LAW ENVIRONMENTAL

JOB No. 11-1532

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DELIVERY ORDER No. 0034

WORKING DRAFT

PRELIMINARY ASSESSMENT/SITE INVESTIGATION REPORT

FOR

PRELIMINARY ASSESSMENT/SITE INVESTIGATION
FORMER DRY CLEANING FACILITY
FORT RILEY, KANSAS

PREPARED FOR

U.S. ARMY CORPS OF ENGINEERS
KANSAS CITY DISTRICT

SEPTEMBER 1992

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September 15, 1992

U.S. Army Engineer District, Kansas City
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Kansas City, MO 64106-2896

Attention: Captain Carol Charette
Project Manager

Subject: Working Draft Preliminary Assessment/Site Investigation Report
Former Dry Cleaning Facility
Fort Riley, Kansas
Contract No. DACW41-89-D-0124
LEGS Project No. 11-1532

Dear Captain Charette:

Law Environmental, Inc., Government Services Branch (LEGS) is pleased to submit the Working Draft Preliminary Assessment/Site Investigation Report for the Preliminary Assessment/Site Investigation at Fort Riley, Kansas. The distribution list for the report is repeated for your convenience:

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If you have any questions regarding the report or any aspect of the project, please call us at (404) 499-6800.

Sincerely,

LAW ENVIRONMENTAL, INC.

Kevin M. Prochaska
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for Arthur J. Whallon
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KMP/AJW:mlh

Enclosure

WORKING DRAFT

PRELIMINARY ASSESSMENT AND SITE INVESTIGATION REPORT

For

PRELIMINARY ASSESSMENT/SITE INVESTIGATION
FORMER DRY CLEANING FACILITY
FORT RILEY, KANSAS

Prepared for:

INSTALLATION RESTORATION PROGRAM
U.S. Army Corps of Engineers
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SEPTEMBER 1992

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EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers - Missouri River Division, Kansas City District (CEMRK) has contracted with Law Environmental, Inc. - Government Services Division (Law) to determine the presence or absence of contamination associated with operating practices at the former Dry Cleaning Facility at Fort Riley, Kansas, and to prepare a Preliminary Assessment/Site Investigation (PA/SI) Report for the site. Fort Riley is listed as a National Priority List (NPL) site. Specific tasks for the PA/SI included a review of the history of operations, preparation of a site map, conducting a soil gas survey, drilling of soil borings and monitoring well installations, survey activities, sample collection and chemical analyses.

The former Dry Cleaning Facility (Bldg. 181) is located in the southwest corner of the Main Post cantonment area and is part of the Historical District at the base. The site is situated on the edge of a bluff cut by the Kansas River, approximately 3,000 feet east-northeast of the confluence of the Republican and Smoky Hill Rivers. The facility is built over residuum and loess underlain by the limestone and shale bedrock. Adjacent to this facility are the alluvial deposits of the Kansas River floodplain.

The Fort Riley Dry Cleaning Facility was operated in Building 181 from the 1930s to 1983; after 1983, operations were moved to Building 183. At some point during the operation of this facility in Building 181, still bottoms derived from the recycling of cleaning solution were disposed of improperly. It has been reported that still bottoms were occasionally dumped on the ground behind the building or placed in dumpsters as a means of disposal. Trash found in the dumpsters would be transported to Southwest Funston Landfill. There is uncertainty as to the specific location of the dumping; doors opening onto the rear portion of the Dry Cleaning site are present at the back of the building on both the southeast and southwest sides, but no signs of systematic dumping

are evident at either portal. Still bottoms generally constitute a sludge comprising sediment and solvent. Prior to 1966, the cleaning solvent used at the Dry Cleaning Facility was Stoddard (naptha) solvent; after 1966, tetrachloroethene (PCE) was used.

The soil gas survey was performed by Target Environmental Services (TARGET) from October 29 through November 2, 1991. Sample analysis was performed on 49 separate samples using an on-site laboratory supplied by TARGET. The survey encompassed the entire former Dry Cleaning Facility. All of the samples collected during the field phase of the survey were subjected to dual analyses. One analysis was conducted to determine concentrations of tetrachloroethene (PCE). The second analysis was conducted to determine the concentrations of petroleum based solvents, such as Stoddard solvent.

The results of laboratory analysis revealed high levels of PCE at the northeast corner of the former Dry Cleaning Facility. More moderate levels of PCE extended westward and northward across Custer Road. Low levels extended throughout the site. Low levels of petroleum based solvents were present at the northeast corner of the building, where PCE was also highest. These low levels extended westward beyond the building.

Fifteen shallow soil borings were drilled to a depth of 15 feet. The locations of the borings were determined by the soil gas results, and the accessibility for a truck-mounted drill rig. Two soil samples were collected from each boring and analyzed for volatile and semi-volatile organic compounds.

Six monitoring wells were drilled and installed based on the results of the soil gas survey and the 15 soil borings. Four soil samples were collected from each of the six borings. Ground-water samples were collected after well development. Soil and ground-water samples were analyzed for volatile and semi-volatile organic compounds.

Borings at the site revealed that the geology consists of a 30- to 40-foot thick soil horizon overlying the regional limestone/shale bedrock. The soil is thickest south of the site and thins to the north. The soil is composed of loess, alluvial deposits, and weathered bedrock. A continuous zone of weathered bedrock is situated between the base of the soil horizon and the top of the bedrock.

Ground water was encountered at the site at depths between 35 to 40 feet below the ground surface. The ground-water flow is discrete, dropping only 2.52 feet from northwest to southeast. Ground-water flow direction is to the southeast.

Analytical results of the soil and ground-water samples collected during the investigation revealed the presence of volatile and semi-volatile organic compounds beneath the site. Those compounds identified in the soils and ground water include trichloroethene, tetrachloroethene, vinyl chloride, 1,2-dichloroethene, toluene, pyrene, 1,1,2-trichloroethane, carbon disulfide, dibromochloromethane, benzo[a]anthracene, benzo[a]pyrene, chrysene, fluoranthene, 2-methylnaphthalene, phenanthrene, and bis(2-ethylhexyl)phthalate. The contamination is most pronounced to the northeast and southeast of the site, and corresponds to the lineation of a sewer line extending from the Current Dry Cleaning Facility and Steam Plant.

An exposure assessment addressing public health and environmental concerns was performed in accordance with current EPA guidance. A conceptual site model was developed to identify the possible exposure pathways that may arise from contaminant releases at the site to both human and ecological receptors. The assessment addressed potential routes of contaminants in all medias of concern to all potential receptors, either directly or indirectly affected. In addition, a brief description of the environmental fate and transport of the chemicals detected at the site was included in the

exposure assessment. Lastly, chemical-specific and location-specific Applicable and Relevant or Appropriate Requirements (ARARs) and To-Be-Considered (TBC) requirements were identified for the site. A comparison to ARARs revealed that the maximum concentrations of several constituents present in the ground water beneath the site exceeded Maximum Contaminant Levels (MCLs). The concentrations of methylene chloride (130 µg/L), tetrachloroethene (660 µg/L), and trichloroethene (33 µg/L) exceeded the standards (for each: MCL = 5 µg/L) for these constituents. In addition, the level of vinyl chloride detected in the site's ground water (11 µg/L) exceeds the MCL of 2 µg/L. 1,2-Dichloroethene was detected at concentrations below the MCL.

ARARs for surface water, the Ambient Water Quality Criteria (AWQC), were exceeded by methylene chloride and tetrachloroethene. Federal AWQC for the protection of human health for the consumption of fish and water and for the consumption of fish alone were exceeded by both constituents.

A comparison of the maximum concentrations detected in site media to TBCs also revealed levels which exceeded these requirements. Kansas Action Levels (KALs) and Kansas Notification Levels (KNLs) for ground water were exceeded by methylene chloride, tetrachloroethene, trichloroethene, and vinyl chloride. The maximum detected concentration of total 1,2-dichloroethenes exceeded the KNL, but not the KAL. A comparison of constituents' maximum concentrations in soil and sediment to TBCs revealed that constituents were present at levels below the Resource Conservation and Recovery Act's (RCRA) soil action levels and below the National Oceanic and Atmospheric Administration's (NOAA) sediment criteria.

The PA/SI was performed to determine the presence of contamination at the former Dry Cleaning Facility. This study has established that there is contamination in the soils, surface water, and ground water at the site, however, the vertical and horizontal extent needs to be delineated. Several additional investigative

alternatives are recommended, including additional monitoring wells, a sewer line survey, a more thorough study of former underground storage tanks, a study of the waste practices at the Current Dry Cleaning Facility and Steam Plant. Localized interim action for soils is also suggested.

1.0 INTRODUCTION

Law Environmental, Inc. - Government Services Division (Law) was contracted by U.S. Army Corps of Engineers - Missouri River Division, Kansas City District (CEMRK) to perform a site reconnaissance and to prepare a Preliminary Assessment and Site Investigation Report (PA/SI) at the former Dry Cleaning Facility at Fort Riley, Kansas. The report documents the investigation procedures and findings of the study. The report is divided into six sections and nine appendices.

1.1 PURPOSE

The purpose of this study is to complete a Preliminary Assessment and Site Investigation to identify if contamination is present at the former Dry Cleaning Facility at Fort Riley. Specifically, the investigation was designed to confirm the presence or absence of significant contamination at the designated sites; assess the potential for contamination migration; identify environmental levels of contaminants relative to regulatory standards; and define future investigations and/or actions which may be required.

1.2 SITE BACKGROUND

1.2.1 Site Description

The Fort Riley Military Reserve was occupied initially in 1852 as a small encampment at the confluence of the Republican and Smoky Hill Rivers. It has since expanded to comprise approximately 150 square miles in Riley and Geary Counties, Kansas. There are six distinct areas on the base: the Main Post, Custer Hill, Camp Funston, Camp Whitside, Camp Forsyth and the Marshall Army

Airfield. These areas account for approximately five percent of the total area of the reserve, with the remaining land used for training maneuvers, gunnery ranges, etc. (Figure 1-1).

The former Dry Cleaning Facility (Bldg. 181, formerly Bldg. 213) is located in the southwest corner of the Main Post cantonment area. Adjacent to Building 181 to the south, Building 180 housed the former laundry facility. Both buildings are situated on the edge of an escarpment approximately 30 feet above the Kansas River floodplain and north of a railway extending along the floodplain, adjacent to the escarpment (Figure 1-2). The facility is located about 800 feet north of the Kansas River. Approximate coordinates for the site are: latitude 39° 04' 32"and longitude 96° 47' 30".

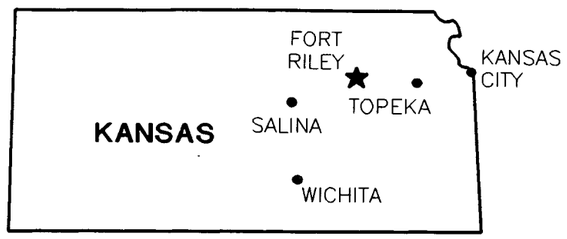
A steeply banked ravine is located approximately 50 feet south-southeast of the buildings. This ravine extends under the railroad tracks and connects with other minor drainages before terminating in the Kansas River. Several sanitary sewer lines, estimated to be fifteen feet below ground, are present to the north and northeast of the site, originating from the steam plant and the current Dry Cleaning Facility (Figure 1-2). The sewer lines are constructed to carry wastes to the southeast, and their presence in the area offers possible routes of migration. During an interview with the former manager of the Dry Cleaning Facility, it was stated that, after dry cleaning operations had moved to Bldg. 183, the diatomaceous earth used to filter spent solvent before the recycling process was periodically dumped into the sewer line. In a follow-up interview with Wayne Wright of the Sanitary Sewer Department, Mr. Wright was unable to confirm that the dumping ever occurred. A recent inspection of the New Dry Cleaning Facility revealed compressor oil leakage into the floor drains (Appendix B). The inspection also found drums of PCE, dyes, detergents, and Therminol oil stored in rooms with floor drains.

Because of slope instability adjacent to the ravine, fill material was reported to have been brought in from off site to maintain the

FIGURE 1-1

FORMER DRY CLEANING FACILITY LOCATION MAP

FORT RILEY, KANSAS



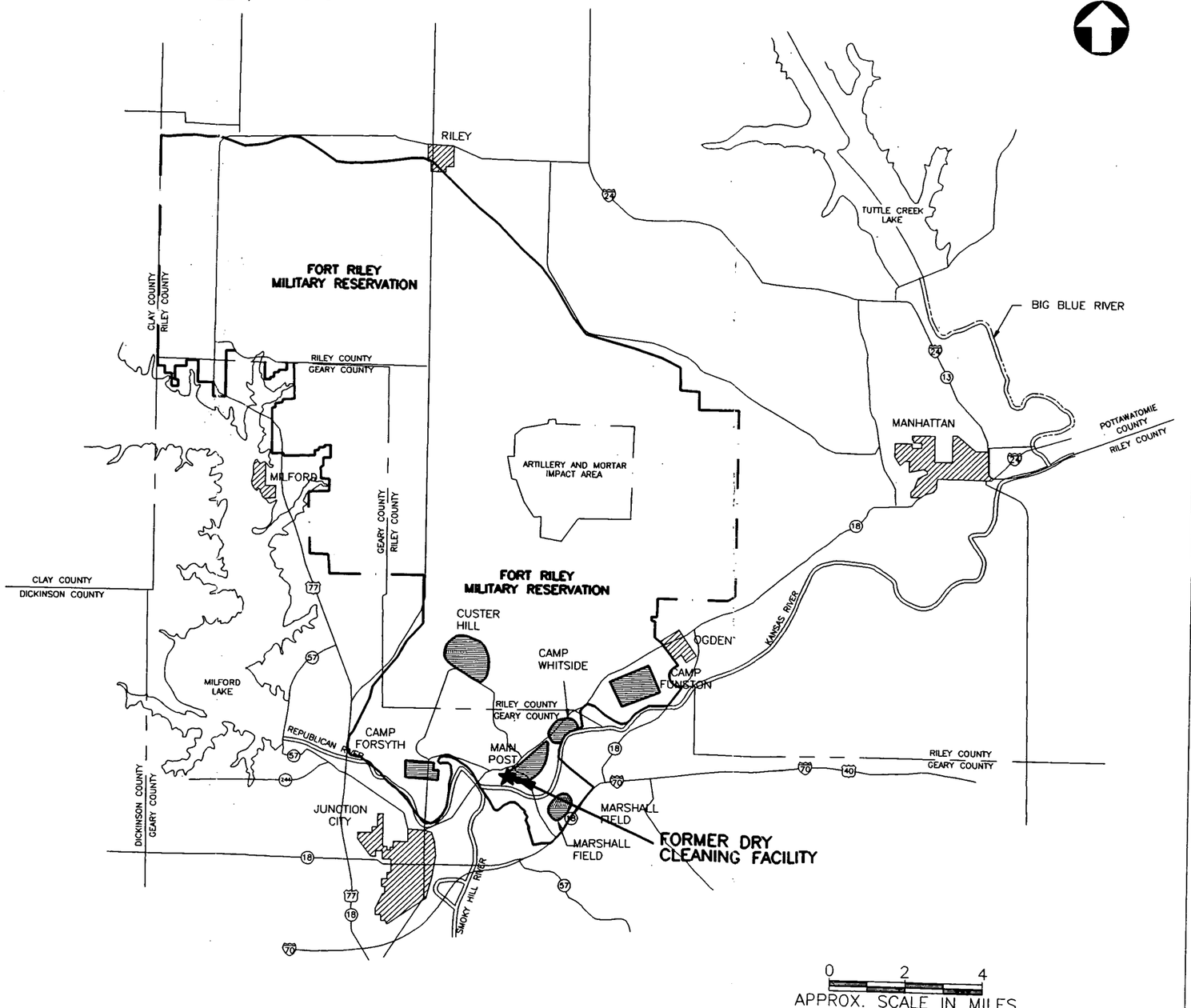


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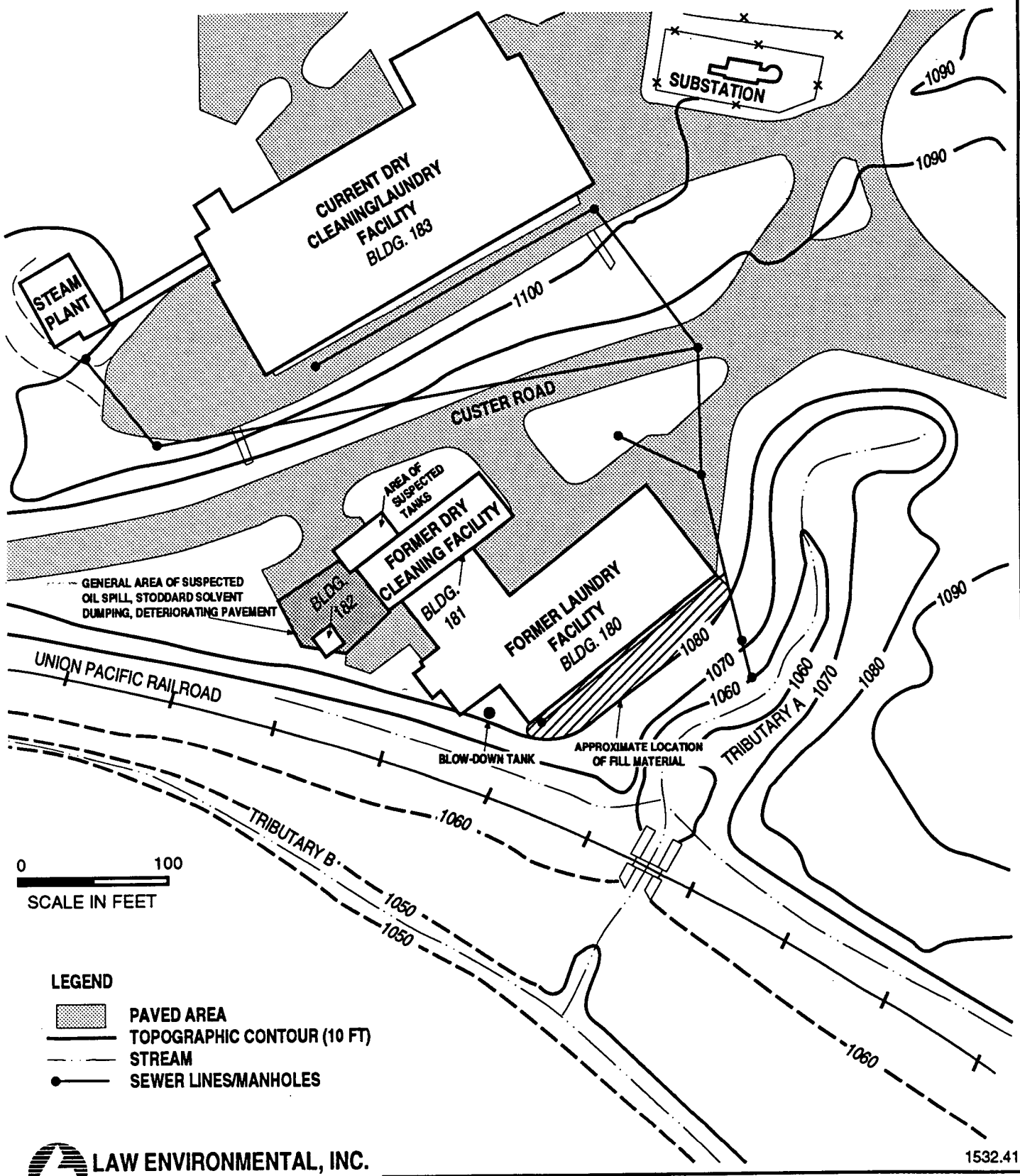
FIGURE 1-2

FORMER DRY CLEANING FACILITY

FORT RILEY, KANSAS



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grade on the east and south sides of Building 180. Most recent filling occurred in the summer of 1991 when approximately three feet of fill dirt was placed along the southeast side of the site. The approximate area (150' x 40') affected by fill is shown on Figure 1-2. All soil samples analyzed during the site investigation were collected below the new fill. Therefore the samples represent "true" site conditions.

Numerous overhead power and telephone lines are present and buried utilities, steep topography, and potentially buried tanks hinder access to the facility. A buried tank was previously located on the north side of the building and thought to be used for heating oil storage was removed at an undetermined date and the tank pit backfilled with soil (Figure 1-2).

A former supervisor for the former Dry Cleaning Plant stated that two 500 gallon tanks, located at the northeast corner of Building 181, were removed around 1978. One tank held new naphtha solvent (Stoddard) while the other tank held used solvent which was eventually "cooked-off". The former supervisor did not remember there being a heating oil tank at the site. However, in recent discussions with Mr. Traxel of the Roads and Grounds Department, Mr. Traxel could not recall any tanks at the former Dry Cleaning Facility other than a blowdown tank. The blowdown tank was located on the southwest side of the building and was used for boiler blowdown collection (Figure 1-2). The location of this tank has been verified from base maps. This tank reportedly has been removed. Also, cisterns may have existed, or still exist, on the north side of the building.

1.2.2 Facility Operations History

According to site plans, the Fort Riley former Dry Cleaning Facility operated in Building 181 as early as the 1930s. After

1983, the dry cleaning operations were moved to Building 183. Presently, both Buildings 180 and 181 are used as office space and for general storage of computers, furniture, and lawn maintenance equipment. The original laundry section (180) was constructed in 1915 and totally reconstructed in 1945. The original dry cleaning plant (181) was constructed in the 1930s. The separate structures were linked in 1945. Figure 1-3 presents the general floor plans of Buildings 180 and 181 as they existed during cleaning activities.

According to a 1956 building listing, laundry operations occurred in both Buildings 180 and 183. Laundry operations are believed to have ceased in Building 180 during this period of time. The dry cleaning operation in Building 181 remained on-site and expanded into the old laundry portion. Prior to 1966, the cleaning solution used was (Stoddard) solvent; since 1966, tetrachloroethylene (PCE) was used. Tetrachloroethylene has been identified as a hazardous substance or contaminant within the meaning Sections 101 (14) and 101 (33) of CERCLA, 42 U.S.C. §§ 9601 (14) and (33). During the facility's use for dry cleaning, still bottoms derived from the recycling of cleaning solution were reportedly dumped on the ground behind the building (USATHAMA, 1984; USAEHA, 1984 and 1987). Still bottoms are the residue remaining after distillation of used cleaning solvent. They generally constitute a sludge comprising sediment and small quantities of solvent.

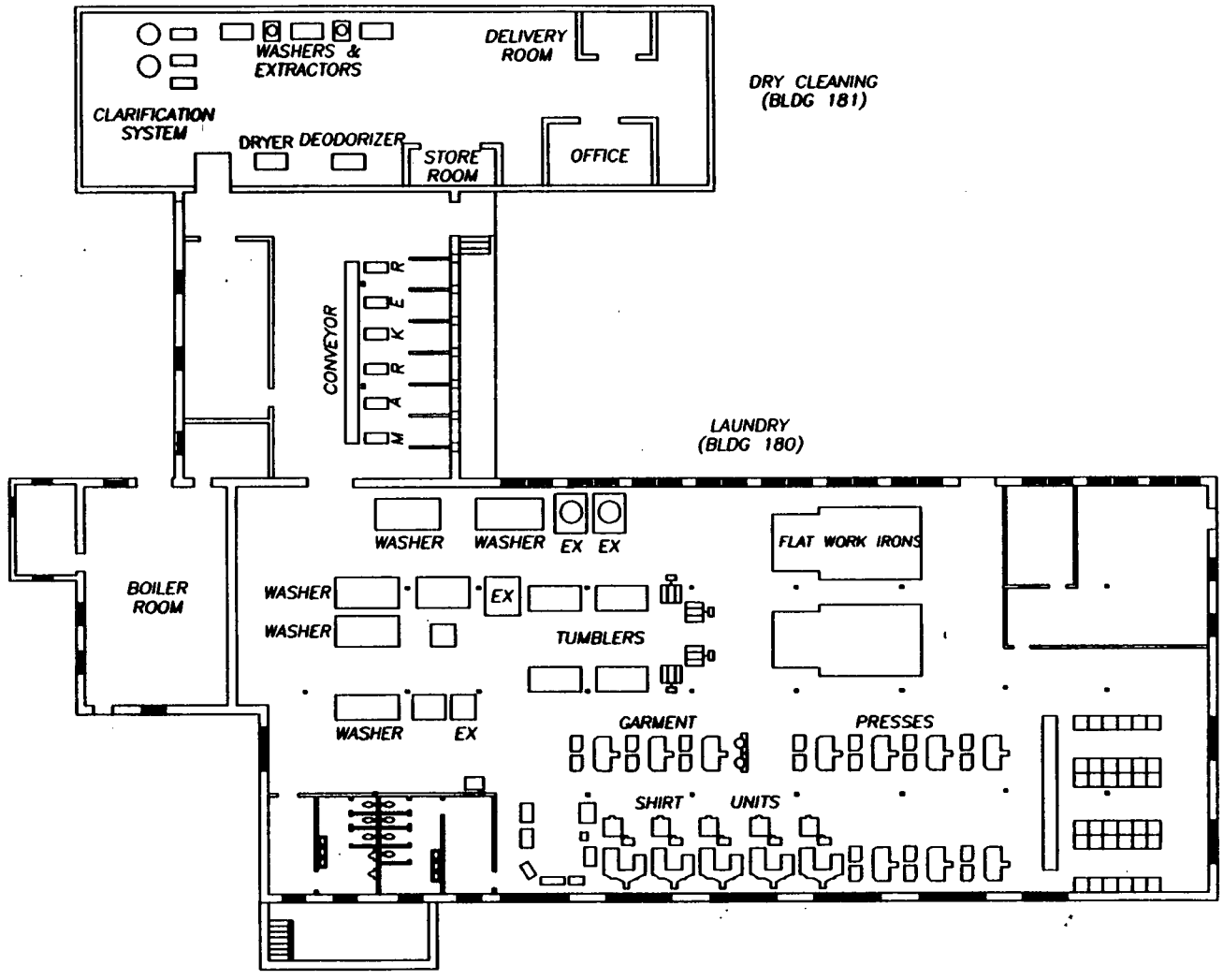
Previous investigation efforts of the former Dry Cleaning Facility have reported that during the facility's dry cleaning operation, an estimated volume of approximately 21 gallons per month of still bottoms were generated and subsequently disposed by dumping behind the building (USAEHA, 1988). At that rate, the total estimated quantity of disposed PCE sludge would exceed 4,000 gallons.

However, Ft. Riley employees familiar with past practices at the facility have indicated that still bottoms were routinely disposed

FIGURE 1-3

GENERAL FLOOR PLAN OF THE FORMER DRY CLEANING FACILITY AND LAUNDRY FACILITY – PRE 1983

FORT RILEY, KANSAS



FLOOR PLAN
SCALE: 1/32" = 1'-0"

0 32 64
SCALE IN FEET

in dumpsters, implying that a relatively small volume was dumped behind the building. According to the CIF Action Officer, no disposal records were assembled during operation of the former Dry Cleaning Facility. Disposal was authorized through the waste dumpster in quantities of less than 200 pounds. Waste items included small quantities of sludge collected from distilling the solvent (1 to 2 gallons every 3 months) and paper/carbon filters from the distilling machine (12 to 30 filters every 3 months).

Another employee familiar with past practices at the former Dry Cleaning Facility stated that an outside dumpster was used to dispose of waste materials since at least 1953. Neither the actual location of the dumpster nor the amounts of waste material disposed are documented.

It has been reported that still residue from Stoddard solution had been disposed of by pouring on the ground behind the building (ESE, 1984). This practice may have occurred near the "back door" outside of the former Dry Cleaning Facility. The "back door" is thought to be located at the west end of the building, near an area where a patch of badly deteriorated asphalt had been reported. Whether the deterioration of the asphalt is related to repeated dumping of Stoddard solvent is unknown. In addition, an oil spill is thought to have occurred in this area (ESE, 1984), although this also cannot be confirmed because the spill supposedly happened in 1980 and a 1985 site reconnaissance found no evidence of the alleged spill.

1.2.3 Previous Investigations

In 1984, an Installation Assessment (USATHAMA, 1984) was conducted under the Department of Defense Environmental Restoration Program to determine the existence of hazardous and/or toxic substances at Fort Riley and the potential for migration of contamination from the installation to off-site areas. The initial data collection

and field investigation efforts indicated the possibility of soil contamination at the former Dry Cleaning Facility.

In June 1986, U.S. Army Environmental Hygiene Agency (USAEHA) analyzed two soil samples collected on the west side of Building 181 for PCE. According to the CIF Action Officer, soil samples were collected from a grassy area along the west side of the building just north of the old boiler room. No PCE was detected in either of the two samples (detection limit was 0.02 ppm). Sample collection procedures and depths of sampling were not documented at the time of the study, and assuming that surficial samples were analyzed, a PCE non-detect would be irrelevant due to the volatile nature of the compound in near surface soils.

In 1988, the USAEHA conducted an evaluation study of all solid waste management units at Fort Riley. The USAEHA report stated that no evidence outside the building was observed which would indicate systematic spilling of dry cleaning solvent or sludge. The report also stated that the potential for solvent (PCE) release to the environment was low due to the lack of detection at the site. USAEHA recommended that no further sampling be done at the site.

On June 28, 1991, the U.S. Department of the Army (DA), 1st Infantry Division (mechanized) and Fort Riley entered into a Federal Facility Agreement (FFA) with the U.S. Environmental Protection Agency (U.S. EPA) and the state of Kansas, through the Kansas Department of Health and Environment (KDHE).

Under the FFA, the DA agreed to conduct a Site Assessment to identify all potential and known, past and present, solid and hazardous waste treatment, storage, or disposal areas where hazardous substances could have been released or come to be located. As part of the Site Assessment, the Inactive Dry Cleaning Facility was reinvestigated.

1.3 SCOPE OF INVESTIGATION

The Preliminary Assessment/Site Investigation at the former Dry Cleaning Facility is primarily intended to characterize potential contamination releases due to past waste management practices or from other types of releases in the vicinity of the site. Prior to commencement of field activities, a records review and historical evaluation was completed, the results of which have been discussed in Section 1.2.

During the Site Investigation, a soil gas survey consisting of 49 separate sampling points was completed as the first stage of field work. The results of the survey were used to determine the placement of 15 soil borings to collect soil samples at two separate depths from each boring. Six monitoring wells were installed at various locations around the site. The wells were designed to intersect the top of the water table. Soil samples were collected from the monitoring well borings during drilling and ground-water samples were collected after development of the completed wells. Three surface water samples and three sediment samples were collected near the site. The site was surveyed and a map was constructed of the area using two-foot contour intervals. All soil boring locations and monitoring wells were also surveyed upon completion of the monitoring well sampling. An in-depth discussion of field activities is presented in Section 3.0.

1.4 REPORT ORGANIZATION

1.0 **INTRODUCTION** - Discusses the purpose of the investigation and provides a general background of the site.

2.0 **STUDY AREA CHARACTERIZATION** - Summarizes regional characteristics influencing field activities.

3.0 SITE-SPECIFIC CHARACTERIZATION - Provides a detailed discussion of site-specific characteristic and methodology of the investigation.

4.0 NATURE AND EXTENT OF CONTAMINATION - Discusses the results of site characterization and the nature and extent of contamination at the site.

5.0 EXPOSURE ASSESSMENT - Discusses contaminant presence and migration potential to human receptors.

6.0 SUMMARY OF CONCLUSIONS - Summarizes the findings of the investigations and makes recommendations for future work.

2.0 STUDY AREA CHARACTERIZATION

2.1 GEOGRAPHY AND PHYSIOGRAPHY

2.1.1 Location

Fort Riley is located in north-central Kansas, occupying 100,000 acres of land in Riley and Geary Counties. Agriculture is the primary land use in the area, comprising approximately 70 percent of the total land use. Urban areas comprise less than 5 percent of the land use. Urban populations near Fort Riley include Junction City to the south, Manhattan, Ogden, and Keats to the east, Riley to the north, and Milford to the west. Manhattan and Junction City contain the largest residential areas.

To the west of Fort Riley, the land is dominated by Milford Reservoir encompassing 16,300 acres. The northern and eastern boundaries of Fort Riley are bordered by agricultural areas and rangeland. The southern and southeastern boundaries are bordered by agricultural and residential areas.

2.1.2 Climate

Based upon data collected at the Manhattan, Kansas Climate Station, the Ft. Riley region experiences a temperate climate, with an average daily high temperature of 90°F in July, and average daily low temperature of 37°F in January.

Prevailing wind direction varies from south to southwest during the period of April to January and from a northerly direction during the months of February and March. Mean wind speed is fairly constant at 8 miles per hour with a normal maximum of 12 miles per hour.

Average annual precipitation near Fort Riley is 31 inches. Approximately 70 percent of this occurs from April through September. Twenty-four hour event totals can exceed 3.5 inches from April through October, during thunderstorm periods. June and July experience the highest incidence of thunderstorms per month. Lake evaporation is approximately 50 inches per year, resulting in a net annual estimated evapotranspiration rate of 19 inches per year (U.S. National Climatic Data Center, 1982).

2.1.3 Physiography

Fort Riley lies within the Osage Plains section of the Central Lowlands physiographic province. The topography around Fort Riley consists of plains incised by steep drainage features. The elevation ranges from 1,025 to 1,356 feet above mean sea level.

Terrain on the installation varies from alluvial bottomlands along the Republican and Kansas Rivers on the southern boundary through the hilly to steep country in the central section, and into the high uplands or prairies toward the north.

2.2 GEOLOGY

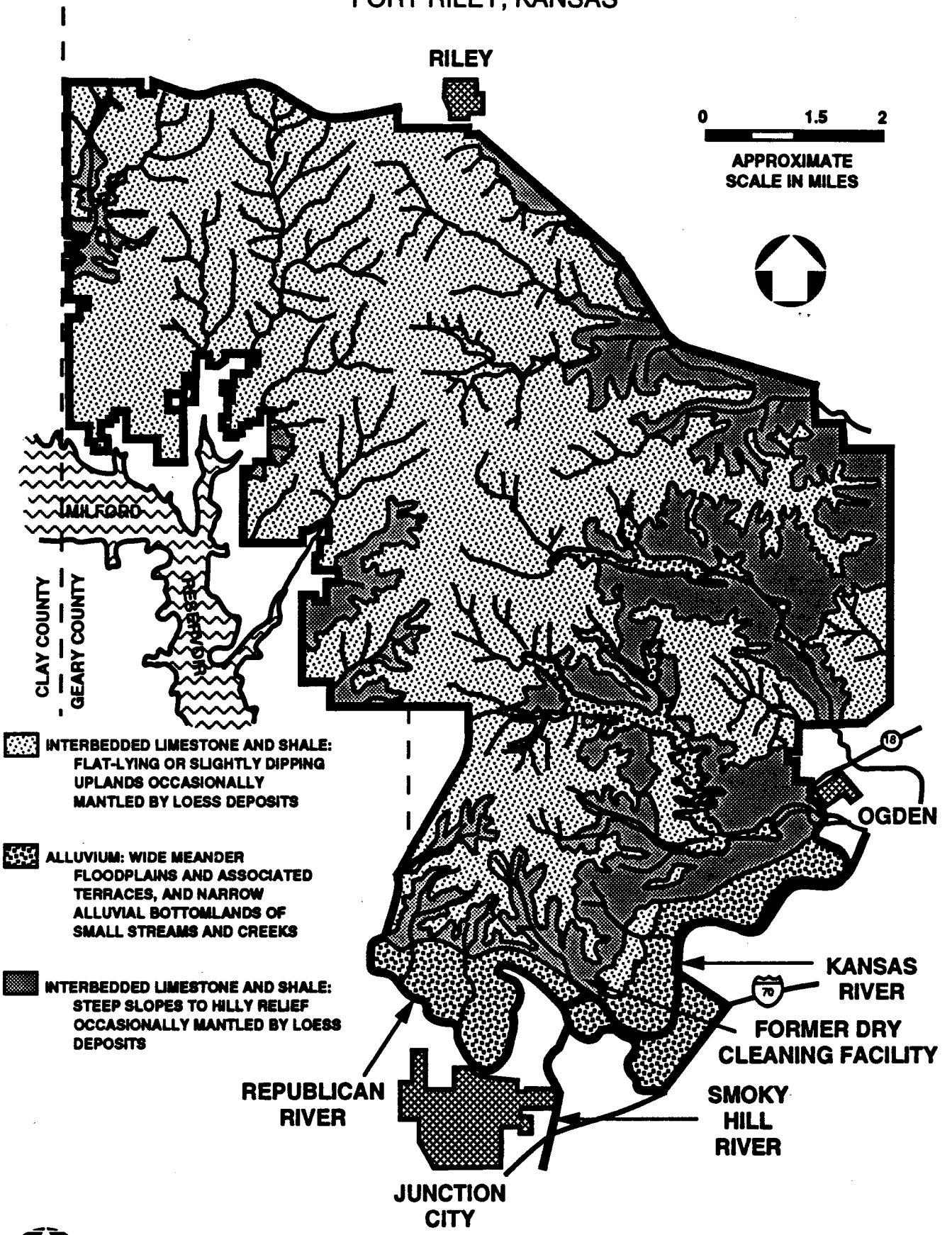
2.2.1 Regional Geology

Fort Riley is situated in three distinct geological-topographical areas (Figure 2-1). The first is the uplands area, consisting of flat-lying to gently, northwesterly dipping limestones and shales. The uplands area generally is covered by various shale units which overlie the escarpment-forming limestones. Small streams have dissected these thick shale units and eroded much of the area into a rolling plateau. Local relief ranges from 164 to 240 feet in the uplands area.

FIGURE 2-1

GEOLOGIC MAP OF FORT RILEY

FORT RILEY, KANSAS



SOURCE: USAETL, TERRAIN ANALYSIS CENTER, 1977.

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The bedrock exposed in the Fort Riley area is Lower Permian age and consists of alternating limestones and shales. The uppermost geologic unit is the Chase Group, comprising up to 335 feet of thick, chert-bearing limestones and red and green shales. Bedding planes dip gently to the northwest.

Overlying the bedrock are alluvial deposits, residual soil developed from the bedrock, and windblown loess of Pleistocene and Recent age. The loess deposits on Fort Riley range from 0 to 2 feet in thickness (USAETL, Terrain Analysis Center, 1977). Where the Republican and Kansas Rivers have cut into the Permian limestones and shales, they have created alluvial deposits of silt, clay, and very fine sand near the surface grading to coarser sand and gravel with depth. The maximum thickness of the alluvium on Fort Riley, as determined from well logs, is 91 feet. Most of the soils at Fort Riley are silty loams between 6 and 12 inches thick, underlain by clays and weathered limestone and shale.

According to the USDA Soil Conservation Survey Report (USDA SCS, 1975) and confirmed by borings at the site, the former Dry Cleaning Facility has similar surface soil characteristics. Outside of each drainage feature, the soil is characterized as Kennebec Series silt loam. This soil type has a medium to rapid surface runoff with erosion problems.

The drainage features are in the Breaks-Alluvium soil association, which includes loess, residuum weathered from shale and limestone, and surrounding soil material types. Surface runoff tends to be rapid and permeability tends to be low.

2.2.2 Local Geology

The former Dry Cleaning Facility is located in the uplands physiographic unit (Figure 2-1). The uplands area consists of flat-lying to gently, northwesterly dipping limestones and shales

and generally is covered by various shale units which overlie the escarpment-forming limestones. Small streams have dissected these thick shale units and eroded much of the area into a rolling plateau. Local relief ranges from 164 to 240 feet in the uplands area. Towards the south is the alluvial bottomlands of the Kansas and Republican Rivers; relief in this area ranges from 25 to 60 feet. North of the site is the hilly to steep country composed of alternating limestones and shales, which extend from the uplands down to the alluvial bottomlands.

At the former Dry Cleaning Facility, the drainage slopes are steep and bedrock outcrops are present from approximately 10 to 15 feet above the drainage floor on the east side. Erosion of the soils on the east side of the building has required the placement of 1 to 6 feet of fill material to maintain the bank stability and prevent undermining of the foundation.

Depending upon location, depth to bedrock ranges from 1 to 30 feet. The area adjacent to the subject site drains into a mixed calcareous/non-calcareous alluvial soil characterized as a silt loam to silty clay loam with medium permeability.

2.2.3 Hydrogeology

The Fort Riley Military Reserve area covers a portion of the watershed for the Republican River, Milford Lake Reservoir and the Kansas River. The area is characterized by poorly developed karst topography in interbedded limestones and shales. The term "karst" refers to topographic and lithologic characteristics associated with carbonate dissolution by the action of ground water. The bedrock is overlain by residual soil, alluvium, and loess.

The former Dry Cleaning Facility is located on the edge of a bluff cut by the Kansas River, approximately 3,000 feet east-northeast of the confluence of the Republican and Smoky Hill Rivers. The

facility is built over residuum and loess underlain by the limestone and shale bedrock. Adjacent to this facility are the alluvial deposits of the Kansas River floodplain.

Ground water can be produced from fractures and solution channels of the limestone and from interstitial spaces in alluvium in the floodplains of the Kansas and Republican Rivers. In the Kansas River basin, the alluvium consists of silt, clay, and very fine sand.

2.2.3.1 Ground Water - The primary source of drinking water for Fort Riley, Junction City and Ogden is the valley fill alluvium (alluvial aquifer) of the Republican and Kansas Rivers (Figure 2-2). Junction City and Fort Riley's water supply wells are within the Republican River floodplain. Ogden's water supply wells are located within the Kansas River floodplain. Depth to water at Fort Riley water supply wells ranges from 15 to 25 feet below the ground surface. Depth to water in Junction City and Ogden water supply wells is approximately 24 and 26 feet below the ground surface, respectively.

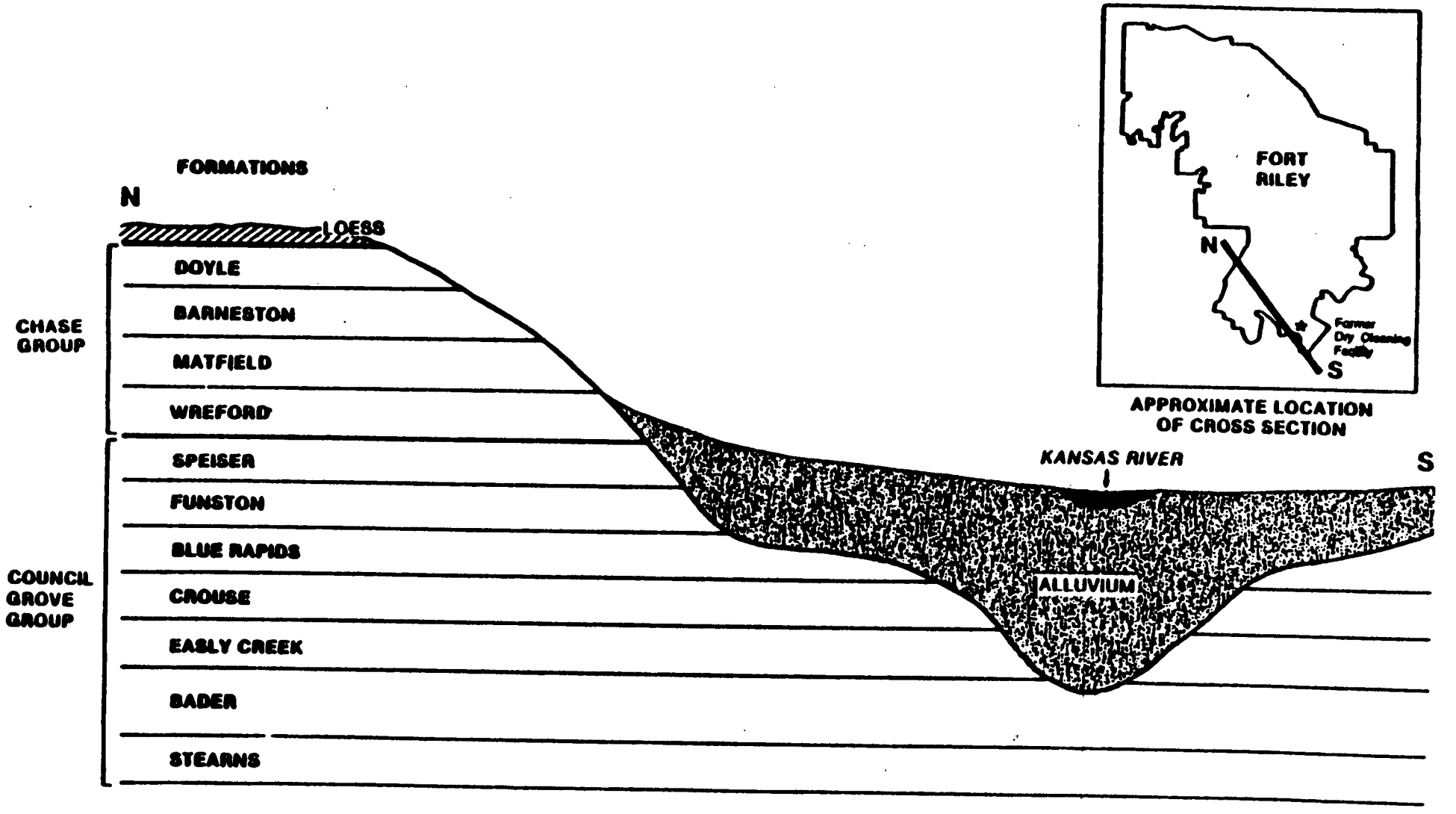
The alluvial deposits are capable of yielding more than 14,000 gpm from a single well. This aquifer is recharged through direct infiltration of rain, seepage from limestone and shales, and the adjacent rivers. The Kansas and Republican Rivers are the primary source of recharge to the alluvial aquifer. The regional direction of ground-water flow is generally towards the Kansas River and is influenced by river stage.

Ground water may also be produced, to a limited extent, from solution channels and joints in the limestones and shales of the Permian bedrock (bedrock aquifer). The Fort Riley and Florence limestones, members of the Barneston Limestone Formation (Figures 2-2 and 2-3), are the chief bedrock aquifers, producing a maximum

FIGURE 2-2

GENERALIZED GEOLOGIC CROSS SECTION THROUGH FORT RILEY

FORT RILEY, KANSAS



NOTE: WINFIELD FORMATION DOES NOT OUTCROP ON FORT RILEY.

SOURCES: USAETL, TERRAIN ANALYSIS CENTER, 1977.
ESE, 1984.

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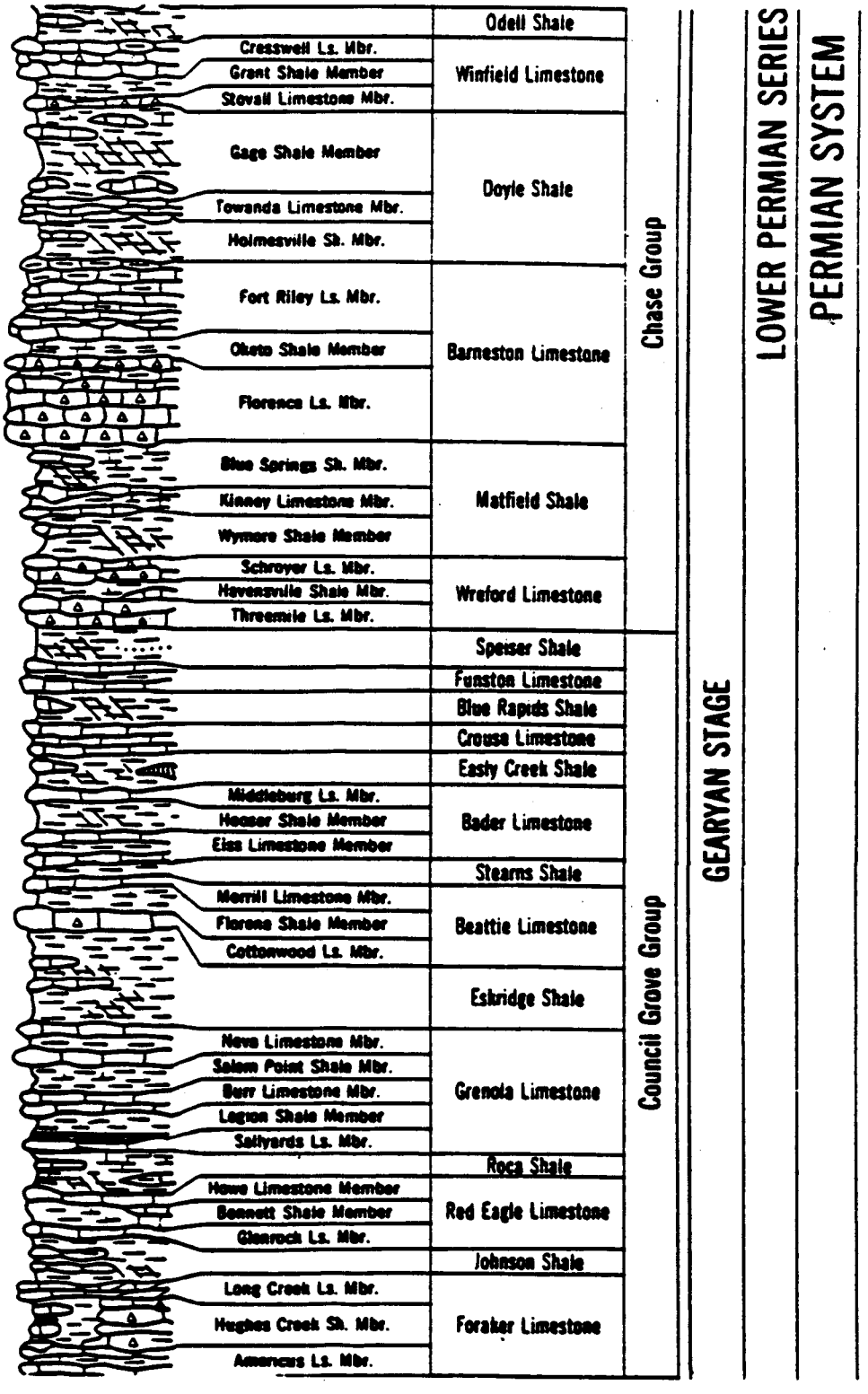
FIGURE 2-3

UPPERMOST ROCK UNITS

FORT RILEY, KANSAS



SOURCE: ZELLER, 1968

flow of 1435 gallons per minute (gpm). Where the soil cover is thick, a perched water table may be found overlying the uppermost shale unit. The expected depth to the water table at the former Dry Cleaning Facility is approximately 40 feet below the ground surface.

Supplies adequate for local drinking water and moderate-scale agricultural activities can be derived from the bedrock wells. Depth and presence of ground water varies depending on local physiographic, geologic, and hydrologic conditions. Wells completed in limestone at Fort Riley are producing from zones approximately 70 feet below the ground surface.

2.2.3.2 Surface Water - Surface waters at Fort Riley generally fall into one of three categories: rivers, streams/drainages, and impoundments.

2.2.3.2.1 Rivers - The major rivers in the vicinity of the sites are the Republican, Smoky Hill, and Kansas River. The Republican River is west of Fort Riley, with flow controlled by Milford Dam. The river flows southeasterly and joins the Smoky Hill River near Junction City to form the Kansas River. The Kansas River eventually drains into the Missouri River at Kansas City.

The Kansas River exhibits high water stages from the last part of February through the first part of June. The lowest river stages occur from late October through January. Prior to the construction of Milford Reservoir and Tuttle Creek Reservoir (on the Big Blue River), major flooding of three to five-day duration occurred approximately every 8 to 10 years.

The Republican River has a mean annual discharge of 1,007 cubic feet per second. The low flow record is 50 cubic feet per second and the high flow record is 13,500 cubic feet per second.

The Smoky Hill River discharges approximately 1,760 cubic feet per second. Flow range extremes are not available.

The Kansas River has a mean annual discharge of 2,750 cubic feet per second, calculated as the combined flow from the Republican and Smoky Hill Rivers. Kansas River level fluctuates between 1.5 feet depth to 12 feet depth, maximum.

Water quality of the Kansas River is greatly influenced by flow rates, but in general is moderate to poor, especially at low flows. The river waters can be generally characterized as: turbid, alkaline, moderately mineralized, well buffered, with good dissolved oxygen content, low organic load, high nutrient levels, and high bacteria numbers.

2.2.3.2.2 Streams and Drainages - Almost all of the streams and drainageways at Fort Riley are ephemeral. No reliable data are available for flow rates of these creeks. Water quality is highly variable dependent on the frequency and severity of precipitation events.

2.2.3.2.3 Surface Impoundments - Surface water impoundments at or near Fort Riley include two man-made reservoirs, several oxbow lakes, and several large and many smaller ponds. Tuttle Creek Reservoir is located northeast of Fort Riley and is fed by the Blue River. Milford Reservoir is located west of Fort Riley and is fed by the Republican River. No surface water impoundments are found within the DCF drainage basin upstream of the Kansas River.

3.0 SITE-SPECIFIC CHARACTERIZATION SUMMARY

This section details the site-specific field investigation activities conducted at the former Dry Cleaning Facility. Unless otherwise noted, field investigation activities were performed in accordance with the Well Installation Plan, Work Plan, and the Chemical Data Acquisition Plan and Site Specific Sampling Plan.

3.1 FIELD ACTIVITIES

Field activities included a soil gas survey, shallow soil borings, monitoring well installation, soil, sediment, surface and ground-water sampling, and surveying activities.

3.1.1 Soil Gas Survey

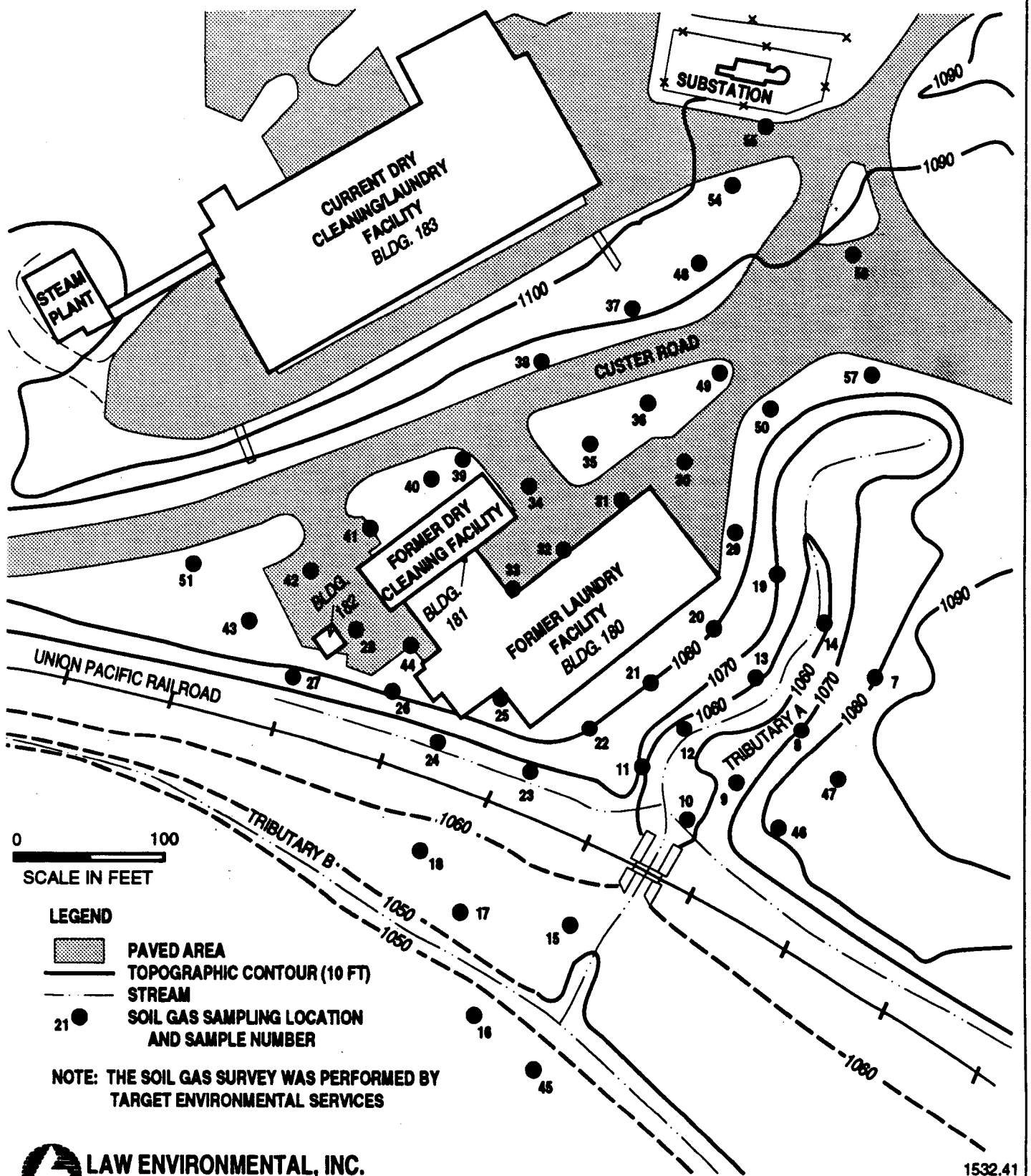
A shallow soil gas survey was conducted at the former Dry Cleaning Facility in October, 1991 by Target Environmental Services. The purpose of this survey were to determine the presence/absence of Stoddard solvent, PCE, or other volatile organic compounds in the soils surrounding the site. This information was used to identify major areas of contamination, and to aid in the placement of soil borings and monitoring wells to assess soil and ground-water contamination beneath the site.

Soil gas samples were collected by driving a probe into the soil above the water table and withdrawing the soil gas by means of a vacuum pump. The soil gas was analyzed at the field laboratory set up at the site. Appendix B contains the methodology and the analytical report submitted by Target.

Soil gas samples were collected at a total of 49 locations at the site (Figure 3-1). The sampling depth varied from 3.5 to 6 feet

FIGURE 3-1

SOIL GAS SAMPLING LOCATIONS
FORMER DRY CLEANING FACILITY
FORT RILEY, KANSAS



below the ground surface. Based upon the findings of the samples collected early in the survey, the soil gas survey was expanded accordingly as field work progressed. The analytical results of the survey will be discussed in the Nature and Extent of Contamination, subsection 4.3.1. Appendix C contains the survey report issued by TARGET.

3.1.2 Soil Borings

Fifteen shallow soil borings were performed at the former Dry Cleaning Facility. The borings were auger drilled to a depth of 15 feet below the ground surface. The locations of the borings were determined by the results of the soil gas survey and accessibility for a truck-mounted drill rig. Figure 3-2 illustrates the locations of the 15 soil borings.

Two soil samples were collected from each boring based on the results of headspace analysis. The soil samples were analyzed for volatile and semi-volatile organic compounds. The analytical results from the soils will be discussed in the Nature and Extent of Contamination, subsection 4.3.2. Appendix D contains HTW logs and Test Boring Records for the borings.

3.1.3 Monitoring Wells

3.1.3.1 Well Drilling/Well Installation - Six monitoring wells were drilled and installed at the former Dry Cleaning Facility (Figure 3-3). Monitoring well DCF92-01 was located upgradient of the site and is the background well for the study. Monitoring wells DCF92-03 and DCF92-05 are located downgradient of the site, and were installed to provide data on soil and ground-water contaminants migrating away from the suspected source. Monitoring wells DCF92-02, DCF92-04, and DCF92-06 were located in areas of contamination determined by the soil gas survey and soil borings.

FIGURE 3-2

SHALLOW SOIL BORING SAMPLING LOCATIONS
FORMER DRY CLEANING FACILITY
FORT RILEY, KANSAS

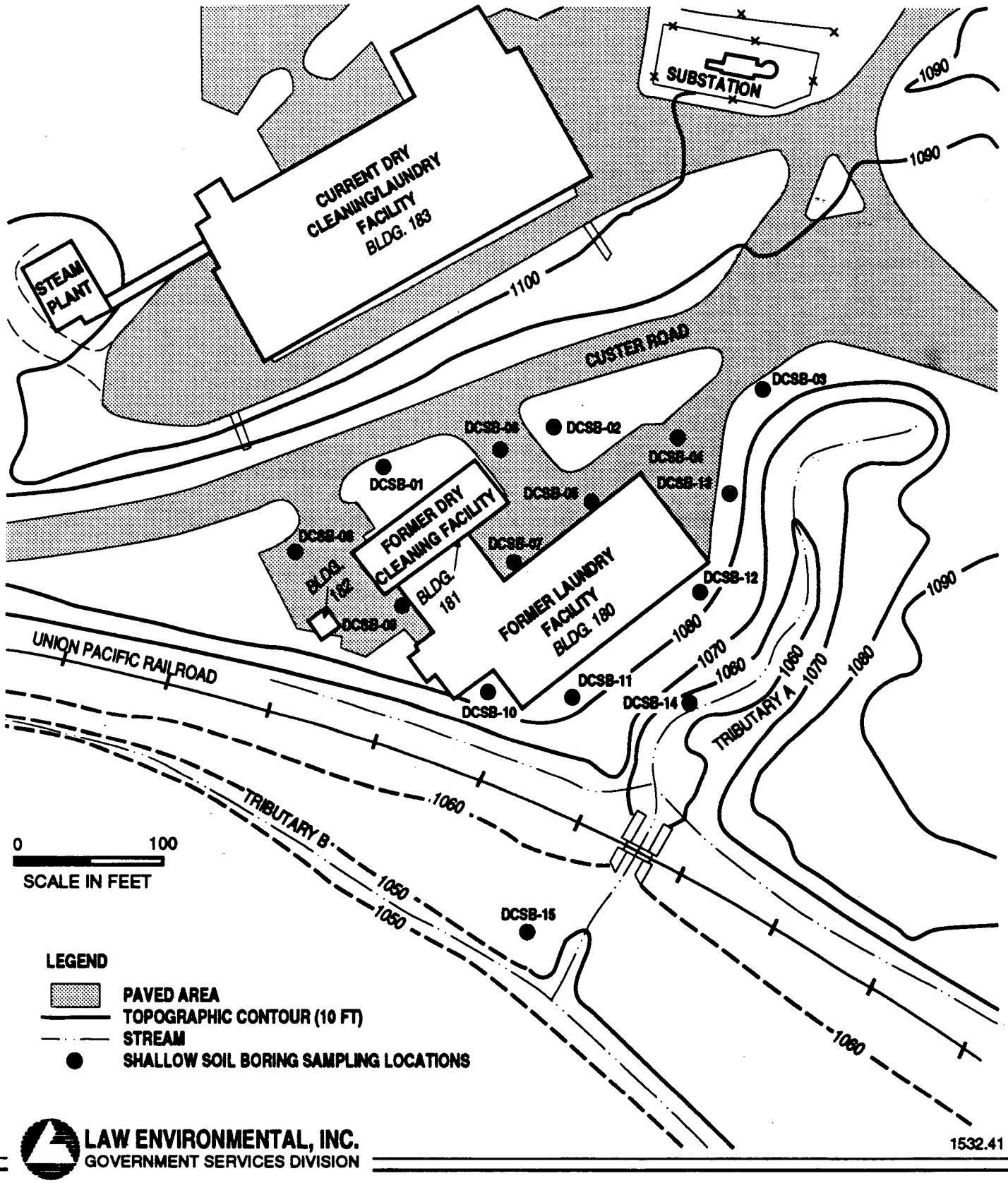


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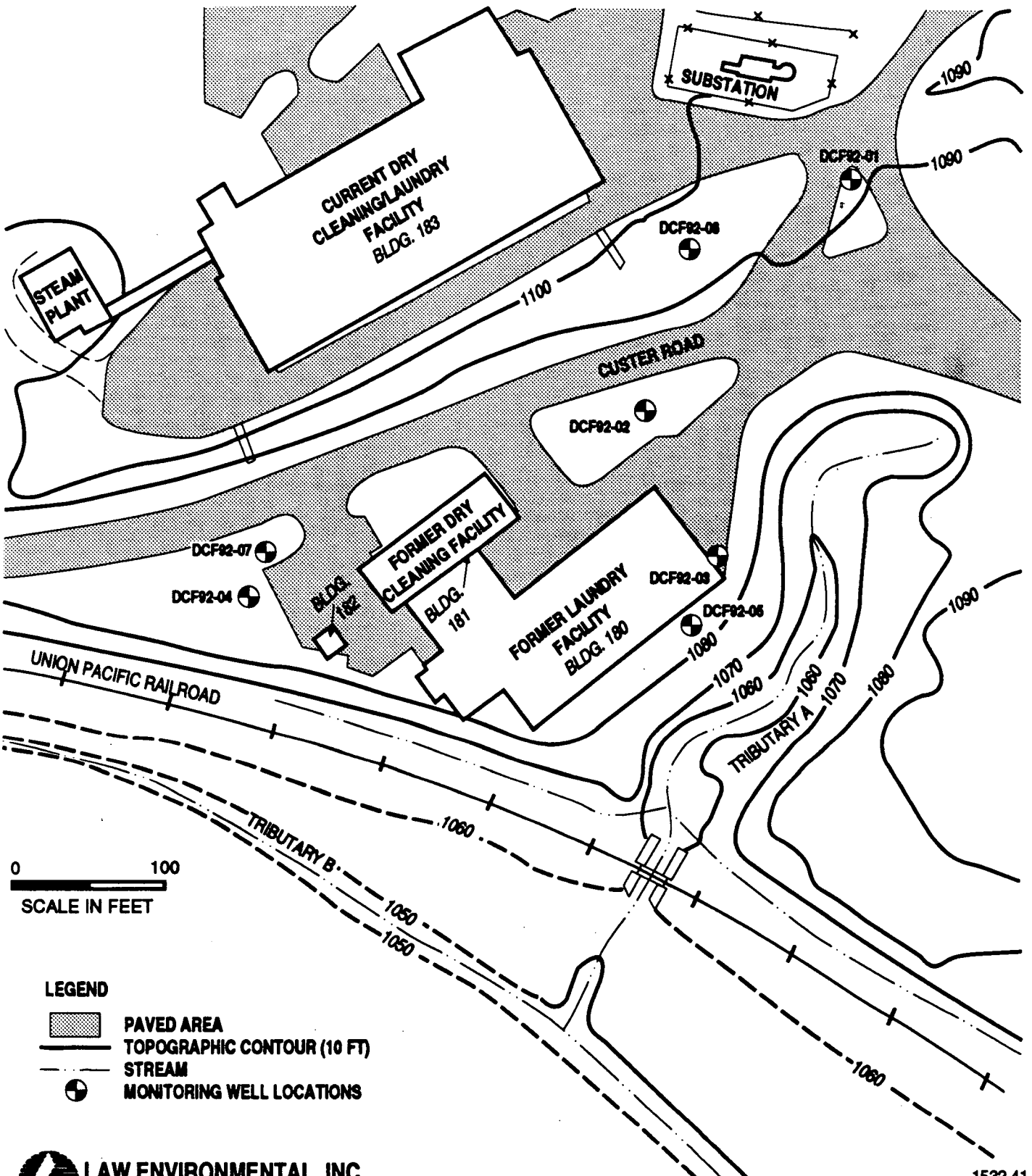
FIGURE 3-3

MONITORING WELL LOCATIONS
FORMER DRY CLEANING FACILITY
FORT RILEY, KANSAS



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Monitoring wells DCF92-01, DCF92-02, DCF92-04, and DCF92-06 encountered the top of the water table in bedrock. The wells were drilled by first augering through the overburden until bedrock was encountered. The boring was deepened by wash boring an additional two feet into the bedrock. A six-inch diameter surface casing was installed from the ground surface to the bottom of the boring and the casing was cemented into place. The boring was then advanced by coring the bedrock, followed by reaming to expand the borehole diameter. The wells were screened to intercept the top of the water table. The wells were drilled and completed as specified in the Well Installation Plan.

Monitoring wells DCF92-03 and DCF92-05 encountered the top of the water table in the soil overburden, therefore required no surface casing. The borings were advanced by augering to a depth adequate to allow the well screen to intercept the top of the water table. The wells were drilled and completed as specified in the Well Installation Plan.

A seventh monitoring well, DCF92-07, (Figure 3-3) was installed north of DCF92-04 to a depth of 19 feet to test ground-water quality in an area of shallow bedrock. The well was drilled as outlined in Technical Memorandum DCF-003, dated July 29, 1992 (Appendix D). The well was not sampled due to insufficient ground water recovered.

Appendix D contains the HTW boring logs and Soil Test Boring Record for each monitoring well. Monitoring Well Installation Diagrams are contained in Appendix E.

3.1.3.2 Monitoring Well Development - Monitoring wells were initially developed through use of a surge/pump method, in which the monitoring well screens were surged to draw fine particulates into the well for removal by pumping. The surge/pump method was continued until three times the amount of water lost during drilling was recovered and the water clarity achieved a NTU reading

of 30 or less. Several rounds of development were necessary to achieve the NTU criteria, including surging with a rig-mounted surge block. Well development information is contained in Appendix F, as well as the COE letter to Law, dated June 12, 1992, outlining the additional development protocol.

3.1.3.3 Sampling Activities - During the hollow stem auger drilling process, split spoon samples were collected at 5.0-foot intervals. A representative soil sample from each boring was selected for geotechnical analysis of the overburden material. Appendix G contains the results of the geotechnical analysis. Four soil samples were selected from each boring and analyzed for volatile and semi-volatile organic compounds. The exception was monitoring well DCF92-04, where only two soil samples were collected because bedrock was encountered shallower than anticipated (nine feet below the ground surface).

Following development, ground-water samples were collected for analysis of volatile and semi-volatile organic compounds. The protocol for sampling the monitoring wells was changed from dedicated bailers to dedicated bladder pumps in order to meet the 30 NTU criteria prior to sampling. The protocol for sampling is outlined in Technical Memorandum DCF-002, PSF-001, SFL-004, dated July 10, 1992 (Appendix I). The results of the chemical analyses for both soils and ground-water samples are discussed in depth in Section 4.0, Nature and Extent of Contamination, subsections 4.3.2 and 4.3.4.

3.1.3.4 Permeability Testing - Permeability tests scheduled to be performed in the six monitoring wells were not conducted following discussions with representatives of the Kansas City District Corps of Engineers. The Corps decided that since the water table intersected the well screens near the midpoint of the screen, the permeability tests would not represent the true nature of the aquifer.

3.1.4 Surface Water and Sediment Sampling

Three surface water and sediment samples were collected near the former Dry Cleaning Facility Site (Figure 3-4). The samples were analyzed for volatile and semi-volatile organic compounds. The analytical results are discussed in the Nature and Extent of Contamination, subsection 4.3.3.

3.1.5 Investigation Derived Waste

Drill cuttings, drilling fluids, development water, and discarded personal protective clothing were containerized in appropriate drums, labeled, and transported to the Operations Center located at Southwest Funston Landfill.

To determine proper disposal methods of the drums, the analytical results of chemical testing of the soils and ground water will be compared to the regulatory limits set in the Toxicity Characteristic Leaching Procedure (TCLP) designed by EPA to control the disposal of wastes containing potentially hazardous substances. A TCLP analysis need not be performed if a total analysis demonstrates that regulated contaminants are not present or are present in such low concentrations that they could not possibly exceed regulatory thresholds. Analytical results of water are directly compared to TCLP limits. The leachable amount of contaminants in soil is calculated assuming that all contaminants leach completely (worst-case scenario). If any TCLP limits are exceeded, a TCLP analysis should be performed. The disposal of wastes containerized at Fort Riley is the responsibility of the base.

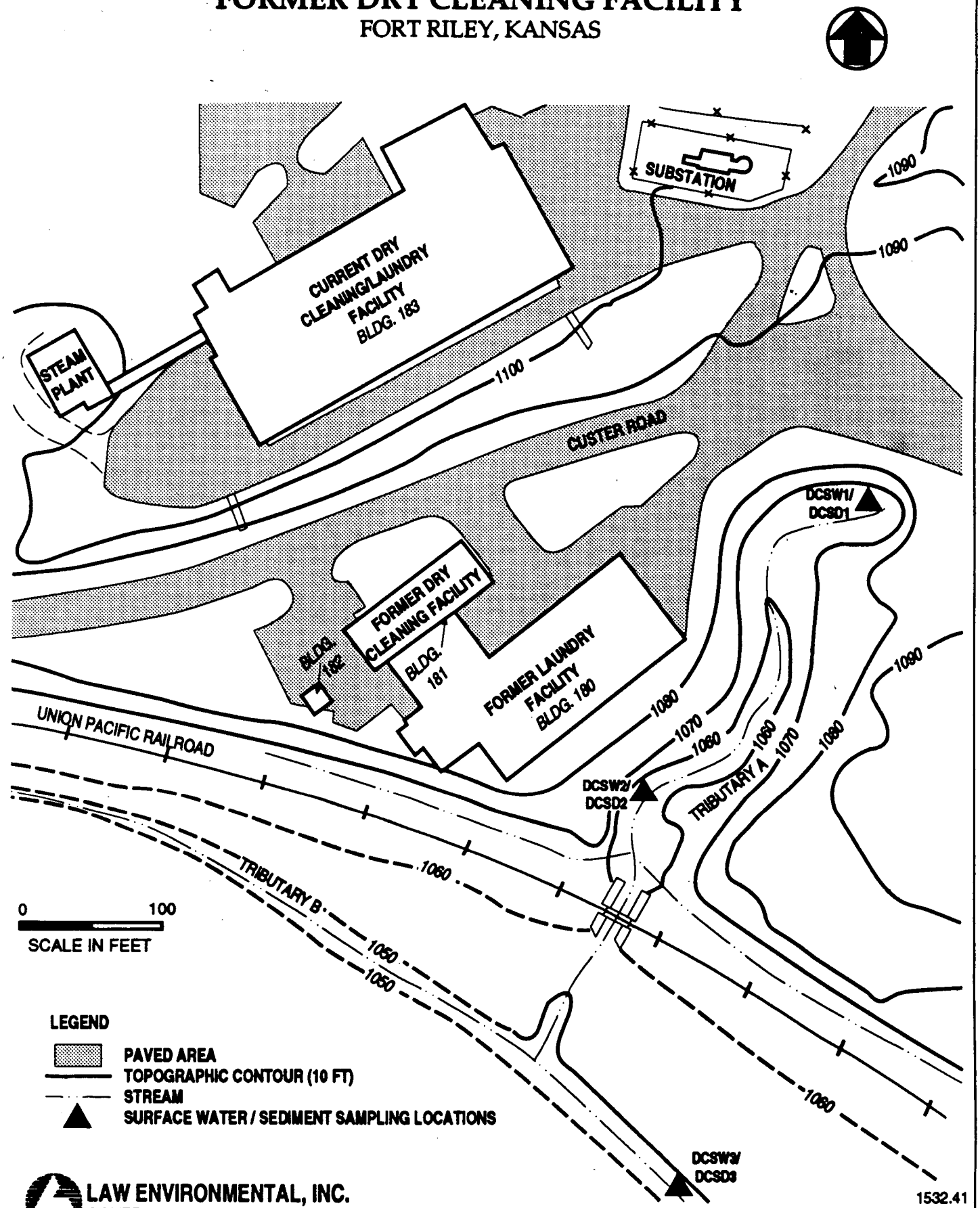
3.1.6 Surveying

Anderson Survey Company completed a site survey at the former Dry Cleaning Facility and prepared a base map for the site. The base

FIGURE 3-4

SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS FORMER DRY CLEANING FACILITY

FORT RILEY, KANSAS



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map included buildings, roads, and relevant fixtures. The base map included 2-foot topographic contour intervals. Upon completion of the field investigations, all soil borings, monitoring wells, and sediment and surface water samples were surveyed and included on the base map as specified in the Well Installation Plan. The base map and survey data are included in Appendix H.

3.2 SITE STRATIGRAPHY AND HYDROGEOLOGY

A discussion of site stratigraphy and hydrologic characteristics found during the site investigation is presented below.

3.2.1 Site Stratigraphy

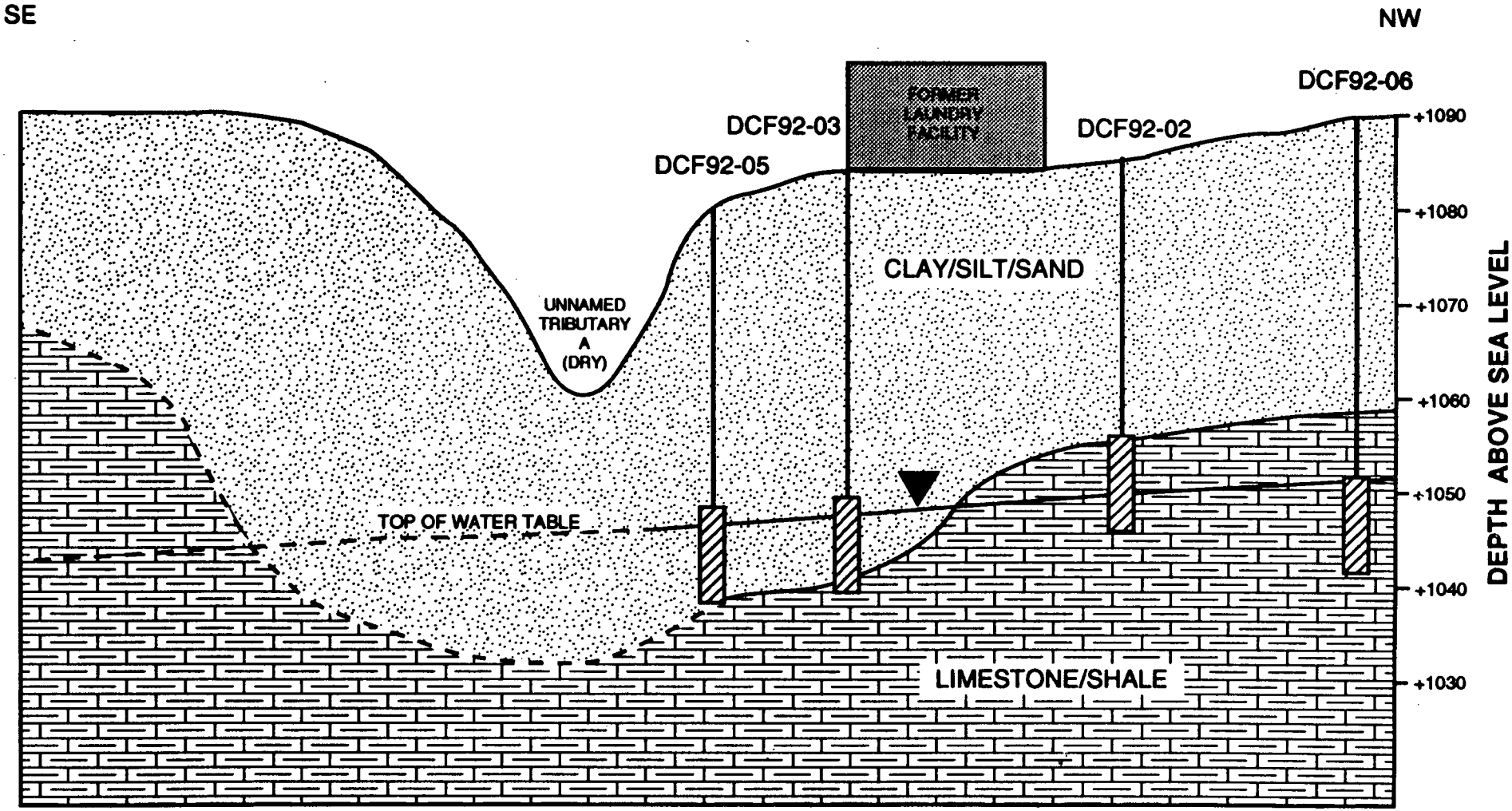
The installation of soil borings and monitoring wells, and the logging records of these borings confirmed the basic regional geology of a thick soil section overlying a bedrock of limestones and shales. To the north of the site, in monitoring well borings DCF92-02 and DCF92-06, the soil profile is approximately 30 feet thick, as illustrated in Figure 3-5. The soil profile thickens to the south to a depth of approximately 40 feet in monitoring well borings DCF92-03 and DCF92-05. The soil profile consists of intermixed sands, silts and clays as illustrated by the Test Boring Records in Appendix D and the geotechnical grain size analysis in Appendix G. Regional geologic studies in the Fort Riley area indicate that the soils are composed of alluvial deposits, residual soils developed from weathered bedrock, and windblown loess of the Pleistocene and Recent age. The soils overlying the bedrock at the former Dry Cleaners appear to be fine to medium-grained alluvial deposits indicative of a low energy depositional environment, and possible loess deposits. To the west of the site, at DCF92-04, the isolated occurrence of bedrock at nine feet below the ground surface indicates that in-place weathering of the bedrock has also occurred because at one time the bedrock had been much higher. The presence of angular chert and limestone fragments in the borings,

FIGURE 3-5

NORTHWEST TO SOUTHEAST CROSS SECTION

DRY CLEANING FACILITY

FORT RILEY, KANSAS



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and the presence of a weathered bedrock zone between the base of the soil horizon and the top of the bedrock adds credibility to this assumption. The weathered bedrock has contributed to the soil horizon in the area, and this process is ongoing.

Below the weathered zone, rock corings revealed that the stratigraphy is comprised of limestone and shale sequences typical of the Fort Riley area. The shales range in thickness from one to five feet and generally exhibit a greenish-gray or reddish-brown color. Limestones varied from competent to fractured and massive to well stratified or vuggy. Limestones varied in color, and consisted of various shades of tans, greens, grays, and black.

3.2.2 Site Hydrogeology

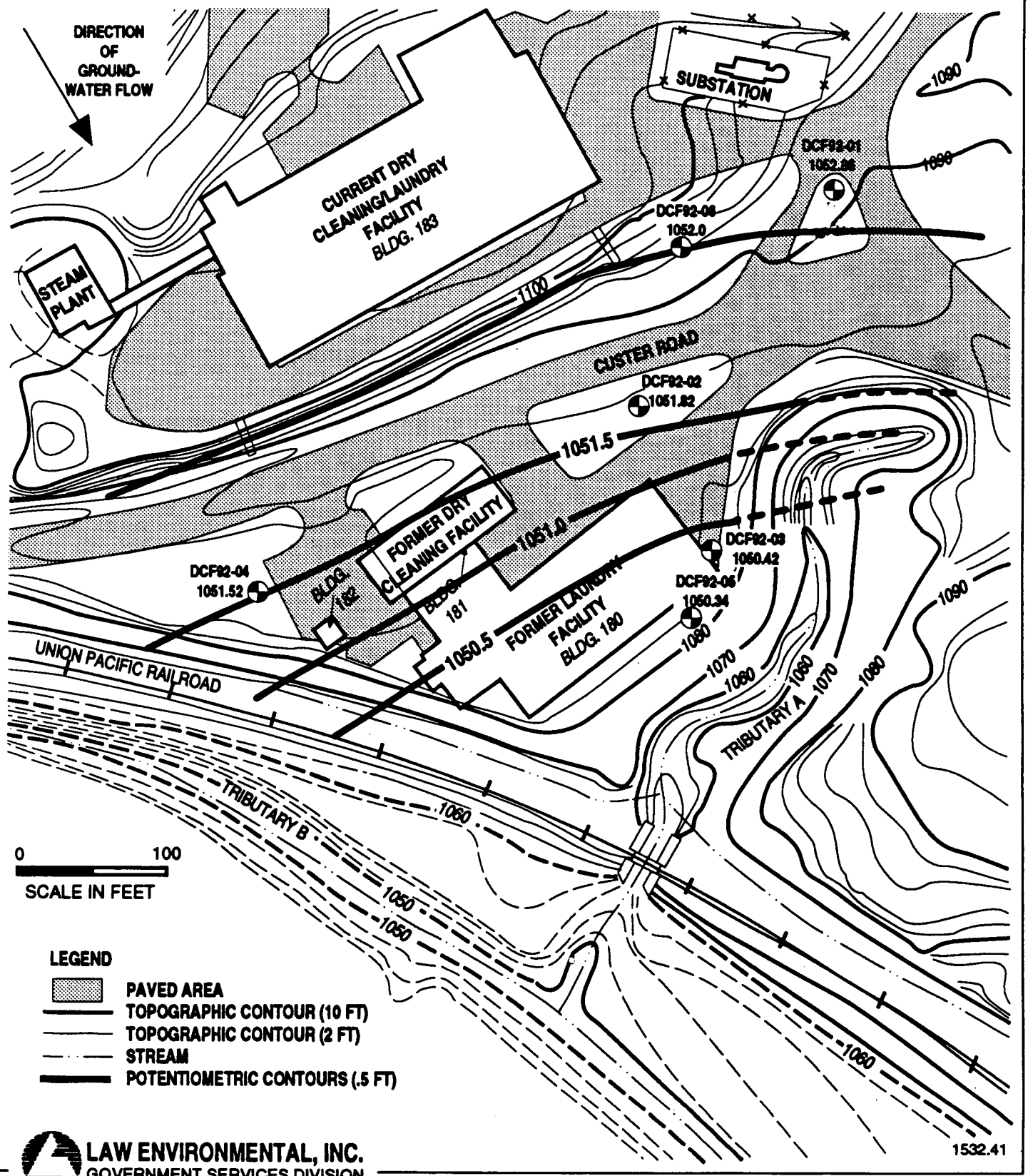
The water table was encountered at the former Dry Cleaning Facility at a depth of 32 to 40 feet below the ground surface. The depth of water in each monitoring well installed at the site is listed below:

Well Number	Static Water Level (8/17/92)	Depth of Water Adjusted to Feet Above Mean Sea Level
DCF92-01	39.20	1052.86
DCF92-02	37.21	1051.82
DCF92-03	36.15	1050.42
DCF92-04	35.85	1051.52
DCF92-05	32.40	1050.34
DCF92-06	40.40	1052.00

Figure 3-6 illustrates the ground-water flow direction at the site. Potentiometric contours of the top of the water table show a descending water table from northwest to southeast. The direction of ground-water flow, therefore, is to the southeast. The ground-

FIGURE 3-6

POTENTIOMETRIC SURFACE MAP
FORMER DRY CLEANING FACILITY
FORT RILEY, KANSAS



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water drop over the site is 2.52 feet, a drop so gradual that .5-foot contours were used in Figure 3-6 to illustrate the direction of flow. The northwest to southeast ground-water drop can also be seen on Figure 3-5. As the figure shows, the top of the water table is in bedrock north of the site, and in the soil horizon to the south of the site.

Based upon ground-water flow direction at the former Dry Cleaning Facility, the most likely route of contaminant migration present in the ground water is to the southeast.

4.0 NATURE AND EXTENT OF CONTAMINATION

The objective of the field investigation at the former Dry Cleaning Facility was to determine if contaminants are present in the subsurface soils and ground water at the site and to assess the potential for off-site migration. The specific objective for each field task is presented in Table 4-1.

Representative samples of soil gas, ground water, surface water, sediments and soils were collected from the site for chemical analysis. This section discusses the results of the analytical program and the conclusions that can be drawn regarding the presence of contamination at these sites.

4.1 SAMPLING PROGRAM

The field work at the site was conducted between November, 1991 and July, 1992. A brief description of sampling activities performed at the site is provided in this section. Additional detailed information is provided in Section 3.0 of this report, the Final Chemical Data Acquisition Plan (Law, 1992) and the Quality Control Summary Report (Law, 1992b), published as separate documents.

4.1.1 Soil Gas Sampling

Soil gas samples were collected from a total of 49 locations at the site by Target Environmental Services (TARGET). Samples were initially planned to be collected at depths of 6 to 15 feet; however, weather conditions prevented access by TARGET's hydraulic probe van and sampling procedures were modified. The actual sampling depths ranged from 3.5 to 6 feet below the ground surface. Thirty-two shallow soil gas samples were collected by using a drive rod inserted to a depth of 3.5 to 4 feet. The sampling

TABLE 4-1

PROJECT ACTIVITIES AND OBJECTIVES
Former Dry Cleaning Facility
Fort Riley, Kansas

ACTIVITIES	OBJECTIVES
Soil Gas Survey	Delineate volatile contaminant plume and aid in the placement of monitoring wells.
Shallow Soil Borings	Determine presence or absence of contamination and aid in the placement of monitoring wells.
Install six monitoring wells and perform ground-water sampling	Determine presence or absence of contamination in uppermost bedrock aquifer.
Collect four soil samples from each well boring (24 soil samples)	Determine presence or absence of suspected contaminants within the soil profile.
Collect three surface water and three sediment samples	Determine presence or absence of contamination in surficial waters and sediments.
Perform periodic ground-water sampling	Determine contaminant fluctuations due to seasonal changes in the aquifer.

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system was purged with ambient air drawn through an organic vapor filter cartridge, and a stainless steel probe was inserted to the full depth of the boring and sealed off from the atmosphere. Seventeen samples were collected using a van-mounted hydraulic probe which advanced a one-inch diameter steel casing to a depth of 6 feet. The sampling system was purged with ambient air drawn through an organic vapor filter cartridge. A teflon line was inserted to the bottom of the casing, and sealed off from atmospheric conditions with an inflatable packer. For both methods, a sample of in-situ soil gas was then withdrawn through the probe and used to purge atmospheric air from the sampling system. A second sample of soil gas was then withdrawn through the probe and encapsulated in a pre-evacuated glass vial at two atmospheres of pressure. Samples were taken to an on-site laboratory and analyzed within 24 hours of collection. The results of this survey were used to determine soil boring and monitoring well placement.

4.1.2 Soil Sampling

Fifteen shallow soil borings and six monitoring well borings were installed at the former Dry Cleaning Facility. Shallow borings were drilled to obtain soil samples and gather information concerning site stratigraphy. Monitoring well borings were installed to obtain soil samples, allow for monitoring well installation, and gather information concerning site stratigraphy. Locations of the shallow soil borings and the monitoring wells are provided in the analytical results discussion later in this section.

The fifteen shallow borings were advanced to a depth of 15 feet using hollow stem augers. Soil samples were collected with a stainless steel split-spoon sampler at five-foot intervals. Soil samples to be analyzed for volatile organic compounds were

collected and placed in two 2-oz. wide-mouth soil vials immediately after opening the split spoon. The jars were filled completely, with no headspace between the soil and the lid. The remaining sample was homogenized, then placed in two 8-oz. soil jars with headspace. A headspace screening was performed at each sampling interval using an HNu. The two samples with the highest HNu readings in each boring were selected for laboratory analysis. If headspace readings were zero, samples from depths of 10 and 15 feet below the ground surface were collected for laboratory analysis.

Four samples were collected from each monitoring well boring with the exception of DCF92-04 where only one sample was collected due to the proximity of bedrock to ground surface. Borings in the soil horizon were advanced utilizing hollow stem augers. Soil samples were collected every five feet using a stainless steel split-spoon. Soil samples to be analyzed for volatile organic compounds were collected and placed in two 2-oz. wide-mouth soil vials immediately after opening the split spoon. The jars were filled completely, with no headspace between the soil and the lid. The remaining sample was homogenized and placed in two 8-oz. soil jars with headspace. A headspace screening was performed at each sampling interval using an HNu. The four samples with the highest HNu readings were selected for laboratory analysis. If headspace readings were zero, one sample was collected at the soil/bedrock interface, and the remaining three samples were collected at discrete intervals through the soil section to determine vertical extent of contaminants.

4.1.3 Surface Water and Sediment Sampling

Three surface water samples and three sediment samples were collected from the vicinity of the former Dry Cleaning Facility. The locations for these surface water and sediment samples were chosen to collect representative samples upstream (DCSW-1/DCSD-01)

and downstream (DCSW-2/DCSD-2, DCSW-3/DCSD-3) of the site. A downstream to upstream sampling priority was used to minimize sediment agitation. Surface waters were collected first, using a pre-cleaned stainless steel beaker. Sediment samples were collected next, and within ten feet of where the surface water sample had been taken. A pre-cleaned stainless steel spoon was used to collect the sediment samples from a depth of approximately 3" to 6" below the creek bed. Sediments for volatile compound analyses were collected immediately after sampling to minimize volatilization. The remaining sediment sample was placed in a decontaminated stainless steel bowl, thoroughly homogenized and placed in appropriate containers.

4.1.4 Ground-Water Sampling

Six ground-water samples were collected from monitoring wells installed in the vicinity of the former Dry Cleaning Facility. The monitoring well locations were selected based upon the results of the headspace screening data collected during the drilling of the shallow soil borings and the results of the soil gas survey. Monitoring well DCF92-01 is located northeast of the site and provides background data. Well DCF92-02 is situated in the area of highest PCE vapor concentrations found during the soil gas survey. Monitoring wells DCF92-03 and DCF92-05 are located to the east and south, respectively, of the former Laundry Facility (Building 180) and are the downgradient wells. Well DCF92-04 is placed in another area of relatively high soil gas concentrations at the west side of the site. Well DCF92-06 is located northeast of the site across Custer Road. The wells were installed to depths ranging from 42 to 46 feet below the ground surface. Monitoring wells DCF92-01, DCF92-02, DCF92-04, and DCF92-06 were screened where the top of the water table intersected the limestone bedrock. Monitoring wells DCF92-03 and DCF92-05 were screened where the top of the water table intersected the soil overburden.

The ground-water sampling procedures were modified from the original dedicated teflon bailer sampling method to a system of dedicated stainless steel and teflon bladder pumps. The modification is discussed in detail in the Technical Memorandum of July 10, 1992, located in Appendix I. This modification was necessary to meet the turbidity criteria of 30 NTUs established for the project. Prior to purging the static water level in each well was measured and checked for the presence of floating product. The well was then purged utilizing the bladder pumps until the parameters of pH, temperature, specific conductance and turbidity were stable (readings differing by +/-10 percent between two successive well volumes), removing a minimum of five well volumes. Samples for volatile organic compounds were collected first, slowing the pump flow rate to 150 ml/min during the sampling. The flow rate was checked with a graduated cylinder and a stopwatch. The samples for semi-volatile compound analyses were collected as the next step.

4.2 ANALYTICAL PROGRAM

The following section briefly describes the analytical program for soil gas, soils, sediments, surface water and ground-water samples. Additional details on analytical methods and procedures are provided in the Chemical Data Acquisition Plan (CDAP) and Quality Control Summary Report (QCSR) (Law, 1992).

4.2.1 Analytical Methods

Soil, sediment, surface water and ground-water samples were analyzed in accordance with Environmental Protection Agency (EPA) analytical methods. The methods are published in EPA SW-846 (EPA, 1986). The soil gas samples were analyzed using an on-site laboratory. The analytical methodologies are described below.

4.2.1.1 Soil Gas Analysis - The soil gas samples were analyzed on-site by a modified EPA method 601/602 analysis. The samples were analyzed by gas chromatography (GC) using a electron capture detector (ECD) and a flame ionization detector (FID). The method was modified to allow the use of direct injection instead of purge and trap for sample introduction. Tetrachloroethene was the only analyte standardized for the ECD analysis. The analytes included for the FID analysis were: benzene, toluene, ethylbenzene, xylenes and total FID volatiles. Additional information concerning the analytical procedures is provided in Appendix B.

4.2.1.2 Soil and Sediment Analyses - Soil and sediment samples from the former Dry Cleaning Facility were submitted for laboratory analyses for the following parameters:

- Volatile Organics by EPA Method 8260
- Semi-Volatile Organics by EPA Method 8270/3550

4.2.1.3 Ground-Water and Surface Water Analyses - Ground-water and surface water samples were submitted for laboratory analyses for the following parameters:

- Volatile Organics by EPA Method 8260
- Semi-Volatile Organics by EPA Method 8270/3520

4.2.1.4 Analytical Methods - The methods identified above were used to analyze soil and ground-water samples for parameters indicative of petroleum and chlorinated solvent contamination. Method 8260 uses gas chromatography/mass spectrometry to qualitatively and quantitatively identify volatile organic compounds including petroleum related and chlorinated volatiles. Method 8270 uses gas chromatography/mass spectrometry to

qualitatively and quantitatively identify semi-volatile organics including phthalates, phenols and polynuclear aromatic hydrocarbons (PAHs).

4.2.1.5 Sample Identification - The sample identification scheme is presented in the following section:

Soil samples: Soil samples collected from shallow borings are identified with the label DCFSB-XXA or DCFSB-XXB where "DCF" refers to the former Dry Cleaning Facility, "SB" refers to a soil boring, "XX" is the soil boring number identified with consecutive integers and "A" or "B" is a letter to differentiate between the two depths collected from each boring.

Soil samples collected from monitoring well borings are identified with the label DCF92-XXZ where "DCF" refers to the former Dry Cleaning Facility, "92" refers to the year in which the well was installed, "XX" is a consecutive numeric well identifier and "Z" is a letter (either A,B,C,D,E) which differentiates between depths collected from each monitoring well boring. Some monitoring well soils were identified as DCF92SB-XXD where the "SB" refers to a soil boring sample.

Sediment Samples: Sediment samples are identified with DCSD-XX where the "DC" refers to the Dry Cleaning Facility, the "SD" represents a sediment sample and the "XX" is a consecutive integer which identifies the sediment sampling location.

Surface Water Samples: Surface water samples are identified with DCSW-XX where the "DC" refers to the former Dry Cleaning Facility, the "SW" represents a surface water sample and the "XX" is a consecutive integer which identifies the surface water sampling location.

Ground-Water Samples: Ground-water samples submitted for laboratory analysis are identified with the label DCF92-XX where "DCF" refers to the former Dry Cleaning Facility, "92" is the year in which the wells were installed and "XX" is a numeric identifier. The letters "TB" indicates that the sample is a trip blank.

4.3 ANALYTICAL RESULTS

The following sections discuss the results of the analytical program for each site. The discussion focuses on the positive analytical results indicative of petroleum and solvent contamination. Positive results which are the result of common laboratory contamination based upon evaluation of quality control data will not be discussed. The quality control data evaluated include sample duplicates, matrix spike recoveries and precision, trip blanks, method blanks and surrogate spike recoveries. Quality control issues affecting data interpretation at the sites are discussed in this section. Detailed information regarding the quality control results and a comparison to project data quality objectives is provided in the Quality Control Summary Report (Law, 1992).

All data collected from this site are useable for the PA/SI. As previously discussed the purpose of the PA/SI is to determine the presence or absence of contamination. The quality of the data generated is sufficient to achieve this goal. However, some data must be qualified. The data qualifiers used and the significance of each is provided below:

B - Indicates sample results associated with a method blank which contains the analyte. The "B" flag indicates that the analyte was detected in the sample at a concentration less than ten times that of the method blank. These results may have a positive bias or run the risk of being false positives due to the laboratory contamination. Results should be considered estimated, possible false positives or biased high.

I - Estimated result based on internal standard recovery exceeding control limits. The quantitation of the result is uncertain.

I2 - Estimated result based on low internal standard recoveries and high surrogate recoveries. Result may be biased high.

T - Estimated result, possible cross-contamination during shipping based on trip blank results.

E - Estimated result, possible low bias due to air bubbles noted in volatile vials.

4.3.1 Soil Gas Analytical Results

The GC/ECD analyses of soil gas samples for tetrachloroethene (PCE) revealed the highest levels of PCE at the northeast corner of the former Dry Cleaning Facility (Figure 4-1). The highest level occurred in Sample 30. More moderate levels extended westward to Building 181 and northward across Custer Road. Lower levels existed throughout the site.

The total FID volatile analysis produced the highest levels at the northeast corner of Building 180, where PCE was highest (Figure 4-2). Low levels extended westward beyond Building 181. None of the specific standardized FID analytes were present above the 1 µg/L detection limit in any of the samples from the site. Sample 28 which is located west of Building 181 was the only sample which may represent low levels of a petroleum-based solvent. The other total FID volatile results primarily consisted of the PCE peak, and no fuel related patterns were noted. Additional information is located in the TARGET report in Appendix C.

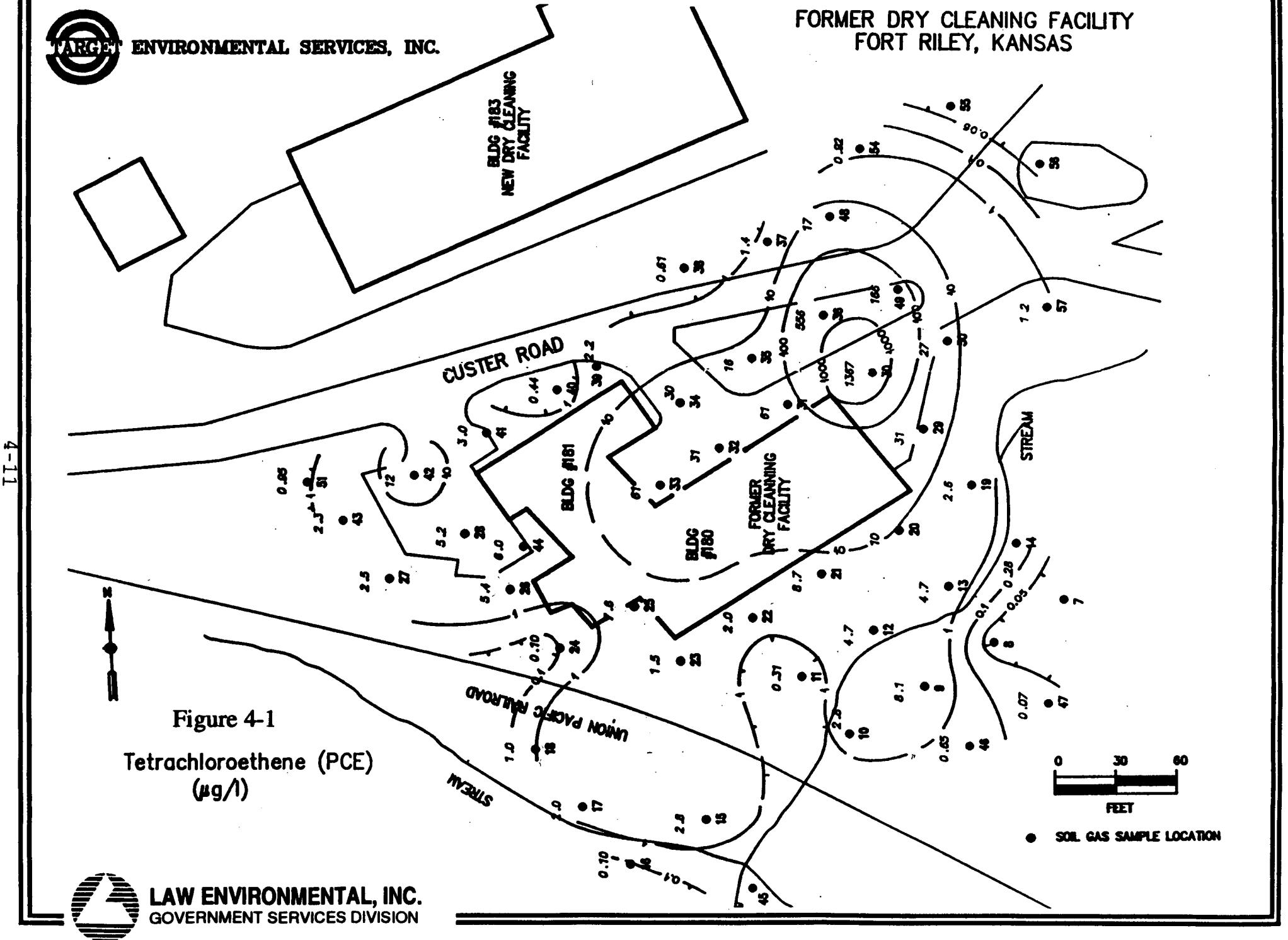

Figure 4-1

Tetrachloroethene (PCE)
(µg/l)

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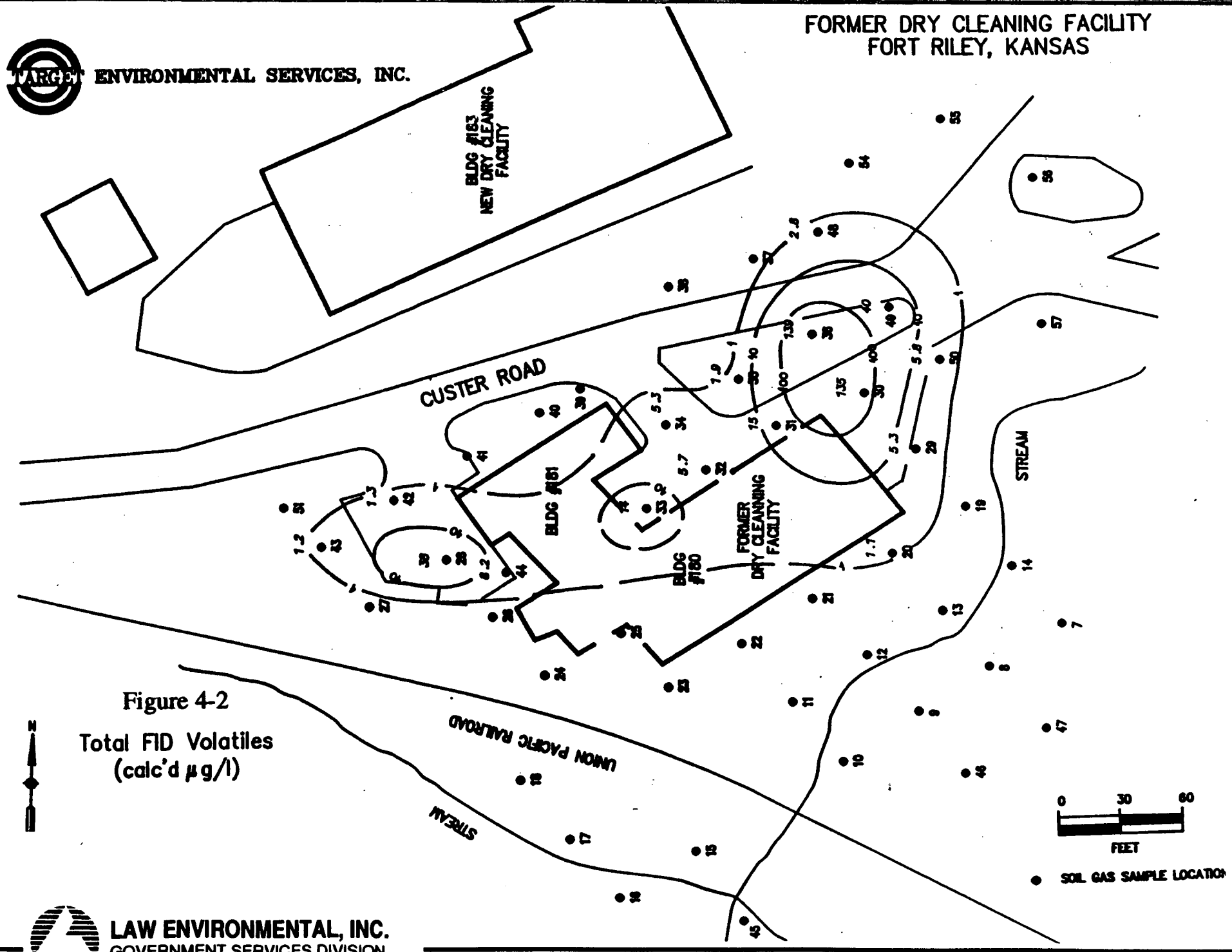

Figure 4-2

Total FID Volatiles
(calc'd µg/l)

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4.3.2 Soil Analytical Results

The soil samples collected were analyzed for volatile organics and semi-volatile organics. The following volatile organics were detected in the soil at the former Dry Cleaning Facility: 1,1,2 - trichloroethane, dibromochloromethane, tetrachloroethene (PCE), carbon disulfide and toluene. The following semi-volatile organics were detected in the soil at the former Dry Cleaning Facility: benzo[a]anthracene, benzo[a]pyrene, chrysene, fluoranthene, phenanthrene, pyrene, 2-methylnaphthalene, and bis(2-ethylhexyl) phthalate. Positive results from the monitoring well borings are presented in Table 4-2. Positive results from the shallow soil borings are presented in Table 4-3.

4.3.2.1 Volatile Organics - Volatile contamination within the monitoring well soil borings exists to the northeast, east and southeast of the former Dry Cleaning Facility (Figure 4-3). The area of highest volatile organic compound results coincides with the location of an existing sewer line which originates from the current Dry Cleaning Facility and Steam Plant and runs southeast towards unnamed tributary A. Tetrachloroethene was detected in the soils collected from monitoring well borings DCF92-02, DCF92-03 and DCF92-05. PCE was detected in DCF92-02 at concentrations ranging from 9.1 µg/kg at a depth of four feet to 53 µg/kg at nineteen feet. The highest concentration of PCE was detected in DCF92-03 at a depth of nine feet where it was detected at a concentration of 120 µg/kg. Concentrations within this boring ranged from 7.1 µg/kg to 120 µg/kg. In addition, PCE was detected once in DCF92-05 at a depth of 35 feet. Toluene was detected twice at low levels in DCF92-01 (5.8 µg/kg) and DCF92-03 (6.8 µg/kg). In addition, 1,1,2-trichloroethane and dibromochloromethane were detected once in the soil from DCF92-03 at concentrations of 86 µg/kg and 190 µg/kg, respectively, at a depth of four feet. Figure 4-4 provides sampling depths of the soil with positive soil sample results. The

TABLE 4-2

POSITIVE HITS
SOILS FROM MONITORING WELL BORINGS
Former Dry Cleaning Facility
Fort Riley, Kansas

PARAMETER / DEPTH:	DCF92SB01A 1'	DCF92SB01B 6'	DCF92SB01C 14'	DCF92SB01E 27'	DCF9202A 4'	SAMPLE DCF9202B 9'	DUPLICATE DCF9202E 9'
Volatile Organics (µg/kg):							
1,1,2-Trichloroethane	--	--	--	--	--	--	--
Dibromochloromethane	--	--	--	--	--	--	--
Methylene chloride	68	60	61	50 (B)	43 (B)	40 (B)	44 (B)
Tetrachloroethene	--	--	--	--	9.1	10	4.5
Toluene	--	--	--	5.8	--	--	--
Semi-Volatile Organics (µg/kg):							
Benzo[a]anthracene	--	--	--	--	--	--	--
Benzo[a]pyrene	--	--	--	--	--	--	--
Chrysene	--	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--
Pyrene	110	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--

-- = Not detected
B = Compound detected in the sample result at less than ten times the amount detected in method blank. Result is estimated.
I = Internal standard recovery is low. Sample quantitation is estimated.
Note: Results are calculated using the dry weight of the sample analyzed.

TABLE 4–2

POSITIVE HITS
SOILS FROM MONITORING WELL BORINGS
Former Dry Cleaning Facility
Fort Riley, Kansas

PARAMETER / DEPTH:	DCF9202C 19'	DCF9202D 24'	D9202E 29'	DC9203A 4'	DC9203B 9'	DC9203C 14'	SAMPLE DC9203E 24'
Volatile Organics (µg/kg):							
1,1,2–Trichloroethane	--	--	--	86 (I2)	--	--	--
Dibromochloromethane	--	--	--	190 (I2)	--	--	--
Methylene chloride	44 (B)	31 (B)	--	43 (B)	36 (B)	30 (B)	37 (B)
Tetrachloroethene	53	--	--	--	120 (I2)	15	--
Toluene	--	--	--	6.8 (I2)	--	--	--
Semi–Volatile Organics (µg/kg):							
Benzo[a]anthracene	--	--	--	380	--	--	--
Benzo[a]pyrene	--	--	--	270	--	--	--
Chrysene	--	--	--	300	--	--	--
Fluoranthene	--	--	--	610	--	--	--
Phenanthrene	--	--	--	610	--	--	--
Pyrene	--	--	--	530	--	--	--
bis(2–Ethylhexyl)phthalate	--	--	--	--	--	--	--

-- = Not detected
B = Compound detected in the sample result at less than ten times the amount detected in method blank. Result is estimated.
I2 = Internal standard recovery is low and surrogate recovery is high. Sample results are biased high.
Note: Results are calculated using the dry weight of the sample analyzed.

TABLE 4-2

POSITIVE HITS
SOILS FROM MONITORING WELL BORINGS
Former Dry Cleaning Facility
Fort Riley, Kansas

PARAMETER / DEPTH:	DUPLICATE DC9203G 24'	DC9203F 29'	DCF92SB03E 35'	DCF92SB04A 3'	DCF92SB05A 9'	DCF92SB05B 10'
Volatile Organics (µg/kg):						
1,1,2-Trichloroethane	--	--	--	--	--	--
Dibromochloromethane	--	--	--	--	--	--
Methylene chloride	32 (B)	32 (B)	25	89 (B)	26 (B)	22 (B)
Tetrachloroethene	7.1	7.2	44	--	--	--
Toluene	--	--	--	--	--	--
Semi-Volatile Organics (µg/kg):						
Benzo[a]anthracene	--	--	--	--	--	--
Benzo[a]pyrene	--	--	--	--	--	--
Chrysene	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--

-- = Not detected
B = Compound detected in the sample result at less than ten times the amount detected in method blank. Result is estimated.
I = Internal standard recovery is low. Sample quantitation is estimated.
Note: Results are calculated using the dry weight of the sample analyzed.

TABLE 4-2

POSITIVE HITS
SOILS FROM MONITORING WELL BORINGS
Former Dry Cleaning Facility
Fort Riley, Kansas

PARAMETER / DEPTH:	DCF92SB05C 24'	DCSB05E 35'	DCF9206A 4'	DCF9206B 9'	DCF9206C 19'	DCF92SB06E 28'
Volatile Organics (µg/kg):						
1,1,2-Trichloroethane	--	--	--	--	--	--
Dibromochloromethane	--	--	--	--	--	--
Methylene chloride	24 (B)	31	37 (B)	46 (B)	32 (B)	50 (B)
Tetrachloroethene	--	21	--	--	--	--
Toluene	--	--	--	--	--	--
Semi-Volatile Organics (µg/kg):						
Benzo[a]anthracene	--	--	--	--	--	--
Benzo[a]pyrene	--	--	--	--	--	--
Chrysene	--	--	--	--	--	--
Fluoranthene	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	2400	--	--

-- = Not detected
B = Compound detected in the sample result at less than ten times the amount detected in method blank. Result is estimated.
I = Internal standard recovery is low. Sample quantitation is estimated.
Note: Results are calculated using the dry weight of the sample analyzed.

TABLE 4-3

POSITIVE HITS
SOILS FROM SHALLOW BORINGS
Former Dry Cleaning Facility
Fort Riley, Kansas

PARAMETER	DCFSB01A	DCFSB01B	DCFSB02A	SAMPLE DCFSB02B	DUPLICATE DCFSB02C	DCSB03A	DCSB03B
DEPTH:	10'	5'	10'	15'	15'	10'	15'
Volatile Organics (µg/kg):							
Carbon disulfide	--	--	--	--	--	--	--
Methylene chloride	28	33 (B)	24	23	24	64 (B)	79 (B)
Tetrachloroethene	--	--	--	--	--	32	--
Toluene	--	--	--	--	--	--	--
Trichloroethene	--	--	--	--	--	--	--
Semi-Volatile Organics (µg/kg):							
2-Methylnaphthalene	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--

-- = Not detected
B = Compound detected in the sample result at less than ten times the amount detected in method blank. Result is estimated.
Note: Results are calculated using the dry weight of the sample analyzed.

TABLE 4-3

POSITIVE HITS
SOILS FROM SHALLOW BORINGS
Former Dry Cleaning Facility
Fort Riley, Kansas

PARAMETER			SAMPLE	DUPLICATE				
	DEPTH:	DCSB04A 10'	DCSB04B 15'	DCSB04C 15'	DCSB05A 10'	DCSB05B 15'	DCSB06A 10'	DCSB06B 15'
Volatile Organics (µg/kg):								
Carbon disulfide		9.2	--	--	--	--	--	--
Methylene chloride		130	100	55	41	46	39	37
Tetrachloroethene		7.0	--	--	--	--	--	--
Toluene		--	--	--	--	--	--	--
Trichloroethene		--	4.2	--	--	--	--	--
Semi-Volatile Organics (µg/kg):								
2-Methylnaphthalene		--	--	--	--	--	--	--
Phenanthrene		--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate		--	--	--	--	--	--	--

-- = Not detected
B = Compound detected in the sample result at less than ten times the amount detected in method blank. Result is estimated.
Note: Results are calculated using the dry weight of the sample analyzed.

TABLE 4–3

POSITIVE HITS
SOILS FROM SHALLOW BORINGS
Former Dry Cleaning Facility
Fort Riley, Kansas

PARAMETER				SAMPLE	DUPLICATE			
	DEPTH:	DCSB07A 10'	DCSB07B 15'	DCSB08A 5'	DCSB08C 5'	DCSB08B 8'	DCFSB09A 10'	DCFSB09B 15'
Volatile Organics (µg/kg):								
Carbon disulfide		--	--	--	--	--	--	--
Methylene chloride		36	27	33	36	27	27	22
Tetrachloroethene		29	3.7	--	--	--	--	--
Toluene		--	--	--	--	--	--	--
Trichloroethene		--	--	--	--	--	--	--
Semi–Volatile Organics (µg/kg):								
2–Methylnaphthalene		--	--	--	--	--	--	--
Phenanthrene		--	--	--	--	--	--	--
bis(2–Ethylhexyl)phthalate		380	460	--	--	--	--	--

-- = Not detected
B = Compound detected in the sample result at less than ten times the amount detected in method blank. Result is estimated.
Note: Results are calculated using the dry weight of the sample analyzed.

TABLE 4–3

POSITIVE HITS
SOILS FROM SHALLOW BORINGS
Former Dry Cleaning Facility
Fort Riley, Kansas

PARAMETER / DEPTH:	DCFSB10A 10'	DCFSB10B 15'	DCFSB11A 10'	DCFSB11B 15'	DCFSB12A 10'	DCFSB12B 15'
Volatile Organics (µg/kg):						
Carbon disulfide	--	--	--	--	--	--
Methylene chloride	23	25	25 (B)	124	48 (B)	51 (B)
Tetrachloroethene	--	--	--	--	--	--
Toluene	--	--	--	--	--	--
Trichloroethene	--	--	--	--	--	--
Semi–Volatile Organics (µg/kg):						
2–Methylnaphthalene	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--
bis(2–Ethylhexyl)phthalate	--	--	--	--	--	--

-- = Not detected
B = Compound detected in the sample result at less than ten times the amount detected in method blank. Result is estimated.
Note: Results are calculated using the dry weight of the sample analyzed.

TABLE 4–3

POSITIVE HITS
SOILS FROM SHALLOW BORINGS
Former Dry Cleaning Facility
Fort Riley, Kansas

PARAMETER / DEPTH:	DCSB13A 10'	DCSB13B 15'	DCSB14A 10'	DCSB14B 15'	DCSB15A 10'	DCSB15B 15'
Volatile Organics (µg/kg):						
Carbon disulfide	--	--	--	--	--	--
Methylene chloride	98	180	37	93	40	49
Tetrachloroethene	180	960	5.5	--	--	--
Toluene	5.9	31	--	--	--	--
Trichloroethene	--	--	--	--	--	--
Semi–Volatile Organics (µg/kg):						
2–Methylnaphthalene	--	220	--	--	--	--
Phenanthrene	--	290	--	--	--	--
bis(2–Ethylhexyl)phthalate	--	--	--	--	--	--

-- = Not detected
B = Compound detected in the sample result at less than ten times the amount detected in method blank. Result is estimated.
Note: Results are calculated using the dry weight of the sample analyzed.

FIGURE 4-3

POSITIVE ANALYTICAL RESULTS: SOILS FROM MONITORING WELL BORINGS FORMER DRY CLEANING FACILITY VOLATILE ORGANICS

FORT RILEY, KANSAS

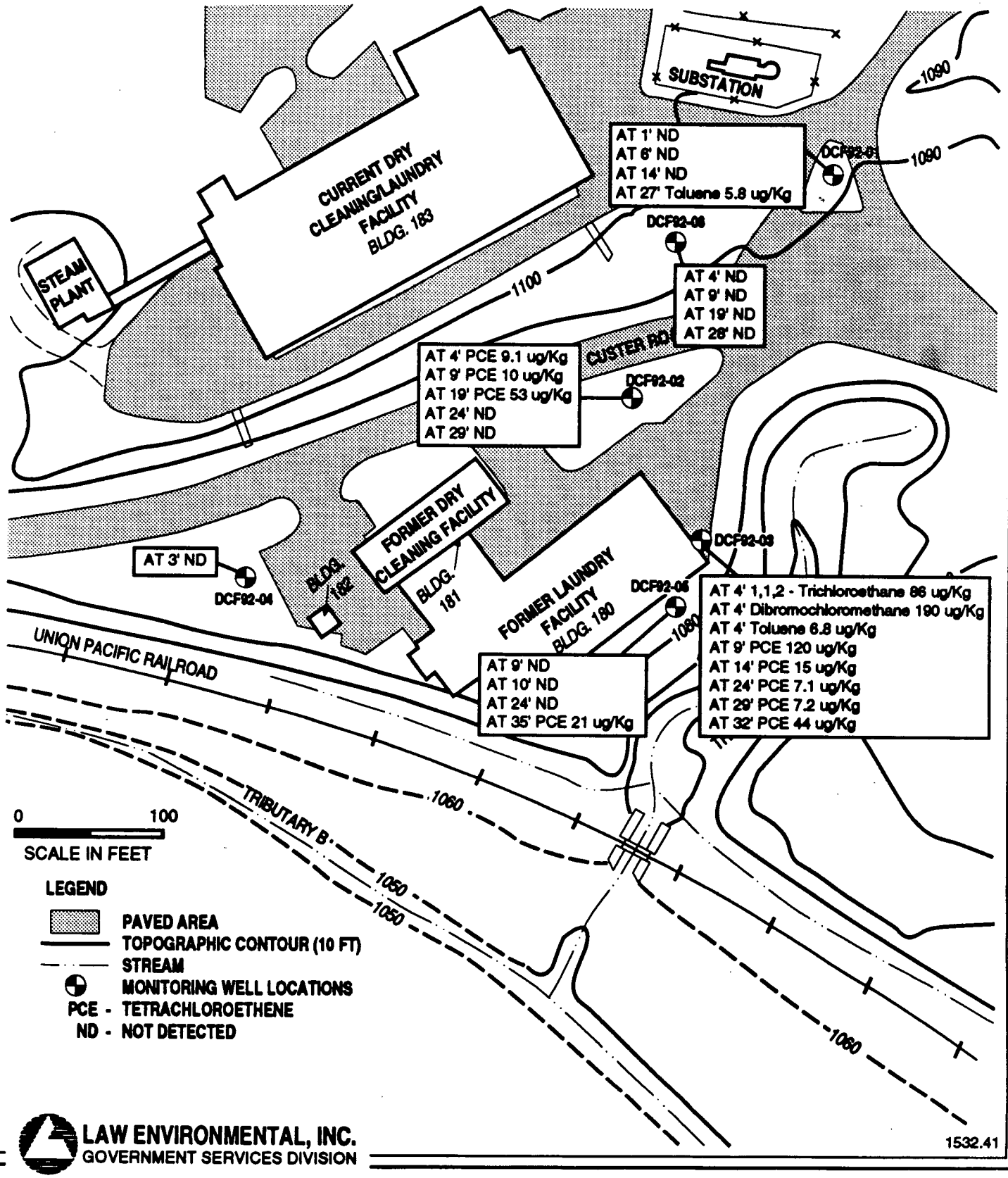

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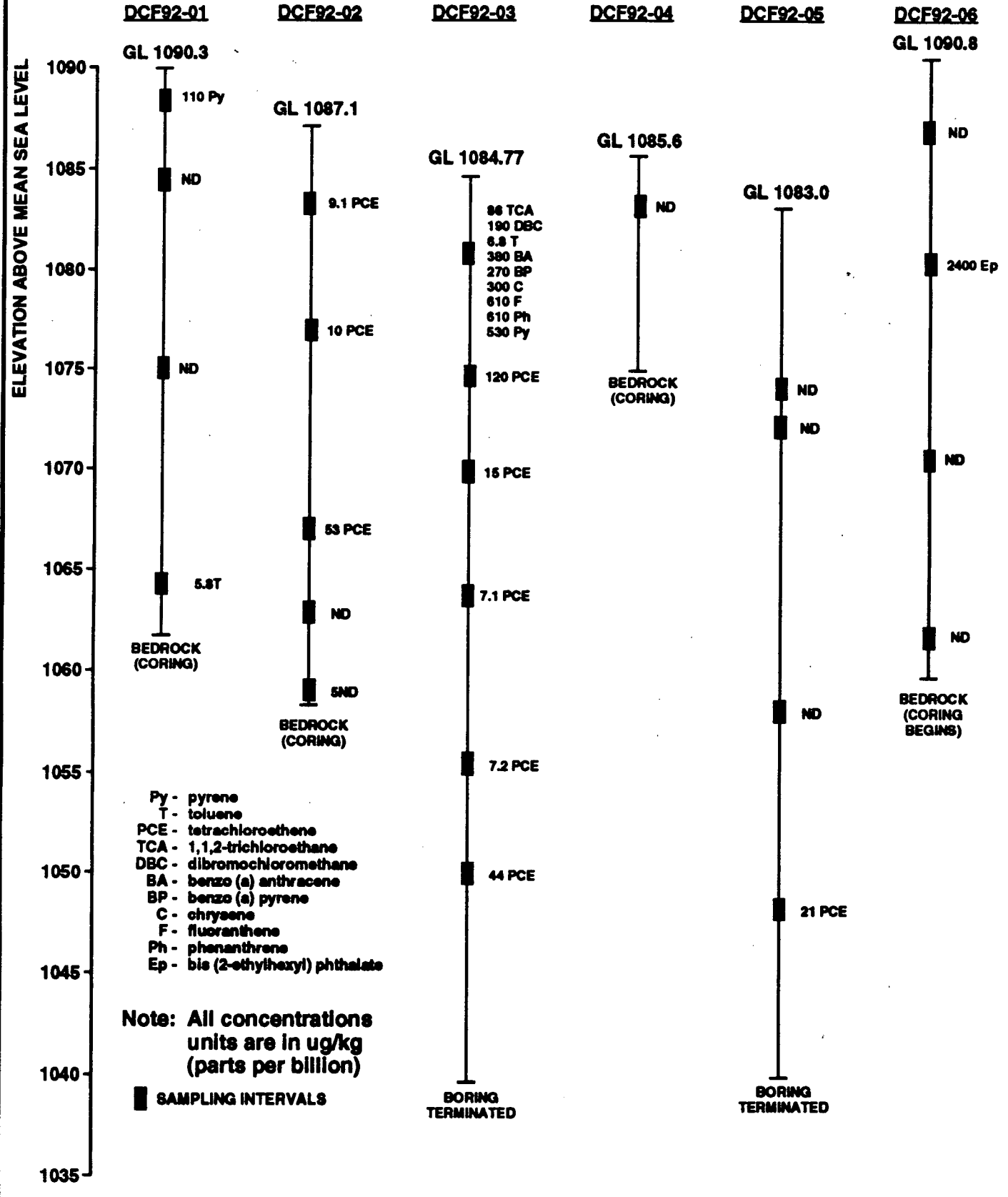
FIGURE 4-4

SOIL BORINGS ANALYTICAL RESULTS FROM MONITORING WELLS AND SAMPLE DEPTHS

FORMER DRY CLEANING FACILITY
FORT RILEY, KANSAS



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vertical extent of PCE contamination in the area east and southeast of the Dry Cleaning Facility extends from soils near the ground surface to the soil/bedrock interface.

Several volatile organic compounds were detected in the soil samples from shallow borings including PCE, trichloroethene (TCE) and carbon disulfide (Figure 4-5). The PCE was detected to the northeast, east and southeast of the Former Dry Cleaning Facility. The highest concentration was detected in DCFSB-13 at a depth of 15 feet where PCE was detected at 960 µg/kg. PCE was detected in DCFSB-07 at concentrations ranging from 3.7 to 29 µg/kg, DCFSB-03 at 32 µg/kg, DCFSB-04 at 7.0 µg/kg, DCFSB-14 at 5.5 µg/kg, and DCFSB-13 at concentrations ranging from 180 to 960 µg/kg. The compound TCE was detected in DCFSB-04 to the east of Building 181 at 4.2 µg/kg. Toluene was detected in DCFSB-13 at both 10 and 15 foot depths at concentrations of 5.9 and 31 µg/kg, respectively. In addition, carbon disulfide was detected in DCFSB-04 at 9.2 µg/kg. Figure 4-6 provides sampling depths with positive results of chemical analyses of the soil samples. The vertical extent of volatile organic contamination ranges from 1075 to 1050 above mean sea level within the shallow borings.

Based upon chemical analysis results of soil samples from monitoring well borings and shallow soil borings, PCE contamination is indicated to the northeast, east and southeast of the former Dry Cleaning Facility. Other volatiles were also detected including 1,1,2-trichloroethane, dibromochloromethane, carbon disulfide and toluene. The horizontal extent of contamination has not been fully defined to the southeast of the site. The data also indicate that the vertical extent of contamination in the areas east to southeast of the site extends from soils near the ground surface to the soil/bedrock interface based on soils from both monitoring well borings and shallow soil borings.

4.3.2.2 Semi-Volatile Organics - Semi-volatile organics were detected in soils from monitoring well borings to the northeast and

FIGURE 4-5

POSITIVE ANALYTICAL RESULTS: SOILS FROM SHALLOW SOIL BORINGS FORMER DRY CLEANING FACILITY VOLATILE ORGANICS

FORT RILEY, KANSAS

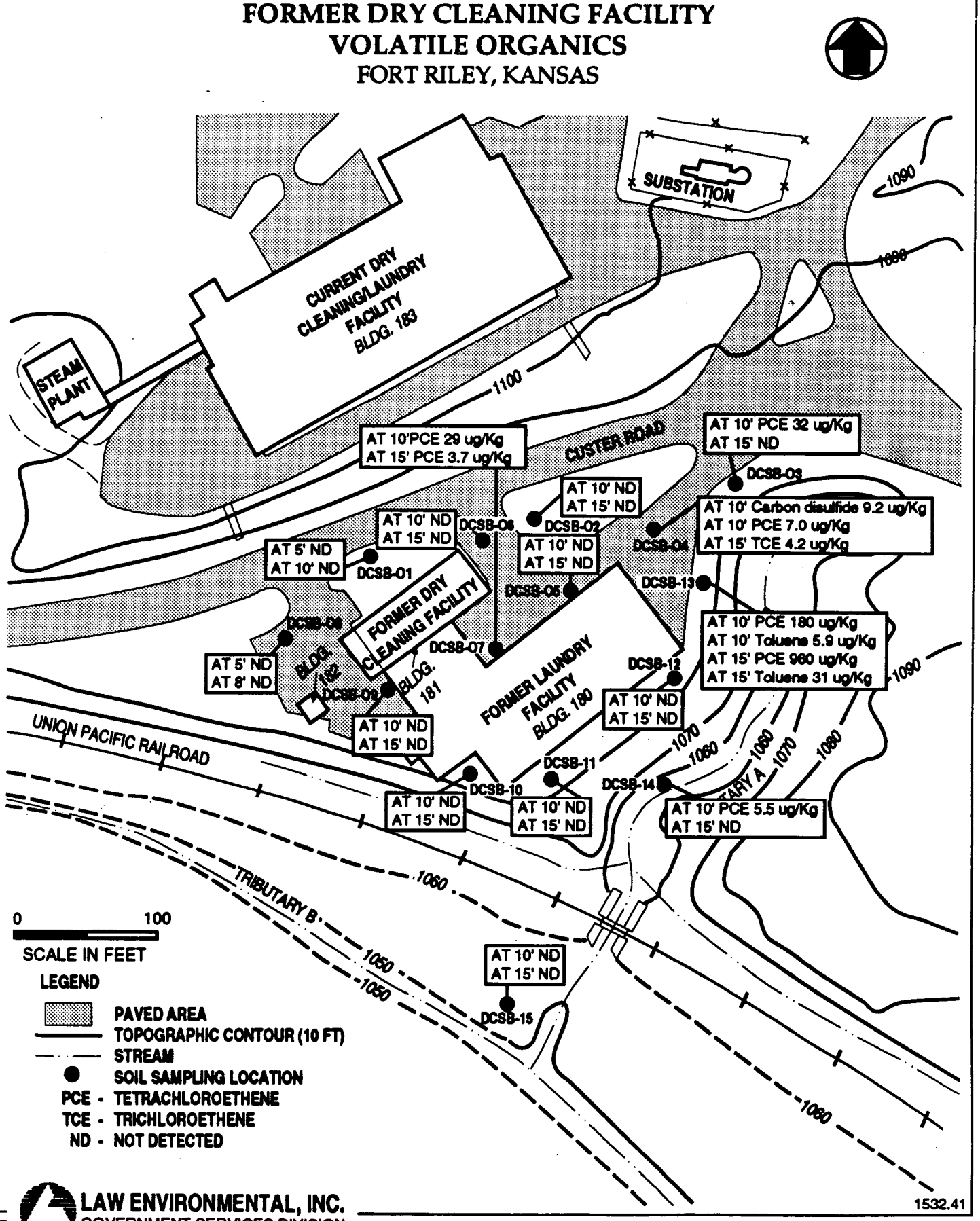

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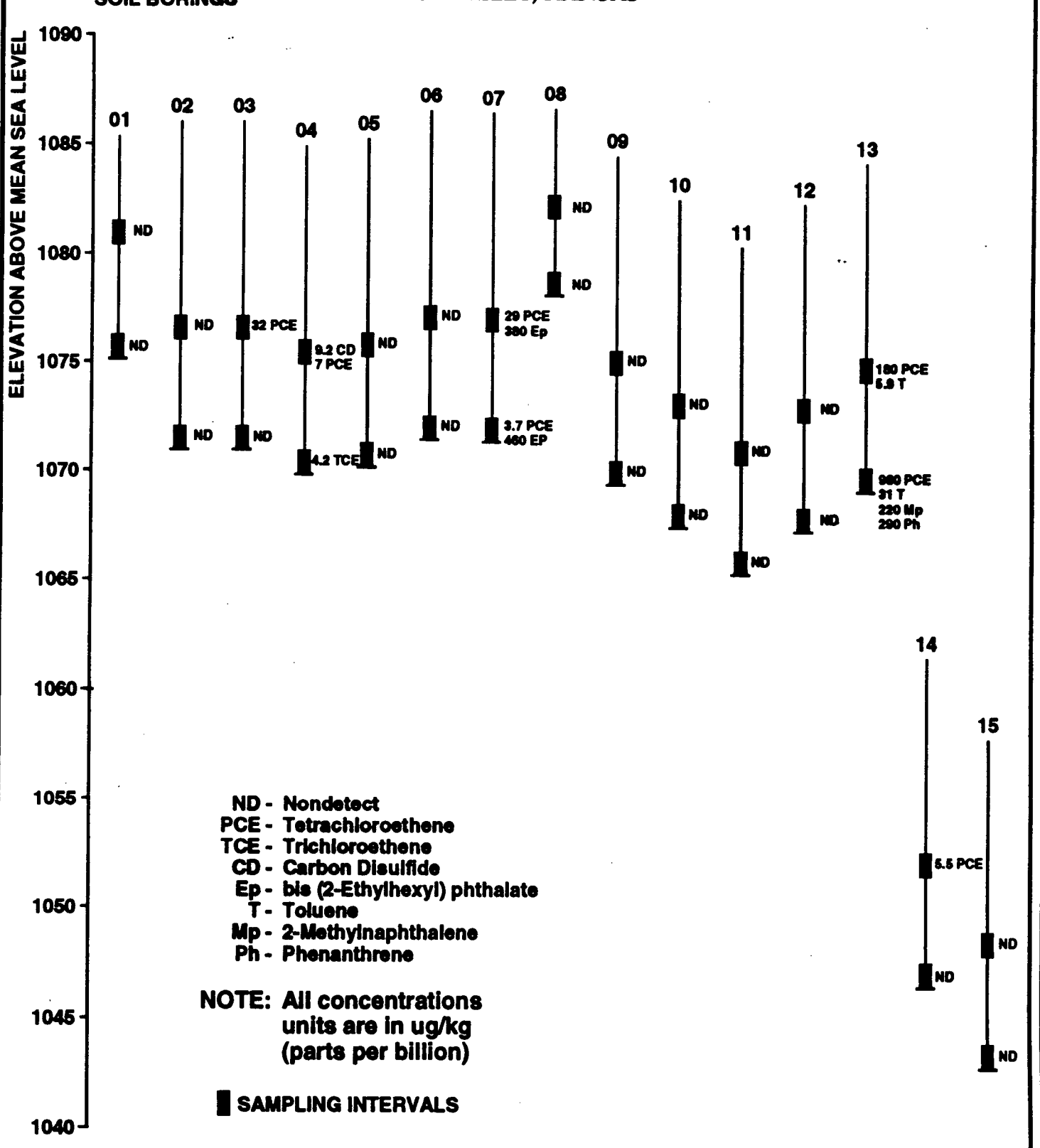
FIGURE 4-6

SHALLOW SOIL BORINGS ANALYTICAL RESULTS AND SAMPLE DEPTHS

FORMER DRY CLEANING FACILITY
FORT RILEY, KANSAS



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east of the former Dry Cleaning Facility (Figure 4-7). Bis(2-ethylhexyl)phthalate was detected in soil from monitoring well DCF92-06 at 2400 µg/kg at a depth of nine feet. Pyrene was detected in DCF92-01 at 110 µg/kg at a depth of one foot. In addition, several polynuclear aromatic hydrocarbons were detected in DCF92-03 at a depth of four feet, including benzo[a]anthracene (380 µg/kg), benzo[a]pyrene (270 µg/kg), chrysene (300 µg/kg), fluoranthene (610 µg/kg), phenanthrene (610 µg/kg) and pyrene (530 µg/kg). Figure 4-4 provides sampling depth of the soil with positive results of the chemical analyses of the soil. The semi-volatile contamination appears to be limited to the more shallow soils. The depths corresponding with positive results range from one to nine feet.

Semi-volatile organics were detected in the soils from shallow borings to the southeast of Building 181 (Figure 4-8). Figure 4-6 provides a depth cross-section of the soil and positive results of the chemical analyses of the soil. Compounds detected include bis(2-ethylhexyl)phthalate, 2-methylnaphthalene and phenanthrene. The 2-methylnaphthalene and phenanthrene were detected in DCFSB-13 at a depth of 15 feet at concentrations of 220 and 290 µg/kg, respectively. Bis(2-ethylhexyl)phthalate was detected twice in DCFSB-07 at concentrations ranging from 380 to 460 µg/kg.

Semi-volatile organics were detected in the soil to the northeast, east and southeast of the former Dry Cleaning Facility. Compounds detected include benzo[a]anthracene, benzo[a]pyrene, chrysene, fluoranthene, phenanthrene, pyrene, 2-methylnaphthalene, and bis(2-ethylhexyl)phthalate. The extent of contamination of semi-volatile compounds is limited to shallow soils from one to nine feet.

4.3.3 Surface Water and Sediment Analytical Results

Three surface water and three sediment samples were collected for chemical analysis at this site. Results indicate the presence of PCE in surface water and sediment samples and pyrene in the

FIGURE 4-7

POSITIVE ANALYTICAL RESULTS: SOILS FROM MONITORING WELL BORINGS FORMER DRY CLEANING FACILITY

SEMI-VOLATILE ORGANICS

FORT RILEY, KANSAS

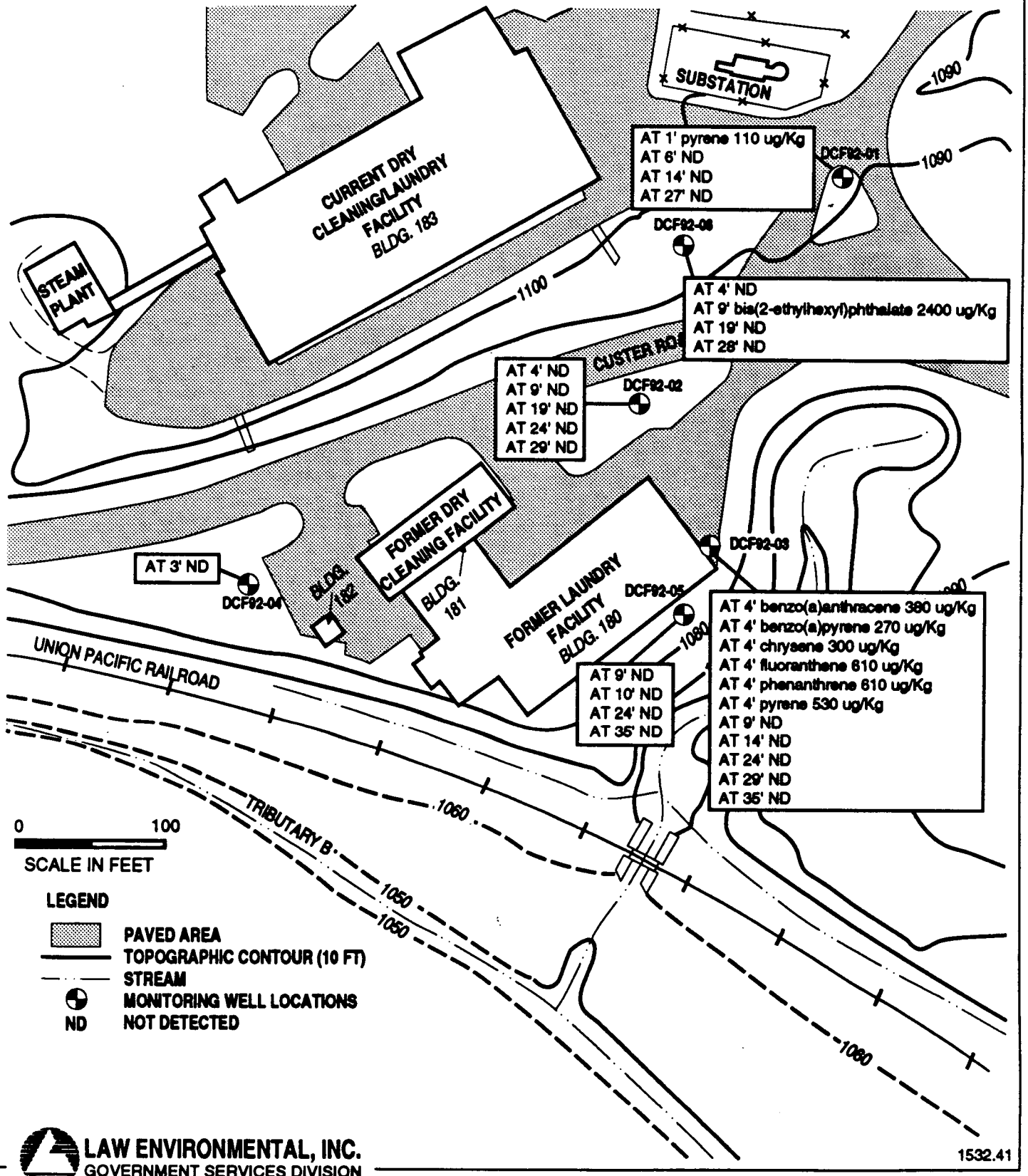

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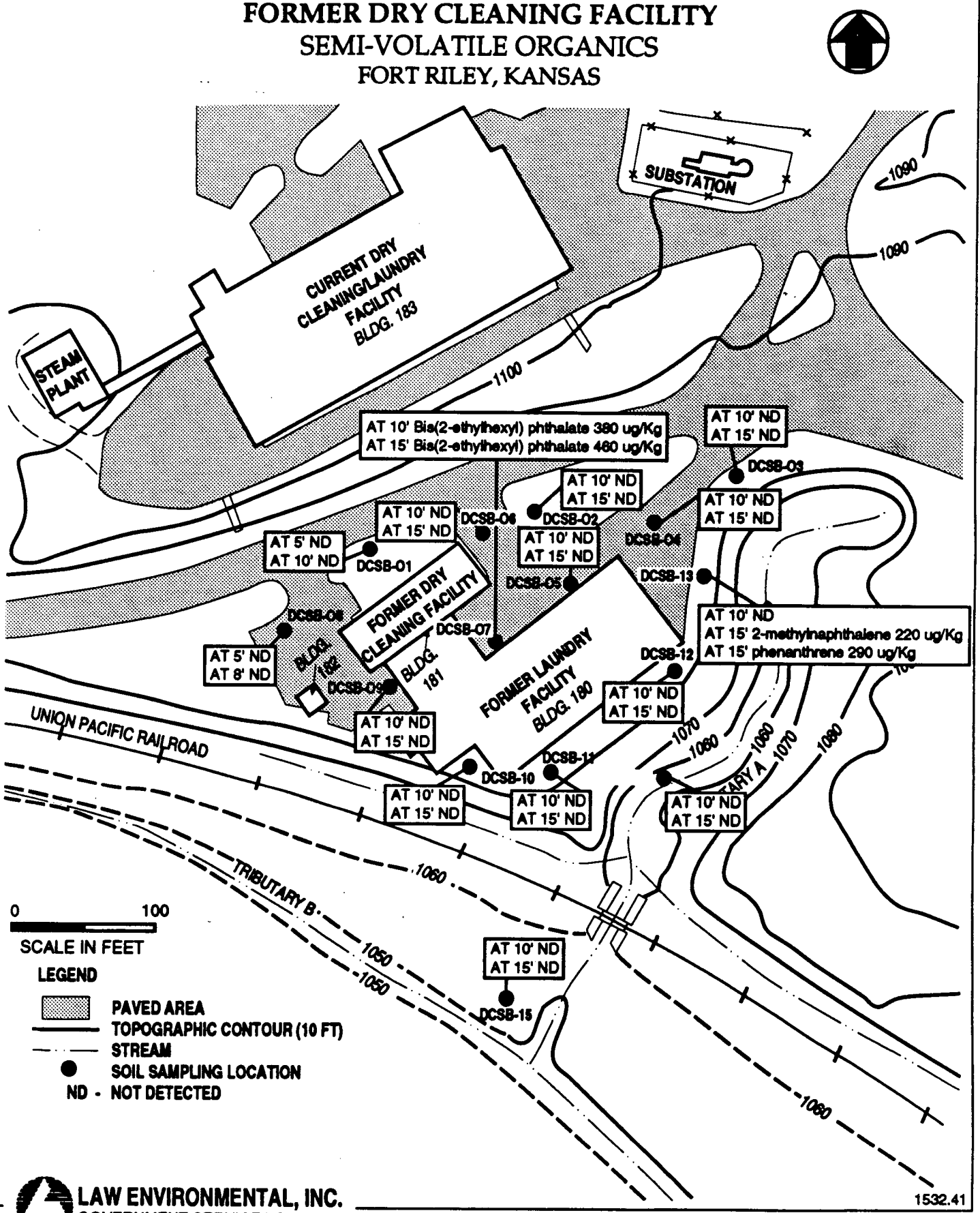
FIGURE 4-8

POSITIVE ANALYTICAL RESULTS: SOILS FROM SHALLOW SOIL BORINGS FORMER DRY CLEANING FACILITY

SEMI-VOLATILE ORGANICS

FORT RILEY, KANSAS



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sediment samples only. Figure 4-9 relates positive results to sample locations. Tables 4-4 and 4-5 provide positive results for surface water and sediment samples. The surface water/sediment locations in unnamed tributary A indicate no contamination entering the area. The samples in unnamed tributary A, DCSW-02 and DCSD-02, contain low levels of PCE, 4.5 µg/L and 6.6 µg/kg, respectively. The most downstream sample, DCSD-03, contained pyrene at 120 µg/kg. This sediment was located in unnamed tributary B, and the contamination could be the result of dry cleaning activities or possible migration from sources upstream of tributary B.

4.3.4 Ground-Water Analytical Results

Results of the ground-water analysis indicate the presence of volatile chlorinated organic compounds to the northeast, east, southeast and west of the former Dry Cleaning Facility. Volatile compounds detected include 1,2-dichloroethene (1,2-DCE), PCE and TCE. One semi-volatile compound naphthalene was detected to the west of building 181. Table 4-6 provides positive results for the ground-water samples.

Tetrachloroethene was detected in four of the six monitoring wells sampled (Figure 4-10). The highest concentration of PCE was detected in DCF92-02 at 660 µg/L. Tetrachloroethene was also detected in DCF92-03 at 80 µg/L, in DCF92-04 at 9.3 µg/L, and in DCF92-05 at 160 µg/L. In addition, TCE, 1,2-DCE and vinyl chloride were detected. These compounds may be the result of anaerobic biodegradation of PCE (Howard,1990). TCE was detected in monitoring wells DCF92-03 and DCF92-05 at concentrations of 6.8 and 33 µg/L, respectively. The compound 1,2-DCE was detected in sample DCF92-03 at a concentration of 5.5 µg/L, in DCF92-04 at 5.0 µg/L and in DCF92-05 at 69 µg/L. Vinyl chloride was detected in DCF92-04 at a concentration of 11 µg/L. Because all downgradient wells contain PCE, the horizontal extent of contamination has not been

FIGURE 4-9

POSITIVE ANALYTICAL RESULTS - SURFACE WATER & SEDIMENT
FORMER DRY CLEANING FACILITY
VOLATILE AND SEMI-VOLATILE ORGANICS
FORT RILEY, KANSAS

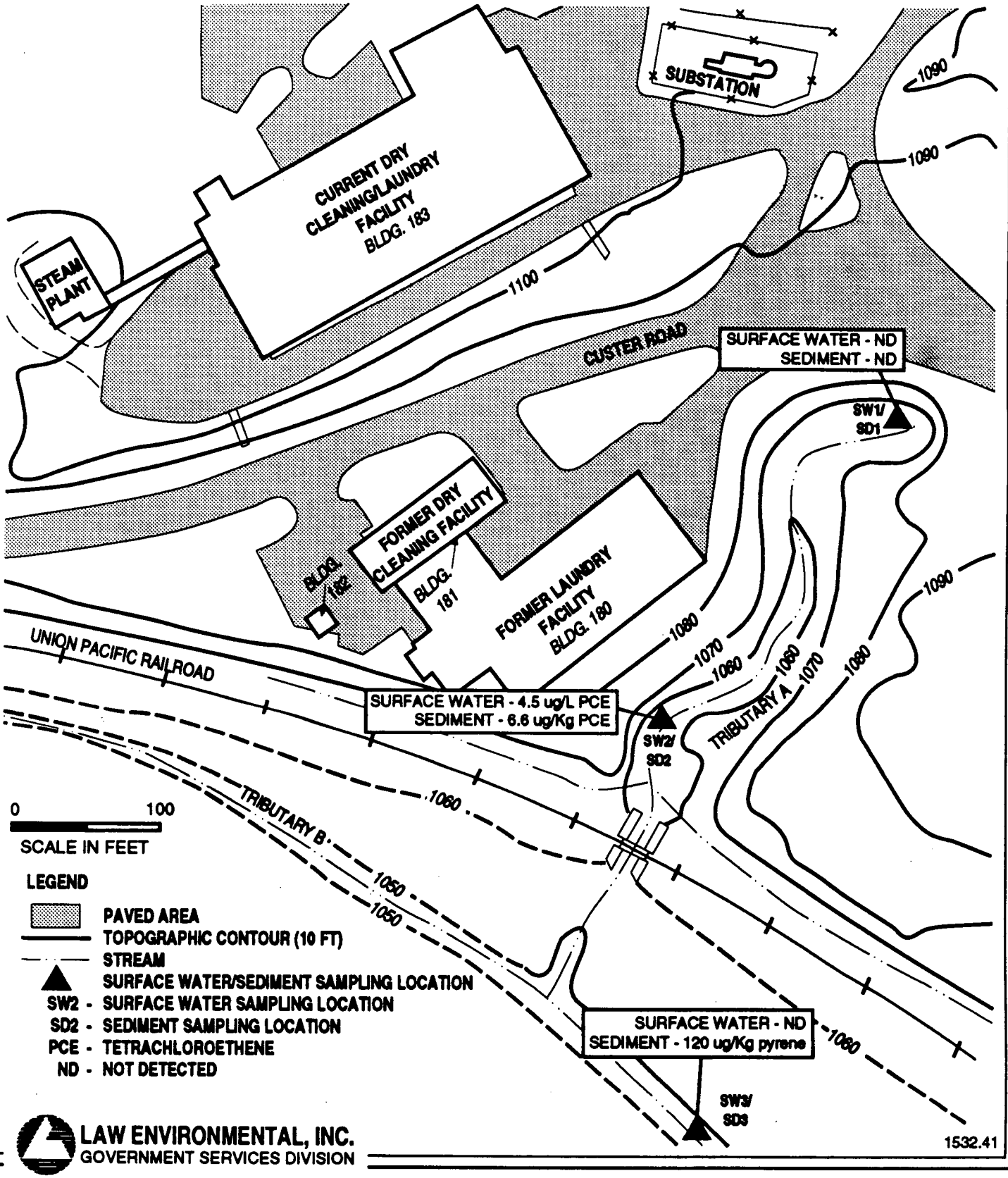

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TABLE 4–4

POSITIVE HITS
SURFACE WATERS
Former Dry Cleaning Facility
Fort Riley, Kansas

PARAMETER	DCSW01	SAMPLE DCSW02	DUPLICATE DCSW04	DCSW03
Volatile Organics (µg/L):	(E)			
Methylene chloride	22(T)	21(T)	22(T)	20(T)
Tetrachloroethene	--	4.5	4.6	--
Semi–Volatile Organics (µg/L)	--	--	--	--

-- = Not detected
T = Estimated result, possible cross–contamination during shipping, based on trip blank results.
E = Estimated result, possible low bias of results due to air bubbles noted in volatile vials.

TABLE 4-5

POSITIVE HITS
SEDIMENTS
Former Dry Cleaning Facility
Fort Riley, Kansas

PARAMETER	DCSD01	SAMPLE DCSD02	DUPLICATE DCSD04	DCSD03
Volatile Organics (µg/kg):				
Methylene chloride	84(B)	80(B)	85(B)	80(B)
Tetrachloroethene	--	6.6	--	--
Semi-Volatile Organics (µg/kg):				
Pyrene	--	--	--	120

-- = Not detected
B = Compound detected in the sample result at less than ten times the amount detected in the method blank. Result is estimated.

TABLE 4-6

POSITIVE HITS
GROUND WATERS
Former Dry Cleaning Facility
Fort Riley, Kansas

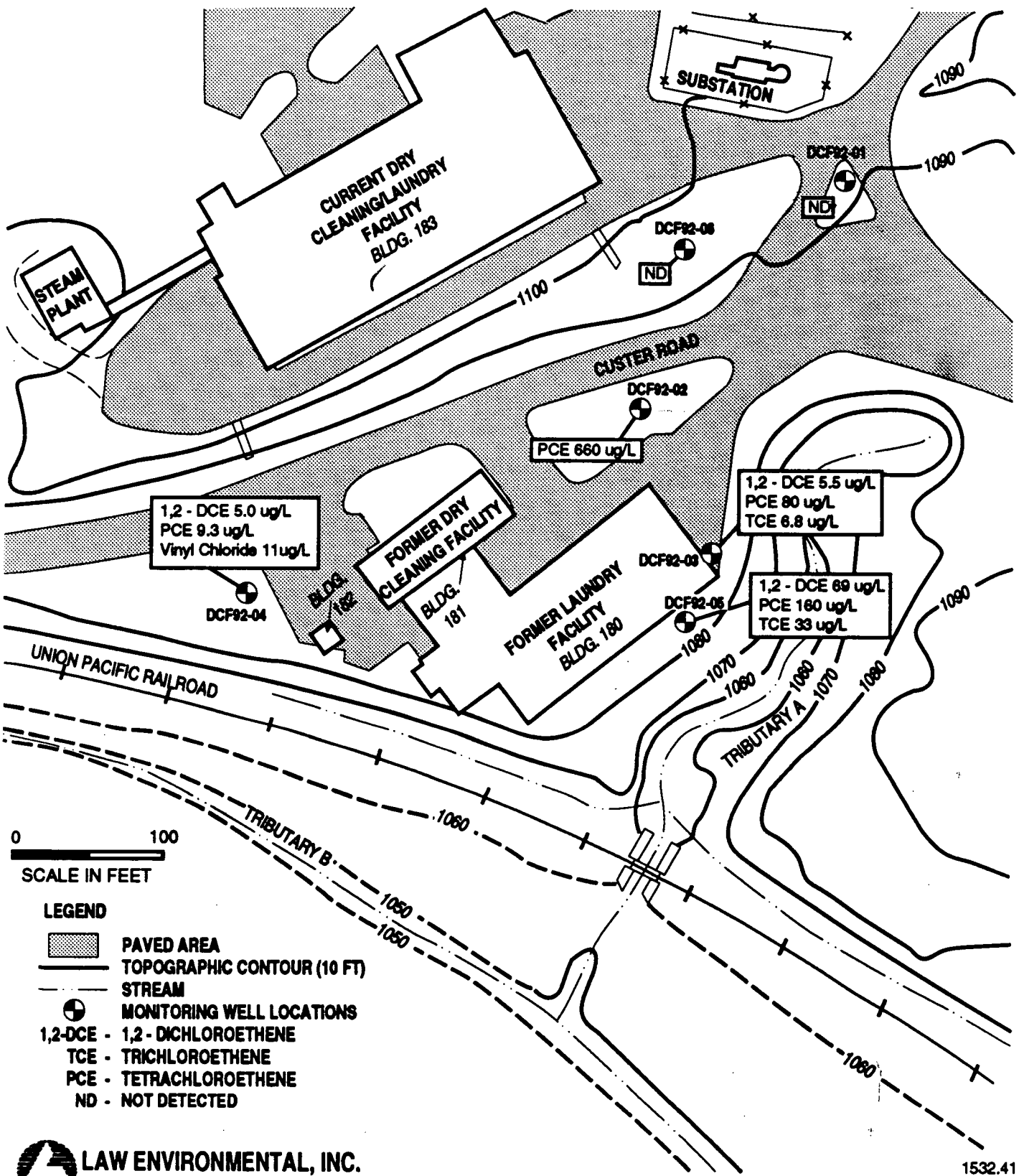
PARAMETER	DCF92-01	SAMPLE DCF92-02	DUPLICATE DCF92-07	DCF92-03	DCF92-04	DCF92-05	DCF92-06
Volatile Organics (µg/L):	(E)						
1,2-Dichloroethene	--	--	--	5.5	5.0	69	--
Tetrachloroethene	--	660	600	80	9.3	160	--
Trichloroethene	--	--	--	6.8	--	33	--
Vinyl chloride	--	--	--	--	11	--	--
Methylene chloride	5.0	130(B)	110(B)	13	--	14(B)	--
Semi-Volatile Organics (µg/L):	(I)						
Naphthalene	--	--	--	--	7.0	--	--

-- = Not detected
I = Internal standard recoveries exceed control limits. Sample quantitation is estimated.
E = Estimated result, possible low bias of result due to air bubbles noted in volatile vials.

FIGURE 4-10

POSITIVE ANALYTICAL RESULTS: GROUND WATER
FORMER DRY CLEANING FACILITY
VOLATILE ORGANICS

FORT RILEY, KANSAS



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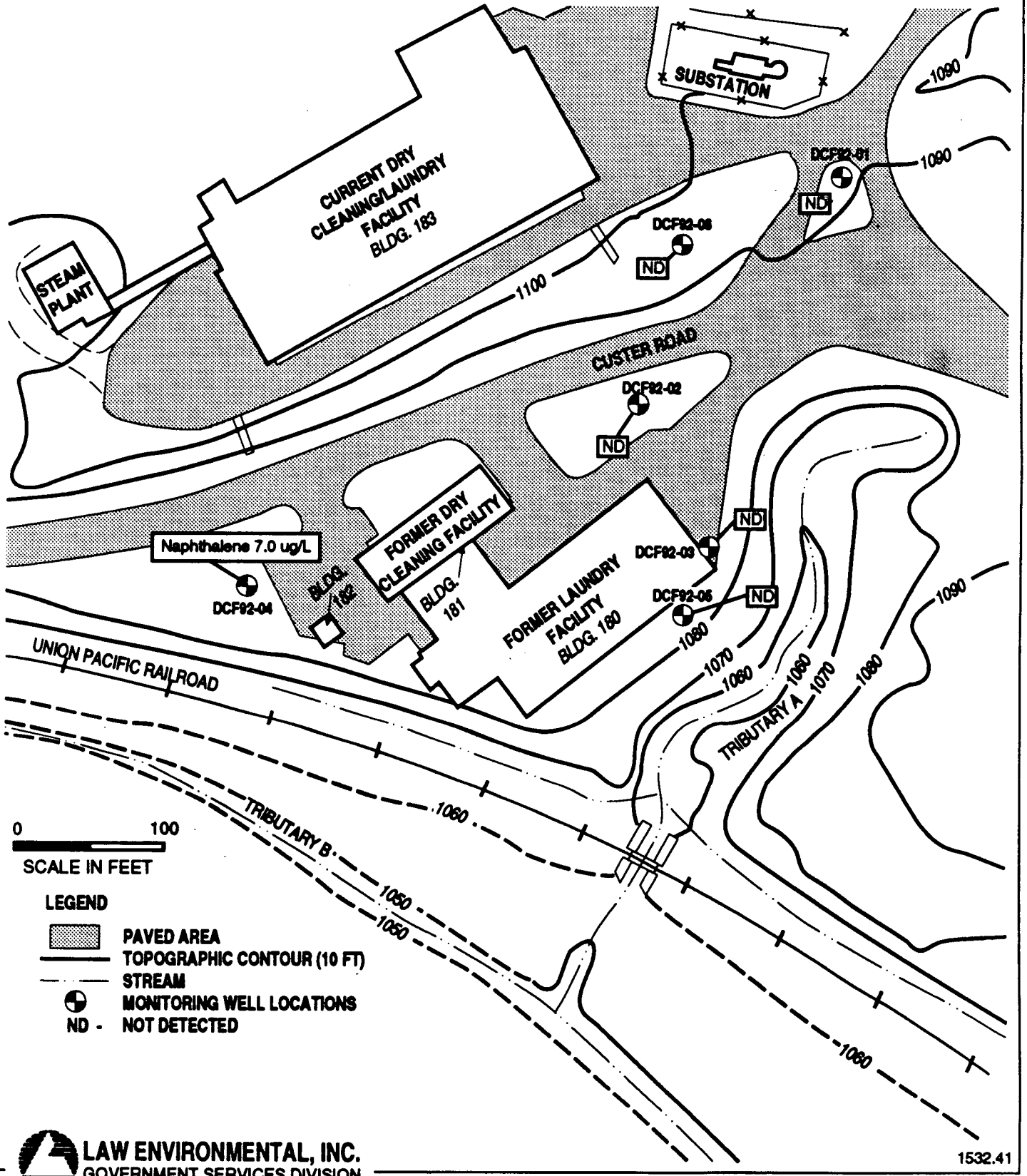
fully defined. Also, the area north of Building 181 has not been investigated. In addition, since PCE and TCE both have a greater density than water, these compounds tend to migrate downwards under the influence of gravity until a less permeable zone is reached. The vertical extent of contamination within the aquifer has not been defined based upon the nature of the chemical constituents detected.

The only semi-volatile compound detected in the ground-water samples was naphthalene which was detected in DCF92-04 at a concentration of 7.0 µg/L (Figure 4-11). During monitoring well installation of DCF92-04, a sheen was detected on the water and a sample was collected and sent to the Missouri River Division Laboratory for analysis. It was analyzed by USEPA method 8015 (modified) for fuel identification. The sample contained 243 µg/L of petroleum hydrocarbons identified as highly weathered gasoline or mineral spirits (Stoddard solvent) residue (Appendix I). In view of the history of the area (suspected oil spill, possible USTs, Stoddard solvent disposal on the ground, deteriorating asphalt), the sheen could be the result of one or more contaminant events.

FIGURE 4-11

POSITIVE ANALYTICAL RESULTS: GROUND WATER
FORMER DRY CLEANING FACILITY
SEMI-VOLATILE ORGANICS
FORT RILEY, KANSAS



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5.0 EXPOSURE ASSESSMENT

Public health and environmental concerns should be addressed at any potentially contaminated site. This section addresses these concerns through the development of a conceptual site model, which aids in the identification of potential site-specific exposure pathways and receptors.

5.1 CONCEPTUAL SITE MODEL

The purpose of a conceptual site model is to identify the possible exposure pathways to human and ecological receptors that may arise from contaminant release(s) at a given site. The objectives of the conceptual site model are to:

- characterize the potential source of contamination
- identify potential migration pathways and exposure pathways by which contaminants may migrate off-site
- identify potential receptors, both human and ecological, which may become exposed to the contaminants.

An exposure pathway is the route a constituent may take from a source to an exposed receptor. For an exposure pathway to be complete, it must consist of the following four elements: (1) a source and a mechanism of release, (2) a transport medium, (3) a point of contact with the contaminated medium, and (4) a route of uptake (e.g., ingestion) at the contact point.

The initial source of contamination at the former Dry Cleaning Facility is the solvent still bottoms or sludges that were generated at the facility. These wastes were reportedly poured

onto the soil (the secondary source) outside the rear portal of the DCF. Infiltration and percolation of the wastes into the soil may have resulted in their release to the ground water beneath the site. Run-off from storm water may have carried the constituents to nearby creeks, resulting in contaminated surface water and sediments. Potential transport of constituents via fugitive dust or volatilization of constituents from surface soils is unlikely, as the area immediately surrounding the DCF is paved or covered with vegetation. The sources, release mechanisms, exposure media, exposure routes, and receptors for the former DCF site are shown in Figure 5-1.

5.2 CHEMICALS OF CONCERN

Soil, ground water, surface water, and sediments were sampled and analyzed for volatile organic and semi-volatile organic compounds to identify constituents of concern. The results of this sampling effort are summarized in this section.

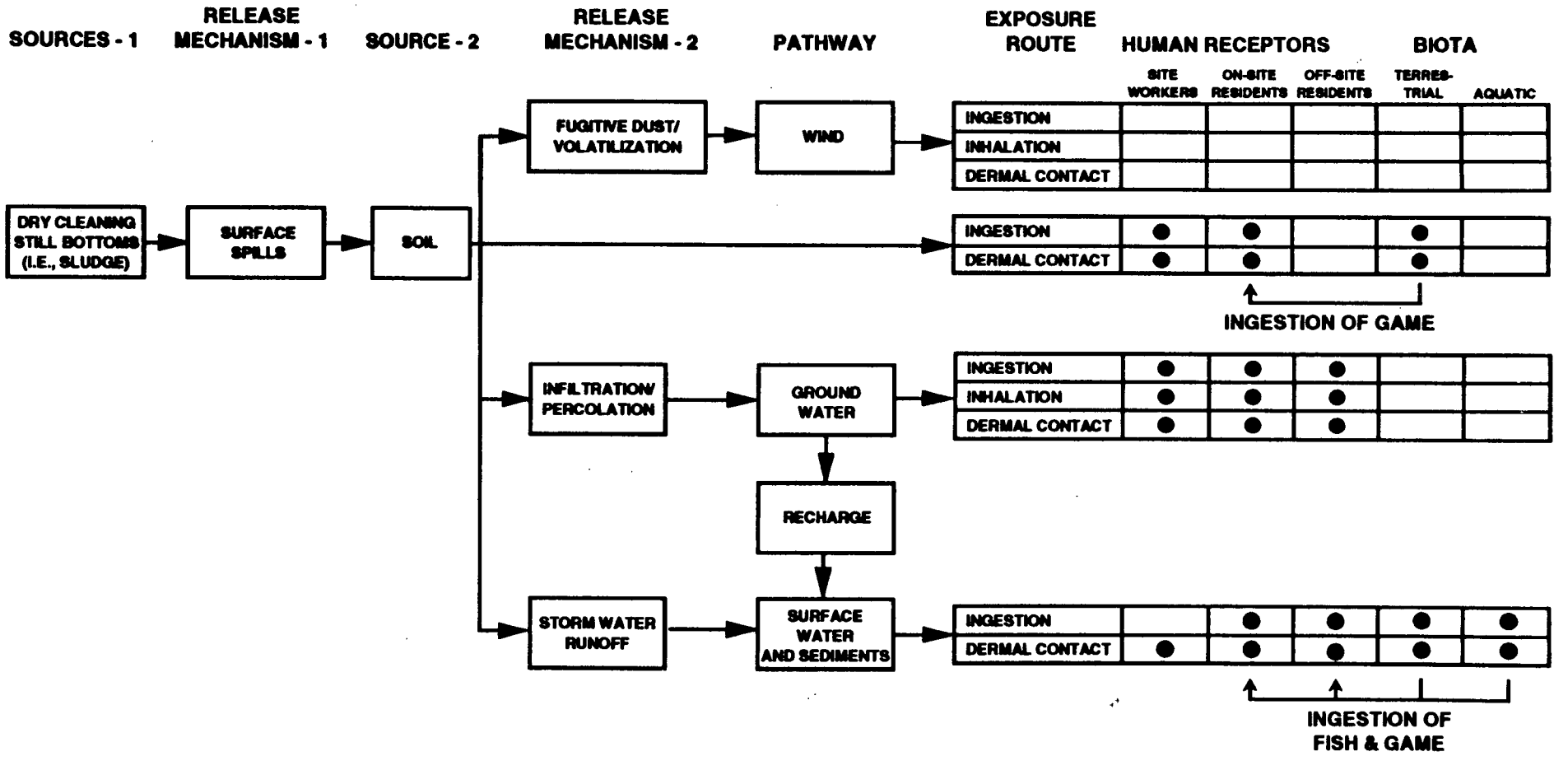
5.2.1 Ground-Water Sampling Results

A total of six constituents, including five chlorinated volatile organic compounds, were detected in the ground-water samples collected at the site. Naphthalene, the only non-chlorinated compound detected in the ground-water samples, was detected at a level of 7 µg/L. Methylene chloride was detected in the samples from four wells, at levels of 5 to 130 µg/L. 1,2-Dichloroethene (1,2-DCE) was detected in monitoring wells DCF92-03, DCF92-04, and DCF92-05 at concentrations of 5.5, 5.0, and 69 µg/L, respectively. Tetrachloroethene (PCE) was detected in four of the six wells (DCF92-02, DCF92-03, DCF92-04, and DCF92-05) at concentrations ranging from 9.3 to 660 µg/L. Trichloroethene (TCE) was detected in two wells: DCF92-03 (6.8 µg/L) and DCF92-05 (33 µg/L). Vinyl chloride was detected once in monitoring well DCF92-04 at 11 µg/L.

FIGURE 5-1

EXPOSURE MODEL

FORMER DRY CLEANING FACILITY (BUILDING 181)
FORT RILEY, KANSAS



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5.2.2 Soil Sampling Results

Soil samples were collected from the six monitoring well borings and from fifteen shallow soil boring locations at the DCF site. A total of five volatile organic compounds and seven semi-volatile organic constituents were detected in samples collected from the monitoring well borings.

The soil boring samples collected from the monitoring well boring located east of the facility, DCF92-03, appeared the most heavily contaminated, with ten constituents detected. Tetrachloroethene was consistently detected at concentrations ranging from 7.1 µg/kg (at 24 feet) to 120 µg/kg (at 9 feet). An additional three volatile organic constituents, toluene (6.8 µg/kg), 1,1,2-trichloroethane (86 µg/kg), and dibromochloromethane (190 µg/kg) were detected in this boring at a depth of four feet. Six semi-volatile compounds, all polycyclic aromatic hydrocarbons (PAHs) were detected in this boring at the same depth: benzo[a]anthracene (380 µg/kg), benzo[a]pyrene (270 µg/kg), chrysene (300 µg/kg), fluoranthene (610 µg/kg), phenanthrene (610 µg/kg), and pyrene (530 µg/kg).

PCE was also detected in soil boring samples collected from monitoring wells DCF92-02 and DCF92-05. PCE was consistently detected in the DCF92-02 samples, at concentrations ranging from 9.1 µg/kg (at 4 feet) to 53 µg/kg (at 19 feet). PCE was detected in one sample collected from DCF92-05 (21 µg/kg), at a depth of 35 feet.

Three constituents were detected in the soil boring samples collected from the upgradient well, DCF92-01: toluene 5.8 µg/kg (27 foot depth), pyrene 110 µg/kg (1 foot depth), and methylene chloride 60 to 68 µg/kg (at depths of 1 to 14 feet). Monitoring well soil boring samples from DCF92-04 and DCF92-06 failed to detect contamination, with the exception of one "hit" of bis(2-

ethylhexyl)phthalate at a concentration of 2,300 µg/kg in soils from DCF92-06 collected at a depth of 9 feet.

Soil samples were also collected from fifteen shallow soil boring locations on the site. Two samples were collected at each location, at two different depths, for a total of thirty samples. Methylene chloride was detected in all samples, at concentrations ranging from 22 µg/kg (DCFSB-09B) to 180 µg/kg (DCFSB-13B). It should be noted that methylene chloride was also detected in the blank associated with six of these samples. PCE was detected in seven samples (DCFSB-03A, DCFSB-04A, DCFSB-07A, DCFSB-07B, DCFSB-13A, DCFSB-13B, and DCFSB-14A) at concentrations of 3.7 to 960 µg/kg. Carbon disulfide and TCE were detected at levels of 9.2 µg/kg and 4.2 µg/kg, respectively, in samples collected from soil boring DCFSB-04. 2-Methylnaphthalene (220 µg/kg), phenanthrene (290 µg/kg), and toluene (5.4 and 31 µg/kg) were detected in DCFSB-13 soil samples. Samples collected from soil boring DCFSB-07 detected the presence of bis(2-ethylhexyl) phthalate at levels of 380 µg/kg (10 foot depth) and 460 µg/kg (15 foot depth).

5.2.3 Surface Water and Sediment Sampling Results

Surface water and sediment were sampled at three locations on the DCF site. Samples from the upgradient location did not contain volatile or semi-volatile organic compounds at detectable levels. However, PCE was detected at levels of 4.6 µg/L and 6.6 µg/kg in surface water (DCF92-SW2) and sediment (DCF92-SD2) samples, respectively, that were collected from a downstream location in Unnamed Tributary A. Pyrene was detected at a concentration of 120 µg/kg in the downgradient sediment sample collected from Unnamed Tributary B, located further downstream.

Based on this evaluation, the following constituents have been identified as chemicals of potential concern at the DCF site:

Ground Water	Soil
1,2-Dichloroethene	Carbon Disulfide
Methylene Chloride	Dibromochloromethane
Tetrachloroethene	Methylene Chloride
Trichloroethene	Tetrachloroethene
Vinyl Chloride	Toluene
Naphthalene	1,1,2-Trichloroethane
	Trichloroethene
	Benzo[a]anthracene
	Benzo[a]pyrene
	Chrysene
	Fluoranthene
	2-Methylnaphthalene
	Phenanthrene
	Pyrene
	bis(2-ethylhexyl)phthalate

Surface Water	Sediment
Methylene Chloride	Methylene Chloride
Tetrachloroethene	Tetrachloroethene
	Pyrene

The majority of the contamination at the DCF site appears to be located northeast of the former laundry facility (Building 180). It should be noted that a sewer line runs through this area, and it may be acting as a conduit for the volatile organic contamination detected in the vicinity.

5.3 COMPARISON TO APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO BE CONSIDERED (TBC) REQUIREMENTS

This section addresses the requirements of the environmental laws which are determined to be "applicable" or "relevant and appropriate". The identification of the ARARs is done on a site-

specific basis, and involves the comparison of a number of factors, including the types of hazardous substances present (chemical-specific) and the physical nature of the site (location-specific), to the statutory or regulatory requirements of the relevant environmental laws.

In addition to the ARARs, TBCs may also be used to evaluate the risk associated with the extent of contamination on a given site. The TBCs are non-promulgated advisories or guidance issued by state or federal government that are not legally binding and do not have the status of potential ARARs. Examples of TBCs include health advisories, reference doses (RFDs), guidance policy documents developed to implement regulations, and calculated risk-based levels such as Alternate Concentration Limits (ACLs).

5.3.1 Chemical Specific ARARS and TBCs

Chemical specific ARARs are usually health or risk-based numerical action values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical action values. These values establish the acceptable concentrations of constituents for a particular exposure pathway.

It should be noted that although only a few constituents may be resent in site media at concentrations above ARARs or TBCs, these guidelines are based on each constituent by itself, and not cumulatively. Exposure to receptors can still occur and the cumulative risk of all constituents across all media expected to be contacted should be assessed to verify that there is no threat to the public or the environment.

5.3.1.1 Ground Water - The National Primary Drinking Water Regulations established by the United States Environmental

Protection Agency (USEPA) provide Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) for a number of constituents. By definition, the MCLGs are non-enforceable health goals while the MCLs are the enforceable standards which must be set as close to the MCLGs as feasible. The MCLs combine health effects data on specific chemicals with other concerns, such as analytical detection limits, treatment technology, and economic impact. Relevant state water regulations which set state MCLs for constituents may be more stringent than federal MCLs.

A comparison of the maximum concentrations of the constituents present in the ground water to MCLs and MCLGs are shown in Table 5-1. The concentrations of methylene chloride (130 µg/L), tetrachloroethene (660 µg/L), and trichloroethene (33 µg/L) exceeded the standards (for each: MCL = 5 µg/L; MCLG = 0 µg/L) for these constituents. In addition, the level of vinyl chloride detected in the site's ground water (11 µg/L) exceeds the MCL of 2 µg/L. 1,2-Dichloroethene was detected at concentrations below MCL and MCLG values. There is no MCL available for naphthalene.

In addition to MCLs, the State of Kansas has developed Kansas Action Levels (KALs), Kansas Notification Levels (KNLs), Alternate Kansas Action Levels (AKALs), and Alternate Kansas Notification Levels (AKNLs). The KNL or AKNL is used to constitute administrative confirmation that ground-water contamination exists. The KAL or AKAL is applied to represent the level at which long-term exposure to contaminant concentrations is unacceptable. The KNL/KAL apply to fresh and usable water aquifers in the state, whereas the AKNL/AKAL apply to alluvial aquifers and/or specific aquifers which surface through springs or seep to become contributors to the surface waters of the state (KDHE, 1988). Discussions with the Kansas Department of Health and Environment indicate that the State of Kansas failed to meet the federally mandated deadline for completing revisions to the drinking water regulations and health advisories. Therefore, by default, the state is required to enforce the federally established MCLs.

TABLE 5-1

POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) FOR GROUND WATER FORMER DRY CLEANING FACILITY Fort Riley, Kansas

CHEMICAL	MAXIMUM CONCENTRATION DETECTED	FEDERAL MCL [a]	FEDERAL MCLG [a]	KANSAS MCL [d]	KAL [e]	KNL [e]
Volatile Organics:						
1,2-Dichloroethene	0.069	0.1 (cis)	0.1 (cis)	NA	0.07	0.007
		0.07[c] (trans)	0.07[c] (trans)	NA	0.07	0.007
Methylene Chloride	0.13	0.005[d]	NA	NA	0.05	0.005
Tetrachloroethene	0.66	0.005[c]	0	NA	0.007	0.0007
Trichloroethene	0.033	0.005	0	NA	0.005	0.0005
Vinyl Chloride	0.011	0.002	0	NA	0.002	0.0002
Semi-Volatile Organics:						
Naphthalene	0.007	NA	NA	NA	0.143	0.0143

All concentrations are in mg/L (ppm).

NA – Not available
a – Maximum Contaminant Levels and Maximum Contaminant Level Goals (40 CFR 141 Subpart B)
b – Kansas Drinking Water Rules (KAR 28.15), last amended 1 May, 1988
c – National Public Drinking Water Rules for 38 Inorganic and Synthetic Organic Chemicals (January, 1991), Phase II Fact Sheet
d – USEPA (57 FR 31776), 17 July, 1992
e – Kansas Action Levels and Kansas Notification Levels (Kansas Department of Health and Environment, memorandum "Revised Groundwater Contaminant Cleanup Target Concentrations for Aluminum and Selenium", 5 December 1988).
T – Value is for total 1,2 – Dichloroethene; isomers were not specified.

The KALs and KNLs for constituents detected in the ground-water samples are included in Table 5-1 as TBCs; AKALs and AKNLs are not available for these constituents. In general, the KNL values are one-tenth the KAL values. Both the KNL and KAL were exceeded by methylene chloride, tetrachloroethene, trichloroethene, and vinyl chloride. The maximum detected concentration of total 1,2-dichloroethenes exceeded the KNL but not the KAL.

5.3.1.2 Soil - Under the Resource Conservation and Recovery Act (RCRA), action levels have been proposed which are established assuming exposure through ingestion of media contaminated with the constituents of concern (USEPA, 1990). According to the proposed rule (40 CFR Parts 264, 265, 270 and 271), action levels for constituents: (1) are derived in a manner which is consistent with USEPA guidelines for assessing health risk; (2) are based on scientifically valid studies; (3) for carcinogens, represent a concentration associated with an excess upper bound cancer risk of 1×10^{-6} due to continuous lifetime exposure; and (4) for systemic toxicants, represent a concentration to which the human population could be exposed on a daily basis without appreciable risk of deleterious effects.

For systemic toxicants, the action level is calculated using the oral Reference Dose (RfD), which corresponds to a threshold concentration below which adverse effects are not expected to occur, even in sensitive subpopulations. For carcinogens, the action levels are based on the Carcinogen Slope Factor (CSF), which is the upper 95 percent confidence limit of the slope of the dose-response curve for each constituent.

The proposed action levels for the constituents present in soil will be considered as TBCs and are found in Table 5-2. All the chlorinated volatile organic constituents detected in site soils were present at concentrations below the proposed RCRA soil action levels. There are no soil action levels for PAHs (see Table 5-2).

TABLE 5-2

POTENTIAL TO BE CONSIDERED (TBC) REQUIREMENTS FOR SOILS FORMER DRY CLEANING FACILITY
Fort Riley, Kansas

CHEMICAL	MAXIMUM CONCENTRATION DETECTED (mg/kg)	PROPOSED RCRA [a] SOIL ACTION LEVEL (mg/kg)
Volatile Organics:		
Carbon Disulfide	0.0092	8,000
Dibromochloromethane	0.19 I2	NA
Methylene Chloride	0.18	90
Tetrachloroethene	0.96	10
Toluene	0.031	20,000
Trichloroethene	0.0042	60
1,1,2-Trichloroethane	0.086 I2	100
Semi-Volatile Organics:		
Benzo[a]anthracene	0.38	NA
Benzo[a]pyrene	0.27	NA
Bis(2-ethylhexyl)phthalate	2.4	50
Chrysene	0.3	NA
Fluoranthene	0.61	NA
2-Methylnaphthalene	0.22	NA
Phenanthrene	0.61	NA
Pyrene	0.53	NA

All concentrations are in mg/kg (ppm).

NA – Not available
a – RCRA Action Levels – Federal Register, Vol. 55, No. 145, July 27, 1990. pp 30798-30884. Corrective Action for Soild Waste Management Facilities, Proposed Rule.
I2 – Internal standard recovery is low. Sample results are biased high.

5.3.1.3 Surface Water - The USEPA has developed Ambient Water Quality Criteria (AWQC) for constituents in surface waters. The AWQC for the protection of aquatic organisms are derived based on two criteria: (1) acute criterion representing the maximum concentrations permissible at any time, and (2) chronic criterion representing the maximum permissible concentration averaged over a 24-hour time period.

The AWQC for the protection of human health accounts for ingestion of contaminated water and/or for the ingestion of contaminated organisms in surface waters (USEPA, 1987). The AWQC for the protection of human health from the ingestion of water and organisms assumes a daily intake of two liters of water and 6.5 grams of fish, while the AWQC for the protection of human health due to the ingestion of fish assumes an intake of 6.5 grams of fish daily. Ambient concentrations corresponding to several incremental lifetime cancer risk levels have been estimated for constituents exhibiting carcinogenic and/or mutagenic effects in laboratory tests and are, therefore, suspected of being carcinogenic to humans. The ambient concentrations which may result in one excess cancer per one million persons (i.e., risk = 1×10^{-6}) are presented as AWQC for constituents known or suspected to be carcinogens.

The State of Kansas incorporates the Federal AWQC for the protection of aquatic life as the State Water Quality Standards by reference (KAR, 1987). Surface water AWQC are relevant for this site because contaminated ground water may discharge to the creeks and rivers surrounding the DCF. Table 5-3 presents the potential ARARs and TBCs for methylene chloride and PCE, the constituents detected in the site's surface water. Federal AWQC for the protection of human health for the consumption of fish and water and the consumption of fish alone were exceeded by both constituents (see Table 5-3).

TABLE 5-3

POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
(ARARs) REQUIREMENTS FOR SURFACE WATER
FORMER DRY CLEANING FACILITY
Fort Riley, Kansas

Chemical	Maximum Concentration Detected	FEDERAL AMBIENT WATER QUALITY CRITERIA [a] For the Protection of Aquatic Life: Acute	Chronic	For the Protection of Human Health: (consumption of) Water & Fish	Fish only	KANSAS STATE WATER QUALITY STANDARDS [b,c] For the Protection of Aquatic Life:
Methylene Chloride	22	11,000 [d,e]	NA	0.19 [d,f]	15.7 [d,f]	NA
Tetrachloroethene	4.6	5,280 [e]	840 [e]	0.8 [f]	8.85 [f]	NA

All concentrations are in µg/L (ppb), unless indicated otherwise.

NA – Not available
a – USEPA, 1987. Quality Criteria for Water, 1986. EPA 440/5-86-001.
b – Kansas Water Quality Standards (KAR 28.16.28), 1 May, 1987.
c – The State of Kansas has incorporated the Federal AWQC for the protection of aquatic llife as the State Water Quality Standards by reference.
d – Value is for Halomethanes.
e – Insufficient data to develop criteria. Value presented is lowest observed effect level.
f – Human health criteria for carcinogens reported for three risk levels. Value presented in this table is the 10^{-6} risk level.

5.3.1.4 Sediments - The National Oceanic and Atmospheric Administration (NOAA) has established effects-based criteria for contaminants in sediments, which may serve as TBCs. Two effects-based values, the Effects Range - Low (ER-L) and the Effects Range - Median (ER-M), are usually determined for a given constituent, using a method (Klapow and Lewis, 1979 as cited in NOAA, 1990) similar to that used in establishing marine quality standards for the State of California (NOAA, 1990). This method involves a three-step approach. First, currently available information (reports and studies) which contain estimates of chemical sediment concentrations associated with adverse biological effects are assembled and reviewed. Next, a range is established for a particular constituent based upon a preponderance of evidence, which reflects the concentrations at which biological effects are noted. Lastly, this range is evaluated relative to the sediment chemical data from the National Status and Trends (NS&T) Program. The ER-L and ER-M values are generated as a result of this process. The ER-L is the 10^{th} percentile of this effects range, while the ER-M is the 50^{th} percentile of the reported range of concentrations associated with biological effects.

A description of the relative degree of confidence associated with the ER-L and ER-M values is also provided by NOAA. The ER-L and ER-M values associated with a high degree of confidence were supported by clusters of data with similar concentrations, by data from multiple geographic locations, by data sets that included more than results from an approach, and for chemicals for which the overall apparent effects threshold was similar to or within the range of the ER-L and ER-M values (NOAA, 1990). Values associated with a low degree of confidence were based on data sets without these qualities.

The NOAA effects-based criteria for the constituents detected in site sediments are shown in Table 5-4. NOAA criteria values were not available for the chlorinated constituents (methylene chloride

TABLE 5-4

POTENTIAL TO BE CONSIDERED (TBC) REQUIREMENTS FOR SEDIMENTS
FORMER DRY CLEANING FACILITY
Fort Riley, Kansas

Chemical	Maximum Detected Concentration	ER-L Concentration	ER-M Concentration	Overall Apparent Effects Threshold	Degree of Confidence
VOLATILE ORGANICS:					
Methylene Chloride	85	NA	NA	NA	NA
Tetrachloroethene	6.6	NA	NA	NA	NA
SEMI-VOLATILE ORGANICS:					
Pyrene	120	350	2,200	1,000	Moderate/Moderate

All concentrations are in µg/kg (ppb).

NA – Not available

Source: National Oceanic and Atmospheric Administration, Technical Memorandum, NOS OMA 52, 1990.

and PCE) detected on-site. The maximum concentration of pyrene detected in site sediments (120 µg/kg) was below the NOAA ER-L (350 µg/kg) and ER-M (2,200 µg/kg) values.

5.3.2 Potential Location-Specific ARARs and TBCs

Location-specific ARARs are restrictions placed on the constituents' concentrations or the activities to be performed at a site because the site occurs in a special location such as floodplains, wetlands, historic places, and fragile ecosystems or habitats. The potential federal requirements for the DCF are listed below:

- Endangered Species Act of 1973 - An action to conserve or provide a program to conserve endangered or threatened species.

- Fish and Wildlife Coordination Act Requirements - An action to conserve fish and wildlife, particularly those species which are indigenous to the state. Wildlife conservation will be coordinated with other features of water resource development programs.

- Historic Site Buildings and Antiquities Act - Provides for the protection, enhancement, and preservation of sites of archaeological or historic significance.

In addition, there are ARARs and TBCs required for the State of Kansas, which include:

- Kansas Surface Water Use Designations - Provides guidelines for approved uses for certain types of waters.

- Kansas Designation of Critical Water Quality Management Areas - Provides for the protection of waters deemed critical by state authorities.

- Kansas Historic Preservation Act - Provides for the protection preservation of sites and buildings listed on state or federal historic registries.

The former Dry Cleaning Facility is bordered by tributaries that eventually empty into the Kansas River; therefore, state and federal regulations for surface water apply.

The Fish and Wildlife Coordination Act is also a potential ARAR, and is designed to protect fish and wildlife when actions result in the modification of a body of water (i.e., the Kansas River). The Endangered Species Act of 1973 is a potential ARAR. Fort Riley falls within an area that eight federally endangered species and thirteen candidate species for the federal endangerment listings are likely to inhabit. Of these 21 total species, two federally endangered species and eight candidate species are known to occur on Fort Riley (Table 5-5).

The Historic Site Building and Antiquities Act is also a potential ARAR, because the Main Post Area at Fort Riley has been designated as an Historic District and is listed on the National Register of Historic Places. The Historic District encompasses an area of approximately 670 acres and the DCF lies within the Historic District boundaries.

5.4 FATE AND TRANSPORT

This section will provide a brief description of the environmental fate and transport for the constituents detected at the DCF site. For purposes of this report, chemically similar constituents will be grouped together and evaluated as one category.

TABLE 5-5

ENDANGERED AND THREATENED SPECIES
(AND ASSOCIATED HABITATS) COMMON TO FORT RILEY AREA
FORMER DRY CLEANING FACILITY
Fort Riley, Kansas

SPECIES	HABITAT
Piping Plover	Open unvegetated beach or sandbar
Least Tern	Sparsely vegetated sandbars in a wide channel with good visibility
Bald Eagle	Near water bodies (rivers, lakes, etc.) utilizing riparian forest
Peregrine Falcon	Large river or waterfowl management areas, cropland, meadows and prairies, river bottoms, marshes, and lakes
Whooping Crane	Wetland, riverine base sandbars, shallow water, slow river flow
Eskimo Curlew	Wet meadows, fields, pastures, drier parts of salt and brackish marshes
Western Prairie Fringed Orchid	Tallgrass prairie and sedge meadow (fire adapted)
Prairie Mole Cricket*	Tallgrass prairie, ungrazed or unmowed native tallgrass with silt-sandy loam soils
Regal Fritillary Butterfly*	Prairie meadows (wet), moist tallgrass prairie, virgin grassland where violets act as host plants
Sturgeon Chub*	Areas of shallow strong currents and gravel bottoms, turbulent areas where shallow water flows across sandbars
Texas Horned Lizard*	Dry-flat areas with sandy, loamy, or rocky surfaces with little vegetation
Loggerhead Shrike*	Grassland or shrubby fields with scattered woody vegetation for perching and nesting
Long-billed Curlew*	Great Plains grasslands, marshes, mud flats, sandbars
White-faced Ibis*	Small ponds with stands of cattail or bulrush
Western Snowy Plover*	Unvegetated riverine
Eastern Spotted Skunk*	Open level cultivated farmland, upland sites with preference for fallen logs and brushpiles
Topeka Shiner*	Turbulent areas in rivers where shallow water flows across sand bars
American Burying Beetle	Tallgrass prairie, ungrazed or unmowed native tallgrass with silt-sandy loam soils
Black Tern*	Wetland areas
Henslow's Sparrow*	Native grassland with few trees
Hairy False Mallow*	Rocky outcrops and dry areas in prairies

Species in BOLDFACE type are known to occur on Fort Riley.
* Candidate species for federal endangerment listing.

5.4.1 Volatile Organic Compounds

Nine volatile organic compounds (VOCs) were detected in DCF samples, including seven chlorinated compounds (PCE, TCE, 1,1,2-trichloroethane, 1,2-dichloroethene, methylene chloride, dibromochloromethane, and vinyl chloride), toluene, and carbon disulfide. In general, VOCs released to the atmosphere exist in vapor phase and, because they are water soluble, are subject to wet deposition. The VOCs are degraded in the atmosphere by reaction with photochemically induced hydroxyl radicals. If released to surface water, VOCs will volatilize to the air; bioconcentration and adsorption to sediments are not important removal processes. The VOCs released to soil tend to volatilize, but leaching to ground water may also occur (Howard, 1990). The chlorinated ethenes (PCE, TCE, and 1,2-dichloroethene) may slowly biodegrade in soil or ground water via sequential dehalogenation to lesser chlorinated compounds such as vinyl chloride and chloroethane. (Barrio-Lage et al, 1986). Toluene biodegrades readily in soil and water, while carbon disulfide does not (Howard, 1990).

5.4.2 Polycyclic Aromatic Hydrocarbons (PAHs)

Eight PAHs were detected in the DCF site media, as follows: benzo[a]anthracene, benzo[a]pyrene, chrysene, fluoranthene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene. The PAHs released to the atmosphere are subject to short- and long- range transport, dependent on molecule size, and are subject to wet and dry deposition. In surface waters, PAHs may volatilize, oxidize, photodegrade, biodegrade, bind to particulates, or accumulate in aquatic organisms. Removal of PAHs in surface water is primarily through volatilization. In sediments, PAHs may biodegrade or bioaccumulate in aquatic organisms or plants. PAHs can enter the ground water and be transported within an aquifer (ATSDR, 1989).

5.4.3 Bis(2-Ethylhexyl)Phthalate

Bis(2-ethylhexyl)phthalate (BEHP) present in the atmosphere tends to strongly adsorb to atmospheric particulates and is able to be transported long distances in the troposphere. BEHP is removed from the atmosphere by both wet and dry deposition. When released to water, BEHP adsorbs strongly to suspended particulates and sediments. Likewise, if spilled onto the ground, BEHP is not expected to volatilize, but will adsorb to soil particles. However, percolation of BEHP through the soil to ground water may occur during times of rapid infiltration or in the presence common organic solvents. Biodegradation of BEHP in water will occur within three weeks under aerobic conditions, and will also occur in soil at a slower rate. Bioconcentration of BEHP has been observed in aquatic and terrestrial organisms (ATSDR, 1991).

5.5 POTENTIAL RECEPTORS

Potential receptors are organisms engaged in activities (working, swimming, foraging, etc.) which bring the organism into contact with a constituent at an exposure point. Examples of receptors are humans, animals, or vegetation.

Potential receptors are determined by a complete pathway from the exposure medium to the receptor. Potential receptors for the DCF site include human and biota receptors. Human receptors include Fort Riley personnel (site workers), on-site residents, and off-site residents. Biota receptors include terrestrial animals, aquatic species, and plants that live on- and off-site.

The most likely human receptors to potential contamination at the DCF are on-site workers. These individuals may contact constituents in the sediment and surface water at the site through routine landscaping and regrading. Potential exposures to these

media are expected to be primarily dermal, but the possibility for incidental ingestion also exists. The potential for exposure to soil, either directly or through the inhalation of fugitive dust, is unlikely. The area immediately surrounding the DCF is covered with pavement, and the adjacent non-paved area (the ravine located east of the building) is covered by dense vegetation. Therefore, exposure to site soils is not expected unless excavation of these areas occurs. In addition, on-site workers and on-site residents may be exposed to constituents detected in the ground water at the site, since wells supplying Fort Riley with potable water are located less than 1.5 miles to the west. Exposure to constituents in the ground water is possible via ingestion of drinking water, inhalation of volatile emissions, and dermal contact.

Although access to Fort Riley is uncontrolled, it is unlikely that off-site residents will come in direct contact with any possible soil or sediment contamination, because the former DCF and surrounding area is unlikely to be frequented by visitors. However, the potential for off-site exposure via the drinking water, and to contaminated surface waters downstream of the site are possible. The residents of Ogden, Kansas (population 1,500) obtain their drinking water from three wells located approximately 3.5 miles downstream of the DCF (Law, 1992). Therefore, Ogden residents have the potential for exposure to ground water through ingestion, inhalation of vapor emissions from volatile compounds, and dermal contact.

The drainageways located adjacent to the DCF, Unnamed Tributary A and Unnamed Tributary B, eventually discharge to the Kansas River. Unnamed Tributary A receives runoff from the site before combining with Unnamed Tributary B. Off-site exposure to constituents detected in surface water may occur through recreational activities (wading, swimming), and through the consumption of food chain organisms (i.e., fish and small game) that may have had contact with contamination.

Ecological receptors (i.e., vegetation, terrestrial, and aquatic organisms) may also contact potential contamination at the site. Vegetative receptors may become contaminated through the potential uptake of constituents from the soil, surface water, ground water, and sediment. Terrestrial receptors have the potential for exposure to soil via incidental ingestion and dermal contact. Potential surface water and sediment exposures may occur via incidental ingestion, dermal contact, ingestion of food chain organisms, and inhalation of fugitive dust or vapor emissions released to the air. Ingestion of surface water, burrowing in soils, foraging and migration patterns, swimming, and predatory behaviors are some of the types of activities that terrestrial species may engage in which have the potential to result in exposure to constituents present in site media.

Aquatic and benthic receptors have the potential for exposure to surface water and sediments through incidental ingestion, dermal contact, and ingestion of food chain organisms. Swimming, water uptake, and predatory behaviors are some of the activities aquatic species engage in that may result in exposure to contaminated media.

5.6 ENVIRONMENTAL IMPACTS

Potential environmental impacts for the DCF site include effects on the ground water, surface water, soils, and sediments. Environmental impacts from the soil will affect the flora and fauna which may contact the constituents detected in site soils. These soil impacts have the potential to affect the food chain, possible endangered or threatened species, and critical habitats. Potential environmental impacts from the ground water may occur if contaminated water is drawn from wells in the underlying aquifer and used as drinking water, irrigation water for commercial crops, watering of commercial livestock, or industrial processes.

Potential surface water effects include the possibility of constituents entering tributaries, streams, and eventually the Kansas River via surface runoff. These surface water impacts may affect sport fishing and hunting, recreational water use, potential surface water intakes used for the public water supply, endangered or threatened flora and fauna, and critical habitats in the vicinity.

6.0 SUMMARY AND CONCLUSIONS

The Preliminary Assessment/Site Investigation performed at the former Dry Cleaning Facility detected the presence of volatile and semi-volatile contaminants in the soils and ground water beneath the site. These contaminants, migrating through the soil and ground-water media, could impact human health and the environment as the contamination is transferred from the media to the receptor.

6.1 SITE INVESTIGATION/CHARACTERIZATION

Several intrusive methods were incorporated during the study.

1) The soil gas survey was performed by Target Environmental Services (TARGET) from October 29 through November 2, 1991. Sample analysis was performed on 49 separate samples using an on-site laboratory supplied by TARGET. The results of laboratory analysis revealed high levels of PCE at the northeast corner of the former Dry Cleaning Facility.

2) Fifteen shallow soil borings were drilled to a depth of 15 feet. The locations of the borings were determined by the soil gas results, and the accessibility for a truck-mounted drill rig. Two soil samples were collected from each boring and analyzed for volatile and semi-volatile organic compounds.

3) Six monitoring wells were drilled and installed based on the results of the soil gas survey and the 15 soil borings. A seventh well was installed, but was not sampled due to the low volume of ground water in the well. Four soil samples were collected from each of the six borings. Ground-water samples were collected after well development. Soil and ground-water samples were analyzed for volatile and semi-volatile organic compounds.

4) Borings at the site revealed that the geology consists of a 30- to 40-foot thick soil horizon overlying the regional limestone/shale bedrock. The soil is thickest south of the site and thins to the north. The soil is composed of loess, alluvial deposits, and weathered bedrock. A continuous zone of weathered bedrock is situated between the base of the soil horizon and the top of the bedrock.

5) Ground water was encountered at the site at depths between 35 to 40 feet below the ground surface. The ground-water flow is discrete, dropping only 2.52 feet from northwest to southeast. Ground-water flow direction is to the southeast.

6.2 ANALYTICAL SUMMARY

Analytical results of the ground-water samples collected during the investigation revealed the presence of volatile and semi-volatile organic compounds beneath the site. Those compounds identified in the ground water include trichloroethene, tetrachloroethene, 1,2-dichloroethene, vinyl chloride, and naphthalene. The horizontal extent of contamination has not yet been fully defined. However, the contamination is most pronounced to the northeast, southeast and west of Building 181. The vertical extent of contamination has not been fully delineated during this study.

The analytical results of the soil samples collected indicate the presence of volatile and semi-volatile organic compounds at the site. Those compounds identified include 1,1,2-trichloroethane, dibromochloromethane, toluene, tetrachloroethene, carbon disulfide, pyrene, bis(2-ethylhexyl)phthalate, benzo[a]anthracene, benzo[a]pyrene, chrysene, fluoranthene and phenanthrene. The volatile organic contamination was detected from the northeast to the southeast of Building 181. The horizontal extent of contamination has not been fully defined. Volatile organic

contamination exists from the near surface soils (4 feet) to soils at the top of bedrock. Semi-volatile organic compounds were detected from the northeast to the southeast of Building 181. The semi-volatile contaminants were detected at depths of one to 15 feet, indicating a more shallow extent of contamination than the volatile organic contamination.

6.3 EXPOSURE ASSESSMENT SUMMARY

The results of the exposure assessment identified possible public health and environmental concerns for the DCF site. Off-site (Ogden) residents, on-site workers, and Fort Riley personnel may be exposed to constituents detected in the ground water via ingestion of drinking water, inhalation of volatile emissions, and dermal contact. Ogden's drinking water wells are located approximately 3.5 miles downstream of the DCF, while Fort Riley's potable water supply wells are located approximately 1.5 upgradient miles west of the site. The denser chlorinated compounds detected in the ground water, such as tetrachloroethene (PCE) and trichloroethene (TCE), tend to sink downward in water, and are expected to accumulate along less permeable strata and move along them (in pure phase) under the influence of gravity gradients. Therefore, it is possible (although perhaps not probable) for PCE and TCE to travel along fissures in bedrock to distantly located potable water supply wells.

On-site workers may also be exposed to constituents detected in site sediments and surface water by dermal contact through routine landscaping and regrading. Exposure to constituents detected in site soils is not expected to occur, since the area immediately surrounding the DCF is either paved or covered by vegetation. Off-site exposure to constituents detected in surface water may occur through recreational activities, and through the consumption of food chain organisms (i.e., fish and small game) that may have had contact with contamination.

Ecological receptors that may be exposed to the constituents detected in site media include the aquatic and benthic biota indigenous to the surface waters of the area and the terrestrial fauna which may utilize the area for drinking water, hunting, and foraging. Vegetative receptors may also become contaminated, through the potential uptake of constituents from the soil, surface water, ground water, and sediment. The exposure of ecological receptors to site constituents may be important because Fort Riley falls within an area that eight federally endangered species and thirteen candidate species for the federal endangerment listings are likely to inhabit. Of these 21 total species, two federally endangered species and eight candidate species are known to occur on Fort Riley.

The exposure assessment also identified potential environment impacts for the DCF site. Soil constituents may affect the food chain, possible threatened or endangered species, and critical habitats. Contaminants detected in ground water may impact drinking water supplies, crops and livestock (if the ground water is used for irrigation), or industrial processes. Potential surface water impacts include the limitation of sport fishing, hunting and recreational water use, the effect on critical habitats and endangered or threatened flora and fauna in the vicinity of the site.

6.4 RECOMMENDATIONS

Several obvious data gaps/action items have tentatively been identified for further consideration at the former Dry Cleaning Facility site. These have been summarized below, along with the logic for the recommended actions.

1) Monitoring Wells - The extent of contamination has not been established, either in the vertical or horizontal direction.

More monitoring wells are needed to accurately assess the extent of contamination. Figure 6-1 illustrates the possible locations of additional wells in the area. Two additional shallow wells would be installed. The first well would be located southeast of the ravine containing tributary A. The well is necessary to determine if ground-water contamination exists southeast of DCF92-05. The well would be designed to test the level of contamination in the soils above the bedrock, and the ground-water quality in the upper part of the aquifer. A second well would be installed northeast of tributary B to also test the soils above bedrock and the ground-water quality in the upper part of the aquifer. Three deep monitoring wells will be installed to a depth of 100 to 200 feet to test ground-water quality deeper in the aquifer. The suggested locations of the wells are shown on Figure 6-1.

2) Sewer Line - A more in-depth study of the area around the sewer line is needed. This would be accomplished by a soil gas survey along the sewer lines.

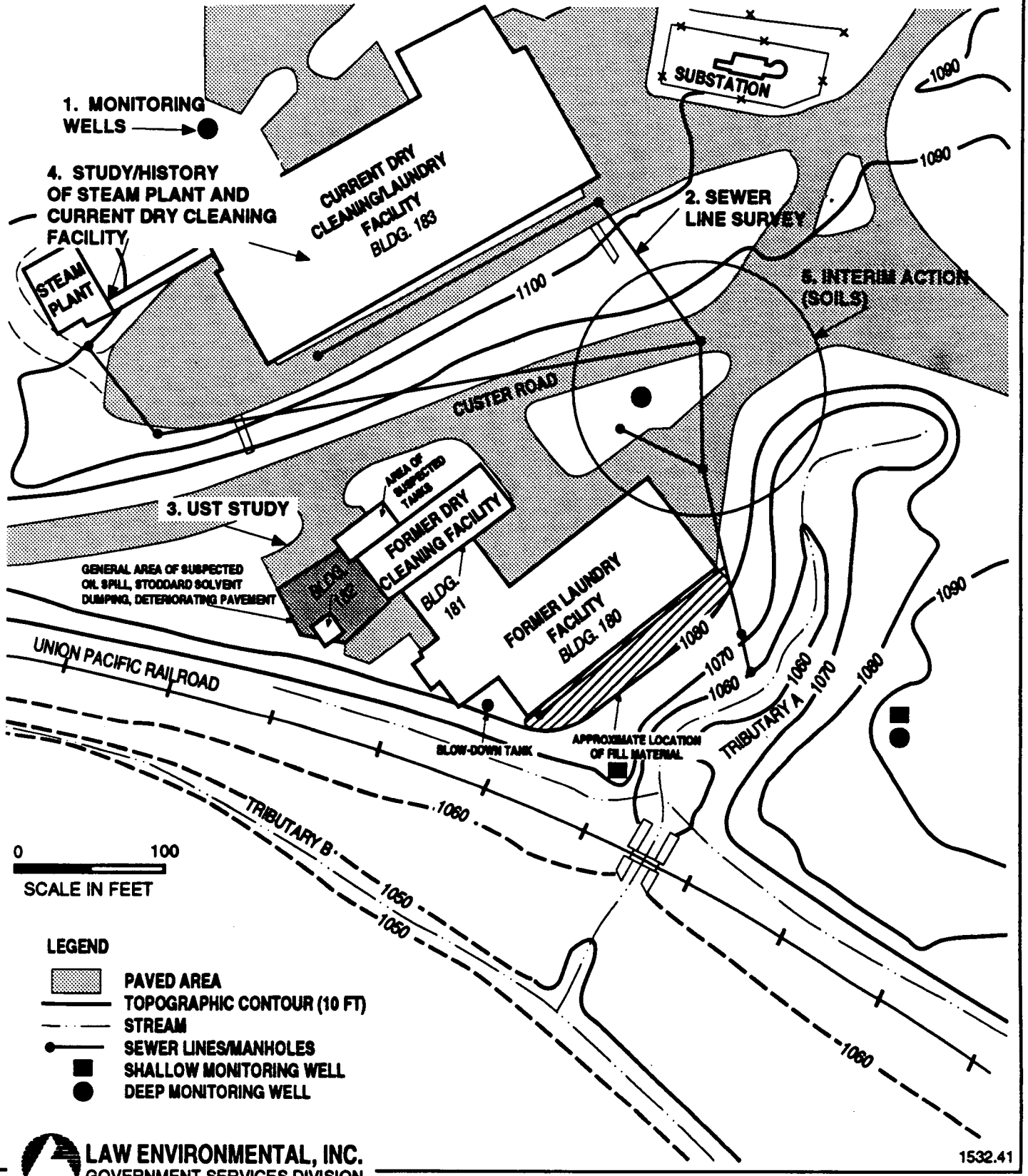
3) Underground Storage Tanks - The issue of the location and number of USTs has still not been resolved. More detailed analysis is needed to resolve the data gaps of where the tanks had been located.

4) Steam Plant and Current Dry Cleaning Facility - A study/history is needed to establish waste practices at the two buildings.

5) Interim Action - The soil vapor extraction project might be plausible at the site.

FIGURE 6-1

ADDITIONAL DATA NEEDS
FORMER DRY CLEANING FACILITY
FORT RILEY, KANSAS



LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

1532.41

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APPENDIX A

SCOPE OF SERVICES

SCOPE OF WORK
FOR
PRELIMINARY ASSESSMENT/SITE INVESTIGATION
DRY CLEANING FACILITY
FORT RILEY, KANSAS

DATE: 8 May 1991
REVISED: 18 JUNE 1991

1.0 OBJECTIVE. The objective of this investigation is to evaluate the extent of chemical contamination at the Dry Cleaning Facility, Building No. 180 (formerly Building No. 109).

2.0 AUTHORITY. This work is authorized by advice of authorization dated 1 May 1989, Directive No. 1, Control No. 89-262.

3.0 DESCRIPTION OF WORK: The A-E will provide professional services necessary to safely conduct field and office investigations and collect and analyze potentially hazardous materials. The work covered under this Scope of Work (SOW) involves the professional services necessary to accomplish the following work:

3.1 Revise and re-submit work plans in accordance with comments received from EPA Region VII, DEH Fort Riley, and Corps of Engineers, Kansas City District (comments are attached). References to the Pesticide Storage Facility will be removed from the Work Plans. If the A-E indicates that ambiguity still exists as to the disposition of any of the comments, the A-E will request clarification from the Corps of Engineers. The A-E's request will be in writing. The Corps of Engineers will respond in writing within 5 working days.

3.2 Perform a Preliminary Assessment/Site Investigation. Perform the necessary site investigations to determine the presence or absence of contamination, from the area. Collect soil, sediment and groundwater samples. The A-E will reevaluate location and number of wells to be installed, requirement for additional borings, and necessity of a soil gas survey at the site. These recommendations will be included with the proposal received from the A-E.

3.3 Prepare a Site Investigation Report which analyzes the results and presents conclusions for the site.

4.0 BACKGROUND. The Dry Cleaning Facility, Building No. 180 (formerly No.109) was located in building 109 from the early 1940's to 1983. The dry cleaning solvent used until from 1940 to 1966 was Stoddard solvent; from 1966 to 1983, tetrachloroethylene was used. Both solvents were distilled and recycled. Tetrachloroethylene still residue was reportedly disposed of by pouring it on the ground behind the building.

of notice to proceed. The Corps will review and return comments to the A-E within 21 days of receipt of the Working Draft. The A-E will make corrections/revisions as a result of review by the Corps of Engineers and submit the DRAFT WORK PLANS within 14 days of receipt of comments from the Corps. Distribution of the Draft Work Plans submittal shall be made by the A-E directly to the reviewing offices with the required number of copies as indicated on the Document Distribution Listing. The A-E can expect to receive regulators' comments within 45-60 days of submittal. The A-E will prepare and submit annotated responses comments within 10 calendar days of receipt of the comments.

8.1.2.2 A review conference will be held in the Kansas City District Corps of Engineers offices 7 calendar days after submission of annotated responses. The A-E will be prepared to discuss all comments and response to comments and make recommendations as to dispostion of the comments. The A-E will prepare minutes of the meeting and forward the minutes with the revised work plans within 21 days of the completion of the meeting.

8.1.3 DRAFT FINAL - WORK PLANS. The Draft Final Work Plans will be submitted within 21 days of completion of the review conference stated above. Distribution of the Draft Final Work Plans submittal shall be made by the A-E directly to the reviewing offices with the required number of copies as indicated on the Document Distribution Listing (Copies being forwarded to the State of Kansas and EPA Region VII will be forwarded 2-3 days after all other copies are distributed.) The Draft Final Work Plan will serve as the Final Work Plan if EPA, the State of Kansas, or DEH Fort Riley do not invoke dispute resolution regarding the document within 30 days.

8.1.4 FINAL WORK PLANS. OPTIONAL. The A-E will make corrections to the Draft Final Work Plan based on comments received and resubmit in the quantities indicated for the Draft Final Work Plan within 14 days of receipt of comments.

8.2 **TASK 2 - Field Investigation.** All field work approved in the Work Plans will be implemented and completed within 90 days of receiving confirmation of approval of Final Work plan from COE in writing.

8.3 **TASK 3 - Draft PA/SI Report.** The Draft PA/SI Report shall include, but limited to, all information gathered during the site investigation, all analytical results, and a discussion on public health and environmental concerns.

8.3.1 The following submissions will be made under Task 3:

8.3.1.1 WORKING DRAFT - PA/SI REPORT. Distribution of the Working Draft PA/SI submittal shall be made by the A-E directly to the reviewing offices with the required number of copies as indicated on

the Document Distribution Listing. The Working Draft will be submitted no later than 30 calendar days after completion of the field work. from the completion of the The Working Draft PA/SI will be reviewed by DEH Fort Riley and the Corps of Engineers. Comments will be returned to the A-E within 30 calendar days of receipt of submittal.

8.3.1.2 ANNOTATED RESPONSES to comments will be submitted by the A-E within 14 calendar days of receipt of comments.

8.3.1.3 A review conference will be held in the Kansas City District Corps of Engineers offices 7 calendar days after submission of annotated responses. The A-E will be prepared to discuss all comments and responses to comments and make recommendations as to disposition of the comments. The A-E will prepare minutes of the meeting and forward the minutes with the revised work plans within 14 days of the completion of the meeting.

8.3.1.4 DRAFT PA/SI REPORT. The Draft PA/SI will be submitted within 14 days of completion of the review conference stated above. Distribution of the Draft PA/SI submittal shall be made by the A-E directly to the reviewing offices with the required number of copies as indicated on the Document Distribution Listing. The A-E can expect to receive regulators' comments within 45-60 days of submittal. The A-E will prepare and submit annotated responses comments within 10 calendar days of receipt of the comments.

8.3.1.5 A review conference will be held in the Kansas City District Corps of Engineers offices 7 calendar days after submission of annotated responses. The A-E will be prepared to discuss all comments and response to comments and make recommendations as to dispostion of the comments. The A-E will prepare minutes of the meeting and forward the minutes with the revised work plans within 21 days of the completion of the meeting.

8.3.1.6 DRAFT FINAL PA/SI REPORT. The Draft Final PA/SI will be submitted within 21 days of completion of the review conference stated above. Distribution of the Draft Final PA/SI submittal shall be made by the A-E directly to the reviewing offices with the required number of copies as indicated on the Document Distribution Listing. The Draft Final PA/SI will serve as the Final PA/SI if EPA, the State of Kansas, or DEH Fort Riley do not invoke dispute resolution regarding the document within 30 days.

8.3.1.7 FINAL PA/SI REPORT. OPTIONAL. The A-E will make corrections to the Draft Final Remedial Investigation Report based on comments received and resubmit in the quantities indicated for the Draft Final Work Plan within 14 days of receipt of comments.

9.0 COMPLETION SCHEDULE: The A-E shall complete the work and services as stated in paragraph 10 above. Should the start of each

phase or portions thereof be delayed more than 6 months by causes other than the A-E's negligence, the remaining fee and time schedule may be renegotiated at the A-E's request.

10.0 GENERAL REQUIREMENTS AND STANDARDS:

10.1 Project Manager:

10.1.1 The A-E shall assign a principal or key employee to serve as the Project Manager. The Project Manager shall oversee the coordination of the entire project and shall be capable of administering all instructions from the Kansas City District Office and obtaining answers to all questions from the Kansas City District Office during and after PA/SI work.

10.1.2 During the prosecution of the work under the contract, the A-E shall keep in close liaison with the Corps of Engineers' Project Manager, who will coordinate work with all other agencies. All requests made to the A-E by other agencies shall be referred to the Corps of Engineers PM.

10.2 Review Comments.

10.2.1 The A-E as part of this scope shall interface and utilize the Corps of Engineers Automated Review Management System (ARMS) for this proejct. The A-E will receive one copy of CESPK-PAM 1110-1-2, Architect/Engineer Response Package (User's Manual) describing the communications software, optimum hardware requirements and access procedures. The necessary software is included with the manual. Minimum equipment requirements are an IBM-XT or compatible computer system running DOS 3.0, or later, with ;640 Kilobyte RAM, at least a 20 Megabyte hard disk and a 1200 or higher baud Hayes-compatible modem. Assistance can be received via a telephone Hotline at (916) 551-3126.

10.2.2 All review comments and responses will be electronically transmitted from CE by ARMS. Comments can be received at a personal computer in the A-E's office by use of ARMS software and modem over telephone lines. The comments reside on the Missouri River Division (MRD) computer. The A-E can then download the review comments, respond to the comments, upload the comments back to the MRD computer and forward responses to the Corps of Engineers Project Manager. All comments will be resolved to the satisfaction of the CE Project Manager.

10.2 Review of Progress and Technical Adequacy: At appropriate times, representatives of the Contracting Officer may review the progress and technical adequacy of the work. Such review will not relieve the A-E from performing all contract requirements.

be made immediately prior to the site visits. Notification by phone is sufficient.

11.0 CONFERENCES/MEETINGS.

11.0 The A-E shall be represented by personnel familiar with all aspects of the work submitted.

11.1 Additional Conferences: Payment for furnishing the services of technically qualified representatives to attend additional conferences, when so requested in writing by the Contracting Officer, will be made at a rate per hour for the discipline involved plus travel expenses computed in accordance with Government Joint Travel Regulations in effect at the time travel is performed and actual cost of transportation.

11.2 The A-E shall be responsible for taking notes and preparing the minutes for all conferences. Conference minutes will be prepared in typed form, signed by the A-E Project Manager, and submitted in triplicate to the CE Project Manager within five (5) days after date of the conference.

11.3 These minutes shall include the date, place, and a list of attendees, including organization and telephone number. Comments made during the conference, or decisions affecting criteria changes, must be recorded in the basic conference minutes. Any augmentation of written comments should be documented by the conference minutes.

11.4 Confirmation Notices: The A-E will be required to provide a record of significant discussions, verbal directions, and telephone conversations participated in by the A-E and/or his representatives on matters relative to this contract and work, irrespective of whom the other participants may have been. These records, entitled "Confirmation Notices," will be numbered sequentially and shall fully identify participating personnel, subject discussed, and any conclusions reached.

12.0 METHOD OF PAYMENT: The A-E shall prepare and submit to the U.S. Army Engineer District, Kansas City, partial payment estimates in accordance with "Instructions for Completion of ENG Form 93." All partial payments shall be based on work completed as of the 15th day of the report month and shall be submitted to the office of the Contracting Officer by the 18th days of the month. The U.S. Army Engineer District, Kansas City, will prepare supporting payment documents after obtaining necessary approvals and forward all documents to the US Army Engineer District, Omaha, for issuance of the payment check. All questions regarding payments shall be directed to the U.S. Army Engineer District, Kansas City. Payment under this contract, for which property or services are provided in a series of partial executions or deliveries, will be made within 30 days after receipt of an invoice which as been properly executed by the A-E.

Addressee	A	B	C	D	E	F	G	H
Commander U.S. Army Engineer District, Kansas City Attn: CEMRK-ED-TP 601 E. 12th Street Kansas City, MO 64106-2896	4	4	4	4	5	5	3	3
U.S. Army Corps of Engineers Missouri River Division ATTN: CEMRD-EP-C 2945 South 132nd Street Omaha, NE 68144	5	5	5	5	5	5	0	0
U.S Army Corps of Engineers Missouri River Division Laboratory ATTN: CEMRD-ED-GL 420 S. 18th Street Omaha, NE 68101	1	1	1	1	1	1	0	0
Directorate of Engineering & Housing Environmental & Natural Resources Division ATTN: Janet Wade Building 408 Fort Riley, Kansas 66442-6000	6	6	6	6	6	6	6	0
Commander U.S. Army Toxic & Hazardous Materials Agency ATTN: CETHA-IR-A Aberdeen Provding Ground, MD 21010-5401	0	3	3	3	3	3	0	0
Cecilia Tapia Waste Management Division, EPA Region VII 726 Minnesota Avenue Kansas City, Kansas 66101	0	3	3	3	3	3	0	0
Marvin Glotzbach Section Chief, Remedial Section Bureau of Environmental Remediation Kansas Department of Health & Environment Forbes Field, Building 740 Topeka, Kansas 66620-7500	0	3	3	3	3	3	0	0

FORMER DRY CLEANING FACILITY
PA/SI
CONTRACT MODIFICATION
SCOPE OF WORK

APRIL 16, 1992
DACW41-89-D-0124
D.O. 34

REVISED: 2 JUNE 92

1. Reference Written Order No. 1-P00001, dated 19 March 92, issued by USAED, Kansas City, to Law Environmental, Inc., and the RI/FS original Scope of Work, dated 18 June 91.

2. This document represents the "Contract Modification - Scope of Work" associated with the "Work and Services" portion of the referenced written order.

3. SERVICES TO BE PERFORMED BY THE ARCHITECT-ENGINEER: The A-E shall perform and shall assume all responsibility for the accuracy and completeness of the following work and services in accordance with the criteria and instructions specified both below and in the SOW, dated 18 June 91. The Government reserves the right to exercise options for work and services which are identified as being optional.

3.1 **Task 1** - Monitor Well Installation, ~~Sample Analysis.~~

a. Well installation - Install ~~2 (two)~~ 3 (three) intermediate wells to approximate depth of 45-50 feet. Obtain one groundwater sample and four soil samples from each well. Install one shallow well screened from 9 to 19 ft. at DCF92-04, total depth shall be 19 ft. **Install an additional shallow well termed 7th well. Install following sampling of the other wells.**

b. Well Development - The AE shall develop all monitor wells (3 original and ~~2 additional~~ 3 additional) until ground-water turbidity values of 30 NTUs or less are obtained.
(NOTE: Original SOW for 4 wells required 4 hrs each of development time. This well development effort is not to be included in the cost proposal for this modification.) **Two wells DCF92-02 and DCF92-04 will be developed for an additional 80 hrs beyond the initial 10 hours of development in an attempt to recover 3X the volume of water lost during development. DCF well #92-05 will be developed an additional 10 hrs**

beyond the initial 10 hrs of development in an attempt attain the required turbidity. Distilled water will be introduced into the well during the additional development. Three times the volume introduced will be removed.

~~e. Chemical Analysis - Perform chemical analysis of the samples obtained from the new monitor wells. Utilize existing SOW chemical parameters and project "CDAP".~~

Task 2 - Pilot Hole Study
MOBILIZATION & DEMOBILIZATION COSTS ONLY

THE FOLLOWING ACTIVITY WAS NOT PERFORMED
DO NOT SUBMIT COST PROPOSAL

A pilot hole study shall be performed to determine construction details of monitoring wells, design well screen and sand pack capable of producing clear (30 NTUs or less) groundwater samples, produce data necessary to select proper sand pack grain size / screen slot width. The following activities are required:

- One hole will be drilled to the top of bedrock. One continuous soil boring will be collected using a rotary drill equipped with hollow stem augers and a 3 inch CME continuous sampling device. The complete interval shall be logged, soil samples of the intervals to be screened shall be placed in jars and sent to a geotechnical laboratory.

- Conduct sieve analysis on soil collected from each well zone to be screened. Particle size distribution curves will be developed and used, in selecting appropriate filter pack gradation coefficients and screen slot size.

- Perform all work in accordance with the previously submitted & approved "Health and Safety Plans", "Work Plans".

- Submit a report detailing the proposed "Well Design" for review and approval.

Task 3 - Quarterly Sampling

The AE shall perform "Sampling & Analyses" events of both the existing and newly installed groundwater monitoring wells as described below:

- Baseline: A sampling event of 6 wells will be performed and analyzed in accordance with the project CDAP. A data package containing only the "RAW" data will be submitted to the COE immediately upon receipt of the data from the lab. A more thorough "QCSR" will be furnished by the AE and will be utilized in determining what additional sampling efforts may be required. (Distribution of the data will be to: CEMRK, KDHE, EPA, and Fort Riley)

- Quarterly: The AE shall perform quarterly (Seasonal Analytical) sampling of the wells for a minimum of (3) three rounds. Each sample will be analyzed and the data submitted (Raw & QCSR) in manner described above (Baseline). The exact time frame that sampling is to be performed will be established by the Kansas City District Office.

- OPTIONAL: If determined necessary by the CO an additional round of sampling will be performed. This activity will be a PRICED OPTION and will be performed in accordance with the Baseline task previously described.

Task 4 - Work Plans / Document Distribution

The AE shall utilize the following document distribution listing in conjunction with the original document listing "Paragraph 14.0" SOW, dated 18 June 92. NOTE: Documents titled A,B,C,E,G and H remain unchanged. The requirement of Aa, Bb, and Cc represents new documents and D and F are revised in quantity only.

	Aa	Bb	Cc	D	F
CEMRK	5	3	4	4	5
MRD-EP	0	0	1	5	5
MRD-ED	0	0	1	1	1
DEH	2	3	10	10	10
CETHA	0	0	1	3	3
EPA	0	3	3	3	3
KDHE	0	2	2	2	3
	7	11	22	28	30
orig con	0	0	0	25	26

Document Annotation for "Modified" plans:
Aa - Working Draft Work Plans
Bb - Draft Work Plans
Cc - Draft Final Work Plans

a) **NOTE:** Submittal of the modified plans are to be in accordance with the project IAG currently detailed for documents A,B and C.
Therefore, it is possible that the submission of the Draft Work Plans would become the Draft Final Work Plans, provided no comments are generated. In the event that this occurred the covers of the (11) Bb documents would be replaced and an additional (11) reports would be required. A contract modification would be processed to reflect this reduction in scope. (A total of 22 documents in-lieu of 33, Bb and Cc)

b) The AE is required to submit a "Preliminary Site Characteristics Summary", PSCS, in accordance with the RI/FS Guidance, dated Oct 88, EPA/540/G-89/004, CERCLA

Task 5 - Record Search / SOW Preparation / Conference Call/ Survey

- The AE shall perform a project record search and interview retired military personnel, former employees and other local community personnel. This task is designed to obtain a history profile of the site and will be utilized during the preparation of the PA/SI reports.

- The AE shall assist in the preparation of the contract modification SOW. The input provided should identify areas of the original contract which are potentially lacking in either technical detail or require revisions as a result of more current information being made available.

- The AE shall participate in a weekly conference call with representatives of: Fort Riley, CEMRK, EPA (Reg 7), KDHE. The purpose of the call is to coordinate project related work effort being conducted (field and office) and to answer/address any concerns. A representative of the AE firm must be sufficiently familiar with the project to enable the call to be productive.

- A minor amount of survey work is required to be performed by the AE. Existing MW's and other landmarks will be located on a site map.

- END OF MODIFICATION SCOPE OF WORK -
2 JUNE 92

REVISED SCOPE OF WORK

DRY CLEANING FACILITY

FORT RILEY, KANSAS

Modify SOW dated 8 May 91 (PSF) to add the design and installation of dedicated sampling pumps, and associated tubing for purging and sampling each well. Also, the contractor will provide and dedicate to Fort Riley a total of two control systems for the three sites (DCF,PSL,SFL) to use in operating the pumps. The contractor will need to furnish a Technical Memorandum to the sampling plan to incorporate the use of sampling pumps. The entire pumping system must meet the requirement of purging 3x the well volume in a timely fashion, provide laminar flow at 100 ml/minute for sampling, and not contaminate the well.

APPENDIX B

INTERVIEW/BACKGROUND INFORMATION

LAW ENVIRONMENTAL, INC.
a professional engineering and earth science consulting firm

Attachments: ☐ Yes ☐ No
Distribution Priority: ☐ Rush
☐ Routine

CONTACT FORM

Contact made by: Art Whallon Date: 2.25.92 Time: 1130 A Project/Proposal Related: ☐ Yes ☐ No

If yes. Project/Proposal Name: _____ Project/Proposal No: _____ Enter in DBase: ☐ Yes ☐ No
If yes. ☐ New ☐ Existing

IF NEW CONTACT: Provide all information in this section or attach copy of business card.

Mr. Bob Krause (Person Contacted) FT. Riley DoL - CCR (Company Name)

(Title) 9-6551 (Phone)

(Street Address (include P.O.B)) (City) (State) (Zip Code)

"KNOWN BY" (Law Environmental employees who know contact) in priority order:

1) _____ **"TYPE":** ☐ Active Client ☐ Inactive Client ☐ Potential Client ☐ Other ____

2) _____ **"STATUS":** ☐ Open ☐ Prior Authorization ☐ Private

3) _____

MEANS OF COMMUNICATION: ☐ Initiated ☐ Received ☐ Phone Call ☐ Letter ☐ SOQ ☐ Proposal ☐ RFP ☐ In person visit

☐ Other. explain: _____

SUMMARY:
- Mr. Krause managed Dry Cleaning Bldg (#100) from 1979 to the mid 1980's. Thompson Haywood Chemicals (K.C. MO.) would provide PCE by pumping from the delivery truck into the dry cleaning machine and ~~write~~ 1-3' barrels (55 gallon) approx. every month. Hand pumps would fill machine from barrels
- Filter cartridges and approximately 1-2 gallons of sludge would be removed from the distiller every 3 months. Initially, this material was put in the dumpster - up to 200 lbs at one time. Later, they would transport this waste to ~~Disposal~~ the Property Disposal Bldg (#A50) who would take it off post.
- Recalls oil slick type material on ground by Bldg 162 - uncertain of origin - oil or PCE sludge.
- Will check into removal date of 3 tanks
- Said the 2 above ground tanks in the brick bldg used to store sludge from clarifier operations were removed when a paper shredder was installed.
- Dry cleaning operation moved to new cleaning bldg.

☐ More Space Over

Action needed? ☒ Yes ☐ No. If so, by whom? Art or ~~Bill~~ John What is needed? _____

Call Mr. Krause later today or tomorrow re. tank removal.

DISTRIBUTE COPIES TO: DBase Entry, Project file _____

Date of Distribution _____ By _____ DBase date _____ By _____

FORM #88-1 Rev. 2

1 of 1

LAW ENVIRONMENTAL, INC.
a professional engineering and earth science consulting firm

Attachments: ☐ Yes ☐ No

Distribution Priority: ☐ Rush ☐ Routine

CONTACT FORM

Contact made by: Cook Law Date: 2/25/92 Time: 1139 (Project/Proposal Related: ☒ Yes ☐ No

If yes. Project/Proposal Name: Ft. Riley, FDC (Project/Proposal No: _____ Enter in DBase: ☐ Yes ☐ No If yes. ☐ New ☐ Existing

IF NEW CONTACT: Provide all information in this section or attach copy of business card.

Greg Sinton, DEH, UST condinator
Person Contacted — Company Name

Ft. Riley (UST, Water/Waste Water Prog Mng)
Title — Phone

Street Address (include P.O.B) — City — State — Zip Code

"KNOWN BY" (Law Environmental employees who know contact) in priority order:

1) _____ "TYPE": ☐ Active Client ☐ Inactive Client ☐ Potential Client ☐ Other _____

2) _____ "STATUS": ☐ Open ☐ Prior Authorization ☐ Private

3) _____

MEANS OF COMMUNICATION: ☐ Initiated ☐ Received ☐ Phone Call ☐ Letter ☐ SOQ ☐ Proposal ☐ RFP ☒ In person visit

☐ Other, explain: _____

SUMMARY: Mr. Cook asked Mr. Sinton about possible removal of USTs at Dry Cleaners. He mentioned that Two USTs near stone bldg used for process blow-down were removed in approximately 1989. Mr. Sinton also thought (& his files indicate such) that there was only one solvent tank at DC and it was removed in 70s. Mr Sinton also said that an employee of LAW named Bob confirmed this. Mr. Sinton was not able to provide last name of Bob. Mr. Sinton's files (data base) also says that 1935 map shows single UST & 4) four cisterns where the alleged tanks are. (along w/ multiple vent pipes) [Possibly confusing vent pipes w/ steam lines (?)]?

☐ More Space Over

Action needed? ☐ Yes ☐ No. If so, by whom? _____ What is needed? _____

DISTRIBUTE COPIES TO: DBase Entry, Project file.

Date of Distribution _____ By _____ DBase date _____ By TDC

FORM #88-1 Rev. 2

LAW ENVIRONMENTAL, INC.
a professional engineering and earth science consulting firm

Attachments: ☐ Yes ☐ No

Distribution Priority: ☐ Rush ☐ Routine

CONTACT FORM

Contact made by: Mr. Art. Whallon & Mr. John Cook Date: 2/25/92 Time: 0930 Project/Proposal Related: ☒ Yes ☐ No

If yes, Project/Proposal Name: Ft. Riley FOC Project/Proposal No: _____ Enter in DBase: ☐ Yes ☐ No If yes, ☐ New ☐ Existing

IF NEW CONTACT: Provide all information in this section or attach copy of business card.

Mr. Jeremiah Mullally (Person Contacted), Former Dry Cleaning Mng. (Company Name)

205 South Bunker Hill (Street Address (include P.O.B.)) (Title) (Phone)

Junction City (City), Kansas (State) 66441 (Zip Code)

"KNOWN BY" (Law Environmental employees who know contact) in priority order: n/A

1) _____ "TYPE": ☐ Active Client ☐ Inactive Client ☐ Potential Client ☐ Other _____

2) _____ "STATUS": ☐ Open ☐ Prior Authorization ☐ Private

3) _____

MEANS OF COMMUNICATION: ☐ Initiated ☐ Received ☐ Phone Call ☐ Letter ☐ SOQ ☐ Proposal ☐ RFP ☒ In person visit

☐ Other, explain: _____

SUMMARY: Mr. Whallon & Mr. Cook met w/ Mr. J. Mullally to discuss operation, practices and physical features of the Dry Cleaning facility (Bldg 180) Fort Riley.

Mr. Mullally was manager of the Dry cleaning facility nearly 31 years until his retirement in 1971. The following is a list of facts and/or observation brought forth during the interview. (were)

- There are three tanks along the north side of the "old" red brick bldg. It is uncertain if the tanks are still there. It is Mr. Mullally's thought that these tanks are still there.
  - 1) 2500 gallon tank
  - 1) 1000 " "
  - 1) 500 " "

☐ More Space Over

Action needed? ☐ Yes ☐ No. If so, by whom? _____ What is needed? _____

DISTRIBUTE COPIES TO: DBase Entry, Project file

Date of Distribution _____ By _____ DBase date _____ By JKC

FORM #88-1 Rev. 2

LAW ENVIRONMENTAL, INC.
a professional engineering and earth science consulting firm

Attachments: ☐ Yes ☐ No

Distribution Priority: ☐ Rush

☐ Routine

CONTACT FORM

Contact made by:_____ Date:_____ Time:_____ Project/Proposal Related: ☐ Yes ☐ No

If yes. Project/Proposal Name:_____ Project/Proposal No:_____ Enter in DBase: ☐ Yes ☐ No
If yes. ☐ New ☐ Existing

IF NEW CONTACT: Provide all information in this section or attach copy of business card.

Person Contacted _____ Company Name _____

Title _____ Phone _____

Street Address (include P.O.B) _____ City _____ State _____ Zip Code _____

"KNOWN BY" (Law Environmental employees who know contact) in priority order:

1)_____ **"TYPE":** ☐ **Active Client** ☐ **Inactive Client** ☐ **Potential Client** ☐ **Other**_____

2)_____ **"STATUS":** ☐ **Open** ☐ **Prior Authorization** ☐ **Private**

3)_____

MEANS OF COMMUNICATION: ☐ **Initiated** ☐ **Received** ☐ Phone Call ☐ Letter ☐ SOQ ☐ Proposal ☐ RFP ☐ In person visit

☐ Other, explain:_____

SUMMARY: - The USTs only stored Stoddard solvents (w/ flash point slightly less than kerosene)

* - It is likely these tanks were "storing" caustic clarification solutions and possibly solvents. There were no fill pipes visible.

- In 1971 the dry cleaning process switched from the Stoddard solvents to PCE.

* - The PCE was stored inside the Stone bldg in a single 55 gallon drum. There was never any more than 110 gallons (2 drums) on hand at any one time. Because of drum weight PCE was stored near the Dry Cleaning Unit.

☐ More space on back

Action needed? ☐ Yes ☐ No. If so, by whom?_____ What is needed?_____

DISTRIBUTE COPIES TO: DBase Entry, Project file.

Date of Distribution_____ By_____ DBase date_____ By JKC

FORM #88-1 Rev. 2

3 of 5

LAW ENVIRONMENTAL, INC.
a professional engineering and earth science consulting firm

Attachments: ☐ Yes ☐ No

Distribution Priority: ☐ Rush

☐ Routine

CONTACT FORM

Contact made by:_____ Date:_____ Time:_____ Project/Proposal Related: ☐ Yes ☐ No

If yes. Project/Proposal Name:_____ Project/Proposal No:_____ Enter in DBase: ☐ Yes ☐ No
If yes. ☐ New ☐ Existing

IF NEW CONTACT: Provide all information in this section or attach copy of business card.

Person Contacted _____ Company Name _____

Title _____ Phone _____

Street Address (include P.O.B) _____ City _____ State _____ Zip Code _____

"KNOWN BY" (Law Environmental employees who know contact) in priority order:

1)_____ **"TYPE":** ☐ **Active Client** ☐ **Inactive Client** ☐ **Potential Client** ☐ **Other**_____

2)_____ **"STATUS":** ☐ **Open** ☐ **Prior Authorization** ☐ **Private**

3)_____

MEANS OF COMMUNICATION: ☐ **Initiated** ☐ **Received** ☐ Phone Call ☐ Letter ☐ SOQ ☐ Proposal ☐ RFP ☐ In person visit

☐ Other. explain:_____

SUMMARY: - There are two above ground tanks inside the brick bldg (one - 1000 gal, one - 250 gal used to store still bottoms, distillate residue and diatomaceous earth filter material
- These tanks discharged their content into sanitary sewer (eventually treated in water treatment plant).
- The Stoddard solvents (+ PCE) were re-cycled
- 1st by filtering (mechanical) through diatomaceous earth.
- Then through caustic clarifyers (No memory of what caustic solution was).
- A still was also used to re-fine or re-cycle Stoddard solvents.

☐ More Space Over

Action needed? ☐ Yes ☐ No. If so. by whom?_____ What is needed?_____

DISTRIBUTE COPIES TO: DBase Entry, Project file._____

Date of Distribution_____ By_____ DBase date_____ By JKC

FORM #88-1 Rev. 2

4 of 5

LAW ENVIRONMENTAL, INC.
a professional engineering and earth science consulting firm

Attachments: ☐ Yes ☐ No

Distribution Priority: ☐ Rush ☐ Routine

CONTACT FORM

Contact made by:_____ Date:_____ Time:_____ Project/Proposal Related: ☐ Yes ☐ No

If yes. Project/Proposal Name:_____ Project/Proposal No:_____ Enter in DBase: ☐ Yes ☐ No
If yes. ☐ New ☐ Existing

IF NEW CONTACT: Provide all information in this section or attach copy of business card.

Person Contacted _____ Company Name _____

Title _____ Phone _____

Street Address (include P.O.B) _____ City _____ State _____ Zip Code _____

"KNOWN BY" (Law Environmental employees who know contact) in priority order:

1)_____ **"TYPE":** ☐ **Active Client** ☐ **Inactive Client** ☐ **Potential Client** ☐ **Other**_____

2)_____ **"STATUS":** ☐ **Open** ☐ **Prior Authorization** ☐ **Private**

3)_____

MEANS OF COMMUNICATION: ☐ **Initiated** ☐ **Received** ☐ **Phone Call** ☐ **Letter** ☐ **SOQ** ☐ **Proposal** ☐ **RFP** ☐ **In person visit**

☐ Other. explain:_____

SUMMARY: Ms. Mullally estimated that most of the monthly loss of Stoddard solvent - nearly 1500 gallons/month - was vapor loss. Very little was lost to disposal.

- Mullally estimated that 55 gallons per month of PCE was evaporative (vapor) loss.

* - Ms Mullally said that there was never any solvent dumping outside the bldg. We did say that the diatomaceous earth (filter material) was broadcast. This filter material was also used as "fill" along the Southwest slope.

- Bldg 18C (west of DC - brick bldg) stored oil(s) and minor un-named solvents.

☐ More Space On Back

Action needed? ☐ Yes ☐ No. If so, by whom?_____ What is needed?_____

DISTRIBUTE COPIES TO: DBase Entry, Project file.

Date of Distribution_____ By_____ DBase date 1/8/96 By_____

FORM #86-1 Rev. 2

5 of 5

LAW ENVIRONMENTAL, INC.
a professional engineering and earth science consulting firm

Attachments: ☐ Yes ☐ No

Distribution Priority: ☐ Rush ☐ Routine

CONTACT FORM

Contact made by:_____ Date:_____ Time:_____ Project/Proposal Related: ☐ Yes ☐ No

If yes. Project/Proposal Name:_____ Project/Proposal No:_____ Enter in DBase: ☐ Yes ☐ No If yes. ☐ New ☐ Existing

IF NEW CONTACT: Provide all information in this section or attach copy of business card.

Person Contacted _____ Company Name _____

Title _____ Phone _____

Street Address (include P.O.B) _____ City _____ State _____ Zip Code _____

"KNOWN BY" (Law Environmental employees who know contact) in priority order:

1)_____ **"TYPE":** ☐ Active Client ☐ Inactive Client ☐ Potential Client ☐ Other_____

2)_____ **"STATUS":** ☐ Open ☐ Prior Authorization ☐ Private

3)_____

MEANS OF COMMUNICATION: ☐ Initiated ☐ Received ☐ Phone Call ☐ Letter ☐ SOQ ☐ Proposal ☐ RFP ☐ In person visit

☐ Other, explain:_____

SUMMARY: There was a boiler room (basement) in Stone bldg - boiler was fueled by natural gas (no fuel oil and/or fuel oil tanks).
- Mr. Mullally is puzzled (as we are) why "higher" SG results at northeast corner of Stone ~~bldg~~ use bldg.
- Brick bldg was Dry Cleaners
Stone bldg minor Dry Cleaning use
  - one unit
  - one 55 gallon drums next to unit.

☐ More Space Over

Action needed? ☐ Yes ☐ No. If so, by whom? JKC What is needed?_____

DISTRIBUTE COPIES TO: DBase Entry, Project file

Date of Distribution_____ By_____ DBase date_____ By_____

FORM eqb-1 Rev. 2

LAW ENVIRONMENTAL, INC.
a professional engineering and earth science consulting firm

Attachments: ☐ Yes ☐ No

Distribution Priority: ☐ Rush ☐ Routine

CONTACT FORM

Contact made by: ART WHALLON Date: 2/24/92 Time: 3:00 P Project/Proposal Related: ☒ Yes ☐ No

If yes, Project/Proposal Name: _____ Project/Proposal No: _____ Enter in DBase: ☐ Yes ☐ No If yes, ☐ New ☐ Existing

IF NEW CONTACT: Provide all information in this section or attach copy of business card.

Mr. COMPTON (Person Contacted) FT. RILEY - Civilian Personnel Office (Company Name)

(Title) 9-2535 (Phone)

(Street Address (include P.O.B)) (City) (State) (Zip Code)

"KNOWN BY" (Law Environmental employees who know contact) in priority order:

1) _____ **"TYPE":** ☐ Active Client ☐ Inactive Client ☐ Potential Client ☐ Other _____

2) _____ **"STATUS":** ☐ Open ☐ Prior Authorization ☐ Private

3) _____

MEANS OF COMMUNICATION: ☐ Initiated ☐ Received ☐ Phone Call ☐ Letter ☐ SOQ ☐ Proposal ☐ RFP ☐ In person visit

☐ Other, explain: _____

SUMMARY: Mr. Compton was unfamiliar with the operations of the former Dry Cleaning Facility. He provided the following names of people who currently work for the Directorate of Logistics on Ft. Riley: Bob Krause x 9-6551 6458

Bob Sheridan - Director of Logistics · 9-[redacted]

Who might be helpful.

Mr. Compton said his office did not have records of former employees - civilian or military - that would have worked at the Funston LF, former dry cleaner or the pesticide Storage bldg.

☐ More Space Over

Action needed? ☐ Yes ☐ No. If so, by whom? _____ What is needed? _____

DISTRIBUTE COPIES TO: DBase Entry, Project file _____

Date of Distribution _____ By _____ DBase date _____ By _____

FORM ecp-1 Rev. 2

DRAFT

Manual Edition Date: January, 1992

Regular Army: X
Army Reserve: ___
Army National Guard: ___

ECAS INDIVIDUAL FINDING SHEET

(Items in boxed area are mandatory) Page 1 of 1

Section (CAA, RCRA-C, Noise, etc.): CWA
Type of Finding (Positive or Negative): NEG
If Tenant Organization, specify: ___
If National Guard, specific site: ___

Question Number: ___
Building Number or Location: BLDG. 183
If Reserve, MUSARC & ARCOM: ___

FINDING CATEGORY (Check one):

Class I (out of compliance) ___
Class II (will be out of compliance) ___
Class III (Management Practice) X
Health/Safety ___

___ Check only if finding requires immediate action due to threat or risk

Basis of Finding (Citation or Regulation):

CONDITION (What did you find?)

Two large compressor units are old and have had chronic oil leak problems. The leaking oil is in proximity to a floor drain used to receive compressor cooling water discharge. Indications that oil was entering this drain were observed at the time of the assessment.

CRITERIA (What is the actual requirement?)

DRAFT

Provide Finding (ECAS, NOV, etc)? ECAS

Continual Finding? ___

NOV Number (If applicable): ___

SUGGESTED SOLUTION(S):

The compressor units should be replaced with new units that do not have leaking problems, and the cooling water drain system should be reconfigured to replace the open floor drain with a closed drain system.

SAMPLING RESULTS (mandatory only if mathematical sampling was used):

Universe: ___ Sample Size: ___
Number of Discrepancies: ___ Percentage of Discrepancies: ___

PREPARED BY: Ross Pickford

DATE: 5/12/92

COMMENTS:

Manual Edition Date: January, 1992

Regular Army: X
Army Reserve: ___
Army National Guard: ___

DRAFT

ECAS INDIVIDUAL FINDING SHEET

(Items in boxed area are mandatory) Page 1 of 1

Section (CAA, RCRA-C, Noise, etc.): HAZMAT
Type of Finding (Positive or Negative): NEG
If Tenant Organization, specify: _____
If National Guard, specific site: _____

Question Number: _____
Building Number or Location: BLDG. 183
If Reserve, MUSARC & ARCOM: _____

FINDING CATEGORY (Check one):

Class I (out of compliance) ___
Class II (Will be out of compliance) ___
Class III (Management Practice) X
Health/Safety

___ Check only if finding requires immediate action due to threat or risk

Basis of Finding (Citation or Regulation):

CONDITION (What did you find?)

Drums of Perchloroethylene and various dyes and detergents are presently stored in a designated room equipped with a floor drain. According to operating personnel, this drain empties into the sanitary sewer system. In addition, drums of Therminol oil are stored near the boiler system which is also near floor drains for the washer units.

CRITERIA (What is the actual requirement?)

DRAFT

Provide Finding (ECAS, NOV, etc)? ECAS

Continual Finding? _____

NOV Number (if applicable): _____

SUGGESTED SOLUTION(S):

The floor drain in this room should be sealed to prevent spilled or leaked materials from entering sanitary sewer system. All liquids should also be stored in ares that will provide containment and prevent accidental spills or leaks from entering the sewer system.

SAMPLING RESULTS (mandatory only if mathematical sampling was used):

Universe: ___ Sample Size: ___
Number of Discrepancies: ___ Percentage of Discrepancies: ___

PREPARED BY: Rose Pickford

DATE: 5/12/92

COMMENTS:

DRAFT

APPENDIX C

SOIL GAS SURVEY

SOIL GAS SURVEY

FORMER DRY CLEANING FACILITY

FORT RILEY, KANSAS

TARGET ENVIRONMENTAL SERVICES, INC.

SOIL GAS SURVEY

FORMER DRY CLEANING FACILITY

CUSTER ROAD

FORT RILEY, KANSAS

PREPARED FOR

LAW ENVIRONMENTAL, INCORPORATED

10100 NORTH EXECUTIVE HILLS BOULEVARD, SUITE 350

KANSAS CITY, MISSOURI 64153

PREPARED BY

TARGET ENVIRONMENTAL SERVICES, INC.

9180 RUMSEY ROAD

COLUMBIA, MARYLAND 21045

(301) 992-6622

NOVEMBER 1991

APPENDIX D

HTW LOGS/TEST BORING RECORDS

EXECUTIVE SUMMARY

On October 29 through 31 and November 2, 1991, **TARGET Environmental Services, Inc. (TARGET)** conducted a soil gas survey at the **Former Dry Cleaning Facility**, Custer Road, Fort Riley, Kansas. Samples were analyzed by GC/FID for petroleum hydrocarbons and by GC/ECD for tetrachloroethene (PCE).

GC/ECD analysis revealed high levels of PCE at the northeast corner of the former dry cleaning facility (Building #180). More moderate levels extended westward to Building #181 and northward across Custer Road. Low levels extended throughout the site.

The Total FID Volatiles were relatively low at the northeast corner of Building #180, where PCE was highest. Low levels extended westward beyond Building #181. None of the standardized FID analytes were present above the 1 µg/l detection limit in any of the samples from the site. The FID chromatogram signatures of the majority of the samples with detectable levels of Total FID Volatiles are dominated by the peak representing PCE. Small, late-eluting peaks which may represent low levels of a petroleum based solvent were observed in one sample from west of Building #181.

Map patterns and chromatographic data indicate that PCE is present in the subsurface throughout most of the surveyed area. The occurrence appears to be limited to the survey area.

Introduction

Law Environmental, Inc. contracted **TARGET Environmental Services, Inc. (TARGET)** to perform a soil gas survey at the **Former Dry Cleaning Facility**, Custer Road, Fort Riley, Kansas. The purpose of the survey was to determine the presence and extent of subsurface contamination by tetrachloroethene (PCE) and stoddard solvents. PCE and stoddard solvents have been used at this site in the past. Based on information available for other portions of Fort Riley, ground water is thought to be 15 feet below grade and the soils are thought to be largely loess with little or no cobbles. A new dry cleaning facility, Building #183, is located to the north of the site, across Custer Road. The site is bordered on the east, south and west by wooded areas. The field phase of the soil gas survey was conducted on October 29 through 31 and November 2, 1991.

Detectability

The soil gas survey data presented in this report are the result of precise sampling and measurement of contaminant concentrations in the vadose zone. Analyte detection at a particular location is representative of vapor, dissolved, and/or liquid phase contamination at that location. The presence of detectable levels of target analytes in the vadose zone is dependent upon several factors, including the presence of vapor-phase hydrocarbons or dissolved or liquid concentrations adequate to facilitate volatilization into the unsaturated zone.

Terminology

In order to prevent misunderstanding of certain terms used in this report, the following clarifications are offered:

The term "feature" is used in reference to a discernible pattern in the contoured data. It denotes a contour form rather than a definite or separate chemical occurrence.

The term "occurrence" is used to indicate an area where chemical compounds are present in sufficient concentrations to be detected by the analysis of soil vapors. The term is not indicative of any specific mode of occurrence (vapor, dissolved, etc.), and does not necessarily indicate or suggest the presence of "free product" or "phase-separated hydrocarbons."

The term "anomaly" refers to an area where hydrocarbons were measured in excess of what would normally be considered "natural" or "background" levels.

The term "analyte" refers to any of the hydrocarbons standardized for quantification in the chromatographic analysis.

The term "vadose zone" represents the unsaturated zone between the ground water table and the ground surface.

The term "indicates" is used when evidence dictates a unique conclusion. The term "suggests" is used when several explanations of certain evidence are possible, but one in particular seems more likely. As a result, "indicates" carries a higher degree of confidence in a conclusion than does "suggests."

The terms "elevated" and "significant" are used to describe concentrations of analytes which indicate the existence of a potential problem in the soil or ground water.

Field Procedures

Soil gas samples were collected at a total of 49 locations at the site, as shown in Figure 1. The sampling depth varied from 3.5 to 6 feet (see Table 1). Although samples were to be collected at depths of 6 to 15 feet at some locations, poor weather conditions prevented access by **TARGET**'s hydraulic probe van and forced a change in the sampling plan to manual collection at a 4 foot depth at many of the locations. Based on the findings of the early samples, the sample grid was expanded to include additional samples.

Thirty-two (32) shallow soil gas samples were collected by using a drive rod to produce a 1/2 inch hole to a depth of approximately 3.5 or 4 feet. The entire sampling system was purged with ambient air drawn through an organic vapor filter cartridge, and a stainless steel probe was inserted to the full depth of the hole and sealed off from the atmosphere.

Seventeen (17) deep soil gas samples were collected using a van-mounted hydraulic probe to advance connected 3 foot sections of 1 inch diameter threaded steel casing down to a depth of 6 feet. The entire sampling system was purged with ambient air drawn through an organic vapor filter cartridge. A teflon line was inserted into the casing to the bottom of the hole, and the bottom-hole line perforations were isolated from the up-hole annulus by an inflatable packer.

For both sampling methods, a sample of in-situ soil gas was then withdrawn through the probe and used to purge atmospheric air from the sampling system. A second sample of soil gas was

withdrawn through the probe and encapsulated in a pre-evacuated glass vial at two atmospheres of pressure (15 psig). The self-sealing vial was detached from the sampling system, packaged, labeled, and stored for laboratory analysis.

Prior to the day's field activities all sampling equipment, slide hammer rods, and probes were decontaminated by washing with soapy water and rinsing thoroughly. Internal surfaces were flushed dry using pre-purified nitrogen or filtered ambient air, and external surfaces were wiped clean using clean paper towels.

Field control samples were collected at the beginning and end of each day's field activities and after the twentieth soil gas sample on the second day. These QA/QC samples were obtained by filtering ambient air through a dust and organic vapor filter cartridge and collecting in the same manner as described above. The low levels of tetrachloroethene (PCE) reported in Field Control Samples 4 and 5 are the result of carryover in the sampling equipment following the collection of Samples 47 and 44, respectively.

Laboratory Procedures

All of the samples collected during the field phase of the survey were subjected to dual analyses. One analysis was conducted according to EPA Method 601 (modified) on a gas chromatograph equipped with an electron capture detector (ECD), but using direct injection instead of purge and trap. Tetrachloroethene (PCE) was standardized for the ECD analysis.

The second analysis was conducted according to EPA Method 602 (modified) on a gas chromatograph equipped with a flame ionization detector (FID), but using direct injection instead of purge and trap. The analytes selected for standardization in this analysis were:

benzene
toluene
ethylbenzene
meta- and para- xylene
ortho-xylene

These compounds were chosen because of their utility in evaluating the presence of fuel products, or petroleum based solvents.

The analytical equipment was calibrated using an instrument-response curve and injection of known concentrations of the above standards. Retention times of the standards were used to identify the peaks in the chromatograms of the field samples and their response factors were used to calculate the analyte concentrations.

The Total FID Volatiles values were generated by summing the areas of all chromatogram peaks and calculated using the instrument response factor for toluene. Injection peaks, which also contain the light hydrocarbon methane, were excluded to avoid the skewing of the Total FID Volatiles (Totals) values due to injection distur-

bances and biogenic methane. For samples with low hydrocarbon concentrations, the calculated Total FID Volatiles concentration is occasionally lower than the sum of the individual analytes. This is because the response factor used for the Total FID Volatiles calculation is a constant, whereas the individual analyte response factors vary with concentration. It is important to understand that the Total FID Volatiles levels reported are relative, not absolute, values.

The tabulated results of the laboratory analyses of the soil gas samples are reported in micrograms per liter (µg/l) in Table 2. Although "micrograms per liter" is equivalent to "parts per billion (v/v)" in water analyses, they are not equivalent in gas analyses, due to the difference in the mass of equal volumes of water and gas matrices. The xylenes concentrations reported in Table 2 are the sum of the m- and p-xylene and o-xylene concentrations for each sample.

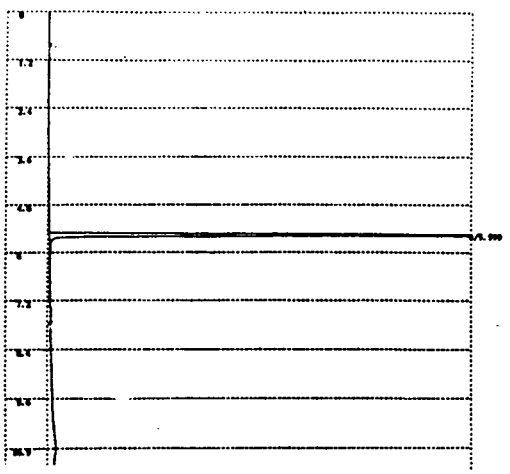
For QA/QC purposes, a duplicate analysis was performed on every tenth field sample. Laboratory blanks of nitrogen gas (99.999%) were also analyzed after every tenth field sample.

Discussion and Interpretation of Results

In order to provide graphic presentation of the results, individual data sets in Table 2 have been mapped and contoured to produce Figures 2 and 3. Map sample points with no data shown indicate that the analyte concentrations in the sample were below the detection limit. Dashed contours are used where patterns are extrapolated into areas of less complete data, or as auxiliary contours.

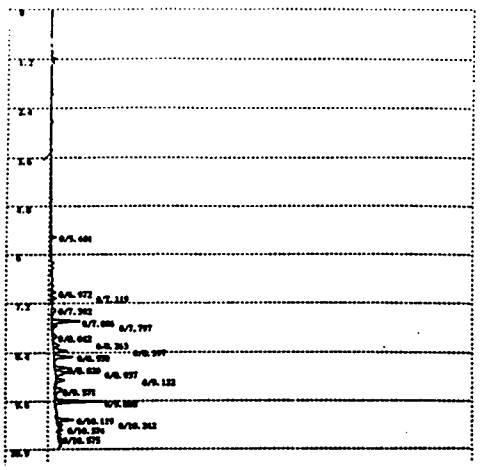
GC/ECD analysis revealed high levels of tetrachloroethene (PCE, Figure 2) at the northeast corner of the former dry cleaning facility (Building #180). The highest level occurred in Sample 30. More moderate levels extended westward to Building #181 and northward across Custer Road. Low levels extended throughout the site.

The Total FID Volatiles map (Figure 3) revealed relatively low levels at the northeast corner of Building #180, where PCE was highest. Low levels extended westward beyond Building #181. None of the standardized FID analytes were present above the 1 µg/l detection limit in any of the samples from the site. The FID chromatogram signatures of the majority of the samples with detectable levels of Total FID Volatiles are dominated by the peak representing PCE, as exemplified by Chromatogram 1, Sample 36. Small, late-eluting



CHROMATOGRAM 1. GC/FID SIGNATURE OF SAMPLE 36

peaks which may represent low levels of a petroleum based solvent were observed only in Sample 28 from west of Building #181 (Chromatogram 2).



CHROMATOGRAM 2. GC/FID SIGNATURE OF SAMPLE 28

Detectable levels of PCE were observed in two field control samples, indicating carryover in the sampling equipment. Careful examination of the sampling order and analytical data suggests that some component of the reported PCE concentrations (up to approximately 0.80 µg/l) may be the result of carryover rather than a reflection of conditions in the soil vapor. This level of carryover, if present, would not affect the overall survey results except to reduce the lateral extent of the PCE occurrence in the outermost samples, where very low levels of PCE were observed.

Map patterns and chromatographic data indicate that PCE is present in the subsurface throughout most of the surveyed area. The occurrence appears to be limited to the survey area.

TABLE 1

SAMPLING DEPTH

SAMPLE	FEET
7	4
8	4
9	4
10	4
11	4
12	4
13	4
14	4
15	4
16	4
17	4
18	4
19	4
20	6
21	6
22	6
23	6
24	4
25	6
27	4
28	6
29	6
30	6
31	6
32	6
33	6
34	6
35	6
36	6
37	4
38	3.5
39	4
40	3.5
41	4
42	6
43	6
44	6
45	4
46	4
47	4
48	4
49	4
50	4
51	4
54	4
55	4
56	4
57	4

TABLE 2

ANALYTE CONCENTRATIONS (µg/l)

SAMPLE	BENZENE	TOLUENE	ETHYL-BENZENE	XYLENES	TOTAL FID VOLATILES[1]	PCE*
7	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
8	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
9	<1.0	<1.0	<1.0	<1.0	<1.0	8.1
10	<1.0	<1.0	<1.0	<1.0	<1.0	2.8
11	<1.0	<1.0	<1.0	<1.0	<1.0	0.31
12	<1.0	<1.0	<1.0	<1.0	<1.0	4.7
13	<1.0	<1.0	<1.0	<1.0	<1.0	4.7
14	<1.0	<1.0	<1.0	<1.0	<1.0	0.28
15	<1.0	<1.0	<1.0	<1.0	<1.0	2.8
16	<1.0	<1.0	<1.0	<1.0	<1.0	0.10
17	<1.0	<1.0	<1.0	<1.0	<1.0	2.0
18	<1.0	<1.0	<1.0	<1.0	<1.0	1.0
19	<1.0	<1.0	<1.0	<1.0	<1.0	2.6
20	<1.0	<1.0	<1.0	<1.0	1.1	10
21	<1.0	<1.0	<1.0	<1.0	<1.0	8.7
22	<1.0	<1.0	<1.0	<1.0	<1.0	2.0
23	<1.0	<1.0	<1.0	<1.0	<1.0	1.5
24	<1.0	<1.0	<1.0	<1.0	<1.0	0.10
25	<1.0	<1.0	<1.0	<1.0	<1.0	7.6
26	<1.0	<1.0	<1.0	<1.0	<1.0	5.4
27	<1.0	<1.0	<1.0	<1.0	<1.0	2.5
28	<1.0	<1.0	<1.0	<1.0	38	5.2
29	<1.0	<1.0	<1.0	<1.0	5.3	31
30	<1.0	<1.0	<1.0	<1.0	135	1,367
31	<1.0	<1.0	<1.0	<1.0	15	61
32	<1.0	<1.0	<1.0	<1.0	5.7	31
33	<1.0	<1.0	<1.0	<1.0	14	61
34	<1.0	<1.0	<1.0	<1.0	5.3	30
35	<1.0	<1.0	<1.0	<1.0	1.9	16
36	<1.0	<1.0	<1.0	<1.0	139	556
37	<1.0	<1.0	<1.0	<1.0	<1.0	1.4
38	<1.0	<1.0	<1.0	<1.0	<1.0	0.61
39	<1.0	<1.0	<1.0	<1.0	<1.0	2.2
40	<1.0	<1.0	<1.0	<1.0	<1.0	0.44
41	<1.0	<1.0	<1.0	<1.0	<1.0	3.0
42	<1.0	<1.0	<1.0	<1.0	1.3	12
43	<1.0	<1.0	<1.0	<1.0	1.2	2.3
44	<1.0	<1.0	<1.0	<1.0	8.2	6.0
45	<1.0	<1.0	<1.0	<1.0	<1.0	0.29
46	<1.0	<1.0	<1.0	<1.0	<1.0	0.65
47	<1.0	<1.0	<1.0	<1.0	<1.0	0.07
48	<1.0	<1.0	<1.0	<1.0	2.8	17
49	<1.0	<1.0	<1.0	<1.0	40	166
50	<1.0	<1.0	<1.0	<1.0	5.8	27
51	<1.0	<1.0	<1.0	<1.0	<1.0	0.95
54	<1.0	<1.0	<1.0	<1.0	<1.0	0.92
55	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
56	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
57	<1.0	<1.0	<1.0	<1.0	<1.0	1.2

* PCE was analyzed via GC/ECD; all others via GC/FID

[1]CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHROMATOGRAM PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLUENE

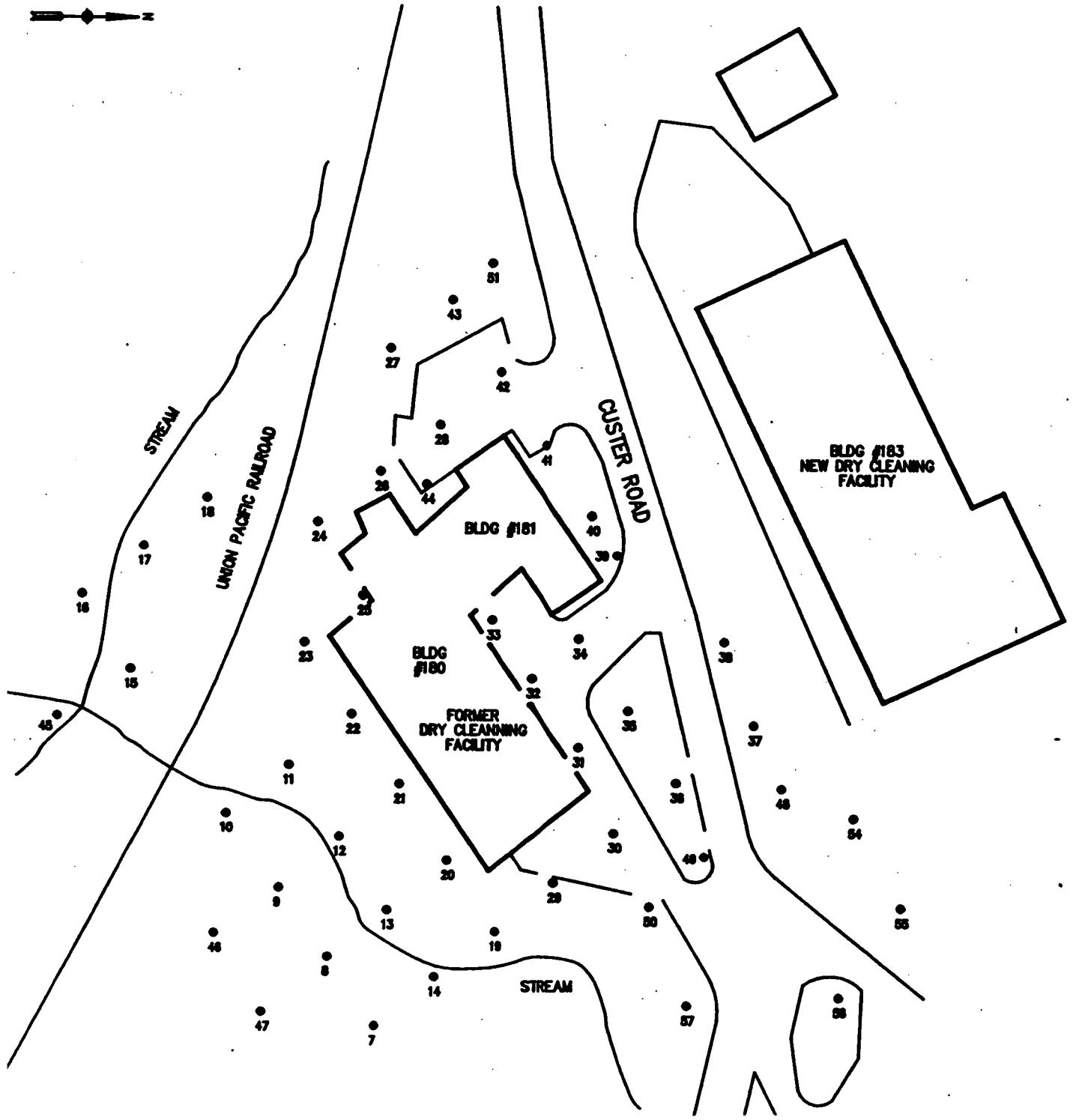
TABLE 2 (cont)

ANALYTE CONCENTRATIONS (µg/l)

SAMPLE	BENZENE	TOLUENE	ETHYL-BENZENE	XYLENES	TOTAL FID VOLATILES[1]	PCE*
FIELD CONTROL SAMPLES						
1	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
2	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
3	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
4	<1.0	<1.0	<1.0	<1.0	<1.0	0.52
5	<1.0	<1.0	<1.0	<1.0	<1.0	0.81
6	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
52	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
53	<1.0	<1.0	<1.0	<1.0	2.2	<0.05
58	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
LABORATORY DUPLICATE ANALYSES						
15	<1.0	<1.0	<1.0	<1.0	<1.0	2.8
15R	<1.0	<1.0	<1.0	<1.0	<1.0	2.7
22	<1.0	<1.0	<1.0	<1.0	<1.0	2.0
22R	<1.0	<1.0	<1.0	<1.0	<1.0	1.9
31	<1.0	<1.0	<1.0	<1.0	15	61
31R	<1.0	<1.0	<1.0	<1.0	15	62
43	<1.0	<1.0	<1.0	<1.0	1.2	2.3
43R	<1.0	<1.0	<1.0	<1.0	<1.0	2.6
52	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
52R	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
58	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
58R	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
LABORATORY BLANKS						
BSFRD-1	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
BSFRD-2	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
BSFRD-3	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
BSFRD-4	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05
BSFRD-5	<1.0	<1.0	<1.0	<1.0	<1.0	<0.05

* PCE was analyzed via GC/ECD; all others via GC/FID

[1]CALCULATED USING THE SUM OF THE AREAS OF ALL INTEGRATED CHROMATOGRAM PEAKS AND THE INSTRUMENT RESPONSE FACTOR FOR TOLUENE



0 30 60

FEET

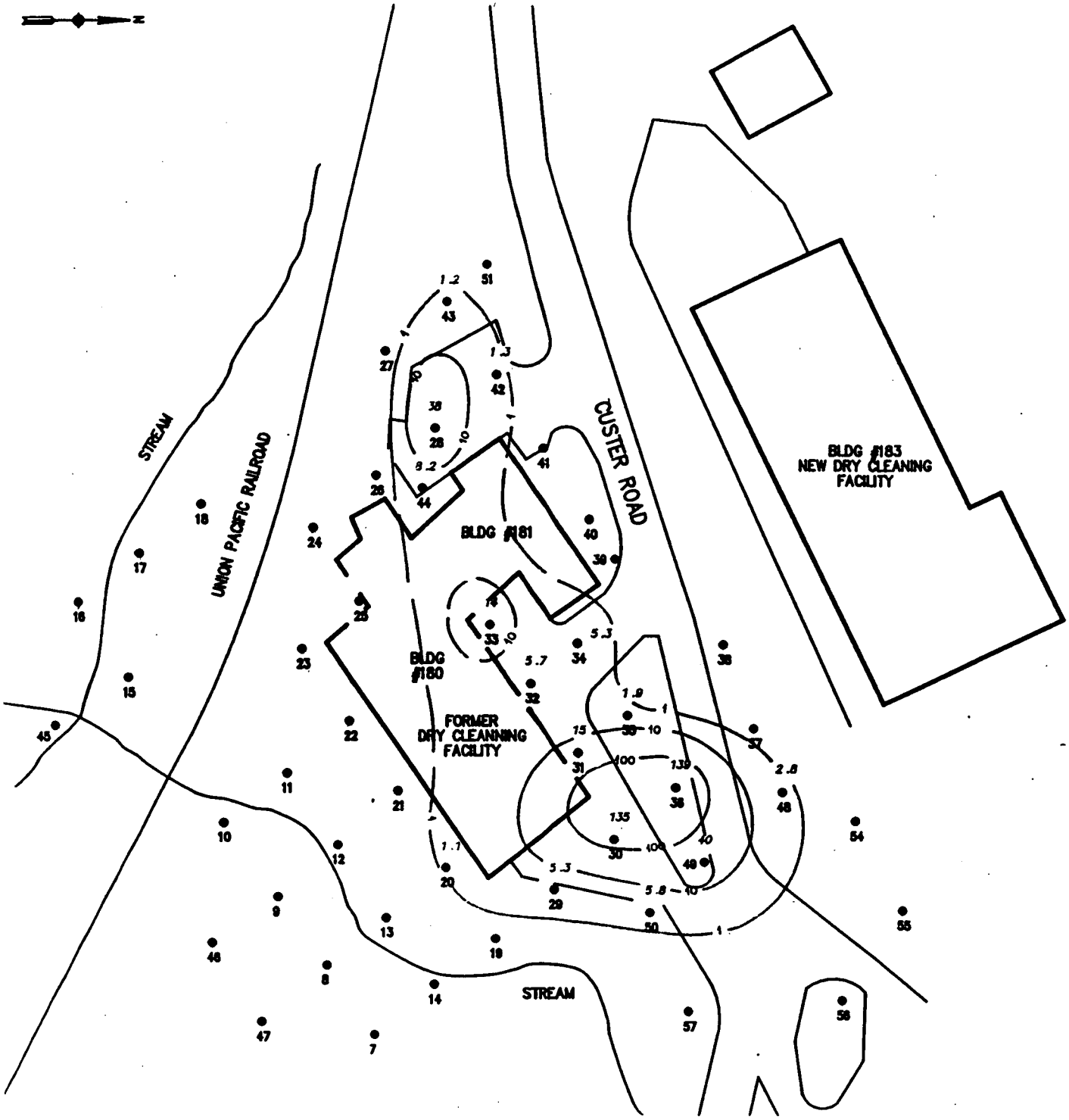
● SOIL GAS SAMPLE LOCATION

FIGURE 1. Sample Locations

FORMER DRY CLEANING FACILITY
FORT RILEY, KANSAS

TARGET ENVIRONMENTAL SERVICES, INC.

This map is integral to a written report and should be viewed in that context.



0 30 60

FEET

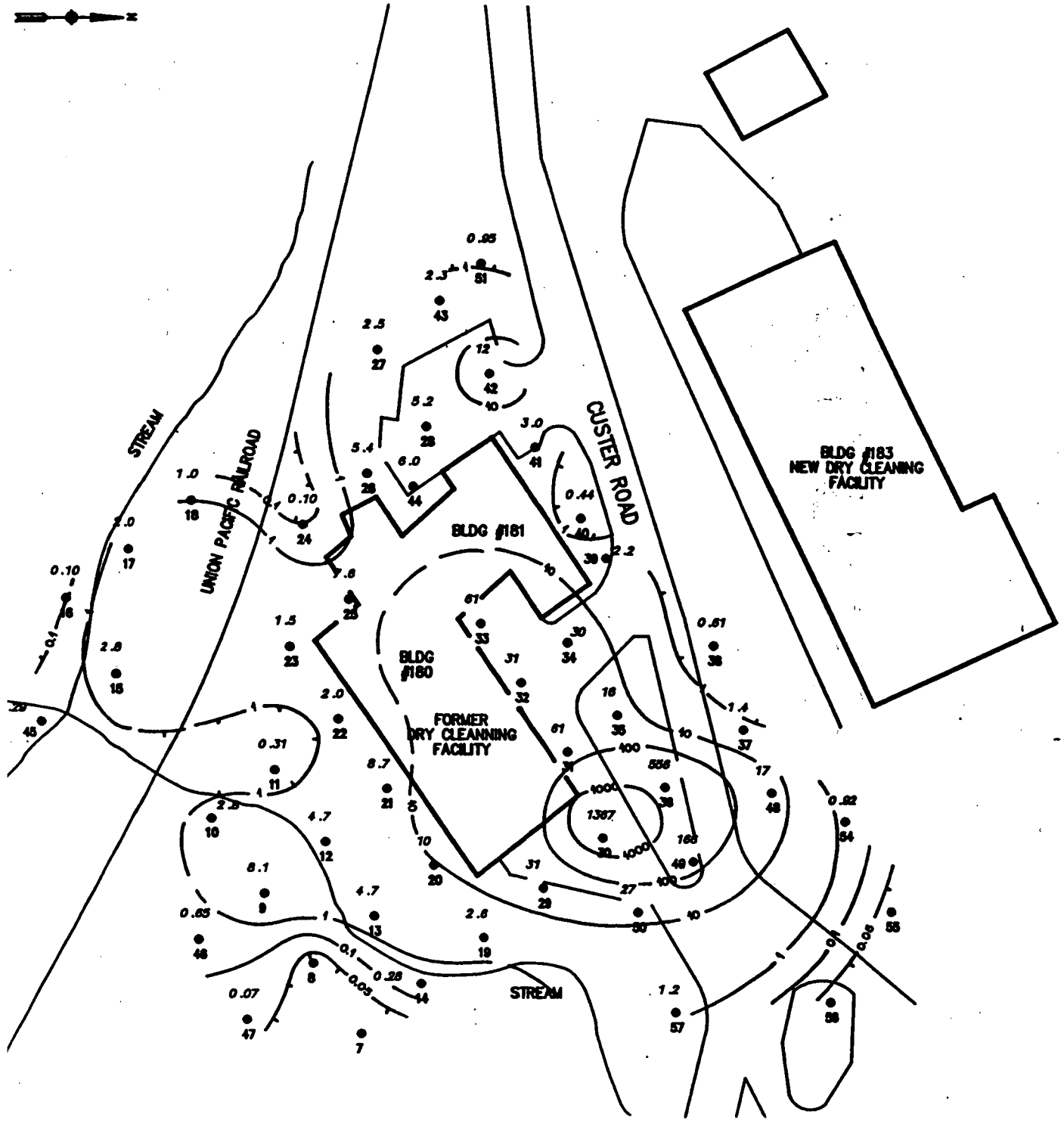
● SOIL GAS SAMPLE LOCATION

FIGURE 3. Total FID Volatiles
(calc'd µg/l)

FORMER DRY CLEANING FACILITY
FORT RILEY, KANSAS

TARGET ENVIRONMENTAL SERVICES, INC.

This map is integral to a written report and should be viewed in that context.



0 30 60

FEET

● SOIL GAS SAMPLE LOCATION

FIGURE 2. Tetrachloroethene (PCE)
(µg/l)

FORMER DRY CLEANING FACILITY
FORT RILEY, KANSAS

TARGET ENVIRONMENTAL SERVICES, INC.

This map is integral to a written report and should be viewed in that context.

APPENDIX E

MONITORING WELL INSTALLATION DIAGRAMS

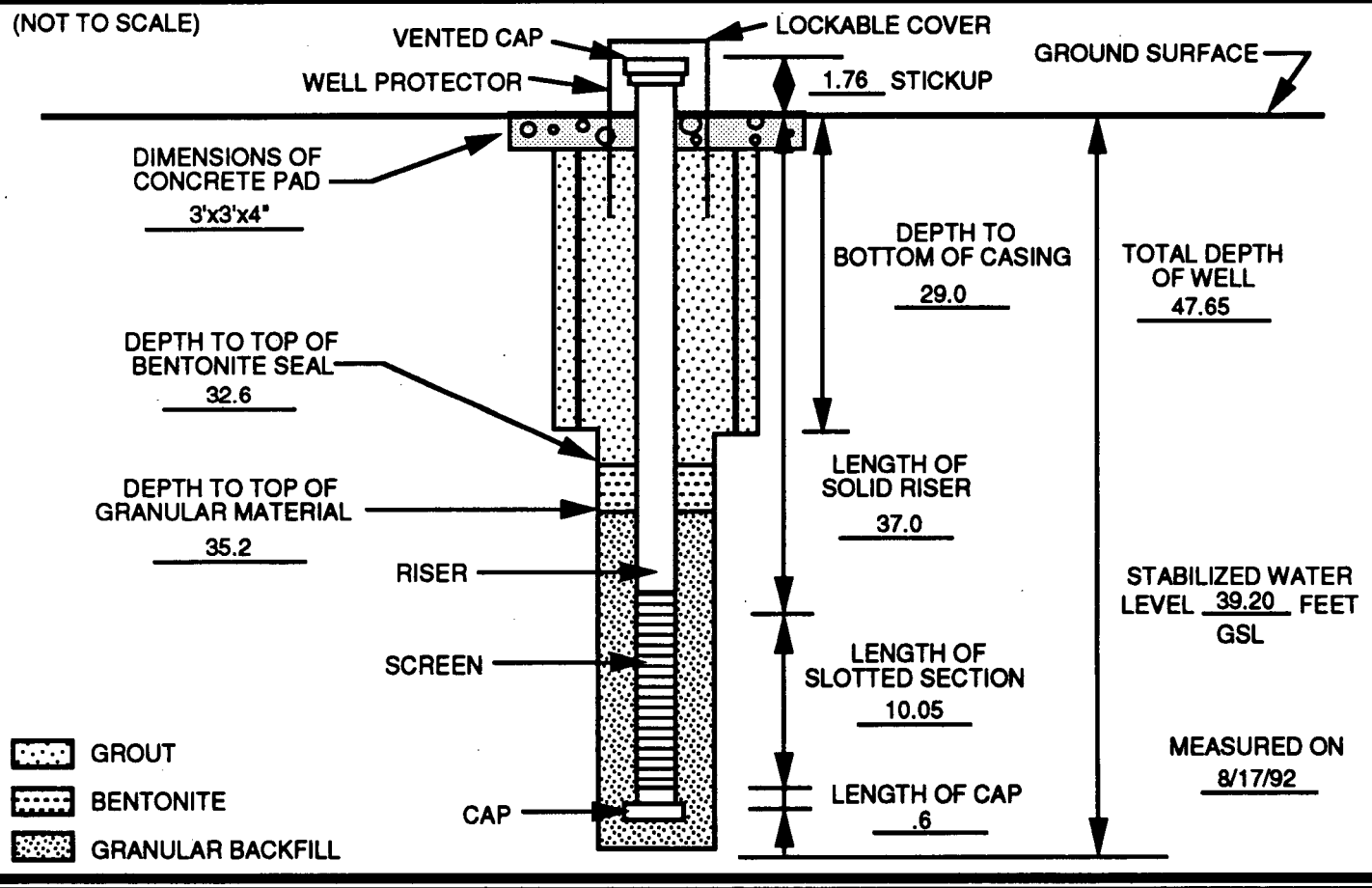
TYPE III MONITORING WELL INSTALLATION DIAGRAM

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

JOB NAME FT. RILEY FORMER DCF
WELL NO. DCF92-01 JOB NO. 11-1532
DATE 4/16/92 TIME 17:30
WELL LOCATION NE OF FORMER DCF

GROUND SURFACE ELEVATION 1090.3
TOP OF SCREEN ELEVATION 1053.1
REFERENCE POINT ELEVATION 1092.06
TYPE SAND PACK SILICA GRADATION 20/40
SAND PACK MANUFACTURER COLORADO ENV. MEDIA
SCREEN MATERIAL SCHEDULE 40 PVC
MANUFACTURER TITAN
RISER MATERIAL SCHEDULE 40 PVC
MANUFACTURER TITAN
RISER DIAMETER 2"
DRILLING TECHNIQUE (above casing) HOLLOW STEM AUGER
BIT SIZE AND TYPE 12" HSA
DRILLING TECHNIQUE (below casing) ROCK CORING/REAMING
BIT SIZE AND TYPE NX CORE/5 7/8" ROCK BIT

BENTONITE TYPE PELLETS
MANUFACTURER BAROID
CEMENT TYPE PORTLAND CEMENT TYPE I
MANUFACTURER LONESTAR
BOREHOLE DIAMETER 6"
SCREEN DIAMETER 2" SLOT SIZE .010
LAW ENVIRONMENTAL, INC.
FIELD REPRESENTATIVE JACK SMITHBACK
DRILLING CONTRACTOR LAYNE WESTERN
AMOUNT BENTONITE USED 1/2 BAG
AMOUNT CEMENT USED
AMOUNT SAND USED 1.8 BAGS
STATIC WATER DEPTH (after dev.) 39.20
TYPE OF CASING 6" PVC



QA / QC

INSTALLED BY: LAYNE WESTERN INSTALLATION OBSERVED BY: JS
DISCREPANCIES:

TYPE III MONITORING WELL INSTALLATION DIAGRAM

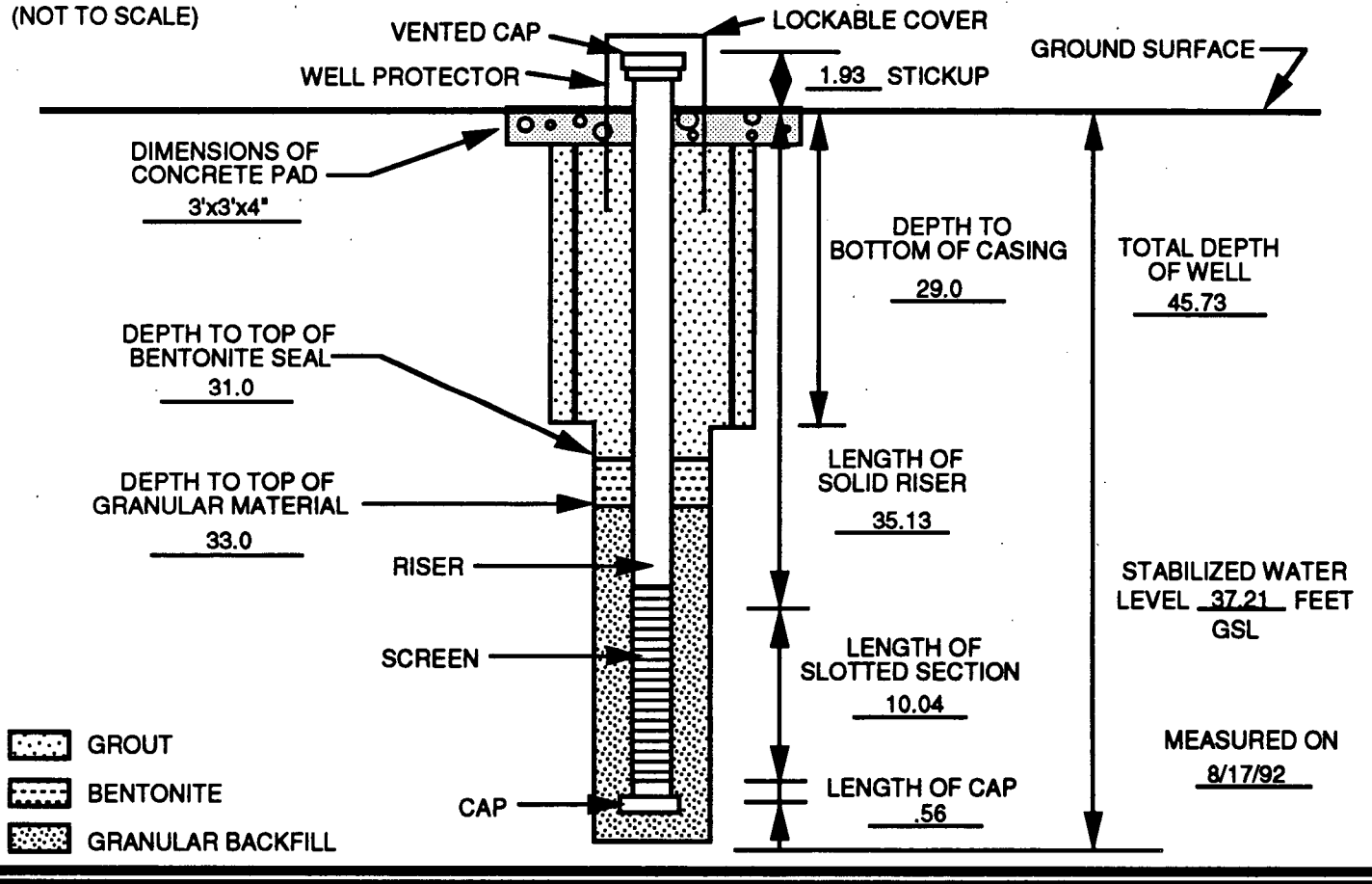
LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

JOB NAME FT. RILEY FORMER DCF
WELL NO. DCF92-02 JOB NO 11-1532
DATE 4/21/92 TIME 16:00
WELL LOCATION NE OF FORMER DCF

GROUND SURFACE ELEVATION 1087.1
TOP OF SCREEN ELEVATION 1048.91
REFERENCE POINT ELEVATION 1089.03
TYPE SAND PACK SILICA GRADATION 20/40
SAND PACK MANUFACTURER COLORADO ENV. MEDIA
SCREEN MATERIAL SCHEDULE 40 PVC
MANUFACTURER TITAN
RISER MATERIAL SCHEDULE 40 PVC
MANUFACTURER TITAN
RISER DIAMETER 2"
DRILLING TECHNIQUE (above casing) HOLLOW STEM AUGER
BIT SIZE AND TYPE 12" HSA
DRILLING TECHNIQUE (below casing) ROCK CORING/REAMING
BIT SIZE AND TYPE NX CORE/5 7/8" ROCK BIT

BENTONITE TYPE PELLETS
MANUFACTURER BAROID
CEMENT TYPE PORTLAND CEMENT TYPE I
MANUFACTURER LONESTAR
BOREHOLE DIAMETER 6"
SCREEN DIAMETER 2" SLOT SIZE .010
LAW ENVIRONMENTAL, INC.
FIELD REPRESENTATIVE JACK SMITHBACK
DRILLING CONTRACTOR LAYNE WESTERN
AMOUNT BENTONITE USED 1/2 BAG
AMOUNT CEMENT USED
AMOUNT SAND USED 2 BAGS
STATIC WATER DEPTH (after dev.) 37.21
TYPE OF CASING 6" PVC

(NOT TO SCALE)



QA / QC

INSTALLED BY: LAYNE WESTERN INSTALLATION OBSERVED BY: JS
DISCREPANCIES:

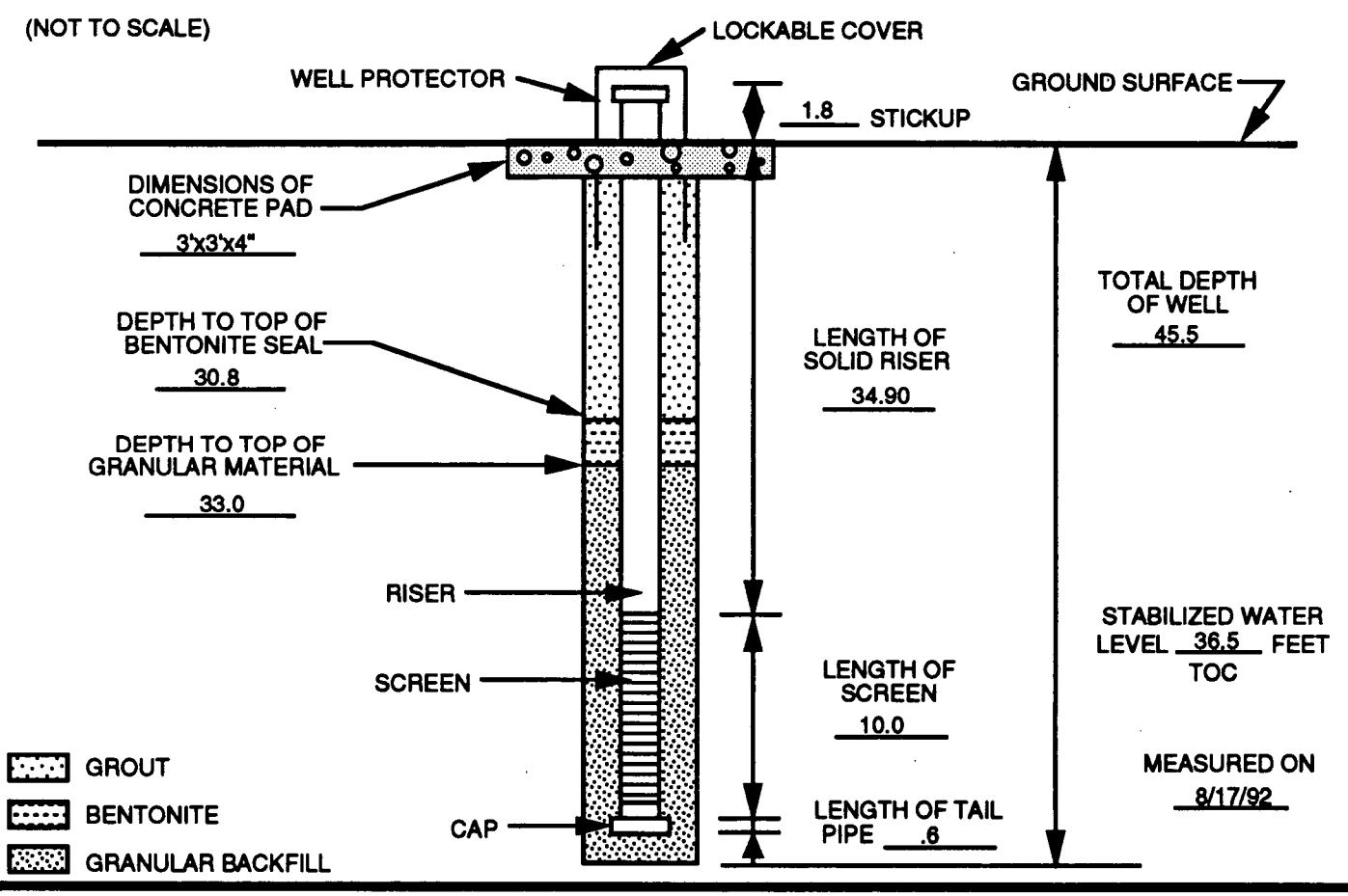
TYPE II MONITORING WELL INSTALLATION DIAGRAM

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

JOB NAME: FT. RILEY FORMER DCF
WELL NO.: DCF92-03 JOB NO.: 11-1532
DATE: 4/16/92 TIME: 18:00
WELL LOCATION: SE OF FORMER DCF

GROUND SURFACE ELEVATION: 1084.77
TOP OF SCREEN ELEVATION: 1051.67
REFERENCE POINT ELEVATION: 1086.57
TYPE SAND PACK: SILICA GRADATION: 20/40
SAND PACK MANUFACTURER: COLORADO ENV. MEDIA
SCREEN MATERIAL: SCHEDULE 40 PVC
MANUFACTURER: TITAN
RISER MATERIAL: SCHEDULE 40 PVC
MANUFACTURER: TITAN
RISER DIAMETER: 2"
DRILLING TECHNIQUE: HOLLOW STEM AUGER
AUGER SIZE AND TYPE: 12" HSA

BENTONITE TYPE: PELLETS
MANUFACTURER: BAROID
CEMENT TYPE: PORTLAND CEMENT TYPE I
MANUFACTURER: LONESTAR
BOREHOLE DIAMETER: 12"
SCREEN DIAMETER: 2" SLOT SIZE: .010
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE: JACK SMITHBACK
DRILLING CONTRACTOR: LAYNE WESTERN
AMOUNT BENTONITE USED: 2 BAGS
AMOUNT CEMENT USED:
AMOUNT SAND USED: 8 BAGS
STATIC WATER DEPTH (after dev.): 36.15



QA / QC

INSTALLED BY: LAYNE WESTERN INSTALLATION OBSERVED BY: JS
DISCREPANCIES: CHECKED BY: DATE:

HF

TYPE III MONITORING WELL INSTALLATION DIAGRAM

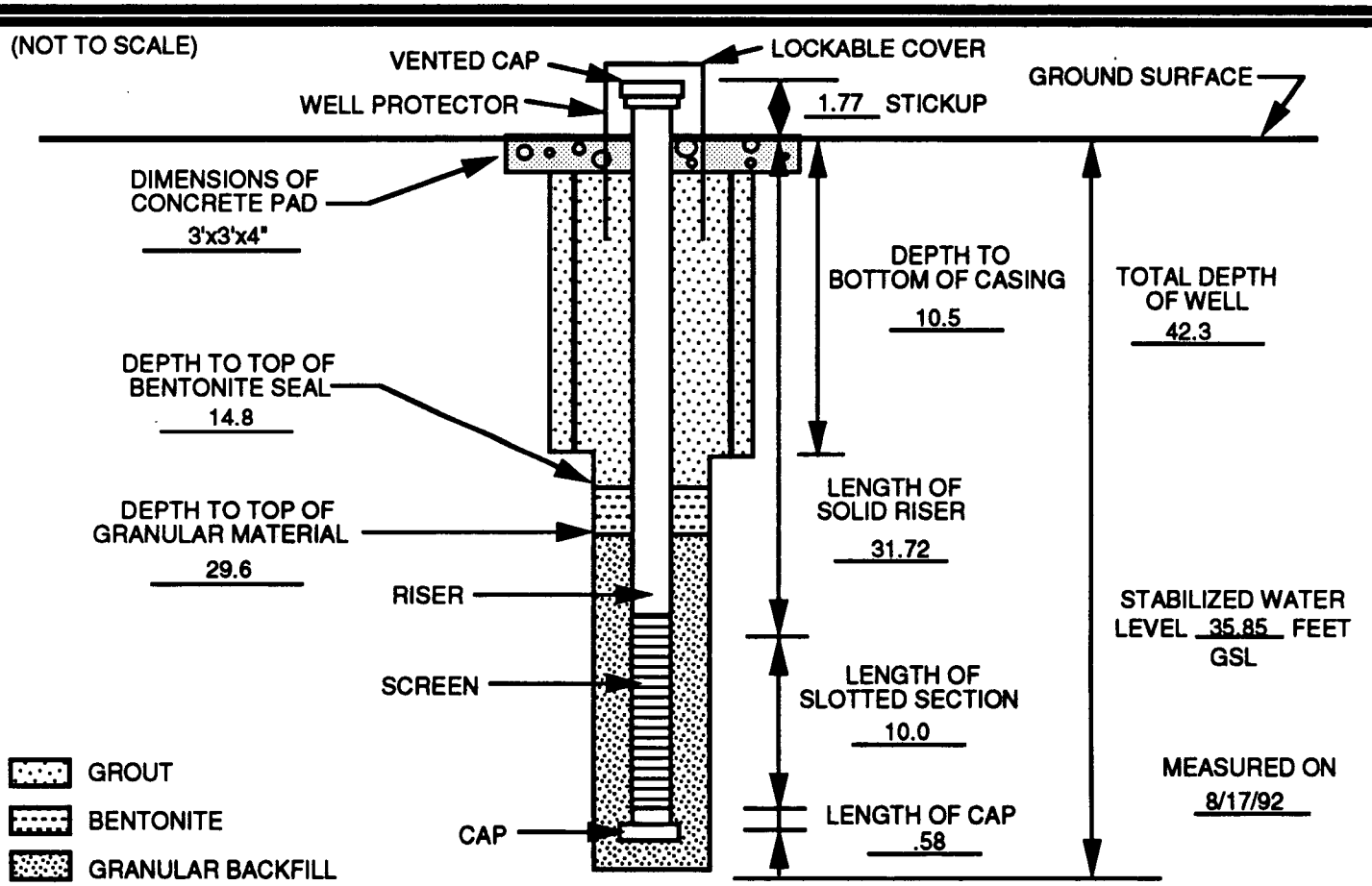
LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

JOB NAME: FT. RILEY FORMER DCF
WELL NO.: DCF92-04 JOB NO: 11-1532
DATE: 4/29/92 TIME: 15:55
WELL LOCATION: NW OF FORMER DCF

GROUND SURFACE ELEVATION: 1085.60
TOP OF SCREEN ELEVATION: 1055.65
REFERENCE POINT ELEVATION: 1087.37
TYPE SAND PACK: SILICA GRADATION: 20/40
SAND PACK MANUFACTURER: COLORADO ENV. MEDIA
SCREEN MATERIAL: SCHEDULE 40 PVC
MANUFACTURER: TITAN
RISER MATERIAL: SCHEDULE 40 PVC
MANUFACTURER: TITAN
RISER DIAMETER: 2"
DRILLING TECHNIQUE (above casing): HOLLOW STEM AUGER
BIT SIZE AND TYPE: 12" HSA
DRILLING TECHNIQUE (below casing): ROCK CORING/REAMING
BIT SIZE AND TYPE: NX CORE/ 5 7/8" ROCK BIT

BENTONITE TYPE: PELLETS
MANUFACTURER: BAROID
CEMENT TYPE: PORTLAND CEMENT TYPE I
MANUFACTURER: LONESTAR
BOREHOLE DIAMETER: 6"
SCREEN DIAMETER: 2" SLOT SIZE: .010
LAW ENVIRONMENTAL, INC.
FIELD REPRESENTATIVE: JACK SMITHBACK
DRILLING CONTRACTOR: LAYNE WESTERN
AMOUNT BENTONITE USED: 2 1/2 BAGS
AMOUNT CEMENT USED:
AMOUNT SAND USED: 1 1/2 BAGS
STATIC WATER DEPTH (after dev.): 35.85
TYPE OF CASING: 6" PVC

(NOT TO SCALE)



QA / QC

INSTALLED BY: LAYNE WESTERN INSTALLATION OBSERVED BY: JS
DISCREPANCIES:

TYPE II MONITORING WELL INSTALLATION DIAGRAM

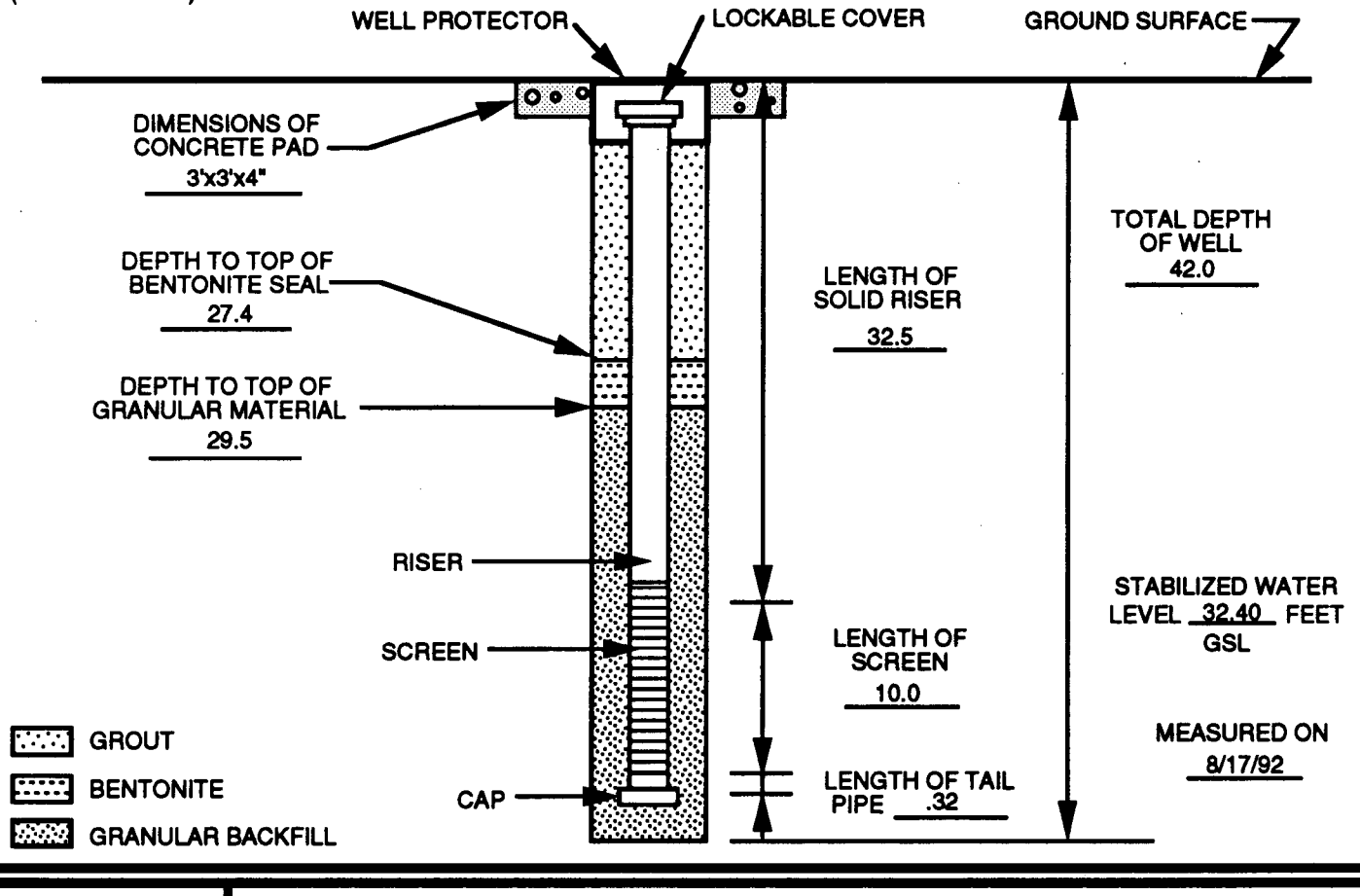
LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

JOB NAME: FT. RILEY FORMER DCF
WELL NO.: DCF92-05 JOB NO.: 11-1532
DATE: 4/6/92 TIME: 10:00
WELL LOCATION: SE OF FORMER DCF

GROUND SURFACE ELEVATION: 1083.0
TOP OF SCREEN ELEVATION: 1049.44
REFERENCE POINT ELEVATION: 1082.74
TYPE SAND PACK: SILICA GRADATION: 20/40
SAND PACK MANUFACTURER: COLORADO ENV. MEDIA
SCREEN MATERIAL: SCHEDULE 40 PVC
MANUFACTURER: TITAN
RISER MATERIAL: SCHEDULE 40 PVC
MANUFACTURER: TITAN
RISER DIAMETER: 2"
DRILLING TECHNIQUE: HOLLOW STEM AUGER
AUGER SIZE AND TYPE: 12" HSA

BENTONITE TYPE: PELLETS
MANUFACTURER: BAROID
CEMENT TYPE: PORTLAND CEMENT TYPE I
MANUFACTURER: LONESTAR
BOREHOLE DIAMETER: 12"
SCREEN DIAMETER: 2" SLOT SIZE: .010
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE: JACK SMITHBACK
DRILLING CONTRACTOR: LAYNE WESTERN
AMOUNT BENTONITE USED: 2 BAGS
AMOUNT CEMENT USED:
AMOUNT SAND USED: 8 BAGS
STATIC WATER DEPTH (after dev.): 32.40

(NOT TO SCALE)



QA / QC

INSTALLED BY: LAYNE WESTERN INSTALLATION OBSERVED BY: JS
DISCREPANCIES:

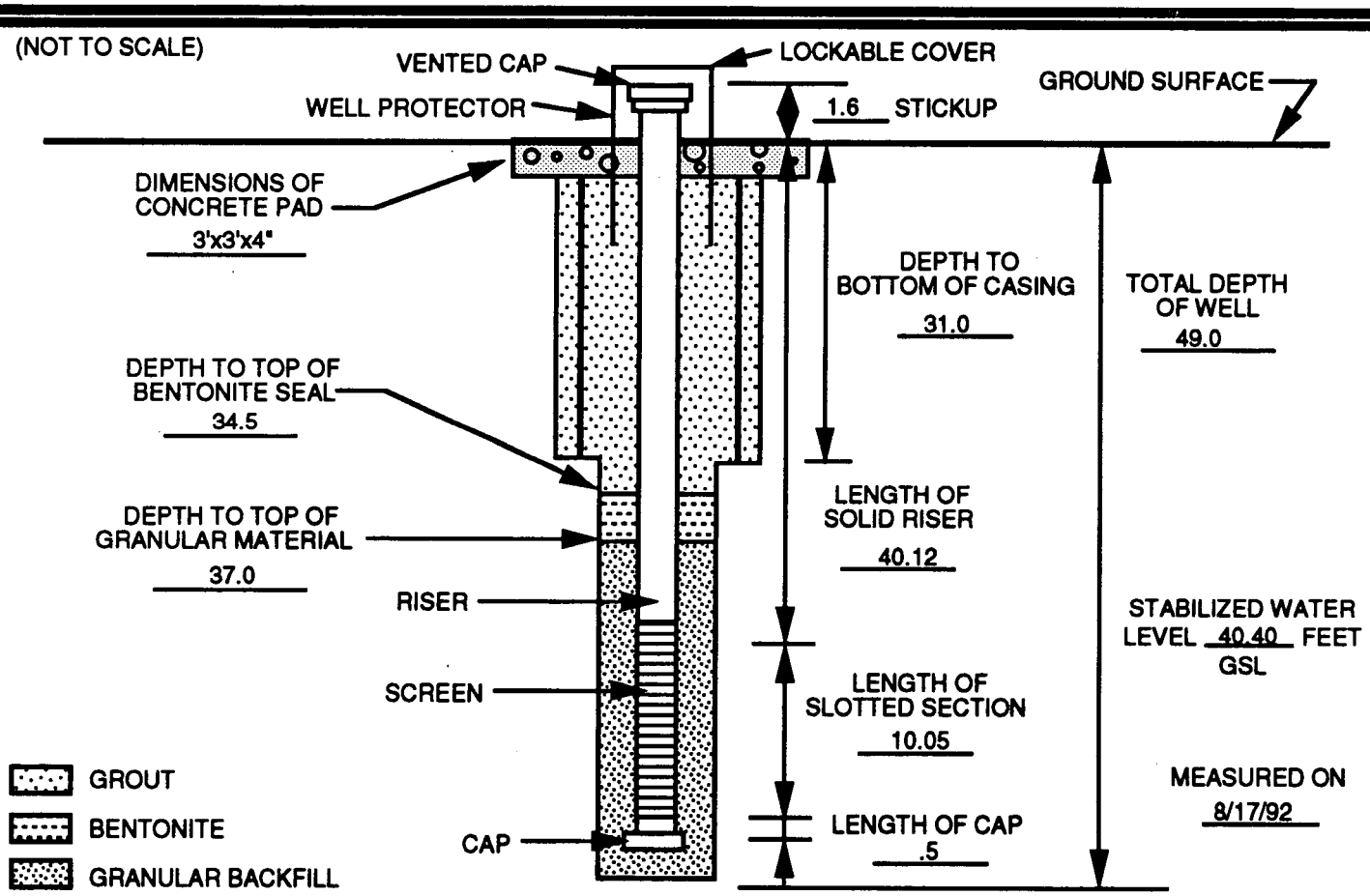
TYPE III MONITORING WELL INSTALLATION DIAGRAM

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

JOB NAME FT. RILEY FORMER DCF
WELL NO. DCF92-06 JOB NO 11-1532
DATE 4/18/92 TIME 09:00
WELL LOCATION NE OF FORMER DCF

GROUND SURFACE ELEVATION 1090.8
TOP OF SCREEN ELEVATION 1052.28
REFERENCE POINT ELEVATION 1092.40
TYPE SAND PACK SILICA GRADATION 20/40
SAND PACK MANUFACTURER COLORADO ENV. MEDIA
SCREEN MATERIAL SCHEDULE 40 PVC
MANUFACTURER TITAN
RISER MATERIAL SCHEDULE 40 PVC
MANUFACTURER TITAN
RISER DIAMETER 2"
DRILLING TECHNIQUE (above casing) HOLLOW STEM AUGER
BIT SIZE AND TYPE 12" HSA
DRILLING TECHNIQUE (below casing) ROCK CORING/REAMING
BIT SIZE AND TYPE NX CORE/ 5 7/8" ROCK BIT

BENTONITE TYPE PELLETS
MANUFACTURER BAROID
CEMENT TYPE PORTLAND CEMENT TYPE I
MANUFACTURER LONESTAR
BOREHOLE DIAMETER 6"
SCREEN DIAMETER 2" SLOT SIZE .010
LAW ENVIRONMENTAL, INC.
FIELD REPRESENTATIVE JACK SMITHBACK
DRILLING CONTRACTOR LAYNE WESTERN
AMOUNT BENTONITE USED 2 1/2 BAGS
AMOUNT CEMENT USED
AMOUNT SAND USED 1 1/2 BAGS
STATIC WATER DEPTH (after dev.) 40.40
TYPE OF CASING 6" PVC



QA / QC

INSTALLED BY: LAYNE WESTERN INSTALLATION OBSERVED BY: JS
DISCREPANCIES:

HTW DRILLING LOG

HOLE No. DS92-01

1. COMPANY NAME: Law Environmental Govt Services	2. DRILLING SUBCONTRACTOR:
SHEET 1 OF 6 SHEETS	
3. PROJECT: Fort Riley	4. LOCATION: Junction City, Kansas
5. NAME OF DRILLER: John Cornick Layne Western	6. MANUFACTURER'S DESIGNATION OF DRILL: Mobile B57
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: NX core barrel; 5 7/8" tricone bit. — 12" od Hollow Stem Augers with continuous flights; 2"x2½' Split Spoon Sampler; 8" Center Plug inside of augers; 8.25" id. augers; 3"x3' Stainless Steel Split Spoon	8. HOLE LOCATION: Dry Cleaning facility
	9. SURFACE ELEVATION:
	10. DATE STARTED: 2 April '92 10:30 — 11. DATE COMPLETED: 4/16/92
12. OVERBURDEN THICKNESS: 28.6'	15. DEPTH GROUNDWATER ENCOUNTERED: ~40.'
13. DEPTH DRILLED INTO ROCK: 19.9'	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 48.5'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
5	5	-	1

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
1	2 VOAs		1 Amber			14.65' 74%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
Monitoring Well		Type III		Jack Smithback

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS HNu d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	0	Grass, organic material	1 ppm background HNu	Samples every 5' from 5'			Gravel drill cuttings
		Gravel fill Material					
	1.0						Cobbles and gravel cuttings
	2.0						Sandy Silt Cuttings
	3.0						Soil cutting are moist and are balling up.
	4.0						
	5.0						

HTW DRILLING LOG

HOLE No. DC92-01

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 2 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS HNu d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		Soft, moist, brown 10YR, 4/4, fine Sandy SILT (ML) some clay	1ppm background	5'-7' 1		2/1/2/3	140 lbs, with 30" draw. 2.0' of recovery Very homogenous Sample.
	6.0						
	7.0						Moist cuttings Cuttings are Same as above soil. Sandy SILT
	8.0						
	9.0						
	10.0						Cuttings are balling up, moist
		Soft, moist, brown (10YR, 4/4) fine sandy SILT (ML) Some clay.		10-12 2		2/3/2/3	2.0' of recovery Homogenous Sample.
	11.0						easy drillings
	12.0						Cuttings are same as above.
	13.0						Sandy SILT
	14.0						

HTW DRILLING LOG

HOLE No. MC92-01

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 3 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	15.0		0ppm above background on cuttings				Cuttings are same as above. Sandy SILT (ML)
		very loose, moist, brown (10 YR, 4/3) silty fine Poorly graded SAND (SM)	0ppm above background HNu	15-17' 3		2,2,2,3	2.0' of recovery Homogenous Sample
	16.0						
	17.0						
							Cuttings are same as above soil.
	18.0						
			0ppm a.b.				
	19.0						
	20.0						
		Loose, moist, tan-rust (10 YR, 5/2) poorly graded medium SAND (SP) with Limestone fragments gravel to cobble size.	0ppm a.b.	20-22' 4		3,2,4,4.	1.2' of recovery rock fragments
	21.0						
	22.0						
	23.0						

HTW DRILLING LOG

HOLE No. MC92-01

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET #4 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		Same as above. (from drill cuttings)	Oppm a.b. Cuttings				Same as above. SAND with little clay.
	24.0						
	25.0						
		Hard, dry, Greenish-brown, (5Y, 4/2) weathered Shale Silt to clay sized. well cemented.		25-27' 5		4,15,20,17	2.0' of recovery. Homogenous Sample.
	26.0						
	27.0	Very hard, dry, greenish-brown (olive) (5Y, 4/2) weathered shale silt and clay size		3"x2' Stainless Steel Splitspoon	27'-28.6' 1 2 VOA's 1 Amber	21,31,50/1"	1.1' of recovery
	28.0						Refusal on Splitspoon
		top of rock					Auger refusal.
		Began coring 14/15 April '92			core box #1	Amount of water loss/return	800 lbs/square inch
	29.0	Gray, fractured Limestone				Start with 187 gallons	Casing set at 28.6'
	30.0	Greenish-grey clayey Shale.					return water is gray with clay.
	31.0	reddish-brown clayey shale.					Same water loss.
	32.0						

HTW DRILLING LOG

HOLE No. DC92-01

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 5 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		thin limestone layer.		Core box #1			brown water from return
		Greenish-grey weathered Shale					2,3' of RQD recovery
	33.0	Reddish-brown, clayey weathered shale.					4,2' of total recovery
		End of 1st 5' run 0930 14 April '92					55% RQD
		Began 2nd 5' run 1000 14 April 92		Core box #1			lost 50 gallons between 1st & 2nd core runs.
	34.0	reddish-brown, clayey Shale					
	35.0	Greenish-grey, clayey shale with sand sized limestone fragments.					Brown return water.
	36.0						
	37.0						
		Grey, weathered, fractured limestone.					40% RQD
	38.0						3,1' total recovery
							1,25' RQD recovery
							water loss
		End of 2nd run 1022					
		Began 3rd run 1105		Core box #1			water return is tan.
	39.0	Grey, competent, Limestone with few vugs and iron staining.					
	40.0						
	41.0						water loss

HTW DRILLING LOG

HOLE No. DC92-01

PROJECT

INSPECTOR

SHEET 6 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	42	Grey, weathered by water Limestone with lots of vugs.		Core box #1			
	43	Dark grey, competent shaley Limestone with vugs.					52% RQD 3.85' total recovery 2.0' RQD recovery
		End of 3rd 5' core run 1120					175 gallons of water lost up to this point.
	44	Began 4th 5' core run 1340 Black to dark grey competent Shaley Limestone with few solution cavities and vugs.		Core box #1			Water loss 25 gallons
	45						
	46	Homogenous throughout 5' Core run.					Reamed to 6" with tri-cone bit
	47	Small amounts of Pyrite inside of vugs.					
	48						3.5' total core 3.0' RQD recovery 86% RQD
		end of 4th 5' core run 1407					
	49						Total water loss 200 gallons coring 60 gallons reaming.
	50						

MRK FORM JUN 89 55-2

PROJECT

HOLE No.

= 260 gallons

HTW DRILLING LOG

HOLE No. DC92-02

1. COMPANY NAME: Law Environmental Govt Services	2. DRILLING SUBCONTRACTOR: Layne Western	SHEET 1 OF SHEETS
3. PROJECT: Fort Riley	4. LOCATION: Junction City, Kansas	
5. NAME OF DRILLER: John Gennick Layne Western	6. MANUFACTURER'S DESIGNATION OF DRILL: Mobile B57	
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 12" od HSA; 2"x2.9' split spoon; 3"x2' Stainless Steel sampler; NX Core barrel; 5 7/8" Tri-cone bit	8. HOLE LOCATION: Dry cleaning facility	
	9. SURFACE ELEVATION	
	10. DATE STARTED: 4 April 92 1010	11. DATE COMPLETED
12. OVERBURDEN THICKNESS: 28.9'	15. DEPTH GROUNDWATER ENCOUNTERED	
13. DEPTH DRILLED INTO ROCK: 16.0	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE: 45.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
5	5	—	1

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
1	4 VOAs		2 Ambers			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
Monitoring Well		type III		

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	0	Grass, organic material	1.0 ppm background HNu	Split Spoon from 5' every 5'			Soil cuttings are dark brown Sandy SILT (SM)
	1.0						
	2.0						
	3.0						
	4.0						
	5.0						

MRK FORM JUN 89 55 | PROJECT | HOLE No.

HTW DRILLING LOG

HOLE No. DC92-02

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 1 OF SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	6.0	Very loose, moist, brown (7.5YR, 4/3) silty SAND (SM)	0ppm a.b.	5-7' 1		2,1,2,3	1.3' of recovery Homogenous Sample.
	7.0						
	8.0		0ppm a.b. on cuttings				Cuttings are same as above
	9.0						Same as above cuttings. Silty SAND
	10.0	Loose, moist, brown (7.5YR, 4/4) silty fine SAND (SM)	0ppm a.b.	10-12' 2		2,2,3,2	2.0' of recovery Homogenous Sample
	11.0						
	12.0						
	13.0						
	14.0						

HTW DRILLING LOG

HOLE No. DC92-02

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 1 OF SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
			0ppm on cuttings				Cuttings are same as above silty SAND
	15.0	Very loose, moist, brown (10 YR, 3/3) silty-clayey fine SAND (SM)	0ppm a.b.	15-17' 3		2,1,2,2	2.0' of recovery Homogenous Sample.
	16.0						
	17.0		0ppm a.b on cuttings.				Cuttings are same as above.
	18.0						
	19.0						
	20.0	Stiff, moist, grey-brown (2.5 Y, 5/2) sandy CLAY (CL)	0ppm a.b.	20-22 4		2,3,7,16	2.0' of recovery 3 different soil types in spoon
	21.0	Loose, moist, grey-brown (2.5Y, 5/2) clayey fine SAND (SM)					
	22.0	Loose, moist, rust-brown (5 YR, 5/8) medium, poorly graded SAND (SP)					
	23.0						

MRK FORM JUN 89 55-2

PROJECT

HOLE No.

HTW DRILLING LOG

HOLE No. DC92-02

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 1 OF SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	24.0			0ppm a.b. on soil cuttings			Soil cuttings are sandy clay to clayey sand
	25.0	Very stiff, moist, greenish-brown (2.5Y, 4/3) lean CLAY (CL)	0ppm a.b.	25-27' 5		3,6,13,19	1.8' of recovery Homogeneous Sample.
	26.0						
	27.0						
	28.0	Very hard, dry, greenish-brown (5Y, 4/3) weathered shale and CLAY (CL)	0ppm		28-30' 1	23, 50/4	Chemical Sample. Difficult augering
	29.0	top of rock, 28.9' Began coring 17.4.92 1055 Reddish-brown, weathered, Shale		Core box #1			Start with 270 gallons of water.
	30.0	Greenish-grey, competent calcareous shale					Good recovery in this layer.
	31.0						
	32.0						

HTW DRILLING LOG

HOLE No. DC92-(X)-2

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 1 OF SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
				Core box #1			
	33.0	Grey weathered Limestone with green weathered Shale					4,3' total recovery 2,8' RQD recovery 65% RQD
	34.0	End of 1st 5' core run 1130					lost 100 gallons
		Began 2nd 5' core run 1435		Core box #1			
	35.0	Grey-tan, weathered, fractured, well laminated Limestone with vugs and iron Staining.					Suspect water due to vug, iron staining and water loss. 100 gallons
	37.0						Lost water, bits ~~~30 gallons~~ 100 gallons
	38.0						3,4' Total recovery Ø RQD recovery 0% RQD
	39.0	End of 2nd 5' run 1425					
		Began 3rd 5' run Tan, competent, Limestone with few vugs		Core box #1			
	40.0						
		Black-dark grey, competent Shaley Limestone					
	41.0						

HTW DRILLING LOG

HOLE No. DC92-02

PROJECT: Fort Riley Army Post

INSPECTOR:

SHEET 1 OF SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	42	Black-dark grey, competent Shaley Limestone.		Core box #1			reamed to 5⅞".
	43						Lost water. 200 gallons
	44						5,1' of total recovery 4,9' RQD recovery 96% RQD
	45	End of 6' core run. 1505					
	46						Water lost: 500 gallons coring
	47						
	48						
	49						
	50						

HTW DRILLING LOG

HOLE No. DS92-03

1. COMPANY NAME: Law Environmental Govt Services	2. DRILLING SUBCONTRACTOR: Layne Western
SHEET 1 OF 6 SHEETS	
3. PROJECT: Fort Riley	4. LOCATION: Junction City, Kansas
5. NAME OF DRILLER: John Gornick Layne Western	6. MANUFACTURER'S DESIGNATION OF DRILL: Mobile B57
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 12" od HSA; 2" x 24" Split Spoon; 8" Center Plug with reverse flights	8. HOLE LOCATION: Dry cleaning facilities
	9. SURFACE ELEVATION:
	10. DATE STARTED: 6 April '92 1500
	11. DATE COMPLETED:
12. OVERBURDEN THICKNESS: 45.5'	15. DEPTH GROUNDWATER ENCOUNTERED:
13. DEPTH DRILLED INTO ROCK: 0	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 45.5'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): —

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
3	3	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
1	2 VOA's		1 Amber	—	—	— %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
Monitoring Well	Grout	type II	—	Jack Smithlock

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		Cement	0.8 ppm background HNu 20.6% O_2				Concrete Parking lot.
		Gravel and fill material.					Augered through Concrete.
	1.0	Brown, dry, silty SAND fill material with limestone gravel.					
	2.0						
	3.0						difficult augering.
	4.0	Bricks, gravel, brown (5YR, 5/8) silty SAND (SM) from cuttings					fill material
	5.0						

HTW DRILLING LOG

HOLE No. DS92-03

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 2 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		Cuttings are gravel with brick fragments and brown (5YR, 4/3) silty SAND (SM)	0ppm on cuttings				fill material
	6.0						
	7.0	Same as above as noted from cuttings.					easy to auger through
	8.0	Brown (10YR, 3/4) dry, Sandy SILT (ML)(cuttings)					
	9.0						
	10.0	Same as above (from cuttings)					
		Limestone fragments from cuttings.	0ppm on cuttings				Hard to auger through at 10,5'
	11.0						fill material
	12.0						Broken glass in cuttings
							Hot augers, steaming
	13.0						
	14.0						

HTW DRILLING LOG

HOLE No. MS92-03

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET # 3 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
							metal object in cuttings
	15.0	Stiff, moist, brown (7.5 YR, 3/4) fine sandy SILT (ML)	Ø ppm a.b.	15-17 1		6,6,5,7	2.0' of recovery Homogenous Sample.
	16.0						
	17.0						
	18.0	Cuttings are same as above sandy SILT					easy to auger.
	19.0		Ø ppm on cuttings				
	20.0						
	21.0						
	22.0	Moist, brown, (7.5 YR, 4/3) Sandy-clayey SILT (ML) (from soil cuttings)	Ø ppm HNu				
	23.0						

HTW DRILLING LOG

PROJECT	INSPECTOR	HOLE No.	SHEET # 4 OF 6 SHEETS
Fort Riley, Kansas		DK92-03	

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	24.0						
	25.0	Loose, moist/wet, tan-brown (10YR, 5/4) clayey fine SAND (SM) with few limestone and chert fragments.	Øppm a. b.	25-27' 2		3,3,7,7	2.0' of recovery. Homogenous Sample.
	26.0						
	27.0						Snapped companion flange
	28.0						
	29.0	cuttings are same as above.	Øppm on cuttings HNu.				
	30.0				Previous chemical sample depth		
	31.0						
	32.0	Fractured limestone in cuttings.					

HTW DRILLING LOG

HOLE No. DC92-03

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET # 5 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	33.0	Moist, brown, (10YR, 3/3) fine sandy CLAY (ML) (from cuttings)					rapid advancement of augers. Void of some sort. Augers dropped about 1 foot
	34.0	Cuttings are same as above except lighter in color with limestone and chert fragments.					
	35.0	Loose, moist, brown-grey (2.5Y, 5/2) clayey fine SAND (SM)	0 ppm	3	35-37 1 2 VOA-s 1 Amber	3,4,6,9	2.0' of recovery Plastic like sample "rubbery" No rock fragments in sample.
	36.0	Stiff, moist, brown-grey (2.5Y, 5/2) sandy CLAY (ML)					
	37.0						
	38.0	Void.					rapid advancement of augers. Augers dropped about 0.5'
	39.0	Cuttings are same as above.					
	40.0						H_2O encountered. Not DCB yet.
	41.0						

HTW DRILLING LOG

HOLE No. DC92-03

PROJECT Fort Riley 11-1532

INSPECTOR

SHEET 6 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	41.0						difficult augering & rocky cuttings
	42						Believe to be augering through fractured limestone
		Fractured limestone with CLAY (based on drilling conditions and cuttings)					
	43						
	44						
	45						Very wet, "flowing" cuttings "slurry"
		Boring terminated 1515 45.5'					
	46						
	47						
	48						
	49						
	50						

HTW DRILLING LOG

HOLE No. D697-08

1. COMPANY NAME: Law Environmental Govt Services	2. DRILLING SUBCONTRACTOR	SHEET 1 OF SHEETS
3. PROJECT: Fort Riley	4. LOCATION: Junction City, Kansas	
5. NAME OF DRILLER: John Gornick Layne Western	6. MANUFACTURER'S DESIGNATION OF DRILL: Mobile B57	
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 12" od Augers; 2"x2.4' split spoon; 8" inside center plug; NX Core barrel; 5⅞" Rock bit	8. HOLE LOCATION: Dry cleaning facility 9. SURFACE ELEVATION	
	10. DATE STARTED: 4 April 92 0830	11. DATE COMPLETED: 21 April 92 1900
12. OVERBURDEN THICKNESS: 10,3'	15. DEPTH GROUNDWATER ENCOUNTERED: 35,0'	
13. DEPTH DRILLED INTO ROCK: 32,4'	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 33', 3hours, 60 gallons after drilling	
14. TOTAL DEPTH OF HOLE: 42,7'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
2	2	—	3

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
* 1	2 VOAs	-	-	-	-	94 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
Monitoring well		type III		Jack Smithback

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	0	Grass, organic material	1.0 ppm background HNu				
	1.0						easy augering
	2.0						Silty-clayey drill cuttings
	3.0	Silty CLAY*					
	4.0						
	5.0						

HTW DRILLING LOG

HOLE No. DC92-04

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 1 OF SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	6.0	Very firm, moist, reddish-brown (5YR, 4/2) silty CLAY (CL)	0ppm a.b.	5-7' 1		5,13,8,9	2.0' of recovery Homogeneous Sample.
	7.0						
	8.0		0ppm a.b. on cuttings				reddish-brown drill cuttings silty CLAY (CL) Hot (smoking) augers 0ppm HNu Difficult to auger. Gravel cuttings
	9.0						
		top of rock					
	10.0	Weathered limestone		10-12 2		50/5"	0.5' of recovery Weathered Limestone Casing set at 10.5'
	11.0	tan, weathered/ Competent Limestone with vugs.		Core box #1			
		Greenish-tan, competent Shale.					2.1' total recovery 1.2' RQD recovery 58% RQD 2.4' run.
	12.0						
		tan/grey, competent Limestone end 1st run 1013					
		Began 2nd run. 1025		Core box #1			5' run.
	13.0						
	14.0						

HTW DRILLING LOG

HOLE No. DC9204

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 1 OF SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		tan-brown, weathered/Competent Limestone with vugs.		Core box #1			4, 4' total recovery
	15.0	Grey weathered Shale.					2, 7' RQD recovery
		Calcareous Shale.					61% RQD
	16.0	Reacts with HCl					
		Shale mixed with Limestone. with calcite crystals.					
	17.0	End of 2nd 5' core run 1045					Some water loss 200 gallons.
	18.0	Began 3rd 5' Core run. 1330 Grey shale with calcite.		Corebox #1			No water return.
		Greenish-grey, competent clayey Shale.					
	19.0	Some iron staining in clay. Clay is mixed with Shale fragments,					5,0' total recovery 4, 7' RQD recovery 94% RQD
	20.0	Greenish-grey, competent clayey Shale.					
	21.0						
	22.0	Black shale, competent. End of 3rd 5' 1415 Began 4th 1440					200 gallons lost
	23.0						

MRK FORM JUN 89 55-2 | PROJECT | HOLE No.

HTW DRILLING LOG

HOLE No. DC92-04

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 1 OF SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		Grey, fractured, weathered, Limestone/shale. Reacts with HCl		Core box #1			
	24.0	Very hard, moist, grey CLAY					More of a clay than shale
	25.0	Calcareous, reacts with HCl					
	26.0	Grey, competent, shaley Limestone.					lost 100 Gallons 5.0' total recover 3.1' RQD recovery 62% RQD
	27.0	End of 4th run. 1550		Core box #1			
	28.0	Began 5th 5' run. 1630 Grey, competent, shaley Limestone. Vertical fractures with iron staining.		Core box #2			iron staining in vertical fractures.
	29.0						
	30.0	Greenish-gray, competent, clayey shale.					4.5' total recove 3.5' RQD recovery 78% RQD
	31.0	Very hard, moist, reddish-brown CLAY (CL)					More clay than shale
	32.0						

HTW DRILLING LOG

HOLE No. DC92-04

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 1 OF SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		Greenish-gray, competent, clayey shale.		Core box #2			
		End of 5th run					Lost 500 gallons
	33.0	Began 6th run 1730		Core box #2			
		Tan-grey, competent, well laminated Limestone.					
	34.0	with vugs. Little iron staining.	switch Limestone to bottom.				
	35.0						
		Greenish-grey, fractured, weathered, clayey Shale.					
	36.0						4,7' total rec.
		Calcareous shale. Reacts with HCl					0.8' RQD recovered
	37.0	Very hard, moist, grey-green CLAY mixed with shale					17% RQD
		End of 6th run 1815					Lost 80 gallons
	38.0	Began 7th run 1830			Sampled return water due to odor and film.		4,8' total rec.
		Tan grey, competent Limestone					4,0' RQD rec.
	39.0						83% RQD
	40.0						
		Dark grey to black Shaley Limestone					
	41.0						

HTW DRILLING LOG

HOLE No. DC92-04

PROJECT

INSPECTOR

SHEET 1 OF SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	42	Dark grey to black Shaley Limestone		Core box #2 + #3			HNu - 2ppm
		End of 7th run 910					Lost 400 gallons
	43	After reaming, borehole is open to 42,3'.					1400 gallons lost during coring.
	44						500 gallons lost during reaming.
	45						1900 gallons lost : total
	46						
	47						
	48						
	49						
	50						

HTW DRILLING LOG

HOLE No. DC92-05

1. COMPANY NAME: Law Environmental Govt Services	2. DRILLING SUBCONTRACTOR: Layne Western Co. Inc.	SHEET 1 OF 6 SHEETS
3. PROJECT: Fort Riley 11-1532	4. LOCATION: Junction City, Kansas	
5. NAME OF DRILLER: John Gornick, Layne Western	6. MANUFACTURER'S DESIGNATION OF DRILL: Mobile B57	
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 12" od HSA; 8" Center Plug; 2"x24' Split Spoon	8. HOLE LOCATION: Dry cleaning facility	
	9. SURFACE ELEVATION	
	10. DATE STARTED: 4 April '92 1700	11. DATE COMPLETED
12. OVERBURDEN THICKNESS: 42.0'	15. DEPTH GROUNDWATER ENCOUNTERED: 34.7'	
13. DEPTH DRILLED INTO ROCK: Ø	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 34.7' 6 April '92 12 hours after drilling	
14. TOTAL DEPTH OF HOLE: 42.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): —	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
2	2	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
1	2 VOA's	—	1 Amber	—	—	— %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
Monitoring Well	grout	type II	—	Jack Smithback

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	0	Grass, organic material	0.9 ppm background HNu				Soil cuttings are dark brown clayey silt with some sand. Boulder/ cobbles at 2.0'
	1.0						
	2.0						
	3.0	Dry, brown (10YR, 5/2) clayey SILT (ML) as observed from drill cuttings					
	4.0						
	5.0						

HTW DRILLING LOG

HOLE No. DC92-05

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 1 2 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	6.0	Very soft, dry, brown (10 YR, 5/2) clayey SILT (ML)	0ppm a.b.	5-7' 1		1, ½, ½, 1	1,7' of recovery Homogenous Sample. ~~Boulder or pipeline cement~~ at ~7.0' very hard to auger.
	7.0	Pipeline hit, unknown source.	0ppm HNu on pipeline				
	8.0	Same as above (from cuttings)					Cuttings are same as above SILT (ML)
	9.0						
	10.0						
	11.0						
	12.0	Hard-brittle, dry silty CLAY. (from cuttings.)					Difficult augering. ~~Dense~~ clay Hard Snapped Pin hex on augers.
	13.0						
	14.0						

HTW DRILLING LOG

HOLE No. OC92-05

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET #3 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	15.0		0ppm a.b on cuttings.				Cuttings are same as above. difficult to auger.
	16.0						
	17.0	Clayey SILT cuttings					
	18.0	fine sand cuttings with some clay.					
	19.0						
	20.0	Loose, moist, tan-brown (10YR, 6/6) Silty poorly graded fine SAND (SM)	0ppm a.b	20-22' 2		4,4,3,6	2.0' of recovery Homogenous Sample
	21.0						Sandy Cuttings
	22.0						
	23.0						

HTW DRILLING LOG

HOLE No. DC92-05

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET # 4 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	24.0	Cuttings are same as above. silty SAND (SM)					Powder cuttings a lot of steam is coming from augers. very hot
	25.0						Cuttings
	26.0						
	27.0						
	28.0						
	29.0	Cemented ~~rock~~ flour ground up shale-clay then compacted by augers.				15 39 25 20	Split Spoon to see if rock is encountered 2.0' of recovery
	30.0						
	31.0						
	32.0						

HTW DRILLING LOG

HOLE No. DC92-05

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET #5 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	33.0		0 ppm on cuttings				
	34.0						Cuttings are silty SAND Some CLAY
	35.0			H_2O 34.6' during drilling ~1645, 5 April 0730, 6 April after setting overnight.			
		Very hard, wet, grey (5Y, 5/3) Silty Sandy CLAY (CL) with fractured Limestone.			35-37' 1 2 VOA's 1 Amber	15, 18, 30, 40	3"x2' Stainless Steel Sampler. Wet split spoon, 2.0' of recovery Wet Sample.
	36.0						
	37.0						rocky drilling difficult to auger, rocky
	38.0	Assume to be same as above but with more fractured limestone than Soil.					very rocky.
	39.0						
	40.0						0730, 6 April '92 Continue
	41.0						

HTW DRILLING LOG

HOLE No. DC92-05

PROJECT: Fort Riley 11-1532

INSPECTOR: Jack Smithback

SHEET 4 6 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		Fractured Shale. Because of augering it is clay packed.	Oppm on cuttings.				easy to auger through rock.
	42,0	Boring terminated 42,0 0855 6 April 92					
	43,0						
	44,0						
	45,0						
	46,0						
	47,0						
	48,0						
	49,0						
	50,0						

HTW DRILLING LOG

HOLE No. DX92-06

1. COMPANY NAME: Law Environmental Govt Services	2. DRILLING SUBCONTRACTOR: Layne Western	SHEET 1 OF 6 SHEETS
3. PROJECT: Fort Riley	4. LOCATION: Junction City, Kansas	
5. NAME OF DRILLER: John Gornick Layne Western	6. MANUFACTURER'S DESIGNATION OF DRILL: B57 Mobile	
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 12" od Hollow Stem Augers; 2" x 2.4' Split Spoon Sampler; 3" x 2' Stainless Steel Sampler; 8" inside auger cutting head; NX Core barrel; 5 7/8" Rock bit	8. HOLE LOCATION: Dry cleaning facility	
	9. SURFACE ELEVATION:	
	10. DATE STARTED: 3 April '92 1015	11. DATE COMPLETED:
12. OVERBURDEN THICKNESS: 30.0'	15. DEPTH GROUNDWATER ENCOUNTERED: ~40'	
13. DEPTH DRILLED INTO ROCK: 19.0'	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:	
14. TOTAL DEPTH OF HOLE: 49.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
6	6	—	1

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
1	2 VOA-s	—	1 Amber	—	—	15.2' 80%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
Monitoring Well	grout	type III		Jack Smithback

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS HNu d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	0	Grass, organic material	1ppm HNu background				Gravel cuttings
		Gravel fill					
	1.0						Silty SAND drill cuttings
	2.0						easy augering
	3.0						Some limestone fragments
	4.0						
	5.0						

HTW DRILLING LOG

HOLE No. DC92-06

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 2 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		Loose, moist, brown (10YR, 5/4) silty fine poorly graded SAND (SM) with organic material (roots)	Oppm above background	5-7' 1		3/3/3/2	2.0' of recovery Homogeneous Sample
	6.0						
	7.0	Cuttings are same as above					Old Communication line dug up. Not suspected to be active.
	8.0	Phone line					
	9.0						
	10.0	Loose, moist, brown (10YR, 5/2) silty fine SAND (SM)	Oppm a.b.	10-12 2		4,4,4,4	1.8' of recovery
	11.0						
	12.0	Loose, moist, tan-brown (10YR 6/6) medium poorly sorted SAND (SP)					
	13.0						Very Sandy cuttings
	14.0	medium poorly sorted SAND (SP) from drill cuttings					

HTW DRILLING LOG

HOLE No. DC92-06

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET # 3 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		"Sandbox Sand"					very clean Sand cuttings medium grained possibly fill material.
	15.0						
		Dense, moist/dry, tan (2.5 YR, 6/6) medium poorly graded very clean SAND (SP)	0ppm a.b.	15-17 3		4,17,17,19	1.6' of recovery Homogenous Sample, "Sand box" SAND Fill material.
	16.0						
	17.0						
	18.0						
	19.0						Silty SAND darker color cuttings.
	20.0						
		Loose, moist, brown (10YR 5/6) clayey-silty fine SAND (SM)	0ppm	20-22' 4/		3,3,4,6	1.7' of recovery Homogenous Sample
	21.0						
	22.0						800PSI backpressure
	23.0						

HTW DRILLING LOG

HOLE No. DC92-C06

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 4 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	24.0						cuttings are clayey-silty SAND (SM) Some limestone fragments Clay on bottom of center plug
	25.0	Very stiff, moist, green-brown (5Y, 3/2) clayey weathered Shale.	Oppm a.b.	25-27' 5		4,7,11,19	1.8' of recovery Homogeneous Sample very hard material.
	26.0						
	27.0	Same as above.		27-29' 6	1	12,34,50,56	Chemical Sample at ~~27.0~~ 28' 2.0' of recovery.
	28.0						
	29.0						
	30.0	top of rock 30.4' Began coring 15 April 92 1430 Grout/Cement - 1st 1' Greenish-grey, competent, calcareous clayey Shale.		Core box #1			0.7' of grout inside of casing.
	31.0	Reddish-brown, competent, Shale.					
	32.0						

HTW DRILLING LOG

HOLE No. DC92-OB6

PROJECT: Fort Riley, Kansas

INSPECTOR:

SHEET 5 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		Greenish-grey, weathered, Shale.		Core box #1			entire core reacts with HCl acid
	33.0	reddish-brown, weathered, Shale					No water loss 1st 5' run.
							3,2' total recovery 2,2' RQD recovery 69% RQD
	34.0	End of 1st 5' Core 1540					
		Began 2nd 5' Core 1615		Core box #1			
		reddish-brown, competent and weathered, calcareous shale					
	35.0	Reacts with HCl					No water loss.
	36.0	Greenish-gray, competent, clayey shale. Does not react with HCl very much.					This layer is true shale. Above and below is shale-Limestone mixture.
	37.0						
		Tan-gray, weathered,					No water.
	38.0	Shaley Limestone. Reacts with HCl. Well Stratified.					3,8' total recovery 1,4' RQD recovery 37% RQD
	39.0	End of 2nd 5' run 1630					
		Began 3rd 5' run 1715		Core box #1			
		Tan-gray, weathered, fractured Limestone. Well Stratified.					little water loss.
	40.0	Tan-gray, competent Limestone. few vugs.					
	41.0						

HTW DRILLING LOG

HOLE No. DC92-06

PROJECT | INSPECTOR | SHEET #6 OF 6 SHEETS

ELEV. a	ELEV. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		tan-gray, competent, Limestone. Some vugs and natural fractures.		Core box #1			
	42						
							1,5 minutes for 1' rapid advancement of core barrel
	43						Drop in circulation 50 gallons lost
		Black-dark grey, competent Shaley Limestone with few vugs.					4,5' total recovery 2,0' RQD recovery 44% RQD
	44	End of 3rd 5' Core run 1738					
		Began 4th 5' run 1810		Core box #1			
		Black-dark grey, competent Shaley Limestone.					Some water loss
	45						
		Reacts with HCl					Homogenous @ core sample
	46	few vugs or solution cavities.					
						*	total 100 gallons lost during coring.
	47						
	48						3,7' total recovery 2,2' RQD recovery 59% RQD
							ream with 5 3/8" rocklait
	49	End of 4th 5' run. 1825					
		Coreing completed					
	50						

MRK FORM JUN 89 55-2 | PROJECT | HOLE No.

HTW DRILLING LOG

HOLE No. DCSB-01

1. COMPANY NAME: Law Environmental	2. DRILLING SUBCONTRACTOR	SHEET 1 OF 1 SHEETS
3. PROJECT: Ft. Riley - DCF PA/SI	4. LOCATION: 15 ft. N of Bldg. 181	
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 3¼" (O.D.) stainless steel hand auger; 2¼" (O.D.) stainless steel hand auger	8. HOLE LOCATION: Former Dry Cleaning Facility 9. SURFACE ELEVATION	
	10. DATE STARTED: 3-6-92	11. DATE COMPLETED: 3-13-92
12. OVERBURDEN THICKNESS: 10.5 feet	15. DEPTH GROUNDWATER ENCOUNTERED	
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE: 10.5 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240		Semi-volatiles 8270			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole plug			D. Shay

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	0	DK Brown silty fine to med. SAND					Boring advanced on 3-6-92 to auger refusal (thought it to be UST or buried utility - sample DC92-09A sent to lab - boring back filled After obtaining more data concerning depth to bedrock, adjacent boring advanced on 3-13-92 and sample DCSB-09B sent to lab MS/MSD sample collected at 4-5 ft. interval
	1.5	Brown silty fine to med. SAND	4-5 ft. ND		DCSB-01B		
	5						
	10	Auger refusal Brown Sandy CLAY	9-10 ft. ND		DCSB-01A		
	10.5	LIMESTONE					

HTW DRILLING LOG

HOLE No. DCSB-02

1. COMPANY NAME: Law Environmental	2. DRILLING SUBCONTRACTOR	SHEET 1 OF 1 SHEETS 1
3. PROJECT: Ft. Riley- DCF PA/SI	4. LOCATION: Former Dry Cleaning Facility	
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 3¼" (O.D.) stainless steel hand auger; 2¼" (O.D.) stainless steel hand auger	8. HOLE LOCATION: Grassy area N of Bldg. 180 9. SURFACE ELEVATION	
	10. DATE STARTED: 3-6-92	11. DATE COMPLETED: 3-6-92
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED	
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE: 15 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240		Semi-vols 8270			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole plug			D. Hay

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		Dark Brown silty fine to med. SAND					
	5	Brown clayey sandy SILT	4-5 feet ND				
	10	Tan-brown silty fine to med. SAND	9-10 feet 1 ppm		DCSB-02A		SPLIT sample collected at this interval
	15	TD	14-15 feet ND		DCSB-02B		DUPLICATE sample collected at this interval

HTW DRILLING LOG

HOLE No. DCSB-03

1. COMPANY NAME: Law Environmental	2. DRILLING SUBCONTRACTOR: Shamrock Environ. Drilling
SHEET 1 OF 1 SHEETS	
3. PROJECT: Ft. Riley - DCF PA/SI	4. LOCATION: Former Dry Cleaning Facility
5. NAME OF DRILLER: Clay Dyer	6. MANUFACTURER'S DESIGNATION OF DRILL: CME-55
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" (I.D.) HSA; 3" CME sampler	8. HOLE LOCATION: 50 ft east of Bldg 180
	9. SURFACE ELEVATION:
	10. DATE STARTED: 3-11-92 / 11. DATE COMPLETED: 3-11-92
12. OVERBURDEN THICKNESS:	15. DEPTH GROUNDWATER ENCOUNTERED:
13. DEPTH DRILLED INTO ROCK:	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 15 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240		Semi-volatiles 8270			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole plug			D. Gray

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	5	Dark brown sandy SILT with weathered limestone & gravel (FILL)	4-5 feet ND				
	8.0	Brown clayey sandy SILT	9-10 feet ND		DCSB-03A		
	10 / 11.0	Brown sandy SILT					
	15	TD	14-15 feet ND		DCSB-03B		MS/MSD sample collected at this interval

HTW DRILLING LOG

HOLE No. DCSB-04

1. COMPANY NAME: Law Environmental	2. DRILLING SUBCONTRACTOR: Shamrock Environ. Drilling
SHEET 1 OF 1 SHEETS	
3. PROJECT: Ft. Riley - DCF PA/SI	4. LOCATION: Former Dry Cleaning Facility
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" (I.D.) HSA; 3" CME sampler	8. HOLE LOCATION: 30 ft. E of NE corner of Bldg. 180
	9. SURFACE ELEVATION
	10. DATE STARTED: 3-10-92 / 11. DATE COMPLETED: 3-10-92
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF HOLE: 15 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240		Semi-vols 8270			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole plug			D. Gray

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	1.5	Concrete & gravel					
	3.5	Green-gray & brown mottled silty CLAY					
	4.5	Dark brown sandy SILT	4-5 feet ND				
	5						
	6.0	Dark brown silty fine SAND					
		Brown silty fine to med. SAND	9-10 feet 1 ppm		DCSB-04A		Split sample collected at this sampling interval
	10						
		Light brown silty fine to med SAND	14-15 feet 1 ppm		DCSB-04B		Duplicate sample collected at this sampling interval
	15						

HTW DRILLING LOG

HOLE No. DCSB-05

1. COMPANY NAME: Law Environmental	2. DRILLING SUBCONTRACTOR: Shamrock Environmental Drilling
SHEET 1 OF 1 SHEETS	
3. PROJECT: Ft. Riley - DCF PA/SI	4. LOCATION: Former Dry Cleaning Facility
5. NAME OF DRILLER: Clay Dyer	6. MANUFACTURER'S DESIGNATION OF DRILL: CME-55
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4 1/4" (I.D.) HSA; 3" CME sampler	8. HOLE LOCATION: ~~30 ft. E of~~ NE corner of Bldg 180
	9. SURFACE ELEVATION:
	10. DATE STARTED: 3-10-92 — 11. DATE COMPLETED: 3-10-92
12. OVERBURDEN THICKNESS:	15. DEPTH GROUNDWATER ENCOUNTERED:
13. DEPTH DRILLED INTO ROCK:	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 15 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240		Semi-vols 8270			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole plug			D. Gray

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	1.0	Concrete and gravel					
		Dark brown silty fine SAND					
	4.0		4-5 feet ND				
	5	Gray-brown silty fine to medium SAND					
	6.0	Dark brown sandy SILT					
	8.0						
		Brown silty fine to medium SAND	9-10 feet ND		DCSB-05A		
	10						
	12.0						
		Brown sandy clayey SILT					
			14-15 feet ND		DCSB-05B		
	15	TD					

MRK FORM 55 JUN 89 | PROJECT | HOLE No. | HF

HTW DRILLING LOG

HOLE No. DCSB-06

1. COMPANY NAME: Law Environmental	2. DRILLING SUBCONTRACTOR
SHEET 1 OF 1 SHEETS	
3. PROJECT: Ft. Riley - DCF PA/SI	4. LOCATION: Former Dry Cleaning Facility
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 3¼" (O.D.) stainless steel hand auger; 2¼" (O.D.) stainless steel hand auger	8. HOLE LOCATION: 25 ft. east of Bldg. 181
	9. SURFACE ELEVATION
	10. DATE STARTED: 3-10-92 / 11. DATE COMPLETED: 3-10-92
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF HOLE: 15 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240		Semi-vols 8270			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole plug			D. Gray

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	1.0	Concrete and gravel					
	5	Gray-brown silty fine to med. SAND	4-5 feet ND				
	6.0	Gray-brown sandy SILT					
	9.5		9-10 feet ND		DCSB-06A		
	10	Gray-brown sandy clayey SILT					
	11.5	Brown silty fine to med. SAND					
	15	TD	14-15 feet ND		DCSB-06B		

HTW DRILLING LOG

HOLE No. DCSB-07

1. COMPANY NAME: Law Environmental	2. DRILLING SUBCONTRACTOR
SHEET 1 OF 1 SHEETS	
3. PROJECT: Ft. Riley - DCF PA/SI	4. LOCATION: Former Dry Cleaning Facility
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 3¼" (O.D.) stainless steel hand auger; 2¼" (O.D.) stainless steel hand auger	8. HOLE LOCATION: north side of Bldg. 180
	9. SURFACE ELEVATION
	10. DATE STARTED: 3-10-92 / 11. DATE COMPLETED: 3-11-92
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF HOLE: 15 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240		Semi-volatiles 8270			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole plug			D. Gray

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	1.0	Concrete and gravel					
	2.5	Brown silty SAND with gravel and bricks (FILL)					
	5	Gray-brown silty fine to med. SAND	4-5 ft. ND				
	10		9-10 ft. ND				DCSB-07A sent to lab
	15	TD	14-15 ft. ND				DCSB-07B sent to lab SPLIT sample collected at this interval

HTW DRILLING LOG

HOLE No. DCSB-08

1. COMPANY NAME: Law Environmental	2. DRILLING SUBCONTRACTOR: Shamrock Environ. Drilling
SHEET 1 OF 1 SHEETS	
3. PROJECT: Ft. Riley - DCF PA/SI	4. LOCATION: Former Dry Cleaning Facility
5. NAME OF DRILLER: Clay Dyer	6. MANUFACTURER'S DESIGNATION OF DRILL
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4 1/4" (I.D.) HSA; 3" CME Sampler	8. HOLE LOCATION: Parking area W of Bldg. 181
	9. SURFACE ELEVATION
	10. DATE STARTED: 3-10-92 / 11. DATE COMPLETED: 3-11-92
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF HOLE: 8 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240		Semi-vols 8270			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole plug			D. Shay

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	1.0	Asphalt and gravel					
	2.5	Dark brown clayey SILT					
	3.0	Light brown silty fine SAND	4-5 feet ND		DCSB-08A		Duplicate sample collected at this interval
	5.0	Light brown silty fine to med. SAND (auger refusal)	7-8 feet ND		DCSB-08B		
	8.0	LIMESTONE					

HTW DRILLING LOG

HOLE No. DCSB-09

1. COMPANY NAME: Law Environmented	2. DRILLING SUBCONTRACTOR: Shamrock Drilling	SHEET 1 OF SHEETS
3. PROJECT: Ft. Riley 11-1532.04	4. LOCATION: Dry Cleaners. CBldg-180 & 181	
5. NAME OF DRILLER: Clay Dyer.	6. MANUFACTURER'S DESIGNATION OF DRILL: CME 55	
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 202 VOA Jars + 250 ml Amber bottle. ~~3¼" & 2¼" Stainless steel hand auger~~ 4¼" (I.D.) HSA 3" CME sampler	8. HOLE LOCATION	
	9. SURFACE ELEVATION	
	10. DATE STARTED: 3-6-92	11. DATE COMPLETED: 3-6-92.
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED	
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE: 15 feet.	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240		Semi-Volatile 8270			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole Plug			Thomas Mathew

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS OVA d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	0	Light brown Sandy Silt.					
	3.0	↓					
	4.0	Dark brown fine Sandy Silt.	4-5 - ND 12.10 p.m				
	5.0	Dark brown silty Sand.					
	6.0	Light brown clayey Silt.					
	9.0	Light brown fine Sand	9-10 - ND 12.25 p.m				DCSB-09A. To lab.
	10.0	Light brown fine Sand.					
	14.0	Light brown fine Sand.	14-15 - ND 12.35 p.m.				DCSB-09B to lab.
	15.0	TD					

HTW DRILLING LOG

HOLE No. DCSB-10

1. COMPANY NAME: Law Environmental	2. DRILLING SUBCONTRACTOR: Shamrock Env. Drilling	SHEET 1 OF SHEETS
3. PROJECT: Ft. Riley 11-1532.04	4. LOCATION: Dry Cleaners Bldg. 180 + 181	
5. NAME OF DRILLER: Clay Dyer	6. MANUFACTURER'S DESIGNATION OF DRILL: C	
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2 oz. VOA Jars + 250 ml Amber bottles. 3 1/4" & 2 1/4" Stainless steel hand auger	8. HOLE LOCATION	
	9. SURFACE ELEVATION	
	10. DATE STARTED: 3-5-92	11. DATE COMPLETED: 3-6-92
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED	
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE: 15 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240	Semi-volatile 8270				

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole Plug			D. Gray

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS OVA d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		Dark brown silt with slag.					
	4.0						
	5.0	Brown sandy clay silt	4-5 - ND 3-5-92 1250 pm				
	7.5						
		Tan Brown silty fine sand	9-10 - ND 3-5-92 1700				DCSB-10A to lab.
	10.0						
		Brown silty fine sand.					
			14-15 - ND 0945				DCSB-10B to lab.
	15.0	TD					

HTW DRILLING LOG

HOLE No. DCSB-11

1. COMPANY NAME: Law Environmental	2. DRILLING SUBCONTRACTOR: Shamrock Env. Drilling
SHEET 1 OF SHEETS	
3. PROJECT: Ft. Riley 11-1532-04	4. LOCATION: Dry Cleaners Bldg. 180 + 181
5. NAME OF DRILLER: Clay Dyer.	6. MANUFACTURER'S DESIGNATION OF DRILL
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2 oz Jar & 250 mL Amber bottles; 3 1/4" & 2 1/4" Stainless Steel Hand Auger.	8. HOLE LOCATION
	9. SURFACE ELEVATION
	10. DATE STARTED: 3-5-92 / 11. DATE COMPLETED: 3-6-92
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF HOLE: 15 feet.	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240		Semi-volatile 8270			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole Plug			D. Clay

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS OVA d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		Dark brown Sandy Silty Clay					
	3.0	Brown silty fine Sand					
	4.5	Brown Sandy Clay Silt.	4-5-ND 3-5-92 1335				
	6.0	Tan Brown Silty fine Sand.					
	7.5	Brown silty fine Sand					
	9.0						
	10.0	Brown silty fine Sand.	9-10-ND 3-5-92 1810				DCSB-11A to lab.
	15.0	TD	14-15 ND. 3-6-92 1010				DCSB-11B to lab.

HTW DRILLING LOG

HOLE No. DCSB-12

1. COMPANY NAME: Law Environmental	2. DRILLING SUBCONTRACTOR
SHEET 1 OF 1 SHEETS	
3. PROJECT: Ft. Riley - DCF PA/SI	4. LOCATION: Former Dry Cleaning Facility
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2¼" (O.D.) stainless steel hand auger; 3¼" (O.D.) stainless steel hand auger	8. HOLE LOCATION: 30 ft S of SE corner of Bldg 180
	9. SURFACE ELEVATION
	10. DATE STARTED: 3-13-92 / 11. DATE COMPLETED: 3-13-92
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF HOLE: 15 ft.	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240		Semi-vols 8270			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole plug			D. Gray

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	0	Dark brown clayey SILT					
	2.0	Light brown silty fine to med. SAND	4-5 feet ND				
	5						
	10		9-10 feet ND		DCSB-12A		
	15	TD	14-15 feet ND		DCSB-12B		

HTW DRILLING LOG

HOLE No. DCSB-13

1. COMPANY NAME: Law Environmental	2. DRILLING SUBCONTRACTOR: Shamrock Environ. Drilling
SHEET 1 OF 1 SHEETS	
3. PROJECT: Ft. Riley - DCF PA/SI	4. LOCATION: Former Dry Cleaning Facility
5. NAME OF DRILLER: Clay Dyer	6. MANUFACTURER'S DESIGNATION OF DRILL
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" (I.D.) HSA; 3" CME sampler	8. HOLE LOCATION: 35 ft. E of Bldg. 180
	9. SURFACE ELEVATION
	10. DATE STARTED: 3-10-92 / 11. DATE COMPLETED: 3-10-92
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF HOLE: 15 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240		Semi-vols 8270			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole plug			D. Gray

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
	2.0	Brown - Dark brown mottled SILT with concrete & bricks (FILL)					
	5	Brown silty fine SAND, trace chips of concrete (FILL)	4-5 feet ND				
	7.0	Dark brown silty SAND	9-10 feet ND		DCSB-13A		
	10	Dark brown clayey silty SAND					
	15	TD	14-15 feet ND		DCSB-13B		

HTW DRILLING LOG

HOLE No. DCSB-14

1. COMPANY NAME: Law Environmental	2. DRILLING SUBCONTRACTOR: Shamrock B.W. Drilling
SHEET 1 OF SHEETS	
3. PROJECT: Ft. Riley 11-1532.04	4. LOCATION: Dry Cleaners Bldg. 180 & 181
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 3 1/4" & 2 1/4" Stainless steel hand auger; 2 oz VOA jars + 250ml Amber bottles.	8. HOLE LOCATION
	9. SURFACE ELEVATION
	10. DATE STARTED: 3-10-92 / 11. DATE COMPLETED: 3-10-92
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF HOLE: 15 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240	Semi-Volatile 8270				

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole Plug			D. Gray

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS OVA d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		Dark Gray Brown clayey silt					
	3.0	Gray brown sandy clayey Silt					
	4.5		4-5 - ND 1150				
	5.0	Gray brown Sandy Silt					
	6.0	Gray-brown silty fine Sand.					
			9-10 - ND 1210				DCSB-14A to lab
	10.0	Tan brown silty fine to medium sand.					
			14-15 - ND 1235				DCSB-14B to lab.
	15.0	TD					

HTW DRILLING LOG

HOLE No. BCSB-15

1. COMPANY NAME: Law Environmental	2. DRILLING SUBCONTRACTOR: Shamrock Env. Drilling	SHEET 1 OF SHEETS
3. PROJECT: Ft. Riley 11-1532-04	4. LOCATION: Dry Cleaners LB109 180+181	
5. NAME OF DRILLER: Clay Dyer.	6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZE AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 3¼" + 2¼" Stainless Steel hand auger. 2 oz VOA Jars. 250 ml Amber Jars.	8. HOLE LOCATION	
	9. SURFACE ELEVATION	
	10. DATE STARTED: 3-10-92	11. DATE COMPLETED: 3-10-92
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED	
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE: 15 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	8240		Semi-volatile 8270			

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	Hole Plug			D. Gray

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS (OVA) d	GEOTECH SAMPLE OR CORE BOX No. e	ANALYTICAL SAMPLE No. f	BLOW COUNTS g	REMARKS h
		Dark Gray Brown Silty clay.					
	4.0	Brown Sandy Silt	4-5-ND 0905				
	5.0 5.5	Light Gray Brown Silty Fine Sand.					
			9-10-ND 0930				BCSB-15A to lab
	10.0 10.5	Tan brown silty fine-medium sand.					
			14-15-ND 0950				BCSB-15B to lab.
	15.0	TD					

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER DCF92-01
JOB NUMBER 11-1532
DATE STARTED 4/2/92
DATE COMPLETED 4/16/92
DRILLED BY LAYNE WESTERN
LOGGED BY JACK SMITHBACK
CHECKED BY KEVIN PROCHASKA

REMARKS:

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	.5	Grass and organic materials				3
	1.5	Gravel fill material				
	2.5	Cobbles and gravel				
		Soft, moist brown (10 YR 4/4) fine grained sandy SILT				5
		ML				
	15.0	Very loose, moist, brown (10 YR 4/3) fine grained silty SAND				
		ML				
	20.0	Loose, moist, tan-rust (10 YR 5/2) poorly graded medium SAND with gravel to cobble size limestone fragments				
		ML				
	25.0	Hard to very hard, green-brown (5Y 4/2) weathered SHALE				6
		Auger refusal- top of rock-coring begins				
	28.6	Gray fractured LIMESTONE				
	29.7	Greenish-gray clayey SHALE				
	30.0	Greenish-gray clayey SHALE				35
	31.0	Reddish -brown clayey SHALE				
	32.5	LIMESTONE				
	32.7	Greenish-gray weather SHALE				
	33.0	Reddish-brown clayey SHALE				1532.54

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER DCF92-01
JOB NUMBER 11-1532
DATE STARTED 4/2/92
DATE COMPLETED 4/16/92
DRILLED BY LAYNE WESTERN
LOGGED BY JACK SMITHBACK
CHECKED BY KEVIN PROCHASKA

REMARKS:

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	35.0	Greenish-gray clayey SHALE with sand sized limestone fragments				
	37.0	Grey weathered LIMESTONE with fractures				
	39.0	Gray competent LIMESTONE with a few vugs				
	41.0	Gray to dark gray LIMESTONE with vugs				
	44.0	Black to dark gray competent shaley LIMESTONE with a few vugs				
	48.6	BORING TERMINATED				

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER DCF92-02
JOB NUMBER 11-1532
DATE STARTED 4-16-92
DATE COMPLETED 4-21-92
DRILLED BY LAYNE WESTERN
LOGGED BY JACK SMITHBACK
CHECKED BY KEVIN PROCHASKA

REMARKS:

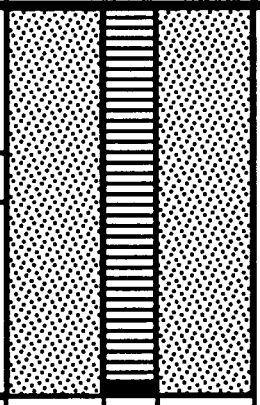
ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	.5	Grass and organic material				
		Dark brown sandy SILT		SM		
	5.0	Very loose, moist brown (7.5 YR 4/3) silty SAND				3
	10.0			SM		5
		Loose, moist brown (7.5 YR 4/4) fine grained silty SAND				
	15.0					3
		Very loose, moist brown (10 YR 3/3) clayey and silty fine grained SAND		SM		
	20.0					
	20.7	Stiff, moist gray-brown (2.5 Y 5/2) sandy CLAY		SM		
	21.8	Loose, moist gray-brown (2.5Y 5/2) clayey fine grained SAND		CL		
		Loose, moist rust-brown (5 YR 5/8) medium grained SAND		SP		
	25.0	Very stiff, moist greenish-brown (2.5 Y 4/3) CLAY		CL		
	28.0					
	28.9	Very hard, dry greenish-brown (5Y 4/3) weathered shale				
	29.9	Auger refusal - Top of Rock - Coring Begins Reddish brown weathered SHALE				50/4"
		Greenish-gray competent calcareous SHALE				
	33.0					
	35.0	Gray weathered LIMESTONE with green weathered shale				1532.54

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER DCF92-02
JOB NUMBER 11-1532
DATE STARTED 4-16-92
DATE COMPLETED 4-21-92
DRILLED BY LAYNE WESTERN
LOGGED BY JACK SMITHBACK
CHECKED BY KEVIN PROCHASKA

REMARKS:

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	35.0	Gray to tan, weathered and fractured LIMESTONE with laminations and vugs				
	39.0	Tan competent LIMESTONE with a few vugs				
	40.1	Dark gray to black competent shaley LIMESTONE				
	45.5	BORING TERMINATED				

1532.54

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER DCF92-03
JOB NUMBER 11-1532
DATE STARTED 4-6-92
DATE COMPLETED 4-7-92
DRILLED BY LAYNE WESTERN
LOGGED BY JACK SMITHBACK
CHECKED BY KEVIN PROCHASKA

REMARKS:

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	.3	Cement				
		Gravel, bricks, fill material mixed with brown sand				
	6.0					
		Brown (5 YR 4/3) silty SAND				
		SM				
	8.0					
		Brown (10 YR 3.4) dry sandy SILT				
		ML				
	15.0					11
		Stiff, moist brown (7.5 YR 3/4) sandy SILT				
		ML				
	22.0					
		Stiff moist brown (7.5 YR 4/3) clayey and sandy SILT				
		ML				
	25.0					10
		Loose, moist/wet tan-brown (10 YR 5/4) clayey fine grained SAND with a few limestone and chert fragments				
		SM				
	33.0					
		Moist, brown (10 YR 3/3) fine grained sandy CLAY				
		ML				1532.54

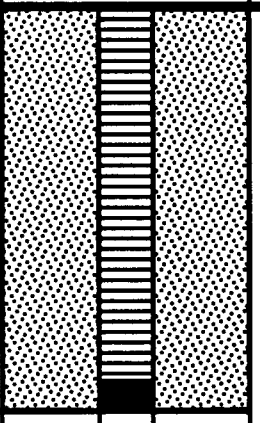
LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER DCF92-03
JOB NUMBER 11-1532
DATE STARTED 4-6-92
DATE COMPLETED 4-7-92
DRILLED BY LAYNE WESTERN
LOGGED BY JACK SMITHBACK
CHECKED BY KEVIN PROCHASKA

REMARKS:

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	35.0					
	36.0	Loose, moist brown-gray (2.5 YR 5/2) clayey fine grained SAND — SM				10
		Stiff, moist brown-gray (2.5 YR 5/2) sandy CLAY — ML				
	42.5	Fractured LIMESTONE and CLAY				
	45.5	BORING TERMINATED				



1532.54

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER DC92-04
JOB NUMBER 11-1532
DATE STARTED 4/4/92
DATE COMPLETED 4/21/92
DRILLED BY LAYNE WESTERN
LOGGED BY THOMAS MATHEW
CHECKED BY KEVIN PROCHASKA

REMARKS:

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	.5	Grass and organic material				
		Very firm, moist reddish-brown (5 YR 4/2) silty CLAY				21
	9.7	Auger Refusal - Top of Rock - Coring Begins				
	10.5	Weathered LIMESTONE				50/5"
	11.5	Tan weathered competent LIMESTONE with vugs				
	12.0	Greenish-tan competent SHALE				
	15.0	Tan to gray competent LIMESTONE with vugs				
	16.0	Gray weathered SHALE				
	18.5	Calcareous SHALE mixed with limestone containing calcite crystals				
	19.0	Greenish gray competent clayey SHALE				
	22.5					
	23.0	Black competent SHALE				
	23.7	Gray weathered LIMESTONE/SHALE with fractures				
	25.9	Very hard, moist gray CLAY				
	29.3	Gray competent shaley LIMESTONE with vertical fractures				
	30.7	Greenish-gray competent clayey SHALE				
	32.0	Very hard, moist reddish-brown CLAY				
	32.7	Greenish-gray competent clayey and calcareous SHALE				

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER DC92-04
JOB NUMBER 11-1532
DATE STARTED 4/4/92
DATE COMPLETED 4/21/92
DRILLED BY LAYNE WESTERN
LOGGED BY THOMAS MATHEW
CHECKED BY KEVIN PROCHASKA

REMARKS:

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	35.7	See previous page				
	36.8	Tan to gray competent LIMESTONE with laminations and vugs				
	37.2	Very hard, moist gray-green CLAY mixed with shale				
		Tan to gray competent LIMESTONE				
	40.4	Dark gray to black shaley LIMESTONE				
		BORING TERMINATED				

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER	DCF92-05
JOB NUMBER	11-1532
DATE STARTED	4/4/92
DATE COMPLETED	4/ 6/92
DRILLED BY	LAYNE WESTERN
LOGGED BY	JACK SMITHBACK
CHECKED BY	KEVIN PROCHASKA

REMARKS:

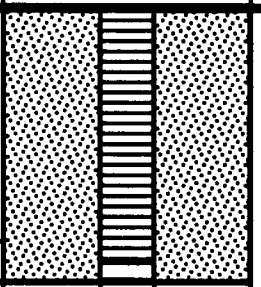
ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	.5	Grass and organic materials				
		Very soft, dry brown (10 YR 5/2) clayey SILT ML				1
	12.0	Hard brittle dry silty CLAY				
		CL				
	17.0	Clayey SILT and CLAY				
		ML/CL				7
	20.0	Loose, moist tan-brown (10 YR 6/6) fine grained silty SAND				
	29.0	Hard SHALE				
	30.0	Moist tan-brown (10 YR 6/6) fine grained silty SAND				45
		SM				
	35.0					1532.54

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER DCF92-05
JOB NUMBER 11-1532
DATE STARTED 4/4/92
DATE COMPLETED 4/ 6/92
DRILLED BY LAYNE WESTERN
LOGGED BY JACK SMITHBACK
CHECKED BY KEVIN PROCHASKA

REMARKS:

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	35.0	Very hard, wet gray (5 Y 5/3) silty sandy CLAY with fractured limestone CL				
	41.0	Fracture SHALE				
	42.0	BORING TERMINATED				

1532.54

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER DCF92-06
JOB NUMBER 11-1532
DATE STARTED 4/4/92
DATE COMPLETED 4/18/92
DRILLED BY LAYNE WESTERN
LOGGED BY JACK SMITHBACK
CHECKED BY KEVIN PROCHASKA

REMARKS:

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	.5	Grass and organic materials				
		Loose, moist brown (10 YR 5/4) fine grained silty SAND				6
		Dug up inactive communications line at 8.0'				
				SM		
	10.0	Loose, moist tan-brown (10 YR 6/6) medium grained silty SAND		SM		8
	15.0	Dense, moist/dry tan (2.5 YR 6/6) medium grained SAND		SP		34
	20.0	Loose, moist brown (10 YR 5/6) clayey to silty fine grained SAND		SM/SC		7
		Very stiff, moist green-brown (5 Y 3/2) clayey weathered SHALE				19
		Auger Refusal - Top of Rock - Coring Begins				
	30.4	Greenish-gray competent calcareous SHALE				
	31.1	Reddish-brown competent SHALE				
	32.0	Greenish-gray weathered SHALE				
	33.0	Reddish-brown competent and weathered calcareous SHALE				

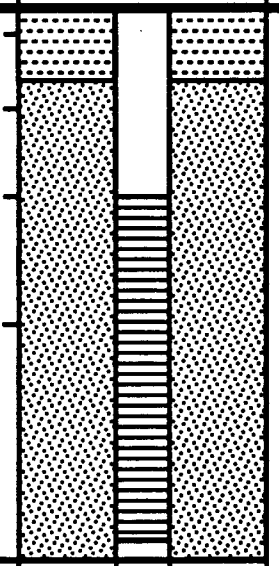
LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER DCF92-06
JOB NUMBER 11-1532
DATE STARTED 4/4/92
DATE COMPLETED 4/18/92
DRILLED BY LAYNE WESTERN
LOGGED BY JACK SMITHBACK
CHECKED BY KEVIN PROCHASKA

REMARKS:

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	35.0	See previous page				
		Greenish-gray competent clayey SHALE				
	37.5	Tan-gray weathered and fractured well stratified LIMESTONE				
	39.9	Tan-gray competent LIMESTONE with a few vugs				
	43.1	Black to dark gray competent shaley LIMESTONE with a few vugs				
	49.0	BORING TERMINATED				



LAW ENVIRONMENTAL, INC.

GOVERNMENT SERVICES BRANCH
114 TOWNPARK DRIVE, 4TH FLOOR
KENNESAW, GEORGIA 30144-5508
404-499-6800

July 29, 1992

Memorandum for: Commander, Engineer District, Kansas City
Attn: CEMRK-MD-H, Cpt. Carol Ann Charette
Kansas City, MO 64106

Subject: Technical Memorandum DCF-003: Installation of Exploratory Monitoring Well DC92-07 at the Dry Cleaning Facility, Ft. Riley, Kansas. Amendment to DCF Draft Modified Well Installation, Section 4.0 Plan (page 4-1).

1. Purpose: The purpose of this memorandum is to describe the installation of a shallow bedrock monitoring well adjacent to existing monitoring well DC92-04. This well and information gathering during drilling will aid in characterization of the shallow bedrock zone. Pursuant to the requirements as noted in Section XV, Paragraph E of the Federal Facilities Agreement (IAG), Law Environmental, Inc. Government Services Branch submits the following modifications and/or changes in field work for the Dry Cleaning Facility. These changes were agreed to by the following representatives from the Corps of Engineers, Ft. Riley, KDHE and EPA Region 7:

Corps of Engineers:	Mr. Volker Schmidt
	Mr. John Cichelli
	Mr. Millard Stone
Ft. Riley:	Ms. Janet Wade
KDHE:	Ms. Rachel Miller
EPA:	Mr. Scott Marquess
Law Environmental:	Ms. Judy Hartness
	Ms. Mary Ann Brookshire
	Mr. Kevin Prochaska
	Mr. Gregory Myers

2. Issue/Background/Rationale: Bedrock conditions encountered during the drilling of monitoring well DC92-04 (see attached log of DCF92-04) indicated a shallow fracture zone 16 feet below ground surface. Ground water entered this fractured zone during drilling activities. Ground water was observed entering the borehole after the drilling ceased. An oily sheen was observed on the water surface in the borehole and sample analysis by MRD laboratories indicated the material is old hydrocarbon substance. Based upon these observations during field work at the site, additional characterization is needed to evaluate whether ground water is present in this upper fracture zone, and if so, to collect a sample for chemical analysis.

3. The well installation for monitoring well DCF92-07 will follow the protocols outlined in the Draft Modified Well Installation Plan of May, 1992, with the following exceptions:

   - The boring will be advanced into bedrock using a tri-cone bit.
   - Soil samples will not be collected.
   - The well screen interval will be from 11 to 21 feet below the ground surface.

Sincerely,

LAW ENVIRONMENTAL, INC.

Kevin M. Prochaska, P.G.
Project Manager

for Gregory P. Myers, P.G.
Principal

KMP:mlh

Attachment

APPENDIX F

MONITORING WELL DEVELOPMENT/ADDITIONAL DEVELOPMENT

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

SHEET 1 OF 1

JOB NAME Ft. Riley, Kansas JOB NO. 11-1532

BY REJ DATE 5/03/92 CHECKED KMP DATE 9/02/92

WELL DEVELOPMENT DATA

1. Well No. DCF92-01
2. Date of Installation : 4/16/92
3. Date of Development : 4/23, 24/92 - 5/1-3/92
4. Static Water Level (TOC): Before Development 42.04 ft.: 24 Hours After 41.97 ft
5. Quantity of Water Loss During Drilling, If Used 260 Gal.
6. Quantity of Water Loss During Installation, If Used 24 Gal.

	Start	During		End
7. Physical Appearance	VeryTurbid	Clear	Clear	Clear
Specific Conductance (umhos/cm)	1325	1225	1250	1250
Temperature (C°)	17	15	15	16
Turbidity (NTU)	>200	9	9	19
pH (s.u.)	7.3	7.3	7.3	7.2

8. Screen Length 10.0 ft. (after cut-off was removed)
9. Depth of Well (TOC): Before Development 49.65 ft.; After Development 49.51 ft.
10. Type and Size of Well Development Equipment : QED manuf. well wizard; air compressor model SGH-E1010; well controller No. 3013 with a PVC development pump
11. Type of Surge Equipment: Two-inch surge block with 3/4 inch Triloc 5 foot extensions
12. Height of Well Casing Above Ground Surface : 1.76 ft. (From Survey Data)
13. Quantity of Water Removed : 852 Gal. Total Time for Development : 26/0 Hr./Min.
14. Date & Time Water Sample Collected : 4/28/92 1755

REMARKS:

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

SHEET 1 OF 1

JOB NAME Ft. Riley, Kansas JOB NO. 11-1532

BY REJ DATE 4/29/92 CHECKED KMP DATE 9/02/92

WELL DEVELOPMENT DATA

1. Well No. DCF92-02
2. Date of Installation : 4/21/92
3. Date of Development : Initial Development 4/29/92
4. Static Water Level (TOC): Before Development 41.65 ft.: 24 Hours After 41.17 ft
5. Quantity of Water Loss During Drilling, If Used 500 Gal.
6. Quantity of Water Loss During Installation, If Used 0 Gal.

	Start	During		End
7. Physical Appearance	VeryTurbid	Clear	Clear	Clear
Specific Conductance (umhos/cm)	1300	1335	1335	1330
Temperature (C°)	19	22	22	22
Turbidity (NTU)	>200	2.8	3.8	3.8
pH (s.u.)	6.6	7.1	7.1	7.1

8. Screen Length 10.0 ft. (after stick-up was cut)
9. Depth of Well (TOC): Before Development 48.10 ft.; After Development 47.66 ft.
10. Type and Size of Well Development Equipment : QED manuf. well wizard; air compressor model SGH-E1010; well controller No. 3013 with a PVC development pump
11. Type of Surge Equipment: Two-inch surge block with 3/4 inch Triloc 5 foot extensions
12. Height of Well Casing Above Ground Surface : 1.93 ft. (From Survey Data)
13. Quantity of Water Removed : 175 Gal. Total Time for Development : 10/0 Hr./Min.
14. Date & Time Water Sample Collected : 4/29/92 1300

REMARKS:

1532.54

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

SHEET 1 OF 1

JOB NAME Ft. Riley, Kansas JOB NO. 11-1532

BY REJ/DLG DATE 4/10/92 CHECKED KMP DATE 9/02/92

WELL DEVELOPMENT DATA

1. Well No. DCF92-03
2. Date of Installation : 4/07/92
3. Date of Development : 4/10/92
4. Static Water Level (TOC): Before Development 38.17 ft.: 24 Hours After 38.31 ft
5. Quantity of Water Loss During Drilling, If Used 0 Gal.
6. Quantity of Water Loss During Installation, If Used 10 Gal.

	Start	During		End
7. Physical Appearance	Very Turbid	MilldyTurbid	Turbid	Clear
Specific Conductance (umhos/cm)	1200	1500	1500	1500
Temperature (C°)	19	20	20	20
Turbidity (NTU)	>200	53	50	20
pH (s.u.)	7.1	7.2	7.3	7.3

8. Screen Length 10.0 ft.
9. Depth of Well (TOC): Before Development 47.21 ft.; After Development 47.18 ft.
10. Type and Size of Well Development Equipment : QED manuf. well wizard; air compressor model SGH-E1010; well controller No. 3013 with a PVC development pump
11. Type of Surge Equipment: Two-inch surge block with 3/4 inch Triloc 5 foot extensions
12. Height of Well Casing Above Ground Surface : 1.80 ft. (From Survey Data)
13. Quantity of Water Removed : 600 Gal. Total Time for Development : 10/12 Hr./Min.
14. Date & Time Water Sample Collected : 4/10/92 1645

REMARKS: Initially, water had a shale oil sheen.

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

SHEET 1 OF 1

JOB NAME Ft. Riley, Kansas JOB NO. 11-1532

BY REJ/BMC DATE _____ CHECKED KMP DATE 9/2/92

WELL DEVELOPMENT DATA

1. Well No. DCF92-04
2. Date of Installation : 4/21/92
3. Date of Development : _____
4. Static Water Level (TOC): Before Development _____ ft.: 24 Hours After _____ ft
5. Quantity of Water Loss During Drilling, If Used _____ Gal.
6. Quantity of Water Loss During Installation, If Used _____ Gal.

	Start	During		End
7. Physical Appearance				
Specific Conductance (umhos/cm)				
Temperature (C°)				
Turbidity (NTU)				
pH (s.u.)				

DRY WELL

8. Screen Length _____ ft.
9. Depth of Well (TOC): Before Development _____ ft.; After Development _____ ft.
10. Type and Size of Well Development Equipment : _____
11. Type of Surge Equipment: _____
12. Height of Well Casing Above Ground Surface : _____ ft. (From Survey Data)
13. Quantity of Water Removed : _____ Gal. Total Time for Development : _____ Hr./Min.
14. Date & Time Water Sample Collected : _____

REMARKS: Monitoring well only produced 025. of water every 4 hours - 8 hrs.

1532.54

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

SHEET 1 OF 2

JOB NAME Ft. Riley, Kansas JOB NO. 11-1532

BY REJ/DLG DATE 4/11/92 CHECKED KMP DATE 9/02/92

WELL DEVELOPMENT DATA

1. Well No. DCF92-05
2. Date of Installation : 4/06/92
3. Date of Development : 4/11/92
4. Static Water Level (TOC): Before Development 35.5 ft.: 24 Hours After 35.39 ft
5. Quantity of Water Loss During Drilling, If Used 0 Gal.
6. Quantity of Water Loss During Installation, If Used 10 Gal.

	Start	During		End
7. Physical Appearance	Very Turbid	VeryTurbid	Very Turbid	VeryTurbid
Specific Conductance (umhos/cm)	1050	1000	1000	1050
Temperature (C°)	18	18	18	19
Turbidity (NTU)	>200	>200	>200	>200
pH (s.u.)	7.2	7.4	7.4	7.4

8. Screen Length 10.0 ft.
9. Depth of Well (TOC): Before Development 42.78 ft.; (Before pad was installed) After Development 42.77 ft. (After pad was installed)
10. Type and Size of Well Development Equipment : QED manuf. well wizard; air compressor model SGH-E1010; well controller No. 3013 with a PVC development pump
11. Type of Surge Equipment: Two-inch surge block with 3/4 inch Triloc 5 foot extensions
12. Height of Well Casing Above Ground Surface : -.26 ft. (From Survey Data)
13. Quantity of Water Removed : 18 Gal. Total Time for Development : 9/25 Hr./Min.
14. Date & Time Water Sample Collected : 4/11/92 1715

REMARKS: 1st Development

1532.54

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

SHEET 2 OF 2

JOB NAME Ft. Riley, Kansas JOB NO. 11-1532

BY REJ/COK DATE 5/13/92 CHECKED KMP DATE 9/02/92

WELL DEVELOPMENT DATA

1. Well No. DCF92-05
2. Date of Installation : 4/06/92
3. Date of Development : 5/12-13/92
4. Static Water Level (TOC): Before Development 35.85 ft.: 24 Hours After 35.60 ft
5. Quantity of Water Loss During Drilling, If Used 0 Gal.
6. Quantity of Water Loss During Installation, If Used 10 Gal.

	Start	During		End
7. Physical Appearance	Very Turbid	Clear	Clear	Clear
Specific Conductance (umhos/cm)	1150	1250	1225	1250
Temperature (C°)	21	18	19	20
Turbidity (NTU)	>200	22	15	17
pH (s.u.)	7.8	7.7	7.6	7.7

8. Screen Length 10.0 ft.
9. Depth of Well (TOC): Before Development 42.77 ft.; After Development 42.12 ft.
10. Type and Size of Well Development Equipment : QED manuf. well wizard; air compressor model SGH-E1010; well controller No. 3013 with a PVC development pump
11. Type of Surge Equipment: Two-inch surge rings attached to development pump.
12. Height of Well Casing Above Ground Surface : -.26 ft. (From Survey Data)
13. Quantity of Water Removed : 115 Gal. Total Time for Development : 10/15 Hr./Min.
14. Date & Time Water Sample Collected : 5/13/92 1015

REMARKS: 2nd Development. This development was performed after the surging and purging event.

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

SHEET 1 OF 1

JOB NAME Ft. Riley, Kansas JOB NO. 11-1532

BY REJ/DLG DATE 4/23/92 CHECKED KMP DATE 9/02/92

WELL DEVELOPMENT DATA

1. Well No. DCF92-06
2. Date of Installation : 4/18/92
3. Date of Development : 4/23/92
4. Static Water Level (TOC): Before Development 43.37 ft.: 24 Hours After 43.51 ft
5. Quantity of Water Loss During Drilling, If Used 100 Gal.
6. Quantity of Water Loss During Installation, If Used 24 Gal.

	Start	During		End
7. Physical Appearance	VeryTurbid	Turbid	Clearing	Clear
Specific Conductance (umhos/cm)	1450	1275	1275	1250
Temperature (C°)	17	18	18	18
Turbidity (NTU)	>200	>200	89.5	17.0
pH (s.u.)	7.0	7.3	7.2	7.1

8. Screen Length 10.0 ft.
9. Depth of Well (TOC): Before Development 50.78 ft.; After Development 50.75 ft.
10. Type and Size of Well Development Equipment : QED manuf. well wizard; air compressor model SGH-E1010; well controller No. 3013 with a PVC development pump
11. Type of Surge Equipment: Two-inch surge block with 3/4 inch Triloc 5 foot extensions
12. Height of Well Casing Above Ground Surface : 1.6 ft. (From Survey Data)
13. Quantity of Water Removed : 386 Gal. Total Time for Development : 28/45 Hr./Min.
14. Date & Time Water Sample Collected : 4/23/92 1815

REMARKS: Initial development all parameters stabilized per Corps protocol. Second purging event removed additional gallons to meet three times the water added during drilling and installation.

DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MISSOURI 64106-2896

REPLY TO
ATTENTION OF:

June 12, 1992

LAW ENVIRONMENTAL
JUN 19 1992
GOVERNMENT SERVICES

Hazardous and Toxic Waste
Project Management Branch

Mr. Lou Karably
Law Environmental, Inc.
115 Townpark Drive
Suite 400
Kennesaw, Georgia 30144-5508

Dear Mr. Karably:

After discussion with my staff, I have determined that the wells at the three sites at Fort Riley have not been properly and/or completely developed. You are hereby directed to perform additional well development which is within your scope of work and IAW the work plans. The additional well development criteria/procedures for ground water monitoring wells at Fort Riley Sites (Pesticide Storage Facility, Dry Cleaning Facility, and South Funston Landfill), which was mutually established and agreed to between the Corps Of Engineers, Fort Riley, Law Environmental, EPA and KDHE, are as follows:

1. Surge for 15 minutes using a surge block.

2. Pump until water becomes translucent. Use QED pump on DCF and PSF wells 1, 2, 3, 4. Use a higher yielding pump on all SFL wells and PSF-05 well.

3. Record time and volume required to pump to a translucent state.

4. Repeat steps 1, 2, and 3 until time of pumping to a translucent state is stabilized over 3 consecutive surge/pump cycles within 30 seconds.

5. Record NTU, PH, specific conductance and temperature at end of last surge/purge cycle

6. Pump until water becomes clear. (Note: Pump from entire screen interval. Move pump up and down well screen, one time at two foot intervals until clear water appears at each 2 foot interval.

7. Measure NTU, PH, specific conductance, and temperature.

8. If NTU is equal to or less than 30 units, well development is complete. If NTU is greater than 30 units following additional well development effort, the USACE project manager will be contacted immediately with all pertinent data so that the issue can be revisited with Fort Riley and the regulators to determine if 1) well development should be continued or abandoned and/or 2) an alternate sampling procedure should be pursued to achieve the 30 NTU criteria.

The approved water source for well development of the wells at Dry Cleaning and Pesticide Storage site is either distilled water or McCormick well water (the same water used during drilling). We are awaiting a decision by EPA as to whether or not they will allow us to use well water from the development of the bottom of the screen in the shallow landfill wells for use in surging the upper portion of the screen in the same well.

If you have any questions, please call CPT Carol Charette, of my staff, at 816-426-7446.

Sincerely,

Wilbur H. Boutin, Jr.
Colonel, Corps of Engineers
District Engineer

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

SHEET 1 OF 1

JOB NAME Ft. Riley (DCF) JOB NO. 11-1532

BY D. Grey R. Jones DATE 6/23/92 CHECKED KMP DATE 9/02/92

WEATHER: LOW: 75° HIGH: 83° RAIN (inches): _____ OTHER: Sunny

ADDITIONAL DEVELOPMENT FORM

MONITORING WELL NO: DCF92-01 DATE OF DEVELOPMENT: 6/23/92

STATIC WATER LEVEL: BEFORE DEV. (TOC) 41.75' 24 HRS. AFTER DEV. 41.90'

TOTAL DEPTH: BEFORE DEV. (TOC) 48.94' AFTER DEV. (TOC) 49.52'

LENGTH OF WATER COLUMN: 7.19'

SURGE/PURGE CYCLE #	TIME TO TRANSLUCENCE STATE	pH	COND.	TEMP. °C	NTU	TOTAL GALS. REMOVED
1	12 min.	6.9	1250	24	51	58
2	12 min. 25 sec.	7.2	1400	24	46	↓
3	11 min. 45 sec.	7.2	1250	24	42	↓
Final pumping (Top)		7.1	1200	26	13	↓
↓ Bottom		7.0	1200	26	5	↓

REMARKS: _____

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

SHEET 1 OF 1

JOB NAME Ft. Riley (DCF) JOB NO. 11-1532

BY D. Grey R. Jones DATE 6/24/92 CHECKED KMP DATE 9/02/92

WEATHER: LOW: 80° HIGH: 92° RAIN (inches): _____ OTHER: P. Cloudy

ADDITIONAL DEVELOPMENT FORM

Monitoring Well No: DCF92-02 Date of Development: 6/24/92

Static Water Level: Before Dev. (TOC) 41.16' 24 hrs. After Dev. 41.27'

Total Depth: Before Dev. (tTOC) 47.63' After Dev. (TOC) 47.63'

Length of Water Column: 6.46'

SURGE/PURGE CYCLE #	TIME TO TRANSLUCENCE STATE	pH	COND.	TEMP.	NTU	TOTAL GALS. REMOVED
1	5 min. 0 sec.	7.66	1470	88.6	10	41
2	2 min. 0 sec.	7.68	1430	80.2	44	↓
3	1 min. 50 sec.	7.68	1420	75.8	21	
4	1 min. 35 sec.	7.66	1410	72.9	27.5	
Final pumping (Top)		7.65	1400	72.7	12	
↓ Bottom		7.67	1410	73.1	6.5	↓

REMARKS: _____

1532.54

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

SHEET 1 OF 1

JOB NAME Ft. Riley (DCF) JOB NO. 11-1532

BY B. Craig D. Grey DATE 6/15-17/92 CHECKED KMP DATE 9/02/92

WEATHER: LOW: 70° HIGH: 80° RAIN (inches): _____ OTHER: Sunny

ADDITIONAL DEVELOPMENT FORM

Monitoring Well No: DCF92-03 Date of Development: 6/15-17/92

Static Water Level: Before Dev. (TOC) 37.92' 24 hrs. After Dev. 38.50'

Total Depth: Before Dev. (tTOC) 47.15' After Dev. (TOC) 47.15'

Length of Water Column: 9.23'

SURGE/PURGE CYCLE #	TIME TO TRANSLUCENCE STATE	pH	COND.	TEMP. °C	NTU	TOTAL GALS. REMOVED
1	78 min.	7.3	1300	17.6	145	606
2	50 min.	7.5	1250	24	196	
3	47 min.	7.8	1300	28	160	
4	58 min.	7.4	1310	26	170	
5	41 min.	7.5	1300	28	162	
6	34 min.	7.9	1310	25	140	
7	56 min.	7.6	1250	18	158	
Final pumping (Top)	30 min.	7.4	1300	17.5	19	
Middle	23 min.	7.4	1300	19	26.8	
Bottom		7.5	1310	20.5	50	

REMARKS: Added a total of 30 gallons during developing monitoring well inorder to develop upper section of the screen.

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

SHEET 1 OF 1

JOB NAME Ft. Riley (DCF) JOB NO. 11-1532

BY R. Jones D. Grey DATE 6/25/92 CHECKED KMP DATE 9/02/92

WEATHER: LOW: 75° HIGH: 90° RAIN (inches): _____ OTHER: _____

ADDITIONAL DEVELOPMENT FORM

Monitoring Well No: DCF92-04 Date of Development: 6/25/92

Static Water Level: Before Dev. (TOC) 40.42' 24 hrs. After Dev. 40.90'

Total Depth: Before Dev. (tTOC) 44.42' After Dev. (TOC) 44.35'

Length of Water Column: 4.00'

SURGE/PURGE CYCLE #	TIME TO TRANSLUCENCE STATE	pH	COND.	TEMP. °F	NTU	TOTAL GALS. REMOVED
1	44 min. 0 sec.	7.8	1212	85	161	31
2	1 hr. 1 min.	7.9	1176	85	95	↓
3	58 min. 0 sec.	7.75	1247	82	66.2	↓
4	90 min.	7.82	1212	79	>200	↓
5	surged - 15 min.					↓

REMARKS: Water recovered is drilling water. The monitoring well was not further developed after 5 cycles.

1532.54

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

SHEET 1 OF 1

JOB NAME Ft. Riley (DCF) JOB NO. 11-1532

BY S. Ruth T. Mathew DATE 6/27/92 CHECKED KMP DATE 9/02/92

WEATHER: LOW: _____ HIGH: _____ RAIN (inches): _____ OTHER: _____

ADDITIONAL DEVELOPMENT FORM

Monitoring Well No: DCF92-05 Date of Development: 6/27/92

Static Water Level: Before Dev. (TOC) 34.78' 24 hrs. After Dev. 34.94'

Total Depth: Before Dev. (tTOC) 42.10' After Dev. (TOC) 41.95'

Length of Water Column: 7.32'

SURGE/PURGE CYCLE #	TIME TO TRANSLUCENCE STATE	pH	COND.	TEMP. °F	NTU	TOTAL GALS. REMOVED
1	34 min. 56 sec.	6.93	1200	18.3	92	138
2	29 min. 38 sec.	7.10	1300	17.6	105	
3	26 min. 33 sec.	7.11	1300	18.4	65	
4	26 min. 40 sec.	6.67	1200	17.2	96	
5	24 min. 05 sec.	6.90	1280	16.5	41	
6	23 min. 55 sec.	6.81	1280	17.9	65	
7	23 min. 50 sec.	6.91	1300	16.9	75	
8	29 min. 29 sec.	6.94	1300	17.7	122	
Final pumping (Top)		7.87	1400	18.4	24	
Middle		6.92	1300	18.2	19	
Bottom		6.99	1350	17.5	28	
9	37 min. 21 sec.	6.97	1200	17.5	79	

REMARKS: _____

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

SHEET 1 OF 1

JOB NAME Ft. Riley (DCF) JOB NO. 11-1532

BY D. Grey T. Mathew DATE 6/24/92 CHECKED KMP DATE 9/02/92

WEATHER: LOW: 80° HIGH: 92° RAIN (inches): _____ OTHER: P. Cloudy

ADDITIONAL DEVELOPMENT FORM

Monitoring Well No: DCF92-06 Date of Development: 6/24/92

Static Water Level: Before Dev. (TOC) 43.52' 24 hrs. After Dev. 43.50'

Total Depth: Before Dev. (tTOC) 50.06' After Dev. (TOC) 50.08'

Length of Water Column: 6.54'

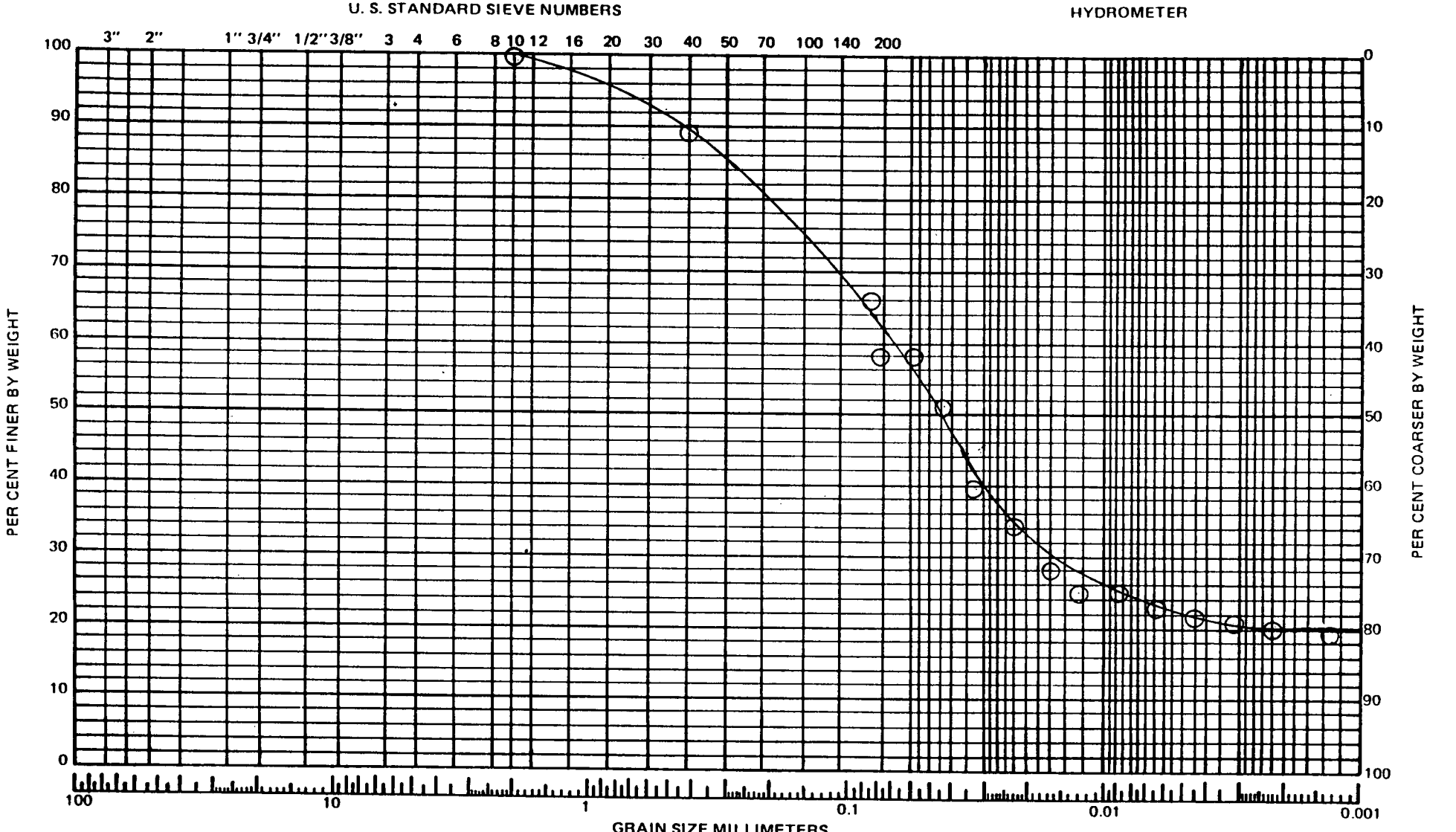
SURGE/PURGE CYCLE #	TIME TO TRANSLUCENCE STATE	pH	COND.	TEMP. °F	NTU	TOTAL GALS. REMOVED
1	7 min. 30 sec.	7.61	1050	184	92	35
2	4 min. 40 sec.	7.70	1280	82.9	97	↓
3	4 min. 30 sec.	7.67	1390	83	52	
4	4 min. 30 sec.	7.71	1410	82.7	67	
Final pumping (Top)		7.71	1450	84.5	15	
↓ Bottom		7.74	1490	85.1	13.5	↓

REMARKS: Added a total of three gallons of DI water to monitoring well.

APPENDIX G

GEOTECHNICAL ANALYSIS

GRAIN SIZE DISTRIBUTION DIAGRAM



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

% Sand = 38.0
% Silt = 42.0
% Clay = 20.0

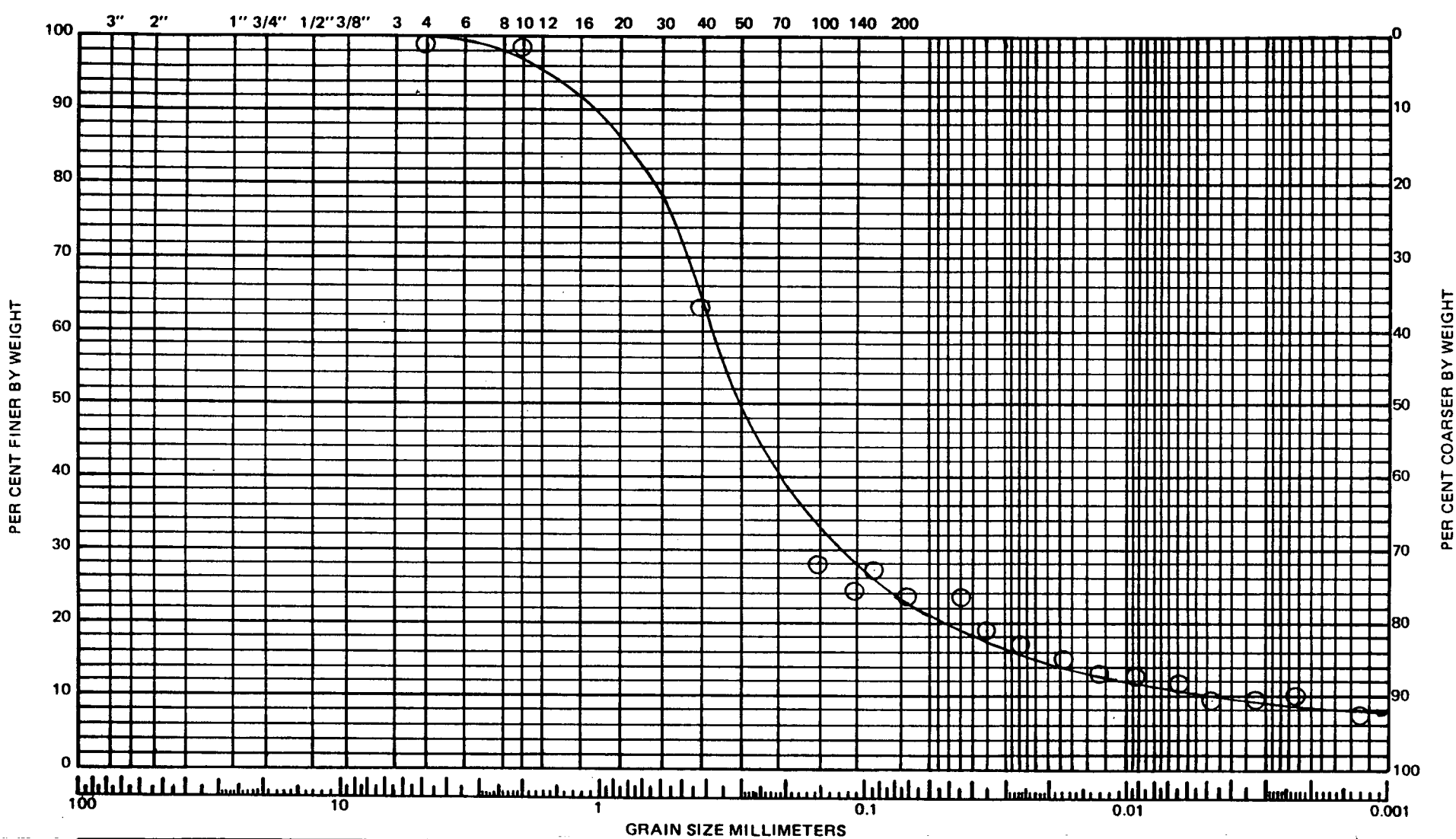
Liquid Limit = 27
Plastic Limit = 14
Plasticity Index = 13

Unified Soil Classification
CL

PROJECT: Law Environmental - Dry Cleaning Facilit

IDENTIFICATION: DCF92-01GT 10'

GRAIN SIZE DISTRIBUTION DIAGRAM



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

% Sand = 77.0
% Silt = 14.5
% Clay = 8.5

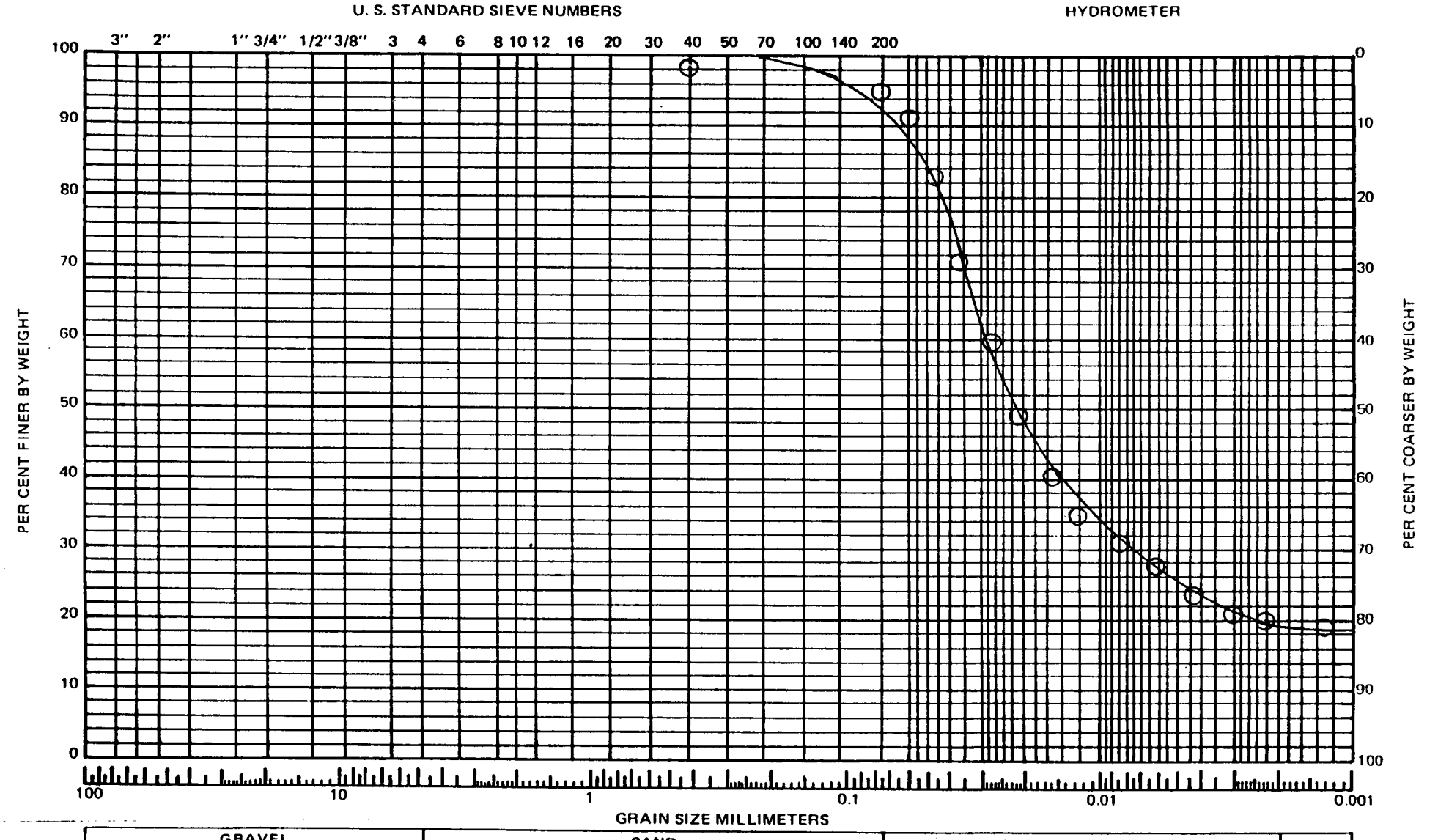
Liquid Limit = 16
Plastic Limit = 14
Plasticity Index = 2

Unified Soil Classification
SC

PROJECT: Law Environmental - Dry Cleaning Facility

IDENTIFICATION: DCF92-01GT 20'

GRAIN SIZE DISTRIBUTION DIAGRAM



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

% Sand = 7.5
% Silt = 73.5
% Clay = 19.0

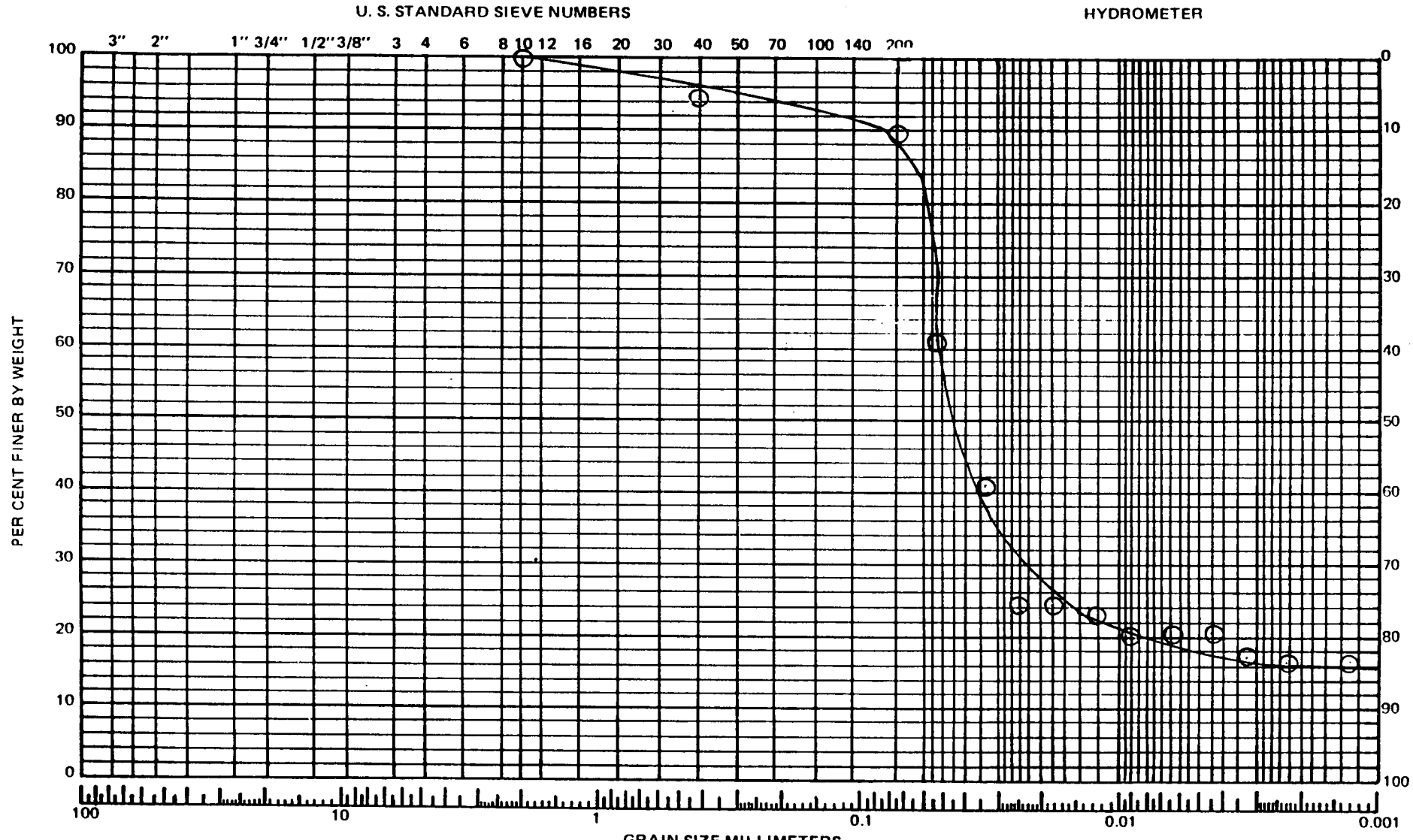
Liquid Limit = 30
Plastic Limit = 19
Plasticity Index = 11

Unified Soil Classification
CL

PROJECT: Law Environmental - Dry Cleaning Facil

IDENTIFICATION: DCF92-02GT 15'

GRAIN SIZE DISTRIBUTION DIAGRAM



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

% Sand = 12.0
% Silt - 72.0
% Clay = 16.0

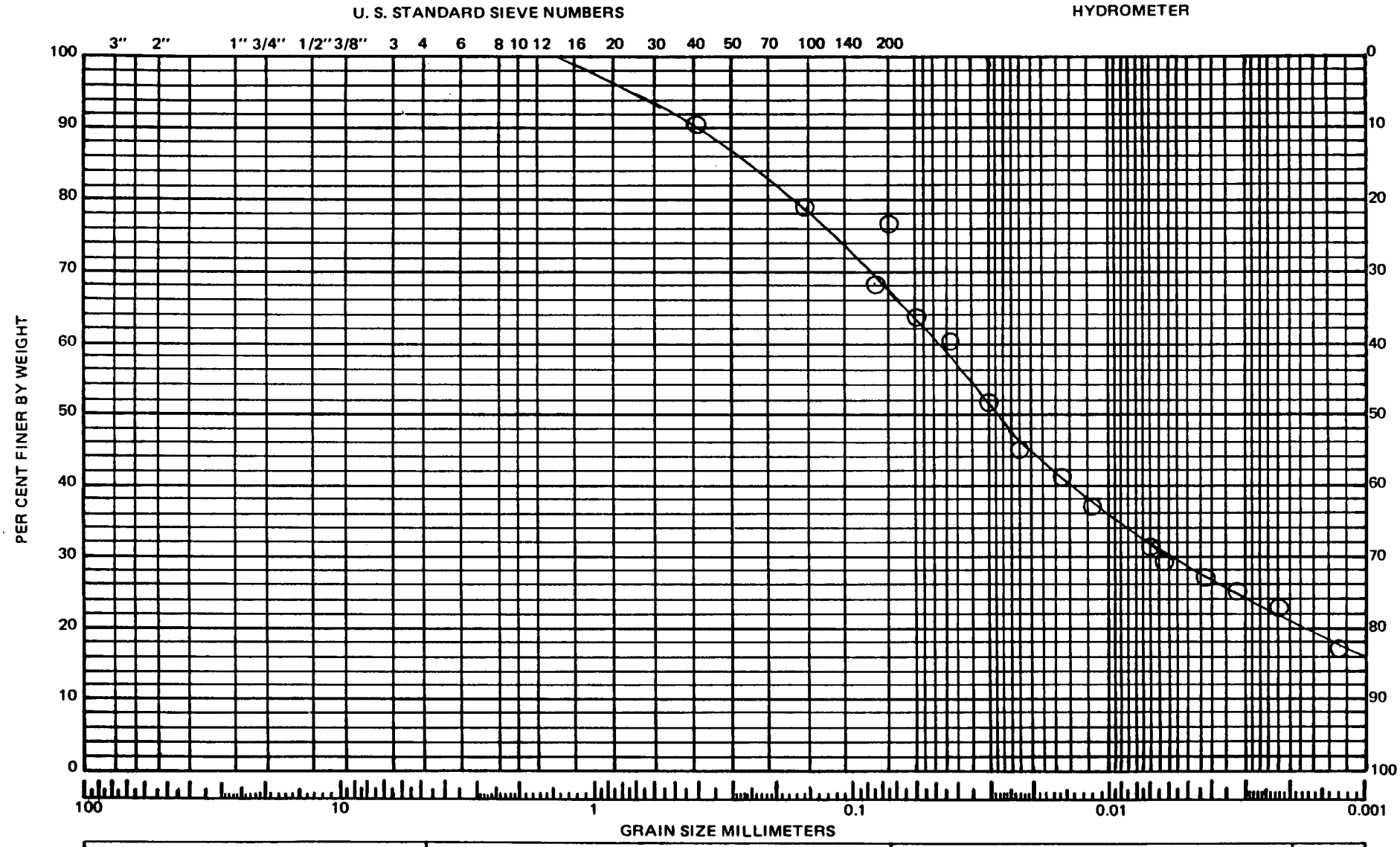
Liquid Limit = 23
Plastic Limit = 15
Plasticity Index = 8

Unified Soil Classification
CL

PROJECT: Law Environmental - Dry Cleaning Facili

IDENTIFICATION: DCF92-02GT 5'

GRAIN SIZE DISTRIBUTION DIAGRAM



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

% Sand - 32.5
% Silt = 46.5
% Clay = 21.0

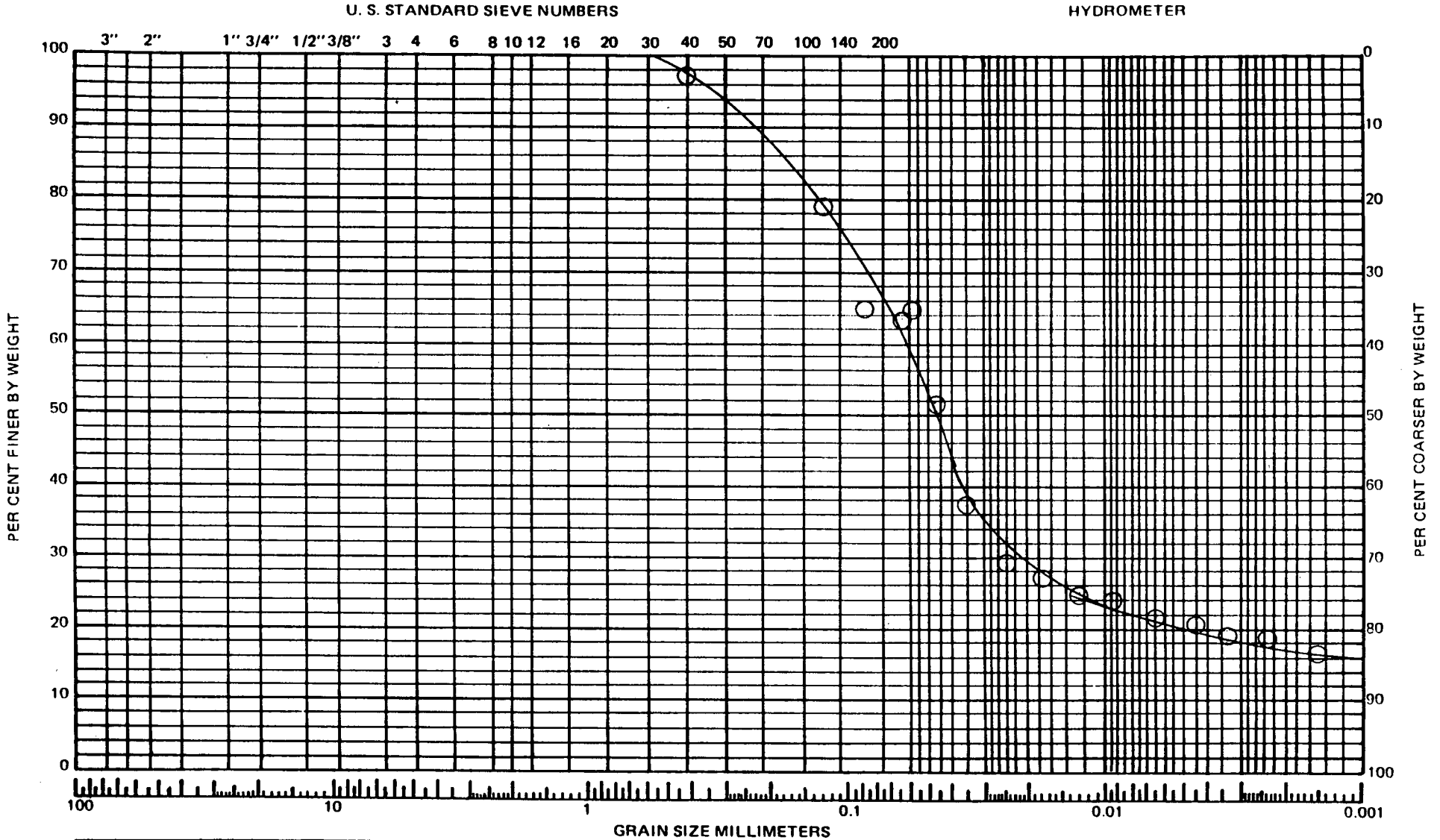
Liquid Limit = 41
Plastic Limit = 19
Plasticity Index = 22

Unified Soil Classification
CL

PROJECT: Law Environmental - Dry Cleaning Facility

IDENTIFICATION: DCF92-03GT 15'

GRAIN SIZE DISTRIBUTION DIAGRAM



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

% Sand = 33.5
% Silt = 49.5
% Clay = 17.0

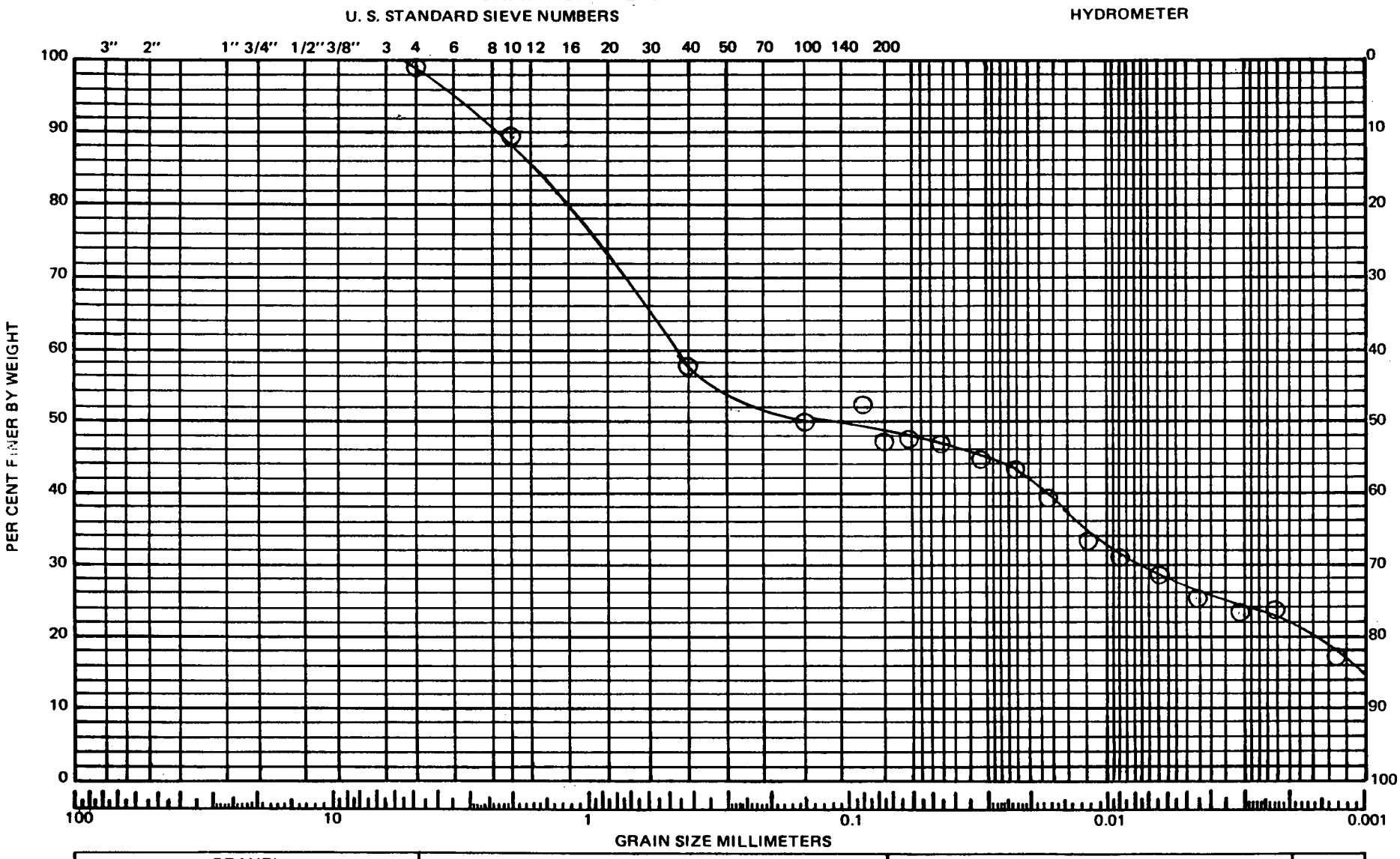
Liquid Limit = 22
Plastic Limit = 13
Plasticity Index = 9

Unified Soil Classification
CL

PROJECT: Law Environmental - Dry Cleaning Facil

IDENTIFICATION: DCF92-03GT 35'

GRAIN SIZE DISTRIBUTION DIAGRAM



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

% Sand = 51.0
% Silt = 27.0
% Clay = 22.0

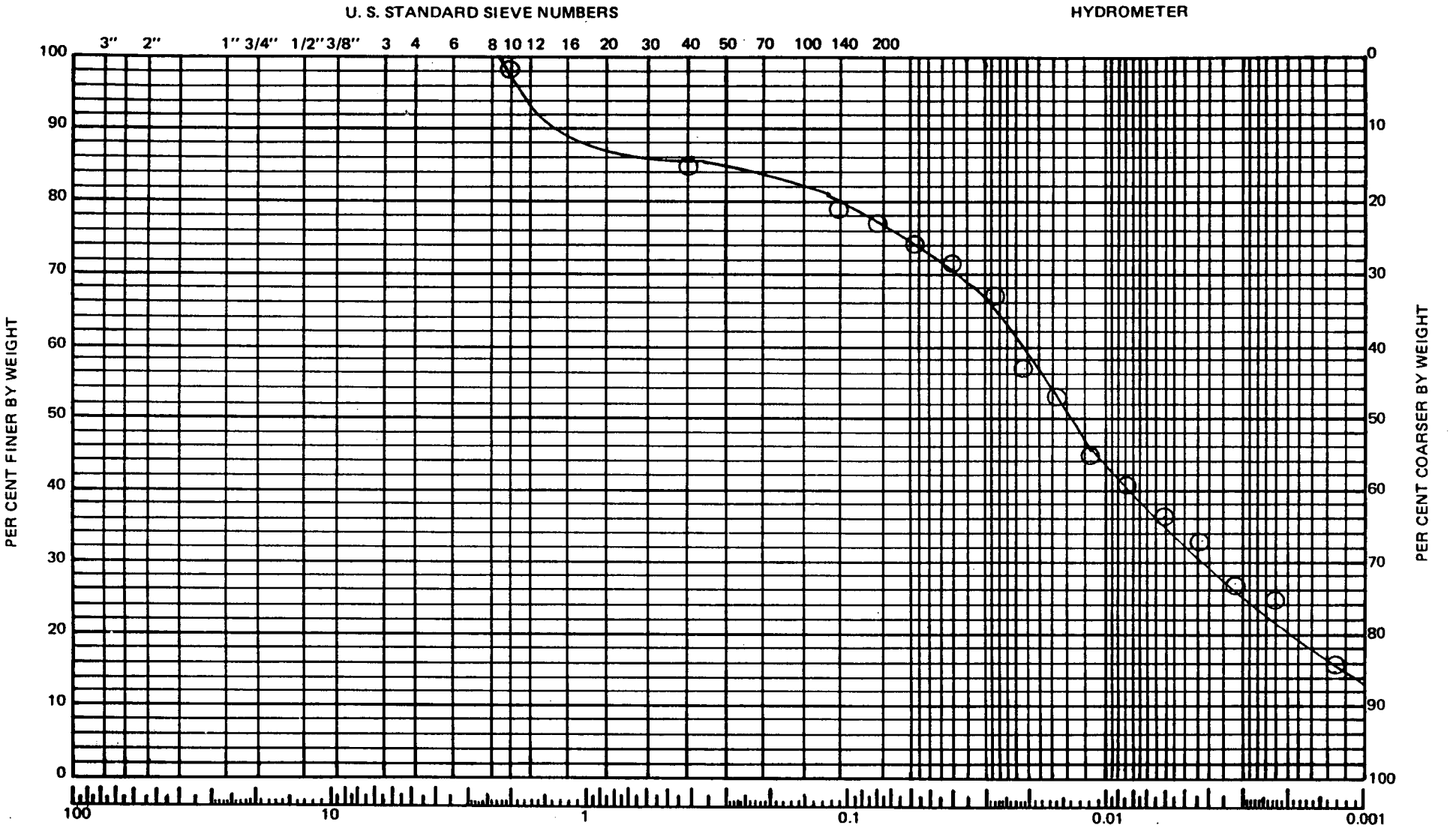
Liquid Limit = 35
Plastic Limit = 16
Plasticity Index = 19

Unified Soil Classification
SC

PROJECT: Law Environmental - Dry Cleaning Facilit

IDENTIFICATION: DCF92-04GT 10'

GRAIN SIZE DISTRIBUTION DIAGRAM



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

% Sand = 23.5
% Silt = 56.0
% Clay = 20.5

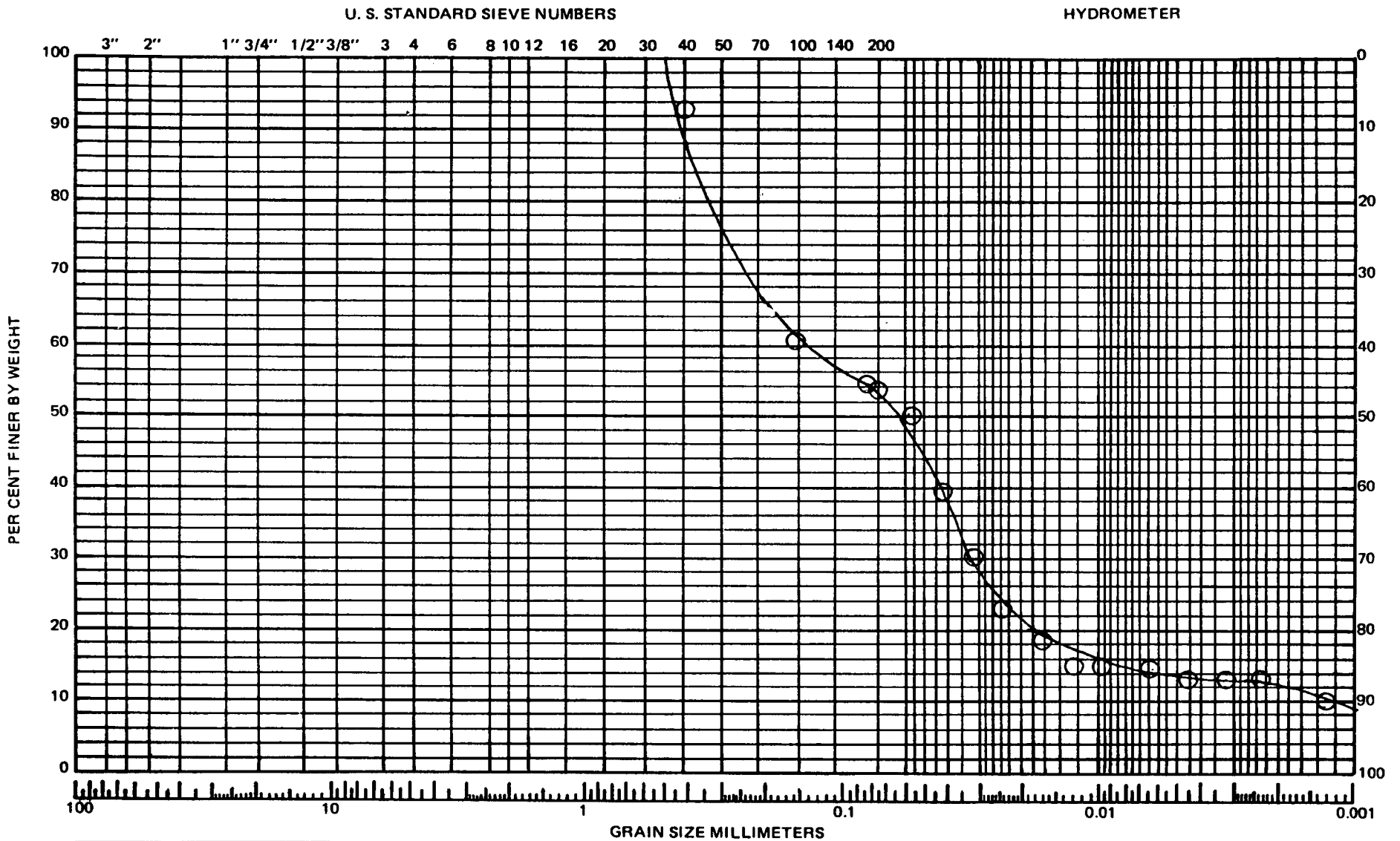
Liquid Limit = 34
Plastic Limit = 17
Plasticity Index = 17

Unified Soil Classification
CL

PROJECT: Law Environmental - Dry Cleaning Facility

IDENTIFICATION: DCF92-04GT 5'

GRAIN SIZE DISTRIBUTION DIAGRAM



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

% Sand = 47.0
% Silt = 40.5
% Clay = 12.5

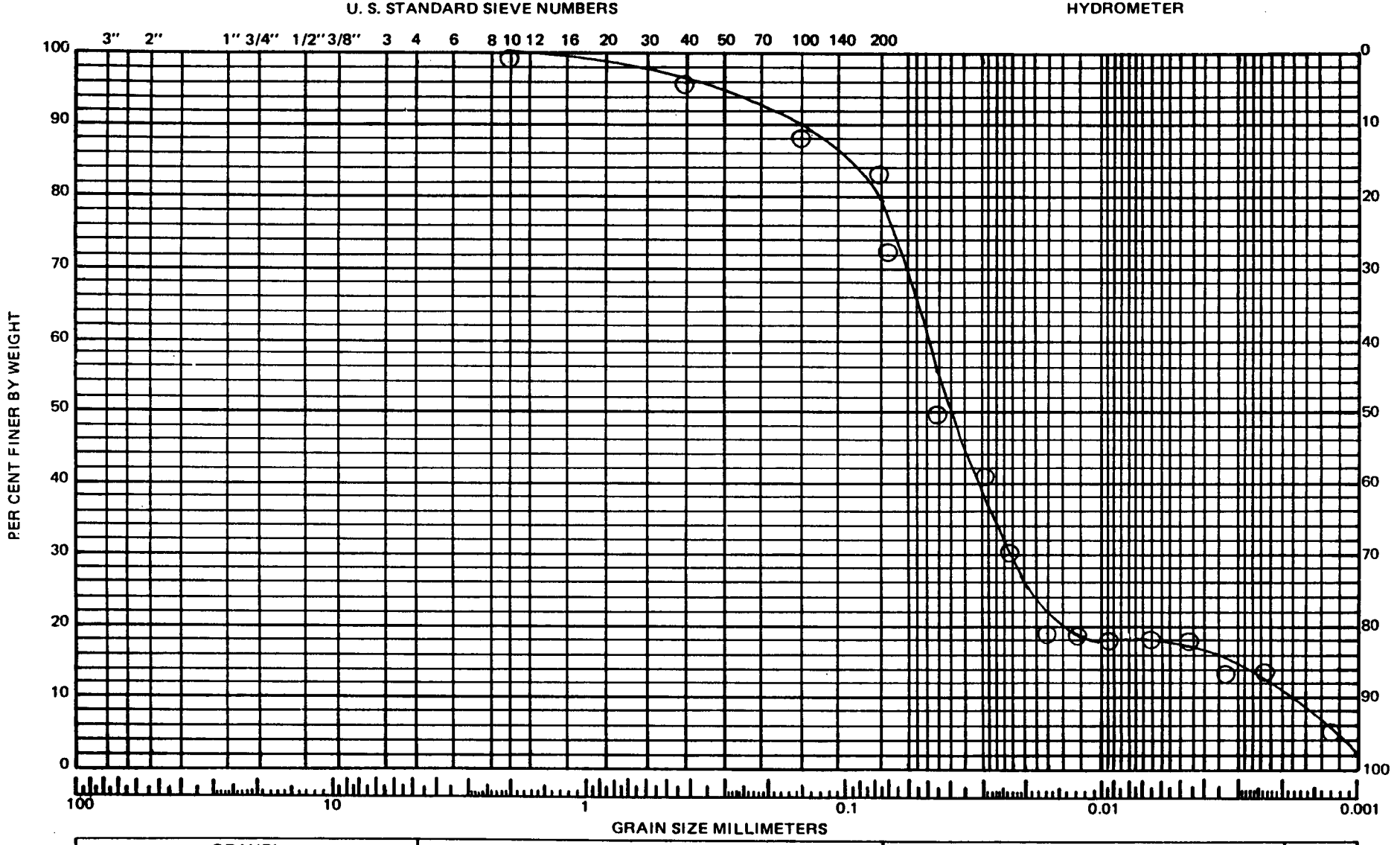
Liquid Limit = 20
Plastic Limit = 16
Plasticity Index = 4

Unified Soil Classification
CL

PROJECT: Law Environmental - Dry Cleaning Facility

IDENTIFICATION: DCF92-05GT 20'

GRAIN SIZE DISTRIBUTION DIAGRAM



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

% Sand = 20.5
% Silt = 68.5
% Clay = 11.0

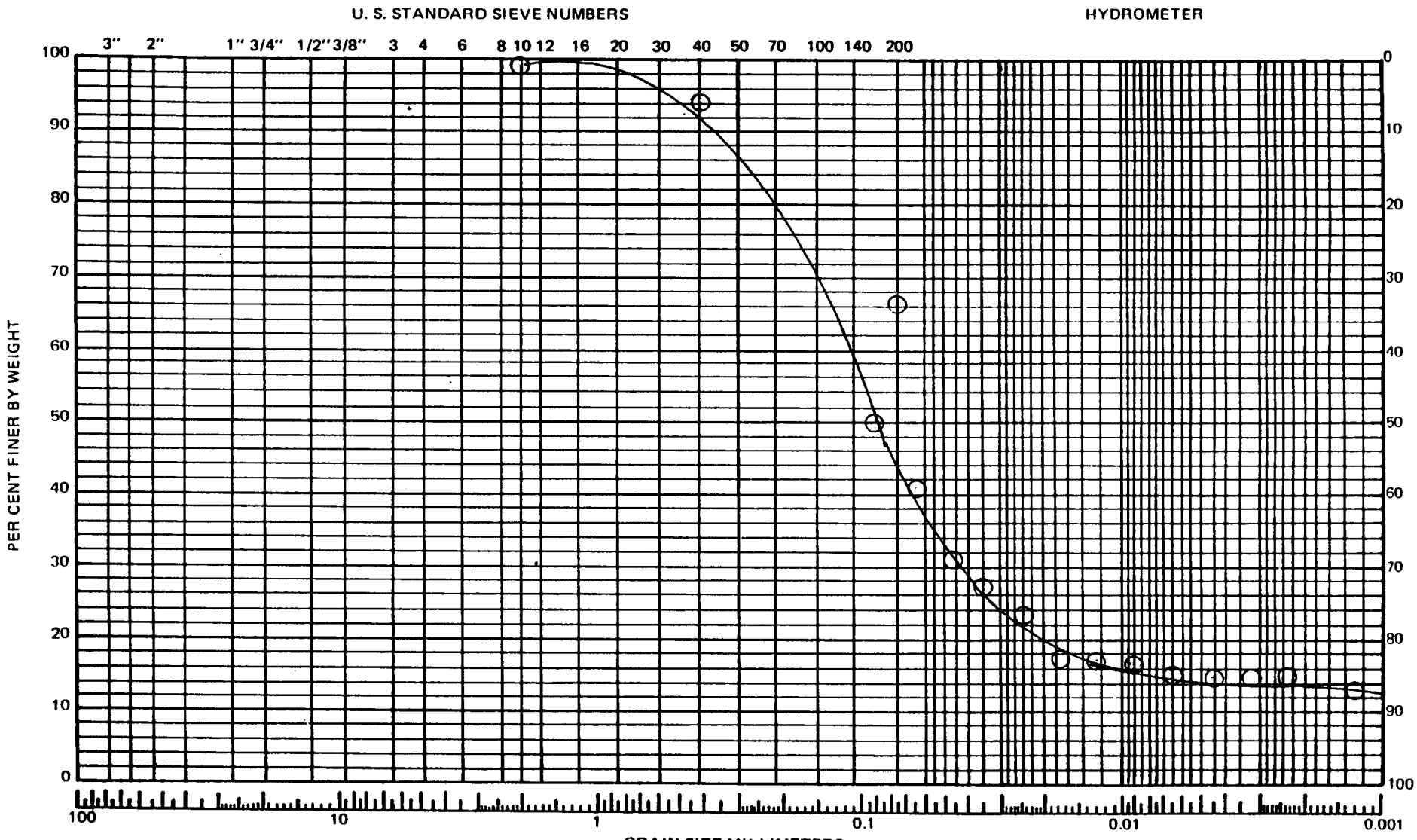
Liquid Limit = 25
Plastic Limit = 22
Plasticity Index = 3

Unified Soil Classification
ML

PROJECT: Law Environmental - Dry Cleaning Facility

IDENTIFICATION: DCF92-05GT 5'

GRAIN SIZE DISTRIBUTION DIAGRAM



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

% Sand = 56.0
% Silt = 30.0
% Clay = 14.0

Liquid Limit = 20
Plastic Limit = 20
Plasticity Index = N.P.

Unified Soil Classification
CL

PROJECT: Law Environmental - Dry Cleaning Facil

IDENTIFICATION: DCF92-06GT 20'

APPENDIX H

SURVEY DATA/SITE MAP

DRY CLEANERS AREA
MONITOR WELLS

POINT NO.	NORTH	EAST	GROUND ELEVATION	TOP OF CASING ELEVATION
MW 1	268,085.86	2,343,473.10	1090.3	1092.06
MW 2	267,955.20	2,343,330.67	1087.1	1089.03
MW 3	267,872.86	2,343,372.46	1084.77	1086.57
MW 4	267,837.57	2,343,056.57	1085.6	1087.37
MW 5	267,803.45	2,343,354.16	1083.0	1082.74
MW 6	268,047.65	2,343,358.34	1090.8	1092.40
MW 7	267,848.66	2,343,051.14	1086.1	1087.98

DRY CLEANERS AREA
SURFACE WATER POINTS

POINT NO.	NORTH	EAST	ELEVATION
SW 1	267,942.37	2,343,515.52	1061.8
SW 2	267,721.52	2,343,350.18	1055.5
SW 3	267,399.73	2,343,398.30	1045.5

DRY CLEANERS AREA
SEDIMENT SAMPLE

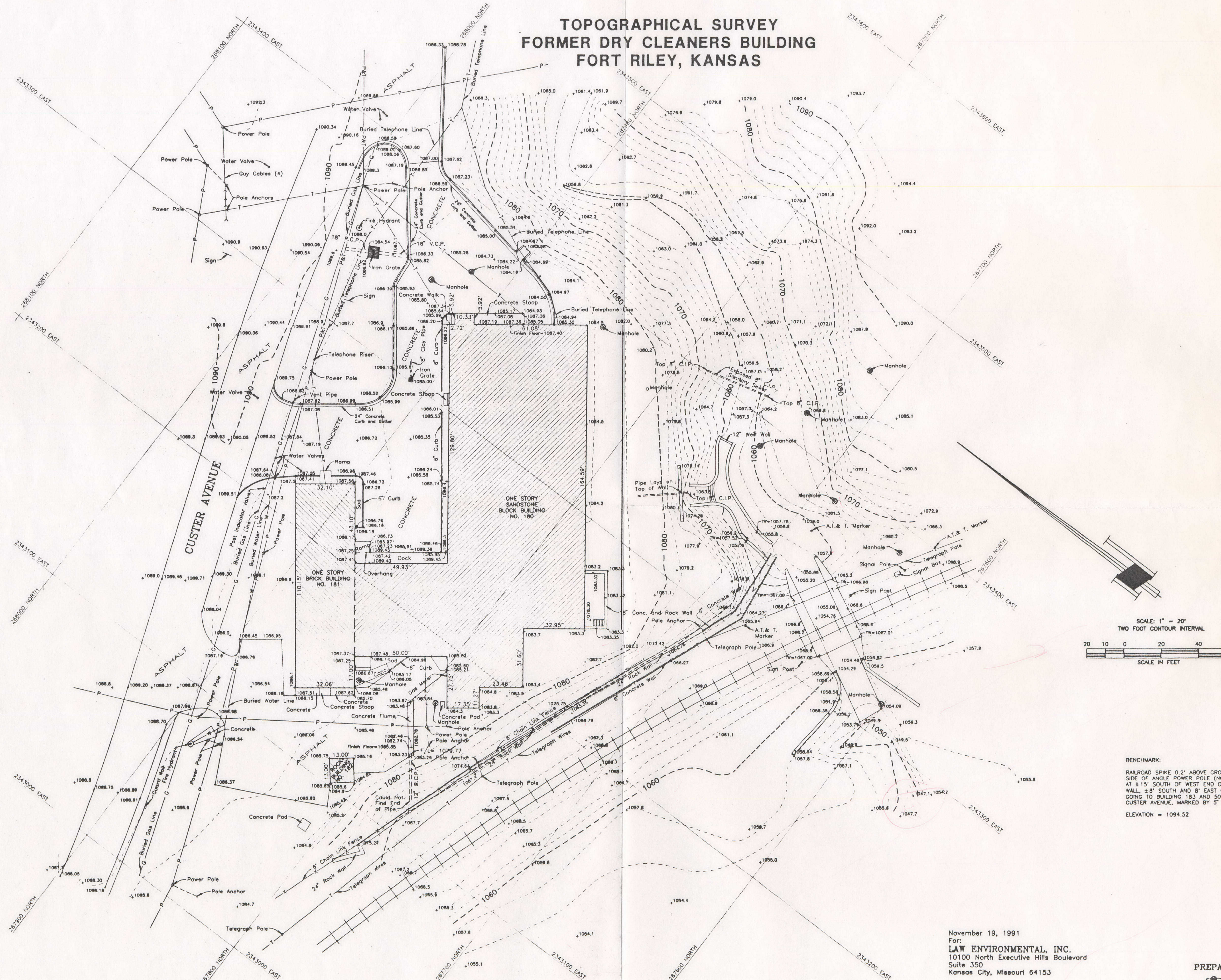
POINT NO.	NORTH	EAST	ELEVATION
SD 1	267,938.80	2,343,512.72	1062.1
SD 2	267,716.38	2,343,348.75	1055.8
SD 3	267,396.38	2,343,400.12	1046.0

DRY CLEANERS AREA
BORE HOLES

POINT NO.	NORTH	EAST	ELEVATION
SB 1	267,914.57	2,343,162.67	1086.2
SB 2	267,947.68	2,343,288.17	1087.6
SB 3	267,968.67	2,343,409.62	1087.6
SB 4	267,939.91	2,343,374.60	1085.50
SB 5	267,909.35	2,343,325.26	1085.54
SB 6	267,922.79	2,343.249.75	1086.93
SB 7	267,844.06	2,343,237.77	1085.88
SB 8	267,859.31	2,343,093.56	1086.23
SB 9	267,814.12	2,343.163.72	1084.84
SB 10	267,749.04	2,343,231.84	1083.1
SB 11	267,751.02	2,343,303.95	1081.7
SB 12	267,822.10	2,343,376.45	1083.0
SB 13	267,921.22	2,343,393.66	1085.3
SB 14	267,732.17	2,343,381.80	1062.6
SB 15	267,587.34	2,343,267.24	1057.4

FORT RILEY, KS
91-11-36383-2
36383DRY.DWG

TOPOGRAPHICAL SURVEY
FORMER DRY CLEANERS BUILDING
FORT RILEY, KANSAS



SCALE: 1" = 20'
TWO FOOT CONTOUR INTERVAL

20 10 0 20 40 60
SCALE IN FEET

BENCHMARK:

RAILROAD SPIKE 0.2' ABOVE GROUND IN SOUTH SIDE OF ANGLE POWER POLE (NORTH AND WEST) AT ±15' SOUTH OF WEST END OF WOLL RETAINING WALL, ±8' SOUTH AND 8' EAST OF STEPS TO NORTH GOING TO BUILDING 183 AND 50' NORTH OF C/L OF CUSTER AVENUE, MARKED BY 5" BY 5" YELLOW SIGN.

ELEVATION = 1094.52

November 19, 1991
For:
LAW ENVIRONMENTAL, INC.
10100 North Executive Hills Boulevard
Suite 350
Kansas City, Missouri 64153

Attn: Mr. Rick Nusy

PREPARED BY:

ANDERSON
SURVEY COMPANY
6412 EAST 87TH STREET
KANSAS CITY, MISSOURI 64138

FORT RILEY, KS
91-11-36383-2
36383DRY.DWG

DRN.	P.C.	CK.	APP.

APPENDIX I

MRD DATA/REVISED SAMPLING PROCEDURE

DEPARTMENT OF THE ARMY
Missouri River Division, Corps of Engineers
Division Laboratory
Omaha, Nebraska

Total Fuel Hydrocarbons PRELIMINARY

FAMIS No: 471
Project: Fort Riley - Dry Cleaning Facility; Fort Riley, KS

QC Sample Identifier: Method Blank
Date Sample Taken: NA **Customer Sample No:** NA
Date Sample Received: NA **MRD Lab Sample No:** 920511MB
Date Extracted: 11 May 92
Date Analyzed: 11 May 92

Analysis Method: EPA Method 8015 (Modified)

Sample Description: DI Water
Sample Container Used: 40 mL vial **Analyst:** M. Woster

RESULTS

A VOA Vial of DI water (44ml) was transferred to a 50 ml crimp-sealed septum top glass bottle and 5 µL of p-bromofluorobenzene (BFB) surrogate spike solution was added. The bottle was sealed, then heated in a water bath at 90°C for one hour. One milliliter of headspace gas was injected into the gas chromatograph.

Analysis for	Sample Result(µg/L)	Detection Limits (µg/L)
TFH, C6-C16	u	50

BFB Surrogate Recovery: 100.0%

u: Below Detection Limit

Approved By: David E. Splichal **Date:** 5-19-92

DEPARTMENT OF THE ARMY
Missouri River Division, Corps of Engineers
Division Laboratory
Omaha, Nebraska

PRELIMINARY

Total Fuel Hydrocarbons

FAMIS No: 471
Project: Fort Riley - Dry Cleaning Facility; Fort Riley, KS

QC Sample Identifier: Laboratory Duplicate
Date Sample Taken: 21 Apr 92 Customer Sample No: Core Water (DC92-04)
Date Sample Received: 22 Apr 92 MRD Lab Sample No: 920223-H016
Date Extracted: 11 May 92
Date Analyzed: 11 May 92

Analysis Method: EPA 8015 (Modified)

Sample Description: Water
Sample Container Used: 40 mL glass vial Analyst: M. Woster

RESULTS

A VOA vial of sample (44 ml) was transferred to a 50 ml crimp-sealed septum-top glass bottle and 5 µL of p-bromofluorobenzene (BFB) surrogate spike solution was added. The bottle was sealed, then heated at 90°C for one hour. One milliliter of headspace gas was injected into the gas chromatograph.

Analysis for	Sample Result 1	Sample Result 2	Detection Limits (µg/L)
TFH, C6-C16	243	160	50
BFB Surrogate Recovery (%)	89.2	67.5	

Average = 202 µg/L
RPD = 41

u: Below Detection Limit

Approved By: David E. Splichal Date: 5-19-92

11-5321 11
Dry Cleaning

DEPARTMENT OF THE ARMY
Missouri River Division, Corps of Engineers
Division Laboratory
Omaha, Nebraska

Total Fuel Hydrocarbons PRELIMINARY

FAMIS No: 471
Project: Fort Riley - Dry Cleaning Facility; Fort Riley, KS

Date Sample Taken: 21 Apr 92
Date Sample Received: 22 Apr 92
Date Extracted: 11 May 92
Date Analyzed: 11 May 92

Customer Sample No: Core Water (DC92-04)
MRD Lab Sample No: 920423-H016

Analysis Method: EPA Method 8015 (Modified)

Sample Description: Water
Sample Container Used: 40 mL glass vial

Analyst: M. Woster

RESULTS

A VOA vial of sample (44 ml) was transferred to a 50 ml crimp-sealed septum-top glass bottle and 5 µL of p-bromofluorobenzene (BFB) surrogate spike solution was added. The bottle was sealed, then heated at 90°C for one hour. One milliliter of headspace gas was injected into the gas chromatograph.

Analysis for	Result (µg/L)	Detection Limits (µg/L)
TFH, C6-C16	243	50
BFB Surrogate Recovery:	89.2%	

Lab Comment: The sample contains C9 to C12 petroleum hydrocarbons, similar to highly weathered gasoline or mineral spirits residues.

u: Below Detection Limit

Approved By: David E. Splichal **Date:** 5-19-92

LAW ENVIRONMENTAL, INC.

GOVERNMENT SERVICES BRANCH
114 TOWNPARK DRIVE, 4TH FLOOR
KENNESAW, GEORGIA 30144-5508
404-499-6800

July 10, 1992

Memorandum for: Commander Engineer District Kansas City
Attn: CEMRK-MD-H, Cpt. Carol Ann Charette
Kansas City, MO 64106

Subject: Technical Memorandum DCF-002, PSF-001, SFL-004: Sampling Procedure for Monitoring Wells at Southwest Funston Landfill (SFL), Pesticide Storage Facility (PSF) and the former Dry Cleaning Facility (DCF), Ft. Riley, Kansas. The sample collection procedure described below replaces the equipment and procedural descriptions in the following documents:

	SFL	PSF	DCF
Draft Modified Field Sampling Plan	Section 5.3, pg.5-28	Section 5.3 pg. 5-26	
Draft Modified Quality Assurance Plan	Section 4.1, pg.4-6	Section 4.1	
Draft Modified Chemical Data Aquisition Plan			Section 4.4 pg. 4-29

1. Purpose: The purpose of this memorandum is to describe the change in sampling procedure for the monitoring wells. Pursuant to the requirements as noted in Section XV, Paragraph E of the Federal Facilities Agreement (IAG), this memorandum was prepared for the EPA, KDHE and the administrative record to document the following modifications and/or changes in field work for the Southwest Funston Landfill, the Pesticide Storage Facility and the former Dry Cleaning Facility. These changes were agreed upon by the following Project Managers from the Corps of Engineers, Ft. Riley, KDHE, Law Environmental, and EPA Region 7:

Corps of Engineers:	Cpt. Carol Ann Charette
Ft. Riley:	Ms. Janet Wade
KDHE:	Ms. Rachel Miller
Law Environmental:	Mr. John Cook
EPA:	Mr. Scott Marquess

2. Issue/Background/Rationale: In an effort to collect less turbid samples from the groundwater monitoring wells at the above mentioned sites, a dedicated bladder pump system will be employed. The bladder pump is designed to deliver a flow stream of 100 mls/minute to help insure volatile organic compound integrity as well as maintaining a constant flow rate throughout the sampling process.

3. Action: The bladder pumps are manufactured by QED, Inc. model numbers T1200 and T1500; the bladder pump body will be constructed of Teflon/316 stainless steel and contain a teflon bladder. Each pump will be connected to polyethylene tubing with an inner teflon lining.

Installation

- The bladder pump will be placed in each well to optimize sampling volume and best represent aquifer conditions.

- For wells containing less than 5 feet of water, bladder pumps will be placed 1 foot above the bottom of screened interval. Bladder pumps will be placed 2 feet from the bottom of the screened interval in wells which contain less than 8 feet of water. In wells that contain 8 or more feet of water, the bladder pump will be placed at 5 feet above the bottom of the screened interval.

WELL TYPE	SITE	# OF PUMPS	AVG. WATER CLMN HEIGHT	PLACEMENT OF BLADDER PUMP FROM BOTTOM OF SCREENED INTERVAL
Shallow	DCF	6*	7 feet	2 feet
Shallow	PSF	5*	5 feet	2 feet
Shallow	SFL	8	7 feet	2 feet
Intermediate	SFL	4	20 feet	5 feet
Deep	SFL	8	40 feet	5 feet

* DCF-04, PSF-03 and PSF-04 wells will have bladder pumps placed at 1 foot above the screened interval.

- The bladder pumps will be placed well above the bottom of the screened interval to prevent possible interferences from fine particles and below the top of the water column to allow sufficient volume during sampling and purging. Eachbladder pump will have a protective screen to resist clogging or pump failure due to particulates.

- The bladder pump will be used to purge the well. Five casing volumes of water will be removed. Flow can be adjusted to yield up to a maximum of 1 gallon per minute (gpm) depending on water column height and well recharge. For example, a deep monitoring well at Southwest Funston Landfill with 40 feet of water would require 33 gallons (5 casing volumes) to be removed. If a maximum purge rate of 1 gpm could be established, this well would take 33 minutes to purge the required amount. However, due to slow recharge at the Pesticide Storage Facility and the Dry Cleaning Facility, a maximum gpm of 0.25 has been established. These wells typically have 7 feet of water which would require approximately 6 gallons of water (5 casing volumes) to be removed. At a gpm of 0.25 this would take 24 minutes to purge the required amount.

- After purging, each well will be sampled immediately providing parameters have stabilized (+/- 10% between two successive readings) and turbidity levels have reached 30 NTUS. If 30 NTUS cannot be reached the well will be allowed to stabilize. This would allow fine soil particles and silts to settle and would allow sufficient time for ground water to recharge to volumes required for sampling. The well will be checked periodically for water "clarity". All wells will be sampled within 5 hours after purging regardless of turbidity levels.

- If a well contains insufficient volume to meet the 5 casing volume purge criteria, the well will be purged dry three times and sampled when sufficient recharge has occurred.

- Sample collection occurs when the teflon bladders are inflated with air and ground-water is discharged. The sample does not come in contact with the air used to inflate the bladder; therefore, no contamination is introduced into the system via air.

4. Impacts/Conclusion: The proposed modification to the Sampling Procedure will impact the schedule for the projects. Ground-water sampling for the Pesticide Storage Facility will begin approximately July 14 and end July 16, 1992. Sampling at the Dry Cleaning Facility will begin approximately July 17 to July 20, 1992. Ground water sampling for Southwest Funston Landfill will begin approximately July 21 and end by July 30, 1992.

Sincerely,

Law Environmental, Inc.

Judith A. Hartness
Project Chemist

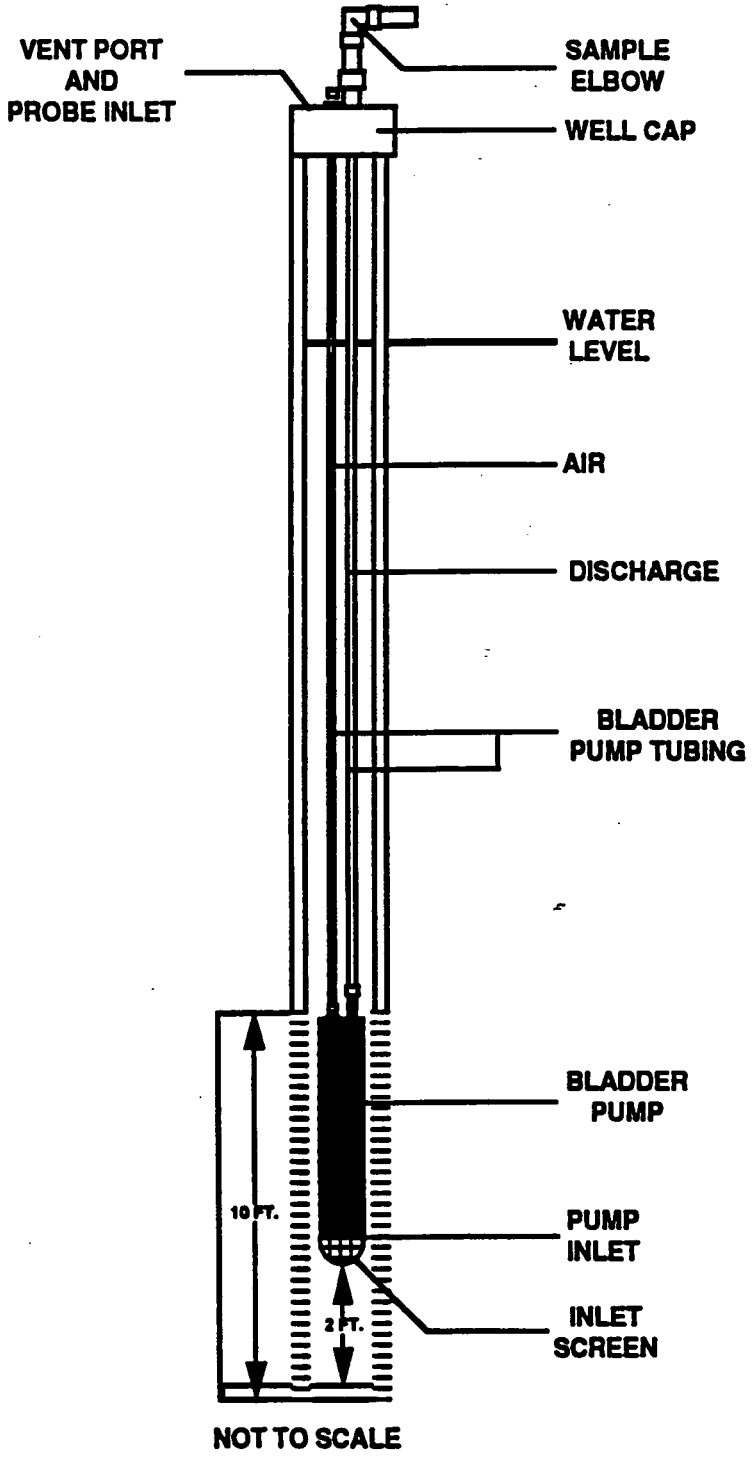
for Kevin M. Rockhold
Gregory P. Myers, P.G.
Project Principal

JAH/dsl

Attachments

cc: Scott Marquess, Region VII, EPA
Janet Wade, DEH, Ft. Riley
Cpt. Carol Ann Charette, COE

DEDICATED WELL SYSTEM
BLADDER PUMP
DRY CLEANING FACILITY
FT. RILEY, KANSAS



NOT TO SCALE

WELL WIZARD

WELL SYSTEM BLADDER PUMP

INSTRUCTIONS

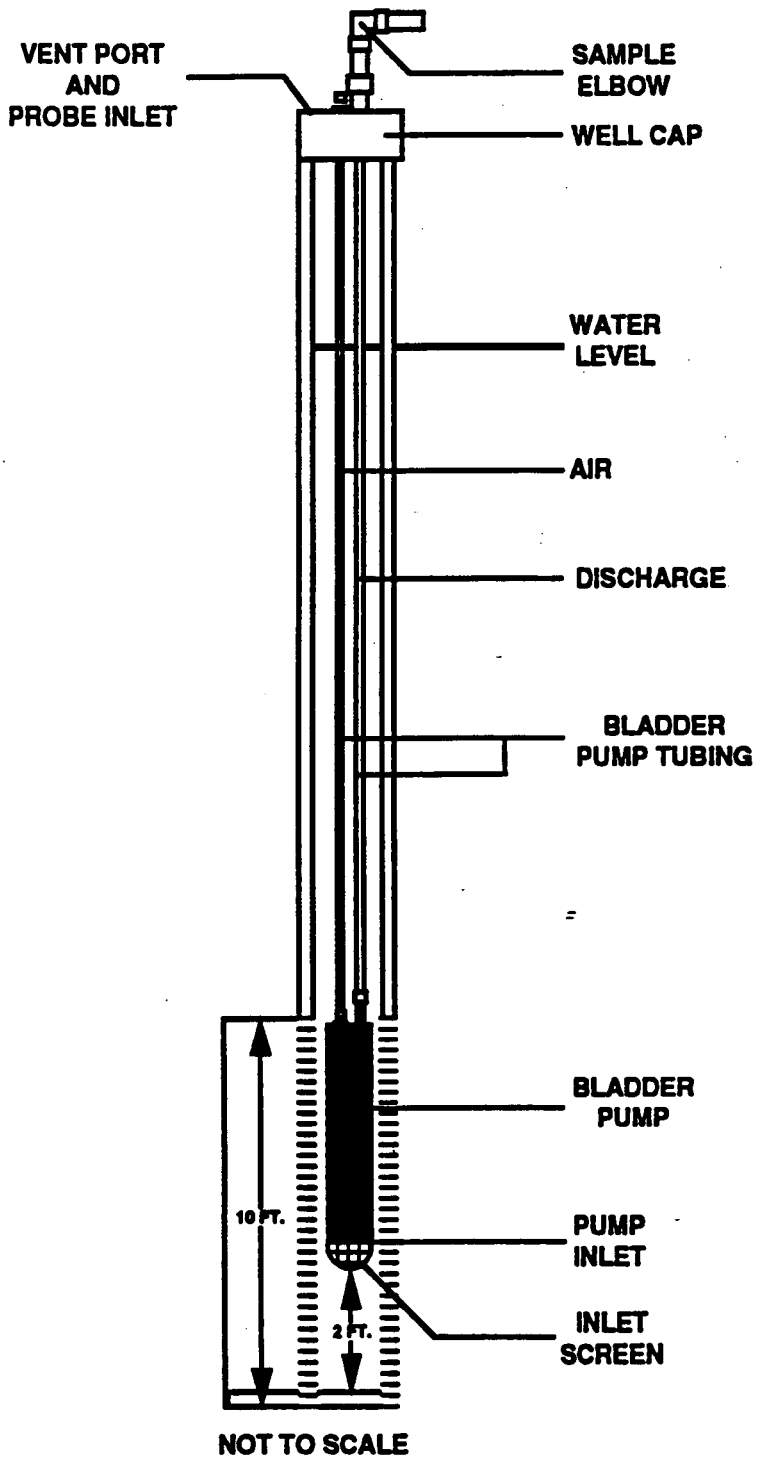
1. ATTACH INLET SCREEN TO BLADDER PUMP (IF APPLICABLE).
2. ATTACH BLADDER PUMP TUBING TO PUMP.
3. LOWER PUMP TO DESIRED DEPTH.
4. PASS DISCHARGE TUBE THROUGH CAP AND ATTACH AIR LINE UNDER CAP.

SOURCE: SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES BRANCH

MFJH

DEDICATED WELL SYSTEM
BLADDER PUMP
PESTICIDE STORAGE FACILITY
FT. RILEY, KANSAS



NOT TO SCALE

WELL WIZARD

WELL SYSTEM BLADDER PUMP

INSTRUCTIONS

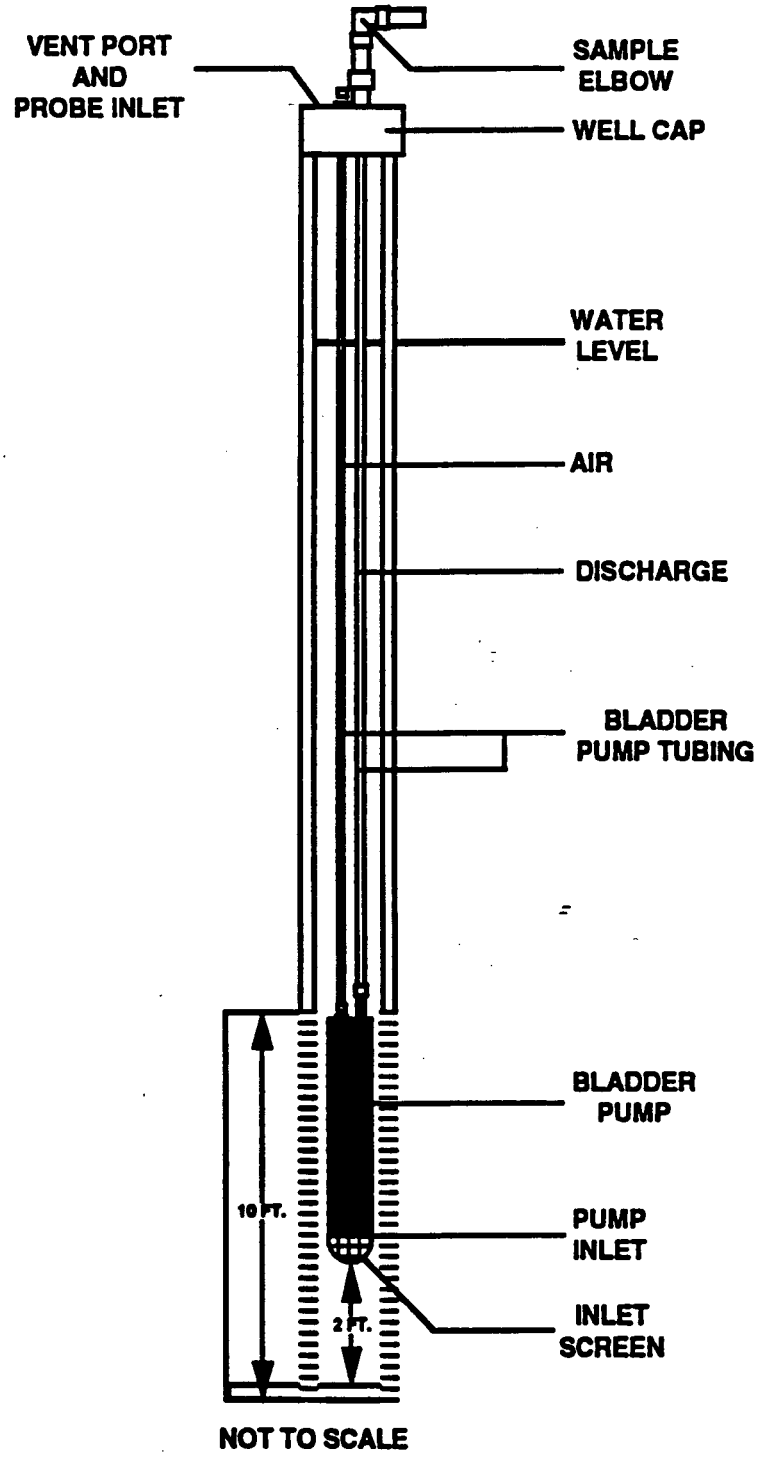
1. ATTACH INLET SCREEN TO BLADDER PUMP (IF APPLICABLE).
2. ATTACH BLADDER PUMP TUBING TO PUMP.
3. LOWER PUMP TO DESIRED DEPTH.
4. PASS DISCHARGE TUBE THROUGH CAP AND ATTACH AIR LINE UNDER CAP.

SOURCE: SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

MFJH

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES BRANCH

DEDICATED WELL SYSTEM
BLADDER PUMP
SOUTHWEST FUNSTON LANDFILL
SHALLOW WELLS
FT. RILEY, KANSAS



NOT TO SCALE

WELL WIZARD

WELL SYSTEM BLADDER PUMP

INSTRUCTIONS

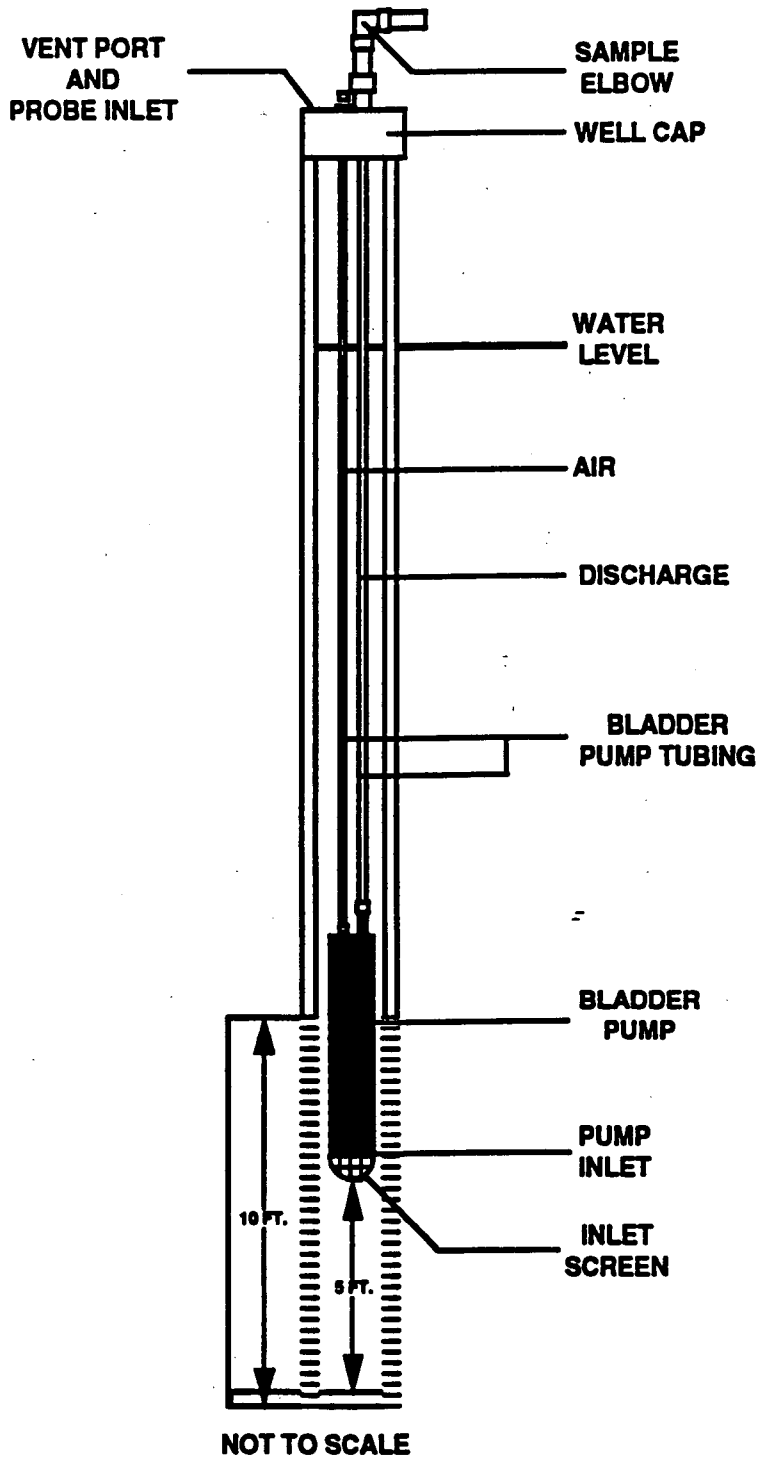
1. ATTACH INLET SCREEN TO BLADDER PUMP (IF APPLICABLE).
2. ATTACH BLADDER PUMP TUBING TO PUMP.
3. LOWER PUMP TO DESIRED DEPTH.
4. PASS DISCHARGE TUBE THROUGH CAP AND ATTACH AIR LINE UNDER CAP.

SOURCE: SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES BRANCH

MFJH

DEDICATED WELL SYSTEM
BLADDER PUMP
SOUTHWEST FUNSTON LANDFILL
INTERMEDIATE AND DEEP WELLS
FT. RILEY, KANSAS



NOT TO SCALE

WELL WIZARD

WELL SYSTEM BLADDER PUMP

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1. ATTACH INLET SCREEN TO BLADDER PUMP (IF APPLICABLE).
2. ATTACH BLADDER PUMP TUBING TO PUMP.
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4. PASS DISCHARGE TUBE THROUGH CAP AND ATTACH AIR LINE UNDER CAP.

SOURCE: SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

MFJH

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES BRANCH