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March 1993

US Army Corps
of Engineers
Waterways Experiment
Station

Soil Sampling Program at Solid Waste Management Unit No. 3, Fort Buchanan, Puerto Rico

by *José L. Llopis*
Geotechnical Laboratory

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Prepared for U.S. Army Environmental Center

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Final report

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Prepared for U.S. Army Environmental Center
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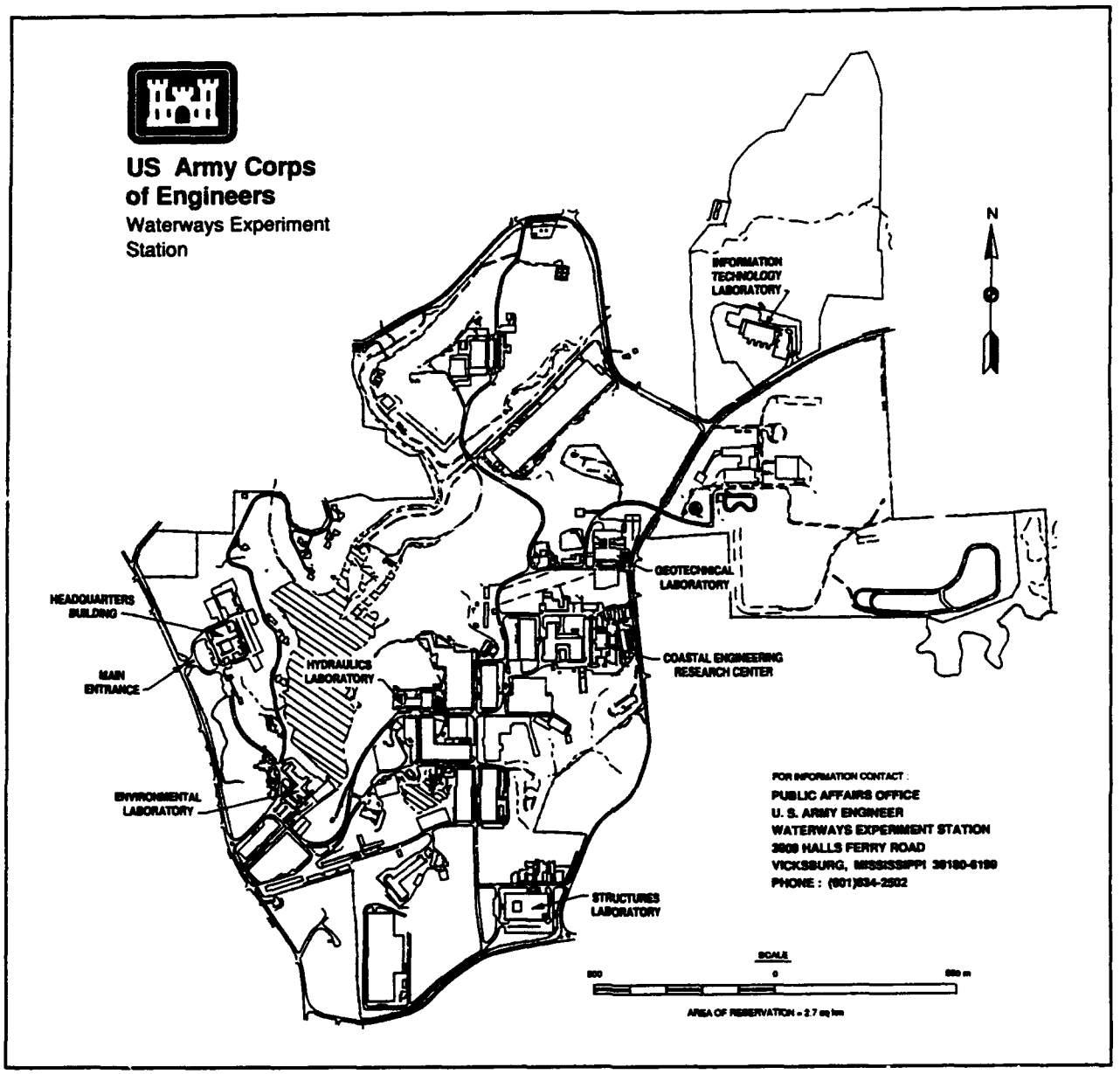

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PREFACE

A soil sampling survey was conducted at Fort Buchanan (FTB), Puerto Rico, by personnel of the Geotechnical Laboratory (GL), US Army Engineer Waterways Experiment Station (WES), between 20 and 23 October 1992. The work was performed for the US Army Environmental Center (AEC), Aberdeen Proving Ground, Maryland. The AEC Technical Monitor was Mr. Dennis Bowser.

This report was prepared by Mr. José L. Llopis, Earthquake Engineering and Geosciences Division (EEGD). The work was performed under the direct supervision of Mr. Joseph R. Curro, Jr., Chief, Engineering Geosciences Branch (EGB). The work was performed under the general supervision of Drs. A. G. Franklin, Chief, EEGD, and William F. Marcuson III, Director, GL.

Field work and data analysis were performed by Mr. Llopis. Mr. Angel Perez, Environmental Coordinator, Directorate of Engineering and Housing (DEH), FTB, provided technical support during the site preparation phase of this study. Mr. Clarence Harris, DEH, did an outstanding job in operating the backhoe used in this investigation. Mr. Robert Scarf extracted and analyzed the soil samples and the chemical analyses was reviewed by Mr. Kenneth Mioduski, US Army Environmental and Hygiene Agency (AEHA). The results of the chemical analyses were approved Mr. J. Howard Vinopal, Chief, Pesticide Analysis Branch, Organic Environmental Chemistry Division, AEHA. This report was reviewed by Dr. Paul Hadala, Assistant Director, GL, Dr. Dwain K. Butler, EGB, Mr. William L. Murphy, Engineering Geology Branch, EEGD, and Ms. Ann B. Strong, Chief, Environmental Chemistry Branch, Environmental Engineering Division, Environmental Laboratory, WES.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Leonard G. Hassell, EN.

CONTENTS

CONVERSION FACTOR, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
Fahrenheit degrees	5/9	Celsius degrees or Kelvins*
feet	0.3048	metres
feet per second	30.48	centimeters per second
gallons	3.785412	cubic decimetres
inches	2.54	centimetres
miles (US statute)	1.609347	kilometres
ounces (US fluid)	0.02957353	cubic decimetres
tons (2,000 pounds, mass)	907.194	kilograms

* To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: $C = (5/9)(F - 32)$. To obtain Kelvin (K) readings, use: $K = (5/9)(F - 32) + 273.15$.

SOIL SAMPLING SURVEY AT
SOLID WASTE MANAGEMENT UNIT NO. 3
FORT BUCHANAN, PUERTO RICO

PART I: INTRODUCTION

Background

1. An onsite Installation Assessment (IA) was conducted between 30 August and 3 September 1982 at Fort Buchanan (FTB), Puerto Rico. The purpose of the IA was to determine the existence of toxic and hazardous materials and related contamination at FTB, emphasizing those substances posing a potential for migration off the installation (McMaster et al. 1984). As a result of the 1982 IA one site, Solid Waste Management Unit (SWMU) No. 3, was identified as warranting further assessment.

2. In 1990 the Puerto Rico Environmental Quality Board (EQB) completed a Resources Conservation and Recovery Act (RCRA) Facility Assessment (RFA) for FTB. The EQB conducted this activity by agreement with the US Environmental Protection Agency (EPA) under the authority of RCRA. On the basis of the 1990 RFA and other documentation, the EPA determined that there was the potential for significant environmental risk at SWMU No. 3.

3. In 1977 approximately 1 ton (1 truckload) of various pesticides reportedly were buried in a shallow trench at SWMU No. 3. The suspected buried pesticides are reported as consisting of Chlordane, p,p'-DDE, and Heptachlor. McMaster et al. (1984) reported that the pesticides, mostly in bags and boxes, but also contained in numerous (10 to 20) 5-gal metal containers, were deposited into a trench estimated to be 6 ft deep, 18 ft wide, and 45 to 90 ft long. The trench was then backfilled with trees and the original soil and compacted with a bulldozer. The precise location of the burial trench is not available from records.

4. In 1980, the Puerto Rico Aqueduct and Sewage Authority (PRASA) installed a potable water supply main across FTB connecting the San Juan and Bayamon water supply systems. The 66-in dia. main is constructed of reinforced concrete and is buried at a depth of approximately 10 ft. The PRASA main passes by the suspected location of the alleged pesticide burial site and may even intersect it. The EPA is concerned that when the main is depressurized, during periodic maintenance, infiltration of contaminated groundwater through the line's seals may occur**. Two other EPA concerns are;

** June 1991. Letter from Joel Golumbek, Chief, New Jersey/Caribbean Section, Hazardous Waste Compliance Branch, Region II, US EPA to Commander, Fort McPherson.

a. The gravel underlayment of the water main could act as a conduit for the off-site migration of contaminated groundwater.

b. Many of the formations which outcrop on the site serve as aquifers and could potentially be contaminated. These aquifers have been designated as an alternative potable water supply for the area. The site is part of the recharge area for these aquifers.

Disposal Area Characteristics

5. Location of Disposal Area. FTB is located approximately 6 miles southwest of San Juan, Puerto Rico as shown in Figure 1. SWMU No. 3 is located in the northwestern part of FTB along the perimeter fence bordering Highway P.R. 28 (Figure 2). The suspected location of the pesticide burial trench at SWMU No. 3 is shown in Figure 2.

6. General Physical Conditions. SWMU No. 3 encompasses an area approximately 100 ft wide by 1500 ft in length with its major axis oriented roughly in an east-west direction (Figure 2). The site is relatively flat and can pond precipitation for a period of time. Because of the tropical marine climate (high rainfall and warm temperatures) the site is heavily vegetated with small to large trees and head-high grasses. Prior to the survey, the site was cleared of vegetation and leveled with a bulldozer.

Previous Investigations

7. The US Army Toxic and Hazardous Materials Agency (USATHAMA) (now the US Army Environmental Center (AEC)) conducted a limited contamination assessment in 1983 to determine the chemical identity of the pesticides and the composition and the geometry of the subsurface materials. One deep and seventeen shallow exploratory borings were placed and two trenches excavated at SWMU No.3. Figure 3 shows the location of the soil borings and trenches used for the 1983 contamination assessment. The deep boring was augered to a depth of 40 ft whereas the shallow borings were augered to depths ranging between 3 and 8 ft. The deep soil boring indicates that the ground water table is 33 ft below the ground surface, or approximately 27 ft below the base of the trench as reported in McMaster et al. (1984). Boring logs indicate that the soil at the site is generally a clay from 0 to 19 ft deep, silty-clay, clay, clayey-silt and silty-, clayey-sand from 19 to 33 ft deep, and is underlain by badly weathered clayey-, sandy-limestone (McMaster et al. 1984). None of the borings encountered conditions or material indicative of the

suspected trench. The log for the deep boring as reported in McMaster et al. (1984) is presented in Figure 4.

8. Two trenches were dug by backhoe to give a visual profile of the soil. The trenches were aligned with the major axis perpendicular to the installation boundary and were between 20 and 25 ft long, 5 ft wide and 6 to 7 ft deep. The trenches intersected the PRASA water main trench. Neither trench showed evidence of any backfilled trenches other than the one dug for the PRASA water main (McMaster et al. 1984). A schematic cross section of SWMU No. 3, showing the suspected location of the trench relative to the PRASA water main, is shown in Figure 5.

9. In October 1991 a comprehensive, integrated geophysical investigation was conducted at SWMU No. 3 by personnel of the US Army Engineer Waterways Experiment Station (WES). The purpose of the survey was to delineate anomalies indicative of buried waste, waste containers, and the boundaries of the burial trench. The geophysical program included electromagnetic (EM) and magnetic methods. The results of the investigation indicated numerous anomalous areas at SWMU No. 3. The locations of the interpreted anomalous areas along with a priority ranking for further investigation are presented in Llopis and Sharp (1992).

Objectives

10. During the period 20-23 October 1992 the US Army Engineer Waterways Experiment Station (WES) conducted a soil sampling program at FTB to delineate the location of the pesticide burial trench at SWMU No. 3. Test pits were excavated at various locations across SWMU No. 3 considered to be anomalous based on the results of the geophysical investigation. The test pits were visually inspected for any evidence indicating the presence of the pesticide disposal trench (i.e. rotting trees used in backfilling the alleged trench, disturbed soil or pesticide containers). Soil samples were also collected in the test pits and forwarded to a laboratory for pesticide analysis.

PART II: SOIL SAMPLING PROGRAM

Soil Sampling Procedures

11 ..ight test pits (trenches) were excavated at SWMU No. 3 to a depth of 8 r' to obtain representative soil samples for laboratory chemical analysis. The locations of the test pits were based on the results of a previous geophysical survey (Llopis and Sharp 1992). Figure 6 shows the locations of the test pits superimposed on the geophysical anomaly priority map. Figure 7 illustrates the locations, dimensions, and layout of each test pit.

12. With the exception of TP7, the test pits were located in areas assigned the highest investigation priority (geophysical anomaly priorities of 1 or 2). The high priority test pits were generally located in the central and western portion of the site as shown in Figure 6. The location of test pit TP7 was located in the eastern portion of the site and was selected based on its geophysical anomaly priority of 3 and its proximity to a topographic anomaly.

13. The test pits used for this investigation were excavated using a backhoe. The test pits were dug to a depth of 8 ft, a width of 4 ft and to a length ranging between 20 and 30 ft as shown in Figure 7. The test pits were oriented in an east-west (parallel to perimeter fence) or north-south (perpendicular to perimeter fence) direction. Samples for pesticide analysis were collected in the test pits at 2-ft depth intervals.

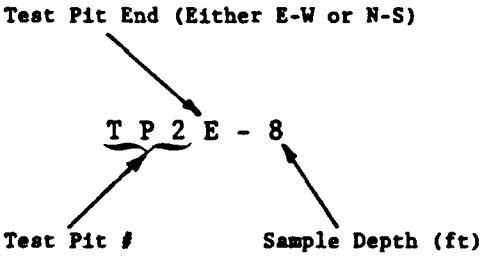
14. During trenching operations for TP8, a concrete slab was encountered at a depth of approximately 2.5 ft. An area approximately 10 ft by 20 ft was excavated in an attempt to find the edge of the slab without success. It was presumed that the concrete slab was the cause of the geophysical anomaly and it was decided to discontinue further trenching of TP8. Further discussions in this report of any sampling or testing procedures will not pertain to TP8.

15. For sampling purposes, each test pit, with the exception of TP1, was divided into two sections. The test pit sections were designated to denote their relative geographic attitude. For example, TP2 is oriented in an east-west direction and the two test pit sections are designated TP2E (eastern end of pit) and TP2W (western end of pit). For test pits oriented in a north-south direction an "N" or an "S" after the test pit number designates the northern and southern sections of the pit, respectively.

16. At each of the test pits the upper 2 ft of soil were stripped away to remove surface debris and the material placed in a pile away from the test pit opening. Soil samples were collected at each test pit at 2-ft intervals between depths of 2 and 8 ft. With the exception of TP1, at each sampling

depth equal amounts of soil were collected from opposite ends of each test pit section, placed in a stainless steel bowl and composited. Figure 8 illustrates the relative location of the sampling points within the test pits. TP1 was not divided into two sections as were the other test pits. For the case of TP1, at each sampling depth, equal amounts of soil were collected from each end of the test pit only and composited.

17. The samples were collected from the undisturbed center portion of the backhoe bucket using a stainless steel scoop and placed in a stainless steel bowl for compositing. The composited sample was placed in a clean laboratory-certified, wide-mouthed glass jar and sealed with a teflon-lined lid. The sample jars were labeled with a waterproof marker using a labeling system identifying the trench number, trench end, depth, and date. The labelling identification key used in this investigation is shown below:



The samples were preserved at a temperature of 4°C by immediately placing them in an insulated chest filled with ice. The samples were delivered by an overnight air delivery service to the laboratory within 3 days after collection.

18. After stripping away the upper 2 ft of soil, the backhoe was moved away from the test pit and the bucket cleaned prior to sampling. The bucket was cleaned by scraping away the majority of any adhered soil and washing away any remaining soil with pressurized water from a fire hose. The water used to wash the backhoe bucket was obtained from an FTB fire hydrant located adjacent the nearby Directorate of Engineering and Housing building and hauled to the site by a tanker truck provided by the FTB Fire Department. The backhoe bucket was cleaned using this method prior to sampling the subsequent test pit section or sampling depth to prevent cross contamination. After collecting a soil sample the sampling scoop and bowl were thoroughly scrubbed and washed using water supplied from the fire engine. The sampling equipment was then rinsed three times with distilled water and dried with clean paper towels.

Chemical Analysis Procedures

19. A chemical analysis of the soil samples was performed by the US Army Environmental Hygiene Agency (AEHA), Aberdeen Proving Ground, MD. The samples were analyzed for pesticides and polychlorinated biphenyls (PCB's). Sample extraction and analysis was performed using the AEHA/Organic Environmental Chemistry Division/Pesticide Analysis Branch Standing Operating Procedure #31B.1 - (Analysis for Organochlorine, Organophosphorus, Organonitrogen Pesticide and Polychlorinated Biphenyls in Soil Using a Rapid Sonication Method) (see Appendix B).

PART III: RESULTS

Visual Observations

20. The soil observed in the test pits at SWMU No. 3 can generally be characterized as a stiff plastic clay. In some locations small (less than 0.25 in. dia.), black, plinthite*** nodules were encountered. McMaster et al. (1984) report the average vertical coefficient of permeability to water (hydraulic conductivity) for the soils at the site to be 6.6×10^{-9} cm/sec. This is an extremely low value. No visual evidence of any pesticides, pesticide containers, or backfilled trenches was found in the excavated test pits. Some debris such as tree limbs, lumber, and steel grating was unearthed in the upper 3 ft of a few of the test pits. A description of the soils found in the test pits is presented in Appendix A.

Chemical Analysis

21. A list of primary pesticides, pesticide metabolites, and PCB's that the soil samples were screened for along with reporting limits is presented in Appendix B. The results of the chemical analysis on 52 samples tested indicate that the concentrations of all the analytes were below detection limits with the exception of soil samples TP3N-2, TP3N-4 and TP3N-6 which occur in the north section of TP3.

22. The results of the chemical analyses for the north section of TP3 are presented in Table 1. It is noted that sample TP5L-1 (AQAD Number B29921) listed in the Report of Analysis (Appendix B) is a quality control sample, not a field sample, and the results are within the acceptable range. The results in Table 1 indicate that p,p'-DDE, p,p'-DDD, p,p'-DDT, and o,p'-DDD were the only compounds found above detection levels. The highest concentration of pesticides detected was 1.64 µg/g of DDT in soil sample TP3N-4. This soil sample was a composite of two samples, and thus the highest possible concentration in either of the two original samples (prior to compositing) is 3.28 µg/g. There are no known Federal or Puerto Rico standards for DDT, DDE, or DDD in soil. AEHA personnel consider these levels of pesticides to be low

*** As defined by Bates and Jackson (1980) plinthite in a soil is a material consisting of a mixture of clay and quartz, that is rich in sesquioxides and poor in humus and is highly weathered. It occurs as red mottles in a platy, polygonal, or reticulate pattern. Repeated wetting and drying changes plinthite to ironstone hardpan or irregular aggregates.

and not indicative of a spill or disposal site****. Figure 9 shows typical amounts of DDT found in the environment: soil, water, terrestrial and aquatic plants, animals, and man. Figure 9 is included in order to provide a means of comparison between the laboratory results and typical amounts of DDT to be expected to be found in the environment.

Table 1

Results of Pesticide Analysis for TP3N

Sample Number	Sample Results µg/g (ppm)		Detection Limits* ppm
TP3N-2	p,p'-DDE	0.26	0.16
	p,p'-DDD	0.33	0.16
	All OTHER ANALYTES BELOW DETECTION LIMITS		---
TP3N-4	p,p'-DDD	0.40	0.16
	p,p'-DDT	1.64	0.30
	ALL OTHER ANALYTES BELOW DETECTION LIMITS		---
TP3N-6	o,p'-DDD	0.28	0.16
	p,p'-DDD	0.23	0.16
	ALL OTHER ANALYTES BELOW DETECTION LIMITS		---
TP3N-8	ALL ANALYTES BELOW DETECTION LIMITS		---

All reported results are based on sample dry weight.

* See Appendix B for detection limits for target compounds not reported above.

23. The compounds DDD and DDE are transformation products of DDT. In soils, under anaerobic conditions, p,p'-DDT is rapidly converted to p,p'-DDD and under aerobic conditions very slowly to p,p'-DDE (Montgomery and Welkom 1990). The solubilities of DDT, DDD, and DDE in water are relatively low and are reported by Montgomery and Welkom (1990) to range between 0.0012 and 0.12 mg/L at a temperature of 25°C. These compounds are strongly adsorbed by the soil and are not likely to leach into the groundwater.

**** Telephone conversations with Mr. J. Howard Vinopal, Chief, Pesticide Analysis Branch, Environmental Chemistry Division, AEHA, and Mr. Jack Heller, Waste Disposal Engineering Division, AEHA, on 7 January 1993.

CONCLUSIONS

24. In 1977, approximately 1 ton (1 truckload) of various pesticides reportedly were buried in a shallow trench at an unknown location at SWMU No. 3. In an effort to determine the location of this trench, 52 soil samples were collected from 7 test pits and analyzed for the presence of pesticides. Test pit location selection was based on the results of a previously conducted geophysical investigation. The soil samples in the test pits were collected at 2-ft depth intervals between depths of 2 and 8 ft. The results of the chemical analysis indicated trace amounts of the pesticides p,p'-DDE, p,p'-DDD, p,p'-DDT, and o,p'-DDD in only one end of one test pit, TP3N. These pesticide levels are considered to be very low and not indicative of the levels expected to be associated with a pesticide disposal site but rather more indicative of routine pest control levels. Based on visual observations during the excavation of the test pits and the results of the soil chemical analysis there is no indication of the presence of a pesticide disposal trench at the locations of these seven test pits.

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McMaster, B.N., Hearns, S. R., Denehan, A. P., Hubbard, K. L., Hatfield, K. L., Govro, K. C., Hobel, M. A., and Civitarese, K. A., 198[illegible]. Installation Assessment of Fort Buchanan, P.R. Report No. 329A. Gainsville, FL: Environmental Science and Engineering, Inc.

Montgomery, J. H. and Welkom, L. M. 1990. In *Groundwater chemicals desk reference*. Chelsea, MI: Lewis Publishers.

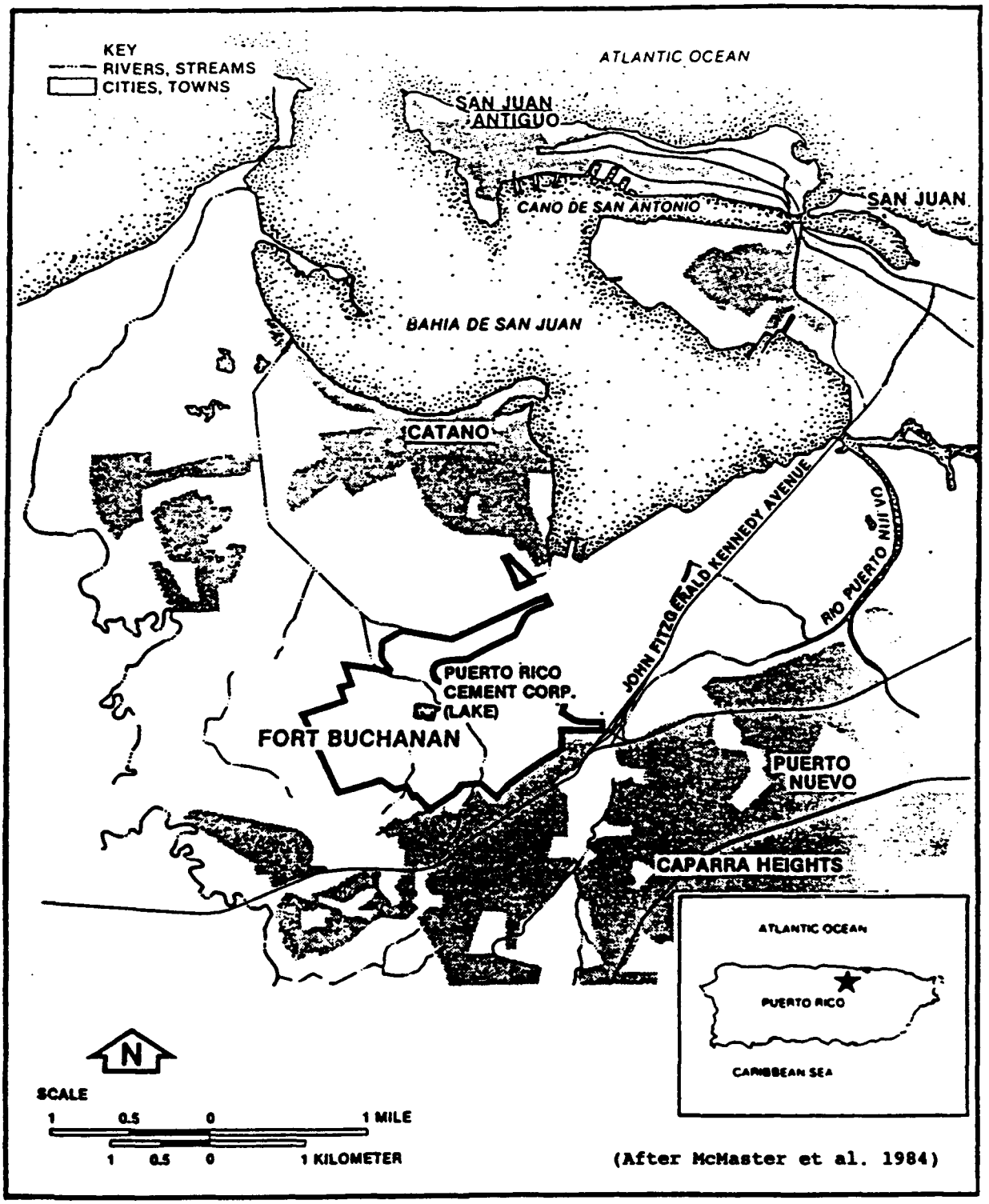


Figure 1. Vicinity map

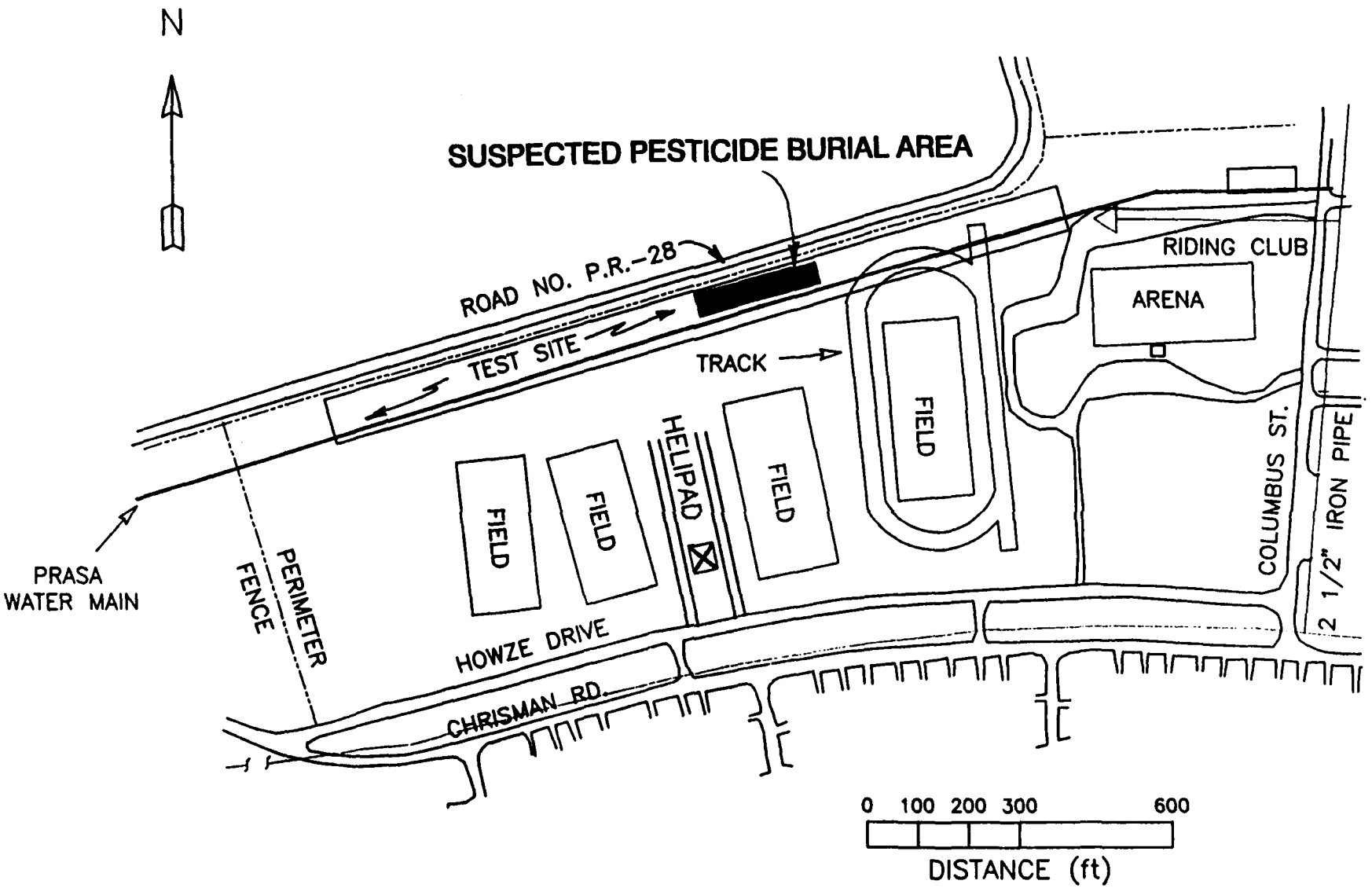


Figure 2. Location of suspected pesticide burial trench

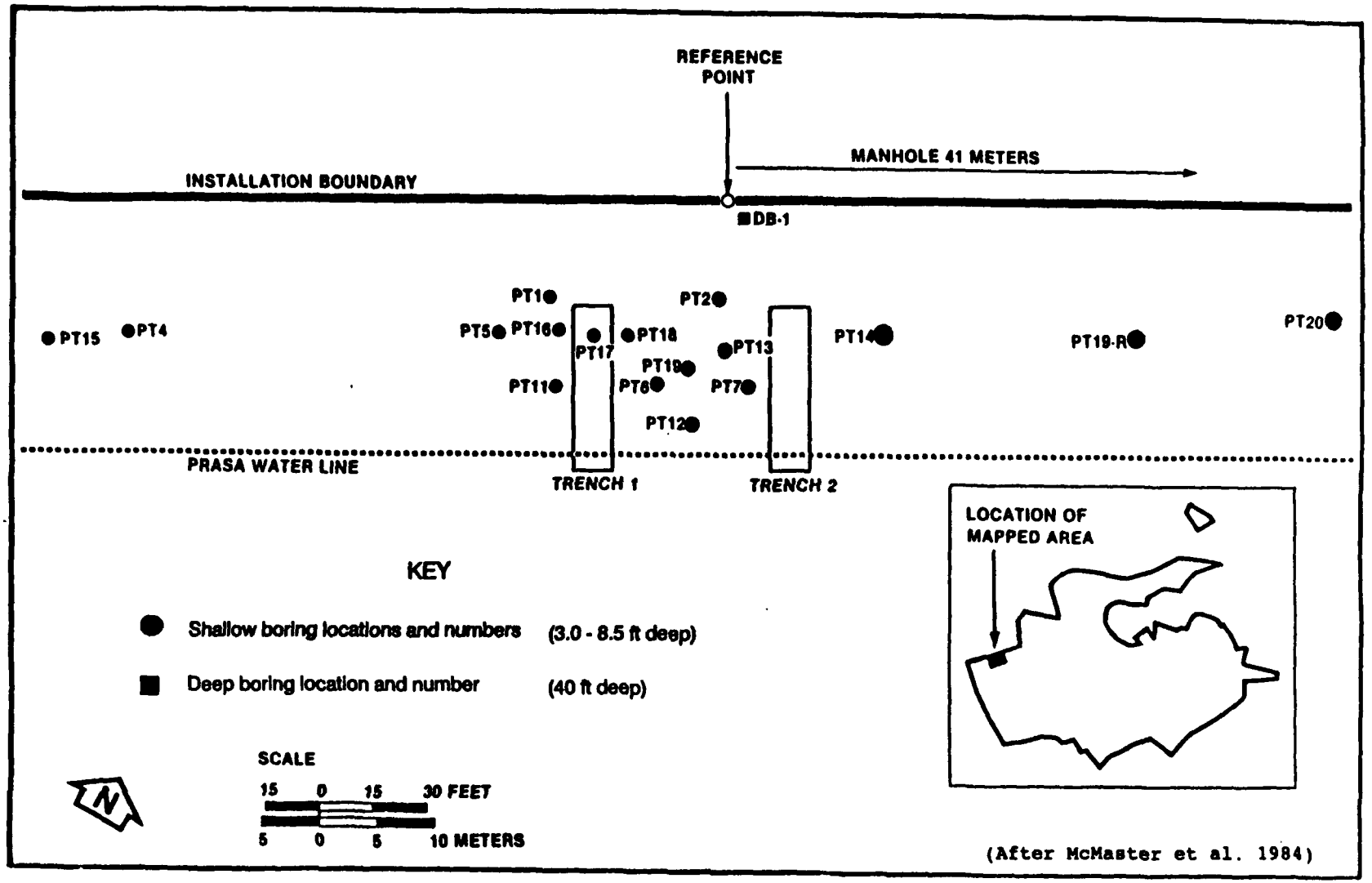


Figure 3. Location of 1983 soil borings and trenches

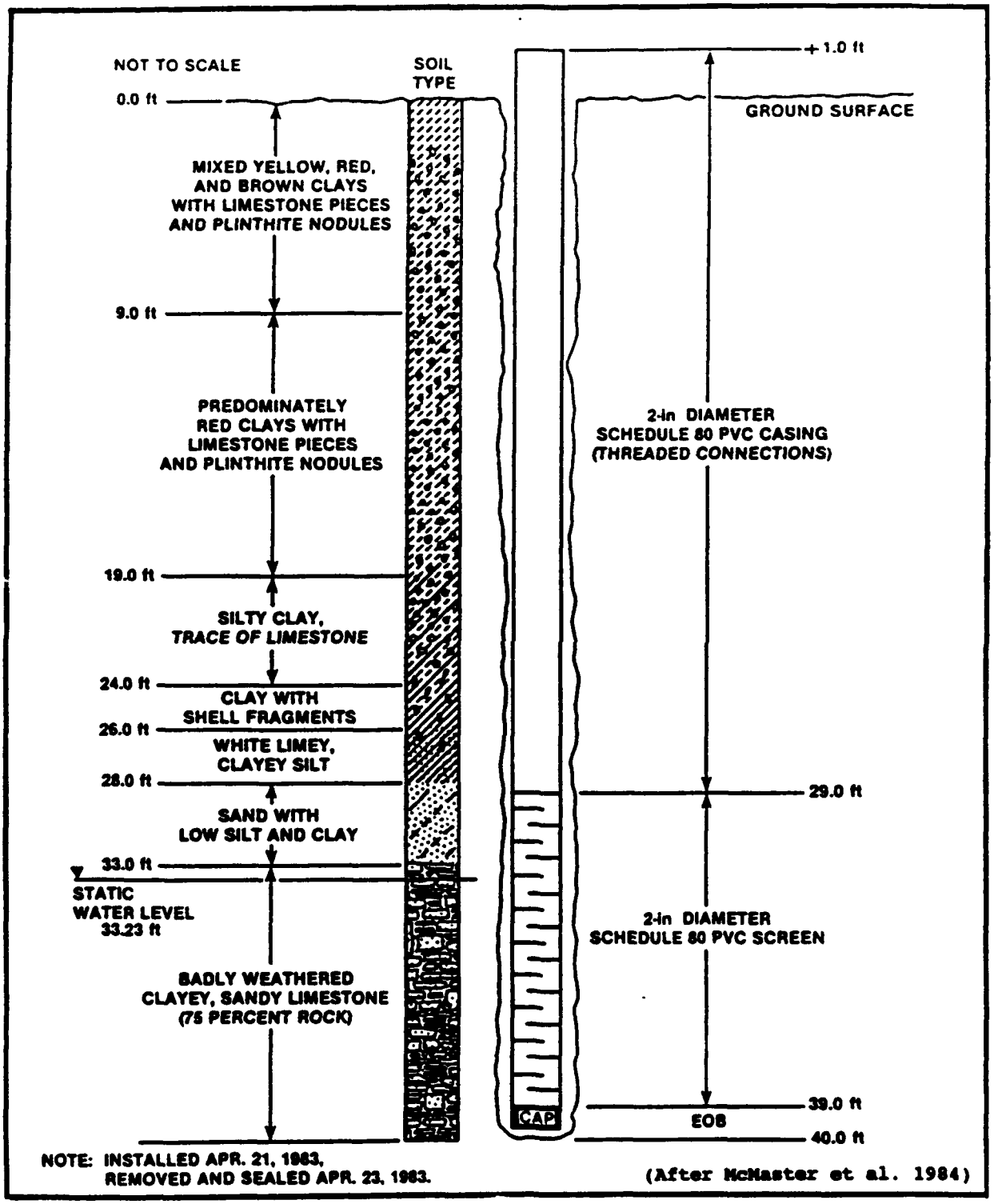


Figure 4. Log of deep soil boring DB-1

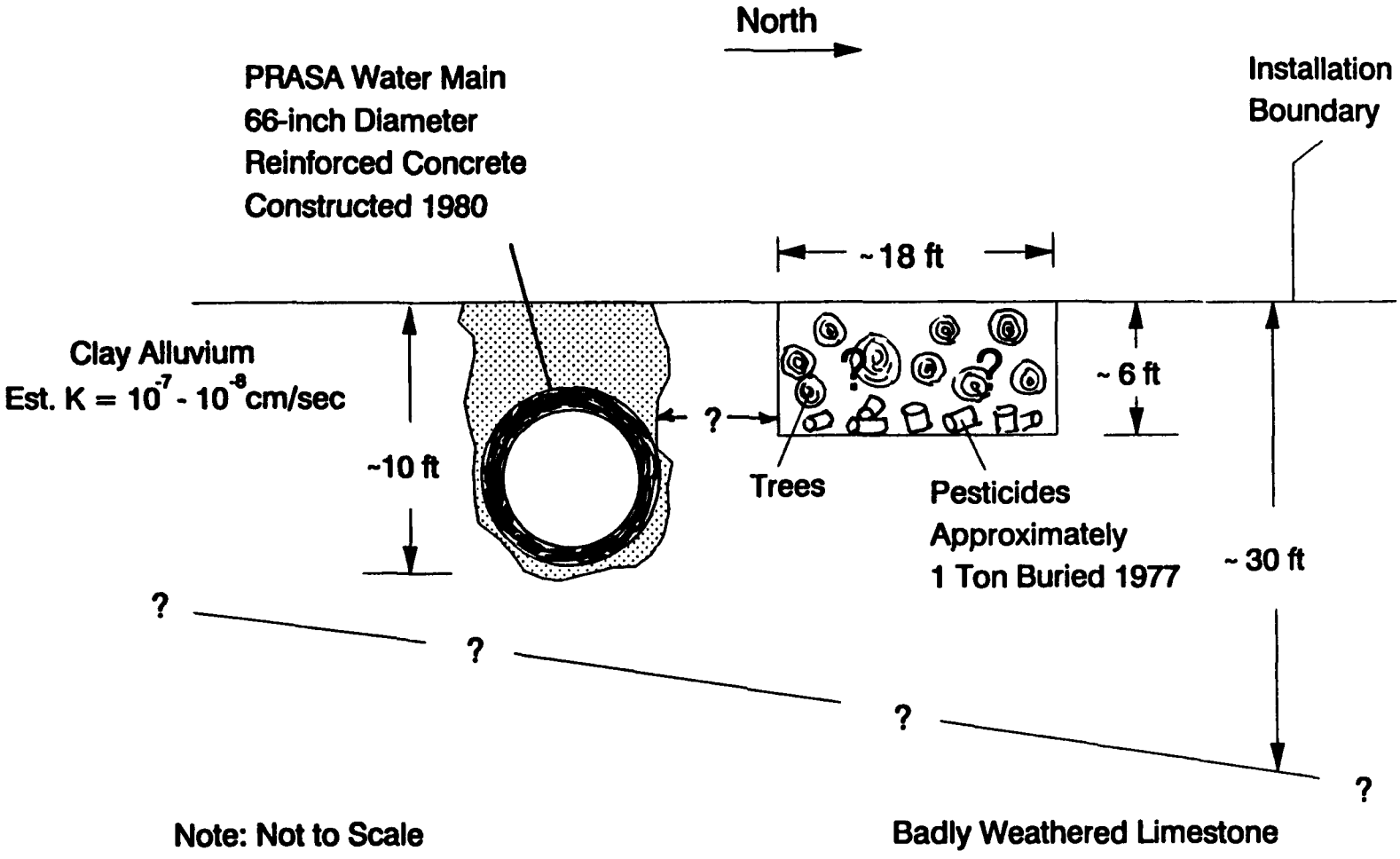
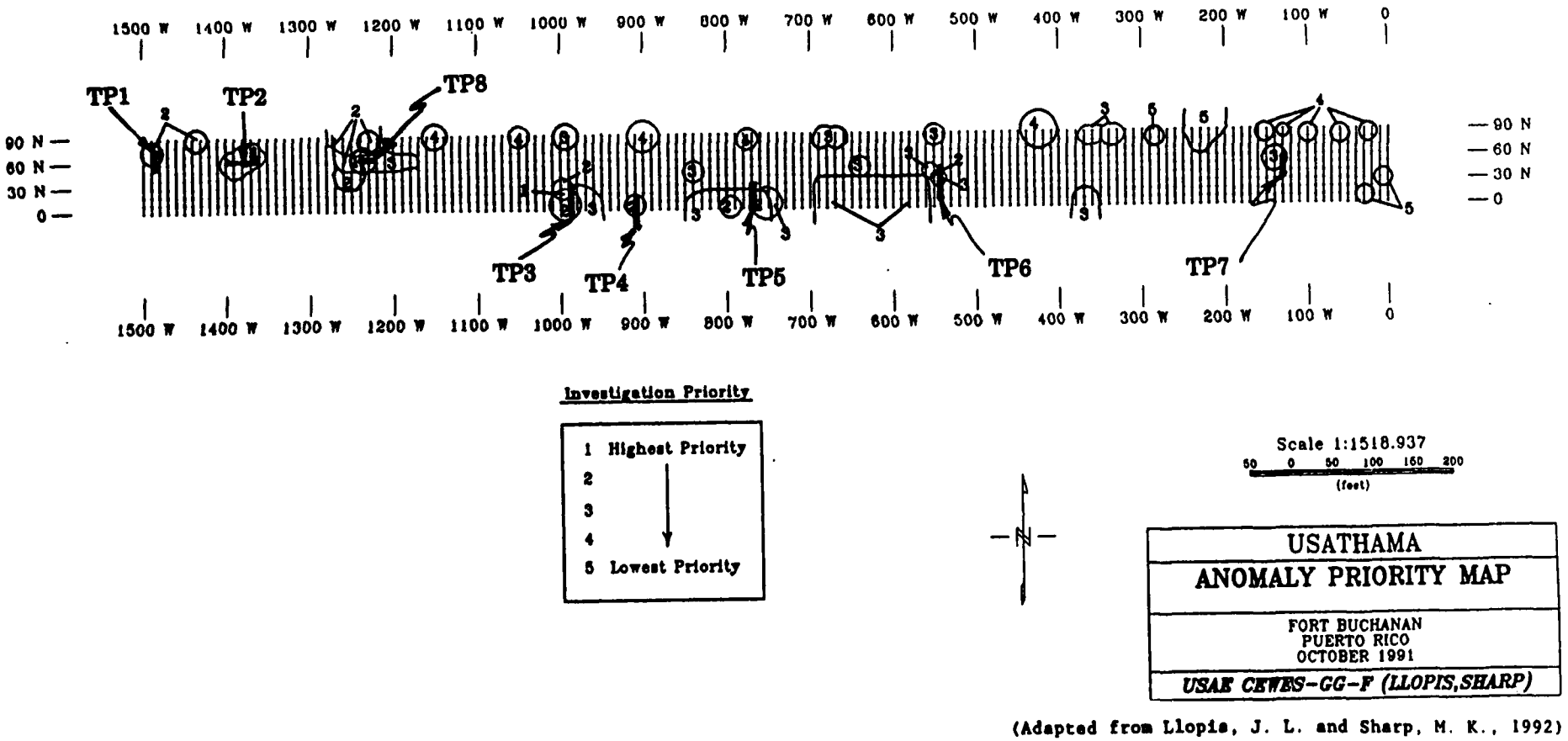


Figure 5. Schematic cross section of alleged pesticide burial area based on information in McMaster et al. 1984



(Adapted from Llopis, J. L. and Sharp, M. K., 1992)

Figure 6. Location of test pits relative to geophysical anomaly locations

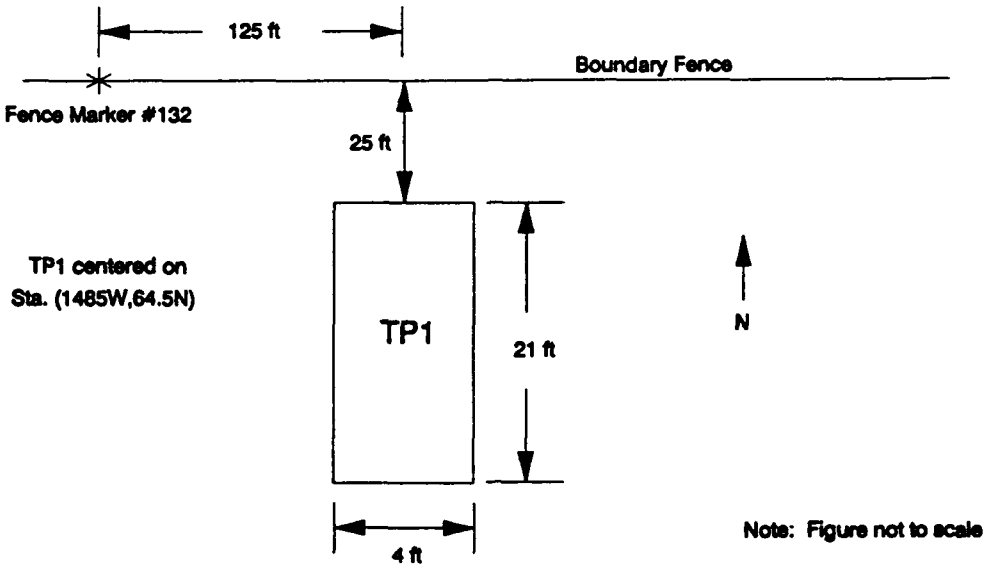


Figure 7a. Layout of test pit TP1

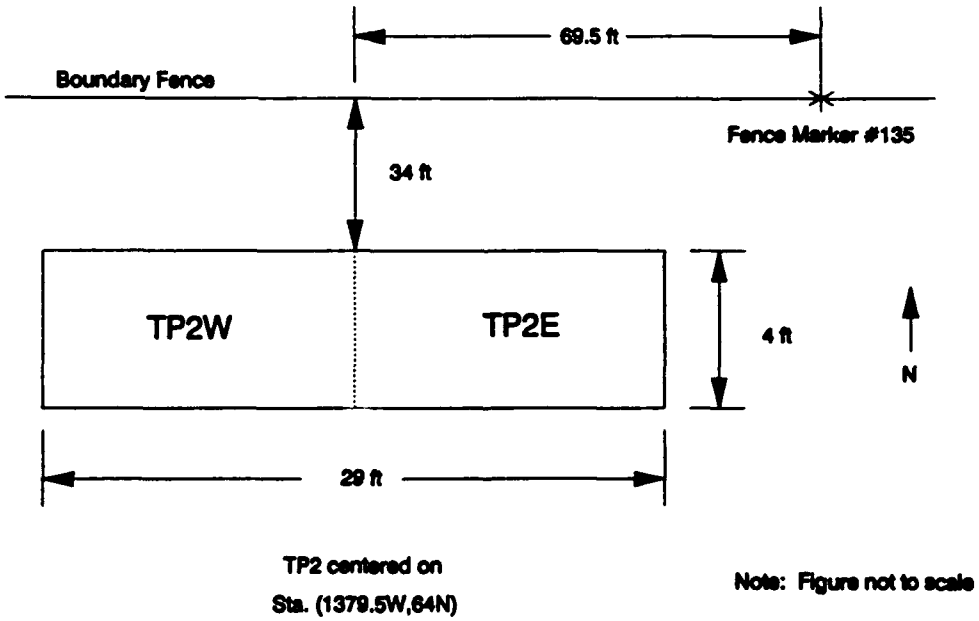


Figure 7b. Layout of test pit TP2

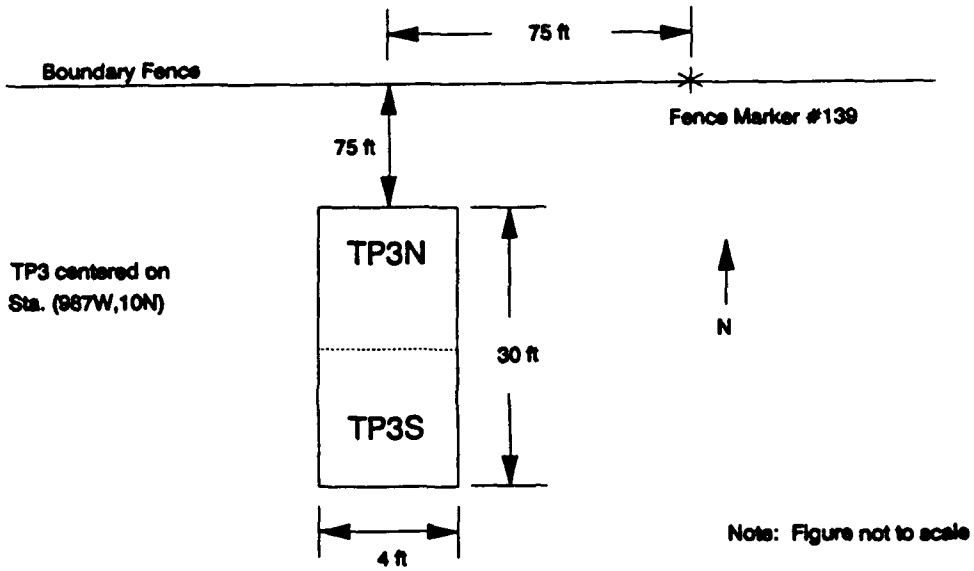


Figure 7c. Layout of test pit TP3

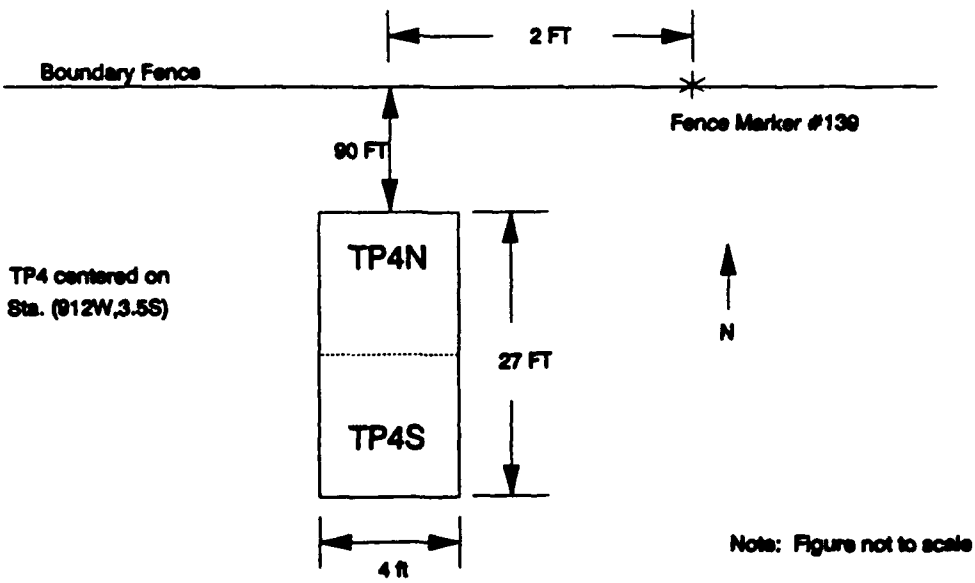


Figure 7d. Layout of test pit TP4

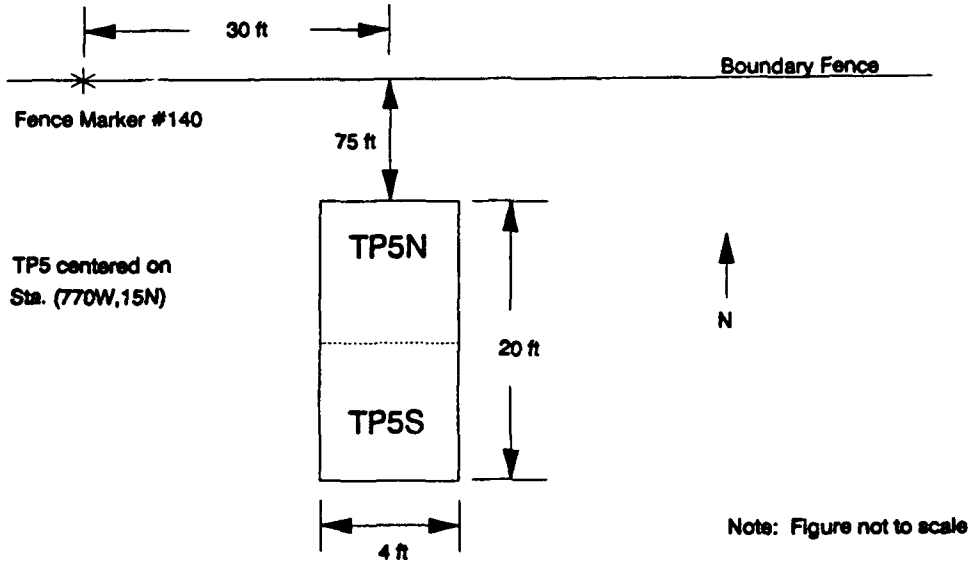


Figure 7e. Layout of test pit TP5

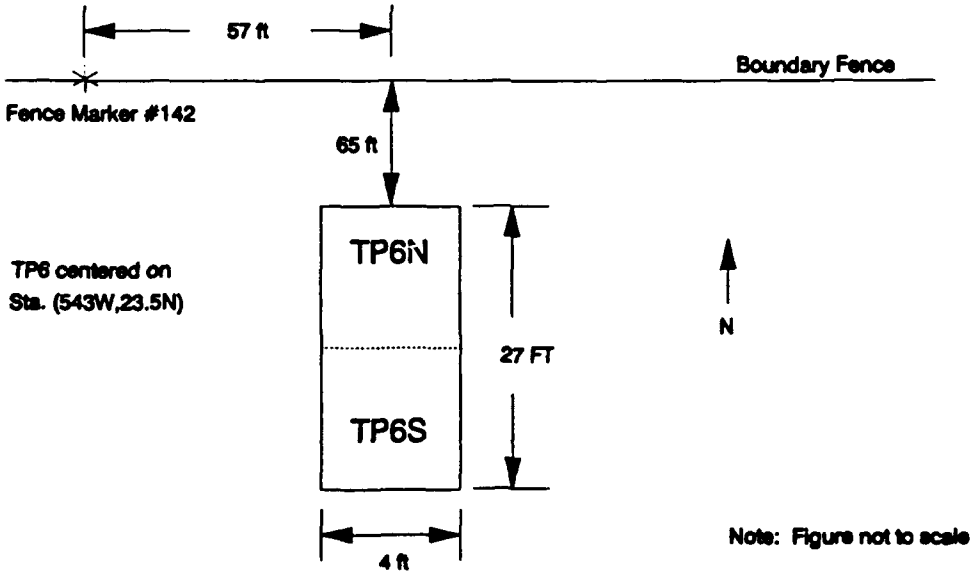


Figure 7f. Layout of test pit TP6

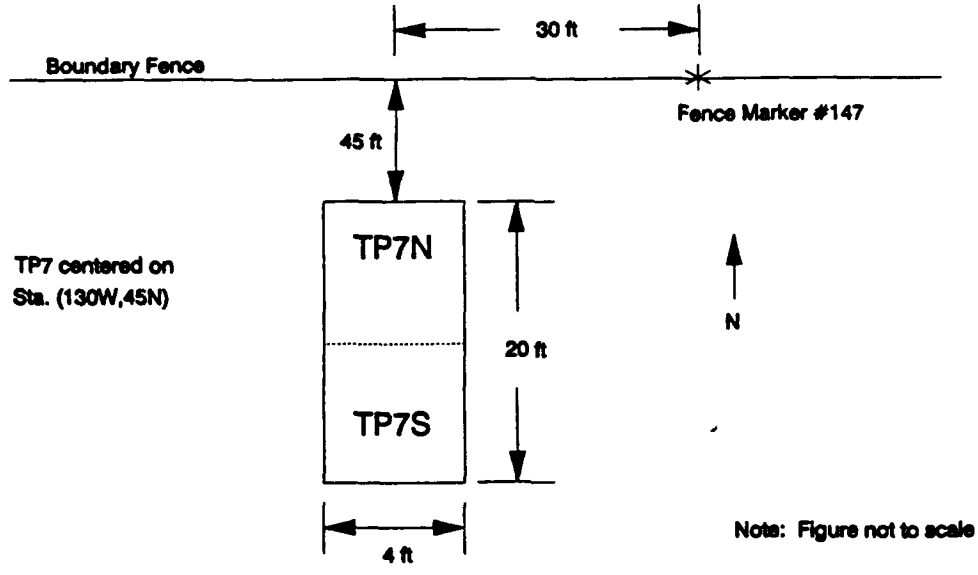


Figure 7g. Layout of test pit TP7

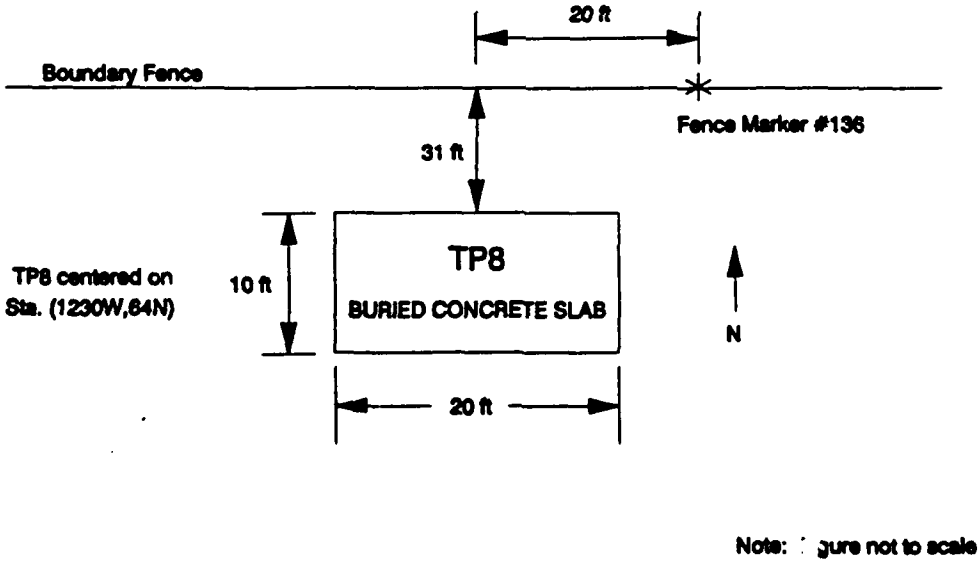


Figure 7h. Layout of test pit TP8

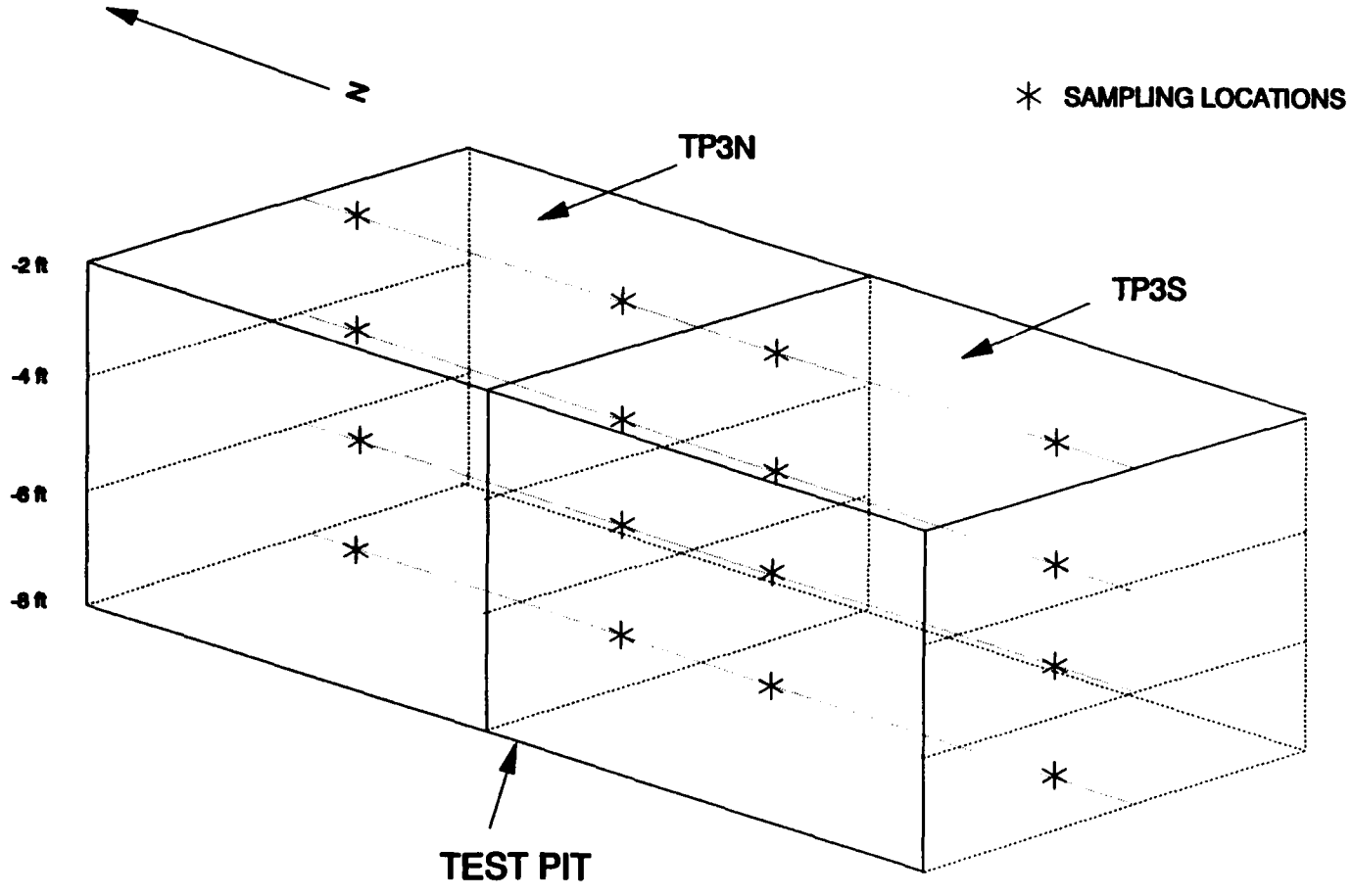
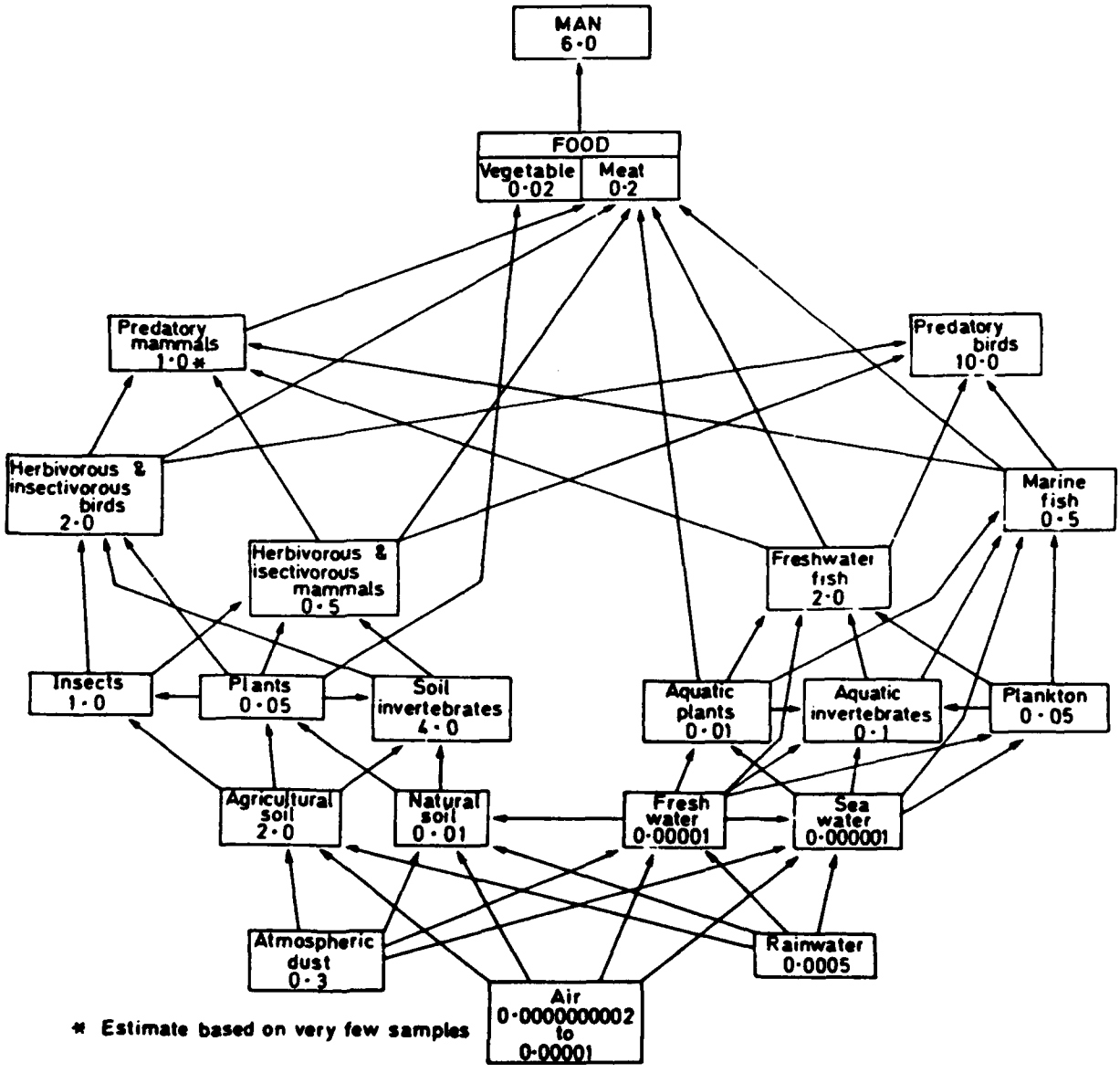


Figure 8. Sampling points within a typical test pit



(Adapted from Edwards, C. A., 1981)

Figure 9. Typical amounts of DDT (ppm) in the environment

APPENDIX A

SOIL LOGS

Fort Buchanan, Puerto Rico
Soil Logs

Test Pit TP1
20 October 1992

0 - 2 ft.	Plastic clay - intermixed crushed limestone.
2 - 4 ft.	Dark brown, stiff, plastic, clay.
4 - 6 ft.	Red, stiff, plastic, clay with some sand.
6 - 8 ft.	Black, gray, red, gravelly, plastic, clay with intermixed sand.

Test Pit TP2
20 October 1992

0 - 2 ft.	Dark brown, plastic, clay grading to reddish brown with depth.
2 - 6 ft.	Red and gray, plastic, clay with some sand.
6 - 8 ft.	Light gray, stiff, plastic, clay with sand (western end). Red, stiff, plastic, clay and fine gravel.

Test Pit TP3
20-22 October 1992

0 - 4 ft.	Brown, stiff, plastic, clay. Pieces of steel grates as used for foot walks encountered.
4 - 6 ft.	Brown, stiff, plastic, clay.
6 - 8 ft.	Light gray, clayey sand with little moisture.

Test Pit TP4

22 October 1992

0 - 4 ft.	Brown clay with black coal-like little (appr. 0.25 in. dia.) nodules (plinthite). Tree trunks observed in the upper 2 ft.
4 - 6 ft.	Light gray, stiff, plastic, clay with intermixed brown clay and black nodules (plinthite).
6 - 8 ft.	Gray, dry, highly weathered in-place limestone?

Test Pit TP5

22 October 1992

0 - 2 ft.	Dark brown, stiff, plastic, clay with plinthite nodules. Soil has mottled appearance.
2 - 4 ft.	Moist, stiff, plastic, reddish brown to reddish gray clay.
4 - 6 ft.	Steel gray, highly plastic, moist, stiff, clay overlying highly weathered limestone. Weathered material is tan with coarse grains.
6 - 8 ft.	Steel gray, stiff, plastic, clay intermixed with tan colored plastic clay and 0.25 in. dia. plinthite nodules.

Test Pit TP6

23 October 1992

0 - 2 ft.	Reddish brown, stiff, plastic, clay with plinthite nodules. Creosote treated board in the upper 1 ft.
2 - 4 ft.	Brown, plastic, clay. Little moisture, crumbly, and containing plinthite nodules.
4 - 6 ft.	Intermixed red, white, tan, very stiff, clay with plinthite nodules.
6 - 8 ft.	Light gray to tan, stiff, clay with intermixed reddish colored fine sand.

Test Pit TP7

23 October 1992

0 - 2 ft.	Light brown, low plasticity, clay. Low moisture and crumbly. Pieces of tree trunks encountered.
2 - 4 ft.	Reddish brown, dry, crumbly, clay with black plinthite nodules.
4 - 8 ft.	Reddish brown, stiff, highly plastic, clay with intermixed sand and black plinthite nodules.

APPENDIX B

REPORT OF ANALYSIS

REPORT OF ANALYSIS

23 NOV 1992
CB

U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ORGANIC ENVIRONMENTAL CHEMISTRY DIVISION
PESTICIDE ANALYSIS BRANCH

INSTALLATION: FT. BUCHANAN, PR
PROJECT NUMBER: 37-58-JZ35
PROJECT OFFICER: BOWSER
DATE SAMPLES COLLECTED: 20-23 OCT 92
DATE SAMPLES RECEIVED: 23,26 OCT 92
SAMPLE TYPE: SOIL
SAMPLE SET#1 EXTRACTION DATE: 30 OCT-2 NOV 92
SAMPLE SET#2 EXTRACTION DATE: 2-3 NOV 92
SAMPLE ANALYSIS DATE: 8-17 NOV 92
QC NUMBERS: S2041, S2042, S2094 S2095, S2096
ANALYSIS REQUESTED: PESTICIDES AND POLYCHLORINATED BIPHENLYS
PROCEDURES PERFORMED: SAMPLE EXTRACTION AND ANALYSIS WAS PERFORMED USING AEHA/OECD/PAB SOP #31B.1-(ANALYSIS FOR ORGANOCHLORINE, ORGANOPHOSPHORUS, ORGANONITROGEN PESTICIDES AND POLYCHLORINATED BIPHENYLS IN SOIL USING A RAPID SONICATION METHOD).

AQAD NUMBER	FIELD NUMBER	SAMPLE RESULTS * ug/g (ppm)
B9898	TP1-2	ALL ANALYTES BELOW DETECTION LIMITS
B9899	TP1-4	ALL ANALYTES BELOW DETECTION LIMITS
B9900	TP1-6	ALL ANALYTES BELOW DETECTION LIMITS
B9901	TP1-8	ALL ANALYTES BELOW DETECTION LIMITS
B9902	TP2E-2	ALL ANALYTES BELOW DETECTION LIMITS
B9902 Duplicate	TP2E-2	ALL ANALYTES BELOW DETECTION LIMITS
B9903	TP2E-4	ALL ANALYTES BELOW DETECTION LIMITS
B9904	TP2E-6	ALL ANALYTES BELOW DETECTION LIMITS
B9905	TP2E-8	ALL ANALYTES BELOW DETECTION LIMITS
B9906	TP2W-2	ALL ANALYTES BELOW DETECTION LIMITS
B9907	TP2W-4	ALL ANALYTES BELOW DETECTION LIMITS
B9908	TP2W-6	ALL ANALYTES BELOW DETECTION LIMITS
B9909	TP2W-8	ALL ANALYTES BELOW DETECTION LIMITS

ALL REPORTED RESULTS ARE BASED ON SAMPLE DRY WEIGHT.
* See parameter list for target compounds and detection limits.

Robert Scarff
EXTRACTED BY: ROBERT SCARFF

Robert Scarff
ANALYST: ROBERT SCARFF

Kenneth Mioduski
REVIEWED BY: KENNETH MIODUSKI

DATE RESULTS REPORTED: 11/25/92

J. Howard Vinopal
APPROVED BY: J. HOWARD VINOPAL
CHIEF, PAB

REPORT OF ANALYSIS (CONT'D)

INSTALLATION: FT. BUCHANAN, PR
PROJECT NUMBER: 37-58-JZ35
PROJECT OFFICER: BOWSER
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DATE SAMPLES RECEIVED: 23,26 OCT 92
SAMPLE TYPE: SOIL
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SAMPLE ANALYSIS DATE: 8-17 NOV 92
QC NUMBERS: S2041, S2042, S2094
S2095, S2096
ANALYSIS REQUESTED: PESTICIDES AND POLYCHLORINATED BIPHENLYS
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AQAD NUMBER	FIELD NUMBER	SAMPLE RESULTS * ug/g (ppm)	
B9910	TP3N-2	p,p'- DDE	0.26
		p,p'- DDD	0.33
		ALL OTHER ANALYTES BELOW DETECTION LIMITS	
B9911	TP3N-4	p,p'- DDD	0.40
		p,p'- DDT	1.64
		ALL OTHER ANALYTES BELOW DETECTION LIMITS	
B9912	TP3N-6	o,p'- DDD	0.28
		p,p'- DDD	0.23
		ALL OTHER ANALYTES BELOW DETECTION LIMITS	
B9913	TP3N-8	ALL ANALYTES BELOW DETECTION LIMITS	
B9914	TP3S-2	ALL ANALYTES BELOW DETECTION LIMITS	
B9915	TP3S-4	ALL ANALYTES BELOW DETECTION LIMITS	
B9916	TP3S-6	ALL ANALYTES BELOW DETECTION LIMITS	
B9917	TP3S-8	ALL ANALYTES BELOW DETECTION LIMITS	
B9918	TP4N-2	ALL ANALYTES BELOW DETECTION LIMITS	
B9919	TP4N-4	ALL ANALYTES BELOW DETECTION LIMITS	
B9920	TP4S-2	ALL ANALYTES BELOW DETECTION LIMITS	
B9921	TP5L-1	AROCLOR 1254	170
QUALITY CONTROL SAMPLE		alpha-BHC	0.24
		HEPTACHLOR	0.23

ALL REPORTED RESULTS ARE BASED ON SAMPLE DRY WEIGHT.
* See parameter list for target compounds and detection limits.

EXTRACTED BY: ROBERT SCARFF

ANALYST: ROBERT SCARFF

REVIEWED BY: KENNETH MIODUSKI

DATE RESULTS REPORTED:

APPROVED BY: J. HOWARD VINOPAL
CHIEF, PAB

REPORT OF ANALYSIS (CONT'D)

INSTALLATION: FT. BUCHANAN, PR
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PROJECT OFFICER: BOWSER
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S2095, S2096
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AQAD NUMBER	FIELD NUMBER	SAMPLE RESULTS * ug/g (ppm)	
B9921 continued	TP5L-1	ALDRIN	0.14
		HEPTACHLOR EPOXIDE	0.19
		DIELDRIN	0.22
	QUALITY CONTROL SAMPLE	ENDRIN	0.22
		p,p'- DDT	0.26
		ALL OTHER ANALYTES BELOW DETECTION LIMITS	
B9922	TP4N-6	ALL ANALYTES BELOW DETECTION LIMITS	
B9923	TP4N-8	ALL ANALYTES BELOW DETECTION LIMITS	
B9924	TP4S-4	ALL ANALYTES BELOW DETECTION LIMITS	
B9924 Duplicate	TP4S-4	ALL ANALYTES BELOW DETECTION LIMITS	
B9925	TP4S-6	ALL ANALYTES BELOW DETECTION LIMITS	
B9926	TP4S-8	ALL ANALYTES BELOW DETECTION LIMITS	
B9927	TP5N-2	ALL ANALYTES BELOW DETECTION LIMITS	
B9928	TP5N-4	ALL ANALYTES BELOW DETECTION LIMITS	
B9929	TP5N-6	ALL ANALYTES BELOW DETECTION LIMITS	
B9930	TP5N-8	ALL ANALYTES BELOW DETECTION LIMITS	
B9931	TP5S-2	ALL ANALYTES BELOW DETECTION LIMITS	
B9932	TP5S-4	ALL ANALYTES BELOW DETECTION LIMITS	

ALL REPORTED RESULTS ARE BASED ON SAMPLE DRY WEIGHT.
* See parameter list for target compounds and detection limits.

EXTRACTED BY: ROBERT SCARFF

ANALYST: ROBERT SCARFF

REVIEWED BY: KENNETH MIODUSKI

DATE RESULTS REPORTED: 11/25/92

APPROVED BY: J. HOWARD VINOPAL
CHIEF, PAB

REPORT OF ANALYSIS (CONT'D)

INSTALLATION: FT. BUCHANAN, PR SAMPLE SET#1 EXTRACTION DATE: 30 OCT-2 NOV 92
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PROJECT OFFICER: BOWSER SAMPLE ANALYSIS DATE: 8-17 NOV 92
DATE SAMPLES COLLECTED: 20-23 OCT 92 QC NUMBERS: S2041, S2042, S2094
DATE SAMPLES RECEIVED: 23,26 OCT 92 S2095, S2096
SAMPLE TYPE: SOIL
ANALYSIS REQUESTED: PESTICIDES AND POLYCHLORINATED BIPHENLYS
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AQAD NUMBER	FIELD NUMBER	SAMPLE RESULTS * ug/g (ppm)
B9933	TP5S-6	ALL ANALYTES BELOW DETECTION LIMITS
B9934	TP5S-8	ALL ANALYTES BELOW DETECTION LIMITS
B9935	TP6N-2	ALL ANALYTES BELOW DETECTION LIMITS
B9936	TP6N-4	ALL ANALYTES BELOW DETECTION LIMITS
B9936 Duplicate	TP6N-4	ALL ANALYTES BELOW DETECTION LIMITS
B9937	TP6N-6	ALL ANALYTES BELOW DETECTION LIMITS
B9938	TP6N-8	ALL ANALYTES BELOW DETECTION LIMITS
B9939	TP6S-2	ALL ANALYTES BELOW DETECTION LIMITS
B9940	TP6S-4	ALL ANALYTES BELOW DETECTION LIMITS
B9941	TP6S-6	ALL ANALYTES BELOW DETECTION LIMITS
B9942	TP6S-8	ALL ANALYTES BELOW DETECTION LIMITS
B9943	TP7N-2	ALL ANALYTES BELOW DETECTION LIMITS
B9944	TP7N-4	ALL ANALYTES BELOW DETECTION LIMITS
B9945	TP7N-6	ALL ANALYTES BELOW DETECTION LIMITS
B9946	TP7N-8	ALL ANALYTES BELOW DETECTION LIMITS

ALL REPORTED RESULTS ARE BASED ON SAMPLE DRY WEIGHT.
* See parameter list for target compounds and detection limits.

EXTRACTED BY: ROBERT SCARFF

ANALYST: ROBERT SCARFF

REVIEWED BY: KENNETH MIODUSKI

APPROVED BY: J. HOWARD VINOPAL
CHIEF, PAB

DATE RESULTS REPORTED: 11/25/92

REPORT OF ANALYSIS (CONT'D)

INSTALLATION: FT. BUCHANAN, PR
PROJECT NUMBER: 37-58-JZ35
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QC NUMBERS: S2041, S2042, S2094
S2095, S2096
ANALYSIS REQUESTED: PESTICIDES AND POLYCHLORINATED BIPHENLYS
PROCEDURES PERFORMED: SAMPLE EXTRACTION AND ANALYSIS WAS PERFORMED USING AEHA/OECD/PAB SOP #31B.1~(ANALYSIS FOR ORGANOCHLORINE, ORGANOPHOSPHORUS, ORGANONITROGEN PESTICIDES AND POLYCHLORINATED BIPHENYLS IN SOIL USING A RAPID *SONICATION METHOD*).

AQAD NUMBER	FIELD NUMBER	SAMPLE RESULTS * ug/g (ppm)
B9947	TP7S-2	ALL ANALYTES BELOW DETECTION LIMITS
B9948	TP7S-4	ALL ANALYTES BELOW DETECTION LIMITS
B9949	TP7S-6	ALL ANALYTES BELOW DETECTION LIMITS
B9950	TP7S-8	ALL ANALYTES BELOW DETECTION LIMITS

ALL REPORTED RESULTS ARE BASED ON SAMPLE DRY WEIGHT.
* See parameter list for target compounds and detection limits..

EXTRACTED BY: ROBERT SCARFF

ANALYST: ROBERT SCARFF

REVIEWED BY: KENNETH MIODUSKI

DATE RESULTS REPORTED: 11/23/92

APPROVED BY: J. HOWARD VINOPAL
CHIEF, PAB

QUALITY CONTROL DATA

QC NUMBER: S2041
QC TYPE: ORGANOCHLORINE, ORGANOPHOSPHORUS AND ORGANONITROGEN PESTICIDES
QC MATRIX: SOIL

SAMPLE SET#1: B9898-B9930
QC EXTRACTION DATE: 30 OCT-2 NOV 92
QC ANALYSIS DATE: 8-9 NOV 92

COMPOUNDS SPIKED	CONCENTRATION SPIKED ug/g (ppm)	CONCENTRATION RECOVERED ug/g (ppm)	PERCENT RECOVERY(%)	PAB ACCEPTANCE CONTROL LIMITS ug/g (ppm)
LINDANE	0.53	0.54	102	0.34-0.72
ENDRIN	0.13	0.13	100	0.08-0.18
BROMACIL	0.80	0.78	98	0.51-1.09
ALACHLOR	0.67	0.84	125	0.43-0.91
o,p'- DDE	0.80	0.76	95	0.51-1.09
PARATHION	0.33	0.41	124	0.21-0.45
CHLORONEB	0.67	0.64	96	0.43-0.91
OXADIAZON	0.53	0.55	104	0.34-0.72

EXTRACTED BY: ROBERT SCARFF

ANALYST: ROBERT SCARFF

REVIEWED BY: KENNETH MIODUSKI

APPROVED BY: J. HOWARD VINOPAL
CHIEF, PAB

DATE RESULTS REPORTED: 11/23/92

QUALITY CONTROL DATA

QC NUMBER: S2094
QC TYPE: POLYCHLORINATED BIPHENYLS
QC MATRIX: SOIL

SAMPLE SET#1: B9898-B9930
QC EXTRACTION DATE: 30 OCT-2 NOV 92
QC ANALYSIS DATE: 8-9 NOV 92

COMPOUNDS SPIKED	CONCENTRATION SPIKED ug/g (ppm)	CONCENTRATION RECOVERED ug/g (ppm)	PERCENT RECOVERY(%)	PAB ACCEPTANCE CONTROL LIMITS ug/g (ppm)
(AROCLOR 1221)	2.00	1.89	95	1.28-2.72
(AROCLOR 1254)	4.00	3.50	88	2.56-5.44

EXTRACTED BY: ROBERT SCARFF

ANALYST: ROBERT SCARFF

REVIEWED BY: KENNETH MIODUSKI

APPROVED BY: J. HOWARD VINOPAL
CHIEF, PAB

DATE RESULTS REPORTED: 11/23/92

MATRIX SPIKE DATA

MATRIX NUMBER: B9904MS (Spiked with PEST QC#S2041)
MATRIX TYPE: ORGANOCHLORINE, ORGANOPHOSPHORUS AND ORGANONITROGEN PESTICIDES
SPIKE MATRIX: SOIL

SAMPLE SET#1: B9898-B9930
QC EXTRACTION DATE: 30 OCT-2 NOV 92
QC ANALYSIS DATE: 8-9 NOV 92

COMPOUNDS SPIKED	CONCENTRATION SPIKED ug/g (ppm)	CONCENTRATION RECOVERED ug/g (ppm)	PERCENT RECOVERY(%)	PAB ACCEPTANCE CONTROL LIMITS ug/g (ppm)
LINDANE	0.53	0.45	85	0.34-0.72
ENDRIN	0.13	0.13	100	0.08-0.18
BROMACIL	0.80	0.73	91	0.51-1.09
ALACHLOR	0.67	0.87	130	0.43-0.91
o,p'- DDE	0.80	0.72	90	0.51-1.09
PARATHION	0.33	0.36	109	0.21-0.45
CHLORONEB	0.67	0.52	78	0.43-0.91
OXADIAZON	0.53	0.59	111	0.34-0.72

EXTRACTED BY: ROBERT SCARFF

ANALYST: ROBERT SCARFF

REVIEWED BY: KENNETH MIODUSKI

DATE RESULTS REPORTED: 11/13/92

APPROVED BY: J. HOWARD VINOPAL
CHIEF, PAB

MATRIX SPIKE DATA

MATRIX NUMBER: B9920MS (Spiked with PCB QC#S2095)
MATRIX TYPE: POLYCHLORINATED BIPHENYLS
SPIKE MATRIX: SOIL

SAMPLE SET#1: B9898-B9930
MATRIX SPIKE EXTRACTION DATE: 30 OCT-2 NOV 92
MATRIX SPIKE ANALYSIS DATE: 8-9 NOV 92

COMPOUNDS SPIKED	CONCENTRATION SPIKED ug/g (ppm)	CONCENTRATION RECOVERED ug/g (ppm)	PERCENT RECOVERY(%)	PAB ACCEPTANCE CONTROL LIMITS ug/g (ppm)
(AROCLOR 1221)	2.00	1.58	79	1.28-2.72
(AROCLOR 1254)	4.00	4.82	121	2.56-5.44

EXTRACTED BY: ROBERT SCARFF

ANALYST: ROBERT SCARFF

REVIEWED BY: KENNETH MIODUSKI

APPROVED BY: J. HOWARD VINOPAL
CHIEF, PAB

DATE RESULTS REPORTED: 11/23/92

QUALITY CONTROL DATA

QC NUMBER: S2042
QC TYPE: ORGANOCHLORINE, ORGANOPHOSPHORUS AND ORGANONITROGEN PESTICIDES
QC MATRIX: SOIL

SAMPLE SET#2: B9931-B9950
QC EXTRACTION DATE: 2-3 NOV 92
QC ANALYSIS DATE: 8-9 NOV 92

COMPOUNDS SPIKED	CONCENTRATION SPIKED ug/g (ppm)	CONCENTRATION RECOVERED ug/g (ppm)	PERCENT RECOVERY(%)	PAB ACCEPTANCE CONTROL LIMITS ug/g (ppm)
LINDANE	0.53	0.54	102	0.34-0.72
ENDRIN	0.13	0.14	108	0.08-0.18
BROMACIL	0.80	0.67	84	0.51-1.09
ALACHLOR	0.67	0.84	125	0.43-0.91
o,p'- DDE	0.80	0.80	100	0.51-1.09
PARATHION	0.33	0.42	127	0.21-0.45
CHLORONEB	0.67	0.67	100	0.43-0.91
OXADIAZON	0.53	0.58	109	0.34-0.72

EXTRACTED BY: ROBERT SCARFF

ANALYST: ROBERT SCARFF

REVIEWED BY: KENNETH MIODUSKI

APPROVED BY: J. HOWARD VINOPAL
CHIEF, PAB

DATE RESULTS REPORTED: 11/12/92

MATRIX SPIKE DATA

MATRIX NUMBER: B9947MS (Spiked with PCB QC#S2096)
MATRIX TYPE: POLYCHLORINATED BIPHENYLS
SPIKE MATRIX: SOIL

SAMPLE SET#2: B9931-B9950
MATRIX SPIKE EXTRACTION DATE: 2-3 NOV 92
MATRIX SPIKE ANALYSIS DATE: 8-9 NOV 92

COMPOUNDS SPIKED	CONCENTRATION SPIKED ug/g (ppm)	CONCENTRATION RECOVERED ug/g (ppm)	PERCENT RECOVERY(%)	PAB ACCEPTANCE CONTROL LIMITS ug/g (ppm)
(AROCLOR 1221)	2.00	1.74	87	1.28-2.72
(AROCLOR 1254)	4.00	5.11	128	2.56-5.44

EXTRACTED BY: ROBERT SCARFF

ANALYST: ROBERT SCARFF

REVIEWED BY: KENNETH MIODUSKI

APPROVED BY: J. HOWARD VINOPAL
CHIEF, PAB

DATE RESULTS REPORTED: 11/22/92

PROGRAM 17 TARGET COMPOUNDS

REPORTING LIMITS FOR PRIMARY PESTICIDES, PESTICIDE METABOLITES, AND PCB's ANALYZED FOR IN SOIL AND SEDIMENT SAMPLES

COMPOUND	REPORTING LIMITS (ppm)
HCB	0.03
alpha-BHC	0.03
beta-BHC	0.10
delta-BHC	0.10
gamma-BHC (LINDANE)	0.04
o,p'-DDE	0.16
p,p'-DDE	0.16
o,p'-DDD	0.16
p,p'-DDD	0.16
o,p'-DDT	0.20
p,p'-DDT	0.30
ALDRIN	0.08
DIELDRIN	0.08
ENDRIN	0.08
CHLORDANE, METAOLIZED	0.30*
CHLORDANE, TECHNICAL	0.60
trans-CHLORDANE	0.08
cis-CHLORDANE	0.08
trans-NONACHLOR	0.08
OXYCHLORDANE	0.08
gamma-CHLORDENE	0.08
1-HYDROXYCHLORDENE	0.08
HEPTACHLOR	0.03
HEPTACHLOR EPOXIDE	0.08
ENDOSULFAN I	0.08
ENDOSULFAN II	0.10
ENDOSULFAN SULFATE	0.20
METHOXYCHLOR	0.80
MIREX	0.20
TOXAPHENE	4.00
PCB (AROCLOR 1016)	2.00
PCB (AROCLOR 1221)	2.00
PCB (AROCLOR 1232)	2.00
PCB (AROCLOR 1242)	2.00
PCB (AROCLOR 1248)	2.00
PCB (AROCLOR 1254)	2.00
PCB (AROCLOR 1260)	2.00
DIAZINON	0.10
PARATHION, METHYL	0.10
PARATHION, ETHYL	0.10
MALATHION	0.10
CHLORPYRIFOS	0.10
RONNEL	0.10
SULFOTEPP	0.10
PROPETAMPHOS	0.10
FONOPHOS	0.10
FENITROTHION	0.10
DICHLOFENTHION	0.10
ISOPHENPHOS	0.10
PHOSALONE	0.30
DISULFOTON	0.20
FENTHION	0.20

* METABOLIZED CHLORDANE IS CALCULATED BY SUMMING THE CHLORDANE COMPONENTS. ANY OR ALL OF THE FOLLOWING COMPOUNDS MAY BE PRESENT: HEPTACHLOR, HEPTACHLOR EPOXIDE, gamma-CHLORDENE, trans-CHLORDANE, cis-CHLORDANE, trans-NONACHLOR, OXYCHLORDANE AND 1-HDROXYCHLORDENE.

PROGRAM 17 TARGET COMPOUNDS (CONT'D)

COMPOUND	REPORTING LIMITS (ppm)
BROMACIL	0.20
ATRAZINE	1.00
SIMAZINE	1.00
PROPAZINE	1.00
DACTHAL	0.08
OXADIAZON	0.08
TRIADIMEFON (BAYLETON)	0.40
VINCLOZALIN	0.10
FLUCHLORALIN	0.10
ETRIDIAZOLE (ETHAZOL)	0.10
TRIFLURALIN	0.10
BENEFIN	0.10
CAPTAFOL	0.50
CHLOROTHALONIL	0.30
CAPTAN	0.50
CHLORONEB	0.20
PCNB	0.10
PRONAMIDE	0.20
ALACHLOR	0.30
DICHLORAN	0.10
FOLPET	0.50
ASPON	0.10
BENSULIDE	0.50
PROCYMIDONE	0.20
IPRODIONE	0.50

REPORT DOCUMENTATION PAGE

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6. AUTHOR(S)
José L. Llopis

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13. ABSTRACT *(Maximum 200 words)*

Results of a soil sampling program at Solid Waste Management Unit No. 3 (SWMU No. 3) at Fort Buchanan, Puerto Rico (FTB), are presented. In 1977, approximately 1 ton (1 truckload) of various pesticides reportedly were buried at SWMU No. 3. The precise location of the burial trench is not available from records. The suspected burial trench lies in the vicinity of a 66-in. diameter water main which supplies the city of San Juan with potable water. There is concern over the possibility of pesticide-contaminated groundwater infiltrating through the line's seals when the line is depressurized during periodic maintenance. Investigations at this site have been ongoing since 1983 and include groundwater monitoring, soil trenching and sampling, and geophysical testing.

In an effort to determine the location of this trench, 52 soil samples were collected from 7 test pits and analyzed for the presence of pesticides. Test pit locations were selected based on the results of a previously

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conducted geophysical investigation. The results of the chemical analysis indicated tract amount of the pesticides p,p'-DDE, p,p'-DDD, p,p'-DDT, and o,p'-DDD in only one end of one test pit. These pesticide levels are not considered to be indicative of the levels expected to be associated with a pesticide disposal site but rather more indicative of amounts expected from routine pest control use. Based on visual observations during the excavation of the test pits and the results of the soil chemical analysis there is no indication of the presence of a pesticide disposal trench.