FINAL

Work Plan for the Installation-Wide Background Soil Study

Former Ramey Air Force Base
Aguadilla, Puerto Rico

Contract No. DACA21-96-D-0018
Task Order No. 0008

May 2000

INTERNATIONAL TECHNOLOGY CORPORATION

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U.S. Army Corps of Engineers
Savannah District

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Final
Work Plan for the Installation-Wide Background Soil Study Former Ramey Air Force Base Aguadilla, Puerto Rico

Prepared for:

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May 2000

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List of Acronyms

AFB	Air Force Base
bgs	below ground surface
CO	contracting officer
COR	contracting officer representative
DQO	data quality objective
E&E	Ecology and Environment, Inc.
EPA	U.S. Environmental Protection Agency
H&S	health and safety
IT	IT Corporation
msl	mean sea level
PAH	polynuclear aromatic hydrocarbons
PM	project manager
QA	quality assurance
QC	quality control
SAP	installation-wide sampling and analysis plan
SSHP	site-specific safety and health plan
TAL	target analyte list
TM	technical manager
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture

1.0 Introduction

The U.S. Army Corps of Engineers (USACE) has retained IT Corporation (IT) to conduct an installation-wide background soil study at the former Ramey Air Force Base (AFB), Aguadilla, Puerto Rico (Figure 1-1). The work will be performed through the USACE Savannah District Total Environmental Restoration Contract No. DACA21-96-D-0018, Task Order No. 8. This work plan was prepared in support of background study activities.

The significance of environmental investigations relies in part on distinguishing site-related impacts from natural and anthropogenic conditions. A powerful way to determine if a chemical or analyte is site-related is to compare its presence to a level of background. The objective of the planned study is to provide background soil chemical data that can be utilized for any Ramey AFB investigation requiring comparison of site data to background. Information obtained from the background study may be used to identify constituents of concern at Ramey AFB sites, determine the nature and extent of site-related contamination, identify naturally high background concentrations, support human health and ecological risk assessments, support No Further Action proposals, develop realistic remediation goals, and evaluate the success of remediation efforts.

Surface soil and subsurface soil samples will be collected in areas believed to be unaffected by former AFB-related contamination and other more recent industrial use. Samples will be analyzed for target analyte list (TAL) metals and polynuclear aromatic hydrocarbons (PAH). U.S. Environmental Protection Agency (EPA) guidance will be used to screen and select background data, evaluate distributional assumptions, determine to what extent samples from adjacent areas can be combined, determine to what extent surface and subsurface samples can be combined, and characterize distributions. A background soil study report will be prepared following statistical analyses of the data.

Investigation activities will be performed in accordance with the installation-wide sampling and analysis plan (SAP) (IT, 2000a), the USACE-Savannah District sampling and analysis plan, and the installation-wide health and safety plan (IT, 2000b). A site-specific safety and health plan (SSHP) is included in this work plan as Appendix A. Copies of the field forms and project forms that will be used throughout the project are provided in Appendix B. Responses to comments received on the draft version of this work plan are provided in Appendix C.

LEGEND:

— – APPROXIMATE BOUNDARY OF FORMER RAMEY AIR FORCE BASE

NOTES:

1. LOCATIONS OF RUNWAY AND INVESTIGATION SITES ARE APPROXIMATE.

PUERTO RICO

QUADRANGLE LOCATION

Atlantic Ocean

Punta Jacinto

Punta Agujereada

TANK FARM 6

TANK FARM 5

PUBLIC WORKS AREA

RUNWAY

MALEZA BAJA

RAMEY AIR FORCE BASE

MALEZA ALTA

AGUACATE

MONTAÑA

TANK FARM 7

DEFUELING PUMP PIT NO. 3

IMMEDIATE STORAGE PUMP STATION 1060

TANK FARM 2

TANK FARM 1

LANDFILL AREA 1

LANDFILL AREA 2

Aguacate

San Antonio

Montaña

Maleza

Arenales

Foso de Préstamo

CANAL

AGUADILLA

ISABELA

ANTIGUA VÍA DEL FERROCARRIL

TUNEL DE ACUEDUCTO

Map Scale 1:2000 (Approximate)
Metric Units
Source: USGS Aguadilla, Isabela, and Moca Quadrangles, 1960

FIGURE 1-1
LOCATION MAP

FORMER RAMEY AIR FORCE BASE
AGUADILLA, PUERTO RICO

IT CORPORATION
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DWG. NO.: 783147es.063
PROJ. NO.: 783146
INITIATOR: THORBJORNSEN
PROJ. MGR.: G. DUARLES
DRAFT, CHCK. BY: C.E. TUMLIN
ENGR. CHCK. BY: THORBJORNSEN
DATE LAST REV.:
DRAWN BY:
STARTING DATE: 05/16/00
DRAWN BY: T. BRADSHAW
05/16/2000
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2.0 Site History and Description

This section presents information pertinent to the background soil study at the former Ramey AFB. Included are a description of the former Ramey AFB, discussion of the regional geology, and description of site soils.

Former Ramey Air Force Base. The former Ramey AFB occupies approximately 4,357 acres in the northwest corner of the island of Puerto Rico, near the city of Aguadilla (Figure 1-1). The property was acquired by the U. S. Government between 1939 and 1963 and was a fully operational AFB until its deactivation in 1973 (Ecology and Environment, Inc. [E&E], 1997). In March 1974, ownership of most of the property was transferred to the Puerto Rico Industrial Development Company. Since then, the U.S. government has transferred numerous parcels of land to federal and local agencies and private companies. Presently, the U.S. Coast Guard occupies 125 acres, and the Puerto Rico Port Authority now owns and operates a municipal airport and an industrial park on the acreage formerly occupied by the Base. Also currently occupying former Ramey AFB property are the Puerto Rico National Guard, U.S. Customs, educational facilities, several privately-owned businesses, and residential property (E&E, 1997). Portions of the former Base are leased to local farmers.

Climate. The climate at Ramey AFB is classified as tropical-maritime, with temperatures ranging from 74 degrees Fahrenheit in January to 80 degrees Fahrenheit in July. The average annual precipitation is approximately 60 inches, with the rainy season occurring from May through December (E&E, 1997). Tropical depressions occasionally drift over the area producing heavy rainfall and occasional flooding. The wind regime is generally under the influence of prevailing easterly trade winds but is also affected by land and sea breezes. Usually the wind is strongest in July and light in autumn (U.S. Department of Agriculture [USDA], 1975).

Topography. The elevation at Ramey AFB ranges from 0 feet above mean sea level (msl) at the north and western coastline to approximately 240 feet above msl. An escarpment is located on the north and west portions of the Base, producing a steep rise in elevation from sea level (the Atlantic Ocean) to approximately 175 feet msl (Figure 1-1). The flightline portion of the Base is flat and higher than much of the facility, with an approximate elevation of 190 to 230 feet msl (U.S. Geological Survey, 1960). Rough relief occurs in parts of Ramey AFB due to the chemical dissolution of the underlying limestone bedrock. This dissolution has produced such karst features as sinkholes, caves, *mogotes* (haystack hills), dead-end valleys, and many precipitous cliffs (Rodríguez-Martínez, 1995).

Soils. The majority of the soils at Ramey AFB are either of the Bejucos-Jobos association or the Coto-Aceitunas association (USDA, 1975). The Bejucos-Jobos association is comprised of strongly leached soils that have a tight, dominantly clayey subsoil. The majority of soils in this classification are well drained and strongly acidic. The Bejucos soils have a dark yellowish-brown, moderately coarse-textured surface layer and a subsoil that is dominantly fine-textured and mottled below a depth of approximately 37 inches. The Jobos soils have a dark grayish-brown, coarse-textured surface layer and a thick, mottled, red and strong brown, compact, fine-textured subsoil.

The Coto-Aceitunas association consists of slightly leached and strongly leached porous soils that are dominantly clayey throughout (USDA, 1975). The major soils of this association are underlain by hard, fragmented limestone and are characterized as deep, gently sloping to sloping, well-drained and moderately permeable. The Coto soils are reddish-brown, slightly acidic, and fine-textured; the Aceitunas soils are dark reddish brown, fine- to moderately fine-textured, and very strongly acidic.

Geology. Ramey AFB is located in the Coastal Plains physiographic region in the Mayaguez area. The coastal plains parallel nearly the entire northern coastline and include most of the area north of the towns of Aguadilla, Moca, San Sebastion, and Lares. The site is underlain by alluvial and terrace deposits that are characterized as unstratified, fine- to medium-grained quartz sand, and light- to moderate-brown clays. These unconsolidated materials are between 0 and 100 feet thick (Monroe, 1969).

The surficial deposits are underlain by limestone of Miocene age and are located in a broad limestone belt that is Puerto Rico's best developed karst region. The geologic formation found beneath the coastal sediments is the Early Miocene Aymamón Limestone. The upper member of this formation is characterized as very pale orange to bright yellow chalk containing fossils and interbedded with hard, vuggy, very pale orange to white limestone, some of which is fossiliferous (Monroe, 1969). The lower member of the Aymamón consists of white to very pale orange, very pure fossiliferous limestone; it is generally indurated into finely crystalline, dense limestone, and is locally a recemented solution breccia (Monroe, 1966, 1969). The Aymamón formation is estimated to be up to 1,000 feet thick beneath the site (Rodríguez-Martínez, 1995). The middle and upper parts of the formation are highly permeable, with as much as 25 percent total porosity (Rodríquez-Martínez, 1995). Underlying the Aymamón Limestone is the Aguada Limestone, which is characterized as a hard, thick-bedded calcarenite interbedded with chalky limestone and marl (Monroe, 1969).

The Aymamón is present beneath the site as a buff to yellow-tan, soft, moderately to heavily weathered, porous and pitted limestone with some iron staining (E&E, 1997). Hardness and color varies slightly with depth. Cuttings from various depths were also observed to contain fossils. A loss of air circulation during drilling activities, likely due to increased secondary porosity and void space, was generally noted between 150 and 200 feet below ground surface (bgs).

Unconsolidated soils encountered during the drilling activities in 1996 at Landfill Areas 1 and 2 (Figure 2-1) were visually characterized and consisted primarily of brown to orange-brown silty sandy clay and sandy clay (E&E, 1997). Some travertine and clear calcite crystals were observed in rock cuttings at approximately 135 feet bgs at Landfill Area 1. Groundwater at Landfill Area 1 was encountered between approximately 214 and 240 feet bgs and flowed toward the east. At Landfill Area 2, where agricultural crops are grown, a thin (1- to 2-foot thick) veneer of brown silt loam overlies the orange-brown silty sandy clays and sandy clays. Groundwater at Landfill Area 2 was encountered between approximately 211 and 223 feet bgs and flowed north and northwest toward the ocean.

Hydrogeology. Most groundwater at Ramey AFB occurs within the water table aquifer that extends throughout the North Coast Province. An underlying artesian aquifer, which is an important source of water in North-Central Puerto Rico, becomes fragmented and unproductive in the site vicinity. The water table aquifer in the North Coast Province extends from the water table surface to the top of the freshwater/saline-water interface and is a gradational zone 75 to 115 feet thick. The water table aquifer is primarily located within the Aymamón and Aguada limestones, although it is present in the uppermost portion of the alluvial aquifer in coastal areas. In the immediate vicinity of the site, the fresh water table is situated in the Aymamón limestone only a few feet above sea level (E&E, 1997). Groundwater in the underlying Aguada Limestone is saline within the site boundary.

Estimated hydraulic conductivities within the Aymamón Limestone range from 57 to 570 feet per day and decrease with depth (E&E, 1997). The decrease in hydraulic conductivity with depth is likely related to the maximum effective depth to which karstification will occur within the aquifer. Transmissivity estimates are sparse because no rigorous aquifer tests have been conducted within the area. Available transmissivity estimates for the freshwater zone of the water table aquifer range from 200 to more than 280,000 feet per day. The high transmissivity values potentially reflect cavernous porosity and enhanced dissolution along bedding planes, joints, and fractures.

DATE LAST REV.:		DRAFT. CHCK. BY: C. TUMLIN	INITIATOR: THORBJORNSEN
DRAWN BY:		ENGR. CHCK. BY: THORBJORNSEN	PROJ. MGR.: G. QUARLES
STARTING DATE: 01/12/00			PROJ. NO.: 783146
DRAWN BY: T. BRADSHAW			DWG. NO.:...\783146es.043
05/16/2000 03:52:14			
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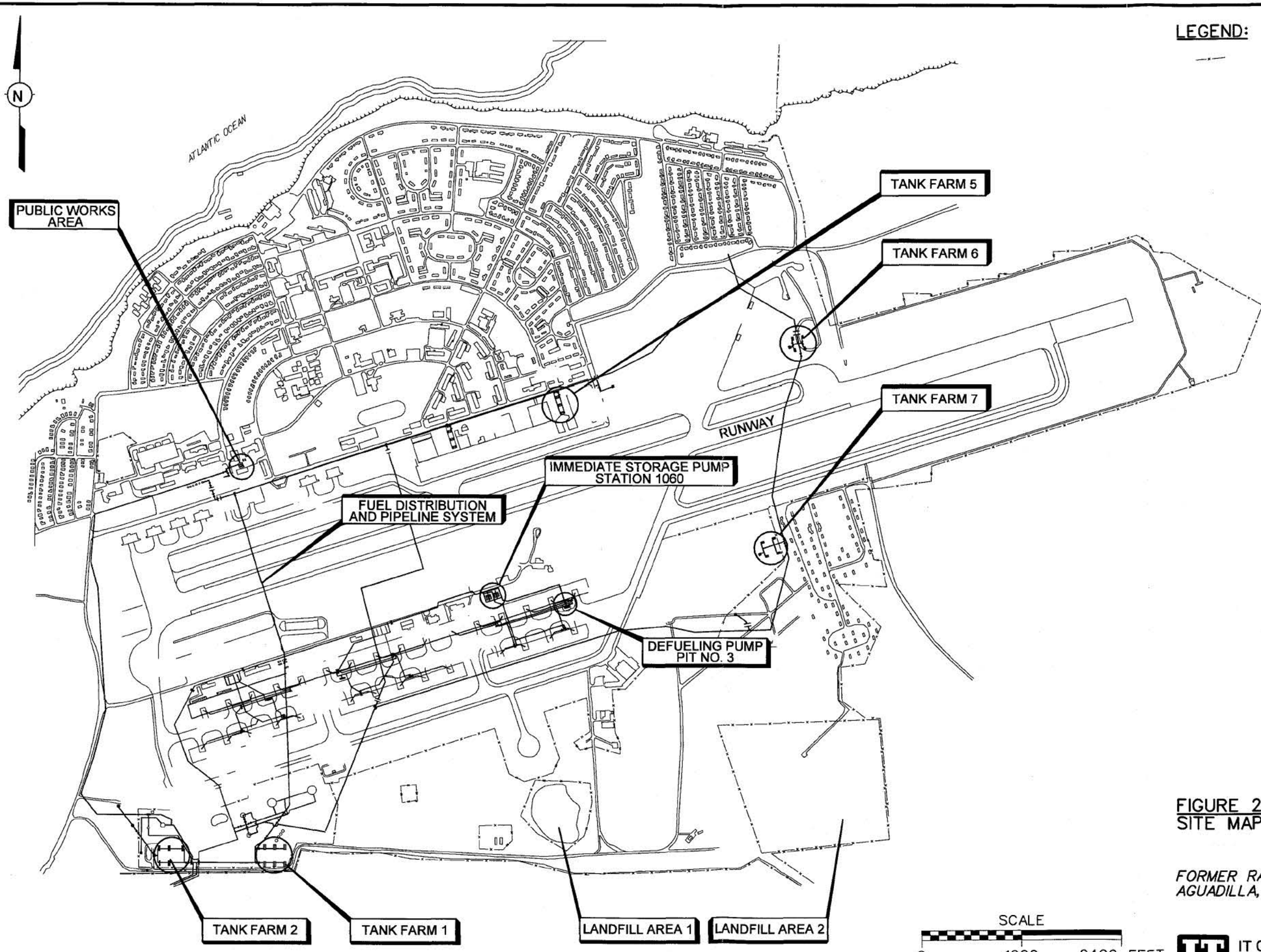

LEGEND:

FENCE

SCALE

0 1200 2400 FEET

FIGURE 2-1
SITE MAP

FORMER RAMEY AIR FORCE BASE
AGUADILLA, PUERTO RICO

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Surface Water Hydrology. Surface water at Landfill Area 1 drains toward an adjacent sinkhole along channels. These narrow drainage channels are approximately 30 feet deep, with exposed bedrock at the bottom. There are swallows along the course of the channels allowing for direct transport of storm water to the underlying groundwater. The easternmost channel has begun to expose landfill material, which is being transported into the sinkhole during storm events. Ponded storm water can remain in the sinkhole for up to a week after a storm, and high water marks as high as 12 feet have been observed in the sinkhole (E&E, 1997).

Inspection of a 1966 map of the Base indicates that the storm flow channels that received runoff from the aircraft apron terminated into a naturally occurring low area (E&E, 1997). The sanitary fill from the Base was placed in the low area as well. A comparison of the 1966 map with current conditions indicates that the 5-acre, 35-foot-deep sinkhole next to Landfill Area 1 has probably developed during the last 30 years so that now it is gradually capturing the western edge of Landfill Area 1.

Water Supply. Potable water at the former Ramey AFB is supplied by the Puerto Rico Aqueduct and Sewer Authority. Puerto Rico Aqueduct and Sewer Authority reports that domestic water supply in the vicinity of Ramey AFB is obtained from several surface water reservoirs located between 5 and 10 miles south and southeast, and upgradient of the Base. A site visit and file review by E&E revealed no indication of private supply wells for domestic use (E&E, 1997). Private potable supply wells are unlikely in the vicinity of the site due to the depth of groundwater below the ground surface. The former Ramey AFB maintained a supply well (or wells) and a water tower for potable use, but this equipment has fallen into extreme disrepair and appears unusable (E&E, 1997).

3.0 Background Soil Study Objectives

This chapter discusses the objectives of the proposed background soil study at the former Ramey AFB. The data quality objectives (DQO) of this investigation are also specified and discussed, to clarify how the analytical data will support the desired study objectives.

3.1 Objectives of Investigation

The proposed study is intended to provide background soil chemical data that can be utilized for any Ramey AFB investigation requiring comparison of site data to background. These data will be used to identify constituents of concern at Ramey AFB sites, determine the nature and extent of contamination, identify naturally high background concentrations, and support baseline human health and ecological risk assessments. In addition, background chemical data may be used to support No Further Action proposals, develop realistic remediation goals, and evaluate the success of remediation efforts.

Surface soil and subsurface soil samples will be collected from areas believed to be uninfluenced by Ramey AFB-related contamination and the more recent industrial use, based on a review of historical records, maps, aerial photographs, and current site conditions. All samples will be analyzed for TAL metals and PAHs. Metals are assumed to be naturally occurring in soil, because they originate from their respective source rocks. PAHs are a class of organic compounds that form from natural or anthropogenic combustion of organic matter (including fossil fuels), and they may also be present in soil. PAHs are generally ubiquitous in the environment, and background levels in urban, rural, and agricultural soils have been compiled (Agency for Toxic Substances and Disease Registry, 1993). With the exception of PAHs, it is assumed that the soil is naturally free from organic compound contamination.

3.2 Associated Data Quality Objectives

DQOs are qualitative and quantitative criteria used to guide sample collection and analysis activities. The DQOs are developed at the outset of an investigation to ensure that the data generated during the investigation are of appropriate quality to support the anticipated end use of the data. The general DQOs for this investigation are to produce scientifically valid data of known accuracy and precision, which are complete with respect to identified critical samples, comparable with similar data types, and representative of the media sampled so as to be useful for the cited investigation purposes.

DQOs describe the level of uncertainty that the decision-maker is willing to accept in results derived from environmental data. The uncertainty is used to specify the quality of the measured

data, usually in terms of objectives for precision, bias, representativeness, comparability, and completeness. DQOs seek to ensure that the right type, amount, and quality of data are collected to accomplish the objectives of the project. More details on DQO elements, including level of precision and accuracy for the target analytes in each sample medium, are provided in the Ramey AFB SAP (IT, 2000a). Table 3-1 provides a summary of the general DQOs for this project. As defined by EPA DQO guidance (EPA, 1993a), analytical data acquired during this background study will be considered definitive.

Table 3-1

Study Objectives and Data Quality Objectives
Installation-Wide Background Soil Study
Former Ramey Air Force Base
Aguadilla, Puerto Rico

Study Objectives	Data Quality Objectives
Obtain definitive surface soil and subsurface soil chemical data for installation-wide background soil study.	Collect surface soil and subsurface soil samples in areas believed to be uninfluenced by AFB-related contamination and other industrial use. Analyze samples for polynuclear aromatic hydrocarbons and target analyte list metals. Perform full data validation on all samples.
Determine background chemical distributions for the media listed above.	Perform statistical analyses on analytical data in accordance with EPA guidance. Compile summary statistics on best-fit distributions.

AFB - Air Force Base.
EPA - U.S. Environmental Protection Agency.

4.0 Technical Approach

This chapter presents the proposed sampling strategy for the background soil study, including sampling locations and analytical methods.

4.1 Sampling and Analysis

This section reviews the proposed sample locations and the rationale behind sample collection and laboratory analysis.

4.1.1 Sampling Locations and Selection Strategy

The following sections briefly describe the objectives for collecting the proposed samples and provide the rationale behind the placement of each sample location. This will allow field deviations, if necessary, so that they are in accordance with the intent of sampling. Table 4-1 summarizes the proposed sampling strategy and Figures 4-1 and 4-2 show the proposed sample locations.

Twenty surface soil (0 to 1 foot bgs) and 20 subsurface soil (1 to 3 feet bgs) samples will be collected to determine background chemical levels. The subsurface soil samples will be collected above the water table. Samples will be collected in areas believed to be free of Ramey AFB-related contamination and other industrial use, based on a review of historical records, maps, aerial photographs, and current site conditions. Ramey AFB sites that are undergoing separate investigation or remedial action are identified on Figure 2-1.

4.1.2 Sampling and Analysis Requirements

Table 4-2 summarizes the sampling and analytical requirements for the background study, including analytical methods, quality assurance (QA)/quality control (QC) requirements, sample containers, preservation requirements, and holding times. Table 4-3 lists the sample identification numbers for each proposed sample. Air monitoring will be performed during ground-intrusive activities in accordance with Chapter 4.0 of the SSHP (Appendix A). Field sampling will be performed in accordance with EM 200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans* (USACE, 1994).

Soil Samples. Surface and subsurface soil samples will be submitted for TAL metals and PAH analyses. Surface and subsurface soil samples will be collected using hand augers or direct-push technology. Direct-push samples will be collected using disposable Teflon™ sleeves.

Table 4-1

Proposed Sampling Strategy
Installation-Wide Background Soil Study
Former Ramey Air Force Base
Aguadilla, Puerto Rico

Media	Number of Samples[a]	Depth	Analyte Groups/ Analyses	Placement Strategy and Rationale
Surface Soil	20 + QA/QC	0' - 1'	PAH TAL Metals[b]	Samples will be located in areas believed to be uninfluenced by AFB-related contamination and other industrial use, based on review of historical records, maps, and aerial photographs.
Subsurface Soil	20 + QA/QC	1' - 3'	PAH TAL Metals[b]	Samples will be collocated with surface soil samples in areas believed to be uninfluenced by AFB-related contamination and other industrial use, based on review of historical records, maps, and aerial photographs.

[a]QA/QC sample types and quantities are specified in Table 4-2.

[b]TAL metals list includes aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

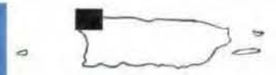
Note: PAH will be analyzed by EPA Method 8310.
AFB - Air Force Base.
NA - Not applicable.
PAH - Polynuclear aromatic hydrocarbons.
QA/QC - Quality assurance/quality control.
TAL - Target analyte list.
TOC - Total organic carbon.

LEGEND:

- BGS001 PROPOSED SOIL BORING
- APPROXIMATE BOUNDARY OF FORMER RAMEY AIR FORCE BASE

NOTES:

1. ALL SAMPLE LOCATIONS ARE APPROXIMATE AND MAY BE MOVED DUE TO FIELD CONDITIONS.
2. LOCATIONS OF SOIL BORINGS BGS009 THROUGH BGS020 ARE DEPICTED ON FIGURE 4-2.
3. LOCATIONS OF RUNWAY AND INVESTIGATION SITES ARE APPROXIMATE.



Atlantic Ocean

Punta Jacinto

Punta Agujereada

TANK FARM 6

TANK FARM 5

PUBLIC WORKS AREA

BGS001

BGS002

BGS003

BGS004

BGS005

BGS006

BGS007

BGS008

RUNWAY

RAMEY AIR FORCE BASE

MALEZA BAJA

MALEZA ALTA

AGUACATE

MONTAÑA

TANK FARM 7

DEFUELING PUMP PIT NO. 3

IMMEDIATE STORAGE PUMP STATION 1060

TANK FARM 2

TANK FARM 1

LANDFILL AREA 1

LANDFILL AREA 2

Aguacate

San Antonio

Montaña

Maleza

Arenales

AGUADILLA

ANTIGUA VÍA DEL FERROCARRIL

TUNEL DE AGUADILLA

Map Scale 1:2000 (Approximate)
Metric Units
Source: USGS Aguadilla, Isabela, and Moca Quadrangles, 1960

FIGURE 4-1
PROPOSED BACKGROUND SOIL SAMPLING LOCATIONS

FORMER RAMEY AIR FORCE BASE
AGUADILLA, PUERTO RICO

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DRAWN BY: T. BRADSHAW | STARTING DATE: 05/16/00
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Table 4-2

Sampling and Analytical Requirements
Installation-Wide Background Soil Study
Former Ramey Air Force Base
Aguadilla, Puerto Rico

Matrix	Parameter	Analytical Method	No. of Samples	QC Samples						QA Samples			Sample Container	Preservation Requirements	Holding Time	Approx. Total No. of Containers
				No. of Dups	No. of MS	No. of MSD	No. of Sample Rinsates	No. of Trip Blanks	Total No. of Samples	No. of Splits	No. of Trip Blanks	Total No. of QA Samples				
Background Soil Study																
Surface Soil	PAH	8310	20	2	1	1	1	0	25	2	0	2	4 oz glass	Cool to 4 deg. C	14 d ext/40 d	27
	TAL Metals	6010B/7471	20	2	1	1	1	0	25	2	0	2	4 oz glass	Cool to 4 deg. C	6 months	27
Subsurface Soil	PAH	8310	20	2	1	1	1	0	25	2	0	2	4 oz glass	Cool to 4 deg. C	14 d ext/40 d	27
	TAL Metals	6010B/7471	20	2	1	1	1	0	25	2	0	2	4 oz glass	Cool to 4 deg. C	6 months	27
IDW Water	Volatiles	8260B	1	0	0	0	0	1	2	0	0	0	(3) 40 mL VOA vials	Cool to 4 deg. C, HCl to pH <2	14 days	6
	SVOC	8270C	1	0	0	0	0	0	1	0	0	0	(2) 1 L amber glass	Cool to 4 deg. C	14 d ext/40 d	2
	Metals (total)	*601B/7470*	1	*0*	*0*	*0*	*0*	*0*	1	*0*	*0*	0	1 L Poly	*Cool to 4 deg. C, HNO_3 to pH <2*	6 months	1
	Metals (dissolved)	601B/7470	1	0	0	0	0	0	1	0	0	0	1 L Poly	Cool to 4 deg. C, HNO_3 to pH <2	6 months	1
	Pesticides	8081A	1	0	0	0	0	0	1	0	0	0	(2) 1 L amber glass	Cool to 4 deg. C	14 d ext/40 d	2
	PCBs	8082	1	0	0	0	0	0	1	0	0	0	(2) 1 L amber glass	Cool to 4 deg. C	14 d ext/40 d	2
	Herbicides	8151A	1	0	0	0	0	0	1	0	0	0	(2) 1 L amber glass	Cool to 4 deg. C	14 d ext/40 d	2
	Cyanide	9010B	1	0	0	0	0	0	1	0	0	0	1 L Poly	Cool to 4 deg. C, NaOH to pH >12	14 days	1
IDW Soils	Full TCLP	1311/various	1	0	0	0	0	0	1	0	0	0	1 L wm glass	Cool to 4 deg. C	14 d ext/40 d	1
	Reactive Cyanide	9012	1	0	0	0	0	0	1	0	0	0	8 oz amber glass	Cool to 4 deg. C	14 days	1
	Reactive Sulfide	9030A	1	0	0	0	0	0	1	0	0	0	8 oz amber glass	Cool to 4 deg. C	14 days	1
	Flashpoint	*1010*	1	*0*	*0*	*0*	*0*	*0*	1	*0*	*0*	0	*16 oz glass*	*Cool to 4 deg. C*	ASAP	1
	Corrosivity	1110	1	0	0	0	0	0	1	0	0	0	1 L wm glass	Cool to 4 deg. C	ASAP	1

Notes:
All quantities are estimated and may change due to field conditions.
All field work will be performed in accordance with EM 200-1-3 (Table I-1) (USACE, 1994).

MS - Matrix spike.
MSD - Matrix spike duplicate.
PAH - Polynuclear aromatic hydrocarbons.
PCB - Polychlorinated biphenyls.
QA - Quality assurance.
SVOC - Semivolatile organic compounds.
QC - Quality control.
TAL - Target analyte list.
TCLP - Toxicity characteristic leaching procedure.
TOC - Total organic carbon

Table 4-3

Sample Designations
Installation-Wide Background Soil Study
Former Ramey Air Force Base
Aguadilla, Puerto Rico

Sample Location	Sample Designation	Sample Depth (feet)	QA/QC Sample Designation		Analytical Suite
			Field Duplicates/ Split Samples	MS/MSD	
Direct-Push Soil Samples					
BGSO01	RAFB-BGSO01-SS-ZA0001-REG	0 - 1	RAFB-BGSO01-SS-ZA0002-FD RAFB-BGSO01-SS-ZA0003-SPLT		PAH TAL Metals
	RAFB-BGSO01-DS-ZA0004-REG	1 - 3			PAH TAL Metals
BGSO02	RAFB-BGSO02-SS-ZA0005-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO02-DS-ZA0006-REG	1 - 3	RAFB-BGSO02-DS-ZA0007-FD RAFB-BGSO02-DS-ZA0008-SPLT		PAH TAL Metals
BGSO03	RAFB-BGSO03-SS-ZA0009-REG	0 - 1		RAFB-BGSO03-SS-ZA0009-MS RAFB-BGSO03-SS-ZA0009-MSD	PAH TAL Metals
	RAFB-BGSO03-DS-ZA0010-REG	1 - 3			PAH TAL Metals
BGSO04	RAFB-BGSO04-SS-ZA0011-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO04-DS-ZA0012-REG	1 - 3		RAFB-BGSO04-DS-ZA0012-MS RAFB-BGSO04-DS-ZA0012-MSD	PAH TAL Metals
BGSO05	RAFB-BGSO05-SS-ZA0013-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO05-DS-ZA0014-REG	1 - 3	RAFB-BGSO05-DS-ZA0015-FD RAFB-BGSO05-DS-ZA0016-SPLT		PAH TAL Metals
BGSO06	RAFB-BGSO06-SS-ZA0017-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO06-DS-ZA0018-REG	1 - 3			PAH TAL Metals
BGSO07	RAFB-BGSO07-SS-ZA0019-REG	0 - 1	RAFB-BGSO07-SS-ZA0020-FD RAFB-BGSO07-SS-ZA0021-SPLT		PAH TAL Metals
	RAFB-BGSO07-DS-ZA0022-REG	1 - 3			PAH TAL Metals

Table 4-3

Sample Designations
Installation-Wide Background Soil Study
Former Ramey Air Force Base
Aguadilla, Puerto Rico

Sample Location	Sample Designation	Sample Depth (feet)	QA/QC Sample Designation		Analytical Suite
			Field Duplicates/ Split Samples	MS/MSD	
BGSO08	RAFB-BGSO08-SS-ZA0023-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO08-DS-ZA0024-REG	1 - 3			PAH TAL Metals
BGSO09	RAFB-BGSO09-SS-ZA0025-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO09-DS-ZA0026-REG	1 - 3			PAH TAL Metals
BGSO10	RAFB-BGSO10-SS-ZA0027-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO10-DS-ZA0028-REG	1 - 3			PAH TAL Metals
BGSO11	RAFB-BGSO11-SS-ZA0029-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO11-DS-ZA0030-REG	1 - 3			PAH TAL Metals
BGSO12	RAFB-BGSO12-SS-ZA0031-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO12-DS-ZA0032-REG	1 - 3			PAH TAL Metals
BGSO13	RAFB-BGSO13-SS-ZA0033-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO13-DS-ZA0034-REG	1 - 3			PAH TAL Metals
BGSO14	RAFB-BGSO14-SS-ZA0035-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO14-DS-ZA0036-REG	1 - 3			PAH TAL Metals

Table 4-3

Sample Designations
Installation-Wide Background Soil Study
Former Ramey Air Force Base
Aguadilla, Puerto Rico

Sample Location	Sample Designation	Sample Depth (feet)	QA/QC Sample Designation		Analytical Suite
			Field Duplicates/ Split Samples	MS/MSD	
BGSO15	RAFB-BGSO15-SS-ZA0037-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO15-DS-ZA0038-REG	1 - 3			PAH TAL Metals
BGSO16	RAFB-BGSO16-SS-ZA0039-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO16-DS-ZA0040-REG	1 - 3			PAH TAL Metals
BGSO17	RAFB-BGSO17-SS-ZA0041-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO17-DS-ZA0042-REG	1 - 3			PAH TAL Metals
BGSO18	RAFB-BGSO18-SS-ZA0043-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO18-DS-ZA0044-REG	1 - 3			PAH TAL Metals
BGSO19	RAFB-BGSO19-SS-ZA0045-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO16-DS-ZA0046-REG	1 - 3			PAH TAL Metals
BGSO20	RAFB-BGSO20-SS-ZA0047-REG	0 - 1			PAH TAL Metals
	RAFB-BGSO20-DS-ZA0048-REG	1 - 3			PAH TAL Metals

Table 4-3

Sample Designations
Installation-Wide Background Soil Study
Former Ramey Air Force Base
Aguadilla, Puerto Rico

Sample Location	Sample Designation	Sample Depth (feet)	QA/QC Sample Designation		Analytical Suite
			Field Duplicates/ Split Samples	MS/MSD	
IDW Samples					
BGIDW01 (liquid)	RAFB-BGIDW01-GENL-ZA9001-REG	NA			VOC, SVOC, Metals, Pesticides, PCBs, Herbicides, Cyanide
BGIDW02 (solid)	RAFB-BGIDW02-GENS-ZA9002-REG	NA			Full TCLP, Waste characterization

MS/MSD - Matrix spike/matrix spike duplicate.
NA - Not applicable.
PAH - Polynuclear aromatic hydrocarbons.
QA/QC - Quality assurance/quality control.
SVOC - Semivolatile organic compounds.
TAL - Target analyte list.
TBD - To be determined.
TOC - Total organic carbon.
VOC - Volatile organic compounds.

Soil samples will be homogenized in a stainless-steel bowl in accordance with Section 6.1.1 of the SAP (IT, 2000a). To be representative of the matrix, the samples must be free of excess vegetation, rock, and foreign matter. These materials can be removed using a sampling spoon during sample mixing.

A hazardous toxic and radiologic waste drilling log (Appendix B) will be completed for each soil boring. All soil samples will be described using the Unified Soil Classification System soil taxonomy nomenclature and the sample location will be sketched in the field. In addition, a sample collection log (Appendix B) will be completed for each sample submitted for chemical analysis. Following sampling, each boring will be backfilled with excess soil and marked with a stake for surveying.

Decontamination procedures for the soil sampling equipment will follow those specified in the SAP (IT, 2000a). Sampling equipment will be brushed free of caked soil and then cleaned with a soap wash and potable water rinse, followed by a nitric acid rinse, and a deionized or distilled water final rinse. Sampling equipment will be allowed to air dry, and will then be wrapped to prevent exposure to foreign matter before the next use. Rinse water will be emptied onto the ground. Soap wash water will be collected and allowed to evaporate.

IT will contact the USACE Project Chemist (Dr. Franz Froelicher) at least three weeks before QA sample shipment. Unless instructed otherwise by USACE, the QA samples from this project will be analyzed by Accura Analytical Labs, Inc. (c/o Dave Fuller, 6017 Financial Drive, Norcross, Georgia 30071-5816). The point of contact is Mr. Dave Fuller (770-494-8800).

4.1.3 Sample Location Surveys

Each sample location will be clearly marked with a pin flag or stake until it can be surveyed. The sample location identifier will be written in waterproof ink on each marker. Each location will be surveyed for horizontal coordinates to the nearest 0.1 foot and referenced to the State Plane Coordinate System. Surveying will be performed in accordance with Section 5.6 of the SAP (IT, 2000a) and will be conducted by a licensed land surveyor.

4.2 Background Soil Study Tasks

Data collected during the field investigation will be presented in an installation-wide background soil study report. This report will provide information on background chemical distributions to support the evaluation of nature and extent of contamination, support site-specific risk assessments, and guide regulatory decision-making. All analytical data will be validated.

Data Management. The data management process includes all aspects of data review and data validation. All data associated with the Ramey AFB project will undergo several evaluations in the laboratory and by IT personnel prior to release to the data end-users. General data management will follow the guidance provided in Chapter 8.0 of the SAP (IT, 2000a) and in this section of the work plan.

- ***Data Packages.*** The data packages received from the laboratory will undergo internal review by the analyst and a peer or supervisor review prior to being sent to the IT project chemist for additional project-specific review. In the data review process, the data will be compared to the planned objectives in the work plan and QC sample data to evaluate the validity of the results.

- ***Data Validation.*** A thorough evaluation of the data will be conducted to determine whether or not the project objectives have been met. Specific issues to be addressed include precision, accuracy, and representativeness such as duplicate results, matrix spike/matrix spike duplicate, and blank sample results. An evaluation of completeness will be performed and data deficiencies will be identified and rectified or documented for the report. An overall assessment will be made against the DQOs identified to ensure that the data meet the objectives.

- The definitive data will undergo a formal validation in accordance with the SAP (IT, 2000a). One hundred percent of the data collected will receive a full Level C data validation. During the data validation process, qualifiers will be added to the data. Since samples will be analyzed by SW-846 methods, the data validators will evaluate the QA/QC guidance provided in each method used to analyze samples. Overall, the SW-846 guidelines mimic the most current edition of the EPA's National Functional Guidelines (EPA, 1993b, 1994). All aspects of validation, as defined in the National Functional Guidelines, will be evaluated for each set of data collected. The QA/QC guidance defined in EPA's *Test Methods for Evaluating Solid Waste*, EPA SW-846 (EPA, 1986) will be used, unless more stringent criteria are defined in the Ramey AFB SAP.

Statistical Approach. Surface soil and subsurface soil background distributions will be established based on EPA guidance (EPA, 1989, 1992). Background data sets will first be analyzed for distribution using the Shapiro-Wilk test for normality. The Shapiro-Wilk test is recommended as a superior alternative to the Chi-square test for testing normality of the data (EPA, 1992). The Shapiro-Wilk test is based on the premise that if a set of data is normally distributed, the ordered values should be highly correlated with corresponding quantiles taken from a normal distribution (Shapiro and Wilk, 1965). Data sets that fail the normality test will be tested for lognormality by performing the Shapiro-Wilk test on the log-transformed data set.

If the data set fails both tests for normality and lognormality, it will be treated as a nonparametric distribution.

After the data set has been tested for distribution, it will be tested for statistical outliers (EPA, 1989). A statistical outlier is an observation that does not belong to the same population from which the rest of the data set was drawn. Outliers will be identified and evaluated as to whether they should be rejected or retained in the data set.

Following the distribution analysis and outlier testing, the following statistics will be compiled on the data sets:

- Frequency of detection
- Type of distribution (normal, lognormal, or nonparametric)
- Range of detected concentrations
- Central tendency (arithmetic mean, geometric mean, or median, depending on the type of distribution)
- Standard deviations
- 95 Percent upper confidence limit of the mean
- 95 Percent upper tolerance limit, or 95th percentile, depending on the type of distribution
- Range of detection limits.

Soil samples obtained from this study will initially be treated as a single data set, because all of the samples are expected to be collected from the same general soil type. Surface and subsurface samples, however, will initially be considered separate data sets. EPA-recommended statistical methods (Wilcoxon rank sum test and box plots) will be used for each metal to determine if the data sets are sampling the same underlying population. Data sets that are statistically equivalent will be combined prior to calculating summary statistics, and sets that are significantly different will be kept as such. Summary statistics will be based on the best-fit distribution.

Reporting. An installation-wide background soil study report will be prepared following the statistical analysis of background data. The report will be prepared in draft and final versions, and will contain summary tables of the statistical results. Appendices will contain the complete set of analytical results, the quality control summary report, field activity daily logs, soil boring

logs, and survey data. Comments received on the draft report will be incorporated in the final version of the report.

5.0 Investigation-Derived Waste Management

All background samples will be collected from areas that have not been impacted by past military or industrial activities. No contamination is expected to be encountered, nor is any solid investigation-derived waste anticipated from the background study field activities. Any excess soils from sampling activities will be placed back into their respective sampling locations. Decontamination rinse water will be released to the ground surface, and soap wash water will be collected and allowed to evaporate.

6.0 Project Organization

The primary participants involved in executing this investigation include the USACE-Jacksonville District, the USACE-Savannah District, and IT. A project organization chart is presented in Figure 6-1.

6.1 USACE Personnel

The following sections describe the USACE personnel involved in the Ramey AFB project and their responsibilities.

Project Manager. The USACE project manager (PM) is responsible for programming and securing funding for environmental restoration activities. The PM is fiscally responsible for the project and is, therefore, consulted on matters involving funding issues.

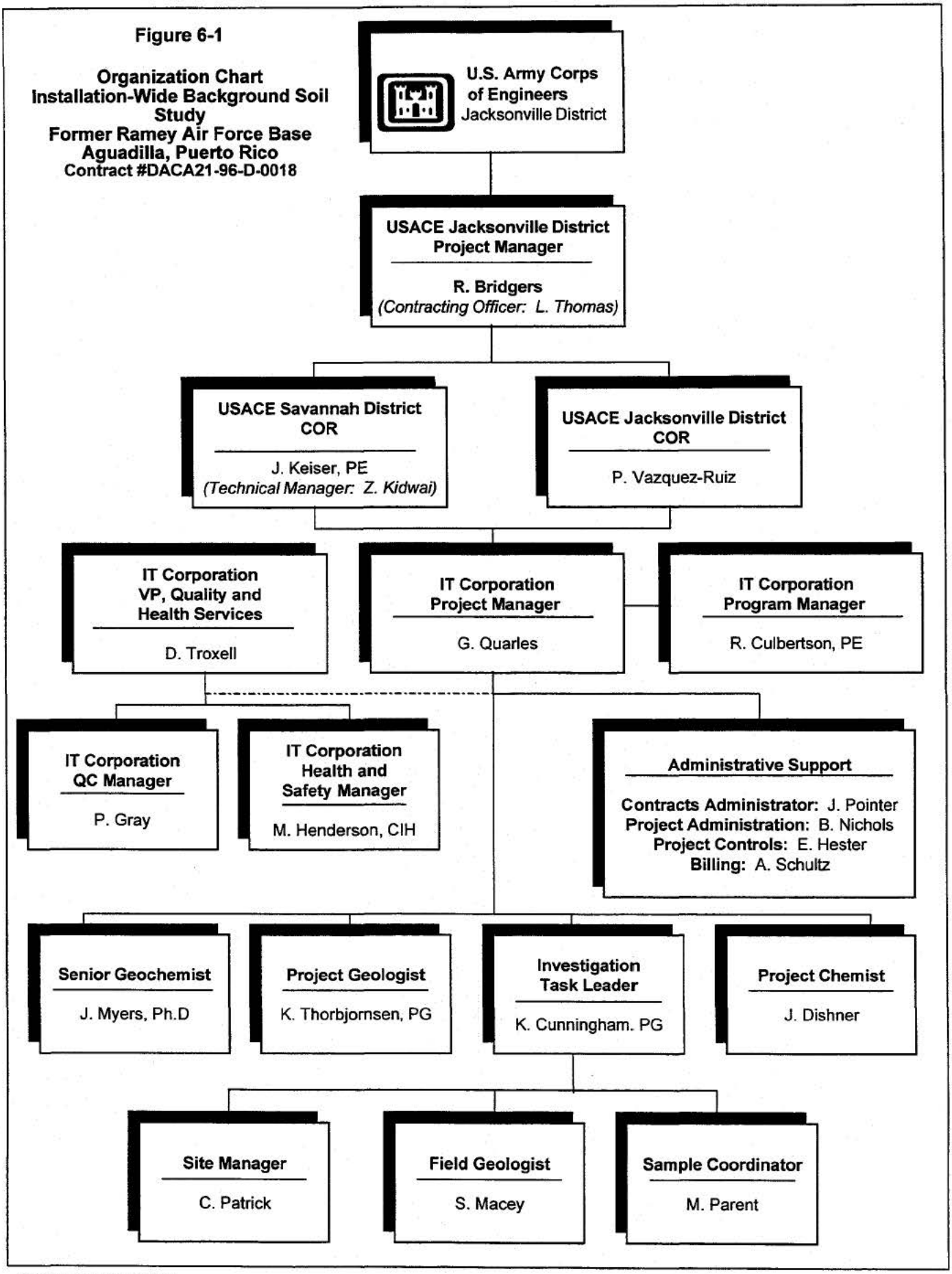
Contracting Officer. The contracting officer (CO) is the contractual authority between USACE and IT. The CO is the only person with contractual authority to negotiate, enter into contracts, obligate funds, order changes, and to negotiate resultant increases or decreases in the estimated contract cost, fee, and performance schedule. The CO is responsible for award and administration of binding contractual documents. Other CO responsibilities include task order award, change notification and negotiation, cost overruns, small and small-disadvantaged business subcontracting, subcontract consent, government property tracking, reporting and dispositions, and project closeout.

Contracting Officer Representative. The contracting officer representative (COR) is responsible for providing technical direction to IT throughout project execution, approving in-scope changes, advising the CO of changes that may affect cost and/or schedule, and issuing technical direction. The COR's authority is limited to technical direction within the general scope of work stated in the contract. The COR may not direct work to be done that is outside the contract scope, request a subcontract change, or otherwise cause an increase or decrease in estimated subcontract cost, fee, or performance schedule without written concurrence from the CO.

Technical Manager. The USACE technical manager (TM) serves as the primary focal point for all project issues relative to the work at Ramey AFB. The USACE TM facilitates the implementation of the terms and conditions of the delivery orders, including interpreting specifications, drawings, or other technical portions of the work description; coordinating responses to technical questions; and reviewing and recommending approval of technical reports and other

Figure 6-1

Organization Chart
Installation-Wide Background Soil Study
Former Ramey Air Force Base
Aguadilla, Puerto Rico
Contract #DACA21-96-D-0018



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deliverables submitted by IT. The USACE TM provides the QA for the installation-wide background soil study work plan, the basis for implementing this investigation.

6.2 IT Personnel

IT management and technical personnel assigned to this project and their responsibilities are described in the following text.

Program Manager – Robert Culbertson, PE. The program manager represents IT on contractual issues and is responsible for ensuring adequate resources, supervising the IT PM, and monitoring project work scope, schedules, and budgets. He has the authority to accept delivery orders, approve all key staff assignments, approve subcontract agreements, and approve management plans, budgets, and schedules.

Project Manager – J. Glenn Quarles. The PM is IT's representative responsible for the effective execution of this project and serves as IT's primary focal point for all environmental restoration activities at the former Ramey AFB, both with the USACE and within IT. The PM takes direction from the USACE COR in executing the installation-wide background soil study work plan and all other site work.

Health and Safety Manager – Michael Henderson, CIH. The health and safety (H&S) manager for this project developed the SSHP included in this work plan (Appendix A). This plan complies with Title 29 Code of Federal Regulations Part 1910.120 and 29 Code of Federal Regulations 1926.65 in all aspects and includes medical surveillance and training requirements, hazard assessment, personal protective equipment specifications, field implementation procedures, and audits. The H&S manager is the point of contact for regulatory agencies on matters of safety and health.

Investigation Task Leader – Ken Cunningham, PG. The investigation task leader coordinates project activities, including work plan preparation, field activities, and report preparation. He will coordinate closely with the site manager and data management group to ensure that field activities are completed in accordance with the work plans. He will also be responsible for preparing scopes of work and procuring subcontracted activities.

Senior Geochemist – Jonathan Myers, Ph.D. The senior geochemist is responsible for background data evaluation and writing the background soil study report. He will serve as a point of contact with USACE on technical issues pertaining to this investigation.

Project Chemist – Joyce Dishner. The project chemist will work with the project management team in formulating plans and approaches. She will assess sampling, analytical, and QA/QC requirements for each project task and assist in the interpretation and use of sampling and QA/QC data. The project chemist will review field analytical and QA/QC data and prepare a quality control summary report before those data are transferred to permanent storage or reported to other project participants.

Project Geologist – Karen Thorbjornsen, PG. The project geologist is responsible for preparing the background study work plan, coordinating investigation tasks with field and technical personnel, and coordinating preparation of the background study report.

Site Manager – Chris Patrick. The site manager provides on-site management and technical direction of tasks. He assigns and directs all on-site activities, ensures adherence to project plans, and prepares status reports for the PM. The site manager also manages subcontractor activities and implements the H&S program.

Field Geologist – Steve Macey. The field geologist is responsible for executing the field work specified in the background study work plan. He collects the background samples and coordinates field tasks with the investigation task leader and site manager.

Sample Coordinator – Mark Parent. The sample coordinator ensures that the background study sampling program is executed in accordance with this work plan. He works closely with the project chemist to ensure that the samples are collected and shipped to the laboratories in accordance with the work plan. The sample coordinator is responsible for completing field documentation, including analysis request and chain-of-custody forms.

Additional IT Personnel. The Vice President for Quality and Health Services oversees IT's QC and H&S programs. The QC manager is responsible for establishing, implementing, and monitoring the QC program on IT projects. The contracts administration, project adminstration, project controls, and billing personnel support the PM in the areas of schedule control, budget control, and general project control and coordination. They ensure that contracts and subcontracts meet Federal and IT contract requirements. In addition, they manage data and records to ensure that contract requirements are met and deliverables meet specifications. The field technician is responsible for the collection of all soil samples associated with the background soil study. He assists the field geologist in all field-related tasks and helps track daily activities.

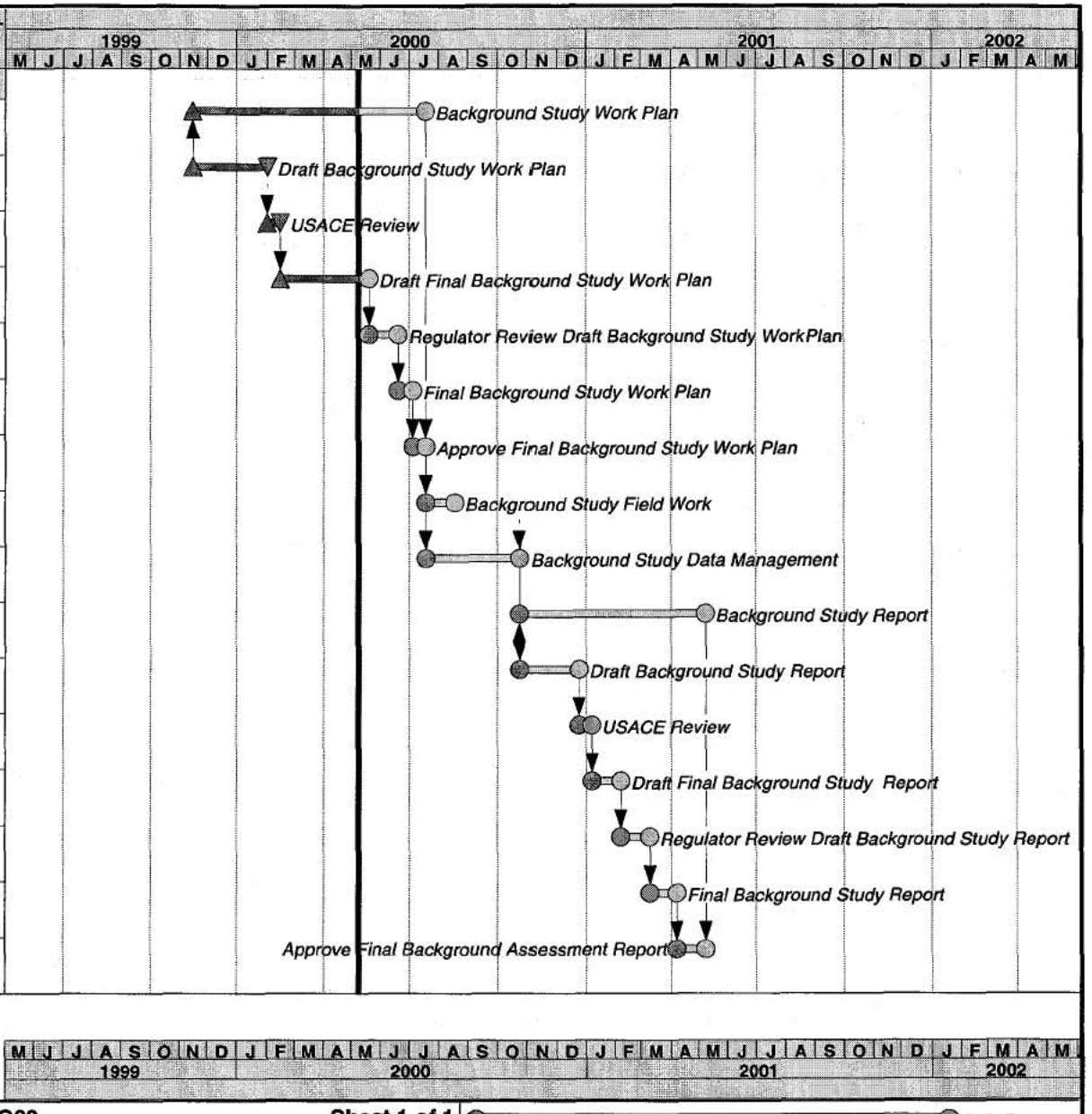
7.0 Project Schedule

To efficiently manage all phases of the project, the PM will utilize the IT Project Management System. The integrated project planning, tracking, and control system is composed of two primary components:

- Versatile, Integrated System for IT's Operational Needs (VISION) is used to track and maintain information on project expenses on a weekly basis.
- Schedule and Budget Controls: IT uses Primavera Project Planner® as a planning system to integrate schedule, resource allocation, and budget.

The schedule for preparing the work plan, performing the investigation, and preparing the background soil study report is presented in Figure 7-1. The PM will actively manage the schedule, and internal checks will determine potential problems early, thereby eliminating costly delays that could affect critical schedule milestones.

Activity ID	Early Start	Early Finish	Rem. Dur.	SORT
Background Study				
03060100	15NOV99A	18JUL00	72*	1
03060101	15NOV99A	31JAN00A	0*	2
03060105	01FEB00A	14FEB00A	0	3
03060106	15FEB00A	19MAY00	12	3
03060102	20MAY00	18JUN00	30	4
03060103	19JUN00	03JUL00	15	4
03060104	04JUL00	18JUL00	15	4
03060200	19JUL00	17AUG00	30	5
03060210	19JUL00	24OCT00	98	6
03060400	25OCT00	07MAY01	195*	6
03060401	25OCT00	23DEC00	60	6
03060405	24DEC00	07JAN01	15	7
03060406	08JAN01	06FEB01	30	7
03060402	07FEB01	08MAR01	30	8
03060403	09MAR01	07APR01	30	8
03060404	08APR01	07MAY01	30	8



M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M
1999
2000
2001
2002

Start Date	01MAY99
Finish Date	12NOV01
Data Date	08MAY00
Run Date	18MAY00 09:15

TO08 **Sheet 1 of 1**

Figure 7-1

Background Soil Study Schedule
Former Ramey AFB Aguadilla, PR

Early Bar
Progress Bar

8.0 References

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