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CNC CHARLESTON
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ZONE C AND ZONE I RESOURCE CONSERVATION AND RECOVERY ACT FACILITY
INVESTIGATION RESULTS CNC CHARLESTON SC
11/12/1996
ENSAFE

Zones C & I

RCRA Facility Investigation

Results

Naval Base Charleston

Scan

Zone C & I

RCRA Facility Investigation

(Administrative Record)



Presented by: EnSafe/Allen&Hoshall

November 12, 1996

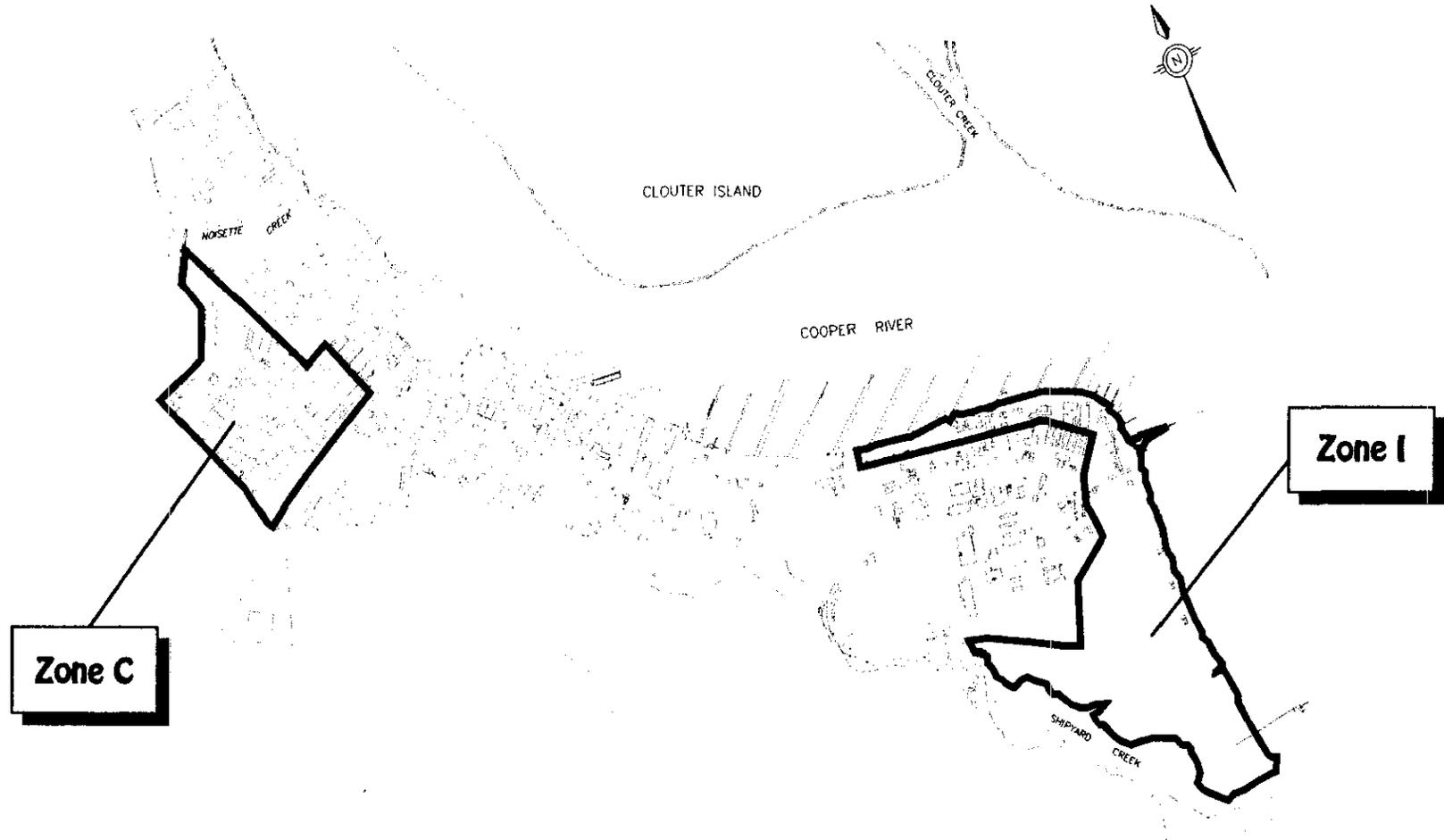
ACRONYMS

AOC	Area of Concern
CMS	Corrective Measures Study
COC	Chemical of Concern
COPC	Chemical of Potential Concern
DHEC	South Carolina Department of Health and Environmental Control
EPA	U. S. Environmental Protection Agency
HI	Hazard Index
HQ	Hazard Quotient
ILCR	Incremental lifetime excess cancer risk
NFA	No Further Action
PCB	Polychlorinated Biphenyl
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
TPH	Total Petroleum Hydrocarbons
VOC	Volatile Organic Compound

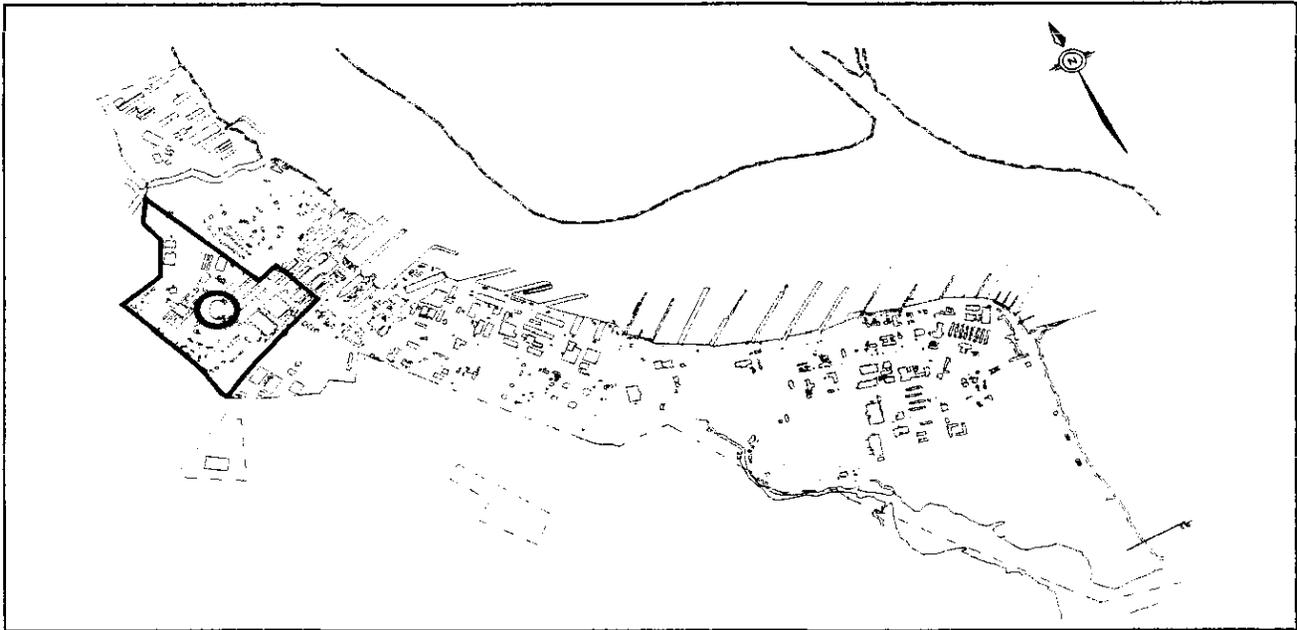
Outline - Zones C & I RFI Results

- ▲ Background
- ▲ Site-specific Results
- ▲ Risk Assessment Review
- ▲ Summary of Risks
- ▲ Recommendations
- ▲ Questions & Answers

Charleston Naval Shipyard



Zone C Overview



Location

- ▲ Zone C is located in the developed northwest portion of Naval Base Charleston.

Reuse

- ▲ Portions of the zone are currently slated for use as open buffer space, parking lots, office property, and limited residential areas.

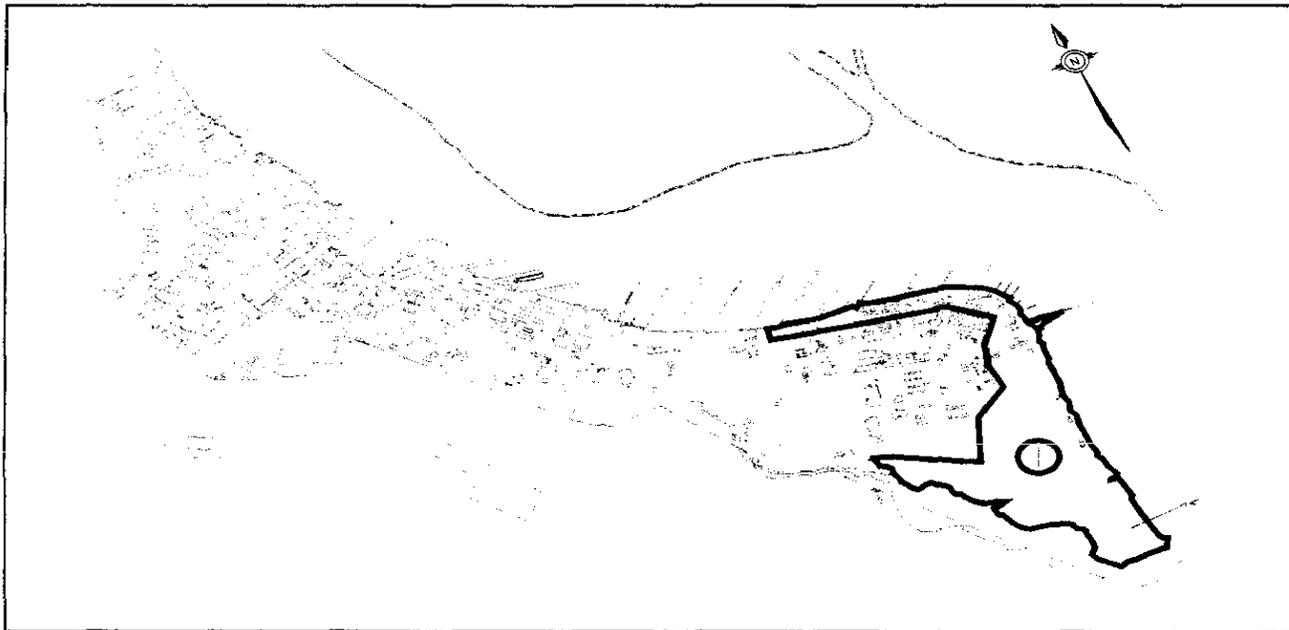
Purpose of Investigation

- ▲ To evaluate the nature and extent of hazardous waste impacts and to identify, develop, and implement appropriate corrective measures to protect human health and the environment.

Sampling Approach

- ▲ 3 Solid Waste Management Units (SWMUs)
- ▲ 14 Areas Of Concern (AOCs)
- ▲ 123 soil samples, 26 water samples

Zone I Overview



Location

- ▲ Zone I is the southern portion of the peninsula formed by Shipyard Creek and the Cooper River.

Reuse

- ▲ Identified for marine cargo terminal, marina, office space and open buffer.

Purpose of Investigation

- ▲ To evaluate the nature and extent of hazardous waste impacts and to identify, develop, and implement appropriate corrective measures to protect human health and the environment.

Sampling Approach

- ▲ 2 Solid Waste Management Units (SWMUs)
- ▲ 15 Areas Of Concern (AOCs)
- ▲ 2 Other Designated Sites
- ▲ 158 soil/sediment samples, 22 water samples
9 asbestos samples, 7 wipe samples for lead

Common Contaminant Categories

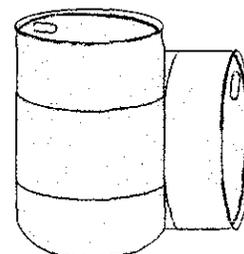
Metals



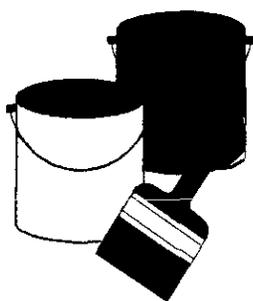
Metals are naturally occurring elements that are generally flexible and good conductors of electricity. These properties, along with the relative abundance of metals, make them valuable materials in industrial and manufacturing processes. Household items that commonly contain metals include paint and enamel, batteries, coins, and electrical components.

Pesticides, Herbicides, & PCBs

Pesticides are chemicals used to eliminate insects and other pests. Herbicides are chemicals used to kill unwanted plants or weeds. PCBs, or Polychlorinated Biphenyls, are industrial compounds that are used as insulating and heat exchange fluids in electrical transformers, and are found in hydraulic fluids used in electrical components and systems.



Semivolatile Organic Compounds



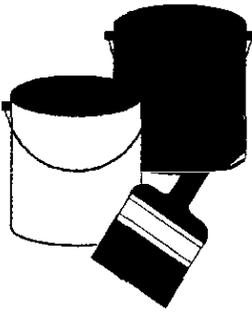
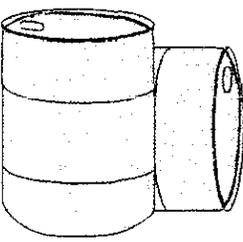
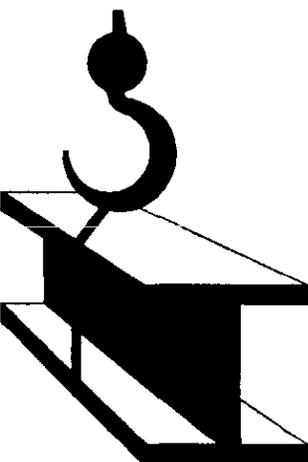
Semivolatile Organic Compounds, also called SVOCs, are common components of asphalt, coal tar, and pitch. Some SVOCs are components of diesel, jet fuel, waste oil, and hydraulic oil. A commonly used household SVOC is naphthalene, which is the main ingredient in many furniture refinishing products including paints, stains, finishes and varnish thinner.

Volatile Organic Compounds

Volatile Organic Compounds, also called VOCs, are commonly used chemicals. Many VOCs are solvents, which are liquid compounds used to dissolve other substances. Ordinary household solvents include paint thinner and mineral spirits. Other household products that contain VOCs include hair spray, nail polish remover, air fresheners, and oven cleaners.



Zones C & I Chemicals of Concern (COCs)

	Contaminant	Category	C	I
	1,4-Dichlorobenzene	VOC		✓
	Methylene chloride	VOC		✓
	3, 3 - Dimethyl Benzidine	SVOC	✓	
	Acetophenone	SVOC	✓	
	BEHP	SVOC	✓	
	Benzo(a)pyrene equivalents	SVOC	✓	✓
	Dioxins/Furans	SVOC	✓	✓
	N-Nitroso-di-n-propylamine	SVOC		✓
	4,4'-DDT	Pesticide	✓	
	Chlordane	Pesticide	✓	
	Dieldrin	Pesticide	✓	
	Isodrin	Pesticide		✓
	Polychlorinated Biphenyls	PCB		✓
	Aluminum	Metal	✓	
	Antimony	Metal	✓	
	Arsenic	Metal	✓	✓
	Beryllium	Metal	✓	✓
	Cadmium	Metal		✓
	Lead	Metal	✓	
	Manganese	Metal	✓	✓
	Nickel	Metal	✓	✓
	Thallium	Metal	✓	

Note: This table includes only chemicals that are primary contributors to Risk/Hazard.

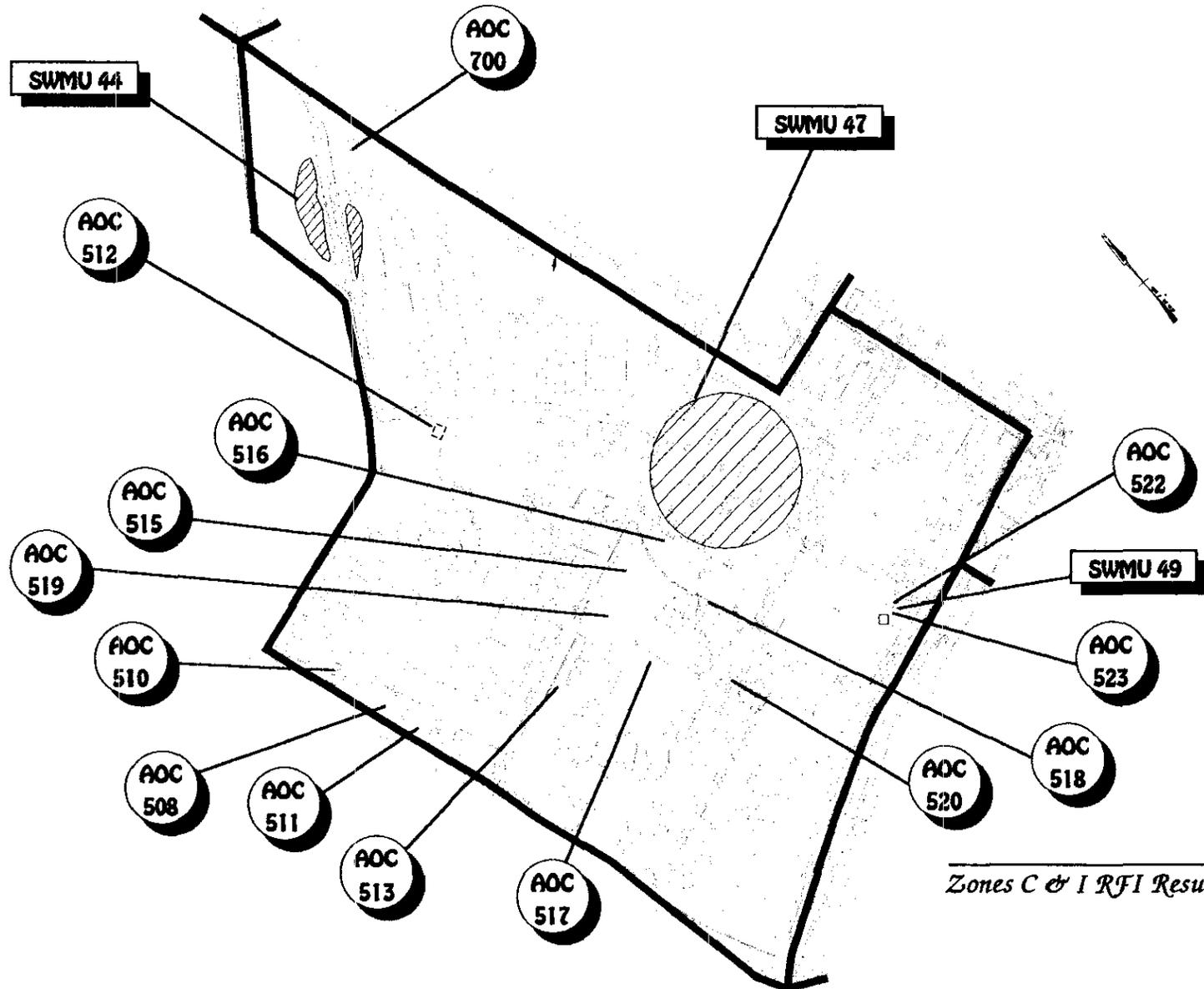
Grouping of Sites - Zones C & I

Grouping 1 - Petroleum Sites

Grouping 2 - Other Designated Sites

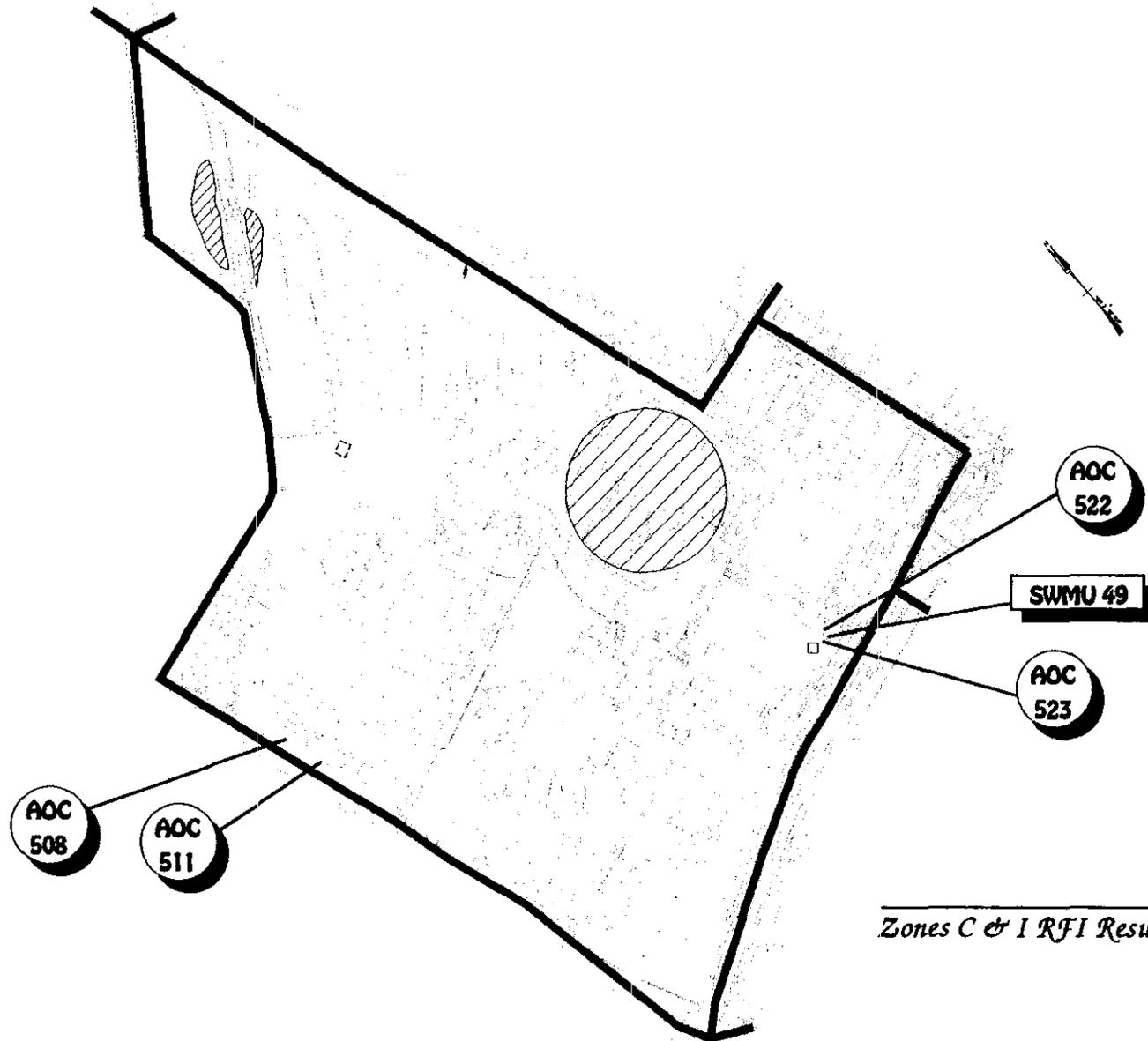
Grouping 3 - Sites Recommended for No Further Action

Zone C AOCs/SWMUs



Zones C & I RFI Results - 11/12/96

Zone C Grouping 1 - Petroleum Sites



Zones C & I RFI Results - 11/12/96

Zone C Grouping 1 - Petroleum Sites

Site #	Site Description	Samples Collected
AOCs 511/508	Former Oil Storehouse/ Former Incinerator	Soil (19)
AOC 522	Former Grease and Wash Area	<i>* Not presented in Draft RFI Report</i>
AOC 523/SWMU 49	Former Gas Station	Soil (2) Groundwater (2)

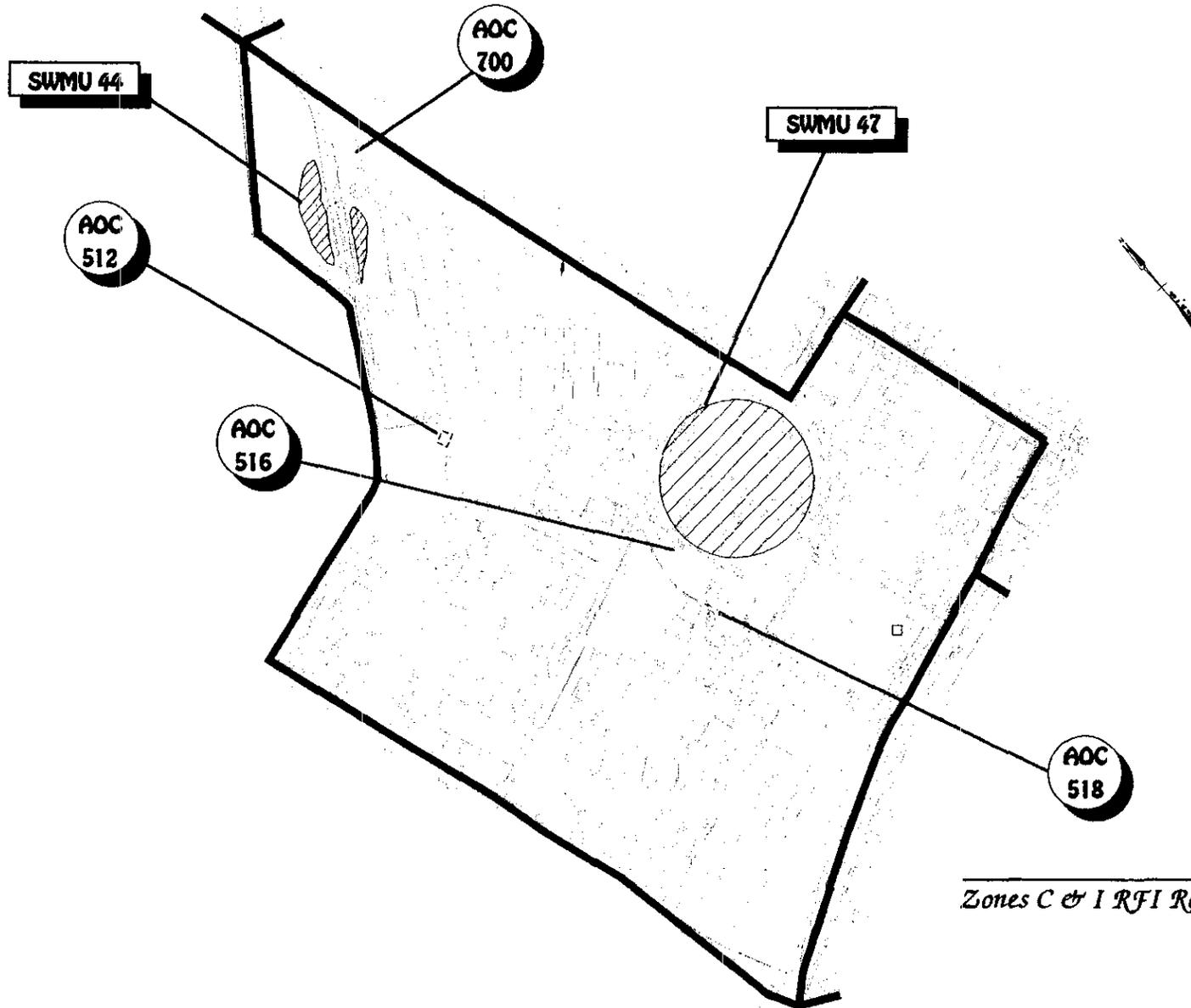
Zone C Grouping 1 - AOC 508/511



Primary Contributors to Risk/Hazard	
Soil:	
	Benzo(a)pyrene Equivalents
	Chlordane
	DDT
	Dieldrin
Groundwater:	
	None

Legend
● Soil Boring

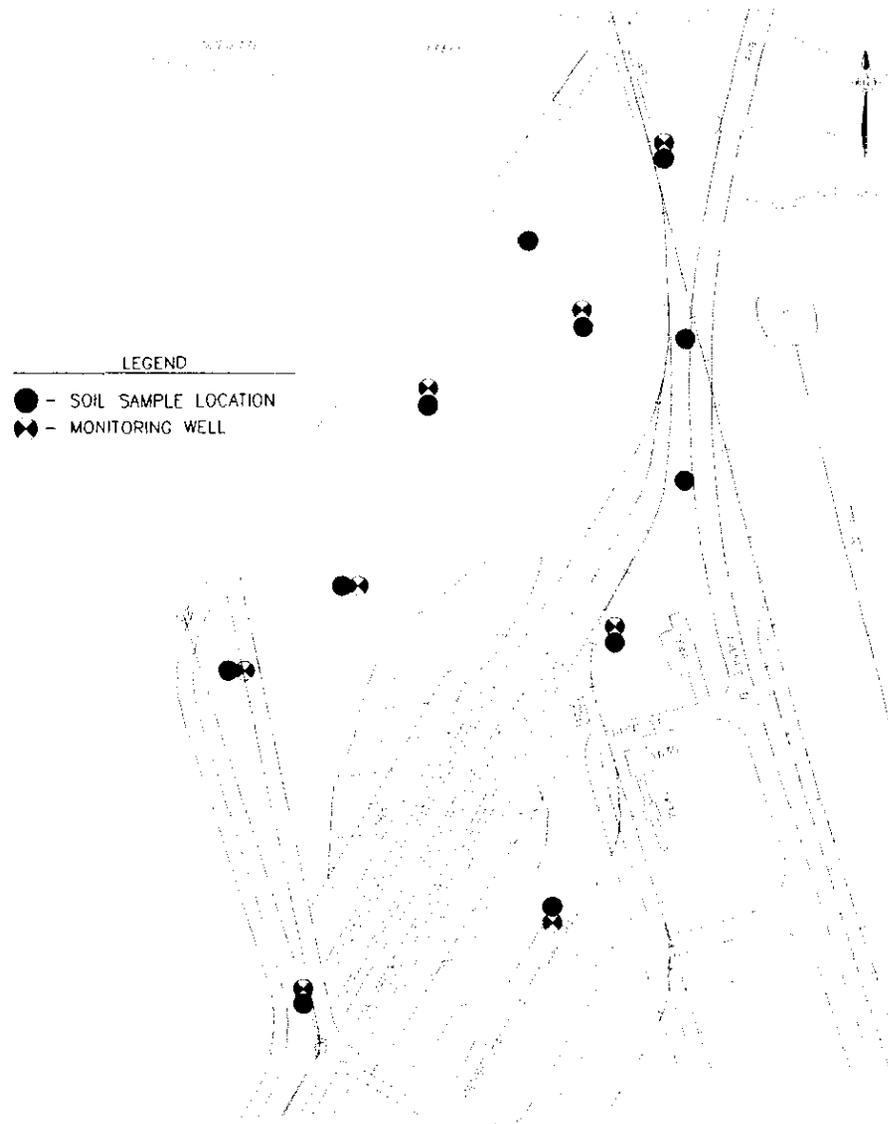
Zone C Grouping 2 - Other Designated Sites



Zone C Grouping 2 - Other Designated Sites

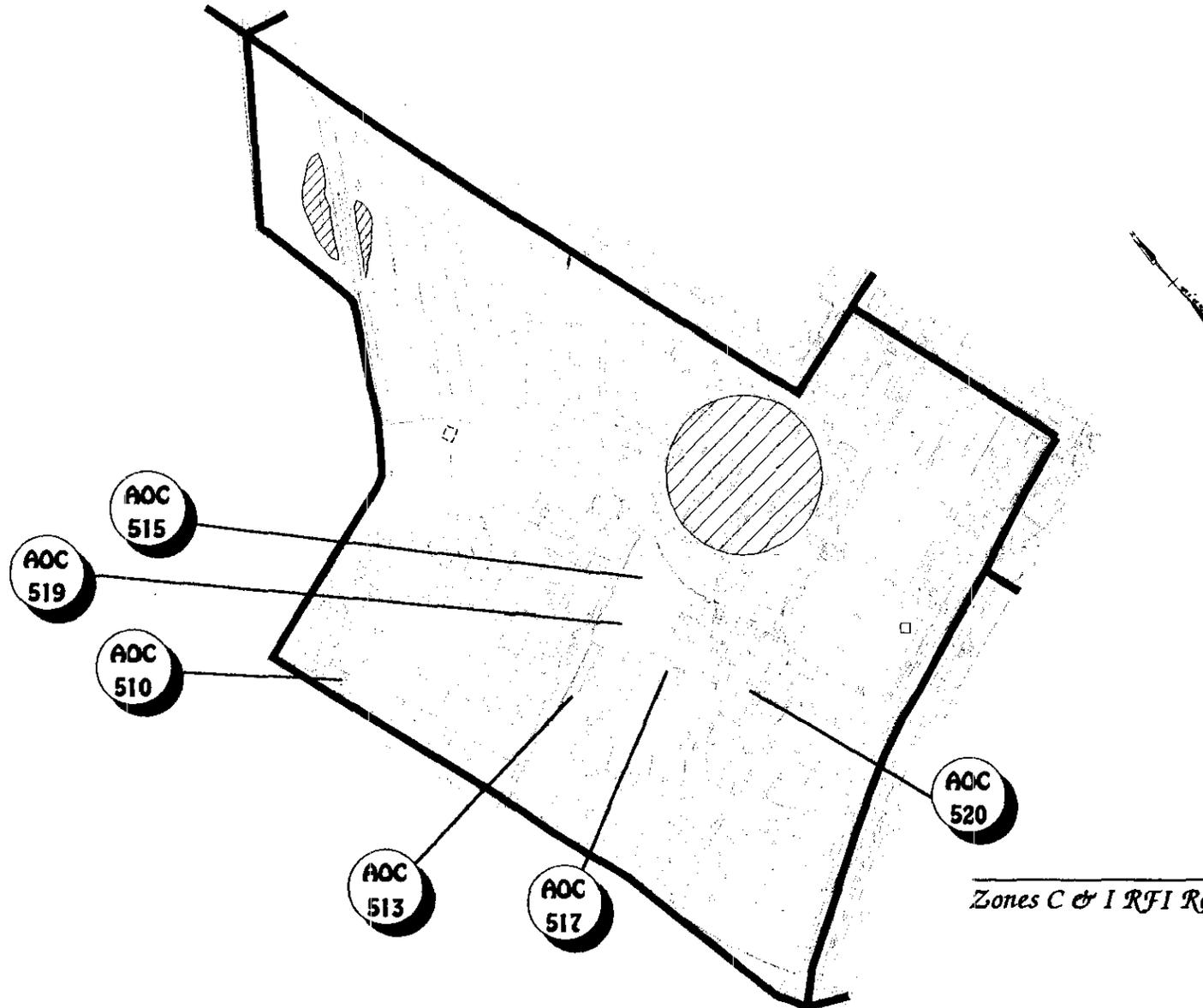
Site #	Site Description	Samples Collected
SWMU 44	Coal Storage Area	Soil (19) Groundwater (8)
SWMU 47/AOC 516	Wash Area/Battery Charging and Former Burning Dump	Soil (24) Groundwater (14)
AOC 512	Former Incinerator	Soil (9)
AOC 518	Coal Storage Bins	Soil (10)
AOC 700	Golf Course Maintenance Building	<i>* Not presented in Draft RFI Report</i>

Zone C Grouping 2 - SWMU 44



Primary Contributors to Risk/Hazard	
Soil:	
	Arsenic
	Benzo(a)pyrene equivalents
Groundwater:	
	Aluminum
	Arsenic
	Beryllium
	Manganese
	2,3,7,8-TCDD

Zone C Grouping 3 - No Further Action

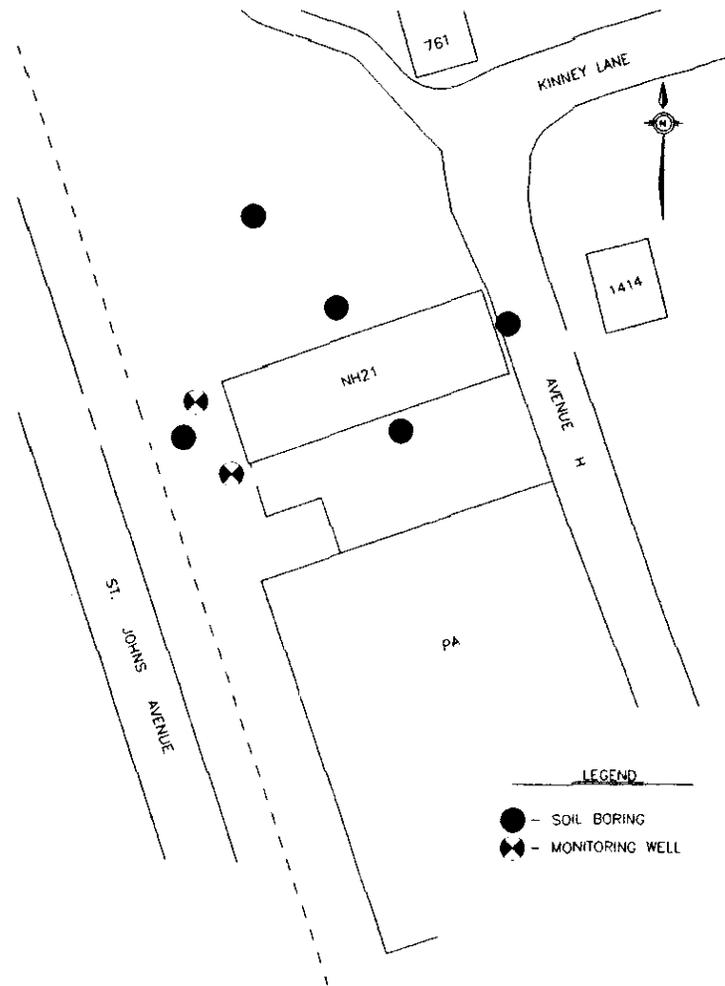


Zones C & I RFI Results - 11/12/96

Zone C Grouping 3 - No Further Action

Site #	Site Description	Samples Collected
AOCs 515/519	Former Incinerator & Paint Shop/ Former Boiler House	Soil (14)
AOC 513	Former Morgue	Soil (6)
AOC 517	Former Indoor Firing Range	Soil (5)
AOC 520	Former Garbage House	Soil (8)
AOC 510	Geotechnical Laboratory	Soil (7) Groundwater (2)

Zone C Grouping 3 - AOC 510



Primary Contributors to Risk/Hazard

Soil:
None

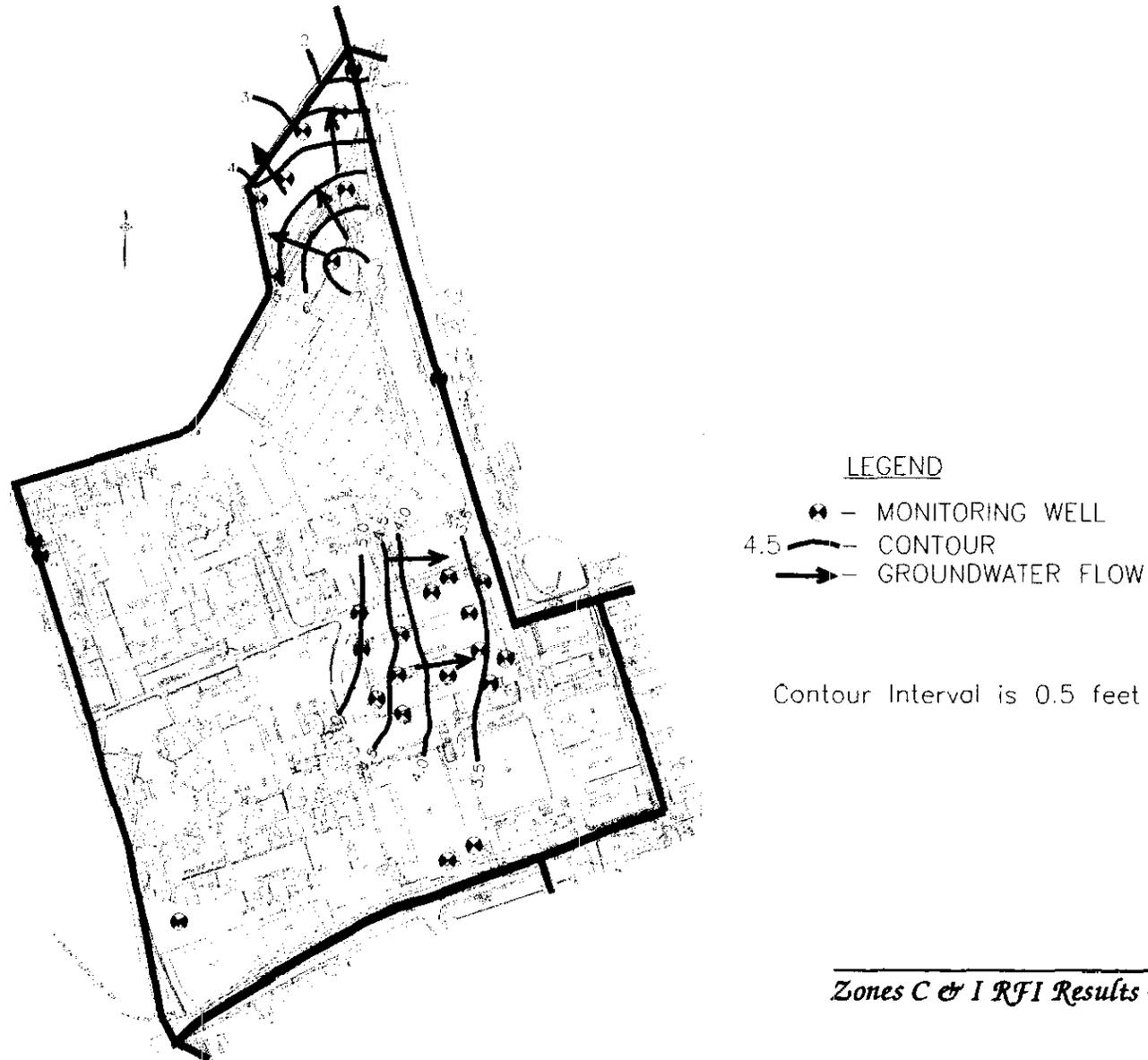
Groundwater:
None

LEGEND

● - SOIL BORING

⊗ - MONITORING WELL

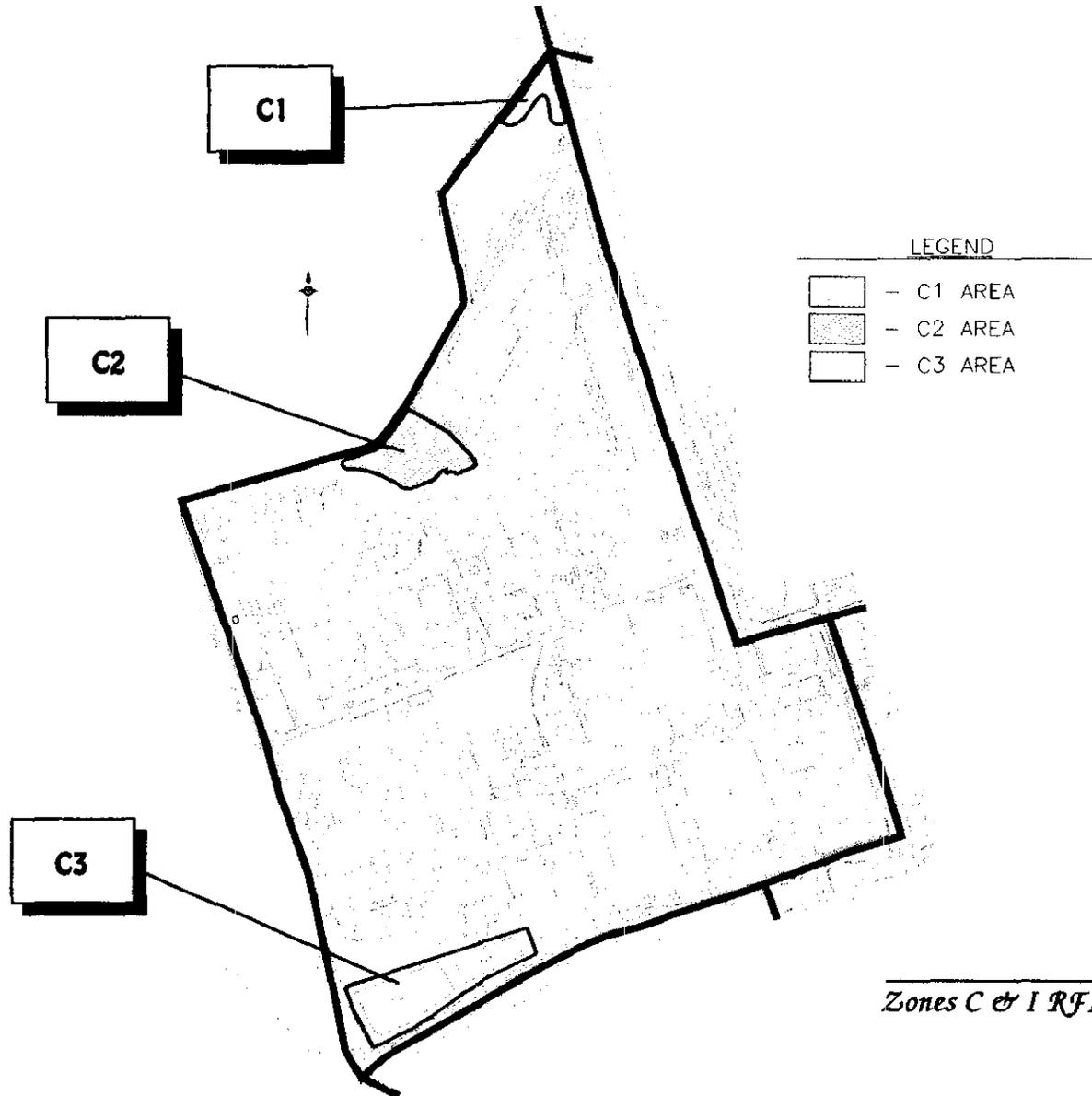
Zone C - Groundwater Monitoring Network



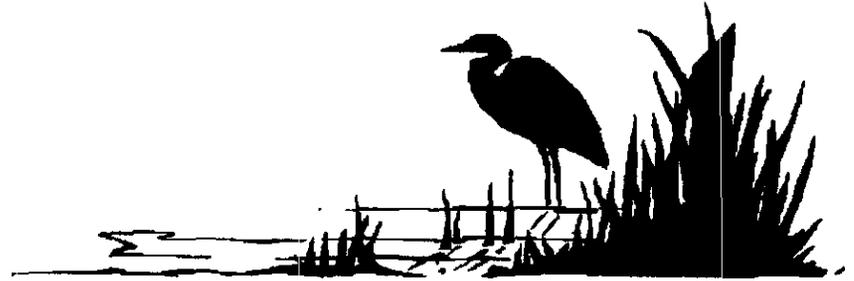
Shallow Groundwater - COCs in Zone C

Area of Significant Impact	Site Description	COCs Driving Risk
SWMU 44	Coal Storage Yard	Aluminum Arsenic Beryllium Manganese 2,3,7,8-TCDD
AOC 516/SWMU 47	Wash Area/Battery Charging Former Burning Dump	Antimony Arsenic Lead Manganese 3,3-Dimethyl benzidine
AOC 523/SWMU 49	Former Gas Station	Aluminum Arsenic Manganese

Zone C - Ecological Areas

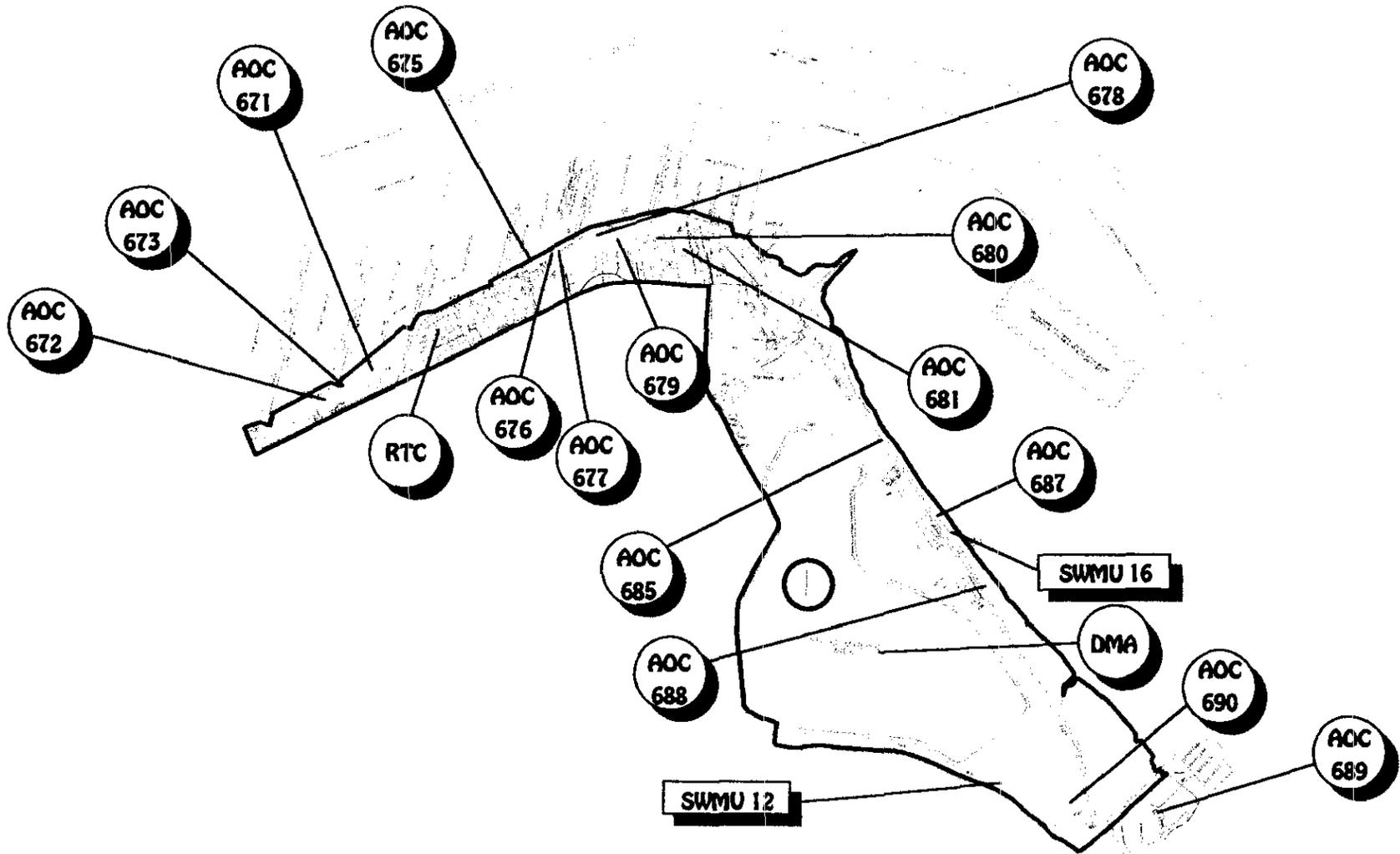


Ecological Impacts - Zone C

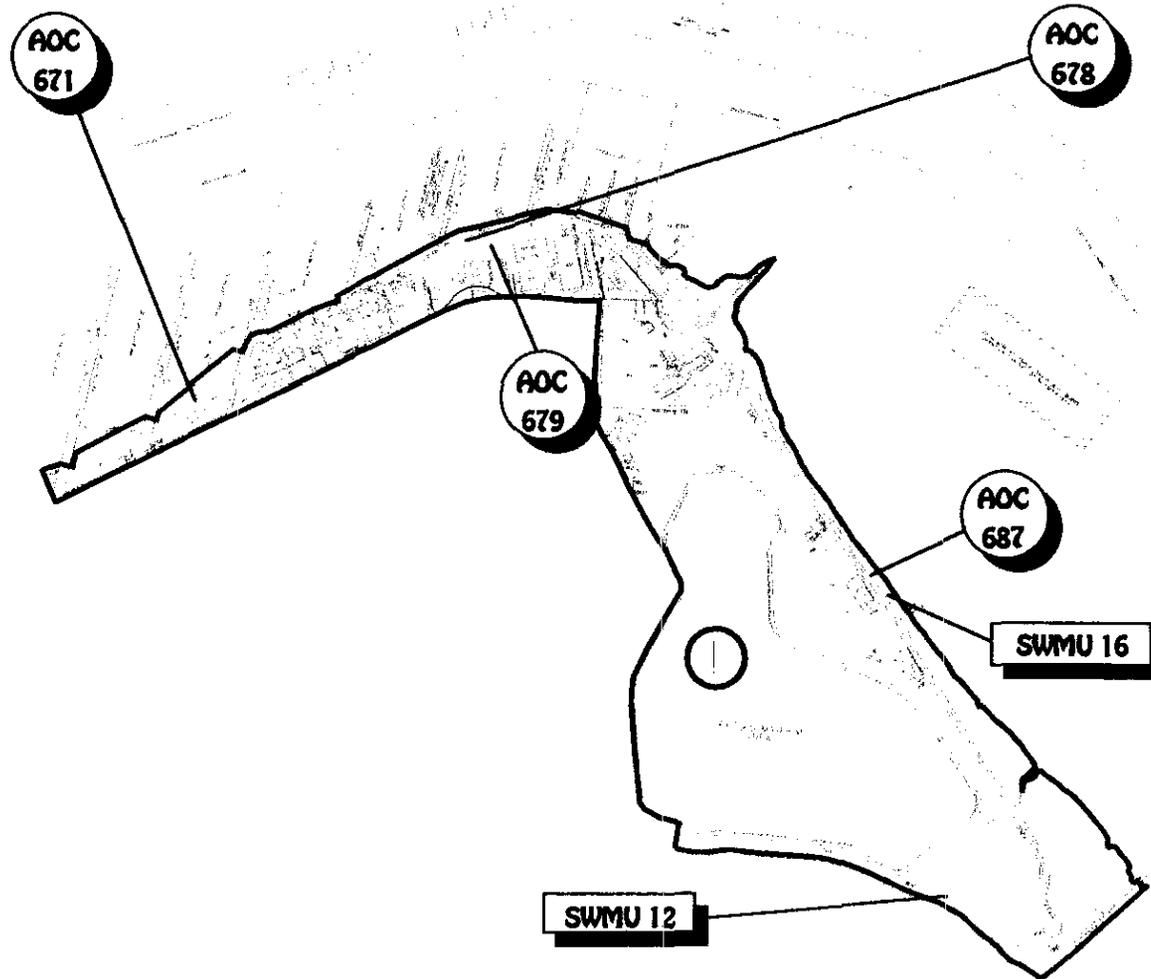


Sub Zone	Description	Associated Sites	COCs	Receptors Potentially at Risk
C-1	Dense shrubs and tall grasses	SWMU 44	Metals (arsenic, copper) in soil	Noisette Creek (Zone J), small mammals, soil biota, and vegetation (seedlings).
C-2	Grass field with few trees	AOCs 512 & 509	Metals (arsenic, copper) in soil.	Small mammals, soil biota, and vegetation (seedlings).
C-3	Detention ponds with aquatic vegetation	AOC 504	Arsenic in nearby soil.	Small mammals and birds.

Zone I AOCs/SWMUs



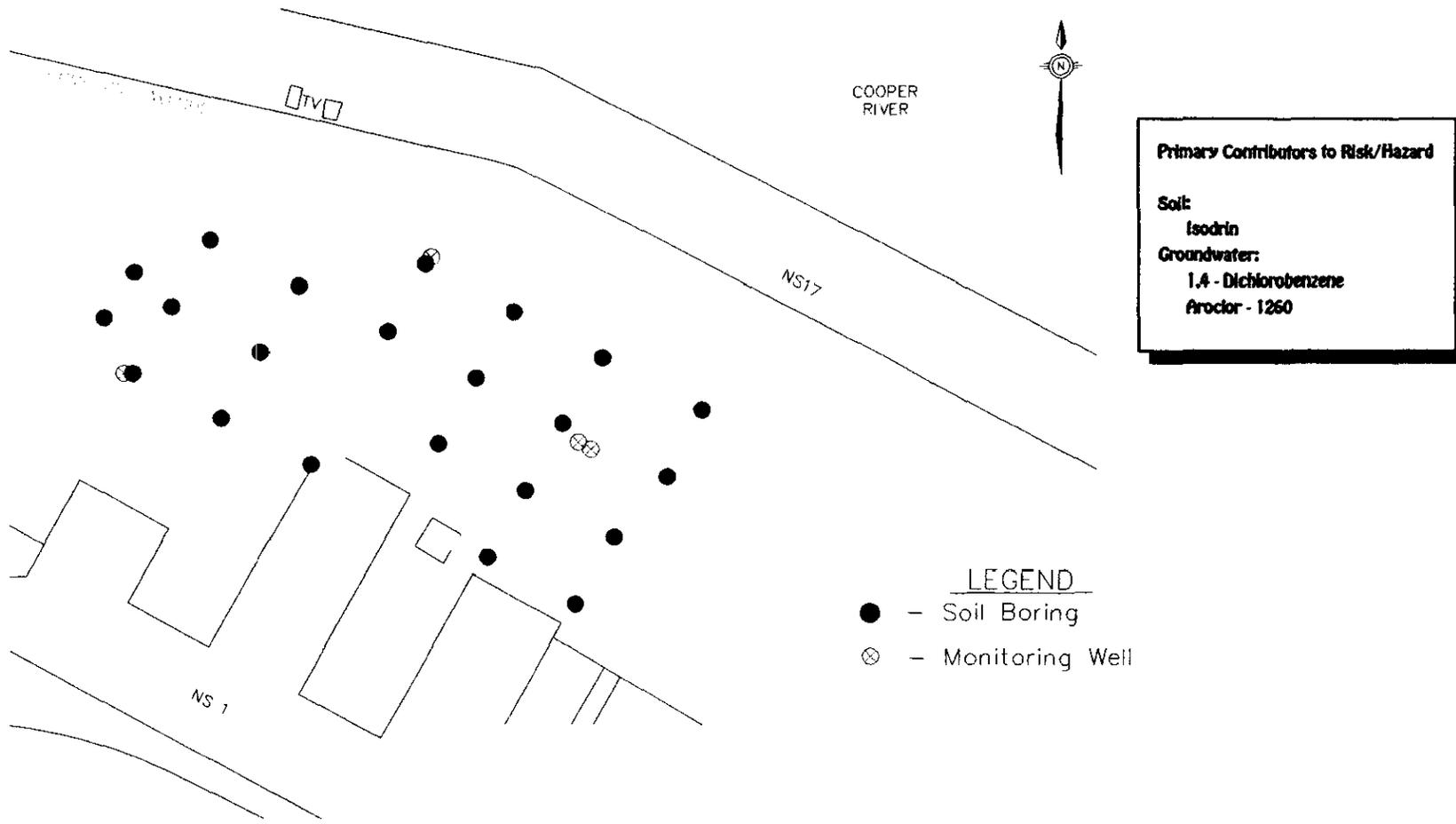
Zone I Grouping 1 - Petroleum Sites



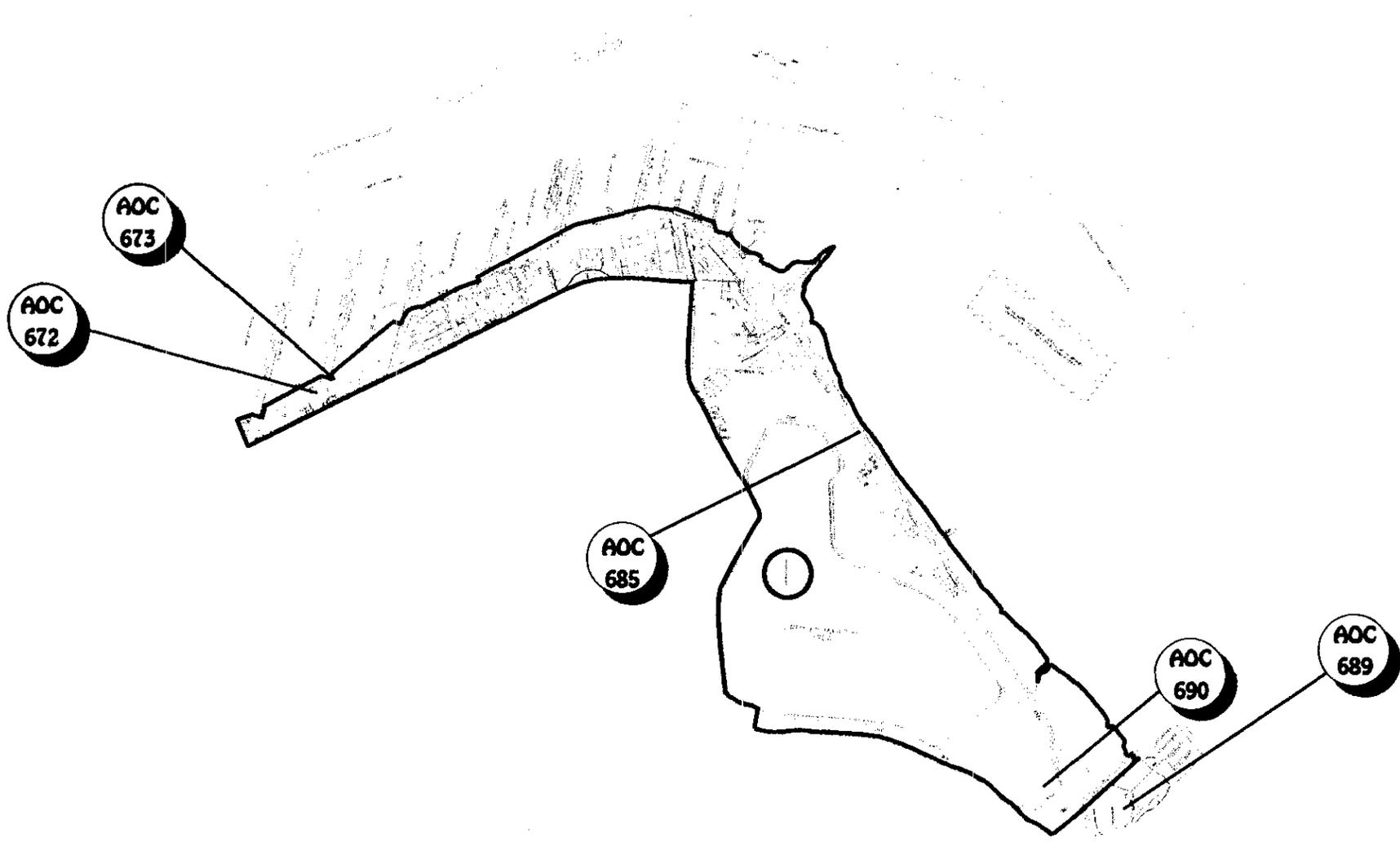
Zone I Grouping 1 - Petroleum Sites

Site #	Site Description	Samples Collected
AOC 671	Underground Storage Tanks for Aviation Gasoline	Soil (10) Groundwater (4)
AOCs 678 & 679	Former Firefighter School/Former Firefighter Wash Rack	Soil (23) Groundwater (2)
SWMU 12	Former Firefighter Training Site	Soil (15) Groundwater (3)
SWMU 16/AOC 687	Unauthorized Open Storage Site/Ammunition Storage Bunker	Soil/Sediment (6) Groundwater (4)

Zone I Grouping 1 - AOC 678/679



Zone I Grouping 2 - Other Designated Sites

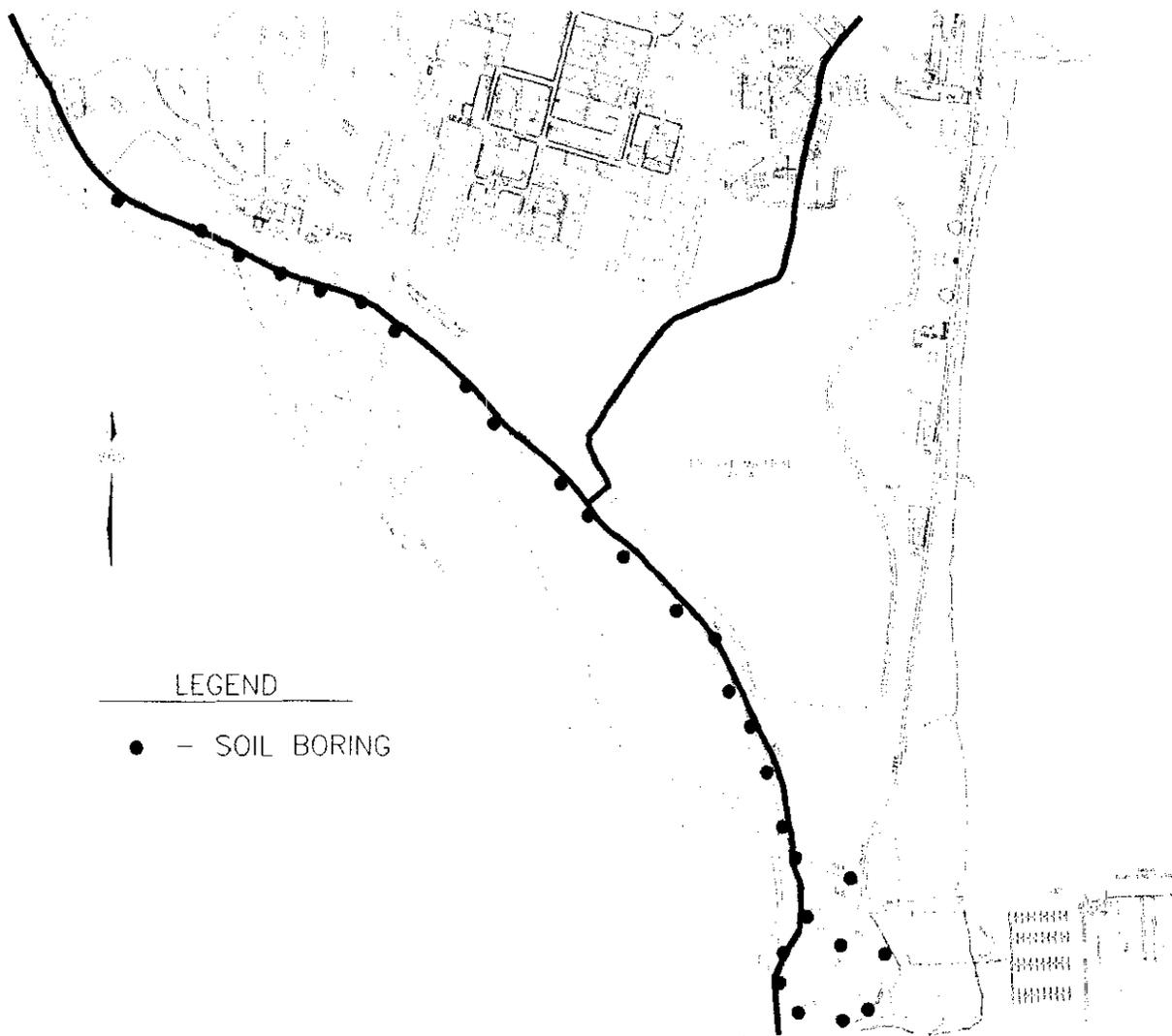


Zones C & I RFI Results - 11/12/96

Zone I Grouping 2 - Other Designated Sites

Site #	Site Description	Samples Collected
AOCs 672 & 673	PCB Transformer Substation	Soil (10)
AOC 685	Former Smoke Drum Area	Soil (15)
AOCs 689 & 690	Unknown Material Disposal Site Dredged Materials Area	Soil (33)

Zone I Grouping 2 - AOC 689/690



LEGEND

● - SOIL BORING

Primary Contributors to Risk/Hazard

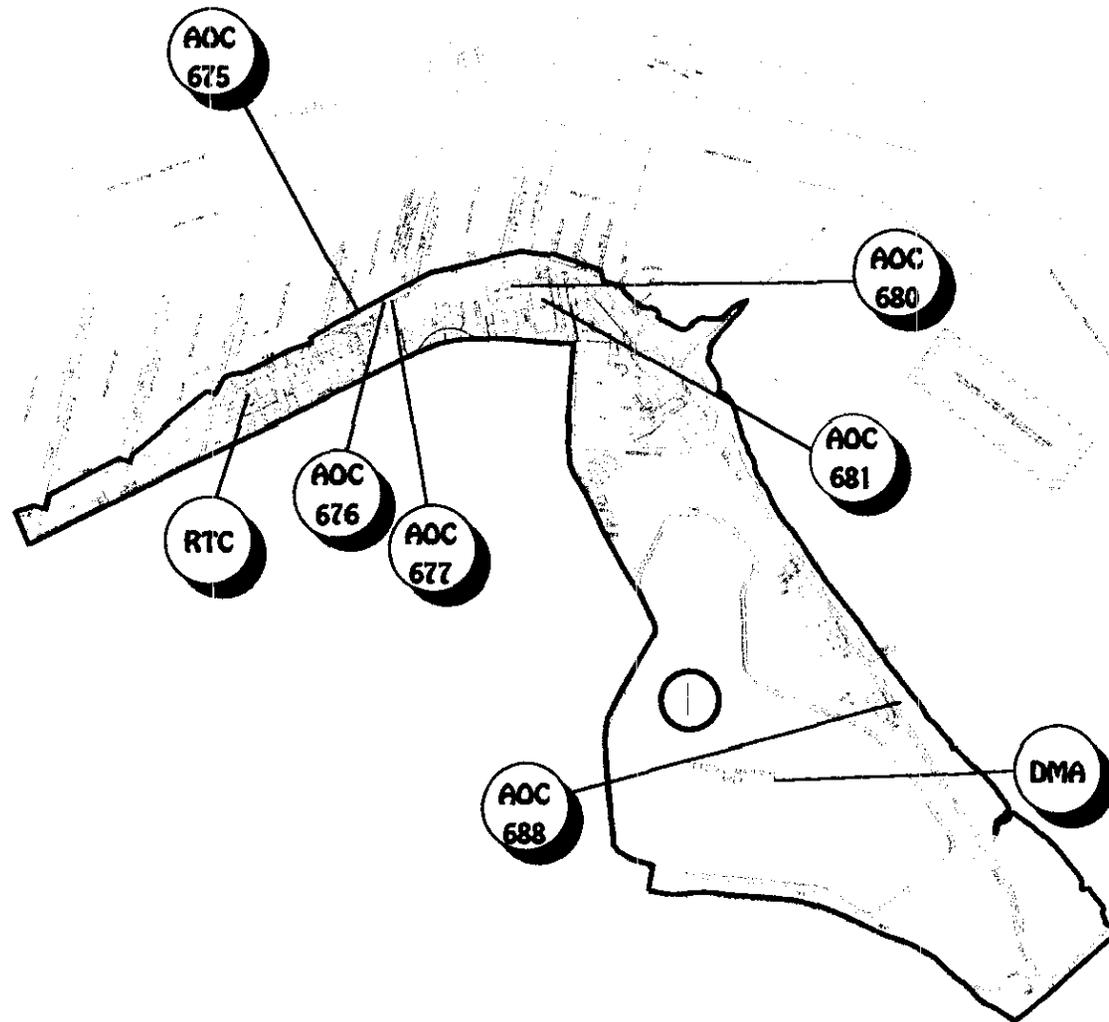
Soil:

Benzo(a)Pyrene Equivalents

Groundwater:

None

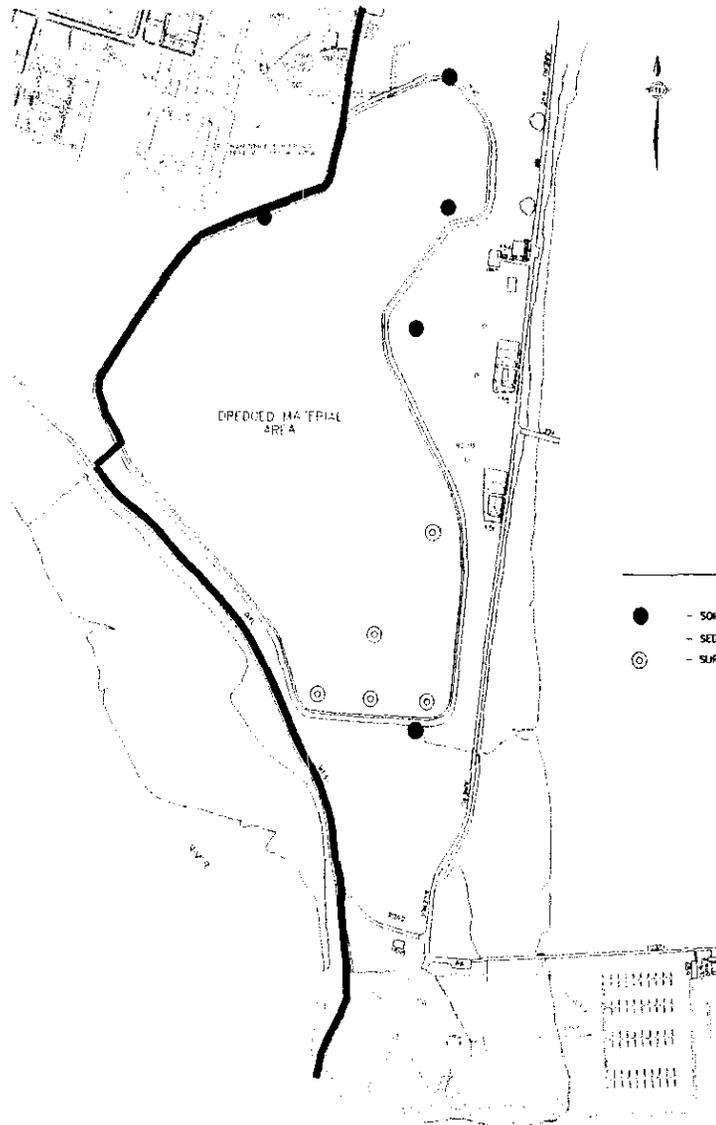
Zone I Grouping 3 - No Further Action



Zone I Grouping 3 - No Further Action

Site #	Site Description	Samples Collected
DMA	Dredged Materials Area	Soil/Sediment (14) Surface Water (5)
RTC	Reserve Training Center	Soil (10)
AOC 680	Former Grinding Room/Brake Repair Area	Asbestos Samples (9) Lead Wipes (7)
AOC 681	Blast Booth	Soil (5)
AOC 688	Ammunition Storage Bunker	Soil/Sediment (2)
AOCs 675, 676, 677	Diesel Fuel UST Incinerator Petroleum Spill Site	Soil/Sediment (15) Groundwater (4)

Zone I Grouping 3 - DMA



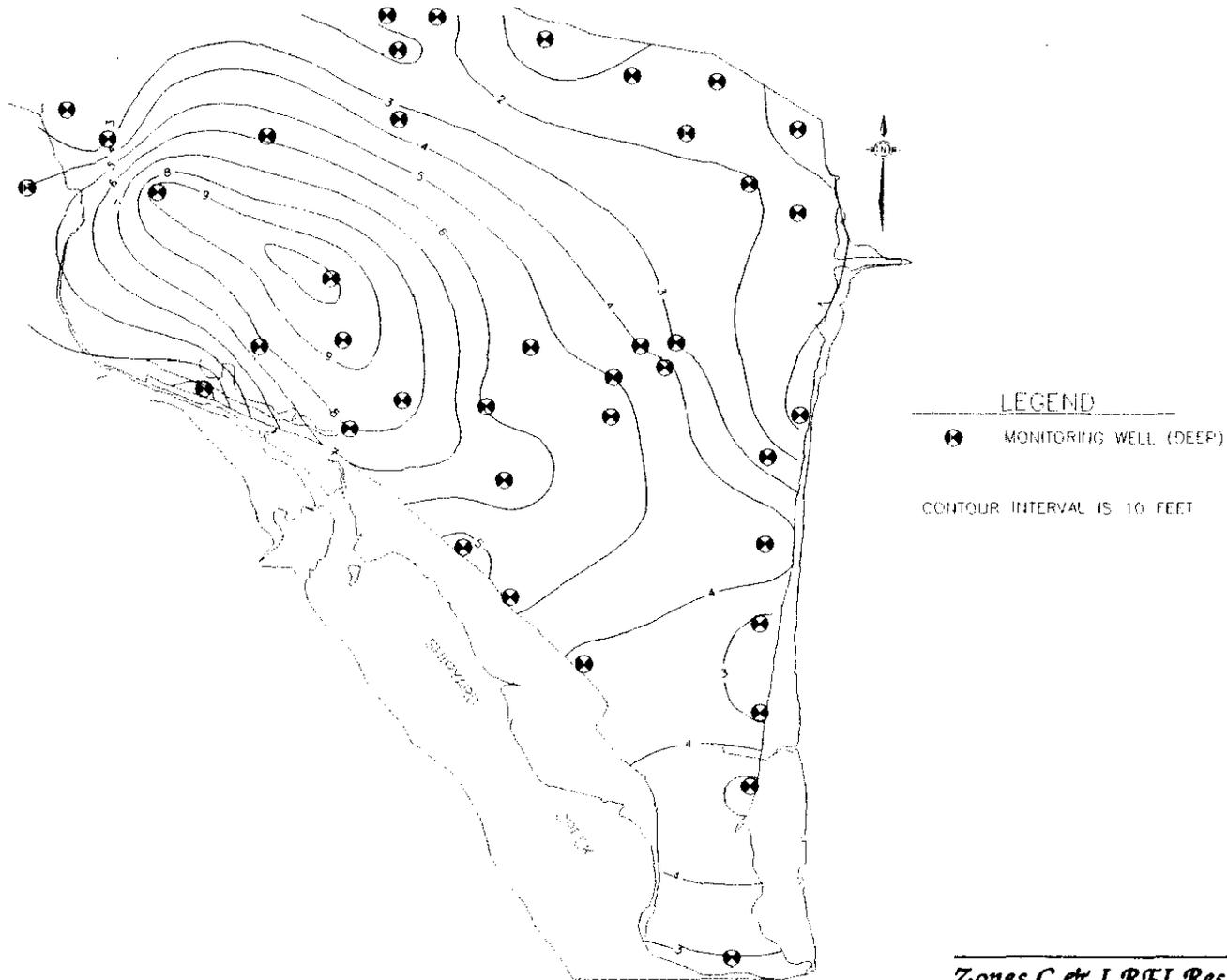
Primary Contributors to Risk/Hazard

Soil:
None

Surface water:
None

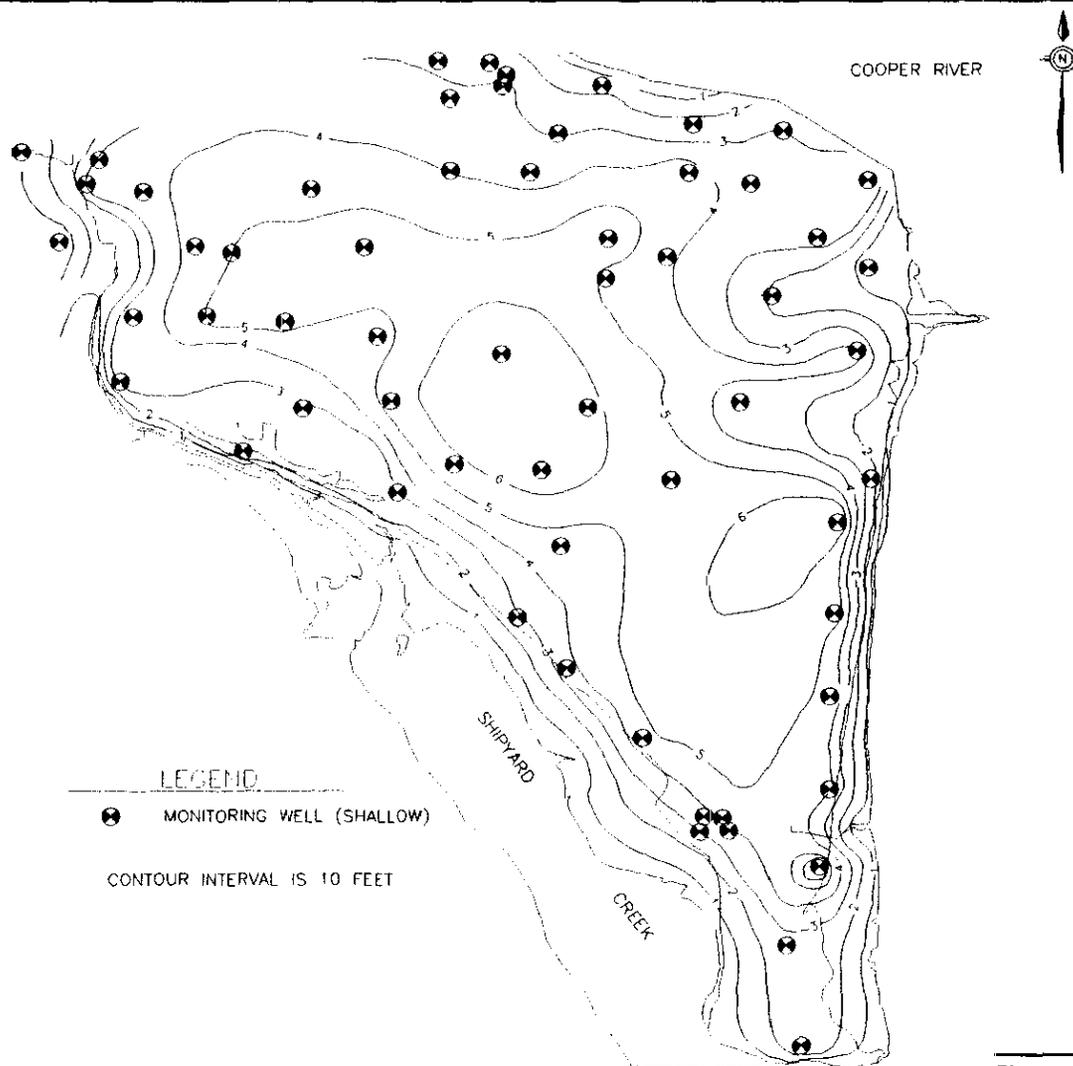
- LEGEND
- - SOIL SAMPLE LOCATIONS
 - - SEDIMENT SAMPLE LOCATIONS
 - ⊙ - SURFACE WATER SAMPLE LOCATIONS

Zone I - Groundwater Monitoring Network Lower Zone/Shallow Aquifer



Zones C & I RFI Results - 11/12/96

Zone I - Groundwater Monitoring Network Upper Zone/Shallow Aquifer

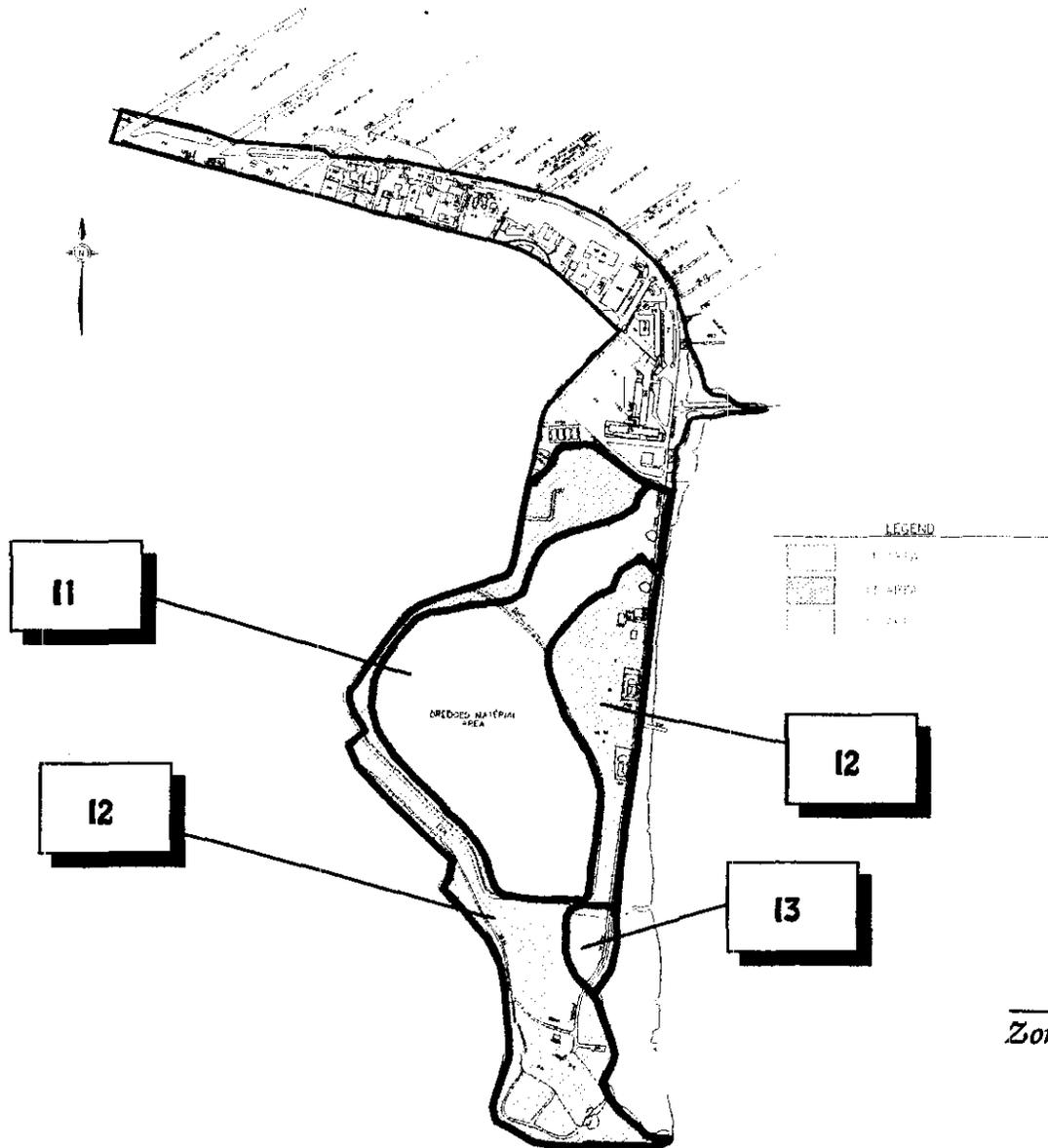


Zones C & I RFI Results - 11/12/96

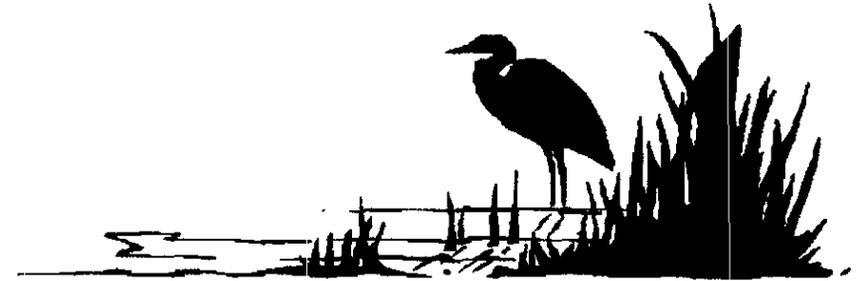
Shallow Groundwater - COCs in Zone I

Area of Significant Impact	Site Description	COCs Driving Risk
AOCs 678 & 679	Former Firefighter School Former Firefighter Wash Rack	1, 4 - Dichlorobenzene Aroclor - 1260
AOC 687/SWMU 16	Ammunition Storage Bunker Unauthorized Storage of Paint and Other Materials	Arsenic Methylene chloride
SWMU 12	Former Firefighter Training Area	2,3,7,8 - TCDD equivalents Arsenic Cadmium Manganese Nickel

Zone I - Ecological Areas



Ecological Impacts - Zone I



Sub Zone	Description	Associated Sites	COCs	Receptors Potentially at Risk
I-1	Dredged Material Area with shrubs and grasses	None	Surface Water Metals and pesticides Sediment Metals and semivolatiles Soil Zinc	Aquatic wildlife in the Cooper River and Shipyard Creek. Herbaceous vegetation (seedlings)
I-2	Forest with some grass fields	AOCs: 685, 687, 688, 690 SWMU: 12	Metals (arsenic, copper, lead, zinc) and pesticides in soil.	Small mammals Soil biota Vegetation (seedlings)
I-3	Wetland	None	Metals and pesticides in sediment.	Aquatic wildlife in the Cooper River.

Review of Risk

There is no such thing as **ZERO** risk.

Risk Assessment - Procedure to evaluate risk.

STEP 1 Hazard Identification

Collect samples. Analyze for type and concentration of contaminants.

STEP 2 Exposure Assessment

Will people come into contact with the hazard? And if so, who? how? how often? and why?

STEP 3 Toxicity Assessment

What is harmful about the chemical? Is it carcinogenic or non-carcinogenic?

STEP 4 Risk Characterization

Determine if potential exposures are great enough to cause human health problems.

Risk Management - How to manage risk.

Question 1 Should cleanup be undertaken?

Question 2 What should cleanup levels be?

Question 3 What cleanup methods should, or can be used?

Review of Risk (cont'd)

Carcinogenic Risk

- ▲ Potential to cause cancer.
- ▲ Risk estimated as probability of getting cancer from exposure.
 - ✓ 1 in 10,000 risk = 10^{-4}
 - ✓ 1 in a million (1,000,000) = 10^{-6}

Non-carcinogenic Risk (Toxicity)

- ▲ Health effects other than cancer.
- ▲ Risk is compared to a calculated value called a hazard index or hazard quotient.
 - ✓
$$\frac{\text{Intake}}{\text{Reference Dose}} = \text{Hazard Quotient (HQ)}$$
 - ✓ Sum of Hazard Quotients = Hazard Index (HI)

Review of Risk (cont'd)

Carcinogenic Risk

- ✓ $< 10^{-6}$ EPA/DHEC generally doesn't require action.
- ✓ $> 10^{-4}$ EPA/DHEC generally requires action.
- ✓ Risk Management: EPA/DHEC must consider many factors that may influence risk such as:
 - ▲ Who will be affected and how?
 - ▲ Future site use.
 - ▲ Existing features (e.g., buildings).
 - ▲ Probability of exposure.

Non-carcinogenic Risk (Toxicity)

- ✓ A hazard index < 1 indicates that no toxic effect is likely.
- ✓ A hazard index > 1 indicates that a toxic effect is likely, typically in sensitive individuals.
- ✓ Example of a Conservative Assumption:
 - Chemical 1: HQ = 0.7 - lungs
 - Chemical 2: HQ = 0.2 - kidney
 - Chemical 3: HQ = 0.2 - mucus membrane
 - HI = 1.1

(Although no organ specific HQ is > 1 , assume an overall toxic effect is possible.)

**Summary of Surface Soil COCs
Naval Base Charleston Zone C
Charleston, South Carolina**

Chemical	AOC						AOC
	SWMU 44	SWMU 47	508 511	AOC 510	AOC 512	AOC 518	515 519
Semivolatile Organic Compounds							
Benzo(a)pyrene Equivalents	X	X	X	X	X		
Metals							
Aluminum	X						
Arsenic	X	X					
Beryllium	X	X			X		
Manganese	X						
Thallium	X						
Chlorinated Pesticides							
Dieldrin			X				
DDT			X				
Chlordane			X			X	
General Petroleum Products							
Total Petroleum HC		Y	Y				Y

NOTES:

X indicates the chemical was identified as a COC in surface soil.

Y indicates petroleum hydrocarbons were detected in soil at concentrations exceeding 100 mg/kg.

**Summary of Groundwater COCs
Naval Base Charleston Zone C
Charleston, South Carolina**

Chemical	SWMU	SWMU	
	44	47 AOC 516	49 AOC 523
Semivolatile Organic Compounds			
BEHP	X		
Acetophenone	X		
3,3-Dimethylbenzidine		X	
Dioxins/Furans			
2,3,7,8-TCDD equivalents	X		
Metals			
Aluminum	X		X
Antimony	X	X	
Arsenic	X	X	X
Beryllium	X		
Lead		X	
Manganese	X	X	X
Nickel	X		
General Petroleum Products			
Total Petroleum HC		X	X

NOTES:

X indicates the chemical was identified as a COC in groundwater

**Summary of Surface Soil COCs
Naval Base Charleston Zone I
Charleston, South Carolina**

Chemical	AOC	AOC	AOC	AOC	AOC	AOC
	671	672 673	678 679	685	687 SWMU 16	689 690
Semivolatile Organic Compounds						
Benzo(a)pyrene Equivalents	X		X	X	X	X
N-Nitroso-di-n-propylamine	X					
Chlorinated Pesticides						
Isodrin			X			
Metals						
Arsenic		X		X		
Beryllium				X		

NOTES:

X indicates the chemical was identified as a COC in surface soil.

**Summary of Groundwater COCs
Naval Base Charleston Zone I
Charleston, South Carolina**

Chemical	AOC	AOC	AOC
	678 679	687 SWMU 16	SWMU 12
Volatile Organic Compounds			
1,4-Dichlorobenzene	X		
Methylene chloride		X	
Chlorinated Pesticides/PCBs			
Aroclor-1260	X		
Dioxins/Furans			
2,3,7,8-TCDD equivalents			X
Metals			
Arsenic		X	X
Cadmium			X
Manganese			X
Nickel			X

NOTES:

X indicates the chemical was identified as a COC in groundwater

**Summary of Risk and Hazard Projections
Naval Base Charleston Zone C
Charleston, South Carolina**

Site	Matrix	ILCR			Hazard Index		TPH	Primary Contributors to Risk/Hazard
		< 10 ⁻⁶	10 ⁻⁶ /10 ⁻⁴	>10 ⁻⁴	< 1	> 1		
SWMU 44	Soil		W	R	W	R		Arsenic, Benzo(a)pyrene equivalents
	Groundwater			R, W		R, W		Aluminum, Arsenic, Manganese, Beryllium, 2378-TCDD
SWMU 47/AOC 516	Soil		R, W		W	R	Yes	Aluminum, Arsenic, Lead, Thallium, Beryllium, Benzo(a)pyrene equivalents
	Groundwater			R, W		R, W	Yes	Antimony, Arsenic, Lead, Manganese, 3,3-Dimethylbenzidine
AOC 508 & 511	Soil		R, W		R, W		Yes	Benzo(a)pyrene equivalents, Chlordane, DDT, Dieldrin
AOC 515 & 519	Soil	R, W			R, W		Yes	None
AOC 523/SWMU 49	Soil	R, W			R, W			None
	Groundwater			R, W		R, W	Yes	Aluminum, Arsenic, Manganese
AOC 510	Soil	R, W			R, W			None
	Groundwater	R, W			R, W			None
AOC 512	Soil	W	R		R, W			Beryllium, Benzo(a)pyrene equivalents
AOC 513	Soil	R, W			R, W			None
AOC 517	Soil	R, W			R, W			None
AOC 518	Soil	W	R		R, W			Chlordane
AOC 520	Soil	R, W			R, W			None

NOTES:

R indicates the resident projections fell within the corresponding risk/hazard range.

W indicates the site worker projections fell within the corresponding risk/hazard range.

AOC 522 & 700 were not investigated during initial field efforts; results and findings are to be presented in Draft Final RFI Report

Yes indicates petroleum hydrocarbons were detected in soil at concentrations exceeding 100 mg/kg.

**Summary of Risk and Hazard Projections
Naval Base Charleston Zone I
Charleston, South Carolina**

Site	Matrix	ILCR			Hazard Index		Primary Contributors to Risk/Hazard
		< 10-6	10-6/10-4	>10-4	< 1	> 1	
AOC 671	Soil	W	R		R, W		Benzo(a)pyrene equivalents, N-Nitroso-di-n-propylamine
	Groundwater	R, W			R, W		None
AOC 672 & 673	Soil		R, W		W	R	Arsenic
AOC 675, 676 & 677	Soil	R, W			R, W		None
	Groundwater	R, W			R, W		None
AOC 678 & 679	Soil	W	R		R, W		Isodrin
	Groundwater		W	R	R, W		1,4-Dichlorobenzene, Aroclor-1260
AOC 680	Wipe	R, W			R, W		None
AOC 681	Soil	R, W			R, W		None
AOC 685	Soil		R, W		R, W		Benzo(a)pyrene equivalents, Arsenic, Beryllium
AOC 687/SWMU 16	Soil	R, W			R, W		None
	Groundwater			R, W		R, W	Arsenic, Methylene chloride
AOC 688	Soil (sediment)	R, W			R, W		None
AOC 689 & 690	Soil	W	R		R, W		Benzo(a)pyrene equivalents
SWMU 12	Soil	R, W			R, W		None
	Groundwater			R, W		R, W	2,3,7,8-TCDD, Arsenic, Cadmium, Manganese, Nickel
RTC	Soil	R, W			R, W		None
DMA	Soil (sediment)	R, W			R, W		None

NOTES:

R indicates the resident projections fell within the corresponding risk/hazard range.

W indicates the site worker projections fell within the corresponding risk/hazard range.

Zone C Recommendations

Site #	Site Description	NFA	Further Action	
			TPH	BRA
SWMU 44	Coal Storage Area			✓
AOC 516/ SWMU 47	Wash Area/Battery Charging and Former Burning Dump		✓	✓
AOC 508/511	Former Incinerator and Former Oil Storage House		✓	
AOC 515/519	Former Incinerator/Paint Shop and Former Boiler House		✓	
AOC 523/ SWMU49	Former Gas Station		✓	✓
AOC 510	Geotechnical Laboratory	✓		✓
AOC 512	Former Incinerator			✓
AOC 513	Former Morgue	✓		
AOC 517	Former Indoor Firing Range	✓		
AOC 518	Coal Storage Bins			✓
AOC 520	Former Garbage House	✓		
AOC 522 AOC 700	Former Grease and Wash Bldg. Golf Course Maintenance Bldg.	* To be addressed in Draft-Final RFI Report.		

NFA = No Further Action

TPH = Further Action is required due to presence of *Total Petroleum Hydrocarbons*.

BRA = Further Action is required according to *Baseline Risk Assessment*.

Zone I Recommendations

Site #	Site Description	NFA	Further Action	
			TPH	BRA
SWMU 12	Former Fire Fighter Training Area			✓
SWMU 16	Unauthorized Storage Area			✓
AOC 671	Underground Storage Tank Site			✓
AOC 672	PCB Transformer Site			✓
AOC 673	Oil, Solvent, and Paint Storage Area			✓
AOC 675	Underground Storage Tank Site	✓		
AOC 676	Incinerator	✓		
AOC 677	Petroleum Spill Site	✓		
AOC 678	Former Fire Fighter School			✓
AOC 679	Former Fire Fighter Wash Rack			✓
AOC 680	Grinding Room/Brake Repair Area	✓		
AOC 681	Blast Booth	✓		
AOC 685	Former Smoke Drum Area			✓
AOC 687	Ammunition Storage Bunker			✓
AOC 688	Ammunition Storage Bunker	✓		
AOC 689	Unauthorized Disposal Area			✓
AOC 690	Dredged Materials Area			✓
DMA	Dredged Materials Area	✓		
RTC	Reserve Training Center	✓		

NFA = No Further Action

TPH = Further Action is required due to presence of *Total Petroleum Hydrocarbons*.

BRA = Further Action is required according to *Baseline Risk Assessment*.

Next Steps

▲ Regulatory Review

- (Reports Submitted January 1996)

▲ Public Comment

▲ Permit Revision

