DECLARATION OF THE RECORD OF DECISION

SITE NAME AND LOCATION

Naval Air Station Whidbey Island, Ault Field
Operable Unit 2, Areas 2/3, 4, 14, and 29
Oak Harbor, Island County, Washington

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial actions for Operable Unit (OU) 2 (Areas 2/3, 4, 14, and 29) at Naval Air Station (NAS) Whidbey Island, Ault Field, a Superfund site near Oak Harbor, Washington. OU 2 is one of four operable units at NAS Whidbey. The remedies selected were developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by-the Superfnnd Amendments and Reauthorization Act (SARA), and, to the extent practical, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record for OU 2.

The lead agency for this decision is the United States Navy (Navy). The United States Environmental Protection Agency (EPA) approves of this decision and, with the Washington State Department of Ecology (Ecology), has participated in scoping the site investigations and in evaluating alternatives for remedial action. The state of Washington concurs with the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from OU 2, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDIES

The selected remedial actions at Operable Unit 2 at NAS Whidbey Island, Ault Field, address the threats posed at the site by providing for surface soil removal, institutional controls, and groundwater monitoring. These actions will reduce the mobility of contamination and limit human exposure. The elements of the remedial action include:

- **Groundwater** Monitoring. At Areas 2/3, 4, and 29, groundwater may contain metals exceeding background and health-based levels. Groundwater will be monitored for metals at these areas using low-stress sampling methods. If contamination is confirmed, the Navy, EPA, and Ecology will determine what additional action, if any, is necessary.

- Area 2/3. Implementation of institutional controls and gronndwater monitoring for metals and volatile organic compounds.

- Area 4. Removal of approximately 1,750 cubic yards of PCB-contaminated surface soil north of the location of the former Walker Barn. The excavated soil will be transported to a permitted off-site hazardous/dangerous waste disposal facility. The excavation will be backfilled with clean soil and reseeded.

- Area 14. Pumpout, treatment, and disposal of water (approximately 1,000 gallons) from a drywell used for pesticide rinsate disposal and from a nearby monitoring well south of Building 2555 followed by removal of both wells and associated dioxin-contaminated soil (approximately 420 cubic yards). The soil excavated from the area will be transported to a permitted off-site hazardous/dangerous waste disposal facility. The excavation will be backfilled with clean soil and reseeded. The groundwater in the immediate vicinity of the drywell will be monitored in the wet season to confirm that remedial action was successful.

- Area 29. Removal of approximately 1,400 cubic yards of PAH-contaminated surface soil west of the intersection of Clover Valley Road and Golf Course Road. The excavated soil will be disposed of on base at the Area 6 landfill. The excavation may be left open to create a wetland.

STATUTORY DETERMINATIONS

The selected remedies protect human health and the environment, comply with federal and state requirements that are legally applicable or relevant and appropriate to the remedial actions, and are cost-effective. These remedies use permanent solutions and alternative treatment technologies to the maximum extent practical for this site. However, because of the low volume of contaminated soil and the types of contaminants present, treatment was not found to be practical. Therefore, these remedies do not satisfy the statutory preference for treatment as a principal element of the remedy. Contaminated soil will be removed from the site and properly managed. A 5-year review will be required for the Area 2/3 landfill and potentially for Area 14 if source removals are not effective.

Signature sheet for the Naval Air Station Whidbey Island, Ault Field, Operable Unit 2, Record of Decision between the United States Navy and the United States Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

Captain John F. Schork
Commanding Officer
Naval Air Station Whidbey Island
United States Navy

Date

Signature sheet for the Naval Air Station Whidbey Island, Ault Field, Operable Unit 2, Record of Decision between the United States Navy and the United States Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

Chuck Clarke
Regional Administrator, Region 10
United States Environmental Protection Agency

Date

Signature sheet for the Naval Air Station Whidbey Island, Ault Field, Operable Unit 2, Record of Decision between the United States Navy and the United States Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

Carol Kraege Acting Toxics Cleanup Program Manager Washington State Department of Ecology	Date

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

Section No. | Page No.

FIGURES

TABLES

ABBREVIATIONS AND ACRONYMS

ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	chemical of concern
COPC	chemical of potential concern
CSR	current situation report
DoD	United States Department of Defense
Ecology	Washington State Department of Ecology
EFA NW	Engineering Field Activity, Northwest
ELCR	excess lifetime cancer risk
EPA	United States Environmental Protection Agency
EPC	exposure point concentration
FFA	Federal Facilities Agreement
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
HQ	hazard quotient
HRS	Hazard Ranking System
IAs	initial assessment study
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
LDR	land disposal restriction
MCPP	Mecoprop
MFS	Minimum Functional Standards
mg/kg	milligrams per kilogram
msl	mean sea level
MTCA	Model Toxics Control Act (Washington State)
NACIP	Navy Assessment and Control of Installation Pollutants
NAS	Naval Air Station
NAVFACENGCOM	Naval Facilities Engineering Command
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance

ABBREVIATIONS AND ACRONYMS (Continued)

OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCP	pentachlorophenol
POTW	publicly owned treatment works
ppb	parts per billion
ppm	parts per million
RA	risk assessment
RAO	remedial action objectives
RCRA	Resource Conservation and Recovery Act
RfC	reference concentration
RfD	reference dose
RI/FS	remedial investigation/feasibility study
RME	reasonable maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SF	slope factor
Svoc	semivolatile organic compound
TAL	target analyte list
TBc	to be considered
TCLP	toxic characteristics leaching procedure
TSCA	Toxic Substances Control Act
UCL	upper confidence limit
USGS	United States Geological Survey
VOC	volatile organic compound
WAC	Washington Administrative Code

DECISION SUMMARY

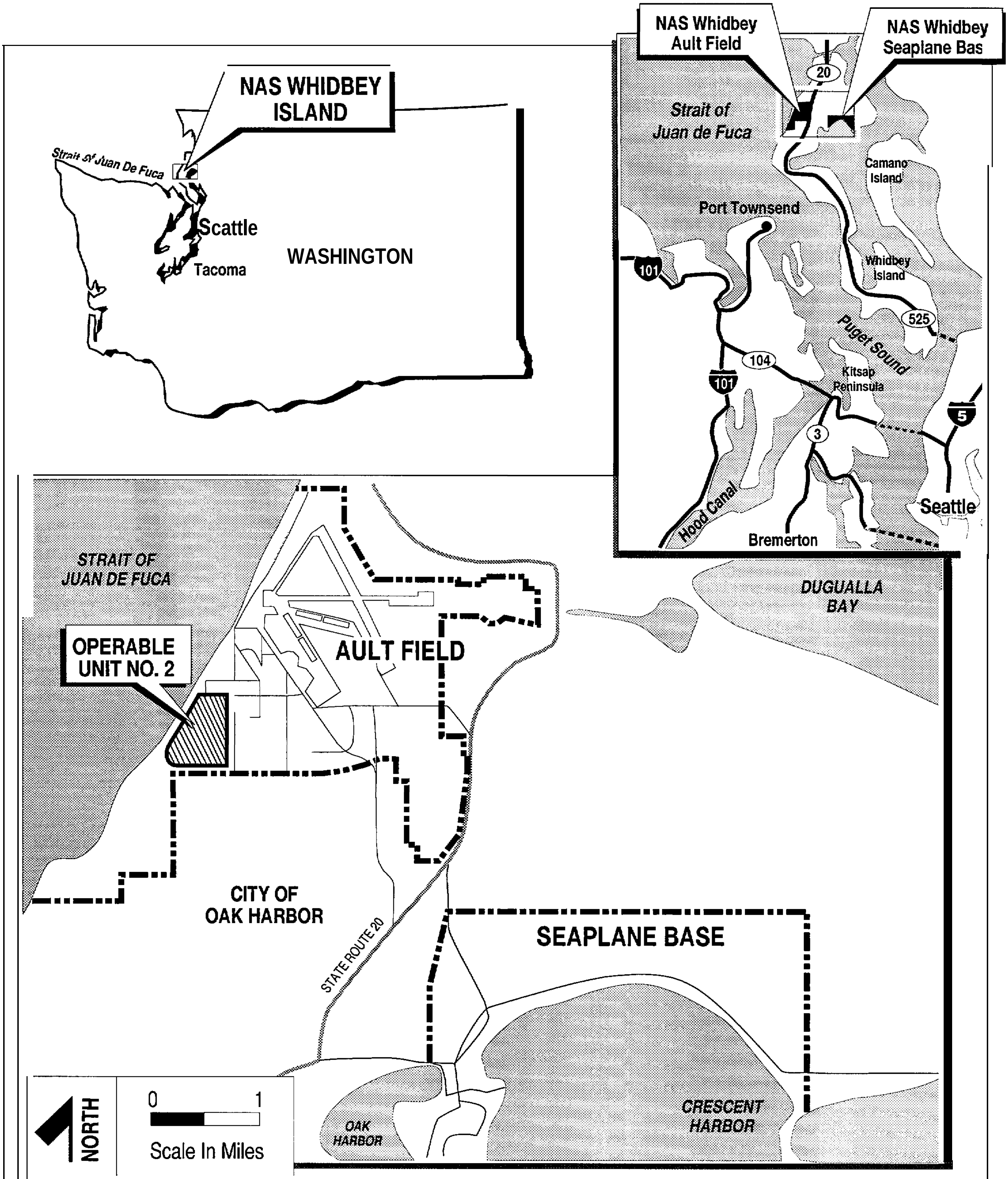
1.0 INTRODUCTION

Under the Defense Environmental Restoration Program, it is the United States Navy's (Navy) policy to address environmental contamination at Navy installations in a manner consistent with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The selected remedial action has the approval of the United States Environmental Protection Agency (EPA) and the concurrence of the Washington State Department of Ecology (Ecology) and is responsive to the expressed concerns of the public. The selected remedial action will comply with applicable or relevant and appropriate requirements (ARARs) promulgated by the EPA, Ecology, and other federal and state agencies.

2.0 SITE NAME, LOCATION, AND DESCRIPTION

Naval Air Station (NAS) Whidbey Island is located in Island County, Washington, at the northern end of Puget Sound and the eastern end of the Strait of Juan de Fuca (Figure 1). The naval air station is divided into two facilities–the Seaplane Base and Ault Field. Ault Field is located at the northern end of the island, north of the city of Oak Harbor (population 14,000). Ault Field is divided into four operable units (OUs); this Record of Decision (ROD) addresses OU 2, which consists of five study areas (Figure 2):

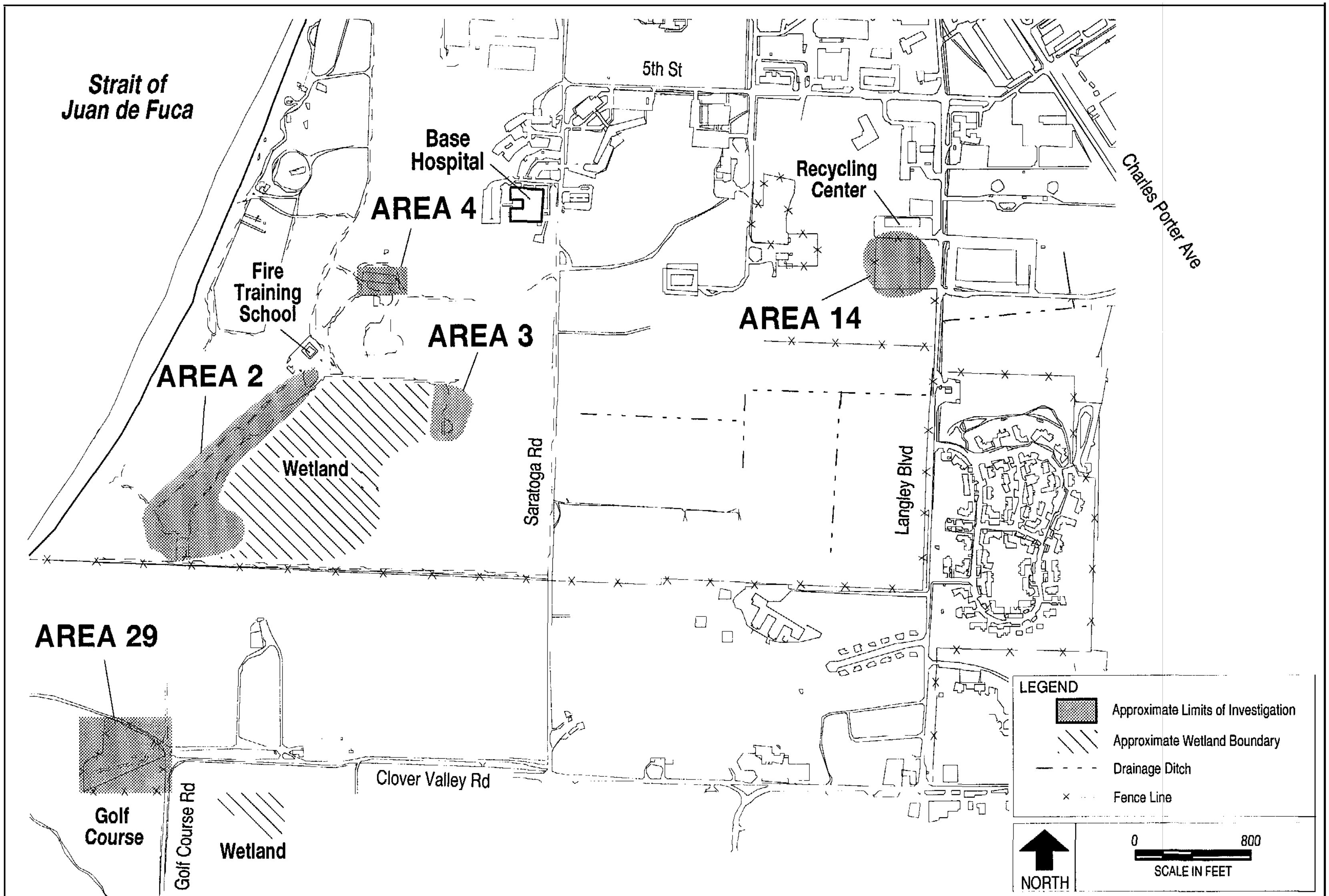
- Area 2: Western Highlands Landfill
- Area 3: 1969-to-1970 Landfill
- Area 4: Walker Barn Storage Area
- Area 14: Pesticide Rinsate Disposal Area
- Area 29: Clover Valley Fire School



CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 1
NAS Whidbey Island
Location Map

CTO 0054
OPERABLE UNIT2
NAS WHIDBEY, WA
RECORD OF DECISION



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 2** **Operable Unit 2 Area Locations**	CTO 0054 OPERABLE UNIT 2 NAS WHIDBEY, WA RECORD OF DECISION

Because of their similar nature and proximity, Areas 2 and 3 were considered together (as Area 2/3) throughout the remedial investigation/feasibility study (RI/FS) and this ROD.

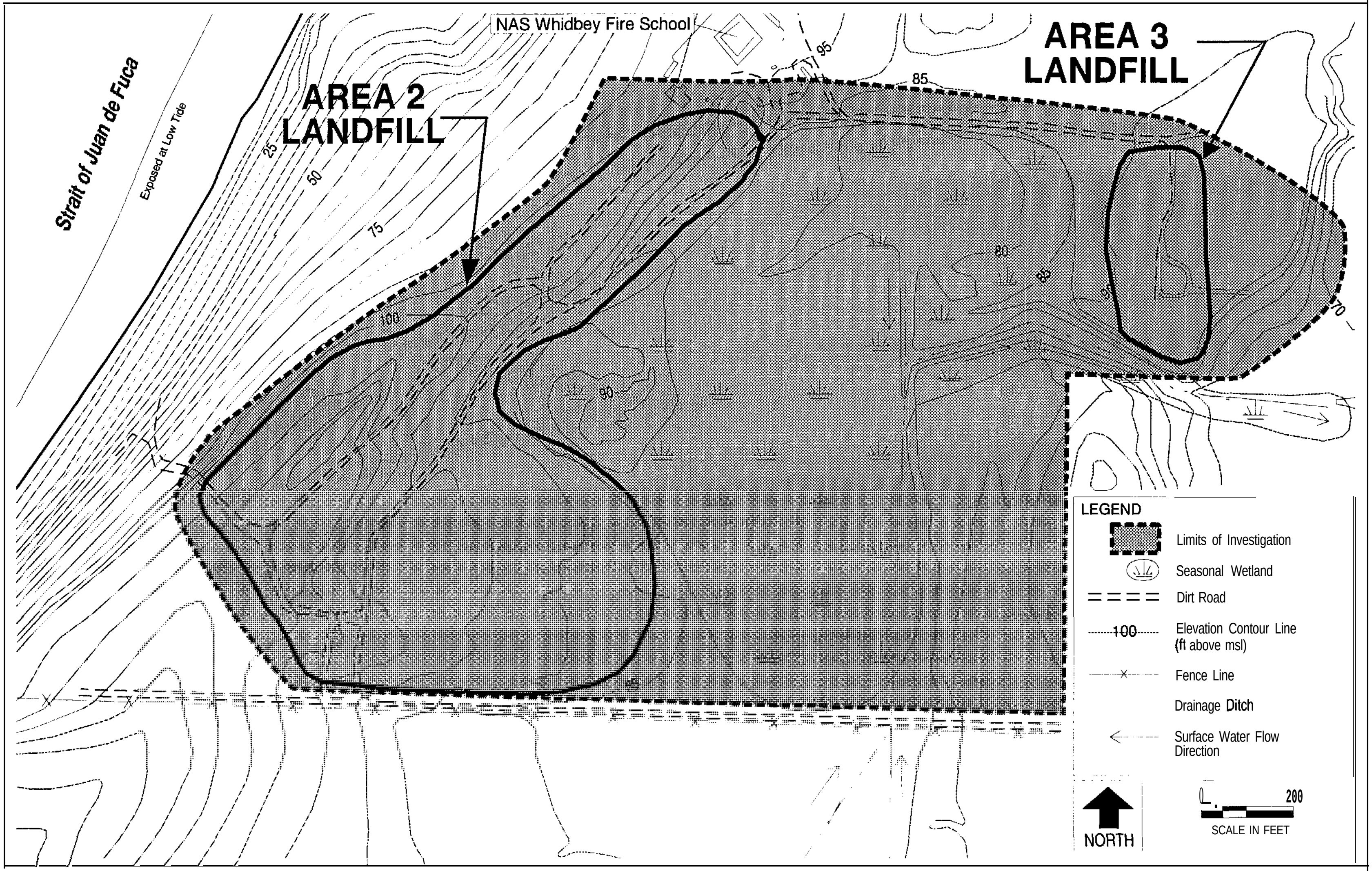
No housing is located in the immediate vicinity of the areas addressed in this ROD. There is military housing approximately one-third of a mile south of Area 14 and one private residence approximately one-quarter of a mile southeast of Area 29. The base hospital is located about 300 yards to the north of Area 4. The properties adjacent to the areas addressed in this ROD include a wetland, the current fire training school, the station recycling center, and the station golf course.

2.1 AREA 2: WESTERN HIGHLANDS LANDFILL

Area 2 (Figure 3) is a 13-acre former landfill located southwest of the current fire training school. From 1959 to 1969, the landfill was the principal disposal area for solid wastes from NAS Whidbey. The landfill received industrial wastes and construction and demolition debris. Currently the surface of the landfill is covered with soil and vegetated. The site is situated on a topographic high of 118 feet above mean sea level (msl) and slopes eastward. The western boundary of Area 2, which is covered with mixed evergreens, slopes toward the Strait of Juan de Fuca. A gravel road and a fence define the southern boundary of Area 2. A wetland is located near the eastern boundary of the site.

2.2 AREA 3: 1969-TO-1970 LANDFILL

Area 3 (Figure 3) is a 1.5-acre parcel located east of Area 2 and southeast of the current fire training school. Area 3 was used for disposal of solid wastes between 1969 and 1970. Materials disposed of at Area 3 are similar to those at the Area 2 landfill. The landfill is covered with soil and is currently vegetated. The site is situated on a small knoll approximately 94 feet above msl. Several remnant house foundations are present at the south end of the knoll, and an evergreen forest is located to the north. The ground slopes to the west and south, into the wetland east of Area 2.



CLEAN
COMPREHENSIVE
LONG-TERM
ENVIRONMENTAL
ACTION NAVY

Figure 3
Area 2 (Western Highlands Landfill) and Area 3 (1969 -to-1970 Landfill)
Site Map

CTO 0054
OPERABLE UNIT2
NAS WHIDBEY, WA
RECORD OF DECISION

2.3 AREA 4: WALKER BARN STORAGE AREA

Area 4 (Figure 4) is located approximately 400 yards west of Saratoga Street in the southwest-central part of Ault Field. The current fire training school is located to the southwest, and the Navy hospital is approximately 300 yards to the north (see Figure 2). A gravel parking lot is located on the site of the former Walker Barn in the southern portion of the area. Area 4 is flat, partially covered with native grasses, and approximately 240 feet wide and 440 feet long. The area is currently fenced.

2.4 AREA 14: PESTICIDE RINSATE DISPOSAL AREA

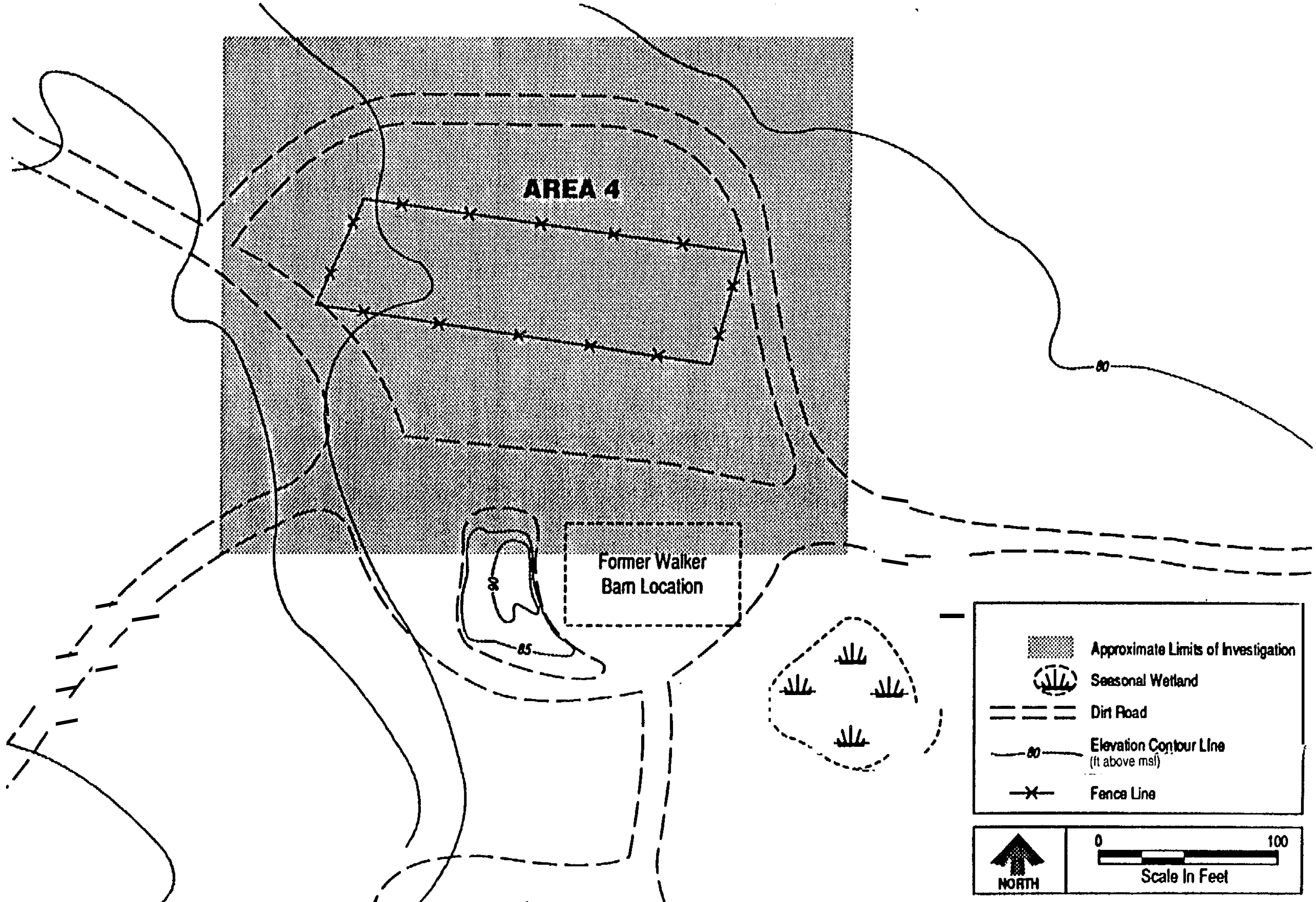
Area 14 (Figure 5) is an approximately O.S-acre fenced parcel located immediately south of Building 2555 and west of Langley Boulevard. Pasture lands are adjacent to the southern and western boundaries of Area 14. A drywell was installed on the north-central edge of the area in 1973. The drywell is located near an intermittent creek that originates from a spring in the northwestern corner of the area and flows southeastward through Area 14, toward Langley Boulevard.

2.5 AREA 29: CLOVER VALLEY FIRE SCHOOL

Area 29 (Figure 6) consists of a 4-acre parcel located west of the intersection of Clover Valley Road and Golf Course Road in the southwestern portion of Ault Field. The site is bordered by evergreen trees to the west, the Navy golf course to the south, Clover Valley Road to the north, and Golf Course Road to the east. A l,600-square-foot concrete pad is located in the center of the area. A small ditch extends northeastward from the concrete pad to a ditch along Clover Valley Road. This ditch eventually flows into the wetland between Areas 2 and 3.

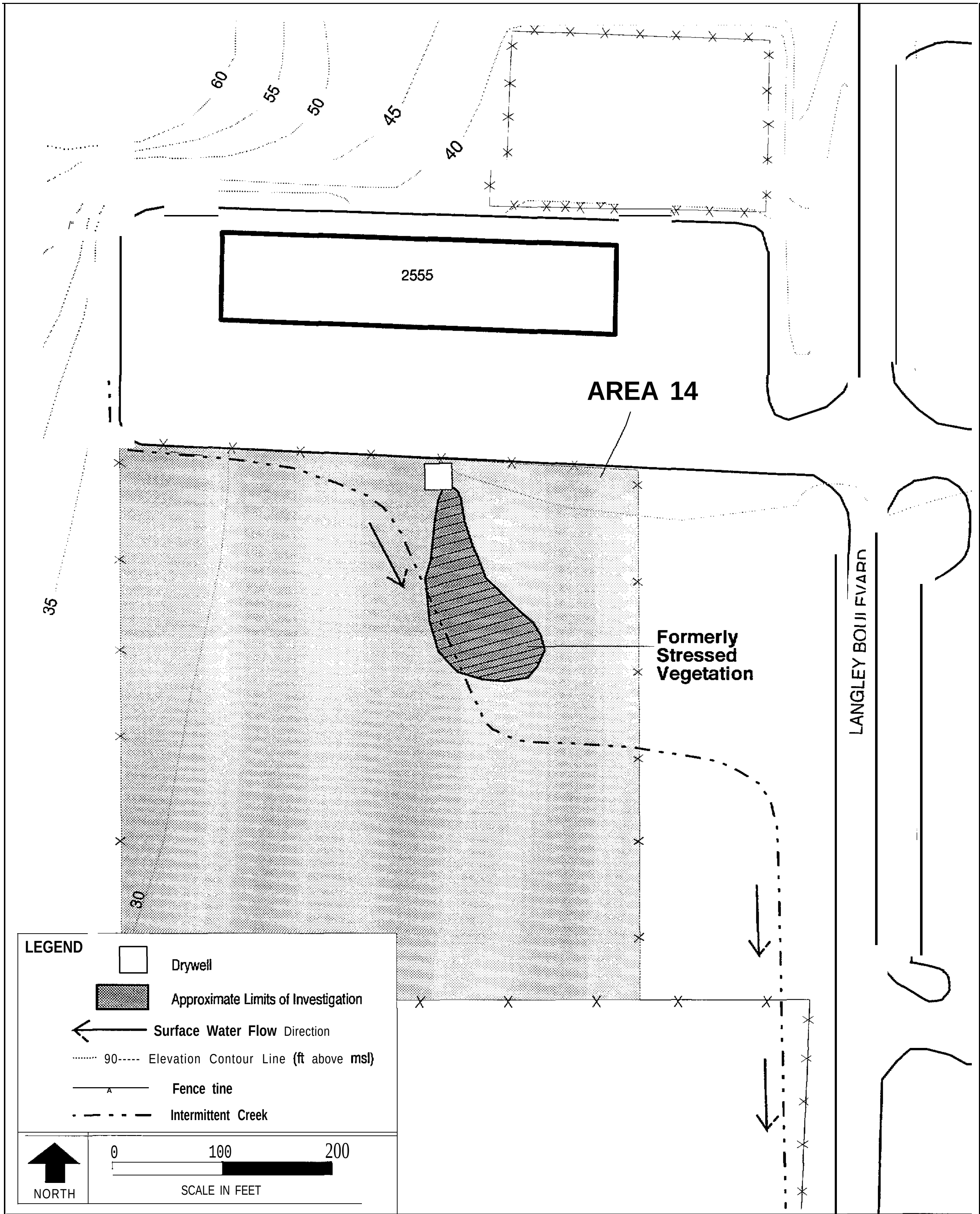
3.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

NAS Whidbey Island was commissioned in 1942. The station was placed on reduced operating status at the end of World War II. In December 1949, a continuing program to increase the capabilities of the station was initiated. The station's current mission is



C EAN

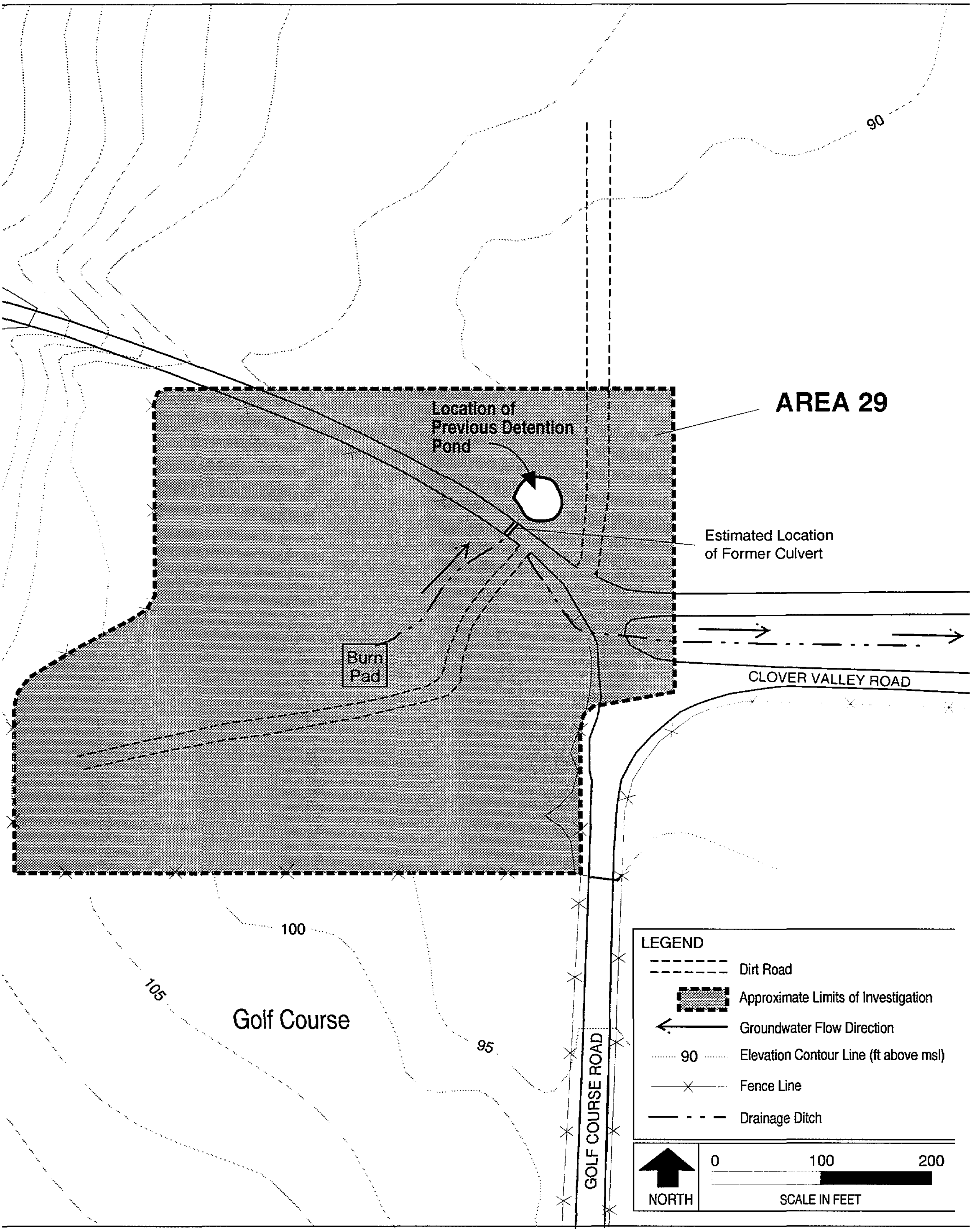
g
W B S g
S M



CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 5
Area 14 (Pesticide Rinsate Disposal Area) Site Map

CTO 0054
OPERABLE UNIT 2
NAS WHIDBEY, WA
RECORD OF DECISION



CLEAN
COMPREHENSIVE
LONG-TERM
ENVIRONMENTAL
ACTION NAVY

Figure 6
Area 29 (Clover Valley Fire School)
Site Map

CTO 0054
OPERABLE UNIT 2
NAS WHIDBEY, WA
RECORD OF DECISION

to maintain and operate Navy aircraft and aviation facilities and to provide associated support.

Since the 1940s, operations at NAS Whidbey Island have generated a variety of hazardous wastes. These wastes were disposed of using practices that were considered acceptable at the time.

In response to the requirements of CERCLA, the United States Department of Defense (DoD) established the Installation Restoration Program (IRP). Responsibility for the implementation and administration of the IRP has been assigned to the Naval Facilities Engineering Command (NAVFACENGCOM). The Engineering Field Activity, Northwest (EFA NW), a part of NAVFACENGCOM, has responsibility for investigations at NAS Whidbey Island and other Navy installations in the Pacific Northwest and Alaska.

In September 1984, the Navy conducted an initial assessment study (IAS) at NAS Whidbey Island. The IAS consisted primarily of a records review. A more detailed report, the NAS Whidbey Island Current Situation Report (CSR), was completed by the Navy in January 1988.

In late 1985, EPA proposed that both Ault Field and the Seaplane Base be nominated to the National Priorities List (NPL) as separate sites. In February 1990, both sites were officially listed on the NPL, based on the following factors:

- The number of waste disposal and spill sites discovered
- The types and quantities of hazardous constituents used and disposed of at the sites (including petroleum products, solvents, paints, thinners, jet fuel, pesticides, and other wastes)
- Potential impacts on domestic wells

In response to the NPL designation, the Navy, the EPA, and Ecology entered into a Federal Facilities Interagency Agreement (FFA) in October 1990. The FFA established a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at NAS Whidbey Island.

Following CERCLA and SARA guidelines, various sites and areas at NAS Whidbey Island were later grouped into operable units. Operable units designate specific areas undergoing the RI/FS process. Five areas at Ault Field (Areas 2, 3, 4, 14, and 29) were collectively identified as OU 2. The purpose of the associated RI/FS was to characterize the site, determine the nature and extent of contamination, assess human and ecological risks, and evaluate remedial alternatives.

4.0 COMMUNITY RELATIONS

The RI, FS, and proposed plan were released to the public in November 1993. These documents were made available to the public in both the administrative record and at the information repositories listed below.

Oak Harbor Library
7030 70th N.E.
Oak Harbor, Washington 98278
Phone: (206) 675-5115

Sno-Isle Regional Library System
Coupeville Library
788 N.W. Alexander
Coupeville, Washington 98239
Phone: (206) 678-4911

For anyone with access to NAS Whidbey Island:

NAS Whidbey Island Library
1115 West Lexington Street
Oak Harbor, Washington 98278
Phone: (206) 257-2702

The administrative record is located at:

Engineering Field Activity, Northwest
Naval Facilities Engineering Command
1040 N.E. Hostmark Street
Olympic Place 1
Poulsbo, Washington 98370
Phone: (206) 396-5984

The mailing address for the administrative record is:

Engineering Field Activity, Northwest
Naval Facilities Engineering Command
3505 N.W. Anderson Hill Road
Silverdale, Washington 98383

Community relations for the Ault Field OU 2 investigation included:

- Creating a community relations plan based on community interviews conducted in 1991 (finalized January 10, 1992)
- Meeting with representatives from the public and from other governmental agencies (under the auspices of the Technical Review Committee)
- Issuing the final proposed plan (on November 10, 1993) with newspaper advertisement
- Meeting with the public (on December 1, 1993) to present the final proposed plan

In accordance with Section 117(a) of CERCLA as amended by SARA, the proposed plan for OU 2 was released to the public through the *Whidbey News Times* on November 10, 1993. The public comment period was from November 12 to December 12, 1993. A public meeting to present the proposed plan to concerned citizens was held at the Chief Petty Officers' Club on Ault Field Road on December 1, 1993, at 7:00 p.m. Two members of the press and four interested citizens attended, along with representatives from the Navy, the EPA, and Ecology.

One comment was received by the Navy at that meeting concerning the proposed plan. No written comments were received on the proposed plan. The single comment is summarized in the Responsiveness Summary (Attachment A) appended to this Record of Decision.

5.0 SCOPE AND ROLE OF OPERABLE UNITS

NAS Whidbey Island comprises two main facilities, Ault Field and the Seaplane Base. Potential source areas at NAS Whidbey Island have been grouped into separate OUS, for which different schedules have been established. There are four operable units at Ault Field and one operable unit at the Seaplane Base. This Record of Decision addresses only OU 2 at Ault Field. Remedies have already been selected for OU 1 at Ault Field and OU 4 at the Seaplane Base (RODS were signed in December 1993). Cleanup actions will be selected later in 1994 for OU 3 and OU 5 (Ault Field).

The remedial actions at Ault Field address soil and on-site groundwater contamination detected above established state and federal health-based and regulatory levels. Surface soils at Areas 4, 14, and 29 are the only environmental media requiring active remediation. Groundwater actions are limited to monitoring at Areas 2/3, 4, and 29 to confirm that no further action is required and at Area 14 to affirm the effectiveness of remediation. The cleanup actions described in this ROD address all known current and potential risks to human health and the environment associated with the OU 2 site.

6.0 SUMMARY OF SITE CHARACTERISTICS

This section presents a summary of site conditions, including a discussion of the geologic and hydrogeologic characteristics and the nature and extent of contaminants.

6.1 HYDROGEOLOGIC SETTING

Whidbey Island lies within the Puget Sound Lowland, a topographic and structural depression between the Olympic Mountains and the Cascade Range. Previous investigations have reported that unconsolidated geologic units on Whidbey Island consist of a sequence of Quaternary-age (less than 2 million years old) glacial and interglacial deposits. These deposits may be as much as 3,000 feet thick in the southern portion of the island, but are relatively thin in the north, where bedrock is present near the surface. The near-surface deposits on Whidbey Island are believed to have been laid down during the Fraser glaciation between 10,000 and 20,000 years ago.

Features of the glacial stratigraphy on northern Whidbey Island and NAS Whidbey Island have been described from surficial exposures and borehole samples during regional geologic studies and site-specific environmental investigations. The general regional stratigraphy of northern Whidbey Island consists of the following geologic units, listed from youngest to oldest:

Recent deposits; sand, silt, and clay
Everson glaciomarine drift: clayey silt to silty clay
Vashon recessional outwash: sand and gravel
Vashon till: gravelly, sandy silt
Vashon advance outwash: clean to silty sand and gravel
Whidbey formation: sand, silt, peat, and clay
Metamorphic bedrock: bedrock

Geologic units encountered during the OU 2 investigation have been correlated to the Everson glaciomarine drift, the Vashon till, the Vashon outwash, and bedrock.

As many as five regional aquifers have been identified on Whidbey Island by the United States Geological Survey (USGS) (Units A through E, from oldest to youngest). These waterbearing units do not directly correlate to distinct geologic units, but rather may comprise part of a single or of multiple geologic units. The aquifers are generally composed of sands and gravels deposited by glacial meltwaters, separated by aquitards made up of fine-grained silts and clays deposited as glacial till, glaciomarine sediments, or nonglacial lake deposits.

The intermediate aquifer (correlating to the USGS Hydrogeologic Unit D) was the only regional waterbearing unit encountered during the OU 2 investigations.

Three perched groundwater zones were encountered above the regional water table beneath OU 2. Discontinuous, low-permeability clay layers within the vadose zone above the Vashon advance outwash deposits, at depths ranging from about 15 to 25 feet below ground surface (bgs), intercept downward-percolating water, creating localized perched groundwater conditions. Perched conditions were encountered on the west side of Area 2, on the south side of Area 3, and in the central portion of Area 29. These perched zones appear to be independent of one another. Water levels in wells installed in the perched groundwater zones showed seasonal variations in excess of 4 feet. Higher water levels were measured during the wet winter months and lower levels during the dry summer season.

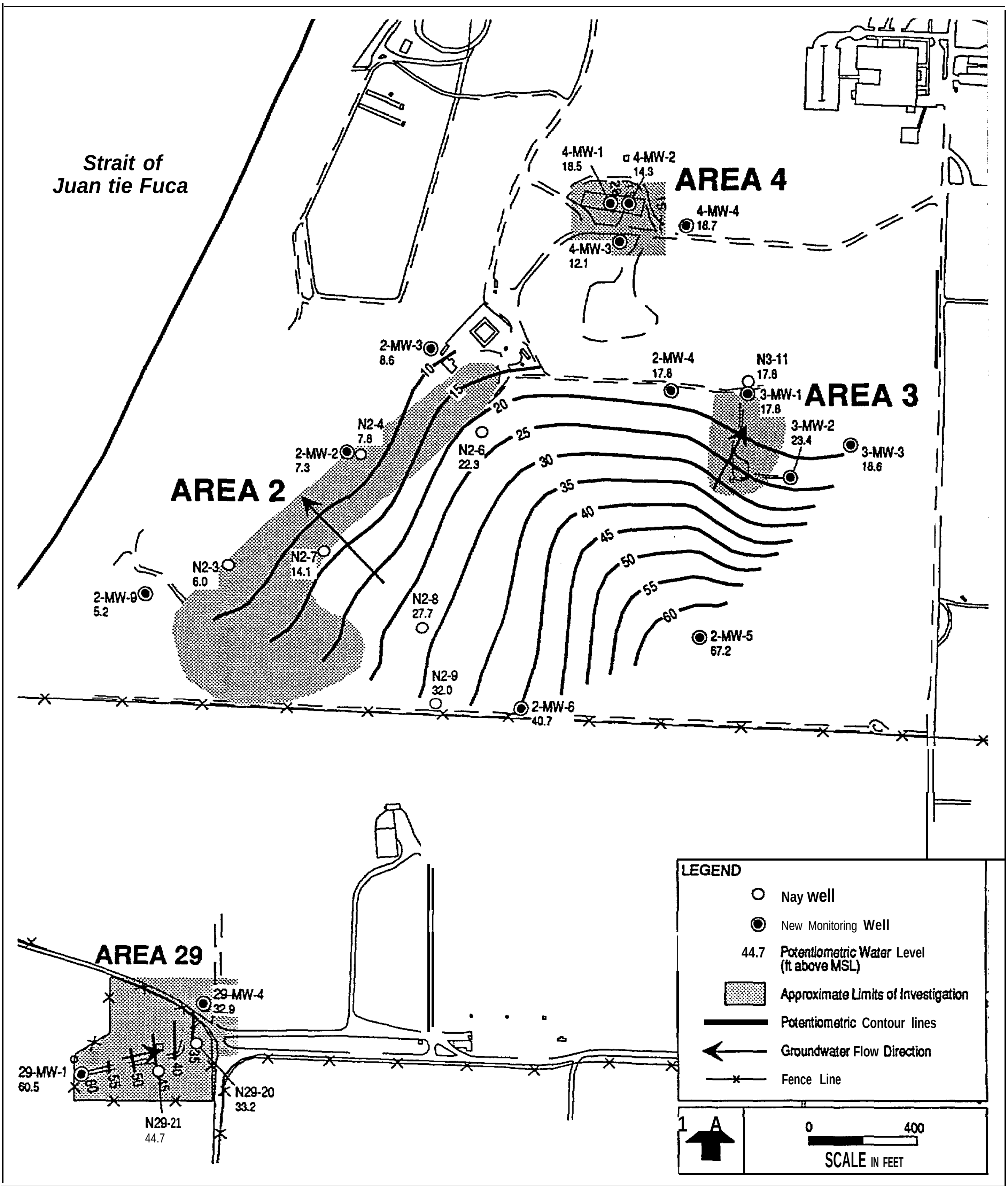
The moderately continuous intermediate aquifer consists of a sandy unit that is typically confined throughout much of Whidbey Island. The aquifer is made up of sands and gravels within the Vashon outwash unit. This waterbearing unit is present beneath most of Ault Field (including OU 2), except for parts of Clover Valley, at depths ranging from about 50 to 100 feet bgs. Groundwater within this unit occurs under artesian conditions where the waterbearing sands are confined by the overlying low-permeability Everson drift deposits. Where this unit has been eroded, groundwater occurs under unconfined conditions. Potentiometric surface elevations within this unit range from about 10 to 75 feet above msl beneath OU 2.

Groundwater within the intermediate aquifer flows generally westward toward the Strait of Juan de Fuca (Figure 7), although the flow direction has a northerly component in Area 3, a southwesterly component in Area 4, and a northeasterly component in Area 29. The groundwater flow direction at Area 14 is generally to the south.

Using the range of hydraulic conductivities and gradients measured at the OU 2 sites, calculated groundwater velocities beneath the area range locally from less than 1 foot per year to over 2,500 feet per year.

The surface water runoff over most of OU 2 flows primarily eastward, through engineered drainage ditches along roads, toward the Ault Field runway area (Figure 8).

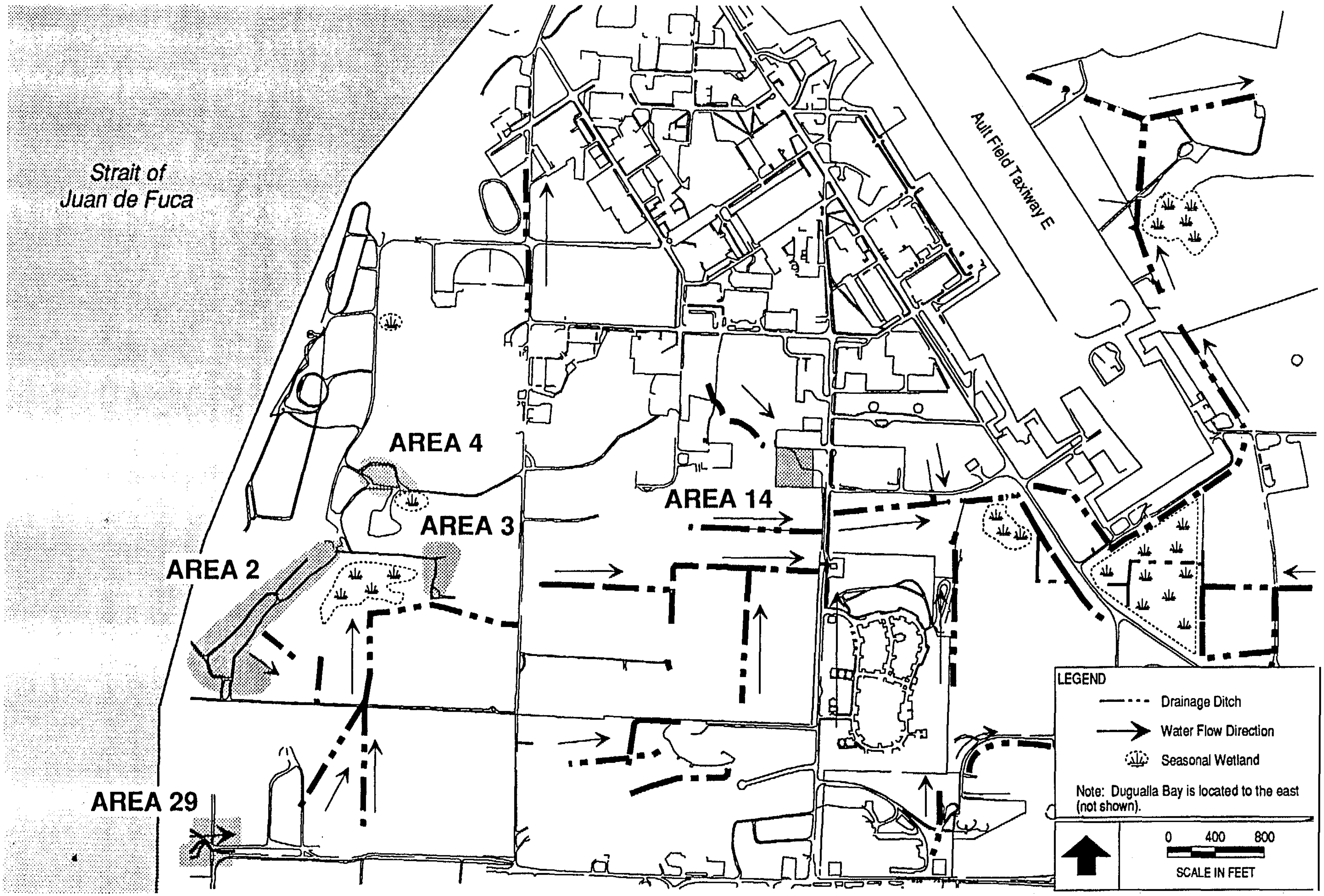
In Areas 2 and 3, the surface runoff flows into the wetland between these two areas. Area 4 is considered to have minimal surface runoff because of the high infiltration rate of the top 2 to 3 feet of soil, which consists of sandy gravels with a dense layer of till below that prevents water movement. The surface runoff for Area 14 moves toward an intermittent creek that flows south through the area. In Area 29, the surface runoff flows from the old fire pad northeast along a small ditch and then parallels Clover Valley Road.



CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 7
Groundwater Potentiometric Surface Contours of the Intermediate Aquifer for Areas 2/3 and 29

CTO 0054
*OPERABLE UNIT 2
NAS WHIDBEY, WA
RECORD OF DECISION



CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 8
Surface Water Drainage Patterns Around OU 2

CTO 0054
OPERABLE UNIT 2
NAS WHIDBEY, WA
RECORD OF DECISION

All the drainage ditches merge at the runway area; the flow is then diverted eastward to a diked lagoon in Clover Valley and subsequently pumped into Dugualla Bay. The most westerly portions of Ault Field drain directly into the Strait of Juan de Fuca. During the winter and spring, most of the freshwater wetlands in and around NAS Whidbey Island are flooded. There is generally no surface runoff during the dry summer and fall months except as a result of intermittent storms.

6.2 NATURE AND EXTENT OF CONTAMINANTS

Surface and subsurface soil, sediment, groundwater, and surface water samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and target analyte list (TAL) inorganic at all the OU 2 areas. At Area 14, where former activities included disposal of pesticide rinsate solutions, additional analyses for dioxins and furans were performed. Background concentration levels for inorganic were established from soil and groundwater samples collected at OU 2 outside the areas of suspected contamination.

There are many ways to investigate landfills and to document the nature and extent of contamination. At Area 2/3, geophysical surveys (electromagnetic and magnetic) were used to delineate the landfill boundaries and locate buried debris. Soil vapor surveys were also used to identify the extent of the landfill and areas of contamination. Rather than characterizing the landfill contents by sampling into the landfill, the impact that these contents have on the environment was investigated by sampling groundwater, surface water, soil, and sediments within and downgradient of the site.

The following paragraphs describe the nature and extent of contamination for chemicals of concern (COC) identified in soil, groundwater, freshwater sediment, and surface water for each area. COC are defined as chemicals that exceed human health and ecological risk threshold concentrations based on federal or state criteria. Inorganic chemicals detected at or below background concentrations are not considered COC.

6.2.1 Soil and Sediment

Table 1 lists the COC for soil and sediment, including the concentration range and frequency of detection for each. The background concentrations of inorganic COC are included for comparison.

Table 1
Chemicals of Concern in Soil and Sediment

Area	Chemical	Concentration Minimum (mg/kg)	Concentration Maximum (mg/kg)	Concentration Mean[a] (mg/kg)	Frequency of Detections[b]	Background Concentration (mg/kg)
2/3	Antimony	4.3	115	16.0	20/47	8.16
	Arsenic	0.53	34.6	3.75	50/56	7.54
	Beryllium	0.24	1.6	0.59	18/56	0.52
	Cadmium	0.30	8.8	3.98	16/56	0.83
	Lead	0.55	805	24.5	55/56	15.60
4	Antimony	3.5	53.7	16.1	9/35	8.16
	Arsenic	1.0	9.6	3.9	29/35	7.54
	Cadmium	0.47	8.6	2.99	23/35	0.83
	Copper	5.2	2,790	103	35/35	44.2
	Lead	0.91	796	44.7	34/34	15.6
	Mercury	0.04	12.7	3.41	5/34	0.11
	zinc	20.7	693	89.5	35/35	100.1
	Benzo(b)fluoranthene	0.013	0.650	0.173	4/18	N/A
	Chrysene	0.350	0.350	0.350	1/18	N/A
	MCPP	133	133	133	1/8	N/A
	PCB Aroclor 1260	0.009	220	20.0	27/80	N/A
	Pentachlorophenol	3.6	1,300	655	3/20	N/A
14	Beryllium	0.40	1.4	0.77	20/47	0.52
	PCB Aroclor 1260	0.95	9.4	5.18	2/49	N/A
	2,3,7,8-TCDD	$7.5x10^{4}$ ppb	0.134 ppb	0.028 ppb	5/18	N/A
29	Arsenic	0.69	26.0	4.73	92/92	7.54
	Beryllium	0.20	4.1	0.58	36/89	0.52
	Cadmium	0.36	9.9	3.98	49/92	0.83
	Lead	2.3	206	18.8	93/93	15.6
	Benzo(a)anthracene	0.010	18.0	2.48	20/93	N/A
	Benzo(a)pyrene	0.007	26.0	3.52	23/93	N/A
	Benzo(b)fluoranthene	0.004	31.0	2.92	34/93	N/A
	Benzo(k)fluoranthene	0.004	13.0	1.29	29/93	N/A
	Chrysene	0.027	22.0	2.69	22/93	N/A
	2,4-Dinitrotolulene	3.704	3.704	3.709	1/35	N/A
	Indeno(1,2,3-cd) pyrene	0.036	17.0	3.06	16/93	N/A
	Pentachlorophenol	0.180	19.0	8.73	7/75	N/A

‘Mean of detections
[b]Detections/number of samples collected
N/A = Not applicable. Background levels were not determined for organic chemicals.
ppb = parts per billion
Note:
Chemicals of concern were identified as those chemicals exceeding federal and state threshold concentrations.

- **Area** 2/3

Antimony, arsenic, beryllium, cadmium, and lead were detected above background concentrations and above risk-based criteria in soil and sediment samples collected from Area 2/3. There was no definable pattern or spatial distribution of the inorganic analytes in the surface or subsurface soil.

- **Area 4**

Antimony, arsenic, cadmium, copper, lead, mercury, and zinc were detected above background concentrations in soils from Area 4 and at levels exceeding risk-based criteria. Lead was detected in the upper 2 inches of soil. No other pattern or spatial distribution of inorganic analytes could be determined.

PCB Aroclor 1260 and pentachlorophenol (PCP), a semivolatile organic compound, were detected in surface soil samples collected north of the former Walker Barn, where transformers were stored. PCB Aroclor 1260 was primarily detected in the surface soils, but was found at depths up to 15 feet in two locations. Pentachlorophenol was detected at three locations in the upper 1 foot of soil. The source of the PCP may have been the electrical power poles, which were treated with wood preservatives, that are stored in the area. Two polycyclic aromatic hydrocarbons (PAHs), benzo(b)fluoranthene and chrysene, were detected above state cleanup levels. The PAHs may have come from the fire training school currently operating approximately 100 yards southwest of Area 4. The chlorinated herbicide Mecoprop (MCPP) was detected in one sample collected 3 feet bgs at monitoring well 4-MW-3, which was drilled within the former Walker Barn foundation.

- **Area 14**

At Area 14, beryllium, PCB Aroclor 1260, and a dioxin, 2,3,7,8-TCDD, were detected in the surface soils at concentrations above risk-based criteria. There was no definable pattern or spatial distribution of beryllium detected in the soil. The beryllium concentrations fell within the range of background concentrations and, therefore, may be associated with naturally occurring levels. PCB Aroclor 1260 was detected in soil boring samples collected from 14-SB-3 at 1 foot and 19 feet bgs. The detection of PC13 Aroclor 1260 at 19 feet bgs is believed to result from surface material that inadvertently entered the boring during drilling. The dioxin, along with some furan congeners at lesser concentrations, was detected at one location, monitoring well 14-MW- 1. Monitoring well 14-MW-1 was installed just downgradient from the drywell.

- **Area 29**

Arsenic, beryllium, cadmium, and lead were detected at concentrations above risk-based criteria in Area 29 soils. As at the other areas, there was no definable pattern or spatial distribution of inorganic analytes in the soil either horizontally or vertically. Six carcinogenic PAHs (benzo(a)anthracene, (benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene) and two SVOCS (PCP and 2,4-dinitrotoluene) were also detected at concentrations above risk-based criteria. Generally, these compounds were found to extend from the burn pad in a northeasterly direction. PAHs were principally detected in the upper 1 foot of soil and were the most frequently detected organic compounds.

6.2.2 Groundwater

During the first phase of sampling, unfiltered groundwater samples were collected using standard bailing techniques and analyzed for organics and total metals content. The samples were cloudy and contained high concentrations of inorganic metals, probably as a result of suspended sediment. During the second phase of sampling, a number of filtered metals samples were collected from selected wells along with the standard total metals samples. In most cases, the filtered samples contained dissolved metals at much lower concentrations than the concentrations of total metals in the unfiltered samples. An insufficient number of dissolved samples were collected to determine dissolved background concentrations. The following paragraphs discuss RI results for both the total and dissolved metals samples.

Tables 2A and 2B show COC for groundwater for each area. Table 2A presents values for total (unfiltered) samples, including both inorganic and organics. Table 2B presents values for filtered (dissolved) samples analyzed only for inorganic (metals).

- **Area 2/3**

Antimony, arsenic, beryllium, cadmium, chromium, lead, manganese, nickel, and vanadium were detected at concentrations above risk-based criteria in groundwater samples analyzed for total metals. Filtered samples were collected for six monitoring wells. In these samples, only antimony, arsenic, and manganese were identified as

Table 2A
Chemicals of Concern in Groundwater
Total (Unfiltered) Samples

Area	Chemical	Concentration			Frequency of Detections[b]	Background Concentration (µg/L)
		Minimum (µg/L)	Maximum (µg/L)	Mean[a] (µg/L)		
2/3	Antimony	41.3	127	66.4	14/50	20.47
	Arsenic	1.4	63.5	13.7	48/50	16.24
	Beryllium	2.0	6.0	3.5	4/50	0.50
	Cadminm	5.0	20.4	10.1	5/50	0.50
	Chromium	4.7	199	57.4	36/50	84.6
	Lead	1.4	75.1	22.6	25/50	9.7
	Manganese	13.0	7,540	1,170	50/50	560
	Nickel	4.9	333	91.2	38/50	157.1
	Vanadium	3.6	251	58.3	25/50	57.6
	Bis(2-ethylhexyl) phthalate	1.0	96	12	16/49	N/A
	1,4-Dichlorobenzene	1.3	3.7	2.3	4/50	N/A
	Vinyl Chloride	0.46	30	19	3/50	N/A
4	Antimony	82.0	82.0	82.0	1/7	20.47
	Arsenic	7.2	22.3	11.5	7/7	16.24
	Cadmium	4.0	9.4	6.7	2/7	0.50
	chromium	12.2	318	139	4/7	84.6
	Lead	6.0	79.2	26.4	5/7	9.7
	Manganese	84.0	3,730	1,010	7/7	560
	Nickel	10.0	461	147	6/7	157.1
	Thallium	1.3	1.3	1.3	1/7	0.17
	Vanadium	12.3	368	150	4/7	57.6
	Zinc	17.0	7,780	1,870	6/7	353.2
14	Bromacil	8.6	6,800	2,300	3/11	N/A
	1,1-Dichloroethane	1.3	1.3	1.3	1/5	N/A
	2,4-Dichlorophenol	2,800	2,800	2,800	1/5	N/A
	Naphthalene	2.5	1,000	500	2/5	N/A
29	Antimony	9.0	58.4	38.3	3/12	20.47
	Arsenic	3.5	53.2	16.9	11/12	16.24
	Beryllium	4.0	28.0	16.0	2/12	0.50
	Chromium	12.9	941	167	8/12	84.6
	Lead	3.6	102	28.8	6/12	9.7

Table 2A (Continued)
Chemicals of Concern in Groundwater
Total (Unfiltered) Samples

Area	Chemical	Concentration Minimum (µg/L)	Concentration Maximum (µg/L)	Concentration Mean[a] (µg/L)	Frequency of Detections[b]	Background Concentration (µg/L)
29	Manganese	5.0	1,780	496	11/12	560
	Nickel	32.3	1,260	215	8/12	157.1
	Vanadium	8.8	1,190	286	5/12	57.6
	Pentachlorophenol	0.02	28	3.6	8/12	N/A

‘Mean of detections
[b]Detections/number of samples collected
N/A = Not applicable. Background levels were not determined.

Table 2B
Chemicals of Concern in Groundwater
Dissolved (Filtered) Metals

Area	Chemical	Concentration Minimum (μg/L)	Concentration Maximum (μg/L)	Concentration Mean[a] (μg/L)	Frequency of Detections[b]	Background Concentration (μg/L)
2/3	Antimony	38.0	72.2	58.2	4/6	N/A
	Arsenic	4.7	9.6	7.1	4/6	N;A
	Beryllium	ND	ND	ND	0/6	N/A
	Cadmium	ND	ND	ND	0/6	N/A
	chromium	3.4	3.4	3.4	1/6	N;A
	Lead	2.4	7.6	5.1	3/6	N/A
	Manganese	7.0	2a4	115	6/6	N/A
	Nickel	10	10	10	1/6	N/A
	Vanadium	15.9	15.9	15.9	1/6	N/A
4	Antimony	10.6	10.6	10.6	1/3	N/A
	Arsenic	3.0	9.3	6.6	3/3	N/A
	Cadmium	ND	ND	ND	0/3	N/A
	Chromium	ND	ND	ND	0/3	N/A
	Lead	ND	ND	ND	0/3	N/A
	Manganese	32.0	139	95.7	3/3	N/A
	Nickel	10.2	10.2	10.2	1/3	N/A
	Thallium	ND	ND	ND	0/3	N/A
	Vanadium	2.7	2.7	2.7	1/3	N/A
	zinc	29.0	29.0	29.0	1/3	N/A
14	No Faltered Samples Collected					
29	Antimony	ND	ND	ND	0/3	N/A
	Arsenic	3.2	7.7	5.5	2/3	N/A
	Beryllium	ND	ND	ND	0/3	N/A
	Chromium	ND	ND	ND	0/3	N/A
	Lead	2.2	2.2	2.2	1/3	N/A
	Manganese	107	424	269	3/3	N/A
	Nickel	11.8	48.0	29.8	2/3	N/A
	Vanadium	2.0	2.0	2.0	1/3	N/A

‘Mean of detections
[b]Detections/number of samples collected
N/A = Not applicable. Background levels were not determined.
ND = Not detected above the analytical detection limit.

contaminants of concern. The organic compounds detected above risk-based criteria in total samples were bis(2-ethylhexyl) phthalate, 1,4-dichlorobenzene, and vinyl chloride. Vinyl chloride was detected once in Area 2 and twice in Area 3. In both areas, the vinyl chloride was detected only in the perched aquifer, not in the intermediate aquifer below.

- **Area 4**

Antimony, arsenic, cadmium, chromium, lead, manganese, nickel, thallium, vanadium, and zinc were detected at concentrations above risk-based criteria in groundwater samples analyzed for total metals. Filtered samples were collected from three of the four Area 4 monitoring wells; only arsenic and manganese were identified as potential COC in the filtered samples. No organic compounds were identified as COC in groundwater samples from Area 4.

- **Area 14**

No inorganic analytes were detected above risk-based criteria in the first encountered groundwater at Area 14. Bromacil, 1,1-dichloroethane, 2,4-dichlorophenol, and naphthalene were detected above risk-based screening concentrations in one monitoring well immediately downgradient of the drywell. These compounds either were not detected or were detected below risk-based screening concentrations in the other wells at Area 14.

One aqueous sample was taken from water that had collected in the drywell at Area 14; the sample contained the herbicide bromacil and the dioxin 2,3,7,8-TCDD at concentrations above risk-based criteria.

- **Area 29**

Antimony, arsenic, beryllium, chromium, lead, manganese, nickel, and vanadium were detected above risk-based criteria in unfiltered groundwater samples analyzed for total metals at Area 29. In filtered groundwater samples collected from three of the four monitoring wells, only arsenic and manganese were identified as potential COC. The only organic compound detected above risk-based criteria was PCP (detected in one well upgradient of the burn pad).

6.2.3 **Surface** Water

Chemicals identified as COC in surface water are shown in Table 3. Background concentrations were not established for comparison against surface water concentrations. In most locations, sediment samples as well as surface water samples were collected. The following paragraphs summarize surface water COC for each area.

- **Area** 2/3

Arsenic, cyanide, lead, and bis(2-ethylhexyl) phthalate were detected at concentrations above federal and state criteria. The detection of inorganic analytes in various surface water samples appears random and does not indicate a potential upstream source. Arsenic, cyanide, and bis(2-ethylhexyl) phthalate were detected at estimated concentrations near the detection limit in three samples, each primarily in the wetlands between Area 2 and Area 3. Lead was detected in seven of eight samples, with each detection exceeding federal and state criteria.

- **Area 4**

Arsenic, chromium, copper, and lead exceeded risk-based criteria in one surface water sample collected from the wetlands downgradient of Area 4. Zinc exceeded risk-based criteria in one surface water sample collected from the wetlands upgradient of Area 4.

- **Area 14**

Arsenic, chromium, copper, and zinc were detected at concentrations above risk-based criteria in one surface water sample collected downgradient of the drywell. Lead exceeded risk-based criteria at all three surface water sampling stations.

- **Area 29**

Arsenic, cadmium, copper, lead, and zinc were detected at concentrations above risk-based criteria, as were one carcinogenic PAH, benzo(b)fluoranthene, and art SVOC, bis(2-ethylhexyl) phthalate. All of the inorganic analytes were detected in one of the three samples collected immediately downgradient of the burn pad. Benzo(b)fluoranthene was detected in all three surface water samples collected at Area 29. Bis(2-ethylhexyl) phthalate was detected in one surface water sample located downgradient of the burn pad.

Table 3
Chemicals of Concern in Surface Water

Area	Chemical	Concentration Minimum (µg/L)	Concentration Maximum (µg/L)	Concentration Mean[a] (µg/L)	Frequency of Detections[b]	Background Concentration (µg/L)
2/3	Arsenic	2.0	2.9	2.4	3/8	N/A
	Cyanide	4.7	7.4	6.1	3/8	N/A
	Lead	2.8	47.7	11.8	7/8	N/A
	Bis(2-ethylhexyl) phthalate	4.0	11	6.7	3/8	N/A
4	Arsenic	2.0	2.0	2.0	1/3	N/A
	chromium	16.2	16.2	16.2	1/3	N/A
	Copper	6.7	16.3	11.5	2/3	N/A
	Lead	2.6	6.6	4.6	2/3	N/A
	zinc	10.0	245	104	3/3	N/A
14	Arsenic	2.4	2.4	2.4	1/3	N/A
	Chromium	23.5	23.5	23.5	1/3	N/A
	Copper	8.7	32.9	16.9	3/3	N/A
	Lead	2.6	10.4	5.7	3/3	N/A
	zinc	119	119	119	1/3	N/A
29	Arsenic	10.6	10.6	10.6	1/3	N/A
	Cadmium	5.8	5.8	5.8	1/3	N/A
	Copper	103	103	103	1/3	N/A
	Lead	572	572	572	1/3	N/A
	zinc	154	154	154	1/3	N/A
	Benzo(b)fluoroanthene	0.04	0.33	0.14	3/3	N/A
	Bis(2-ethylhexyl) phthalate	4.0	4.0	4.0	1/3	N/A

[a]Mean of detections
[b]Detections/number of samples collected
N/A = Not applicable. Background levels were not determined.

7.0 SUMMARY OF SITE RISKS

The baseline risk assessment (RA) provides an analysis of both current and potential future risks for a site and is used to evaluate whether remedial action is needed. It serves as the baseline to indicate what risks could exist if no action were taken at the site and if existing land use patterns were to shift to full-time residential or occupational use of the site. The primary components of the risk assessment include identification of the chemicals of concern, exposure assessment, toxicity assessment, and risk characterization. This section of the ROD reports the results of the baseline risk assessment conducted for OU 2.

Both human health and ecological risk assessments were performed for OU 2 to determine the potential risks associated with chemicals identified at the site. The human health assessment was generally conducted in accordance with EPA's *Risk* Assessment *Guidance for Superfund*, Volume I: *Human Health Evaluation Manual (Part A), Region 10 Supplemental Risk Assessment Guidance,* and *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors.* Groundwater was evaluated on a site wide basis as compared to a clustering approach. The ecological risk assessment followed the latest federal guidance. The RA methods and results are summarized below.

7.1 HUMAN HEALTH RISKS

The human health RA evaluated potential risks associated with exposure to chemical contaminants from OU 2. All chemicals that were detected at least once were considered in the risk assessment. Art initial screening was performed to compare the maximum detected concentrations of chemicals in soil and groundwater with background concentrations (inorganic only) and risk-based screening concentrations developed by EPA Region 10. (For groundwater, the risk-based screening concentration designated by EPA represents a 10^{-6} risk for carcinogenic effects and a hazard quotient [HQ] of 0.1 for noncarcinogenic effects. For soils, the risk-based screening concentrations are 10^{-7} for carcinogenic effects and an HQ of 0.1 for noncarcinogenic effects.) Only those chemicals that exceeded background or risk-based screening concentrations were carried through the quantitative risk assessment. These chemicals are considered to be chemicals of potential concern, or COPC. (The COPC are different from those chemicals identified as COC in Section 6.2, which are those chemicals that exceeded a 10^{-4} cancer risk or a noncancer hazard index (HI) of 1 or that exceeded state standards.)

The cancer risks summarized in this report represent those risks at or above the upper end (10^{-4}) of EPA's acceptable risk range. However, the entire 10^{-6} to 10^{-4} risk range was considered in the evaluation of the risks.

The RA considered potential exposure to chemicals from the groundwater, surface water, and soil and from the ingestion of plants, meat, and dairy products grown on site. Inhalation of volatile chemicals released into indoor air while showering and inhalation of particulate in outdoor air were also evaluated. Three exposure scenarios were evaluated for OU 2: current recreational, future occupational, and future residential. Potential exposures to both children and adults were evaluated under the recreational and the future residential scenarios.

7.1.1 Exposure Assessment

The purpose of the exposure assessment is to quantify contact with chemicals of potential concern identified at the site. This is accomplished by identifying the exposure media, the potentially exposed populations (based on current and future land uses), and the routes of exposure and by quantifying human intake of chemicals. Table 4 presents the populations, media, and routes of exposure that were evaluated for each area.

- **Exposed Populations**

Both current and potential future land uses were considered in identifying potentially exposed populations. The same populations were evaluated for each area at OU 2. These potentially exposed populations include recreational visitors, future workers, and future residents. Risks have been calculated for both average exposures and for a reasonable maximum exposure (RME). The RME corresponds to the highest plausible degree of exposure that may be anticipated at a site.

- **Exposure Media and Pathways**

Because of the similar nature of the sites at OU 2, the same media were evaluated for each of the areas. The media that were quantitatively evaluated in the human health risk assessment include soil, groundwater, surface water, vegetables, beef, and dairy

Table 4
Populations, Media, and Routes of Exposure Evaluated at Areas 2/3, 4, 14, and 29

	Current Recreational			Future Occupational			Future Residential		
Medium	Ingestion	Inhalation	Dermal Contact	Ingestion	Inhalation	Dermal Contact	Ingestion	Inhalation	Dermal Contact
Area 2/3									
Soil	YES	YES	YES	YES	YES	YES	YES	YES	YES
Groundwater	—	—	—	—	—	—	YES	YES	YES
Surface water	YES	NO	YES	NO	NO	NO	NO	NO	NO
Food	—	—	—	—	—	—	YES	—	—
Area 4									
Soil	YES	YES	YES	YES	YES	YES	YES	YES	YES
Groundwater	—	—	—	—	—	—	YES	YES	YES
Surface water	YES	NO	YES	NO	NO	NO	NO	NO	NO
Food	—	—	—	—	—	—	YES	—	—
Area 14									
Soil	YES	YES	YES	YES	YES	YES	YES	YES	YES
Groundwater	—	—	—	—	—	·	YES	YES	YES
Surface water	YES	NO	YES	NO	NO	NO	NO	NO	NO
Food	—	—	—	—	—	—	YES	—	—
Area 29									
Soil	YES	YES	YES	YES	YES	YES	YES	YES	YES
Groundwater	—	—	—	—	—	·	YES	YES	YES
Surface water	YES	NO	YES	NO	NO	NO	NO	NO	NO
Food	—	—	—	—	—	—	YES	—	—

Notes:
NO = Pathway not evaluated
YES = Pathway evaluated
— = Pathway is not applicable to this receptor.

products. Although a limited number of sediment samples were collected from several of the areas, these sediments were not significantly different from native soils and were evaluated in the risk assessment as if they were soil samples.

Although residential use of groundwater was evaluated, there is currently no residential groundwater development at OU 2, and these exposures are strictly hypothetical. For each area, groundwater risks were calculated using data from unfiltered groundwater samples. When data were available (Areas 2/3, 4, and 29), risks resulting from residential use of groundwater containing dissolved (filtered) inorganic were also evaluated. A perched aquifer exists at Area 2/3, but its extent is so limited that it was not considered a potential drinking water source in the risk assessment.

Surface water from the wetland between Areas 2 and 3, seasonally ponded water at Areas 4 and 29, and surface water in the Area 14 drainage ditch were evaluated only for the recreational exposure scenario. Recreational contact with surface water by children could be considered a potential exposure route under the future residential scenario. However, because this route was considered in the current recreational scenario and no significant risks were found, the route was not re-evaluated for future residents.

The following pathways were evaluated for each media of concern:

- Soil: Ingestion, dermal contact, and inhalation of suspended particulate
- Groundwater: Ingestion, inhalation of volatiles, and dermal contact while bathing
- Surface water: Ingestion and dermal contact
- Food chain: Ingestion of vegetables, beef, and dairy products

- **Exposure Point Concentrations**

Exposure point concentrations (EPCs) are those concentrations of each chemical to which an individual may potentially be exposed for each medium at the site. For CERCLA risk assessments, the EPC is intended to be an upper-bound representation of the average site concentration, such as the 95 percent upper confidence limit (UCL) on the mean (95 percent UCL). If, however, the 95 percent UCL exceeds the maximum detected concentration, then the maximum concentration is used instead. The 95 percent UCL was used to represent the EPC for all chemicals at OU 2.

Table 5 presents the EPCS for those chemicals whose calculated risk at OU 2 exceeded EPA's acceptable risk range (i.e., a cancer risk greater than 10^{-4} or a noncancer hazard quotient greater than 1) and those chemicals that, when added together, posed a cancer risk greater than 10^{-4} or a noncancer hazard index greater than 1. The soil values listed in Table 5 combine both surface and subsurface soils.

- **Chemical Intake by Exposure Pathway**

Estimates of potential human intake of chemicals of concern for each exposure pathway were calculated by combining the EPCS with pathway-specific exposure assumptions (such as ingestion and inhalation rates, body weights, and exposure frequencies and durations) for each medium of concern. Exposure estimates for chemicals at OU 2 were calculated using a combination of federal and EPA Region 10 default and site-specific exposure assumptions.

7.1.2 Toxicity Assessment

The purposes of the toxicity assessment are (1) to weigh the available evidence regarding the potential for chemicals to have adverse effects on exposed individuals (i.e., hazard identification) and (2) to provide a quantitative estimate of the relationship between the magnitude of exposure and the likelihood or severity of adverse effects (i.e., dose response assessment). Toxicity values are developed separately for carcinogenic effects (cancer slope factors) and noncarcinogenic health effects (reference doses). Toxicity values are derived from either epidemiological or animal studies, to which uncertainty factors are applied (to account for variability among humans, as well as for the use of animal data to predict effects on humans). The primary sources for toxicity values are the EPA's Integrated Risk Information System (IRIS) database and Health Effects Assessment Summary Tables (HEAST). Table 6 lists the toxicity values and supporting information for the chemicals that either singly, or when added together, posed a cancer risk greater than 10^{-4} or a hazard index greater than 1.

Slope factors (SFs) have been developed by EPA for estimating excess lifetime cancer risks (ELCR) associated with exposure to potential carcinogens. SFS are expressed in units of $(mg/kg\text{-}day)^{-1}$ and are multiplied by the estimated daily intake rate of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime

Table 5
Exposure Point Concentrations for Chemicals of Greatest Significance for the Human Health Risk Assessment at OU 2

Chemical/Area[a]	Mean Concentration	RME Concentration (95% UCL)	Maximum Detected
Area 2/3			
Soil	**(ppm)**	**(ppm)**	**(ppm)**
Antimony	10.6	22.9	115
Arsenic	4.7	7.6	34.6
Groundwater (total/dissolved)	**(ppb)**	**(ppb)**	**(ppb)**
Antimony	24/34	31/65	127/72
Arsenic	13/6	16/9	63.5/9.6
Manganese	1,170/110	1,590/200	7,540/284
Area 4			
Soil	**(ppm)**	**(ppm)**	**(ppm)**
Antimony	6.1	11.9	53.7
Arsenic	5.1	6.3	9.6
Lead	73.4	158.0	796
MCPP	18.8	49.8	133
PCB Aroclor 1260	20.2	38.9	220
Groundwater (total/dissolved)	**(ppb)**	**(ppb)**	**(ppb)**
Antimony	19/ND	40/ND	82.0/ND
Arsenic	12/5	15/8	22.3/7.6
Manganese	1,000/127	2,030/139	3730/139
Area 14			
Groundwater (total)	**(ppb)**	**(ppb)**	**(ppb)**
Bromacil	620	1.740	6.800
2,4-Dichlorophenol	560	1,760	2,800

Table 5 (Continued)
Exposure Point Concentrations for Chemicals of Greatest Significance for the Human Health Risk Assessment at OU 2

Chemical/Area[a]	Mean Concentration	RME Concentration (95% UCL)	Maximum Detected
Area 29			
Groundwater (total/dissolved)	**(ppb)**	**(ppb)**	**(ppb)**
Antimony	n/ND	20/ND	58.4/ND
Arsenic	15/5	23/7	53.2/7.4
Beryllium	3/ND	7/ND	28/ND
Chromium	no/ND	240/ND	941/ND
Manganese	8601190	1.500/2s0	1.780/276
Nickel	140/ND	310/ND	1,260/ND
Vanadium	120/ND	280/ND	1,190/ND

‘No chemicals of potential concern were detected in surface water.

Notes:
95% UCL = 95th percentile of the upper confidence limit of the arithmetic mean of the untransformed data set.
RME = Reasonable Maximum Exposure
ppm = parts per million (mg/kg for soil; mg/L for groundwater)
ppb = parts per billion (μg/kg for soil; μg/L for groundwater)
ND = not detected

Table 6
Toxicity Values for Chemicals of Potential Concern

Carcinogenic Effects

Chemical	Slope Factor (mg/kg-day)$^{-1}$			
	Oral	Source	Inhalation	Source
Arsenic	1.75	IRIS	50	HEAST
Beryllium	4.3	IRIS	8.4	HEAST
Chromium	—	—	41	HEAST
PCBs	7.7	IRIS	—	—

Noncarcinogenic Effects

Chemical	Chronic Reference Dose (RfD) (mg/kg-day)				Uncertainty Factor		Critical Effect
	Oral	Source	Inhalation	Source	Oral	Inhalation	
Antimony	0.0004	IRIS	—	—	1,000	NA	Systemic, blood
Arsenic	0.0003	IRIS	–		3	NA	Skin, keratosis, hyperpigmentation
Beryllium	0.005	IRIS	–	–	100	NA	No observed effects
Bromacil	0.002[a]	—	—	—	NA	NA	NA
Chromium	0.005	IRIS	—	–	500	NA	No observed effects
2,4-Dichlorophenol	0.003	IRIS	—	–	100	NA	Altered immune function
Manganese	0.14 (food) 0.005 (water)	IRIS IRIS	0.00014	IRIS	1	300	Central nervous system/respiratory system
MCPP	0.001[a]	—	—	—	3,000	NA	Kidney/decreased weight
Nickel	0.02	IRIS	—	–	300	–	Decreased weight
PCBS	—	—	—	—	—	—	—
Vanadium	0.007	HEAST	–	–	100	NA	No observed effects

Notes:
[a]This value derived from the RI, where the methodology used to calculate the value is described.
IRIS = Integrated Risk Information System (EPA database)
HEAST = Health Effects Assessment *Summary* Tables (EPA)
— = No toxicity information available for this chemical by this pathway
NA = Not available

cancer risk associated with exposure at that intake level. The upper bound reflects the conservative estimate of the risks calculated from the SF. Use of this approach makes underestimation of the actual cancer risk highly unlikely.

Reference doses (Rills) were developed by EPA for evaluating the potential for adverse health effects associated with exposure to noncarcinogenic chemicals. RfDs are expressed in units of mg/kg-day and are estimates of acceptable lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals of concern from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) are compared with the RfD. RfDs have not been developed for all noncarcinogens, primarily because of a lack of toxicity data. For chemicals lacking RfDs, surrogate toxicity values were derived from structurally similar compounds when possible. However, it was not possible to calculate noncancer values for all chemicals.

Toxicity values are only available for the oral and inhalation pathways. EPA has not published toxicity values for evaluating the dermal pathway and recommends using the oral toxicity values to evaluate dermal exposure.

Because of its unique toxicity, lead does not have a verified reference dose. Instead, EPA recommends an alternative approach to evaluating lead toxicity. This approach involves using EPA's LEAD 0.5 model to estimate blood lead levels resulting from multipathway exposures. The results of this model are used to determine whether the lead present at the site in various media poses a potential risk to children.

7.1.3 Risk Characterization

The risk characterization integrates the information developed in the toxicity assessment and exposure assessment to develop carcinogenic and noncarcinogenic risks. Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation. An excess lifetime cancer risk of 1 x 10^{-6} indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site. The National Contingency Plan recommends an acceptable target cancer risk range of 10^{-6} to 10^{-4} for CERCLA sites.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (or the ratio of the estimated intake derived from the contaminant concentration in a single given medium to the contaminant's reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the hazard index can be generated. If the HI is less than 1.0, it indicates that noncarcinogenic health effects are unlikely. If the HI is greater than 1.0, it indicates that adverse health effects are possible.

Tables 7 through 10 present noncancer and cancer risk summaries for each area at OU 2. Only under the future residential scenario were carcinogenic and noncarcinogenic risks found to exceed 10^{-4} or an HI of 1, respectively. Risks are presented for groundwater; however, as discussed previously, these risks are hypothetical because there are no on-site residential receptors using the groundwater. Risks from exposure to lead were evaluated using the LEAD 0.5 biokinetic model recommended by the EPA. The noncancer risks from lead at Area 4 calculated using this model were slightly above EPA's acceptable limit.

Risks were evaluated for inorganic chemicals in both filtered and unfiltered groundwater samples from Areas 2/3, 4, and 29. The filtering of suspended solids significantly reduced the risks for the filtered samples. In addition, the contribution of background levels of metals in soil and groundwater to the overall site risk was evaluated. A large proportion of the overall risk resulting from inorganic is attributable to naturally occurring background levels. Although food pathway risks were evaluated in the RI, they are a source of substantial uncertainty in the overall risk estimates and are not presented here.

Risk summaries for Areas 2/3, 4, 14, and 29 are presented below.

- **Area 2/3**

Soil. There were no cancer risks associated with chemicals in soil that exceeded 10^{-4}. Antimony and arsenic were found to pose a potential noncancer risk to future residents.

Groundwater. Antimony, arsenic, and manganese were found to produce a noncancer risk (HI = 13). Cancer risk for the groundwater pathway was 4.6 x 10^{-4} because of arsenic in groundwater. The cancer risk for the filtered groundwater was 1.8 x 10^{-4} and was entirely attributable to arsenic. The noncancer risk from filtered groundwater (HI = 6.4) was due primarily to antimony.

Table 7
Area 2/3—Summary of RME Noncancer and Cancer Human Health Risks

Media/ Route	Current Land Use		Future Land Use			
	Recreational		Residential		Occupational	
	Noncancer HI	Cancer	Noncancer HI	Cancer	Noncancer HI	Cancer
Soil						
Ingestion	0.045 B	8.7E-07 B	1.4 E	2.5E-05 W	0.048 B	2.8E-06 W
Inhalation	<0.001 B	1.4E-11 B	<0.01 B	7.0E-10 B	<0.001 B	2.4E-10 B
Dermal	0.004 B	1.0E-07 B	0.031 B	7.1E-07 B	0.005 B	2.8E-07 B
Combined	0.049 B	9.7E-07 B	1.4 E	2.6E-05 W	0.053 B	3.1E-06 W
Groundwater[1]						
Ingestion			13. E	4.6E-04 E		
Inhalation			0.002 B	1.5E-06 W		
Dermal			0.028 B	1.5E-06 W		
Combined			13. E	4.6E-04 E		
Surface Water						
Ingestion	0.003 B	7.2E-09 B				
Dermal	<0.001 B	2.7E-09 B				
Combined	0.004 B	9.9E-09 B				
All Media Combined	0.053 B	9.8E-07 B	14. E	4.9E-04 E	0,053 B	3.1E-06 W

Notes:
B = Below or at limit of EPA's target noncancer hazard index (HI $\leq$ 1) or cancer risk (ELCR $\leq 10^{-6}$).
W = Within EPA's target cancer risk range of 10^{-6} to 10^{-4}.
E = Exceeds EPA's target for noncancer hazard index (HI $\leq$ 1) or cancer risk (ELCR $\leq 10^{-4}$).

[1]The groundwater risks presented in this table are based on unfiltered samples. The cancer risks from filtered groundwater at Area 2/3 (1.8×10^{-4}) were due primarily to arsenic; the noncancer risks from filtered groundwater (HI of 6.4) were due primarily to antimony and manganese.

Table 8
Area 4—Summary of RME Noncancer and Cancer Human Health Risks

Media/ Route	Current Land Use		Future Land Use			
	Recreational		Residential		Occupational	
	Noncancer HI	Cancer	Noncancer HI	Cancer	Noncancer HI	Cancer
Soil						
Ingestion	0.045 B	2.0E-05 W	2.1 E	5.4E-04 E	0.074 B	6.0E-05 W
Inhalation	<0.001 B	3.0E-10 B	<0.001 B	1.5E-08 B	<0.001 B	5.2E-09 B
Dermal	0.007 B	2.1E-05 W	0.21 B	1.5E-04 E	0.033 B	5.8E-07 B
Combined	0.052 B	4.1E-05 W	2.3 E	6.9E-04 E	0.11 B	6.0E-05 W
Groundwater[1]						
Ingestion			19. E	3.1E-04 E		
Inhalation			0.0 B	0.0E+00 B		
Dermal			0.032 B	5.2E-07 B		
Combined			19. E	3.2E-04 E		
Surface Water						
Ingestion	0.003 B	6.8E-09 B				
Dermal	<0.001 B	1.1E-09 B				
Combined	0.003 B	7.9E-09 B				
All Media Combined	0.055 B	4.1E-05 W	21. E	1.0E-03 E	0.11 B	6.0E-05 W

Notes
B = Below or at limit of EPA's target noncancer hazard index (HI $\leq$ 1) or cancer risk (ELCR $\leq 10^{-6}$).
W = Within EPA's target cancer risk range of 10^{-6} to 10^{-4}.
E = Exceeds EPA's target for noncancer hazard index (HI $\leq$ 1) or cancer risk (ELCR $\leq 10^{-4}$).

[1]The groundwater risks presented in this table are based on unfiltered groundwater samples. The risks from filtered groundwater at Area 4 (noncancer HI of 1.5, cancer risk of 1.6 x 10^{-4}) were due primarily to arsenic and manganese.

Table 9
Area 14—Summary of RME Noncancer and Cancer Human Health Risks

Media/ Route	Current Land Use		Future Land Use			
	Recreational		Residential		Occupational	
	Noncancer HI	Cancer	Noncancer HI	Cancer	Noncancer HI	Cancer
Soil						
Ingestion	<0.001 B	2.21307 B	0.33 B	3.5E-05 W	0.011 B	3.9E-06 W
Inhalation	<0.001 B	3.5E-12 B	<0.001 B	9.8E-10 B	<0.001 B	3.4E-10 B
Dermal	<0.001 B	3.0E-08 B	0.010 B	3.7E-06 W	0.002 B	1.4E-06 W
Combined	<0.001 B	2.5E-07 B	0.34 B	3.9E-05 W	0.013 B	5.3E-06 W
Groundwater[1]						
Ingestion			40. E	1.9E-07 B		
Inhalation			0.0 B	4.9E-09 B		
Dermal			1.7 E	3.6E-08 B		
Combined			42. E	2.3E-07 B		
Surface Water						
Ingestion	0.001 B	8.2E-09 B				
Dermal	<0.001 B	1.3E-09 B				
Combined	0.001 B	9.5E-09 B				
All Media Combined	0.002 B	2.6E-07 B	42. E	3.9E-05 w	0.013 B	5.3E-06 W

Notes:
B = Below or at limit of EPA's target noncancer hazard index (HI $\leq$ 1) or cancer risk (ELCR $\leq 10^{-6}$).
W = Within EPA's target cancer risk range of 10^{-6} to 10^{-4}.
E = Exceeds EPA's target for noncancer hazard index (HI $\leq$ 1) or cancer risk (ELCR $\leq 10^{-4}$).

[1] The groundwater risks presented in this table are based on unfiltered groundwater samples. Filtered samples from Area 14 were not available for comparison.

Table 10
Area 29—Summary of RME Noncancer and Cancer Human Health Risks

Media/ Route	Current Land Use		Future Land Use			
	Recreational		Residential		Occupational	
	Noncancer HI	Cancer	Noncancer HI	Cancer	Noncancer HI	Cancer
Soil						
Ingestion	<0.001 B	8.1E-07 B	0.92 B	6.2E-05 W	0.032 B	6.9E-06 W
Inhalation	<0.001 B	1.3E-11 B	<0.001 B	1.7E-09 B	<0.001 B	6.0E-10 B
Dermal	<0.001 B	9.3E-07 B	0.024 B	1.2E-05 W	0.004 B	4.6E-06 W
Combined	<0.001 B	1.7E-06 W	0.94 B	7.4E-05 W	0.036 B	1.2E-05 W
Groundwater[1]						
Ingestion			15. E	8.4E-04 E		
Inhalation			0.0 B	0.0E+00 B		
Dermal			0.033 B	1.1E-05 W		
Combined			15. E	8.5E-04 E		
Surface Water						
Ingestion	0.035 B	3.7E-08 B				
Dermal	0.010 B	5.2E-08 B				
Combined	0.045 B	8.9E-08 B				
All Media Combined	0.046 B	1.8E-06 W	16. E	9.E-04 E	0.036 B	1.2E-05 W

Notes:
B = Below or at limit of EPA's target noncancer hazard index (HI&1) or cancer risk (ELCR $\leq 10^{-6}$).
W = Within EPA's target cancer risk range of 10^{-6} to 10^{-4}.
E = Exceeds EPA's target for noncancer hazard index (HI $\leq$ 1) or cancer risk (ELCR $\leq 10^{-4}$).

'The groundwater risks presented in this table are based on unfiltered samples. 'he cancer risks from filtered groundwater at Area 29 (1.5 x 10^{-4}) were due primarily to arsenic; the noncancer risks from filtered groundwater (HI of 2.2) were due primarily to manganese.

Surface Water. There were no cancer or noncancer risks associated with surface water in excess of the EPA's acceptable risk range or an HI of 1.0.

- **Area 4**

Soil. Although no single chemical posed a potential noncancer risk, the cumulative noncancer risk (posed primarily by antimony, arsenic, and MCPP) exceeded a hazard index of 1 for future residents. The potential cancer risk for future residents was 6.9 x 10^{-4}, resulting solely from PCBs in soil.

Groundwater. Antimony, arsenic, and manganese were found to produce a noncancer risk to future residents. Arsenic was the only chemical posing a potential cancer risk in excess of 10^{-4}. The risks for the filtered groundwater were less than for the unfiltered groundwater and were primarily due to arsenic.

Surface Water. There were no cancer or noncancer risks associated with surface water in excess of the EPA's acceptable risk range or an HI of 1.0.

- **Area 14**

Soil. There were no cancer or noncancer risks associated with soil in excess of the EPA's acceptable risk range or an HI of 1.0.

Groundwater. Bromacil and 2,4-dichlorophenol in groundwater resulted in a noncancer risk (HI = 42) for future residents. No significant cancer risks were found for the groundwater.

Surface Water. There were no cancer or noncancer risks associated with surface water in excess of the EPAs acceptable risk range or an HI of 1.0.

a **Area** 29

Soil. There were no cancer or noncancer risks associated with soil in excess of the EPA's acceptable risk range or an HI of 1.0.

Groundwater. Antimony, arsenic, chromium, manganese, nickel, and vanadium were found to produce noncancer risks to future residents (HI = 15). Arsenic and beryllium exceeded the target range for carcinogenic effects. The cancer risks for the filtered groundwater were less than for the unfiltered groundwater and were primarily due to arsenic.

Surface Water. There were no cancer or noncancer risks associated with surface water in excess of the EPA's acceptable risk range or an HI of 1.0 associated with surface water.

7.1.4 Uncertainty

The accuracy of a risk assessment depends to a large extent on the quality and representativeness of the data and assumptions that are used. The most critical sources of uncertainty associated with each step of the risk assessment are described below.

- **Exposure Assessment**

The exposure assumptions used in the risk assessment are default values recommended by the EPA. These values are not site specific and are intended to be overly conservative. They are used to ensure that site risks are not underestimated. Because the groundwater is not currently used, the risks from ingestion of groundwater are hypothetical.

- **Toxicity Assessment**

There are numerous uncertainties associated with the approaches used to develop toxicity criteria (e.g., differences in study design, species, sex, and route). The magnitude and direction of uncertainty associated with the toxicity values are unknown.

As discussed in the toxicity assessment, oral toxicity values have been used for evaluating dermal exposures. The magnitude and direction of uncertainty associated with this approach are unknown.

Although chromium was not speciated, the toxicity values used to evaluate chromium are based on its carcinogenic form (chromium VI). Using this value will probably result in an overestimate of risk, because it is unlikely that all the chromium detected on site is in its carcinogenic form.

The cancer slope factor for arsenic is also uncertain, and the EPA has noted that the actual risks associated with arsenic may be substantially lower than those calculated. In addition, a verified toxicity factor is not available for bromacil. An alternative toxicity factor was developed for this risk assessment. This also contributes to the uncertainty associated with the toxicity criteria.

e **Risk Characterization**

Some uncertainty is associated with the summation of risks for multiple chemicals. For example, not all noncarcinogenic chemicals have toxic effects on the same organ. Therefore, combining individual chemical noncancer risks may yield a conservative estimate.

7.2 ECOLOGICAL RISK ASSESSMENT

A screening-level ecological risk assessment was conducted to evaluate potential toxicological threats to ecological receptors from contamination at OU 2. The evaluation was performed for both terrestrial and wetland receptors.

7.2.1 Exposure Assessment

- **Terrestrial Habitat**

Areas 2/3, 4, 14, and 29 are dominated by a brush and grassland community. Areas 2/3, 4, and 29 are bordered on at least one side by a mixed evergreen forest community. Wildlife populations frequenting the sites include microtine (e.g., voles, deer mice), black-tailed deer, coyote, and birds of prey (e.g., northern harrier, red-tailed hawk). Species inhabiting the site are primarily exposed to risks by ingestion of

- Chemicals in the soil
- Plants that accumulate chemicals from the soil
- Prey that accumulate chemicals from ingestion of soil, plants, and other prey items

- **Wetland Habitat**

Freshwater wetland habitat exists between Areas 2 and 3. Species potentially using the wetland include hydrophytic plants, plankton, invertebrates, waterfowl, shorebirds, amphibians, raptors, and mammals. Wildlife in the wetland is primarily exposed to risks from ingestion of:

- Chemicals in sediment
- Chemicals in water
- Plants that accumulate chemicals from sediment and water
- Prey that accumulate chemicals from sediment, water, plants, and other prey items

7.2.2 Toxicity Assessment

The screening-level assessment of potential ecological risks compared concentrations of chemicals in sediment with sediment quality values and concentrations of chemicals in surface water with ambient water quality criteria. Potential exposures of terrestrial receptors to chemicals detected in the soils were compared with toxicity reference values. The toxicity reference values were selected to be protective of target organisms following chronic and continuous exposure to chemicals.

Toxicity reference values for mammals and birds were expressed as a dose and were obtained from a review of available mammalian and avian toxicological data. Sediment toxicity reference values were either obtained from toxicological information compiled by Ecology or derived from ambient water quality criteria using equilibrium partitioning for non-ionic organic chemicals. Freshwater toxicity values were derived from either federal ambient water quality criteria or a review of available aquatic toxicity data.

7.2.3 Risk Characterization

- **Terrestrial Habitat**

Potential ecological risks from chemicals detected in soil were evaluated using an exposure modeling approach. The modeling estimated reasonable maximum exposures to four receptors with four different foraging patterns: a herbivorous small mammal (vole), insectivorous small mammal (shrew), carnivorous mammal (coyote), and carnivorous bird (northern harrier). Results of the ecological risk assessment suggest that chemicals in the soil at all areas pose negligible risks to the receptors occupying higher trophic levels (coyote and northern harrier). However, modeling suggested risks to organisms at lower trophic levels (vole and shrew) from all areas for the chemicals listed in Table 11.

Table 11
Chemicals Posing Potential Risks to Terrestrial Organisms at Lower Trophic Levels

Area 2/3	Area 4	Area 14	Area 29
Antimony	Antimony	2,3,7,8-TCDD	Cadmium
Cadmium	Cadmium		Lead
Lead	Copper		Pentachlorophenol
	Lead		
	Mercury		
	PCB Aroclor 1260		
	Pentachlorophenol		
	zinc		

- **Wetland Habitat**

Potential ecological risks posed by chemicals in freshwater sediments were evaluated by comparing chemical concentrations in area sediments to sediment toxicity reference values (i.e., Washington state's summary of freshwater sediment criteria or values derived by using the equilibrium partitioning approach). Sediment toxicity reference values are acceptable to state and federal agencies as indicators of potential ecological impacts. Arsenic, chromium, copper, iron, lead, manganese, mercury, nickel, zinc, 4,4'-DDT, and endosulfan sulfate concentrations pose risks to aquatic organisms found in the wetland between Areas 2 and 3.

Ecological risks posed by chemicals in wetland surface water were evaluated by comparing the concentrations of chemicals measured in the single sample collected to surface water toxicity reference values (i.e., federal chronic freshwater ambient water quality criteria or the lowest freshwater aquatic toxicity value). Chronic ambient water quality criteria are protective of 95 percent of aquatic organisms. Chemicals representing potential risks to aquatic biota in the Area 2/3 habitat were aluminum, cyanide, iron, and lead.

7.2.4 Uncertainty

The screening-level ecological risk assessment performed on OU 2 was based on analytical results from soil, freshwater sediment, and surface water samples. Uncertainties associated with this approach include:

- **Exposure Assessment**
  - Exposure models were based on receptor ingestion rates of water, forage, and soil. Water and forage ingestion rates were not site specific. Soil ingestion rates were neither site nor species specific.
  - Biotransfer factors were used in the exposure models to estimate chemical tissue concentrations in prey species. These factors were based on a limited number of species and chemicals. Thus, the biotransfer factors may not appropriately estimate exposure for the receptors used in the models.
  - Risks to terrestrial receptors from chemical exposure were based on average and reasonable maximum exposure estimates that assume uniform chemical distribution, and therefore exposure, throughout the site. Based on past evaluations, chemicals are likely to be heterogeneously distributed on site; thus, the duration of exposure may be overestimated, thereby overestimating risk.
- **Toxicity Assessment**
  - Typically, toxicity reference values were not available for the receptor species. Therefore, values for species of similar taxonomic classification were used. The magnitude and direction of uncertainty associated with extrapolating toxicity values between taxonomic groups are unknown.
  - Toxicity reference values were often based on a limited data set. The magnitude of uncertainty associated with these values is unknown.

- Toxicity reference values for surface water assumed that inorganic chemicals are present in their most biologically available and toxic form. However, the site-specific characteristics of the chemicals were unknown, and chemicals are seldom found in the environment in their most toxic forms. Therefore, potential risks are probably overestimated.

7.3 RISK ASSESSMENT CONCLUSIONS

The potential human health risks calculated for OU 2 result primarily from PCBS in soil at Area 4, bromacil and 2,4-dichlorophenol in groundwater at Area 14, and metals in the groundwater at Areas 2/3, 4, and 29. The metals responsible for nearly all the potential human health risks include antimony, arsenic, and manganese. Because these metals are naturally occurring in the environment, much of the calculated risks may result from background levels of these metals.

Low ecological risks at the terrestrial portions of OU 2 largely result from metals in soil. Because analysis did not identify the form of the metals present on site, evaluation was based on the most toxic form of the chemicals known. It is unlikely the chemicals on site exist in their most toxic forms; therefore, risks from metals at the terrestrial areas are likely to be exaggerated. PCB Aroclor 1260 and pentachlorophenol at Area 4 and 2,3,7,8-TCDD at Area 14 are likely to pose the greatest terrestrial ecological risks at OU 2. Most of the ecological risks posed to aquatic organisms in the wetland between Areas 2 and 3 derive from elevated levels of aluminum in the surface water and from elevated levels of manganese, nickel, and copper in the sediments.

8.0 REMEDIAL ACTION OBJECTIVES (RAOs)

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Sampling results and the risk assessment indicate some health risk to hypothetical future residents from surface soils and groundwater. Remedial action will be conducted at those areas where there are unacceptable CERCLA human health risks and/or where chemicals exceed state standards.

The intent of the remedial action at Areas 2/3, 4, 14, and 29 is to:

- Reduce risks to hypothetical future residents from groundwater contaminants at Area 2/3.

- Reduce the health risk to hypothetical future residents and the environmental risk to small mammals by remediating surface and near-surface soil (containing PCB, PCP, and MCPP) at Area 4 to meet state and federal standards.

- Reduce risks to hypothetical future residents by removing the sources of organic contamination (the drywell and surrounding soils) at Area 14.

- Reduce future exposure to Area 29 soil containing residual organic compounds that exceed state regulatory limits or present ecological risks.

- Reduce risks to hypothetical future residents from inorganic groundwater contaminants at Areas 4 and 29 by implementing residential use deed restrictions and, if necessary, implementing groundwater use restrictions.

- Minimize the potential for migration of contaminants from surficial soils to surface water or other media at Areas 4, 14, and 29.

The primary ARARs used in establishing remedial goals and developing alternatives are discussed below. ARARs are discussed in more detail in Section 12.2.

- The Washington Model Toxics Control Act Cleanup Regulation, Chapter 173-340 WAC, is the applicable regulation used to set cleanup goals for soil and groundwater.

- The Washington Dangerous Waste Regulation, Chapter 173-303 WAC, is the applicable regulation for the designation, storage, transportation, treatment, and disposal of any dangerous waste generated as a result of cleanup actions.

- The Toxic Substances Control Act (TSCA) regulations (40 CFR Part 761) are applicable when determining disposal requirements for soils containing PCBs.

- The Resource Conservation and Recovery Act (RCRA) regulations (40 CFR Parts 260-268) are the applicable regulations for the designation, storage, treatment, and disposal of any hazardous waste generated as a result of cleanup actions.

8.1 SOIL

Specific numeric goals for soil remediation at Areas 4, 14, and 29 are presented in Table 12. Soils less than 15 feet below the surface (the point of compliance) must be remediated if the concentration of the COC listed in Table 12 is greater than the associated cleanup objective.

- Area **2/3**

Remedial action objectives were not developed for Area 2/3 soils because the soils did not pose a risk exceeding the CERCLA risk range. Although there was a low ecological risk to wetlands receptors, performing an intrusive remedial action in the wetland would do more environmental harm than the isolated detections of inorganic warrant.

- Area **4**

Remediation of surface and near-surface soils is required because PCB, PCP, and MCPP concentrations constitute a human health risk to hypothetical future residents above acceptable levels.

- Area **14**

While the soil itself at Area 14 does not constitute a current or future unacceptable risk to human health, the drywell and soil surrounding it are sources of groundwater contamination from bromacil and 2,4-dichlorophenol (which does represent an unacceptable risk). Additionally, ecological risks are associated with 2,3,7,8-TCDD present in surface soils surrounding the drywell. Remedial action is required to minimize groundwater contamination; source control is one option. Therefore, cleanup levels for soil remedial action were developed.

Table 12
Remedial Goals Selected for Soils at OU2

Area	Chemical of Concern	Cleanup Level (mg/kg)	Practical Quantitation Limit (mg/kg)	Rationale	Risk at Cleanup Level	
					Carcinogenic Risk	Noncarcinogenic Effects
Area 4	MCPP	80	38.4	MTCA B		1
	PCBS	1	0.3	MTCA A	7.7E-6	
	Pentachlorophenol	8.33	0.8	MTCA B	1E-6	0.003
	Total Risk/ Effects				8.7E-6	1.003
Area 14	Bromacil	7.0	1.0[2]	MTCA B[1]		1
	2,3>7,8 TCDD	6.67E-6	1E-6	MTCA B	1E-6	
	2,4-Dichlorophenol	4.8	0.33	MTCA B[3]		0.02
	Total Risk/ Effects				I-E-6	1,02
Area 29	Pentachlorophenol	8.33	0.8	MTCA B	lE-6	
	PAHS	1	0.15	MTCA A	7.3E-6	
	Total Risk/ Effects				8.3E-6	

Notes:
[1]Based on National Academy of Science Standards and protection of groundwater.
'Estimated
[3]Based on protection of groundwater
MTCA = Model Toxics Control Act, Chapter 173-340 WAC

The remedial goal established for soil at Area 14 is to remediate soils in the vicinity of the drywell containing concentrations of bromacil, 2,4-dichlorophenol, and 2,3,7,8 -TCDD above MTCA Method B cleanup levels.

- Area 29

Elevated levels of metals, PAHs, and PCP (one location) were detected in surface soils at Area 29. The future residential risk for soil ingestion and contact was within the acceptable range. However, because the contamination was concentrated in one area (the burn pad and drainage) and numerous samples within this area exceeded MTCA cleanup levels for PAHs, remedial goals and alternatives were developed for remediation of Area 29.

8,2 GROUNDWATER

Groundwater analysis detected inorganic at Areas 2/3, 4, and 29 at concentrations that resulted in a human health risk to hypothetical future residents exceeding the risk range. In addition, vinyl chloride was detected in the perched aquifer at Area 2/3. However, indications from the sampling program are that the inorganic concentrations may be caused by excess turbidity in the samples taken. Additional groundwater monitoring is necessary to establish background concentrations of inorganic based on samples with low turbidity. Groundwater monitoring is also necessary at Areas 2/3, 4, and 29 to establish site groundwater concentrations of inorganic based on samples with low turbidity. In addition, the monitoring program for Area 2/3 will include volatile organic compounds. At Areas 2/3, 4, and 29, the wells to be sampled would be identical to the ones used in the OU2/OU3 RI. The results of the groundwater monitoring will be compared to the decision criteria presented in Table 13. If levels exceed the decision criteria presented in Table 13, EPA, Ecology, and the Navy will evaluate the results and jointly determine what additional actions may be necessary. These additional actions may include capping the Area 2/3 landfill.

At Area 14, the risk assessment indicated a future residential noncancer risk from bromacil and 2,4-dichlorophenol in the groundwater next to the drywell. Therefore, remedial action is required to reduce this risk to acceptable levels. However, backfill material around the drywell is the source, not groundwater. Removing the backfill material is expected to remove any of the risks found in the groundwater. After the remedial action, the groundwater will be sampled from a new monitoring well (14-MW-1) to confirm soil removal was effective in reducing the groundwater risks. The results of the groundwater monitoring will be compared to the decision criteria presented in Table 13. If bromacil or 2,4-dichlorophenol concentrations exceed the decision criteria presented in Table 13, EPA, Ecology, and the Navy will evaluate the results and jointly determine what additional actions may be necessary. These additional actions may include further monitoring, excavations, or groundwater treatment.

Table 13
Decision Criteria for Groundwater at 0U2

Area(s)	Chemical of Concern	Cleanup Level Objective (µg/l)	Cleanup Level Source
2/3	Antimony	6/background*	SDWA MCL
2/3, 4, 29	Arsenic	0.05/background*	MTCA Method B
2/3, 4, 29	Manganese	80/background*	MTCA Method B
2/3	Vinyl Chloride	0.023 /PQL*	MTCA Method B
14	Bromacil	70	NAS Standards
14	2,4-dichlorophenol	48	MTCA Method B

Notes:
*Whichever is higher.
PQL = Practical Quantitation Limit
SDWA = Safe Drinking Water Act
MCL = Maximum Contaminant Level
MTCA = Model Toxics Control Act, Chapter 173-340 WAC
NAS = National Academy of Science

8.3 SURFACE WATER

Remedial action is not required for surface water at any of the areas because no risks exceeding the risk range were identified. While there was a low ecological risk at the wetland between Area 2 and Area 3, the potential for darnage to the wetland from any remediation is considered greater than the potential benefits of such remediation.

9.0 DESCRIPTION OF ALTERNATIVES

The remedial investigation revealed that surface soils in three of the five areas in OU 2 have some contaminant concentrations that require remedial action. Eight alternatives were evaluated as possible remedial actions. Not all of the alternatives are applicable to each area. The description of each alternative discusses the area(s) to which it applies. For example, Alternative 3 (excavation and off-site disposal of contaminated soil) is not practicable for Area 2/3 and therefore was not evaluated for that area.

Costs for each alternative are presented in Section 10.7 (see Table 14, page 68).

9.1 ALTERNATIVE 1: NO ACTION—AREAS 2/3, 4, 14, AND 29

This alternative is included for comparison purposes as required under CERCLA. Alternative 1 would not require any action, but does include continued monitoring of the site every 5 years. This alternative does not sufficiently protect human health and the environment, nor does it meet state and federal regulations for Areas 2/3, 4, 14, and 29. It does not remove or remediate potential contaminants detected in the surface soil or sediment at OU 2 and, therefore, would result in a continued risk to human health and the environment.

9.2 ALTERNATIVE 2: INSTITUTIONAL CONTROLS-AREAS 2/3 AND 29

Institutional (physical or administrative) controls could prevent or reduce exposure to chemicals of concern at Areas 2/3 and 29. Such controls alone would not be protective at Areas 4 and 14 and, therefore, this alternative was not evaluated for those areas.

Institutional controls include warning signs and deed restrictions (to prevent future excavation). This action would also include a 6-month groundwater monitoring program to establish the background concentrations of inorganic and to confirm that the metals detected in groundwater were not the result of site activities. A low-stress sampling method would be employed during the monitoring program, using low-flow pumps. If the Navy transfers the Area 2/3 property to another owner, the deed would contain a notification that the property contains a past landfill.

This alternative, with the exception of the Area 2/3 deed notification, can commence within a 15-month period after the ROD is signed. Remedial activities would take 6 months to complete.

9*3 ALTERNATIVE 3: EXCAVATION, TRANSPORTATION, AND OFF-SITE DISPOSAL-AREAS 4, 14, AND 29

This alternative involves excavating surface soils from Areas 4 and 29, removing the drywell and monitoring well 14-MW-1 at Area 14 and excavating the associated soils, and transporting the soils to a licensed solid waste or RCRA-approved landfill for disposal. Disposing of soils would require conformance with land disposal restrictions (LDRs). Dust controls and provisions against the accidental release of the excavated soils back into the environment would be implemented during excavation. The excavated areas would be backfilled with uncontaminated soil and revegetated.

The excavated soils would be characterized to ensure that they are disposed of in a manner that protects human health and the environment and that complies with state and federal regulations. According to federal and Washington state definitions (40 CFR $261.2 and WAC $173-303-016(3)(a)), these soils are contaminated media. The state of Washington requires generators of solid waste to determine whether the waste is a dangerous waste or an extremely hazardous waste, using the procedures in WAC $173-303-070 through 103. These procedures would be followed to characterize the removed soils to ensure that the proper disposal location or facility would be selected. If required by the above-listed regulations, the excavated soils would be treated prior to disposal.

At Areas 4 and 29, groundwater monitoring would be performed for 6 months to confirm that inorganic found in the groundwater are not the result of site activities. At Area 14, groundwater monitoring would be performed to confirm that organics found in monitoring well 14-MW-1 are effectively remediated.

The soil removal portion of Alternative 3 applies to each area as follows:

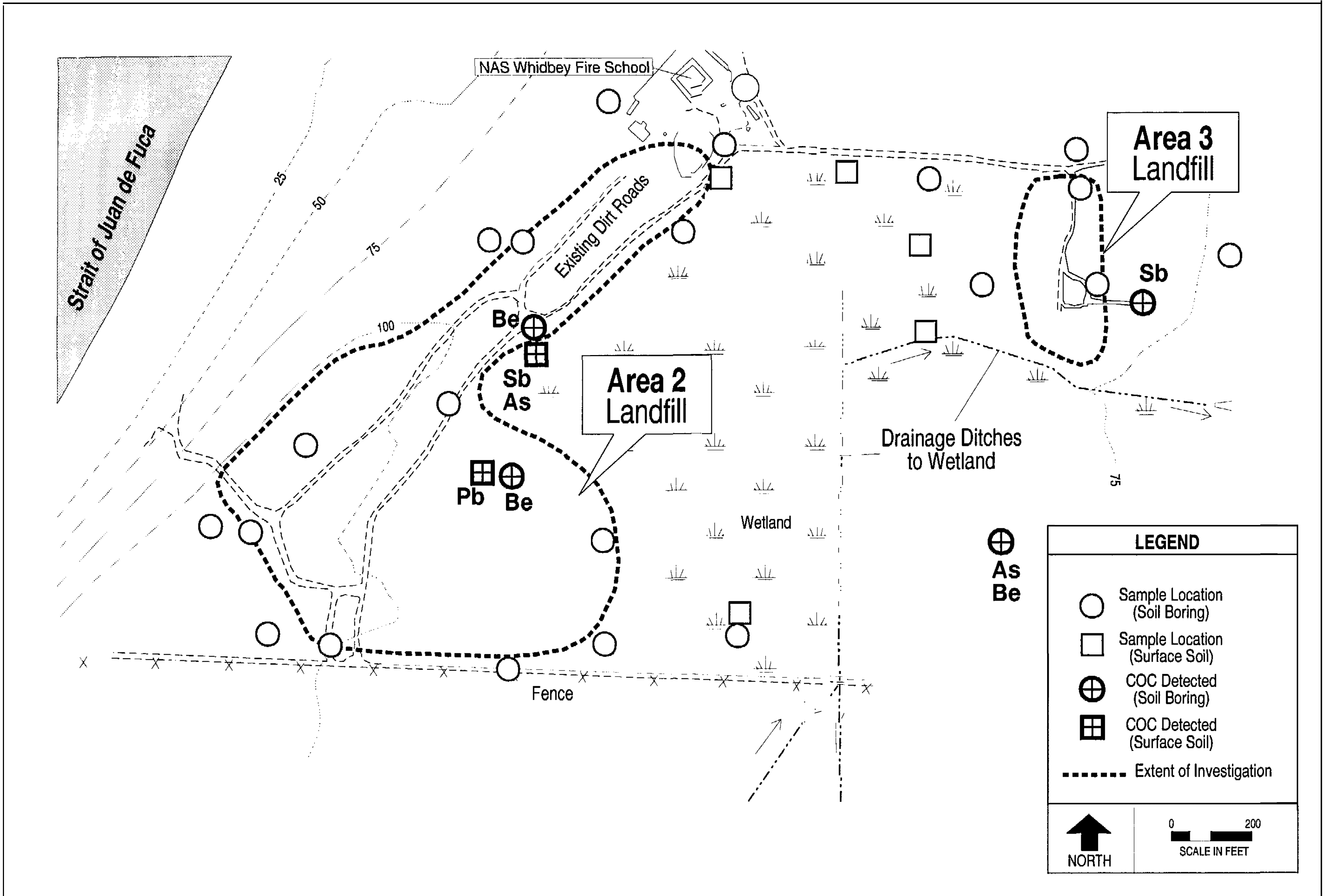
- **Area 2/3**

Because chemical detections are scattered (see Figure 9) and discrete areas of surface soil contamination were not identified, soil removal was not evaluated for Area 2/3. If groundwater results indicate that landfilled materials are a source of contamination in this former landfill, excavation is not considered feasible.

- **Area 4**

Surficial soils (approximately 1,750 cubic yards) would be excavated to a depth of approximately 3 feet (see Figure 10). Confirmatory soil samples would be taken from evenly spaced areas at the bottom of the excavation. The samples would be analyzed for PCBs, PCP, and MCPP (see Table 12). If sample results exceed the soil cleanup levels in Table 12, the location where the exceedance occurred would be further excavated and sampled until cleanup levels were attained.

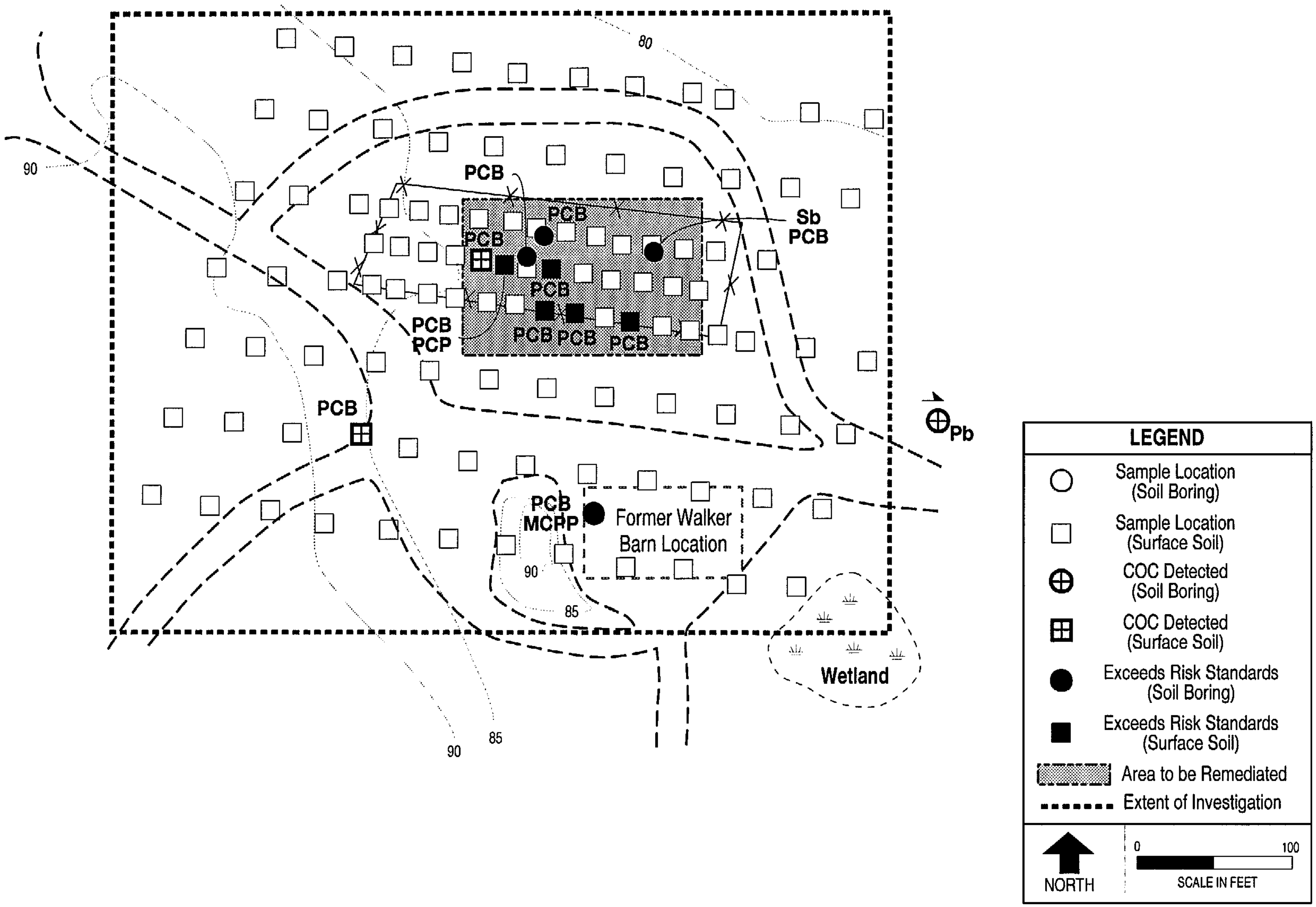
After backfilling operations were complete, the area would be graded to conform with surrounding terrain and revegetated.



CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 9
Area 2/3 - Spatial Distribution of COCs Detected in Surface Soil

CTO 0054
OPERABLE UNIT 2
NAS WHIDBEY, WA
RECORD OF DECISION



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 10** **Area 4 - Spatial Distribution of COCs Detected in Surface Soil**	CTO 0054 OPERABLE UNIT 2 NAS WHIDBEY, WA RECORD OF DECISION

- **Area 14**

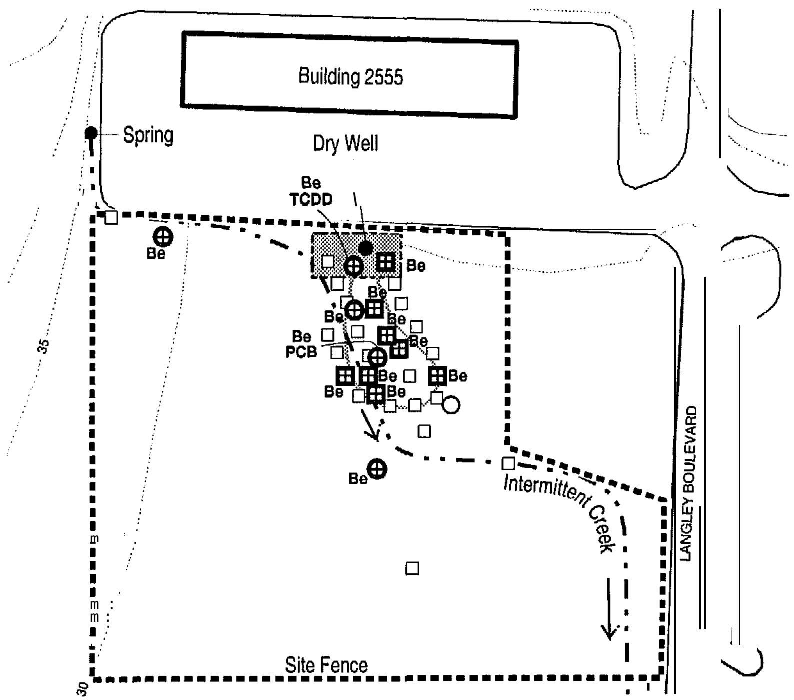
This alternative (and all of the alternatives developed for Area 14) includes removal of the drywell and nearby monitoring well (14-MW-1). Prior to their removal, the wells would be dewatered. To dewater the wells, several well volumes would be pumped from the drywell and monitoring well; both are expected to recharge slowly. The water would be pumped into temporary storage tanks and then passed through activated carbon to remove organics by adsorption to the carbon. The treated water would be disposed of at a publicly owned treatment works (POTW). The spent carbon would be disposed off site. Following dewatering, the well casings would be removed and decontaminated. Any liquid generated from decontamination would be added to the liquid storage tanks for treatment. Approximately 1,000 gallons of liquid is expected to be treated.

Following dewatering and concurrent with removal of the well casing, contaminated soil surrounding the drywell and well 14-MW- 1 would be excavated (see Figure 11). Evenly spaced confirmatory soil samples would be analyzed for dioxins, 2,4-dichlorophenol, and bromacil (see Table 12). Excavation and sampling would continue until sampling results indicated that soil concentrations fell below the cleanup level for 2,4-dichlorophenol and bromacil. Confirmatory samples for dioxins would be limited to the top 3 feet of soils. Approximately 420 cubic yards are expected to be excavated. The depth of the excavation would be 15 feet, or 1 foot below the bottom of the drywell casing, whichever were greater. The excavated soil and well casings would be disposed of off site.

The excavated area would be backfilled with clean soil below approximately 3 feet at the till/sand interface. The backfill material would be of sufficient impermeability, and compacted or otherwise made impermeable, to prevent downward migration of groundwater. After filling operations were complete, the area would be graded to conform with the surrounding terrain and revegetated.

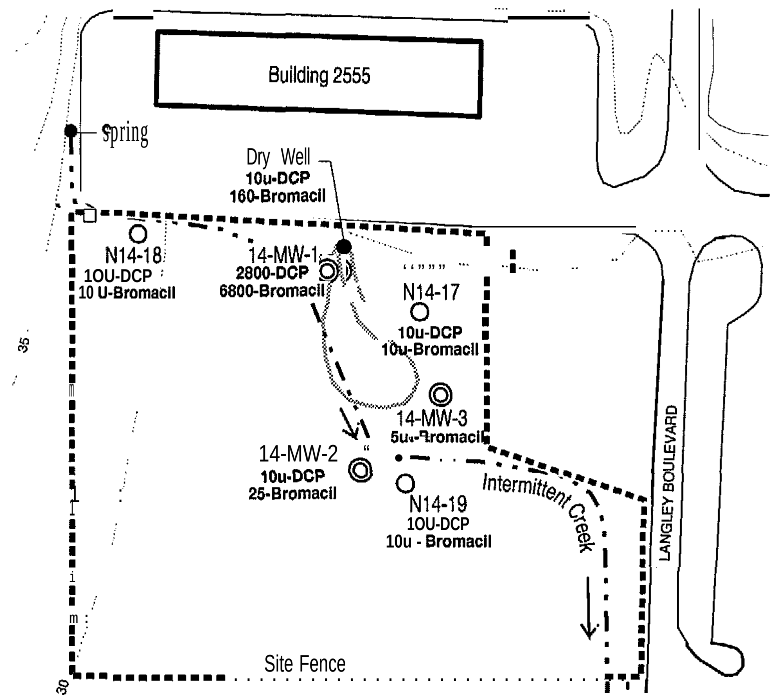
- **Area 29**

Surficial soils (approximately 1,400 cubic yards) would be excavated to a depth of 1.5 to 5 feet (see Figure 12). Evenly spaced confirmatory soil samples would be collected and analyzed for PAHs and PCP. If chemical concentrations were below the cleanup levels listed in Table 12 for Area 29, excavation would cease. The excavation would be filled to original height with clean soil, graded to conform with the surrounding terrain, and revegetated.



COCs in Surface Soil

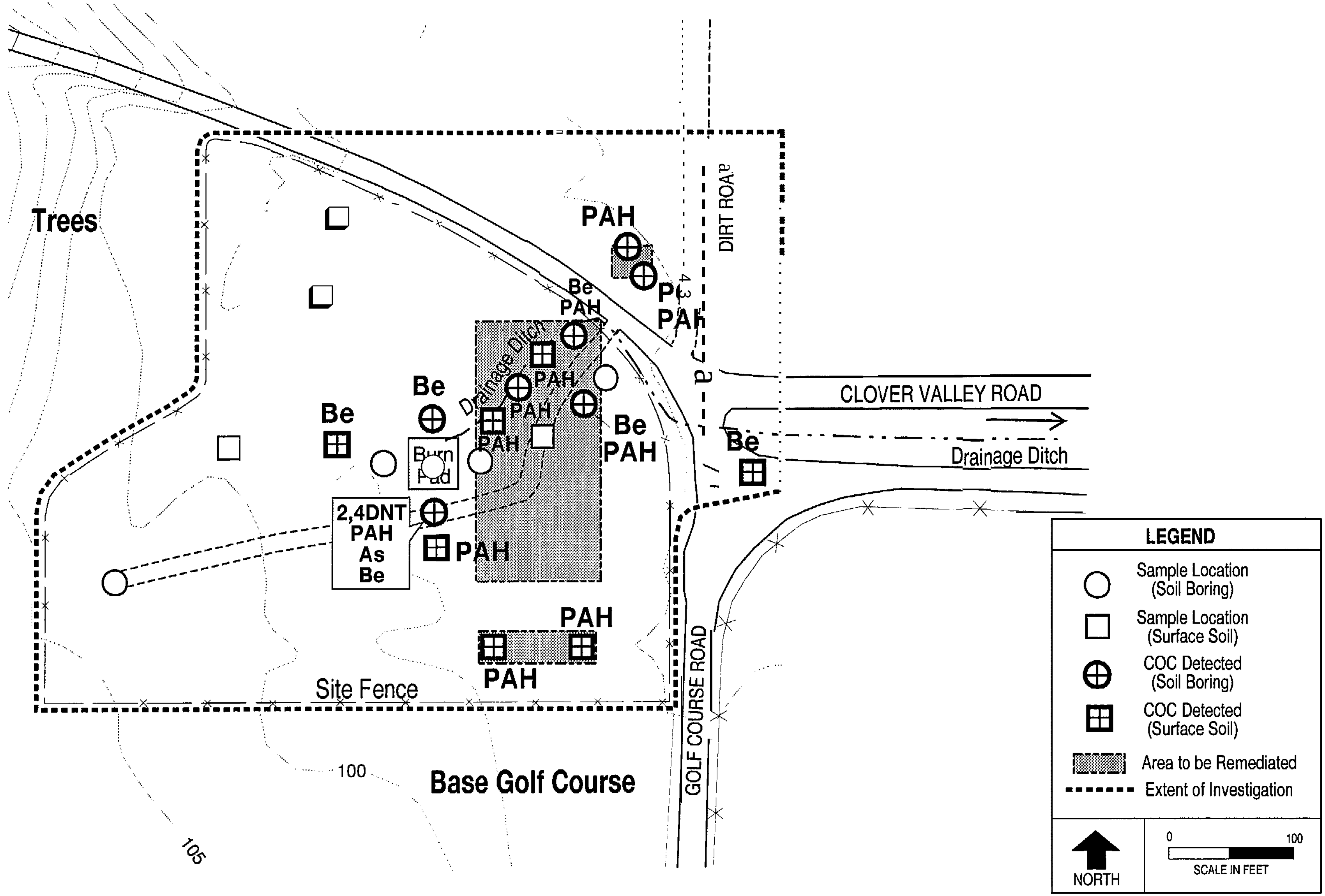
LEGEND	
○	Sample Location (Soil Boring)
□	Sample Location (Surface Soil)
⊕	COC Detected (Soil Boring)
⊞	COC Detected (Surface Soil)
▒	Area to be Remediated
- - -	Extent of Investigation
NORTH	0 100 SCALE IN FEET



COCs in Groundwater

LEGEND	
○	Navy Well
◎	New Monitoring Well
u	Compound is not detected
- - -	Extent of Investigation
NORTH	0 100 SCALE IN FEET

CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 11** **Area 14- Spatial Distribution of COCs Detected in Surface Soil and Groundwater**	**CTO** 0054 **OPERABLE UNIT 2** NAS WHIDBEY, WA RECORD OF DECISION



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	Figure 12 Area 29 - Spatial Distribution of COCs Detected in Surface S	CTO 0054 OPERABLE UNIT 2 NAS WHIDBEY, WA RECORD OF DECISION

This alternative can commence within a 15-month period after the ROD is signed. The remedial action would take approximately 6 months to complete.

9.4 ALTERNATIVE 4: EXCAVATION, TRANSPORTATION, AND ON-BASE DISPOSAL-AREAS 4, 14, AND 29

Alternative 4 includes the same remedial actions as Alternative 3, with the exception that the contaminated soil would be disposed of on base at the Area 6 landfill. This alternative is applicable to contaminated soils at Areas 4, 14, and 29. Soil excavation, confirmatory sampling, and backfilling at Areas 4 and 29 would be the same as described for Alternative 3. Dewatering and removal of the drywell and monitoring well and soil excavating, sampling, and backfilling at Area 14 would be the same as described for Alternative 3. The 6-month groundwater monitoring program described in Alternative 3 would be implemented.

The excavated soil would be characterized to ensure disposal in a manner that is protective of human health and the environment and that complies with state and federal regulations. The Area 6 landfill is unlined, but will be closed and capped with a Minimum Functional Standards (MFS)-equivalent cover upon closure. Area 6 is part of OU 1; the closure of the landfill is described in the OU 1 ROD.

This alternative can commence within a 15-month period after the ROD is signed. Remedial activities would take approximately 9 months to complete.

9.5 ALTERNATIVE 5: EXCAVATION, TRANSPORTATION, AND OFF-SITE INCINERATION-AREAS 4, 14, AND 29

This alternative consists of excavating the soils at Areas 4, 14, and 29 and transporting the soils to a fixed TSCA-approved or RCRA hazardous waste incinerator. DryWell and monitoring well dewatering and removal at Area 14 and soil excavation and confirmatory sampling at Areas 4, 14, and 29 would be performed as described for Alternative 3. Dust controls and provisions against the accidental release of excavated soils back into the environment would be implemented during excavation. The excavations would be backfilled with clean soils, revegetated, and restored to full use following remediation.

There are no TSCA-approved incinerators in Region 10; the nearest incinerator is in Utah. Dewatering liquid from the remediation of Area 14 would be treated as described in Alternative 3, which is considered protective of human health and the environment. The special backfill requirements described in Alternative 3 for Area 14 would be implemented. The 6-month groundwater monitoring program described in Alternative 3 would be implemented.

This alternative can commence within a 15-month period after the ROD is signed. Remedial activities would take approximately 6 months to complete.

9.6 ALTERNATIVE 6: CAPPING THE AREAS-AREAS 2/3, 4, AND 29

This alternative involves placing a RCRA- or MFS-equivalent cap over the soils at Areas 2/3, 4, and 29. Capping Area 14 would not remediate the concentrated area of contamination around the drywell; therefore, this alternative was not evaluated for Area 14.

At Area 2/3, approximately 106,000 square yards (s.y.) of contaminated soils would be capped; at Area 4, approximately 1,425 s.y. of soils would be capped; and at Area 29, approximately 2,570 s.y. of soils would be capped. Capping eliminates the potential exposure pathway for all the areas of OU 2. A RCRA-type cap, which is standard for capping sites containing hazardous waste, contains two layers serving as barriers to water infiltration and is topped with a minimum 24-inch-thick layer of soil with a 3 to 5 percent slope. The top layer would be vegetated to prevent erosion. An MFS-type cap contains four layers; the third layer is the barrier layer, which is topped with 6 inches of topsoil for vegetative cover. For both types of soil caps, institutional controls would be implemented to maintain the integrity of the cover and to prevent future construction in the capped areas. Long-term groundwater monitoring would be required to ensure there is no migration of contaminants.

This alternative protects human health and the environment and can be commenced within a 15-month period after the ROD is signed. Remedial activities would take approximately 6 months to complete.

9.7 ALTERNATIVE 7: SOIL COVER-AREA 29

Alternative 7 involves placing a 3-foot layer of clean fill over Area 29 and revegetating the area. Approximately 2,570 square yards of contaminated soils would be covered. The surface exposure risk would be eliminated by a soil cover and revegetation. Water infiltration would not be prevented, but PAHs tend to naturally attenuate and not to migrate. Institutional controls would be required to prevent future disturbance of these soils. Groundwater monitoring and limited soil monitoring would be implemented to confirm there is no migration of chemicals.

Soil covers can be implemented to eliminate human health or ecological risks posed by direct contact with or ingestion of chemicals in surface soils. Because soil covers do not prevent water infiltration, they were considered only at areas where chemicals in the surface soil are immobile in the environment and where a soil cover would provide adequate protectiveness. These two cases exist only at Area 29. Although PCBS at Area 4 are also immobile in the environment, a soil cover was not considered for Area 4 because the magnitude of the risk was greater and more protectiveness was required. In addition, the Toxic Substances Control Act requires that PCB-contaminated soil be either incinerated or capped per RCRA.

This alternative can commence within a 15-month period after the ROD is signed. Remedial activities would take approximately 6 months to complete.

9.8 ALTERNATIVE 8: LANDFARMING-AREA 29

This alternative consists of excavating contaminated soil (approximately 1,400 cubic yards) at Area 29 and performing on-site bioremediation of the PAHs in soil using landfarming techniques. Landfarming could be executed at or near the existing location. The time required to complete remediation of Area 29's surface soils would depend largely on the outcome of treatability testing and could range from 1 to 2 years. This alternative would be expected to attain the MTCA Method A cleanup level of 1.0 mg/kg for total carcinogenic PAHs. The site would be backfilled and revegetated following excavation. Groundwater monitoring would be performed for 6 months to confirm that inorganic found in the groundwater are not the result of site activities.

Landfarming is expected to meet the RAOS, although its ability to do so must be verified by treatability testing.

This alternative can commence within a 15-month period after the ROD is signed. Remedial activities would take approximately 24 months to complete.

10.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The EPA has established nine criteria for the evaluation of remedial alternatives. The eight remedial action alternatives discussed in Section 9.0 were evaluated against these criteria. The following section presents a brief discussion of each remedial alternative relative to the evaluation criteria to identify a preferred alternative.

10.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The primary risk to human health and the environment is through direct contact with or ingestion of contaminants. The no-action alternative (Alternative 1) is not considered protective at any of the areas, because the potential for direct contact with or ingestion of contaminants would continue to exist. Because Alternative 1 is not protective, it is not evaluated further in this ROD. Institutional controls (Alternative 2) are adequately protective at Areas 2/3 and 29, assuming that results of the groundwater monitoring program show soil contaminants are not being transported into the aquifer. Off-site disposal, incineration, and capping (Alternatives 3, 5, and 6) are considered protective of human health and the environment. A cap at Area 2/3 (Alternative 6), while protective of groundwater, may prove more destructive to the environment overall because of impacts on the wetland. Alternatives 3 through 8 would be protective of the environment at Area 29. On-base disposal of soils at Area 6 (Alternative 4) is considered protective at Areas 4 and 29, because the chemicals of concern would be removed and placed in a controlled area. However, Alternative 4 is not considered protective at Area 14, because bromacil present in Area 14 soils is relatively mobile and may eventually leach into groundwater if the soils are placed in the Area 6 landfill (which is unlined).

10.2 COMPLIANCE WITH ARARs

If the groundwater monitoring program indicates that Area **2/3 is not** a source of inorganic contamination, the institutional controls provided in Alternative 2 would comply with ARARs at Area 2/3. The institutional controls provided in Alternative 2 also satisfy ARARs at Area 29.

Alternatives 3 and 5 comply with all ARARs for Areas 4, 14, and 29. Alternative 4 (disposal at the Area 6 landfill) will satisfy ARARs for Areas 4 and 14, provided that the excavated soils are not designated dangerous or hazardous waste. If the excavated soils are designated as dangerous or hazardous waste, Alternative 4 would not comply with the dangerous waste regulations (WAC 173-303) or the RCRA land disposal restrictions (40 CFR Part 268).

Alternative 6 provides for MFS or RCRA caps over Areas 2/3, 4, and 29; the caps would be designed and constructed to comply with all ARARs. Alternative 7 provides for a soil cover over Area 29, which meets ARARs. Alternative 8 (landfarming) would comply with all ARARs at Area 29.

10.3 REDUCTION OF TOXICITY, MOBILITY, AND VOLUME THROUGH TREATMENT

No reduction in toxicity, mobility, or volume through treatment is provided for contaminated soils under Alternatives 1, 2, 4, 6, or 7, because treatment is not a component of these alternatives. Alternative 2 relies on institutional controls for protectiveness and Alternatives 4, 6, and 7 rely on containment to achieve protectiveness.

The off-site disposal technology described in Alternative 3 may involve treatment of the soils from Areas 4 and 14 using a stabilization process that would reduce the mobility of the chemicals of concern in soils. Incineration of soils from Areas 4, 14, and 29 under Alternative 5 would destroy organic compounds to the fullest extent possible. Landfarming under Alternative 8 would provide for the destruction of the PAH compounds at Area 29.

Alternatives 3, 4, and 5 each include treatment of Area 14 contaminated drywell and monitoring well water with activated carbon as a component of the remedial alternative. This treatment reduces the mobility and volume of contaminants at Area 14. If the spent carbon is disposed of in a RCRA landfill, no reduction in the toxicity of the contaminants will occur. If the spent carbon is regenerated, the thermal regeneration process will permanently destroy the contaminants.

10.4 SHORT-TERM EFFECTIVENESS

There are two primary considerations when evaluating alternatives by this criterion: (1) whether the alternative creates human health or environmental concerns during remediation and (2) the length of time the alternative takes to achieve the established objectives.

Because Alternative 2 includes no active remediation, no short-term impacts are expected and remedial goals would be met immediately. Under Alternatives 3 through 8, earthmoving and construction activities would require that protective measures be taken to ensure worker safety and prevent potential exposure to soil and dust. These precautions are not expected to be difficult to implement. Alternatives 3, 4, 5, 6, and 8 would impact wildlife in the short term while soil is excavated. Alternative 7 (soil cover at Area 29) would have less impact on the environment during cover construction.

Several months would be required to complete remedial activities under Alternatives 3 through 7. Landfarming under Alternative 8 would require an extended time (approximately 2 years) to achieve remedial goals.

10.5 LONG-TERM EFFECTIVENESS AND PERMANENCE

Institutional controls (Alternative 2) may require periodic maintenance and inspection to be effective at Areas 2/3 and 29. Both off-site disposal (Alternative 3) and off-site incineration (Alternative 5) are considered highly effective in the long term, although off-site incineration is the more permanent remedial action.

Excavation of contaminated soils and their on-base disposal in the Area 6 landfill (Alternative 4) provide long-term effectiveness and permanence for Area 4 and Area 29 soils. Long-term controls will be provided at the Area 6 landfill. However, Alternative 4 may not provide long-term effectiveness for Area 14 soils that contain bromacil. Bromacil is relatively mobile in the environment and may eventually leach into groundwater if placed in the Area 6 landfill.

An MFS or RCRA cap (Alternative 6) is considered effective for Area 2/3. The cap would prevent leaching from the landfill to the groundwater. For Areas 4 and 29, an MFS or RCRA cap is considered moderately effective, although preventing water infiltration (a major function of an engineered cap) is not a high priority at these sites.

A soil cover over Area **29** (Alternative 7) is also considered an effective action to eliminate environmental exposure. Long-term maintenance and monitoring are required to ensure effectiveness of either the cap or cover. Landfarming Area 29 soils (Alternative 8) is potentially effective and permanent, but is contingent on successful treatability testing.

10.6 IMPLEMENTABILITY

Institutional controls (Alternative 2) can be easily implemented at Areas 2/3 and 29. The capping (Alternative 6) and soil cover (Alternative 7) are demonstrated technologies that are commonly applied, readily implementable, reliable, and present no unusual construction difficulties. Likewise, the soil excavation and disposal alternatives (Alternatives 3 and 4) are commonly applied and should present no implementation difficulties.

Confirmational sampling during soil excavation requires that soil analyses of various chemicals occur. There should be no difficulty achieving detection limits below the selected cleanup levels.

Implementation of off-site incineration (Alternative 5) depends upon availability of incinerators to accept the soils. Landfarming (Alternative 8) would require treatability testing to verify performance and process parameters prior to implementation.

10.7 COST

The estimated capital and operations and maintenance costs for each alternative are summarized in Table 14. Net present worth costs are also summarized and are based on 15 years of operations and an assumed annual discount rate of 5 percent. The cost estimates provide an accuracy of +50 percent to -30 percent, in accordance with EPA guidelines.

10.8 STATE ACCEPTANCE

Ecology concurs with the selection of the final remedial alternative for Areas **2/3, 4, 14, and 29.** Ecology has been involved with the development and review of the remedial

Table 14
Estimated Costs of Remedial Alternatives

Criteria	Alternative 1 No Action	Alternative 2 Institutional Controls for Areas 2/3 and 29	Alternative 3[1] Excavation and Disposal of Areas 4, 14, and 29 Soils in Off-Site Landfill	Alternative 4 Excavation and Disposal of Areas 4, 14, and 29 Soils in the Area 6 Landfill Prior to Capping	Alternative 5 Off-Site Incineration of Areas 4, 14, and 29 Soils	Alternative 6[2] RCRA or MFS Cap Over Areas 2/3, 4, and 29	Alternative 7 Soil Cover and Revegetation of Area 29	Alternative 8 Landfarming of Area 29 Surface Soils
AREA 2/3: Addressing 106,000 square yards of soil								
Cap Cost	$10,400	$110,000	N/A	N/A	N/A	$2,890,000	N/A	N/A
Annual O&M	$16,990	$0	N/A	N/A	N/A	$33,800	N/A	N/A
Present Worth	$84,000	$110,000	N/A	N/A	N/A	$3,036,000	N/A	N/A
Area 4: Addressing 1,750 cubic yards of soil								
Cap Cost	$10,400	N/A	$1,107,000	$233,000	$6,176,000	$220,000	N/A	N/A
Annual O&M	$8,080	N/A	$0	$0	$0	$14,500	N/A	N/A
Present Worth	$45,000	N/A	$1,107,000	$233,000	$6,176,000	$283,000	N/A	N/A
Area 14: Addressing 420 cubic yards of soil; 1,000 gallons of water from the drywell and monitoring well								
Cap Cost	$10,400	N/A	$423,000	$213,000	$1,613,000	N/A	N/A	N/A
Annual O&M	$8,080	N/A	$0	$0	$0	N/A	N/A	N/A
Present Worth	$45,000	N/A	$423,000	$213,000	$1,613,000	N/A	N/A	N/A
Area 29: Addressing 1,400 cubic yards of soil								
Cap Cost	$10,400	$40,000	$918,000	$225,000	$4,958,000	$282,700	$210,400	$460,000
Annual O&M	$8,080	$0	$0	$0	$0	$25,700	$10,400	$0
Present Worth	$45,000	$40,000	$918,000	$225,000	$4,958,000	$394,000	$255,000	$460,000

Notes:

‘Assumes stabilization and disposal of soils in an off-site RCRA landfill.
‘Costs assume MFS cap
N/A = Not applicable

investigation, feasibility study, proposed plan, and record of decision. Ecology's comments have resulted in changes to these documents.

10.9 COMMUNITY ACCEPTANCE

Comments received during the public comment period (November 12 through December 12, 1993) indicate that the public accepted the proposed plan.

11.0 SELECTED REMEDIES AND CLEANUP LEVELS

This section summarizes the selected remedies for Areas 2/3, 4, 14, and 29 and the associated cleanup levels, if any.

11.1 THE SELECTED REMEDIES

Based on consideration of the CERCLA requirements, the detailed analysis of alternatives using the nine criteria, and the public comments, the Navy, the EPA, and Ecology have determined that a combination of Alternatives 2 (institutional controls and groundwater monitoring), 3 (excavation and off-site disposal), and 4 (excavation and on-base disposal) is the most appropriate remedy for OU 2 at NAS Whidbey Island. The following outlines the remedies proposed for each area.

11.1.1 Area 2/3

Institutional controls (residential use deed restrictions) and a 6-month groundwater monitoring program were selected for Area 2/3. The groundwater monitoring program seeks to confirm that concentrations of inorganic in groundwater are within background and below risk-based levels. Two rounds of groundwater samples will be collected from OU 2 background wells and site monitoring wells for analysis of total and dissolved metals. The sampling will occur once in the wet season and once in the dry season. Two groundwater sampling rounds will generate sufficient data for statistical analysis and permit the evaluation of any seasonal variation in the data. Additional action (in the form of groundwater use restrictions or leachate control) will be considered if test results show the groundwater poses an unacceptable risk, as defined in Table 13, from inorganic chemicals at concentrations above naturally occurring (background) levels. If the monitoring results confirm that inorganic in groundwater do not exceed decision criteria in Table 13, then monitoring for inorganic will cease.

The groundwater will also be monitored for volatile organic compounds; this will occur concurrent with the inorganic sampling and yearly until the 5-year review. Depending on the results of monitoring, the Navy, EPA, and Ecology will determine whether further monitoring is warranted.

The estimated costs for this component of the remedy are: capital costs, $1 10,000; operation and maintenance (O&M) costs, $0; present worth, $110,000.

11.1.2 Area 4

Alternative 3 is selected as the remedy for Area 4. This involves removal and disposal of approximately 1,750 cubic yards (to an approximate depth of 3 feet) of PCB-contaminated soil. The soils from Area 4 will be transported off site to a TSCA-approved landfill for final disposal. The soils will be tested by the toxic characteristics leaching procedure (TCLP) to determine whether stabilization is required prior to disposal.

The soil removal will meet regulatory soil cleanup standards established under WAC 173-340 (MTCA) for the COC. MTCA cleanup standards for individual chemicals correspond to a risk-based cancer risk of 10^{-6} and an HI of less than 1. Cleanup levels were developed in Section 8.1. For Area 4, the remedy will address all soils contaminated with PCBs, PCP, and MCPP in excess of 1 parts per million (ppm), 8.33 ppm, and 80 ppm, respectively. After confirmatory sampling indicates cleanup levels have been met, the excavation will be backfilled with clean soil and reseeded.

At Area 4, low-stress groundwater monitoring will be conducted to determine the level of inorganic in the groundwater for both on-site and background wells (for similar reasons as discussed for Area 2/3). Institutional controls may be required if further action is warranted. If the concentrations of inorganic in the groundwater exceed those in Table 13, further action, such as institutional controls, is warranted.

The estimated costs for this component of the remedy are: capital costs, $1,107,000; O&M costs, $0; present worth, $1,107,000.

11.1.3 Area 14

Alternative 3 is the selected remedy for Area 14. This alternative includes pumpout of the drywell and monitoring well 14-MW- 1; treatment of the extracted water (approximately 1,000 gallons) by carbon adsorption; disposal of the treated water to a POTW; excavation of the drywell, monitoring well, and approximately 420 cubic yards of surrounding contaminated soil; and disposal of the soils and decontaminated well casings. The soils will be transported off site to a licensed solid waste or RCRA-approved landfill. The soils will be tested for TCLP to determine if solidification is required prior to disposal.

The remedy will address dioxin-contaminated soil with concentrations in excess of 0.0067 parts per billion (ppb) and bromacil-contaminated soil with concentrations in excess of 7.0 ppm, resulting in a residual site lifetime excess cancer risk of 10^{-6}. In addition, this remedy will ensure the protection of groundwater by addressing soils containing 2,4-dichlorophenol in excess of 4.8 ppm. After confirmatory sampling indicates cleanup levels have been met, the excavation will be backfilled and revegetated.

Following remediation, monitoring well 14-MW-1 will be reinstalled and groundwater will be sampled in the wet season to confirm that remediation was effective in reducing bromacil and 2,4-dichlorophenol in the groundwater to below cleanup levels (70 ppb and 48 ppb, respectively). Well 14-MW-1 will be reinstalled downgradient of its original location, just outside of the excavated/backfilled area.

The estimated costs for this component of the remedy are: capital costs, $423,000; O&M costs, $0; present worth, $423,000.

11.1.4 Area 29

Alternative 4 is the selected remedy for Area 29. The remedy includes excavation and disposal of approximately 1,400 cubic yards of PCP- and PAH-contaminated soil (to a depth of approximately 3 feet) from several locations surrounding the burn pad. The excavated soil will be transported to the NAS Whidbey Island landfill at Area 6 for final disposal The disposal will be timed so that the Area 29 soil is placed prior to installation of an MFS cap at Area 6 (capping of the Area 6 landfill is described in the ROD for OU 1 at NAS Whidbey Island).

The remedy will address PCP- and PAH-contaminated soils in excess of 8.33 ppm and 1 ppm, respectively. After confirmatory sampling indicates cleanup levels have been met, the excavation will be backfilled with clean soil and reseeded.

At Area 29, low-stress groundwater monitoring will be conducted to determine the level of inorganic in the groundwater for both on-site and background wells (for similar reasons as discussed for Area 2/3). Institutional controls may be required if further action is warranted. If the concentrations of inorganic in the groundwater exceed those listed in Table 13, further action, such as institutional controls, is warranted.

The estimated costs for this component of the remedy are: capital costs, $225,000; O&M costs, $0; present worth, $225,000.

12.0 STATUTORY DETERMINATION

The Navy and the EPA have primary responsibility, under their CERCLA authority, to ensure that remedial actions will protect human health and the environment. These goals will be achieved through removal of surface soils, groundwater monitoring, and implementation of the institutional controls proposed in this ROD. Implementing institutional controls and establishing a groundwater monitoring program at Area 2/3 will reduce exposure and better define risks associated with groundwater. The removal of contaminated surface soils will eliminate on-site exposure pathways caused by these soils at Areas 4, 14, and 29.

12.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedial actions will protect human health and the environment by (1) implementing institutional controls in conjunction with groundwater monitoring at Area 2/3; (2) removing contaminated soils from Areas 4, 14, and 29 and disposing of the soils in a controlled landfill; and (3) sampling groundwater at Areas 2/3, 4, and 29 to confirm that inorganic concentrations are below background and/or risk-based concentrations.

Implementation of this remedial action will not pose unacceptable short-term risks to site workers or nearby residents. There are no critical habitats, floodplains, or historical preservation sites within OU 2 that required consideration during the RI/FS process. A bald eagle observed on site was considered in these remedial actions.

12.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

The selected remedy for OU 2 will comply with federal and state ARARs that have been identified. The ARARs identified for the site include, but are not limited to, those discussed in the following sections.

12.2.1 Action-Specific ARARs

The applicable regulations that establish procedures for the designation of waste as hazardous and standards for the treatment, storage, and shipment of these wastes by generators are the Hazardous Waste Management Act, 42 U.S.C. See 6901 et seq., RCRA Subtitle C, 40 CFR Parts 260-268, and the Washington state Dangerous Waste Regulations, WAC $173-303.

The state of Washington Hazardous Waste Cleanup–Model Toxics Control Act (Chapter 70.150D RCW) is applicable, because it establishes cleanup standards for facilities where hazardous substances have come to be located, as codified in WAC Chapter 173-340, and compliance monitoring requirements.

The National Oil and Hazardous Substances Contingency Plan off-siterule (40 CFR $300.440) is applicableto soils removed from Areas 4 and 14 and transported to an off-site area for disposal.

The Toxic Substances Control Act (40 CFR §761) is applicable to the disposal of PCB-contaminated soils removed from Area 4.

The Clean Air Act, Section 101, 42 U.S.C. §7405 and 7601, and Washington General Regulations for Air, WAC $173-400, are the requirements applicable to sources of fugitive dust generated during the remediation efforts; such dust must be controlled to avoid nuisance conditions.

The requirements set forth by federal and state Occupational Safety and Health Regulations, 29 CFR Part 1926 and WAC $296-62, Part P, establish applicable health and safety standards for workers engaged in hazardous waste investigations.

Hazardous Materials Transportation Act regulations (49 CFR Parts 171-172) are applicable to the transportation of potentially hazardous materials, including samples and wastes.

12.2.2 Chemical-Specific ARARs

The state of Washington Hazardous Waste Cleanup–Model Toxics Control Act (RCW Chapter 70.150D promulgated by WAC 173-340) is applicable for determining cleanup standards.

The maximum contaminant levels and non-zero maximum contaminant level goals established under the Safe Drinking Water Act (40 CFR Parts 141, 142, 143) and the Department of Health drinking water standards (WAC $246-290-310) are relevant and appropriate for determining cleanup levels and evaluating the effectiveness of the cleanup remedy.

The regulations that establish procedures for the designation of wastes as hazardous or dangerous (RCRA Subtitle C [40 CFR Part 261] and Washington State Dangerous Waste Regulations [WAC 173-303]) are applicable when determining handling and disposal requirements for solid wastes generated during cleanup activities.

12.2.3 Location-Specific ARARs

The Wetland Protection Act (Federal Executive Order 11990, 40 CFR Part 6, Appendix A) is the requirement applicable to the protection of wetlands.

The Rare and Endangered Species Act (16 U.S.C. $1531, et seq.; 50 CFR Parts 200 and 402) is applicable because a baldeagle was sighted in the area.

12.2.4 Other Criteria, Advisories, or Guidance

Except for the State of Washington Statistical Guidance for Site Managers, there are no other criteria, advisories, or guidance to be considered for the remedial action.

12.3 COST EFFECTIVENESS

For Area 2/3, Alternative 2 protects human health and the environment and complies with ARARs. Alternative 2 will also confirm whether the inorganic in groundwater are associated with naturally occurring levels and, therefore, do not require remediation. The cost to implement Alternative 2 at Area 2/3 is less than the cost of capping (Alternative 6) and would provide equivalent protection should the results of groundwater monitoring prove that inorganic in groundwater are within background or below acceptable limits.

Alternative 3 for Areas 4 and 14 protects human health and the environment and complies with ARARs. The cost for Alternative 3 ranges from $385,000 to $1,107,000 at Area 4 and from $250,000 to $423,000 at Area 14, depending on final classification of the excavated material and the need for stabilization of the waste at the landfill. The cost for on-site disposal (Alternative 4) is less than for off-site disposal; however, for Areas 4 and 14 on-site disposal will not meet chemical-specific ARARs if the excavated materials are designated as a dangerous or hazardous waste. Alternative 6 is also less costly, but would prevent the Navy's future use of the property and would be less protective of human health and the environment. Alternative 3, therefore, provides the best overall protectiveness proportionate to its cost for Areas 4 and 14.

The remedial action at Area 29 is not required based on CERCLA risk calculations. However, the Navy has decided to remediate the area to achieve its goal of unrestricted use. All of the alternatives developed for remediation at Area 29 are protective; the preferred remedy, Alternative 4 (soil removal and on-base disposal), is the least expensive.

12.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICAL

The selected remedies represent the best balance of tradeoffs among the alternatives evaluated. They provide a high degree of permanence, use treatment to the maximum extent practical, do not negatively impact human health or the environment during remediation, can be completed in a short time, and are cost-effective.

The selected remedies meet the statutory requirement to use permanent solutions and treatment technologies to the maximum extent practical. Treatment of soil from all the areas was not practical because of the small volumes involved. Combining the soil from the different areas for treatment was not practical because of the different types of contaminants at each area. In selecting the remedy, the most important nonthreshold criteria were cost (incineration was much more expensive than soil excavation and disposal) and long-term effectiveness (soil excavation and disposal was more protective than soil cover).

The remedy selected for Area 29 was chosen primarily to comply with MTCA.

12.5 PREFERENCE FOR TREATMENT AS PRINCIPAL ELEMENT

Soil from Areas **4 and 14 will be treated prior** to disposal if designated a hazardous waste. Although evaluated, treatment alternatives (incineration and landfarming) were not selected for soil remediation because of questionable effectiveness (landfarming) and high cost (incineration).

Water extracted from the drywell and from monitoring well 14-MW-1 will be treated prior to disposal.

13.0 DOCUMENTATION OF SIGNIFICANT CHANGES

No significant changes to the findings of the RI/FS and the proposed plan have been made in this ROD.

ATTACHMENT A

RESPONSIVENESS SUMMARY

OVERVIEW

The responsiveness summary addresses public comments on the proposed plan for remedial action at NAS Whidbey Island OU 2. The public comment period on the proposed plan was held from November 12, 1993, to December 12, 1993. A public meeting was held on December 1, 1993, to explain the proposed plan and solicit public comments. Members of the public attended the meeting; only one formal comment was received during the meeting. A transcript of the proceedings of the public meeting is available in the administrative record. No written comments were received on the RI, FS, or proposed plan during the public comment period.

The one verbal comment received, and the Navy's response to it, is summarized below.

1. RESPONSE TO COMMENTS ON THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY REPORTS (RI/FS)

No comments were received on the RI or FS reports.

2. SUMMARY OF COMMENTS ON THE PROPOSED PLAN

There was one verbal comment made on the proposed plan. The comment is summarized below.

Comment

The commenter was concerned that contaminated water runoff could have ponded in the area south of Clover Valley Road because of clogged drainage ditches.

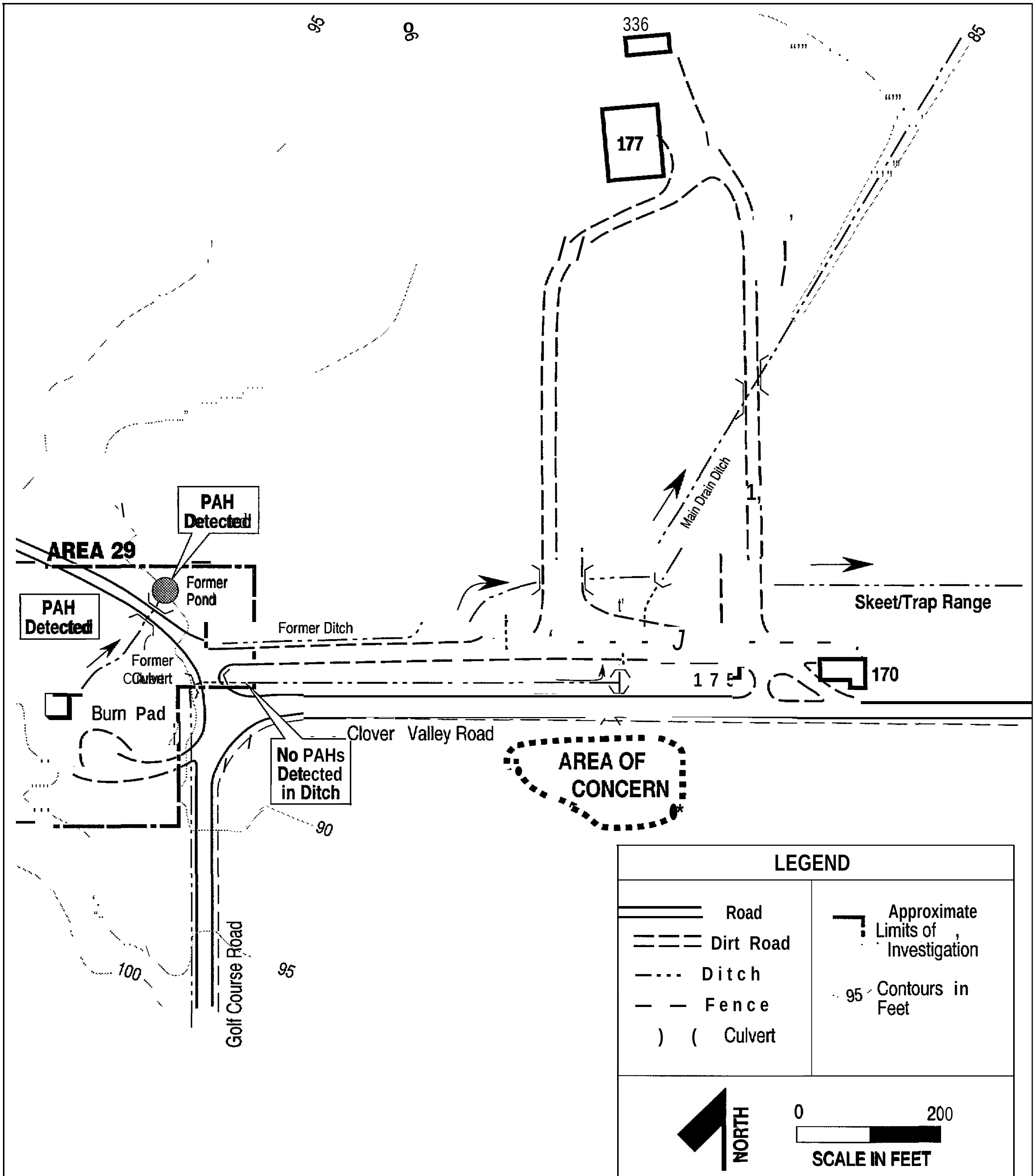
Response

At the time the fire school was in service, runoff collected in a drainage ditch. The ditch ran northeast from the burn pad through a culvert to a detention pond on the north side of the service road. (See Figure A-1.) Both the culvert and the detention pond are no longer present. Aerial photographs taken when the fire school was in operation show that there was no consistent drainage from the detention pond. The pond appeared to be seasonal in nature; it was dry in some of the photographs. The contaminants of concern (polycyclic aromatic hydrocarbons, or PAHs) in the surface runoff from the fire school site would, therefore, remain in the detention pond and would eventually settle into the soil at the bottom of the pond.

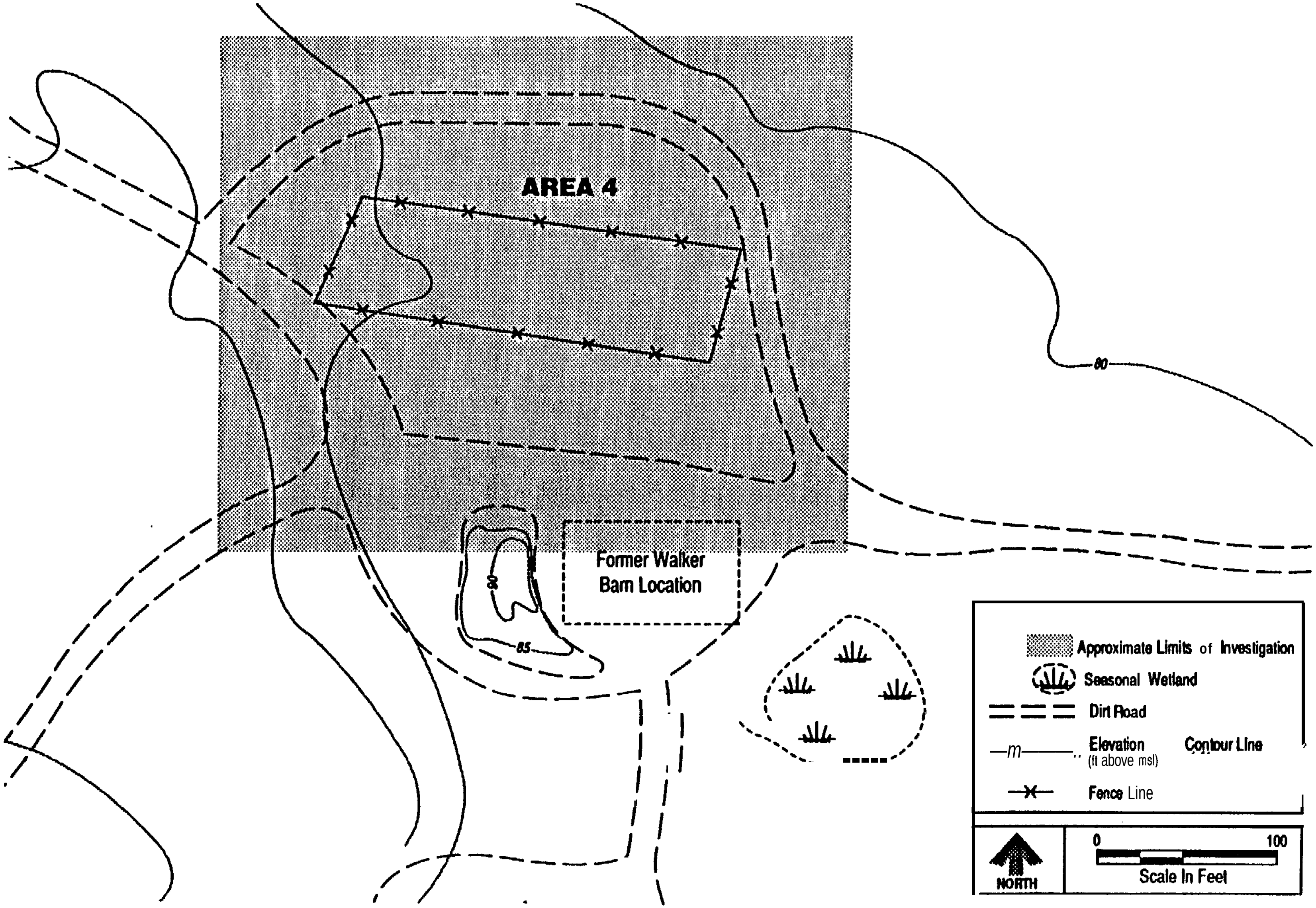
At present, there is a wetland south of Clover Valley Road that is the area of concern to the commenter. This wetland does not appear in past aerial photographs. If the drainage ditches shown in the photographs had become plugged and flooding had occurred, the contaminated runoff would have remained on the north side of Clover Valley Road; there is no defined drainage course and no historical indication of a wetland on the south side of Clover Valley Road. Little or no runoff from the fire school ponded south of Clover Valley Road in the past.

The present elevations of the culverts under Clover Valley Road and north of the area of concern indicate that the drainage runs north and collects at the main drainage ditch north of Clover Valley Road. A drainage ditch along the west side of Golf Course Road that now collects runoff from the fire school site also ties in to the main drainage at this point. The topography indicates that the runoff at this collection point then moves northeasterly, away from the wetland.

PAHs, the contaminant of concern, tend not to migrate; instead, PAHs remain in the soil because they bind with organic matter in the soil. This is apparent from the soil and surface water samples taken at the site—PAHs were detected only at the location of the fire school and the detention pond, not in the drainage ditch. Therefore, even if the runoff from the fire school site had backed up through the culvert and into the area south of Clover Valley Road, it is unlikely that the runoff would have been contaminated with PAHs.



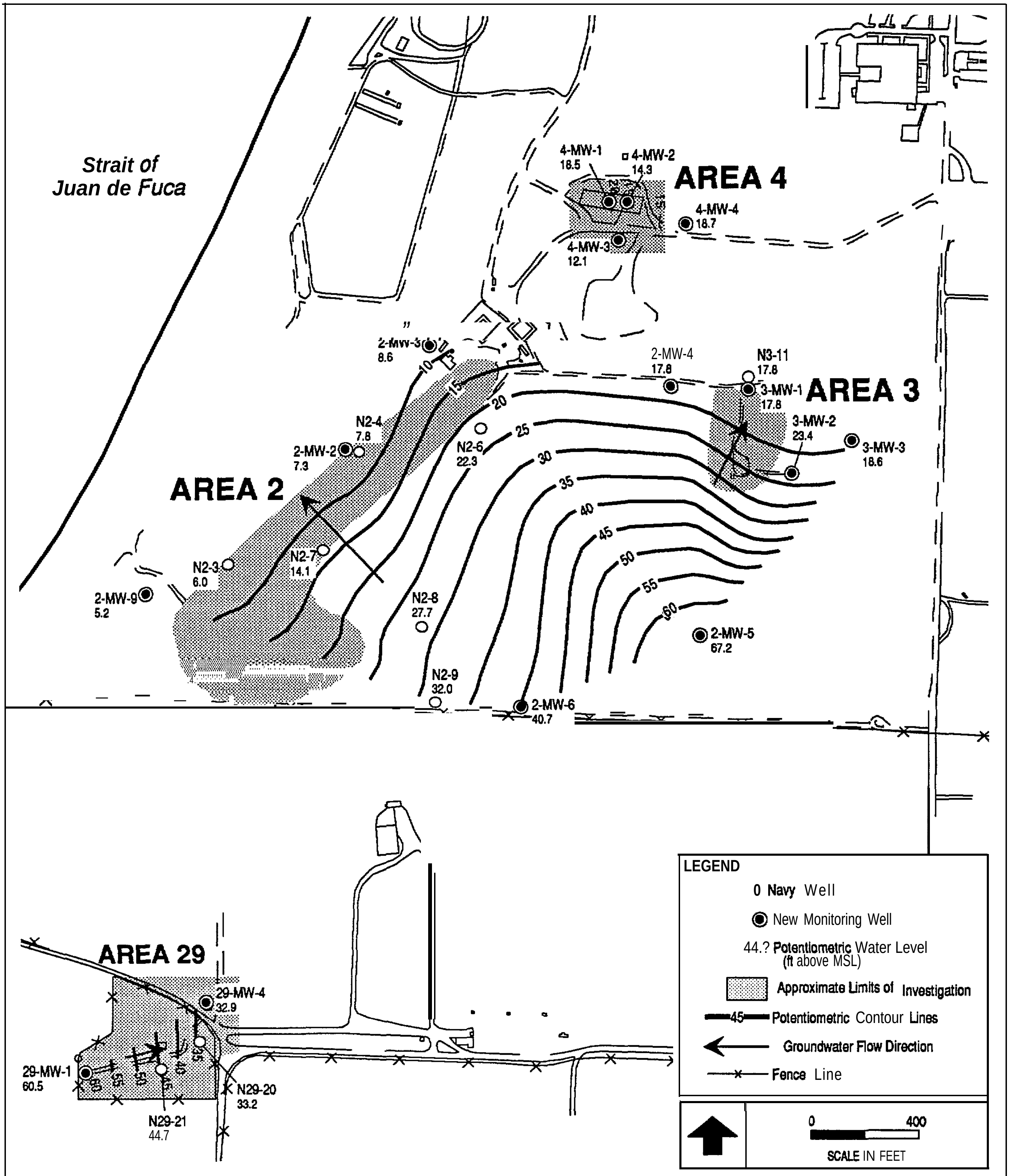
CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure A-1** **Area 29 Drainage Ditches**	CTO 0054 OPERABLE UNIT 2 NAS Whidbey, WA RECORD OF DECISION



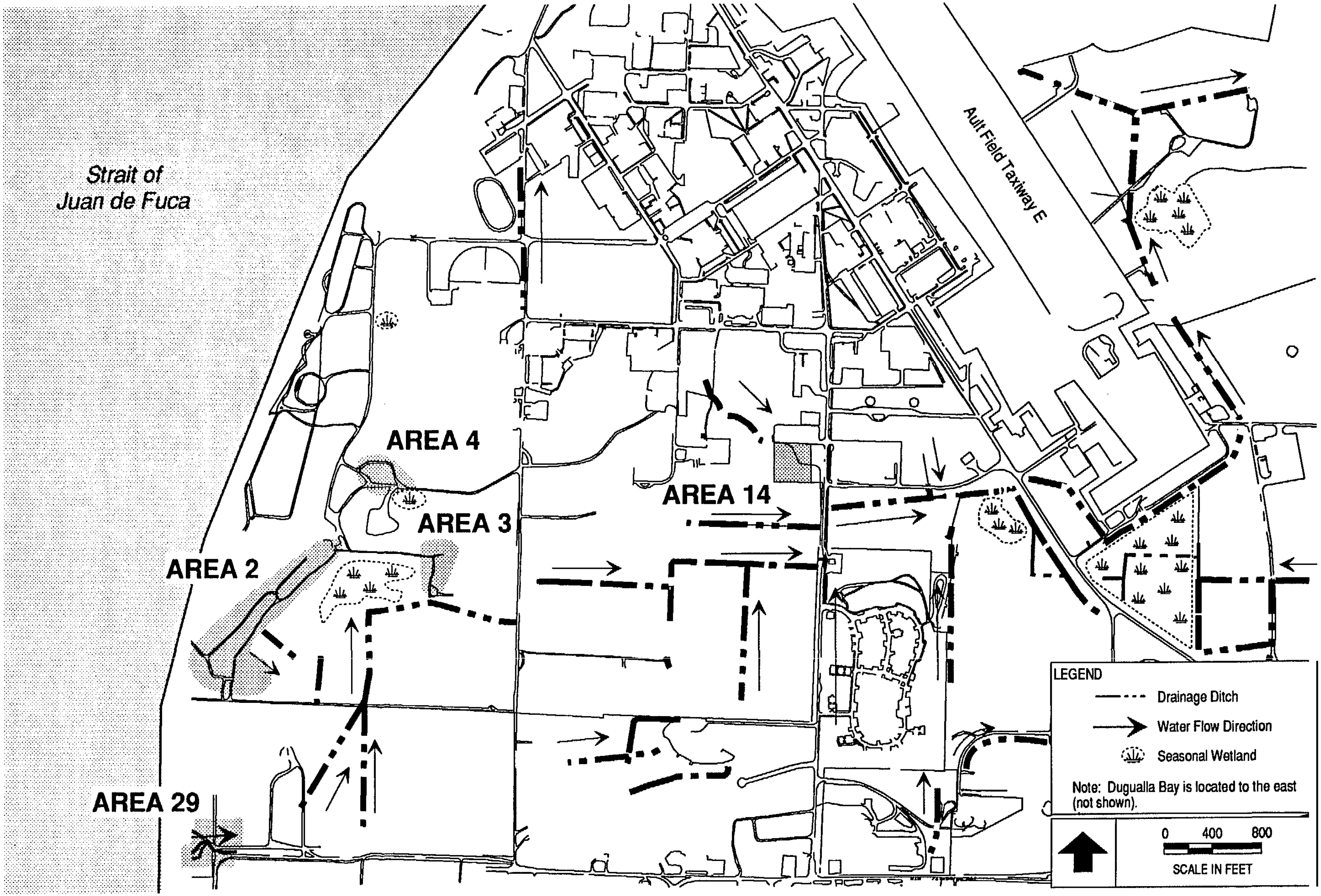
CLEAN
COMPREHENSIVE
LONG-TERM
ENVIRONMENTAL
ACTION NAVY

Figure 4
Area 4 (Walker Barn Storage Area)
Site Map

CTO 0054
OPERABLE UNIT 2
NAS WHIDBEY, WA
RECORD OF DECISION



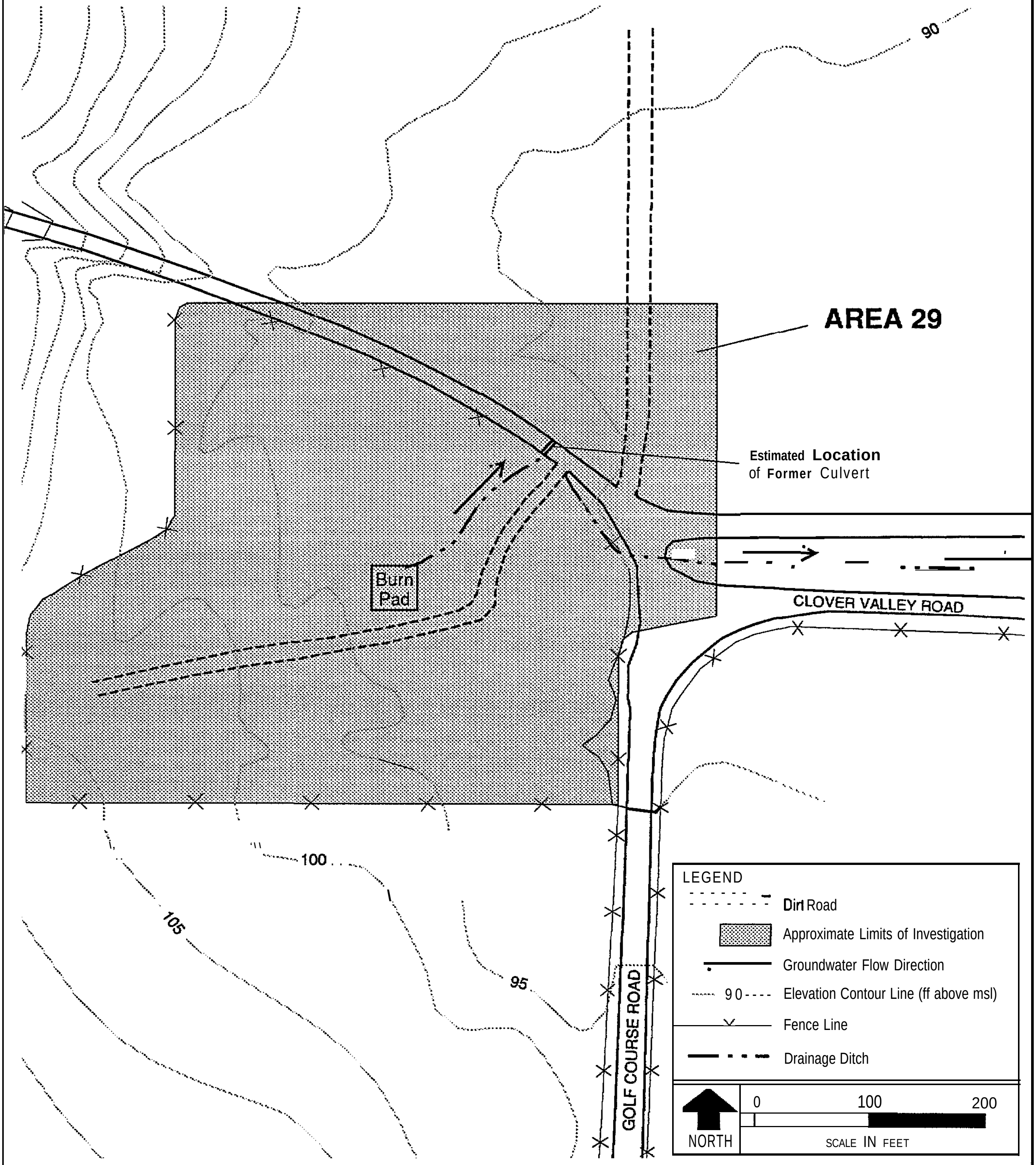
CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	Figure 7 Groundwater Potentiometric Surface Contours of the Intermediate Aquifer for Areas 2/3 and 29	CTO 0054 OPERABLE UNIT 2 NAS WHIDBEY, WA RECORD OF DECISION



CLEAN
COMPREHENSIVE
LONG-TERM
ENVIRONMENTAL
ACTION NAVY

Figure 8
Surface Water Drainage Patterns Around OU 2

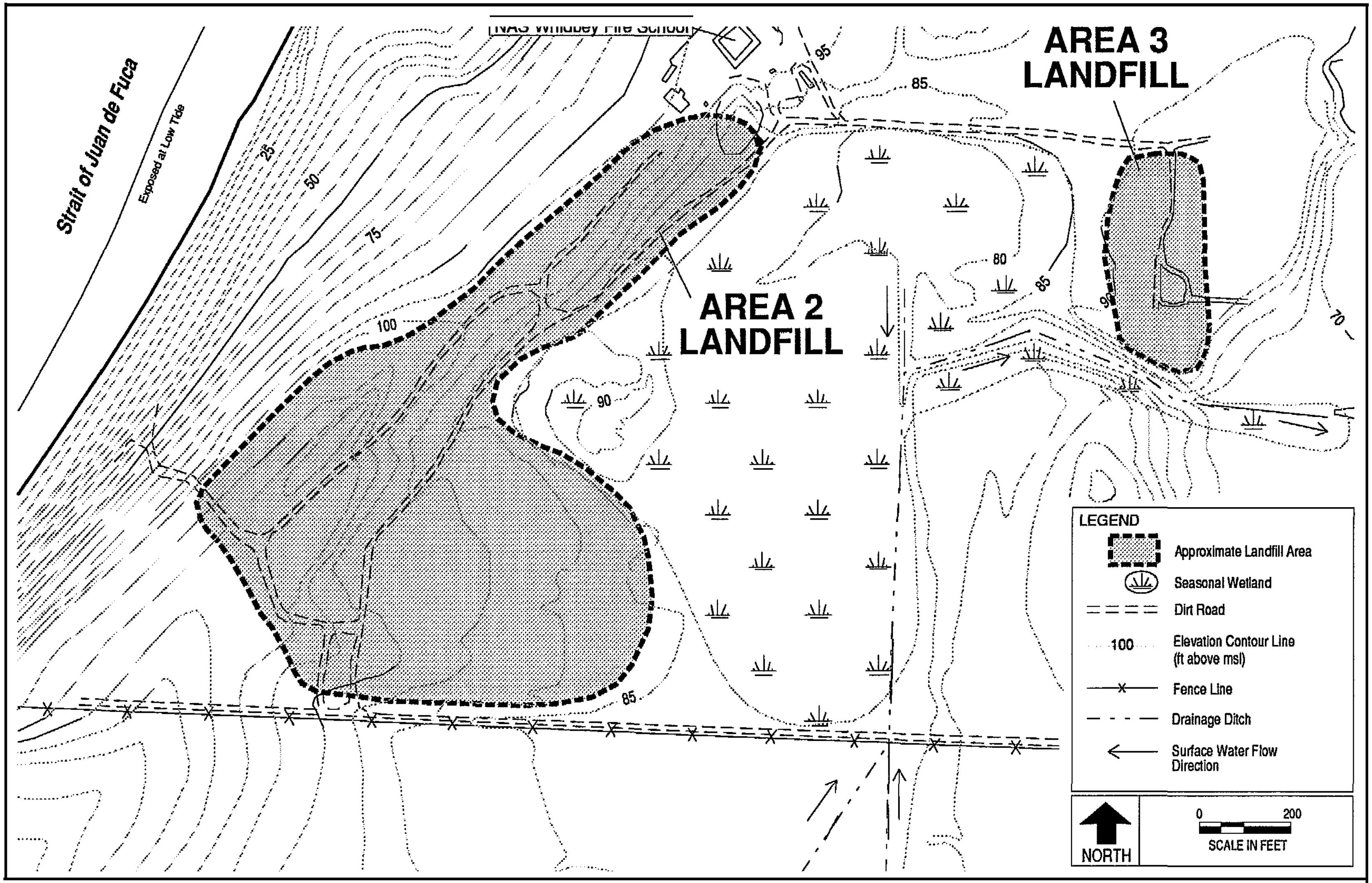
CTO 0054
OPERABLE UNIT 2
NAS WHIDBEY, WA
RECORD OF DECISION



CLEAN
COMPREHENSIVE
LONG-TERM
ENVIRONMENTAL
ACTION NAVY

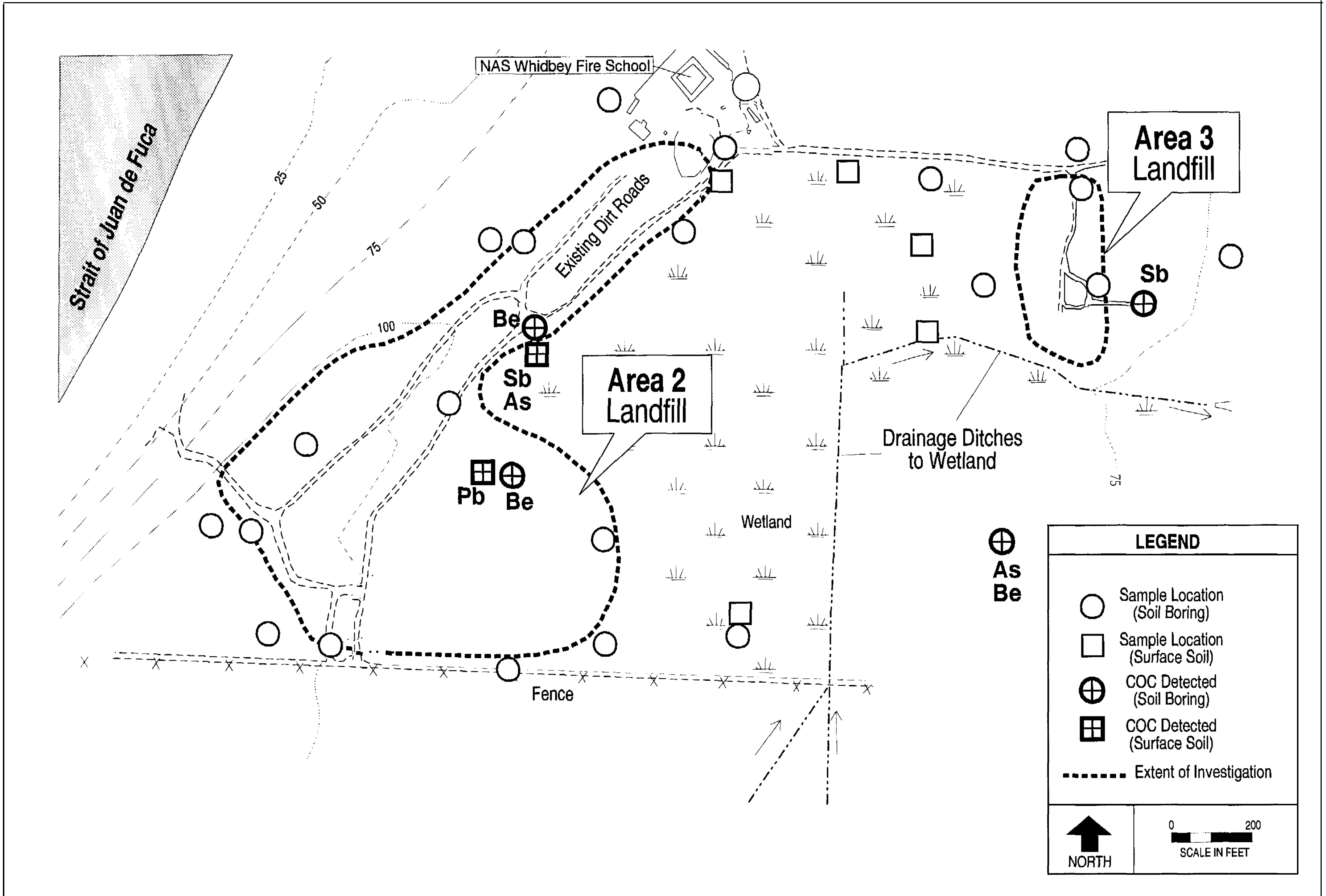
Figure 6
Area 29 (Clover Valley Fire School)
Site Map

CTO 0054
OPERABLE UNIT 2
NAS WHIDBEY, WA
RECORD OF DECISION



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	Figure 3 Area W Highlands Landfill) and Area 3 9 9 -to-1970 Landfill) Site Map	CTO 0054 OPERABLE UNIT 2 NAS WHIDBEY, WA RECORD OF DECISION

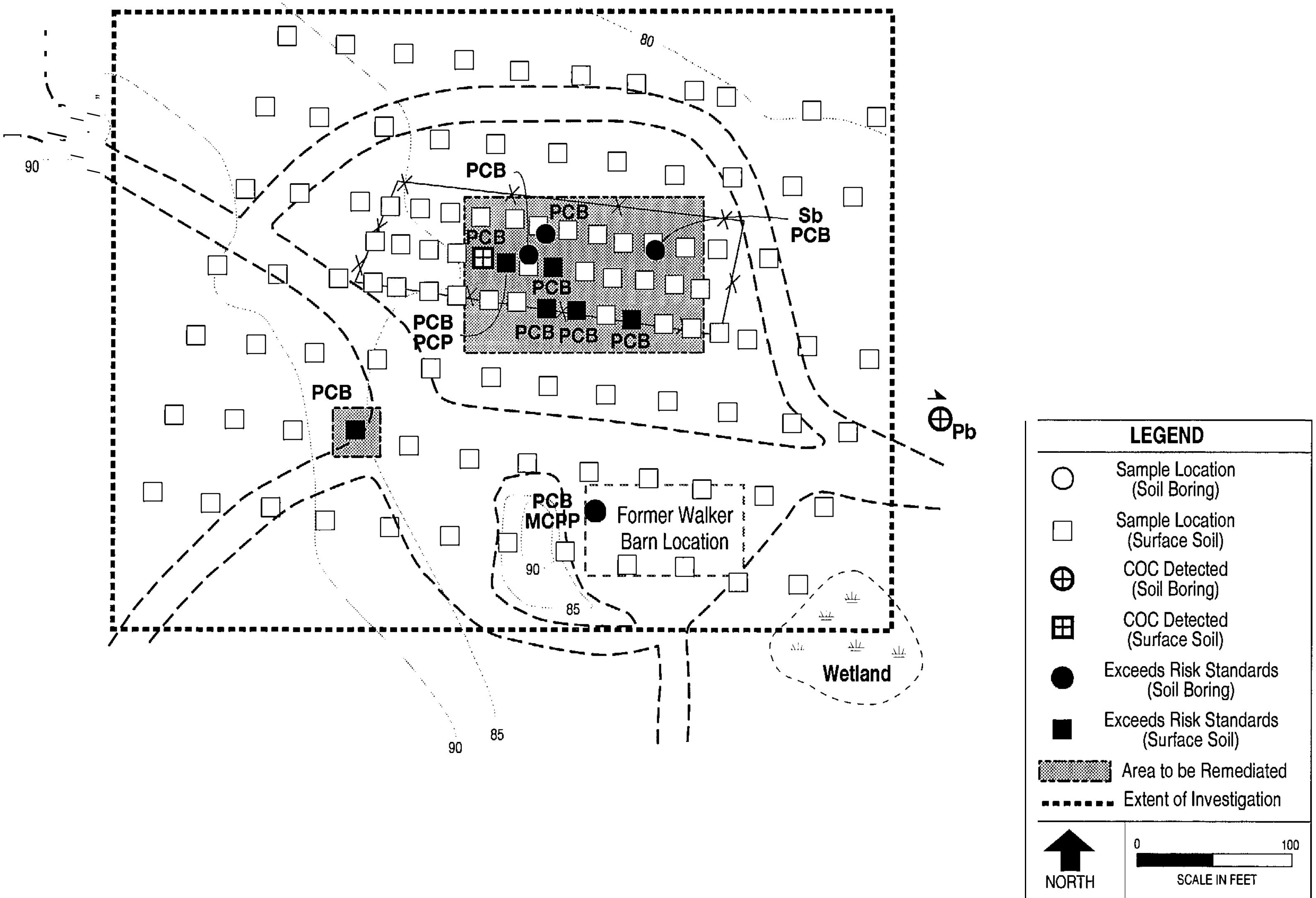
CTO54\FS\FIG1 RW 2/2/93



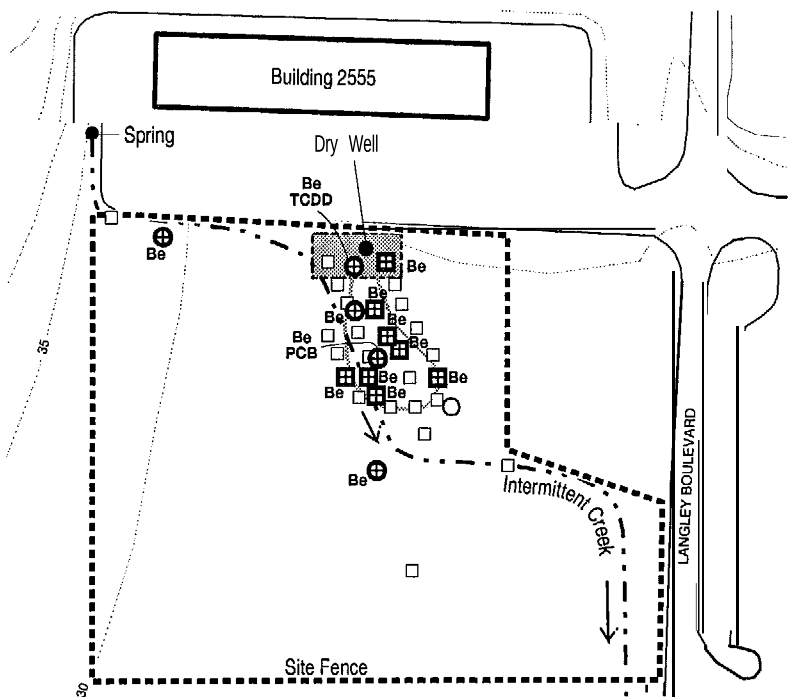
CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 9
Area 2/3 - Spatial Distribution of COCs Detected in Surface Soil

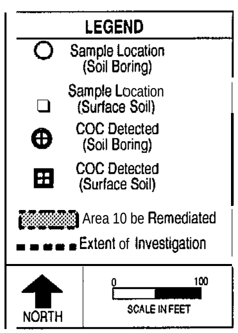
CTO 0054
OPERABLE UNIT 2
NAS WHIDBEY, WA
RECORD OF DECISION

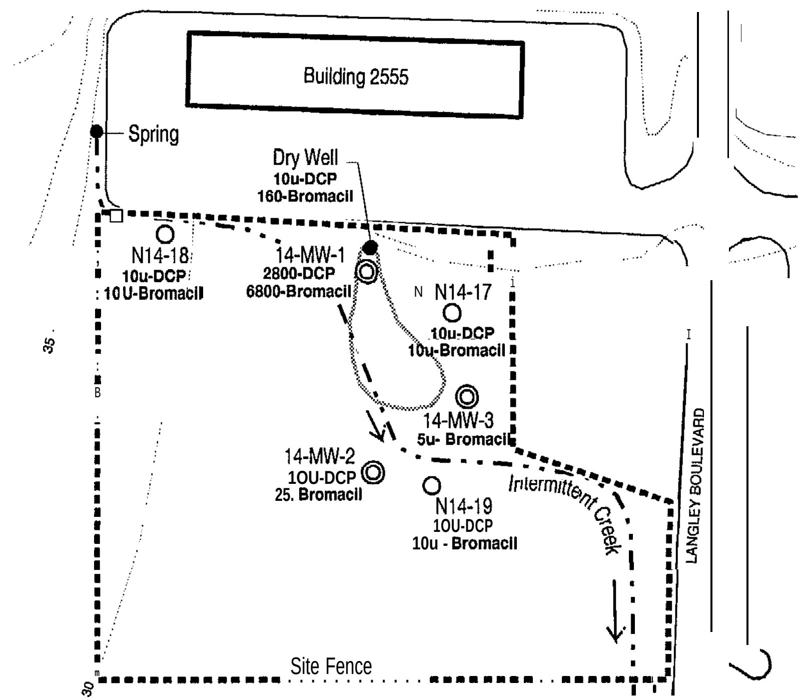


CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 10** **Area 4 - Spatial Distribution of COCs Detected in Surface Soil**	CTO 0054 OPERABLE UNIT 2 NAS WHIDBEY, WA RECORD OF DECISION

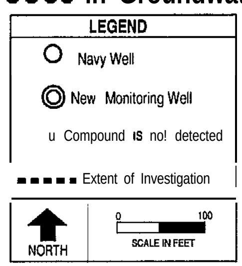


COCs in Surface Soil

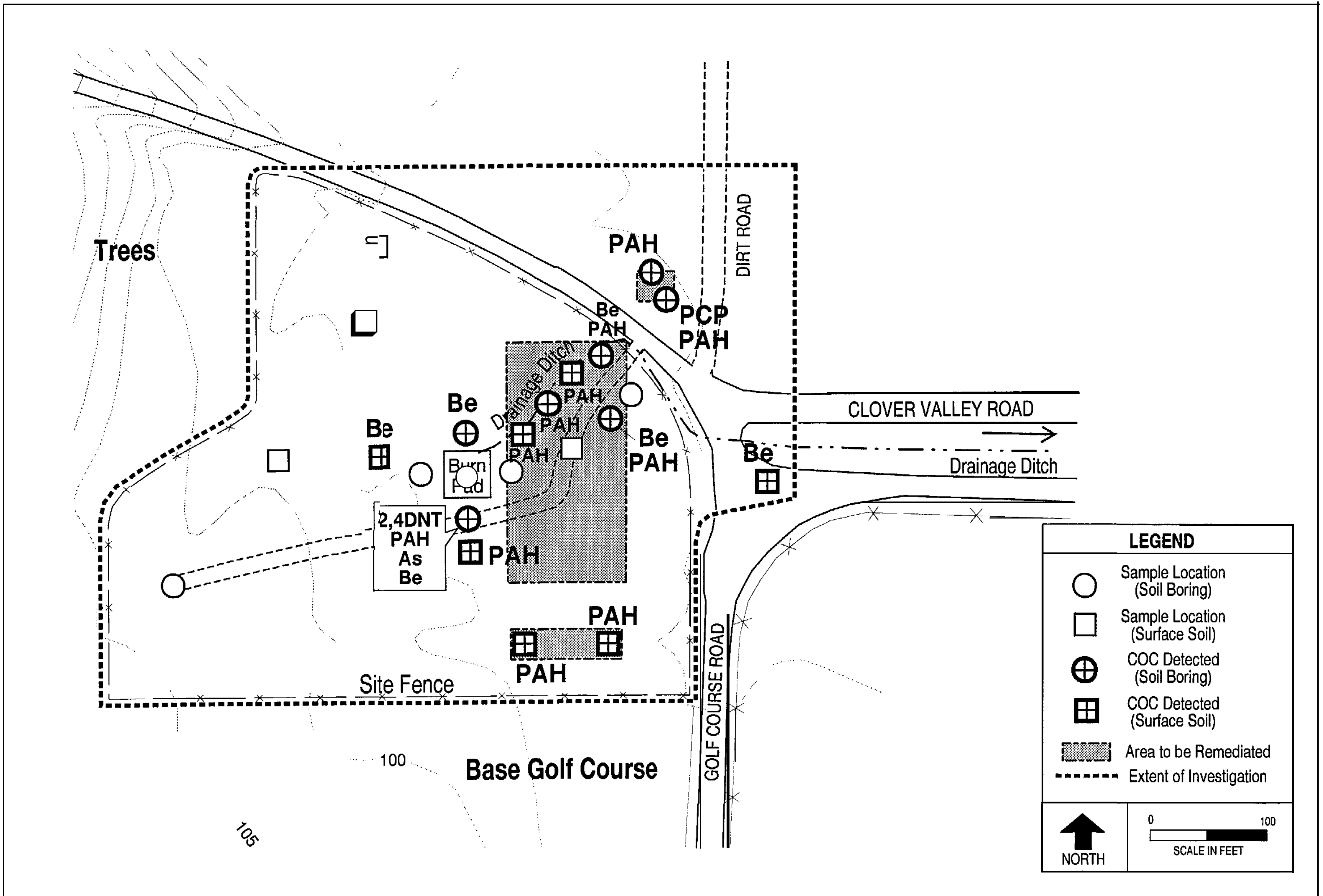




COCs in Groundwater



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 11** **Area 14= Spatial Distribution of COCS Detected in Surface Soil and Groundwater**	**CTO 0054** **OPERABLE UNIT 2** **NAS WHIDBEY, WA** **RECORD OF DECISION**



CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 12
Area 29 - Spatial Distribution of COCs Detected in Surface Soil

CTO 0054
OPERABLE UNIT 2
NAS WHIDBEY, WA
RECORD OF DECISION