Comprehensive Long-Term Environmental Action Navy (CLEAN) II
Contract No. N62742-94-D-0048
Contract Task Order No. 0004

Sampling and Analysis Plan

Removal Action Design Support and Confirmation Sampling - Group C Sites

Halawa-Main Gate GSA
Naval Housing GSA
PWC Main Complex GSA
Shipyard GSA
Waipio Peninsula GSA
West Loch GSA
NCTAMS Wahiawa
NRTF, Lualualei
NAVMAG PH Lualualei
Oahu, Hawaii

Department of the Navy
Pacific Division
Naval Facilities Engineering Command
258 Makalapa Drive, Suite 100
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TABLES

ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
$\mu g/100cm^2$	micrograms per 100 square centimeters
ACS	American Chemical Society
AM	action memorandum
bgs	below ground surface
CIA	Controlled Industrial Area
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
COC	chain of custody
CPR	cardiopulmonary resuscitation
CTO	contract task order
DOH	Department of Health
DON	Department of the Navy
DQA	data quality assessment
DQAR	data quality assessment report
DQI	data quality indicator
DQO	data quality objective
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
EQL	estimated quantitation limit
GC/MS	gas chromatography
GSA	geographic study area
H&S	health and safety
HSP	health and safety plan
IAS	initial assessment study
ID	identification
IDW	investigation-derived waste
IRP	Installation Restoration Program
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
mg/kg	milligram per kilogram
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
msl	mean sea level
MSR	monthly status report
NAS	Naval Air Station
NAVMAG	Naval Magazine
NCTAMS	Naval Computer and Telecommunications Area Master Station
NEDTS	Navy Environmental Data Transfer Standards
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
NPL	National Priorities List
NRTF	Naval Radio Transmitting Facility
OSHA	Occupational Safety and Health Administration
PACNAVFACENGCOM	Pacific Division, Naval Facilities Engineering Command
PARCC	precision, accuracy, representativeness, comparability, and completeness
PCB	polychlorinated biphenyl
PHNC	Pearl Harbor Naval Complex

PID	photoionization detector
PPE	personal protective equipment
PRG	preliminary remediation goal
PWC	Public Works Center
QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
RA	removal action
RDBMS	relational database management system
RI	remedial investigation
RL	reporting limit
RME	reasonable maximum exposure
RPD	relative percent difference
RPM	Remedial Project Manager
SAL	soil action level
SAP	sampling and analysis plan
SDG	sample delivery group
SI	site inspection
SOP	standard operating procedure
SOW	statement of work
STO	subcontract task order
TSCA	Toxic Substances Control Act
UIC	underground injection control
USDA	United States Department of Agriculture

1. PROJECT DESCRIPTION AND MANAGEMENT

This sampling and analysis plan (SAP) was prepared for the Department of the Navy (DON), Pacific Division, Naval Facilities Engineering Command (PACNAVFACENGCOM), under the Comprehensive Long-Term Environmental Action Navy (CLEAN) II Program, Contract N62742-94-D-0048, Contract Task Order 0004. Previous investigations have identified contaminated areas suitable for removal actions (RAs) at nine Naval Geographic Study Areas (GSA) on Oahu, Hawaii: Halawa-Main Gate GSA, Naval Housing GSA, Public Works Center (PWC) Main Complex GSA, Shipyard GSA, Waipio Peninsula GSA, West Loch GSA, Naval Computer and Telecommunications Area Master Station (NCTAMS) Wahiawa; Naval Radio Transmitting Facility (NRTF) Lualualei, and Naval Magazine (NAVMAG) Pearl Harbor (PH) Lualualei. The RA sites at these GSAs are slated for excavation and treatment of contaminated soil at an on-site thermal treatment unit to be constructed and operated at former NAS Barbers Point. These RA sites have been designated as the Group C sites.

This SAP outlines the sampling and analysis methods and procedures proposed to support the design efforts and confirmation sampling for RAs at the Group C sites. This document also includes elements of a quality assurance plan, summarizing the policies and procedures that will be implemented to attain the data quality objectives (DQOs) specified for the project. The site-specific health and safety plan (HSP) has been prepared under a separate cover (Earth Tech, Inc. [Earth Tech] 2002d).

Table 1-1 demonstrates how this SAP addresses the quality assurance project plan (QAPP) elements currently required by the U.S. Environmental Protection Agency (EPA) QA/R-5 guidance document (EPA 2001).

Table 1-1: Comparison of SAP to EPA Required QAPP Elements

EPA QA/R-5 QAPP Element		Sampling and Analysis Plan Section	
A1	Title and Approval Sheet	Title and Approval Sheet	
A2	Table of Contents	Table of Contents	
A3	Distribution List	Distribution List	
A4	Project/Task Organization	1.6	Project Organization
A5	Problem Definition/Background	1.1	Problem Definition and 1.3 Background Information
A6	Project/Task Description	1.4	Project Description
A7	Quality Objectives and Criteria	1.5	Quality Objectives and Criteria
A8	Special Training/Certification	1.7	Special Training and Certification
A9	Documents and Records	1.8	Documents and Records
B1	Sampling Process Design	2.1	Sampling Process Design
B2	Sampling Methods	2.2	Sampling Methods
B3	Sample Handling and Custody	2.3	Sample Handling and Custody
B4	Analytical Methods	2.4	Analytical Methods
B5	Quality Control	2.5	Quality Control
B6	Instrument/Equipment Testing, Inspection, and Maintenance	2.6	Equipment Testing, Inspection, and Maintenance
B7	Instrument/Equipment Calibration and Frequency	2.7	Instrument Calibration and Frequency
B8	Inspection/Acceptance of Supplies and Consumables	2.8	Inspection and Acceptance of Supplies and Consumables

Table 1-1: Comparison of SAP to EPA Required QAPP Elements (Continued)

EPA QA/R-5 QAPP Element		Sampling and Analysis Plan Section	
B9	Non-direct Measurements	2.9	Non direct Measurements
B10	Data Management	2.10	Data Management
C1	Assessment and Response Actions	3.1	Assessment and Response Actions
C2	Reports to Management	3.2	Reports to Management
D1	Data Review, Verification, and Validation	4.1	Data Review, Verification, and Validation
D2	Validation and Verification Methods		
D3	Reconciliation with User Requirements	4.2	Reconciliation with User Requirements

1.1 PROBLEM DEFINITION

1.1.1 Purpose of the Investigation

The field effort described in this SAP has two purposes:

1. Conduct pre-excavation sampling to define the vertical and lateral extent of contamination at Group C sites
2. Conduct confirmation sampling following RA activities at Group C sites

Preliminary sampling has been completed at all Group C sites; pre-excavation sampling is required to further delineate contamination prior to soil excavation and treatment. A summary of the Group C sites and their associated RA activities is presented in Table 1-2.

Table 1-2: Group C Sites, Field Activities

GSA	Number of Sites	Field Activities	
		Pre-Excavation Sampling	Confirmation Sampling
Halawa-Main Gate GSA	11	X	X
Naval Housing GSA	2	X	X
PWC Main Complex GSA	1	X	X
Shipyard GSA	19	X	X
Waipio Peninsula GSA	3	X	X
West Loch GSA	2	X	X
NCTAMS Wahiawa	2	X	X
NRTF Lualualei	4	X	X
NAVMAG PH Lualualei	3	X	X

Note:
X = Activity will be completed.

1.1.2 Problem to be Solved

Group C sites contain contamination of concern that necessitates the removal and treatment of contaminated soil, as identified in the *Action Memorandum (AM) Addendum Attachment II* (DON 2002a). The detected contamination, which is related to former operations at the Group C sites, consists of polychlorinated biphenyls (PCBs). Sampling and analysis for this project is intended to solve the following problems: (1) to characterize the extent of contamination at each site prior to removal activities; and (2) to ensure that residual contaminant levels following excavation meet the established cleanup criteria.

1.2 SAMPLING PROGRAM OVERVIEW

Pre-Excavation Sampling. Group C sites will be sampled to further delineate the lateral and vertical extent of contamination. Results of the preliminary surface sampling conducted in 1991 and 2001 (Earth Tech 2001b, 2002a, and 2002b) will form the basis for the selection of pre-excavation sampling locations for this investigation. Soil samples will be collected using a direct push rig at 2, 4, and 6 feet below ground surface (bgs) at each sampling location where the screening level was exceeded in the preliminary sampling events. (Appendix A, Figures) These pre-excavation samples are referred to in this document as "original" samples. The collected samples will be analyzed in a stepwise approach beginning with the samples collected at the shallowest depth. The decision whether to have samples from the next depth interval analyzed by the laboratory will be based on review of the original soil sample results. Proposed sampling locations will be cleared by an underground utility clearance subcontractor.

Additional soil samples will be collected in a "step-out" fashion to delineate the lateral and vertical extent of contamination. These samples will be referred to in this document as "first step-out samples." In general, first step-out samples will be collected at a 5-foot lateral interval from the original sampling location if the preliminary surface sample had a PCB soil concentration less than or equal to 10 mg/kg. If the preliminary surface sample had a PCB soil concentration greater than 10 mg/kg, then first step-out samples will be collected at a 10-foot lateral interval from the original sampling location. First step-out samples will be collected at the surface, 2, 4, and 6 feet bgs and only the surface samples will initially be analyzed by the laboratory; the decision whether to analyze the samples collected at the subsequent depths will be based on review of the results of the initial sampling.

If necessary, additional 5-foot lateral interval locations will be selected following review of the previous sampling results. These samples will be referred to in this document as "second step-out samples." Vertical sampling at the second step-out sampling locations will be conducted consistent with the approach presented above. Samples will be collected from subsequent lateral step-outs until results from each site indicate that contaminant levels are below the screening levels.

The following activities will also be conducted:

- Soil samples will be analyzed by an offsite, subcontracted chemical laboratory.
- A subcontractor will validate all routine site chemical data.
- Investigation-derived waste (IDW) disposal documentation will be prepared.

Results of the pre-excavation delineation sampling will be included in an amendment to the design package for the excavation and remediation of Group C sites. The design amendment will include site maps, sample results, estimated excavation boundaries and soil quantities, and any unusual field conditions encountered.

Confirmation Sampling. The extent of contamination at the Group C sites will have been defined during the pre-excavation delineation sampling; however, confirmation sampling and analysis must be conducted during the RA to ensure that the RA objectives are met and that the action will be a final action. The objectives of the confirmation sampling include verifying that PCB concentrations in soil at the bottom and edges of each excavation are lower than cleanup criteria.

A grid sampling approach will be used at each site to verify the removal of PCB-contaminated soil after the RA is complete. Discrete samples will be collected at centers of a grid spaced 10 feet apart. At least five samples will be collected per site: one from the excavation bottom and one from each sidewall boundary where contamination was present (may only include two sidewalls). Additional excavation bottom samples will be collected from each 10-foot center grid identified at each site. Whenever possible, samples will be collected near locations where high levels of contamination were detected during the RA.

Cleanup criteria and reporting limits established for this project are shown in Table 1-3.

Table 1-3: Cleanup Criteria and Reporting Limits for PCBs as Aroclors

Analyte Parameter	EPA Analytical Method	Reporting Limit [a] Soils (mg/kg)	Cleanup Criterion [b] Soils (mg/kg)	Reporting Limit [a,c] Waters (μg/L)
Aroclor 1016	SW8082	0.033	1.0	1.0
Aroclor 1221	SW8082	0.033	1.0	2.0
Aroclor 1232	SW8082	0.033	1.0	1.0
Aroclor 1242	SW8082	0.033	1.0	1.0
Aroclor 1248	SW8082	0.033	1.0	1.0
Aroclor 1254	SW8082	0.033	1.0	1.0
Aroclor 1260	SW8082	0.033	1.0	1.0

Notes:
[a] EPA Contract Laboratory Program (CLP) reporting limits.
[b] TSCA Screening Level (high occupancy)
[c] All water samples collected for this method during this project are field or equipment rinsate blanks; therefore, comparisons with regulatory goals such as PRGs are not appropriate.
EPA = U.S. Environmental Protection Agency
mg/kg = milligrams per kilogram
μg/L = micrograms per liter
PCBs = polychlorinated biphenyls
PRG = preliminary remediation goal
TSCA = Toxic Substances Control Act

The following activities will also be conducted:

- Soil samples will be analyzed by an offsite, subcontracted chemical laboratory.
- A subcontractor will validate all routine site chemical data.

Results of the confirmation sampling will be included in a letter report for submittal to the Navy and remediation contractor responsible for excavation and treatment. The letter report will include site maps, confirmation results, and a data validation summary report. This letter report will be used by the contractor.

1.3 BACKGROUND INFORMATION

1.3.1 Facility Background

This SAP addresses 47 Group C sites located at nine separate GSAs throughout Oahu, Hawaii: Halawa-Main Gate GSA, Naval Housing GSA, PWC Main Complex, Shipyard GSA, Waipio Peninsula, West Loch GSA, NCTAMS Wahiawa, NRTF Lualualei, and NAVMAG PH Lualualei. Site histories and contaminant levels for each of the 47 Group C sites are presented in this section. Sites are grouped by their respective GSA. Figures in Appendix A provide the geographical location, and the original and proposed sampling locations for each site.

Available historic records indicate that PCBs were present in the dielectric fluid used in many of the former and existing transformers within these GSAs. The PCB-containing fluids may have been released to surface soil by leaking directly from the transformers, or during regular transformer testing and maintenance. During operation of the transformers, periodic sampling was required to test the dielectric properties of the transformer fluid. Once testing was completed, the fluid (approximately 12 ounces) was reportedly poured onto the adjacent area, such as grass, concrete pads, or building walls. All of the active transformers within these GSAs have been replaced or retrofilled with non-PCB-containing dielectric fluid. The site inspection (SI) planning documents for transformer sites (Earth Tech 2001b) list the analytical results from soil and concrete samples collected before 2000.

Investigation activities at the electrical transformers included the collection of surface or shallow subsurface soil samples in areas that may have been impacted by PCBs based on known historical activities or disposal practices. Discrete surface soil samples (0 to 6 inches bgs) were collected from locations considered most likely to contain the maximum concentrations of any PCB contaminants in soil. For transformers with asphalt surrounding the concrete pad, soil samples were collected immediately below the asphalt and underlying road base gravel.

The sites summarized in section 1.3.3 are recommended for removal actions because detected PCB concentrations exceeded the screening level of 1mg/kg for high-occupancy sites. Although some of the sites are low-occupancy sites, where the screening level was originally set at 10 mg/kg, the Navy has decided to also delineate and excavate the low-occupancy sites to 1 mg/kg based on further evaluation.

1.3.2 Summary of Previous Investigations

This section discusses previous investigations conducted at each of the nine GSAs associated with the Group C sites.

Halawa-Main Gate, Naval Housing, PWC Main Gate, Shipyard, and West Loch

The following investigations or supporting documents pertain to these GSAs:

- **Initial Assessment Study (IAS) of Pearl Harbor Naval Base, Oahu, Hawaii, 1983.** An IAS was conducted in 1983 at 30 potentially contaminated sites at Pearl Harbor Naval Complex. The assessment of sites was based on past hazardous waste storage operations and disposal practices. The study concluded that three sites warranted further investigation to assess potential long-term impacts to human health or the environment. Sampling was not included in the IAS (Naval Energy and Environmental Support Activity [NEESA] 1983).
- **AM Addendum, 2001.** An AM addendum was prepared in 2001 documenting the recommendation for an RA of PCB-contaminated soil and concrete at Group B sites. The addendum referenced two previous AMs: (1) *Polychlorinated Biphenyl Removal Action at Various Transformer Sites Within the Naval Computer and Telecommunications Area Master Station, Pacific, Hawaii, August 18, 1999* (DON 1999); (2) *Treatment of Contaminated Soil, NCTAMS, Former Naval Air Station Barbers Point, and Pearl Harbor Naval Complex, October 3, 2000* (DON 2000). The referenced action memoranda documented the Navy's decision to excavate (DON 1999) and treat (DON 2000) contaminated soils and concrete from PCB transformer sites. The AM addendum for treatment of contaminated soils presents information regarding treatment and final disposal of the treated media in a coral pit near the treatment area at former NAS Barbers Point, Oahu, Hawaii (DON 2001).

- **SI Planning Documents, Various Transformer Sites, Oahu, Hawaii, 2001**. This document was prepared for various electrical transformer sites located at Bishop Point GSA, Halawa-Main Gate GSA, Makalapa Crater GSA, Naval Housing GSA, PWC Main Complex GSA, Richardson GSA, Shipyard GSA, Waipio Peninsula GSA, West Loch GSA, NCTAMS Wahiawa, NRTF Lualualei, and NAVMAG Lualualei. The planning documents include inspection and environmental sampling guidelines that were used to evaluate the presence or absence of PCB contamination. The guidelines were used to determine if a site required a further response action or could be designated "no further response action planned." The planning documents include data that were collected at the subject sites for the relatively comprehensive program of concrete wipe sampling conducted in 1991 and the limited soil and transformer oil characterizations conducted in the 1990s (Earth Tech 2001b).
- **SI, Various Transformer Sites, Pearl Harbor Naval Complex, 2002.** An SI was conducted between November and December 2001 at Bishop Point, Halawa-Main Gate, Makalapa Crater, Naval Housing, PWC Main Complex, Richardson, and Shipyard. Biased field sampling was conducted to identify the presence or absence of PCBs at each transformer site. Sampling results were used to classify each site for further evaluation or for no further action (Earth Tech 2002c).

Waipio Peninsula and NAVMAG PH Lualualei GSAs

The following investigations or supporting documents pertain to these GSAs:

- **SI Planning Documents, Various Transformer Sites, Oahu, Hawaii, 2001**. This document was prepared for various electrical transformer sites located at Bishop Point GSA, Halawa-Main Gate GSA, Makalapa Crater GSA, Naval Housing GSA, PWC Main Complex GSA, Richardson GSA, Shipyard GSA, Waipio Peninsula GSA, West Loch GSA, NCTAMS Wahiawa, NRTF Lualualei, and NAVMAG Lualualei. The planning documents include inspection and environmental sampling guidelines that were used to evaluate the presence or absence of PCB contamination. The guidelines were used to determine if a site required a further response action or could be designated "no further response action planned." The planning documents include data that were collected at the subject sites for the relatively comprehensive program of concrete wipe sampling conducted in 1991 and the limited soil and transformer oil characterizations conducted in the 1990s (Earth Tech 2001b).
- **Action Memorandum, Removal Action at Naval Magazine Lualualei, Oahu, Hawaii. November 2002** (DON 2002b). This AM proposed and documented the approval of a time-critical RA to address PCB contamination of surface soil, subsurface soil, and concrete surface areas at Building 77 at NAVMAG Lualualei Headquarters Branch, and Building 49 at NAVMAG Lualualei, West Loch Branch on Oahu, Hawaii. This AM was the primary decision document substantiating the need for the RA, identifying the selected RA alternatives, and presenting the rationale for the proposed RA.

NCTAMS Wahiawa and NRTF Lualualei GSAs

The following investigations or supporting documents pertain to these GSAs:

- **IAS, NAVCAMS EAST PAC, 1986.** An IAS was conducted in 1986 at 25 potentially contaminated transformer locations at NCTAMS PAC: 19 at NCTAMS Wahiawa and 6 at NRTF Lualualei. The 19 transformers at NCTAMS Wahiawa were located at or near 11 buildings (Building 3, 106, 109, 118, 199, 120, 127, 130, 230, 234, and 261). The six transformers at NRTF Lualualei were located at or near three buildings (Building 26, 68, and 81). The assessment of sites was based on past hazardous waste storage operations and disposal practices. The study concluded that three sites warrant further investigation to assess potential long-term impacts to human health or the environment (Buildings 106 and 261 at NCTAMS Wahiawa and S-26 at NRTF Lualualei); however, no sampling was included in the IAS (NEESA 1986).

- **Site Inspection, Naval Communication Area Master Station Eastern Pacific Area, Wahiawa, Oahu, Hawaii. 1989.** This document presents the results of the SIs of four sites at the Naval Communication Area Master Station, Eastern Pacific Area, Oahu. The four sites are the Old Wahiawa Landfill, Building 6 Disposal Area, Antenna 354 Disposal Area, and Transformer Locations. The purpose of the SI was to assess whether hazardous wastes were present in quantities that posed a threat to human health or the environment (Harding Lawson and Associates 1989).
- **AM Addendum, 2001.** An AM addendum was prepared in 2001 documenting the recommendation for an RA of PCB-contaminated soil and concrete at Group B sites. The addendum referenced two previous AMs: (1) *Polychlorinated Biphenyl Removal Action at Various Transformer Sites Within the NCTAMS, Hawaii, August 18, 1999* (DON 1999); (2) *Treatment of Contaminated Soil, NCTAMS; former Naval Air Station (NAS) Barbers Point; and PHNC, October 3, 2000* (DON 2000). The referenced action memoranda documented the Navy's decision to excavate (DON 1999) and treat (DON 2000) contaminated soils and concrete from PCB transformer sites. The AM for treatment of contaminated soils presents information regarding treatment and final disposal of the treated media in a coral pit near the treatment area at former NAS Barbers Point, Oahu, Hawaii (DON 2001).
- **SI Planning Documents, Various Transformer Sites, Oahu, Hawaii, 2001**. This document was prepared for various electrical transformer sites located at Bishop Point GSA, Halawa-Main Gate GSA, Makalapa Crater GSA, Naval Housing GSA, PWC Main Complex GSA, Richardson GSA, Shipyard GSA, Waipio Peninsula GSA, West Loch GSA, NCTAMS Wahiawa, NRTF Lualualei, and NAVMAG Lualualei. The planning documents include inspection and environmental sampling guidelines that were used to evaluate the presence or absence of PCB contamination. The guidelines were used to determine if a site required a further response action or could be designated "no further response action planned." The Planning documents include data that were collected at the subject sites for the relatively comprehensive program of concrete wipe sampling conducted in 1991 and the limited soil and transformer oil characterizations conducted in the 1990s (Earth Tech 2001b).
- **SI, NCTAMS Pacific, 2002.** This document presents the results for the SI at NCTAMS Wahiawa and NRTF Lualualei. Field investigations were conducted at the sites in November and December 2001. Seven transformer sites at NCTAMS Wahiawa and eight transformer sites at NRTF Lualualei were sampled during this SI. Biased sampling was conducted at transformer sites to determine whether each site required further evaluation or could be designated no further action (Earth Tech 2002b).

1.3.3 GSA Background and Site Description

Halawa-Main Gate GSA

The Halawa-Main Gate GSA is bounded by Halawa Stream to the north; the East Loch, Southeast Loch, and Shipyard GSA to the west; Kamehameha Highway to the east; and South Road to the south (Figure A-1). The GSA comprises approximately 595 acres: the area under the jurisdiction of the Fleet and Industry Supply Center (FISC) includes approximately 432 acres; the area under the jurisdiction of the Submarine Base (SUBASE) includes approximately 123 acres; and the NAVSTA occupies an estimated 40 acres, including open recreation fields in the south portion of the GSA. The southernmost portion of the GSA is occupied by Hale Moku and Hokulani Naval Housing.

Eighty-nine transformer sites were investigated between November and December 2001 to evaluate the impact of PCB-contaminated dielectric fluid that may have been released to surface soil and concrete surfaces. Eighty-two of the 89 transformer sites were sampled (Earth Tech 2002c). Of the 82 sites sampled, 11 sites yielded samples with concentrations of PCBs that exceeded action levels. These 11 sites are recommended for removal actions. A summary of the 11 sites is presented in Table 1-4.

Table 1-4: Halawa-Main Gate GSA Sites

Transformer	Description	Maximum PCB Concentration (mg/kg)
Former Building 653	Transformer was removed. Former transformer building still exists and is surrounded by soil and grass. (Figure A-2)	32
H-2	Transformer is on a concrete pad surrounded by soil and gravel and a chain-link fence. The fence is surrounded by grass, and adjoins Building 1337. (Figure A-3)	4.0
H-3	Transformer H-3 is located at Building 1333 atop a concrete pad. There is grass to the north and west of the transformer. (Figure A-4)	1.22
H-5	Transformer H-5 is located adjacent to Building 88. It rests atop a 4-inch-high concrete pad. Soil and gravel cover the areas to the east and south. (Figure A-5)	3.48
J-12	Transformer J-12 is located northwest of Building 1613. It is surrounded by soil and rock with a soil berm to the northeast. (Figure A-6)	1.72
J-17	Transformer J-17 is located adjacent to Building 1535. It is surrounded on the east, west, and north, by asphalt and by concrete to the south. (Figure A-7)	3.2
J-21	Transformer J-21 is located within a concrete block building surrounded by soil and grass. An asphalt parking lot is located south of the building and an asphalt drive is located west. Secondary switch controls are located east and west of the transformer. (Figure A-8)	1.58
J-29	Transformer J-29 is located southeast of Building 1334 and northeast of Building 1626. It is situated atop a raised concrete pad and surrounded by chain link fencing. (Figure A-9)	15
K-14	Transformer K-14 is located within a concrete block building. Asphalt parking is located around the building to the southeast, north, and northwest. Gravel is located to the southwest. (Figure A-10)	783
K-15	Transformer is indoors. Building is surrounded by soil and weeds. The established PCB action level of 10 mg/kg is applicable to the site. (Figure A-11)	2.79
K-20	Transformer K-20 is located within a concrete block building. A radioactive material storage area is located to the northeast, and the area is surrounded by asphalt. (Figure A-12)	38

Notes:
PCB = polychlorinated biphenyl
mg/kg = milligrams per kilogram
The Navy is applying the TSCA high-occupancy PCB action level (1 mg/kg) to all sites, even though Transformers J-21, K-14, K-15, and K-20 are considered low-occupancy sites.

Naval Housing GSA

The Naval Housing GSA includes three noncontiguous properties. The first property encompasses several housing areas, including Catlin Park, Doris Miller Park, Halsey Terrace, Little Makalapa, Makalapa, Maloeloap, Moanalua Terrace, and Radford Terrace housing areas. This property is situated immediately north of the Honolulu International Airport along Kamehameha Highway, between Puuloa Road to the east and Halawa Stream to the west. Also located within this property are the Navy-Marine Golf Course; an administration area adjacent to the Makalapa Crater GSA; headquarter buildings (HQ) including the Commander-in-Chief, Pacific Fleet CINCPACFLT, and Joint Intelligence Center Pacific; the Moanalua Shopping Center, and the Navy Exchange (NEX). The second and third properties consist of the McGrew Point Housing Area, situated north of the

Richardson GSA and northeast of Aiea Bay; and the Halawa Housing Area, located northeast of Aloha Stadium. Figure A-13 shows the Naval Housing GSA.

Thirty transformer sites were investigated between November and December 2001 to evaluate the impact of PCB-contaminated dielectric fluid that may have been released to surface soil and concrete surfaces. Twenty-nine of the 30 transformer sites were sampled (Earth Tech 2002c). Of the 29 sites sampled, only two sites yielded samples that exceeded action levels. These two sites are recommended for removal actions. A summary of the three sites is presented in Table 1-5.

Table 1-5: Naval Housing GSA Sites

Transformer	Description	Maximum PCB Concentration (mg/kg)
M-3	Transformer M-3 is located within the Makalapa Housing Area near Building 200. It is situated atop a concrete pad and is surrounded by a chain link fence. An asphalt road is located north of the transformer. (Figure A-14)	199
NH-f	Transformer is located in the Moanalua Housing area. Transformer is indoors. Building is surrounded by soil, weeds and an asphalt loading area. (Figure A-15)	2.51

Notes:
PCB = polychlorinated biphenyl
mg/kg = milligrams per kilogram
The Navy is applying the TSCA high-occupancy PCB action level (1 mg/kg) to all sites.

PWC Main Complex GSA

The PWC Main Complex encompasses approximately 71 acres and is situated approximately 1 mile east of the Pearl Harbor Makalapa Gate, adjacent to the Navy Exchange and Commissary complex on Johnson Circle (Figure A-16). It is bounded by the Bougainville Industrial Park on the north, Salt Lake Boulevard on the east, Moanalua Terrace Naval Housing on the south, and Radford Drive on the west. PWC provides public works, public utilities, transportation, engineering services, shore facilities planning, and other logistical engineering and maintenance support required by the operating forces, dependant activities, and other commands. Most of the PWC maintenance shops are located in the main complex; however, PWC facilities are situated throughout the PHNC. Administration, operational, and training facilities are also situated at the PWC Main Complex. In addition, facilities are provided for outdoor recreation and community support functions.

Two transformer sites were investigated between November and December 2001 to evaluate the impact of PCB-contaminated dielectric fluid that may have been released to surface soil and concrete surfaces (Earth Tech 2002c). Of the two transformer sites sampled, one site yielded samples that exceeded action levels. This site is recommended for a removal action. A summary of the site is presented in Table 1-6.

Table 1-6: PWC Main Complex GSA Sites

Transformer	Description	Maximum PCB Concentration (mg/kg)
M-5	Transformer is located on a raised concrete pad. The pad is surrounded by asphalt, gravel, and soil. Transformer M-5 site is considered a high-occupancy site. (Figure A-17)	1.05

Notes:
PCB = polychlorinated biphenyl
mg/kg = milligrams per kilogram

Shipyard GSA

The Shipyard GSA (Figure A-18) comprises 445 acres in the main base area of PHNC. It is bordered on the north and west by waters of the main channel of Pearl Harbor, on the south by Hickam AFB, and on the east by the Halawa-Main Gate. The GSA currently contains property owned and operated by the Naval Shipyard and by Commander Navy Region Hawaii. The Naval Shipyard activity comprises 299 acres of the Shipyard GSA and contains four dry docks, industrial shops, and many thousands of feet of berthing with several portable cranes. Much of the Shipyard property is within the Controlled Industrial Area (CIA). The Naval Shipyard is the largest industrial activity in the State of Hawaii, conducting major ship repair and overhaul projects, and containing many industrial shops, testing laboratories, and engineering and administrative offices.

One hundred and thirty-eight transformer sites were investigated between November and December 2001 to evaluate the impact of PCB-contaminated dielectric fluid that may have been released to surface soil and concrete surfaces. Of these, 118 transformer sites were sampled (Earth Tech 2002c). Of the 118 transformer sites sampled, 19 yielded samples that exceeded action levels. These 19 sites are recommended for removal actions. A summary of the 19 sites is presented in Table 1-7.

Table 1-7: Shipyard GSA Sites

Transformer	Description	Maximum PCB Concentration (mg/kg)
A-2	Transformer A-2 is enclosed by a chain link fence and is surrounded by grass. (Figure A-19)	19
A-4	Transformer A-4 is situated atop a concrete pad and is enclosed by a chain link fence. Grass surrounds the area. (Figure A-20)	1.19
A-8	Transformer A-8 is situated atop a 5-inch high concrete pad and is enclosed with a chain link fence. Grass surrounds the area. (Figure A-21)	2.65
A-10	Transformer A-10 is located southwest of Building 1444 in the Controlled Industrial Area (CIA). It is situated atop a concrete pad and is enclosed by a chain link fence. Asphalt surrounds the area. (Figure A-22)	350
B-2	Transformer B-2 is located northeast of Avenue G within a building in the CIA. Gravel bounds the building to the south and west, concrete is to the north, and asphalt is to the east. (Figure A-23)	21.5
C-2	Transformer C-2 is located within Building S280, which is surrounded by soil and gravel. Transformer C-14 is located on a concrete pad to the south. (Figure A-24)	321
C-4	Transformer C-4 is located within a concrete building with a concrete floor. The building is surrounded by grass and soil, and a grass-covered earthen berm is located to the east. (Figure A-25)	3.95
C-7	Transformer C-7 is located to the east of Building 1430. It is situated atop a 6-inch concrete pad and is surrounded by a chain link fence. There is asphalt to the north, east, and south. (Figure A-26)	7.5
C-8	Transformer C-8 is located west of Building 1673 atop a concrete pad. (Figure A-27)	3.13
C-13	Transformer C-13 is situated atop a bermed 2-foot-high concrete pad enclosed with a chain link fence and surrounded by soil. (Figure A-28)	2.8

Table1-8: Shipyard GSA Sites (Continued)

Transformer	Description	Maximum PCB Concentration (mg/kg)
E-11	Transformer E-11 is located within a building surrounded by asphalt to the west, south, and east, and concrete to the north. (Figure A-29)	20.5
E-13	Transformer E-13 is located in the CIA. The transformer is outdoors and surrounded by a chain-link fence. Fence is surrounded by asphalt. (Figure 30)	2.6
E-16	Transformer E-16 is located in the CIA within Building 182, which is surrounded by asphalt. (Figure A-31)	33
E-25	Transformer E-25 is situated atop a 6-inch-high concrete pad enclosed by a chain link fence and surrounded by asphalt. (Figure A-32)	3.1
F-3	Transformer F-3 is located within Building S100 southeast from Building 92 in the CIA. (Figure A-33)	500
F-20	Transformer F-20 is collocated with Transformer F-20A located within a building north of Building 149 in the CIA. Gravel is to the north and west of the transformer. (Figure A-34)	1000
F-20A	Transformer F-20A is collocated with Transformer F-20 located within a building north of Building 149 in the CIA. Gravel is to the north and west of the transformer. (Figure A-34).	1.8
G-12	Transformer G-12 is located within a building southeast of Building 39. Soil and gravel surround the building. (Figure A-35)	84
K	Transformer K is located within a building adjacent to a 3-foot-high metal barrier between Hickam Air Force Base and Pearl Harbor Naval Complex. Gravel surrounds the building. (Figure A-36)	3.62

Notes:
Controlled Industrial Area (CIA)
PCB = polychlorinated biphenyl
mg/kg = milligrams per kilogram
The Navy is applying the TSCA high-occupancy PCB action level (1 mg/kg) to all sites, even though Transformers B-2, E-11, E-13, E-16, F-3, F-20, and F-20A are considered low-occupancy sites.

Waipio Peninsula GSA

Waipio Peninsula GSA is situated approximately 4.5 miles southwest of Pearl City (Figure A-37). The area is approximately 3.5 miles in length and 1.3 miles at its widest point. It is bordered on the north by Ted Makalena Golf Course and the ash landfill area for the adjacent former Waipahu incinerator, on the east by the Middle Loch of Pearl Harbor, on the west by the West Loch of Pearl Harbor, and on the south by the entrance to Pearl Harbor.

Four transformer sites were investigated and sampled in November 2001 to evaluate the impact of PCB-contaminated dielectric fluid that may have been released to surface soil and concrete surfaces. Six additional samples were collected from one of the sites, transformer W-11, in May 2002. Of the four transformer sites sampled, three sites yielded samples that exceeded action levels. These sites are recommended for removal actions. A summary of the three sites is presented in Table 1-8.

Table 1-8: Waipio Peninsula GSA Sites

Transformer	Description	Maximum PCB Concentration (mg/kg)
W-4	Transformer is located outdoors on a concrete pad. Concrete pad is surrounded by a chain-link fence. Fence is surrounded by soil and gravel on three sides and a concrete walk on one side. Transformer is collocated with transformer W-5. The TSCA PCB action level of 1 mg/kg is applicable to the site. (Figure A-38)	1.64
W-5	Transformer is located outdoors on a concrete pad. Concrete pad is surrounded by a chain-link fence. Fence is surrounded by soil and gravel on three sides and a concrete walk on one side. Transformer is collocated with transformer W-4. The TSCA PCB action level of 1 mg/kg is applicable to the site. (Figure A-38)	3.21
W-11	Transformer is located outdoors on a concrete pad. Pad is surrounded by gravel, which is surrounded by a chain-link fence. Concrete block walls are on three sides. Soil and grass surround the wall. The TSCA PCB action level of 1 mg/kg is applicable to the site. (Figure A-39)	13,000

Notes:
PCB = polychlorinated biphenyl
mg/kg = milligrams per kilogram
The Navy is applying the TSCA high-occupancy PCB action level (1 mg/kg) to all sites.

West Loch GSA

West Loch GSA is situated in the Ewa Plain on the island of Oahu (Figure A-40). The GSA contains the NAVMAG PH West Loch Branch and the Iroquois Point and Puuloa housing areas. The GSA comprises 3,103 acres. It is bordered on the north and east by waters of the West Loch of Pearl Harbor; on the west by Ewa Beach housing, the Hawaii Prince golf course, and James Campbell Trust Estate land (formerly used for sugar cane cultivation by the Oahu Sugar Company); and on the south by the Pacific Ocean.

Ten transformer sites were investigated in November 2001 to evaluate the impact of PCB-contaminated dielectric fluid that may have been released to surface soil and concrete surfaces. Of the 10 transformer sites investigated, only one site (former S11) yielded samples that exceeded action levels. In addition, transformer site S33 was sampled in May 1991 by PWC. The samples exhibited PCB concentrations that exceeded action levels. Five additional soil samples were collected from S33 in May 2001 (Earth Tech 2002a). These two sites are recommended for removal actions. A summary of the two sites is presented in Table 1-9.

Table 1-9: West Loch GSA Sites

Transformer	Description	Maximum PCB Concentration (mg/kg)
Former S11	Former transformer S11 (removed) is outdoors on a concrete pad surrounded by a tall concrete brick wall. Walls are surrounded by grass (Figure A-41)	2.56
Former S33	Former transformer S33 (removed) was a pad-mounted transformer located within former Building 33 (demolished). The former building location is still surrounded by concrete and soil. (Figure A-42)	14

Notes:
PCB = polychlorinated biphenyl
mg/kg = milligrams per kilogram
The Navy is applying the TSCA high-occupancy PCB action level (1 mg/kg) to all sites, even though former Transformers S33 is considered a low-occupancy site.

NCTAMS Wahiawa

NCTAMS Wahiawa occupies approximately 700 acres in Oahu’s central plateau (Figure A-43). The facility operates and maintains communications facilities for the Navy in the eastern Pacific. It is part of the Defense Communications System and of the military satellite communications system. Land bordering the station is largely agricultural and devoted to pineapple cultivation. The nearest urban area is the town of Wahiawa, located about 1 mile south of the property.

Eight transformer sites were investigated between November and December 2001 to evaluate the impact of PCB-contaminated dielectric fluid that may have been released to surface soil and concrete surfaces. Of the eight transformers investigated, seven were sampled during November and December 2001. One additional transformer, Transformer 236, was sampled under a previous investigation in 1991 (Earth Tech 2002b). Of the eight transformer sites sampled, two sites yielded samples that exceeded action levels. These two sites, Transformers 121 and 236, are recommended for a removal action. A summary of the two sites is presented in Table 1-10.

Table 1-10: NCTAMS Wahiawa Sites

Transformer	Description	Maximum PCB Concentration (mg/kg)
121	Transformer 121 is located in a concrete building. The building is surrounded by grass and a hedge. An asphalt road is located nearby. (Figure A-44)	849
236	Transformer is located indoors. Building is surrounded by a hedge and grass. (Figure A-45)	4.12

Notes:
PCB = polychlorinated biphenyl
mg/kg = milligrams per kilogram
The Navy is applying the TSCA high-occupancy PCB action level (1 mg/kg) to all sites, even though Transformers 236 is considered a low-occupancy site.

NRTF Lualualei

NRTF Lualualei is located on Oahu, Hawaii (Figure A-46). NRTF Lualualei was activated in 1936 as a transmitting facility. It occupies 1,700 acres in Lualualei Valley, a large valley between the leeward coast of Oahu and the crest of the Waianae Mountain Range. The small communities of Maili, Waianae, and Nanakuli are the nearest urban areas.

Ten transformer sites are located at NRTF Lualualei. Eight of the sites were investigated between November and December 2001 to evaluate the impact of PCB-contaminated dielectric fluid that may have been released to surface soil and concrete surfaces (Earth Tech 2002b). Two of the ten transformers, Transformers 68 and 81, were sampled under a previous investigation (Earth Tech 2002b and Earth Tech 2001a). Investigation activities during the 2001 site inspection at the remaining eight electrical transformers included the collection of surface or shallow subsurface soil samples in areas that may have been impacted by PCBs based on known historical activities or disposal practices. Discrete surface soil samples (0 to 6 inches bgs) were collected from biased locations selected to maximize the potential for encountering maximum concentrations of any PCB contaminants present. Of the ten transformer sites located at NRTF Lualualei, four sites -- Transformers 1, 68, and S84, and the former Rigger Shop (FRS) -- are recommended for a removal action. A summary of the four sites is presented in Table 1-11.

Table 1-11: NRTF Lualualei Sites

Transformer	Description	Maximum PCB Concentration (mg/kg)
1	Transformer is located outside Building 1. Transformer is surrounded by grass and a chain-link fence. The established PCB action level of 10 mg/kg is applicable to the site. (Figure A-47)	1.70

68	Transformer 68 is located within Building 68. Building is surrounded mostly by grass. (Figure A-48)	10
Former S84	Transformer has been removed. The abandoned concrete pad is outdoors and is surrounded by concrete, which is bordered on three sides by a chain-link fence. Adjoins Building 84. Soil and weeds surround the fence. (Figure 49)	2.7
FRS	Building demolished and transformer removed. Exact former transformer location unknown. (Figure 50)	1.10

Notes:
PCB = polychlorinated biphenyl
mg/kg = milligrams per kilogram
The Navy is applying the TSCA high-occupancy PCB action level (1 mg/kg) to all sites, even though former Transformers 1, 68, former S84, and FRS are considered low-occupancy sites.

NAVMAG PH, Lualualei Branch

NAVMAG PH, Lualualei Branch is located on Oahu, Hawaii (Figure A-51). The facility occupies approximately 7,498 acres of land in the Lualualei Valley on the Leeward (western) coast of Oahu.

Twelve transformer sites were investigated in November 2001 to evaluate the impact of PCB-contaminated dielectric fluid that may have been released to surface soil and concrete surfaces. Of the 12 transformer sites investigated, three sites yielded samples that exceeded action levels. These three sites are recommended for removal actions. A summary of the three sites is presented in Table 1-12.

Table 1-12: NAVMAG PH Lualualei Sites

Transformer	Description	Maximum PCB Concentration (mg/kg)
S380	Transformer S380 is outdoors on a concrete pad surrounded by a chain link fence. The concrete pad is surrounded by grass and soil. (Figure A-52)	11
S382	Transformer is outdoors on a concrete pad surrounded by a chain-link fence. The concrete pad is surrounded by soil. Staining was noted on the concrete pad under the transformer during the January-February 2001 visual site inspection (Figure A-53)	19,000
Former S384	Transformer has been removed. Transformer was outdoors on a concrete pad surrounded by a chain-link fence. Concrete pad and chain-link fence are still in place. The concrete pad is surrounded by asphalt, grass, and trees. (Figure A-54)	200

Notes:
PCB = polychlorinated biphenyl
mg/kg = milligrams per kilogram
The Navy is applying the TSCA high-occupancy PCB action level (1 mg/kg) to all sites, even though Transformers S382 and former S384 are considered low-occupancy sites.

1.3.4 Physical Setting

1.3.4.1 Geology

Basaltic shield volcanoes rising from the floor of the Pacific Ocean form the island of Oahu, which is characterized by four major geomorphic provinces, including the Koolau Range, Waianae Range, Schofield Plateau, and coastal plain (Stearns 1985). The Koolau and Waianae Ranges are the eroded remnants of the large, elongated shield volcanoes that have lost most of the original shield outlines and are now long narrow ridges shaped largely by erosion.

The following discussion of geological and hydrological setting is separated into five main sections because the GSAs are grouped according to proximity to one another. The five groups are (1) Halawa-Main Gate, Naval Housing, PWC Main Complex, and Shipyard, (2) West Loch, (3) Waipio Peninsula, (4) NRTF Lualualei and NAVMAG PH Lualualei, and (5) NCTAMS Wahiawa.

Halawa-Main Gate, Naval Housing, PWC Main Complex, and Shipyard GSAs

Pearl Harbor, which encompasses the Halawa-Main Gate, Naval Housing, PWC Main Complex, and Shipyard GSAs, has a complicated geologic history, but essentially consists of drowned river valley sediments interbedded with coral and pyroclastic material. The formation of three Pearl Harbor lochs is related to the repeated downcutting of a coalescing network of stream valleys into coral reef plateaus and volcanic strata. As sea levels fluctuated and rebounded to their present-day level, the stream valley was submerged, forming the present Pearl Harbor. This thick sequence of Tertiary and Pleistocene strata (approximately 1,000 feet) is underlain by the basal Koolau Volcanic Series.

Pearl Harbor soils consist of poorly drained soils on nearly level coastal plains. These soils developed in alluvium overlying organic material. Pearl Harbor soils are geographically associated with Hanalei, Kaloko, and Keaau soils. Hanalei soils consist of poorly drained soils on bottom lands developed in alluvium derived from basic igneous rock. Kaloko soils are poorly drained soils developed in alluvium derived from basic igneous rock; the alluvium has been deposited over marshy lagoon deposits. Keaau soils are poorly drained soils that were developed in alluvium deposited over reef limestone or consolidated coral sand. In addition, some of the land making up Pearl Harbor is fill land. Fill land consists of areas filled with material dredged from the ocean or hauled from nearby areas, garbage, and general material from other sources. Fill land is dominantly composed of packed, but unconsolidated, angular gravel and sand intermixed with varying proportions of silt and clay.

Soils from the Waipahu silty clay series predominate in the Naval Housing area. Soils in the series range from silty clay to a stony silty clay. The Waipahu series of soil are grayish-brown in color; these soils were developed on alluvium and derived from basic igneous rock. Permeability in these soils is moderately low.

West Loch GSA

The West Loch GSA is situated along the Ewa Coastal plain on southern Oahu. Regionally, the coastal deposits, or caprock, consist of coralline limestone, alluvium, colluvium, and mud flow and lagoon deposits. Locally, well-cemented sandstone or conglomerate may be found incorporating sand- and gravel-size fragments of volcanic rock within a matrix of calcareous beach sand called "beach rock." This caprock extends from the surface or near-surface down more than 300 feet bgs.

The major soil types found in the West Loch area consist of coral outcrop and Mamala silty stone clay loam (USDA 1972). This loam, which covers approximately 45 to 50 percent of the area, is a shallow, well-drained soil formed from alluvium and deposited over coral limestone and consolidated, calcareous sand. Coral fragments and stone are common in the surface layer and the profile. These soils are moderately permeable, and runoff is slow to medium on the 0- to 12-percent slopes on which they occur. The Mamala silty stone clay is principally found in the south and west portions of the West Loch GSA. Surficial soils within the GSA include those assigned to the Lualualei-Fill Land-Ewa Association and have been mapped as fill material.

Outcroppings consisting of exposed coral and cemented, calcareous sand are present throughout the Ewa Coastal plain area. In the West Loch GSA, coral outcrops are present over approximately 45 percent of the area, occurring primarily in the southern and northern portions of the GSA, with smaller areas of outcroppings occurring throughout the explosive safety quantity distance arc. A friable red soil is present in cracks and depressions within the coral outcroppings. This soil is similar to that of the Mamala series (USDA 1972).

Waipio Peninsula GSA

Native coastal plain sediments line the edges of the Waipio Peninsula, with fill material located above the sediments. The fill material consists of miscellaneous nonhazardous waste materials from sugar cane cultivation and mill operations, and from the disposal of soil, household trash, and construction debris (such as wood and scrap metal) (Hart Crowser 1995). The fill material occupies approximately 40 percent of the Waipio Peninsula area and is likely to be relatively permeable. Historical lease documents also showed significant fill activities to reclaim land for agricultural use, but did not differentiate in the type of fill materials used. Other specific soils found at Waipio Peninsula, primarily coastal plan sediments, include, in order of descending occurrence, Mamala stony silty clay loam, Honouliuli clay, Pearl Harbor clay, Mokuleia clay, Keaau clay, and Ewa silty clay loam.

NRTF Lualualei and NAVMAG PH Lualualei

The stratigraphy of Lualualei Valley consists of a thick sequence of calcareous and noncalcareous sedimentary rocks overlying basalts of the Waianae Volcanic series. The sedimentary sequence is thickest near the center of the valley; the youngest strata are unconsolidated, noncalcareous alluvial deposits derived from weathered volcanics or Pleistocene alluvium. The underlying calcareous sedimentary strata include coralline limestones and detrital limestones composed of broken shell fragments and beach sands. The basal Waianae Volcanic series, which include lower, middle, and upper basalt members with a total thickness of more than 6,000 feet, are exposed northwest and southeast of the facility. NRTF Lualualei is generally level; elevations range between 10 and 100 feet above mean sea level (msl) (Earth Tech 1998).

Soils in the Lualualei area are included in the Lualualei-Fill Land-Ewa Soil Association, an assemblage of well-drained, fine-textured soils that occur in drainages and on alluvial fans in nearly level to moderately sloping layers. Surficial soils consist of 20 to 50 inches of silty clay loam. These surface soils overlie coralline limestone (Earth Tech 1998).

NCTAMS Wahiawa

Three stratigraphic units occur at NCTAMS Wahiawa:

- The upper layer is silty clay or clayey silt laterite, a reddish soil formed by weathering of the underlying basalt. In the gullies, the surface soil is silty clay or clayey silt alluvium deposited in the beds of intermittent streams.
- Below the silty clay and laterite is saprolite, 10 to 100 feet thick, formed by weathering of the underlying Koolau volcanic rocks. Saprolite is distinguished from soil by its residual basaltic structure and texture, including fractures and vesicles.
- Below are unweathered to moderately weathered Koolau volcanic rocks (basalt) deposited as lava and tuff flows. These flows crop out near the crest of the Koolau Range. Unweathered Koolau volcanic rocks are highly permeable, jointed, dense to very dense vesicular basalt. They may be locally weathered along joints.

NCTAMS Wahiawa is located on the Schofield Plateau at approximately 1,300 feet above msl. The plateau, which forms central Oahu between the Koolau and Waianae Ranges, was created when Koolau lava flows overlapped the flanks of the older Waianae Range. Near the facility, the plateau slopes gently westward, corresponding to the dip of the underlying lava beds. A thick layer of surface soil covering most of the facility is dissected by a system of narrow, steep-sided gullies formed by local erosion.

Surface soil at NCTAMS Wahiawa is predominantly part of the Helemano-Wahiawa association of laterite soils (highly weathered reddish soil rich in secondary oxides of iron). Derived from weathered basalt, these upland soils are generally level to moderately sloping, well drained, and moderately fine textured.

Helemano silty clay soil occurs throughout the facility but is predominant in the southern region. On the gentler slopes (2 to 12 percent), this clay is moderately to highly permeable, has slow surface runoff, and is slightly susceptible to erosion. On the steeper slopes (30 to 90 percent), permeability is moderate, runoff medium to very rapid, and the erosion hazard very severe.

In the flatter northern portion of the facility, the surface soil is predominantly Paaloa silty clay, a moderately permeable upland soil with slow-to-medium surface runoff and 3 to 12 percent slopes. Manana silty clay loam, a moderately permeable upland soil containing more than 10 percent sand with medium surface runoff, also occurs in this area (USDA 1972).

1.3.4.2 HYDROGEOLOGY

Oahu has a deep basal groundwater body floating on, displacing, and existing in dynamic equilibrium with salt water saturating the highly permeable basalt of the island base. The basal groundwater originates primarily as rainwater percolating into the island from higher elevations and migrating seaward through the basalt until it meets the relatively impermeable caprock that overlaps the seaward margins of the basal rock (Radiological Control Office [RCO] 1997).

Halawa-Main Gate, Naval Housing, PWC Main Complex, and Shipyard GSAs

The Halawa-Main Gate, Naval Housing, PWC Main Complex, and Shipyard GSAs lie within the Honolulu Pearl Harbor basal aquifer. In this area, the cap rock confines the basal aquifer under artesian conditions and it is found at depths between 50 and 750 bgs. Groundwater is also found in the overlying cap rock at shallower depths. This unconfined aquifer has an elevation of about sea level and is recharged by leakage from the underlying volcanics, rainfall, and percolating groundwater. The shallow groundwater is not used for drinking water because of its salinity. Groundwater flow is expected to be downhill, toward Pearl Harbor or the ocean. Localized flow directions within the four GSAs may vary as a result of underground utilities or subsurface conditions (Earth Tech 2002c).

West Loch

The West Loch GSA overlies the Waipahu aquifer system within the Pearl Harbor aquifer sector (Mink and Lau 1990). In this area, a caprock confines the basal aquifer under artesian conditions. The groundwater in the vicinity of the West Loch GSA has an artesian head of 15 to 20 feet. The potentiometric surface of groundwater in the basal aquifer ranges in depth from 50 to 750 feet bgs. The regional groundwater flow direction is toward Pearl Harbor and the open ocean; however, the movement of groundwater is influenced by tides based on the proximity of the GSA to ocean waters. The potential for groundwater pollution migration is moderate because soils are permeable and the water table is shallow. Although groundwater discharges to Pearl Harbor, the gradient is low and groundwater movement is slow (NEESA 1983).

Groundwater is also found in the overlying caprock at shallower depths. This unconfined groundwater has an elevation of about sea level and is recharged by leakage from the underlying Koolau volcanics and percolating surface water. This shallow groundwater discharges into Pearl Harbor. The West Loch GSA lies in the region defined by the State of Hawaii Underground Injection Control (UIC) Program as not having groundwater that is considered to be a potential source of drinking water.

Waipio Peninsula

The Waipio Peninsula GSA lies within the Waipahu Sector of the Pearl Harbor system (Mink and Lau 1990). In this area, the basal aquifer is confined by the caprock under artesian conditions and is found at depths between 50 and 750 feet bgs. Groundwater is also found in the overlying caprock at shallower depths. This unconfined aquifer has an elevation of about sea level and is recharged by leakage from the underlying volcanics, rainfall, and percolating groundwater. However, the shallow groundwater is not used for drinking water because of its salinity. Shallow groundwater beneath the Waipio Peninsula likely discharges radially into the surface waters of Pearl Harbor.

Nine registered wells have been identified in the area. One sealed sewage UIC well was also identified. In the past, this well at the Degaussing Facility at Beckoning Point was used for disposal of sewage. An onsite wastewater treatment plant now treats this sewage.

NRTF Lualualei and NAVMAG PH Lualualei

The occurrence of groundwater resources beneath the Waianae Coastal area is the result of precipitation infiltrating the ground surface and percolating downward into permeable rock materials. Groundwater occurs in the upland Waianae Range basalt lava flows, the Lualualei Valley alluvium, the coralline (reef) deposits, and the basaltic lava flows beneath Lualualei Valley. Groundwater at NRTF Lualualei exists within a shallow unconfined aquifer. Depth to groundwater is projected to be approximately 60 to 80 feet bgs (OHM Remediation Services Corporation [OHM] 1997), with a gradient of approximately 1 foot per mile southwest (Earth Tech 2002b).

NCTAMS Wahiawa

Groundwater of the Schofield High-Level Aquifer lies within the fractured basalt of the Koolau Volcanic Series and, possibly at greater depths, within the Waianae Volcanics. Basalt dikes form relatively impermeable barriers in the permeable volcanic rock. The dikes divert groundwater to successively lower compartments, creating step-like breaks in the water table. Perched water occurs locally where less permeable strata impede the downward flow of surface water. Groundwater flows westward. The aquifer is recharged by infiltration of rainfall in the Koolau Range and by rainwater and streamflow infiltration on the Schofield Plateau (Earth Tech 2000).

The potentiometric surface of the Schofield Aquifer downgradient of NCTAMS Wahiawa is 800 to 900 feet bgs, based on initial water level measurements in a municipal well located approximately 500 feet east of Transformer 234. The 960-foot-deep well has supplied municipal water to NCTAMS Wahiawa since April 1997; it is sampled quarterly by the State of Hawaii Department of Health (DOH).

1.3.5 Principal Decision Makers

Principal decision makers for the removal actions include the Navy, regulatory agencies, and the public. Data collected during the pre-excavation sampling will be used to determine the lateral and vertical extent of soil to be excavated. Data collected during confirmation sampling will be used to assess the completion of the RA.

1.3.6 Technical or Regulatory Standards

Specific regulatory screening levels or cleanup criteria have been established to screen analytical results from the Group C sites.

Toxic Substances Control Act (TSCA) requirements for PCBs (40 CFR 761.61[a][4]) present cleanup levels for PCB remediation wastes. While these cleanup levels are not applicable for CERCLA removal actions, as stated in Section 761.61(a)(1)(ii), they may be relevant and appropriate. Section 761.61(a)(4) sets cleanup levels for PCB bulk remediation waste (including soil) at less than or equal to 1 ppm for high-occupancy areas and less than or equal to 25 ppm for low-occupancy areas. Screening levels for this project were originally established at 1 ppm for sites in close proximity to residential areas and 10 ppm for sites currently in industrial use and where industrial use is anticipated in the future. Based on further site-specific evaluation, the Navy has decided to also delineate and excavate low-occupancy sites to 1 mg/kg. These cleanup levels were set based on a human health risk evaluation in addition to consideration of the Applicable or Relevant and Appropriate Requirements (DON 1999).

1.4 PROJECT DESCRIPTION

The following sections discuss the objectives and measurements of the project. Table 1-13 presents a schedule for pre-excavation delineation sampling, excavation, confirmation sampling, and associated reporting at Group C sites.

Table 1-13: Schedule for Group C Sampling and Reporting

Task	Start Date	End Date	Duration[a]
Prepare and submit draft SAP	July 30, 2002	October 28, 2002	61
Review of draft SAP	October 28, 2002	November 15, 2002	19
Submit In-Progress replacement pages for new sites	November 18, 2002	December 17, 2002	30
Prepare and submit final SAP	January 20, 2003	February 24, 2003	36
Conduct pre-excavation delineation sampling	January 13, 2003	February 4, 2003	23
Prepare and submit delineation sampling results[b]	February 18, 2003	March 31, 2003	42
Conduct confirmation sampling	April 1, 2003	October 31, 2003	213
Prepare and submit confirmation sampling report	December 1, 2003	January 30, 2003	61

Notes:
a = Duration in calendar days
b = Results of pre-excavation delineation sampling will be included in a design package amendment.

1.4.1 Project Objectives

Field activities will be conducted in accordance with standard operating procedures (SOPs) established for PACNAVFACENGCOM environmental investigations. References to specific SOPs contained in the *Project Procedures Manual, U.S. Navy PACDIV IRP* (DON 1998) are made in the following sections of the SAP.

1.4.2 Project Measurements

Project measurements will primarily consist of laboratory analytical data for surface soil and subsurface soil samples collected from the five areas of concern at the site. Table 1-14 lists the laboratory analytical methods that will be used to evaluate the RA samples.

Table 1-14: Laboratory Methods

Parameter	Analysis Method No.	Analysis Methodology	Method Reference	Preparation Method No.	Preparation Method
Soil	EPA 8082	GC-ECD	EPA SW-846 2000c	EPA 3550B	Sonication extraction
Water	EPA 8082	GC-ECD	EPA SW-846 2000c	EPA 3510C/3520C	Separatory-funnel/ Continuous extraction

Notes:
All analyses for confirmation samples will be performed by an NFESC-evaluated fixed-base analytical laboratory.
EPA = U.S. Environmental Protection Agency
GC-ECD = gas chromatography - electron capture detector

1.5 QUALITY OBJECTIVES AND CRITERIA

The following sections present the DQOs and quality assurance and quality control (QA/QC) requirements identified for the pre-excavation and confirmation sampling activities.

1.5.1 Data Quality Objectives

DQOs are qualitative and quantitative statements developed through the EPA seven-step DQO process (EPA 2000a, 2000c). The DQOs clarify the study objective, define the most appropriate data to collect and the conditions under which to collect the data, and specify tolerable limits on decision errors that will be used as the basis for establishing the quantity and quality of data needed to support decision-making. The DQOs are used to develop a scientific and resource-effective design for data collection. Table 1-15 presents the seven steps of the DQO process for the pre-excavation and confirmation sampling approaches at Group C sites.

Table 1-15: Data Quality Objectives

STEP 1: State the Problem
• **Pre-excavation sampling.** The Navy is proposing to excavate contaminated soil at Group C sites; however, excavation boundaries cannot be specified due to uncertainty regarding the lateral and vertical extent of soil contamination. • **Confirmation sampling.** The concentration of residual contaminants in soil following excavation activities is unknown.
STEP 2: Identify the Decisions
• **Pre-excavation sampling.** Are the lateral and vertical limits of contamination in soil identified? • **Confirmation sampling.** Do sample results indicate that contaminated soil has been removed from the excavation?
STEP 3: Identify Inputs to the Decisions
• **Pre-excavation sampling.** Analytical data from soil samples collected during previous sampling events, analytical data collected during this sampling event, screening levels, and QA/QC data. • **Confirmation sampling.** Analytical results from pre-excavation sampling, field excavation summaries, field screening results, confirmation sampling results, screening levels, and QA/QC data.

Table 1-15: Data Quality Objectives (Continued)

STEP 4: Define Study Boundaries

- **Pre-excavation sampling.** Sampling will be limited to the Group C sites. Specific boundaries of the sites have not been identified; however, the boundaries are not anticipated to extend beyond 100 feet of the current site locations. Temporal boundaries are estimated at 44 working days for sampling, followed by additional time required for laboratory analysis, data validation, data quality assessment, and evaluation of sample results.
- **Confirmation sampling.** Confirmation samples will be collected from completed Group C excavation areas, as identified during the pre-excavation sampling and field screening results. Samples will be collected from between 0 and 6 inches within the floor and sidewalls of each excavation. The temporal boundary is based on the completion of excavation activities, followed by additional time required for laboratory analysis, data validation, data quality assessment, and evaluation of sample results.

STEP 5: Develop Decision Rules

- **Pre-excavation sampling.** If concentrations in a soil sample exceed the screening levels, then an additional sample will be collected from 2 feet below and an additional 10-foot lateral step-out will be conducted from the original location. If concentrations in the samples do not exceed the screening level, then no further sampling will be conducted.
- **Confirmation sampling.** If concentrations in the confirmation sample exceed the cleanup level, then additional excavation will be conducted. If concentrations in the confirmation sample do not exceed the cleanup level, then no further sampling will be conducted. The temporal boundary for confirmation sampling should not exceed 6 months.

STEP 6: Specify Tolerable Limits on Decision Errors

- **Pre-excavation sampling.** Samples will be collected at each Group C site using a systematic sampling design to provide sufficient data to evaluate the vertical and lateral extent of contamination. One sample will be collected from 2, 4, and 6 feet below the previously identified contaminated area, and surface samples (0 to 0.5 feet bgs) will be collected from 5 to 10 feet laterally. Samples from successive depths and lateral intervals will be analyzed based on results of these initial samples. Vertical samples will be collected at 2-foot intervals until sample results are below the screening level, and horizontal samples will be collected at 5 to 10-foot intervals. The spacing was selected to provide reasonable coverage at each area, based on a review of existing data.
- **Confirmation sampling.** At least five confirmation samples will be collected at each Group C excavation area following notification that excavation limits have been reached. Confirmation samples will be collected using a systematic sampling design to provide sufficient data for ensuring residual soils do not contain contaminants at levels greater than the cleanup goal. A 10-foot grid will be placed over the completed excavation, and a confirmation sample will be collected from the excavation floor of each grid. A confirmation sample will also be collected from each excavation sidewall. The grid was selected to provide reasonable coverage at each excavation and is consistent with other Navy PCB RAs.
- **Pre-excavation and confirmation sampling.** “One-sample” tests will be used to compare a site population with a fixed value. The most appropriate one-sample statistical test will be selected, based on data characteristics such as data distribution and detection rate. Use of a formal statistical test allows error rates to be controlled and confidence and power goals to be specified, as opposed to simple threshold (point-by-point) comparisons. Decision errors fall into two main categories, based upon the following hypotheses:
  - Null hypothesis (Ho): Concentrations meet or exceed the screening or cleanup level in the soil sample.
  - Alternative hypothesis (Ha): Concentrations do not exceed the screening or cleanup level at the soil sample location.
  - Type 1 Error: Reject Ho. Decide that the concentration in soil at a Group C site does not exceed the screening or cleanup level, when, in fact, it does. There is no consequence for this incorrect decision for pre-excavation sampling since confirmation samples will be collected at the area following soil excavation. The consequence of this incorrect decision for confirmation sampling is a potentially unacceptable risk to human receptors.
  - Type 2 Error: Reject Ha. Decide that the concentration in soil at a Group C site does exceed the screening or cleanup level, when it really does not. The consequence of this incorrect decision is the unnecessary expenditure of resources to further delineate or excavate an area that does not pose an unacceptable risk to receptors. Sampling error may occur when the samples are not representative of the true state of the environment at a site. This type of error is minimized by designing sampling locations on a regular grid or methodology that is applied systematically at each Group C site.
  - Measurement error includes random and systematic errors associated with sample collection, handling, and preparation, in addition to analytical errors. Measurement error is minimized by following QA/QC procedures and protocol for sample collection, and by using an accredited laboratory for analysis of samples. The quality and reliability of the data are assessed by evaluating data quality indicators (DQIs), which are quantitative and qualitative measures of principal quality attributes (EPA 2001b).

Table 1-15: Data Quality Objectives (Continued)

STEP 7: Optimize the Sampling Design
• **Pre-excavation sampling.** Sampling locations are proposed in a systematic method designed to collect the minimal amount of samples while meeting the objective of vertical and lateral characterization. Vertical delineation will be completed by analyzing samples only from beneath areas previously identified contamination only; if no contamination is identified, then no additional samples from that location will be analyzed. A similar methodology will be used for lateral delineation in that samples will be collected at areas adjacent to known contamination; if no contamination is identified closest to known contamination then samples from further out laterally will not be analyzed. If more than 3 rounds of lateral sampling are conducted, then the subsequent lateral samples will be collected at 10-foot increments until site contamination has been delineated. • **Confirmation sampling.** Sampling locations are proposed in a systematic design based on at least 1 confirmation sample for every 100 square feet of excavation floor space. The general area covered by the sampling grid will be determined by the results of the pre-excavation delineation sampling.

Source: U.S. Environmental Protection Agency 2001
Notes:
bgs = Below ground surface
EPA = U.S. Environmental Protection Agency
QA/QC = Quality assurance and quality control

1.5.2 Project Quality Assurance Objectives

All analytical results will be evaluated in accordance with precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters to ensure the attainment of project-specific DQOs. Of these PARCC parameters, precision and accuracy will be evaluated quantitatively through the collection of the QC samples listed in Table 1-16.

Table 1-16: Quality Control Samples for Precision and Accuracy

QC Type	Precision	Accuracy	Frequency
Field QC	Field Duplicate RPD	Field Blanks	Field Duplicate = 1 per 10 samples (soil) Field Blank = 1 per week of sampling event Equipment Rinsate = 1/day/piece of equipment
Laboratory QC	MS/MSD RPD Field Duplicate RPD	MS/MSD %R Method Blanks LCS or Blank Spikes Field Duplicate Surrogate Standards %R Internal Standards %R	MS/MSD = 1 per 20 samples (soil) Method Blank = 1 per 20 samples LCS or Blank Spikes = 1 per 20 samples Field duplicate = 1 per 10 samples (soil) every sample every sample

Notes:
%R = percent recovery
LCS = laboratory control sample
MS/MSD = matrix spike/matrix spike duplicate
RPD = relative percent difference

Precision and accuracy goals for these QC samples are listed in Table 1-17.

Table 1-17: Quality Control Criteria for Polychlorinated Biphenyls as Aroclors

Analyte Parameter	EPA Analytical Method	Soils and Waters [b]: MS/MSD/ Surrogate (%R)	Soils and Waters: Laboratory Control Sample (%R)	Soils and Waters: RPD
Aroclor 1016 [a]	**SW8082**	**50-130**	**50-130**	**35**
Aroclor 1221	SW8082	50-130	50-130	35
Aroclor 1232	SW8082	50-130	50-130	35
Aroclor 1242	SW8082	50-130	50-130	35
Aroclor 1248	SW8082	50-130	50-130	35

Table 1-17: Quality Control Criteria for Polychlorinated Biphenyls as Aroclors (Continued)

Analyte Parameter	EPA Analytical Method	Soils and Waters [b]: MS/MSD/ Surrogate (%R)	Soils and Waters: Laboratory Control Sample (%R)	Soils and Waters: RPD
Aroclor 1254	SW8082	50-130	50-130	35
Aroclor 1260 [a]	**SW8082**	**50-130**	**50-130**	**35**
Surrogate:				
Decachlorobiphenyl (DCB) [a]	**SW8082**	**30-150**	N/A	N/A

Notes:
[a] EPA Contract Laboratory Program (CLP) **controlling compounds** (shown in boldface) and control limits will be used for method control and corrective action. Remaining compounds will be used for data validation, not for corrective action.
[b] All water samples collected for this method during this project are field, trip, or equipment rinsate blanks; therefore, MS/MSD analyses are not applicable.
%R = percent recovery
EPA = U.S. Environmental Protection Agency
MS/MSD = matrix spike/matrix spike duplicate
N/A = not applicable
RPD = relative percent difference
Laboratory-specific control limits may be substituted for the control limits specified in this table, pending laboratory procurement and regulatory approval.

The subsections below detail the objectives relating to each of the PARCC parameters.

1.5.2.1 PRECISION

Precision is the degree of mutual agreement between individual measurements of the same property under similar conditions. Precision is expressed quantitatively as the measure of variability of a group of measurements compared to their average value. Analytical precision for a single analyte is expressed as a percentage of difference between results of duplicate samples for the analyte. Combined field and laboratory precision is evaluated by collecting and analyzing field duplicates, comparing the results, and then calculating the variance between the samples, typically as a relative percent difference (RPD). The RPD of the field duplicates is calculated by using the following equation:

$$RPD = \frac{|A-B|}{(A+B)/2} \; x \; 100\%$$

where: A = primary sample concentration

B = duplicate sample concentration

Field duplicates will be collected for surface soil and subsurface soil. For field duplicate samples, the goal for precision has been set at 50 percent RPD for PCBs.

Laboratory analytical precision is evaluated by analyzing matrix spikes (MS) and matrix spike duplicates (MSDs). Analytical precision will be assessed through the analysis of laboratory control samples (LCSs) and laboratory control sample duplicates (LCSDs). For this project, MS/MSD samples will be generated for all analyses of soil samples. The results of the analysis of each MS/MSD pair will be used to calculate an RPD for evaluating precision.

General precision control limits for the analytical laboratory, shown as RPDs for MS/MSD, LCS/LCSD, or laboratory duplicate samples, are provided in Table 1-17. Data that do not meet the precision criteria listed in Table 1-17 may be qualified as estimated (i.e., "J") during data validation, as outlined in IRP Procedure II-D, *Data Validation, Procedure 4, Levels C and D Organochlorine Pesticides/PCBs by GC - PACDIV* (DON 1998). Due to the RPD calculation, RPDs cannot be calculated in the instance that one or both values are nondetects. In addition, RPDs for trace or low-level results may not be appropriate for evaluation of precision. In these cases, an evaluation will be made during data validation based on comparison of the results with respect to the reporting limit (RL) on the replication. In general, results within ±RL for waters or ±2 RL for soils are considered to indicate acceptable precision for results reported at less than five times the RL.

A summary of precision results will be presented in the sampling letter report to provide an overall assessment of project data precision. The summary will consist of the mean and standard deviation of RPD values for each analytical method, by matrix, for MS/MSDs and field duplicates.

A summary of precision results will be presented to provide an overall assessment of data precision. The summary will consist of the mean and standard deviation of RPD values for each analytical method, by matrix, for MS/MSDs and field duplicates.

1.5.2.2 Accuracy

Accuracy is the degree of agreement between an analytical measurement and a reference accepted as a true value. The accuracy of a measurement system can be affected by errors introduced by cross-contamination in the field sampling process, sample preservation, sample handling, matrix sample preparation, analytical techniques, and cross-contamination in the laboratory. A program of sample spiking will be conducted to evaluate laboratory accuracy. This program includes analysis of the MS and MSD samples, LCS or blank spikes, surrogate standards, and method blanks. MS/MSD samples and LCS/LCSD or blank spike samples are analyzed at a frequency of one per batch; a batch of samples is limited to 20 samples. Surrogate standards and internal calibration standards, where applicable, are added to every sample analyzed for organic constituents. The results of the spiked samples are used to calculate the percent recovery for evaluating accuracy.

Accuracy is expressed as the percent recovery of an analyte that has been added (spiked) to an environmental sample in a known concentration before extraction/analysis. Accuracy is calculated using the following equation:

$$Percent\,Recovery \quad = \quad \frac{S-C}{T} \quad x \quad 100$$

where: S = Measured spike sample concentration

C = Sample concentration

T = True or actual concentration of the spike

Table 1-17 presents accuracy goals for the Group C sampling activities based on the percent recovery of matrix and surrogate spikes. Results that fall outside the accuracy goals will be further evaluated based on other QC samples. Table 1-16 presents the samples to be collected for precision and accuracy.

Field blank and equipment blank samples monitor accuracy by detecting potential biases caused by cross-contamination. All field QC sample collection procedures will be documented in field notebooks.

Objectives for reference standards will be based on the type that is analyzed. Appropriate spike and reference standard compounds and concentration levels are specified in the analytical methods. When MS compounds are not specified, they will be selected in a manner such that the range of analytes is fairly represented (in terms of chemical characteristics, retention times, and other appropriate criteria). If the spiking levels for MS and surrogate standards are not provided, the spiking will be conducted at a mid-calibration concentration level.

Laboratory data will meet the accuracy criteria shown in Table 1-16 and Table 1-17, which includes internal laboratory and method criteria. Data that do not meet the accuracy criteria listed in Table 1-17 may be qualified as estimated ("J") or may be rejected ("R") during data validation, as discussed in IRP Procedure II-D *Data Validation Procedure 4, Levels C and D Organochlorine Pesticides/PCBs by GC - PACDIV* (DON 1998).

A summary of accuracy results (e.g., a mean and standard deviation of surrogate recovery values for each analytical method, by matrix) may be prepared to give an overall assessment of the accuracy.

1.5.2.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents the characteristics of a population, variations in a parameter at a sampling point, or an environmental condition. For this project, representative data will be obtained through careful selection of sampling locations and analytical parameters. Representative data will also be obtained through proper collection and handling of samples to avoid interference and minimize contamination. Representativeness of data will also be ensured through established field and laboratory procedures and their consistent application. To aid in evaluating the representativeness of the sample results, field and laboratory blank samples and background samples will be evaluated for the presence of contaminants. Data determined to be nonrepresentative, by comparison with existing data, will be used only if accompanied by appropriate qualifiers and limits of uncertainty. Representativeness shall be assessed qualitatively for each matrix (medium), spatially (laterally and vertically), and for each contaminant of concern. The following questions may be asked to assess representativeness:

- Were the appropriate media sampled?
- Were samples collected correctly?
- Were samples collected from appropriate locations?
- Were potential hot spots likely missed?
- Was an appropriate number of samples collected and analyzed?
- May other factors have biased the results?

1.5.2.4 Completeness

Completeness is a measure of the percentage of project-specific data that is valid. Valid data is obtained when samples are collected and analyzed in accordance with QC procedures outlined in this SAP, and when none of the QC criteria that affect data usability are exceeded. Data that is validated and qualified as estimated ("J") will not be counted against the completeness goal because it is considered usable. Only rejected data ("R") or data not collected will be counted against the completeness goal. When all data validation is completed, the percent completeness will be calculated by dividing the number of valid sample results by the total number of sample results planned for this investigation. The following equation is used to determine completeness:

$$Completeness(\%C) = \frac{V}{T} \ x \ 100$$

where: %C = Percent completeness

V = Number of valid samples

T = Total number of planned samples

Although a quantitative number can be calculated for each analyte, the data user must use this qualitatively to assess whether the investigation objectives can be met with the data obtained. As a guideline, data completeness should be approximately 90 percent for each analyte for all samples.

Data that does not meet the completeness goals suggests the need for resampling and analysis or, at a minimum, suggests that the data set should be used with caution. Data that was planned but not collected should count against the completeness goal, unless it was omitted for a valid reason and is not anticipated to produce a data gap.

As discussed further in Section 4.2, completeness will also be evaluated as part of the data quality assessment process in Section 4 (EPA 2000b). This evaluation will help determine whether any limitations are associated with the decisions to be made based on the data collected.

1.5.2.5 Comparability

Comparability is a qualitative parameter that expresses the degree of confidence with which one data set can be compared to another data set. Comparability of data will be achieved by consistently following IRP procedures for sampling and field activities, by using the same types of sampling equipment at each site during all phases of the investigation, and by using standard measurement units in reporting analytical data. Laboratory data will be reported in consistent units for each analytical test (mg/kg for the soil confirmation samples). Data will be corrected for percent moisture and will be reported in dry weight.

1.5.2.6 Detection and Quantitation Limits

The method detection limit (MDL) is the minimum concentration of an analyte that can be reliably distinguished from background noise for a specific analytical method. The quantitation limit represents the lowest concentration of an analyte that can be accurately and reproducibly quantified in a given sample matrix. RLs are contractually specified maximum quantitation limits for a sample matrix, such as soil or water, and are typically several times the MDL to allow for matrix effects. RLs are set liberally to establish minimum criteria for laboratory performance; actual laboratory quantitation limits may be substantially lower.

Table 1-13 presents the RLs for the selected analytical methods in comparison to the screening criteria. The purpose of this comparison is to show that the selected analytical methods and associated RLs are capable of quantifying contaminants of concern at or below the applicable screening level. In comparing the RLs to screening criteria, however, it is important to note that actual laboratory quantitation limits may be lower than RLs and that estimates of analyte concentrations down to MDLs can typically be provided in order to allow comparisons to screening levels that are below RLs.

For this project, samples analyzed for PCBs will be reported as estimated values if concentrations are less than RLs but greater than MDLs. The MDL for each analyte will be listed as the detection limit in the laboratory's electronic data deliverable (EDD). This procedure is being adopted to help ensure that effective comparisons of analyte results to the screening criteria can be performed for certain compounds where the RL is near or below the screening criteria and to ensure that subsequent statistical evaluations of the data will not be biased by high-value nondetect results.

The RLs for soil for this RA are presented in Table 1-13 and will generally be used for determining whether an analytical method is capable of detecting the analyte of concern at or below the screening level.

1.6 PROJECT ORGANIZATION

Table 1-18 presents the responsibilities and contact information for key personnel involved in the field investigation for the Group C sites. In some cases, more than one responsibility has been assigned to a person.

Table 1-18: Key Personnel, Group C Site Investigation

Name	Organization	Role	Responsibilities	Contact Information
Janice Fukumoto	Navy	Remedial Project Manager	Responsible for overall project execution and for coordination with base representatives, regulatory agencies, and Navy management. Provides management and technical oversight during data collection.	PACNAVFACENGCOM 258 Makalapa Drive, Suite 100 Pearl Harbor, Hawaii 96860-3134 FukumotoJL@efdpac.nav.fac.navy.mil (808) 472-1424
Leighton Wong	Navy	QA Officer	Responsible for QA issues for all Navy CLEAN work. Provides government oversight of the CLEAN II QA program. Reviews and approves SAP and any significant modifications. Has authority to suspend project activities if Navy quality requirements are not met.	PACNAVFACENGCOM 258 Makalapa Drive, Suite 100 Pearl Harbor, Hawaii 96860-3134 WongLG@efdpac.navfac.navy.mil (808) 472-1417
John Fern	Earth Tech	Technical Director	Ensures that all CLEAN II Program activities are carried out in a consistent manner and in accordance with current Navy requirements and CLEAN II Program guidance. Reviews all documents.	Earth Tech, Inc. 841 Bishop Street, Suite 500 Honolulu, Hawaii 96813 JFern@earthtech.com (808) 523-8874
Bob Poll	Earth Tech	Health and Safety (H&S) Manager	Oversees all H&S aspects of the project; performs H&S audits to verify Earth Tech and field subcontractor compliance; reviews SOPs and subcontractor SOWs for H&S considerations; provides H&S oversight and support of field activities; coordinates medical monitoring program and OSHA training; issues site H&S certification letter.	Earth Tech, Inc. 100 W. Broadway, Suite 240 Long Beach, California 90802 Bpoll@earthtech.com (562) 951-2242

Table 1-18: Key Personnel, Group C Site Investigation (Continued)

Name	Organization	Role	Responsibilities	Contact Information
Ryan Truong	Earth Tech	Procurement Manager	Oversees development of statements of work and procurement or subcontractors, equipment, and miscellaneous supplies. Reviews invoices and oversees payment of invoices.	Earth Tech, Inc. 841 Bishop Street, Suite 500 Honolulu, Hawaii 96813 ryan_truong@earthtech.com (808) 523-8874
James Romine	Tetra Tech EMI Inc. (Tetra Tech)	H&S Manager	Oversees Tetra Tech H&S aspects of the project; provides H&S oversight and support of field activities; coordinates medical monitoring program and OSHA training. Reviews and approves Tetra Tech H&S plan and determines appropriate site control measures and personal protection levels.	Tetra Tech EM Inc. 250 West Court St., Suite 200 West Cincinnati, Ohio 45202 (513) 564-8351 James.Romine@ttemi.com
Ron Boyle	Earth Tech	Contract Task Order (CTO) Manager	Responsible for implementing all activities called out in CTO. Prepares or supervises preparation of SAP. Monitors all field activities to ensure compliance with SAP requirements.	Earth Tech, Inc. 841 Bishop Street, Suite 500 Honolulu, Hawaii 96813 RBoyle@earthtech.com (808) 523-8874
Kim Markillie	Tetra Tech	Subcontract Task Order (STO) Manager	Responsible for implementing all Tetra Tech activities called out in CTO SOW. Prepares or supervises preparation of parts of SAP.	Tetra Tech EM Inc. 2828 Paa Street, Suite 3080 Honolulu, Hawaii 96819 Kim.Markillie@ttemi.com (808) 441-6655
Teresa Shinder	Tetra Tech	Field Manager	Monitors and directs Tetra Tech field activities to ensure compliance with SAP requirements. Directs day-to-day field activities conducted by Tetra Tech and subcontractor personnel. Verifies that field sampling and measurement procedures follow SAP.	Tetra Tech EM Inc. 2828 Paa Street, Suite 3080 Honolulu, Hawaii 96819 Teresa.Shinder@ttemi.com (808) 441-6610
Alex Globerson	Tetra Tech	On-Site H&S Coordinator	Conducts safety briefings for Tetra Tech, subcontractor personnel, and site visitors. Can suspend operations that threaten health and safety.	Tetra Tech EM Inc. 2828 Paa Street, Suite 3080 Honolulu, Hawaii 96819 (808) 441-6600
Joslyn Noonan	Tetra Tech	In-office Field Coordinator	Coordinates directly with Tetra Tech field manager regarding sample tracking and laboratory coordination. Summarizes analytical results upon receipt. Coordinates with Tetra Tech project chemist regarding any laboratory discrepancies. Provides STO manager with analytical results status reports.	Tetra Tech EM Inc. 2828 Paa Street, Suite 3080 Honolulu, Hawaii 96819 Joslyn.Noonan@ttemi.com (808) 441-6600

Table 1-18: Key Personnel, Group C Site Investigation (Continued)

Name	Organization	Role	Responsibilities	Contact Information
Sara Woolley	Tetra Tech	Project Chemist	Oversees analytical QA/QC program. Assists with analytical laboratory procurement; coordinates with analytical laboratory; coordinates with field managers to ensure compliance with field QC requirements; reviews chain-of-custody forms; ensures adherence to analytical plan; coordinates with data validators; and reviews and summarizes data validation reports.	Tetra Tech EM Inc. 135 Main Street, Suite 1800 San Francisco, California 94105 Sara.Woolley@ttemi.com (415) 222-8311
Susan Gallagher	Tetra Tech	Data Manager	Develops, monitors, and maintains project database under guidance of CTO and STO managers. Works with project chemist during SAP preparation to resolve sample identification issues.	Tetra Tech EM Inc. 135 Main Street, Suite 1800 San Francisco, California 94105 Susan.Gallagher@ttemi.com (415) 222-8329
Hugh Prentice	Laucks Laboratory	Project Manager	Delivers analytical services that meet SAP requirements. Reviews SAP to understand analytical requirements. Works with Project Chemist and field managers to confirm sample delivery schedules and sample analyses. Reviews laboratory data package before delivery to Earth Tech and Tetra Tech.	Laucks Testing Laboratories, Inc. 940 South Harney Street Seattle, Washington 98108 (206) 767-5060 (phone) (206) 767-5063 (fax)
Terra Physics	Subcontractor	Utility Clearance Project Manager	Ensures that utility clearance activities are conducted in accordance with SAP requirements and the statement of work. Coordinates subcontractor activities with Earth Tech CTO or Tetra Tech STO manager.	Terra Physics 28841 Base Line Highland, California 92346 TerraPhysics@AOL.com (909) 862-0626 (phone and fax)
Christina Poma	ESN Pacific	Direct Push Sampling Project Manager	Ensures that direct push sampling activities are conducted in accordance with SAP requirements and the statement of work. Coordinates subcontractor activities with Earth Tech CTO or Tetra Tech STO manager.	ESN Pacific 1818 Kahai Street Honolulu, Hawaii 96819 tegpacific@aol.com (808) 847-0067

Table 1-18: Key Personnel, Group C Site Investigation (Continued)

Name	Organization	Role	Responsibilities	Contact Information
Richard Amano, President	Laboratory Data Consultants, Inc.	Data Validator	Enters validation qualifiers for each result and checks hard copy results against the results in the electronic version	7750 El Camino Real, Suite 2C Carlsbad, CA 92009 (760) 634-0437 richamano@aol.com

Notes:
CLEAN = Comprehensive Long-Term Environmental Action Navy
CTO = contract task order
H&S = health and safety
OSHA = Occupational Safety and Health Administration
SAP = sampling analysis plan
SOW = statement of work
STO = Subcontract Task Order
QA = quality assurance
QC = quality control

1.7 SPECIAL TRAINING AND CERTIFICATION

This section outlines the training and certification required to complete the activities described in this SAP. The following sections describe the requirements for Earth Tech, Tetra Tech, and other subcontractor personnel working on site.

1.7.1 Health and Safety Training

All personnel who work at hazardous waste project sites are required to meet the Occupational Safety and Health Administration (OSHA) training requirements defined in Title 29 Code of Federal Regulations (29 CFR) Part 1910.120(e). These requirements include (1) 40 hours of formal offsite instruction; (2) a minimum of 3 days of actual onsite field experience under the supervision of a trained and experienced field supervisor; and (3) 8 hours of annual refresher training.

Field personnel who directly supervise employees engaged in hazardous waste operations also receive at least 8 additional hours of specialized supervisor training. The supervisor training covers CLEAN II health and safety program requirements, training requirements, personal protective equipment (PPE) requirements, spill containment program, and health-hazard monitoring procedures and techniques. At least one member of every field team will maintain current certification in the American Red Cross "Multimedia First Aid" and "Cardiopulmonary Resuscitation (CPR) Modular," or equivalent.

Copies of field personnel health and safety (H&S) training records, including course completion certifications for the initial and refresher health and safety training, specialized supervisor training, and first aid and CPR training, are maintained in project files.

Before work begins at a specific hazardous waste project site, Earth Tech and Tetra Tech personnel are required to undergo site-specific training that thoroughly covers the following areas:

- Names of personnel and alternates responsible for H&S at a hazardous waste project site
- H&S hazards present on site

- Selection of the appropriate personal protection levels
- Correct use of PPE
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment on site
- Medical surveillance requirements, including recognition of symptoms and signs that might indicate overexposure to hazardous substances
- Contents of the site-specific HSP

1.7.2 Subcontractor Training

Subcontractors who work on site will certify that their employees have been trained for work on hazardous waste project sites. Training will meet OSHA requirements defined in 29 CFR 1910.120(e). Before work begins at the project site, subcontractors will submit copies of the training certification for each employee to Earth Tech.

All employees of associate and professional services firms and technical services subcontractors will attend a safety briefing and complete the “Safety Meeting Sign-Off Sheet” before conducting onsite work. A briefing covers the topics described in Section 1.6.1 and is conducted by the Tetra Tech onsite H&S coordinator (OHSC) or other qualified person (Table 1-18).

1.8 Documents and Records

Documentation is critical for evaluating the success of any environmental data collection activity. The following sections discuss the requirements for documenting field activities and for preparing laboratory data packages.

1.8.1 Field Documentation

Complete and accurate documentation is essential to demonstrate that field measurement and sampling procedures are carried out as described in the SAP. Field personnel will use permanently bound field logbooks with sequentially numbered pages to record and document field activities. The logbook will list the contract name and number, the CTO number, the site name, and the names of subcontractors, the service client, and the project manager. At a minimum, the following information will be recorded in the field logbook:

- Name and affiliation of all onsite personnel or visitors
- Weather conditions during the field activity
- Summary of daily activities and significant events
- Notes of conversations with coordinating officials
- References to other field logbooks or forms that contain specific information
- Discussions of problems encountered and their resolution
- Discussions of deviations from the SAP or other governing documents
- Description of all photographs taken

The field team will also use the various field forms included in Appendix B to record field activities.

1.8.2 Summary Data Package

Laboratory subcontractors will prepare summary data packages in accordance with the instructions provided in the EPA Contract Laboratory Program (CLP) statement of work (SOW) (EPA 1999a, 2000c). The summary data package will consist of a case narrative, copies of all associated chain-of-custody forms, sample results, and QA/QC summaries. The case narrative will include the following information:

- Subcontractor name, project name, CTO number, project order number, sample delivery group (SDG) number, and a table that cross-references client and laboratory sample identification numbers (ID).
- Detailed documentation of all sample shipping and receiving, preparation, analytical, and quality deficiencies, including analyses performed without an American Association for Laboratory Accreditation (A2LA)-certified standard.
- Thorough explanation of all instances of manual integration.
- Copies of all associated nonconformance and corrective action forms that will describe the nature of the deficiency and the corrective action taken.
- Copies of all associated sample receipt notices.

Additional summary data package requirements are outlined in Table 1-19. The laboratory will provide Tetra Tech with two copies of the summary data package within 7 days after it receives the last sample in the SDG.

1.8.3 Full Data Package

When a full data package is required, the laboratory subcontractor will prepare data packages in accordance with the instructions provided in the EPA CLP statements of work (EPA 1999a, 2000a). Full data packages will contain all of the information from the summary data package and all associated raw data. Full data package requirements are outlined in Table 1-19. Full data packages are due to Tetra Tech within 28 days after the last sample in the SDG is received. Unless otherwise requested, the subcontractor will deliver one copy of the full data package.

Table 1-19: Requirements for Summary and Full Data Packages

Requirements for Summary Data Packages – Organic Analysis	
Section I	Case Narrative
1.	Case narrative
2.	Copies of nonconformance and corrective action forms
3.	Chain-of-custody forms
4.	Copies of sample receipt notices
5.	Internal tracking documents, as applicable
Section II	Sample Results - Form I for the following:
1.	Environmental samples, including dilutions and reanalysis
2.	Tentatively identified compounds (TIC)
Section III	QA/QC Summaries - Forms II through XI for the following:
1.	System monitoring compound and surrogate recoveries (Form II)
2.	MS and MSD recoveries and RPDs (Forms I and III)
3.	Blank spike or LCS recoveries (Forms I and III-Z)

Table 1-19: Requirements for Summary and Full Data Packages (Continued)

Requirements for Summary Data Packages – Organic Analysis	
4.	Method blanks (Forms I and IV)
5.	Performance check (Form V)
6.	Initial calibrations with retention time information (Form VI)
7.	Continuing calibrations with retention time information (Form VII)
8.	Quantitation limit standard (Form VII-Z)
9.	Internal standard areas and retention times (Form VIII)
10.	Analytical sequence (Forms VIII-D and VIII-Z)
11.	Gel permeation chromatography (GPC) calibration (Form IX)
12.	Single component analyte identification (Form X)
13.	Multicomponent analyte identification (Form X-Z)
14.	Matrix-specific method detection limit (MDL) (Form XI-Z)
Sections I, II, and III	Summary Package
Section IV	Sample Raw Data - indicated form, plus all raw data
1.	Analytical results, including dilutions and re-analysis (Forms I and X)
2.	TICs (Form I — VOA and SVOA only)
Section V	QC Raw Data - indicated form, plus all raw data
1.	Method blanks (Form I)
2.	MS and MSD samples (Form I)
3.	Blank spikes or LCSs (Form I)
Section VI	Standard Raw Data - indicated form, plus all raw data
1.	Performance check (Form V)
2.	Initial calibrations, with retention-time information (Form VI)
3.	Continuing calibrations, with retention-time information (Form VII)
4.	Quantitation-limit standard (Form VII-Z)
5.	GPC calibration (Form IX)
Section VII	Other Raw Data
1.	Percent moisture for soil samples
2.	Sample extraction and cleanup logs
3.	Instrument analysis log for each instrument used (Form VIII-Z)
4.	Standard preparation logs, including initial and final concentrations for each standard used
5.	Formula and a sample calculation for the initial calibration
6.	Formula and a sample calculation for soil sample results

Note:
A copy of the preliminary form I's will be faxed to the STO manager upon completion of the analyses.

1.8.4 Data Package Format

EDDs are required for all soil analytical results. An automated laboratory information management system must be used to produce the EDD. Manual creation of the deliverable (data entry by hand) is unacceptable. The laboratory will verify EDDs internally before they are issued. The EDD will correspond exactly to the hard-copy data. No duplicate data will be submitted. EDDs will be delivered in a format compatible with Navy Environmental Data Transfer Standards (NEDTS). Results that should be included in all EDDs are as follows:

- Target analyte results for each sample and associated analytical methods requested on the chain-of-custody form

- Method and instrument blanks and preparation and calibration blank results reported for the SDG
- Percent recoveries for the spike compounds in the MS, MSDs, blank spikes, or LCSs
- Matrix duplicate results reported for the SDG
- All reanalysis, reextractions, or dilutions reported for the SDG, including those associated with samples and the specified laboratory QC samples

Electronic and hard-copy data must be retained for a minimum of 3 and 10 years, respectively, after final data have been submitted. The subcontractor will use an electronic storage device capable of recording data for long-term, off-line storage. Raw data will be retained on an electronic data archival system.

1.8.5 Reports to be Generated

1.8.5.1 Pre-Excavation Delineation Sampling

Results of the pre-excavation delineation sampling will be included in an amendment to the design package for the excavation and remediation of Group C sites. The design amendment will include site maps, sample results, estimated excavation boundaries and soil quantities, and any unusual field conditions encountered.

After IDW disposal related to pre-excavation delineation sampling, a brief report will be prepared that summarizes the disposal program and final disposition of the IDW. Pertinent manifests and disposal documentation will be attached to the memo.

1.8.5.2 Confirmation Sampling

Results of the confirmation sampling will be included in a letter report for submittal to the Navy and contractor responsible for excavation and treatment. The letter report will include site maps, confirmation results, and a data validation summary memo.

After disposal of IDW related to confirmation sampling, a brief memo will be prepared that summarizes the disposal program and final disposition of the IDW. Pertinent manifests and disposal documentation will be attached to the memo.

2. DATA GENERATION AND ACQUISITION

2.1 SAMPLING PROCESS DESIGN

The soil samples collected during Group C sampling activities will provide (1) the information needed to establish the lateral and vertical extent of contamination, and (2) the information necessary to confirm that soil cleanup criteria have been achieved following excavation activities. Section 2.1.1 presents the rationale for the pre-excavation delineation sampling at Group C sites. Section 2.1.2 discusses the confirmation sampling design at Group C sites except at PHNC, where confirmation sampling is being conducted under a separate investigation. Sections 2.1.3 to 2.1.5 include information on vegetation clearing, locating underground utilities, and surveying, respectively. The samples to be analyzed for each site for the pre-excavation delineation sampling are presented in Table 2-1.

All sampling methodologies and procedures will conform to those set forth in the project procedures manual (DON 1998). No major deviations from those procedures have been identified at this time, although the need to modify field activities may arise because of field conditions and observations. Any necessary significant modifications (e.g., changes in equipment or materials, or deletion of a procedural step) will first be discussed with the subcontract task order (STO) and CTO managers, the CLEAN II technical director, and the Navy remedial project manager (RPM). Upon approval, significant modifications and their corresponding justifications will be documented in the summary reports.

Table 2-1: Estimated Pre-Excavation Delineation Soil Samples by Site

Type of Sample	Number of Samples to be Analyzed	Number of Duplicates to be Analyzed[a]
Halawa-Main Gate GSA		
Former Building 653	15	2
H-2	3	1
H-3	10	1
H-5	30	3
J-12	10	1
J-17	20	2
J-21	10	1
J-29	50	5
K-14	25	3
K-15	16	2
K-20	15	2
Naval Housing GSA		
M-3	100	10
NH-f	20	2
PWC Main Complex GSA		
M5	10	1
Shipyard GSA		
A-2	45	5
A-4	20	2
A-8	20	2

Table 2-1: Estimated Pre-Excavation Delineation Soil Samples by Site (Continued)

Type of Sample	Number of Samples to be Analyzed	Number of Duplicates to be Analyzed[a]
Shipyard GSA		
A-10	60	6
B-2	30	3
C-2	45	5
C-4	40	4
C-7	20	2
C-8	30	3
C-13	10	1
E-11	40	4
E-13	20	2
E-16	30	3
E-25	20	2
F-3	15	2
F-20	30	3
F-20A	13	2
G-12	45	5
K	20	2
Waipio Peninsula GSA		
W-4	10	1
W-5	40	4
W-11	75	8
West Loch GSA		
Former S11	10	1
Former S33	75	8
NCTAMS Wahiawa		
121	60	6
236	3	1
NRTF Lualualei		
1	9	1
68	80	8
Former S84	24	3
FRS	15	2
NAVMAG PH Lualualei		
S380	45	5
S382	60	6
Former S384	26	3

Notes:
a = based on 10% of original
One equipment rinsate and MS/MSD sample will be collected each day.
bgs = below ground surface
N/A = not applicable
PCBs = polychlorinated biphenyls

2.1.1 Pre-Excavation Delineation Sampling

Group C sites will be sampled to further delineate the lateral and vertical extent of contamination. Sampling at NCTAMS Wahiawa, NRTF Lualualei, NAVMAG Lualualei, West Loch GSA, Naval Housing GSA, Shipyard GSA, Halawa-Main Gate GSA, and Waipio Peninsula GSA will be conducted with direct-push technology. Figures in Appendix A provide the site locations, and the original and proposed sampling locations within each site.

Initial soil samples will be collected at 2, 4, and 6 feet below ground surface (bgs) for original sampling locations and 0, 2, 4, and 6 feet bgs for first step-out locations to define the vertical and horizontal extent of contamination. The collected samples will be analyzed in a stepwise approach beginning with the samples collected at the shallowest depth. The decision whether to have samples from the next depth interval analyzed by the laboratory will be based on the original sample results and review of the results of the initial sampling. Proposed sampling locations will be cleared by an underground utility clearance subcontractor.

For areas where original contamination is less than 10 ppm, soil samples collected at 2 feet bgs will be analyzed at every original location and 50 percent of the remaining samples are estimated to require analysis. For areas where original contamination is greater than 10 ppm, 100 percent of the samples taken at 2, 4, and 6 feet bgs are estimated to require analysis. All samples obtained will be sent to the laboratory; those not initially analyzed will be held at the laboratory pending results of the initial analysis.

Additional soil samples will be collected in a “step-out” fashion to delineate the lateral and vertical extent of contamination. First step-out samples will be collected at either a 5- or 10-foot lateral interval from the initial contaminated area depending on whether the original sample result was greater than or less than 10 mg/kg. First step-out samples will be collected at the surface, 2, 4, and 6 feet bgs. All samples collected from the surface will be analyzed initially; the decision whether to analyze the additional depth samples collected will be based on review of the results of the initial sampling.

If necessary, additional 5-foot lateral interval locations will be selected following review of the sampling results. Vertical sampling will be conducted consistent with the approach presented above. Samples will be collected until results from each site indicate that contaminant levels are below the screening levels.

All samples will be collected with direct-push technology, at an assumed rate of 75 linear feet of direct push per day for a total of 3,642 linear feet. Two field crews, one each from Earth Tech and Tetra Tech, working simultaneously, will complete the field work in approximately 5 weeks.

2.1.2 Confirmation Sampling – Group C Sites

Confirmation sampling will be conducted at Group C sites. A grid sampling approach will be used at each site to verify the removal of PCB-contaminated soil after the RA is complete. Discrete samples will be collected from the center of each 10-foot by 10-foot grid plotted at each site (one sample per 100 square feet). A minimum of two samples will be collected per site: one from the excavation bottom and one from each sidewall boundary where contamination was not excavated (may only include one sidewall). Whenever possible, samples will be collected near locations where high levels of contamination were detected during the RA.

If analytical results indicate that site cleanup criteria have not been attained, further excavation and sampling will continue until analytical results indicate that site cleanup criteria have been achieved or until excavation is not feasible. Site-specific details such as grid location and estimated number of

Site-specific details such as grid location and estimated number of confirmation samples for Group C sites will be determined following completion of the pre-excavation delineation sampling activities.

2.1.3 Surveying

No survey activities will be conducted during this investigation, as the remedial action contractor will be performing this as part of their effort. Specific surveying requirements are addressed in the design package associated with thermal treatment of the contaminated soil.

2.1.4 Underground Utility Survey

Prior to intrusive activities, a subcontracted geophysical surveyor will locate underground utilities using radiodetection and electromagnetic toning survey equipment in accordance with IRP Procedure I-A-6, *Utility Clearance* (DON 1998). Utilities will also be located using information from existing utility maps. The purpose of the survey is to prevent damage to utilities during intrusive activities.

2.1.5 Vegetation Clearing

Prior to sampling, vegetation will be removed at each site, as necessary to prevent interference with sampling and RA procedures.

2.2 SAMPLING METHODS

2.2.1 Sampling Methods and Equipment

Surface and Subsurface Soil Sampling. Soil samples for pre-excavation and confirmation sampling at Group C sites will be collected in accordance with IRP Procedures I-B-1, *Soil Sampling* and I-H, *Direct Push Sampling Techniques* (DON 1998). Vegetation will be cleared away from the surface, and the top 2 inches of soil removed to ensure a representative sample. Soil samples will be collected and placed in stainless steel sleeves with Teflon©–lined caps. Samples will be packed in a cooler at 4 ^{o}C for shipment to the laboratory. Soil samples will be collected with a direct-push drilling rig at all Group C sites. Split-spoon samplers will be used to collect direct-push samples in 1.5-inch-diameter, 24-inch-long stainless-steel sleeves. Stainless-steel sample tubes will be capped and sealed according to IRP Procedures I-B-1, *Soil Sampling*, and III-F, *Sample Handling, Storage and Shipping Procedures* (DON 1998), respectively.

All soil samples will be logged in the field to describe lithology and areas of apparent contamination. Field observations will be noted in the field notebook. Lithologic descriptions will include soil classification information, as listed in IRP Procedure I-E, *Soil and Rock Classification*.

Samples will be labeled according to Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures* (DON 1998), and placed in insulated coolers with frozen gel packs or ice packs.

Borehole Abandonment. Following completion of soil sampling in each soil boring, the borehole shall be properly abandoned. Abandonment will involve placing bentonite chips or pellets from the bottom of the boring to within 0.5 to 2 feet of the ground surface. The remaining portion of the boring will be filled with material to match the original surface, such as topsoil, black patch for asphalt or will be patched with concrete if in a paved area. If material cannot be replaced, it will be treated as IDW, in accordance with IRP Procedure I-A-7, *IDW Management* (DON 1998).

2.2.2 Decontamination

Equipment. All nonconsumable equipment that comes into contact with potentially contaminated soil will be decontaminated in accordance with IRP Procedure I-F, *Equipment Decontamination*

(DON 1998). Equipment will be decontaminated by steam cleaning or by a nonphosphate detergent scrub, followed by rinses with fresh water and distilled or deionized water. Decontamination will take place on pallets or on plastic sheeting. Clean equipment will be stored in an uncontaminated area. Equipment stored for an extended period will be covered by plastic sheeting or aluminum foil or replaced in its case.

All consumable equipment (for example, gloves and disposable spoons) and liquid and solid wastes (for example, decontamination water, and soil cuttings) will be treated as potentially hazardous and discarded in accordance with the procedures prescribed in Section 2.2.3 of this report.

Personnel. The field team and equipment operator will perform personnel decontamination before leaving the work site at the conclusion of each workday, following procedures described in the HSP.

2.2.3 Management of Investigation-Derived Waste

Expected IDW includes soil cuttings, decontamination water, disposable field sampling equipment, and PPE. IDW will be staged at a site within each of the six Group C installations (Pearl Harbor Naval Complex, West Loch GSA, NCTAMS Wahiawa, NRTF Lualualei, and NAVMAG PH Lualualei) in 55-gallon drums, pending review of analytical results and disposal.

All hazardous IDW will be disposed of within 90 calendar days of completing field activities in accordance with IRP Procedure I-A-7, *IDW Management* (DON 1998). Soil cuttings may be relocated to the thermal treatment storage area at former NAS Barbers Point for future treatment. The other, nonhazardous IDW will be disposed of in a timely fashion following field work. The classification of IDW will be determined by using site soil sample results where possible, and by collecting samples from IDW containers and conducting analysis in accordance with the SAP where necessary. Depending on suspected contaminants in the areas where wastes originated, the samples will be tested for PCBs.

An IDW disposal letter report will be prepared that summarizes analytical data and identifies disposal options. The IDW disposal letter report will include an inventory of all IDW bins, and drums, their contents, and recommendations for disposal and/or further testing and evaluation of potential disposal options. The IDW disposal letter report will be prepared in accordance with the *Generic IDW Screening, Sampling, and Disposal Plan for Various Hawaii Naval Installations* (DON 1995).

After IDW disposal, a brief notification letter will be prepared that summarizes the disposal program and final disposition of the IDW. Pertinent manifests and disposal documentation will be attached to the letter.

2.2.4 Sample Containers and Holding Times

The type of sample containers to be used for each analysis, the sample volumes required, the preservation requirements, and the maximum holding times for sample extraction and analysis are presented in Table 2-2.

Table 2-2: Sample Containers, Preservatives, and Holding Times

Parameter	Method Number[a]	Sample Volume	Sample Container	Preservative	Holding Time[c]
Organic Analyses (Soil)					
PCBs	EPA 8082	8-ounce	6-inch sleeve/ 8-ounce glass jar	Cool, 4°C	14 days to extraction /40 days to analysis
Organic Analyses (water)					
PCBs	EPA 8082	2 @ 1 Liter	Amber glass with Teflon-lined lid	Cool, 4°C	7 days to extraction /40 days to analysis

Notes:
[a] Complete method references are presented in Section 2.4.
EPA = U.S. Environmental Protection Agency
PCB = polychlorinated biphenyl

2.3 SAMPLE HANDLING AND CUSTODY

The following subsections describe sample-handling procedures, including sample identification and labeling, documentation, chain-of-custody (COC), and shipping.

2.3.1 Sample Identification

2.3.1.1 EPA ID NUMBER

To facilitate tracking and storage of data, all samples will be labeled with a five-character sample ID number, referred to as an EPA ID, in accordance with IRP Procedure I-A-9, *Sample Naming,* and IRP Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures* (DON 1998). An EPA identification number will be assigned to each sample (to facilitate data tracking and storage) as follows:

TQzzz

where

T Project office ("T" for Tetra Tech)

Q EPA site letter identification ("Q" for Group C sites)

zzz Chronological number, starting with 001

For example, the EPA ID number for the 30th sample from the project, where Tetra Tech is the managing office, is TQ030. QC samples will be included in the chronological sequence. If a sample is lost during shipping, a replacement sample will be assigned a new EPA ID number. If different containers for the same sample are shipped on different days, a new EPA ID number must be assigned.

2.3.1.2 PROJECT SPECIFIC ID NUMBER

A project specific sample identification number will be used to provide sample-specific information (for example, location, sequence, matrix, depth). This identification number will be formatted as shown below.

AA-BB-CC-DDE (depth), where:

AA Refers to the site location where the sample was collected (refer to Table 2-3)

BB Specifies the sample matrix (refer to Table 2-4)

CC Specifies the chronological sampling location at the specified site

DD Specifies sample number at that location (soil samples collected from the same soil sampling location)

E Specifies the type of sample for QC samples (refer to Table 2-5).

(depth) Specifies the sample depth interval, in feet bgs

For example, a sample labeled H3-SB-01-02 (2-4) would indicate a subsurface soil sample collected at H-3, from the first sample location, sample number two, at a depth of 2 to 4 feet bgs.

Table 2-3: Sample Identifiers for Group C Sites

Sample Identifier	Location
653	Halawa-Main Gate
H2	Halawa-Main Gate
H3	Halawa-Main Gate
H5	Halawa-Main Gate
J12	Halawa-Main Gate
J17	Halawa-Main Gate
J21	Halawa-Main Gate
J29	Halawa-Main Gate
K14	Halawa-Main Gate
K15	Halawa-Main Gate
K20	Halawa-Main Gate
M3	Naval Housing
NHf	Naval Housing
A2	Shipyard
A4	Shipyard
A8	Shipyard
A10	Shipyard
B2	Shipyard
C2	Shipyard
C4	Shipyard
C7	Shipyard
C8	Shipyard
C13	Shipyard
E11	Shipyard
E13	Shipyard
E16	Shipyard
E25	Shipyard

Table 2-3: Sample Identifiers for Group C Sites (continued)

Sample Identifier	Location
F3	Shipyard
F20	Shipyard
F20A	Shipyard
G12	Shipyard
K	Shipyard
W4W5	Waipio Peninsula
W11	Waipio Peninsula
S11	West Loch
33	West Loch
121	NCTAMS Wahiawa
236	NCTAMS Wahiawa
1	NRTF Lualualei
68	NRTF Lualualei
S84	NRTF Lualualei
FRS	NRTF Lualualei
S380	NAVMAG Lualualei
S382	NAVMAG Lualualei
S384	NAVMAG Lualualei

Table 2-4: Sample Type and Matrix Identifiers

Identifier	Sample Type	Matrix
SS	Surface soil sample	Soil
SB	Subsurface soil sample	Soil
QS	Field QC	Soil
QW	Field QC	Water
WS	Waste	Soil
WW	Waste	Water

Table 2-5: Field or QC Sample Types

Identifier	Field or QC Sample Type	Description
S	Primary sample	All field samples, except QC samples
D	Duplicate sample	Collocate (adjacent locations)
ER	Equipment rinsate	Water
FB	Field blank	Water
MS/MSD	Matrix Spike/Matrix Spike Duplicate	Soil or Water

2.3.2 Sample Labels

A sample label will be affixed with adhesive backing to all sample containers and covered with clear tape to further secure it to the container and to keep the ink from smearing. The label will be completed with the following information, written in indelible ink, as specified in IRP Procedure I-A-9, *Sample Naming* (DON 1998):

- Project name and location or identifier
- Project number
- EPA ID number
- Date and time of collection
- Analyses to be performed
- Sample collector's initials
- Preservative used (if applicable)

After labeling, each soil sample will be refrigerated or placed in a cooler that contains ice to maintain the sample temperature at or below 4 ºC.

2.3.3 Sample Documentation

Field Documentation. Records will be kept in accordance with IRP Procedure III-D, *Logbooks* (DON 1998), a bound field notebook with consecutively numbered, water-repellent pages will be maintained. The logbook will be clearly labeled with the name of the activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries. Data forms, including soil boring logs, with predetermined formats for logging field data, will be incorporated into the logbook.

The field logbook will serve as the primary record of field activities. Logbooks should allow a reviewer to reconstruct field events by presenting entries in chronological order and in sufficient detail. The logbook will be maintained in a clean area and used only when outer gloves have been removed.

Entries on the data forms and in the logbook will meet the same requirements. Entries will be made in indelible ink. Information recorded in the logbook will include the following:

- The logbook will reference data maintained in other logs.
- Corrections to entry records will be made by drawing a single line through the incorrect entry, then initialing and dating the change. An explanation is to be included if more than a simple mistake was made.
- Entries will be signed or initialed by the individual making the entry at the end of each day.
- Page numbers will be entered on each logbook page.
- The preparer will send photocopies of completed pages to the STO manager on a weekly basis. The field manager will conduct a daily technical review of the logbook.

Laboratory Documentation. The laboratory will provide PACNAVFACENGCOM Level D data packages as described in IRP Procedure II-A, *Data Validation Procedure 1, Presentation* (DON 1998). The packages will include a case summary. The laboratory will also provide data deliverables in a specified electronic format. All laboratory deliverables are due to Tetra Tech within 28 days of receipt of the last sample in the SDG at the laboratory.

2.3.4 Chain of Custody Procedures

The COC documentation provides an accurate written record that traces the possession of individual samples from the time of collection in the field to the time of acceptance at the laboratory. The COC record also will be used to document all samples collected and the analysis requested. Information that the field personnel will record on the COC record includes:

- Project name and number
- Sampling location
- Name and signature of sampler
- Destination of samples (laboratory name)
- EPA ID number
- Date and time of collection
- Number and type of containers filled
- Analysis requested
- Preservatives used (if applicable)
- Filtering (if applicable)
- Sample designation (grab or composite)
- Signatures of individuals involved in custody transfer, including the date and time of transfer
- Airbill number (if applicable)
- Project contact and phone number

Unused lines on the COC record will be crossed out. Two copies of the COC forms will be placed in an adhesive plastic pouch and affixed to the inside of each sample cooler. The coolers will then be sealed with waterproof tape and labeled “Fragile,” “This End Up” (or marked with directional arrows pointing up), and other appropriate notices. Custody seals will be placed on coolers according to IRP Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures* (DON 1998). Signed airbills will serve as evidence of custody transfer between field personnel and the courier, and between the courier and the laboratory. Copies of the COC record and the airbill will be retained and filed by field personnel before the containers are shipped.

It is the responsibility of the CLEAN II contractor field team leader to ensure that all samples are handled properly to maintain the integrity of the samples from collection until shipment. These requirements are listed in IRP Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures* (DON 1998). The COC form serves as an analytical request form and has a space to record the sample upon receipt.

Upon receipt, the laboratory shall sign and retain copies of the air bill. The COC form shall be signed, and the temperature of the samples or cooler upon receipt will be documented on the COC form and the “Sample Condition Upon Receipt” form. If any breakage of a container occurs or any discrepancy is noted between the COC, sample labels, or requested analysis, the sample custodian will notify the laboratory project manager. A nonconformance report will be completed, and the project chemistry support coordinator will be notified within 24 hours. At the time of the notification, the proper corrective action will be decided upon. The sample custodian will enter the information into the laboratory system and send a login confirmation sheet to the project chemistry support coordinator within 48 hours. A declaration of the samples in each SDG will also be sent by the laboratory to the CLEAN II contractor.

2.3.5 Sample Shipment

Soil samples will be transferred directly to the laboratory for immediate analysis. All samples will be recorded on the COC forms in accordance with IRP Procedure III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures* (DON 1998). Sample containers will be placed in insulated coolers. Coolers will be chilled with frozen gel packs or ice in double, sealable bags. Samples will be placed in the lower portion of the cooler, and the ice packs will occupy the upper portion of the cooler. Material such as styrofoam pads or bubble wrap will line the top and bottom interior of the cooler (pads may also be placed on the sides at the discretion of field personnel). In the case of liquid samples, an absorbent material will be placed on the bottom of the cooler to help contain any spills. Glass containers will be individually wrapped in bubble-wrap, styrofoam, or other padded material to prevent breakage. Empty spaces between containers will be filled with styrofoam "peanuts" or other appropriate padding material. To prevent leaks, water sample containers will be packed in an upright position—not on their sides or stacked. Ice and gel packs will be replaced at the time of shipment to keep the inside temperature of the cooler as close as possible to 4°C. Samples will be shipped within 24 hours to allow the laboratory to meet holding times for analysis.

Field personnel are aware that soil samples shipped from Hawaii to a laboratory in the continental United States are subject to inspection by the U.S. Department of Agriculture (USDA). The CTO or STO manager or field manager will ensure that the required USDA shipment clearance permits are obtained from the laboratory. Field personnel will attach USDA soil permits to the air bill. Sample shipping procedures are described in IRP Procedure III-F, *Sample Handling, Storage, and Shipping Procedures* (DON 1998).

Nonhazardous Material Shipment. Samples considered nonhazardous based on previous site sampling results, field-screening results, or visual observations may be shipped as nonhazardous.

2.4 ANALYTICAL METHODS

Table 1-14 presents the analytical methods that will be used to analyze the collected samples. Table 1-17 presents the project QA objectives and control limits for sample analyses established as part of the DQO process (Section 1.3). Table 1-13 presents the individual target analytes required for this investigation and their associated RLs. The analytical laboratory will attempt to achieve the RLs for all investigative samples collected. If problems occur in achieving the RLs, the laboratory will contact the project chemist immediately and other alternatives will be pursued (such as analyzing an undiluted aliquot and allowing nontarget compound peaks to go off-scale) to achieve acceptable reporting limits. In addition, results below the reporting limit but above the MDL will be reported with appropriate flags to indicate the greater uncertainty associated with those values.

The analytical methods required for this investigation include EPA SW-846 (EPA 2000c) and methods that were used for previous investigations. Protocols for laboratory selection and for ensuring laboratory compliance with project analytical and QA/QC requirements are presented in the following subsections.

2.4.1 Selection of Analytical Laboratories

Laucks laboratory was selected for this investigation from a list of prequalified laboratories developed by Earth Tech and Tetra Tech to support the CLEAN contract. The Earth Tech laboratory prequalification and selection process relies on a standard procedure to evaluate and prequalify laboratories for work under the contract and a contractual document that specifies standard requirements for analyses that are routinely conducted. Earth Tech established a master service agreement, incorporating and enforcing the laboratory SOW, with each prequalified laboratory. Individual purchase orders can then be written for specific investigations. These aspects of laboratory selection are further described in the following subsections, along with Earth Tech procedures for selecting laboratories when project-specific analytical methods or QC requirements are not specifically addressed by the laboratory SOW.

Laboratory evaluation and prequalification; CLEAN laboratory statement of work; and laboratory selection and oversight will be performed in the same manner as discussed in the Sampling and Analysis Plan for Removal Action Design Support and Confirmation Sampling for the Group B sites (Earth Tech 2001d).

2.4.2 Project Analytical Requirements

For this investigation, analysis of soil samples will be conducted by a certified laboratory. The laboratory will be selected prior to initiation of the field program, based on its ability to meet the project analytical and QC requirements as well as its ability to meet the project schedule. The analytical methods selected for samples from the Group C sites specified for this project are standard EPA methods. The methods are identical to the analytical methods used in previous investigations at these sites and should provide comparable data. All methods are from EPA (2000c) SW-846 *Test Methods for Evaluating Solid Waste*.

This SAP documents project-specific QC requirements for the selected analytical methods. Table 1-13 presents reporting limits for all target analytes for all analytical methods, and Table 1-16 presents project-specific precision and accuracy goals for the methods.

2.5 QUALITY CONTROL

The quality of field data will be assessed through regular collection and analysis of field QC samples. Laboratory QC samples will also be analyzed in accordance with referenced analytical method protocols to ensure that laboratory procedures and analyses are conducted properly and that the quality of the data is known. No deviations from laboratory QC checks specified in Procedure III-A-1, *Laboratory QC Samples* (DON 1998) are intended. Laboratory control samples will be included in all Group C sample analyses. Laboratory QC checks will include the following items:

- Method blanks and reagent blanks
- MS samples
- MSD samples (organic analytes) or sample duplicates (inorganic analytes)
- Surrogates
- Blank spike or LCSs
- Initial and continuing calibration standards
- For organic analytes, internal standard area and retention time checks
- For GC analyses, second column confirmations
- Other QC requirements stated in the analytical methods to be used

Laboratory acceptance limits are summarized in Table 1-17 and are based on EPA CLP criteria.

2.5.1 Field Quality Control Samples

Field QC samples are collected and analyzed to check sampling and analytical precision, accuracy, and representativeness. Field QC samples will be collected in accordance with the guidelines presented by the Navy (NFESC 1999) and IRP Procedure III-B, *Field QC Samples (Water, Soil)* (DON 1998). Table 2-6 provides a summary of the types and frequency of collection of field QC samples.

In addition to the QC samples presented in Table 2-6, one field blank is required for each source of water used for decontamination. These samples will be analyzed for PCBs using the method identified in Table 1-13.

Table 2-6: Field Quality Control Samples

Type of Sample	Collection Rate
Field Duplicate	10% of samples per sampling activity
Equipment Rinsate	Minimum of 1 per day
Field Blank	Minimum of 1 per week
Laboratory QC Samples (MS/MSD)	5% of samples collected. Triplicate volumes will be collected and submitted.

Source: Modified from the NFESC (1999) guidance document, Navy Installation Restoration Chemical Data Quality Manual.

2.5.1.1 *Field Duplicates*

Field duplicate samples will be split or collocated samples collected at the same time and from the same source and then submitted as separate samples to the laboratory for analysis. Duplicate samples will be collected at a frequency of 10 percent for soil samples. Both samples will be assigned a unique sample ID number that will not reveal to the laboratory that they are duplicates.

Field duplicates will be evaluated qualitatively to assess the reproducibility of the sample collection procedures. The results of the analyses will be compared to laboratory criteria to assess whether the results demonstrate that the error inherent in the sampling procedures is within the expected analytical error.

2.5.1.2 *Matrix Spike and Matrix Spike Duplicates*

MS/MSD samples will be used to determine the accuracy and precision of the analytical results. MS/MSDs require the collection of an additional volume of soil for laboratory spiking and analysis. Triplicate aliquots of the same sample are prepared in the laboratory, and each aliquot is treated exactly the same throughout the analytical method.

MS/MSD samples will be collected at a frequency of 5 percent for soil. Matrix spike samples measure the efficiency of all the steps in the analytical method in recovering target analytes from an environmental matrix. The percent recoveries will be calculated for each of the spiked analytes and used to evaluate analytical accuracy. For the MS/MSD, spike compounds are added to two of the aliquots at concentrations specified in the method, and accuracy will be determined from the percent recovery of the analyte from the sample matrix. The RPD between spiked samples will be calculated to evaluate precision.

2.5.1.3 *Field Blanks*

A field blank will be collected each week from each water source or vendor to measure potential contamination resulting from the water used in the final rinse in the decontamination process, and from the use of reusable equipment, respectively. Analytes detected in field blanks will be compared to any analytes detected in equipment rinsates and samples. The effect of the presence of the analytes in the field blanks is discussed in Section 4 of this SAP.

2.5.1.4 *Equipment Rinsate Samples*

Equipment rinsate samples demonstrate whether decontamination procedures are effective in removing contaminants from the field sampling equipment. The presence of contamination in equipment rinsate samples indicates that cleaning procedures were not effective, allowing for the possibility of cross-contamination. Equipment rinsate samples will be collected during soil and IDW sampling at a frequency of once per day of sampling. An equipment rinsate is a sample collected after a sampling device is subjected to standard decontamination procedures. Water will be poured over or through the sampling equipment into a sample container and sent to the laboratory for analysis. Analytically certified, organic-free, high performance liquid-chromatography-grade water or its equivalent will be used for organic parameters; deionized or distilled water will be used for inorganic parameters.

Equipment rinsate samples will be sent blind to the laboratory. During data validation, the results for the equipment rinsate samples will be used to qualify data or to evaluate the levels of analytes in the field samples collected on the same day.

2.5.2 Laboratory Quality Control Samples

Laboratory QC samples are prepared and analyzed at the laboratory to evaluate the effectiveness of sample preparation and analysis and to assess analytical precision and accuracy. The types of laboratory QC samples that will be used for this project and their required frequencies are discussed in the following sections. Table 1-16 presents project-specific precision and accuracy goals for these samples.

2.5.2.1 *Method Blanks*

Method blanks are prepared to evaluate whether contamination is originating from the reagents used in sample handling, preparation, or analysis. They are critical in distinguishing between low-level field contamination and laboratory contamination. A method blank consists of laboratory analyte-free water and all of the reagents used in the analytical procedure. It is prepared for every analysis in the same manner as a field sample and is processed through all of the analytical steps. Method blanks will be prepared at the frequency prescribed in the individual analytical method.

2.5.2.2 *Laboratory Control Samples or Blank Spikes*

An LCS, or blank spike, originates in the laboratory as deionized or distilled water that has been spiked with standard reference materials of a known concentration. An LCS is analyzed to verify the accuracy of the calibration standards. These internal QC samples are also used to evaluate laboratory accuracy in the presence of matrix interference for field samples. LCSs are processed through the same analytical procedure as field samples. LCSs will be analyzed at the frequency prescribed in the analytical method or at a rate of 5 percent of the total samples if a frequency is not prescribed in the method. If percent recovery results for the LCS or blank spike are outside of the established goals, laboratory-specific protocols will be followed to gauge the usability of the data.

2.5.2.3 *Surrogate Standards*

Surrogate standards consist of known concentrations of nontarget organic analytes that are added to each sample, method blank, and MS/MSD before samples are prepared and analyzed. The surrogate standard measures the efficiency of the analytical method in recovering the target analytes from an environmental sample matrix. Percent recoveries for surrogate compounds are evaluated using laboratory control limits. Surrogate standards provide an indication of laboratory accuracy and matrix effects for every field and QC sample that is analyzed for extractable organic constituents. Surrogate compounds are used to monitor purge efficiency and analytical performance, whereas surrogates are used in the analysis of extractable organic compounds to monitor the extraction process and analytical performance.

Factors such as matrix interference and high concentrations of analytes may affect surrogate recoveries. The effects of the sample matrix are frequently outside the control of the laboratory and may present unique problems. Laboratory personnel are required to reextract (when applicable) and reanalyze samples when associated surrogates are outside of control limits. Data from both analyses of the samples in question are reported.

During validation, data will be qualified as estimated for any result that fails to meet surrogate criteria. Data will be qualified as estimated if two or more surrogates from each fraction (base/neutral and acid) are outside the control limits. The tables in Table 1-17 provide the guidelines for surrogate recovery for analyses that are planned for this project.

2.5.2.4 INTERNAL STANDARDS

Internal standards are compounds that are added to every standard, method blank, MS/MSD, and sample or sample extract at a known concentration prior to analysis. Internal standards are used as the basis for quantification of GC/MS target compounds and ensure that the GC/MS sensitivity and response are stable during the analytical run. An internal standard is used to evaluate the efficiency of the sample introduction process and monitors the efficiency of the analytical procedure for each sample matrix encountered. Internal standards are also used in the analysis of organic compounds by GC to monitor retention-time shifts. Validation of internal standards data will be based on EPA protocols presented in guidelines for evaluating organic analyses (EPA 1999b).

2.5.3 Additional Laboratory Quality Control Procedures

In addition to the analysis of laboratory QC samples, subcontractor laboratories will conduct the QC procedures discussed in the following sections.

2.5.3.1 METHOD DETECTION LIMIT STUDIES

The MDL is the minimum concentration of a compound that can be measured and reported. The MDL is a specified limit at which there is 99 percent confidence that the concentration of the analyte is greater than zero. The MDL takes into account sample matrix and preparation. The subcontractor laboratory will demonstrate the MDLs for all analyses except inorganic analyses and physical properties test methods.

MDL studies will be conducted annually for soil matrices, or more frequently if any method or instrumentation changes. Each MDL study will consist of seven replicates spiked with all target analytes of interest at concentrations no greater than required quantitation limits. The replicates will be extracted and analyzed in the same manner as routine samples. If multiple instruments are used, each will be included in the MDL study. The MDLs reported will be representative of the least sensitive instrument.

2.5.3.2 REPORTING LIMITS

The RLs presented in Table 1-13 are chemical-specific levels that a laboratory should be able to routinely detect and quantitate in a given sample matrix. The RL is usually defined in the analytical method or in laboratory method documentation. The RL takes into account changes in the preparation and analytical methodology that may alter the ability to detect an analyte, including changes such as use of a smaller sample aliquot or dilution of the sample extract. Physical characteristics such as sample matrix and percent moisture that may alter the ability to detect the analyte are also considered. The laboratory will calculate and report RLs for all environmental samples.

2.5.3.3 CONTROL CHARTS

Control charts document data quality in graphic form for specific method parameters such as surrogates and blank spike recoveries. A collection of data points for each parameter is used to statistically calculate means and control limits for a given analytical method. This information is useful in determining whether analytical measurement systems are in control. In addition, control charts provide information about trends over time in specific analytical and preparation methodologies. Although they are not required, Earth Tech and Tetra Tech recommend that subcontractor laboratories maintain control charts for organic and inorganic analyses. At a minimum, method-blank surrogate recoveries and blank spike recoveries should be charted for all organic methods. Blank spike recoveries should be charted for inorganic methods. Control charts should be updated monthly.

2.6 EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

This section outlines the testing, inspection, and maintenance procedures that will be used to keep both field and laboratory equipment in good working condition.

2.6.1 Maintenance of Field Equipment

Preventive maintenance for most field equipment is carried out in accordance with procedures and schedules recommended in (1) the equipment manufacturer's literature or operating manual, or (2) IRP procedures that describe equipment operation associated with particular applications of the instrument. However, more stringent testing, inspection, and maintenance procedures and schedules may be required when field equipment is used to make critical measurements.

A hydraulic direct-push rig and drill rig will be used for sampling. The subcontractor will be required to provide detailed written procedures for inspecting, maintaining, and servicing the rig and will keep them on site. At a minimum, these procedures should address standard maintenance items.

2.6.2 Maintenance of Laboratory Equipment

Subcontractor laboratories will prepare and follow a maintenance schedule for each instrument used to analyze samples collected from the Group C sites. All instruments will be serviced at scheduled intervals necessary to optimize factory specifications. Routine preventive maintenance and major repairs will be documented in a maintenance logbook.

An inventory of items to be kept ready for use in case of instrument failure will be maintained and restocked as needed. The list will include equipment parts subject to frequent failure, parts that have a limited lifetime of optimum performance, and parts that cannot be obtained in a timely manner.

The laboratory's QA plan and written SOPs will describe specific preventive maintenance procedures for equipment maintained by the laboratory. These documents identify the personnel responsible for major, preventive, and daily maintenance procedures, the frequency and type of maintenance performed, and procedures for documenting maintenance activities.

Laboratory equipment malfunctions will require immediate corrective action. Actions should be documented in laboratory logbooks. No other formal documentation is required unless data quality is adversely affected or further corrective action is necessary. On-the-spot corrective actions will be taken as necessary in accordance with the procedures described in the laboratory QA plan and SOPs.

2.7 Instrument Calibration and Frequency

Laboratory equipment calibration procedures and frequencies will follow the requirements in the reference method in Section 2.4.2 of this SAP. Qualified analysts will calibrate laboratory equipment and document the procedures and results in a logbook.

The laboratory will obtain calibration standards from the EPA repository or commercial vendors for both inorganic and organic compounds and analytes. Stock solutions for surrogate parameters and other inorganic mixes will be made from reagent-grade chemicals or as specified in the analytical method. Stock standards will also be used to make intermediate standards that will be used to prepare calibration standards. Special attention will be paid to expiration dating, proper labeling, proper refrigeration, and freedom from contamination. Documentation on receipt, mixing, and use of standards will be recorded in the appropriate laboratory logbook. Logbooks must be permanently bound. Additional specific handling and documentation requirements for the use of standards may be provided in subcontractor laboratory QA plans.

2.8 Inspection and Acceptance of Supplies and Consumables

The CTO and STO managers have primary responsibility for identifying the types and quantities of supplies and consumables needed to complete CLEAN projects and are also responsible for determining acceptance criteria for these items.

Supplies and consumables can be received either at CLEAN contractor offices or at the work site. When supplies are received at an office, the CTO or STO manager or field manager will sort them according to vendor, check packing slips against purchase orders, and inspect the condition of all supplies before they are accepted for use on a project. If an item does not meet the acceptance criteria, deficiencies will be noted on the packing slip and purchase order and the item will then be returned to the vendor for replacement or repair.

Procedures for receiving supplies and consumables in the field are similar. When supplies are received, the field manager will inspect all items against the acceptance criteria. Any deficiencies or problems will be noted in the field logbook, and deficient items will be returned for immediate replacement.

Analytical laboratories are required to provide certified clean containers for all analyses. These containers must meet EPA standards described in *Specifications and Guidance for Obtaining Contaminant-Free Sampling Containers* (EPA 1992).

Table 2-7 lists the acceptance criteria for common supplies and consumables used to ensure the quality of these items.

Table 2-7: Acceptance Criteria for Common Supplies and Consumables

Supplies and Consumables	Minimum Acceptance Criteria
Water Sample Containers – glass	Glass containers, certified from the manufacturer for pesticide/PCB, and metals analyses. Each case of containers will include a Certificate of Assurance or a Certificate of Analysis verifying that the containers conform to the manufacturer's performance-based specifications.
Soil Samples Containers – glass	Glass containers, certified from the manufacturer for pesticide/PCB, and metals analyses. Each case of containers will include a Certificate of Assurance or a Certificate of Analysis verifying that the containers conform to the manufacturer's performance-based specifications.
Decontamination Water – deionized/potable	Deionized water, and if necessary potable water, will be analyzed via field blanks for possible contamination. Field blanks will be analyzed once per week of sampling event for each water source.
Reagents	Reagents used for organic analysis will be at least pesticide-grade or equivalent. Reagents for inorganic analysis will be at least ACS certified grade or equivalent. Reagents for metals analysis will be at least trace-metal grade or equivalent.

Notes:
ACS = American Chemical Society
PCB = polychlorinated biphenyl

2.9 NON-DIRECT MEASUREMENTS

No data for project implementation or decision-making will be obtained from nondirect measurement sources.

2.10 DATA MANAGEMENT

Field and analytical data collected from this project are critical to site characterization efforts and selection of remedial actions to protect human health. An information management system is necessary to ensure efficient access so that decisions based on the data can be made in a timely manner.

After the field and laboratory data reports are reviewed and validated, the data will be entered into an electronic database. The database contains data for (1) summarizing observations on contamination and geologic conditions, (2) preparing reports and graphics, and (3) transmitting in an electronic format compatible with NEDTS. The database will also be used with geographic information systems (GIS). The following sections describe the data tracking procedures, data pathways, and overall data management strategy for the sites.

2.10.1 Data-Tracking Procedures

To assist data tracking and adherence to the SAP, field or office personnel will track samples using a spreadsheet or database. An example of a typical COC tracking system is shown in Appendix B.

All data that are generated in support of the Group C sampling will be tracked through a database created by Tetra Tech. Tetra Tech will prepare a control/cross-reference database, and download the electronic chain-of-custody data into a relational database management system (RDBMS). Information related to the receipt and delivery of samples, project order fulfillment, and invoicing for laboratory and validation tasks is stored in the system. All data are filed according to the document control number. Receipt of hard copy data will also be tracked in RDBMS.

2.10.2 Data Pathways

Data are generated from three primary pathways at the sites—data derived from field activities, laboratory analytical data, and validated data. Data from all three pathways must be entered into

RDBMS. To evaluate whether the data have been accurately loaded into the database in a timely manner, data pathways must be established and well documented.

Handwritten data (e.g., chain-of-custody forms, field data, field notes) will be entered into the RDBMS. Data generated during field activities are recorded using field forms (Appendix B). These forms are reviewed for completeness and accuracy by the project chemist or field manager.

Data generated during laboratory analysis are recorded in hard-copy and in EDDs after the samples have been analyzed. The laboratory will send the hard-copy and EDD records to the project chemist. The project chemist reviews the data deliverable for completeness, accuracy, and format. After the format has been approved, the electronic data are manipulated and downloaded into the database. Data entry personnel will then update RDBMS with the total number of samples received and number of days required to receive the data.

A minimum of one hard copy will be delivered from the laboratory to the project chemist, the CTO manager, the STO manager, and the data validators. Preliminary QC checks will verify the consistency of EDD format, run data loading and translation programs, fix errors and anomalies reported by the translation programs, verify successful loading and translations, and download data for users. PACNAVFACENGCOM will receive a copy of the laboratory data on CD-ROM in the form of data tables generated from the RDBMS.

After validation, the project chemist reviews the data for accuracy, and the data qualifiers will be loaded into the RDBMS. Additional data not supplied from the laboratory will also be loaded into the RDBMS.

Early in a project, electronic laboratory data will be checked against the hard copy data for the entire SDG. Later, if no problems have been encountered, a small portion of data in the RDBMS for each analytical method will be checked against the hard copy version to ensure that data types match. Data validators who enter validation qualifiers for each result will be tasked to check hard copy results against the results in the electronic version.

Computer files will be backed up daily to prevent loss of information. Hard copy data will be stored in secure areas, while electronic data will be stored in password-protected files with read-only access to users without authorization to edit the data. The data will be stored for a period of 10 years after the close of the contract.

2.10.3 Data Management Strategy

Chemical data will be summarized and then screened against the comparison criteria listed in Table 1-13. The database for the Group C sites will be updated weekly. The data consist of chemical and field data from Navy contractors, entered into an Oracle (Version 7.3) database. The database can be used to generate reports using available computer-aided drafting and design and contouring software. All electronic data from this database will be transmitted in a format compatible with NEDTS.

To satisfy long-term data management goals, the data will be loaded into the database at Tetra Tech for storage, further manipulation, and retrieval after the off-site laboratory and field reports are reviewed and validated. The database will be used to provide data for chemical and geologic analysis and for preparing reports and graphic representations of the data. Additional data acquired from field activities are recorded on field forms (Appendix B) that are reviewed for completeness and accuracy by the project chemist or field manager. Hard copies of forms, data, and chain-of-custody forms are filed in a secure storage area according to project and document control numbers. Laboratory data packages and reports will be archived at Earth Tech or Navy offices. Laboratories that generated the data will archive hard-copy data for a minimum of 10 years after the close of the contract.

3. ASSESSMENT AND OVERSIGHT

This section describes the field and laboratory assessments that may be conducted during this project, the individuals responsible for conducting assessments, corrective actions that may be implemented in response to assessment results, and how quality-related issues will be reported.

Overall responsibility for implementation and monitoring of the Earth Tech QA program resides with the CLEAN II technical director. The CLEAN II technical director and the CTO manager will be responsible for reviewing the technical contents of all submittals required under this project. The QA activities applicable to this CTO are described in the *Project Procedures Manual (*DON 1998) and Earth Tech SOPs (Earth Tech 1996). The Earth Tech Peer Review Program, as outlined in the SOPs, will be followed during this project.

3.1 ASSESSMENTS, AUDITS, AND RESPONSE ACTION

Earth Tech, Tetra Tech, and the Navy will oversee environmental data collection using the audit and assessment activities described below. Any problems encountered during an audits or assessment of field investigation or laboratory activities will require appropriate corrective action to ensure that the problems are resolved. This section describes the types of audits or assessments that may be completed; Earth Tech's, Tetra Tech's, and the Navy's responsibilities for conducting the audits or assessments; and corrective action procedures to address problems identified during an audit or assessment.

3.1.1 Field Audits

The CLEAN II technical director or his designee will conduct at least one field audit. The findings will be compiled in a report and submitted to the CTO manager (and technical director, if not performing the audit). The CTO manager will address the findings within 10 days of receiving the report. Both the auditor and technical director will review the response to the findings to determine whether the responses are adequate. If, during the audit, it is determined that a procedure is being performed in a manner that may cause harm to the field crew or render the data unusable, the field auditor has the authority to stop work until the issue has been adequately resolved. Items to be examined during the field audit include:

- Availability of project plans such as the SAP and HSP
- Documentation of personnel qualifications and training
- Sample collection, identification, preservation, handling, and shipping procedures
- Sampling equipment decontamination
- Equipment calibration and maintenance
- Completeness of logbooks and other field records (including nonconformance documentation)
- Health and safety procedures

The frequency of field audits is described below:

- Field System Audits: One or more field system audits will be completed, depending on the size and complexity of the project and the experience of the personnel.
- Field Performance Audits: One or more audits will be completed, depending on the size and complexity of the project and the experience of the personnel.

3.1.2 Laboratory Assessments

As described in Section 2.4.1, NFESC and Earth Tech conduct assessments of all laboratories that analyze samples collected under the CLEAN II contract. These assessments include (1) reviews of laboratory certifications, and (2) laboratory audits. Laboratory audits may consist of an onsite review of laboratory facilities, personnel, documentation, and procedures, or an offsite evaluation of the ability of the laboratory's data management system to meet contract requirements. Earth Tech also conducts project-specific laboratory assessments when an approved laboratory has been selected for nonroutine analyses or when a laboratory that is not on the approved list must be used.

The Navy may audit any laboratory that will analyze samples on this project. The Navy QA officer will determine the need for these audits, and typically will conduct any such audits before samples are submitted to the laboratory for analysis.

3.1.3 Assessment Responsibilities

Personnel conducting audits and assessments will be independent of the activity being evaluated. The CLEAN II technical director will select the appropriate personnel to conduct each audit and assessment and will assign them responsibilities and deadlines for completing the task. These personnel may include the CLEAN II technical director, project chemist, or senior technical staff with relevant expertise and experience.

When an audit or assessment is planned, the CLEAN II technical director selects a lead who is responsible for:

- Selecting and preparing the assessment team
- Preparing an assessment plan
- Coordinating and scheduling the assessment with the project team, subcontractor, or other organization being evaluated
- Participating in the assessment
- Coordinating preparation and issuance of assessment reports and corrective action request forms
- Evaluating responses and resulting corrective actions.

After the assessment is completed, the lead assessor will submit an audit report to the Navy QA officer and RPM and to the CLEAN II technical director, CTO manager, and project chemist; other personnel may be included in the distribution as appropriate. Assessment findings will also be included in the data quality assessment report (DQAR) for the project (Section 3.2.2).

The Navy QA officer is responsible for coordinating audits that may be conducted by Navy personnel under this project. Audit preparation, completion, and reporting responsibilities for Navy auditors would be similar to those described above.

3.1.4 Field Corrective Action Procedures

An effective QA program requires prompt and thorough correction of nonconformance conditions affecting quality. Rapid and effective corrective action minimizes the possibility of questionable data or documentation.

If problems with either laboratory or field procedures occur, or if problems of noncompliance are noted during the laboratory, field system, or performance audits, corrective actions will be implemented. All QA problems and corrective actions will be documented to provide a complete record of QA activities and to help identify needed long-term corrective actions.

In the event that a corrective action is required due to improper field technique, the CTO manager, field manager, and project chemist will be notified. The CTO manager, field manager, and the project chemist will meet to discuss the appropriate steps to resolve the problem, and will use the following list:

- Determine when and how the problem developed
- Assign responsibility for problem investigation and documentation
- Determine the corrective action to eliminate the problem
- Design a schedule for completion of the corrective action
- Assign responsibility for implementing the corrective action
- Document and verify that the corrective action has eliminated the problem
- Notify the Navy of the problem and the corrective action taken

3.1.5 Laboratory Corrective Action Procedures

Internal laboratory procedures for corrective action and descriptions of out-of-control situations that require corrective action are contained in laboratory QA plans. At a minimum, corrective action will be implemented when any of the following three conditions occurs: control limits are exceeded, method QC requirements are not met, or sample-holding times are exceeded. The laboratory will report out-of-control situations to the project chemist within 2 working days after they are identified. In addition, the laboratory project manager will prepare and submit a corrective action report to the project chemist. This report will identify the out-of-control situation and the steps that the laboratory has taken to rectify it.

3.2 REPORTS TO MANAGEMENT

Effective management of environmental data collection requires (1) timely assessment and review of all activities and (2) open communication, interaction, and feedback among all project participants. Earth Tech and Tetra Tech will use the reports described below to address any project-specific quality issues and to facilitate timely communication of these issues.

3.2.1 Project Monthly Status Report

The Earth Tech CTO manager and Tetra Tech STO manager will prepare a monthly status report (MSR) to be submitted to the CLEAN program manager and the Navy RPM. Monthly status reports address project-specific quality issues and facilitate their timely communication. The MSR will include the following quality-related information:

- Project status
- Instrument, equipment, or procedural problems that affect quality and recommended solutions
- Objectives from the previous report that were achieved
- Objectives from the previous report that were not achieved
- Work planned for the next month

If appropriate, similar information from project subcontractors will be obtained and incorporated in the MSR.

3.2.2 Data Quality Assessment Report

A DQAR will be included with the summary reports generated during the assessment activities. The DQAR will include a summary and evaluation of QA/QC activities, including any field or laboratory assessments, completed during the Group C sampling. The DQAR will also indicate the location and duration of storage for the complete data packages. Particular emphasis will be placed on determining whether project DQOs were met and whether data are of adequate quality to support required decisions.

4. DATA VALIDATION AND USABILITY

This section describes the procedures that are planned to review, verify, and validate field and laboratory data. This section also discusses procedures for verifying that the data are sufficient to meet DQOs for the project.

4.1 DATA REVIEW, VERIFICATION, AND VALIDATION

Validation and verification of the data generated during field and laboratory activities are essential to obtaining data of defensible and acceptable quality. Verification and validation methods for field and laboratory activities are presented below.

4.1.1 Field Data Verification

Project team personnel will verify field data through reviews of data sets to identify inconsistencies or anomalous values. Any inconsistencies discovered will be resolved as soon as possible by seeking clarification from field personnel responsible for data collection. All field personnel will be responsible for following the sampling and documentation procedures described in this SAP so that defensible and justifiable data are obtained.

Data values that are significantly different from the population are called "outliers." A systematic effort will be made to identify any outliers or errors before field personnel report the data. Outliers can result from improper sampling or measurement methodology, data transcription errors, calculation errors, or natural causes. Outliers that result from errors found during data verification will be identified and corrected; outliers that cannot be attributed to errors in sampling, measurement, transcription, or calculation will be clearly identified in project reports.

4.1.2 Laboratory Data Verification

Laboratory personnel will verify analytical data at the time of analysis and reporting and through subsequent reviews of the raw data for any nonconformances to the requirements of the analytical method. Laboratory personnel will make a systematic effort to identify any outliers or errors before they report the data. Outliers that result from errors found during data verification will be identified and corrected; outliers that cannot be attributed to errors in analysis, transcription, or calculation will be clearly identified in the case narrative section of the analytical data package.

4.1.3 Laboratory Data Validation

An independent third-party contractor will validate all laboratory data in accordance with current EPA national functional guidelines (EPA 1994, 1999b). The data validation strategy will be consistent with Navy guidelines. For this project, 10 percent of the data will undergo NFESC Level D validation and 90 percent of the data will undergo NFESC Level C validation. Data validation requirements are detailed in IRP Procedure II, *Data Validation Procedures* (DON 1998).

4.2 RECONCILIATION WITH USER REQUIREMENTS

After environmental data have been reviewed, verified, and validated in accordance with the procedures described in Section 4.1, the data must be further evaluated to determine whether DQOs have been met. To the extent possible, the EPA data quality assessment (DQA) process will be followed to verify that the type, quality, and quantity of data collected are appropriate for their intended use. DQA methods and procedures are outlined in EPA's *Guidance for Data Quality Assessment, Practical Methods for Data Analysis* (2000b). The DQA process includes five steps: (1) review the DQOs and sampling design; (2) conduct a preliminary data review; (3)

select a statistical test; (4) verify the assumptions of the statistical test; and (5) draw conclusions from the data.

When the five-step DQA process is not completely followed because the DQOs are qualitative in nature, data quality and data usability will be systematically assessed. This assessment will include:

- A review of the sampling design and sampling methods to verify that these were implemented as planned and are adequate to support project objectives
- A review of project-specific data quality indicators for precision, accuracy, representativeness, completeness, comparability, and quantitation limits (Table 1-16) to determine whether acceptance criteria have been met
- A review of project-specific DQOs to determine whether they have been achieved by the data collected
- An evaluation of any limitations associated with the decisions to be made based on the data collected. For example, if data completeness is only 90 percent compared to a project-specific completeness objective of 95 percent, the data may still be usable to support a decision, but at a lower level of confidence.

The DQAR for the project will discuss any potential impacts of these reviews on data usability and will clearly define any limitations associated with the data.

5. REFERENCES

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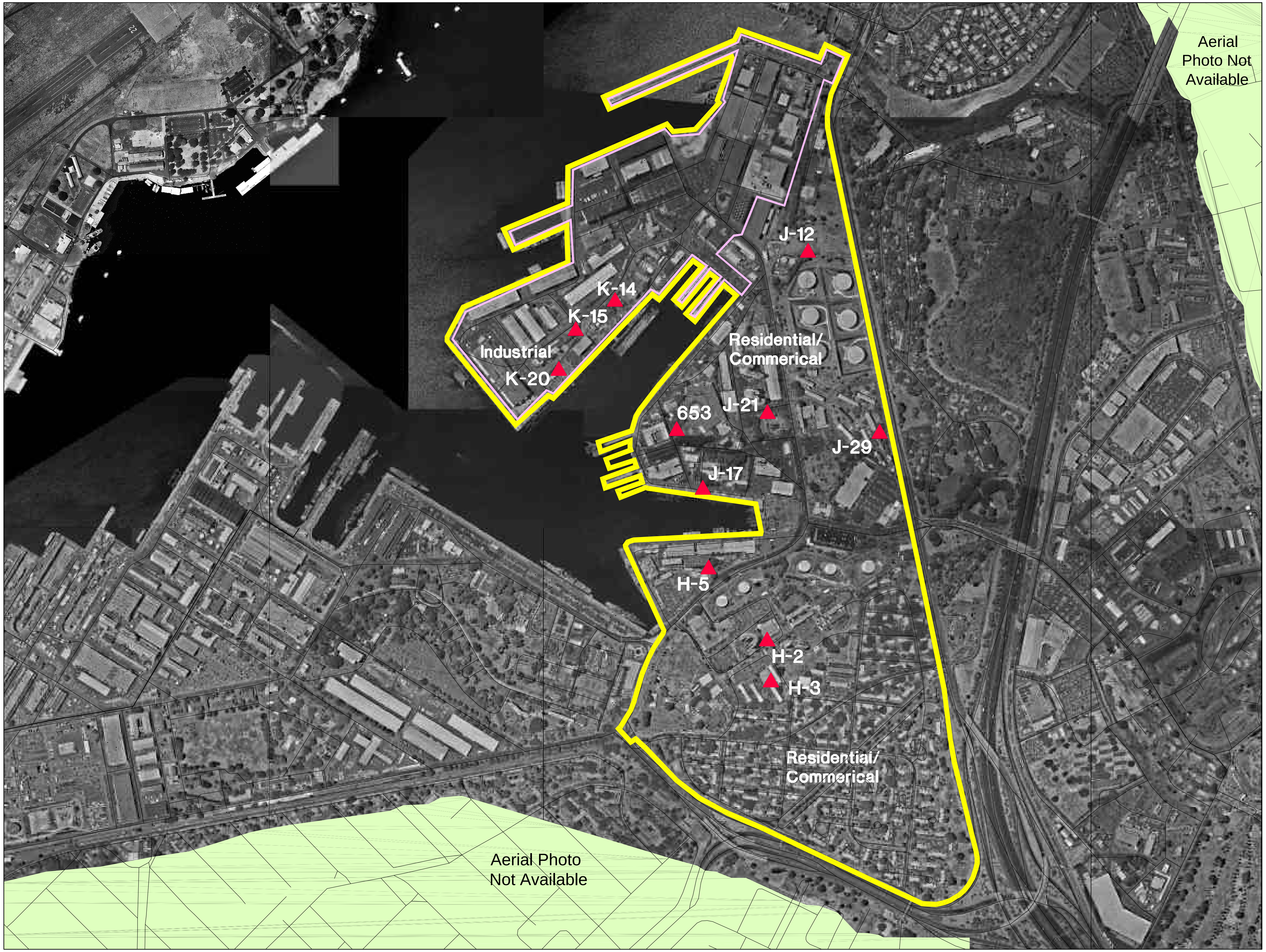
Appendix A
Figures



Legend

- Transformer Sites Recommended for Further Action
- Halawa Main Gate GSA Boundary
- Surrounding Area
- Boundary Between Industrial and Commercial/Residential Areas
- Roads

Notes

1. The accuracy of this document is limited to the quality of the source information and is not suitable for mapping engineering applications and is not to used for "as built."
2. Industrial, Restricted Access Areas: Areas other than electrical substations that are at least 0.1 kilometer (km) from a Residential/Commercial area and where accessibility is limited by man-made or natural barriers (40 CFR 761.125, Definitions.)
3. Residential/Commercial, Non-Restricted Access Areas: Residential and Commercial Areas such as indoor locations and unrestricted rural areas (40 CFR 761.125, Definitions).
4. Boundary between High Occupancy Residential and Commercial Areas and Low Occupancy Industrial Areas was drawn 0.1 km away from high occupancy areas.

Source

- Base mapping from State of Hawaii statewide GIS data and other mapping developed by and for the U.S. Navy.

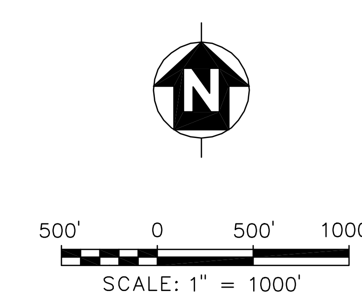
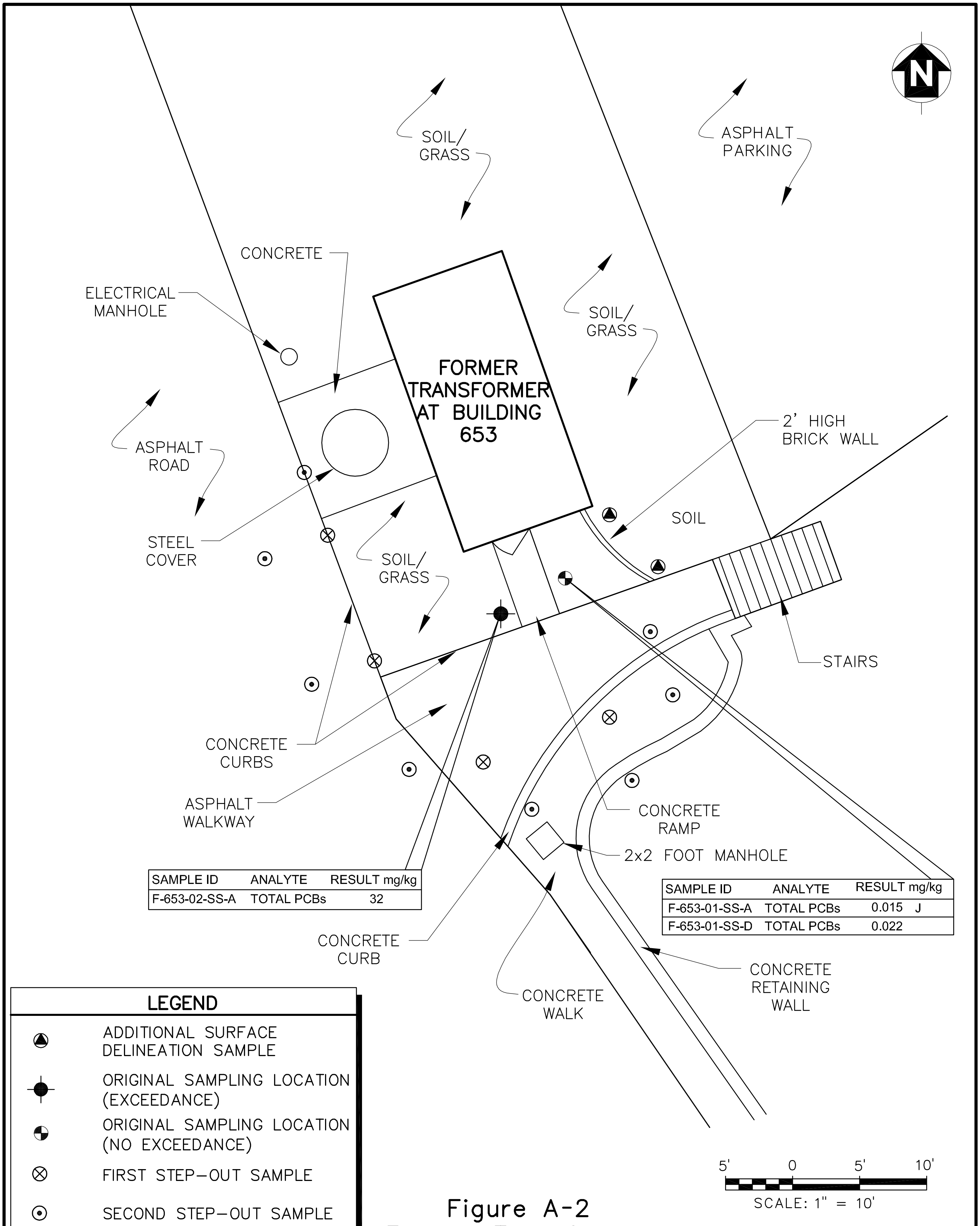


Figure A-1
Transformer Sites Recommended for Further Action
Halawa-Main Gate GSA
Oahu, Hawaii

R:\Navy\PearlHarbor\CTO004\M02\SAP\ SI-HALAWA_MG.DWG 03/03/2003 Vincent.Cavanaugh DN



SAMPLE ID	ANALYTE	RESULT mg/kg
F-653-02-SS-A	TOTAL PCBs	32

SAMPLE ID	ANALYTE	RESULT mg/kg
F-653-01-SS-A	TOTAL PCBs	0.015 J
F-653-01-SS-D	TOTAL PCBs	0.022

Figure A-2
Former Transformer
at Building 653
Halawa Main Gate GSA
Oahu, Hawaii

NOTES:

mg/kg milligrams per kilogram
PCB Polychlorinated Biphenyl
J Estimated value

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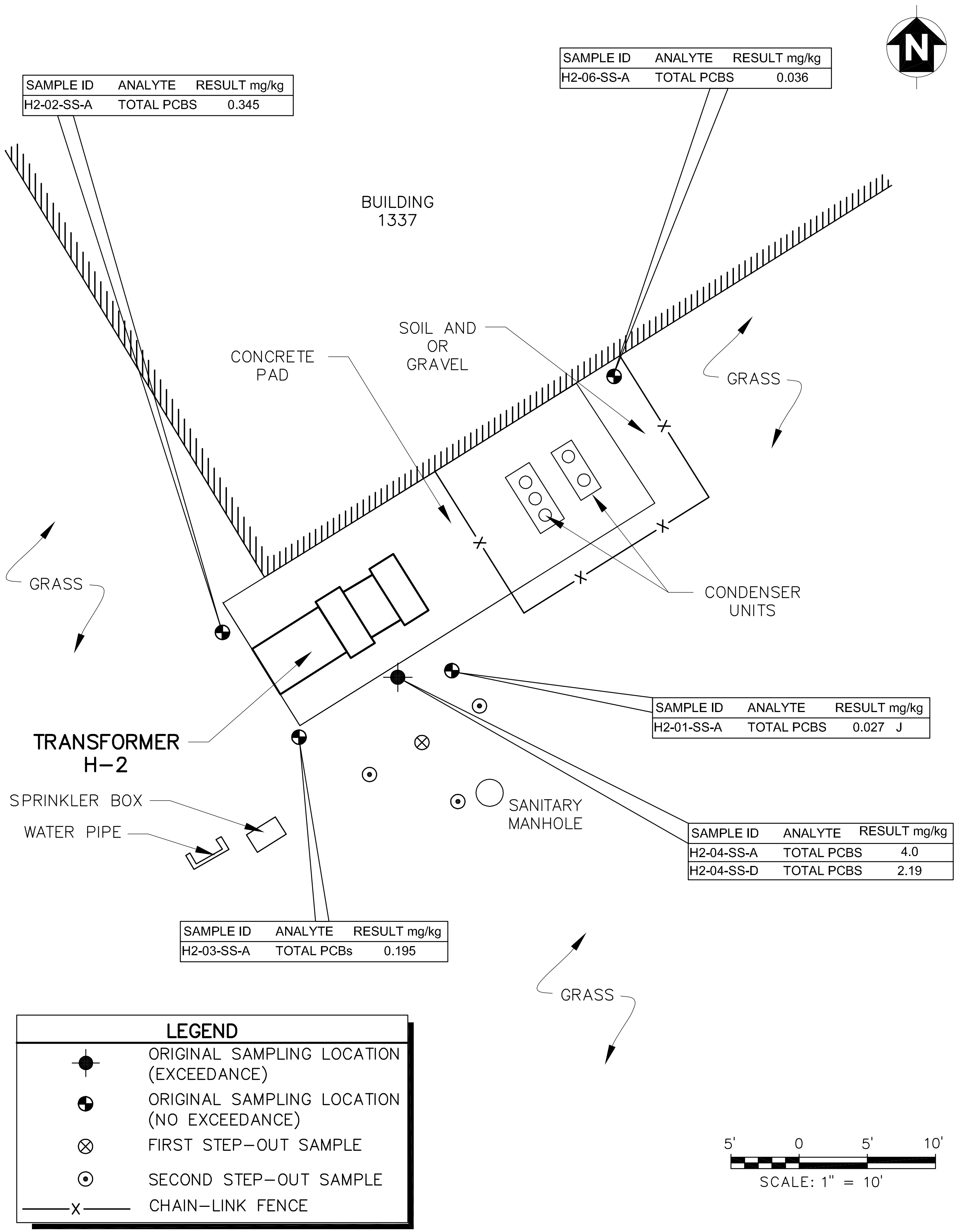

SAMPLE ID	ANALYTE	RESULT mg/kg
H2-02-SS-A	TOTAL PCBS	0.345

SAMPLE ID	ANALYTE	RESULT mg/kg
H2-06-SS-A	TOTAL PCBS	0.036

SAMPLE ID	ANALYTE	RESULT mg/kg
H2-01-SS-A	TOTAL PCBS	0.027 J

SAMPLE ID	ANALYTE	RESULT mg/kg
H2-04-SS-A	TOTAL PCBS	4.0
H2-04-SS-D	TOTAL PCBS	2.19

SAMPLE ID	ANALYTE	RESULT mg/kg
H2-03-SS-A	TOTAL PCBs	0.195

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-3
Transformer H-2
Halawa Main Gate GSA
Oahu, Hawaii

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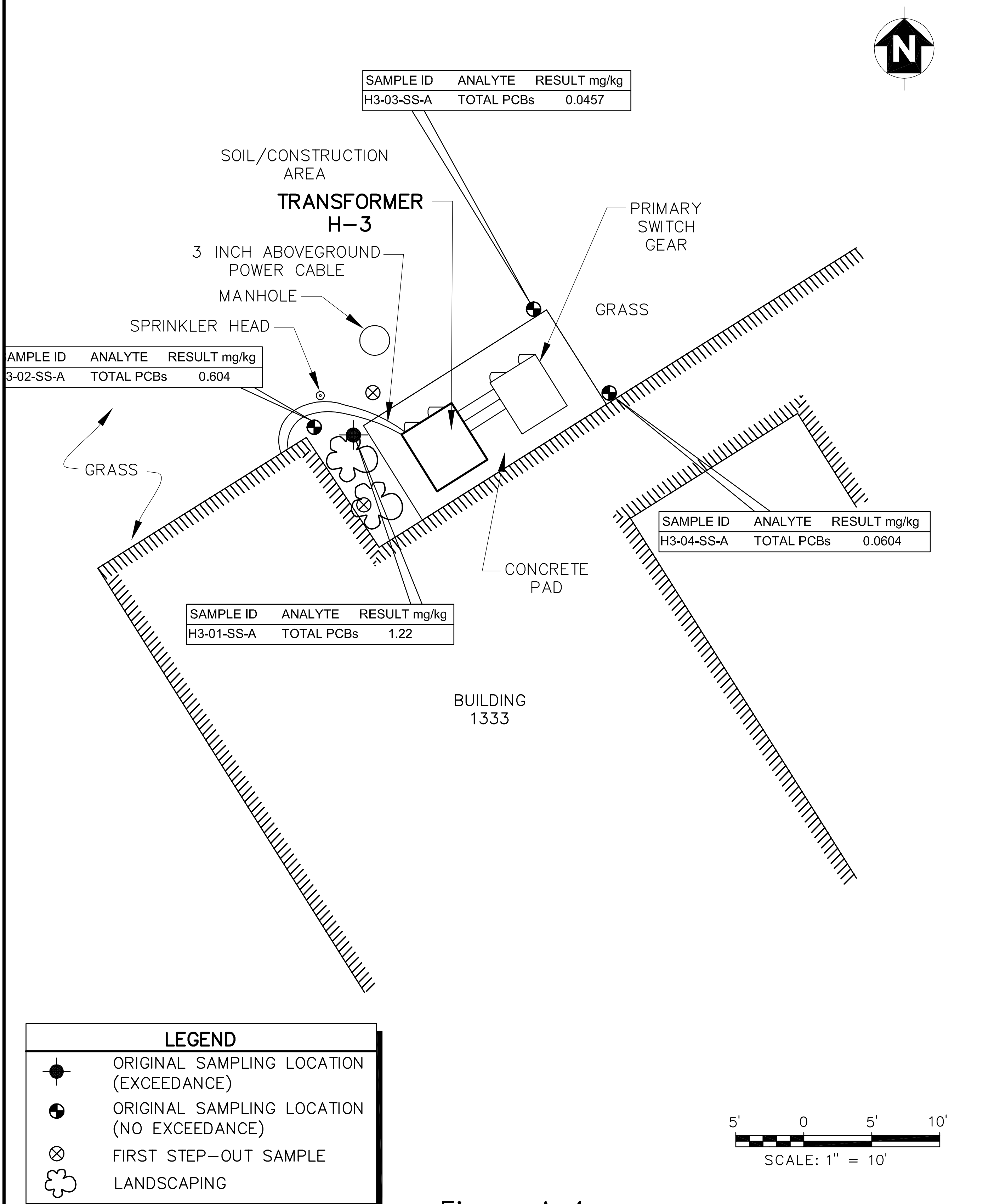

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-4
Transformer H-3
Halawa Main Gate GSA
Oahu, Hawaii

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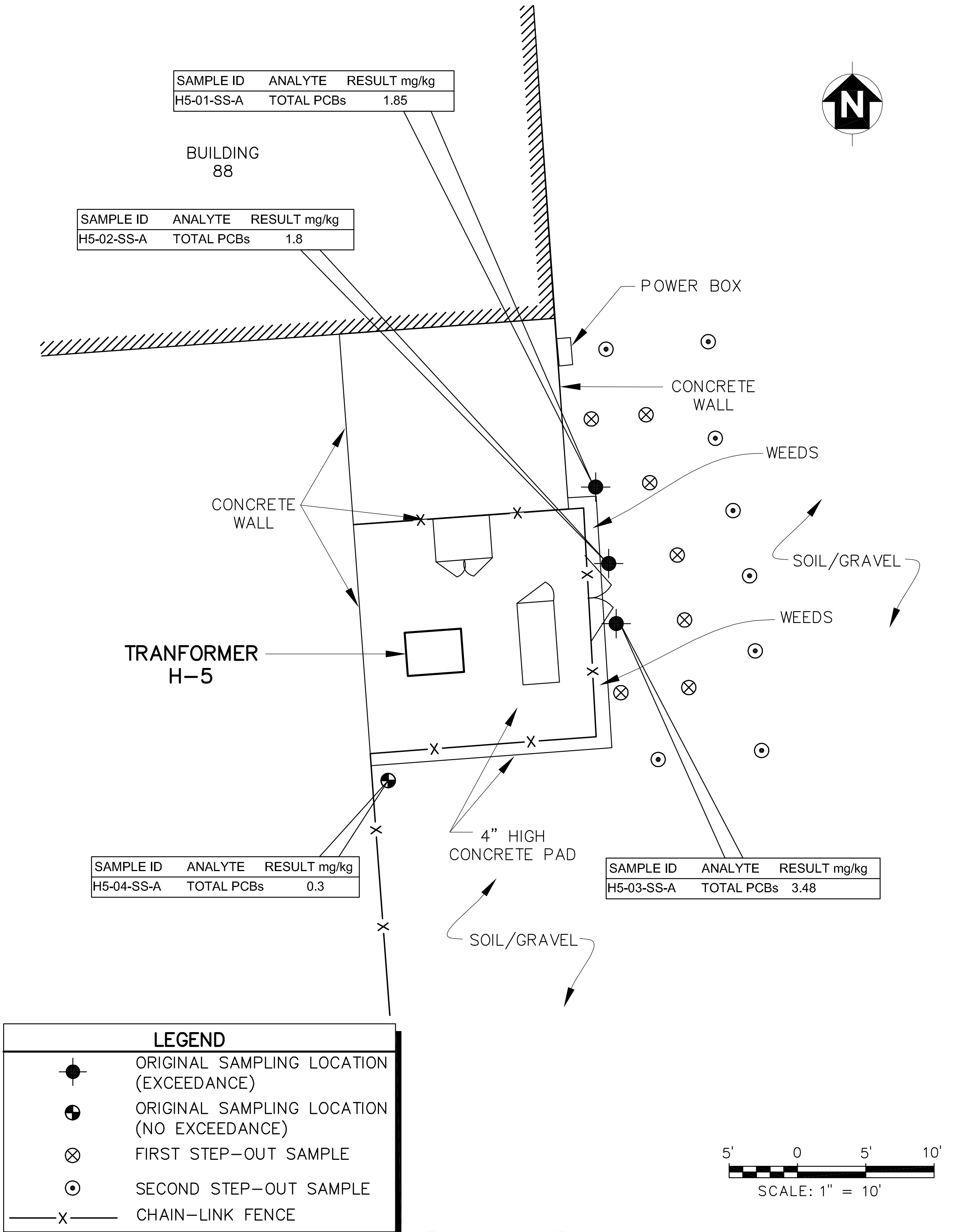

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-5
Transformer H-5
Halawa Main Gate GSA
Oahu, Hawaii

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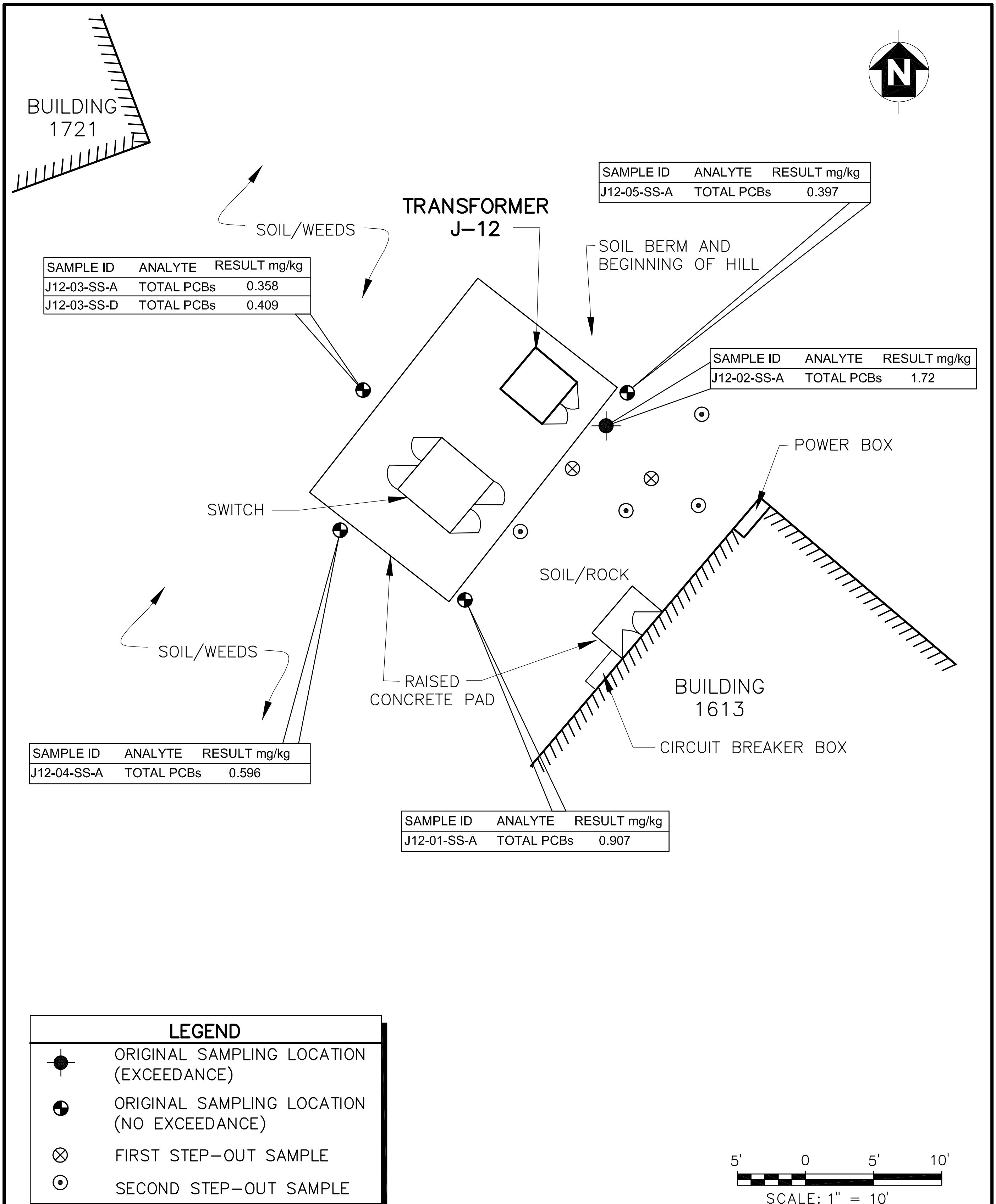
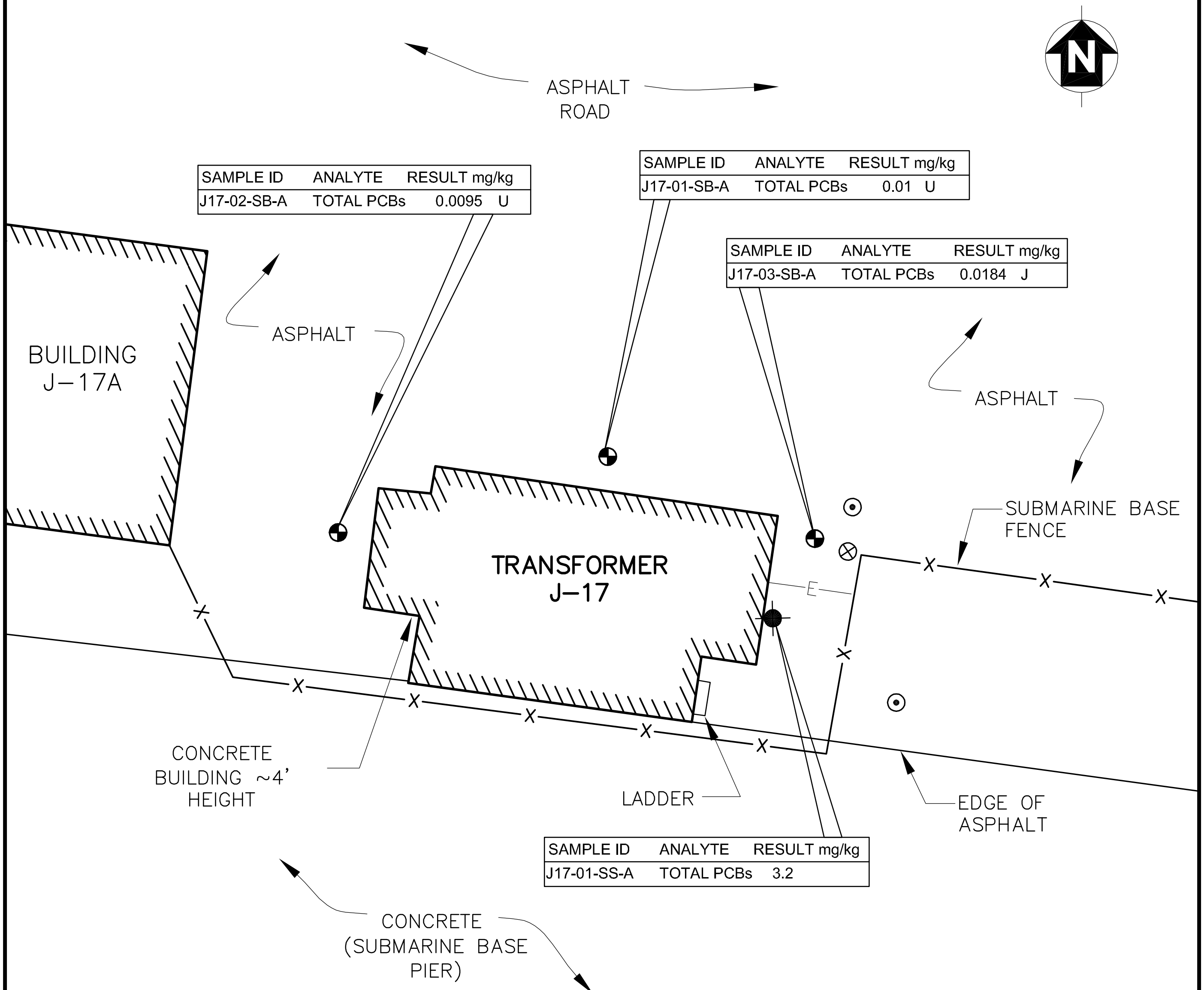


NOTES:
mg/kg milligrams per kilogram
PCB Polychlorinated Biphenyl

Figure A-6
Transformer J-12
Halawa Main Gate GSA
Oahu, Hawaii



LEGEND

⌖ (filled)	ORIGINAL SAMPLING LOCATION (EXCEEDANCE)
◐	ORIGINAL SAMPLING LOCATION (NO EXCEEDANCE)
⊗	FIRST STEP-OUT SAMPLE
⊙	SECOND STEP-OUT SAMPLE
—E—	ELECTRICAL UTILITY

5' 0 5' 10'
SCALE: 1" = 10'

NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl
J	estimated
U	Nondetected

Figure A-7
Transformer J-17
Halawa Main Gate GSA
Oahu, Hawaii

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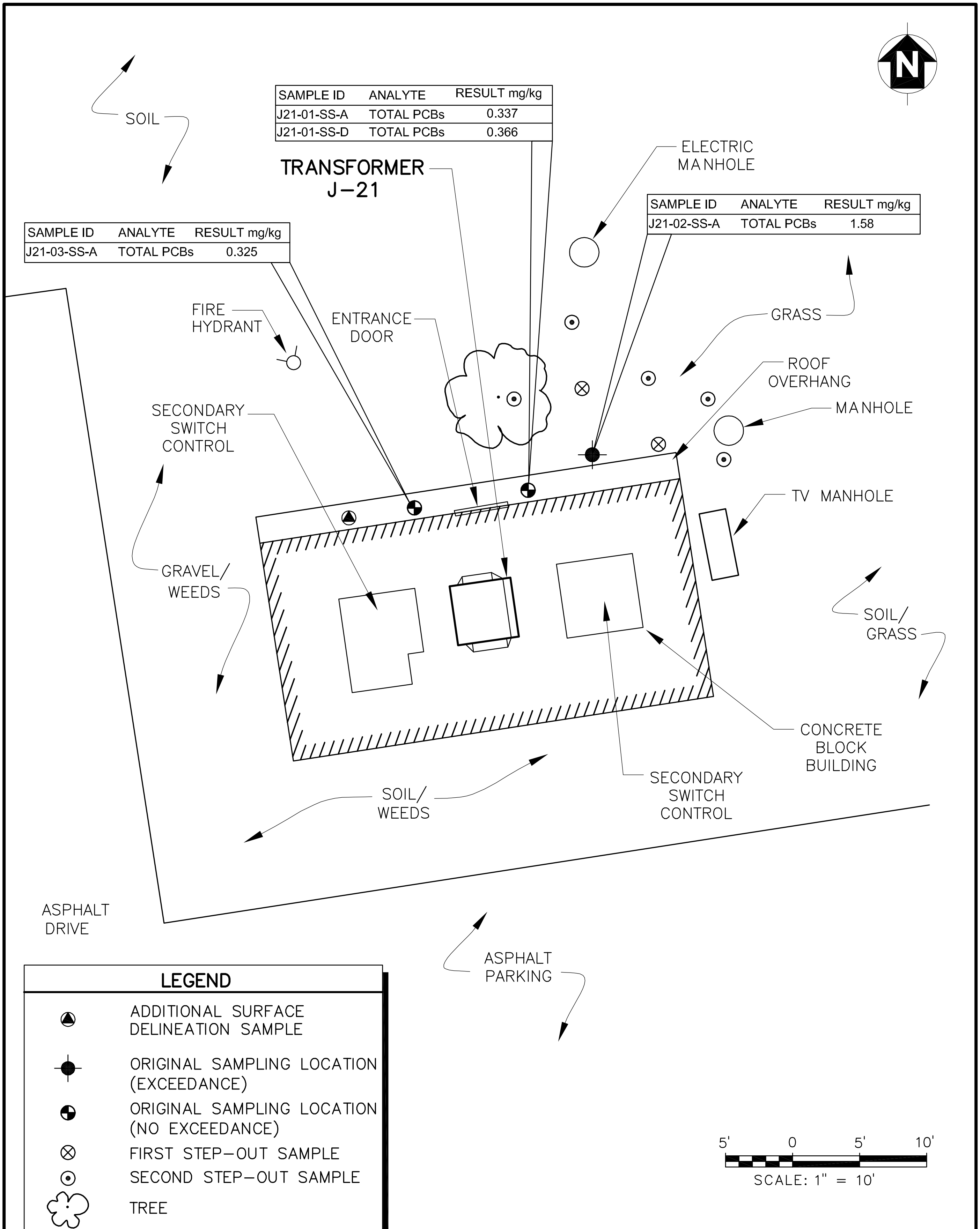

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-8
Transformer J-21
Halawa Main Gate GSA
Oahu, Hawaii

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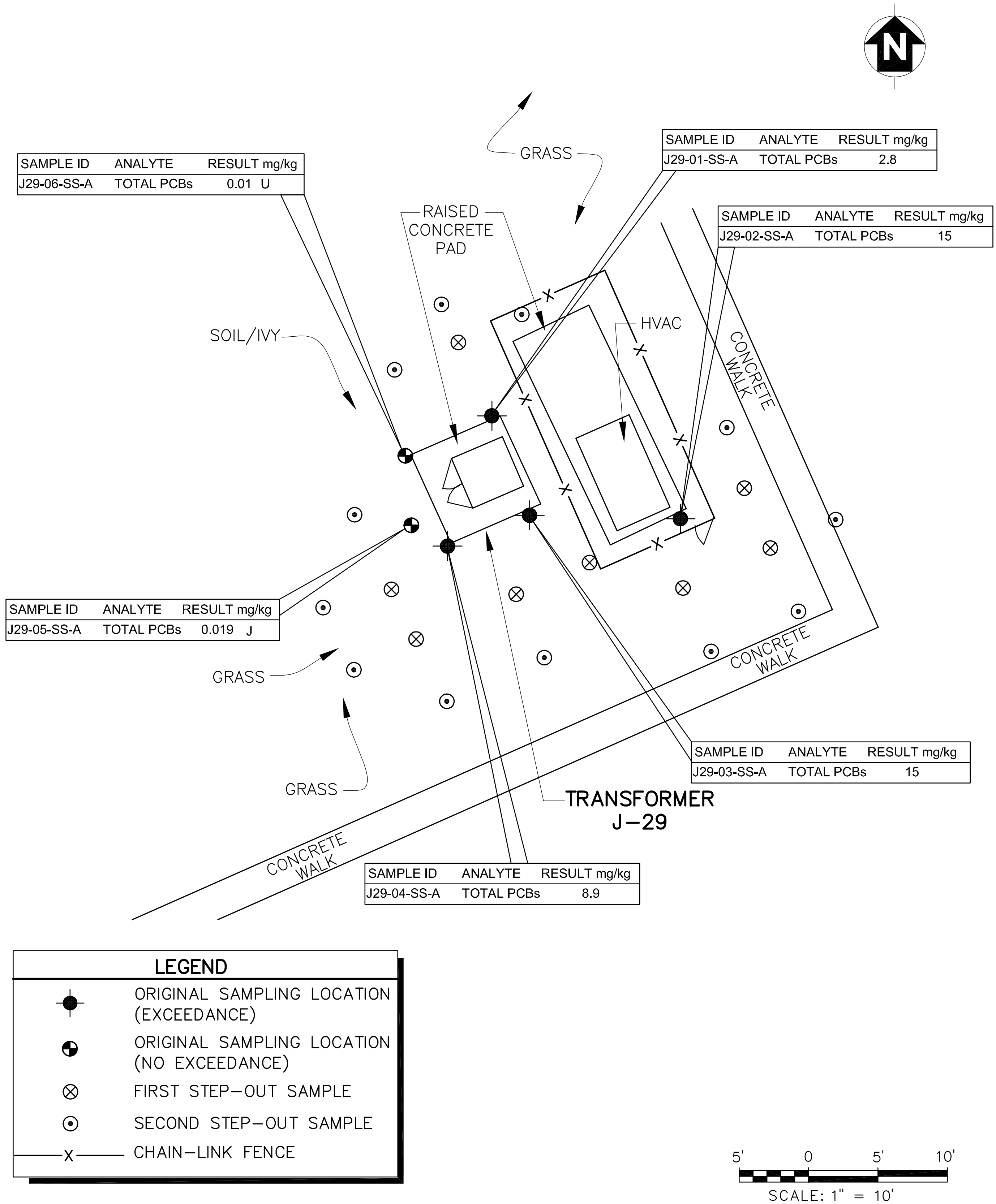
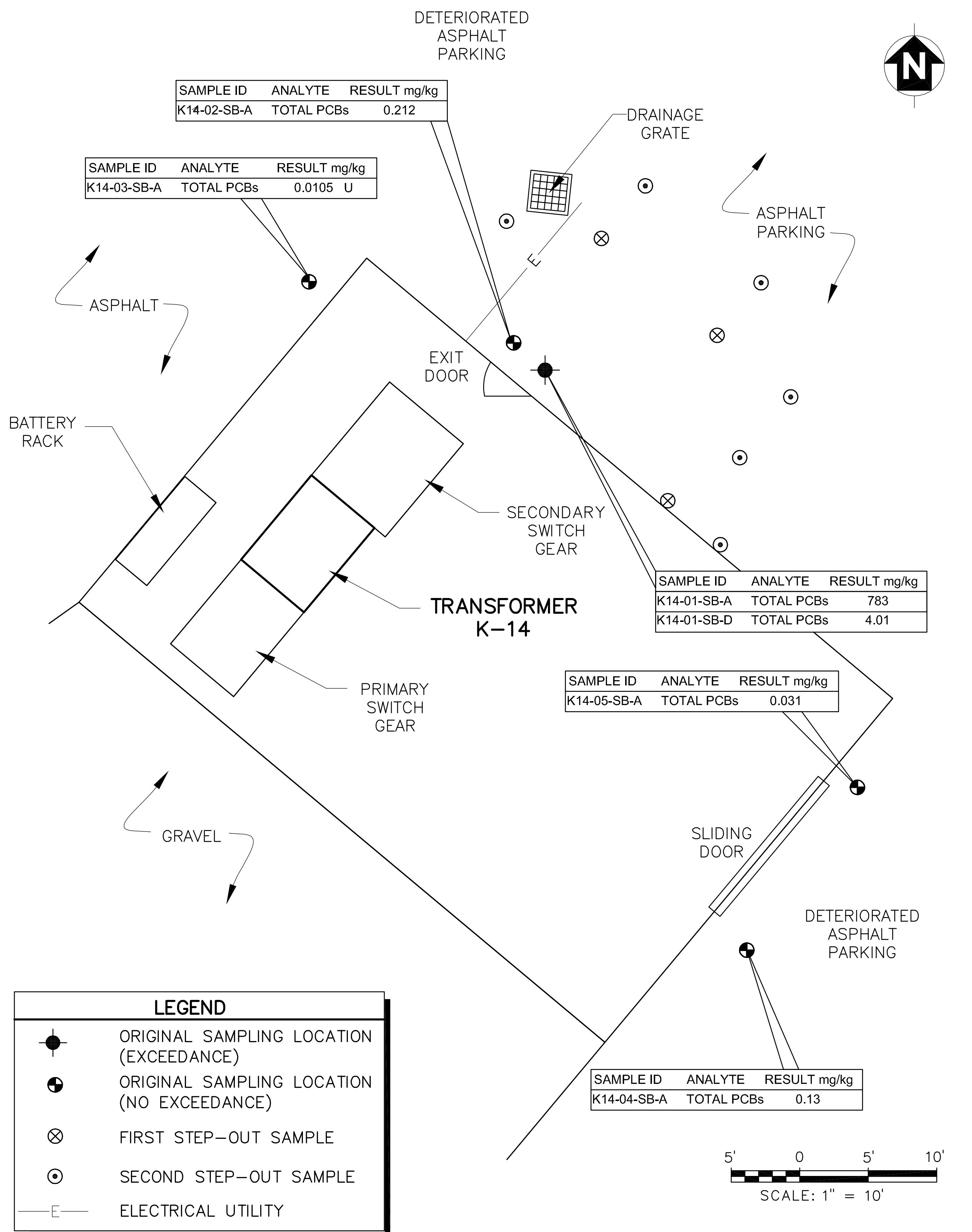


NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl
J	estimated
U	Nondetected

Figure A-9
Transformer J-29
Halawa Main Gate GSA
Oahu, Hawaii



SAMPLE ID	ANALYTE	RESULT mg/kg
K14-02-SB-A	TOTAL PCBs	0.212

SAMPLE ID	ANALYTE	RESULT mg/kg
K14-03-SB-A	TOTAL PCBs	0.0105 U

SAMPLE ID	ANALYTE	RESULT mg/kg
K14-01-SB-A	TOTAL PCBs	783
K14-01-SB-D	TOTAL PCBs	4.01

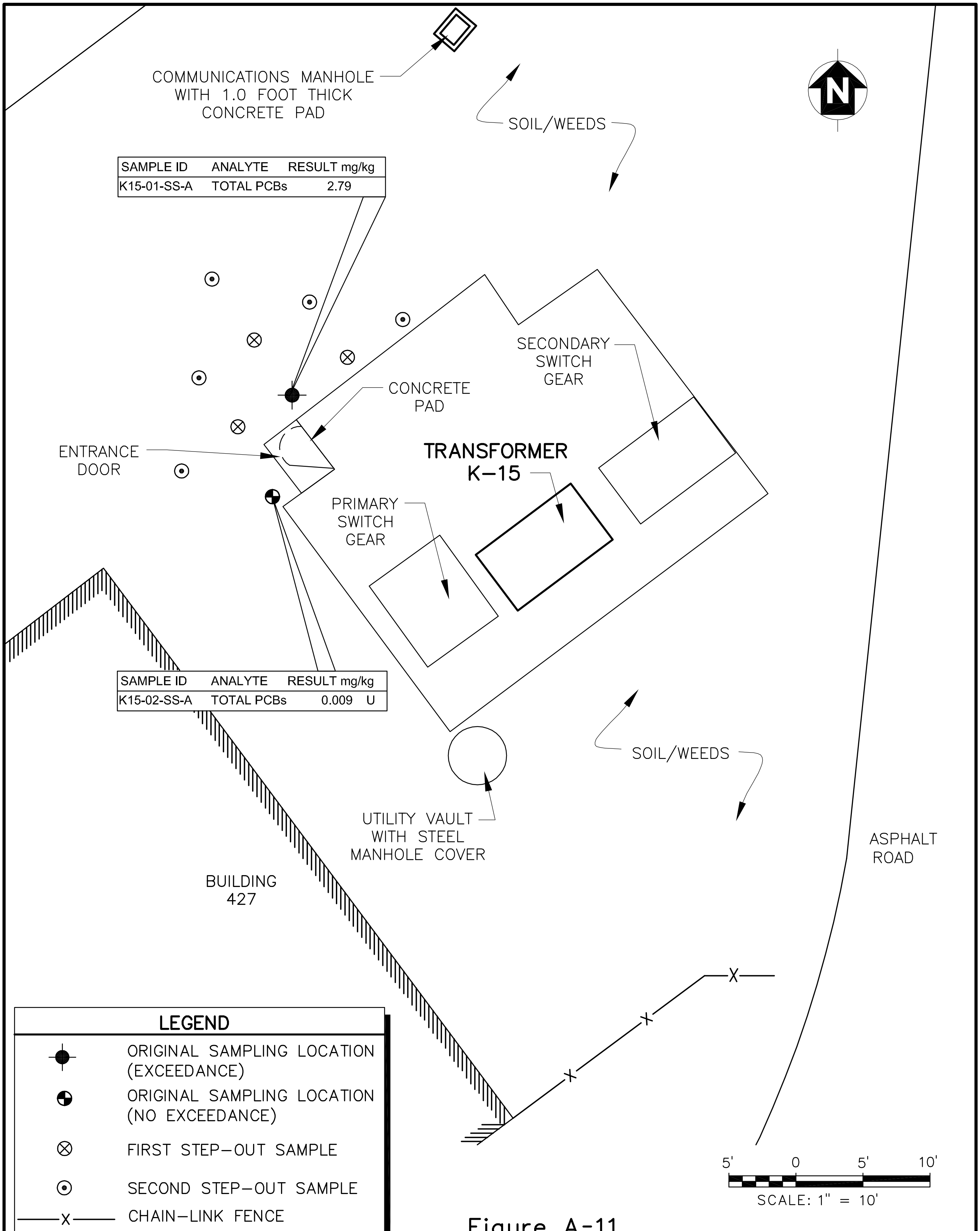
SAMPLE ID	ANALYTE	RESULT mg/kg
K14-05-SB-A	TOTAL PCBs	0.031

SAMPLE ID	ANALYTE	RESULT mg/kg
K14-04-SB-A	TOTAL PCBs	0.13

NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl
U	Nondetected

Figure A-10
Transformer K-14
Halawa Main Gate GSA
Oahu, Hawaii



NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl
U	Nondetected

Figure A-11
Transformer K-15
Halawa Main Gate GSA
Oahu, Hawaii

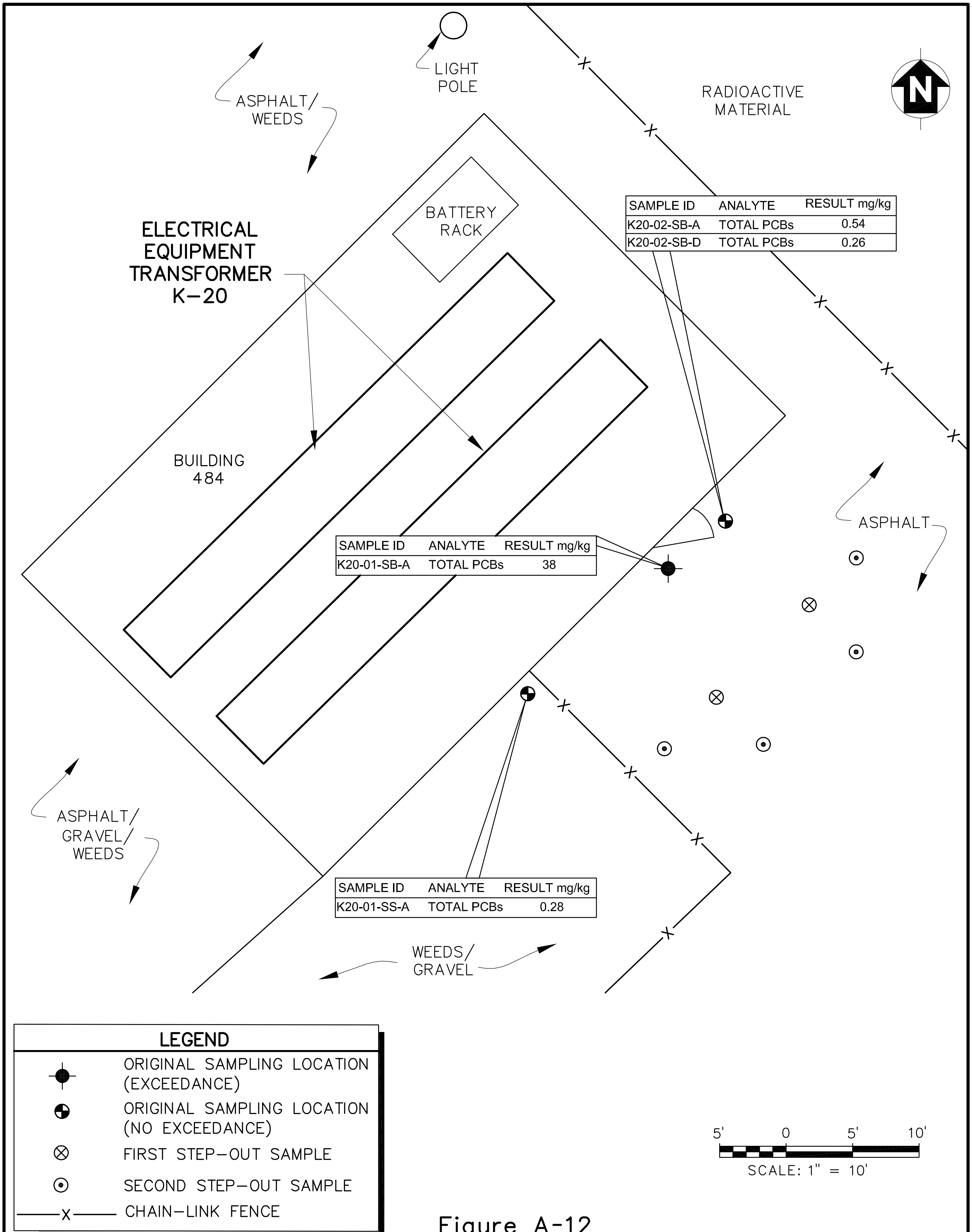


Figure A-12
Transformer K-20
Halawa Main Gate GSA
Oahu, Hawaii

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

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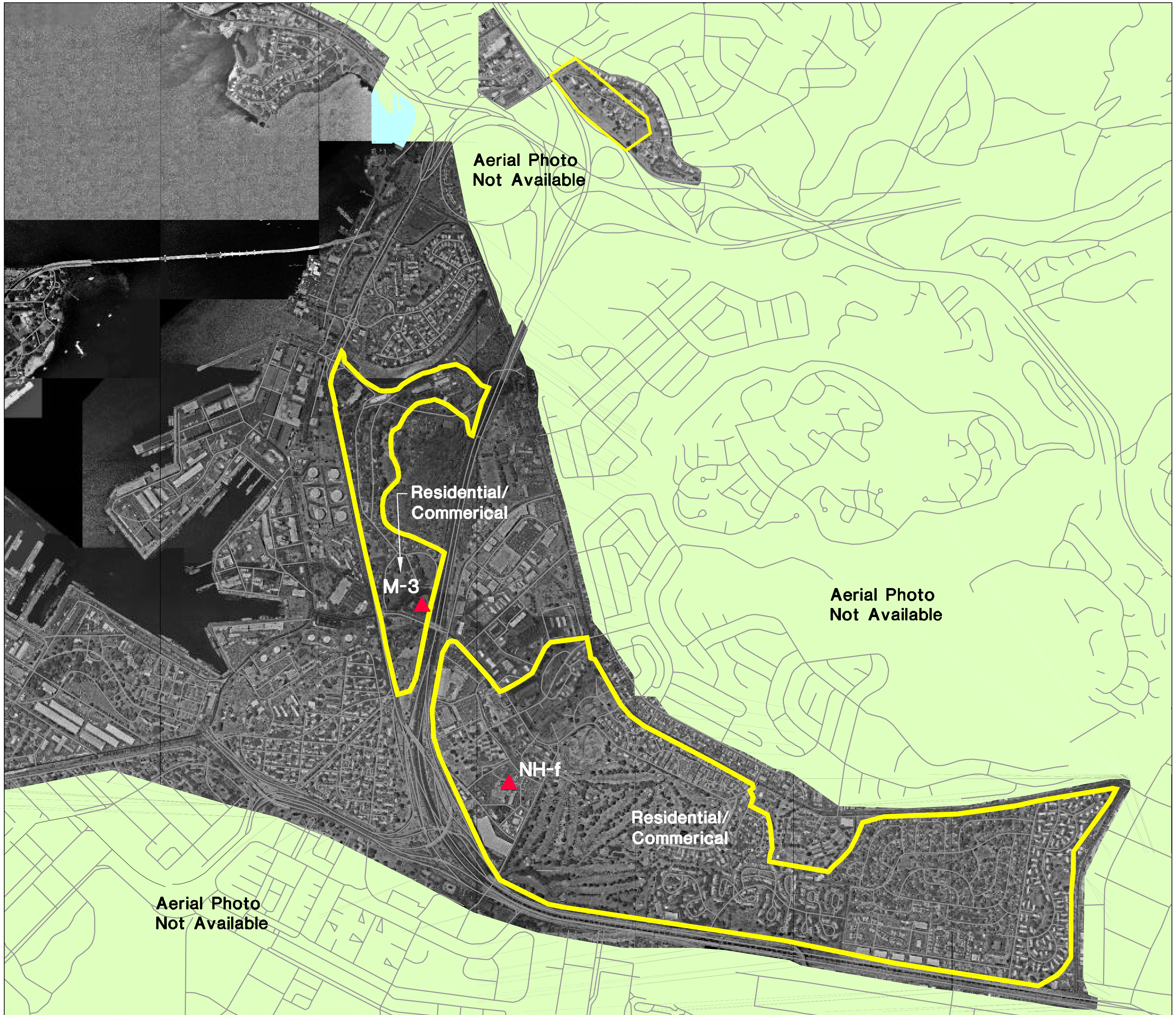


Legend

- Transformer Site Recommended for Further Action
- Naval Housing GSA Boundary
- Surrounding Area
- Ocean
- Roads

Notes

1. The accuracy of this document is limited to the quality of the source information and is not suitable for mapping engineering applications and is not to used for "as built."
2. Residential/Commercial, Non-Restricted Access Areas: Residential and Commercial Areas such as indoor locations and unrestricted rural areas (40 CFR 761.125, Definitions).

Source

- Base mapping from State of Hawaii statewide GIS data and other mapping developed by and for the U.S. Navy.

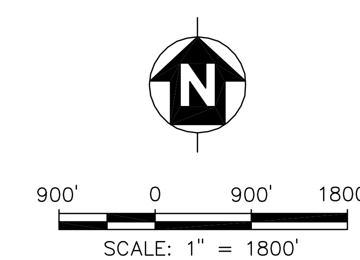
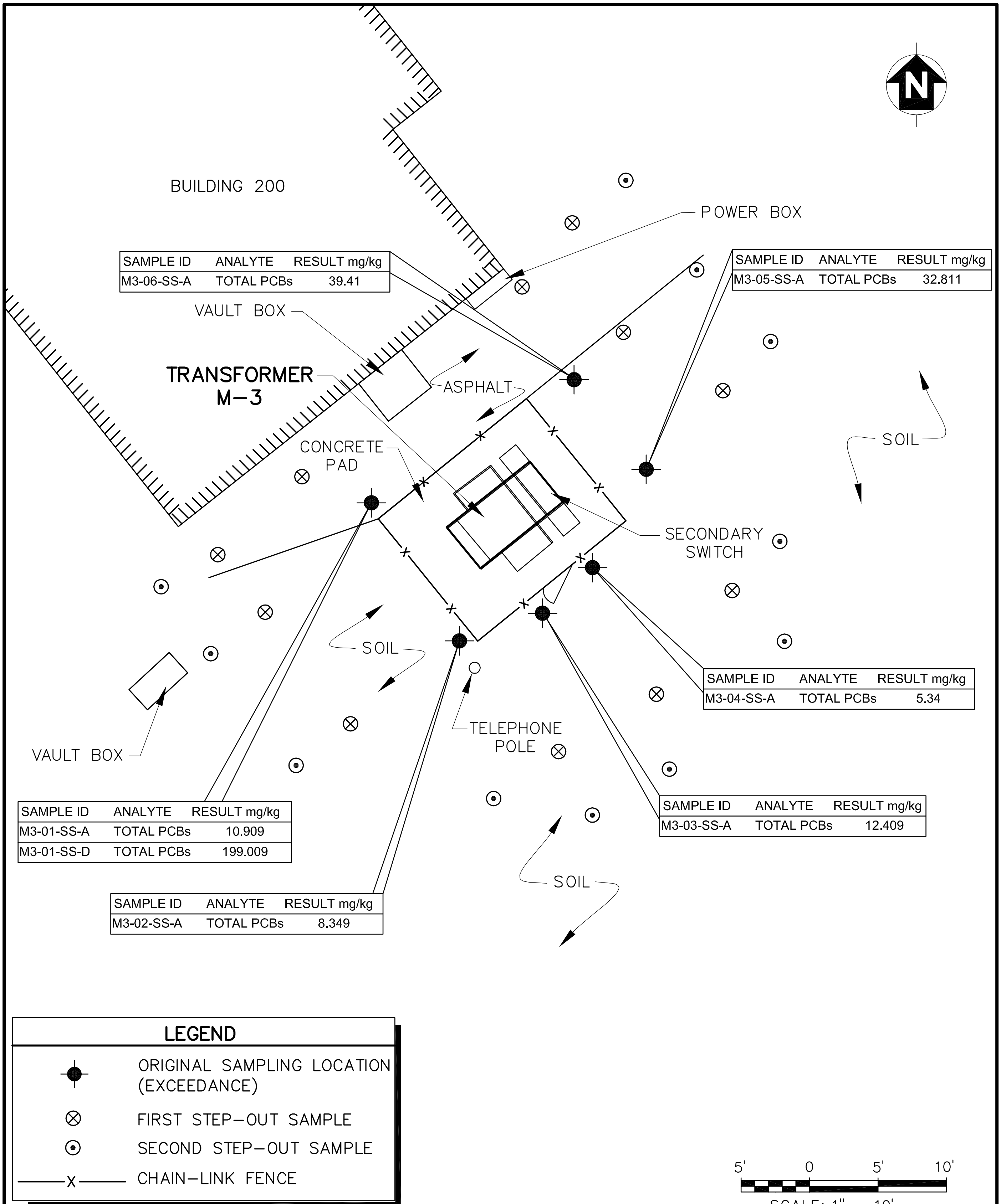


Figure A-13
Transformer Sites Recommended for Further Action
Naval Housing GSA
Oahu, Hawaii



NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl

Figure A-14
Transformer M-3
Makalapa Housing Area
Naval Housing GSA
Oahu, Hawaii

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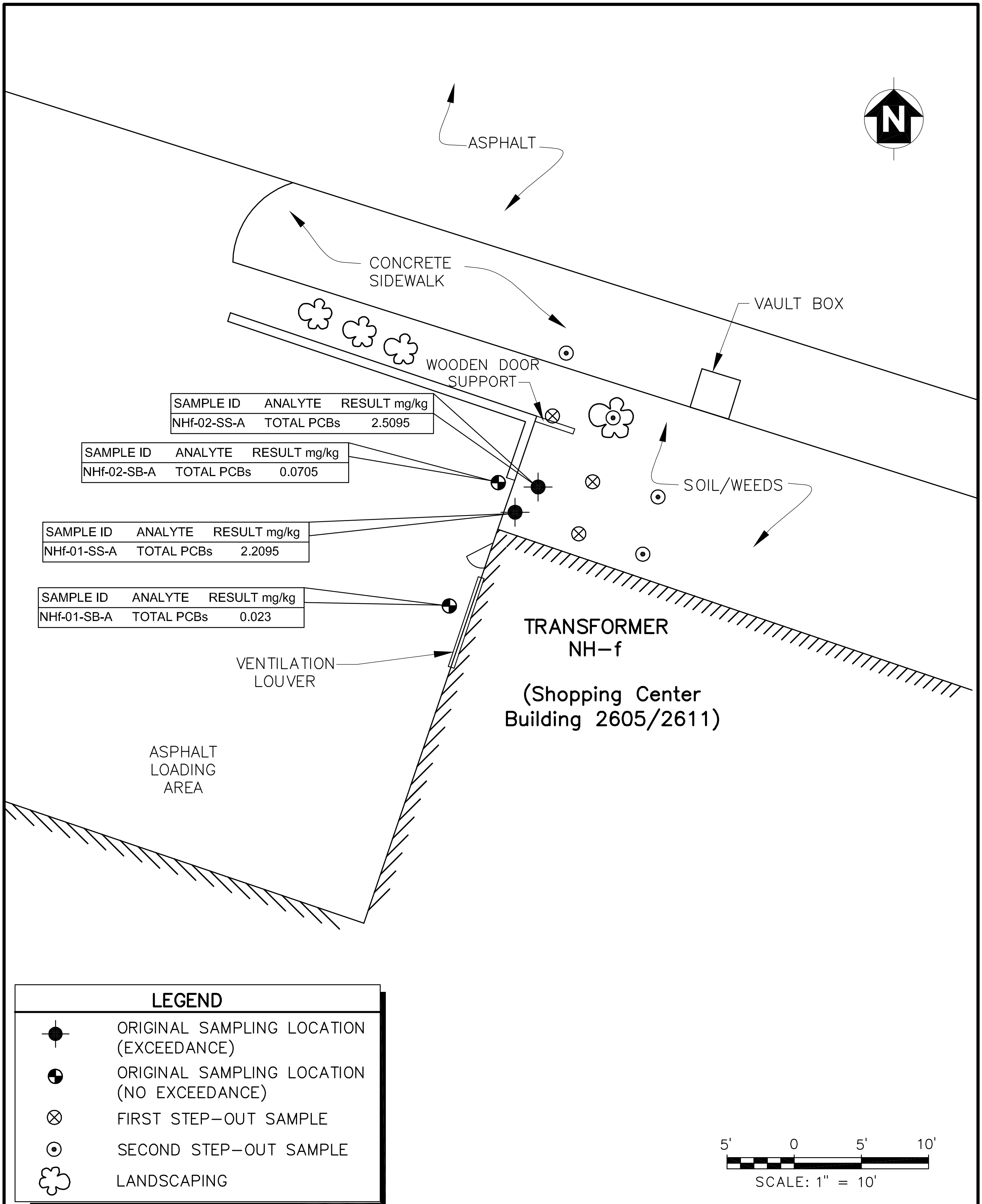

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-15
Transformer NH-f
Naval Housing GSA
Oahu, Hawaii

Legend

- Transformer Site Recommended for Further Action
- PWC Main Complex GSA Boundary
- Surrounding Area
- Roads

Notes

1. The accuracy of this document is limited to the quality of the source information and is not suitable for mapping engineering applications and is not to used for "as built."
2. Residential/Commercial, Non-Restricted Access Areas: Residential and Commercial Areas such as indoor locations and unrestricted rural areas (40 CFR 761.125, Definitions).

Source

- Base mapping from State of Hawaii statewide GIS data and other mapping developed by and for the U.S. Navy.

N

150' 0 150' 300'

SCALE: 1" = 300'

Figure A-16
Transformer Sites Recommended for Further Action
PWC Main Complex GSA
Oahu, Hawaii

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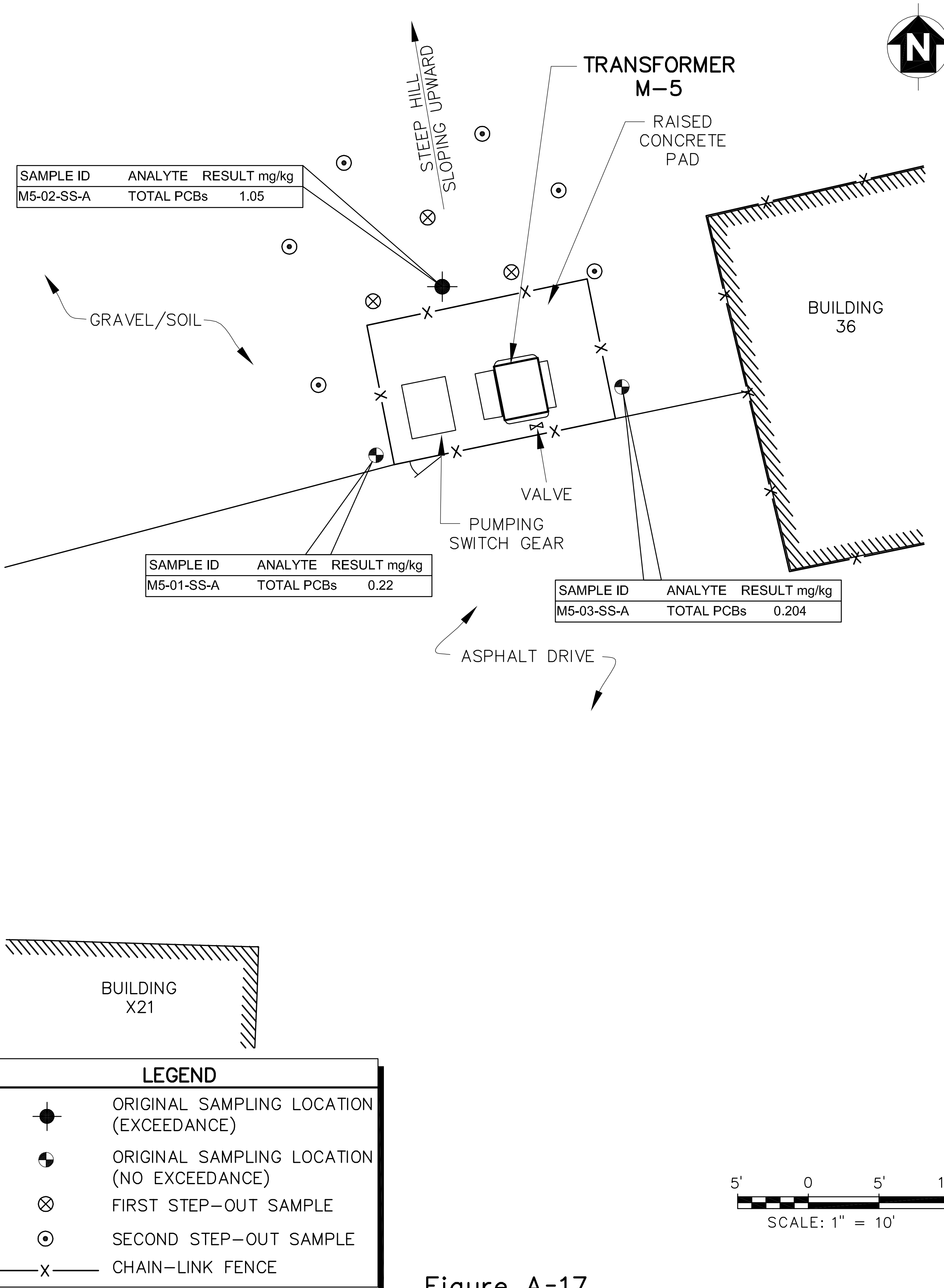

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-17
Transformer M-5
PWC Main Complex GSA
Oahu, Hawaii

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Legend

- Transformer Site Recommended for Further Action
- Shipyard GSA Boundary
- Surrounding Area
- Ocean
- Boundary Between Industrial and Commercial/Residential Areas
- Fence
- Roads

Notes

1. The accuracy of this document is limited to the quality of the source information and is not suitable for mapping engineering applications and is not to used for "as built."
2. Industrial, Restricted Access Areas: Areas other than electrical substations that are at least 0.1 kilometer (km) from a Residential/Commercial area and where accessibility is limited by man-made or natural barriers (40 CFR 761.125, Definitions.)
3. Residential/Commercial, Non-Restricted Access Areas: Residential and Commercial Areas such as indoor locations and unrestricted rural areas (40 CFR 761.125, Definitions).
4. Boundary between High Occupancy Residential and Commercial Areas and Low Occupancy Industrial Areas was drawn 0.1 km away from high occupancy areas.

Source

- Base mapping from State of Hawaii statewide GIS data and other mapping developed by and for the U.S. Navy.

N

400' 0 400' 800'

SCALE: 1" = 800'

Figure A-18
Transformer Sites Recommended for Further Action
Shipyard GSA
Oahu, Hawaii

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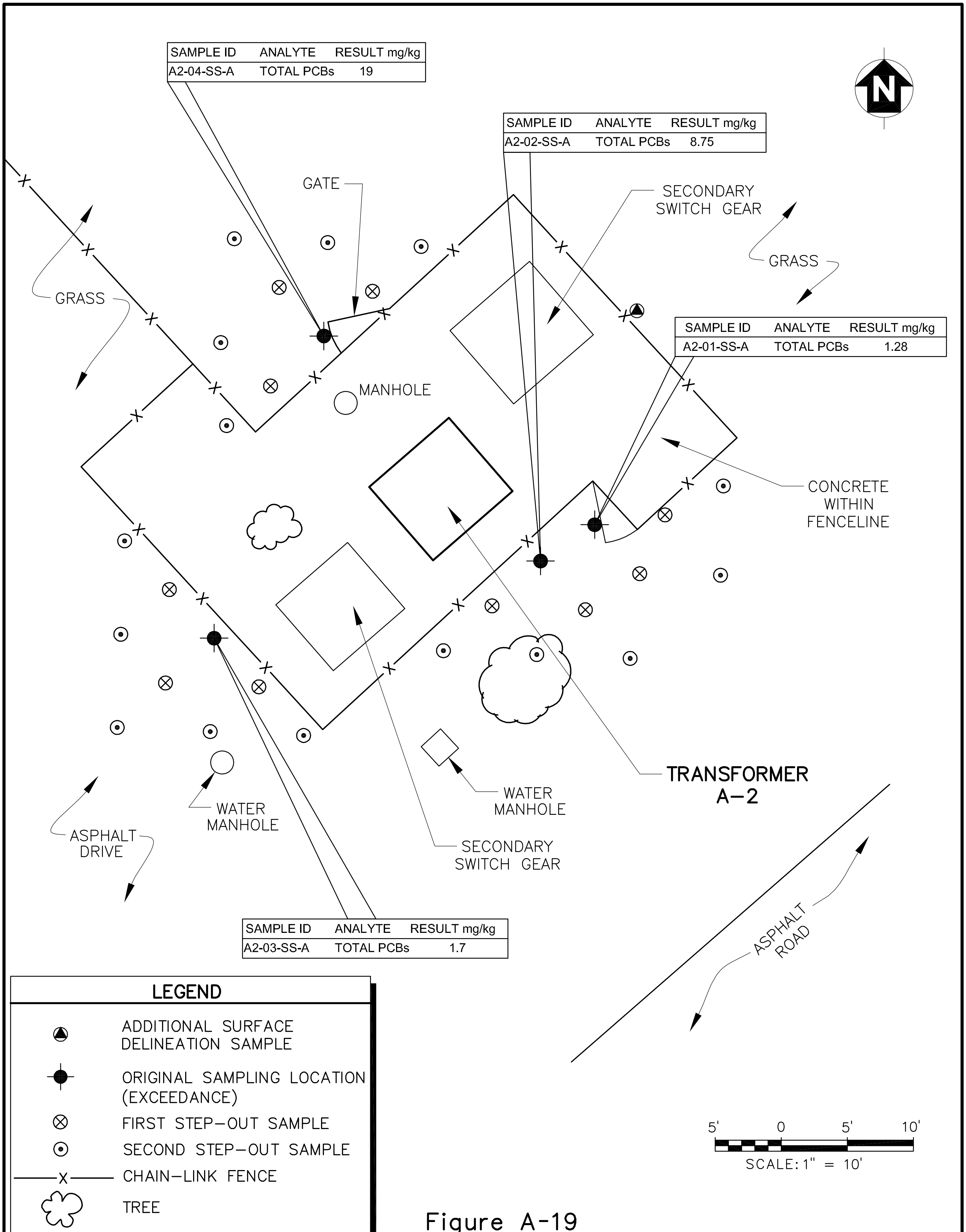

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-19
Transformer A-2
Shipyard GSA
Oahu, Hawaii

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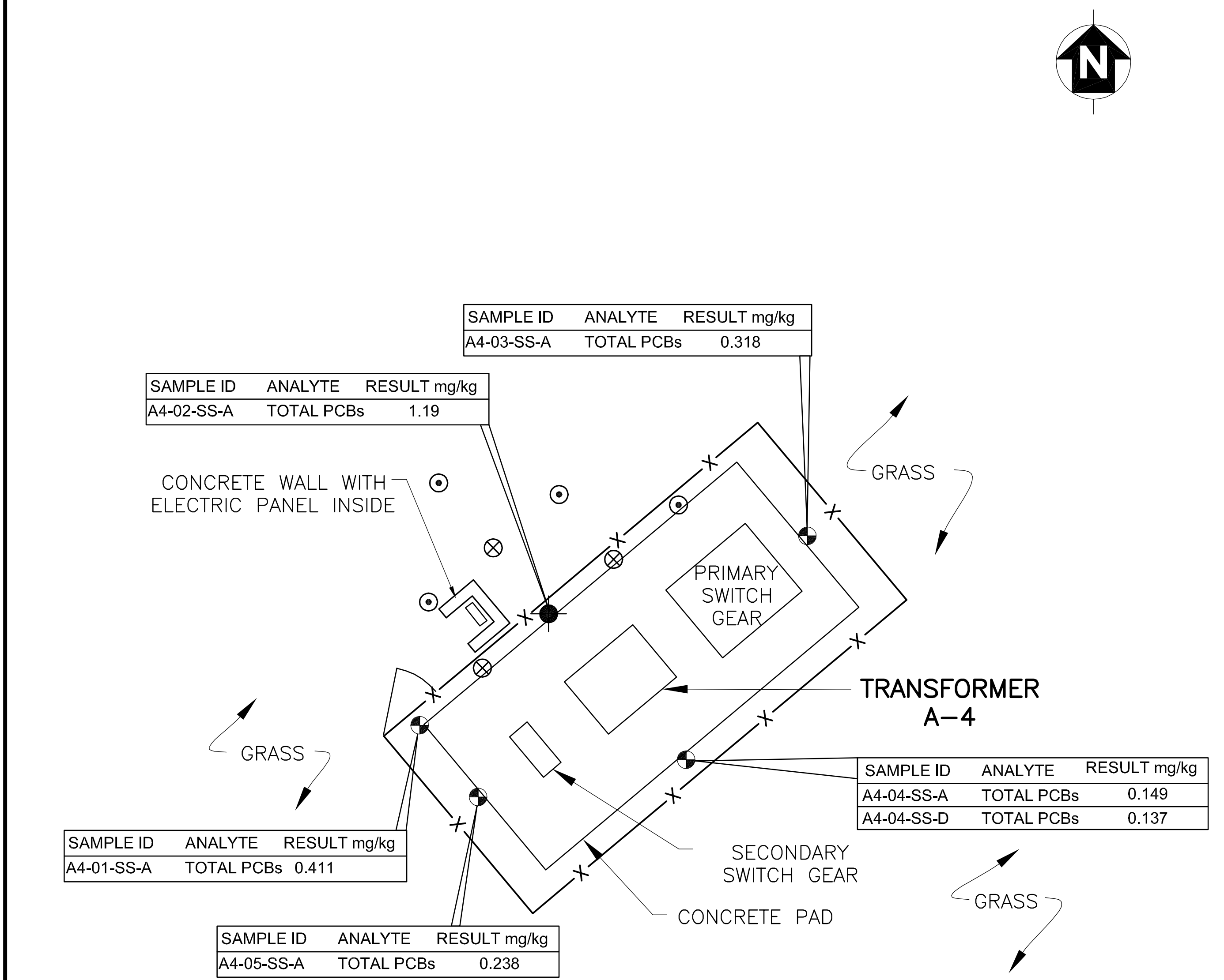

LEGEND

- ORIGINAL SAMPLING LOCATION (EXCEEDANCE)
- ORIGINAL SAMPLING LOCATION (NO EXCEEDANCE)
- FIRST STEP-OUT SAMPLE
- SECOND STEP-OUT SAMPLE
- —X— CHAIN-LINK FENCE

5' 0 5' 10'
SCALE: 1" = 10'

NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl

Figure A-20
Transformer A-4
Shipyard GSA
Oahu, Hawaii

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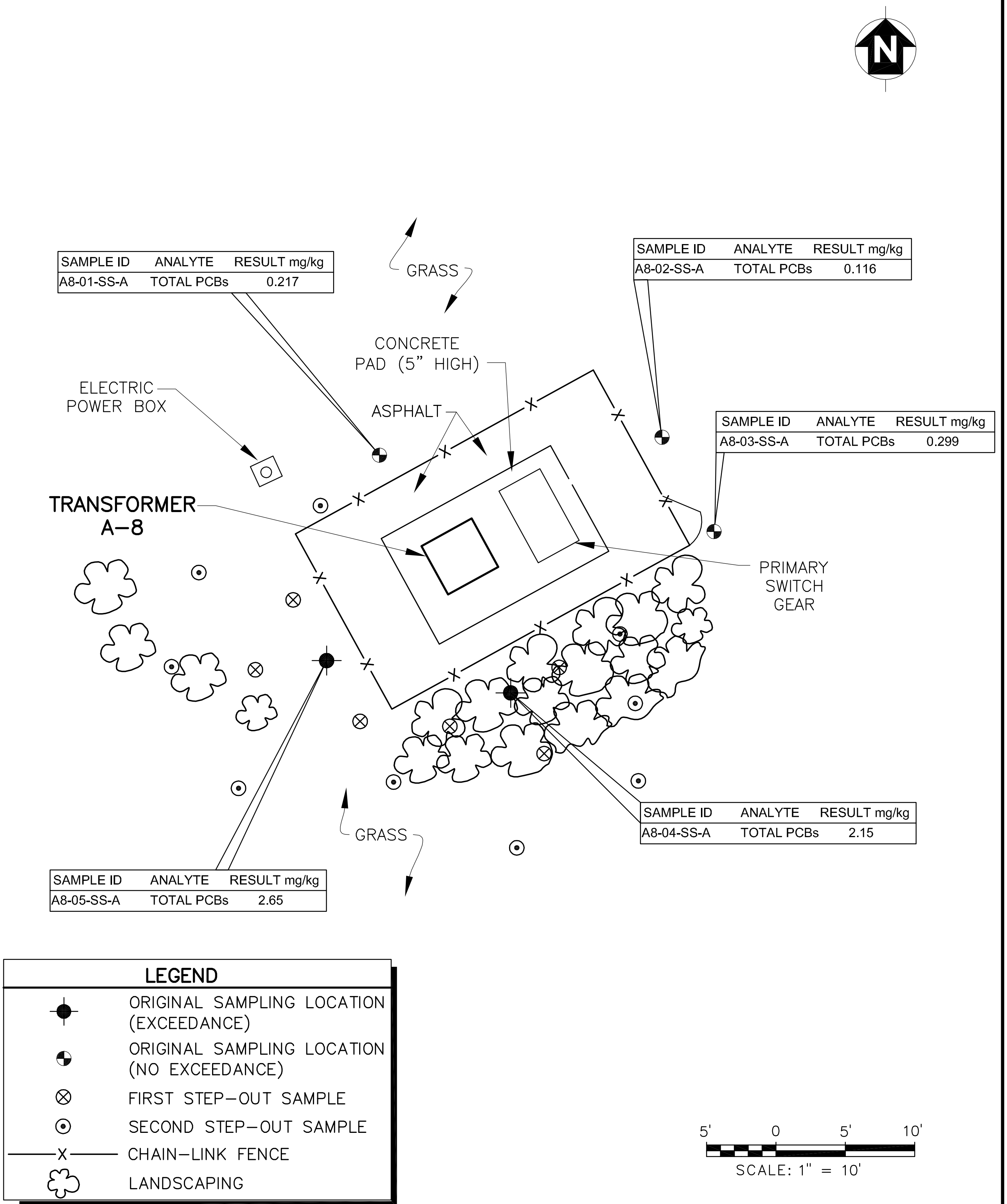


Figure A-21
Transformer A-8
Shipyard GSA
Oahu, Hawaii

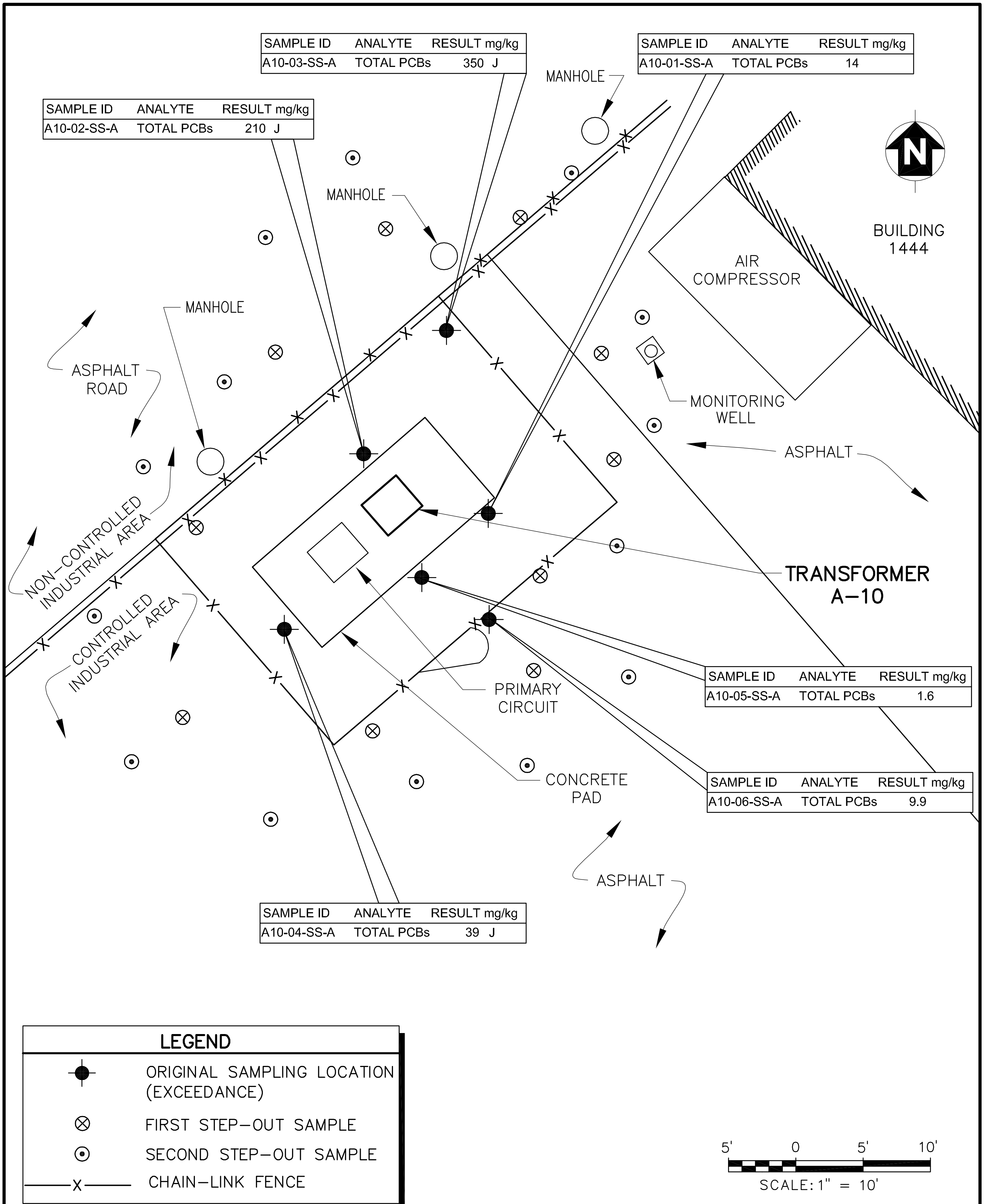
NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Vegetation was cleared – (January 2003)

R:\Navy\PearlHarbor\CTO004\M02\SAP\ A-8.dwg 02/10/2003 Vincent.Cavanaugh DN

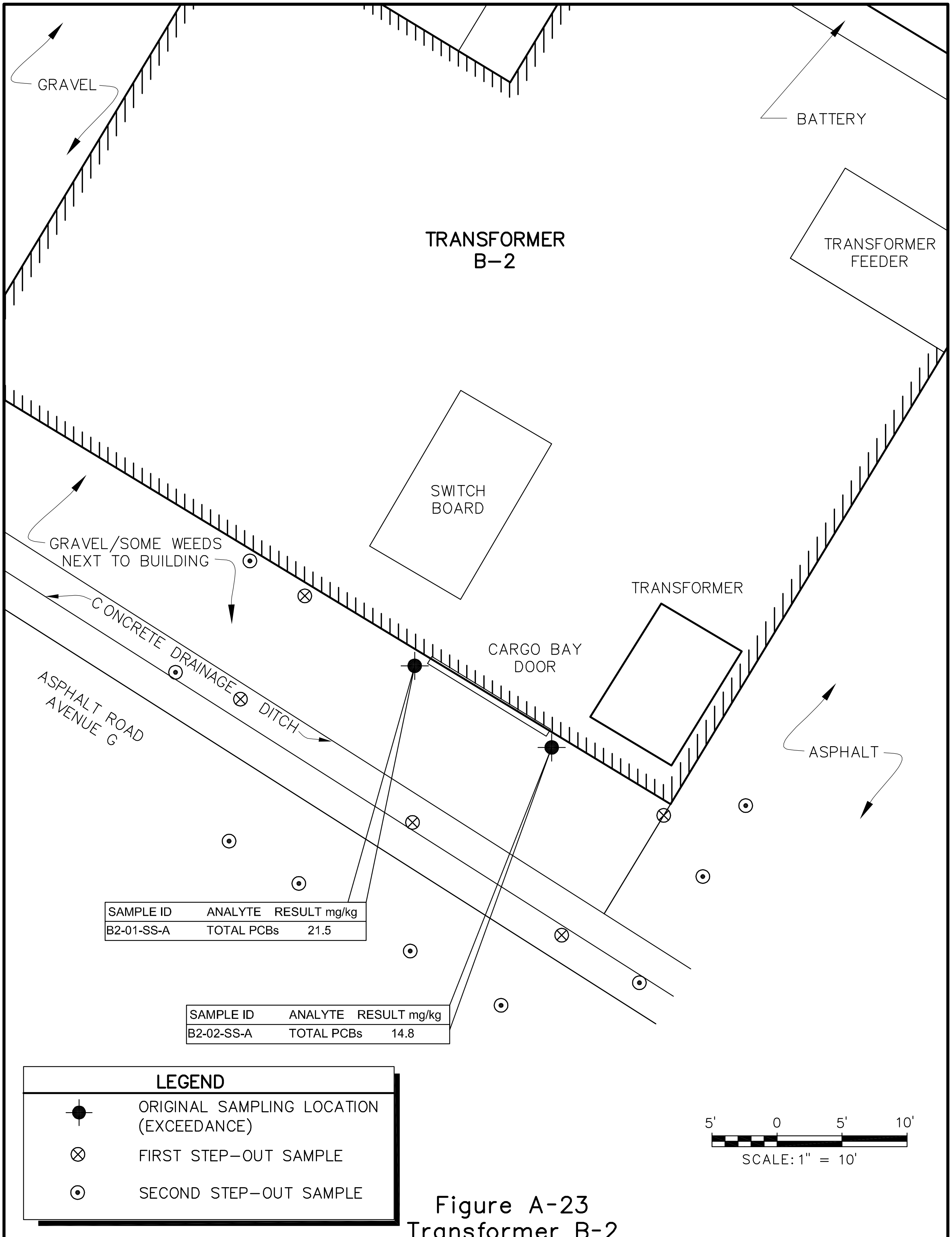


NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl
J	estimated

Figure A-22
Transformer A-10
Shipyard GSA
Oahu, Hawaii

R:\Navy\PearlHarbor\CTO004\M02\SAP\ A-10.dwg 02/06/2003 Vincent.Cavanaugh DN



NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-23
Transformer B-2
Shipyard GSA
Oahu, Hawaii

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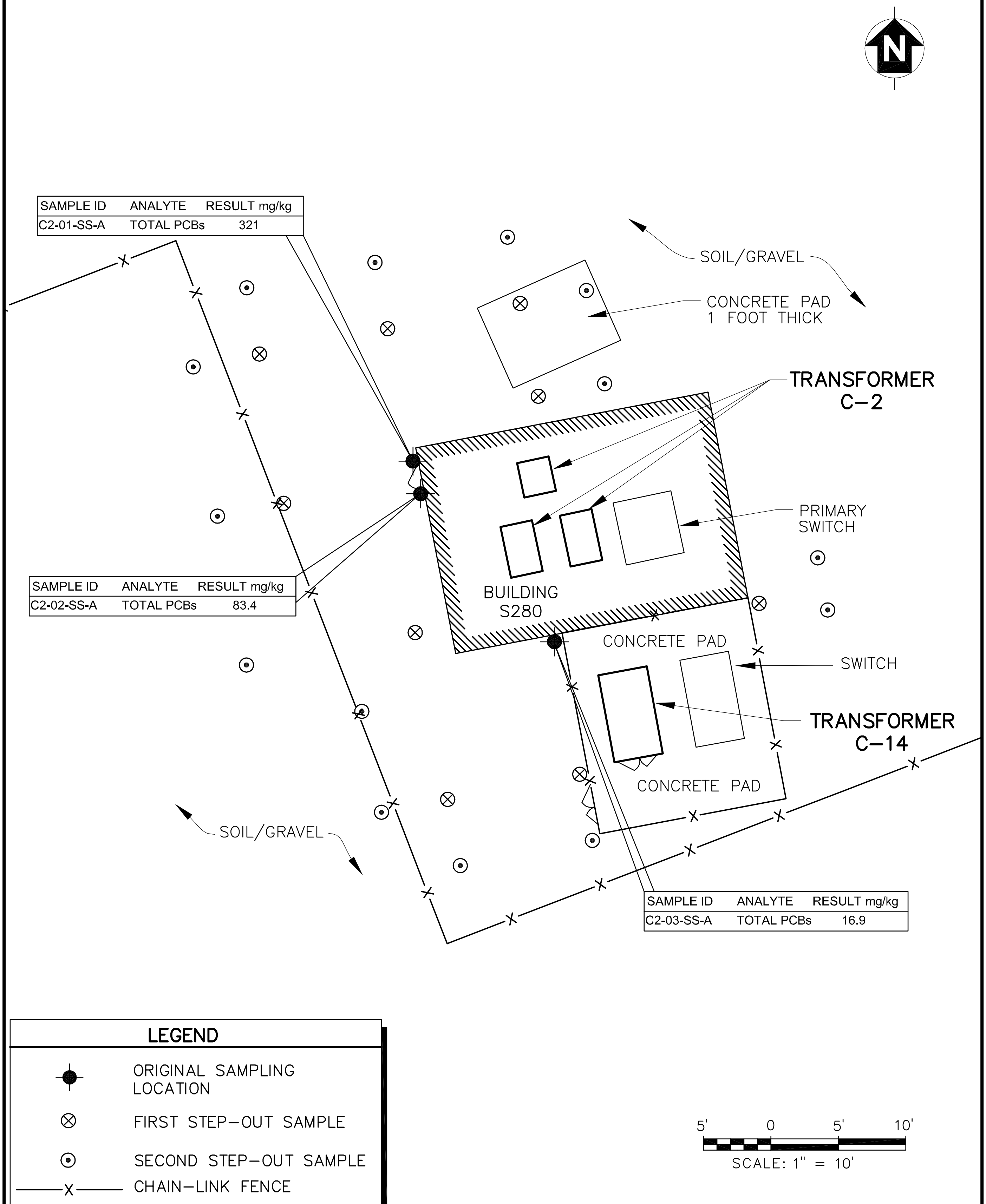

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-24
Transformer C-2
Shipyard GSA
Oahu, Hawaii

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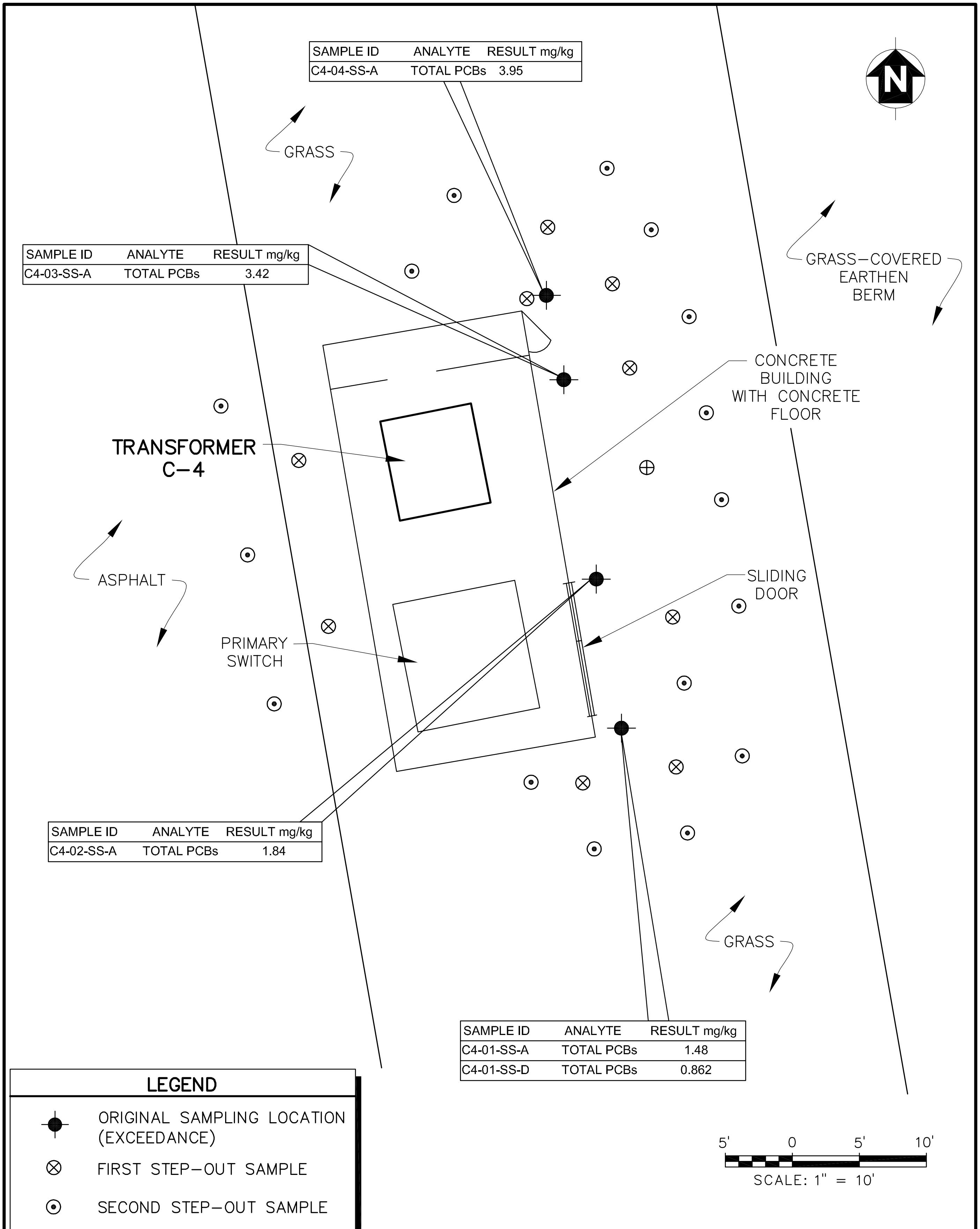

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-25
Transformer C-4
Shipyard GSA
Oahu, Hawaii

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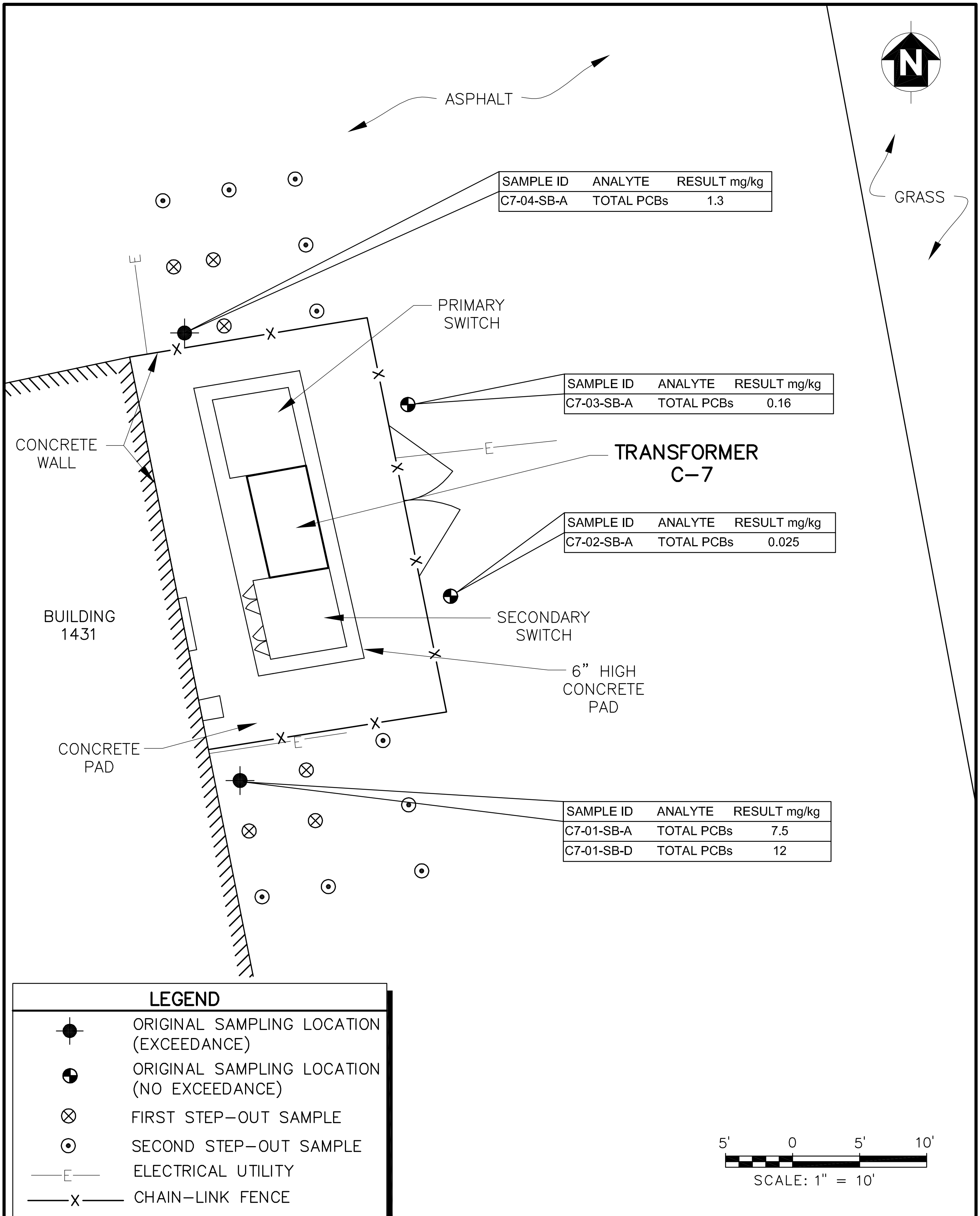

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-26
Transformer C-7
Shipyard GSA
Oahu, Hawaii

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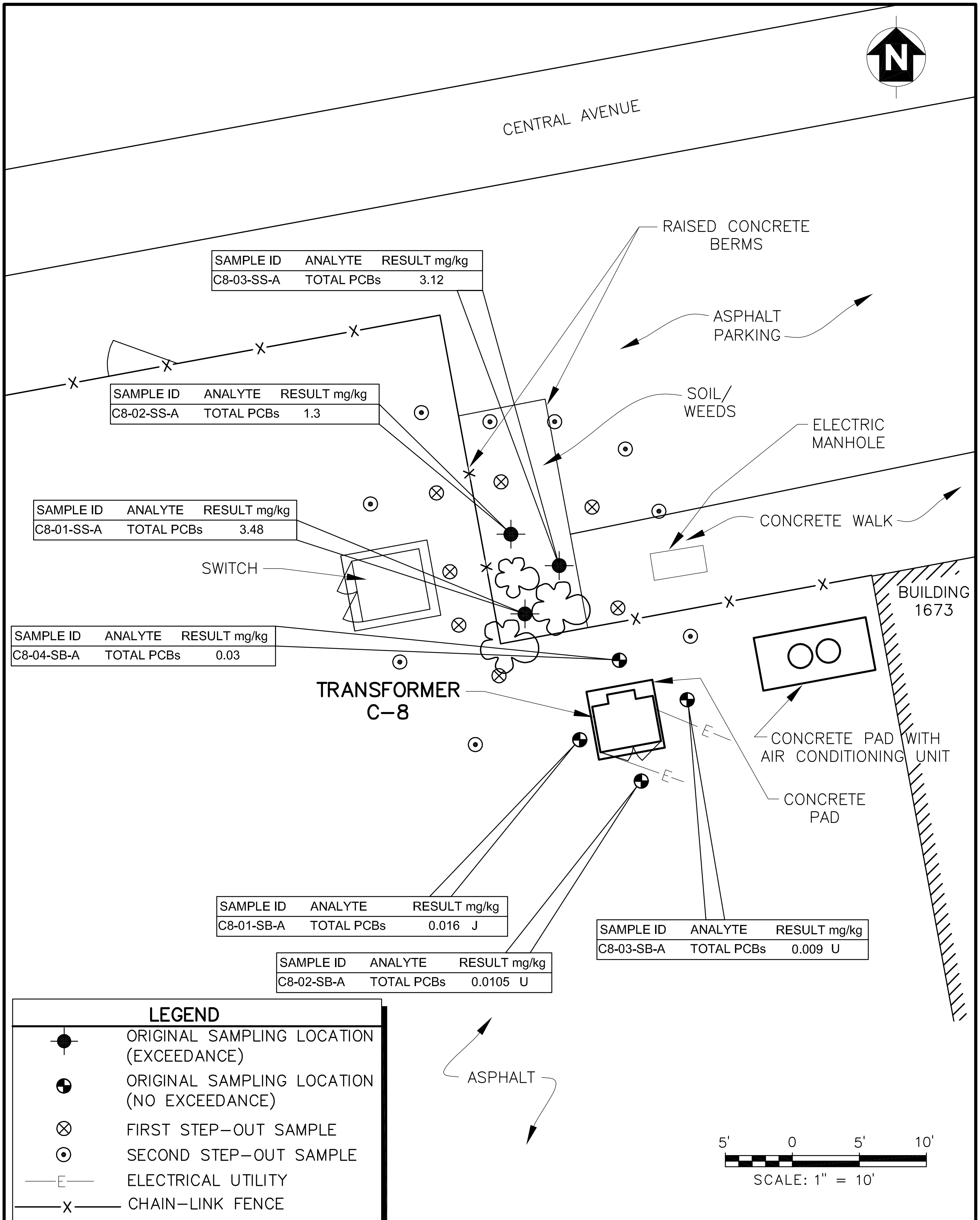

NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl
J	Estimated value
U	Nondetected

Figure A-27
Transformer C-8
Shipyard GSA
Oahu, Hawaii

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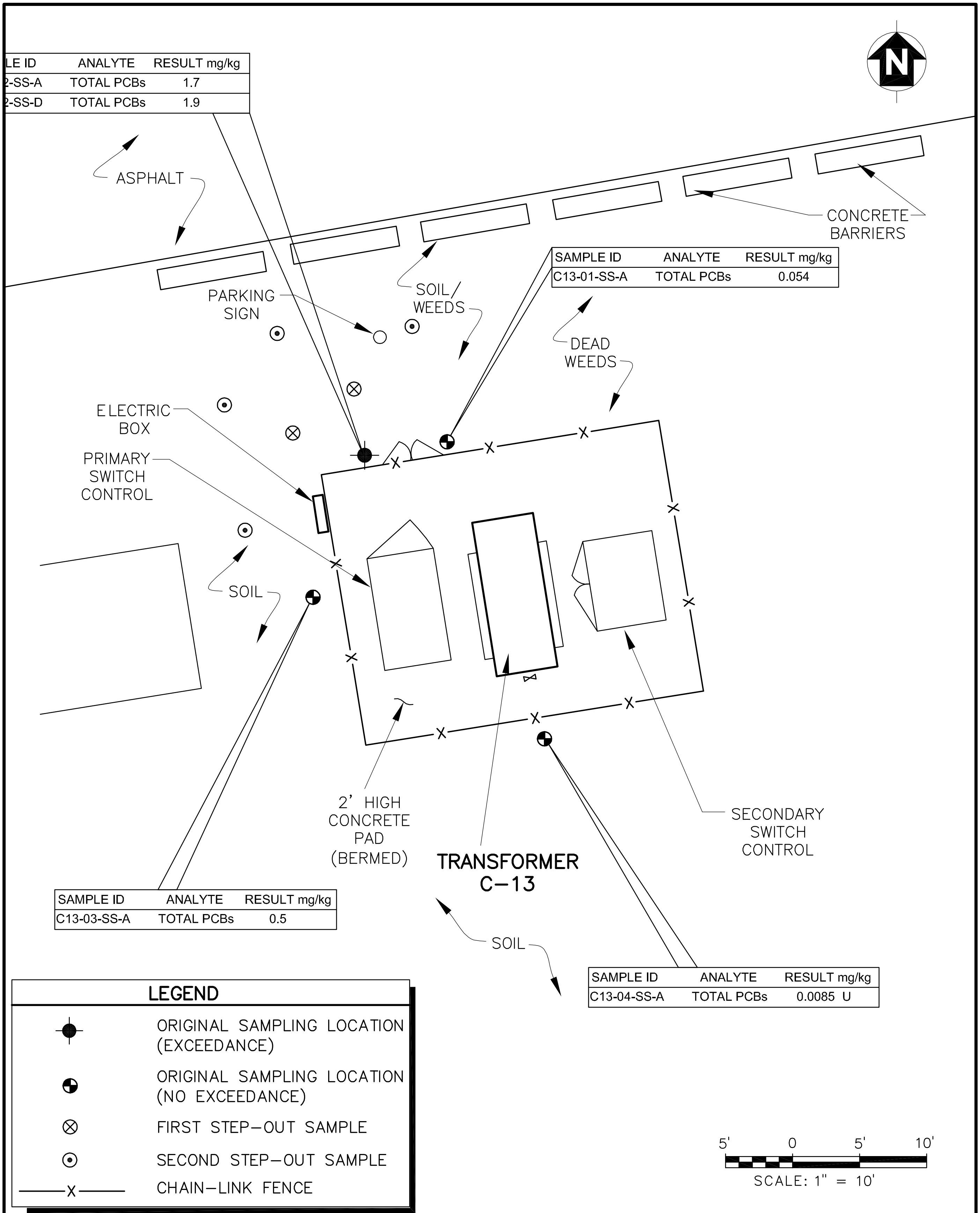
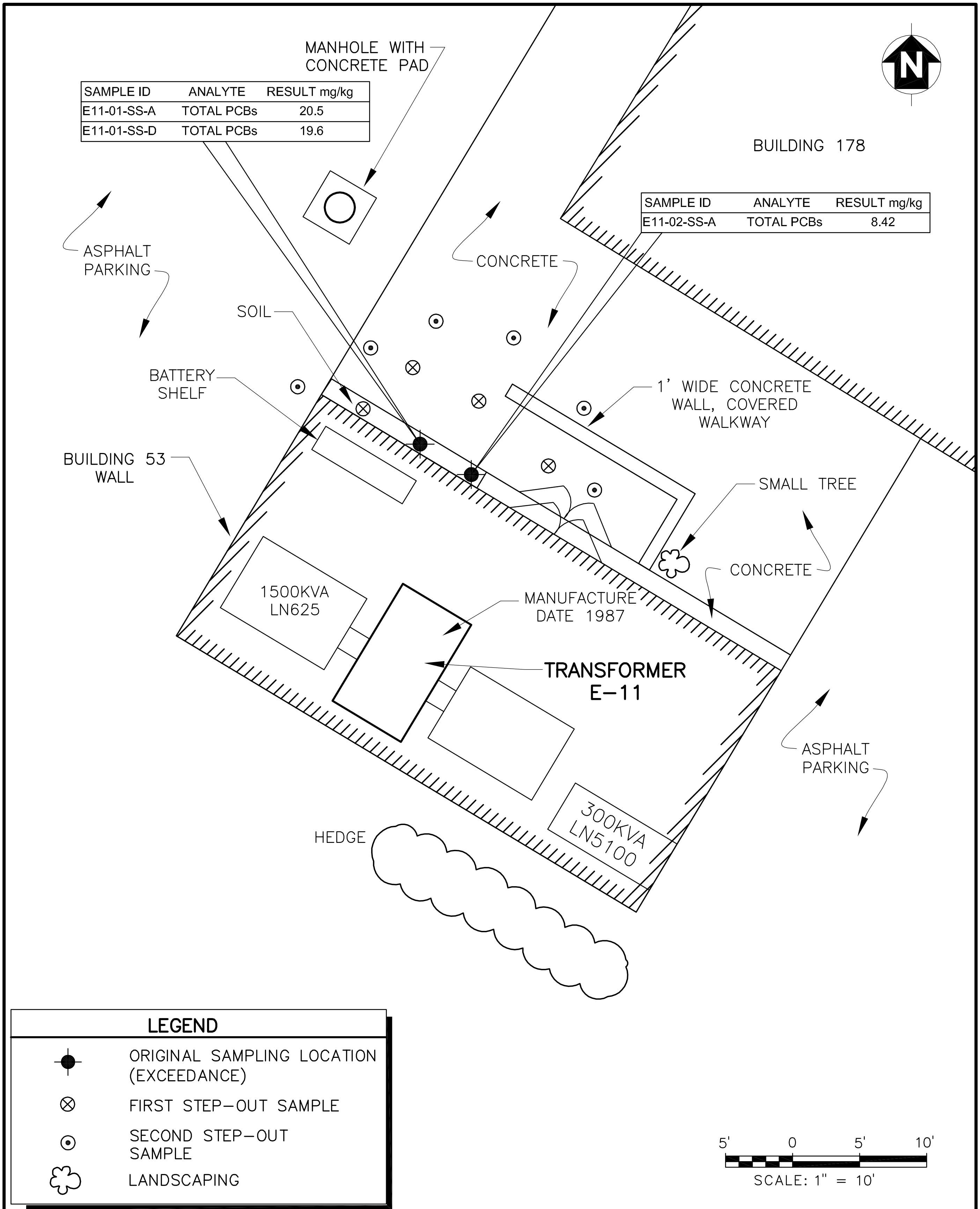


NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl
U	Nondetected

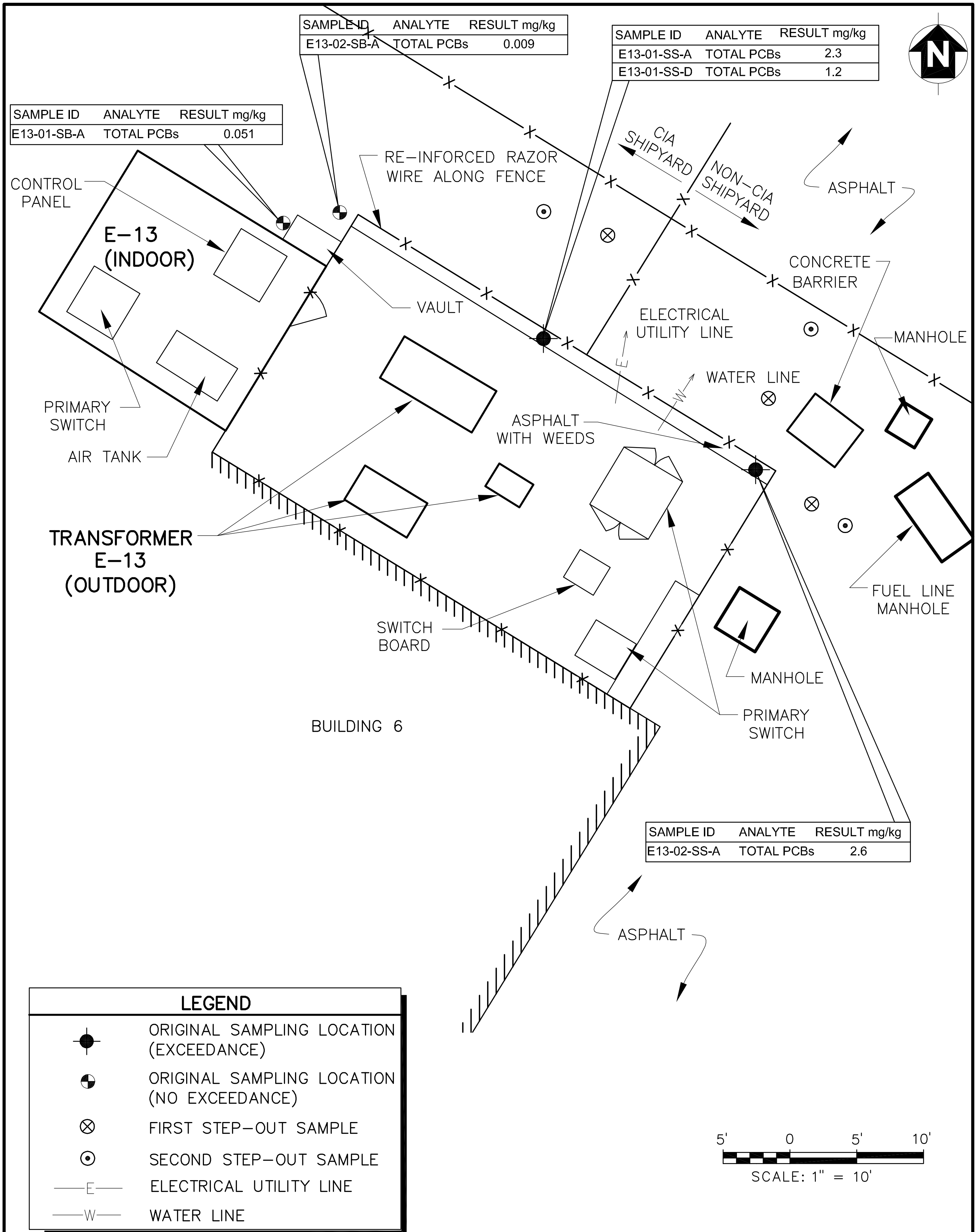
Figure A-28
Transformer C-13
Shipyard GSA
Oahu, Hawaii

R:\Navy\PearlHarbor\CTO004\M02\SAP\ C-13.dwg 02/06/2003 Vincent.Cavanaugh DN



NOTES:
mg/kg milligrams per kilogram
PCB Polychlorinated Biphenyl

Figure A-29
Transformer E-11
Shipyard GSA
Oahu, Hawaii



NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl
CIA	Controlled Industrial Area

Figure A-30
Transformer E-13
Shipyard GSA
Oahu, Hawaii

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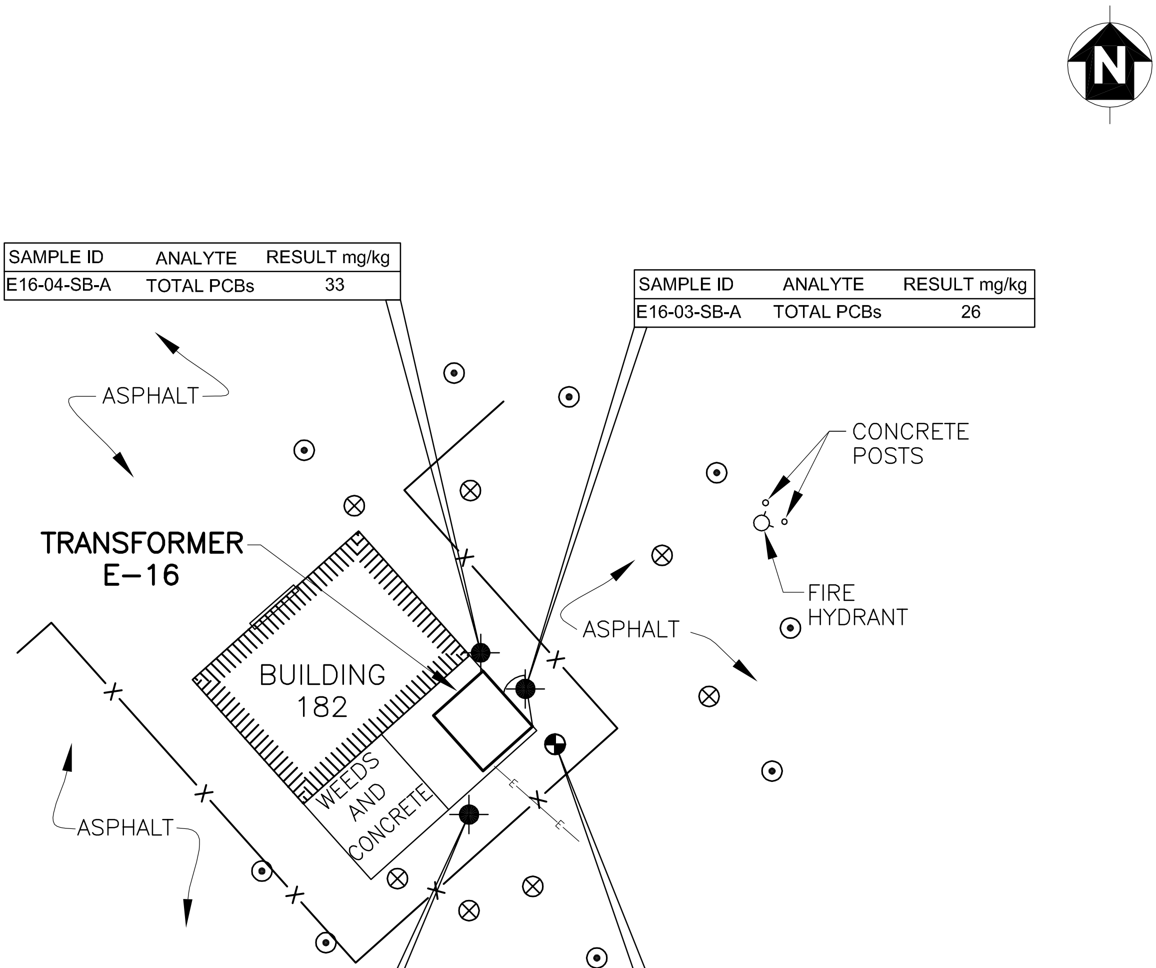

SAMPLE ID	ANALYTE	RESULT mg/kg
E16-04-SB-A	TOTAL PCBs	33

SAMPLE ID	ANALYTE	RESULT mg/kg
E16-03-SB-A	TOTAL PCBs	26

SAMPLE ID	ANALYTE	RESULT mg/kg
E16-02-SB-A	TOTAL PCBs	0.25

SAMPLE ID	ANALYTE	RESULT mg/kg
E16-01-SB-A	TOTAL PCBs	3.8
E16-01-SB-D	TOTAL PCBs	4.1

LEGEND

- ORIGINAL SAMPLING LOCATION (EXCEEDANCE)
- ORIGINAL SAMPLING LOCATION (NO EXCEEDANCE)
- FIRST STEP–OUT SAMPLE
- SECOND STEP–OUT SAMPLE
- —E— ELECTRICAL UTILITY LINE
- —X— CHAIN–LINK FENCE

5' 0 5' 10'
SCALE: 1" = 10'

NOTES:

mg/kg milligrams per kilogram
PCB Polychlorinated Biphenyl

Figure A-31
Transformer E-16
Shipyard GSA
Oahu, Hawaii

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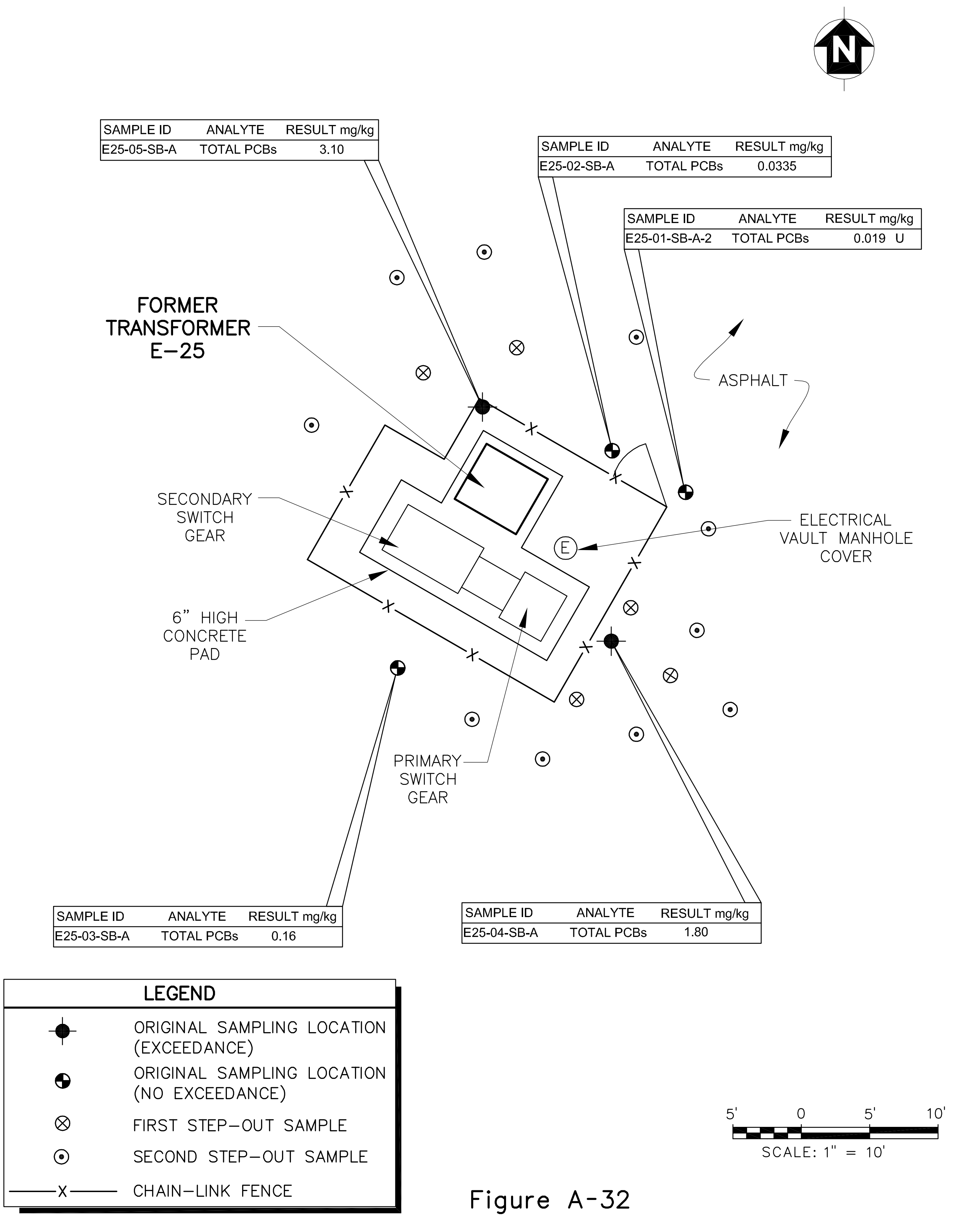
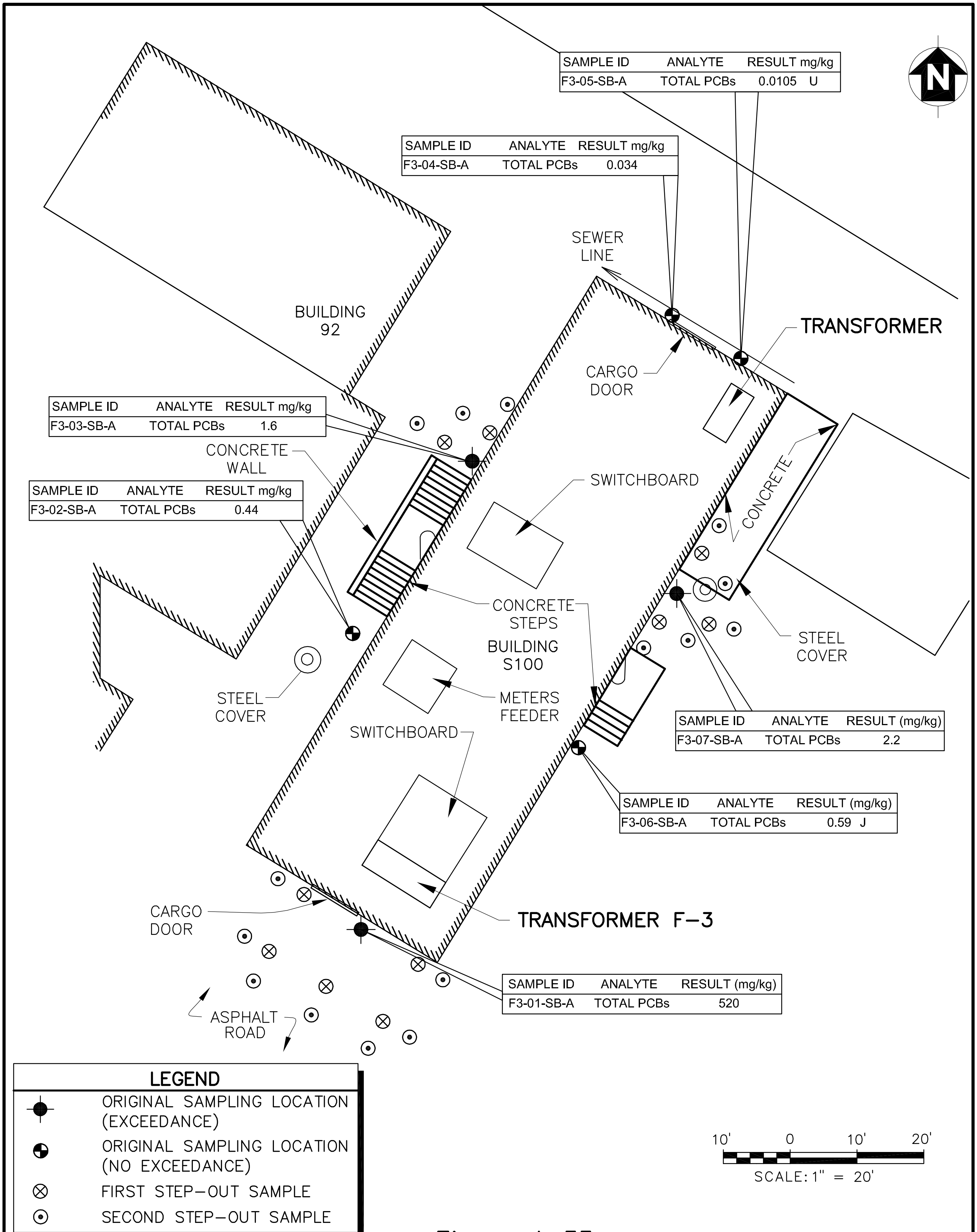


NOTES:

mg/kg milligrams per kilogram
PCB Polychlorinated Biphenyl
U Nondetected

Figure A-32
Transformer E-25
Shipyard GSA
Oahu, Hawaii



NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl
U	Nondetected

Figure A-33
Transformer F-3
Shipyard GSA
Oahu, Hawaii

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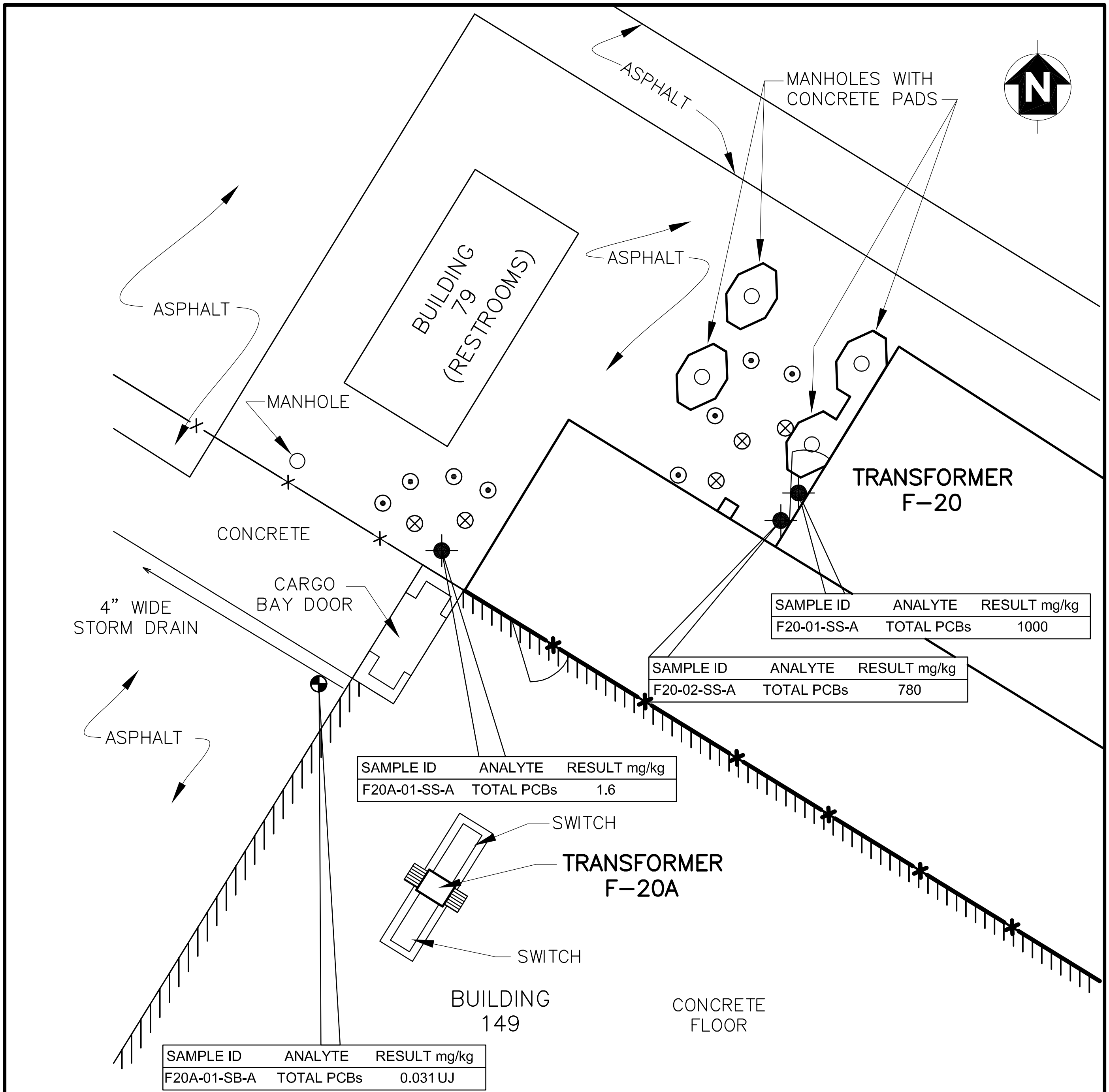


SAMPLE ID	ANALYTE	RESULT mg/kg
F20-01-SS-A	TOTAL PCBs	1000

SAMPLE ID	ANALYTE	RESULT mg/kg
F20-02-SS-A	TOTAL PCBs	780

SAMPLE ID	ANALYTE	RESULT mg/kg
F20A-01-SS-A	TOTAL PCBs	1.6

SAMPLE ID	ANALYTE	RESULT mg/kg
F20A-01-SB-A	TOTAL PCBs	0.031 UJ

LEGEND

- ORIGINAL SAMPLING LOCATION (EXCEEDANCE)
- ORIGINAL SAMPLING LOCATION (NO EXCEEDANCE)
- FIRST STEP-OUT SAMPLE
- SECOND STEP-OUT SAMPLE
- ——X—— CHAIN-LINK FENCE

NOTE: EXACT LOCATION OF F-20 INSIDE BUILDING IS UNKNOWN. LOCATION OF TRANSFORMER F-20A IS BASED ON A 2001 INSPECTION (EARTH TECH 2002c).

NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl
UJ	Estimated nondetect

Figure A-34
Transformer F-20A & F-20
Shipyard GSA
Oahu, Hawaii

R:\Navy\PearlHarbor\CTO004\M02\SAP\ F-20.dwg 02/06/2003 Vincent.Cavanaugh DN

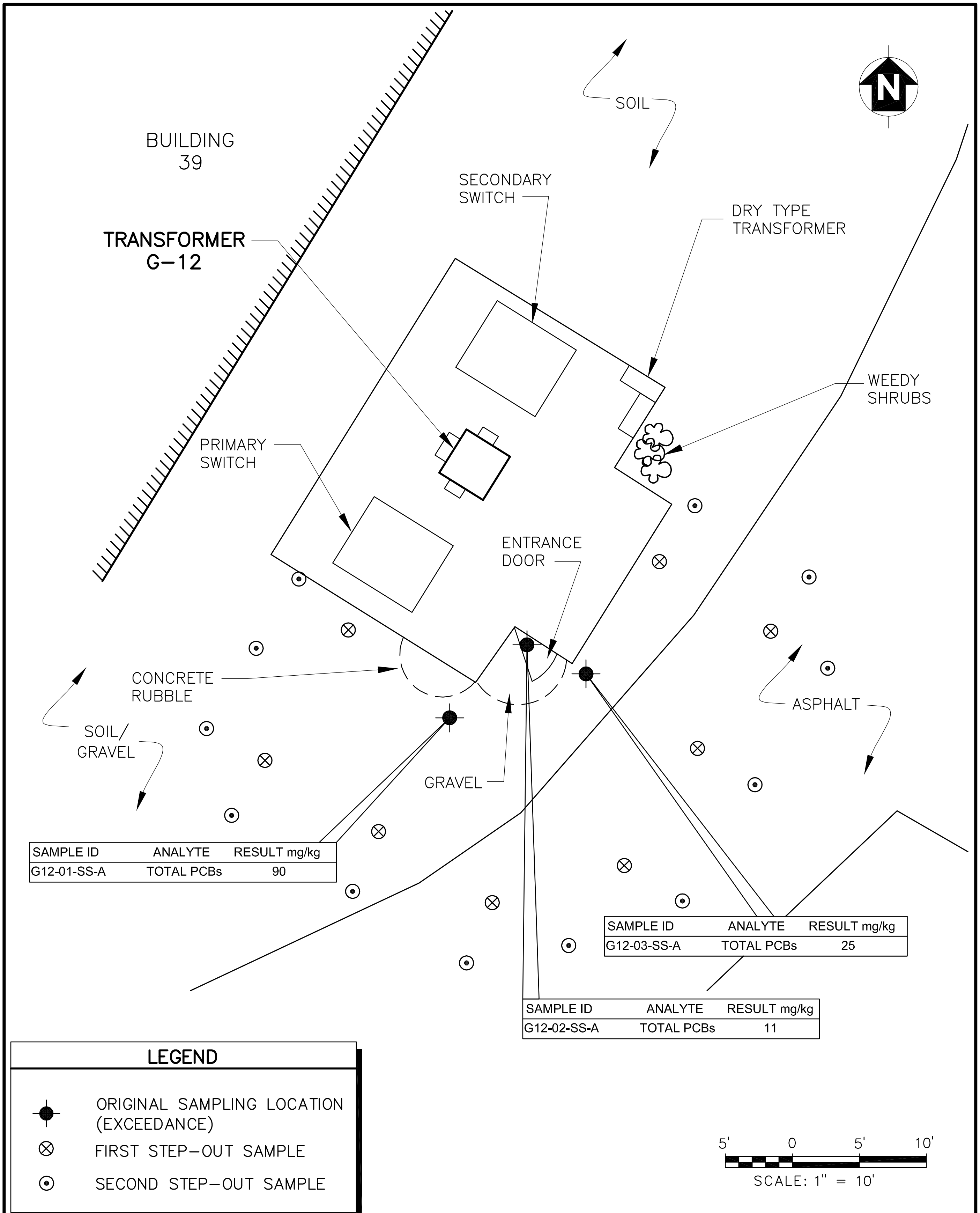
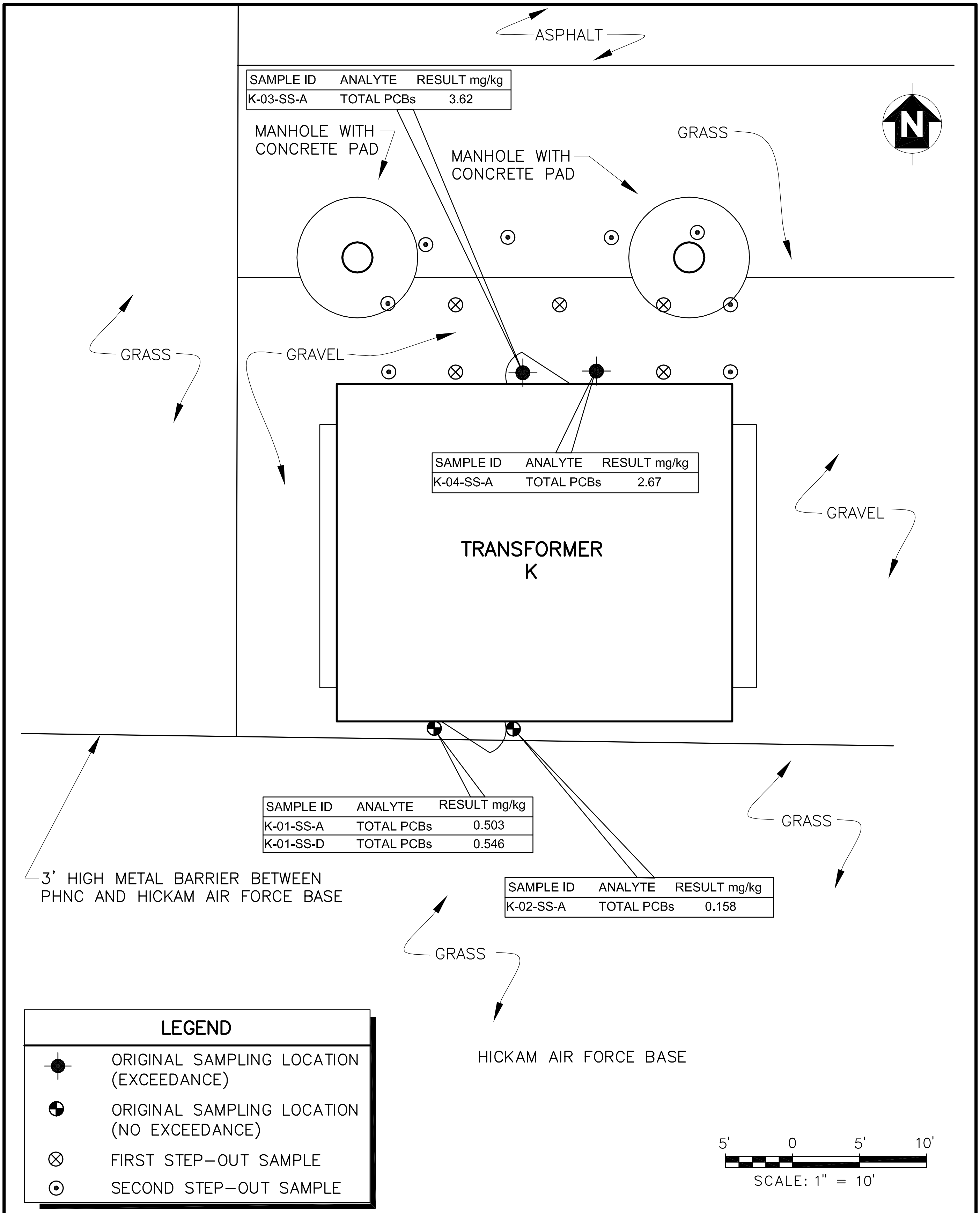


Figure A-35
Transformer G-12
Shipyard GSA
Oahu, Hawaii

NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl

R:\Navy\PearlHarbor\CTO004\M02\SAP\ G-12.dwg 02/06/2003 Vincent.Cavanaugh DN



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NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl
PHNC	Pearl Harbor Naval Complex

Figure A-36
Transformer K
Shipyard GSA
Oahu, Hawaii

Legend

- Transformer Site Recommended for Further Action
- Waipio Peninsula GSA Boundary
- Surrounding Area
- Ocean
- Roads

Notes

1. The accuracy of this document is limited to the quality of the source information and is not suitable for mapping engineering applications and is not to used for "as built."

Source

- Base mapping from State of Hawaii statewide GIS data and other mapping developed by and for the U.S. Navy.

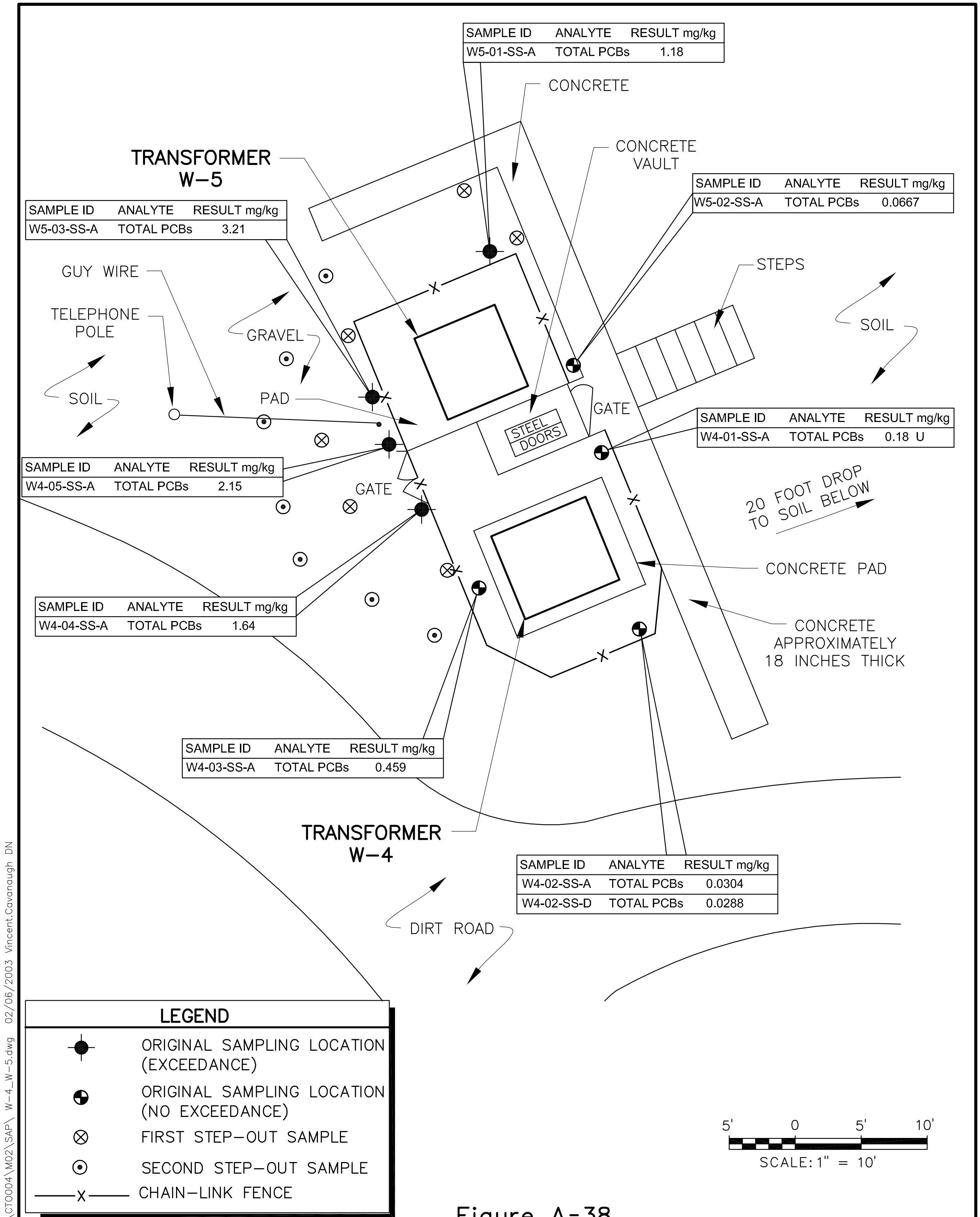
N

1000' 0 1000' 2000'

SCALE: 1" = 2000'

Figure A-37
Transformer Sites Recommended for Further Action
Waipio Peninsula GSA
Oahu, Hawaii

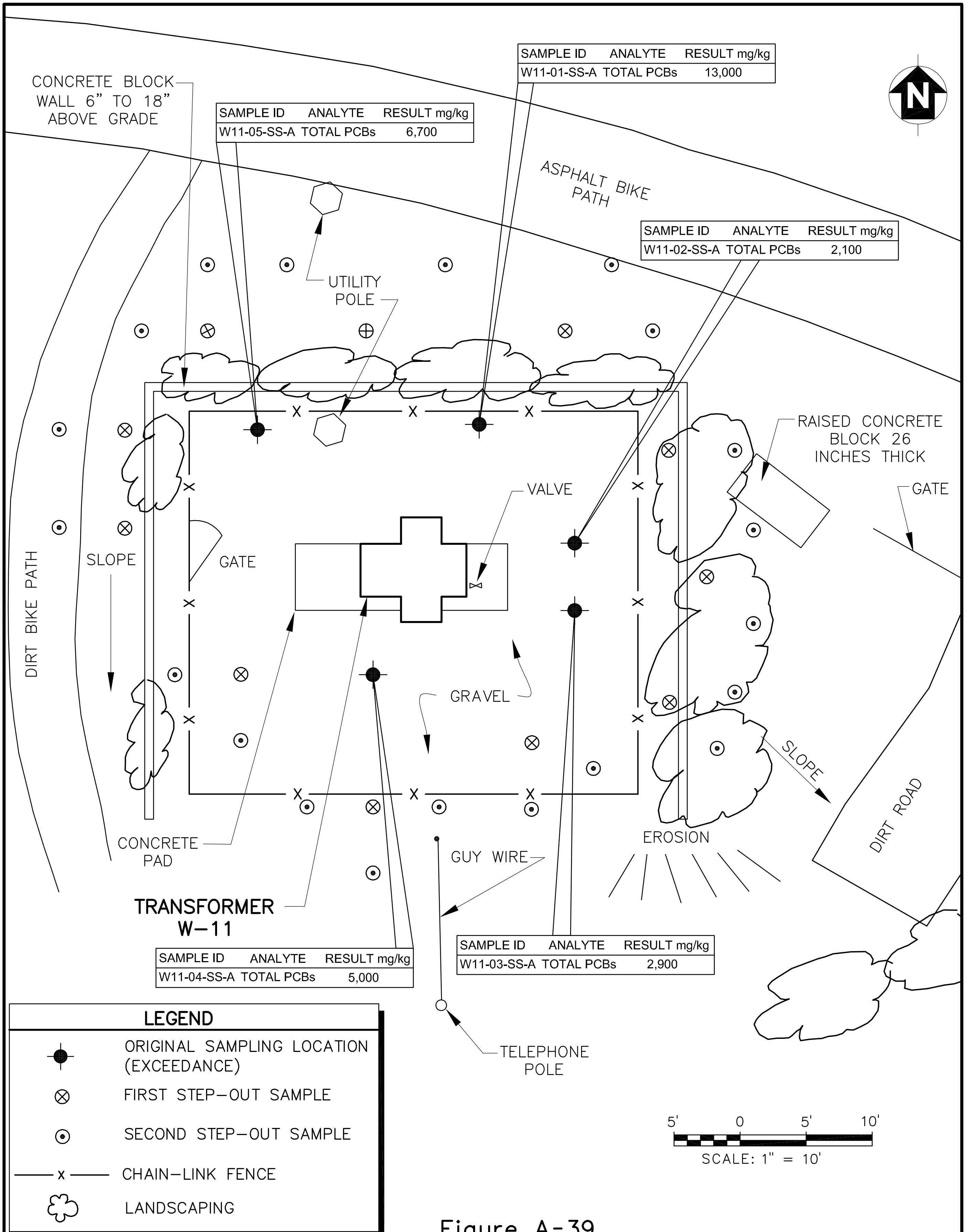
R:\Navy\PearlHarbor\CTO004\M02\SAP\ SI-WAIPIO.DWG 01/28/2003 Vincent.Cavanaugh DN



NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl
U	Nondetected

Figure A-38
Transformer W-4 & W-5
Waipio Peninsula GSA
Oahu, Hawaii



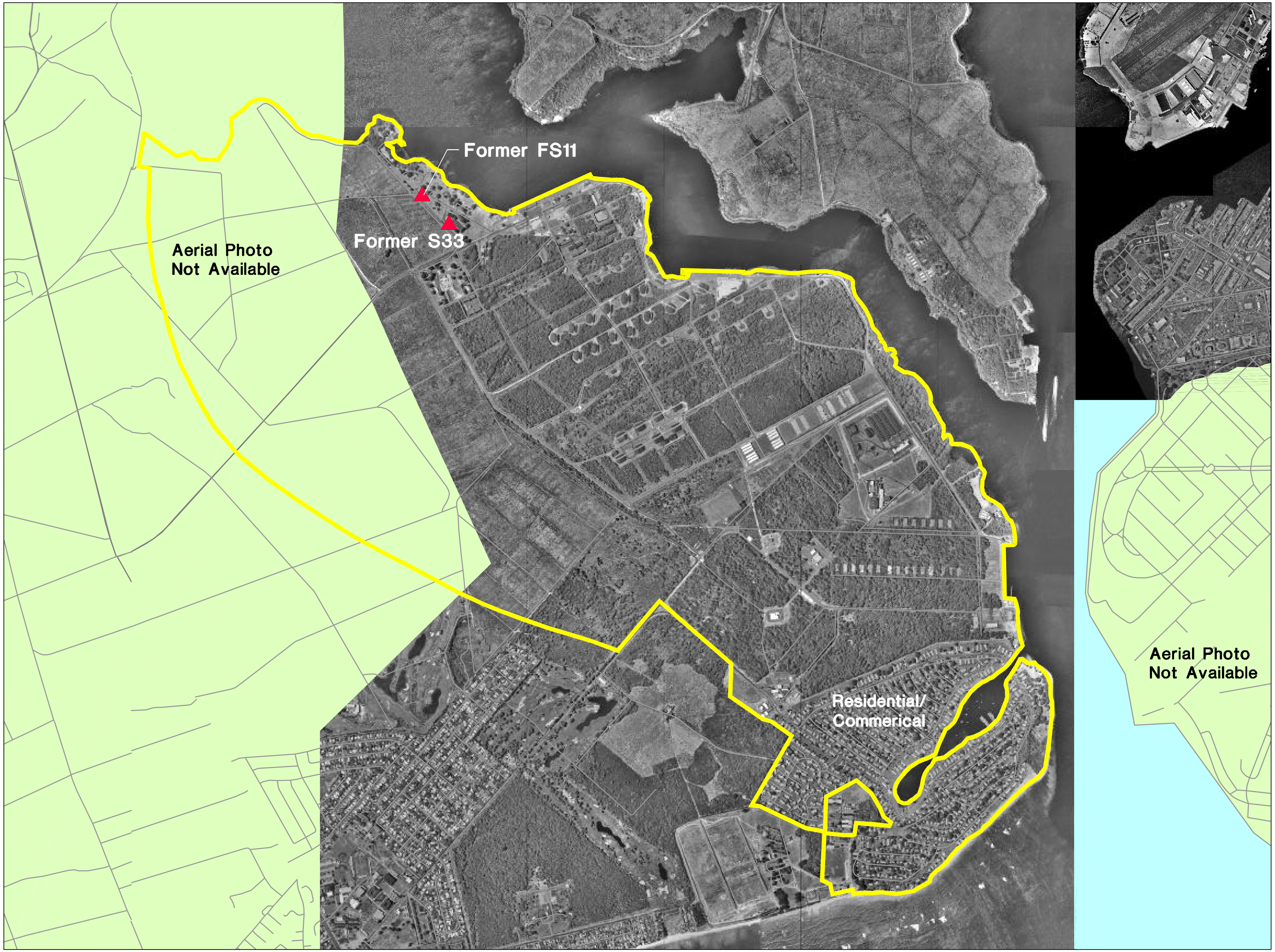
NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-39
Transformer W-11
Waipio Peninsula GSA
Oahu, Hawaii

R:\Navy\PearlHarbor\CT0004\M02\SAP\ W11.dwg 02/06/2003 Vincent.Cavanaugh DN



Legend

- Transformer Site Recommended for Further Action
- West Loch GSA Boundary
- Surrounding Area
- Ocean
- Roads

Notes

1. The accuracy of this document is limited to the quality of the source information and is not suitable for mapping engineering applications and is not to used for "as built."
2. Residential/Commercial, Non-Restricted Access Areas: Residential and Commercial Areas such as indoor locations and unrestricted rural areas (40 CFR 761.125, Definitions).

Source

- Base mapping from State of Hawaii statewide GIS data and other mapping developed by and for the U.S. Navy.

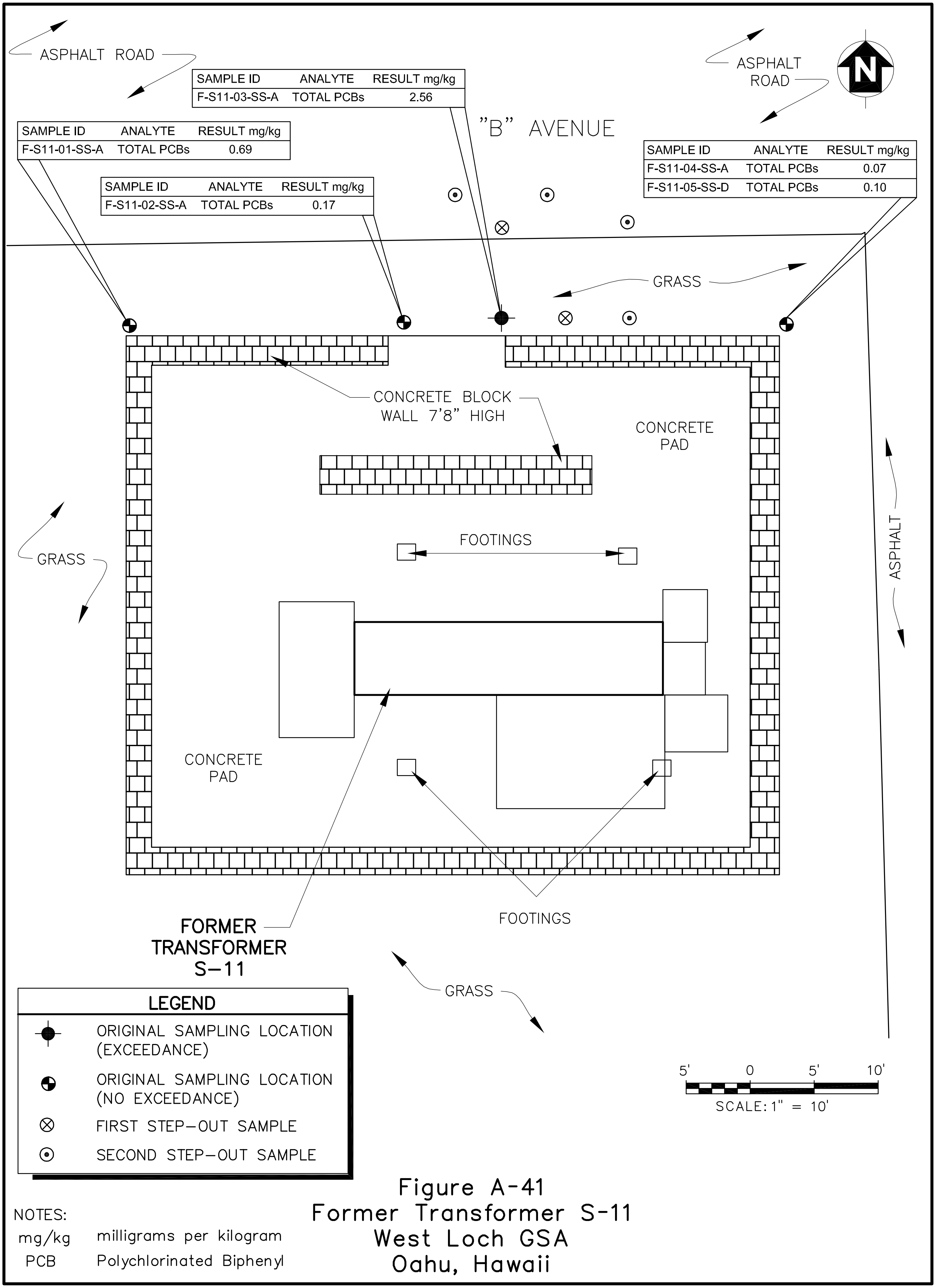
N

1000' 0 1000' 2000'

SCALE: 1" = 2000'

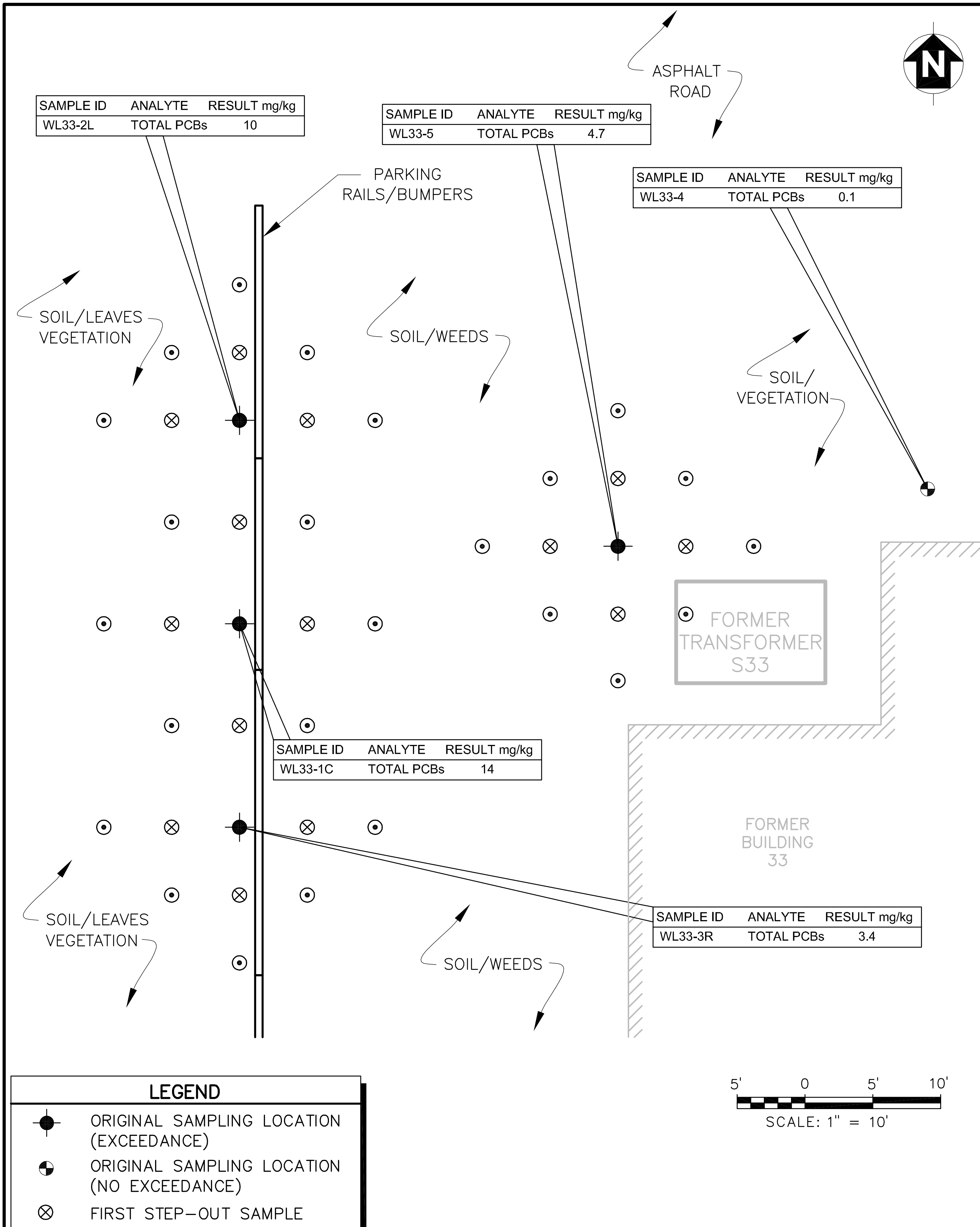
Figure A-40
Transformer Sites Recommended for Further Action
West Loch GSA
Oahu, Hawaii

R:\Navy\PearlHarbor\CT0004\M02\SAP\ SI-WESTLOCH.DWG 01/28/2003 Vincent.Cavanaugh DN



NOTES:
mg/kg milligrams per kilogram
PCB Polychlorinated Biphenyl

Figure A-41
Former Transformer S-11
West Loch GSA
Oahu, Hawaii



SAMPLE ID	ANALYTE	RESULT mg/kg
WL33-2L	TOTAL PCBs	10

SAMPLE ID	ANALYTE	RESULT mg/kg
WL33-5	TOTAL PCBs	4.7

SAMPLE ID	ANALYTE	RESULT mg/kg
WL33-4	TOTAL PCBs	0.1

SAMPLE ID	ANALYTE	RESULT mg/kg
WL33-1C	TOTAL PCBs	14

SAMPLE ID	ANALYTE	RESULT mg/kg
WL33-3R	TOTAL PCBs	3.4

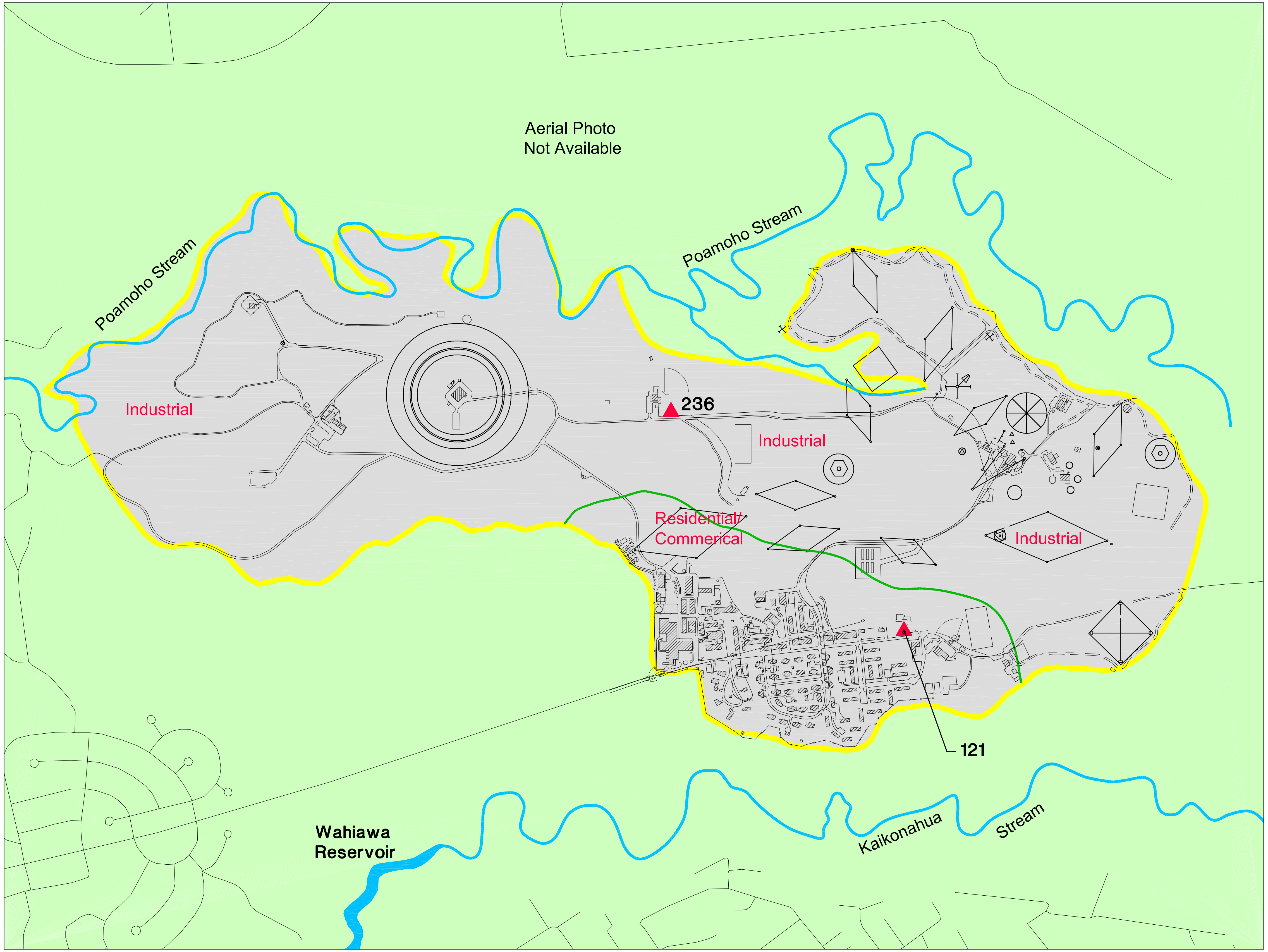
LEGEND

- ORIGINAL SAMPLING LOCATION (EXCEEDANCE)
- ORIGINAL SAMPLING LOCATION (NO EXCEEDANCE)
- FIRST STEP-OUT SAMPLE
- SECOND STEP-OUT SAMPLE

NOTES:

mg/kg milligrams per kilogram
PCB Polychlorinated Biphenyl

Figure A-42
Former Transformer S33
West Loch Branch
Oahu, Hawaii



Legend

- Transformer Site Recommended for Further Action
- NCTAMS Wahiawa Boundary
- Surrounding Area
- Boundary Between (Low-Occupancy) Industrial and (High-Occupancy) Commerical/Residential areas
- Roads
- Streams

Notes

1. The accuracy of this document is limited to the quality of the source information and is not suitable for mapping engineering applications and is not to used for "as built."
2. Industrial, Restricted Access: Areas other than electrical substations that are at least 0.1 kilometer (km) from a Residential/Commercial area and where accessibility is limited by man-made or natural barriers (40 CFR 761.125, Definitions.)
3. Residential/Commercial, Non-Restricted Access Areas: Residential and Commercial Areas such as indoor locations and unrestricted rural areas (40 CFR 761.125, Definitions).
4. Boundary between High Occupancy Residential and Commercial Areas and Low Occupancy Industrial Areas was drawn 0.1 km away from high occupancy areas.

Source

- Base mapping from State of Hawaii statewide GIS data and other mapping developed by and for the U.S. Navy.

150' 0 150' 300'

SCALE: 1" = 300'

Figure A-43
Transformer Sites Recommended for Further Action
NCTAMS Wahiawa
Oahu, Hawaii

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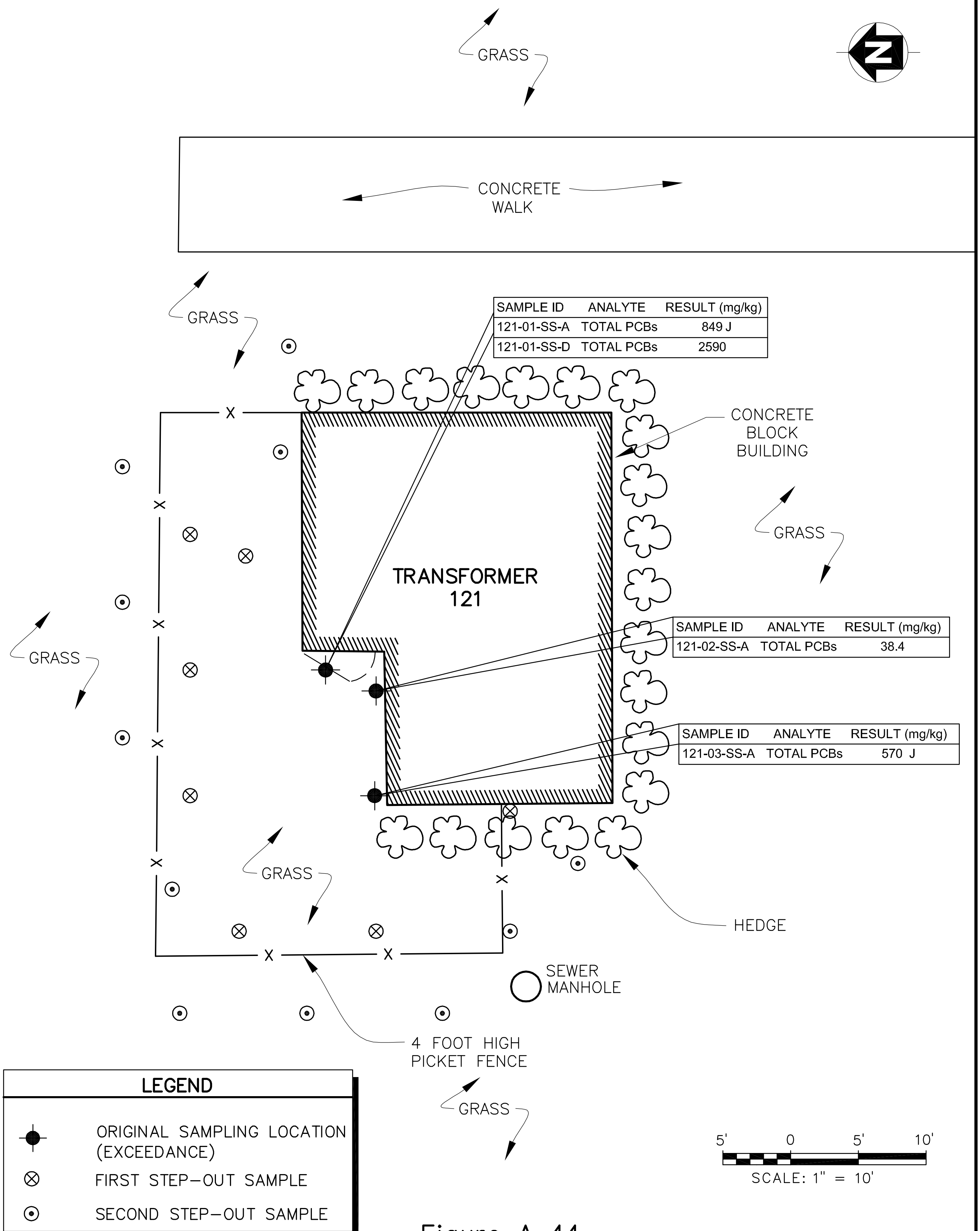

SAMPLE ID	ANALYTE	RESULT (mg/kg)
121-01-SS-A	TOTAL PCBs	849 J
121-01-SS-D	TOTAL PCBs	2590

SAMPLE ID	ANALYTE	RESULT (mg/kg)
121-02-SS-A	TOTAL PCBs	38.4

SAMPLE ID	ANALYTE	RESULT (mg/kg)
121-03-SS-A	TOTAL PCBs	570 J

NOTES:

mg/kg	milligrams per kilogram
PCB	Polychlorinated Biphenyl
J	Estimated value

Figure A-44
Transformer 121
NCTAMS Wahiawa
Oahu, Hawaii

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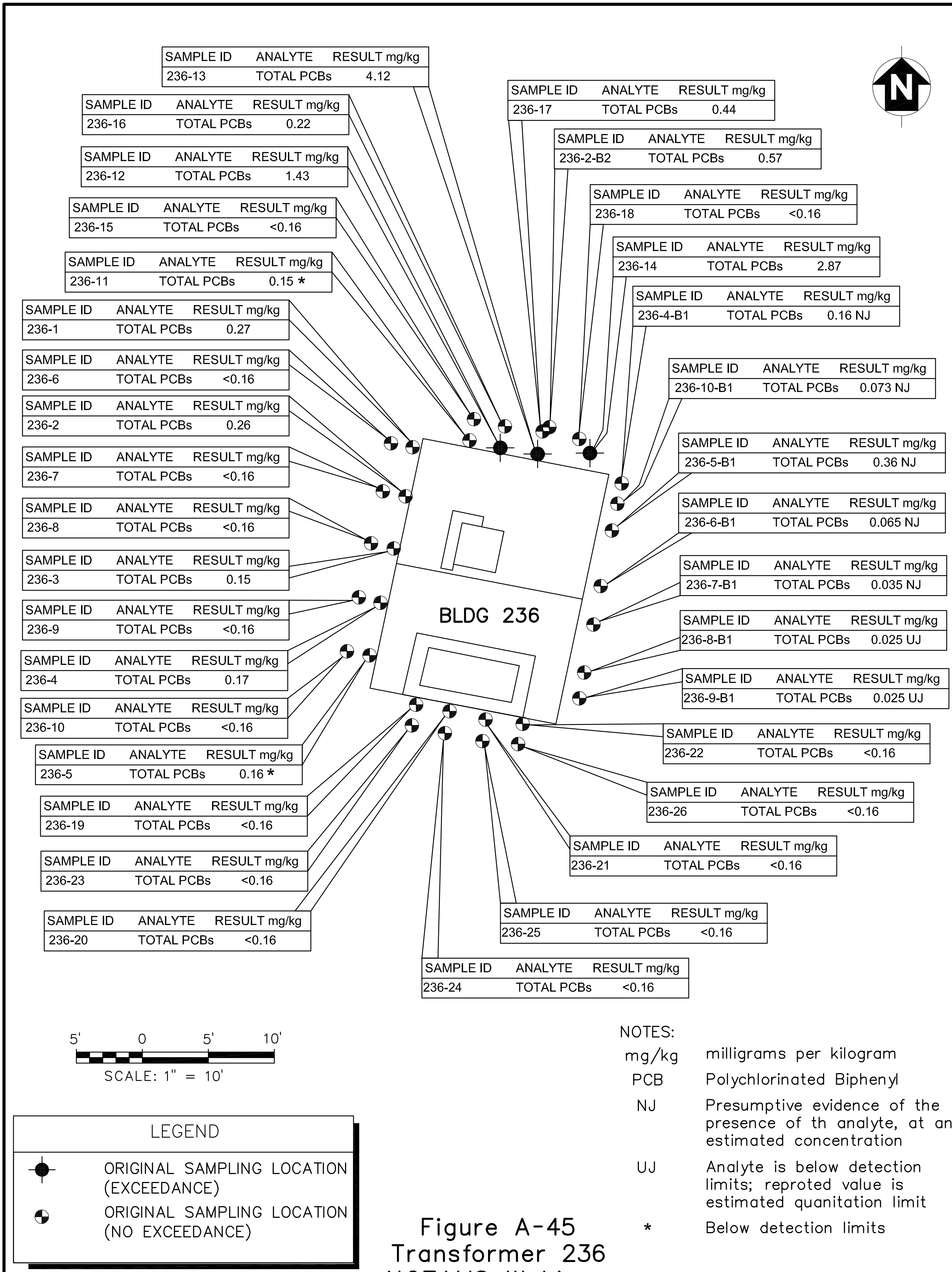
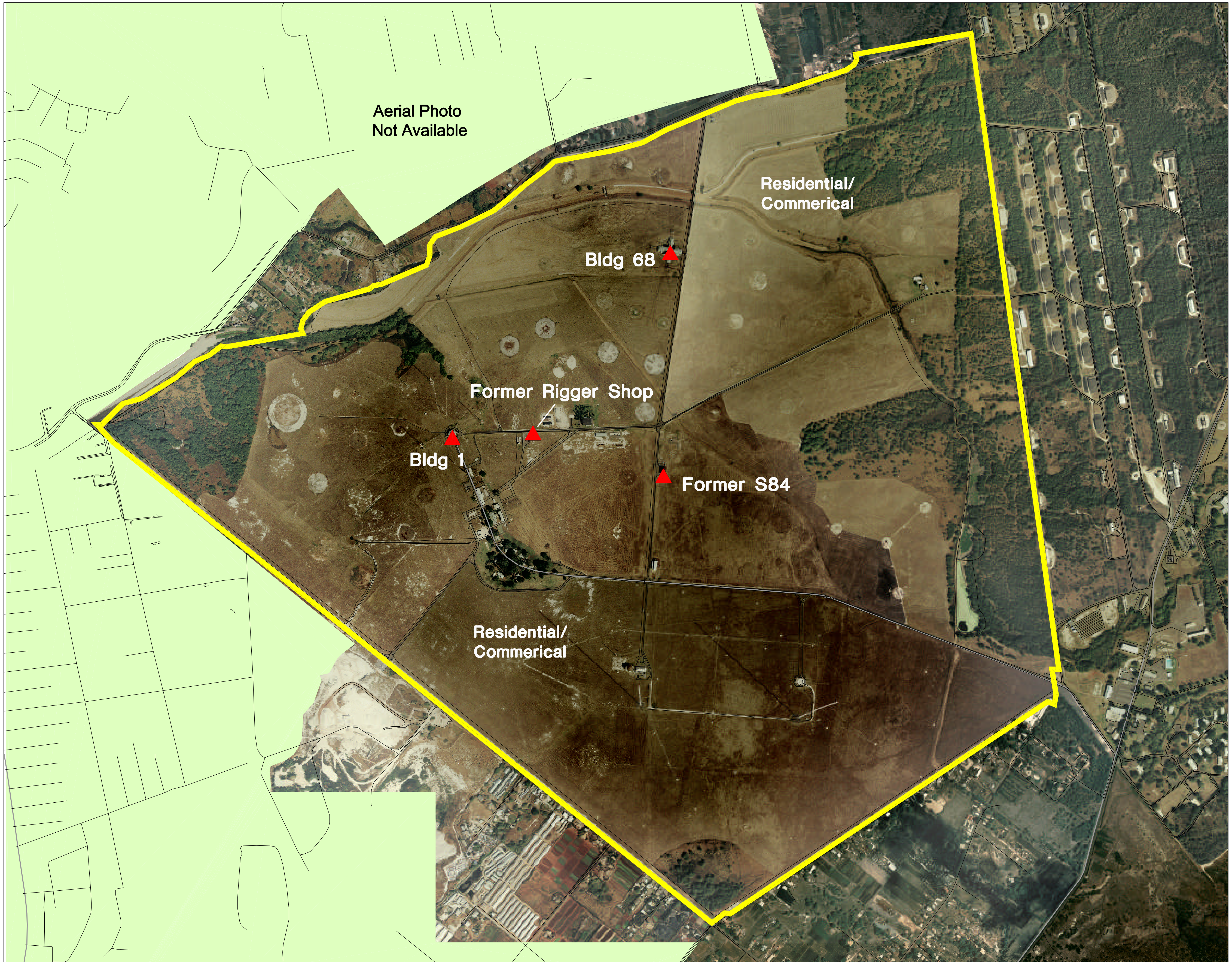


Figure A-45
Transformer 236
NCTAMS Wahiawa
Oahu, Hawaii



Legend

- Transformer Sites Recommended for Further Action
- NRTF Lualualei Boundary
- Surrounding Area
- Roads

Notes

1. The accuracy of this document is limited to the quality of the source information and is not suitable for mapping engineering applications and is not to used for "as built."

Source

- Base mapping from State of Hawaii statewide GIS data and other mapping developed by and for the U.S. Navy.

N

650' 0 600' 1300'

SCALE: 1" = 1300'

Figure A-46
Transformer Sites Recommended for Further Action
NRTF Lualualei
Oahu, Hawaii

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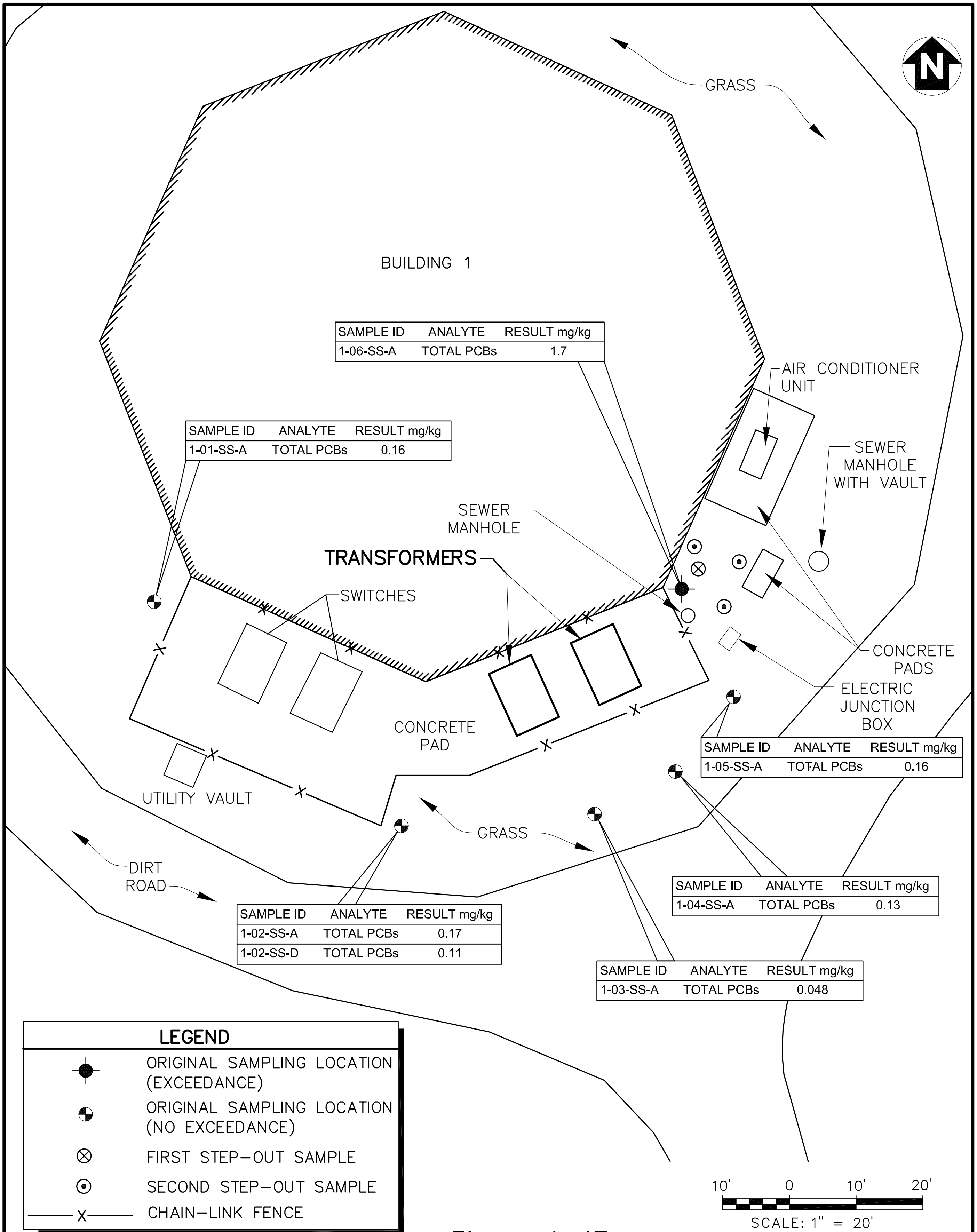

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-47
Transformer Building 1
NRTF Lualualei
Oahu, Hawaii

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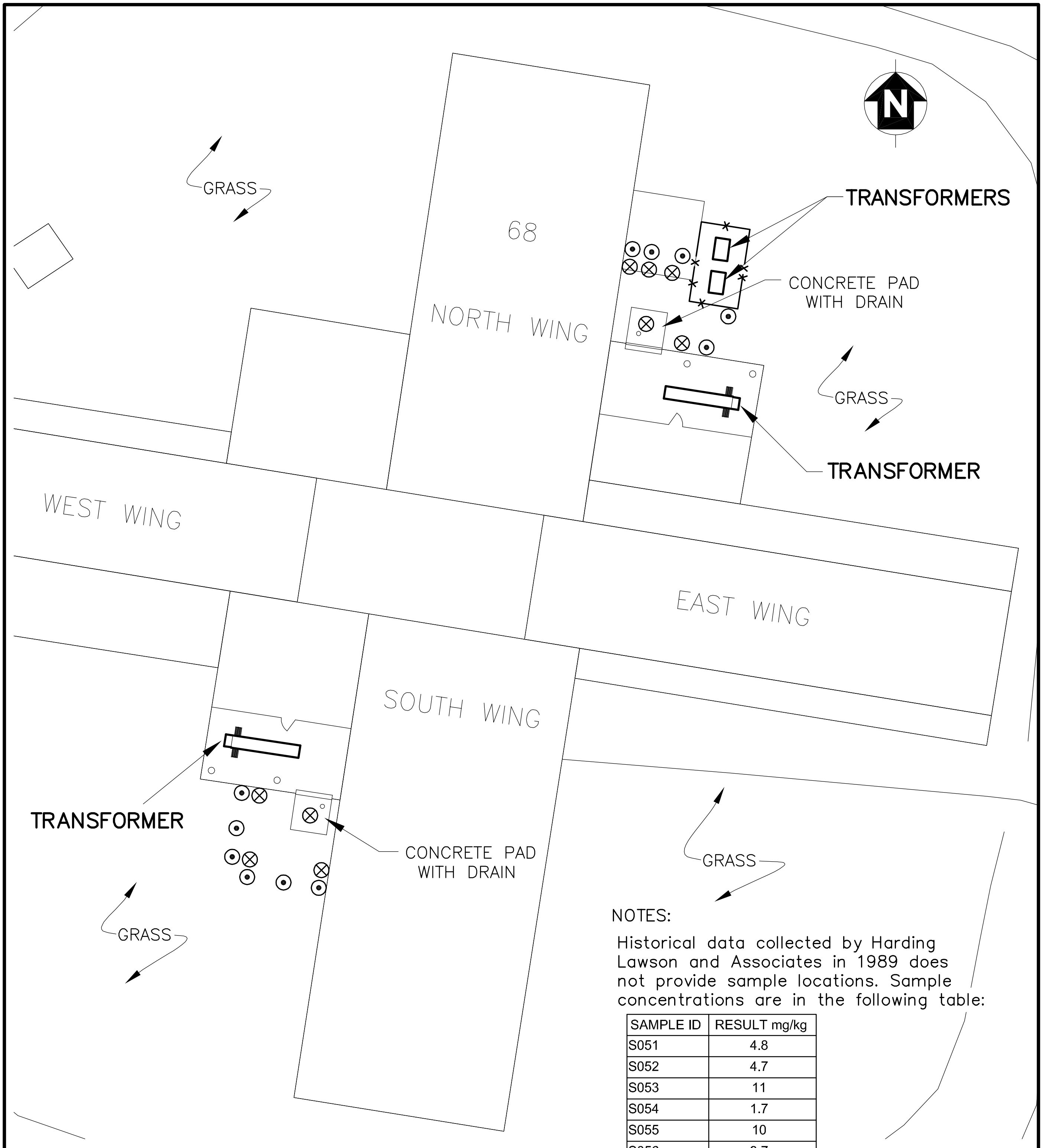

NOTES:

Historical data collected by Harding Lawson and Associates in 1989 does not provide sample locations. Sample concentrations are in the following table:

SAMPLE ID	RESULT mg/kg
S051	4.8
S052	4.7
S053	11
S054	1.7
S055	10
S056	9.7

mg/kg milligrams per kilogram

LEGEND

⊗ FIRST STEP-OUT SAMPLE

⊙ SECOND STEP-OUT SAMPLE

——X—— CHAIN-LINK FENCE

Figure A-48
Transformer Building 68
NRTF Lualualei
Oahu, Hawaii

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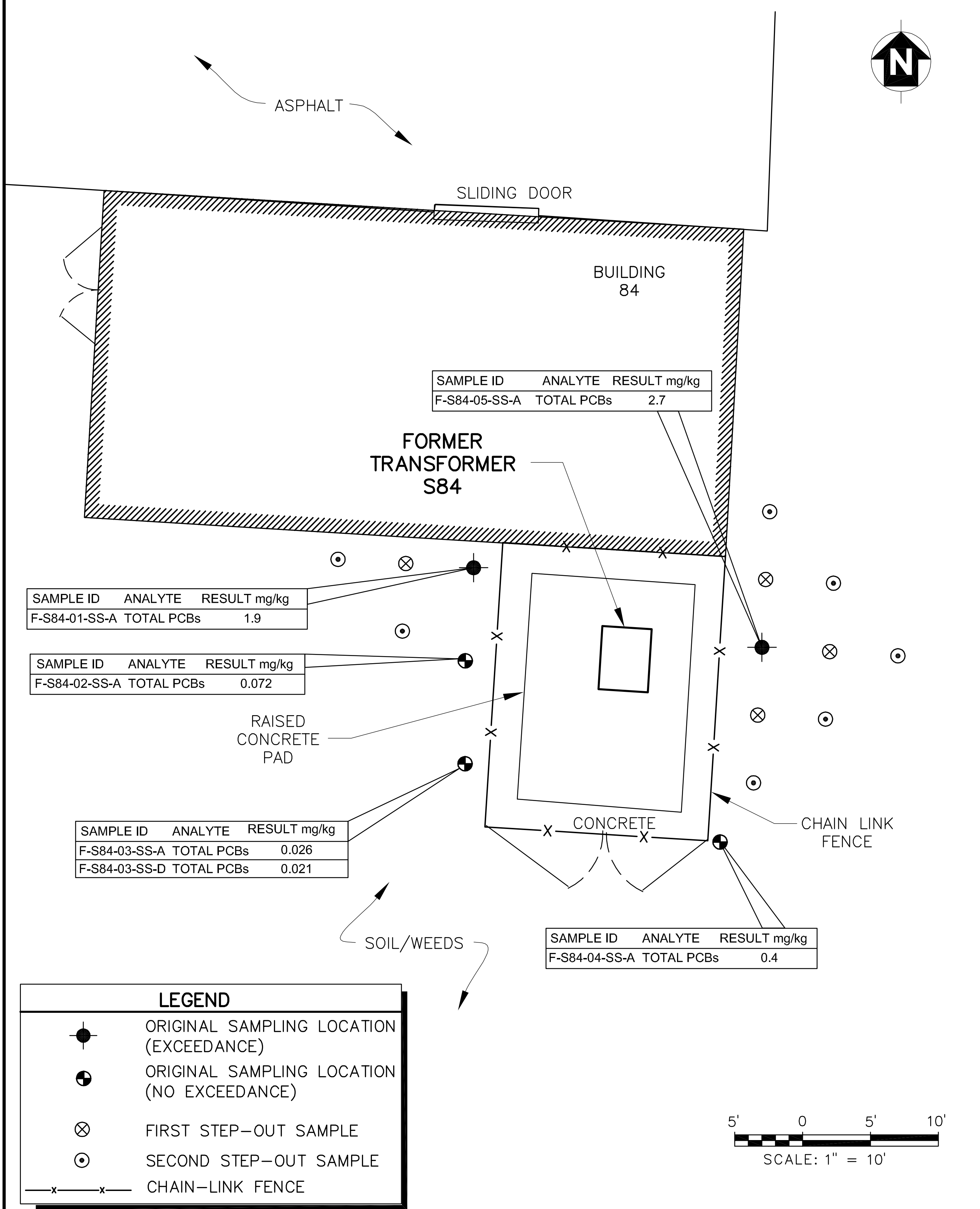

NOTES:
mg/kg milligrams per kilogram
PCB Polychlorinated Biphenyl

Figure A-49
Former Transformer S84
NRTF Lualualei
Oahu, Hawaii

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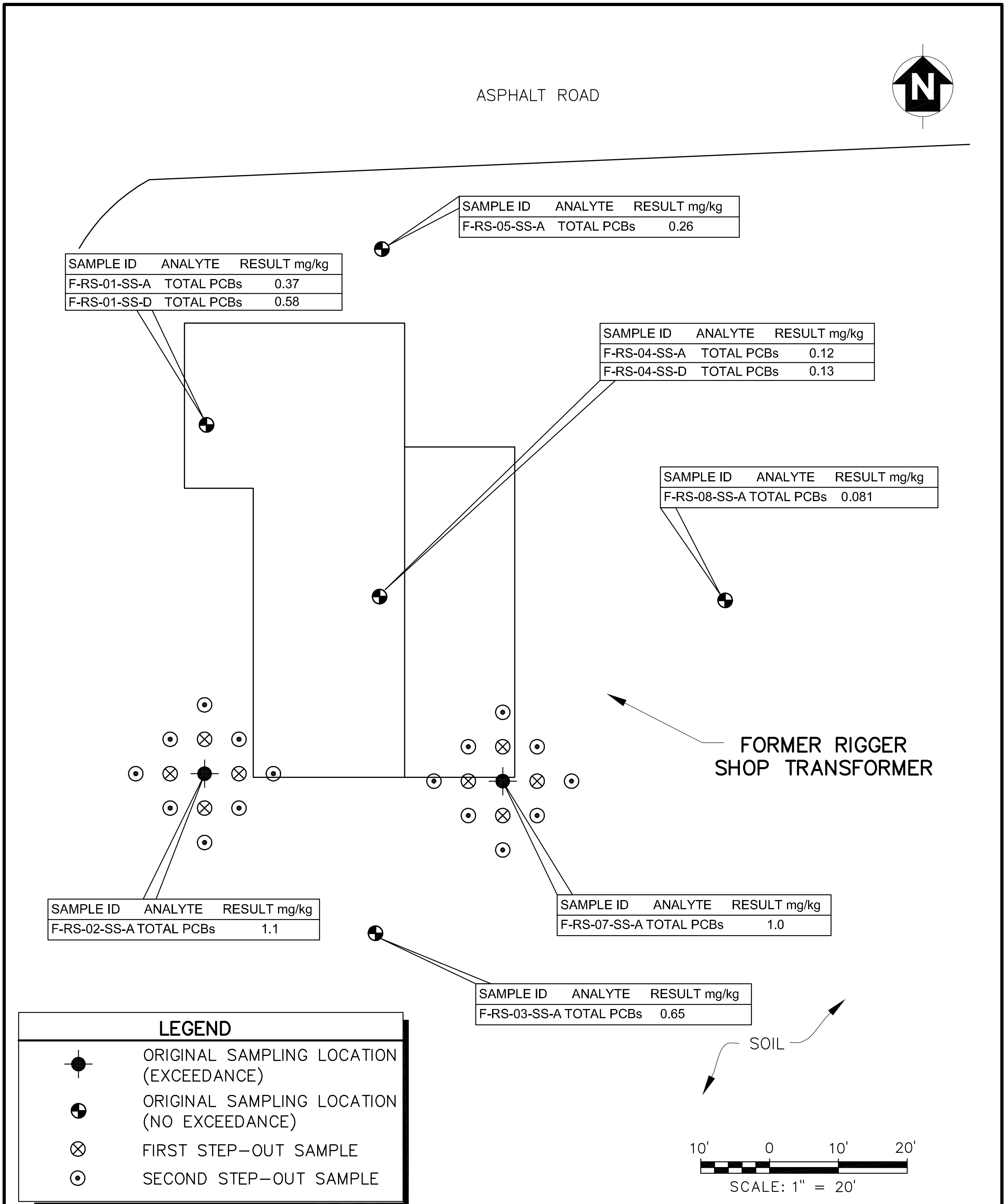


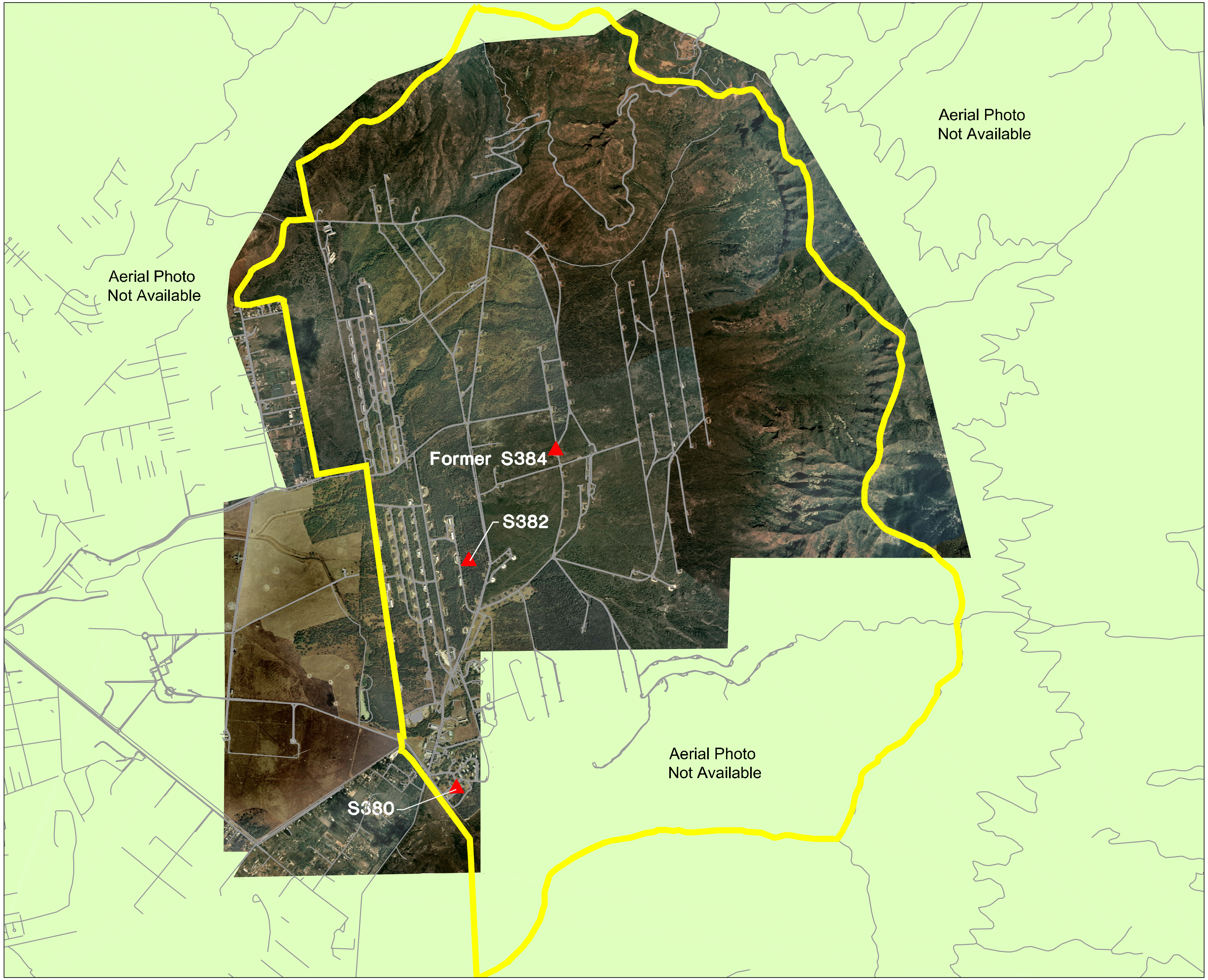
Figure A-50
Former Rigger Shop
Transformer
NRTF Lualualei
Oahu, Hawaii

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

R:\Navy\PearlHarbor\CTO004\M02\SAP\ FRS.dwg 02/10/2003 Vincent.Cavanaugh DN



Legend

- Transformer Site Recommended for Further Action
- NAVMAG Lualualei Branch Boundary
- Surrounding Area
- Roads

Notes

1. The accuracy of this document is limited to the quality of the source information and is not suitable for mapping engineering applications and is not to used for "as built."

Source

- Base mapping from State of Hawaii statewide GIS data and other mapping developed by and for the U.S. Navy.

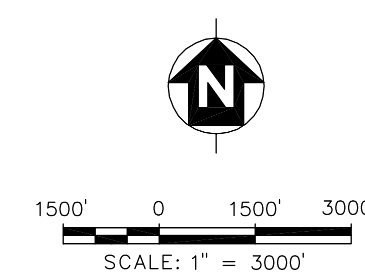


Figure A-51
Transformer Sites Recommended for Further Action
NAVMAG Lualualei Branch
Oahu, Hawaii

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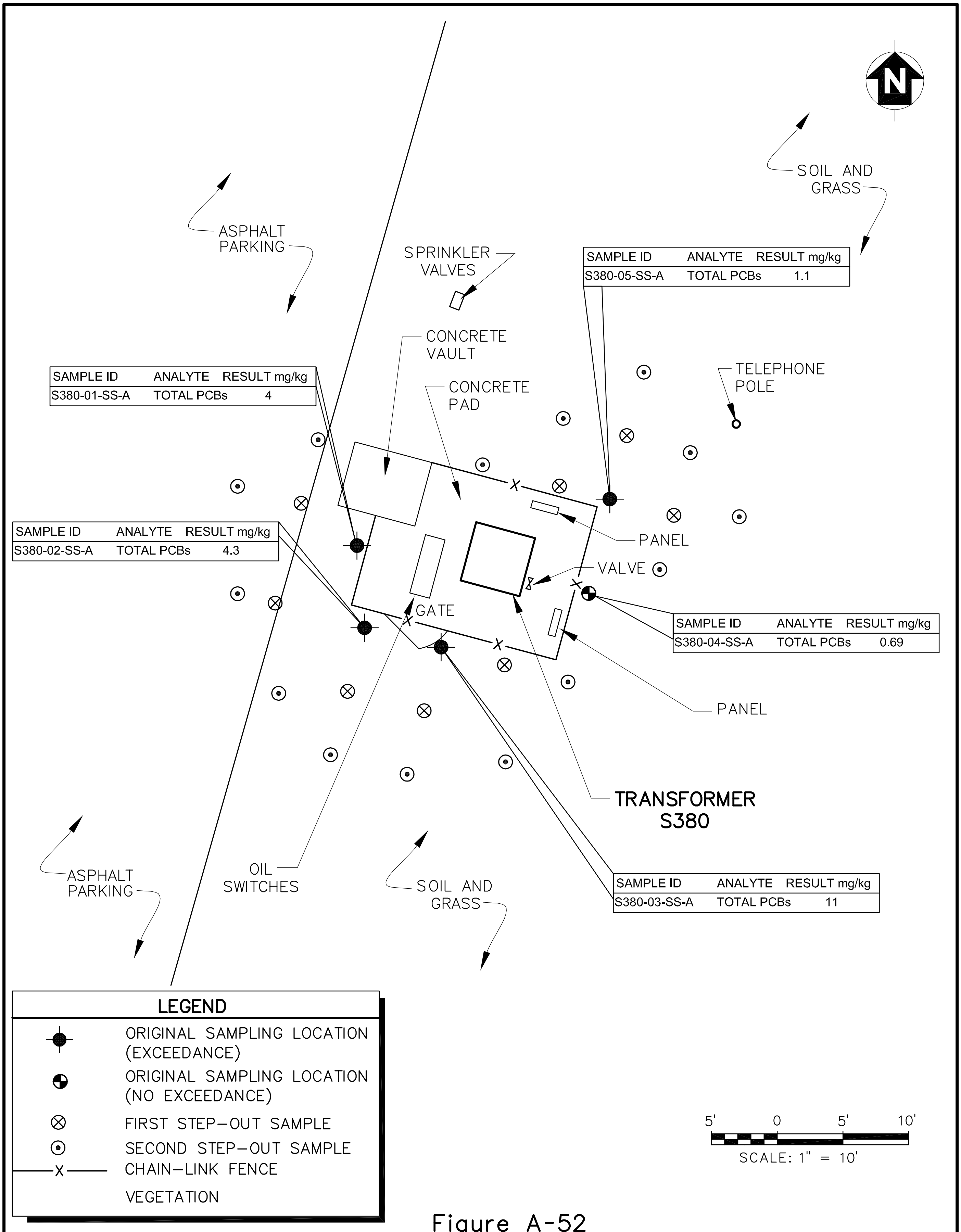

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-52
Transformer S380
NAVMAG PH Lualualei Branch
Oahu, Hawaii

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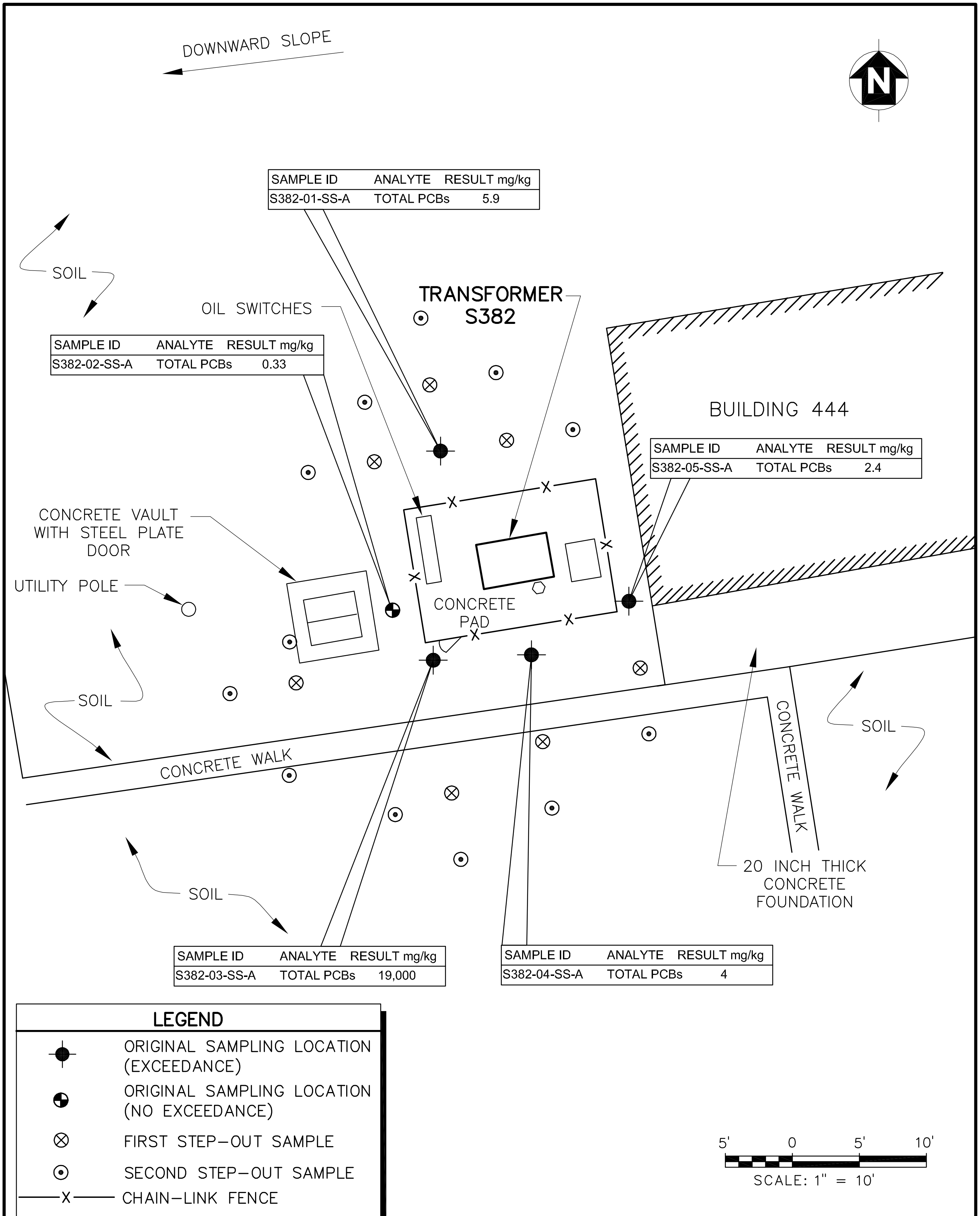

NOTES:

mg/kg milligrams per kilogram

PCB Polychlorinated Biphenyl

Figure A-53
Transformer S382
NAVMAG PH Lualualei Branch
Oahu, Hawaii

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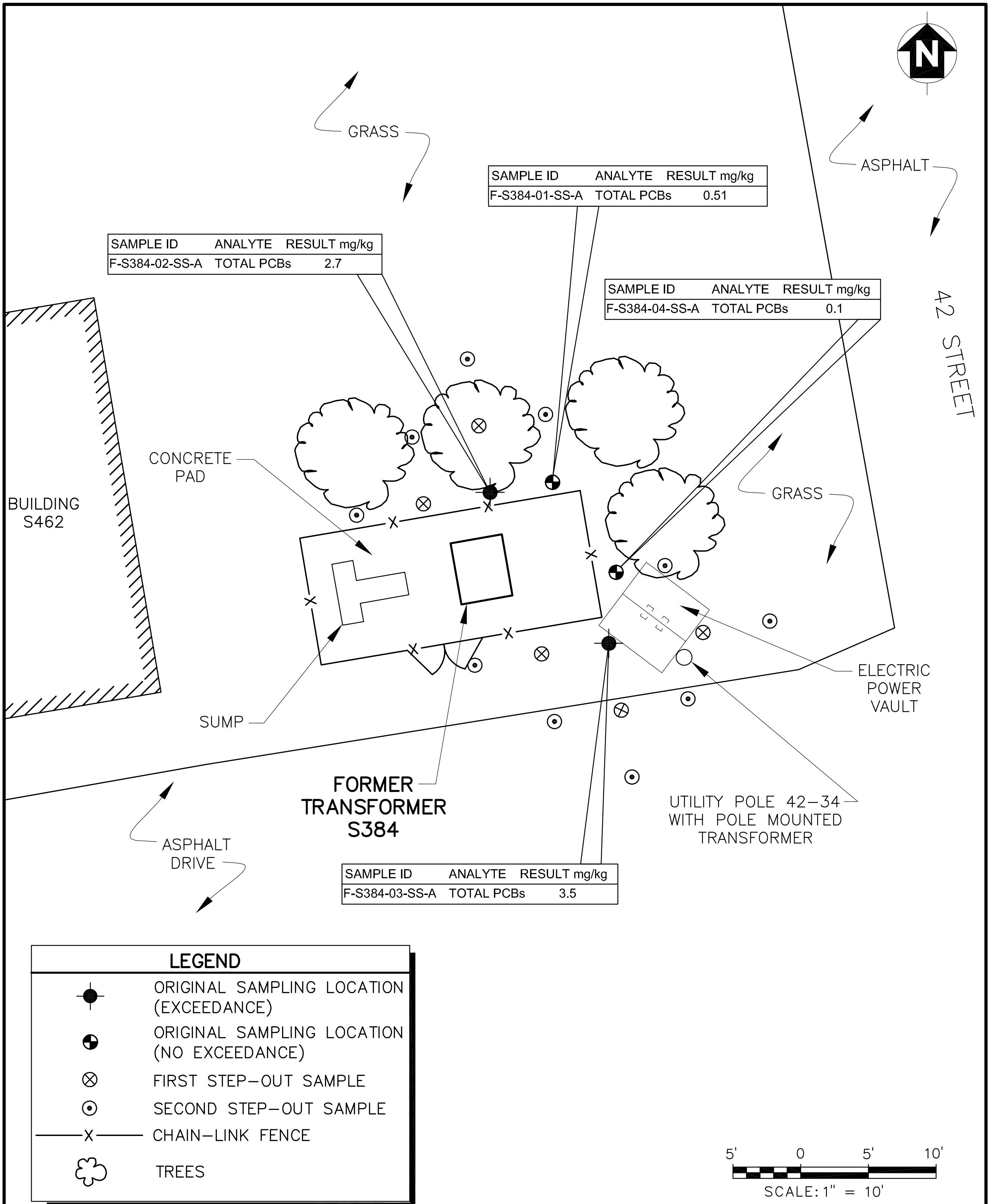

NOTES:
mg/kg milligrams per kilogram
PCB Polychlorinated Biphenyl
Vegetation was cleared – (January 2003)

Figure A-54
Former Transformer S384
NAVMAG PH Lualualei Branch
Oahu, Hawaii

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Appendix B
Field Forms

CTO 004
DRUM INVENTORY LOG FOR FIELD INVESTIGATION
SITE NAME:

DRUM NO. (xxxx_AA_Dzzz)	DRUM STORAGE LOCATION	SOURCE ID NUMBER	IDW TYPE	CAPACITY (fill level %)	DATE GENERATED (dd-Mon-yy)	EXPECTED DISPOSAL DATE (Mon-yy)	ACTUAL DISPOSAL DATE (dd-Mon-yy)

Project Name: Field Investigation, Group C, CTO 004
Project Number: G0096004H03
Laboratory: Laucks Testing Laboratories Inc.

Sample Tracking Form

Site	USEPA ID	Field Sampling ID	Matrix	Collection Date	Collection Time	Number of Containers and Size/Type	Sampler Initials & Sample Notes, i.e DUP, ER, FB

Notes:
DUP = Duplicate
ER = equipment rinsate
FB = field blank
ft bgs = feet below ground surface
L = liter
oz = ounce
SB = subsurface
SS = surface
ss = stainless steel

Tetra Tech EM Inc.

BOREHOLE LOG

SHEET _____ OF _______

LOCATION OF BOREHOLE	JOB NO.:	BOREHOLE ID:
	CLIENT:	DEPTH TO WATER:
	SITE:	LOGGED BY:
	SUBSITE:	DRILLING DATE(S):
	DRILLING CO.:	DRILLING METHOD:
	PERSONNEL:	SAMPLING METHOD:

SAMPLE INTERVAL			BLOWS/ 6 IN. SAMPLE	TIME	PID READING	LABORATORY ANALYSIS	DEPTH IN FEET	USCS SOIL TYPE	SOIL DESCRIPTION
TOP	BOTTOM	RECOVERED							
							1		
							2		
							3		
							4		
							5		
							6		
							7		
							8		
							9		
							0		
							1		
							2		
							3		
							4		
							5		
							6		
							7		
							8		
							9		
							0		

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Appendix C
Installation Restoration Program Procedures

The following IRP Procedures were used to support this sampling and analysis plan:

I-A-6, *Utility Clearance*

I-A-7, *IDW Management*

I-A-9, *Sample Naming*

I-B-1, *Soil Sampling*

I-E, *Soil and Rock Classification*

I-F, *Equipment Decontamination*

I-H, *Direct Push Sampling Techniques*

II-A, *Data Validation Procedure 1, Presentation*

II-D *Data Validation Procedure 4, Levels C and D Organochlorine Pesticides/PCBs by GC - PACDIV*

III-B, *Field QC Samples (Water, Soil)*

III-D, *Logbooks*

III-E, *Record Keeping, Sample Labeling, and Chain-of-Custody Procedures*

III-F, *Sample Handling, Storage and Shipping Procedures*

Department of Navy. 1998. *Project Procedures Manual, U.S. Navy PACDIV Installation Restoration Program (IRP). Prepared for Pacific Division, Naval Facilities Engineering Command (PACNAVFACENGCOM).* October.

Appendix D
Response to Comments

Project Title: Draft SAP Removal Action Design Support and Confirmation Sampling – Group C Sites
Oahu, Hawaii
Reviewer: State of Hawaii, Department of Health, Michael Miyasaka
November 26, 2002

Comment No.	Section No.	Comment	Response
1	General	The plan needs to identify in the figures the locations where the 2, 4, and 6 feet bgs subsurface soil samples will be collected to characterize the vertical extent of the PCB contamination.	Section 1.2 of the sampling and analysis plan (SAP) describes the sampling scheme. This section identifies the original sampling locations, where samples will be collected at 2, 4, and 6 feet below ground surface (bgs). The original sampling locations are shown on figures in Appendix A. First and second step-out locations, if needed, will be selected based on the results of the initial sampling.
2	General	The plan also needs to identify which transformer sites were screened against the 10 mg/kg PCB action level for industrial sites and the reason why.	Further site-specific evaluation was conducted and the Navy has decided to delineate all sites to the high-occupancy level of 1 mg/kg. Tables 1-2 through 1-12 show the sites were initially considered to be low-occupancy.
3	Figure A-19, Transformer A-2, Shipyard GSA	To fully characterize the extent of PCB contaminated soil, three more pre-excavation samples should be collected just outside of the fence, two on the northeast side and one on the south side of the fence.	The figure has been revised to include one new sampling location on the northeast side. This sampling location will be an additional surface delineation sample. If this surface sample has PCB concentration results above 1 mg/kg, then further sampling will be conducted at the deeper depths. No further surface samples are necessary, as the areas surrounding the transformer fence are delineated by the original and first and second step-out samples.
4	Figure A-25, Transformer C-4, Shipyard GSA	To fully characterize the extent of PCB contaminated soil, two more pre-excavation samples should be collected just outside of the wall of the building, one on the north side and one on the south side of the building.	The sampling scheme at the Transformer C-4 site has been revised to include sampling locations at the north and south sides of the building.
5	Figure A-31, Transformer E-25, Shipyard GSA	To fully characterize the extent of PCB contaminated soil, one more pre-excavation sample should be collected just outside of the fence on the northwest side of the fence.	The area on the northwest side of the fence was determined to be delineated by the presence of a second step-out sample from that location.

Project Title: Draft SAP Removal Action Design Support and Confirmation Sampling – Group C Sites
Oahu, Hawaii
Reviewer: PLN20/23 Cultural Resources Management, Melvin N. Kaku
11 December 2002

Comment No.	Section No.	Comment	Response
1	General	The proposed action, which involves collection of surface and subsurface soil samples at various transformer sites included in the Group V sites of the upcoming thermal desorption treatment project, is the type of undertaking with no potential to cause effects on listed, contributing or eligible archaeological properties. The transformer sites within the Halawa-Main Gate GSA, Naval Housing GSA, PWC Main Complex GSA, Shipyard GSA, and West Loch GSA are located outside of the archaeologically sensitive area indicated on Figure 2 of the Integrated cultural Resources Management Plan for Pearl Harbor naval Complex. In addition, there are no known cultural resources located within or in close proximity to the transformer sited locate at NCTAMS Wahiawa, NRTF Lualualei, and NAVMAG Lualualei Branch based on the Cultural Resources Management Plans for those installations.	Comment noted.
2	General	In accordance with the 2002 PROGRAMMATIC AGREEMENT (PA) AMONG THE COMMANDER NAVY REGION HAWAII, THE ADVISORY COUNCIL ON HISTORIC PRESERVATION, AND THE HAWAII STATE HISTORIC PRESERVATION OFFICER, Stipulation IX.A.1, no further review under the PA or NHPA is required.	Comment noted.
3	General	As discussed with ENV182JF, when details on subsequent excavation of contaminated soils at these sites are known (i.e., in the Action Memorandum), we will need to review once again to confirm that the excavations will not cause effects on historic properties.	Comment noted.

Project Title: Draft SAP Removal Action Design Support and Confirmation Sampling – Group C Sites
Oahu, Hawaii
Reviewer: PACDIV ENV1821JF, Janice Fukumoto
October 2002

Comment No.	Section No.	Comment	Response
1	General	We need to add to the discussion that the sites will be delineated to 1ppm due to Navy's decision based on further site specific evaluation.	A discussion has been included in Section 1.3.6 that states, "Based on further site-specific evaluation, the Navy has decided to also delineate and excavate low-occupancy sites to 1 mg/kg."
2	Section 1.3.2; Waipio Peninsula and NAVMAG PH Lualualei GSAs	Didn't Bldg 77 have more documentation that we used? (The IT documents?)	The reference to the *Action Memorandum, Removal Action at Naval Magazine Lualualei, Oahu, Hawaii* (Department of the Navy 2002b) has been added to Section 1.3.2.
3	Page 1-10; Table 1-7	Please include in the descriptions whether or not the site is in the CIA area.	Transformer sites A-10, B-2, E-13, E-16, F-3, F-20, and F-20A have been described as being located in the Controlled Industrial Area (CIA).
4	Page 1-13; Table 1-11	Let's discuss the strategy for this site, as it will not be part of the Removal action due to the logistics at the site. Potential to delineate the surface at this time or defer it to the individual project.	Comment noted. Transformer 2 has been removed from the SAP based on discussions between Janice Fukumoto and Tetra Tech's project manager, Kim Markillie.
5	Page 1-13; Section 1.3.3	Should be NAVMAG PH, Lualualei Branch.	Text has been revised as suggested.
6	Page 1-18; Table 1-13	Need to change the schedule shown.	Schedule has been revised as suggested.
7	Page 1-20; Table 1-15; Step 6; second bullet	Please coordinate this paragraph with page 1-3 Section 1-2 which states that a minimum of 5 samples will be taken for the confirmation.	Text has been revised as suggested.
8	Page 1-20; Table 1-15; Step 6	Please correct the subheadings by bolding them.	Text has been revised as suggested.

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Comment No.	Section No.	Comment	Response
9	General	Let's discuss the sampling locations and strategies for transformers at 1. Halawa Main Gate: 653, (where is the door at J-17), J-21, J-29, K-2, 2. Naval Housing: R-6 3. PWC Main Complex: A-17 4. Shipyard: (Figure A-18 please verify why we state Notes 2 and 6) A-2, C-2, C-4, C-8, C-13, E-11, A-30, F-5 5. Waipio Peninsula: W-11 6. NCTAMS Wahiawa: A-45 now has a white picket fence around it. 7. NRTF LLL: 2, (where are the doors at Bldg 68?) 8. NAVMAG LLL: S-382 questions on the ground cover and a symbol in the plan.	Sampling strategies for the sites listed in the comment were discussed and subsequently revised pursuant to discussion between Ms. Fukumoto and Ms. Markillie. Transformers R-6 and 2 are no longer included in this SAP.

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Reviewer: Terence H. Tengan N465
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Comment No.	Section No.	Comment	Response
1	1st Paragraph, page 1-12	Are there only two sites within West Loch GSA recommended for removal actions? I have not seen SI Report? What about Iroquois Point transformer I-4 or others?	Iroquois Point Transformer I-4 was sampled during the contract task order (CTO 4) Group B field investigation during January and February 2002, and is not included in this sampling and analysis (SAP) for Group C. This SAP is based upon the results of the investigations conducted under CTO 87 during November and December 2001. The only sites that require further soil evaluation at West Loch are the two sites, former S11 and former S33, mentioned in this SAP.
2	Table 1-9, page 1-12	Change to "Former transformer FS11 (removed) …"	Text has been revised as suggested.
3	Table 1-9, page 1-12	Change to "Former transformer S33 (removed) was a pad-mounted transformer located within former Building 33 (demolished). The former building location is still surrounded by concrete and soil."	Text has been revised as suggested.
4	2nd Paragraph, page 1-13	Are there only two sites within NAVMAG PH Lualualei recommended for removal actions? I have not seen SI Report? What about Iroquois other transformer sites?	See the response to comment number 1. There are three sites within NAVMAG PH Lualualei that require further soil evaluation: S380, S382, and former S384. Former Transformer S384 has been added to the SAP since the draft.
5	Table 1-12, page 1-13	Maximum PCB concentrations should be 11 ppm and 19,000 ppm for S380 and S382, respectively as depicted in Figures A-50 and A-51.	Text has been revised as suggested.
6	General	Attachment (a) is a list of transformer sites in my area of responsibility, and remarks regarding contractor access. Sites at the Waipio Peninsula GSA are as/near NISMO. POC at NISMO is Mr. Ron Bow. Please ensure proper coordination with PWC Utilities Dept. for access to all transformer sites.	Comment noted.

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Comment No.	Section No.	Comment	Response
7	General	Attachment (b) is a Safety Brief (e.g. no smoking, etc. in magazine areas) Contractor/subcontractors will review, initial each attribute and sign the cover page of attached Safety Brief. Return the completed package to Terence Tengan prior to the start of work.	Comment noted. The safety brief has been reviewed and signed and will be submitted to Mr. Tengan.
8	General	Attachment (c) is the NAVMAG PH Personnel Registration and Information Form. Contractors/subcontractors will complete the form as follows: 1) complete Section 1; 2) circle LLL, WL, and MAG and cross out WF in Section 2; 3) circle No in Section 3; and 4) obtain Contracting Officer or other authorized Navy representative to sign both Sections 2 and 3. Provide all original forms to the Pass & ID Office at West Loch Building 600 to obtain a NAVMAG PH badge. See Ms. Sharon Anderson (Ph 474-7916), Mon thru Fri, 0600 to 1430 hours (except 1100-1200 lunch). Contractor/subcontractors will also need to provide all vehicle information for base access. Only marked company vehicles (no POVs) will be allowed in the magazine area. All visitor badges and vehicle passes will be obtained from Pass & ID Office at West Loch Building 600.	Comment noted. All required base passes have been obtained by the contractor and subcontractor.