8967

US Army Corps of Engineers

Toxic and Hazardous
Materials Agency

FINAL TECHNICAL PLAN

Including the Final Sampling and Analysis Plan Final Quality Assurance Project Plan

Fort Douglas
Environmental Investigation/Alternatives Analysis

Contract Number DAAA-15-90-D-0018
Task Order 0005, Data Items A004, A016, A005

Prepared For

Commander
U.S. Army Toxic and Hazardous Materials Agency
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September 1991

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FINAL TECHNICAL PLAN

SEPTEMBER 1991

CONTRACT NO. DAAA-15-90-D-0018

TASK ORDER 0005

FORT DOUGLAS
ENVIRONMENTAL INVESTIGATION/ALTERNATIVES ANALYSIS

Prepared by:

R. L. STOLLAR & ASSOCIATES INC.
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Prepared for:

U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY

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LIST OF ACRONYMS AND ABBREVIATIONS

AA	Alternatives Analysis
ACBM	asbestos containing building material
ACM	asbestos containing material
AHERA	Asbestos Hazard Emergency Response Act
ARAR	Applicable or Relevant and Appropriate Requirements
AREE	area requiring environmental evaluation
BAT	best available technology
BETX	benzene, ethylbenzene, toluene, and xylenes
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
cfs	cubic feet per second
CLP/RAS	Contract Laboratory Program/Routine Analytical Service
COR	Contracting Officer's Representative
DEH	Directorate of Engineering and Housing
DOMW	(Fort) Douglas Monitoring Well
DQO	data quality objective
EI	Environmental Investigation
EPA	U.S. Environmental Protection Agency
ESE	Environmental Science and Engineering, Inc.
ESO	environmentally significant operation
FEIS	Final Environmental Impact Statement
ft	feet
HASP	Health and Safety Plan
IRDMS	Installation Restoration Data Management System
MCL	maximum contaminant level
NCO	noncommissioned officer
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollution Discharge Elimination System
OVA	organic vapor analyzer

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

PA	Preliminary Assessment
PCB	polychlorinated biphenyl
ppb	parts per billion
ppm	parts per million
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SLC	Salt Lake City
SOP	standard operating procedure
SVOC	semivolatile organic compound
TCL	Target Compound List
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
USATHAMA	United States Army Toxic and Hazardous Materials Agency
USCS	Unified Soil Classification System
USDA	United States Department of Agriculture
UST	underground storage tank
UU	University of Utah
VOC	volatile organic compound

1.0 INTRODUCTION

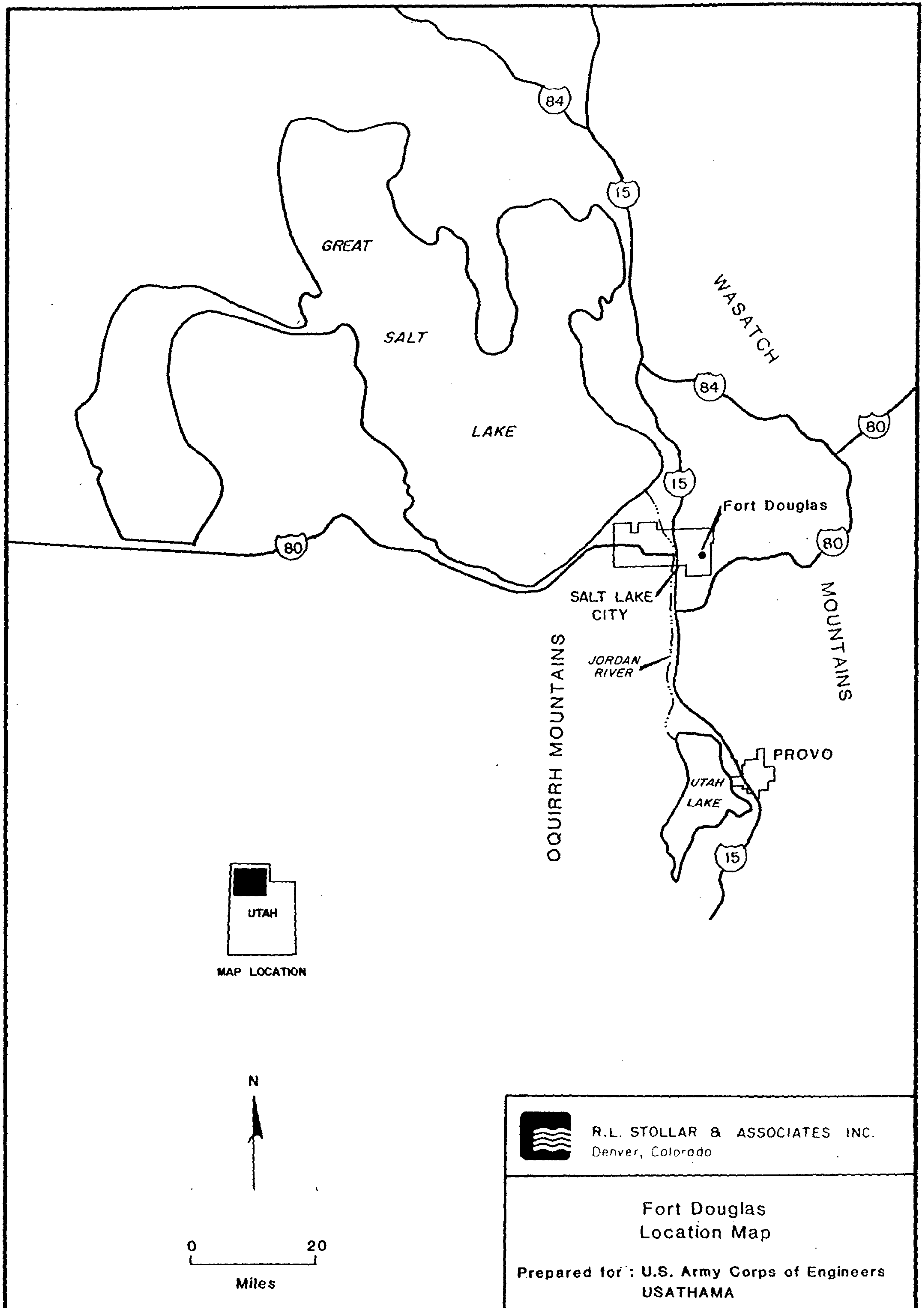
Fort Douglas, an Army installation located east of Salt Lake City, Utah, (Figure 1-1) was recommended for closure and realignment by the Defense Secretary's Commission on Base Realignment and Closure in December 1988. The U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) has the authority for centrally managing the environmental investigation portion of the Base Closure Program. In order to facilitate the closure of Fort Douglas, an enhanced Preliminary Assessment (PA) and Final Environmental Impact Statement (FEIS) have been completed. Based on the recommendations of the PA, additional environmental investigations will be conducted as part of an Environmental Investigation/Alternatives Analysis (EI/AA).

1.1 PURPOSE

The closure and realignment of Fort Douglas, a subinstallation of Fort Carson, Colorado, will result in the reassignment of its functions to other installations. (Fort Carson has, and will continue to provide environmental support to Fort Douglas). Following closure, approximately 51 acres of the approximately 119-acre Fort Douglas installation will be declared as excess property for public disposal (Figure 1-2). The remaining acreage will be retained by the federal government for use as a military Reserve Center. In preparation for excessing approximately 51 acres of Fort Douglas, the tasks of the EI/AA, as delineated in the Technical Plan, will be performed from the perspective of a property transfer assessment. The property transfer assessment will involve environmental studies consisting of (1) an investigative phase to determine the nature and extent of any areas of environmental concern, (2) a risk assessment phase to characterize risk to human health and the environment, and (3) an alternatives assessment phase to develop and evaluate remedial action alternatives. A Decisions Document will be developed in response to the findings of these studies and in response to public comment.

1.2 SCOPE

The Technical Plan is a component of a work plan package which provides overall technical guidance for the Fort Douglas EI/AA. The work plan package also includes a Sampling and Analysis Plan (SAP), which provides a detailed description of the EI/AA sampling program, including types of sampling, sample locations, and analytical suites; the Quality Assurance Project Plan (QAPP), which contains field and laboratory protocols designed to ensure the collection of complete, representative, comparable, precise, and accurate data; and the Health and Safety Plan (HASP), which provides



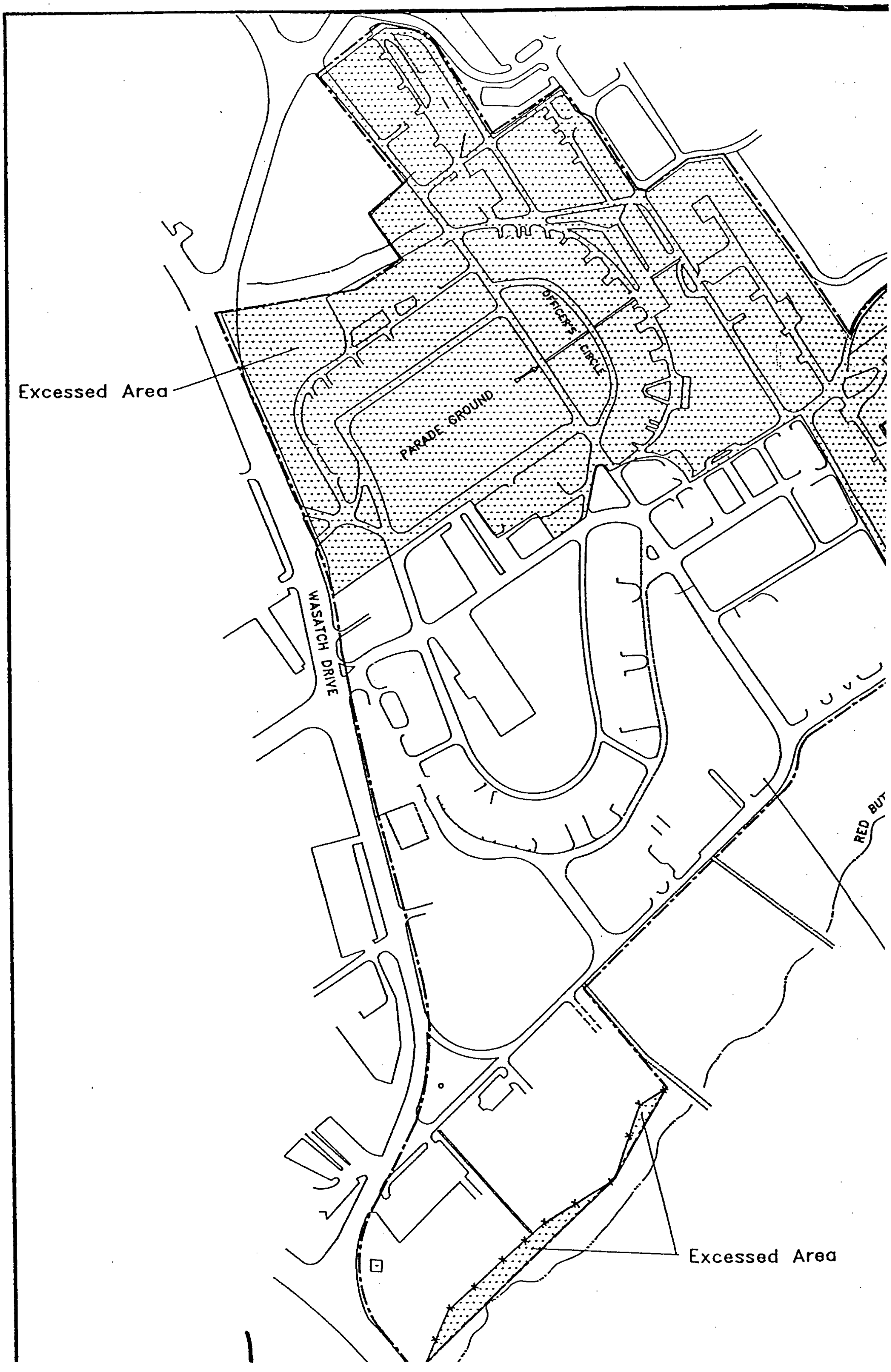
R.L. STOLLAR & ASSOCIATES INC.
Denver, Colorado

Fort Douglas
Location Map

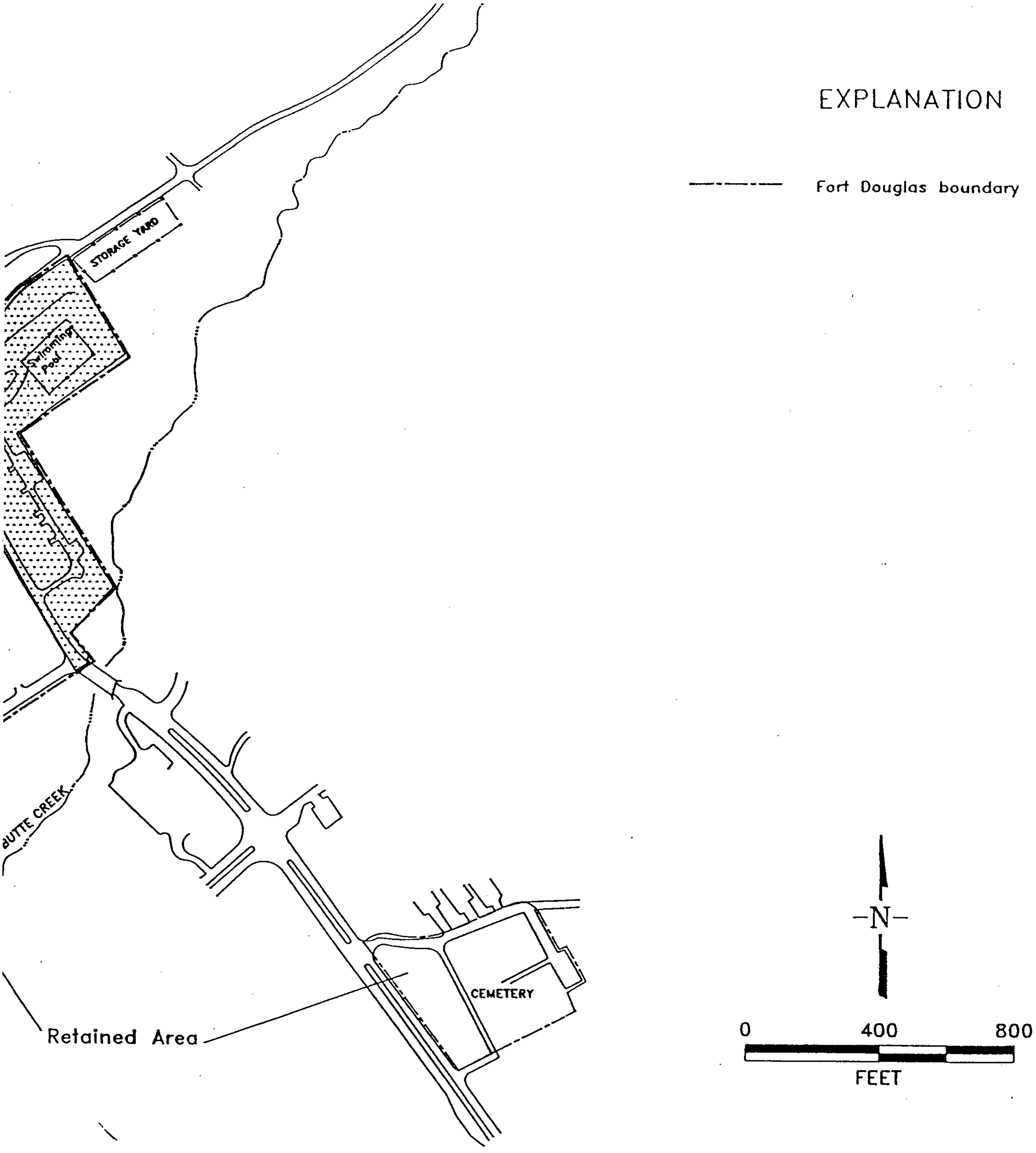
Prepared for : U.S. Army Corps of Engineers
USATHAMA

Date: **May, 1991**

Figure **1-1**


Excessed Area

Excessed Area



R.L. STOLLAR & ASSOCIATES INC.
Ground-Water Consultants

Site Plan
Fort Douglas

Prepared for:
U.S. Army Corps of Engineers
USATHAMA

Date: August 1991

Figure 1–2

2

procedures which will be implemented during the field program to minimize associated risks to human health. A separate Asbestos Sampling Plan describes the sampling program that will be used to identify asbestos or asbestos containing material (ACM). The plans incorporate the results and recommendations of the PA and will be used as a basis for performing the EI and associated field work.

1.3 SITE HISTORY

Fort Douglas was established as Camp Douglas on October 26, 1862, near Salt Lake City, Utah, primarily to guard the Overland Mail route from hostile Indians and protect the lines of communication that linked the East and West Coasts. In addition, the presence of the camp served to quell any opposition to the federal government from the Mormon settlers. The camp was officially redesignated as Fort Douglas in 1878. In the first 50 years of the 20th century, Fort Douglas was used to garrison troops, house prisoners-of-war, and serve as headquarters for military units.

Original site boundaries included approximately 2,560 acres. Additional land acquisitions occurred primarily between 1867 and 1909 when Fort Douglas reached a maximum of approximately 7,900 acres.

The first structures at Fort Douglas were hastily constructed primarily of logs or adobe. In the 1870's, most of the original buildings were replaced with locally quarried red sandstone buildings, many of which remain intact today. Additional building programs were implemented primarily between 1904 and 1910, from 1928 through the 1930's, and in 1941.

In 1948, activities at Fort Douglas were curtailed to the point that the U.S. Government decided to turn over a large portion of Fort Douglas to the War Assets Administration. Since this time, Fort Douglas has been used as headquarters for Reserve and National Guard units and a support detachment for military activities in the region. The present acreage of Fort Douglas is approximately 119 acres. Excessed properties have been transferred primarily to other government agencies and the University of Utah.

1.4 REGULATORY FRAMEWORK

The environmental investigations in support of the Fort Douglas closure are being managed by U.S. Army Corps of Engineers, Toxic and Hazardous Materials Agency (USATHAMA) under the Base

Closure Program. The closure and subsequent transferral of the property must be conducted in accordance with the provisions of Section 120(h), "Federal Facilities, Property Transferred by Federal Agencies" of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA). This section stipulates that the transferral of Federal properties is dependent on the evaluation of hazardous substances which are known or suspected to be present at the site. It also requires that any remedial action which is necessary to control releases to the environment be conducted prior to the transfer.

As required, the EI/AA will be conducted in accordance with the requirements of the National Contingency Plan (NCP) and the National Environmental Policy Act (NEPA) and is structured according to guidelines provided by the U.S. Environmental Protection Agency (EPA) and USATHAMA.

2.0 SITE BACKGROUND

The site background of Fort Douglas has been discussed in several previous reports directed by the Army (ESE, 1983; Weston, 1988; Weston, 1989, Dames and Moore, 1991). The following sections present a summary of the physical setting of the site as well as a physical description of the facility. These discussions are based primarily on information compiled from previous investigations; however, additional sources were used and are noted when applicable.

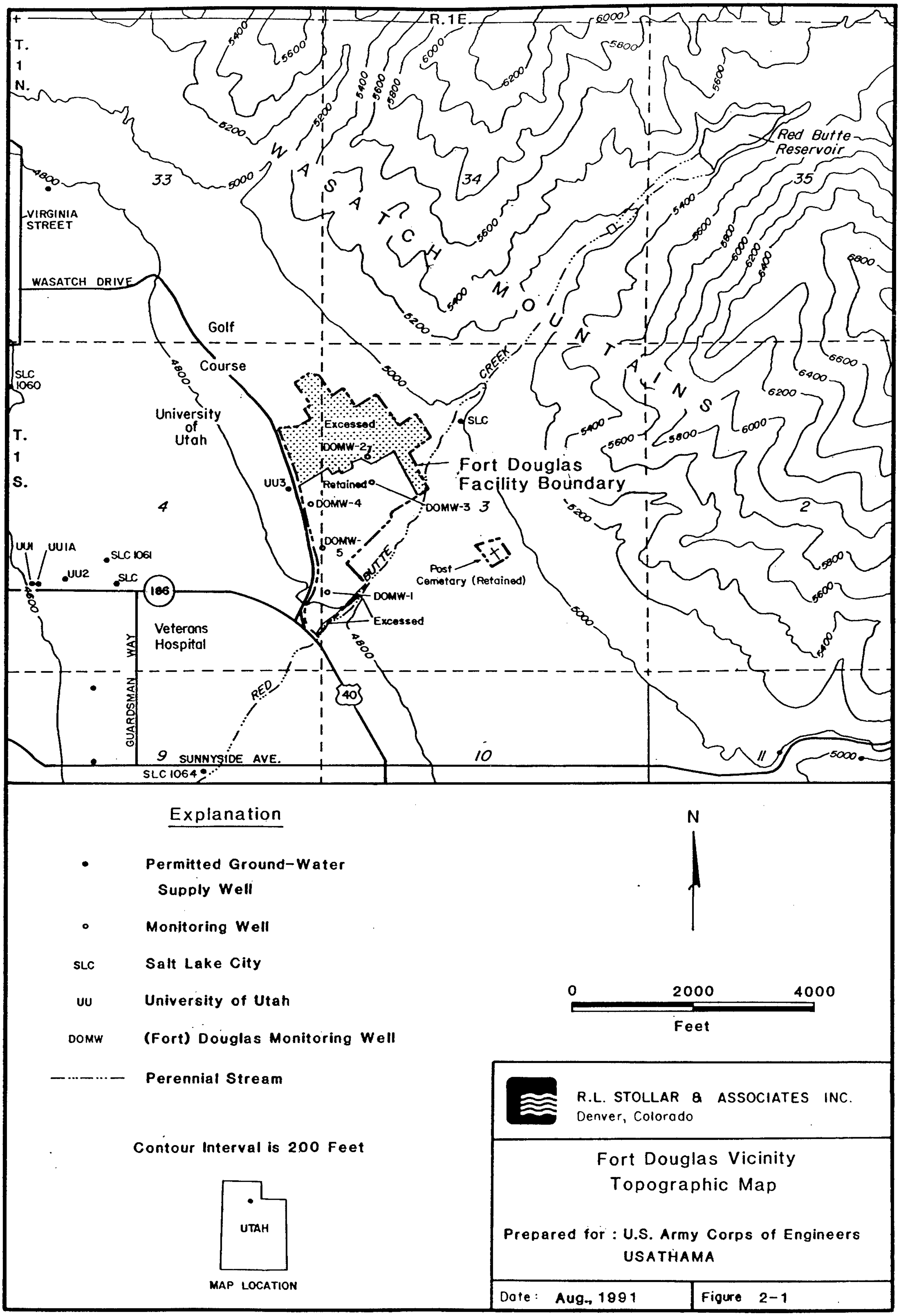
2.1 PHYSICAL SETTING

Fort Douglas is located on the western slope of the Wasatch Mountains approximately 3 miles east of downtown Salt Lake City, in Salt Lake County, Utah. It is on the eastern edge of the Basin and Range Province and Great Basin sub-Province. The current acreage of Fort Douglas is 119 acres. Four of these acres consist of a post cemetery located less than a mile southeast of the main installation (Figure 2-1).

2.1.1 GEOLOGY

Most of Fort Douglas is underlain by Quaternary alluvial fan deposits, consisting of poorly sorted, clast-supported pebble and cobble gravel, locally containing boulders, in a matrix of sand and silty sand. The alluvial fan deposits are underlain by lacustrine deposits of ancient Lake Bonneville. Lacustrine deposits of the transgressive phase of the Bonneville lake cycle, consisting of clay and silt with a minor amount of fine sand, locally containing medium to coarse sand and pebble gravel, have been mapped at the ground surface near the post cemetery (Personius et al., 1990). The thickness of the alluvium at Fort Douglas is unknown, but is inferred to be at least 750 feet (ft) based on a lithologic log of a University of Utah Well (UU3) installed adjacent to Fort Douglas. The alluvial deposits thin to the west and unconformably overlie Lower Jurassic and older rocks, consisting primarily of sandstone, shale, and limestone.

The eastern Salt Lake Valley area, along the front of the Wasatch Mountains, is seismically active. A generally north-south trending fault zone marks the western extent of the Wasatch Mountains. This zone consists of many types of faults, of varying ages. Faults trending northwest-southeast and northeast-southwest have been identified within one-half mile both east and west, respectively, of Fort Douglas (Davis, 1983).



Explanation

●	Permitted Ground-Water Supply Well
○	Monitoring Well
SLC	Salt Lake City
UU	University of Utah
DOMW	(Fort) Douglas Monitoring Well
—·····—	Perennial Stream

Contour Interval is 200 Feet

R.L. STOLLAR & ASSOCIATES INC.
Denver, Colorado

Fort Douglas Vicinity
Topographic Map

Prepared for : U.S. Army Corps of Engineers
USATHAMA

Date: Aug., 1991 Figure 2-1

2.1.2 SOILS

Most of the soil at Fort Douglas is classified as Bingham gravelly loam which formed in gravelly alluvium on moderate slopes (USDA, 1974). The Bingham series consists of well-drained soils on high lake terraces and alluvial fans near the base of the Wasatch Mountains. Soil depth typically is 5 ft or more. This series is characterized by rapid intake of water and moderately high permeability. Along Red Butte Creek (Figure 2-1), the soil material is rocky and shallow and cannot be classified by soil series. It is classified as a miscellaneous land type, identified as stony terrace escarpments. Timpanogos sandy loam is found at the post cemetery. This series consists of well-drained soils formed on lake terraces. Intake of water and permeability are moderate.

2.1.3 HYDROGEOLOGY

Surface water from the Wasatch Mountains flows west to the Jordan River. The Jordan River flows northward along the west side of Salt Lake City from Utah Lake, near Provo, Utah to the Great Salt Lake. In the vicinity of Fort Douglas, surface water occurs in Red Butte Creek which is a perennial stream flowing southwest from the Wasatch Mountains. Red Butte Creek has a relatively constant baseflow of 2.5 cubic feet per second (cfs) from October to February. Peak flows occur in the spring. Between 1963 and 1980, the mean annual flow was 4.1 cfs and maximum discharge was 60 cfs. Approximately 1.5 miles upstream of Fort Douglas, water from Red Butte Creek is stored in Red Butte Reservoir. The Army constructed the reservoir in 1930 as a source of potable water for the installation. Since 1986, Fort Douglas has been connected to the Salt Lake City water supply.

The 51 acres of Fort Douglas to be excessed are located outside both the 100-year and 500-year flood plains of Red Butte Creek (Weston, 1989). The combined 100- and 500-year floodplains extend less than 500 ft from Red Butte Creek (FEMA, 1983). No lakes or ponds exist in the area to be excessed. Storm runoff from Fort Douglas is diverted through underground storm drains to the Salt Lake City system. Surface runoff from the eastern edge of the excessed area can also enter Red Butte Creek.

In the Salt Lake Valley, ground water occurs in both a confined aquifer and a shallow-unconfined aquifer overlying the confined aquifer (Seiler et al, 1984). Near the Wasatch Mountains, the confining unit is absent, and ground water is present in basin fill materials in a deep unconfined aquifer and may occur locally in perched aquifers, where saturated discontinuous lenses of sand and gravel lie above the water table (Price, 1985). Water supply wells in the vicinity of Fort Douglas produce water from the regional unconfined aquifer. These wells are owned by the University of Utah and the Salt

Lake City Water Department (Figure 2-1). The aquifer has been logged as a thick alluvial sequence of poorly sorted coarse sand and gravel. Water levels in these wells range from 338 ft below ground surface (bgs) in a university well (UU3) adjacent to Fort Douglas to 105 ft bgs in Salt Lake City Well 1060, approximately 1 mile northwest of Fort Douglas. Ground-water flow in this deep regional aquifer is generally west to southwest. Recharge to the aquifer primarily results from seepage from streams and underflow in the alluvium of stream channels, such as Red Butte Creek; subsurface flow from the mountains; and seepage from precipitation, irrigation ditches, and canals (Price, 1985). The depth to ground water decreases to the west of the Fort Douglas area.

Five monitoring wells were installed at Fort Douglas in November and December 1990 to investigate underground storage tanks (USTs) located in the proposed retained area (Figure 2-1). Two of the USTs and one of the monitoring wells (Well DOMW-2) are located in the area of Fort Douglas currently planned to be excessed. No saturated zones were penetrated during drilling of DOMW-2; however, 4 to 6 in. of water were measured after completion of the monitoring well. Similar observations were noted for Well DOMW-3. A saturated unit was reached in one of the wells (Well DOMW-1) between 17 and 20 ft bgs in a silty clay unit. The static perched ground-water level was 24 ft bgs. Sufficient quantities of water were not available in Wells DOMW-1, DOMW-2, and DOMW-3 to collect samples for analysis; no ground water was measured in any of the other wells.

2.1.4 TOPOGRAPHY

The elevation of Fort Douglas ranges from approximately 4,800 ft above sea level to 4,960 ft above sea level (Figure 2-1). The topography of the site dips gently to the west, toward the Great Salt Lake. To the east of Fort Douglas, the surface rises steeply toward the Wasatch Mountains.

2.1.5 CLIMATE

Salt Lake City has a semi-arid intermountain climate with well-defined seasons. The climate is influenced by the altitude, the Wasatch and Oquirrh Mountains, and the Great Salt Lake (Figure 1-1). The annual precipitation is 15.31 in, and the majority of the precipitation falls during March, April, and May. Temperatures are moderated by the Great Salt Lake which never freezes due to high salt content. Average monthly temperatures range from 28.6°F in January to 77.5°F in July. The prevailing winds are from the south-southeast, and annual average wind speeds are approximately 9 miles per hour.

2.1.6 LAND USE

Fort Douglas is located on the edge of the metropolitan area of Salt Lake City. It is generally surrounded by lands used for various institutional purposes. The University of Utah administers most of the properties adjoining Fort Douglas and the post cemetery. The Veterans Administration Hospital occupies an area to the south of Fort Douglas. Fort Douglas Golf Course is located north of Fort Douglas. Immediately to the east of Fort Douglas open foothill lands lead into the Wasatch-Cache National Forest. The Forest Service, in conjunction with local governments, manages the forest, which includes a portion of the foothills. The Army retains water rights and responsibilities for Red Butte Reservoir and its facilities, located within the forest. Red Butte Canyon has been designated by the Forest Service as a Research Natural Area. Research Natural Areas are relatively undisturbed areas that are closed to the public; only researches are allowed access. Red Butte Canyon has been closed to the public since 1910, and research is conducted in this area by the University of Utah.

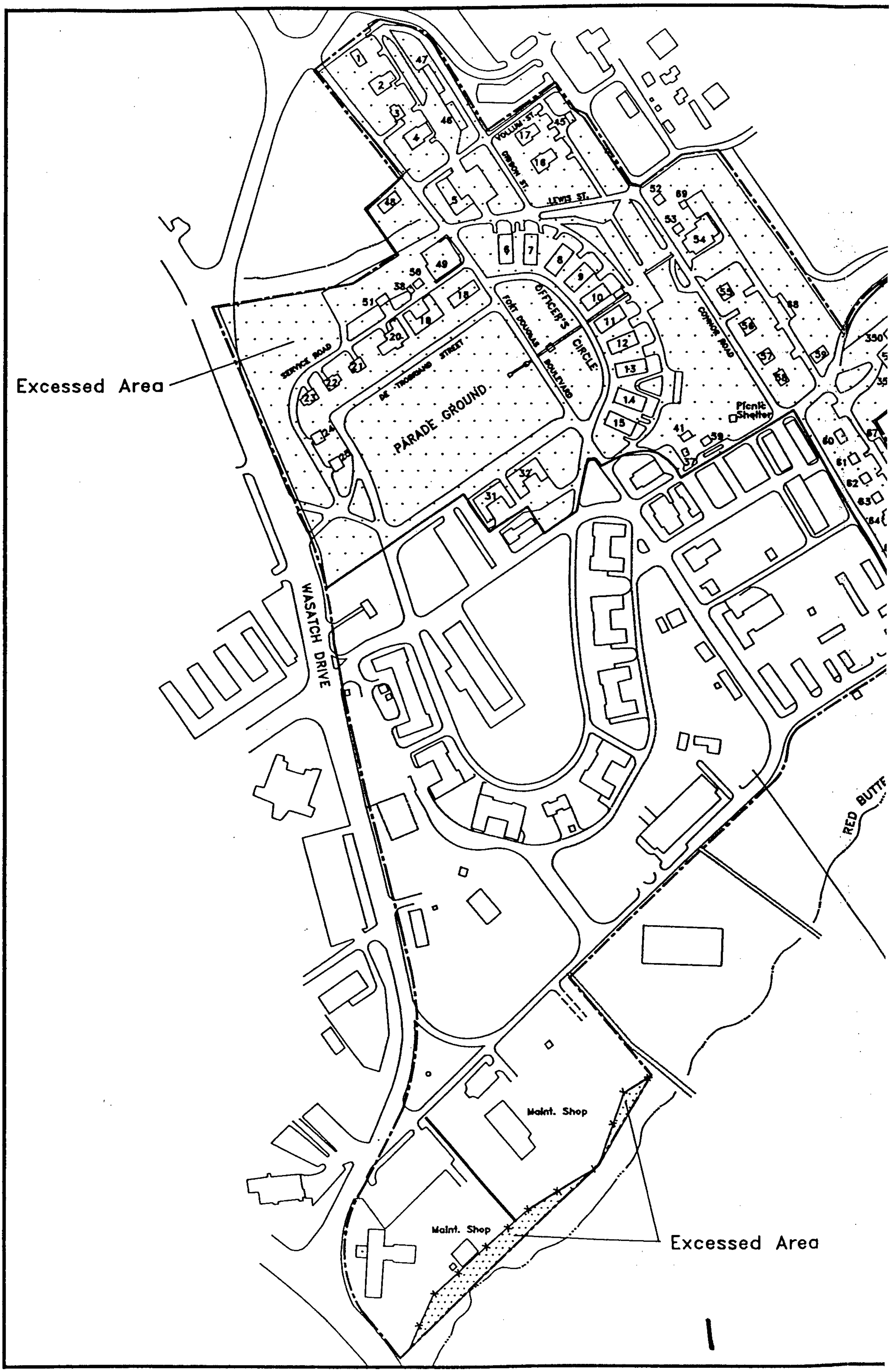
With the exception of university student housing, residential properties are not located in the vicinity of Fort Douglas. Residential communities are located approximately two-thirds of a mile to the north, west, and south of the university property.

2.2 FACILITY DESCRIPTION

The approximately 119-acre installation includes 117 structures, including 36 housing structures containing 61 housing units (Figure 2-2). One hundred of the structures are of permanent construction (red brick, sandstone, or concrete), in good to excellent condition, and structurally sound with an estimated life of 50 more years with proper and timely maintenance (Dames and Moore, 1991).

Approximately 36 acres of Fort Douglas, including the 4-acre post cemetery have been entered in the National Register of Historic Places. In addition, an area encompassing approximately 49 acres (incorporating most of the National Register district but excluding the cemetery) has been upgraded to the status of a National Historic Landmark, and additional buildings were identified as historically significant.

The approximately 51-acre area to be excessed includes 69 structures (Figure 2-2). The type of structures are summarized as follows:



Excessed Area
Excessed Area
WASATCH DRIVE
PARADE GROUND
OFFICER'S CIRCLE
FORT DOUGLAS BOULEVARD
DE TROBRIAND STREET
SERVICE ROAD
VOLLUM ST.
GIBBON ST.
LEWIS ST.
CONNOR ROAD
Picnic Shelter
Maint. Shop
Maint. Shop
RED BUTTE
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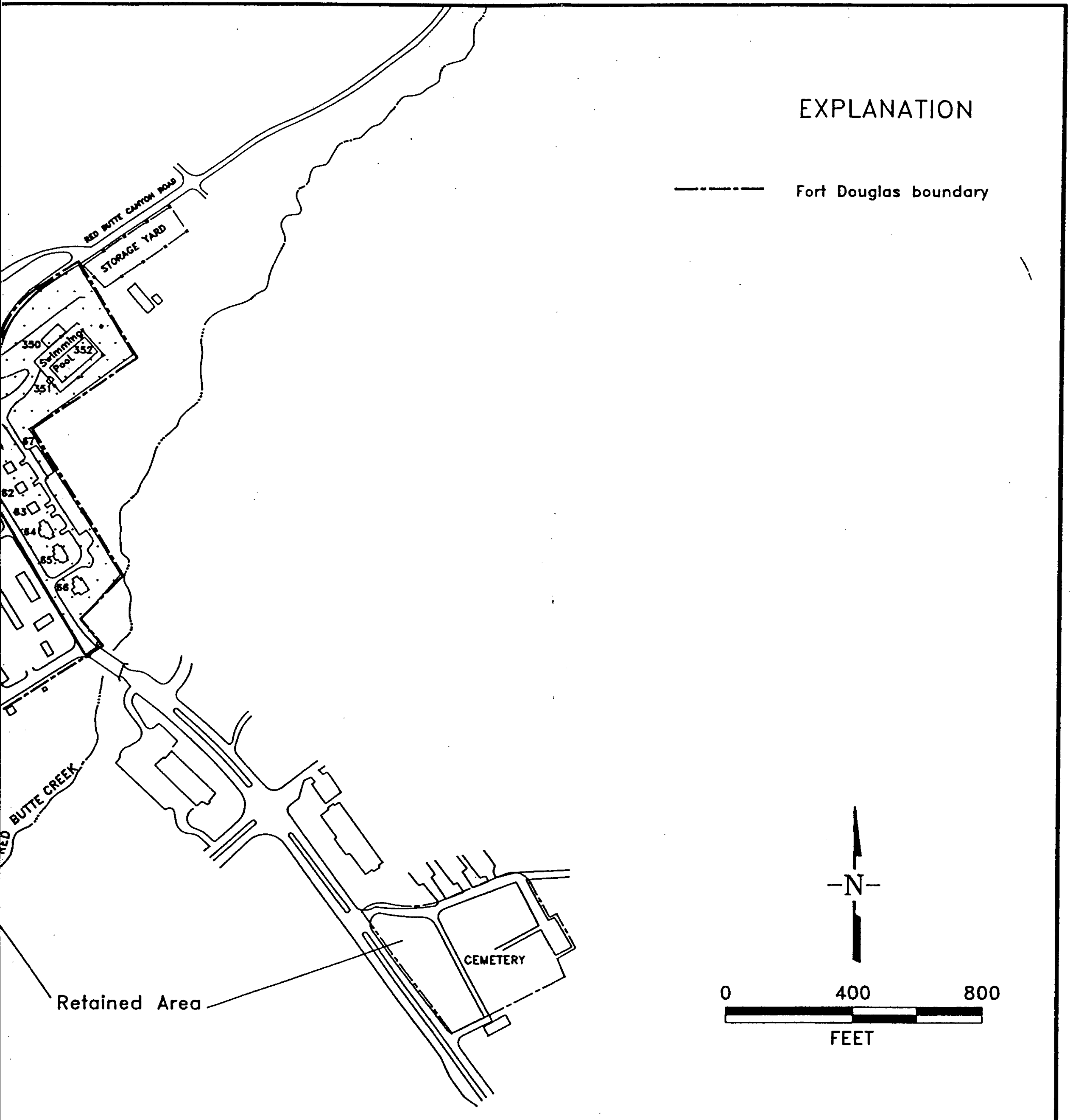


R.L. STOLLAR & ASSOCIATES INC.
Ground-Water Consultants

Structure Locations
Fort Douglas

Prepared for:
U.S. Army Corps of Engineers
USATHAMA

Date: August 1991

Figure 2–2

- Fort Douglas Military Museum;
- Administrative office building;
- Thirty-six family housing structures, containing 61 housing units;
- Three family housing structures, currently used as administrative offices;
- Eighteen detached garages;
- A chapel;
- An Officers Club, used as a community and family center;
- A Noncommissioned Officers (NCO) Club;
- An office building;
- A former gas valve building;
- A latrine;
- A swimming pool with an associated water treatment building and bath house; and
- A bandstand.

Each housing unit is identified by the building number and by a letter (a, b, or c) designating the position of the unit. The units are labeled from left to right, as identified when facing the front of the building.

The structures were constructed primarily between 1874 and 1942. The gas valve building, now vacant, was constructed in 1954. Eight of the detached garages were built in 1972. A swimming pool that was rebuilt in 1988 is also to be excessed. These structures and their current use are listed in Table 2-1. Much of the area to be excessed is within the National Historic Landmark area, and most of the buildings are included in the National Register of Historical Places.

Table 2-1 Description of Structures at Fort Douglas to be Excessed

Structure Number	Current Use	Date of Construction
1	NCO Quarters	1910
2	NCO Quarters	1884
3	Officers Quarters	1931
4	Administrative Offices	1875
5	Administrative Offices	1904
6	Officers Quarters	1875
7	Officers Quarters	1875
8	Officers Quarters	1875
9	Officers Quarters	1875
10	Officers Quarters	1875
11	Officers Quarters	1875
12	Officers Quarters	1875
13	Officers Quarters	1875
14	Officers Quarters	1875
15	Officers Quarters	1875
16	NCO Quarters	1884
17	NCO Quarters	1884
18	Officers Quarters	1875
19	Officers Quarters	1875
20	Officers Quarters	1875
21	Officers Quarters	1931
22	Officers Quarters	1931
23	Officers Quarters	1931
24	Officers Quarters	1931
25	Officers Quarters	1931
31	Administrative Offices	1876
32	Museum	1876
34	Bandstand	1912
37	Offices	1918
38	Vehicle STR FAC	1917
39	Latrine	1876
40	Detached Garages	1942
41	Vacant (former Gas Valve Building)	1954
45	Detached Garages	1942
46	Detached Garages	1942
47	Detached Garages	1942
48	Post Chapel	1884
49	Officers Club	1876
50	Detached Garages	1932
51	Detached Garages	1931
52	NCO Quarters	1900
53	NCO Quarters	1910
54	NCO Club	1933
55	Administrative Offices	1874
56	NCO Quarters	1916

Table 2-1 Description of Structures at Fort Douglas to be Excessed (continued)

Structure Number	Current Use	Date of Construction
57	NCO Quarters	1916
58	NCO Quarters	1930
59	NCO Quarters	1917
60	NCO Quarters	1930
61	NCO Quarters	1891
62	NCO Quarters	1891
63	NCO Quarters	1891
64	NCO Quarters	1930
65	NCO Quarters	1930
66	NCO Quarters	1900
67	Detached Garages	1931
68	Detached Garages	1930
69	Detached Garages	1917
70	Detached Garages	1972
71	Detached Garages	1972
72	Detached Garages	1972
73	Detached Garages	1972
74	Detached Garages	1972
75	Detached Garages	1972
76	Detached Garages	1972
77	Detached Garages	1972
350	Bath House	1937
351	Water Treatment Building	1937
352	Swimming Pool	Rebuilt 1988

3.0 INITIAL EVALUATION

An on-site assessment of Fort Douglas was conducted by the Army in 1982 to determine past and current use of toxic and hazardous materials and the potential for migration of these substances (ESE, 1983). Problems identified included improper storage of petroleum, oil, lubricants, and herbicides, and the potential existence of polychlorinated biphenyls (PCBs) in transformers. Remediation of these problems was recommended. Results of the assessment indicated that migration of contaminants to the off-post areas was not occurring via surface or ground water.

In 1988, another site assessment was completed (Weston, 1988). Based on observations and historical documentation, 20 locations at Fort Douglas were identified by this site assessment to have contained toxic or hazardous substances. None of these areas were located in the original area of Fort Douglas that was planned to be excessed; however, one was included when the size of the property to be excessed was increased in May 1991. This area is the site of two abandoned underground hydrocarbon storage tanks and a former vehicle wash rack and oil change/degreasing area. Additionally, an added area near the southeastern fence line of Fort Douglas is adjacent to four of these locations, primarily maintenance and hydrocarbon storage areas. The UST sites are the focus of a site investigation (report pending release) initiated in 1990.

An Enhanced Preliminary Assessment (PA) and a Final Environmental Impact Statement (FEIS) were completed in 1989 and 1991, respectively (Weston, 1989; Dames and Moore, 1991). These reports were prepared under the Base Closure Program in preparation for the closure and realignment of Fort Douglas. The results of the PA will serve as the basis for EI/AA field work. In addition, observations made during an initial site visit for the EI/AA program been incorporated in planning the field program. Summaries of the PA and FEIS investigations and the initial site visit are presented in the following sections.

3.1 PRELIMINARY ASSESSMENT

The PA was conducted at Fort Douglas under the Base Closure Program (Weston, 1989). The purpose of the PA was to present the environmental conditions at Fort Douglas and to provide recommendations for further action. The report was prepared using existing information obtained from the property records and interviews with current employees. Sampling was not conducted as part of the assessment.

No conditions were observed on the property that appear to represent an immediate threat to human health or the environment. However, environmentally significant operations (ESOs) were assessed to identify areas requiring environmental evaluation (AREEs). AREEs were judged to have the potential to affect human health or the environment. The AREEs included:

- Asbestos or asbestos-containing materials (ACMs), suspected to be present in every building in the area to be excessed.
- Radon, identified by preliminary results from short-term detectors in various buildings.
- Transformers, potentially containing PCBs, mounted on poles at each of 14 locations throughout the excessed property.

Certain potential AREEs such as painted surfaces and drinking water were excluded from consideration for the purposes of the PA. These could be identified as AREEs solely because both potentially contain lead.

Pathways by which human and environmental receptors may be exposed to site-related contaminants were identified in the PA. These pathways included ground water, with crops and humans as potential receptors; and air, with potential asbestos and radon contaminants. Surface water and soil were discounted as not having a significant impact on human and environmental receptors.

The PA recommended that three investigative actions be taken. The recommendations were (1) a comprehensive asbestos sampling program be conducted, (2) results from a current radon sampling program should be analyzed and the appropriate actions taken, and (3) fluids from all transformers on the property to be excessed should be sampled and tested for PCBs.

3.2 FINAL ENVIRONMENTAL IMPACT STATEMENT

A Final Environmental Impact Statement (FEIS) was directed by the U.S. Army Corps of Engineers in February 1991 in accordance with U.S. Army Regulation 200-2 and the Council on Environmental Quality regulations for implementation of NEPA. The FEIS was designed to address the effects of the closure and realignment on the natural and socioeconomic environments and historic properties at Fort Douglas and facilities where Fort Douglas services will be relocated. In addition, four types of potential future uses for the excessed property were evaluated. Future land use alternatives that were considered in the study include residential use, historical park/regional cultural center, University of Utah facilities, Veterans services, and multiple use development. The results of the studies indicated that no significant impacts to the natural or socioeconomic environments would occur as a result of the partial closure of Fort Douglas. The FEIS also concluded that if appropriate mitigation measures are taken, impacts to the historic properties will be minimal.

3.3 INITIAL EI/AA VISITS

During an initial site visit for the EI/AA program in March 1991, several buildings were entered and, based on observations, suspected to contain ACMs. In addition, a potential source of contaminants, a University of Utah storage yard, was identified north of the area of Fort Douglas to be excessed. Miscellaneous equipment, drums, and transformers were observed in the storage yard. In June 1991, a site visit and interview indicated activities near the southeast fence line on Fort Douglas included heavy and light equipment maintenance and storage of heavy equipment and drums. Some of the drums were labeled to contain fuels, solvents, lubricants, and paints. This information was used, in conjunction with results of the previous investigations, to evaluate contaminants of concern and potential sources in the area of Fort Douglas that will be excessed.

3.4 CONTAMINANTS OF CONCERN

Based on the previous investigations, the primary contaminants of concern in the area to be excessed from Fort Douglas include PCBs, hydrocarbons, lead (in lead-based paint and/or gasoline), degreasing solvents, asbestos, and radon.

3.5 POTENTIAL SOURCES

Potential contaminant sources to the area of Fort Douglas to be excessed include electrical transformers, structures, USTs, storage areas, and maintenance areas.

3.5.1 TRANSFORMERS

Transformers are present at 16 locations in or adjacent to the area to be excessed. Between one and three transformers of various ages are mounted on a pole at each location. Dielectric fluid from three of the transformers reportedly has been sampled; PCB concentrations of 2 parts per million (ppm) were detected (Weston, 1989). The sampled transformers have not been identified. In 1985, transformers at eight locations in the area to be excessed were labeled as PCB-containing, based on their age; however, no sampling was performed to verify this assumption. Transformers at six other locations on the area to be excessed were more recently installed. Information has been obtained for one of these transformers, which is located southwest of the swimming pool adjacent to the Fort Douglas family camp; no PCBs were used in this transformer (Appendix A). No information regarding the PCB content in the dielectric fluid in any of the other transformers is currently available.

The PA reported that no staining was observed in the immediate area of the transformer locations. Some of the transformers were reportedly rusted, while others were in good condition. Historical releases of potentially PCB-containing oil from the transformers have not been reported.

3.5.2 STRUCTURES

Structures on the area of Fort Douglas to be excessed contain three types of sources for contaminants of concern: (1) asbestos containing materials, (2) radon, and (3) lead-based paint.

Asbestos Containing Materials - Asbestos or asbestos containing materials (ACMs) are suspected to be present in every building in the area to be excessed. The buildings were primarily constructed between 1874 and 1942. Numerous remodeling and maintenance activities have continued to the present. Asbestos was utilized in construction materials primarily between 1945 through 1970.

Asbestos sampling has been conducted in four of the buildings (8, 15A, 18C, and 32, Figure 2-2) in the area to be excessed (Weston, 1989). Asbestos was found in the material covering the pipes in all four buildings. In addition, asbestos insulation is suspected to cover hot water pipes in the NCO Club, Officers Club, and the swimming pool bath house. Suspected asbestos-containing building materials (ACBMs) include asbestos siding on the Chapel and Building 69 and roof shingles of some buildings, including Building 20 and a storage area near Building 234.

A building survey conducted during the PA indicated the presence of suspected asbestos insulation around hot water pipes in basements of the buildings. The insulation was cracked and broken in some places and poorly wrapped or encapsulated. The damaged or friable ACMs are potential sources of asbestos.

Radon Accumulations - Radon is a naturally occurring radioactive gas that is produced through the decay of uranium and thorium present in rocks and soil. Radon tends to accumulate in buildings; the highest concentrations typically are detected in basements. Concentrations fluctuate during the year; the winter concentrations are generally the highest.

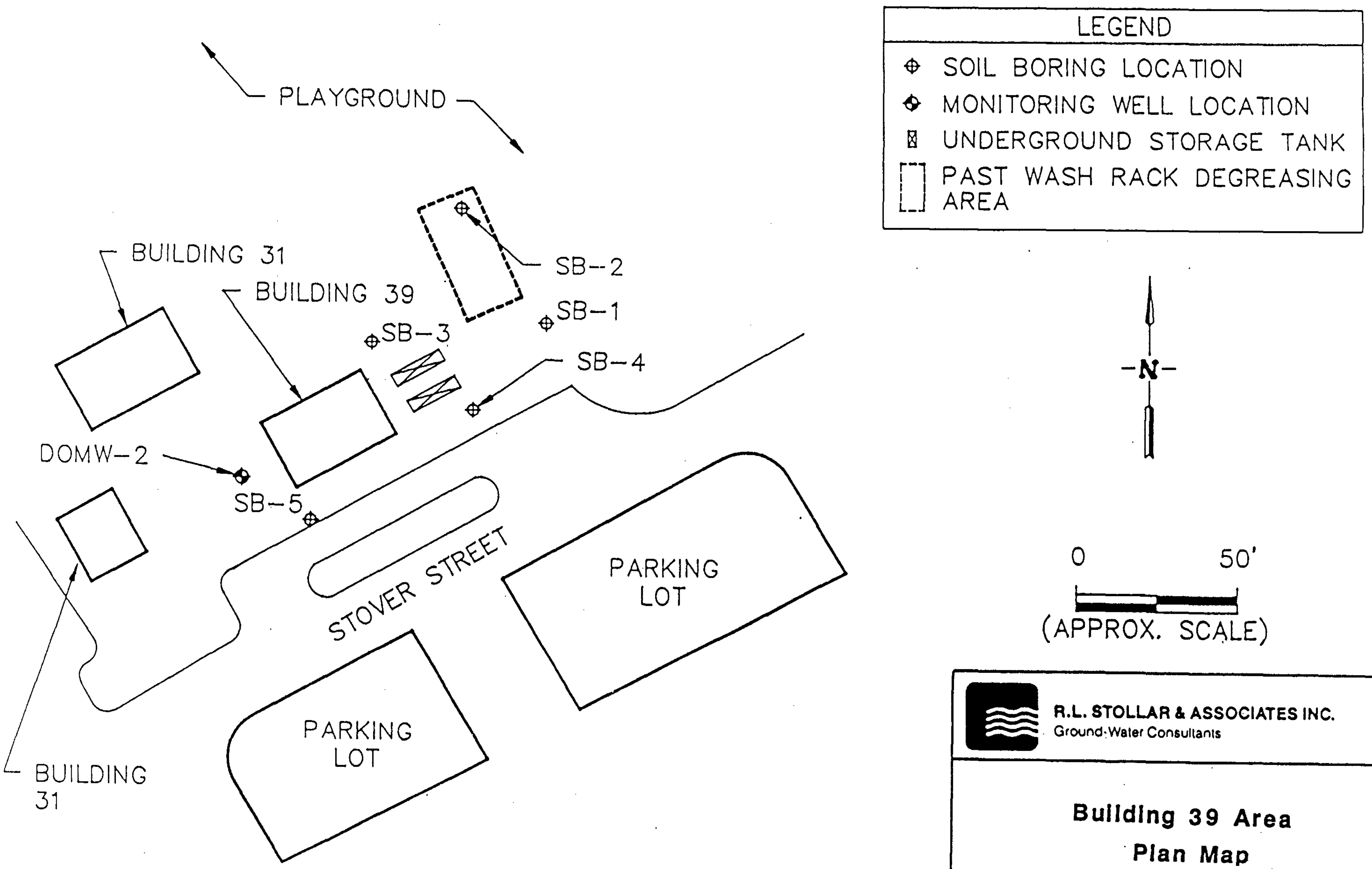
Two radon sampling programs have been conducted at Fort Douglas. Results of the first program, consisting of short-term (4-day) monitoring, indicated the average concentration was 1 picocurie/liter, and the highest concentration was 4 picocuries/liter. The second program, primarily a long-term monitoring program with detectors in place for 6 to 12 months, has recently been completed. The results will be assessed as part of the EI report.

Lead-Based Paint - Many types of house paint included lead as a major ingredient in the years prior to and through World War II. In the 1950's, other pigment materials became more popular, but lead compounds were still used in some pigments and as drying agents. The content of lead in paint was regulated beginning in 1971. Lead dust can be created from both interior and exterior paints containing lead and is an inhalation and ingestion hazard. There is no available information regarding lead content in paint at Fort Douglas; however, the age of the buildings suggests that painted surfaces may include one or more coats of lead-based paint.

3.5.3 UNDERGROUND STORAGE TANKS

Two USTs are located immediately east of Building 39 (Figure 3-1). The Building 39 area was historically used as a service station for vehicle refueling and maintenance. To support these operations, a 10,000-gallon UST (of unknown construction) was used to contain gasoline, and an approximately 250-gallon UST (of unknown construction) possibly was used to contain waste oil or gasoline. Two pump sites were located to the south of Building 39, and a fill spout is visible on the east side of the building. Diagrams of the area are included in Appendix B. The tanks are not in service, and the area is currently used as a picnic area.

Potential contaminants associated with the Building 39 USTs include hydrocarbons and lead. During a UST site investigation 10 soil samples were collected from five borings in this area (Figure 3-1). The borings were located based on results from a soil gas survey. The samples were analyzed for total petroleum hydrocarbons (TPH), benzene, ethylbenzene, toluene, and xylenes (BETX). No detectable concentrations were present in the soil samples (Table 3-1). One monitoring well was also installed, however, it does not produce sufficient quantities of water to allow sample collection.



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Building 39 Area
Plan Map

Date: August 1991
Figure 3-1

Table 3-1 UST Site Investigation Analytical Results for Buildings 39 and 134 Soil Samples

Site ID	Sample Number	x-Xylene	Benzene	Ethylbenzene	Toluene	TPHC	Xylene
BUILDING 39 AREA							
SB-1	DOSS-1A	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 10	LT 0.390
SB-1	DOSS-1B	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 10	LT 0.390
SB-2	DOSS-2A	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 10	LT 0.390
SB-2	DOSS-2B	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 10	LT 0.390
SB-3	DOSS-3A	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 20	LT 0.390
SB-3	DOSS-3B	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 20	LT 0.390
SB-4	DOSS-4A	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 20	LT 0.390
SB-4	DOSS-4B	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 20	LT 0.390
SB-5	DOSS-5A	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 20	LT 0.390
SB-5	DOSS-5B	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 20	LT 0.390
BUILDING 134 AREA							
SB-7	DOSS-7A	LT 0.260	LT 0.085	LT 0.160	LT 0.190	480	LT 0.390
SB-7	DOSS-7B	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 10	LT 0.390
SB-8	DOSS-8A	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 10	LT 0.390
SB-8	DOSS-8B	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 10	LT 0.390
SB-9	DOSS-9	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 10	LT 0.390
SB-10	DOSS-10A	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 10	LT 0.390
SB-10	DOSS-10B	LT 0.260	LT 0.085	LT 0.160	LT 0.190	LT 10	LT 0.390

Units in μg/g
LT = less than certified reporting limit
TPHC = total petroleum hydrocarbons

A 1,000 gallon UST, formerly used to store waste oil as part of vehicle maintenance operations, is located on the retained property approximately 130 ft northwest of the southeast Fort Douglas fence line near Building 134 (Figure 2-2). Waste solvents were also reportedly disposed of in this tank. The tank construction materials and lining are unknown. A fill pipe, temporarily covered, is located near the ground surface. The tank was pumped out and removed from service in 1985, because of a possible leak. As part of a UST site investigation, four borings and a monitoring well were located and drilled in the retained area on the basis of results from a soil gas survey (Figure 3-2). TPH (480 μg/g) were detected in a sample collected within 15 ft of the tank at a depth corresponding to the bottom of the tank pit (Table 3-1). No TPH or BETX were detected in any other soil samples. A sufficient amount of water was not available to collect ground-water samples. Potential releases from the tank which could impact the excessed property will be considered in the storage and maintenance area investigations as discussed in Section 4.7.

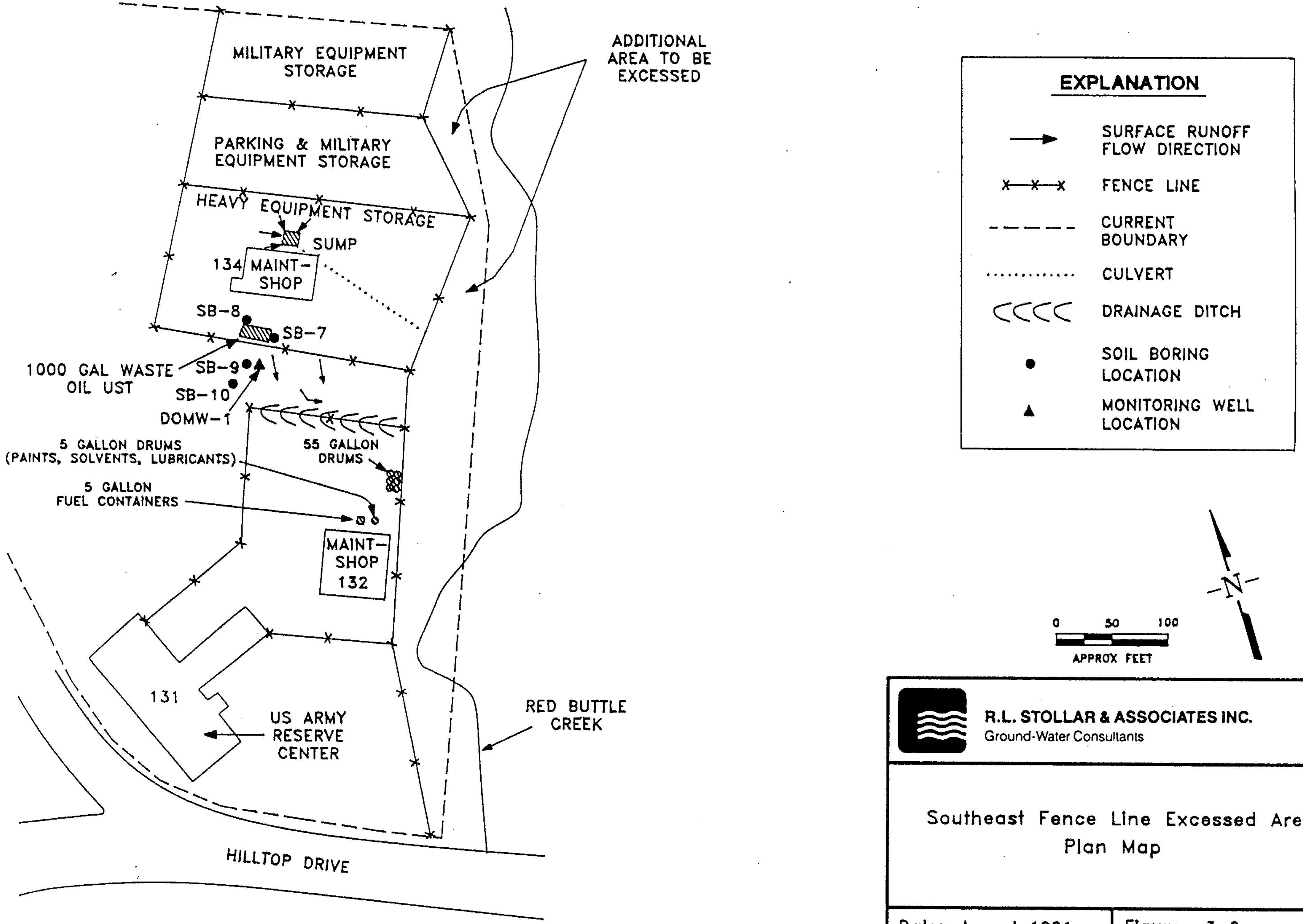
3.5.4 STORAGE AREAS

A storage yard owned by the University of Utah is located off-post, adjacent to the northeast boundary of Fort Douglas (Figure 2-2). Aerial photos indicate the storage yard was constructed after 1968. Miscellaneous equipment, poorly marked drums, and transformers were observed in the storage yard during an initial EI/AA site visit. No investigations have been conducted to determine if this area is a source of contaminant migration to Fort Douglas. Potential contaminants stored in this yard cannot be confidently identified with available information, but may include PCBs and hydrocarbons.

Several other storage areas are adjacent to the narrow parcel of land immediately east of the southeasternmost fence line on Fort Douglas (Figure 2-2). Red Butte Creek is just east of this narrow parcel of excessed property. Heavy equipment and drums (some labelled to contain fuels, solvents, lubricants, and paints) were observed to be stored in these areas during an initial EI/AA site visit.

3.5.5 MAINTENANCE AREAS

Three maintenance areas may be potential sources of contaminants to Fort Douglas excessed property. A former vehicle wash rack and oil change/degreasing area was located east of Building 39 (Figure 3-1). A concrete pad and vehicle wheel guides were located in the area; they have been removed from the site. A soil boring was collected from this area during the UST investigation; no contaminants were detected (Table 3-1).



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Southeast Fence Line Excessed Area
Plan Map

Date: August 1991

Figure 3-2

Two other maintenance areas are located in the southern portion of Fort Douglas, near the excessed property adjacent to Red Butte Creek (Figure 2-2). No subsurface investigations have been conducted in these areas. A preliminary site visit and interview indicated that these shops have been used for both heavy and light equipment maintenance. Potential contaminants involved with these maintenance operations include solvents/degreasers, fuels, lubricants, and paints.

4.0 SAMPLING RATIONALE

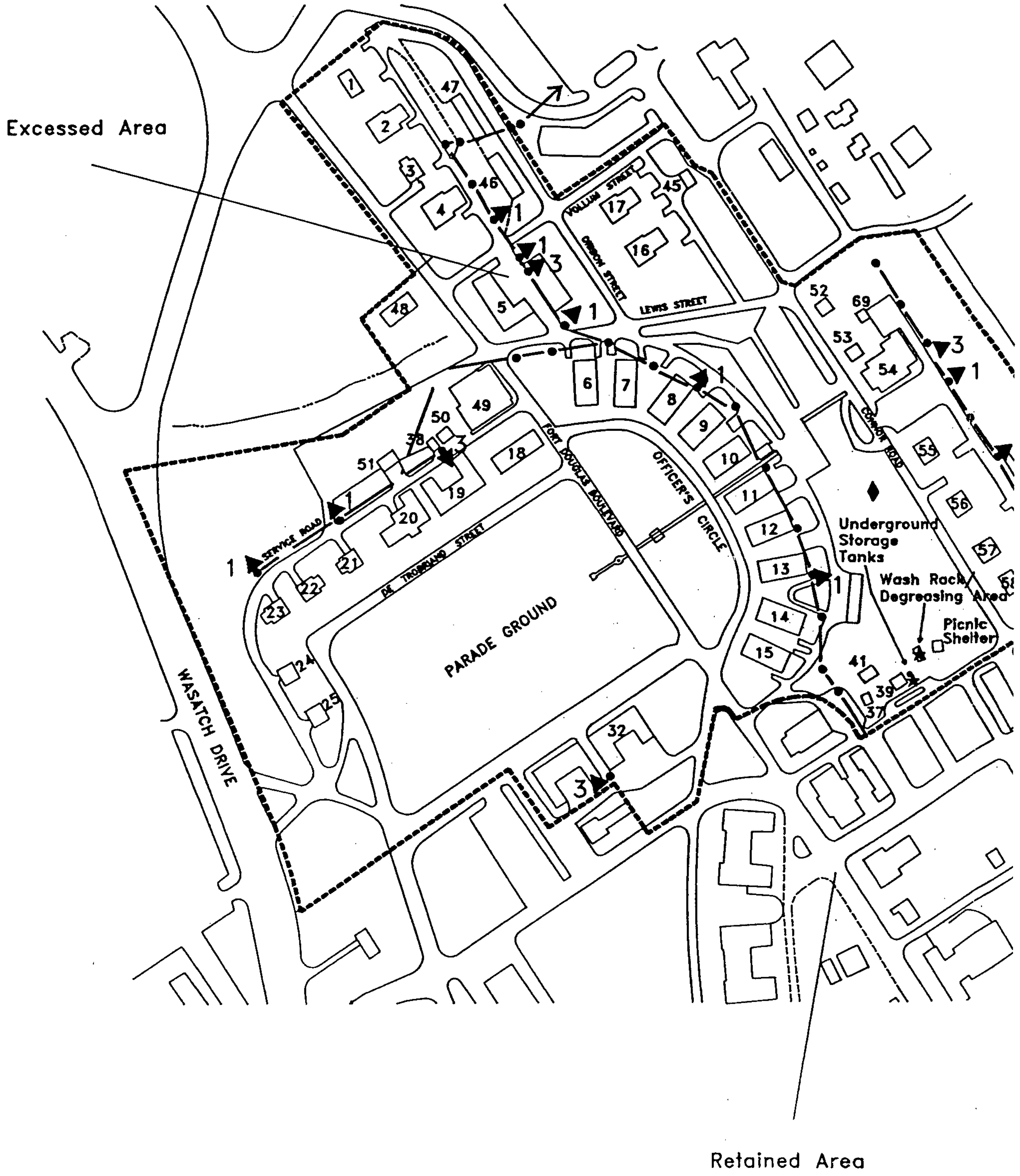
The following sections describe data quality objectives (DQOs) and the sampling programs recommended for background samples and potential contaminant sources identified at the site. Proposed sample locations are shown on Figures 4-1, 4-2, and 4-3. Buildings planned to be sampled are listed in Table 4-1. Investigative samples will be collected from transformers, buildings, soil, and if present, shallow ground water. Asbestos sampling in buildings is described in a separate document, the Asbestos Sampling Plan.

The analytical suites selected for transformers, paint, and ACMs are specific to known practices and contaminants. Alternatively, analytical suites for ground water and soils are designed to screen for a broad range of compounds. Background soil samples will be collected and analyzed to determine analyte concentrations typically present in soil in the area. A detailed discussion of the sampling program and field methods can be found in the Sampling and Analysis Plan (SAP) and the Quality Assurance Project Plan (QAPP). The procedures and methods described in the QAPP and SAP were developed and will be implemented in order to produce data from the sampling program that meet DQOs for the EI/AA at Fort Douglas. These DQOs are described in the following section.

4.1 DATA QUALITY OBJECTIVES

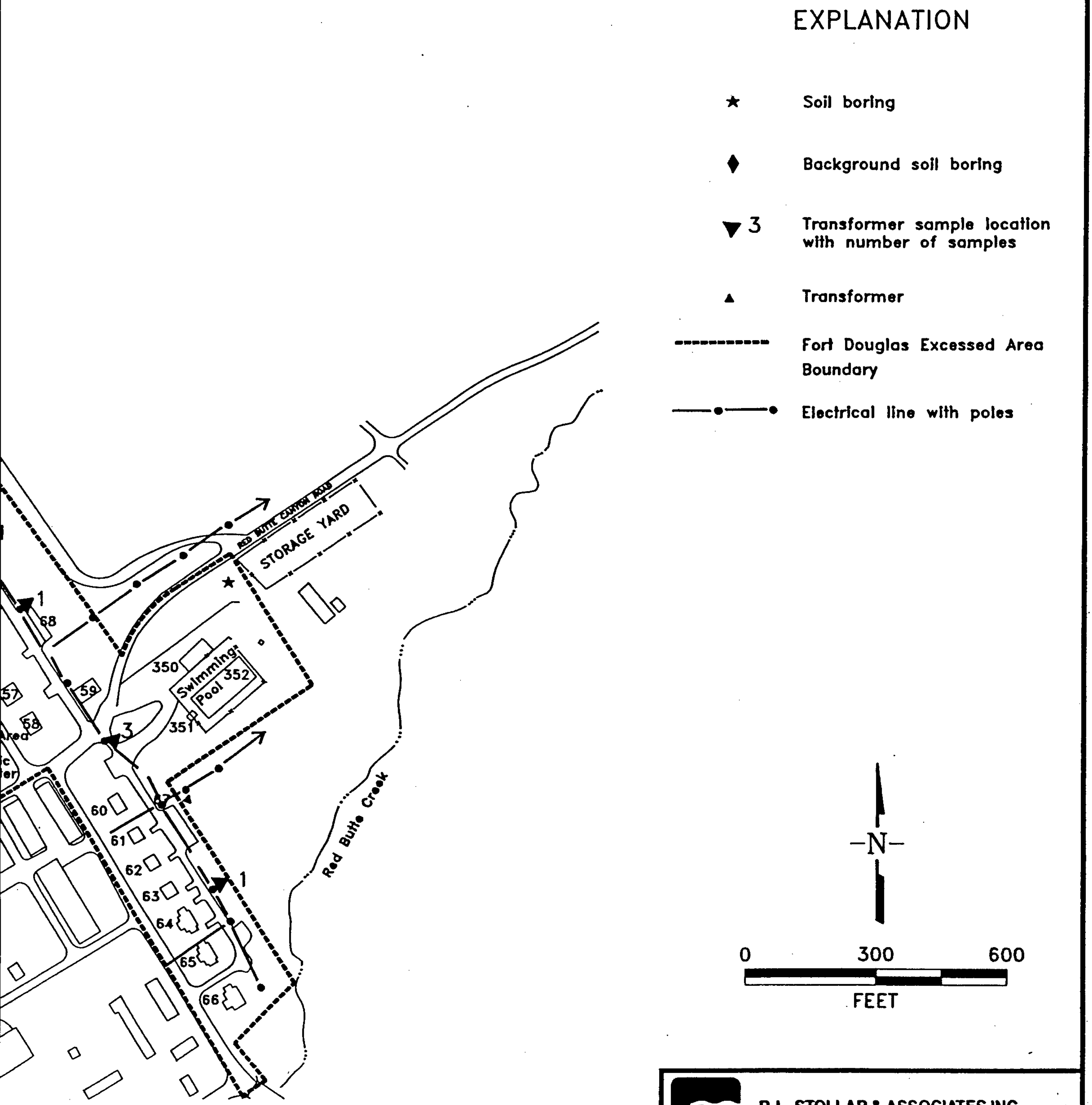
Data quality objectives (DQOs) specify the quality of the data required to support decisions that must be made during the EI/AA program. The objectives have been developed by considering the end-uses for the data. Data collected during the EI at Fort Douglas will be used to characterize the site, assess risks to human health and the environment, and analyze remedial alternatives in preparation for transfer of the excessed property to the University of Utah.

The samples will be collected for laboratory analysis, lithologic characterization, field screening measurements and health and safety monitoring. These data uses require various levels of data quality. The data quality as classified by the EPA (1988) ranges from the lowest level, Level I - Field Analysis, to the highest level, Level IV - Contract Laboratory Program/Routine Analytical Service (CLP/RAS), which represents confirmational data generated using rigorous quality control and validation procedures.



Excessed Area

Retained Area



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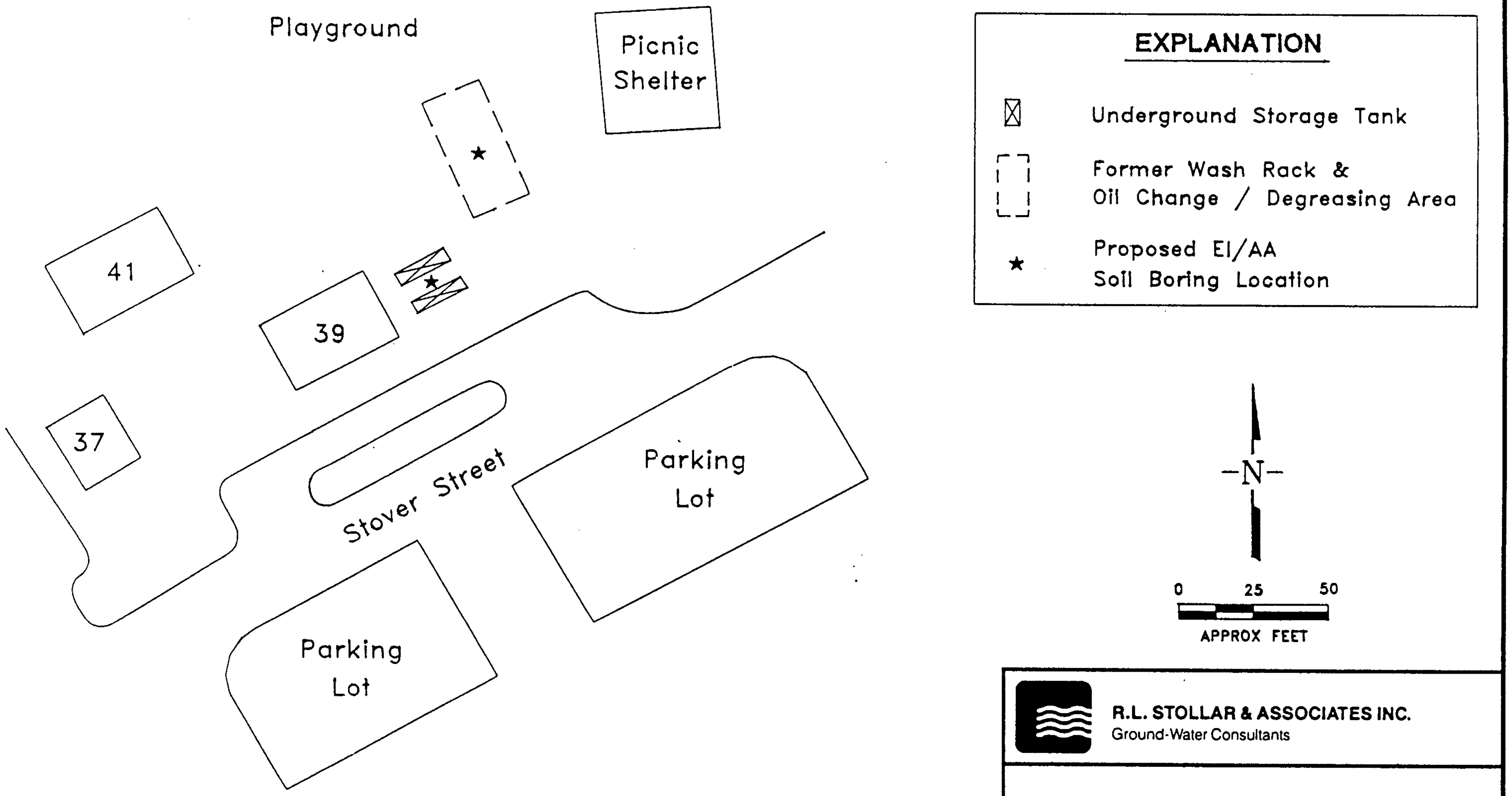
Northern Excessed Area
Proposed Sample Locations
Fort Douglas
Prepared for:
U.S. Army Corps of Engineers
USATHAMA

Date: August 1991 | Figure 4-1



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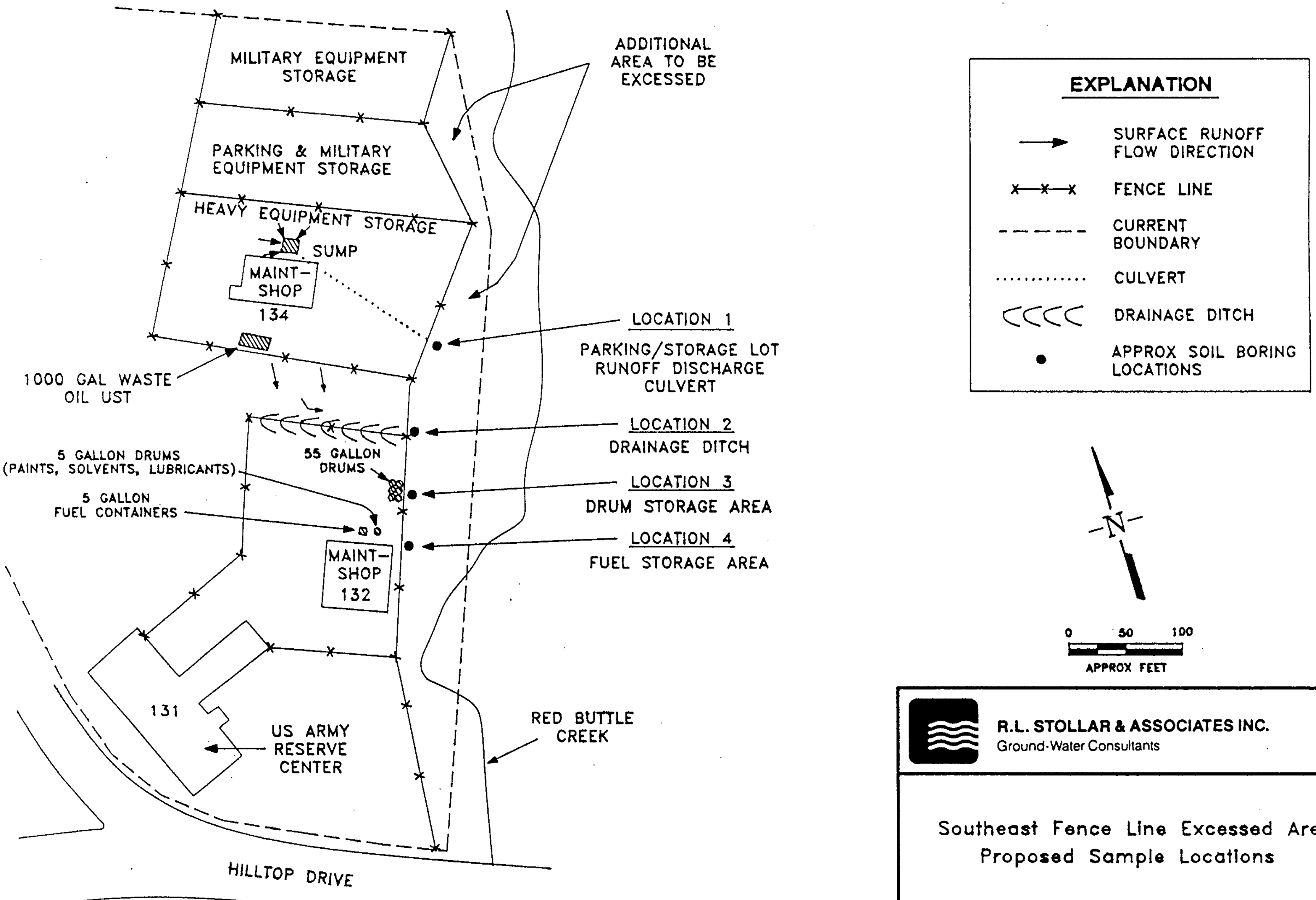
Building 39 Area
Proposed Sample Locations

Date: August 1991

Figure 4-2



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Southeast Fence Line Excessed Area
Proposed Sample Locations

Date: August 1991

Figure 4-3

Table 4-1 Structures at Fort Douglas to be Sampled

Structure Number	Current Use	Number of Housing Units	Media Asbestos	 Paint
1	NCO Quarters	2	X	X
2	NCO Quarters	2	X	X
3	Officers Quarters	1	X	X
4	Administrative Offices	-	X	X
5	Administrative Offices	-	X	X
6	Officers Quarters	2	X	X
7	Officers Quarters	2	X	X
8	Officers Quarters	2	X	X
9	Officers Quarters	2	X	X
10	Officers Quarters	2	X	X
11	Officers Quarters	2	X	X
12	Officers Quarters	2	X	X
13	Officers Quarters	2	X	X
14	Officers Quarters	2	X	X
15	Officers Quarters	2	X	X
16	NCO Quarters	2	X	X
17	NCO Quarters	2	X	X
18	Officers Quarters	3	X	X
19	Officers Quarters	3	X	X
20	Officers Quarters	1	X	X
21	Officers Quarters	1	X	X
22	Officers Quarters	1	X	X
23	Officers Quarters	1	X	X
24	Officers Quarters	1	X	X
25	Officers Quarters	1	X	X
31	Administrative Offices	-	X	X
32	Museum	-	X	X
37	Offices	-	X	X
39	Latrine	-	X	X
41	Vacant (former Gas Valve Building)	-	X	X
48	Post Chapel	-	X	X
49	Officers Club	-	X	X
50	Detached Garages	-	X	
51	Detached Garages	-	X	
52	NCO Quarters	1	X	X
53	NCO Quarters	1	X	X
54	NCO Club	-	X	X
55	Administrative Offices	-	X	X
56	NCO Quarters	2	X	X
57	NCO Quarters	2	X	X
58	NCO Quarters	2	X	X
59	NCO Quarters	1	X	X
60	NCO Quarters	2	X	X

Table 4-1 Structures at Fort Douglas to be Sampled (continued)

Structure Number	Current Use	Number of Housing Units	Media Asbestos	 Paint
61	NCO Quarters	1	X	X
62	NCO Quarters	1	X	X
63	NCO Quarters	1	X	X
64	NCO Quarters	2	X	X
65	NCO Quarters	2	X	X
66	NCO Quarters	2	X	X
69	Detached Garages	-	X	
350	Bath House	-	X	X
351	Water Treatment Building	-	X	X

The Fort Douglas EI data will be collected in accordance with the protocols established by the USATHAMA Quality Assurance Program (USATHAMA, 1990), and laboratory analytical data will be generated by a USATHAMA-certified laboratory. The procedures used by the laboratory are equivalent to analytical Level III and Level IV EPA data. A more detailed description of the analytical protocols and the associated data quality levels is presented in the Quality Assurance Project Plan.

Data quality objectives for Fort Douglas are described below:

- Ground-water, soil, dust wipe, and transformer oil samples collected during the EI field program will be analyzed by USATHAMA methods to provide Level III and Level IV data. Certified methods do not exist for asbestos and lead-based paint chips; these analyses will be conducted using EPA methods which provide equivalent data quality.

- Samples from the soil borings will be screened in the field with an organic vapor analyzer (OVA) providing Level I data.

- Air quality will be monitored by an OVA during field operations, providing Level I data.

- Temperature, pH, specific conductance, and dissolved oxygen will be monitored in the field during ground-water sampling, providing Level II data.

4.2 BACKGROUND SAMPLES

Background samples will be collected to aid in identification of site-specific contamination. The background concentrations may include naturally occurring concentrations and concentrations due to anthropogenic (human-made) sources not specific to Fort Douglas. These data will be used to distinguish between any risks normally associated with the area and risks due to site-specific contamination.

Background soil samples will be collected from a boring drilled in an area expected to be both contaminant free and representative of Fort Douglas soils (Figure 4-1). The background boring will be drilled after the investigative borings, to the same depth (30 ft). Three soil samples will be collected from the background boring: one at the surface, and two at deeper intervals that will correspond stratigraphically to the intervals sampled in the investigative borings. In the background boring, the soil samples will be analyzed for metals on the CERCLA TCL (Table 4-2) and cyanide. As indicated by previous investigations, shallow ground water at Fort Douglas exists in localized perched zones, therefore background ground-water samples will not be collected.

4.3 TRANSFORMERS

Electrical transformers are located at 16 pole locations on and adjacent to the area to be excessed. Between one and three transformers are attached to each pole yielding a total of 26 transformers to be investigated. The oldest transformers are marked as containing PCBs; the newer transformers are not marked. No analytical information is available to verify the PCB content of the transformer oil for either the older or newer transformers. Manufacturing information is available for one transformer. This transformer does not contain PCBs and, therefore, will not be sampled (Appendix A).

The oil in 25 transformers will be sampled and analyzed for PCBs. These data will be used to assess the risks to human health and to perform an alternatives analysis of the transformers. The condition of some of the transformers indicates transformer oil may have leaked onto the ground. If stained soil is observed in the immediate area of the transformers, a surface soil sample (0 to 0.5 ft bgs) will be collected from each location and analyzed for PCBs.

4.4 STRUCTURES

Three types of contaminant sources associated with the structures at Fort Douglas have been identified. These include ACMs, radon accumulations, and lead-based paint. The EI field program has been designed to identify the location and distribution of asbestos and lead within the structures. Long-term monitoring of radon has been completed recently at Fort Douglas. This monitoring was managed by Fort Carson; the results will be assessed and presented in the Fort Douglas EI report.

4.4.1 ASBESTOS CONTAINING MATERIALS

Asbestos is suspected to be present in all of the buildings in the area to be excessed. Limited asbestos sampling has been conducted in some of the buildings, confirming the presence of asbestos in

Table 4-2 Target Compound List

Volatile Organic Compounds

Acetone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
2-Butanone
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
1,2-Dichloroethene
1,2-Dichloropropane
cis-1,3-Dichloropropene
1,3-Dichloropropene
Ethylbenzene
2-Hexanone
Methylene chloride
4-Methyl-2-pentanone
Styrene
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Vinyl acetate
Vinyl chloride
Xylene

Semivolatile Organic Compounds

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i)perylene
Benzo(a)pyrene
Bis(2-chloroethoxy)methane
Bis(2-chloroethyl)ether
Bis(2-chloroisopropyl)ether
Bis(2-ethylhexyl)phthalate
4-Bromophenyl phenyl ether
Butyl benzyl phthalate
Carbazole
4-Chloroaniline
2-Chloronaphthalene
4-Chloro-3-methylphenol
2-Chlorophenol
4-Chlorophenyl phenyl ether
Chrysene
Dibenz(a,h)anthracene
Dibenzofuran
Di-n-butylphthalate
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,2-Dichlorobenzene
3,3-Dichlorobenzidine
2,4-Dichlorophenol
Diethylphthalate
2,4-Dimethylphenol
Dimethylphthalate
4,6-Dinitro-2-methylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Di-n-octylphthalate
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno(1,2,3-cd)pyrene
Isophorone
2-Methylnaphthalene
2-Methylphenol (o-cresol)
4-Methylphenol (p-cresol)
Naphthalene
2-Nitroaniline
3-Nitroaniline
4-Nitroaniline
Nitrobenzene
2-Nitrophenol
4-Nitrophenol
N-Nitroso-di-n-propylamine
N-Nitrosodiphenylamine
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
1,2,4-Trichlorobenzene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol

PCB

Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1245
Aroclor-1254
Aroclor-1260

Metals

Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Selenium
Silver
Sodium
Thallium
Vanadium
Zinc

Inorganic Compounds

Cyanide

Miscellaneous

Total Petroleum Hydrocarbons (TPH)
Asbestos

insulating materials. In addition, much of the suspected ACM has been damaged and is considered friable. A comprehensive asbestos survey has not been conducted, therefore, one is planned for the EI. Sixty-one housing units and 16 other buildings, comprising 52 structures, will be sampled and surveyed for asbestos (Table 4-1). Details of the asbestos survey will be included in an Asbestos Sampling Plan.

4.4.2. LEAD-BASED PAINT

Lead-based paints are suspected to be present in almost all of the buildings at Fort Douglas. No information regarding the lead content in the paints is available; however, most of the building and remodeling at Fort Douglas was conducted before 1971, during the period when the use of lead-based paints was widespread. In several structures at Fort Douglas, the paint is in a state of disrepair, potentially releasing hazardous lead dust. Paint chips will be sampled where paint is peeling; dust-wipe sampling will be conducted where the paint is in good condition. The lead content in the paint or paint dust will be determined to provide information regarding potential lead releases. These data will be used to assess the risks to human health. One paint sample per structure, excluding the garages and bandstand, will be collected. In addition, a total of two samples representative of exterior paint on Fort Douglas structures will be collected.

4.5 BUILDING 39 AREA

The Building 39 Area contains two types of potential sources: USTs (two), and a former vehicle wash rack and oil change/degreasing area (Figure 4-2). In addition, spills may have occurred in the vicinity during refueling operations or other related activities. The results of a previous investigation that included soil gas and soil sampling, as described in Section 3.5.3, indicated that concentrations of TPH or BETX were not detected in soil samples collected around these potential sources; however, the tanks will be removed to determine if any subsurface releases have occurred directly below or adjacent to the tanks. Tank removal and soil sampling from the tank and piping excavations will be supervised by Fort Carson and the Fort Douglas post engineers office, in accordance with state and federal regulations. The state of Utah closure plan for the USTs, including diagrams of the UST locations, pump sites, and piping, are in Appendix B. Prior to tank removal, the local fire department will be notified. The EI/AA field activities in this area will be coordinated with the tank removal and associated sampling.

4.5.1. UNDERGROUND STORAGE TANKS

Potential soil contamination in the UST area will be investigated by collecting and analyzing samples from one soil boring. The boring will be drilled to a total of 30 ft bgs. The geology encountered during drilling will be logged by an on-site geologist. Organic vapors from the sediments in the bore hole will be monitored during drilling using an organic vapor analyzer (OVA). (All EI/AA subsurface drilling activities will involve geologic logging and organic vapor monitoring). In the unlikely event that a saturated zone is encountered during drilling, the boring will be completed as a monitoring well.

Samples will be collected from depth intervals designed to investigate potential soil contamination. Soil contamination resulting from leaks in the USTs would likely exist at or below the bottom of the tanks. The bottom of the tanks are estimated to be 10 ft bgs or deeper. Composite samples are planned to be collected from each 5-ft. interval below the bottom of the tanks to the total depth of the boring (30 ft bgs). In addition, a surface sample will be collected to provide data for any subsequent risk assessment.

The surface soil sample will be analyzed for TPH, cyanide, and all metals on the CERCLA TCL (Table 4-2). The remaining deeper samples will be analyzed for the same constituents plus volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) on the CERCLA TCL. If any ground-water samples are obtained, analyses for TPH, cyanide, and all VOCs, SVOCs, and metals on the CERCLA TCL will be conducted.

The planned soil sample intervals (assuming that the bottom of the USTs are 10 ft bgs) and chemical analysis are summarized below:

• Surface-0.5 ft bgs	TPH, Cyanide, CERCLA TCL Metals
• 10-15 ft bgs	TPH, Cyanide; CERCLA TCL Metals, Volatiles, and Semivolatiles
• 15-20 ft bgs	TPH, Cyanide; CERCLA TCL Metals, Volatiles, and Semivolatiles
• 20-25 ft bgs	TPH, Cyanide; CERCLA TCL Metals, Volatiles, and Semivolatiles
• 25-30 ft bgs	TPH, Cyanide; CERCLA TCL Metals, Volatiles, and Semivolatiles

4.5.2 FORMER WASH RACK AND OIL CHANGE/DEGREASING AREA

Potential soil contamination in the vicinity of the former wash rack and oil change/degreasing area will be investigated by collecting and analyzing samples from one soil boring (Figure 4-2). Data from this boring will be used to confirm previous sampling results and to assess health risks associated with this area. The boring will be drilled to a total depth of 15 ft bgs.

Samples are planned to be taken from 0 to 0.5 ft bgs and from 0.5 to 5 ft bgs (composite). The interval from 5 to 15 ft bgs will be visually logged and monitored for organic vapors with an OVA. If field observations indicate that contaminants may be present in this interval, appropriate samples will be collected.

The surface soil sample will be analyzed for TPH, cyanide, and all metals on the CERCLA TCL. The 0.5 to 5 ft interval will be analyzed for the same constituents plus VOCs and SVOCs on the CERCLA TCL. The sample depths and analyses are summarized below:

• Surface-0.5 ft bgs	TPH, cyanide, CERCLA TCL Metals
• 0.5-5 ft bgs	TPH, cyanide, CERCLA TCL Metals, VOCs, SVOCs

4.6 OFF-SITE STORAGE YARD

A portion of the area of Fort Douglas to be excessed is located adjacent to a University of Utah storage yard (Figure 4-1). No information is available concerning any releases from this area; however, poorly marked drums, transformers, and miscellaneous equipment were observed to be present.

Potential soil contamination on Fort Douglas that could result if releases in the storage area occurred will be investigated by collecting and analyzing samples from a soil boring located just inside the Fort Douglas property line. The soil boring will be located downslope of the storage area; it will be drilled to a depth of 30 ft bgs.

Contamination which may have migrated via surface runoff will be investigated with a surface soil sample from 0 to 0.5 ft bgs. The vertical extent of potential contamination will be investigated with four additional samples, composited from 0.5 to 5 ft, 5 to 10 ft, 15 to 20 ft, and 25 to 30 ft bgs depth intervals. If visual observations or organic vapor monitoring indicate that other depth intervals may potentially be contaminated, the sample depth intervals may be altered, or the number of samples increased.

The surface soil sample will be analyzed for TPH, cyanide, and all metals on the CERCLA TCL. The deeper samples will be analyzed for the same constituents, plus VOCs and SVOCs on the CERCLA TCL.

The following summarizes the planned sample intervals and chemical analysis:

• Surface-0.5 ft bgs	TPH, Cyanide; CERCLA TCL Metals
• 0.5-5 ft bgs	TPH, Cyanide; CERCLA TCL Metals, Volatiles, Semivolatiles
• 5-10 ft bgs	TPH, Cyanide; CERCLA TCL Metals, Volatiles, Semivolatiles
• 15-20 ft bgs	TPH, Cyanide; CERCLA TCL Metals, Volatiles, Semivolatiles
• 25-30 ft bgs	TPH, Cyanide; CERCLA TCL Metals, Volatiles, Semivolatiles

4.7 SOUTHEAST FENCE LINE AREA

A portion of the excessed property is located along the southeastern-most boundary of Fort Douglas (Figure 4-3). This excessed portion is bounded to the west by Fort Douglas storage and maintenance areas; it is bounded on the east by Red Butte Creek. A preliminary site inspection, conducted on June 12, 1991, indicated that four locations could potentially exhibit contaminants, if releases occurred:

- Discharge culvert for Parking/Storage lot runoff
- Drainage ditch down slope from 1,000 gallon waste oil UST
- Drum Storage Area
- Fuel Storage Area

One soil boring will be drilled in each of these locations to investigate potential soil contamination. These borings will be located just east of the existing fence line, downslope of potential release locations. (The existing fence line bounds the retained portion of Fort Douglas in this area).

The borings will be drilled to a total depth of 5 feet. Samples will be collected from the 0 to 0.5 ft and 0.5 to 5 ft bgs intervals. The surface sample will be analyzed for TPH, cyanide, and CERCLA TCL Metals. The 0.5 to 5 ft bgs intervals will be analyzed for the same constituents, plus CERCLA TCL VOCs and SVOCs. The sample depths and analyses to be conducted at each of the four borings along the southeastern fence line, are summarized below:

• 0-0.5 ft bgs	TPH, Cyanide, CERCLA TCL Metals
• 0.5-5 ft bgs	TPH, Cyanide, CERCLA TCL Metals, VOCs, SVOCS

5.0 ENVIRONMENTAL INVESTIGATION AND ALTERNATIVES ANALYSIS TASKS

The following section contains descriptions of the tasks which will be conducted during the EI/AA. These are preliminary descriptions which will be refined as the program progresses and the scope of each task is further defined. The tasks include project scoping, field investigation, sample analysis and validation, data evaluation, risk assessment, environmental investigation reports, alternatives analysis, and preparation of the responsiveness summary and decision document. The preliminary task of project scoping includes all the activities which have been conducted to prepare and gain approval for the project work plans. These activities include: review of existing information; identification of data needs, preliminary remedial action alternatives, applicable or relevant and appropriate regulations (ARARs) and data quality objectives; and development of a sampling program. A list of potential ARARs is provided in Appendix C, and data quality objectives for the project are described in Section 4.1.

5.1 FIELD INVESTIGATION

The field investigation program at Fort Douglas will include soil, asbestos, transformer oil, paint, and possibly ground water. Activities such as surveying, field screening methods, waste management, project management and quality control will be conducted in support of the sampling. A detailed discussion of the sampling program for the site is presented in the SAP, and the QAPP describes sampling and data management procedures. All field activities will be conducted in accordance with the HASP for the EI/AA.

5.1.1 SOIL AND GROUND-WATER SAMPLING

Soil samples will be collected at the site to determine whether releases have occurred from potential contaminant sources. A hand auger and a drill rig equipped with a hollow-stem auger or mud-rotary coring device will be used for drilling of the borings.

Lithologic samples will be collected continuously from the borings and logged by the field geologist using the Unified Soil Classification System (USCS). A split-spoon sampler will be advanced ahead of the drill bit so that an undisturbed sample can be collected, if possible. Polybuterate or brass liners may be used in the core barrel to retain the sample.

The samples will be screened for the presence of volatile organic compounds using an OVA and headspace analysis. The headspace analysis is performed by placing a consistent volume of soil into a jar, then sealing and placing the jar in a warm location for at least 15 minutes. All samples should be held at a comparable temperature. The concentration of organic compounds in the air space above the soil is then measured. If organic concentrations above the background level are measured, or visual observations indicate that the soil is stained, the corresponding interval(s) will be sampled and added to the planned sample intervals sent to the lab for chemical analysis.

If saturated conditions are observed in a soil boring, the boring will be completed as a monitoring well. Ground-water samples and water levels collected from the wells will be used to characterize water quality in the water-bearing zones. The wells will be constructed in accordance with USATHAMA geotechnical requirements (USATHAMA, 1987) and requirements of the State of Utah, described in the QAPP. Following construction, the well will be developed to remove residual drill cuttings and to insure hydraulic connection between the water-bearing zone and the well.

Ground-water samples will be collected for water-quality analysis following procedures outlined in the QAPP and the Sampling and Analysis Plan. The wells will be purged prior to sampling to ensure that formation water, rather than stagnant water from the casing, is sampled. Initial sampling will take place no sooner than 14 days after well development. Water levels and field parameters such as pH, temperature, specific conductance and dissolved oxygen will be measured to monitor water quality during the well purge, and the results will be recorded on field data sheets.

5.1.2 TRANSFORMER OIL SAMPLING

The concentration of PCBs in the electrical transformers will be investigated by collecting samples from the transformers on and adjacent to the area to be excessed. This information will be used to assess any risks to human health and to determine if any remedial actions need to be taken. Prior to sampling, field activities will be coordinated with the Directorate of Engineering and Housing (DEH) to ensure all safety precautions are observed.

The sampling will be performed by a trained, licensed electrical journeyman and his/her apprentice. Sampling procedures will be guided by the standard operating procedures (SOPs) used by the journeyman. Appropriate measures will be taken during sampling to avoid damage to the transformers or spillage of transformer oil.

5.1.3 ASBESTOS SAMPLING

A comprehensive survey of suspected ACMs will be conducted to perform a risk assessment and determine if any remedial actions need to be taken. In addition to sampling suspected ACMs, the location, type, extent, and physical condition of suspected ACMs, and the potential for disturbance of these materials will be assessed during the survey. Homogeneous sampling areas will be delineated and sampled in each housing unit and in 16 miscellaneous-use buildings. Details regarding the asbestos survey are presented in the Asbestos Sampling Plan.

5.1.4 PAINT SAMPLING

Paint sampling will be conducted at the buildings to assess the release of lead dust and the risks associated with the lead-based paint in the buildings to be excessed. Paint chip samples will be collected in areas where the paint is peeling. Wipe samples will be collected from baseboards or other areas where potential lead dust may have settled. Approximately one sample of the peeling paint or one wipe sample will be collected from the interior of each building. A total of two exterior paint chip samples will be collected to characterize the exterior paint on the structures. The location of each paint chip or wipe sample will be marked on a map of the floor plan. The general condition of the paint in each building will be assessed, and the approximate area of peeling paint will be estimated. The paint samples will be analyzed for lead content using atomic absorbtion. The results will be used in the risk assessment.

5.1.5 TOPOGRAPHIC AND ELEVATION SURVEY

A topographic map will be compiled for the sites evaluated under this project. These maps will contain all surface features pertinent to the site and the investigation and the sampling locations.

The inner casing (riser) for the monitoring wells will be surveyed for horizontal control, to a degree of accuracy of 0.1 feet. Vertical control will be surveyed to a degree of accuracy of 0.01 feet. Soil borings will be measured for horizontal control to a degree of accuracy of 3 feet.

5.1.6 DATA MANAGEMENT

Data generated from sample collection will be managed in accordance with USATHAMA data management procedures that require strict chain-of-custody. Data for this project will include chemical analysis data *from the laboratory subcontractor, geotechnical data from the field drilling* program, and survey data. The chemical analysis data for Fort Douglas will be entered into the Installation Restoration Data Management System (IRDMS) by the laboratory subcontractor, and a review will be conducted by RLSA. All original logbooks, model outputs, and hardcopy of chemical/geotechnical data will be supplied to USATHAMA.

5.2 SAMPLE ANALYSIS AND VALIDATION

Procedures for chemical analysis of environmental samples have been selected to support the DQOs. The rationale for selection of the specific analytical procedures is presented in the SAP. Sample data management protocols are described in the QAPP, which also describes the sample container and preservation requirements, the sample chain-of-custody program protocol and records, and sample tracking and shipping. Data approval/validation will be performed by the USATHAMA Technology Division, Chemistry Branch. RLSA will receive control charts for all samples from the subcontractor laboratory, and will assist in QA by performing an independent review of a percentage of these data.

5.3 DATA EVALUATION

Data collected from investigation activities will be evaluated to determine whether they meet data quality objectives and to present data interpretations in formats useful for making decisions about subsequent work during the AA. The data will be used to develop contamination, public health, and environmental assessments.

The contamination assessment will evaluate the nature and extent of contaminants present at each site. The concentrations of the chemicals will be compared to appropriate standards and background levels. Those chemicals identified as contaminants will be evaluated further to characterize the potential fate and transport mechanisms allowing migration of contaminants from the site.

5.4 BASELINE RISK ASSESSMENT

The EI/AA will include a baseline risk assessment to evaluate the potential threat to human health and the environment if remediation is not conducted at the site. The baseline risk assessment will be conducted in accordance with EPA protocol specified in "Risk Assessment Guidance for Superfund," Vol. 1-Human Health Evaluation Manual and Vol. II-Environmental Evaluation Manual (EPA, 1989). The baseline risk assessment contributes information to the site characterization, and the results will be used in the subsequent development, evaluation and selection of appropriate response alternatives. Specifically, the results will be used to determine whether additional response action is necessary at the site, modify preliminary remediation goals, and support the selection of a no-action alternative, if appropriate. The environmental evaluation and the human health evaluation are parallel studies which use much of the same data relating to the nature, fate, and transport of contaminants. The assessment consists of the following components:

- Data collection and evaluation;
- Exposure assessment;
- Toxicity assessment; and
- Risk characterization.

5.4.1 DATA COLLECTION AND EVALUATION

During the data collection and evaluation, the available data from the site will be reviewed and organized for use in the baseline risk assessment. All site data will be gathered and analytical methods used, sample quantitation limits achieved and quality control results from the samples will be evaluated. In addition, tentatively identified compounds will be reviewed and sample results will be compared to background levels. The review and evaluation of the data will result in the development of a set of data for use in the risk assessment. Preliminary studies at the site indicate that asbestos, PCBs, hydrocarbons, lead, and radon are potential contaminants of concern at the site. These compounds will be the focus of the baseline risk assessment. In addition, compounds which are detected in the soil or ground-water samples may be used in the assessment if their intrinsic toxicity, quantity or potential migration capacity indicate that they are contaminants of concern.

5.4.2 EXPOSURE ASSESSMENT

The objectives of the exposure assessment will be to identify actual or potential exposure pathways and to estimate the magnitude, frequency and duration of potential exposures. Identifying potential exposure pathways will help to conceptualize how contaminants may migrate from a source to an existing or potential point of contact. An exposure pathway consists of four elements: (1) a source and mechanism of chemical release to the environment; (2) an environmental transport medium (e.g., air, ground water) for the released chemical; (3) a point of potential contact with the contaminated medium (referred to as the exposure point); and (4) an exposure route (e.g., inhalation, ingestion) at the exposure point. An exposure pathway is considered complete only if all of these elements are present.

Once the sources and release mechanisms have been identified, an analysis of the environmental fate and transport of the contaminants will be conducted. This analysis will consider the potential environmental transport (e.g., airborne transport, and surface-water and ground-water migration) and transfer mechanisms (e.g., sorption, volatilization) to provide information on the potential magnitude and extent of environmental contamination. Potential sources at Fort Douglas have been identified and include: transformers containing PCBs; structures containing lead-based paint, ACMs, and radon; USTs formerly containing gasoline, waste oil, and associated constituents; and a vehicle maintenance and degreasing area where hydrocarbons or degreasing solvents may have been present. In addition, transformers and drums located in an off-site storage yard and maintenance and storage areas located on the area to be retained are considered potential contaminant sources. Analyses are planned for contaminants that may be associated with these sources to determine which contaminants have been released and/or transported and the type of environmental transport medium.

Potentially exposed populations and the actual or potential exposure points for receptors will be identified next. This effort will focus on those locations where actual contact with the contaminants of concern will occur or is likely to occur. Inhabitants and visitors to Fort Douglas may be exposed to contaminants such as asbestos, lead, and radon inside the structures. They may be exposed to other contaminants, such as hydrocarbons or lead, in surface soils near the other sources discussed above, particularly those located near playground and picnic areas.

Finally, potential exposure routes that describe the potential uptake mechanism once a receptor comes into contact with contaminants in a specific environmental medium will be identified and described. Environmental media that may need to be considered include air, ground water, and soil. Primary exposure routes at Fort Douglas may include inhalation of asbestos, lead, and radon, ingestion of surface soils, and dermal contact with surface soils. Ingestion of ground water is not expected to be a significant exposure route; potable water is supplied from Salt Lake City.

After the exposure pathway analysis is completed, the potential for exposure will be assessed. Information on the frequency, mode, and magnitude of exposure will be gathered. These data will be assessed to yield a value that represents the amount of contaminated media contacted per day. This analysis will include not only identification of current exposures but also exposures that may occur in the future if action is not taken at the site. The frequency, mode and magnitude of exposures will vary based on the primary use of the area (e.g., residential, industrial, or recreational); therefore, the expected use of the area in the future will be evaluated. Because the possible reuse scenarios for Fort Douglas are uncertain, a reasonable maximum exposure scenario will be developed. This scenario will be based on the potential land use scenario identified in the FEIS (Dames & Moore, 1991) which includes residential, recreational and institutional and multiple-use development alternatives.

The final step in the exposure assessment will be to integrate the information and develop a qualitative and/or quantitative estimate of the expected exposure level(s) resulting from the actual or potential release of contaminants from the site.

5.4.3 TOXICITY ASSESSMENT

Toxicity assessment, as part of the baseline risk assessment process, will consider the types of adverse health or environmental effects associated with individual and multiple chemical exposures; the relationship between magnitude of exposures and adverse effects; and related uncertainties such as the weight of evidence for a chemical's potential carcinogenicity in humans. The risk assessment process will rely heavily on existing toxicity information and will not involve the development of new data on toxicity or dose-response relationships.

5.4.4 RISK CHARACTERIZATION

The potential risks of adverse health or environmental effects for each of the exposure and land-use scenarios derived in the exposure assessment will be developed and summarized in the risk characterization. Estimates of risks will be obtained by integrating information developed during the exposure and toxicity assessments to characterize the potential or actual risk, including carcinogenic risks, noncarcinogenic risks, and environmental risks. The final analysis will include a summary of the risks associated with a site including each projected exposure route for contaminants of concern and the distribution of risk across various sectors of the population. In addition, such factors as the weight-of-evidence associated with toxicity information, and any uncertainties associated with exposure assumptions will be discussed.

Characterization of the environmental risks will involve identifying the potential exposures to the surrounding ecological receptors and evaluating the potential effects associated with such exposure(s). Important factors to consider will include disruptive effects to populations (both plant and animal) and the extent of perturbations to the ecological community.

The results of the baseline risk assessment may indicate that the site poses little or no threat to human health or the environment. In such situations, the AA will be either scaled down as appropriate to that site and its potential hazard, or eliminated altogether. The results of the EI and the baseline risk assessment will therefore serve as the primary means of documenting a no-action decision.

5.5 TREATABILITY STUDIES

Treatability studies and/or pilot testing may be required to provide information for the detailed evaluation of alternatives, remedial alternatives selection, and remedial design. The need for pilot tests and treatability studies will be determined upon evaluation of data from the EI. As the EI progresses, determinations will be made to initiate such studies for the various sites, based on the applicability of treatability studies and pilot testing. As data needs are identified, recommendations for these studies will be submitted to USATHAMA as technical memoranda. USATHAMA will approve treatability study recommendations before implementation.

5.6 ENVIRONMENTAL INVESTIGATION REPORT

Hydrogeologic, contaminant assessment, and risk assessment data will be synthesized during the EI to provide a comprehensive understanding of site conditions. The EI report will present the data collected and conclusions based on the evaluations and interpretations conducted. Each EI report version will be submitted for review to the USATHAMA Project Officer, Project Geologist, and QA personnel. After comments have been addressed, USATHAMA will release the report to other agencies for their review and comments.

Internal Draft EI Report. Upon completion of EI tasks, an internal draft EI report will be prepared. The report will include a summary and interpretation of the data gathered during the EI. Data interpretation will include an evaluation of the degree and distribution of contamination and a risk assessment. Recommendations regarding potential additional data needs and objectives for potential remedial actions will also be included.

The EI report will follow EPA guidelines (EPA, 1988). The draft EI Report will be submitted to USATHAMA for review. USATHAMA will then distribute the drafts to the appropriate internal departments for review. The contractor will address USATHAMA comments, and a Draft Final version of the report will be issued to regulatory agencies for review. The Final EI report will address regulatory comments as directed by USATHAMA.

5.7 ALTERNATIVES ANALYSIS

The purpose of the alternatives analysis is to identify and screen appropriate technologies for the remediation of sources and affected environmental media within the excessed area at Fort Douglas. Once the technologies are screened, remedial alternatives will be formulated by combining technologies wherever feasible such that removal, treatment, and/or containment of sources and control or clean-up of contaminated environmental media will be addressed. The following sections provide details on the approach to accomplishing the AA based on the appropriate EPA guidance.

The AA will consist of the following tasks:

- Compilation of Applicable or Relevant and Appropriate Requirements (ARARs);
- Development and screening of remedial alternatives;
- Detailed analysis of remedial alternatives;
- Engineering description of selected remedial alternatives;
- AA reports, including a proposed plan;
- Public meeting;
- Responsiveness Summary; and
- Decision Document.

The overall objective of the AA is to develop and evaluate remedial alternatives that allow the selection of a remedial action that (1) is protective of public health and the environment, (2) is implementable, (3) is cost effective, and (4) meets CERCLA requirements, as amended by SARA.

5.7.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Section 121(d)(2) of CERCLA, as amended by the 1986 Superfund Amendments and Reauthorization Act (SARA), requires that remedial actions must at least attain Federal and more stringent state applicable or relevant and appropriate requirements (ARARs) upon completion of the remedial action.

A requirement may be either "applicable" or "relevant and appropriate" to remedial activities at the site, but not both. Applicable requirements are those clean-up standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site. A remedial action must satisfy all jurisdictional prerequisites of a requirement for that particular requirement to be applicable (EPA, 1988). For example, EPA guidance states that Resource Conservation and Recovery Act (RCRA) minimum technology requirements would be applicable for the construction of a new hazardous waste landfill at a CERCLA site. Thus, the RCRA requirement to construct a double liner with a leak detection system for a hazardous waste landfill would be applicable to a CERCLA remedial action.

If a requirement is not "applicable", it may still be "relevant and appropriate". Relevant and appropriate requirements mean those standards that, while not "applicable" at a CERCLA site, address problems or situations "sufficiently similar" to those at the site that their use is well suited to the particular site. It is also possible that a requirement may be relevant but not appropriate for the site-specific situation (EPA, 1988). For example, maximum contaminant levels (MCLs) promulgated under section 141.11 of the Safe Drinking Water Act are relevant and appropriate to the remediation of Class I or Class II aquifers, i.e. ground water that is or may be a potential source for drinking water. However, MCLs may be relevant but not appropriate where there is no actual, planned or potential use of ground water for drinking due to widespread naturally occurring contamination or where substantial contamination exists in, for example, an area that has been heavily industrialized for many years.

ARARs are divided into three major categories: chemical-specific requirements, location-specific requirements and action-specific requirements. Chemical-specific ARARs are derived from health-or risk-based concentration limits which, when applied to site-specific conditions, may result in a numerical value used to guide a clean-up activity. For example, RCRA maximum concentration limits (MCLs) promulgated in Part 264.94 of RCRA are standards for 14 toxic compounds, primarily toxic metals and pesticides, that have been adopted as RCRA ground-water protection standards.

Location-specific ARARs are restrictions placed on the concentrations of hazardous substances or the types of activities permitted based solely on the site's location. A common example is the location-specific restriction on discharge or dredging of fill material into wetlands, as specified under section 404 of the Clean Water Act. Another example is the restrictions imposed on the construction of a hazardous waste Treatment, Storage and Disposal (TSD) facility within a 100-year floodplain to avoid washout or overflowing.

Action-specific ARARs are usually technology- or activity-based requirements or limitations on remedial actions taken with respect to hazardous waste. They are triggered by the remedial alternative under consideration and are used to indicate how a selected alternative must be achieved. For example, discharge of treatment system effluent to a surface-water body must meet National Pollution Discharge Elimination System (NPDES) permit requirements, which include the use of best available technology (BAT) economically achievable for the control of toxic and non-conventional pollutants. Also, applicable state water-quality standards must be complied with and a Best Management Practices program must be developed and implemented to prevent the release of toxic constituents to surface waters.

At the remedial investigation phase, the list of potential ARARs must be kept general and preliminary. After final remedial alternatives are developed during the feasibility study, the list can become more specific and finalized, particularly with respect to action-specific and location-specific requirements. A list of potential ARARs specific to Fort Douglas is provided in Appendix C.

5.7.2 DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

During this phase of the AA program, remedial alternatives will be developed by combining potentially applicable technologies. During the development of these alternatives remedial action objectives will be identified, general response actions for each medium or contaminant of interest will be developed, volumes of material requiring remediation will be calculated, technologies applicable to each general response will be screened based on effectiveness, implementability and cost, and the selected technologies will be assembled into alternatives. The number of contaminants suspected to be present at Fort Douglas and the possible remedial alternatives for these contaminants are limited; therefore, the time spent screening alternatives may be minimized. A preliminary list of remedial alternatives includes: (1) encapsulation or removal of ACMs; (2) encapsulation, removal, or replacement of components covered by lead-based paint; (3) reduction of radon by ventilation, sealing, and depressurization and pressurization techniques; and (4) replacement of transformer oil or transformers.

5.7.3 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The detailed analysis presents the relevant information that allows decision makers to select a site remedy. The detailed analysis of each remedial alternative will include descriptions and specifications, and analysis relative to evaluation criteria established to address CERCLA requirements.

The detailed description of each remedial alternative will emphasize the technologies used and the components of each alternative. Where appropriate, the description will present preliminary site layouts, and a discussion of limitations, assumption, and uncertainties concerning each alternative. Anticipated work activities also will be summarized, and figures will graphically depict the alternatives or their components.

As part of the criteria analysis, remedial alternatives will be examined with respect to requirements stipulated in CERCLA (Section 121), as amended by SARA. CERCLA emphasizes the evaluation of long-term effectiveness and related considerations for each remedial alternative. The evaluation criteria developed to address these statutory considerations are:

- Overall protection of human health and the environment;
- Compliance with ARARs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume;
- Short-term effectiveness;

- Implementability;
- Cost;
- State acceptance; and
- Community acceptance.

Based on this evaluation, a proposed plan will be selected and included in the AA report.

5.8 ALTERNATIVES ANALYSIS REPORTS

Throughout the AA process, reports will be produced and delivered to USATHAMA for review. The reports produced will include a draft AA report, draft-final AA report, and final AA report. Each document will be submitted to USATHAMA for review by the Project Officer, Project Geologist, and QA personnel. Comments will be addressed by the contractor within 15 days, and USATHAMA will release the draft-final report to appropriate agencies for their review and comments. The contractor will revise the document, addressing regulatory agency comments and submit the final AA report to USATHAMA within 15 days.

5.9 RESPONSE SUMMARY AND DECISION DOCUMENT

Following regulatory concurrence on the EI/AA reports a public meeting will be held in which the EI/AA conclusions and the proposed plan will be released. The public will have 60 days to provide comments to USATHAMA. The comments received will be addressed in a Responsiveness Summary and, finally, a Decision Document will be prepared which describes the remedial program which will be conducted at the site.

6.0 PROJECT ORGANIZATION

The EI/AA for Fort Douglas is being conducted as part of the Base Closure Program under the direction of USATHAMA. RLSA will implement the program using the management structure illustrated in Figure 6-1. In addition to USATHAMA, outside regulatory agencies will be involved in the review of draft-final reports from the EI/AA.

6.1 ROLES OF KEY PERSONNEL

The roles and responsibilities of key EI/AA personnel are described below. These roles have been established to ensure that the objectives of the program are accomplished.

USATHAMA Contracting Officer's Representative (COR) - The COR is responsible for establishing policy and providing guidance for the program. The COR approves project funding and officially releases and distributes documents.

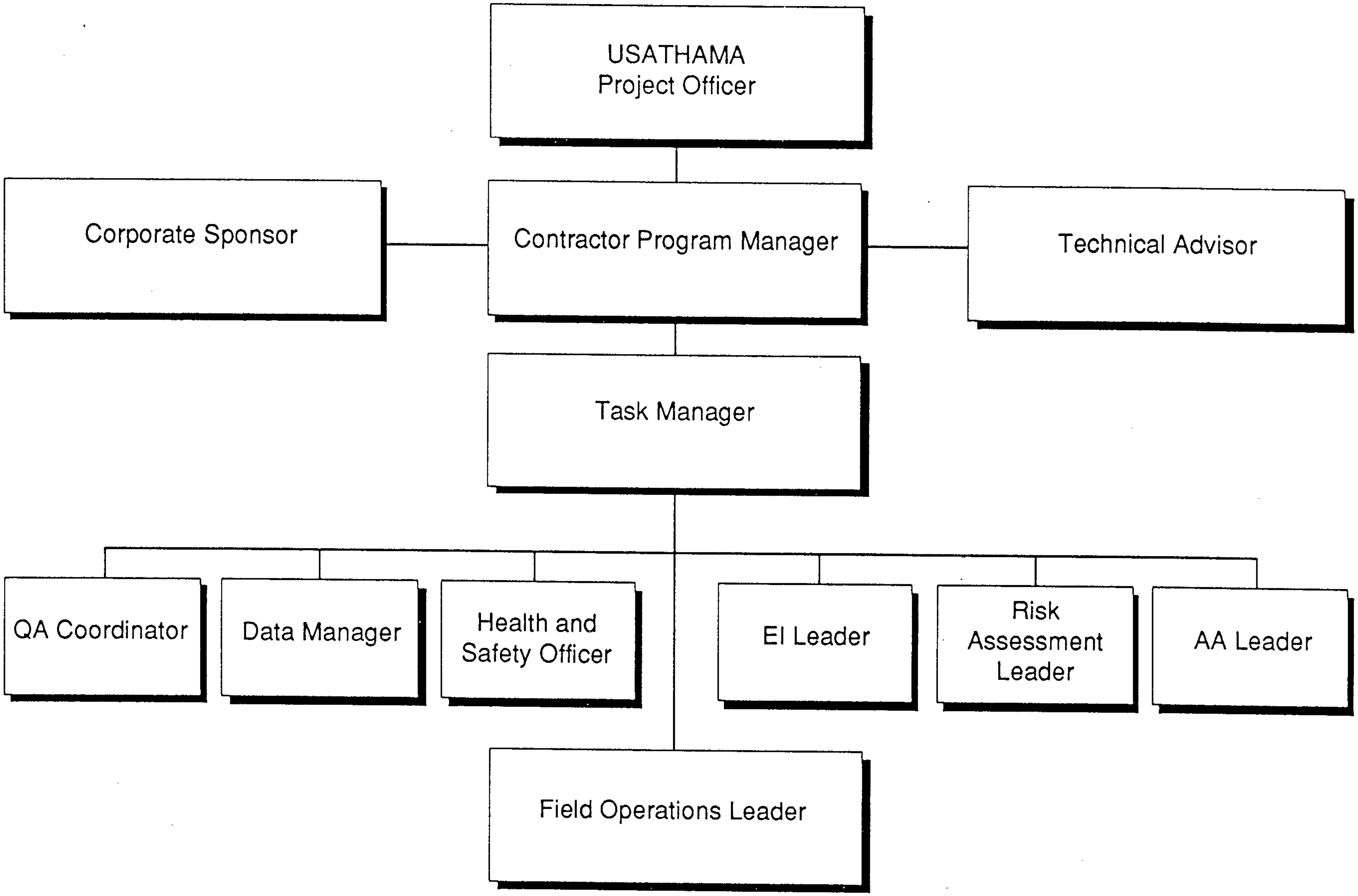
USATHAMA Project Officer - The Project Officer manages the EI/AA activities at Fort Douglas, providing oversight of all technical and administrative issues. He reviews and approves deliverables for technical accuracy and for compliance with USATHAMA guidelines and objectives.

Contractor Program Manager - The function of the Program Manager is to solve any management, technical or administrative problems that arise during the program and to serve as the point of contact with the COR. The Program Manager ensures that the program meets the objectives of the client.

Contractor Task Manager - The Task Manager is responsible for directing day-to-day technical and administrative project activities and coordinating subcontractor activities. The Task Manager monitors progress of the program for comparison with the budget, project milestones and program objectives.

6.2 SUPPORT ROLES

Program-wide technical and administrative support is provided by the Technical Advisor and the Corporate Sponsor. Support for the Fort Douglas technical program is provided by the EI Leader, Risk Assessment Leader, AA Leader, Data Manager, QA Coordinator, and Program Health and Safety Officer.



R.L. STOLLAR & ASSOCIATES INC.
Ground-Water Consultants

Figure 6-1
Fort Douglas Project
Management Structure

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Technical Advisor - The Technical Advisor provides broad review and oversight of technical aspects of the program. The Advisor also is able to provide information on and insight into new or developing technologies that may be applicable to the program.

Corporate Sponsor - The Corporate Sponsor ensures that overall objectives of the project are achieved and the relevant resources and support infrastructure of the company are directed toward the project's needs. The Sponsor also resolves conflicting priorities within the company.

EI Leader - The EI Leader ensures that data quality objectives are met during the field program and subsequent chemical analysis, and that assessments of the data are technically accurate. The EI Leader is responsible for submitting the EI reports to USATHAMA on schedule.

Risk Assessment Leader - The Risk Assessment Leader conducts an assessment of risks to human health and the environment from any contamination present at the site. The Risk Assessment Leader ensures that the results are incorporated in the EI report.

AA Leader - The AA Leader evaluates possible remedial alternatives for the site based on the results of the EI investigation. The AA Leader ensures that AA reports are submitted to USATHAMA on schedule.

QA Coordinator - The QA Coordinator oversees the implementation of appropriate USATHAMA and EPA protocols for the Fort Douglas EI/AA. The Coordinator is responsible for the development of the QAPP and works with the Task Manager to establish quality control (QC) procedures.

Data Manager - The Data Manager is responsible for management of all field and laboratory data, and ensures that required data is transferred to USATHAMA. The Data Manager supervises conversion of geotechnical and map data to IRDMS format, group and record checking of Level 1 analytical data and uploading of appropriate data to the 3COM network.

Program Health and Safety (H & S) Officer - The H&S Officer is responsible for implementation of the Health and Safety Plan during EI field activities. The H&S officer is also responsible for developing a Health and Safety Plan for implementation of remedial alternatives if necessary.

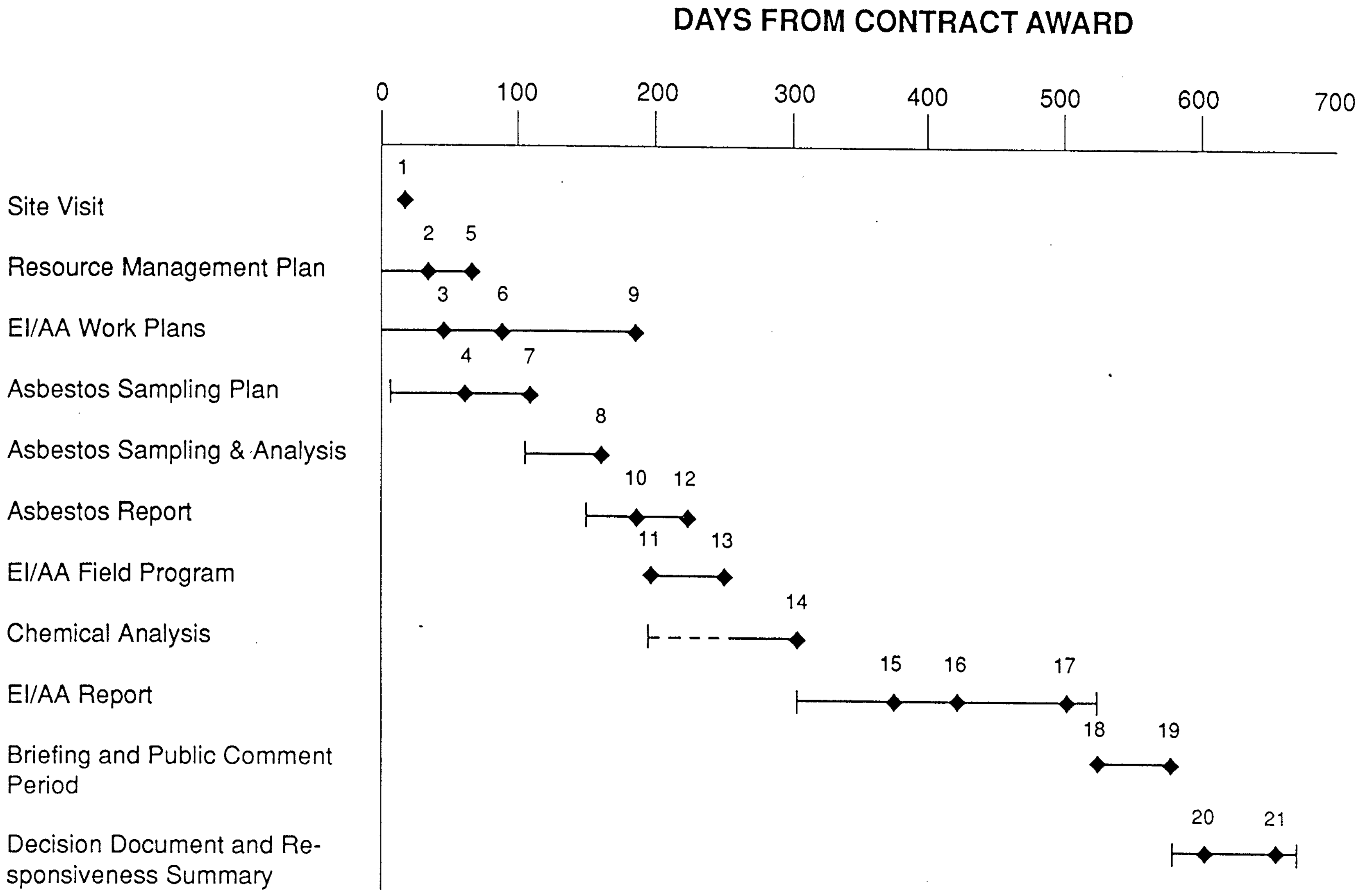
Field Operations Leader - The Field Operations Leader is responsible for ensuring that the work plans are implemented. The Field Operations leader also performs field QC.

6.3 PROGRAM SCHEDULE

The schedule for the Fort Douglas EI/AA is presented on Table 6-1 and Figure 6-2. The final Decision Document will be submitted on December 6, 1992.

Table 6-1 Fort Douglas EI/AA Schedule

ITEM	DATE
1. Site Visit	Completed
2. Submit Draft Resource Management Plan	Completed
3. Submit Draft EI/AA Work Plans	Completed
4. Submit Draft Asbestos Sampling Plan	Completed
5. Submit Final Resource Management Plan	Completed
6. Submit Draft-Final EI/AA Work Plans	Completed
7. Submit Final Asbestos Sampling Plan	Completed
8. Complete Asbestos Sampling and Lab Analysis	Completed
9. Submit Final EI/AA Work Plans	August 5, 1991
10. Submit Draft Asbestos Report	August 20, 1991
11. Complete EI/AA Field Mobilization	August 30, 1991
12. Submit Final Asbestos Report	October 4, 1991
13. Complete EI/AA Field Program	October 29, 1991
14. Complete Chemical Analysis	December 23, 1991
15. Submit Draft EI/AA Report	February 21, 1992
16. Submit Draft-Final EI/AA Report	April 21, 1992
17. Submit Final EI/AA Report	July 5, 1992
18. EPA/Public Briefing	August 5-11, 1992
19. End of Public Comment Period	September 25, 1992
20. Submit Draft Decision Document and Responsiveness Summary	October 16, 1992
21. Submit Final Decision Document and Responsiveness Summary	December 6, 1992



◆ Deliverable or Milestone
See Table 6-1

R.L. STOLLAR & ASSOCIATES INC.
Ground-Water Consultants

Figure 6-2
Fort Douglas EI/AA
Schedule

FORTD.426/1

7.0 REFERENCES

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APPENDIX A

TRANSFORMER INFORMATION

HEVI-DUTY/DOWZER
A UNIT OF GENERAL SIGNAL

RECEIVED

March 25, 1991

R. L. STOLLAR & ASSOC.
303 E. 17th Ave. - Suite 550
Denver, CO 80203

Attention: Nan Glenn

Reference: Hevi-Duty/Dowzer New Transformers - PCB Content?

Dear Ms. Glenn:

In reference to your request for information as to PCB content of oil used in Hevi-Duty/Dowzer new distribution transformers, the following will help clarify any concern.

1. Hevi-Duty/Dowzer Electric has never manufactured transformers filled with PCB liquid. This eliminates any possibility of contamination in the plant's oil handling system.

2. Hevi-Duty/Dowzer has received written assurance from mineral oil suppliers that no PCB material is used in the processing of petroleum products nor does PCB occur naturally in petroleum. They have analyzed their oil and no PCBs were detected at the minimum detectable level.

   Hevi-Duty/Dowzer Electric has also analyzed the new oil and confirmed that no PCBs exist at the minimum detectable level.

We feel the above explanation should relieve any concern as to the classification of Hevi-Duty/Dowzer new transformers as non-PCB when shipped.

For further information or additional questions please contact the Hevi-Duty/Dowzer office at the address or phone number listed below.

Yours truly,

HEVI-DUTY/DOWZER ELECTRIC
A Unit of General Signal

Kevin Edwards

Kevin Edwards
Engineering Manager

KE/nm

P.O. BOX 829 • MT. VERNON, ILLINOIS 62864 • PHONE 618-242-0190

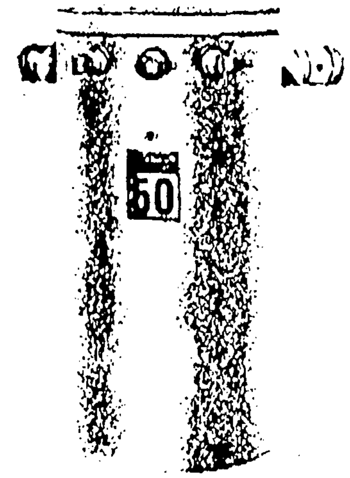
FAMILY CAMP
FORT DOUGLAS, UTAH
ELECTRICAL SUBMITALS

AMERICAN ELECTRICAL SERVICE
P.O. BOX 151007, S.L.C., UT. 84115 PHONE 248-3222

QUANITY		DESCRIPTION
1	Transformer:	Dowzer 50 KVA single phase
2	Arresters:	VariSTAR type AZS
2	Cutouts:	S&C Open Cutouts type XS Catalog Number 89021R9
2	Fuse Links:	McGraw Edison C Fuse Link 100 Amp
1	Load Center:	Square "D" QO30M225RB

DOWZER

POLE MOUNT
OIL FILLED
DISTRIBUTION
TRANSFORMERS



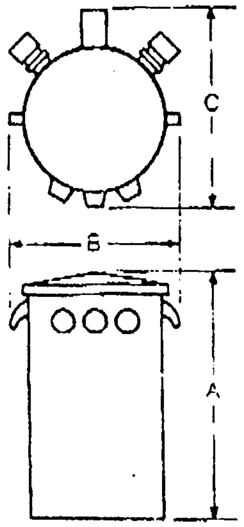


FIGURE 1

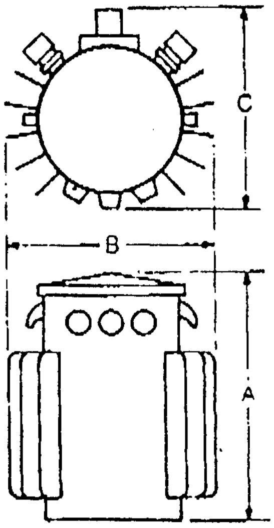


FIGURE 2

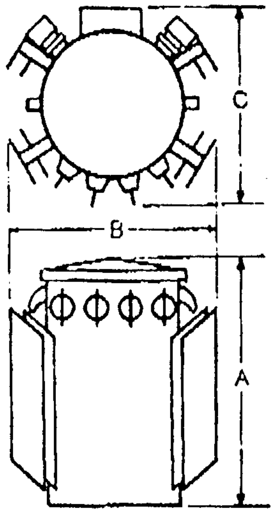


FIGURE 3

DOWZER TYPE CA TRANSFORMERS

Conventional style transformer with one set of mounting brackets, two high voltage bushings tank wall mounted. Designed, manufactured and tested in accordance with NEMA and ANSI specifications.

PATENTED* POWER CORE CONSTRUCTION
The low loss, low exciting current characteristics and quiet operation results from the patented POWER CORE. Made of high grade silicon steel, the core is assembled with a precise, distributed-gap technique providing the best magnetic qualities.

DURABLE WEATHER-TESTED FINISH
Tanks are primed with a rust inhibitor then coated with a pre-heated acrylic enamel. Less thinner is required resulting in a heavier finish.

ARC WELDED BRACKETS AND LIFTING LUGS
Designed with a built-in extra margin of safety, mounting brackets and lifting lugs are secured with a continuous arc weldment.

MANUFACTURED UNDER RIGID
QUALITY CONTROL
Transformers are 100% inspected through every phase of manufacturing. Up-to-the-minute test equipment assures reliability and product integrity.

---

*Patent No. 3404360

MECHANICAL DATA TYPE CA
SINGLE PHASE / 60 HERTZ / 65° RISE / OISC

HIGH VOLTAGE	**2400 / 4160Y BIL 60 KV** **4160 / 7200Y BIL 75 KV** **4800 / 8320Y BIL 75 KV**
LOW VOLTAGE	**120 / 240 BIL 30 KV** **240 / 480 BIL 30 KV**

	DIMENSIONS INCHES			OIL GALS.	WEIGHT LBS.	REFERENCE
KVA	A	B	C			
10	25.5	25.5	20.5	8	225	FIGURE 1
15	26.5	26.5	21.5	10	265	FIGURE 1
25	31	28	23.5	16	365	FIGURE 1
37½	31	30	25.5	20	495	FIGURE 1
50	36	30	25.5	22	600	FIGURE 1
75	42.5	33	29.5	40	850	FIGURE 1
100	43.5	33	30	42	1070	FIGURE 2
167	44.5	38.5	32	50	1300	FIGURE 3
250	44.5	40.5	34.5	61	1730	FIGURE 3
333	45	46	39	72	2055	FIGURE 3
500	58	46	39	95	2850	FIGURE 3

For additional information contact: **DOWZER ELECTRIC** P.O. BOX 828 • MT VERNON, IL 62864 • 618/242-0190 • TELEX 40-4402

DUE TO CONTINUING PRODUCT IMPROVEMENTS, DATA SUBJECT TO CHANGE WITHOUT NOTICE

Power Systems Division

Surge Arresters

VariSTAR® Type AZS Distribution-Class (IEC 5-kA Series B) Certified Test Data

R235-61-1

Reference Data

Design tests have been conducted on the McGraw-Edison VariSTAR Type AZS distribution-class arrester for overhead system application. They have been tested in accordance with the appropriate sections of the ANSI/IEEE Standard C62.1, IEC Publication 99-1, and CSA Standard 233 and has met the requirements of these standards. In addition, tests have been performed on the VariSTAR arrester not specified by ANSI, IEC or CSA standards but appropriate to metal-oxide varistor (MOV) surge arresters. The results of these standard tests are summarized in this text. Refer to Table 1 for the reference between required tests and specific paragraphs or clauses of the standard.

Table 1
Surge Arrester Standards Cross Reference

Test	ANSI C62.1-1981 Paragraph No.	CSA 223-1972 Clause No.	IEC 99-1-1970 Clause No.
Insulation Withstand	8.1	6.2	—
Discharge (Residual) Voltage	8.4	6.5	62
High-Current, Short-Duration Impulse	8.6.1	6.6.2	63.2
Low-Current, Long-Duration Impulse	8.6.2.2	6.6.5	63.3.3
Duty Cycle	8.7.1.3	6.7	64
Internal Ionization and Radio Influence Voltage	8.8	6.8	—
Arrester Disconnector	8.11	6.10	66
Contamination (Pollution)	8.12	—	Appendix D

VOLTAGE-WITHSTAND TESTS OF ARRESTER INSULATION

The external insulation of VariSTAR Type AZS arresters has been tested in accordance with the standards. The withstand voltage of these arresters exceeds the values in these standards for all voltage ratings as shown in Table 2. Creepage and arcing distances are also listed.

Table 2
Insulation Characteristics

Arrester Rating (kV rms)	Creepage Distance in.	Creepage Distance (cm)	Arcing Distance in.	Arcing Distance (cm)	Minimum 1.2 × 50 Withstand (kV crest)	Minimum Power Frequency Withstand kV rms Wet	Minimum Power Frequency Withstand kV rms Dry
3/4.5	3.0	(7.6)	1.8	(4.6)	45	15	20
6/7.5	5.5	(14.0)	3.5	(8.8)	60	25	35
9/10	8.5	(21.6)	5.2	(13.2)	95	35	50
12	8.5	(21.6)	5.2	(13.2)	95	35	50
15	12.2	(31.0)	7.7	(19.6)	120	45	66
18	13.5	(34.3)	8.5	(21.6)	140	50	70
21	13.5	(34.3)	8.5	(21.6)	140	50	70
24	16.0	(40.6)	9.2	(23.4)	150	60	85
27	22.0	(55.9)	12.5	(31.8)	200	80	120
30	22.0	(55.9)	12.5	(31.8)	200	80	120

DISCHARGE (RESIDUAL) VOLTAGE CHARACTERISTICS

The discharge (residual) voltage characteristics of the VariSTAR Type AZS are shown in Table 3 for various surge current magnitudes. These values are assured in production arresters by a discharge voltage test performed on every disk. Discharge voltage oscillograms are shown in Figures 1 through 5.

Table 3
Protective Characteristics

Arrester Rating (kV rms)	MCOV* (kV rms)	Equivalent** Front of Wave (kV crest)	Discharge Voltage for 8. × 20μs Wave kV crest 1.5 kA	5 kA	10 kA	20 kA	40 kA	65 kA
3/4.5	3.0	19	13.0	14.0	16.5	18.0	20.0	22.0
6/7.5	6.0	30	21.0	22.5	26.0	29.0	31.0	34.0
9/10	8.4	45	31.0	34.0	39.0	43.0	47.0	52.0
12	10.2	57	39.0	43.0	49.5	54.0	59.0	65.0
15	12.7	67	46.0	50.0	58.0	63.5	69.0	76.0
18	15.3	76	52.0	57.0	66.0	72.5	79.0	87.0
21	17.0	95	66.0	71.0	82.5	91.0	99.0	109.0
24	19.5	111	76.0	82.5	96.0	105.0	115.0	127.0
27	22.0	114	79.0	85.0	99.0	109.0	119.0	131.0
30	24.7	131	91.0	97.0	113.0	125.0	138.0	152.0

*MCOV — Maximum continuous operating voltage.

**Based on a 10-kA discharge voltage using 0.5 × 1.5 microsecond wave. For equivalent front-of-wave protective levels at other times to crest, see Figure 8.

APPENDIX B

STATE OF UTAH
UNDERGROUND STORAGE TANK CLOSURE PLAN

RECEIVED
AUG 22 1991

UNDERGROUND STORAGE TANK CLOSURE PLAN
(revised 11/89)

IN ORDER TO EXPEDITE THE REVIEW OF YOUR CLOSURE PLAN, PLEASE FILL IN ALL BLANKS COMPLETELY. THIS CLOSURE PLAN SUPERCEDES PRIOR VERSIONS.

/ Date Received
/ Reviewer/Date Reviewed
/ Reviewer Recommendation
/ EHM Review/Date

****

Closure Plan prepared by James D. Smith of Westech Fuel Equipment
tel # 266-2545 Address 195 West 3900 South, Murray Zip 84107

SITE INFORMATION
Owner Name U.S. Army Address Fort Douglas, Utah
Zip 84113 Tel # 524-4137
Site Name F.D. Bldg's 134,129,39,129,122 Address Fort Douglas, Utah
Zip 84113 (Contact Person) John Cloonan Tel. #719-579-4825
Tank Location Identification Number (found on billing forms, 7 digit #)
4001149
Number of tanks at this site 10. Number of tanks at this site to be closed 8.

TANK INFORMATION

Tank #:	1	2	3	4	5	6	7	8
Age of tank	unknown	unknown	unknown	unknown	unknown	unknown	unknown	unknown
Capacity	5,000	5,000	5,000	10,000	250	1,000	500	500
Subs. stored	unleaded	regular	premium	unknown	unknown	waste oil	diesel	diesel
Date last used	unknown	unknown	unknown	unknown	unknown	in use	unknown	unknown

SITE PLAT ATTACHED Located on the plat should be buildings, tanks, lines, dispensers, underground utilities, proposed sampling locations, sampling depths, substance stored in tanks and other important features.

CLOSURE NOTICE FORM This must be filled out and returned to the Bureau when closure is completed.

TANK HANDLER Name Steve Foster/Westech Fuel Equip Certificate #TH-0056
Address 195 West 3900 South, Murray, Utah Zip 84107

SOIL/GROUNDWATER SAMPLER NAME James D. Smith/Westech Fuel Equipment
Certificate # (after 12/31/89) GS-0142 Address Same
Zip

DISPOSAL INFORMATION
Tank(s) will be disposed at: Facility Hugo Neu
Address 4221 West 700 South Contact Warren Jennings
Tel. # 973-8665

Product lines will either be X removed or ______ secured in place and capped.
Vent lines will either be X removed or ______ secured open
Piping will be disposed at: Facility Hugo Neu
Address 4221 West 700 South Contact Warren Jennings
Tel. # 973-8665
Tank will be emptied by Advanced Petroleum Equipment (company)
and cleaned by Advanced Petroleum Recycling (company).
The tank will be rendered inert by the following method:
with dry ice, 20 lbs per 1000 gallon capacity
If tanks are to be closed in-place, has approval been obtained from the Fire Dept? ______ yes ______ no

THE FOLLOWING INFORMATION MUST BE FILLED OUT COMPLETELY
If found, contaminated soils are to be disposed at the following facility
E.T. Technologies address 6030 West 1300 South
contact Cindy Anderburg tel. # 973-2065
If found, contaminated water is to be disposed at the following facility
Tri K Construction address 210 North Robinson Ave, Am Fork, Utah

contact Kal Kessler tel. # 756-4296
Residual sludges are to be disposed at the following facility: Chemical Handling CorpAddress 1636 Pioneer Rd., SLC, Utah Contact Jim Finney

Tel. # 975-1800

IF CONTAMINATED SOILS ARE TO BE AERATED, CONTACT BUREAU OF AIR QUALITY FOR ANY NECESSARY PERMITS AT 538-6108

IF CONTAMINATED GROUNDWATER IS FOUND, CONTACT BUREAU OF WATER POLLUTION CONTROL FOR ANY NECESSARY PERMITS AT 538-6146

CONTACT LOCAL HEALTH DISTRICT Name of Dist. S.L. County Date 10/15/90
Contact Joann Stinar Title Secretary Tel.# 534-4547
CONTACT LOCAL FIRE DEPT. Name of Dept. Salt Lake City Date 10/15/90
Contact Wayne Leydsman Title Fire Marshall Tel.# 799-4164

SITE ASSESSMENT

A site assessment must be performed on all tanks to be closed. At a minimum, protocol found in R450-205 UAC should be followed during close assessment.

Groundwater sample lab analysis to be used: X 8015 (modified), ______ EPA 413.1, other ______
Soil sample, lab analysis to be used: X 8015 (modified), X EPA 413.1, other USC
State Certified Laboratory to be used: American West Analytical
Address 463 West 3600 South Zip 84107
Tel # 263-8686 contact Steve Getz

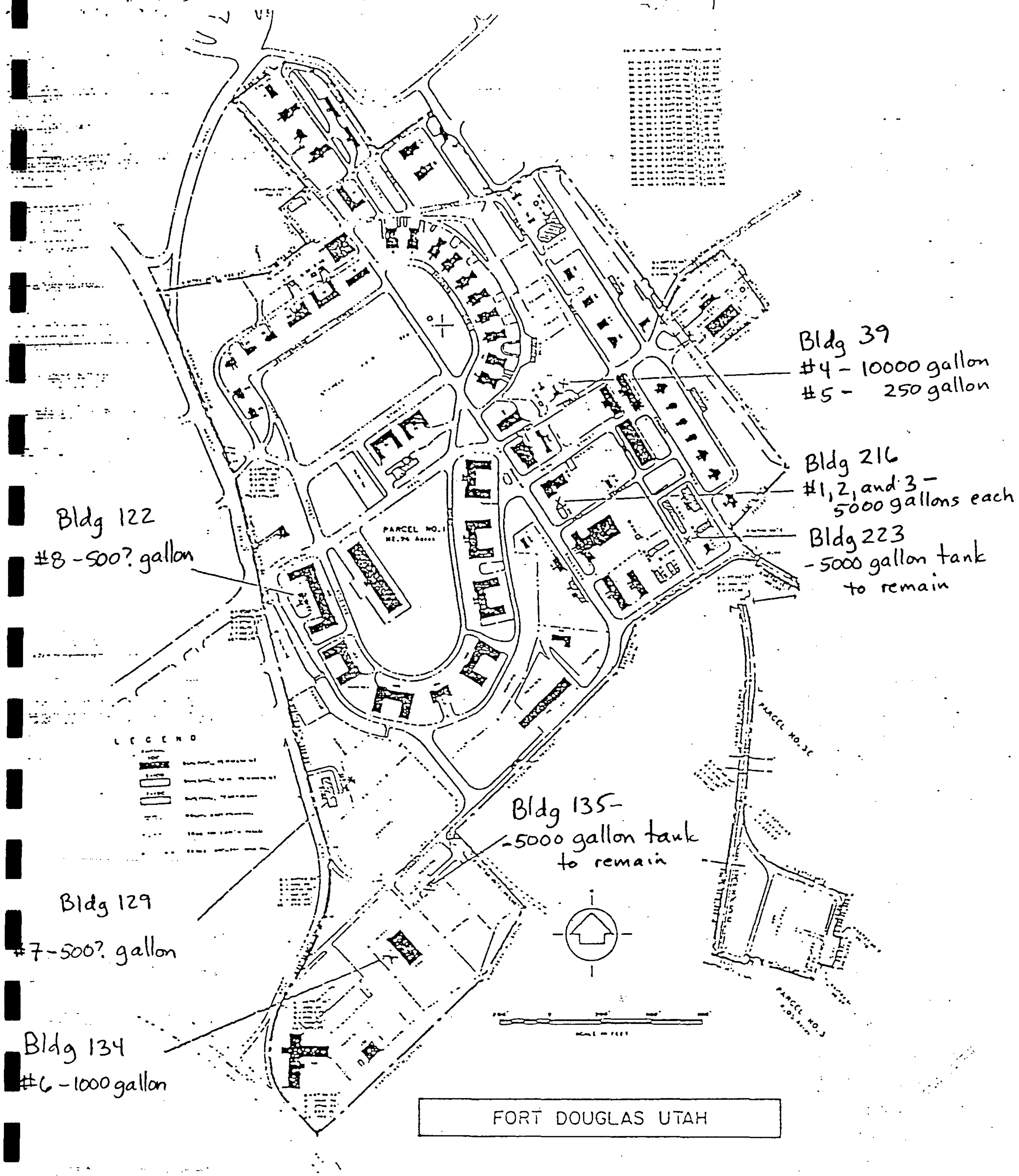
CONTAMINATION INFORMATION

In the event that contamination is detected or suspected, you must report a release to the Executive Secretary, Solid and Hazardous Wastes

Committee at 801-538-6170. If contamination is suspected or detected a qualified environmental consultant should assist you in your remediation. In the event contamination is found the environmental consultant will be:

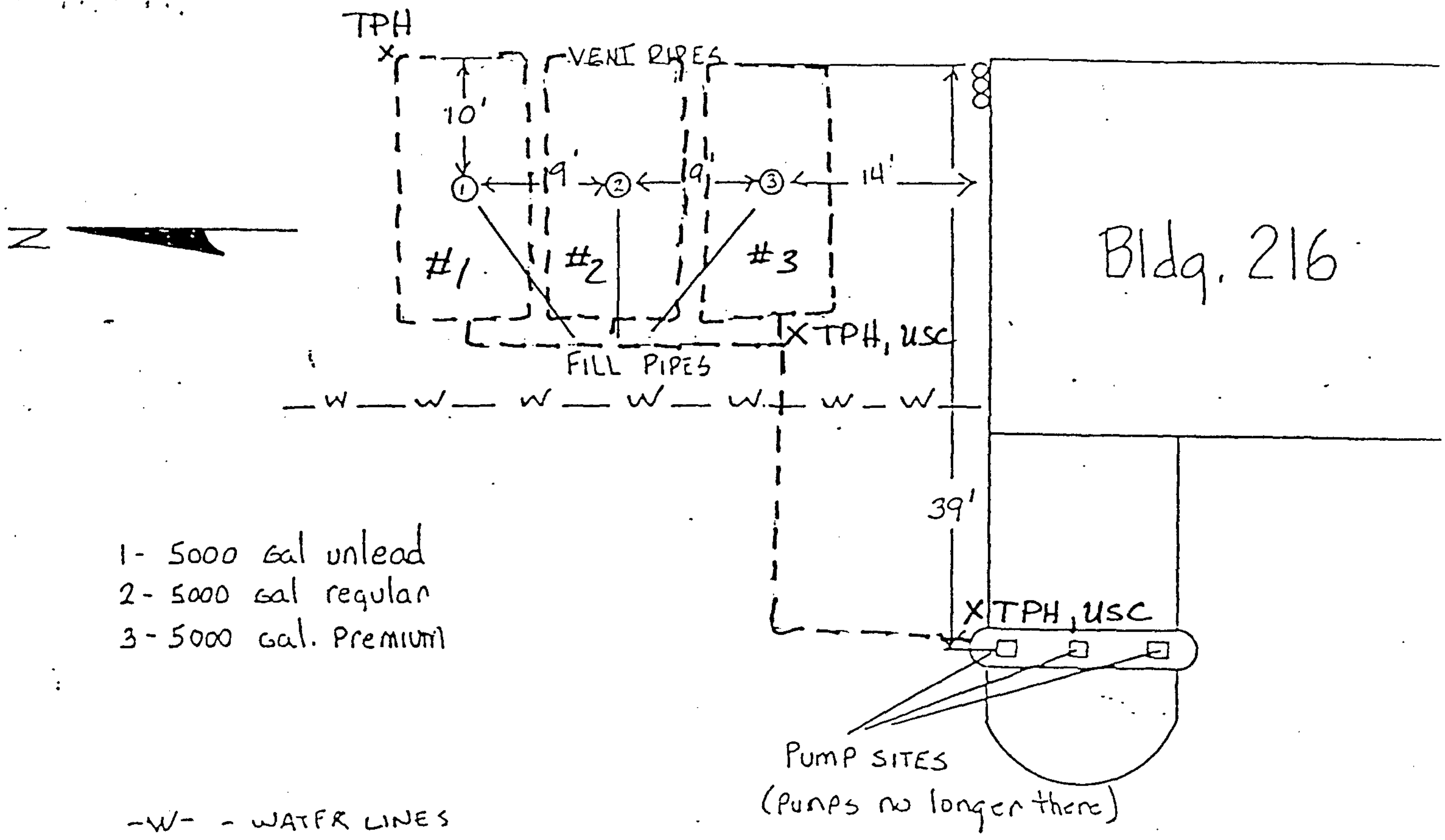
Company Westech Fuel Equipment
Address 195 West 3900 South City Salt Lake City
State Utah Zip 84107 Tel. # 266-2545

CHNICAL EXHIBIT 2



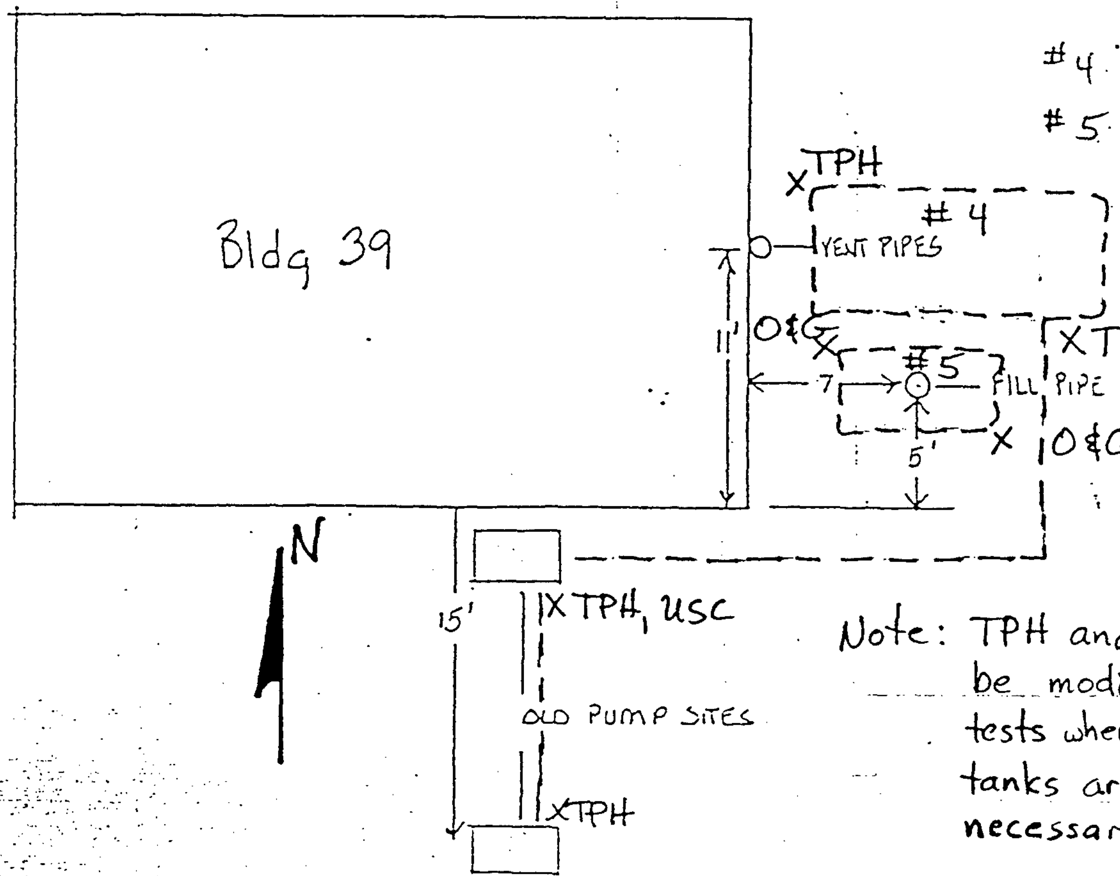
FORT DOUGLAS UTAH

12 SEPT 1973



1- 5000 Gal unlead
2- 5000 Gal regular
3- 5000 Gal. Premium

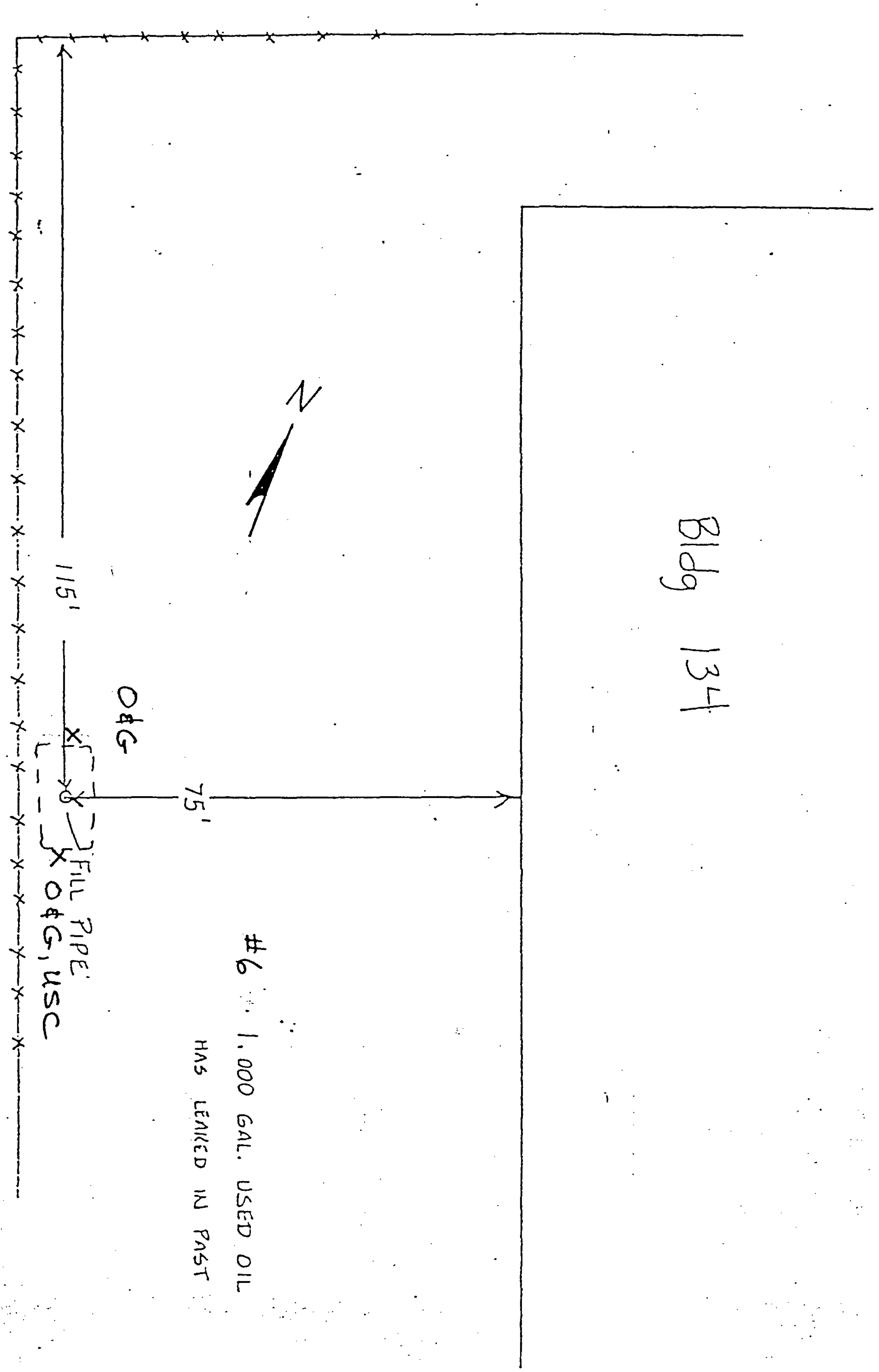
-W- - WATER LINES

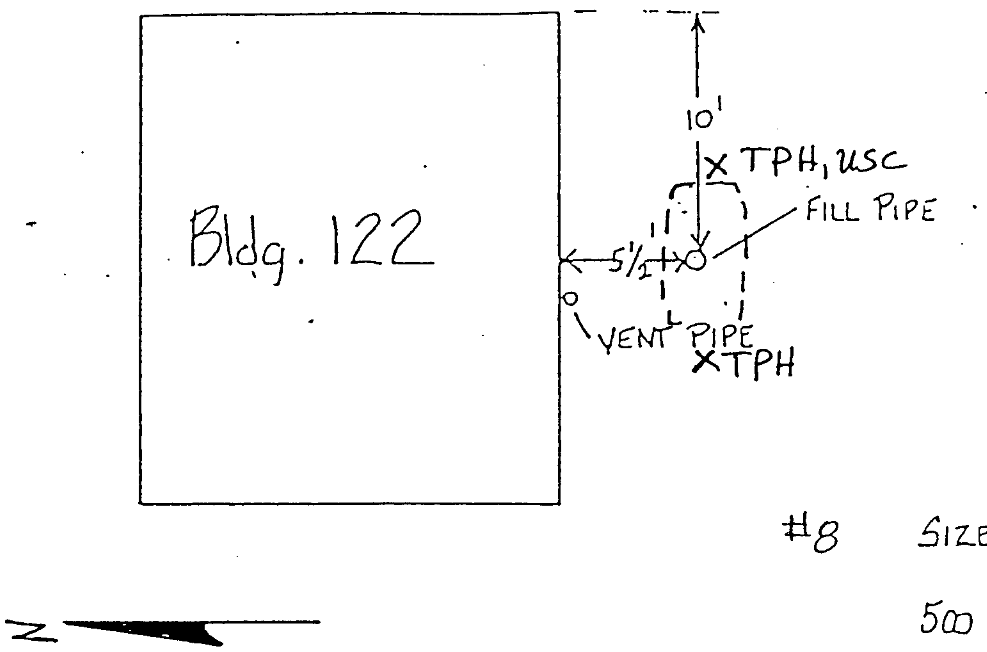


#4 10,000 Gal. unknown
#5 250 Gal unknown

Note: TPH and O&G will be modified to suitable tests when contents of tanks are known. if necessary.

TEHCNICAL EXHIBIT 2



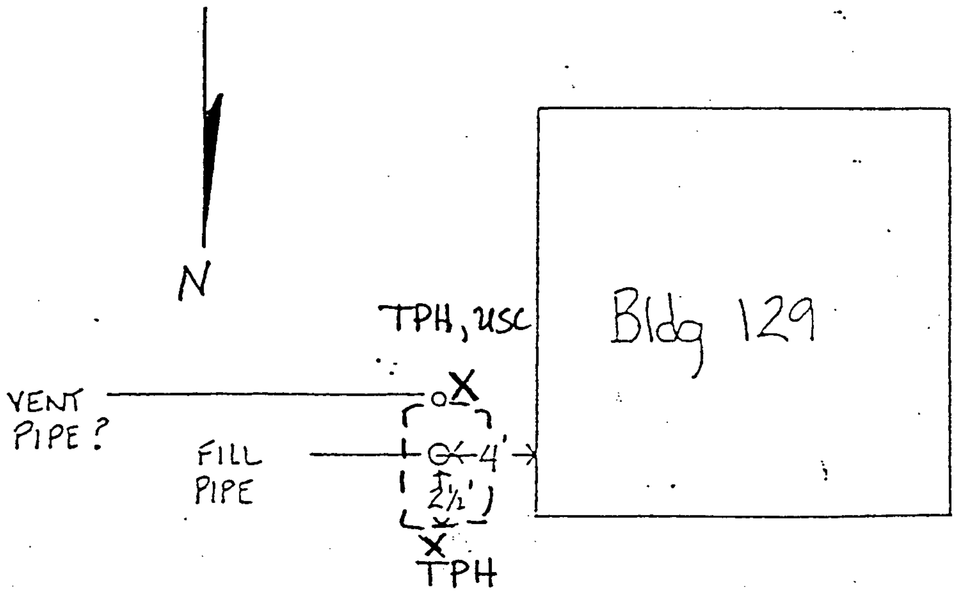


#8 SIZE + PRODUCT UNKNOWN

500 GAL. - DIESEL ?

TPH will be modified if necessary when contents of tank are known.

TPH will be modified if necessary when contents of tank are known.



#7 SIZE + PRODUCT UNKNOWN

500 GAL. DIESEL ?

TERRIBLE CONDITION - EXPOSED

State of Utah
DEPARTMENT OF HEALTH
DIVISION OF ENVIRONMENTAL HEALTH

Norman H. Bangerter
Governor
Suzanne Dandoy, M.D., M.P.H.
Executive Director
Kenneth L. Alkema
Director

Bureau of Environmental Response and Remediation
288 North 1460 West. P.O. Box 16690
Salt Lake City, Utah 84116-0690
(801) 538-6338

RECEIVED
DEC 18 1990

DEC 13 1990

John Cloonan
U.S. Army
Fort Douglas, UT 84113

Re: Closure Plan for Underground Storage Tank(s) located at Fort Douglas, Fort Douglas, Utah
Facility Identification No. 4001149

Dear Mr. Cloonan:

The closure plan for the above-referenced facility, received by the Bureau of Environmental Response and Remediation on November 8, 1990, has been approved subject to the noted modifications, if any. Local health and fire departments must be notified 72 hours before beginning closure activities. These agencies may have additional requirements for closure or may charge inspection fees.

Enclosed is a copy of the "Closure Notice" form which must be received by the Executive Secretary before the closed tanks can be removed from the fee billing list. Please provide all of the requested information on the Closure Notice form and submit the form together with the sample analysis data when this information is available.

Any deviation from an approved closure plan must be reported to the Bureau of Environmental Response and Remediation immediately. Any proposed change in the Closure Plan must be approved before implementation. If contamination is suspected or found during closure activities, you must report it to the Bureau of Environmental Response and Remediation within 24 hours of discovery. If you have any questions, please contact Jim Thiros at (801)538-6338.

Sincerely,

Kt P. Gray

Kent P. Gray
Executive Secretary (UST)
Utah Solid and Hazardous Wastes Committee

Enclosure

cc: Harry L. Gibbons, M.D., M.P.H., Director, Salt Lake City/County Health Department
Salt Lake City Fire Department
James D. Smith, Westech Fuel Equipment

KPG/JLT/cc
Shw\ust\cc\tnk-cls 6

WESTECH FUEL EQUIPMENT®

PETROLEUM & CHEMICAL HANDLING EQUIPMENT
DBA WESTERN TECHNICAL FUEL EQUIPMENT, A SUBSIDIARY OF F.W. JONES & ASSOC., INC.
195 WEST 3900 SOUTH • P.O. BOX 57307 • SALT LAKE CITY, UTAH 84157-0307
(801) 266-2545 • OUTSIDE UTAH TOLL FREE 1-800-433-8831 • 24 HR. FAX (801) 261-4054
UTAH TOLL FREE 1-800-344-6009

June 27, 1991

Kent P. Gray, Executive Secretary (UST)
Bureau of Environmental Response and Remediation
288 North 1460 West
P.O. Box 16690
Salt Lake City, Utah 84116-0690

Re: Modification of Closure Plan for UST's located at
Fort Douglas, Utah Facility I.D. #4001149

Dear Mr. Gray,

Approval of the following modifications to the approved Closure Plan are requested:

1) Addition of Tank #9, a 5000 gallon unleaded gasoline tank of unknown age, still in use, and located at Building 135 (see attached plat)

2) Addition of Tank #10, a 5000 gallon unleaded gasoline tank of unknown age, still in use, and located at Building 233 (see attached plat)

3) Tank remover will be James D. Smith, Certificate #TR-0042

4) Contaminated water and residual sludges will be disposed of at either Golden Eagle Refinery, 1474 West 1500 South, Woods Cross, Utah, Contact D.J. Blood at 295-2828 - or at - Advanced Petroleum Recycling 2586 West 4700 South #215, Salt Lake City, Utah, Contact Brad Oakley, 964-9444

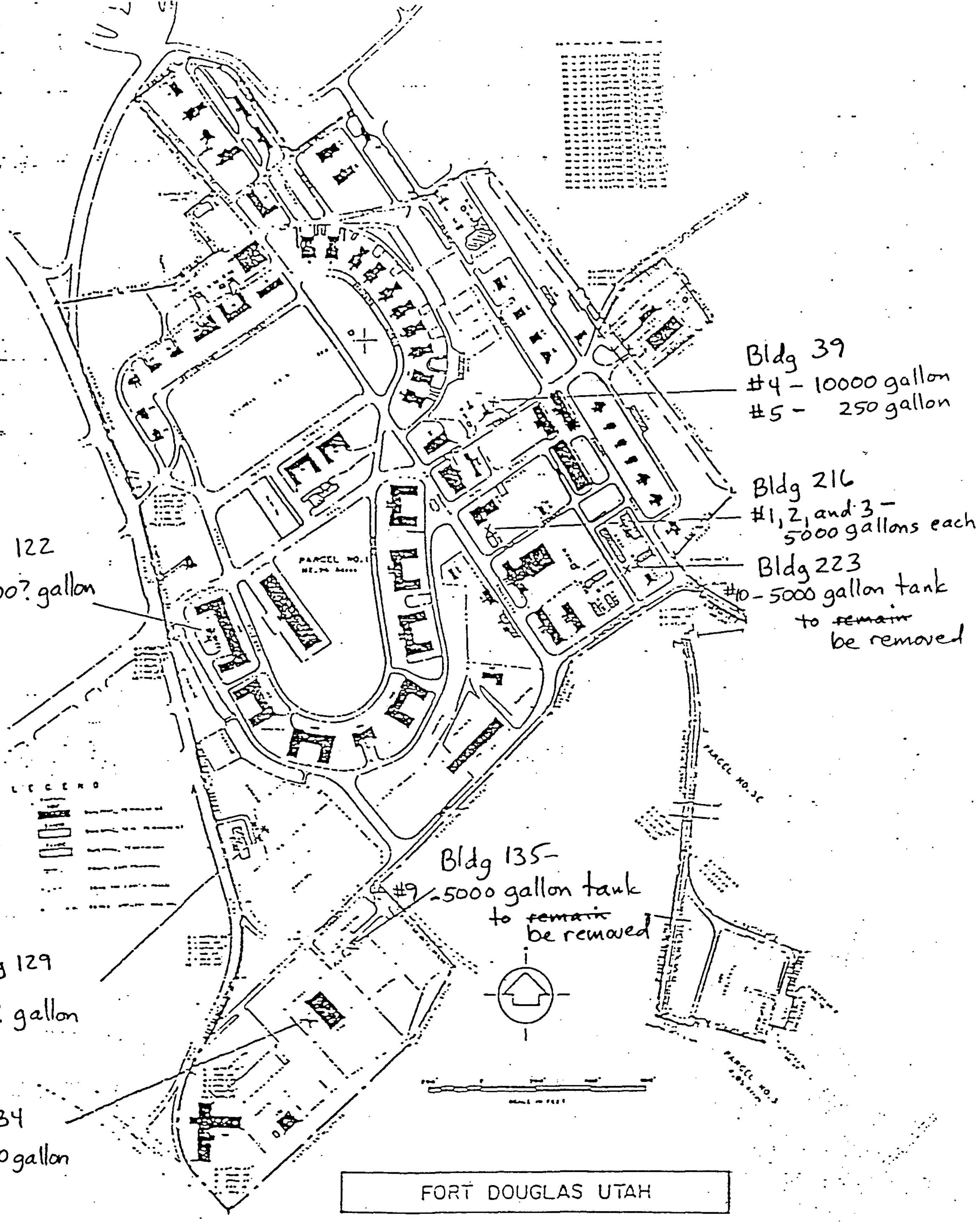
Sincerely,

James D. Smith
Hydrogeologist

JDS/lc

Enclosures

cc: John Cloonan



Bldg 39
#4 - 10000 gallon
#5 - 250 gallon

Bldg 216
#1, 2, and 3 - 5000 gallons each

Bldg 223
#10 - 5000 gallon tank to ~~remain~~ be removed

Bldg 122
#8 - 500? gallon

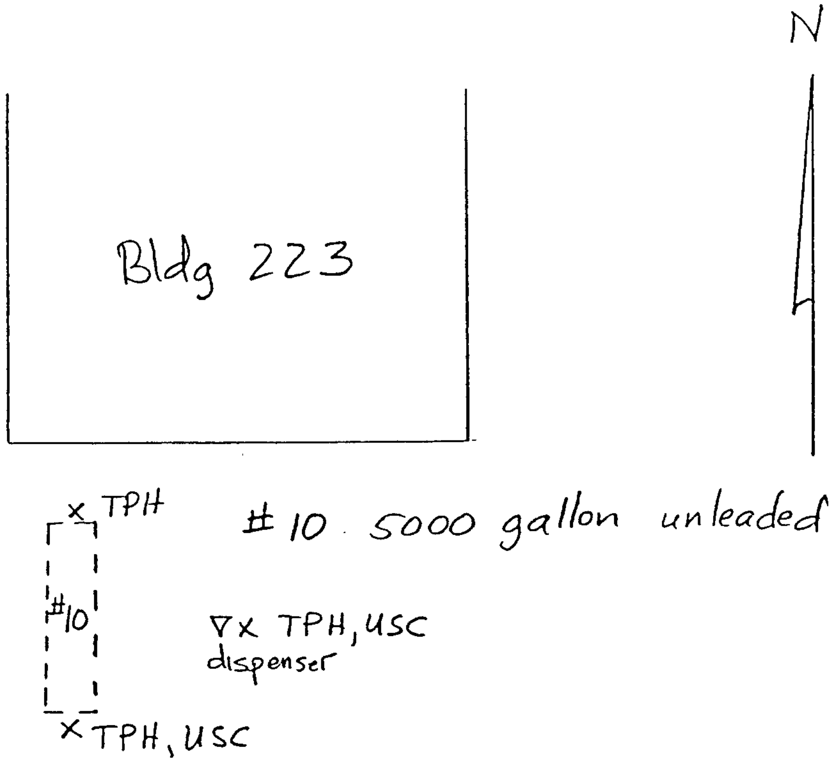
Bldg 135 - #9 - 5000 gallon tank to ~~remain~~ be removed

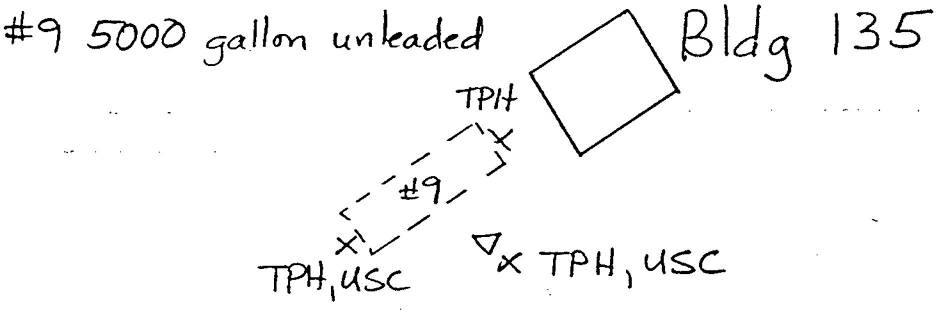
Bldg 129
#7 - 500? gallon

Bldg 134
#6 - 1000 gallon

FORT DOUGLAS UTAH

12 SEPT 1973


#10 5000 gallon unleaded


#9 5000 gallon unleaded

APPENDIX C

POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Potential Chemical - Specific ARAR's

Regulation/Guidance	Comments
Clean Water Act-Water Quality Criteria (40 CFR Part 131)	Establish criteria for ambient water quality based on toxicity to aquatic organisms and human health.
Resource Conservation and Recovery Act (RCRA) 40 CFR 261, (Utah Administrative Codes R450-2-1) Definition and Identification of Hazardous Wastes	Defines solid and hazardous wastes.
TSCA - PCB Spill Cleanup Policy (40 CFR 761 Parts 120-135, Subpart G)	
TSCA - Management, Storage and Disposal of PCBs (40 CFR 761.40 - .79)	
TSCA - Indoor Radon Abatement, Title III (15 U.S.C. 2601)	
Clean Air Act - National Ambient Air Quality Standards (40 CFR 50)	
Asbestos Hazardous Emergency Response Act (AHERA)	Addresses identification, evaluating and controlling asbestos containing materials in schools.
Clean Air Act - National Emission Standards for Hazardous Air Pollutants (NESHAP).	Asbestos and Radon emission standards
Lead-Based Paint: Interim Guidelines for Hazard Identification and Abatement in Public and Indian Housing (Fed. Reg. Vol. 55, 14556)	
Safe Drinking Water Act - National Primary Drinking Standards	Establishes health-based standards for public drinking water systems.
Safe Drinking Water Act - National Secondary Drinking Water Standards	Establishes welfare-based standards for public drinking water systems.

Potential Location - Specific ARARs

Regulation/Guidance	Comments
National Historical Preservation Act (16 USC 470)	30 acres of the Fort Douglas National Historic Landmark including 30 significant buildings are located within the area to be excessed.
Endangered Species Act (16 USC 1531; 50 CFR Parts 81, 225, 402)	No endangered species have been identified at the site.
Fish and Wildlife Coordination Act (16 USC 661 Note)	
Fish and Wildlife Conservation Act (16 USC 2901; 50 CFR Part 83)	
National Defense Authorization Act for Fiscal Year 1991 (P.L. 101-510, Section 2836) and Military Construction Appropriations Act of 1991 (P.L. 101-519, Section 130)	Contain identical language mandating transfer of Fort Douglas to University of Utah.

Part B

Final Sampling and Analysis Plan

FINAL SAMPLING AND ANALYSIS PLAN

SEPTEMBER 1991

CONTRACT NO. DAAA-15-90-D-0018

TASK ORDER 0005

FORT DOUGLAS
ENVIRONMENTAL INVESTIGATION/ALTERNATIVES ANALYSIS

Prepared by:

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Prepared for:

U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY

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LIST OF ACRONYMS AND ABBREVIATIONS

AA	Alternatives Analysis
ACM	asbestos containing material
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
DEH	Directorate of Engineering and Housing
DOMW	(Fort) Douglas Monitoring Well
EI	Environmental Investigation
EPA	U.S. Environmental Protection Agency
ESE	Environmental Science and Engineering, Inc.
FEIS	Final Environmental Impact Statement
ft	feet
HASP	Health and Safety Plan
NCO	noncommissioned officer
OVA	organic vapor analyzer
PA	Preliminary Assessment
PCB	polychlorinated biphenyls
ppm	parts per million
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and Analysis Plan
SVOC	semivolatile organic compound
TCL	Target Compound List
TPH	Total Petroleum Hydrocarbons
USATHAMA	United States Army Toxic and Hazardous Materials Agency
UST	underground storage tank
VOC	volatile organic compound

1.0 INTRODUCTION

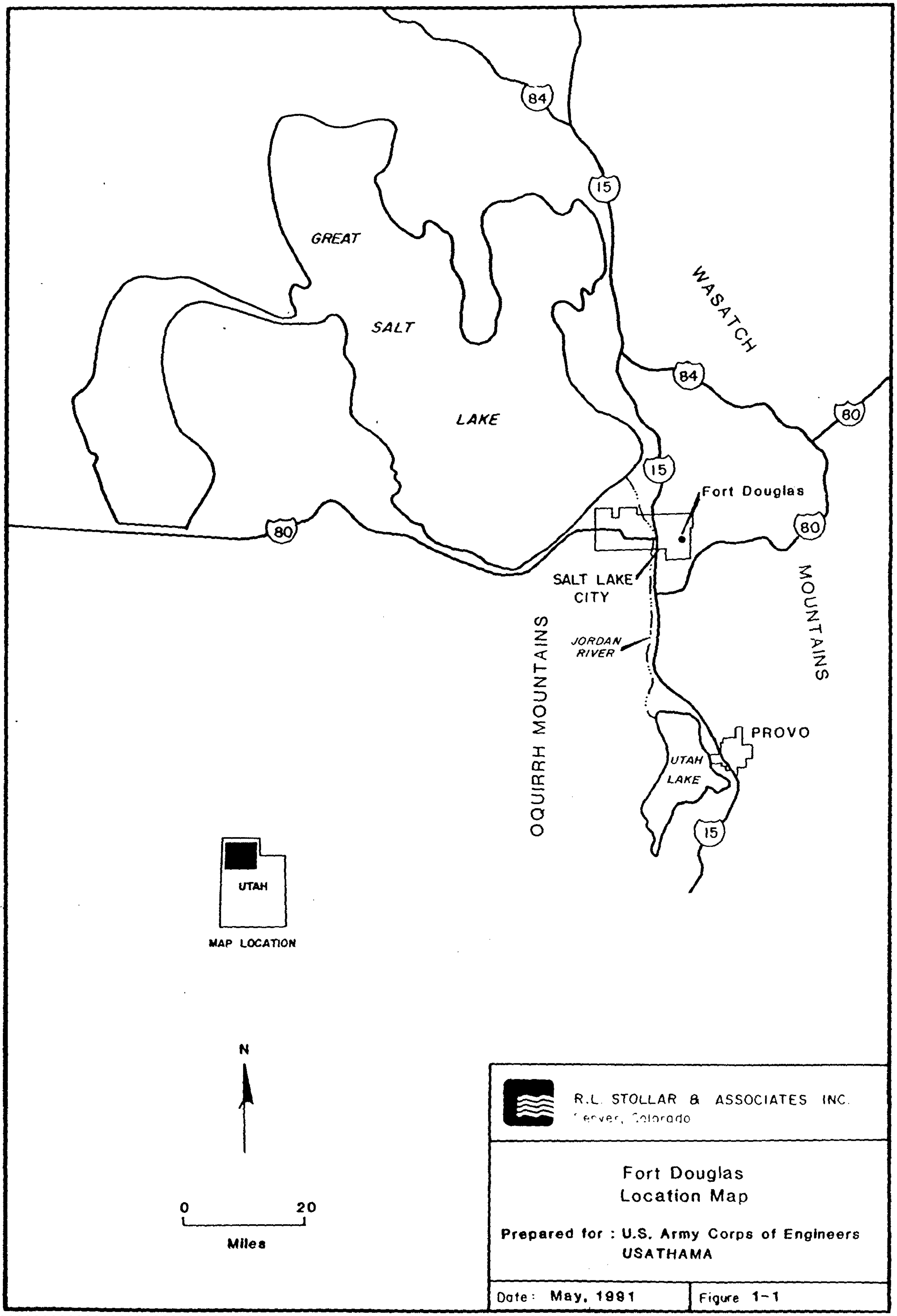
This Sampling and Analysis Plan (SAP) has been developed to guide the field investigations at Fort Douglas, Utah, (Figure 1-1) in support of an Environmental Investigation/Alternatives Analysis (EI/AA). The EI/AA is being conducted prior to the closure and realignment of Fort Douglas, which was directed by the Base Closure and Realignment Act (Public Law 100-526). The U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) has the authority for centrally managing the environmental investigation portion of the base closure program. The EI/AA is designed to assess hazardous substances which are known or suspected to be present at the site and to evaluate remedial actions which may be necessary to control releases to the environment prior to transfer of Fort Douglas. The closure and realignment of Fort Douglas will result in the reassignment of its functions to other installations. Following closure, approximately 51 acres of the approximately 119-acre installation will be declared as excess property (Figure 1-2) for public disposal. The remaining acreage will be retained by the federal government for use as a military Reserve Center.

The SAP provides a detailed description of the sampling program, including the types of sampling, sample locations, and analytical suites. A description of the overall technical program for the EI/AA is presented in the Technical Plan. The Quality Assurance Project Plan (QAPP) and Health and Safety Plan (HASP) provide additional technical guidance for the field program.

1.1 SITE HISTORY

Fort Douglas was established originally as Camp Douglas on October 26, 1862 near Salt Lake City, Utah, and redesignated as Fort Douglas in 1878. The initial mission of Fort Douglas was to guard the Overland Mail route and protect communication lines between the East and West Coasts. Since its inception, Fort Douglas has undergone many changes in response to its role in military functions. It has been used to garrison troops, house prisoners of war, and serve as headquarters for military units.

Original site boundaries included approximately 2,560 acres. Additional land acquisitions occurred primarily between 1867 and 1909 when Fort Douglas reached a maximum size of approximately 7,900 acres. After 1948, numerous parcels of land were transferred to other federal agencies and the University of Utah. The current acreage of Fort Douglas is approximately 119 acres. All but four of the acres are contiguous. These four acres are less than a mile southeast of the main installation, and have been used for the post cemetery since 1862.



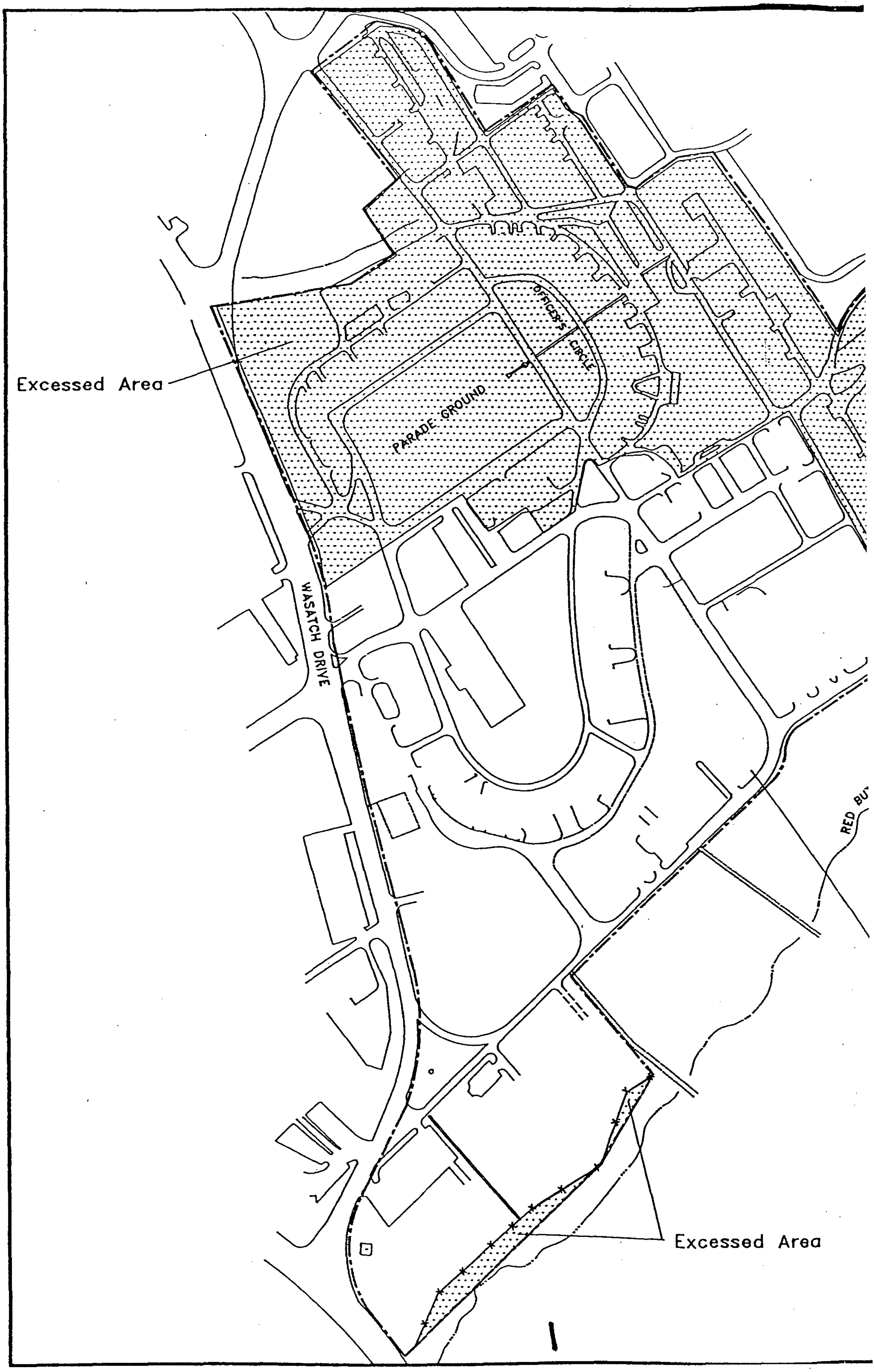
R.L. STOLLAR & ASSOCIATES INC.
Denver, Colorado

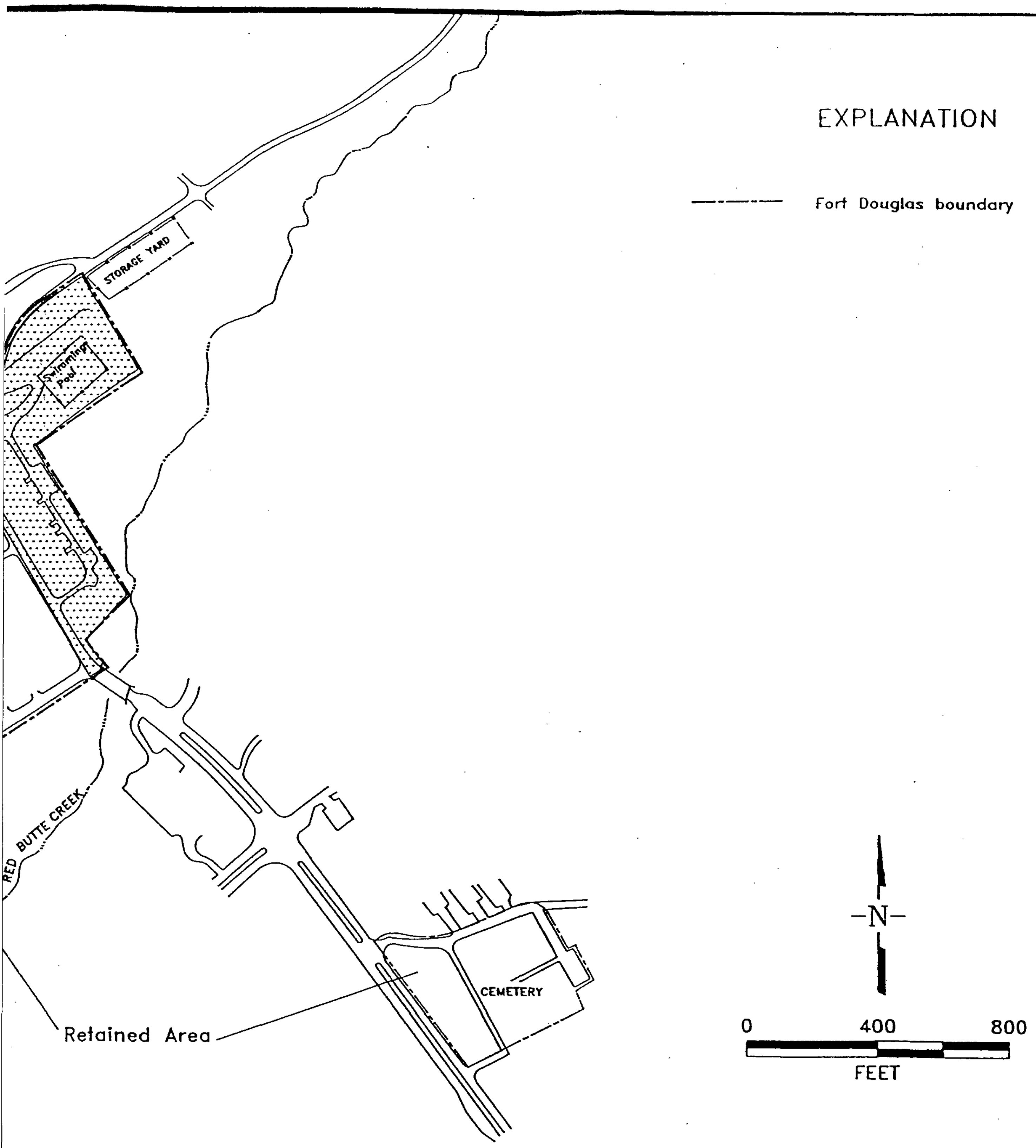
Fort Douglas
Location Map

Prepared for : U.S. Army Corps of Engineers
USATHAMA

Date: May, 1991

Figure 1-1


Excessed Area
OFFICER'S CIRCLE
PARADE GROUND
WASATCH DRIVE
RED BU
Excessed Area



R.L. STOLLAR & ASSOCIATES INC.
Ground-Water Consultants

Site Plan
Fort Douglas

Prepared for:
U.S. Army Corps of Engineers
USATHAMA

Date: August 1991

Figure 1-2

2

1.2 DESCRIPTION OF FACILITY

The approximately 119-acre installation includes 117 structures. Sixty-nine of these structures are on the area to be excessed. Most of the structures were constructed of red brick, sandstone, or concrete between 1874 and 1942 and are presently in good to excellent condition. Much of the area to be excessed is within the National Historic Landmark area, and most of the buildings are included in the National Register of Historical Places. The structures on the area to be excessed can be summarized as follows:

- Fort Douglas Military Museum;
- Administrative office building;
- Thirty-six family housing structures, containing 61 housing units;
- Three family housing structures currently used as administrative offices;
- Eighteen detached garages;
- A chapel;
- An Officers Club, used as a community and family center;
- A Noncommissioned Officers (NCO) Club;
- An office building;
- A former gas valve building;
- A latrine;
- A swimming pool with associated water treatment building and bath house; and
- A bandstand.

1.3 HYDROGEOLOGIC SETTING

Fort Douglas is located on the western slope of the Wasatch Mountains approximately 3 miles east of downtown Salt Lake City, in Salt Lake County, Utah. Most of Fort Douglas is underlain by a poorly-sorted, alluvial fan deposit, consisting of pebble-, cobble-, and boulder-sized clasts in a matrix of sand and silty sand. The thickness of the alluvium at Fort Douglas is unknown, but is inferred to be at least 750 feet (ft) thick, based on a lithologic log of a well installed adjacent to Fort Douglas. The alluvium thins to the west and unconformably overlies Lower Jurassic and older rocks.

The surface topography of the area of Fort Douglas to be excessed dips to the west. Near the southeast boundary of Fort Douglas, the land surface slopes toward Red Butte Creek, a perennial stream that flows southwest from the Wasatch Mountains (Figure 1-2).

Ground water at Fort Douglas has been measured in a locally perched zone approximately 24 ft below ground surface (bgs) near Red Butte Creek. Saturated conditions were not observed in four other wells at Fort Douglas. These wells were drilled to depths between 25.2 and 180 ft below ground surface. Wells in the vicinity of Fort Douglas produce water from a deep regional aquifer and include wells owned by the University of Utah and the Salt Lake City Water Department. Water levels in these wells range from approximately 100 to 340 ft below ground surface.

1.4 INITIAL EVALUATION

Results of previous site assessments (ESE, 1983; Weston, 1988), an enhanced Preliminary Assessment (PA) (Weston, 1989), a Final Environmental Impact Statement (Dames and Moore, 1991), an underground storage tank (UST) site investigation initiated in 1990 (report pending release), and preliminary EI/AA site visits were used to identify potential contaminant sources and data needs for the EI/AA. Potential contaminant sources on the area of Fort Douglas to be excessed include: electrical transformers; two underground hydrocarbon storage tanks and a vehicle wash rack and oil change/degreasing area, located near Building 39; and structures. Contaminants of concern are (1) polychlorinated biphenyls (PCBs), potentially contained in the transformer oil; (2) hydrocarbons, associated with sources in the Building 39 Area; (3) degreasing solvents, possibly used in the vicinity of Building 39; (4) lead, used in lead-based paints and leaded gasoline; (5) asbestos, in asbestos containing materials (ACMs); and (6) radon. Storage areas containing heavy equipment and drums (some labeled to contain fuels, solvents, lubricants and paints), maintenance areas for heavy and light equipment, and a waste oil UST are potential contaminant sources located on the area of Fort Douglas to be retained, adjacent to an area that is planned to be excessed along the southeast Fort Douglas boundary. These areas are potential sources of hydrocarbons, solvents, degreasers, and possibly a variety of other contaminants. One additional potential source area is located adjacent to and upgradient of Fort Douglas. This area is a University of Utah storage yard which was observed to contain miscellaneous equipment, drums and transformers in the storage yard during a preliminary site visit. The storage yard is a potential source of hydrocarbons, PCBs, and possibly a variety of other contaminants.

Exposure to asbestos, lead, and radon could occur through the air pathway, primarily to occupants of the Fort Douglas buildings. Pathways of lesser potential for exposure to or migration of contaminants from sources include soil, surface water, and ground water. Through the soil pathway, human or environmental receptors could be exposed to PCBs that leaked from transformers, hydrocarbons or degreasing solvents from the Building 39 Area, or lead dust created from exterior painted surfaces. Surface-water could transport potential contaminants from where the contaminants were released to the soil, primarily from the storage yards, maintenance areas, below transformers, or from the area of the USTs, to downgradient areas. Potential contaminants could reach the ground-water pathway, if shallow ground water is present, through infiltration of surface water or by the subsurface release of hydrocarbons from the USTs.

2.0 SAMPLING AND ANALYSIS PROGRAM

The EI/AA sampling and analysis program has been designed to address the nature, magnitude, and extent of any areas of environmental concern on the area of Fort Douglas to be excessed. The sampling program includes the collection of transformer oil, paint chip and wipe samples from buildings, and soil and possibly ground-water samples near potential sources. Background soil samples will be collected and analyzed to determine analyte concentrations typically present in the soil. In addition, suspected ACMs will be sampled; however, the sampling program for ACMs is included in a separate document. Long-term and short-term monitoring has been conducted for radon; data from this monitoring will be utilized in the EI reports. No additional radon sampling will be conducted as part of the EI/AA.

2.1 CHEMICAL ANALYSIS PROGRAM

Laboratory analyses for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, total petroleum hydrocarbons (TPH), PCBs, and cyanide will be conducted during the program. A list of target compounds for these analyses is presented on Table 2-1. Analysis for volatile and semivolatile organics will be conducted on samples to screen for a broad range of organic compounds which may have been present in the vicinity of the area to be excessed. The target analyte lists for these methods are based on the CERCLA Target Compound List (TCL) and on target compounds for the EPA methods 8240 and 8270 (EPA, 1986). The inorganics which will be analyzed include the 23 metals on the CERCLA TCL and cyanide. Methods of analysis are described in the QAPP.

2.2 PHYSICAL ANALYSIS PROGRAM

In addition to the samples collected for chemical analysis as described above, soil samples representative of penetrated lithologies will be collected and retained every 5 feet (ft) or at each major change in lithology, whichever occurs first. Physical soil testing, including Atterberg Limits, sieve grain size distribution, and USCS assignment, will be performed on 10 to 20 percent of these samples.

Table 2-1 Target Compound List

Volatile Organic Compounds

Acetone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
2-Butanone
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
1,2-Dichloroethene
1,2-Dichloropropane
cis-1,3-Dichloropropene
1,3-Dichloropropene
Ethylbenzene
2-Hexanone
Methylene chloride
4-Methyl-2-pentanone
Styrene
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Vinyl acetate
Vinyl chloride
Xylene

Semivolatile Organic Compounds

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i)perylene
Benzo(a)pyrene
Bis(2-chloroethoxy)methane
Bis(2-chloroethyl)ether
Bis(2-chloroisopropyl)ether
Bis(2-ethylhexyl)phthalate
4-Bromophenyl phenyl ether
Butyl benzyl phthalate
Carbazole
4-Chloroaniline
2-Chloronaphthalene
4-Chloro-3-methylphenol
2-Chlorophenol
4-Chlorophenyl phenyl ether
Chrysene
Dibenz(a,h)anthracene
Dibenzofuran
Di-n-butylphthalate
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,2-Dichlorobenzene
3,3-Dichlorobenzidine
2,4-Dichlorophenol
Diethylphthalate
2,4-Dimethylphenol
Dimethylphthalate
4,6-Dinitro-2-methylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Di-n-octylphthalate
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno(1,2,3-cd)pyrene
Isophorone
2-Methylnaphthalene
2-Methylphenol (o-cresol)
4-Methylphenol (p-cresol)
Naphthalene
2-Nitroaniline
3-Nitroaniline
4-Nitroaniline
Nitrobenzene
2-Nitrophenol
4-Nitrophenol
N-Nitroso-di-n-propylamine
N-Nitrosodiphenylamine
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
1,2,4-Trichlorobenzene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol

PCB

Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1245
Aroclor-1254
Aroclor-1260

Metals

Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Selenium
Silver
Sodium
Thallium
Vanadium
Zinc

Inorganic Compounds

Cyanide

Miscellaneous

Total Petroleum Hydrocarbons (TPH)
Asbestos

2.3 AREA SPECIFIC SAMPLING PROGRAMS

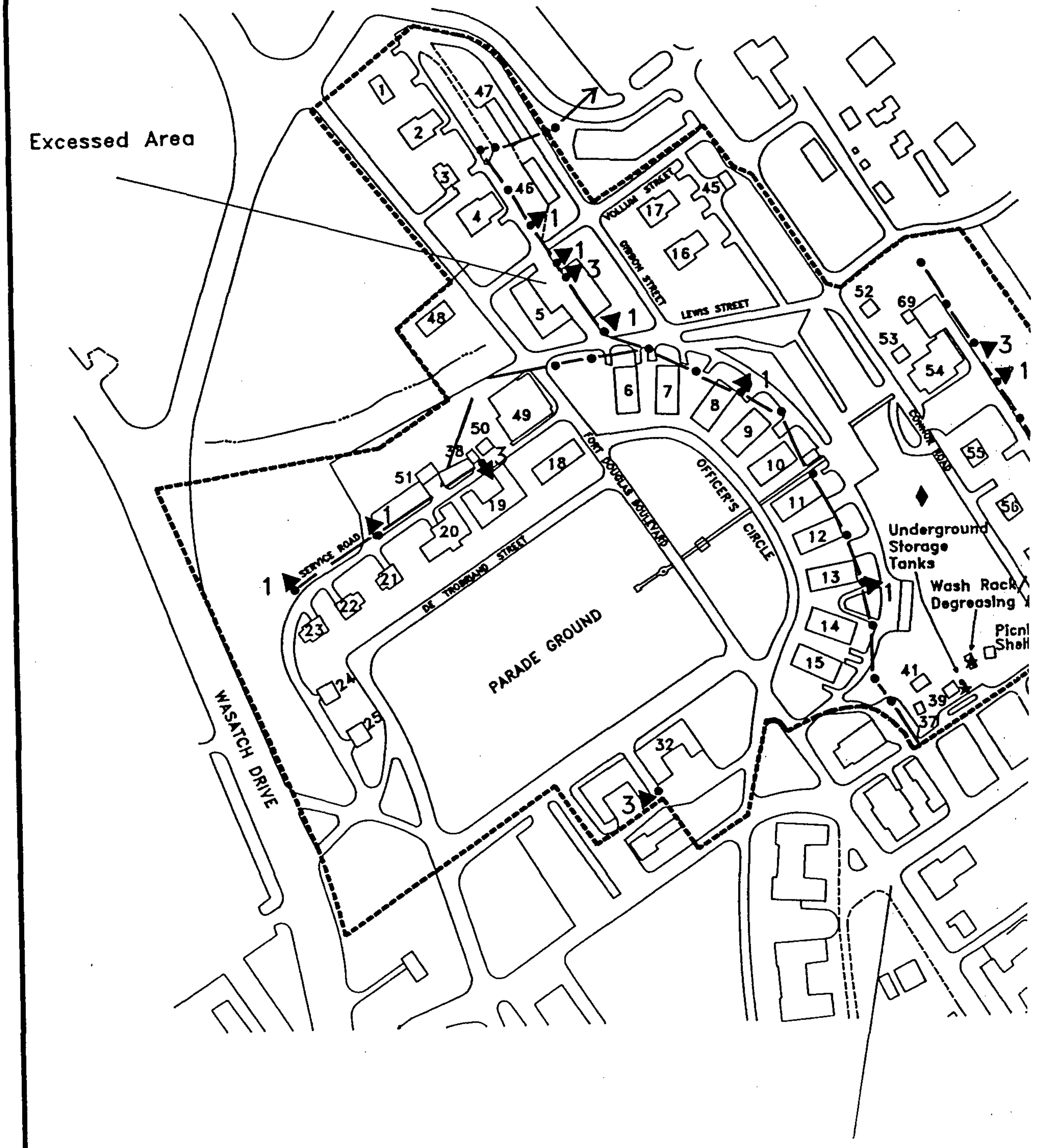
Proposed sampling locations for the transformer and soil EI/AA field investigations are shown on Figures 2-1, 2-2, and 2-3. The structures to be sampled for lead-based paint are identified on Table 2-2. Locations of these structures are shown on Figure 2-4. Boring locations may be adjusted at the discretion of the field geologist based on the presence of underground utilities, surface soil staining, or other field observations. Sample intervals and the number of samples may be altered if staining is observed in the soils or if concentrations of organics above background are measured in the field. Concentrations of organics will be measured utilizing an organic vapor analyzer (OVA) or similar instrument to measure headspace concentrations, as described in the Technical Plan. Tables 2-3 and 2-4 are summaries of the liquid and soil samples that will be collected during the EI/AA. All samples will be collected in accordance with protocols specified in the Fort Douglas QAPP.

2.3.1 BACKGROUND SAMPLING

Background soil samples will be collected to distinguish between site-specific contamination and concentrations of naturally occurring inorganic compounds or concentrations due to anthropogenic (human-made) sources not specific to Fort Douglas. One boring will be drilled to a depth of 30 ft in an area of Fort Douglas that is expected to have soil representative of background conditions (Figure 2-1). Soil samples will be collected from the surface and at two deeper intervals that correspond to lithologic types sampled in the other borings planned to be drilled. The samples will be analyzed for all metals on the CERCLA TCL and cyanide (Table 2-1).

2.3.2 TRANSFORMERS

The transformers to be sampled are located on 15 poles throughout and adjacent to the area of Fort Douglas to be excessed (Figure 2-1). Either one or three transformers are located on each pole. Transformers at eight of the locations have been labeled as PCB-containing based on their age; however, no data is available to specifically identify these transformers as containing or not containing PCBs. Some of the transformers have rusted and may have leaked. Samples of the transformer oil will be collected by a licensed journeyman electrician and his/her apprentice to determine if PCBs are present in the oil. A total of 25 transformer oil samples will be collected and analyzed for PCBs (Table 2-3). This information will be used to assess any potential risks to human health and determine if any remedial measures are necessary.


Excessed Area
Retained Area
WASATCH DRIVE
SERVICE ROAD
DE TROBRIAND STREET
FORT DOUGLAS BOULEVARD
OFFICER'S CIRCLE
PARADE GROUND
VOLLUM STREET
GIBBON STREET
LEWIS STREET
CONNOR ROAD
Underground Storage Tanks
Wash Rack/
Degreasing
Picni
Shel
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
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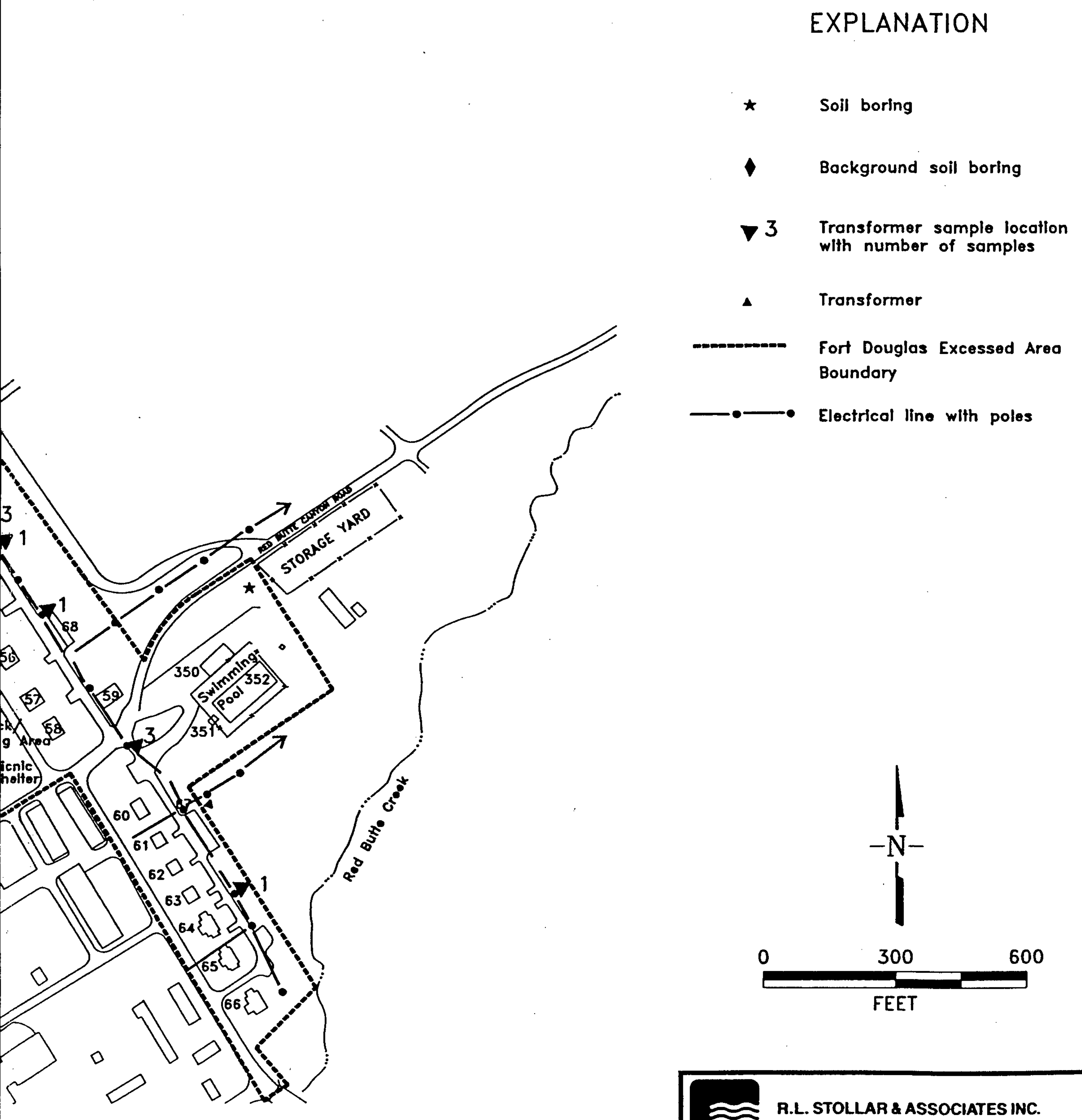


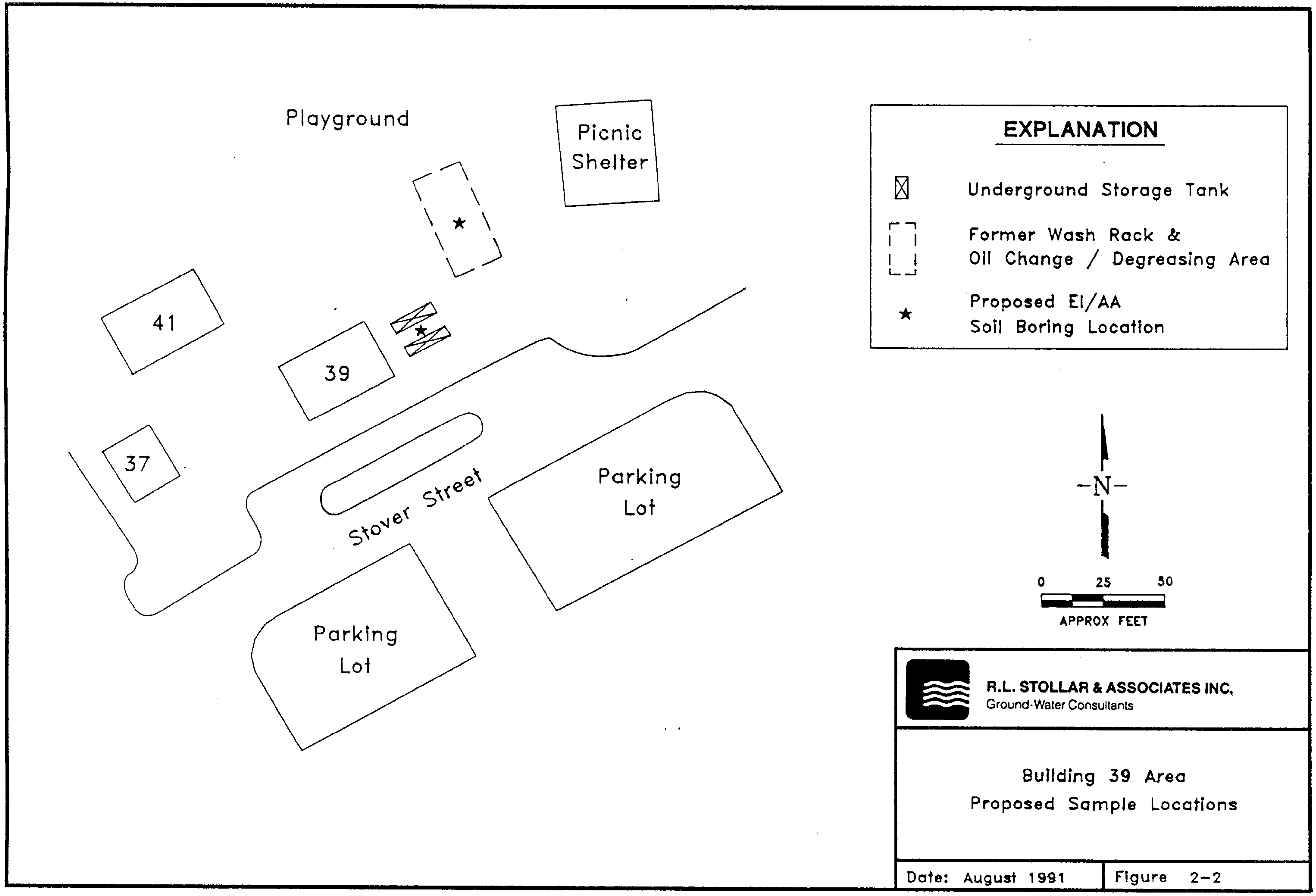
R.L. STOLLAR & ASSOCIATES INC.
Ground-Water Consultants

Northern Excessed Area
Proposed Sample Locations
Fort Douglas

Prepared for:
U.S. Army Corps of Engineers
USATHAMA

Date: August 1991

Figure 2-1



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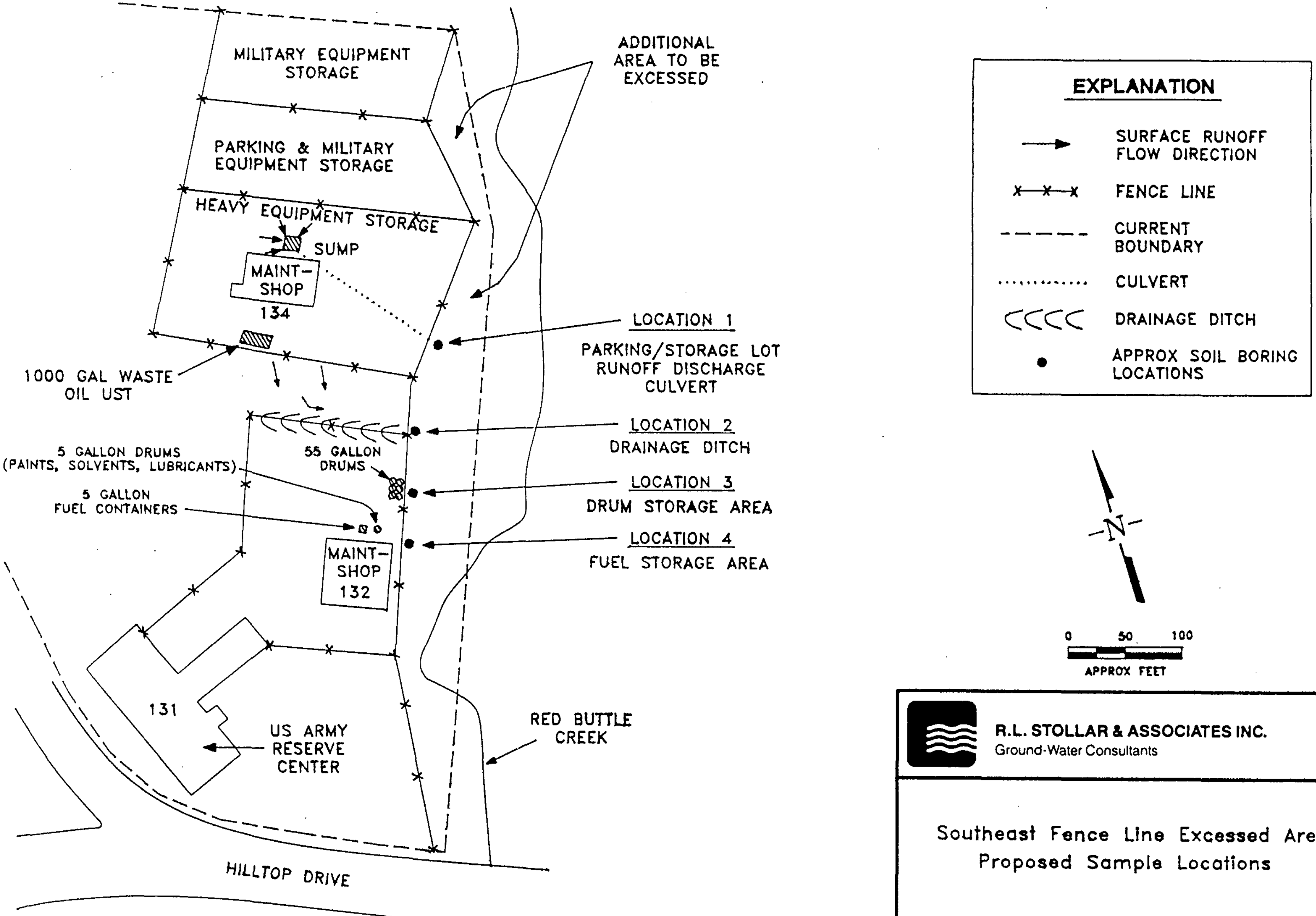
Ground-Water Consultants

Building 39 Area
Proposed Sample Locations

Date: August 1991

Figure 2-2



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Ground-Water Consultants

Southeast Fence Line Excessed Area
Proposed Sample Locations

Date: August 1991

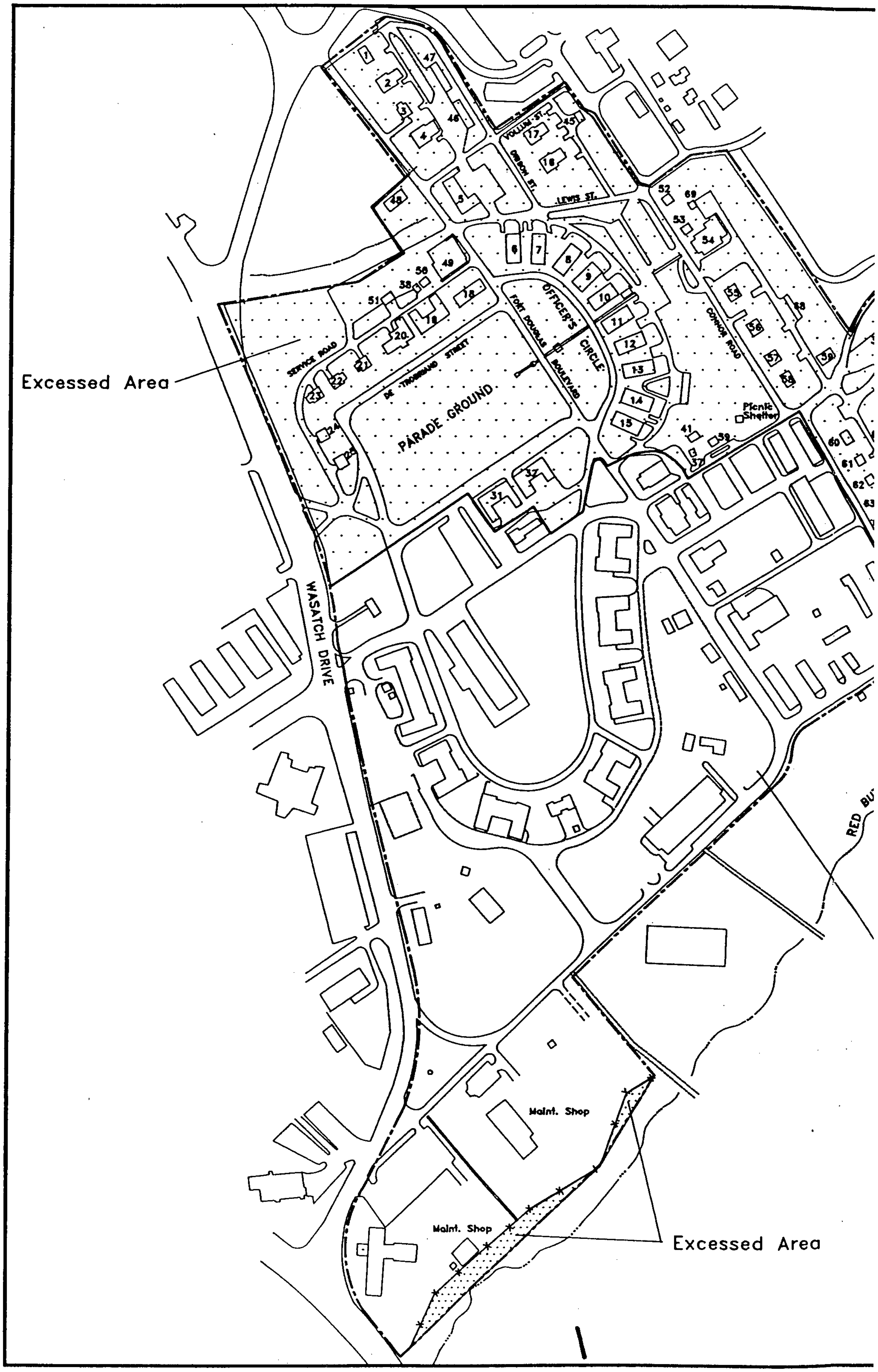
Figure 2-3

Table 2-2 Lead-Based Paint Sampling Summary

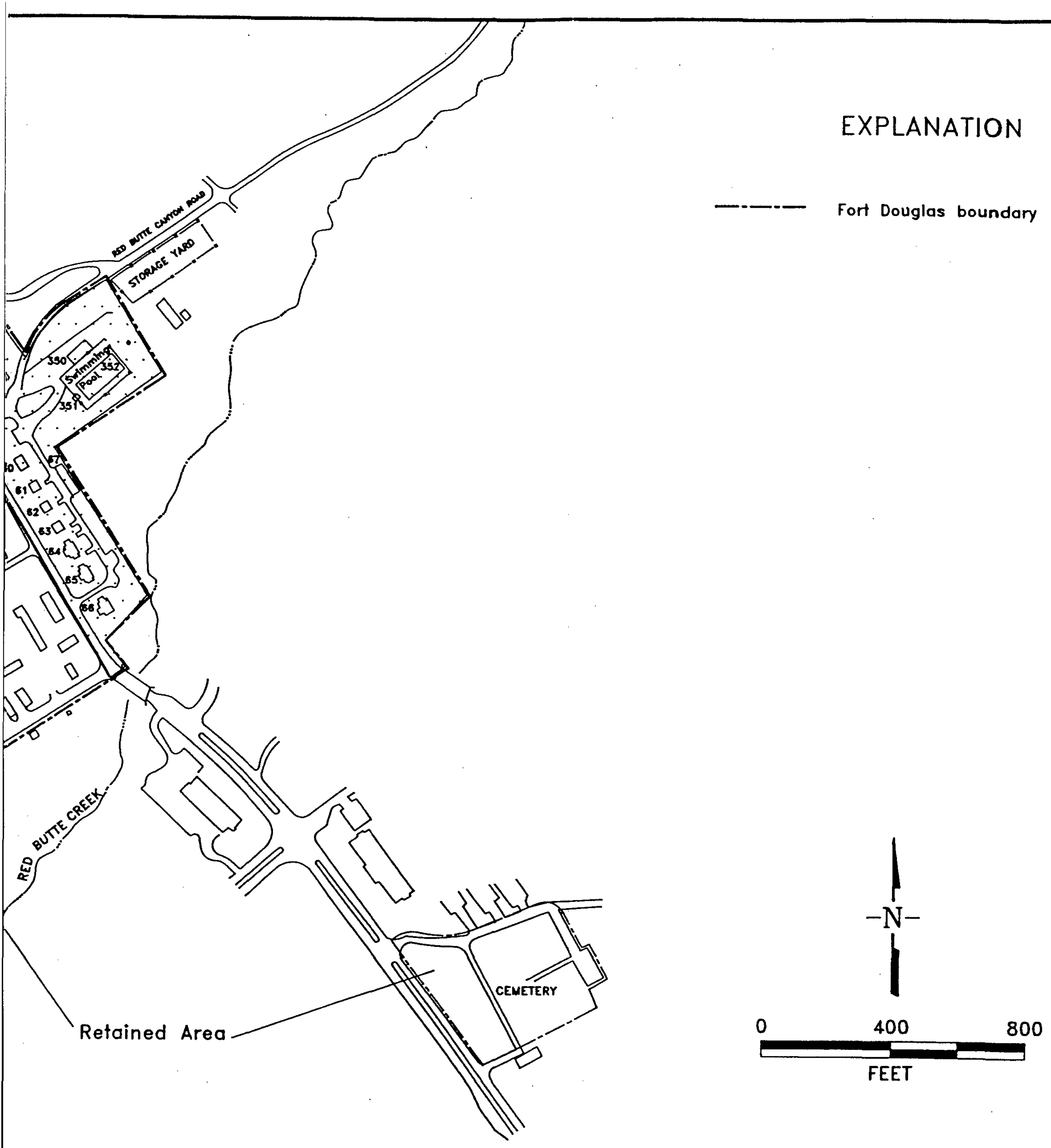
Structure Number	Current Use	Number of Housing Units	Number of Chip or Wipe Samples	
			Interior	Exterior
1	NCO Quarters	2	1	-
2	NCO Quarters	2	1	-
3	Officers Quarters	1	1	-
4	Administrative Offices	-	1	-
5	Administrative Offices	-	1	-
6	Officers Quarters	2	1	-
7	Officers Quarters	2	1	-
8	Officers Quarters	2	1	-
9	Officers Quarters	2	1	-
10	Officers Quarters	2	1	-
11	Officers Quarters	2	1	-
12	Officers Quarters	2	1	-
13	Officers Quarters	2	1	-
14	Officers Quarters	2	1	-
15	Officers Quarters	2	1	-
16	NCO Quarters	2	1	-
17	NCO Quarters	2	1	-
18	Officers Quarters	3	1	-
19	Officers Quarters	3	1	-
20	Officers Quarters	1	1	-
21	Officers Quarters	1	1	-
22	Officers Quarters	1	1	-
23	Officers Quarters	1	1	-
24	Officers Quarters	1	1	-
25	Officers Quarters	1	1	-
31	Administrative Offices	-	1	-
32	Museum	-	1	-
37	Offices	-	1	-
39	Latrine	-	1	-
41	Vacant (former Gas Valve Building)	-	1	-
48	Post Chapel	-	1	-
49	Officers Club	-	1	-
52	NCO Quarters	1	1	-
53	NCO Quarters	1	1	-
54	NCO Club	-	1	-
55	Administrative Offices	-	1	-
56	NCO Quarters	2	1	-
57	NCO Quarters	2	1	-
58	NCO Quarters	2	1	-
59	NCO Quarters	1	1	-
60	NCO Quarters	2	1	-
61	NCO Quarters	1	1	-
62	NCO Quarters	1	1	-
63	NCO Quarters	1	1	-

Table 2-2 Lead-Based Paint Sampling Summary (continued)

Structure Number	Current Use	Number of Housing Units	Number of Chip or Wipe Samples	
			Interior	Exterior
64	NCO Quarters	2	1	-
65	NCO Quarters	2	1	-
66	NCO Quarters	2	1	-
350	Bath House	-	1	-
351	Water Treatment Building	-	1	-
Undetermined	--	-	-	2
TOTALS	--	-	49	2



Excessed Area
VOLLUM ST.
ORBON ST.
LEWIS ST.
OFFICER'S CIRCLE
FORT DOUGLAS BOULEVARD
CONNOR ROAD
SERVICE ROAD
DE-TROBRIAND STREET
PARADE GROUND
Picnic Shelter
WASATCH DRIVE
RED BU
Maint. Shop
Maint. Shop
Excessed Area



R.L. STOLLAR & ASSOCIATES INC.
Ground-Water Consultants

Structure Locations
Fort Douglas

Prepared for:
U.S. Army Corps of Engineers
USATHAMA

Date: August 1991 | Figure 2-4

2

Table 2-3 Liquid Sampling Summary

Location	Sample Type	Number of Samples	Number of Analyses					
			VOC	SVOC	Metals	Cyanide	TPH	PCB
Transformers	Oil	25	-	-	-	-	-	25
USTs	Ground Water	1 *	1	1	1	1	1	-
Downslope from Storage Yard	Ground Water	1 *	1	1	1	1	1	-
TOTALS		27	2	2	2	2	2	25

* Ground-water wells will be installed and sampled only if saturated conditions are observed.

NOTE: The boring drilled to investigate the storage yard will be located on Fort Douglas.

Table 2-4 Soil Sampling Summary

Location	Number of Borings	Depth (ft)	Number of Samples	Sampling Depth (ft)	Number of Analyses					
					VOC	SVOC	Metals	Cyanide	TPH	PCB
Background	1	30	3	0-0.5 ***	-	-	3	3	-	-
Transformers	1 *	2	1	0-0.5	-	-	-	-	-	1
Bldg 39/UST	1	30	5	0-0.5, 10-15, 15-20, 20-25, 25-30	4	4	5	5	5	-
Bldg 39/Wash Rack and Oil Change/Degreasing Area	1	15	2 **	0-0.5, 0.5-5	1	1	2	2	2	-
Downslope from Storage Yard	1	30	5	0-0.5, 0.5-5, 5-10, 15-20, 25-30	4	4	5	5	5	-
Southeast Fence Line	4	5	8	0-0.5, 0.5-5	4	4	8	8	8	-
TOTALS	9	-	24	-	13	13	23	23	20	1

* Boring will be drilled only if surface soil staining is observed.

** Additional samples may be collected if stained soil are penetrated.

*** Deeper samples will correspond stratigraphically to intervals sampled in investigative borings.

NOTE: The boring drilled to investigate the storage yard will be located on Fort Douglas.

If stained soil is observed below a transformer, a boring will be drilled to determine whether PCBs containing hydrocarbons have leaked out of the transformers onto the ground. The boring will be drilled to a depth of 2 ft with a hand auger. Soil from the boring will be sampled from 0 to 0.5 ft and analyzed for PCBs (Table 2-4). If stained soil is present below this depth or if headspace measurements indicate the presence of organics, additional samples will be collected for analysis.

2.3.3 STRUCTURES

Sampling and analysis by atomic absorption for lead-based paint will be conducted at the structures on Fort Douglas to be excessed (Table 2-2; Figure 2-4). No information regarding the lead content of the paint is available; however, much of the construction and remodeling at Fort Douglas was conducted during the years when the use of lead-based paint was common. Lead dust, created from lead-based paint, is primarily an inhalation and ingestion hazard; therefore, sampling will be conducted to determine the levels of lead and assess the risks to human health from potential exposures. Factors to be considered in determining the risk to lead-based paint include whether lead is a constituent of painted surfaces at the site, the concentration of lead in the samples (if present), whether the lead is a constituent of the paint or the primer, and abatement considerations. The most probable exposure route is ingestion by children. Normal adults absorb approximately 10 percent of an oral dose of lead compounds, however this rate increases to approximately 50 percent in children when eaten on an empty stomach. Absorption rates are reduced somewhat when the lead is incorporated in dried paint films. Worst case and probable scenarios for children and abatement workers will be evaluated in the risk assessment.

Radon and asbestos are additional contaminants of concern associated with the Fort Douglas structures. As discussed above, additional radon sampling will not be conducted as part of the EI/AA. The asbestos sampling program is outlined in a separate document, the Asbestos Sampling Plan.

One paint chip or one wipe sample will be collected from each inhabitable structure (Table 2-2). Paint chip samples will be collected primarily from areas where the paint is peeling, where lead dust is potentially released. Wipe samples will be collected from structures where the paint is in good condition. The overall condition of the paint in each building will be noted and the area of disturbance estimated. To collect a paint chip sample, an approximate 2-in. square sample of all paint layers, but no wood, plaster or paper, will be removed from the surface with a knife or other sharp object. Wipe samples will be collected from baseboards or other areas where potential lead dust may have settled by wiping an approximate 5-cm by 5-cm area with a moistened filter paper. Sample locations will be marked on the floor plan. Many of the buildings at Fort Douglas are built of stone or brick, but at least two exterior paint samples will be collected to characterize the lead content in the exterior paint.

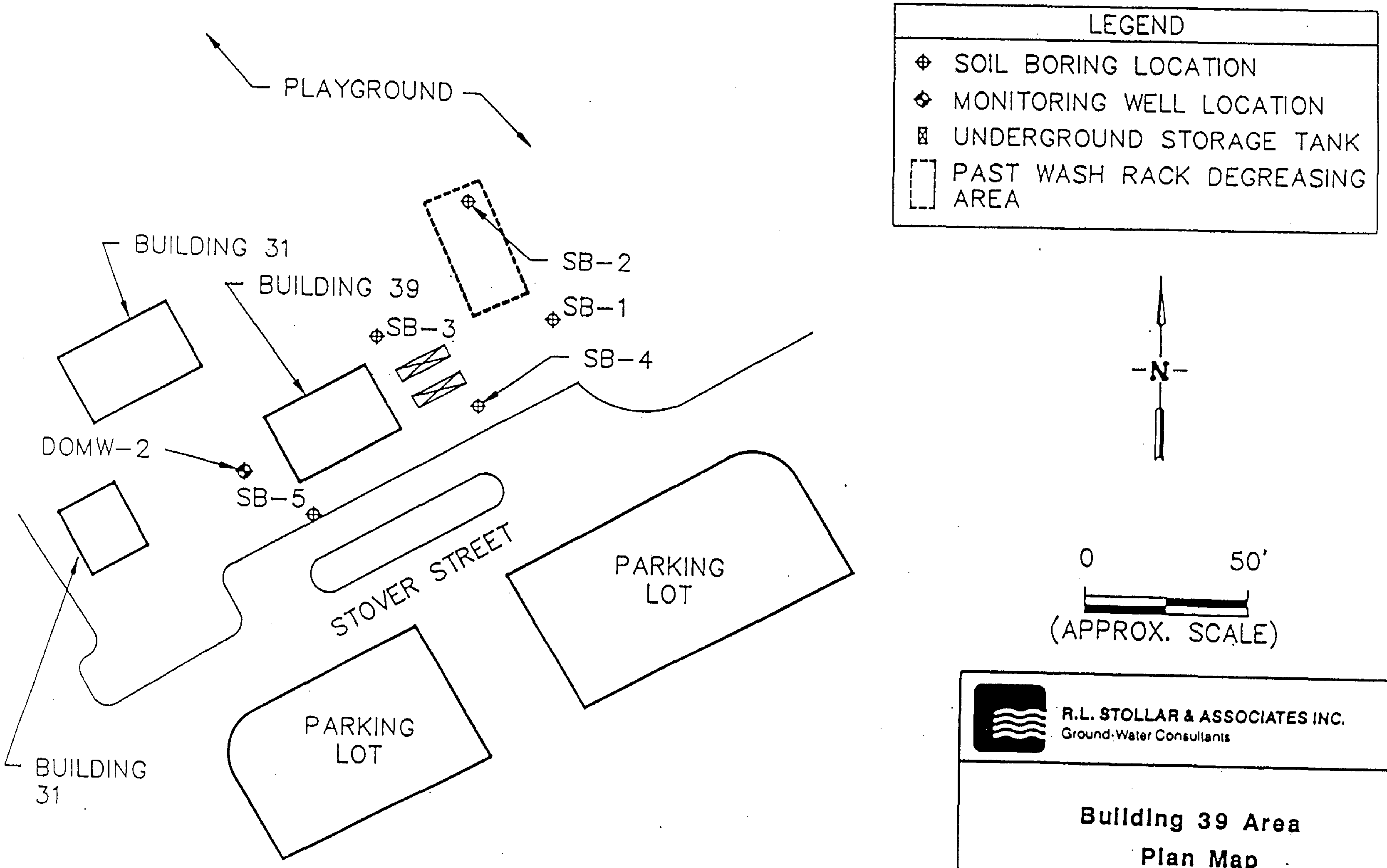
2.3.4 BUILDING 39 AREA

Two abandoned hydrocarbon USTs and a former wash rack and oil change/degreasing area are located in the vicinity of Building 39 (Figure 2-2). This area was formerly included in the area to be retained; it was added to the excessed area in May 1991. During a previous investigation of this area, five borings surrounding the potential sources were drilled on the basis of soil gas results, and soil samples were collected and analyzed for TPH and BETX (Figure 2-5). No detectable concentrations were measured. An additional boring was completed as a monitoring well (DOMW-2) downgradient of the USTs. Sufficient quantities of water cannot be obtained in order to collect a sample.

The tanks will be removed to determine if any subsurface releases have occurred directly below or adjacent to the tanks. The local fire department will be notified prior to tank removal. Tank removal and soil sampling from the tank and piping excavations for closure will be supervised by Fort Carson, observed by personnel from the Fort Douglas Directorate of Engineering and Housing (DEH), and performed in accordance with state and federal regulations. The underground storage closure plan is in Appendix A.

The EI/AA field activities will be coordinated with the tank removal and associated sampling. EI/AA sampling will utilize a soil boring in the UST area to collect samples for chemical analysis. Results will be used to assess whether leaks or spills from the USTs or associated piping has occurred, and, if leaks or spills occurred, the vertical extent of migration. Sampling will be conducted in the wash rack and oil change/degreasing area to confirm previous sampling results and provide data to assess any health risks associated with this area.

The soil boring will be located in the vicinity of the UST as shown on Figure 2-2. If any visual contamination is noted, the boring will be located as close to that location as possible. The boring will be drilled to an approximate depth of 30 ft or through a water-bearing zone, whichever is reached first. If stained soil is observed or if headspace measurements indicate the presence of organics at 30 ft, the depth of the boring will be increased. If saturated conditions are observed, drilling will not advance through an aquiclude. The samples from this boring will be collected at the 0 to 0.5 ft interval, and then from each 5 ft-interval below the bottom of the tank, to the total depth. A monitoring well will be completed in the borehole if saturated conditions are observed during drilling. Ground-water samples will be collected no sooner than 14 days after the well is installed and developed. The surface soil sample (0 to 0.5 ft) will be analyzed for TPH, cyanide, and all metals on the CERCLA TCL. Deeper soil samples and ground-water samples will be analyzed for the same suite of analytes and also for all VOCs and SVOCs on the CERCLA TCL.



R.L. STOLLAR & ASSOCIATES INC.
Ground-Water Consultants

Building 39 Area
Plan Map

Date: August 1991

Figure 2-5

A boring will be drilled and logged in the wash rack and oil change/degreasing area to a depth of 15 ft (Figure 2-2). The boring will be located as close to as possible to stains, stressed vegetation, ponding areas, or disturbed material. A surface soil sample will be collected from 0 to 0.5 ft, and a deeper sample will be collected from the 0.5 to 5 ft interval. Additional samples may be collected from the deeper intervals if staining is observed or if field headspace measurements indicate the presence of organics. The depth of the boring will also be increased if field observations indicate that contamination may be present below 15 ft.

The surface soil sample will be analyzed for TPH, cyanide, and all metals on the CERCLA TCL. The deeper soil sample(s), will be analyzed for the same suite of analytes, plus VOCs and SVOCs on the CERCLA TCL.

2.3.5 OFF-SITE STORAGE YARD

A storage yard owned by the University of Utah is located north and upgradient of the area of Fort Douglas to be excessed (Figure 2-1). During a preliminary site visit, the storage yard was observed to contain various equipment, drums, and transformers. A boring will be drilled downslope of the storage yard inside the excessed area boundary. This location is near the Fort Douglas swimming pool parking lot and will be used to determine if potential contaminants from the storage yard have migrated to the excessed area.

One boring will be drilled to a depth of 30 ft or into a water-bearing zone, whichever is reached first. A surface soil sample from 0 to 0.5 ft bgs and four additional samples, composited from 0.5 to 5 ft, 5 to 10 ft, 15 to 20 ft, and 25 to 30 ft depth intervals, will be collected. If saturated conditions are observed during drilling operations, the boring will be completed as a well and a ground-water sample will be collected. The surface soil sample will be analyzed for TPH, cyanide, and all metals on the CERCLA TCL. Deeper soil samples and ground-water samples will be analyzed for the same suite of compounds and also for all VOCs and SVOCs on the CERCLA TCL.

2.3.6 SOUTHEAST FENCE LINE AREA

An area of Fort Douglas that is planned to be excessed is located east of the southeast Fort Douglas fence line and west of Red Butte Creek (Figure 2-3). Fort Douglas maintenance and storage areas are located adjacent to this area. Potential releases and migration of contaminants from a drum storage area, fuel storage area, waste oil UST, and parking/storage lot will be investigated by drilling a soil boring inside the excessed boundary area at a downslope location from each potential source area.

A total of four, 5-ft deep, borings will be drilled and sampled at the 0 to 0.5 ft and 0.5 to 5 ft depth intervals. The surface soil samples will be analyzed for TPH, cyanide, and all metals on the CERCLA TCL. The deeper samples will be analyzed for the same suite of analytes and also for all VOCs and SVOCs on the CERCLA TCL.

2.4 QUALITY CONTROL SAMPLES

Quality control (QC) samples will be collected during the field program, as specified in the Draft QAPP, to monitor the precision, accuracy and reproducibility of field sampling and handling techniques. These samples include duplicates, field blanks, trip blanks, and rinsate blanks. Eleven QC samples will be collected during the program, as shown on Table 2-5.

A minimum of 23 soil samples and up to two ground-water samples are to be collected during the field program. Approximately nine soil samples will be collected using a hand auger, and the other soil samples will be collected using a drill rig and split spoon sampler. Two rinse blanks will be collected from the split spoon sampler, and, if more than one monitoring well is sampled, one rinse blank will be collected from a ground-water bailer. Two rinse blanks will be collected using the wipe filter papers. Two trip blanks will accompany the soil and ground-water samples if they are collected within the same day. Otherwise, one trip blank will be shipped with each set of samples collected for analysis of volatiles.

One soil sample will be split at the lab and analyzed as two distinct samples. Two duplicate transformer oil samples, one duplicate ground-water sample, and approximately one duplicate paint chip sample will be collected in the field.

Representative soil samples from each unique lithologic interval will be retained and stored on site.

Table 2-5 Field Quality Control Sampling Summary

Media	Number of Investigative Samples	Duplicate	Rinsate Blank	Trip Blank	Total No. of QC Samples	Total No. of Samples
Soil	24	1*	2	2**	5	29
Transformer Oil	25	2	-	-	2	27
Ground Water	2	1	1	2**	4	6
Paint Chips	18	2	2	-	2	20
Paint Dust Wipes	33	-	2	-	2	35
TOTALS	102	6	5	4	15	116

* Soil duplicates will be split at the laboratory.

** If soil and ground-water samples are collected on the same day, there will be a total of two trip blanks for these two media.

3.0 SITE MANAGEMENT

Site management activities conducted to support the EI/AA field program will include mobilization, establishment of the field documentation, decontamination, and waste management systems.

3.1 MOBILIZATION

Prior to the start of field activities, an adequate communication system should be set up to link field teams to each other and to technical, QA, and health and safety management personnel. In addition, access to a water supply for decontamination and other sampling needs, and access to sanitation facilities should be arranged. The water supply which will be used during the EI/AA program must be sampled, analyzed, and approved by USATHAMA before the sampling program begins.

Copies of the work plan package including the Technical Plan, SAP, QAPP, and the HASP should be distributed to all field personnel. An orientation should be conducted to familiarize the team with the site, the sampling program and the QA and health and safety protocols established for the investigation.

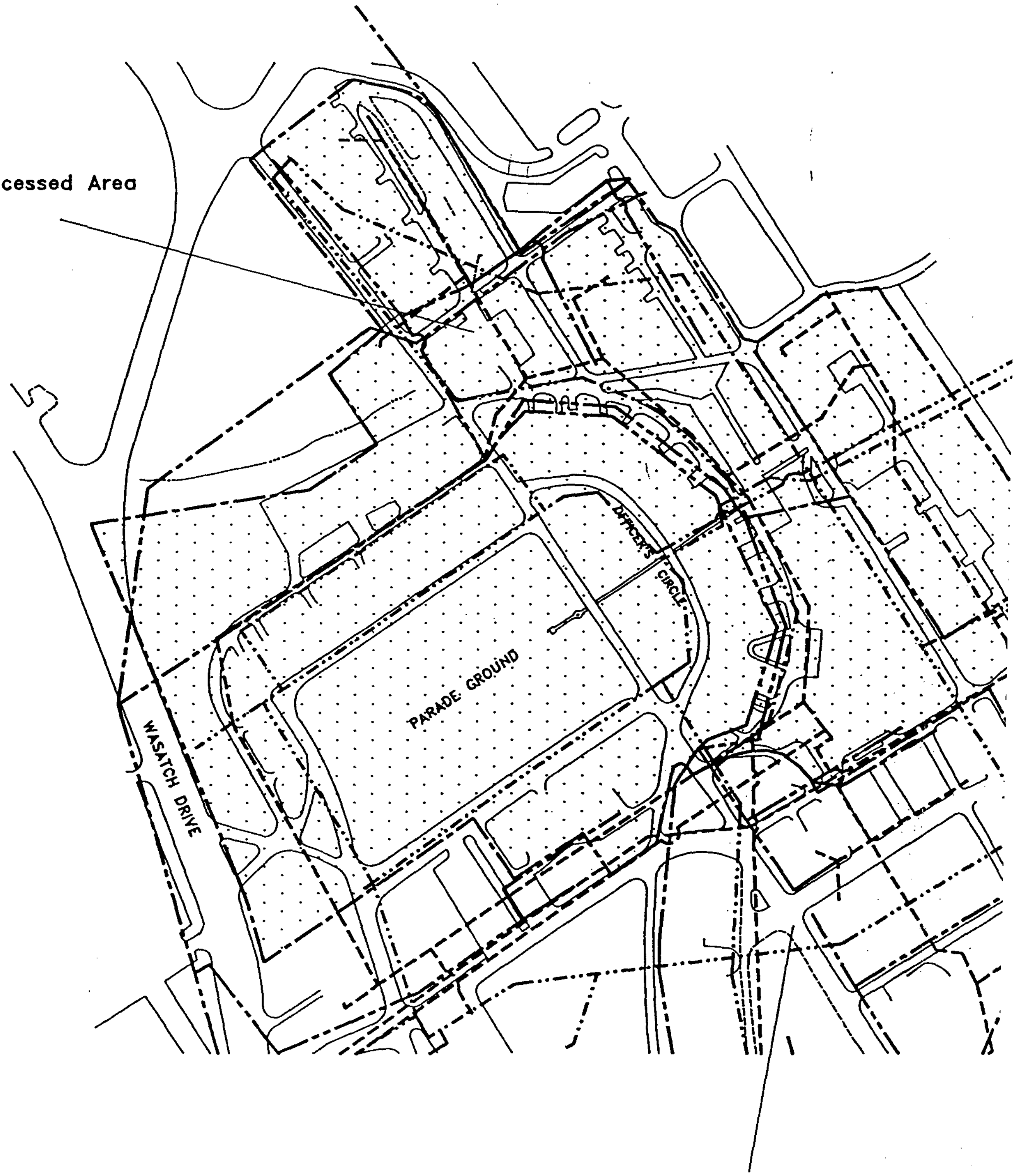
Before the soil sampling program begins, drilling locations will be screened for the presence of underground utilities or other structures. Approximate locations of the underground utilities are shown on Figure 3-1. Locations will be cleared in the field by the Directorate of Housing and Engineering (DEH) at Fort Douglas. All utilities at the site will be turned off prior to drilling activities and prior to transformer sampling.

Prior to beginning the structure sampling phase of the EI/AA program, occupants at Fort Douglas should be notified and arrangements should be made to enter and sample the structures. Access to the University of Utah well will also be arranged.

3.2 SITE ACCESS

Fort Douglas is an active installation located adjacent to public areas. Access to work areas, such as drilling locations, will be controlled by the use of stakes and visible flagging tape.

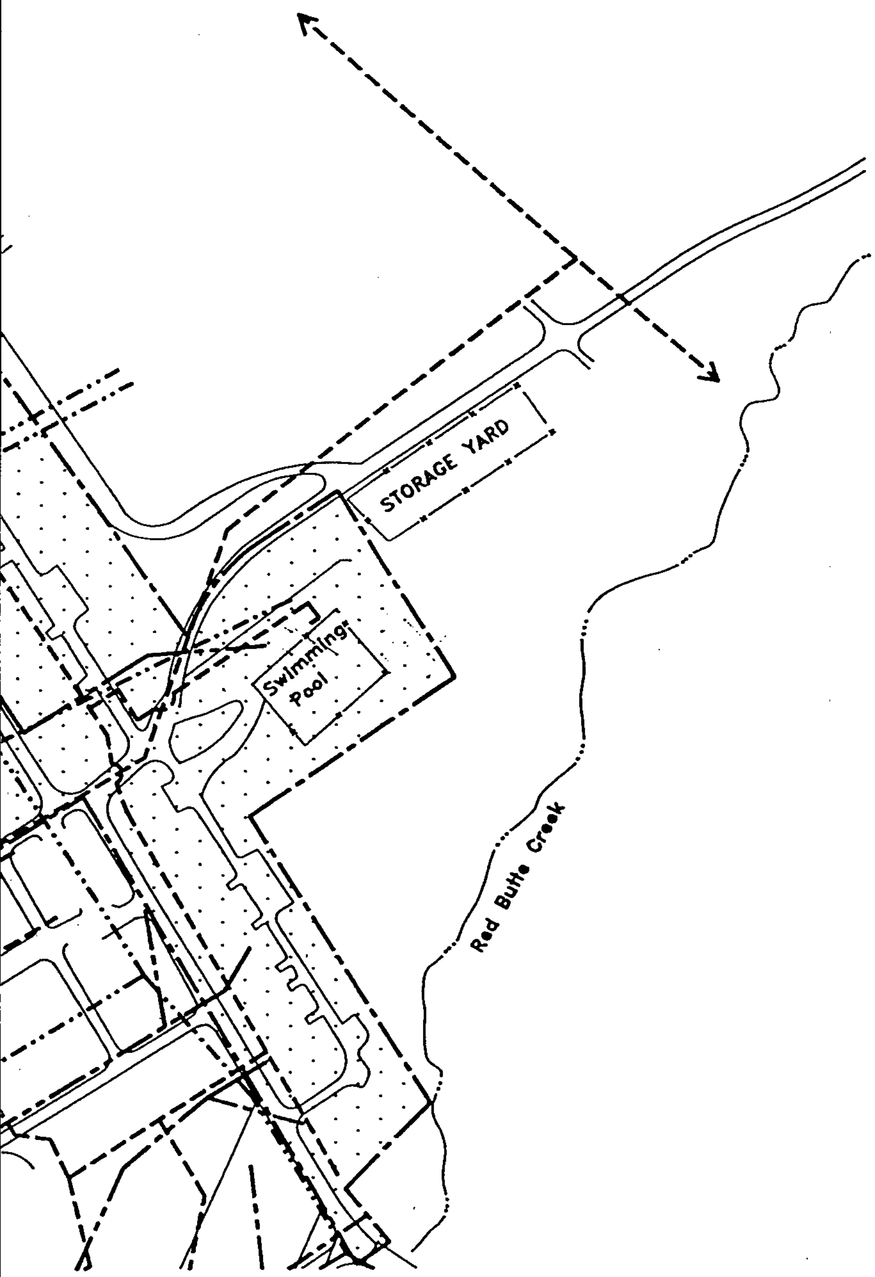
Excessed Area

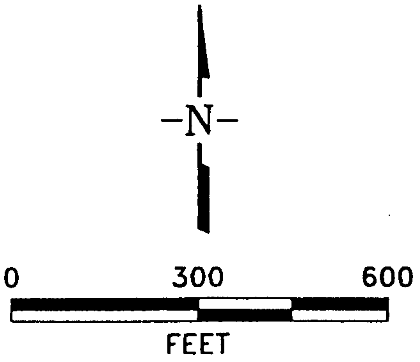


Retained Area

EXPLANATION

– – – – – –	Gas line
—— – – ——	Sanitary sewer
–··–··–··	Water line
—— – —— –	Fort Douglas Excessed Area Boundary





R.L. STOLLAR & ASSOCIATES INC.
Ground-Water Consultants

Underground Utility Locations
Fort Douglas

Prepared for:
U.S. Army Corps of Engineers
USATHAMA

Date: August 1991

Figure 3-1

2

3.3 DECONTAMINATION

A central area will be set up for decontamination of drill rigs and sampling equipment. Decontamination water should be contained within the area. To prevent cross contamination, all down-hole drilling equipment will be steam cleaned before its first use on the site and between use at each boring location. Sampling equipment, such as split spoons, hand augers, bailers, and paint sampling tools, will be decontaminated between collection of each sample by steam cleaning or washing with USATHAMA-approved water. Details on decontamination techniques are provided in the QAPP.

3.4 WASTE MANAGEMENT

Wastes generated by the field investigation which may be hazardous include soil cuttings, development and purge water from ground-water monitoring wells, and protective clothing. These wastes must be handled in accordance with the requirements of Resource Conservation and Recovery Act (RCRA) unless they are shown to be nonhazardous.

Drill cuttings and other soil will be screened in the field for the presence of organic vapors using the headspace technique described in the QAPP. If this analysis indicates that the concentration of organic vapors is less than 5 parts per million (ppm), the cuttings will be disposed at the boring site as nonhazardous. Soils which contain organic vapors greater than 5 ppm will be containerized in drums until laboratory analysis of the samples collected at the site can be completed. The drums will be labeled according to the locations and depth of the sediments contained. Based on the laboratory results, additional samples of the soils in the drums may be collected. Uncontaminated soils will be disposed at the boring site as nonhazardous; contaminated soils will be disposed as hazardous waste at an appropriate permitted facility.

Wastewater from sampling and decontamination will be stored in drums or bulk containers. Analysis of ground-water samples or bulk samples collected from the wastewater holding tanks will be reviewed and used to determine an appropriate disposal mechanism.

As required by Title 40 of the Code of Federal Regulations (CFR), Part 261, all containers should be labeled as "Hazardous Waste" and information on the label should include a unique identification number for the container, the type and origin of the waste and the date of accumulation. A record of all waste generated at the site should be maintained to document its handling from the point of generation until its disposal. Therefore, documentation at the site will include a log of the waste stored at the site, the location of generation, associated sample numbers, sampling results, and transportation and disposal manifests. The material should be transported from the site for disposal within 90 days of its accumulation.

4.0 REFERENCES

Dames and Moore, 1991. Base Closure Final Environmental Impact Statement for Fort Douglas, UT. Prepared for the Department of the Army Headquarters, FORCES Command Fort McPherson, GA.

Environmental Science and Engineering, Inc. (ESE), 1983. Installation Assessment of the Headquarters, Fort Carson, Colorado, and its Subinstallation Headquarters, Fort Douglas and U.S. Army Support Detachment, Fort Douglas, Utah, and Headquarters, Missoula, Fort Missoula, Montana, Report 330.

U.S. Environmental Protection Agency (EPA), Office of Solid Waste and Emergency Response, November, 1986. Test Methods for Evaluating Solid Waste, SW-846, 3rd Edition.

Weston, R. F., Inc. (Weston), 1988. Property Report, Waste Site Report. Prepared for U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland.

Weston, R. F., Inc., 1989. Enhanced Preliminary Assessment, Task Order 2, Fort Douglas, Salt Lake City, Utah. Prepared for U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland.

APPENDIX A

STATE OF UTAH

UNDERGROUND STORAGE TANK CLOSURE PLAN

RECEIVED
AUG 22 1991

UNDERGROUND STORAGE TANK CLOSURE PLAN

(revised 11/89)

IN ORDER TO EXPEDITE THE REVIEW OF YOUR CLOSURE PLAN, PLEASE FILL IN ALL BLANKS COMPLETELY. THIS CLOSURE PLAN SUPERCEDES PRIOR VERSIONS.

/ Date Received
/ Reviewer/Date Reviewed
/ Reviewer Recommendation
/ EHM Review/Date

****

Closure Plan prepared by James D. Smith of Westech Fuel Equipment
tel # 266-2545 Address 195 West 3900 South, Murray Zip 84107

SITE INFORMATION

Owner Name U.S. Army Address Fort Douglas, Utah
Zip 84113 Tel # 524-4137
Site Name F.D. Bldg's 134,129,39,129,122 Address Fort Douglas, Utah
Zip 84113 (Contact Person) John Cloonan Tel. #719-579-4826
Tank Location Identification Number (found on billing forms, 7 digit #)
4001149
Number of tanks at this site 10. Number of tanks at this site to be closed 8.

TANK INFORMATION

Tank #:	1	2	3	4	5	6
Age of tank	unknown	unknown	unknown	unknown	unknown	unknown
Capacity	5,000	5,000	5,000	10,000	250	1,000
Subs. stored	unleaded	regular	premium	unknown	unknown	waste oil
Date last used	unknown	unknown	unknown	unknown	unknown	in use
	7	8				
	unknown	unknown				
	500	500				
	diesel	diesel				
	unknown	unknown				

SITE PLAT ATTACHED Located on the plat should be buildings, tanks, lines, dispensers, underground utilities, proposed sampling locations, sampling depths, substance stored in tanks and other important features.

CLOSURE NOTICE FORM This must be filled out and returned to the Bureau when closure is completed.

TANK HANDLER Name Steve Foster/Westech Fuel Equip Certificate #TH-0056
Address 195 West 3900 South, Murray, Utah Zip 84107

SOIL/GROUNDWATER SAMPLER NAME James D. Smith/Westech Fuel Equipment
Certificate # (after 12/31/89) GS-0142 Address Same
Zip

DISPOSAL INFORMATION
Tank(s) will be disposed at: Facility Hugo Neu
Address 4221 West 700 South Contact Warren Jennings
Tel. # 973-8665

Product lines will either be X removed or ______ secured in place and capped.
Vent lines will either be X removed or ______ secured open
Piping will be disposed at: Facility Hugo Neu
Address 4221 West 700 South Contact Warren Jennings
Tel. # 973-8665

Tank will be emptied by Advanced Petroleum Equipment (company) and cleaned by Advanced Petroleum Recycling (company).
The tank will be rendered inert by the following method:
with dry ice, 20 lbs per 1000 gallon capacity
If tanks are to be closed in-place, has approval been obtained from the Fire Dept? ______yes ______no

THE FOLLOWING INFORMATION MUST BE FILLED OUT COMPLETELY

If found, contaminated soils are to be disposed at the following facility.
E.T. Technologies address 6030 West 1300 South
contact Cindy Anderburg tel. # 973-2065
If found, contaminated water is to be disposed at the following facility
Tri K Construction address 210 North Robinson Ave, Am Fork, Utah

contact Kal Kessler tel. # 756-4296
Residual sludges are to be disposed at the following facility: Chemical Handling Corp Address 1636 Pioneer Rd., SLC, Utah Contact Jim Finney

Tel. # 975-1800

IF CONTAMINATED SOILS ARE TO BE AERATED, CONTACT BUREAU OF AIR QUALITY FOR ANY NECESSARY PERMITS AT 538-6108

IF CONTAMINATED GROUNDWATER IS FOUND, CONTACT BUREAU OF WATER POLLUTION CONTROL FOR ANY NECESSARY PERMITS AT 538-6146

CONTACT LOCAL HEALTH DISTRICT Name of Dist. S.L. County Date 10/15/90
Contact Joann Stinar Title Secretary Tel.# 534-4547
CONTACT LOCAL FIRE DEPT. Name of Dept. Salt Lake City Date 10/15/90
Contact Wayne Leydsman Title Fire Marshall Tel.# 799-4164

SITE ASSESSMENT

A site assessment must be performed on all tanks to be closed. At a minimum, protocol found in R450-205 UAC should be followed during close assessment.

Groundwater sample lab analysis to be used: X 8015 (modified), ______ EPA 413.1, other ______
Soil sample, lab analysis to be used: X 8015 (modified), X EPA 413.1, other USC
State Certified Laboratory to be used: American West Analytical
Address 463 West 3600 South Zip 84107
Tel # 263-8686 contact Steve Getz

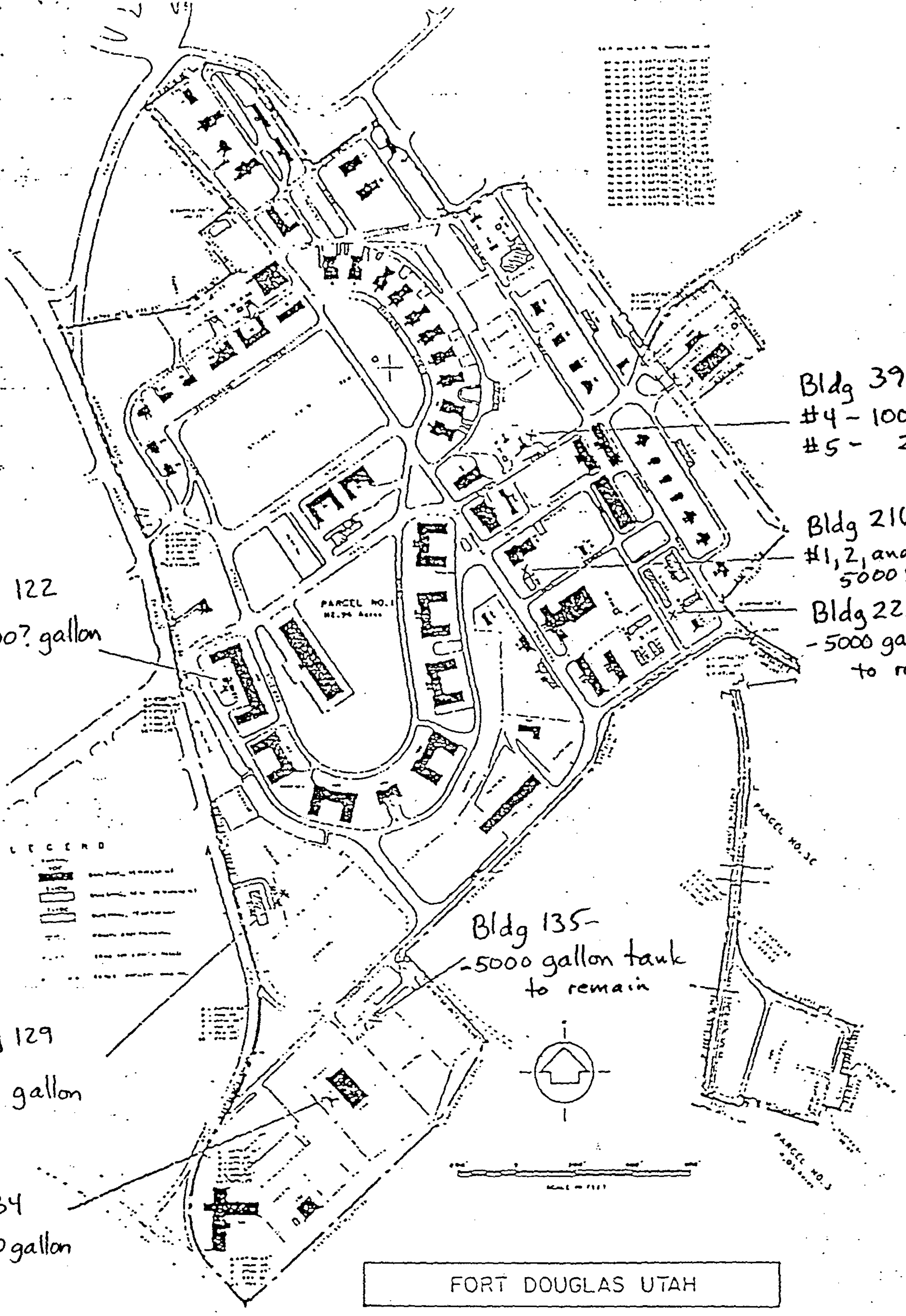
CONTAMINATION INFORMATION

In the event that contamination is detected or suspected, you must report a release to the Executive Secretary, Solid and Hazardous Wastes

Committee at 801-538-6170. If contamination is suspected or detected a qualified environmental consultant should assist you in your remediation. In the event contamination is found the environmental consultant will be:

Company Westech Fuel Equipment
Address 195 West 3900 South City Salt Lake City
State Utah Zip 84107 Tel. # 266-2545

CHNICAL EXHIBIT 2



Bldg 39
#4 - 10000 gallon
#5 - 250 gallon

Bldg 216
#1, 2, and 3 -
5000 gallons each

Bldg 223
- 5000 gallon tank
to remain

Bldg 122
#8 - 500? gallon

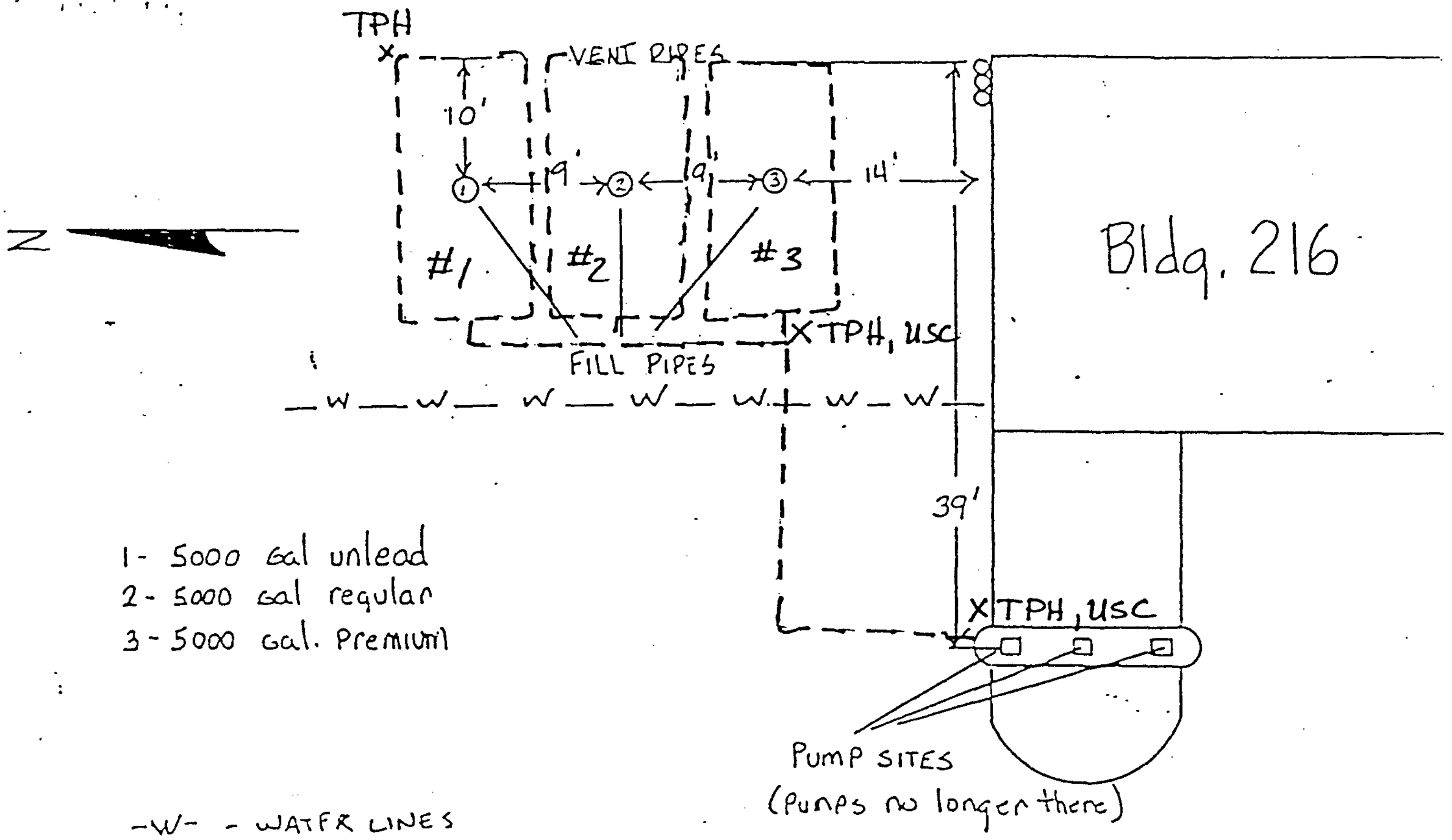
Bldg 135 -
- 5000 gallon tank
to remain

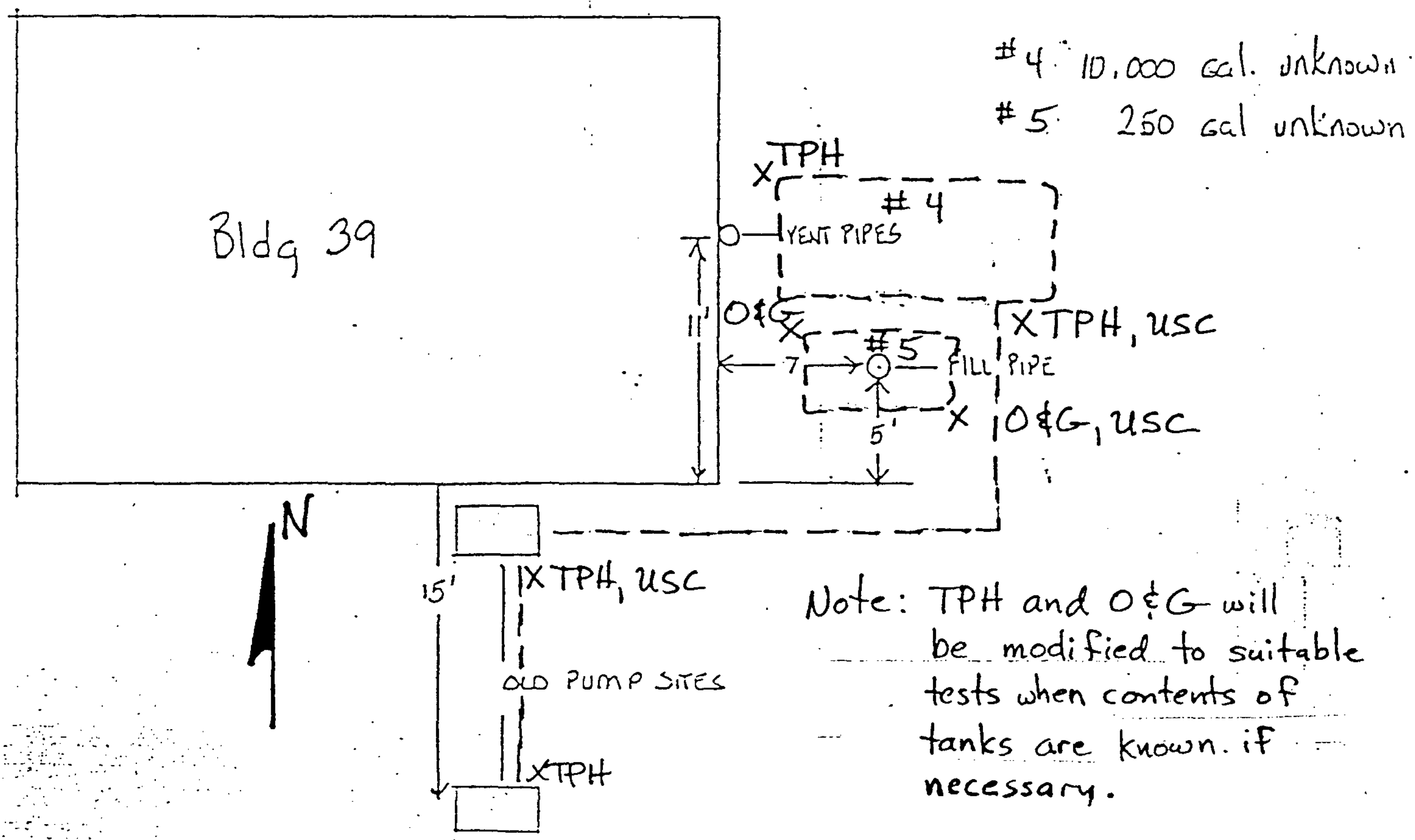
Bldg 129
#7 - 500? gallon

Bldg 134
#6 - 1000 gallon

FORT DOUGLAS UTAH

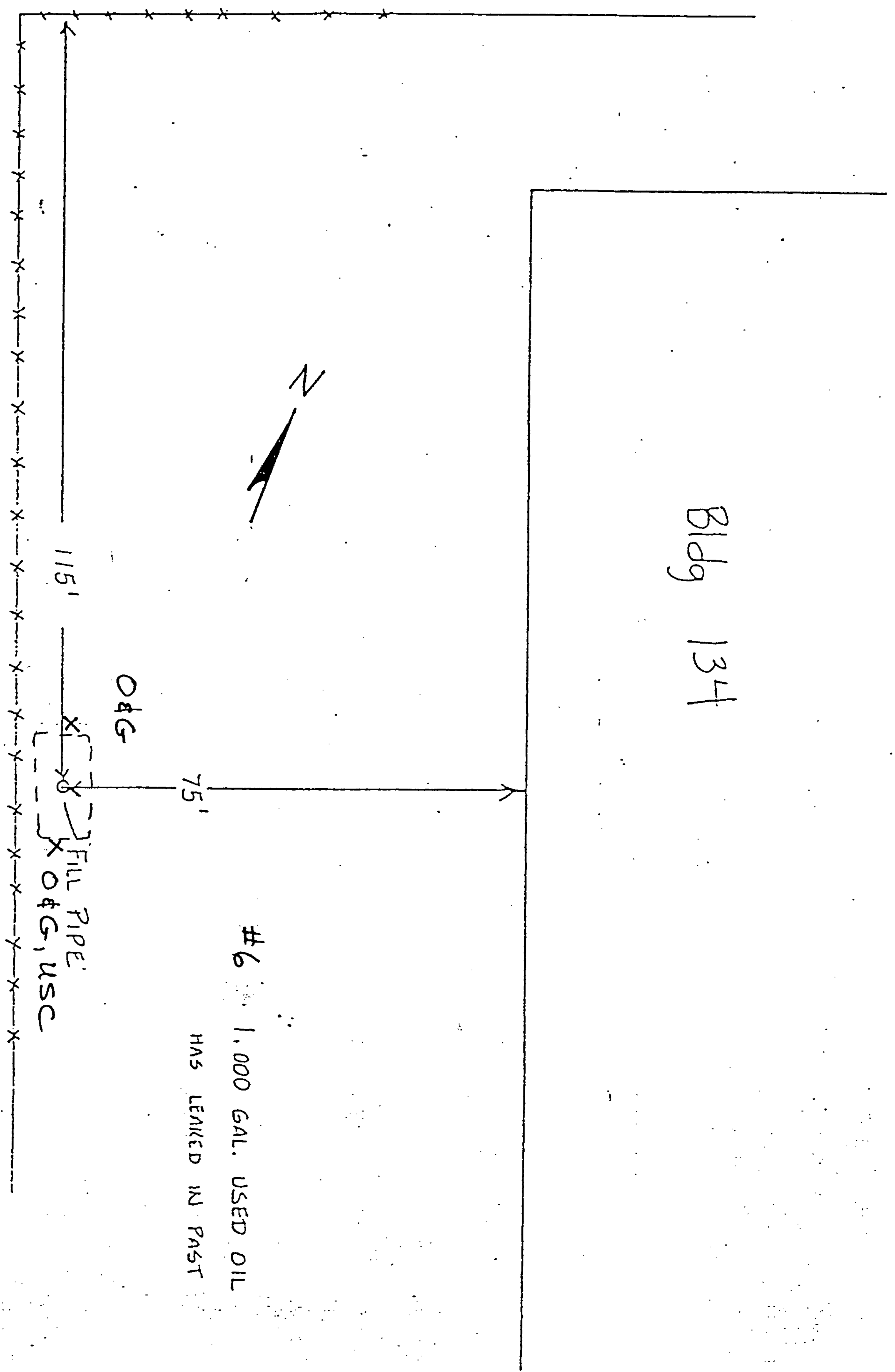
12 SEPT 1973

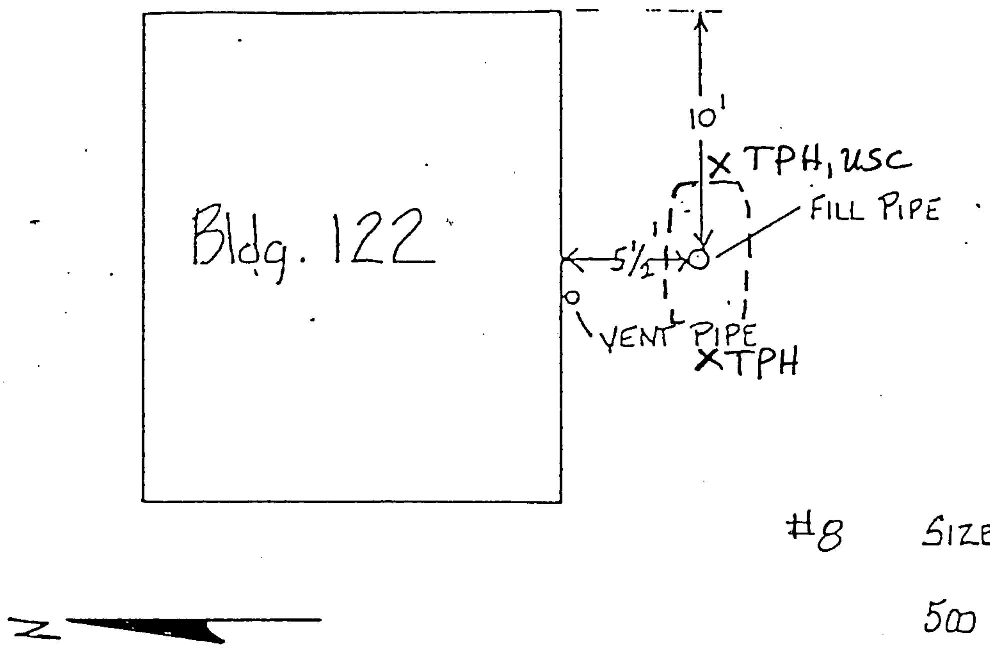




Note: TPH and O&G will be modified to suitable tests when contents of tanks are known. if necessary.

TEHCNICAL EXHIBIT 2



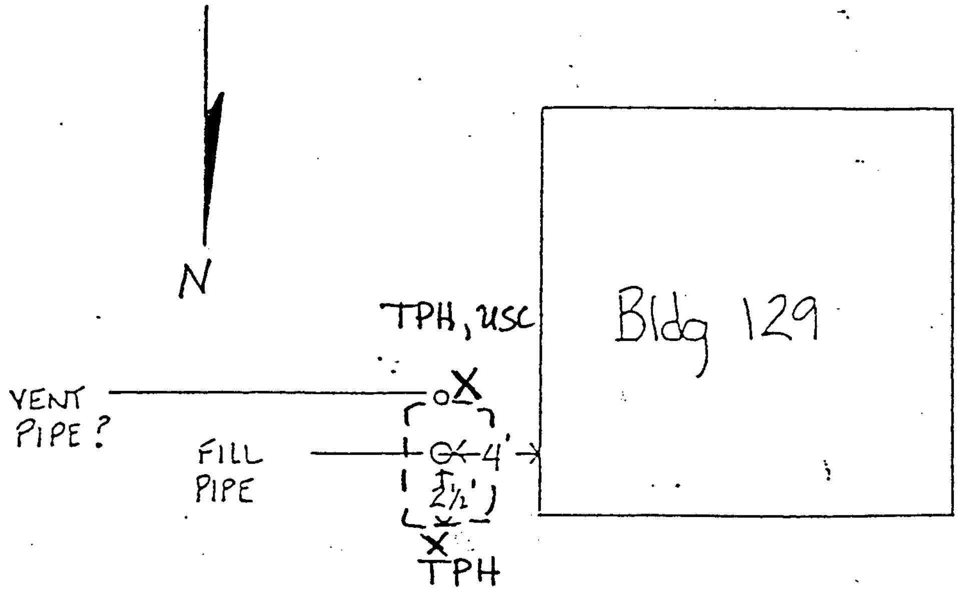


#8 SIZE + PRODUCT UNKNOWN

500 Gal. - DIESEL ?

TPH will be modified if necessary when contents of tank are known.

TPH will be modified if necessary when contents of tank are known.



#7 SIZE + PRODUCT UNKNOWN

500 GAL. DIESEL ?

TERRIBLE CONDITION - EXPOSED

State of Utah
DEPARTMENT OF HEALTH
DIVISION OF ENVIRONMENTAL HEALTH

Norman H. Bangerter
Governor
Suzanne Dandoy, M.D., M.P.H.
Executive Director
Kenneth L. Alkema
Director

Bureau of Environmental Response and Remediation
288 North 1460 West, P.O. Box 16690
Salt Lake City, Utah 84116-0690
(801) 538-6338

RECEIVED
DEC 1 8 1990

DEC 13 1990

John Cloonan
U.S. Army
Fort Douglas, UT 84113

Re: Closure Plan for Underground Storage Tank(s) located at Fort Douglas, Fort Douglas, Utah
Facility Identification No. 4001149

Dear Mr. Cloonan:

The closure plan for the above-referenced facility, received by the Bureau of Environmental Response and Remediation on November 8, 1990, has been approved subject to the noted modifications, if any. Local health and fire departments must be notified 72 hours before beginning closure activities. These agencies may have additional requirements for closure or may charge inspection fees.

Enclosed is a copy of the "Closure Notice" form which must be received by the Executive Secretary before the closed tanks can be removed from the fee billing list. Please provide all of the requested information on the Closure Notice form and submit the form together with the sample analysis data when this information is available.

Any deviation from an approved closure plan must be reported to the Bureau of Environmental Response and Remediation immediately. Any proposed change in the Closure Plan must be approved before implementation. If contamination is suspected or found during closure activities, you must report it to the Bureau of Environmental Response and Remediation within 24 hours of discovery. If you have any questions, please contact Jim Thiros at (801)538-6338.

Sincerely,

Kent P. Gray

Kent P. Gray
Executive Secretary (UST)
Utah Solid and Hazardous Wastes Committee

Enclosure

cc: Harry L. Gibbons, M.D., M.P.H., Director, Salt Lake City/County Health Department
Salt Lake City Fire Department
~~James D. Smith,~~ Westech Fuel Equipment

KPG/JLT/cc
Shw\ust\cc\tnk-cls.6

WESTECH
FUEL EQUIPMENT®

PETROLEUM & CHEMICAL HANDLING EQUIPMENT
DBA WESTERN TECHNICAL FUEL EQUIPMENT, A SUBSIDIARY OF F.W. JONES & ASSOC., INC.
195 WEST 3900 SOUTH • P.O. BOX 57307 • SALT LAKE CITY, UTAH 84157-0307
(801) 266-2545 • OUTSIDE UTAH TOLL FREE 1-800-433-8831 • 24 HR. FAX (801) 261-4054
UTAH TOLL FREE 1-800-344-6009

June 27, 1991

Kent P. Gray, Executive Secretary (UST)
Bureau of Environmental Response and Remediation
288 North 1460 West
P.O. Box 16690
Salt Lake City, Utah 84116-0690

Re: Modification of Closure Plan for UST's located at
Fort Douglas, Utah Facility I.D. #4001149

Dear Mr. Gray,

Approval of the following modifications to the approved Closure Plan are requested:

1) Addition of Tank #9, a 5000 gallon unleaded gasoline tank of unknown age, still in use, and located at Building 135 (see attached plat)

2) Addition of Tank #10, a 5000 gallon unleaded gasoline tank of unknown age, still in use, and located at Building 233 (see attached plat)

3) Tank remover will be James D. Smith, Certificate #TR-0042

4) Contaminated water and residual sludges will be disposed of at either Golden Eagle Refinery, 1474 West 1500 South, Woods Cross, Utah, Contact D.J. Blood at 295-2828 – or at – Advanced Petroleum Recycling 2586 West 4700 South #215, Salt Lake City, Utah, Contact Brad Oakley, 964-9444

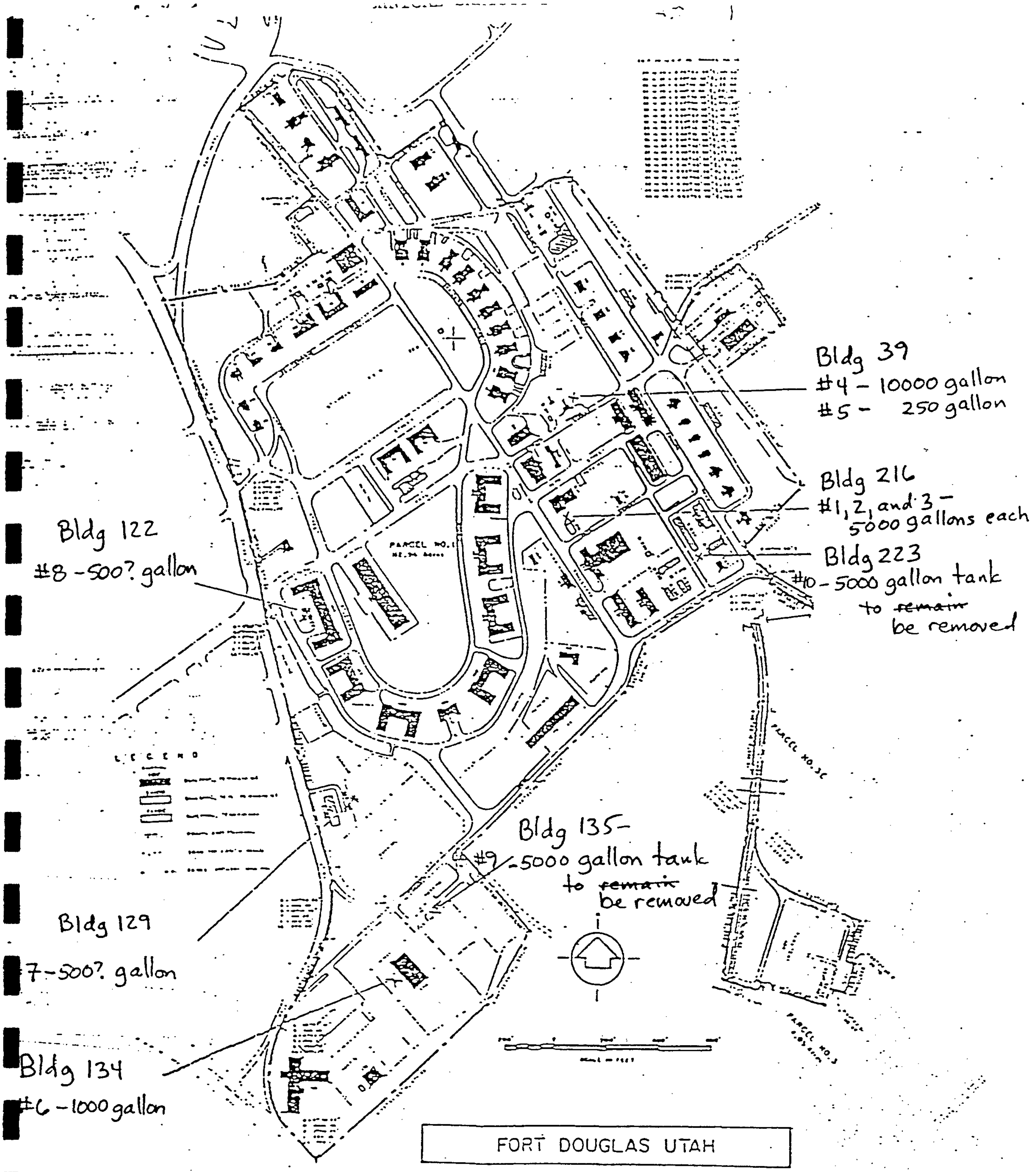
Sincerely,

James D. Smith
Hydrogeologist

JDS/lc

Enclosures

cc: John Cloonan



Bldg 39
#4 - 10000 gallon
#5 - 250 gallon

Bldg 216
#1, 2, and 3 - 5000 gallons each

Bldg 223
#10 - 5000 gallon tank to ~~remain~~ be removed

Bldg 122
#8 - 500? gallon

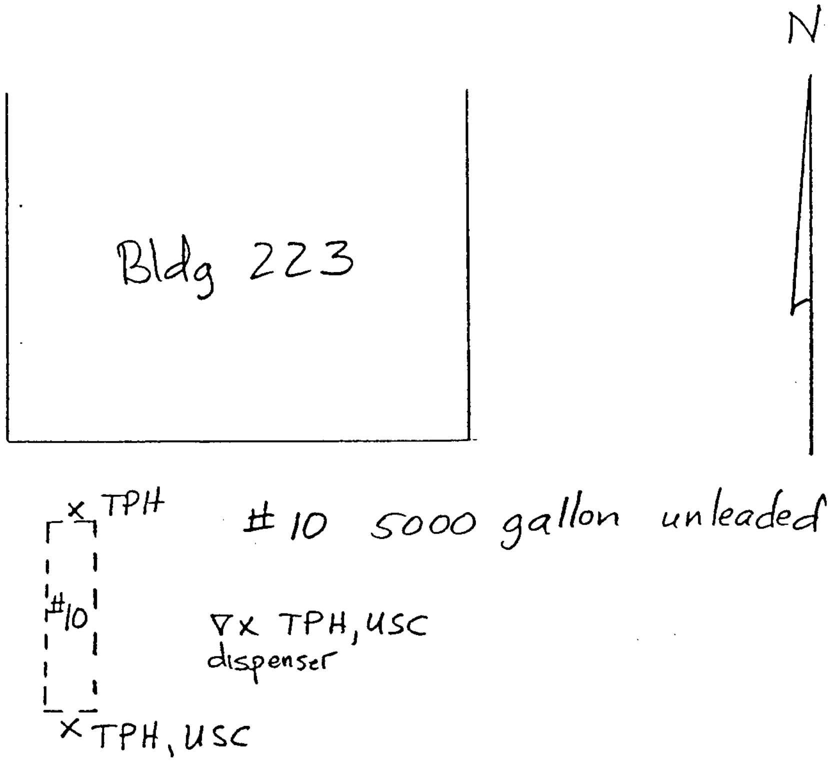
Bldg 135 -
#9 - 5000 gallon tank to ~~remain~~ be removed

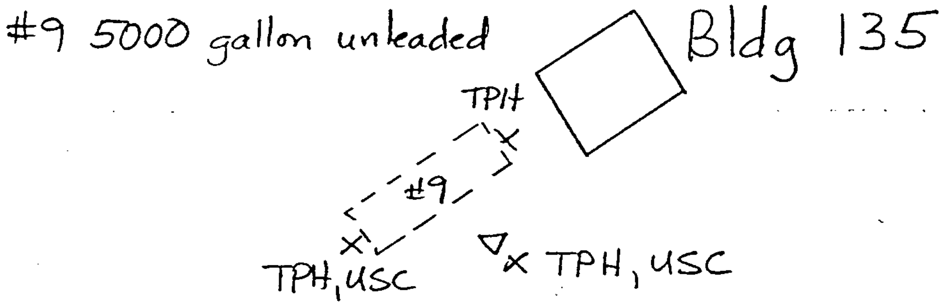
Bldg 129
#7 - 500? gallon

Bldg 134
#6 - 1000 gallon

FORT DOUGLAS UTAH

12 SEPT 1973


N
Bldg 223
TPH
#10 5000 gallon unleaded
#10
TPH, USC
dispenser
TPH, USC


#9 5000 gallon unleaded
Bldg 135
TPH
#9
TPH, USC
TPH, USC

Part C

Final Quality Assurance Project Plan

FINAL QUALITY ASSURANCE PROGRAM PLAN

SEPTEMBER 1991

CONTRACT NO. DAAA-15-90-D-0018

TASK ORDER 0005

FORT DOUGLAS
ENVIRONMENTAL INVESTIGATION/ALTERNATIVES ANALYSIS

Prepared by:

R. L. STOLLAR & ASSOCIATES INC.
URS CONSULTANTS, INC.
PTI ENVIRONMENTAL SERVICES
URIE ENVIRONMENTAL HEALTH, INC.
DATACHEM LABORATORIES
ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
ENVIRONMENTAL HAZARDS SPECIALISTS INTERNATIONAL, INC.

Prepared for:

U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY

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LIST OF ACRONYMS AND ABBREVIATIONS

AA	Alternatives Analysis
ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
cm	centimeter
COC	chain-of-custody
COR	Contracting Officer's Representative
CRL	Certified Reporting Limit
DOT	Department of Transportation
DQO	data quality objective
ECD	electron capture detector
EI	Environmental Investigation
EPA	U.S. Environmental Protection Agency
ESE	Environmental Science and Engineering, Inc.
FID	flame ionization detector
ft	feet
GC	gas chromatography
GC/MS	gas chromatography/mass spectroscopy
GFAA	graphite furnace atomic adsorption
HCl	hydrochloric acid
HCN	hydrocyanic acid
HNO_3	nitric acid
HPLC	high pressure liquid chromatography
H_2SO_4	sulfuric acid
H&S	Health and Safety
IC	ion chromatography
ICP	inductively coupled plasma
in	inch
IRDMS	Installation Restoration Data Management System
IRMs	Interim Reference Materials
LAC	Laboratory Analytical Coordinator
LCL	lower control limit
LQAC	Laboratory Quality Assurance Coordinator
LWL	lower warning limit
ml	milliliter
NaOH	sodium hydroxide
NIST	National Institute of Standards and Technology
NMR	nuclear magnetic resonance
OD	outer diameter
OVA	organic vapor analyzer
PCB	polychlorinated biphenyls
ppb	parts per billion
ppm	parts per million
PVC	polyvinyl chloride
QA	quality assurance
QAC	Quality Assurance Coordinator
QAPP	Quality Assurance Project Plan
QC	quality control
SAP	Sampling and Analysis Plan
SARMs	Standard Analytical Reference Materials
SOP	standard operating procedure
RLSA	R. L. RLSA and Associates, Inc.
SRMs	Standard Reference Materials
SVOC	semivolatile organic
TCL	Target Compound List
TPH	Total Petroleum Hydrocarbons

UCL	upper control limit
μl	microliters
μmhos	micromhos
USATHAMA	United States Army Toxic and Hazardous Materials Agency
USCS	Unified Soil Classification System
UWL	upper warning limit
VOC	volatile organic

APPROVALS

Contractor Program Manager	USATHAMA Project Officer
Contractor QA Coordinator	USATHAMA QA Officer

1.0 PROJECT DESCRIPTION

This Quality Assurance Program Plan (QAPP) has been developed to support the Environmental Investigation and Alternatives Analysis (EI/AA) of Fort Douglas. The Quality Assurance Program will ensure that the quality of the data collected during the program is sufficient to support the objectives of the EI/AA. Fort Douglas was recommended for closure under the Base Closure and Realignment Act in 1989. The closure and transfer of this federal facility is subject to the requirements of Section 120(h) of the Comprehensive Environmental Response, Compensation, and Recovery Act (CERCLA). This section requires the evaluation and remediation of hazardous substances which pose a threat to human health or the environment prior to the property transfer.

During the EI/AA, data will be collected to identify the nature, magnitude and extent of environmental contamination at the site. These data will also be used to assess environmental and human health risks associated with the transfer of the property for other uses; evaluate the need for remedial action at the site; and develop remedial alternatives. The Environmental Protection Agency's Target Compound List (TCL) will be utilized for this EI/AA project at Fort Douglas (Table 1-1).

The EI/AA sampling program is described in the Fort Douglas Technical Plan and Sampling and Analysis Plan (SAP). During the program, lead-based paint, asbestos, transformer oil, soil and water samples will be collected for analysis by field screening instruments or an analytical laboratory. The policies which are contained in this plan will ensure that:

- Samples are collected using appropriate and documented procedures and are controlled using proper techniques for sample identification, preservation and chain of custody;

- Field measurements and laboratory results are precise and accurate; and

- All activities, findings and results are properly documented.

This plan was developed in accordance with applicable U.S. Environmental Protection Agency (EPA) and U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) guidance including "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (EPA, 1988) and The Quality Assurance Program (USATHAMA, 1990).

For this QAPP, laboratory-specific procedures described are for Environmental Science & Engineering Inc. (ESE), a member of the R.L. Stollar and Associates (RLSA) team for the U.S. Army Total Environmental Program Support contract. ESE is assuming the primary laboratory role for the Fort Douglas EI/AA.

Table 1-1 Target Compound List

Volatile Organic Compounds

Acetone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
2-Butanone
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
1,2-Dichloroethene
1,2-Dichloropropane
cis-1,3-Dichloropropene
1,3-Dichloropropene
Ethylbenzene
2-Hexanone
Methylene chloride
4-Methyl-2-pentanone
Styrene
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Vinyl acetate
Vinyl chloride
Xylene

Semivolatile Organic Compounds

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i)perylene
Benzo(a)pyrene
Bis(2-chloroethoxy)methane
Bis(2-chloroethyl)ether
Bis(2-chloroisopropyl)ether
Bis(2-ethylhexyl)phthalate
4-Bromophenyl phenyl ether
Butyl benzyl phthalate
Carbazole
4-Chloroaniline
2-Chloronaphthalene
4-Chloro-3-methylphenol
2-Chlorophenol
4-Chlorophenyl phenyl ether
Chrysene
Dibenz(a,h)anthracene
Dibenzofuran
Di-n-butylphthalate
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,2-Dichlorobenzene
3,3-Dichlorobenzidine
2,4-Dichlorophenol
Diethylphthalate
2,4-Dimethylphenol
Dimethylphthalate
4,6-Dinitro-2-methylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Di-n-octylphthalate
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno(1,2,3-cd)pyrene
Isophorone
2-Methylnaphthalene
2-Methylphenol (o-cresol)
4-Methylphenol (p-cresol)
Naphthalene
2-Nitroaniline
3-Nitroaniline
4-Nitroaniline
Nitrobenzene
2-Nitrophenol
4-Nitrophenol
N-Nitroso-di-n-propylamine
N-Nitrosodiphenylamine
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
1,2,4-Trichlorobenzene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol

PCB

Aroclor-1016
Aroclor-1221
Aroclor-1232
Aroclor-1242
Aroclor-1245
Aroclor-1254
Aroclor-1260

Metals

Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Selenium
Silver
Sodium
Thallium
Vanadium
Zinc

Inorganic Compounds

Cyanide

Miscellaneous

Total Petroleum Hydrocarbons (TPH)
Asbestos

2.0 QUALITY ASSURANCE ROLES AND RESPONSIBILITY

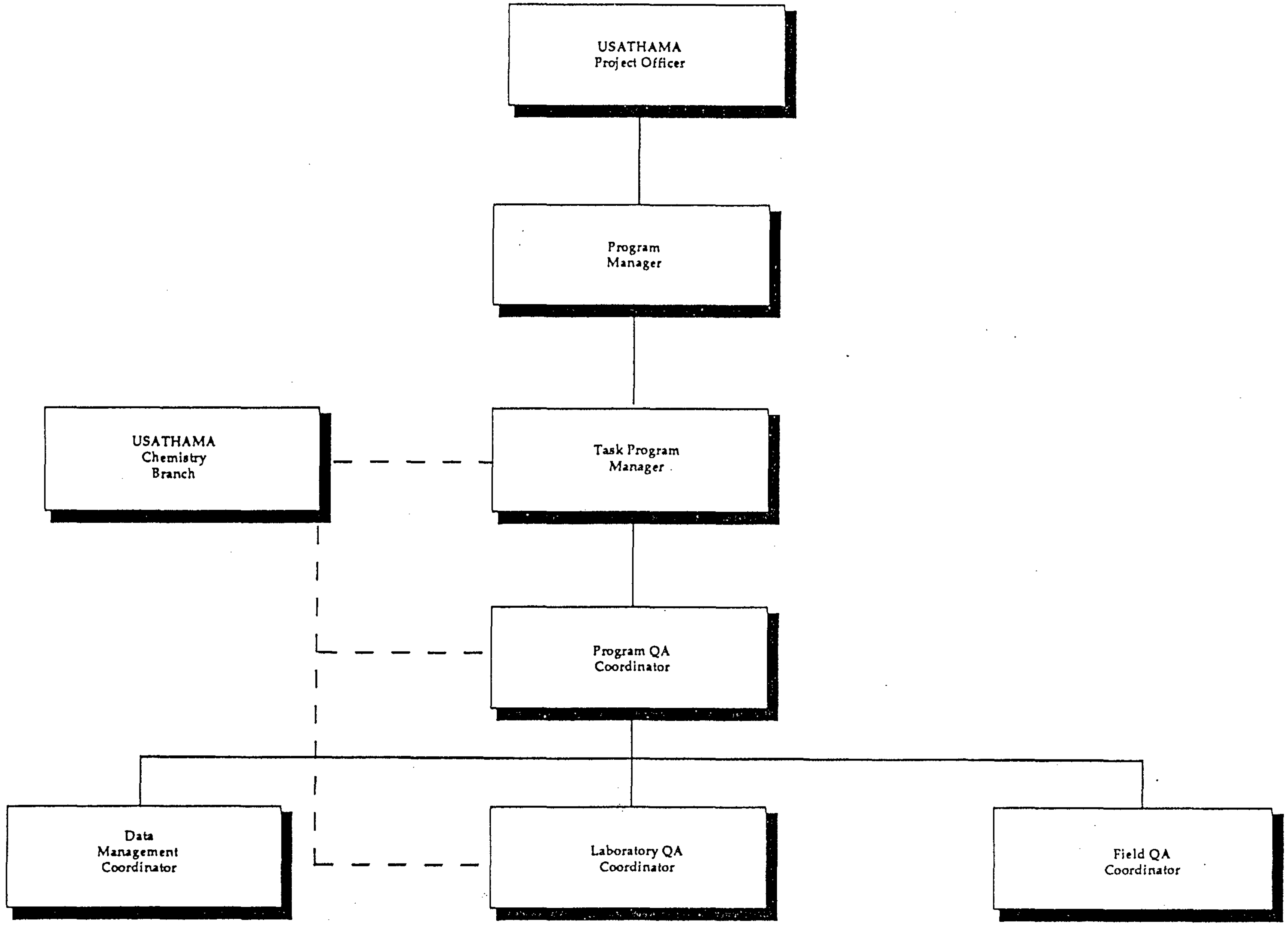
The organizational structure of the Quality Assurance Program for the Fort Douglas EI/AA, illustrated on Figure 2-1, has been designed to ensure that project goals and data quality objectives are met. The contractor Quality Assurance Coordinator (QAC) will manage the quality assurance (QA) efforts of the contractor team and serve as the liaison to the USATHAMA personnel responsible for implementing the QA Program. The roles and responsibilities of key personnel in the QA program are described below.

2.1 RESPONSIBILITIES AND AUTHORITY OF USATHAMA PERSONNEL

2.1.1 CHEMISTRY BRANCH, TECHNICAL SUPPORT DIVISION

The Chemistry Branch, Technical Support Division will:

- Advise the Commander on QA/quality control (QC) practices;
- Recommend to the Commander QA practices to be used to support USATHAMA projects;
- Approve Project QC Plans submitted by Contractor Laboratories;
- Provide standardized analytical methods, if available, for specific analytes to Contractor Laboratories;
- Provide analytical reference materials to Contractor Laboratories;
- Review and recommend approval of any proposed modifications to analytical methodology;
- Provide guidance to USATHAMA Project Officers on implementation of QA/QC in Contractor Laboratories;
- Provide guidance to USATHAMA Project Officers on chemistry matters;
- Evaluate the quality of data generated by Contractor Laboratories;
- Monitor the effective implementation of QA/QC at Contractor Laboratories and report questionable practices to the Commander of USATHAMA;



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Ground-Water Consultants

Figure 2-1
Program QA Organization

- Conduct on-site audits of Contractor Laboratories;
- Conduct field audits of sampling activities;
- Review contractor technical plans for adequacy of analytical methods and QA/QC; and
- Coordinate data reporting requirements with the USATHAMA Data Management Group.

2.1.2 USATHAMA PROJECT OFFICER

The Project Officer will, where applicable:

- Act as the principal contact between USATHAMA and RLSA;
- Forward Chemistry Branch review comments to RLSA;
- Provide formal notification to the Contracting Officer of unapproved deviations from the QA Program;
- Ensure timely QC chart submission from RLSA on a weekly basis;
- Inform the Chemistry Branch of difficulties and problems encountered by RLSA in implementing the QA Program;
- Discuss proposed changes in approved sampling and analysis procedures with the Chemistry Branch;
- Provide project QC plans to the Chemistry Branch for review and approval;
- Provide certification documentation to the Chemistry Branch for review and approval; and
- Notify RLSA of certification status.

2.2 RESPONSIBILITIES AND AUTHORITY OF THE CONTRACTOR PERSONNEL

2.2.1 LABORATORY QUALITY ASSURANCE COORDINATOR (LQAC)

The LQAC has the responsibility to establish, oversee, and audit specific procedures for documenting and controlling analytical data quality. Many of the procedures will be implemented by other individuals, but the LQAC must ensure that procedures are being implemented properly and the results interpreted correctly. Appropriate LQAC activities include, but may not be limited to the following:

- Monitor the QA and QC activities of the laboratory to ensure conformance with authorized policies, procedures, and sound practices, and recommend improvements as necessary;

- Inform the Contractor Program Manager, Contractor Analytical Task Manager, and/or contractor laboratory management of nonconformance to the QA Program;

- Ensure that all records, logs, standard procedures, project plans, and analytical results are maintained in a retrievable fashion;

- Ensure that copies of standard procedures, project plans, and standard operating procedures are distributed to all laboratory personnel involved in the project;

- Review all laboratory data before those data are transmitted to permanent storage, reported to other project participants, or submitted via the USATHAMA Installation Restoration Data Management System (IRDMS). Before data are released, the LQAC must have completed the Contractor QAC Checklist and inspected calibration data, control charts, and other performance indicators to verify that the data were collected under conditions consistent with laboratory certification and that the analytical systems were in control;

- Ensure that a signed Data Package Checklist is included in each completed data package;

- Ensure that all sampling logs, instrument logs, and QC documents are maintained and are completed with the required information;

- Collect control charts from laboratory, discuss control chart noncompliance with the Analytical Task Manager; and

- Audit sampling documentation and procedures to ensure that samples are labeled, preserved, stored, and transported according to prescribed methods following approved chain-of-custody procedures.

2.2.2 LABORATORY ANALYTICAL TASK MANAGER

The responsibility for implementing the USATHAMA QA Program resides with the Contractor Analytical Task Manager. This responsibility includes, but may not be limited to the following:

- Submit a detailed Project QC Plan to USATHAMA Project Officer or Contracting Officer's Representative for approval.

- Support a LQAC who will not be subordinate to or be in charge of any person having direct responsibility for sampling analyses;

- Provide sufficient equipment, space, resource, and personnel to conduct analyses and implement the USATHAMA project and QA Program;

- Submit the required documentation and laboratory certification data to the USATHAMA Chemistry Branch prior to analyzing field samples;

- Ensure that subsampling and other handling procedures are adequate for the sample types received;

- Oversee the quality of purchased laboratory materials, reagents, and chemicals to ensure that these supplies do not jeopardize the quality of analytical results;

- Ensure implementation of corrective action for any QA/QC deficiencies;

- Request analytical reference materials from USATHAMA through the USATHAMA Chemistry Branch;

- Establish, with the analysts and the Contractor Analytical Task Manager, the correct analytical lot size, the correct QC samples to be included in each lot, and the correct procedures for evaluating acceptable, in-control analytical performance; and

- Ensure that logging of received samples includes establishing appropriate lot size for each analysis, allocating sample numbers for the correct control samples in each lot, and filling out and maintaining checklist.

2.2.3 CONTRACTOR PROGRAM MANAGER

The function of the Program Manager is to solve any management, technical or administrative problems that arise during the program and to ensure that the program objectives are met. The Program Manager will oversee the program to ensure that work is conducted in accordance with QA protocols, and provide adequate QA support.

2.2.4 CONTRACTOR TASK MANAGER

The Task Manager will direct day-to-day project activities, including supervising field activities and ensuring that protocols established in the QAPP are adhered to. The Task Manager will coordinate activities and schedules with the analytical laboratory and other subcontractors, and resolve any QA/QC deficiencies that may arise.

2.2.5 CONTRACTOR QUALITY ASSURANCE COORDINATOR

The Contractor Quality Assurance Coordinator's (QAC) responsibilities include, but may not be limited to, the following:

- Ensure that sampling is conducted in a manner consistent with the QA Program and other USATHAMA guidelines. This responsibility includes making unannounced trips to the site to inspect the sampling where applicable. A minimum of coordination with the Contractor Analytical Task Manager prior to the unannounced inspection is acceptable. The QAC will document each inspection and ensure that procedures described in the Scope of Work, Technical Plan, and QAPP are followed. The QAC has the authority to require resampling of any site if sample integrity was determined to have been affected by faulty sampling procedures.

- Review control charts from the laboratory, and document control chart non-compliance with the Laboratory Quality Assurance Coordinator and the USATHAMA Chemistry Branch.

- Audit sampling documentation and procedures to ensure that samples are labeled, preserved, stored, and transported according to prescribed methods following approved chain-of-custody procedures.

- Conduct periodic performance audits to ensure acceptable performance.

- Help with coordinating activities and schedules with the analytical laboratory.

3.0 QUALITY ASSURANCE OBJECTIVES

3.1 DATA QUALITY OBJECTIVES

Data obtained during the investigation of Fort Douglas are intended to be used for site characterization, determination of the distribution of contaminants, and other uses consistent with an EI/AA. Data will be obtained under the constraints and controls of the USATHAMA QA Program (1990) and the USATHAMA Geotechnical Requirements (March 1987). Analytical data will be generated under strict QC and validation protocols by a USATHAMA-approved laboratory utilizing Class 1, 1A, and 1B USATHAMA-certified procedures. Detailed data quality objectives (DQOs) for the program are presented in the Technical Plan.

Other important measures of project data quality are representativeness, completeness, comparability, precision and accuracy. These characteristics are used to develop sampling protocols and identify applicable documentation, sample-handling procedures, and measurement system procedures. These objectives are established based on site conditions, objectives of the project, and knowledge of available measurement systems.

3.2 REPRESENTATIVENESS

Representativeness is a qualitative parameter which is most concerned with the proper design of the sampling program. Sampling protocols are developed to assure that samples collected are representative of the media. Sample handling protocols, such as storage and transportation procedures, are selected to protect the representativeness of the collected sample. Proper documentation will establish that protocols have been followed and sample identification and integrity assured.

3.3 COMPLETENESS

Completeness is a measure of the amount of valid data obtained compared to the amount that was expected to be obtained under normal conditions. The amount of valid data expected is established based on the measurements required to accomplish project objectives. The number and type of samples to be obtained are specified for each site in the Sampling and Analysis Plan. Because sampling and waste characterization activities are dependent on field conditions, the number of samples collected may vary from the number planned. The extent of completeness must therefore be reviewed on a relative basis for sample collection activities.

3.4 COMPARABILITY

Comparability reflects both internal consistency of measurements made at the site and the expression of results in units consistent with other organizations reporting similar data. Each value reported for a given measurement should be similar to other values within the same data set and within other related data sets. This characteristic implies operating within the calibrated range of an instrument and utilizing analytical methodologies which produce comparable results.

Measurements, which appear as "outliers" when compared to similar measurements will be reassessed. Units of measurement will be externally comparable by utilizing the appropriate standard units for each measurement system.

3.5 PRECISION

Precision is a measure of agreement of a set of replicate results among themselves without assumption of any prior information as to the true result. Sampling precision may be determined by collecting and analyzing collocated or field replicate samples and then creating and analyzing laboratory replicates from one or more of the field samples. The analytical results from the collocated or field replicate samples provide data on overall measurement precision; analysis results from the laboratory replicates provide data on analytical precision. Subtracting the analytical precision from the measurement precision defines the sampling precision.

3.6 ACCURACY

Accuracy measures the bias in a measurement system; it is difficult to measure for the entire data collection activity. Sources of error are the sampling process, field contamination, preservation, handling, sample matrix, sample preparation and analysis techniques. Sampling accuracy may be assessed by evaluating the results of field/trip blanks; analytical accuracy may be assessed through use of known and unknown QC samples and spikes.

3.7 REPORTING

The actual precision and accuracy of the chemical data collected will be calculated by the laboratory and confirmed by the QA Coordinator. The results of precision and accuracy calculations from spikes will be presented in the laboratory sample result reports and the final report.

The percent recovery and the range for each analytical method will be compared to the compound-specific acceptance values and the warning and control limits developed by the laboratory for the analysis period. The warning and control limits will be based upon all the QA/QC data generated from the analyses performed at the laboratory during the period that the samples are analyzed. These limits will serve to evaluate the performance of the laboratory on individual analyses. If individual analyte percent recovery values do not meet these acceptance criteria, they will be so noted in the final reports and corrective action will be taken where appropriate as described in Section 14.0.

Reporting of comparable data will be assisted by using consistent units for each data type. All depths, distances, elevations, etc. will be reported in English units. Chemical data will be reported in parts per billion (ppb) for water and parts per million (ppm) for soil and transformer oil samples. Lead content of paint will be reported by weight percent, and asbestos will be reported in number of fibers per cubic meter. Temperature will be reported in degrees Celsius (°C) and specific conductance will be reported in micromhos per centimeter (umhos/cm) at 25°C. In addition, consistent standardized sampling and analytical procedures will be applied throughout the site investigation program to ensure that differences in the analytical results do not result from variations in operational procedures.

The representativeness of reported data will also be ensured by the use of established field and laboratory procedures and their consistent application. These procedures are discussed in later sections of the QAPP.

The preparation of the EI/AA report is accomplished by accessing the data base, assimilating ideas from the various technical staff, and drawing conclusions. Documentation of secondary data is typically accomplished via data verification/tracking checklists with accompanying written criteria describing "acceptable" data to ensure consistency in data selection. This allows all database components to be traced to the primary generator and forces a review of data quality as the database is developed.

4.0 FIELD PROCEDURES

The following section contains description of techniques which will be used during the field investigation. These activities include drilling, soil sampling, ground-water well installation and sampling, collection of transformer oil, paint, wipe, and asbestos samples, field measurements and decontamination. Consistent procedures for these field activities will be followed so that the data which is collected is comparable. These procedures have been developed in accordance with the requirements of USATHAMA (1987) and guidance provided by the EPA, including the RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (EPA, 1986a).

4.1 SOIL SAMPLING

Soil samples for laboratory analysis, lithologic description, retention, and/or headspace analyses will be collected during the EI/AA using a drill rig or hand auger. The type of system used for collecting subsurface samples is chosen based on the type of samples which are to be collected and the site hydrogeologic conditions. Two mechanical drilling systems may be used during the program at Fort Douglas: hollow stem auger and mud rotary.

Hollow-stem auger drilling is accomplished utilizing a hollow central shaft which is attached to a spiral scroll. A bit is attached at the bottom of the first auger flight. Cuttings created by the bit are removed by the scroll as the auger stem is turned. This method is suitable for relatively shallow drilling in unconsolidated formations, and undisturbed lithologic samples can be collected easily using this technique. If conditions such as heaving sands or auger refusal prevent completing a borehole, the auger will be withdrawn and the boring will be completed with a mud-rotary technique.

Mud rotary drilling can be done in unconsolidated and consolidated sediments. This method allows construction of deep, large diameter wells with sufficient annular space to ensure proper placement of screen, casing, filter pack, seal, and grout column. Mud rotary drilling involves circulation of a drilling fluid, consisting of a mixture of powdered bentonite and water, down through the drill stem to cool the bit and back up the annular space of the borehole to bring cuttings to a portable mud pit at the surface. Cuttings settle out of the mud slurry to the bottom of the pit and the mud is recirculated. The drilling mud holds the borehole open by the force of hydrostatic pressure and by the formation of a mudcake or clay lining of the borehole walls. The drilling mud will be composed of fresh water (from an approved source) and sodium bentonite type drilling mud. The quality of the drilling fluid will be maintained to assure the protection of water-bearing and potential water-bearing formations in the borehole. Lithologic samples can be collected using a coring device during drilling. The disadvantage of the mud rotary technique is that mud can be retained in the borehole and make well development difficult. In addition, the mud may make it difficult to observe changes in lithology or saturated zones.

Shallow borings will be drilled with a hand auger if possible. The hand auger employs a stainless steel bucket auger attached to a rod with a T-shaped handle. Cuttings are removed from the hole by withdrawing the bucket auger. Samples can be collected as grab samples from the cuttings or obtained by using a hand-driven hammer sampler.

Soil samples will be obtained using a split-barrel sampler if possible. While the drilling is being performed, the site hydrogeologist will record the following information on the field boring log (Figure 4-1):

- Depths recorded in feet and tenth of feet.
- The estimated interval by depth for each sample taken, classified, and/or retained. For each sample, the length of sample interval and length of sample recovery will be recorded. The sampler type and size (diameter and length) will be recorded.
- Soil classification determined in the field at the time of sampling by the hydrogeologist, in accordance with the Unified Soil Classification System or the equivalent (ASTM D2487-83). Field soil classification is subject to change based on laboratory test and/or subsequent review. Any such changes will be incorporated in the project report.
- A full lithologic description of each soil sample taken.
- The results of the headspace analyses for volatile organic compounds (as described in Section 4.9.3), noting headspace and background reading in ppm. The headspace analysis will be conducted in the field utilizing an organic vapor analyzer (OVA).
- A record of soil samples selected for laboratory analysis.
- The use of all drilling additive (including water), noting the amount added and the brand name. The source of water for drilling mud must be clean and approved for use by USATHAMA.

Figure 4-1

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FIELD LOG OF BORING

SITE TYPE	SITE ID
BORING	

SHEET ____ OF ____

PROJECT NAME AND LOCATION	PROJECT NUMBER	ELEVATION AND DATUM		
DRILLING COMPANY	DRILLER	DATE AND TIME STARTED		DATE AND TIME COMPLETED
DRILLING EQUIPMENT: METHOD		COMPLETION DEPTH		TOTAL NO. OF SAMPLES
SIZE AND TYPE OF BIT		NO. OF SAMPLES:	BULK / SS	DRIVE / LABORATORY
DRILLING FLUID		WATER LEVEL:	FIRST	AFTER ____ HOURS
SAMPLER HAMMER TYPE / DRIVING WT. / DROP		HYDROGEOLOGIST/DATE		CHECKED BY/DATE

DEPTH/FEET	SAMPLES				DESCRIPTION	USCS SYMBOL	ESTIMATED PERCENT OF			MOISTURE	CONSISTENCY	COLOR	COMMENTS
	TYPE AND NUMBER	INTERVAL	RECOVERY	BLOW COUNT			GR	SA	FI				
0													
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													

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- A description of drilling equipment used, including a record of its manufacturer, model number, bit size (corresponding to actual borehole diameter), and auger size.

- Before drilling begins, record the amount of drill rod on-site so that the depth of the borehole can easily be determined as drilling proceeds.

- A record of the drill sequence and activities.

- A record of all special problems and their solutions; e.g., hole squeezing, recurring problems at a particular depth, or unrecovered tools in the hole.

- The date for the start and completion of borings along with a notation by depth for drill crew shifts and individual days.

- Each sequential boundary between the various soils and individual lithologies, noted by depth. When depths are estimated, the estimated range will be noted along the boundary.

- The depth of first-encountered free water, along with the method of determination.

- Applicable health and safety monitoring results, such as organic vapors or combustible gases which are present above background level in the borehole.

Each original boring log will be submitted directly from the field to the Contracting Officer's designated office within three working days of boring completion. In those cases where a monitoring well or other instrument is to be inserted into the boring, both the log for that boring and the installation diagram must be submitted within three working days of well or instrument installation. Only the original boring log (and diagram) will be submitted from the field to fulfill this requirement. Carbon, typed, or reproduced copies will not be submitted. Copies will be retained by RLSA.

Headspace analysis will be performed on soil samples as a gross assessment of potential contamination. The sample will be placed in a clean, wide-mouth glass jar. The jar will be filled halfway. Headspace readings will be recorded in the field boring log in units of ppm. The procedures for testing the headspace are described in Section 4.9.3.

Samples to be analyzed for chemical constituents may be collected with continuous samplers, drive samplers or hand augers. Soil samples will be transferred into glass jars for shipment to the laboratory. Brass or polybuterate liners may also be used inside the split spoon to minimize the potential for cross-contamination between samples due to contact with the sampler. The liners may also serve as containers for sample shipment to avoid the loss of volatile components from the samples. The brass liners will be precleaned prior to being used according to the procedures described in Section 4.8.1. After the sampler is removed from the boring, the following procedures will be implemented:

- Liners will be removed from the sampler and marked with a waterproof pen to indicate top and bottom.
- A geologist will examine and log the exposed soil at the end of each brass liner and the soil within those liners which are not submitted for analysis.
- If the sample is to be submitted for laboratory analysis, the liner is capped with Teflon sheeting and clean, tight-fitting plastic caps that are secured with duct tape and labeled.
- Field notes will be recorded in appropriate logbooks in ink.
- Samples for chemical analysis will be stored with ice in coolers for transfer to the off-site laboratory.
- Each sample collected will be recorded on a chain-of-custody record as described in Section 6.0.
- When coolers are ready for transfer to the laboratory, the original chain-of-custody record form will be placed inside a zip-lock bag and taped inside the lid of the coolers.
- Coolers will be sealed with duct tape and custody seals will be attached.
- If coolers are to be shipped off-site, they will be labeled "Fragile" and "This-End-Up". In addition, coolers will be labeled, if necessary, with appropriate Department of Transportation (DOT) label designations.

In addition to the samples collected for headspace and chemical analysis as described above, soil samples representative of penetrated lithologies will be collected and retained every 5 feet (ft) or at each major change in lithology, whichever occurs first. Physical soil testing, including Atterberg Limits, sieve grain size distribution, and USCS assignment, will be performed on 10 to 20 percent of these samples. The remaining samples will be stored in glass jars on-site, as arranged between

USATHAMA and Fort Douglas personnel. The jars will be labeled with the boring number, date of sampling, sample number, and depth.

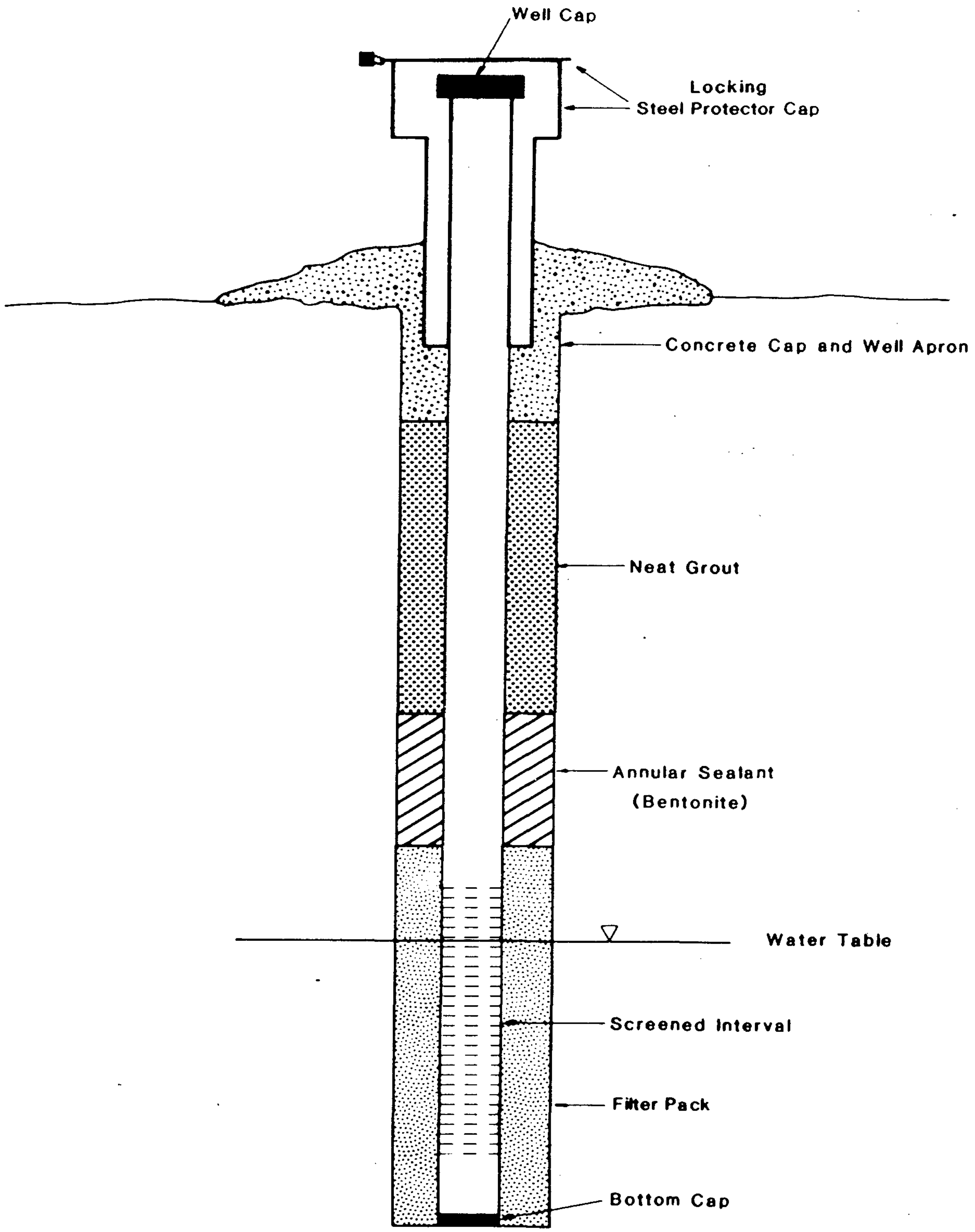
4.2 WELL CONSTRUCTION

Monitoring wells will be constructed of 4-in outer diameter (OD), flush threaded, Schedule 40, polyvinyl chloride (PVC) casing. A typical well-construction diagram is presented in Figure 4-2. The final well-construction details will be determined after hydrogeologic conditions are better known. These details include total well depth, screen slot size, screen length, and filter pack material. The Task Manager shall approve the well construction details prior to construction of the well. The source of water used in well construction and the type of bentonite and filter pack material will be approved by USATHAMA. In addition, any deviation from USATHAMA geotechnical requirements for well construction will be approved by the USATHAMA Project Officer or Geologist prior to construction.

Well completion depth will be decided based on the depth to ground water and the saturated thickness of the aquifer. Well screen lengths will be determined by the thickness of the saturated interval to be screened. In general, screens will be 20 ft long, with 5 ft above the water table and 15 ft below. All casing joints will be flush threaded and no solvents or cements will be used on the PVC. Teflon tape may be used as a pipe joint filler only if required. All pipe and screen will be steam-cleaned before use.

Once the borehole is drilled to the total depth, the well casing will be installed. In the auger or air percussion methods the casing is set in the annular space within the auger or drill pipe to ensure that the borehole remains open. When using the mud rotary technique, the casing will be installed in the open borehole filled with a column of mud. The filter pack will be placed in the annular space around the well screen extending from the base of the well to a level 2 to 5 ft above the top of the screen. Extending the filter pack above the top of the screen will allow room for the gravel to settle and will ensure that the bentonite seal does not enter the screen. In the auger and air percussion methods, the drill pipe is slowly pulled up as the filter pack is poured to allow the sand to fill the entire borehole. A bentonite seal, 2 to 5 ft thick will be placed above the filter pack. The seal will be composed of bentonite pellets or granules or a bentonite slurry may be installed using a tremmie pipe. The remaining annular space will be filled with neat cement-bentonite grout. The grout will be mechanically mixed and free of bumps.

Wells will be completed above grade and the well head will be encased with an 8-in steel security casing with a locking lid. Well-construction information will be recorded on a Well-Construction Summary form (Figure 4-3).



R.L. STOLLAR & ASSOCIATES INC
Denver, Colorado

Generalized Well Construction Diagram

Prepared for:
U.S. Army Corps of Engineers
USATHAMA

Date: April, 1991

Figure 4-2

Figure 4-3

R. L. STOLLAR & ASSOCIATES, INC.

WELL CONSTRUCTION SUMMARY

SITE TYPE

WELL	

PROJECT

PERSONNEL

LOCATION OR COORDS.

ELEVATION: GROUND LEVEL

TOP OF CASING

DRILLING SUMMARY

TOTAL DEPTH

BOREHOLE DIAMETER

DRILLER

RIG

BIT(S)

DRILLING FLUID

SURFACE CASING

WELL DESIGN

BASIS: GEOLOGIC LOG
GEOPHYSICAL LOG

CASING STRING (S): C = CASING S = SCREEN

CASING C1

C2

C3

C4

SCREEN S1

S2

S3

S4

FILTER MATERIAL:

SEAL:

GROUT:

OTHER:

CONSTRUCTION TIME LOG

TASK	START		FINISH	
	DATE	TIME	DATE	TIME
DRILLING:				
GEOPHYSICAL LOGGING:				
SCREEN PLACEMENT:				
FILTER:				
SEAL:				
GROUT:				
DEVELOPMENT:				
OTHER:				

WELL DEVELOPMENT

COMMENTS

4.3 WELL DEVELOPMENT

Well development will be performed to remove fine-grained material from the well screen, filter pack, and formation near the well. It will also be used to evacuate any fluid introduced downhole during drilling or well construction such as drilling mud and fresh water. By removing fine-grained material the porosity and permeability of the nearby formation increases, the filter pack is stabilized, and a hydraulic connection between the well and the aquifer is assured.

Well development will be initiated at least 48 hours and not longer than 7 days after the grout is poured around the well. Well development data will be recorded on the form shown in Figure 4-4. A bailer or pump will be used to develop the well. Water and sediment will be evacuated from the well during development and a swab or the bailer may be used to agitate the water column within the screened interval. The agitation displaces fine material in the well screen and filter pack and allows the material to be removed by additional bailing.

A minimum of five well volumes of water will be removed during development. A volume includes the water standing in the well casing and the saturated annular space. Mud rotary drilled wells will probably require more extensive development. Water added to the well during construction needs to be taken into account. In general, for every volume of water added, five volumes need to be removed. Well volume will be calculated using the formula:

$$V = \pi \frac{h}{4}[r_c 2 + (r_w 2 - r_c 2) n]$$

where V - volume of standing water in well, ft^3
π - 3.14
r_w - radius of borehole, ft
r_c - radius of well casing, ft
n - porosity of the filter pack, decimal fraction
h - height of standing water in well, ft.

The variable h will be determined by subtracting the depth of water from the top of the well casing from the total well depth. The value n is assumed to be 0.3 for this investigation. To convert the well volume from cubic ft (ft^3) to gallons, V will be multiplied by 7.48. Water levels and well depths will be measured with an electric sounding device and/or a steel tape, following procedures detailed in Section 4.9.1. Before development, and at regular intervals during development, measurements of specific conductance and pH will be made. Wells should be developed until the water produced is clean to the unaided eye, the water quality parameters have stabilized or five volumes have been removed.

Figure 4-4

R. L. STOLLAR & ASSOCIATES, INC.

WELL DEVELOPMENT DATA

SITE TYPE	SITE ID
WELL	

DEPTH TO BOTTOM (INITIAL) __________

(FINAL) __________

STATIC WATER LEVEL (INITIAL) __________

(FINAL) __________

MEASURING POINT __________

CASING I.D. __________

HYDROGEOLOGIST __________

DRILLER __________

PROJECT NO. __________

DATE(S) INSTALLED __________

DATE(S) DEVELOPED __________

PUMP (TYPE) __________

CAPACITY __________

BAILER (TYPE) __________

CAPACITY __________

TIME	VOLUME OF WATER REMOVED (gallons)	pH	SPECIFIC CONDUCTANCE	TEMP (°C)	SAND CONTENT	OTHER PHYSICAL CHARACTERISTICS (CLARITY, ODOR, PARTICULATES, COLOR)

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4.4 COLLECTION OF GROUND-WATER SAMPLES

Ground-water sampling will be conducted at least 14 days after well development has been completed. Information collected during sampling will be recorded on a Water Quality Field Sampling Data Sheet (Figure 4-5). All sampling equipment will be decontaminated before being used in each well, as described in Section 4.8.1.

Plastic sheeting will be placed on the ground surrounding the well to prevent contamination of downhole equipment. The water-level and total depth of the well will be measured using an electric sounding device, and the height of well casing above ground surface will be measured.

The volume of water standing in the well and the saturated annular space will then be calculated as shown in Section 4.3, Well Development. At least five volumes of water will be evacuated from the well using a pump or bailer to ensure that formation water is being sampled. Wells should be purged until the discharge is clean, colorless, free of particulates and stable in pH, specific conductance, and temperature. Water shall be evacuated starting at the top of the water column so that all standing water is removed. If a well becomes dry before five volumes are removed, sampling will be conducted when a sufficient amount of water is available for collection.

Water quality parameters including pH, temperature, and specific conductance will be measured periodically during the evacuation. In addition, the dissolved oxygen concentration will be measured if a pump is used. The measurements will be taken at least once for every volume of water removed.

Samples will be obtained using a bottom filling Teflon bailer or from a sample port on the pump. Prior to sample collection, bottles will be rinsed three times with formation water. Samples for volatile organics should be collected first with as little agitation as possible to prevent loss of the volatile components. Samples collected for metals analysis will be filtered using a .45 micron filter. A prefilter will be used for heavily silted water.

4.5 COLLECTION OF PAINT CHIPS AND WIPE SAMPLES

In each structure, a paint sample will be collected in an area where there is a potential for lead paint and the paint is in a state of disrepair. In an area where the paint is peeling, a putty knife will be used to scrape the paint onto a stainless steel tray. Care will be taken to avoid wood, paper, plaster, soil or dirt in the sample. Each sample will be placed in a small plastic bag with the appropriate labeling.

Figure 4-5

R. L. STOLLAR & ASSOCIATES. INC.

WATER QUALITY FIELD SAMPLING DATA SHEET

PROJECT ____________________ SAMPLERS ____________________

PROJECT NUMBER ____

WELL NO. ____________________ SUPERVISOR ____________________

DATE SAMPLED ____________________ TIME SAMPLED ____________________

MEASURING POINT ____________________ WELL DIAMETER (ID) ____________________

WATER LEVEL __________ DATE __________ TIME __________ WELL DEPTH ____________________

SCREENED INTERVAL ____________________ SINGLE WELL VOLUME (Gallons) ____________________

PURGE PUMPING RATE ____________________ PURGE VOLUME (Gallons) ____________________

DEPTH OF SAMPLING ____

SAMPLE PUMPING RATE ____________________ NO. OF SAMPLES ____________________

NO. OF SAMPLES RELINQUISHED __________ TO ____________________ DATE ____________________

FIELD EQUIPMENT

Eh/pH METER ____________________ SERIAL NO. ____________________

EC. METER ____________________ SERIAL NO. ____________________

PUMP ____________________ SERIAL NO. ____________________

TUBING TYPE ____

WATER LEVEL METER ____________________ SERIAL NO. ____________________

FILTER APPARATUS ____________________ FILTERS ____________________

BAILER ____________________ SIZE __________

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In structures where the paint is in good condition and no peeling paint is evident, a wipe sample will be collected from a baseboard or other area where lead dust may be present. To obtain a wipe sample, a filter paper will be moistened with deionized water and used to wipe an area approximately 5 cm by 5 cm. If a differently sized area is wiped, the approximate area should be noted. The filter will be folded in half so that the exposed halves of the filter are in contact, and folded once again at a 90-degree angle to the first fold. The folded filter should be placed into a clean glass scintillation vial, covered with a polyethylene cap, and appropriately labeled.

4.6 COLLECTION OF ASBESTOS SAMPLES

The immediate area to be sampled will be moistened with water before sampling is conducted. The sample will be extracted using a clean knife, cork borer, linoleum cutter, or other implement to cut out or scrape off a small piece of the material. Care will be taken to penetrate all layers of material. The largest sample size necessary for analysis will be approximately one half-inch square. Samples will be placed in plastic bags with the appropriate labeling.

4.7 COLLECTION OF TRANSFORMER OIL

Transformer oil will be sampled by a licensed journeymen electrician and his/her apprentice, under the supervision of RLSA personnel. Standard operating procedures (SOPs) used by the journeymen will be reviewed and, if necessary, modified to ensure collection of representative samples.

4.8 DECONTAMINATION PROCEDURES

All equipment that comes into contact with potentially contaminated soil, drilling fluid, water, paint, transformer oil, asbestos or other materials will be decontaminated prior to and after each use. Decontamination will consist of steam-cleaning and fresh water and distilled water rinses. Water used for decontamination will be analyzed for all constituents specified on the target compound list (with the exception of asbestos) and approved for use by USATHAMA prior to the EI/AA drilling and sampling activities. Equipment will be decontaminated on pallets or plastic sheeting. Decontaminated equipment will be stored on clean plastic sheeting in uncontaminated areas. Materials to be stored more than a few hours will be covered with clean plastic sheeting or stored in plastic bags.

All decontamination waste water will be contained in drums or bulk containers as described in the Sampling and Analysis Plan. Samples of the waste water will be analyzed to determine an appropriate disposal mechanism.

4.8.1 SAMPLING EQUIPMENT

Drilling, sampling, field measurement, and well installation equipment will be decontaminated as follows:

- Drill rigs, auger, drill rods, mud tanks, temporary casing and any other equipment placed in the hole during drilling will be steam-cleaned prior to use and between borings. Visible soil and grease will be removed with a stiff brush.

- Hand augers and other soil sampling equipment will be steam-cleaned prior to each use. Brass liners and caps will be cleaned prior to use to remove any residual cutting oils. The liners and caps will then be rinsed with distilled water.

- Casing, screen couplings and caps used in monitoring well installation will be steam-cleaned prior to installation. Visible foreign matter will be removed with a brush. Well casing will be handled with clean gloves during installation.

- The exterior surfaces and accessible interior portions of submersible, centrifugal and bladder pumps will be cleaned with distilled water prior to each use. Inaccessible interior portions of the pumps will be cleaned prior to each use by purging water through the pump and discharge lines. Every effort will be made to sample the wells in the order of the least to most contaminated to minimize the risk of sample cross-contamination.

- The stainless steel or Teflon bailer used for collection of the ground-water samples will be cleaned at the start of the job and between wells as follows:

    - Tap water rinse; and
    - Distilled water rinse.

- Steel tapes, water probes, transducers, thermometers, water-quality meter probes, and paint and asbestos sampling tools will be rinsed in distilled water between wells or sample locations.

To the extent practical, all cleaning shall be performed in an area that is remote from and surficially cross-gradient or downgradient from any site to be sampled. All decontamination will be done by personnel in protective gear appropriate for the level of decontamination, as determined by the Health and Safety Officer.

4.8.2 MONITORING EQUIPMENT

Monitoring equipment will be protected as much as possible from contamination by draping, masking, or otherwise covering as much of the instruments as possible with plastic without hindering the operation of the unit. The OVA housing, for example, can be placed in a clear plastic bag which allows reading of the scale and operation of the controls. The OVA probe can be partially wrapped, keeping the sensor tip and discharge port clear.

The contaminated equipment will be taken from the drop area and the protective coverings removed and disposed of in the appropriate containers. Any direct or obvious contamination will be brushed or wiped with a disposable paper wipe. The units will be checked, standardized, and recharged as necessary for the next day's operation. They will then be prepared with new protective coverings.

4.8.3 RESPIRATORS

Respirators will be decontaminated on a daily basis. Respirators taken from drop areas will be disassembled, the cartridges set aside, and the rest placed in a cleansing solution. After an appropriate time within the solution, the parts will be removed and rinsed with tap water. Personnel will inspect their own masks to be sure of proper readjustment of straps for proper fit.

4.9 FIELD MEASUREMENTS

Field data will be collected during various sampling and monitoring activities. The methods presented below are intended to ensure that field measurements are consistent and reproducible when performed by various individuals. Field personnel will record field measurements on standardized logs. In addition to properly recording data on these forms, personnel will maintain field notebooks in which data will be recorded. The calibration and precision requirements for field measurements are discussed in Section 7.0. The types of field measurements to be made at the site include:

- Water-level measurements in wells to establish vertical and horizontal hydraulic gradients during well installation, purging and prior to sampling.

- Conductivity, temperature, dissolved oxygen and pH measurements made on groundwater samples during pumping, well purging and sampling.

- Volatile organic vapor analysis of ambient air quality and soil sample headspace using an organic vapor analyzer.

4.9.1 WATER-LEVEL MEASUREMENTS

Water level may be measured using a steel tape, electric probe and/or pressure transducer. If a pump or other equipment is in the well, measurement devices will be lowered slowly to avoid entanglements. Water-level measurements in completed wells will be made from a permanently marked reference point on the well casing. The elevation of this point will be established by survey and referenced to mean sea level. Water levels measured in boreholes or wells during construction will be made relative to the ground surface. Measurements will be made and recorded to the nearest hundredth of a foot on a Water Level Measurement Sheet (Figure 4-6). Water-level measurements to determine hydraulic gradients, and permeability or aquifer testing, will be made with an electric probe. A steel tape may also substitute for the electric probe.

4.9.2 CONDUCTIVITY, TEMPERATURE, DISSOLVED OXYGEN AND PH MEASUREMENTS

Electrical conductivity, water temperature, dissolved oxygen and pH measurements will be made in the field during purging, before each water sample collection and during well development. The water sample will be placed in a bottle or jar used solely for field testing. A field pH meter with a combination electrode or equivalent will be used for pH measurements. Temperature measurements will be performed using standard thermometers or equivalent temperature meters. Combination instruments capable of measuring two or all three of the parameters may also be used.

All instruments will be calibrated as described in Section 7.0. If conductivity standards or pH buffers are used for field calibration, their values will be recorded in the field notebook. The sample-testing bottle and all probes will be cleaned and rinsed with distilled water prior to any measurements.

Figure 4-6

R. L. STOLLAR & ASSOCIATES, INC.

WATER LEVEL MEASUREMENT SHEET

Project Number ____________

WELL NUMBER	DATE	TIME	MEASURING POINT	MEASURING DEVICE	ORIGINAL WELL DEPTH	TOTAL DEPTH	STICK UP	ELEV. OF MEAS. PT.	DEPTH TO WATER	ELEV. OF WATER TABLE	COMMENTS

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4.9.3 HEADSPACE ANALYSES

Volatile organic vapor present in the headspace of soil samples will be measured using an organic vapor analyzer (OVA). These measurements will be obtained from soil samples in the following manner:

- A portion of the soil sample collected will be placed in a clean wide mouth glass jar;
- The jar will be sealed with Teflon film, or aluminum foil, capped and labeled;
- The samples will be allowed to sit in a warm place for at least 15 minutes so soil gases can equilibrate with the air in the headspace of the jars;
- The headspace will be tested for volatile organic vapors with an OVA; and
- Headspace and background readings will be recorded in ppm and incorporated into boring logs.

4.10 SAMPLE LABELS AND RECORDS

Field sampling personnel will maintain bound field logbooks and will record at the minimum the information identified below:

- Boring or well identification number;
- Sample identification numbers;
- Sample collection date and time;
- Sample matrix;
- Boring/well depth;
- Sampler's name;
- Sample appearance, note any unusual staining or coloration and odor (if possible);
- Sample field measurements including static water level, pH, temperature, and electrical conductivity (if applicable);

- Type of sample equipment and method used;
- Type and number of sample containers;
- Decontamination procedures;
- Purging methods, purge volume, pumping rate, and purging time period (if applicable);
- Weather conditions including ambient temperature;
- Field observations of the sampling event and other notable occurrences and the time of occurrences;
- Documentation of procedures for preparation of reagents or supplies which become an integral part of the sample;
- Analyses to be performed on the sample; and
- Method of sample shipment.

Some of the information listed above is recorded on specific forms associated with sample acquisition. These forms will be kept with the project file.

Color slides or photographs may be taken of the sample locations to facilitate identification and later recollection by the sampler. A photograph log will be maintained and will include the signature of the photographer, time, date, site location, and brief description of the subject of the photograph.

An adhesive, waterproof sample label will be affixed to each individual sample collected. The following information will be recorded with a waterproof marker on each label.

- Project name and location;
- Project number;
- Unique chronological sample identification number;
- Sample location and depth;

- Sample type;
- Date and time of collection;
- Sampler's initials;
- Analyses to be performed on the sample; and
- Sample preservation (if any).

5.0 SAMPLE COLLECTION AND MANAGEMENT

The quality of sample collection and management techniques must be assured by keying the technique used to both the medium/matrix to be sampled and the analytes of interest. Acquisition of environmental samples requires specialized collection techniques to preserve integrity and ensure that a representative portion of the source is collected. Further, unless the proper sample bottle preparation and sample preservation measures are taken in the field, sample composition can be altered. This can take the form of introduced contamination, degradation, biological transformation, chemical interactions, and other factors during the time between sample collection and analysis. Sample management and recordkeeping are key elements in the documentation of environmental measurements and are essential to an effective sampling QA program.

5.1 SAMPLING SITES

The rationale for each sampling site location is identified in the Technical Plan and Sampling and Analysis Plan. To permit proper evaluation of the analytical results, it is important that the actual location of the samples be properly documented. Sampling sites will be marked in the field with stakes or flags. Asbestos, paint chip, and wipe sampling sites will be marked on floor plans. Transformer oil sample locations will be marked on a site map. All sampling site locations will be accurately referenced on a base map for entry into the IRDMS Map File. Samples collected in structures will be located using the approximate map coordinates for the center of the structure. Monitoring wells will be surveyed with horizontal and vertical accuracy of 0.01 feet. All other sampling sites will be located to the accuracy required in the USATHAMA Geotechnical Requirements (Sections III.1). Horizontal accuracy will be within ±3.0 ft and vertical accuracy to within ±0.05 feet. Photographs of sampling sites are taken as necessary to document site conditions. Geotechnical data collected during the field investigation will be entered into the USATHAMA data management system as described in Section III:I.6 of the USATHAMA Geotechnical Requirements.

5.2 SAMPLE CONTAINERS

To ensure the integrity of aqueous and solid samples, steps must be taken to minimize contamination from the containers in which they are stored. If the analyte(s) to be determined are organic in nature, the container should be made of amber glass. If the analyte(s) are inorganic, the container should be polyethylene. When both organic and inorganic substances are expected to be present, separate samples should be taken. New sample bottles will be used for each sample (Table 5-1).

Table 5-1 Sample Preservation and Holding Times

		Container			Preservative		
Parameter	Soil	Water	Other	Soil	Water	Other	Holding Times
Metals	PI	P		Cool, 4 °C	HNO_3 PH <2		6 months with the exception of mercury (28 days)
Semivolatiles	GI	AG		Cool, 4 °C	Cool, 4 °C		7 days to extraction (40 days after extraction)
Volatiles	GI	VG		Cool, 4 °C	HCl pH<2		14 days
PCBs	GI			Cool, 4 °C	H_2S0_4 pH <2		7 days to extraction (40 days after extraction)
TPH	GI	AG		Cool, 4 °C	H_2S0_4 pH <2		28 days
Cyanide	PI	P		Cool, 4 °C	NaOH pH >12		14 days
Lead in Paint			PB			Cool 4 °C	6 months
PCB in Oil			AGI			Cool 4 °C	7 days to extraction (40 days after extraction)
Asbestos			PB			NR	

AGI = widemouth amber glass jar
VG = 40 ml VOA vial
GI = 8 oz widemouth glass jar
PI = 8 oz widemouth plastic jar
P = 1000 ml plastic bottle
AG = 1000 ml amber glass bottle
NR = not required
PB = plastic bags

HNO_3 = nitric acid
HCl = hydrochloric acid
H_2SO_4 = sulfuric acid
NaOH = sodium hydroxide

5.2.1 PRECLEANED SAMPLE CONTAINERS

Precleaned sample containers will be supplied by the laboratory. The laboratory will purchase precleaned containers from a laboratory supplier. The supplier will preclean the container as follows:

5.2.1.1 Amber Glass Bottles and Wide-Mouth, Clear Glass Jars

1. Wash the containers, closures, and Teflon liners in hot tap water with a laboratory grade nonphosphate detergent.
2. Rinse three times with tap water.
3. Rinse one time with a 1:1 mixture of nitric acid (HNO_3) and deionized water.
4. Rinse three times with ASTM Type 1 deionized water.
5. Rinse one time with pesticide-grade methylene chloride.
6. Oven dry containers, closures, and liners.
7. Remove containers, closures, and Teflon liners from oven.
8. Place Teflon liners in closures and place closures on container. Attendant will wear gloves and the containers will not be removed from the preparation room until sealed.

5.2.1.2 40 ml Borosilicate Glass Vials

1. Wash the containers, septa or liners, closures in hot tap water with a laboratory-grade nonphosphate detergent.
2. Rinse three times with tap water.
3. Rinse three times with ASTM Type 1 deionized water.
4. Oven dry containers, septa or liners, and closures.
5. Remove containers, septa or liners, and closures from the oven.

6. Place liners in closures, Teflon side down, and place closures on containers. Attendant will wear gloves and the containers will not be removed from the preparation room until sealed.

5.2.1.3 Polyethylene Bottles

1. Wash the containers, closure, and Teflon liners in hot tap water with a laboratory-grade, nonphosphate detergent.

2. Rinse three times with tap water.

3. Rinse one time with a 1:1 mixture of nitric acid and deionized water.

4. Rinse three times with ASTM Type 1 deionized water.

5. Air dry in contaminant-free environment.

6. Place liners in closures and place closures on containers. Attendant will wear gloves and the containers will not be removed from preparation room until sealed.

5.3 SAMPLE PRESERVATION

It is important to maintain the integrity of the samples from the time of collection until the analyses are performed. Before transportation and storage of sample preservation techniques and procedures recommended by USATHAMA and the EPA will be used.

Sample preservation will be performed in the field by a qualified technician trained in the preservation techniques for inorganic and organic compounds. All water and soil samples will be preserved as shown on Table 5-1.

5.4 SAMPLE HOLDING

The time that a preserved sample may be held between sampling and analysis is based on the stability of the analyte(s) of interest. Holding time limitations are intended to minimize chemical change in a sample before it is analyzed. Results reported for samples analyzed after holding times have been exceeded will be considered out of control and unacceptable. To expedite analysis and to minimize the possibility of exceeding holding times, samples must be sent to the laboratory by a fast, reliable method as soon as possible after collection. Table 5-1 summarizes allowable holding times for each analysis and sample matrix. In general, all samples shipped from the field will be maintained at 4°C and retained in the laboratory at 4°C.

5.5 SAMPLE SHIPMENT

The following discussion outlines generic procedures for shipment of samples.

- A member of the field team will be designated Sample Coordinator. The Sample Coordinator will place the sample in a plastic ice chest with appropriate preservation material tightly packed with suitable packing material. The original chain-of-custody (COC) will be signed, dated, and the time recorded by the Sample Coordinator prior to transferring custody for shipment. A notation will be made in the remarks section of the record indicating method of shipment, courier's name, and other pertinent information. The COC will be sealed in an envelope and a custody seal will be placed on the envelope flap. The envelope will be taped to the inside of the ice chest with the name and address of the receiving laboratory prominently displayed. The ice chest will be taken directly to the shipping agent by the Sample Coordinator and custody relinquished to the shipping agent.

- The Sample Coordinator will close and seal the ice chest with a custody seal. The seal will be attached to the ice chest in such a way that it will be necessary to break it to open the ice chest. All custody seals must be applied to sample containers and ice chests by the Sample Coordinator. The ice chest will be taped closed by wrapping each end at least twice with either fiberglass-reinforced tape or a strong adhesive tape. Paper tape or "Scotch" tape will not be allowed.

6.0 SAMPLE CUSTODY

RLSA will establish a program of sample tracking and chain-of-custody (COC) that is followed during sample handling activities in both field and laboratory operations. This program, which is compatible with USATHAMA and EPA COC programs, is designed to assure that each sample is accounted for at all times.

The objective of the sample custody identification and control system is to ensure, to the extent practicable, that:

- All samples scheduled for collection, as appropriate for the data required, are uniquely identified;
- The correct samples are analyzed and are traceable to their records;
- Important sample characteristics are preserved;
- Samples are protected from loss or damage;
- Any alteration of samples (e.g., filtration and preservation) is documented;
- A forensic record of sample integrity is established;
- Legally traceable custody and possession records are maintained; and
- Sample security is maintained.

The sample custody will comply with the USATHAMA QA Program (1990). The COC protocol followed by the sampling crews involves the following steps:

- Documenting procedures and amounts of reagents or supplies (e.g., filters) which become an integral part of the sample from sample preparation and preservation;
- Recording sampling locations, sample bottle identification, and specific sample acquisition measures on the appropriate forms;
- Using preprinted sample labels to document all information necessary for effective sample tracking; and

- Completing standard field data record forms to establish sample custody in the field before sample shipment.

The COC record contains the following information:

- The sample number, sample bottle identification number, preservation, and sample type;
- The names of the sampler(s) and the person shipping the samples;
- Pertinent field data;
- The date and time that the samples were delivered for shipping;
- Analyses required; and
- The names of those responsible for receiving the samples at the laboratory.

An example COC form is shown in Figure 6-1. These records are completed in triplicate. The original will accompany the samples to the laboratory, another is kept by the sample crew and transferred to the contractor QAC, and the last copy is maintained in the project file. Written records, which may be used as evidence, are handled in such a way that COC can be established.

6.1 LABORATORY CUSTODY

COC procedures are also necessary in the laboratory from the time of sample receipt to the time the sample is discarded. The following procedures will be implemented by the laboratory:

- All incoming samples will be received by the sample custodian, who will indicate receipt by signing the accompanying custody forms and who will retain the signed forms as permanent records. The samples are checked at the time of receipt for any problems that may have occurred during shipping or discrepancies with the COC record. All problems are immediately reported to the field operations leader.
- The sample custodian maintains a permanent logbook to record, for each sample, the person delivering the sample, the person receiving the sample, the date and time received, the source of the sample, the sample identification or log number, how the sample was transmitted to the laboratory, and the condition received (i.e., sealed, unsealed, broken container, or other pertinent remarks).

Figure 6-1

CHAIN-OF-CUSTODY RECORD

R. L. STOLLAR & ASSOCIATES, INC.
143 Union Boulevard, Suite 640
Lakewood, CO 80228
(303) 969-9002

PROJECT NAME____________________ PROJECT NO.____________________

COLLECTED BY (Name) ____________________ (Signature) ____________________

						ANALYSES TO BE PERFORMED																
SITE ID	LAB SAMPLE NUMBER	COLLECTORS SAMPLE NUMBER	DATE	TIME	TYPE OF SAMPLE	601/8010 Halogenated Volatiles	602/8020 Aromatic Volatiles	8015 Fuel Hydrocarbons	624/8240 GC/MS Volatile Cmpds	625/8270 GC/MS Base/Neutral/Acid Cmpds	418.1 Petroleum Hydrocarbons	413.2 Oil & Grease	604/8040 Phenols, sub phenols	Metals ( )							Number of Containers	REMARKS

RELINQUISHED BY (Signature)	ORGANIZATION	DATE/TIME	RECEIVED BY (Signature)	ORGANIZATION	DATE/TIME	REMARKS
RELINQUISHED BY (Signature)	ORGANIZATION	DATE/TIME	RECEIVED BY (Signature)	ORGANIZATION	DATE/TIME	
RELINQUISHED BY (Signature)	ORGANIZATION	DATE/TIME	RECEIVED FOR LABORATORY BY (Signature)		DATE/TIME	

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- A clean, dry, isolation room, building, and/or refrigerated space that can be securely locked from the outside will be designated as a "Sample Storage Security Area".

- The custodian ensures that heat-sensitive, light-sensitive, radioactive, or other samples having unusual physical characteristics or requiring special handling, are properly stored and maintained prior to analysis.

- Distribution of samples to individuals who are responsible for the laboratory performing the analysis is made only by the custodian.

- Laboratory personnel are responsible for the care and custody of the sample once it is received by them. They will sign the COC and will be prepared to testify that the sample was in their possession and view or secured in the laboratory at all times from the moment it was received from the custodian until the time that the analyses are completed.

- Once the sample analyses are completed, the unused portion of the sample, together with all identifying labels, is returned to the custodian. The returned tagged sample is retained in the custody room until permission to destroy the sample is received by the custodian.

- Sample will be destroyed only upon the order of the Task Manager, in consultation with the USATHAMA Contracting Officer's Representative (COR). This only occurs after elevation of chemical data into the IRDMS Level 3.

6.2 SAMPLE SECURITY, STORAGE, AND DISPOSAL

Chain-of-custody procedures are also necessary in the laboratory from the time of sample receipt to the time the sample is discarded. The following procedures are recommended for the laboratory:

- A specific person shall be designated custodian and an alternate designated to act as custodian in the custodian's absence. All incoming samples shall be received by the custodian, who shall indicate receipt by signing the accompanying custody forms and who shall retain the signed forms as permanent records.

- A clean, dry, isolation room, building, and/or refrigerated space that can be securely locked from the outside shall be designated as a "Sample Storage Security Area."

- The custodian shall ensure that heat-sensitive, light-sensitive, radioactive, or other samples having unusual physical characteristics or requiring special handling, are properly stored and maintained prior to analysis.

- Distribution of samples to individuals who are responsible for the laboratory performing the analysis shall be made only by the custodian.

- Laboratory personnel are responsible for the care and custody of the sample once it is received by them and shall be prepared to testify that the sample was in their possession and view or secured in the laboratory at all times from the moment it was received from the custodian until the time that the analyses were completed.

- Once the sample analyses are completed, the unused portion of the sample, together with all identifying labels, must be returned to the custodian. The returned tagged sample should be retained in the custody room until permission to destroy the sample is received by the custodian.

- Samples shall be destroyed only after all analytical results have been validated to level 3 in the USATHAMA Data Management System and such action is approved by the USATHAMA Project Officer. Samples may be required to be held in storage longer to fulfill contractual requirements or as directed by the USATHAMA Project Officer.

7.0 CALIBRATION PROCEDURES

The procedures for calibration of field equipment and laboratory instrumentation follow standard operating procedures which specify calibration frequency and standards. All calibrations for field and laboratory equipment will be recorded in appropriate log books and/or forms.

7.1 FIELD INSTRUMENTS

Field instruments which will require calibration include instruments for measuring water levels, headspace analysis, pH, conductivity, dissolved oxygen and temperature. Suggested calibration procedures and precision requirements are summarized in Table 7-1.

7.1.1 WATER-LEVEL MEASUREMENTS

The following are calibration methods for various measuring devices which may be ultimately utilized:

- Electrical probe calibration: Check against steel surveyor's tape prior to use;
- Graduated steel tape calibration: Manufacturer-supplied temperature correction will be applied if applicable for field conditions; and
- Pressure transducer calibration: Factory calibrated once, field calibration check with water columns prior to permeability or aquifer tests, and periodic field checks against steel tape or electrical probe during long-term monitoring or testing.

7.1.2 HEADSPACE ANALYSIS

An OVA used for headspace analysis will be calibrated daily to methane before field use, as specified by the manufacturer.

7.1.3 pH MEASUREMENT

Calibration of pH meters will be checked before each field use. Laboratory-supplied buffer solutions will be renewed daily in the field, and used periodically between measurements. Temperature corrections will be applied during measurement, either manually, or automatically by the instrument.

Table 7-1 Field Instrument Calibration

Field Measurement	Instrument	Calibration Procedure	Precision
Water-level survey	Electrical water probe Steel tape	Reference to steel tape Reference to new tape	0.01 ft 0.01 ft
Elevation of monitoring wells	Level and rod	Surveyor calibration	0.01 ft
Location of sample site	Steel tape	Reference to new tape	0.01 ft
Water pH	pH meter	2-point buffer solutions	0.1 pH unit
Specific conductance	Conductivity meter	Potassium chloride reference solution	±5 percent of reading micromhs/centimeter
Water temperature	Thermometer	Factor calibration; periodic reference to boiling water at known atmospheric pressure	0.5 °C
Dissolved Oxygen	Dissolved Oxygen Meter	Reference to barometric pressure	0.2 ppm

7.1.4 ELECTRICAL CONDUCTIVITY

Electrical conductivity meters will be calibrated before each field use. Temperature correction may be applied automatically by instrument during measurement.

7.1.5 WATER TEMPERATURE

Mercury thermometers are factory calibrated once against U.S. Bureau Standards, and checked at least annually. Temperature meters will be calibrated weekly against standardized mercury thermometers.

7.1.6 DISSOLVED OXYGEN

Dissolved oxygen meters are calibrated before and after each field use. Instruments will automatically compensate for barometric pressure.

7.2 LABORATORY INSTRUMENTS

The calibration and frequency of calibration for laboratory instrumentation is ruled by the specific analytical methods used. These analytical methods are discussed in Section 8.5. All instruments will be calibrated by using standard solutions of known concentrations. Standards will be prepared from certified reference solutions obtained from the EPA Repository or approved chemical vendors. Calibration will be verified continuously by analysis of these calibration standards or laboratory control samples at regular intervals. Calibration will be performed at specified time intervals or when continuous calibration verification procedures indicate the need.

8.0 ANALYTICAL PROCEDURES

All analytical procedures performed by the laboratory will be governed by USATHAMA protocol. These procedures are defined in the USATHAMA QA Plan (January 1990). Strict protocol is adhered to in order to provide analytical data that is meaningful and comparable. Any deviation from the set guidelines will be approved by the USATHAMA Project Officer and RLSA will be notified.

8.1 LABORATORY CERTIFICATION

ESE Laboratory is certified under the USATHAMA QA program. Laboratory certification is a two-phase process. The process has an initial submission of data from precertification standards, followed by a submission of data from certification performance samples. Certification is for specific analytes over a given tested range determined by specific methods.

8.2 LABORATORY EQUIPMENT DECONTAMINATION

Sample handling areas and equipment will be cleaned and wiped down daily. Disposable wipes will be used and discarded in a plastic bag. These will subsequently be taken to and placed in the disposal drum for final deposition. For final cleanup, all equipment will be disassembled and decontaminated. Any equipment that cannot be satisfactorily decontaminated will be disposed of (e.g., glassware and covers for surfaces) as previously indicated.

8.3 REFERENCES AND FREQUENCY

Before analyzing project samples, the laboratory will submit a request to the USATHAMA Project Officer for reference materials. The USATHAMA Project Officer will forward the request to the USATHAMA Chemistry Branch, which will notify the Standards Repository. Samples of reference materials will be shipped to the laboratory from the Standards Repository. Only if reference materials are not available through USATHAMA should the laboratory obtain the materials from an outside source.

Reference materials for metals and nonmetallic inorganics may be maintained at room temperature in a locked storage area. All other reference materials must be stored in a locked refrigerator at or below 4°C. All reference materials will be maintained under chain-of-custody.

8.3.1 STANDARD ANALYTICAL REFERENCE MATERIALS (SARMs)

Whenever possible, chemical analyses conducted in support of USATHAMA projects are based on SARMs which are developed and distributed by the Standards Repository. These reference materials are labeled and carry a SARM identification number. These materials will either be National Institute of Standards and Technology (NIST) Standard Reference Materials (SRMs) or will be traceable to NIST SRMs. The laboratories may use secondary standards that are referenced and are periodically checked against SARMs. When the secondary standard has deteriorated below the 98 mole percent purity level, the laboratory will suspend use of the standard until a new lot can be supplied.

8.3.2 INTERIM REFERENCE MATERIALS (IRMs)

Some of these materials are maintained and distributed by the Standards Repository and should be used if SARMs are not available. Although IRMs are supplied through USATHAMA, they are not as rigorously characterized, as are SARMs. IRM characterization includes positive identification of the material and an estimate of purity. The SARM label on each bottle is modified by adding the word "Interim" and includes an identification number. These materials may be used as received from USATHAMA. Reference materials obtained from the Standards Repository, Environmental Protection Agency, or NIST do not require characterization by the laboratory. If IRMs are not available from the Standards Repository, they may be developed by the laboratory.

8.3.3 OFF-THE-SHELF MATERIALS

SARMs or IRMs may not be available for some target analytes. If materials are unavailable through USATHAMA, the laboratories will be instructed to purchase materials from an outside supplier. Before using any material classified as "off-the-shelf," the laboratories must analyze the material to obtain a positive identification and estimate of purity. When possible, characterization analyses for purity shall be conducted using at least two different methods. Off-the-shelf materials should be compared to NIST or EPA standard material whenever possible. The characterization analyses must be performed before certification efforts are initiated and the results must be provided to USATHAMA with the Precertification Performance Data Package. Documentation for purity and identity characterization analyses shall be kept on file at each laboratory. Possible techniques for characterizing the off-the-shelf materials include, as applicable:

- Infrared spectroscopy;
- Melting point, decomposition point, or boiling determinations;
- Mass spectrometry;
- Nuclear magnetic resonance (NMR) spectrometry;
- Elemental analysis;

- Gas chromatography (for purity); and

- Liquid chromatography (for purity).

This list is not exhaustive and all of the listed techniques need not be used. The laboratory is responsible for providing positive identification and purity estimate for each off-the-shelf material (including internal standards) to USATHAMA with Precertification Performance Data Package.

8.4 SAMPLE PREPARATION

Water used in the course of organic analyses (dilutions, standard samples, etc.) shall conform to ASTM Type II grade (Table 8-1). Water used in the course of inorganic analyses shall conform to ASTM Type I grade. Each certified procedure contains clear details of how a sample will be handled during sample preparation.

Table 8-1 ASTM Reagent Water

	Type I	Type II
Total Matter, max,. mg/liter	0.1	0.1
Electrical Conductivity, Max., μmho/cm at 298 K (25°C)	0.06	1.0
Electrical resistivity, min., MΩ•cm at 298 K (25°C)	16.7	1.0
Minimum color retention time of potassium permanganate, minutes	60	60
Maximum soluble silica	not detectable	not detectable

8.5 ANALYTICAL METHODS

To provide a common point of reference for all projects and to provide a means of evaluating laboratory performance, USATHAMA prescribes the use of standardized methods for commonly encountered analytes. The standardized methods are based on published methods of analysis (e.g., by EPA, ASTM, APHA-AWWA-WPCF, and USGS) or past USATHAMA experience (e.g., for military-unique compounds). Methods have been evaluated in terms of sound analytical practice and applicability to projects. In addition to specifying sample preparation and analysis, each method also specifies calibration procedures and frequency, calibration check acceptance criteria, methods of preparing standard solutions, and preparation of QC samples. A description of any proposed deviations from the standardized methods must be submitted to USATHAMA prior to generation of the Precertification Performance Data Package. After certification of a method, additional deviations will not be acceptable, unless written approval, in advance, is provided by the USATHAMA Chemistry Branch. Changes made after certification may require generation of new Precertification and Certification Performance Data Packages.

Some methods, including calibration of test and measurement equipment, do not require certification, due to either the nature of the measurement or the intended used of the data. When such methods are part of the project, USATHAMA will not provide a standardized method. However, laboratories must submit sufficient information in Test Plans, Work Plans, Project QC Plans, etc. to describe exactly the procedures to be used.

The following methods do not require certification by the USATHAMA Chemistry Branch:

- Temperature
- Conductivity
- pH
- Lead Paint
- Asbestos
- Total Petroleum Hydrocarbons (TPH)

Other methods may be included in this category. Certification may be required for these types of analyses if the resulting data serves as the basis for project decisions or regulatory compliance.

Any analytical method must be described by a set of written instructions completely defining the procedure to be used to process a sample and obtain an analytical result. Descriptions of analytes, sample type (matrix), sample preparation, types and quantities of reagents, instrumental calibration and measurements, and computations are all integral parts of a complete method.

Table 8-2 lists the laboratory-specific USATHAMA approved analytical methods, EPA equivalent methods, and reporting limits and the upper ranges for each type of certified analysis.

8.5.1 GC/MS VOLATILES

<u>Proposed Water Method and Reference</u>: The proposed method of analysis for water is certified Method UM27, which is based on EPA Method 8240 (SW-846 EPA, 1986b).

Table 8-2 Certified Methods for Target Compounds

WATER

USATHAMA Method No.	EPA Method No.	Method Name	Analyte Code	Analyte	CRL µg/l	Upper Limit µg/l
VV8	7060	Metals/Water/GFAA	AS	Arsenic	2.50	50.0
SD20	7421	Metals/Water/GFAA	PB	Lead	1.26	100
SD21	7740	Metals/Water/GFAA	SE	Selenium	3.02	100
WW8	7470	Metals/Water/CVAA	HG	Mercury	0.50	5.00
SS14	6010	Metals/Water/ICP	AL	Aluminum	200	10000
SS14	6010	Metals/Water/ICP	SB	Antimony	27.4	5000
SS14	6010	Metals/Water/ICP	BA	Barium	3.0	5000
SS14	6010	Metals/Water/ICP	BE	Beryllium	2.0	10000
SS14	6010	Metals/Water/ICP	CD	Cadmium	5.0	5000
SS14	6010	Metals/Water/ICP	CA	Calcium	50.0	5000
SS14	6010	Metals/Water/ICP	CR	Chromium	22.4	7500
SS14	6010	Metals/Water/ICP	CO	Cobalt	10.8	7500
SS14	6010	Metals/Water/ICP	CU	Copper	10.0	7500
SS14	6010	Metals/Water/ICP	FE	Iron	112	7500
SS14	6010	Metals/Water/ICP	MG	Magnesium	89.2	7500
SS14	6010	Metals/Water/ICP	MN	Manganese	20.0	10000
SS14	6010	Metals/Water/ICP	NI	Nickel	23.3	7500
SS14	6010	Metals/Water/ICP	K	Potassium	1080	10000
SS14	6010	Metals/Water/ICP	AG	Silver	10.0	2000
SS14	6010	Metals/Water/ICP	NA	Sodium	251	10000
SS14	6010	Metals/Water/ICP	TL	Thallium	288	7500
SS14	6010	Metals/Water/ICP	V	Vanadium	7.62	10000

GFAA - graphite furnace atomic adsorption
CVAA - cold vapor atomic adsorption
ICP - inductively coupled plasma
GCEC - gas chromatography/electron capture
GCMS - gas chromatography/mass spectrometry
* - Detection limits for non-certified compounds
-- - non-certified parameters see Section 9.3 for reporting information

Table 8-2 Certified Methods for Target Compounds (continued)

USATHAMA Method No.	EPA Method No.	Method Name	Analyte Code	Analyte	CRL μg/l	Upper Limit μg/l
SS14	6010	Metals/Water/ICP	ZN	Zinc	20.0	5000
CN1	335.2	Cyanide/Water/Color	CYN	Cyanide	8.9	200
UM27	8240	Volatiles/Water/GCMS	ACET	Acetone	17	200
UM27	8240	Volatiles/Water/GCMS	C6H6	Benzene	2.8	200
UM27	8240	Volatiles/Water/GCMS	BRDCLM	Bromodichloromethane	2.0	200
UM27	8240	Volatiles/Water/GCMS	CHBR3	Bromoform	2.0	200
UM27	8240	Volatiles/Water/GCMS	CH3BR	Bromomethane	36	200
UM27	8240	Volatiles/Water/GCMS	MEK	2-Butanone	6.2	200
UM27	8240	Volatiles/Water/GCMS	CS2	Carbon disulfide	16	200
UM27	8240	Volatiles/Water/GCMS	CCL4	Carbon tetrachloride	4.4	200
UM27	8240	Volatiles/Water/GCMS	CLC6H5	Chlorobenzene	2.0	200
UM27	8240	Volatiles/Water/GCMS	C2H5CL	Chloroethane	8.0	200
UM27	8240	Volatiles/Water/GCMS	CHCL3	Chloroform	2.0	200
UM27	8240	Volatiles/Water/GCMS	CH3CL	Chloromethane	9.0	200
UM27	8240	Volatiles/Water GCMS	DBRCLM	Dibromochloromethane	2.0	200
UM27	8240	Volatiles/Water/GCMS	11DCLE	1,1-Dichloroethane	2.0	200
UM27	8240	Volatiles/Water/GCMS	12DCLE	1,2-Dichloroethane	6.7	200
UM27	8240	Volatiles/Water/GCMS	11DCE	1,1-Dichloroethene	21	200
UM27	8240	Volatiles/Water/GCMS	12DCE	1,2-Dichloroethene (total)	37	200
UM27	8240	Volatiles/Water/GCMS	12DCLP	1,2-Dichloropropane	2.0	200
UM27	8240	Volatiles/Water/GCMS	C13DCP	cis-1,3-Dichloropropene	2.4	200
UM27	8240	Volatiles/Water/GCMS	T13DCP	trans-1,3-Dichloropropene	1.6	200
UM27	8240	Volatiles/Water/GCMS	ETC6H5	Ethylbenzene	2.0	200
UM27	8240	Volatiles/Water/GCMS	MNBK	2-Hexanone	4.8	200

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ICP - inductively coupled plasma
GCEC - gas chromatography/electron capture
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* - Detection limits for non-certified compounds
-- - non-certified parameters see Section 9.3 for reporting information

Table 8-2 Certified Methods for Target Compounds (continued)

USATHAMA Method No.	EPA Method No.	Method Name	Analyte Code	Analyte	CRL µg/l	Upper Limit µg/l
UM27	8240	Volatiles/Water/GCMS	CH2CL2	Methylene chloride	19	150
UM27	8240	Volatiles/Water/GCMS	MIBK	4-Methyl-2-pentanone	2.0	200
UM27	8240	Volatiles/Water/GCMS	STYR	Styrene	2.0	200
UM27	8240	Volatiles/Water/GCMS	TCLEA	1,1,2,2-Tetrachloroethane	2.0	200
UM27	8240	Volatiles/Water/GCMS	TCLEE	Tetrachloroethene	2.0	200
UM27	8240	Volatiles/Water/GCMS	MEC6H5	Toluene	2.0	200
UM27	8240	Volatiles/Water/GCMS	111TCE	1,1,1-Trichloroethane	3.6	200
UM27	8240	Volatiles/Water/GCMS	112TCE	1,1,2-Trichloroethane	2.0	200
UM27	8240	Volatiles/Water/GCMS	TRCLE	Trichloroethene	2.2	200
UM27	8240	Volatiles/Water/GCMS	C2H3CL	Vinyl chloride	2.0	200
UM27	8240	Volatiles/Water/GCMS	XYLEN	Xylenes (Total)	11	600
UM28	8270	Semivolatiles/Water/GCMS	ANAPNE	Acenaphthene	3.4	120
UM28	8270	Semivolatiles/Water/GCMS	ANAPYL	Acenaphthylene	1.1	120
UM28	8270	Semivolatiles/Water/GCMS	ANTRC	Anthracene	1.0	120
UM28	8270	Semivolatiles/Water/GCMS	BAANTR	Benzo(a)anthracene	5.8	120
UM28	8270	Semivolatiles/Water/GCMS	BBFANT	Benzo(b)fluoranthene	1.3	120
UM28	8270	Semivolatiles/Water/GCMS	BKFANT	Benzo(k)fluoranthene	2.3	120
UM28	8270	Semivolatiles/Water/GCMS	BGHIPY	Benzo(g,h,i)perylene	1.1	160
UM28	8270	Semivolatiles/Water/GCMS	BAPYR	Benzo(a)pyrene	1.2	120
UM28	8270	Semivolatiles/Water/GCMS	B2CEXM	Bis(2-chloroethoxy)methane	3.8	160
UM28	8270	Semivolatiles/Water/GCMS	B2CLEE	Bis(2-chloroethyl)ether	1.8	40
UM28	8270	Semivolatiles/Water/GCMS	B2CIPE	Bis(2-chloroisopropyl)ether	1.3	160
UM28	8270	Semivolatiles/Water/GCMS	B2EHP	Bis(2-ethylhexyl)phthalate	1.0	40
UM28	8270	Semivolatiles/Water/GCMS	4BRPPE	4-Bromophenyl phenyl ether	1.4	160

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CVAA - cold vapor atomic adsorption
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GCEC - gas chromatography/electron capture
GCMS - gas chromatography/mass spectrometry
* - Detection limits for non-certified compounds
-- - non-certified parameters see Section 9.3 for reporting information

Table 8-2 Certified Methods for Target Compounds (continued)

USATHAMA Method No.	EPA Method No.	Method Name	Analyte Code	Analyte	CRL µg/l	Upper Limit µg/l
UM28	8270	Semivolatiles/Water/GCMS	BBZP	Butyl benzyl phthalate	1.1	120
UM28	8270	Semivolatiles/Water GCMS	CARBAZ	Carbazole	--	--
UM28	8270	Semivolatiles/Water/GCMS	4CANIL	4-Chloroaniline	17	160
UM28	8270	Semivolatiles/Water/GCMS	2CNAP	2-Chloronaphthalene	1.6	160
UM28	8270	Semivolatiles/Water/GCMS	4CL3C	4-Chloro-3-methylphenol	7.0	160
UM28	8270	Semivolatiles/Water/GCMS	2CLP	2-Chlorophenol	2.4	160
UM28	8270	Semivolatiles/Water/GCMS	4CLPPE	4-Chlorophenyl phenyl ether	4.0	160
UM28	8270	Semivolatiles/Water/GCMS	CHRY	Chrysene	2.5	80
UM28	8270	Semivolatiles/Water/GCMS	DBAHA	Dibenz(a,h)anthracene	2.0	160
UM28	8270	Semivolatiles/Water/GCMS	FURANS	Dibenzofuran	2.6	160
UM28	8270	Semivolatiles/Water/GCMS	DNBP	Di-n-butylphthalate	4.9	40
UM28	8270	Semivolatiles/Water/GCMS	13DCLB	1,3-Dichlorobenzene	1.1	160
UM28	8270	Semivolatiles/Water/GCMS	14DCLB	1,4-Dichlorobenzene	1.0	160
UM28	8270	Semivolatiles/Water/GCMS	12DCLB	1,2-Dichlorobenzene	1.0	160
UM28	8270	Semivolatiles/Water/GCMS	33DCBD	3,3'-Dichlorobenzidine	32	160
UM28	8270	Semivolatiles/Water/GCMS	24DCLP	2,4-Dichlorophenol	5.8	160
UM28	8270	Semivolatiles/Water/GCMS	DEP	Diethylphthalate	2.2	120
UM28	8270	Semivolatiles/Water/GCMS	24DMPN	2,4-Dimethylphenol	4.6	160
UM28	8270	Semivolatiles/Water/GCMS	DMP	Dimethylphthalate	5.1	120
UM28	8270	Semivolatiles/Water/GCMS	46DN2C	4,6-Dinitro-2-methylphenol	14	160
UM28	8270	Semivolatiles/Water/GCMS	24DNP	2,4-Dinitrophenol	33	160
UM28	8270	Semivolatiles/Water/GCMS	24DNT	2,4-Dinitrotoluene	9.7	160
UM28	8270	Semivolatiles/Water/GCMS	26DNT	2,6-Dinitrotoluene	5.0	160
UM28	8270	Semivolatiles/Water/GCMS	DNOP	Di-n-octylphthalate	8.0	40

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Table 8-2 Certified Methods for Target Compounds (continued)

USATHAMA Method No.	EPA Method No.	Method Name	Analyte Code	Analyte	CRL µg/l	Upper Limit µg/l
UM28	8270	Semivolatiles/Water/GCMS	FANT	Fluoranthene	1.0	40
UM28	8270	Semivolatiles/Water/GCMS	FLRENE	Fluorene	1.3	120
UM28	8270	Semivolatiles/Water/GCMS	CL6BZ	Hexachlorobenzene	1.0	160
UM28	8270	Semivolatiles/Water/GCMS	HCBD	Hexachlorobutadiene	1.0	160
UM28	8270	Semivolatiles/Water/GCMS	CL6CP	Hexachlorocyclopentadiene	7.6	160
UM28	8270	Semivolatiles/Water/GCMS	CL6ET	Hexachloroethane	1.2	160
UM28	8270	Semivolatiles/Water/GCMS	ICDPYR	Indeno(1,2,3-cd)pyrene	4.4	160
UM28	8270	Semivolatiles/Water/GCMS	ISOPHR	Isophorone	1.1	160
UM28	8270	Semivolatiles/Water/GCMS	2MNAP	2-Methylnaphthalene	1.9	80
UM28	8270	Semivolatiles/Water/GCMS	2MP	2-Methylphenol	3.9	160
UM28	8270	Semivolatiles/Water/GCMS	4MP	4-Methylphenol	6.1	160
UM28	8270	Semivolatiles/Water/GCMS	NAP	Naphthalene	3.8	80
UM28	8270	Semivolatiles/Water/GCMS	2NANIL	2-Nitroaniline	9.6	160
UM28	8270	Semivolatiles/Water/GCMS	3NANIL	3-Nitroaniline	30	160
UM28	8270	Semivolatiles/Water/GCMS	4NANIL	4-Nitroaniline	40	160
UM28	8270	Semivolatiles/Water/GCMS	NB	Nitrobenzene	2.9	160
UM28	8270	Semivolatiles/Water/GCMS	2NP	2-Nitrophenol	6.7	160
UM28	8270	Semivolatiles/Water/GCMS	4NP	4-Nitrophenol	44	160
UM28	8270	Semivolatiles/Water/GCMS	NNDNPA	N-Nitroso-di-n-propylamine	3.2	160
UM28	8270	Semivolatiles/Water/GCMS	NNDPA	N-Nitrosodiphenylamine	5.9	120
UM28	8270	Semivolatiles/Water/GCMS	PCP	Pentachlorophenol	12	120
UM28	8270	Semivolatiles/Water/GCMS	PHANTR	Phenanthrene	1.0	160
UM28	8270	Semivolatiles/Water/GCMS	PHENOL	Phenol	6.2	160
UM28	8270	Semivolatiles/Water/GCMS	PYR	Pyrene	1.0	80

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Table 8-2 Certified Methods for Target Compounds (continued)

USATHAMA Method No.	EPA Method No.	Method Name	Analyte Code	Analyte	CRL µg/l	Upper Limit µg/l
UM28	8270	Semivolatiles/Water/GCMS	124TCB	1,2,4-Trichlorobenzene	1.4	160
UM28	8270	Semivolatiles/Water/GCMS	245TCP	2,4,5-Trichlorophenol	4.6	160
UM28	8270	Semivolatiles/Water/GCMS	246TCP	2,4,6-Trichlorophenol	4.8	160
UH02	608	PCBs/Water/GCEC	PCB016	Aroclor-1016	0.15	3.6
UH02	608	PCBs/Water/GCEC	PCB260	Aroclor-1260	0.15	3.6
UH02	608	PCBs/Water/GCEC	PCB221	Aroclor-1221	0.15*	3.6*
UH02	608	PCBs/Water/GCEC	PCB232	Aroclor-1232	0.15*	3.6*
UH02	608	PCBs/Water/GCEC	PCB242	Aroclor-1242	0.15*	3.6*
UH02	608	PCBs/Water/GCEC	PCB248	Aroclor-1248	0.15*	3.6*
UH02	608	PCBs/Water/GCEC	PCB254	Aroclor-1254	0.15*	3.6*

GFAA - graphite furnace atomic adsorption
CVAA - cold vapor atomic adsorption
ICP - inductively coupled plasma
GCEC - gas chromatography/electron capture
GCMS - gas chromatography/mass spectrometry
* - Detection limits for non-certified compounds
-- - non-certified parameters see Section 9.3 for reporting information

Table 8-2 Certified Methods for Target Compounds (continued)

SOIL

USATHAMA Method No.	EPA Method No.	Method Name	Analyte Code	Analyte	CRL µg/g	Upper Limit µg/g
JD19	7060	Metals/Soil/GFAA	AS	Arsenic	0.250	10.0
JD17	7421	Metals/Soil/GFAA	PB	Lead	0.177	10.0
JD15	7740	Metals/Soil/GFAA	SE	Selenium	0.250	10.0
HG9	7470	Metals/Soil/CVAA	HG	Mercury	0.0269	0.300
JS13	6010	Metals/Soil/ICP	AL	Aluminum	20.0	5000
JS13	6010	Metals/Soil/ICP	SB	Antimony	41.3	5000
JS13	6010	Metals/Soil/ICP	BA	Barium	0.962	5000
JS13	6010	Metals/Soil/ICP	BE	Beryllium	0.500	5000
JS13	6010	Metals/Soil/ICP	CD	Cadmium	0.528	2000
JS13	6010	Metals/Soil/ICP	CA	Calcium	72.5	5000
JS13	6010	Metals/Soil/ICP	CR	Chromium	0.669	5000
JS13	6010	Metals/Soil/ICP	CO	Cobalt	0.665	2000
JS13	6010	Metals/Soil/ICP	CU	Copper	0.937	5000
JS13	6010	Metals/Soil/ICP	FE	Iron	11.3	5000
JS13	6010	Metals/Soil/ICP	MG	Magnesium	89.2	5000
JS13	6010	Metals/Soil/ICP	MN	Manganese	2.00	5000
JS13	6010	Metals/Soil/ICP	NI	Nickel	1.54	2000
JS13	6010	Metals/Soil/ICP	K	Potassium	119	5000
JS13	6010	Metals/Soil/ICP	AG	Silver	0.521	100
JS13	6010	Metals/Soil/ICP	NA	Sodium	44.8	5000
JS13	6010	Metals/Soil/ICP	TL	Thallium	14.7	5000
JS13	6010	Metals/Soil/ICP	V	Vanadium	1.77	5000

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GCEC - gas chromatography/electron capture
GCMS - gas chromatography/mass spectrometry
* - Detection limits for non-certified compounds
-- - non-certified parameters see Section 9.3 for reporting information

Table 8-2 Certified Methods for Target Compounds (continued)

USATHAMA Method No.	EPA Method No.	Method Name	Analyte Code	Analyte	CRL µg/g	Upper Limit µg/g
JS13	6010	Metals/Soil/ICP	ZN	Zinc	1.94	2000
KY01	9012	Cyanide/Soil/Color	CYN	Cyanide	0.920	10.0
LM19	8240	Volatiles/Soil/GCMS	ACET	Acetone	0.017	0.10
LM19	8240	Volatiles/Soil/GCMS	C6H6	Benzene	0.0015	0.20
LM19	8240	Volatiles/Soil/GCMS	BRDCLM	Bromodichloromethane	0.0029	0.20
LM19	8240	Volatiles/Soil/GCMS	CHBR3	Bromoform	0.0069	0.20
LM19	8240	Volatiles/Soil/GCMS	CH3BR	Bromomethane	0.0057	0.20
LM19	8240	Volatiles/Soil/GCMS	MEK	2-Butanone	0.070	0.20
LM19	8240	Volatiles/Soil/GCMS	CS2	Carbon disulfide	0.0044	0.10
LM19	8240	Volatiles/Soil/GCMS	CCL4	Carbon tetrachloride	0.0070	0.20
LM19	8240	Volatiles/Soil/GCMS	CLC6H5	Chlorobenzene	0.00086	0.20
LM19	8240	Volatiles/Soil/GCMS	C2H5CL	Chloroethane	0.012	0.20
LM19	8240	Volatiles/Soil/GCMS	CHCL3	Chloroform	0.00087	0.20
LM19	8240	Volatiles/Soil/GCMS	CH3CL	Chloromethane	0.0088	0.10
LM19	8240	Volatiles/Soil/GCMS	DBRCLM	Dibromochloromethane	0.0031	0.20
LM19	8240	Volatiles/Soil/GCMS	11DCLE	1,1-Dichloroethane	0.0023	0.20
LM19	8240	Volatiles/Soil/GCMS	12DCLE	1,2-Dichloroethane	0.0017	0.20
LM19	8240	Volatiles/Soil/GCMS	11DCE	1,1-Dichloroethene	0.0039	0.10
LM19	8240	Volatiles/Soil/GCMS	12DCE	1,2-Dichloroethene (total)	0.0030	0.10
LM19	8240	Volatiles/Soil/GCMS	12DCLP	1,2-Dichloropropane	0.0029	0.20
LM19	8240	Volatiles/Soil/GCMS	C13DCP	cis-1,3-Dichloropropene	0.0032	0.25
LM19	8240	Volatiles/Soil/GCMS	T13DCP	trans-1,3-Dichloropropene	0.0028	0.15
LM19	8240	Volatiles/Soil/GCMS	ETC6H5	Ethylbenzene	0.0017	0.20
LM19	8240	Volatiles/Soil/GCMS	MNBK	2-Hexanone	0.032	0.10

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GCEC - gas chromatography/electron capture
GCMS - gas chromatography/mass spectrometry
* - Detection limits for non-certified compounds
-- - non-certified parameters see Section 9.3 for reporting information

Table 8-2 Certified Methods for Target Compounds (continued)

USATHAMA Method No.	EPA Method No.	Method Name	Analyte Code	Analyte	CRL µg/g	Upper Limit µg/g
LM19	8240	Volatiles/Soil/GCMS	CH2CL2	Methylene chloride	0.012	0.20
LM19	8240	Volatiles/Soil/GCMS	MIBK	4-Methyl-2-pentanone	0.027	0.10
LM19	8240	Volatiles/Soil/GCMS	STYR	Styrene	0.0026	0.20
LM19	8240	Volatiles/Soil/GCMS	TCLEA	1,1,2,2-Tetrachloroethane	0.0024	0.20
LM19	8240	Volatiles/Soil/GCMS	TCLEE	Tetrachloroethene	0.00081	0.20
LM19	8240	Volatiles/Soil/GCMS	MEC6H5	Toluene	0.00078	0.20
LM19	8240	Volatiles/Soil/GCMS	111TCE	1,1,1-Trichloroethane	0.0044	0.20
LM19	8240	Volatiles/Soil/GCMS	112TCE	1,1,2-Trichloroethane	0.0054	0.20
LM19	8240	Volatiles/Soil/GCMS	TRCLE	Trichloroethene	0.0028	0.20
LM19	8240	Volatiles/Soil/GCMS	C2H3CL	Vinyl chloride	0.0062	0.20
LM19	8240	Volatiles/Soil/GCMS	XYLEN	Xylenes (Total)	0.0015	0.20
LM27	8270	Semivolatiles/Soil/GCMS	ANAPNE	Acenaphthene	0.033	2.7
LM27	8270	Semivolatiles/Soil/GCMS	ANAPYL	Acenaphthylene	0.033	2.7
LM27	8270	Semivolatiles/Soil/GCMS	ANTRC	Anthracene	0.033	2.7
LM27	8270	Semivolatiles/Soil/GCMS	BAANTR	Benzo(a)anthracene	0.033	5.3
LM27	8270	Semivolatiles/Soil/GCMS	BBFANT	Benzo(b)fluoranthene	0.033	5.3
LM27	8270	Semivolatiles/Soil/GCMS	BKFANT	Benzo(k)fluoranthene	0.033	5.3
LM27	8270	Semivolatiles/Soil/GCMS	BGHIPY	Benzo(g,h,i)perylene	0.25	5.3
LM27	8270	Semivolatiles/Soil/GCMS	BAPYR	Benzo(a)pyrene	0.033	5.3
LM27	8270	Semivolatiles/Soil/GCMS	B2CEXM	Bis(2-chloroethoxy)methane	0.033	5.3
LM27	8270	Semivolatiles/Soil/GCMS	B2CLEE	Bis(2-chloroethyl)ether	0.080	5.3
LM27	8270	Semivolatiles/Soil/GCMS	B2CIPE	Bis(2-chloroisopropyl)ether	0.033	5.3
LM27	8270	Semivolatiles/Soil/GCMS	B2EHP	Bis(2-ethylhexyl)phthalate	0.39	5.3
LM27	8270	Semivolatiles/Soil/GCMS	4BRPPE	4-Bromophenyl phenyl ether	0.033	5.3

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CVAA - cold vapor atomic adsorption
ICP - inductively coupled plasma
GCEC - gas chromatography/electron capture
GCMS - gas chromatography/mass spectrometry
* - Detection limits for non-certified compounds
-- - non-certified parameters see Section 9.3 for reporting information

Table 8-2 Certified Methods for Target Compounds (continued)

USATHAMA Method No.	EPA Method No.	Method Name	Analyte Code	Analyte	CRL µg/g	Upper Limit µg/g
LM27	8270	Semivolatiles/Soil/GCMS	BBZP	Butyl benzyl phthalate	0.033	5.3
LM27	8270	Semivolatiles/Soil GCMS	CARBAZ	Carbazole	--	--
LM27	8270	Semivolatiles/Soil/GCMS	4CANIL	4-Chloroaniline	1.6	5.3
LM27	8270	Semivolatiles/Soil/GCMS	2CNAP	2-Chloronaphthalene	0.14	5.3
LM27	8270	Semivolatiles/Soil/GCMS	4CL3C	4-Chloro-3-methylphenol	0.073	5.3
LM27	8270	Semivolatiles/Soil/GCMS	2CLP	2-Chlorophenol	0.11	5.3
LM27	8270	Semivolatiles/Soil/GCMS	4CLPPE	4-Chlorophenyl phenyl ether	0.044	4.0
LM27	8270	Semivolatiles/Soil/GCMS	CHRY	Chrysene	0.22	4.0
LM27	8270	Semivolatiles/Soil/GCMS	DBAHA	Dibenz(a,h)anthracene	0.033	5.3
LM27	8270	Semivolatiles/Soil/GCMS	FURANS	Dibenzofuran	0.033	4.0
LM27	8270	Semivolatiles/Soil/GCMS	DNBP	Di-n-butylphthalate	0.92	4.0
LM27	8270	Semivolatiles/Soil/GCMS	13DCLB	1,3-Dichlorobenzene	0.12	5.3
LM27	8270	Semivolatiles/Soil/GCMS	14DCLB	1,4-Dichlorobenzene	0.033	5.3
LM27	8270	Semivolatiles/Soil/GCMS	12DCLB	1,2-Dichlorobenzene	0.033	5.3
LM27	8270	Semivolatiles/Soil/GCMS	33DCBD	3',3'-Dichlorobenzidine	3.4	5.3
LM27	8270	Semivolatiles/Soil/GCMS	24DCLP	2,4-Dichlorophenol	0.14	5.3
LM27	8270	Semivolatiles/Soil/GCMS	DEP	Diethylphthalate	0.19	4.0
LM27	8270	Semivolatiles/Soil/GCMS	24DMPN	2,4-Dimethylphenol	2.6	5.3
LM27	8270	Semivolatiles/Soil/GCMS	DMP	Dimethylphthalate	0.13	5.3
LM27	8270	Semivolatiles/Soil/GCMS	46DN2C	4,6-Dinitro-2-methylphenol	0.026	5.3
LM27	8270	Semivolatiles/Soil/GCMS	24DNP	2,4-Dinitrophenol	0.70	5.3
LM27	8270	Semivolatiles/Soil/GCMS	24DNT	2,4-Dinitrotoluene	0.37	5.3
LM27	8270	Semivolatiles/Soil/GCMS	26DNT	2,6-Dinitrotoluene	0.066	4.0
LM27	8270	Semivolatiles/Soil/GCMS	DNOP	Di-n-octylphthalate	0.24	1.3

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GCMS - gas chromatography/mass spectrometry
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-- - non-certified parameters see Section 9.3 for reporting information

Table 8-2 Certified Methods for Target Compounds (continued)

USATHAMA Method No.	EPA Method No.	Method Name	Analyte Code	Analyte	CRL µg/g	Upper Limit µg/g
LM27	8270	Semivolatiles/Soil/GCMS	FANT	Fluoranthene	0.085	2.7
LM27	8270	Semivolatiles/Soil/GCMS	FLRENE	Fluorene	0.033	5.3
LM27	8270	Semivolatiles/Soil/GCMS	CL6BZ	Hexachlorobenzene	0.046	5.3
LM27	8270	Semivolatiles/Soil/GCMS	HCBD	Hexachlorobutadiene	0.18	5.3
LM27	8270	Semivolatiles/Soil/GCMS	CL6CP	Hexachlorocyclopentadiene	1.7	5.3
LM27	8270	Semivolatiles/Soil/GCMS	CL6ET	Hexachloroethane	0.067	2.7
LM27	8270	Semivolatiles/Soil/GCMS	ICDPYR	Indeno(1,2,3-cd)pyrene	0.033	5.3
LM27	8270	Semivolatiles/Soil/GCMS	ISOPHR	Isophorone	0.033	5.3
LM27	8270	Semivolatiles/Soil/GCMS	2MNAP	2-Methylnaphthalene	0.033	5.3
LM27	8270	Semivolatiles/Soil/GCMS	2MP	2-Methylphenol	0.35	5.3
LM27	8270	Semivolatiles/Soil/GCMS	4MP	4-Methylphenol	0.30	5.3
LM27	8270	Semivolatiles/Soil/GCMS	NAP	Naphthalene	0.033	1.3
LM27	8270	Semivolatiles/Soil/GCMS	2NANIL	2-Nitroaniline	0.079	5.3
LM27	8270	Semivolatiles/Soil/GCMS	3NANIL	3-Nitroaniline	0.95	5.3
LM27	8270	Semivolatiles/Soil/GCMS	4NANIL	4-Nitroaniline	1.2	5.3
LM27	8270	Semivolatiles/Soil/GCMS	NB	Nitrobenzene	0.071	5.3
LM27	8270	Semivolatiles/Soil/GCMS	2NP	2-Nitrophenol	0.069	5.3
LM27	8270	Semivolatiles/Soil/GCMS	4NP	4-Nitrophenol	0.86	5.3
LM27	8270	Semivolatiles/Soil/GCMS	NNDNPA	N-Nitroso-di-n-propylamine	0.071	5.3
LM27	8270	Semivolatiles/Soil/GCMS	NNDPA	N-Nitrosodiphenylamine	0.038	5.3
LM27	8270	Semivolatiles/Soil/GCMS	PCP	Pentachlorophenol	0.20	5.3
LM27	8270	Semivolatiles/Soil/GCMS	PHANTR	Phenanthrene	0.033	4.0
LM27	8270	Semivolatiles/Soil/GCMS	PHENOL	Phenol	0.11	5.3
LM27	8270	Semivolatiles/Soil/GCMS	PYR	Pyrene	0.033	1.3

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CVAA - cold vapor atomic adsorption
ICP - inductively coupled plasma
GCEC - gas chromatography/electron capture
GCMS - gas chromatography/mass spectrometry
* - Detection limits for non-certified compounds
-- - non-certified parameters see Section 9.3 for reporting information

Table 8-2 Certified Methods for Target Compounds (continued)

USATHAMA Method No.	EPA Method No.	Method Name	Analyte Code	Analyte	CRL µg/g	Upper Limit µg/g
LM27	8270	Semivolatiles/Soil/GCMS	124TCB	1,2,4-Trichlorobenzene	0.033	5.3
LM27	8270	Semivolatiles/Soil/GCMS	245TCP	2,4,5-Trichlorophenol	0.086	5.3
LM27	8270	Semivolatiles/Soil/GCMS	246TCP	2,4,6-Trichlorophenol	0.082	5.3
LH16	8080	PCB/Soil/GCEC	PCB016	Aroclor-1016	0.0666	0.367
LH16	8080	PCB/Soil/GCEC	PCB221	Aroclor-1221	0.0804	--
LH16	8080	PCB/Soil/GCEC	PCB232	Aroclor-1232	0.0804	--
LH16	8080	PCB/Soil/GCEC	PCB242	Aroclor-1242	0.0804	--
LH16	8080	PCB/Soil/GCEC	PCB248	Aroclor-1248	0.0804	--
LH16	8080	PCB/Soil/GCEC	PCB254	Aroclor-1254	0.0804	--
LH16	8080	PCB/Soil/GCEC	PCB260	Aroclor-1260	0.0804	0.407

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CVAA - cold vapor atomic adsorption
ICP - inductively coupled plasma
GCEC - gas chromatography/electron capture
GCMS - gas chromatography/mass spectrometry
* - Detection limits for non-certified compounds
-- - non-certified parameters see Section 9.3 for reporting information

Water Method Summary: A 5-milliliter (ml) portion of the sample is spiked with internal standard and surrogate then transferred to the purging device. The sample is purged with helium and the analytes are trapped on a 3-phase sorbent tube. The analytes are desorbed at 180°C into a gas chromatograph/mass spectrometer with electron impact ionization and quadrupole detector.

Proposed Soil Method and Reference: The proposed method of analysis for soil is certified Method LM19, which is based on EPA Method 8240 (SW-846).

Soil Method Summary: A 10-gram portion of the sample is extracted with 9 ml of methanol and 1 ml of the surrogate solution. A 50-μl portion of the extraction solution is spiked into 5 ml of water containing the internal standard and then transferred to the purging device. The sample is purged with helium, and the analytes are trapped on a 3-phase sorbent tube. The analytes are desorbed at 180°C into a gas chromatograph/mass spectrometer with an electron impact ionization source and a quadrupole detector.

8.5.2 GC/MS SEMIVOLATILES (BASE NEUTRAL ACIDS)

Proposed Water Method and Reference: The proposed method of analysis for water is certified Method UM28, which is based on EPA Method 8270 (SW-846).

Water Method Summary: An 800-ml portion of sample is spiked with surrogate compounds, and extracted with methylene chloride. The extract is dried with sodium sulfate and concentrated to 1 ml with a Kuderna-Danish apparatus. After the sample extract is screened by gas chromatography/flame ionization detector (GC/FID) it is injected with a gas chromatograph equipped with a mass spectrometer detector.

Proposed Soil Method and Reference: The proposed method of analysis for soil is certified Method LM27, which is based on EPA Methods 3540 and 8270.

Soil Method Summary: A 15-gram sample is mixed with sodium sulfate in a thimble. The thimble is spiked with surrogate spiking solution and extracted for 8 hours in a soxhlet apparatus. The solvent is concentrated to 10 ml with a Kuderna-Danish apparatus. The sample extract is screened by GC/FID and injected into a gas chromatograph equipped with a mass spectrometer detector.

8.5.3 ICP METALS

Proposed Water Method and Reference: The proposed method of analysis for water is certified Method SS14, which is based on EPA Method 6010 (SW-846) and EPA Method 200.7 (600/4-79-020, March 1983).

Water Method Summary: A 50-ml portion of the sample is heated in the presence of nitric and hydrochloric acids. The volume is reduced to between 10 and 20 ml. The sample is cooled and diluted to 50 ml with ASTM Type I water. The resulting digest is analyzed using an Inductively Coupled Plasma (ICP) Spectrometer.

Proposed Soil Method and Reference: The proposed methods of analysis for soil are certified methods JS13 which is based on EPA Methods 3050 and 6010 (SW-846).

Soil Method Summary: A 1-gram portion of the sample is heated in the presence of nitric acid and hydrogen peroxide. The sample is evaporated to near-dryness on a hot plate and refluxed with hydrochloric acid. The digest is analyzed using a sequential ICP. The ICP is integrated with a data system capable of controlling the instrument data acquisition function and processing the data acquired, including correcting for interelement interferences.

Proposed Lead Wipe Method and Reference: The proposed method of analysis for wipe samples is certified Method AS01, which is based on EPA Methods 3050 (Modified) and 6010 (SW-846).

Wipe Method Summary: The wipe sample is weighed and placed in a beaker with nitric acid. The sample is heated and refluxed with the nitric acid. The sample is then evaporated to near dryness and diluted to volume with deionized water. The resulting digest is analyzed using an ICP Spectrometer. Results are reported as total micrograms of lead per filter.

8.5.4 GRAPHITE FURNACE ATOMIC ABSORPTION (GFAA)

8.5.4.1 Arsenic

Proposed Water Method and Reference: The proposed method of analysis for water is certified Method VV8 which is based on EPA Method 7060.

Water Method Summary: A 100-ml portion of the sample is heated in the presence of nitric acid. The solution is diluted to 100 ml with ASTM type I water. A portion of the resulting digest is mixed with a modifier solution (containing nickel nitrate) and analyzed using an atomic absorption spectrophotometer equipped with a graphite furnace.

Proposed Soil Method and Reference: The proposed method of analysis for soil is certified Method JD19 which is based on EPA Methods 3050 and 7060 (SW-846).

Soil Method Summary: A 1-gram portion of the sample is digested with nitric acid and hydrogen peroxide. The solution is diluted to 100 ml with ASTM type I water. A portion of the resulting digest is mixed with a modifier solution (containing nickel nitrate) and analyzed using an atomic absorption spectrophotometer equipped with a graphite furnace.

8.5.4.2 Lead

Proposed Water Method and Reference: The proposed method of analysis for water is SD20 which is based on EPA Method 7421.

Water Method Summary: A 100-ml portion of the sample is heated in the presence of nitric acid. The solution is filtered and diluted to 100 ml with ASTM type I water. A portion of the resulting digest is mixed with a modifier solution (containing magnesium nitrate and ammonium phosphate) and then analyzed using an atomic absorption spectrophotometer equipped with a graphite furnace.

Proposed Soil Method and Reference: The proposed method of analysis for soil is certified Method JD17 which is based on EPA Methods 3050 and 7421.

Soil Method Summary: A 1-gram portion of the sample is digested with nitric acid and hydrogen peroxide. The solution is diluted to 100 ml with ASTM type I water. A portion of the resulting digest is mixed with a modifier solution (continuing nickel nitrate) and analyzed using atomic absorption spectrophotometer equipped with a graphite furnace.

Proposed Paint Method and Reference: The proposed analysis for paint utilizes atomic absorption techniques. The method, ASTM 3335-85A, is not a USATHAMA certified procedure.

8.5.4.3 Selenium

Proposed Water Method and Reference: The proposed method of analysis for water is SD21 which is based on EPA Method 7740.

Water Method Summary: A 100-ml portion of sample is heated in the presence of nitric acid. The solution is diluted to 100 ml with ASTM type I water. A portion of the resulting digest is mixed with a modifier solution (Magnesium nitrate and nickel nitrate) and analyzed using an atomic absorption spectrophotometer equipped with a graphite furnace.

Proposed Soil Method and Reference: The proposed method of analysis for soil is SD15 which is based on EPA Methods 3050 and 7740 (SW-846).

Soil Method Summary: A 1-gram portion of sample is heated in the presence of nitric acid and hydrogen peroxide. The solution is diluted to 100 ml with ASTM type I water. A portion of the resulting digest is mixed with a modifier solution (Magnesium nitrate and nickel nitrate) and analyzed using an atomic absorption spectrophotometer equipped with a Zeeman Furnace.

8.5.5 MERCURY

Proposed Water Method and Reference: The proposed method of analysis for water is WW8 which is based on EPA Method 245.1.

Water Method Summary: A 100-ml portion of sample is digested with a sulfuric/nitric acid-potassium permanganate solution by heating for 2 hours at 95°C. After reduction with hydroxylamine hydrochloride, stannous chloride is introduced into the vessel containing the digest and the vessel is attached to an atomic absorption spectrophotometer fitted for determination of mercury by cold vapor.

Proposed Soil Method and Reference: The proposed method of analysis for soil is HG9 which is based on EPA Method 7471 (SW-846).

Soil Method Summary: A 1-gram portion of sample is digested with aqua regia-potassium permanganate by heating at 95°C. After reduction with hydroxylamine hydrochloride, stannous chloride is introduced into the vessel containing the digest and the vessel is attached to an atomic absorption spectrophotometer fitted for determination of mercury by cold vapor.

8.5.6 POLYCHLORINATED BIPHENYLS (PCBs)

Proposed Water Method and Reference: The proposed method of analysis for water is UHO2, which is based on EPA Method 608.

Water Method Summary: An 800-ml sample is extracted with 3 x 50 ml of methylene chloride. The solvent is exchanged to hexane and concentrated to a final volume of 5 ml. The extracts are analyzed by gas chromatography/electron capture detector (GC/ECD) with helium as a carrier gas.

Proposed Soil Method and Reference: The proposed method of analysis for soil is LH16 which is based on EPA Method 8080.

Soil Method Summary: A 20-gram sample is extracted with 20 ml acetone/hexane, using a wrist-action shaker. The extract is analyzed by gas chromatography/electron capture detector (GC/ECD) with helium as a carrier gas.

Proposed Oil Method and Reference: The proposed method of analysis for transformer oil is not a USATHAMA certified procedure. The method will be based on EPA-600/4-81-045.

Oil Method Summary: The sample is diluted on a weight/volume basis so that the concentrations of each PCB isomer is within the capability of the GC system. The diluted sample is then injected into a gas chromatograph for separation of the PCB isomers.

8.5.7 TOTAL PETROLEUM HYDROCARBONS

Proposed Water Method and Reference: The proposed method of analysis for water is based on EPA Method 418.1.

Water Method Summary: An 800-ml sample is extracted with 3 X 30 ml of fluorocarbon-113 and brought to a final volume of 100 ml. Following the addition of silica gel, the extract is analyzed by infrared spectrophotometry.

Proposed Soil Method and Reference: The proposed method of analysis for soil is based on EPA Method 418.1, modified for the analysis of soil.

Soil Method Summary: A 10-gram sample is extracted with 3 X 30 ml of fluorocarbon-113 and brought to a final volume of 100 ml. Following the addition of silica gel, the extract is analyzed by infrared spectrophotometry.

8.5.8 ASBESTOS

Proposed Method and Reference: The proposed method of analysis for asbestos is not a USATHAMA certified procedure. The method that will be used is based on EPA 800/M4-82-020.

Method Summary: The identification of asbestos fiber bundles is determined by the visual properties (as seen by Polarized light microscopy) displayed when the sample is treated with various dispersion staining liquids.

8.5.9 CYANIDE

Proposed Water Method and Reference: The proposed method of analysis for water is CN1 which is based on EPA Method 9010.

Water Method Summary: The cyanide, as hydrocyanic acid (HCN), is released by refluxing 500 mls of sample with strong acid and distillation of the HCN into an absorber-scrubber containing sodium hydroxide solution. The cyanide ion in the absorbing solution is then manually determined colorimetrically.

Proposed Soil Method and Reference: The proposed method of analysis for soil is KY01 which is based on CLP-M Method 335.2.

Soil Method Summary: A 15-gram sample is wetted with 500 mls of water. Cyanide, as hydrocyanic acid (HCN), is released from cyanide complexes by means of a reflux-distillation operation and absorbed in a scrubber containing sodium hydroxide solution. The cyanide ion in the absorbing solution is then determined by volumetric titration or colorimetrically.

9.0 DATA REDUCTION, VALIDATION AND REPORTING

Final reports generated from data collected during the sampling activities will be appropriately identified and validated. Where test data have been reduced, the method of reduction will be described in the text of such reports. Entry of any data to computer databases will be checked by cross reading hard copy data files with the data in its original form.

9.1 FIELD MEASUREMENT DATA

Validation of data obtained from field measurements will be performed by the task leaders or their designees. Validation of data will be performed by checking procedures utilized in the field and comparing the data to similar, previous measurements when they exist. If there are data which cannot be validated, the reason will be documented.

The following are suggested reporting requirements that may be applied for field data:

- pH: Field measurements will be reported to 0.1 pH units.
- Specific conductance: Field measurement will be reported to ±5 percent of the reading, umhos/cm.
- Temperature measurements will be reported to the nearest 0.5 °C.
- Dissolved oxygen measurements will be reported to ±0.2 ppm.
- Water levels: Measurements will be repeated until at least two are documented to be in agreement to the nearest 0.01 foot.
- Soil sample depths: Tape measurements will be made to the nearest 0.1 ft; measurement made by known lengths of drill string will be made to the nearest 0.5 feet.
- Elevations of sampling sites: Measuring points for all new monitoring wells and unsurveyed existing wells will be surveyed to the nearest 0.01 ft and referenced to Mean Sea Level. Approximate elevations of all other nonsurveyed sampling sites will be determined to the nearest 3.0 foot.
- Locations of sampling sites: Locations of monitoring wells will be surveyed to the nearest 0.01 foot.

- Lithologic descriptions: Sample descriptions will be consistent with the Unified Soil Classification System. Grain size will be adequately described for sand and coarse fractions.

9.2 LABORATORY DATA

9.2.1 RECORD KEEPING AND REVIEW

Personnel responsible for sample extraction will utilize method-specific bound books to record all data associated with sample extraction and preparation. A copy of the extraction benchsheet will be transferred to the gas chromatography (GC) analyst with each extracted sample.

The GC laboratories will utilize benchsheets, maintained in analysis-specific binders for QC data; and bound logbooks (instrument-specific) for injection data. Computer generated quantification reports and chromatographs will be filed by accession number.

The individual analysts and technicians will be responsible for maintaining accurate, legible records and logs in accordance with standard operating procedures. The laboratory department supervisors will be responsible for ensuring adherence to procedures.

Raw data and its reduction to final results will be reviewed by the section supervisor or group leader periodically. The frequency and completeness of the review will be individually determined, but is not less than 10 percent of all data every 2 weeks.

The laboratory QA Manager will be responsible for routinely auditing all records and logs and reporting deficiencies to the laboratory department supervisor for corrective action.

9.2.2 RAW DATA STORAGE

The paperwork containing the raw data for a sample set (i.e., chart paper, computer readouts, paper tapes, calibration curves, tables of data, etc.) is collected and placed in an 8 1/2-inch (in) by 11-in envelope which has been labeled with sample numbers, analyst, date, and other pertinent information. The data envelopes are filed by laboratory number for future reference and data retrieval. Each chemist maintains a bound laboratory notebook in which are detailed events related to sample analyses. Appropriate and complete data, along with a description of the samples and analytical method, are also entered in the chemist's notebook. Completed notebooks are filed by each chemist. At termination of employment, all laboratory notebooks are placed in archives.

9.3 DATA PROCESSING AND COLLECTION

Data processing includes the collection, validation, storage, transfer, and reduction of analytical data. Procedures are determined according to USATHAMA guidelines. The laboratory employs extensive automated data processing procedures, including:

- The generation of standard calibration curves
- Mathematical modeling of standard curves
- Statistical analysis
- Calculations
- Data storage and retrieval
- The generation of hard copy output

9.3.1 REDUCTION

Data reduction by the computer includes calculations, generation of standard calibration curves, mathematical modeling of standard curves, statistical analyses, and the generation of hard copy output. Four different computerized mathematical models are available to fit data derived from the analysis of standards and to generate calibration curves. The analyst has the option of selecting the model which best fits standard data. The computer program will print a plot of the standard curve as an aid in selecting the curve of best fit. Although a correlation coefficient is provided, it is not always the best indication of a reasonable data fit. Once the model has been selected, it will remain constant for all subsequent uses of the method. This mathematical model will then be used to determine the quality of analyte present in field samples.

9.3.2 VALIDATION

At the completion of an analysis, each chemist calculates his/her results and reports them on the Sample Data and Laboratory Report sheet. Results for internal QC samples are calculated immediately after analysis. The results are checked either by computer or by the Laboratory Quality Assurance Coordinator (LQAC). Thus, the chemist may determine immediately if his QC samples and the overall analysis are in control. A peer scientist, other than the analyst, is assigned to check the results for possible errors in calculations or data processing. The checker must approve the results reported for both the quality control samples and the field samples. Should the QC data be out of control, the chemist and his supervisor are required to assess possible problems. They must notify the LQAC of the problem and its proposed solution. The Section Manager, after his evaluation of the data, gives the report to the LQAC for evaluation and implementation of any required corrective action. Upon approval by the LQAC, the completed report is routed through to the Laboratory

Analytical Coordinator (LAC) for final review and reporting. Items to be reviewed during the process are listed in the QA Program (USATHAMA, 1990).

9.3.3 REPORTING

Analytical reports are submitted immediately following the completion of the analyses and the associated calculations for each work effort. A typical analytical report is comprised of the analytical results and limits of detection.

A copy of all reports are placed in a master file for storage and retrieval of information as required. This file is organized and maintained according to laboratory sample number and general sample type. Material filed for each sample set includes reports of analytical results, methodology, and QC results.

All data reported will meet USATHAMA requirements. All numerical results shall be reported in terms of concentration in the environmental sample. Concentrations submitted for entry into IRDMS must remain unadjusted before being reported to USATHAMA. Correction factors (e.g., accuracy, percent moisture, and dilution factor) are maintained separately in the IRDMS. All data are collected during periods when calibration and control systems were used. Only concentrations measured within the certified range, prior to correction, are reported. Specific instructions are provided in the IRDMS User's Guide regarding the coding of entries. Flagging codes, as described in the IRDMS User's Guide will be used when applicable, to comment on the usability of the data. Comments on the usability of the data will be provided.

In reporting results, rounding to the correct number of significant figures occurs only after all calculations and manipulations are completed. Premature rounding can significantly affect the final result. The method blank results are subtracted from quality control samples only, and the actual method blank values are reported to IRDMS. Each analytical method describes the correct procedure for using method blank results.

9.3.3.1 Class 1, Class 1A, and Class 1B Certified Methods

Class 1 and 1B Methods:

If results for an analyte were obtained using the method exactly as tested, without dilution, the analyte concentration in the sample may be reported to three significant figures. If dilution was required for a particular analyte, the result is reported to only two significant figures, reflecting the fact that total method performance was not demonstrated at that concentration during certification.

Class 1A Methods:

Results for certified analytes (target and surrogate) are reported with two significant figures if the method was used without dilution. Results obtained after dilution and results of screening for noncertified analytes are reported to only one significant figure. Any result for Class 1A methods that result from manual integration of chromatographic peaks shall be justified with copies of the specific peaks provided in the data package.

9.3.4 TRANSFER

Procedures used ensure that data transfer is error free and that no information is lost in the transfer. Because of the extensive use of a computerized data processing system, data transfer steps are minimized.

9.4 SYSTEM CONTROL

To comply with the USATHAMA QA Program, it is essential that controls are initiated during and maintained throughout the collection and analysis of samples. Data generated from the laboratory control samples are plotted on control charts, which are used to monitor day-to-day variations in routine analyses.

A new lot of samples is not to be introduced into the analytical instrument until results for QC samples in the previous lot have been calculated, plotted on control charts as necessary, and the entire analytical method shown to be in control. If time is a constraint, the calculation of associated environmental sample results may be postponed until a later date. The analyst should maintain control charts by the instrument so that the results of QC samples could be hand-plotted in order to have an early indication of problems.

9.4.1 CONTROL SAMPLES

Control samples will be used to monitor the performance of each analytical method, as described in the QA Program (USATHAMA, 1990). These samples reproduce (in so far as is possible) the specific matrix and properties of the samples under consideration or are method blanks. Validation of spiking solutions will be performed on a regular basis before the solution is used and not after as part of a corrective action.

Numbers and concentrations of QC samples required for different certification classes, per lot of field samples, are summarized in Table 9-1. Each analytical lot will include QC samples of the following type:

Table 9-1 Numbers and Concentrations of Quality Control Samples per Lot

CLASS 1

1 - Standard Matrix Method Blank
3 - Standard Matrix Spikes
    2, 10, & 10 CRL (approx)
1 - Standard Matrix Spike - Extended Range
    100 CRL (approx) or Near Method Maxima

CLASS 1A

1 - Standard Matrix Method Blank/Spike
    0 CRL Non-surrogate/10 CRL (approx) Surrogate
ALL - Natural Matrix (Field Sample) Spikes
    10 CRL (approx) Surrogate

CLASS 1B

1 - Standard Matrix Method Blank
1 - Standard Matrix Spike
    10 CRL (approx)

CRL - Certified Reporting Limit

Class 1 and Class 1B Certified Method:

- Method Blank, to verify that the laboratory is not a source of sample contamination.
- Spikes of all control analytes (required analytes spiked into QC samples) in standard matrices, to verify performance.

Class 1A Certified Method (GC-MS Only):

- Method Blank/Spike, to verify that the laboratory is not a source of sample contamination (non-surrogates) and to verify performance (surrogates).
- Spikes of all control analytes (surrogate only) in every field sample, to observe recovery effects in the environmental matrix.

9.4.2 METHOD BLANKS

Any values above the Certified Reporting Limit (CRL) are reported as determined. Corrections to the QC samples, necessitated by background levels in the method blank, shall be performed using instrument response values and not the found values calculated from the linear calibration curve. (Exceptions to this convention for specific methods will be specified in the appropriate analytical method). Method blank correction for nonlinear calibrations requires contacting the USATHAMA Chemistry Branch for instructions on a case-by-case basis. Entries into the USATHAMA IRDMS are in terms of concentration. The importance attached to finding measurable concentrations in the method blank is dependent on analyte and method.

Method blank results are handled as follows:

- Inorganic results greater than the CRL are prepared and analyzed again;
- Organic results greater than five times the CRL for routine laboratory solvents (acetone, chloroform, methylene chloride) are reanalyzed. Other organic analyte results greater than 1.5 CRL are reanalyzed;
- Method blank contamination is immediately investigated and eliminated, if possible. Determination of source may include investigation of:

    -Contaminated syringes

-Contaminated solvents

-Contaminated glassware

-Fume hood flow rates

-Cleaning procedures

9.4.3 CONTROL CHARTS

Data from QC sample analysis will be utilized to construct control charts as described in the USATHAMA QA Program. Control charts are used to monitor the variations in the precision and accuracy of routine analysis and to detect trends in these variations. Data from the laboratory certification of analytical methods will be used to initiate the control charts. After the charts are formatted, data from spiked QC samples within a lot will be plotted and compared to control limits. The graphs will demonstrate if analyses of the lot are in control. The QC sample analysis of each lot will then be used to update the control charts. Mean, Range ($\overline{x}$ - R) control charts are the type to be utilized for this QA program and will be available for review by all analysts involved in this project. Analysts will also have available the criteria to determine if analysis results are within the required specifications that determine control.

9.4.3.1 Single Day $\overline{x}$ - R Charts

Single day $\overline{x}$ - R control charts are to be prepared for each control analyte using data from the duplicate spiked QC samples in each lot to determine mean percent recovery. The formula for determining percent recovery for QC samples is defined as follows:

$$\frac{\text{Found concentration - Method blank}}{\text{Spiked concentration}} \times 100$$

The initial $\overline{x}$ - R control chart will be prepared using the 4 days of certification data closest to the spiking concentration used during analysis. The average mean ($\overline{x}$), average range (R), and control limits for $\overline{x}$ and R shall be updated after each lot for the first 20 lots. Limits established after 20/lots will be used for the next 20 lots. Control charts are updated after each 20 lots and thereafter, using the most recent 40 points. In interpreting the control charts developed for the initial lots (lots 1-20), the limits established from the previous lots will be used to control the current lot. When modified limits are established, data for samples will be accepted if the control data falls between the modified limits. If modified limits have not been established, data for samples will be accepted based on the recoveries established during certification and the current performance of the method. In updating the control charts, the new data must be combined with the individual values of previous average percent recoveries and not the mean of all previous data. Only lots evaluated as in-control are applicable to the 20 and 40 lot requirements for establishing and updating control limits. Out-of-control or outlier points will be plotted; however, such lots are not used for control limit calculations.

9.4.3.2 Three-Point Moving Average Control Charts

Three-point moving average control charts are maintained for each control analyte spiked in the single low concentration spiked QC sample (Class 1), single high concentration spiked QC sample (Class 1B), surrogate spiked standard matrix sample (Class 1A), or the additional spiked QC sample for extended ranges. The $\overline{x}$ - R three-point moving average control chart is constructed for each control analyte as follows:

- Use percent recovery to allow for minor variations in spiking concentration;
- The first plotted point is the average of the first three recoveries (from certification, at concentrations nearest the spiking level);
- Subsequent points are obtained by averaging the three most recent individual recovery values, plotting and excluding outliers in subsequent calculations;
- The range for each point is the difference between the highest and lowest value for each group of three values; and
- The central line, upper warning limit (UWL), upper control limit (UCL), lower control limit (LCL), and lower warning limit (LWL) for the control charts are calculated according to the USATHAMA QA Program.

All data are plotted, whether or not they are in control, and the plotted points represent averaged instrument measurements and not the individual measurements. Each individual recovery measurement is tested as an outlier using Dixon's test at the 98 percent confidence level. If one of the individual measurements is an outlier, it will be used in calculating the three-point moving average for plotting only. The outlier, however, is then excluded from calculations which are based on the three most recent acceptable individual points and the control chart limits determined accordingly.

Each control chart shall include the following information:

- Analyte;

- Method number;
- Laboratory;
- Spike concentration;
- Matrix;
- Chart title - select one of the following:
  Single Day $\overline{x}$-Bar Control Chart;
  Single Day Range Control Chart;
  Three Day $\overline{x}$-Bar Control Chart-Low Spike Concentration
  Three Day Range Control Chart - Low Spike Concentration
- Three letter lot designation for each point, shown on the x-axis;
- Percent Recovery (for $\overline{x}$ control charts) or Range (for R control charts) along the y-axis;
- Upper control limit (UCL), on $\overline{x}$ and R control charts;
- Upper warning limit (UWL), on $\overline{x}$ and R control charts;
- Mean, on $\overline{x}$ and R control charts;
- Lower warning limit (LWL), on $\overline{x}$ control charts; and
- Lower control limit (LCL), on $\overline{x}$ control charts.

9.5 DOCUMENT CONTROL

The goal of the Document Control Program is to assure that all required documents for a specific sample set are appropriately completed, distributed, and filed. Document control addresses, but is not limited to: sample tags, chain-of-custody records, sample tracking records, information recorded in analysts' notebooks and in instrumentation logbooks, hardcopy output from instrumentation (e.g., chromatograms, tapes of absorbance values, recorder output), computer printouts, raw data summaries, analytical request documentation and accompanying correspondence, analytical reports, methodology reports, and quality assurance reports. Central files are maintained in the Reporting

Section which contain copies of all analytical and technical correspondence, work orders, chain-of-custody records, sample tracking sheets, laboratory data and worksheets and any other paperwork relevant to the project. A secured storage area will be used for storage of USATHAMA data.

Each analyst is assigned a bound notebook to assure the integrity of their records. Each notebook is given a tracking number. The tracking number is an integral part of each page in the notebook. The notebook entries are in ink and contain the procedures used, deviations in the procedures, raw data, corrective actions, date of analysis of extraction, name of the analyst, and the name of the contract. Examples of calculations and the results are also reported. After a notebook is completed it will be returned to the Quality Control Coordinator or document control personnel and stored with the USATHAMA designated data class files.

Some analyses, due to their repetitive scheduling, have notebooks already formatted for use by the analysts. These are assigned numbers as mentioned above, and turned in when complete. The Laboratory Quality Control Coordinator maintains a list of all notebook numbers, dates out, and dates in.

Each instrument or apparatus which requires maintenance, standardization, tuning or calibration will have a dedicated logbook maintained along with the instrument. This logbook will contain documentation of the instrument's performance over time and records of instrument certification and maintenance. The instrument logbook will be maintained for 1 year beyond the life of the instrument.

The LAC prepares a complete list (inventory) of all required documentation and designates a specific individual responsible for the collection and completion of each type of documentation after the samples of a set are received, logged, and a work order is completed. At this point, the analytical work is well defined and the documentation required has been identified. Each responsible individual is provided with a copy of the documentation inventory sheet. The Project Manager reviews the development of documentation as the project proceeds, and collects and organizes all essential documents at the conclusion of the work. It is the current policy of the laboratory to file all documentation packages indefinitely unless directed otherwise by contract.

9.6 OUT-OF-CONTROL SITUATIONS

Failure to meet calibration criteria, record keeping omissions, improper sampling technique, and improper storage or preservation of samples are all conditions that affect data quality and require investigation/ correction. This section describes only evaluations performed by the analyst, in consultation with the LQAC, to determine whether the entire analytical method is in control. These evaluations must be done daily so that action can be taken immediately to investigate and correct problems. Failure to take immediate action may necessitate discarding large quantities of data and acquiring, preparing, and reanalyzing samples processed after the problem was detected.

For both duplicate spiked QC results and moving averages, a single mean ($\overline{x}$) outside of modified limits requires immediate investigation/corrective action. When two or more successive lot means for duplicate-spiked QC data are outside normal control limits but within modified limits, investigation/corrective action should be taken even though the data from these lots are acceptable. For moving averages, a single mean outside of normal control limits but within modified limits requires investigation/corrective action though the data are acceptable.

The following are cases of out-of-control situations:

1. Holding time - samples or sample extracts held beyond the time periods described in Section 5.3 are out-of-control. These samples should not be analyzed unless a written, incident-specific exception is received from the USATHAMA Chemistry Branch.

2. Control Charts $\overline{x}$ and R:

   - A value outside the control limits or classified as outlier by statistical test;

   - A series of seven successive points on the same side of the central line ($\overline{x}$ charts only);

   - A series of five successive points going in the same direction;

   - A cyclical pattern of control values; or

   - Two consecutive points between the UWL and UCL or the LWL and LCL.

   Whenever one of these conditions is detected, the analyst and LQAC must investigate to determine the cause and document actions taken. Data acquired concurrently with one of these conditions shall be discarded and samples reanalyzed unless the investigation of the problem proves that the analysis was in control or modified control limits are being used to determine acceptability of data. Justification for the acceptance of data will be provided with the weekly quality-control submission.

   As outlined below, the analyst will determine whether all sample analyses by a multi-analyte method should cease.

- Plot average percent recovery ($\overline{x}$) for each analyte.

- If the points for two-thirds (Table 9-2) of the control analytes for a multi-analyte method are classified as in-control, based on the conditions described above, the method is in control and environmental sample data may be reported (providing that the condition of two consecutive out-of-control points has not occurred). The conditions which may have caused more than one-third of the control analytes to fail the control criteria shall be investigated and corrected as necessary. All activities shall be documented. The data points indicating possible error shall be annotated with a reference to the investigation and to the fact that the method met control criteria.

- A method may be deemed out-of-control even if greater than or equal to two-thirds of the control analytes meet control criteria. Of the remaining control analytes (less than one-third possible out-of-control), if one analyte has two consecutive out-of-control points, as defined above, the method is out-of-control. Analyses must cease, the cause must be investigated and corrected, and a determination made by the USATHAMA Chemistry Branch on whether the lot must be reanalyzed.

- If data points for fewer than two-thirds of the control analytes are classified as in control (more than one-third meet one of the out-of-control conditions), the method is considered to be out-of-control and all work on that method (including sample preparation) must cease immediately. No data for environmental samples in that lot may be reported. Efforts must be initiated to determine the cause of the problem. If the problem is instrumental, samples prepared after the out-of-control situation occurred may be processed after the instrumental system is repaired and recalibrated, provided holding times are not exceeded. If no specific cause can be assigned, the instrument should be recalibrated and all samples prepared subsequent to the last in-control lot should be reprepared. In any case, the out-of-control lot must be reanalyzed. The out-of-control situation and corrective actions taken must be fully documented. Each point shall be annotated with a reference to the investigation and to the disposition of samples and results.

- The establishment of overall method control for analyses may not be accurate for describing a particular analyte. For analyses where control cannot be established for certain control analytes (i.e., loss of surrogate due to volatility), such analyte results may still be deemed as out-of-control even though the method is

Table 9-2 Minimum Number of In-Control Points for Multi-Analyte Methods

Required Control Analytes Per Method	Required Number of Data Values Falling Between the UCL and LCL
1	1
2	2
3	2
4	3
5	4
6	4
7	5
8	6
9	6
10	7
11	8
12	8
13	9
14	10
15	10
16	11
17	12
18	12
19	13
20	14
21	14
22	15
23	16
24	16
25	17

considered in control. The evaluation of control in such instances will be handled on a case-by-case basis.

If a lot is still out-of-control after reanalysis, analysis will stop immediately and the problem will be investigated.

10.0 INTERNAL QUALITY CONTROL

10.1 MEASUREMENT SYSTEMS

QC procedures have been established for RLSA's field activities and the subcontractor laboratory activities. Laboratory quality controls are addressed in the laboratory's QA Program submitted as part of the USATHAMA approval process. Field QC includes the use of calibration standards and blanks for pH, specific conductance, temperature, and dissolved oxygen measurements. Special samples to be submitted to the laboratory include trip blanks, sampler rinsate blanks, duplicate samples and background samples. These samples provide a quantitative basis for evaluating the data reported. The number and type of field QC samples to be collected is outlined in the Sampling and Analysis Plan.

10.1.1 TRIP BLANKS

Trip blanks are required for assessing the potential for contaminating samples with volatile organics (VOCs) during sampling or in transit. The trip blank consists of a VOC sample container filled with reagent water which is shipped to the site along with the empty VOC sample containers. A trip blank is included with each shipment of soil or water samples scheduled for VOC analysis and will be analyzed with the other VOC samples.

10.1.2 SAMPLER RINSATE BLANKS

A minimum of one sampler blank for the bailer, sampling pump, and/or tubing assembly is scheduled during monitoring well sampling. VOCs, Semivolatile organics (SVOCs), or inorganics present within the bailer, pump apparatus, or discharge tubing are assessed by collecting a sample of rinse water passed through the sampling apparatus after completing the decontamination procedure. All rinse water used for decontamination will be a USATHAMA-approved water source.

Two soil sampler rinsate blanks are planned to be collected. VOCs, SVOCs, or inorganics present on the sampling apparatus where intimate contact with the sample occurs (i.e., split spoon, hand auger, and Shelby tubes) are assessed by pouring USATHAMA-approved water over the sampling apparatus. Rinsates are collected directly into the appropriate soil jar.

Two wipe blanks will be collected to assess background levels of lead associated with the filter paper and sampling process. The filter paper will be moistened with deionized water, folded, sealed in an appropriately labeled glass scintillation vial, and submitted to the laboratory with the other wipe samples.

10.1.3 DUPLICATE SAMPLES

During ground-water sampling, one duplicate ground-water sample will be collected and submitted to the laboratory for every 20 field samples. Given the heterogeneity of soils, and thus the questionable significance of a field soil duplicate, field soil duplicates will not be collected. Duplicate soil samples will be split in the laboratory. Duplicates for paint chips and asbestos sampling will be prepared in the field. Duplicates will be collected at the frequency described in the Sampling and Analysis Plan.

10.2 COMPLETENESS

Completeness of scheduled sample collection will be controlled in the field by comparing a computer-generated label inventory with samples actually collected each day. Daily checking of field data sheets and comparison of transport and COC logs will provide further control of documentation and completeness.

11.0 AUDITS

System audits of the field and analytical programs will be performed by the QAC. Field activities will also be audited by the site and project managers. Audits will be performed as early in the field and analytical programs as is reasonably possible to ensure that any developing problems are identified at the earliest time possible. The results of all field and analytical audits will be briefly discussed in the final reports for each site. The field audits will focus on adherence to procedures outlined in the QAPP.

11.1 PERFORMANCE AUDITS

Performance audits will focus on the laboratory analytical program.

A continuous internal performance audit is administered in the laboratory. As discussed in Section 9.4, quality control samples are prepared and analyzed routinely within the laboratory as part of the internal quality control program. The data are evaluated by the LQAC as part of the internal quality control program. Any required corrective measures are initiated by the LQAC.

11.2 SYSTEM AUDITS

System audits are performed at least biannually by the USATHAMA Chemistry Branch. Most laboratories are also certified by their states Department of Health.

11.3 DOCUMENTATION AND REPORTING AUDITS

11.3.1 AUDIT FORMAT

System audits will be formally documented in a comprehensive report. The following information shall be included:

- Document identification;
- Activity audited;
- Name of company and/or individuals performing activity;
- Location;
- Date(s) of audit;

- Name of individual performing audit;
- Reference utilized, e.g., procedures, procurement documents, checklists, etc.;
- Results of audits;
- Summary of observations;
- Listing and/or description of nonconformance(s);
- Listing and/or description of corrective actions taken or to be taken for resolution;
- Listing and/or description of unresolved nonconformance(s); and
- Evaluation statement.

11.3.2 DISTRIBUTION OF DOCUMENTATION

Audit reports will be distributed to at least the Program Manager, Task Manager, Laboratory Analytical Coordinator, USATHAMA and the record file.

11.3.3 FOLLOW-UP ACTIONS

The individual who performed the audit will be responsible for follow-up correction actions to resolve nonconformances which were not serious enough to issue a stop work order. Documentation of this subsequent resolution will be issued to personnel who received the original audit report. The correspondence will specifically reference the actions taken to correct the nonconformances, and contain a current status evaluation and/or statement of acceptance.

11.3.4 DOCUMENTATION

The following documents generated by this procedure shall be retained in the QAC's records:

- Schedule of activities;
- Audit schedule and any revisions;
- Documentation of audit responses and corrective action taken;

- Audit reports;
- Follow-up correspondence; and
- All QA documents will be maintained in a permanent fashion.

12.0 PREVENTIVE MAINTENANCE

Laboratory instrument maintenance as described in this section pertains to maintaining test and measurement equipment used to conduct analyses utilizing absolute physical or electronic calibration and service contracts. Chemical calibration curves are discussed in Section 8.1 of the QA Program (USATHAMA, 1990).

Examples of equipment that must be calibrated include, but will not be limited to those listed below.

- Balances -- These are the clearest examples of equipment requiring calibration. National Institute of Standards Technology (NIST) certified weights are used to ensure the accuracy of measurements.

- Thermometers -- NIST-certified thermometers are used to verify the accuracy of measurements.

- Other Temperature Sensors and Controllers -- For analytical equipment that incorporates temperatures sensing or control, the accuracy of the sensors and controllers will affect method performance. When a method specifies an injector temperature of 100°C, the analyst must be sure that the instrument settings for 100°C actually correspond to that temperature. Oven temperatures (e.g., drying ovens, GC ovens) must be accurately known. Equipment manufacturers describe procedures for temperature calibration, using either NIST-calibrated thermometers or measured electrical signals.

- Flow Controllers -- Measuring and controlling gas and liquid flow are integral parts of many instrumental analysis systems. The devices used to measure/control must be calibrated to ensure that actual flow corresponds to instrument readings or settings. ICP, ion chromatography (IC), GC, GC/MS, and high pressure liquid chromatography (HPLC) are examples of systems that must be calibrated for flow.

- Autoinjectors -- The actual volume injected into the analytical system must correspond to the instrumental settings for the intended volume. This calibration is particularly critical when absolute analyte response (e.g., peak height) is used for quantification (as opposed to the ratio of analyte peak height to internal standard peak height).

- Recorders -- When physical records (e.g., strip charts) are used for quantification, the recorder response must correspond to the electronic signal received. If the basis of quantification is a linear relationship between response and concentration, the recorder must exhibit linear response to linear changes in electric signals.

All equipment to be calibrated will have an assigned record number permanently affixed to the instrument. A label will be affixed to each instrument showing: description, manufacturer, model number, serial number, date of last calibration or maintenance, by whom calibrated/maintained, (laboratory or service contract) and due date of next servicing. Calibration reports and compensation or correction figures will be maintained with the instrument in a logbook. Thermometers are excepted from the labeling requirement, but not from the calibration requirement.

A written stepwise calibration procedure should be available for each piece of test and measurement equipment. Any instrument which is not calibrated to within the manufacturer's original specifications must display a red warning tag to alert the analyst that the device carries only a "limited calibration." Equipment unable to meet approved calibration specifications shall not be used for sample analysis.

12.1 CALIBRATION IDENTIFICATION

Instruments past due for calibration or maintenance must be immediately removed from service, either physically or, if this is impractical, by tagging, sealing, labeling, or other means. Calibration or maintenance services provided to the laboratory by other organizations will be reported and kept in the permanent file system.

12.2 CALIBRATION STANDARDS

All physical or electronic measurements or calibrations (excluding chemical calibration curves) performed by or for the laboratory must be traceable, directly or indirectly, through an unbroken chain of properly conducted calibrations (supported by reports or data sheets) to the NIST. Reports must be up-to-date for each reference standard and each subordinate standard used for calibration of test and measurement equipment. When calibration services are performed by a non-contractor laboratory organization, copies of reports and records showing traceability to the NIST should be immediately available. These records may be inspected during laboratory audits.

The laboratory has three sets of traceable physical standards that are used routinely. They are:

- NIST traceable calibration thermometer;

- NIST traceable Class S weight for analytical balance calibration; and

- Special UV/Visible glass for spectrophotometer calibration.

The laboratory will document instrument maintenance schedules and maintenance contracts to ensure immediate response and that routine maintenance is performed.

13.0 DATA MANAGEMENT

Data generated from exploration and sample collection will be managed in accordance with USATHAMA data management procedures. Data for this project will include chemical analysis data from the laboratory subcontractor, geotechnical data from the field drilling program, and survey data. The chemical analysis data will be entered into the IRDMS by the Laboratory and reviewed by RLSA. All field-generated data will be entered on field log forms and field daily report forms for transmission to both RLSA and USATHAMA. Computerized geotechnical field and survey data will be entered by RLSA into IRDMS.

Data to be entered into IRDMS will be coded, reviewed, verified, and entered by RLSA and/or the Laboratory prior to required maximum suspense dates. All original logbooks, model outputs, and hard copy of chemical/geotechnical data will be supplied as Data Item A013 - A015 (Informal Technical Data). These will be transmitted by letter report and will be summarized and appended to the EI Report.

14.0 CORRECTIVE ACTIONS

If it appears that field or laboratory data are in error, the error or potential error will be documented and appropriate corrective action will be taken. Corrective actions may include one or more of the following:

- Measurements may be repeated to check the error;
- Calibrations may be checked and/or repeated;
- Instrument or measuring device may be replaced or repaired;
- New samples may be collected; and/or
- Samples may be reanalyzed.

Appropriate corrective actions will be determined on a case by case basis. A discussion of any corrective actions taken will be included in the appropriate final report.

The QAC will be responsible for identification of problems and implementation of corrective actions. If the project manager, task leaders or project staff become aware of any problems in sample collection or analysis they will immediately notify the QAC. The QAC will then decide the appropriate actions to be taken to resolve the problem. Section 11.0 describes the system audits that will be performed by the QAC or designee to monitor sampling and analytical programs. These audits will be performed as early as possible to ensure that developing problems are identified and corrected at the earliest possible time.

14.1 LABORATORY CORRECTIVE ACTION

The LQAC carefully monitors the results of the control samples analyzed and, in the event that a QC result is unacceptable, implements specific steps to identify and correct the deficiency. Generally, a Corrective Action Record is prepared by the LQAC and forwarded to the appropriate Section Manager. Action for correcting the problem, pursued jointly by the analyst, the appropriate Group Leader, the appropriate Section Manager, and the LQAC is recorded on the Corrective Action Record. The steps to be followed include:

- Check all data processing procedures and calculations.
- Check blank samples for identification of possible interferences or other problems.

- Check instrumentation performance (if applicable) by observing the response of the instrument while processing a sample material for which the expected response is known. Operating conditions must be similar to those used for analysis of the samples under consideration.

- Check the original standard preparation procedures by preparing new standards, obtaining a new standard calibration curve from the new data, and comparing the new standard curve with the original standard calibration curve.

- Check the integrity of the original QC samples by preparing new QC samples following the same procedures and analyzing the new QC samples.

- Carefully review raw data (e.g., recorder output, chromatograms, computer output) in an effort to identify interferences, unusual signals (unusual peak shapes, etc), or other factors which could produce inaccuracies.

- Reanalyze the samples with new standards and new QC samples if sufficient field sample material is available. The entire analytical process including, for example, extractions, digestions, etc. should be repeated if possible.

- If QC results are still unacceptable and no reason has been identified, discuss the problem in detail with personnel from the USATHAMA Chemistry Branch and determine how results should be reported.

15.0 QUALITY CONTROL REPORTS

Normal submissions to USATHAMA include the Precertification and Certification Performance Data Packages, IRDMS submissions, audit reports, and the results of QC activities. During those periods when analyses are being conducted, all QC charts (tabular and graphical) will be submitted to the USATHAMA Project Chemist on a weekly basis. The QC report will be provided to the Project Chemist not later than five working days after analyses for a week are completed. Analysis date shall be defined by the day the analytical instrument was run. All points which indicate an out-of-control situation will be evaluated and explained. Any corrective measures and reanalysis of samples will be fully explained and documented, including procedural changes to prevent recurrence. Printouts generated from control chart software programs provided by USATHAMA will be utilized, when available.

As an appendix to the project final report, the LQAC, in coordination with the LAC shall provide tabulation of all QC sample data, as well as specific observations delineating the control effectiveness for each analytical method. These observations will include the following:

- QC samples in each lot and how analytical results were combined to prepare control charts;
- Spike levels and rationale for choosing those levels;
- Possible effects on environmental sample results of detected concentrations in method blanks; and
- Unique matrix characteristics of environmental samples.

If at any time during the analytical effort a process was not in control, a discussion will be submitted on:

- Rationale for judging a point as in control, if it appears to satisfy an out-of-control criterion;
- Investigation of the out-of-control situation;
- Actions taken to bring the process back into control;
- Actions taken to ensure that the out-of-control situation did not recur; and

- Disposition of data acquired while the process was out-of-control.

The control chart checklist should be completed in the fashion described below.

Item 1 The USATHAMA Method Number(s) under which the control charts were generated that are included in this current package are to be listed in numerical order.

Item 2 A summary table shall be prepared listing the method number(s), USATHAMA lots, dates of analysis, and analytes that are included in this package.

Items 3 & 4 All $\overline{x}$ - R Control charts generated in the control of analyses performed during this period shall be included. Each control chart shall include the following information:

- Analyte
- Method number
- Laboratory
- Spike concentration
- Chart title - one of the following:
  - Single Day $\overline{x}$ Control Chart;
  - Single Day R Control Chart;
  - Three-Point Moving Average $\overline{x}$ Control Chart; or
  - Three-Point Moving Average R Control Chart.
- Three-letter lot designation and analysis date for each point, shown on the x-axis
- Percent Recovery (for $\overline{x}$ control charts) or Range (for R control charts) along the y-axis
- Upper control limit (UCL), on $\overline{x}$ and R control charts
- Upper warning limit (UWL), on $\overline{x}$ and R control charts

- Mean, on $\overline{x}$ and R control charts

- Lower warning limit (LWL), on $\overline{x}$ control charts

- Lower control limit (LCL), on $\overline{x}$ control charts

The charts must contain sufficient data so that any trends, if present, could be discerned. (Charts developed during the initial stages of analysis shall contain all points. Charts developed after the process has been stabilized, at least 20 points, shall contain at a minimum the most recent 10 points). Any point(s) that exceed the control limits shall be flagged (by circling in red) for discussion under 5b below. Any Outlier Tests must included.

Item 5 The observations made during the review of the control charts, including but not limited to the items listed, shall be submitted in writing.

Item 5b An analysis of any points flagged on the control chart(s) as being out-of-control shall be included. Discussion should attempt to describe the cause of the out-of-control status and whether the point(s) are to be expected due to the random statistics used to demonstrate control or are the results of a possible systematic error or bias that would affect the analytical results. The discussion should include evaluation of Outlier Test results.

Item 5c Describe all actions taken to get process back into control.

Item 5d The data generated to prove that the analysis is back in control along with the criteria used ascertaining same shall be included.

Item 6 Recommendations made as to the acceptance or rejection of the lot analysis, based on Item 5 above.

16.0 REFERENCES

U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), January 1990. U.S. Army Toxic and Hazardous Materials Agency Quality Assurance Program. Prepared for Commander U.S. Army Toxic and Hazardous Materials Agency. Aberdeen Proving Ground, MD 21010-5401.

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U.S. Environmental Protection Agency (EPA), Environmental Monitoring and Support Laboratory Office of Research and Development, March 1983. Methods for Chemical Analysis of Water and Wastes.

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