

Department of the Navy
Record of Decision for OU-6
Naval Air Warfare Center
Warminster, Pennsylvania



June 2000

DECLARATION

SITE NAME AND LOCATION

Naval Air Development Center
Site 4 Soil, Sediment, and Surface Water
Warminster Township
Bucks County, Pennsylvania
CERCLIS ID No. PA6170024545

STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the determination that no further action is necessary to protect human health and the environment for Operable Unit Six (OU-6) at the former Naval Air Development Center in Warminster Township, Bucks County, Pennsylvania (the "Site"), chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, 42 U.S.C. § 9601 *et seq.* and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. This decision is based on the Administrative Record for this Site.

In January 1993, the facility was renamed Naval Air Warfare Center (NAWC) Aircraft Division Warminster. NAWC was disestablished on September 30, 1996 and is targeted for transfer to the private sector.

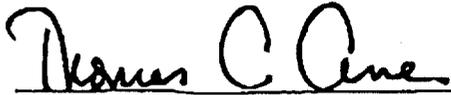
The Commonwealth of Pennsylvania, as represented by the Pennsylvania Department of Environmental Protection (PADEP), concurs with the selected remedy for OU-6 at the Site.

DESCRIPTION OF THE SELECTED REMEDY

A no-further action alternative is the selected remedy for OU-6 at the Site. OU-6 consists of soil, sediment, and surface water associated with Site 4. A 1997 removal action eliminated the unacceptable risk associated with contaminated soils. Post-removal verification sampling and risk assessment activities support the no further action remedial alternative.

STATUTORY DETERMINATIONS

The no further action remedy selection is based upon post-removal verification sampling and the risk assessment results from the remedial investigation for OU-6, which indicate that no further action is necessary at OU-6 to be protective of human health and the environment. A 5-year review will not be necessary for OU-6.



Thomas C. Ames
BRAC Environmental Coordinator
Naval Air Warfare Center
Naval Air Warfare Center, Warminster

6.14.00

Date



Abraham Ferdas, Director
Hazardous Site Cleanup Division
U.S. EPA Region III

6/19/00

Date

**RECORD OF DECISION
NAVAL AIR DEVELOPMENT CENTER
WARMINSTER, PA
SITE 4, OPERABLE UNIT 6 (OU-6)**

JUNE 2000

DECISION SUMMARY

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
I. SITE BACKGROUND	1
II. SCOPE AND ROLE OF OPERABLE UNIT SIX (OU-6)	3
III. SITE CHARACTERISTICS	4
IV. INVESTIGATION RESULTS	5
V. SUMMARY OF SITE RISKS	6
VI. SELECTED REMEDY	7
VII. HIGHLIGHTS OF COMMUNITY PARTICIPATION	7

APPENDIX A

Table	Title
1	Subsurface Soil Results Summary for Site 4 - Data Collected from Test Pits
2	Surface Soil Results Summary for Site 4
3	Occurrence and Distribution of Organics and Inorganics in Site 4 Soils (Post- Removal)
4	Surface Water Results Summary for Site 4
5	Sediment Results Summary for Site 4
6	Recreational Risk Estimates – Soil Ingestion (Post-Removal)
7	Residential Risk Estimates – Soil Ingestion (Post-Removal)
8	Risks from Groundwater Based on Site 4 Soil Concentrations
9	Risk Estimates for Surface Water and Sediment Near Site 4

APPENDIX B

Figure	Title
1	The Former NAWC, Warminster, PA
2	IR Site Location Map
3	Site 4 Layout
4	Trench Locations
5	Subsurface Sample Locations
6	Site 4 Surface Water/Sediment Sampling Location

DECISION SUMMARY

I. SITE BACKGROUND

NAWC Warminster is a 824-acre facility located in Warminster Township, Northampton Township and Ivyland Borough, Bucks County, Pennsylvania (see Figure 1). Under the Base Realignment and Closure Act (BRAC), NAWC ceased operations on 30 September 1996. The majority of NAWC, including Site 4 (see Figure 2 for location), is being transferred to the private sector. The facility lies in a populated suburban area surrounded by private homes, various commercial and industrial activities, and a golf course. On-base areas include various buildings and other complexes connected by paved roads, the runway and ramp area, mowed fields, and a small wooded area.

Commissioned in 1944, the facility's main function was research, development, testing, and evaluation for naval aircraft systems. NAWC also conducted studies in anti-submarine warfare systems and software development. Historically, wastes were generated during aircraft maintenance and repair, pest control, fire-fighting training, machine and plating shop operations, spray painting, and various materials research and testing activities in laboratories. These wastes included paints, solvents, sludges from industrial wastewater treatment, and waste oils that were disposed in pits, trenches, and/or landfills on the facility property.

NAWC Warminster was listed on the Superfund National Priorities List in 1989. This list comprises sites where uncontrolled hazardous substance releases present the most significant potential threats to human health and the environment. The areas of concern identified to date by the Navy at NAWC include eight reported waste disposal locations covering more than 15 acres:

- Three locations with waste disposal pits (Sites 1, 3, and 6)
- Two locations with sludge disposal pits (Sites 2 and 7)
- Two landfills (Sites 4 and 5)
- One fire-fighting training area (Site 8)

Operable Unit 6 (OU-6) consists of soil, sediment, and surface water associated with Site 4. Site 4 is currently a grassy area just north of the main runway and just south of Kirk Road within an area the RI refers to as Area C (see Figure 2). Site 4 is the largest of the NAWC Warminster waste disposal locations and is less than 100 feet from the facility boundary (see Figure 3). Two unnamed tributaries of Little Neshaminy Creek just north of the facility boundary collect drainage from Site 4. These tributaries run through a residential area and a local park. Several off-base residences are present within 200 feet of Site 4.

The Navy initially reported Site 4 as a disposal site in a Navy Shore Activity Disposal Fact Form in 1980. The site reportedly operated from 1966 to 1970. Several trenches on the site reportedly were used to dispose of non-industrial solid waste, paints, waste oils, waste metals, construction debris, solvents, and sewage sludge from the sewage treatment plant. A review of historical aerial photographs initially verified the presence of at least two trenches at Site 4 and indicated that Site 4 was active through 1973.

Site 4 was addressed under CERCLA by a remedial investigation (RI) that was conducted in three phases. Site 4 was investigated under each of these phases. The Phase I RI was initiated in late 1988 and completed in 1990 with the release of the Phase I (or Stage 1) RI report. Phase I included surveying and mapping volatile organic compounds (VOCs) in soil gas, detecting buried materials through electromagnetic surveys, performing exploratory soil borings, and installing and sampling groundwater monitoring wells. In addition, test pits were excavated, nearby wells were inventoried, and a bedrock fracture-trace analysis was conducted.

The Phase II RI, begun in 1991 and completed in 1992, included the installation of additional monitoring wells, sampling of groundwater, and the performance of hydraulic tests to assess aquifer characteristics. Both the Phase I and Phase II RI investigated the nature and extent of groundwater contamination within the vicinity of Sites 1, 2, and 3 (Area A), Sites 5, 6, and 7 (Area B) and Sites 4 and 8 (Area C).

The Phase III RI, initiated in 1993 and completed in 1999, included further investigation of the nature and extent of contaminated groundwater attributable to releases within Areas A, B and C, as well as potentially contaminated soils, buried wastes, surface water, and sediment associated with these areas. As noted earlier, Site 4 is located within Area C. Since that time, RI work addressing groundwater and soil has also been performed in the more recently designated Area D.

Based on the findings of the Phase II RI work, in 1995, the Navy and EPA issued a Record of Decision for Operable Unit 3 that selected pumping and treatment of Area C groundwater as a remedy to address groundwater contaminated with tetrachloroethene (PCE). This remedy has since been constructed and is now in operation.

The findings of remedial investigations performed at Site 4 through 1995 are presented in an Engineering Evaluation and Cost Analysis (EE/CA) Report for Site 4 issued in July 1995. Based on geophysical surveys and test pits, the EE/CA reported that Site 4 consisted of eight trenches which varied between 150 and 490 feet in length. The trenches were reported to average about 6.5 feet in depth, 12.5 feet in width, and to contain varying waste materials from about 2 to 6.5 feet in depth. The trenches were generally covered with about 2 feet of apparent clean fill and vegetated topsoil. The waste materials observed during test pit excavations included refuse such as paper, plastic, cans, glass, styrofoam, cardboard, and photographic film, and construction debris consisting of wood, metal, concrete, brick, tires, cables, and wire.

Samples were collected of subsurface soils from the test pits as well as surface soils. Substances detected in subsurface soils at a significant concentration and frequency included Aroclor-1248 (a polychlorinated biphenyl or PCB) and polynuclear aromatic hydrocarbons (PAHs), which included benz(A)anthracene, benzo(B)fluoranthene, and benzo(A)pyrene. In addition, a wide variety of other hazardous substances were detected in subsurface soils at lower concentrations and frequency (see Table 1). Aroclor-1248 and the PAHs were also detected in surface soils, but at lower concentrations (see Table 2). Tables 1 and 2 also indicate those cases where maximum detected contaminant concentrations exceeded screening criteria indicative of a potential threat to human health. Tetrachloroethene (PCE), the contaminant of concern in Area C groundwater, was not detected in any of the soil samples collected.

Based on the results of the investigations summarized in the EE/CA report, the Navy determined that soils at Site 4 presented an unacceptable risk to human health and the environment. In response, on June 18, 1996, the Navy signed an Action Memorandum to request and document approval of a removal action at Site 4, pursuant to Section 104 of CERCLA as amended, 42 U.S.C. Section 9604.

The Navy conducted the subject removal action between December 1996 and July 1997. During the removal action, approximately 13,000 cubic yards of soils and wastes associated with the trenches were removed from Site 4 (see Figure 4 for locations of trenches and waste/soil removal). Soil samples were collected from the bottom and sidewalls of each excavation to verify the completeness of the removal action. The sample analysis results were compared to target soil clean-up concentrations protective of recreational use and groundwater quality. For all samples, any exceedances of the target soil clean-up concentrations were followed up by additional excavation of the area from where the sample was collected. Where soils remained after the additional excavation, supplemental verification samples were obtained and analyzed for the compounds that initially exceeded the target concentration, to verify that sufficient excavation had been performed. As a result, there were no exceedances of any target soil clean-up concentration for the final samples from each area sampled. All sampling results are summarized in a Summary Report on Verification Sampling Results from Site 4 Removal Action, which was issued in February 1997.

The excavated areas were then backfilled with clean fill material, covered with 4 inches of topsoil, regraded, and seeded. A vegetative cover was established over the disturbed areas.

The results of all RI work addressing soil, sediment, and surface water associated with Site 4 are described or summarized in the RI report for Site 4 issued by the Navy in February 2000. This report characterizes Site 4 prior to and after the removal action and contains an assessment of any risk posed by OU-6 to human health and the environment after the removal action.

II. SCOPE AND ROLE OF OPERABLE UNIT SIX (OU-6)

Section 300.430 (a) (1) (ii) (A) of the NCP, 40 C.F.R. Section 300.340 (a) (1) (ii) (A) provides that CERCLA NPL sites "should generally be remediated in operable units when early actions are necessary or appropriate to achieve significant risk reduction quickly, when phase analysis or response is necessary or appropriate given the size or complexity of the site, or to expedite the completion of a total cleanup." In the case of NAWC Warminster, the Navy has organized work to date into six operable units (OUs). These OUs are as follows:

- OU-1: Area A and Area B groundwaters
- OU-2: Off-base private wells
- OU-3: Area C groundwater
- OU-4: Area D groundwater
- OU-5: Soil, sediment, and surface water at Site 8
- OU-6: Soil, sediment, and surface water at Site 4

The Navy and EPA selected an interim remedy for OU-1 in a ROD signed on September 23, 1993, and the removal action for OU-2 was selected by EPA in a Removal Action Memorandum signed on July 14, 1993. The Navy and EPA selected a final remedy for OU-3 in a ROD signed on March 10, 1995. In September 1999, the Navy and EPA determined that institutional controls were necessary to prevent the use of Area C groundwater presenting an unacceptable human health risk and to protect the long-term effectiveness of the OU-3 remedy. An Explanation of Significant Differences (ESD) was signed to make changes to the OU-3 ROD. The institutional controls address portions of Area C (including Sites 4 and 8) on both current Navy and private property, and consist of restrictions on the use of water from existing wells, restrictions on the future installation of wells, and restrictions on the use of water installed in the future.

An interim remedy for OU-4 was selected in a ROD signed by the Navy and EPA on September 30, 1997. A no further action ROD for OU-5 was signed by the Navy and EPA on September 30, 1999. The selected remedies for OU-1, OU-3, and OU-4 are all operational at this time, and the removal addressing OU-2 has been completed. This ROD documents the selected remedy for OU-6.

III. SITE CHARACTERISTICS

A. Hydrology

NAWC is located in an upland area lying between two local drainage basins, the Little Neshaminy Creek Basin to the north and the Southampton Creek Basin to the south. The northern 65 percent of the Site, including Site 4, drains toward several unnamed tributaries of Little Neshaminy Creek.

An unnamed creek is located north of Site 4, in Munro Park. This stream originates at the base of the stormwater drain located east of Site 4 and runs east to west through Munro Park before turning north, away from NAWC Warminster. During base flow conditions, this stream appears heavily silted and has an estimated maximum flow rate of 7 to 10 gallons per minute. The uppermost part of this stream is small and intermittent and, during dry periods, water in the stream tends to be limited to pool areas. The stream channel is well developed despite the low or intermittent flow rates. Channel width is 3 to 5 feet and channel depth is 1 to 2 feet. Sediments in the stream are primarily sands and cobbles in run areas and sands and silts in pools.

B. Meteorology

The climate of the area is humid continental and is modified by the Atlantic Ocean. Temperatures average 76°F (24.4°C) in July and 32°F (0°C) in January. The average daily temperature for the NAWC location is 53.3°F (11.8°C). Precipitation averages 42.5 inches per year (106.25 cm per year), and snowfall averages 22 inches per year (55 cm per year). The distribution of precipitation is fairly even throughout the year. The relative humidity for the Site averages 70 percent. The mean wind speed for this area is 9.6 mph, with a prevailing direction of west-southwest.

C. Ecology

A relatively large wooded area borders the stream to the north and northwest of Site 4. The wooded area extends along the stream from Kirk Road downstream toward Werner

Park. This area offers a secluded and physically diverse habitat. Snails, earthworms, and amphipods are common in sediments and leaf packs from downstream portions of the study area, as are small numbers of mayfly larvae. In addition, various songbirds, rabbits, raccoons, and white-tailed deer are found in this area.

A wetlands assessment of the area north of Area C classified a wetland along the unnamed tributary of Little Neshaminy Creek as primarily palustrine, forested, broad-leaved, deciduous, and temporary (PF01A). This wetland is characterized by green ash, silver maple, box elder, black cherry, and spicebush as the canopy and sub-canopy. Blackberry, Japanese honeysuckle, jewelweed, poison ivy, and skunk cabbage are the dominant herbaceous species. A small scrub-shrub wetland, located immediately southwest of a residence, is also associated with this area. Riparian vegetation in the upstream portion of this creek includes a canopy of mature maples and sycamores (*Plantanus occidentalis*), with a moderate understory of young trees and arrowwood shrubs. Downstream portions are characterized by fewer mature trees, a more open stream corridor, and greater bankside shrub and herbaceous growth.

The wetlands assessment concluded that the stream and wetlands appear to be fairly healthy. No evidence of pollution, fish kills, or stressed vegetation was observed. Urban trash and litter (tires, boards, bottles, cans, paper, plastic) were common.

D. Soils

Soil thicknesses observed during the RI at Site 4 were between 3.5 and 10 feet. The soil cover was generally thinner to the south, upslope of Site 4. The thickest soil cover was encountered along the southern and topographically lowest area of the Site. Soil types observed at Site 4 were brown and maroon-red silts and clays along with maroon and red fine- to medium- grained sand.

IV. INVESTIGATION RESULTS

This section characterizes the conditions associated with Site 4 after performing the removal action discussed in Section I.

A. Soils

During the removal action, surface soils were removed from Site 4 as part of the subsurface waste/soil excavation process and replaced with clean fill and topsoil. As a result, no post-removal surface soil sampling was necessary. Subsurface soil samples were collected from 126 locations to characterize the quality of soil remaining after waste/soil excavation. These locations are shown in Figure 5. The analyses for the samples collected were as outlined in a Verification and Sampling Analysis Plan, which considered an evaluation of pre-removal data (see Appendix B of the RI report). All subsurface soil samples were analyzed for target compounds identified in the Verification Sampling and Analysis Plan for the Site 4 Removal Action. In addition, soils from 32 of these locations were analyzed for all EPA target compound list and target analyte list substances. The tabulation of the results of these analyses is provided in Table 3. As noted in Section I, no soils with detected contaminant concentrations exceeding the target concentrations as identified in Table 3 were left in place during the removal action.

B. Surface Water and Sediment

Samples were collected for surface water and sediment in the vicinity of Site 4 during three sampling rounds. Sampling locations are shown in Figure 6 and, for the purposes of this discussion, are designated as "background" and "downstream." The background surface water/sediment sampling locations were 3A, 3B, 4A, and 4B during the Phase I and II RIs and C-8 during the Phase III RI. The downstream surface water/sediment sampling locations were 5A, 5B, 6A, and 6B in Phases I and II and C-1, C-2, C-3, C-4, C-5, C-6, C-7/C-10, and C-9 during Phase III. Sampling locations C-1 and C-2 were collected from an apparent groundwater seep, which may have contained water migrating through Site 4. Sampling locations C-3, C-4, and C-5 were taken from the ponded areas on the downslope edge of the site within the base property boundary.

Table 4 summarizes surface water results and presents a comparison to applicable chemical-specific Ambient Water Quality Criteria (AWQCs). Those analytes exceeding background and surface water screening criteria include copper, lead, carbon disulfide, and mercury. Manganese was found in one sample (C-5) at a concentration (364ug/l) higher than the background range. The RI also notes that these same metals were not detected at levels above the screening criteria in filtered samples.

Table 5 summarizes the chemicals detected in sediment samples upstream and downstream of Site 4 and presents a comparison of the downstream sample concentrations to available sediment screening criteria indicative of a potential risk of concern to ecological receptors. As noted in Table 5, substances exceeding background and sediment screening criteria include eight PAHs, 4,4'DDT, Aroclor-1254, and seven metals.

V. SUMMARY OF SITE RISKS

As part of the final RI, a risk assessment was conducted to estimate the potential risks to human health posed by soils, sediments and surface water associated with Site 4. In the case of soils, the risk assessment addressed conditions after the performance of the removal action. To assess these risks, the potential exposure scenarios identified below were assumed.

- Ingestion of soils.
- Ingestion and dermal contact with surface water and sediment.

Potential human health risks are categorized as carcinogenic or noncarcinogenic. A hypothetical carcinogenic risk increase from exposure should not exceed a risk range from 1×10^{-6} (an increase of one case of cancer for one million people exposed) to 1×10^{-4} (one additional case per 10,000 people exposed). Noncarcinogenic risks are estimated utilizing Hazard Indices (HI), where an HI exceeding one is considered an unacceptable health risk.

A. Soil

Tables 6 and 7 show calculated risks under recreational and residential land use, respectively. The hazard indices (non-cancer risks) were well below unity (i.e., 1.0) for child and adult receptors under both recreational and residential land use, indicating no adverse non-cancer effects are expected from exposure to soil through ingestion by a

recreational or residential receptor. The maximum incremental cancer risks through soil ingestion under residential and recreational land use were 1.05×10^{-5} and 5.33×10^{-7} , respectively, below or within the EPA 10^{-4} to 10^{-6} acceptable risk range.

Surface and subsurface soil sampling data were evaluated to determine whether Site 4 might be a past or present source of PCE in Area C groundwater or otherwise present a threat to groundwater quality. A remedy for OU-3 is currently being implemented to address the PCE levels of concern. PCE was not detected in any soil samples collected at Site 4. As a result, Site 4 does not appear to be a past or present source of PCE in Area C groundwater. In addition, soil data were evaluated to determine whether leaching of hazardous substances from Site 4 soils might present a threat to groundwater quality. The estimated contaminant concentrations in groundwater and corresponding incremental carcinogenic risks are presented in Table 8. The total estimated incremental carcinogenic risk due to consumption of groundwater impacted by Site 4 was calculated to be 8.47×10^{-6} , well within the acceptable range.

B. Surface Water and Sediment

The results for the human health risk assessment for surface water and sediment associated with Site 4 are presented in Table 9. Carcinogenic risks associated with potential sediment ingestion and dermal contact were estimated at 1.0×10^{-6} and 2.0×10^{-7} , respectively. In each case, the calculated risk is considered acceptable. In assessing the non-carcinogenic risks associated with surface water ingestion and dermal contact, the calculated HIs were 0.27 and 0.37, respectively. Again, in each case, the non-carcinogenic risk is considered acceptable.

An ecological risk characterization was performed with the surface water and sediment sampling data summarized in Section IV.B to assess potential risks posed by sediments and surface water to the environment. Potential risks posed by releases from Site 4 to ecological receptors in two unnamed tributaries of Little Neshaminy Creek were characterized. While surface water and sediment screening criteria indicative of a potential risk of concern were exceeded in the case of certain substances, a biological survey and wetlands assessment found no evidence of ecological stress attributable to Site 4 (SMC Martin, April 1991; Halliburton NUS, 1994).

VI. SELECTED REMEDY

The results of the post-removal risk assessment indicate that, based on available information, soils, sediment, and surface water associated with Site 4 do not present an unacceptable risk to human health and the environment. In this case, the Navy, with the support of EPA, determines that no further action is necessary. There are no costs associated with this remedy. Based on available information, the Navy and EPA believe that this remedy would be protective of human health and the environment and would be cost effective.

VII. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Since 1988, the plans and results of CERCLA investigations and actions have been presented to a Technical Review Committee or a Restoration Advisory Board (RAB) that has been established by the Navy for the Site. Members of the RAB at this time include representatives of the Bucks County Health Department, Northampton Township,

Northampton Township Municipal Authority, Warminster Township Municipal Authority, Warminster Township, and Ivyland Borough.

In accordance with Sections 113 and 117 of CERCLA, 42 U.S.C. Sections 9613 and 9617, the Navy, in conjunction with EPA, issued a Proposed Plan on February 16, 2000, presenting the preferred remedy for OU-6. The Proposed Plan and RI report for OU-6 became available for review at the time and are among the documents that comprise the Administrative Record for NAWC Warminster. The Administrative Record is available for review by the public at the following information repositories:

- Caretaker Site Office
Jacksonville Road (building located on west side)
P.O. Box 2609
Warminster, Pennsylvania 18974-0061
- Bucks County Library
150 South Pine Street
Doylestown, Pennsylvania 18901

An announcement of the public meeting, the comment period, and the availability of the Administrative Record for the proposed remedy for OU-6 was issued on February 16, 2000 in the Philadelphia Inquirer, Intelligencer, and Courier Times. Additionally, the Proposed Plan and the Notice of Availability were mailed to local municipal and government agencies and residents in the vicinity of the site. A public meeting was held on March 1, 2000.

The public comment period for the Proposed Plan was from February 16, 2000 to March 17, 2000. A public meeting was held at the North American Technology Center, Jacksonville Road, Warminster, Pennsylvania, on March 1, 2000 to present the RI and Proposed Plan, answer questions, and solicit and accept both oral and written comments. Approximately 20 individuals attended and no oral or written comments were received during this availability session.

Since no comments were received during the public comment period, a Responsiveness Summary has not prepared as part of this ROD. Upon signing the ROD, the Navy will publish a notice of availability of this ROD in the Philadelphia Inquirer, Intelligencer, and Courier Times and place the ROD in the Administrative Record located at the repositories mentioned above.

This Record of Decision presents the selected remedial action for OU-6 chosen in accordance with CERCLA and, to the extent practicable, the National Contingency Plan (NCP).

APPENDIX A

TABLES

TABLE 1
SUBSURFACE SOIL RESULTS SUMMARY FOR SITE 4 - DATA COLLECTED FROM TEST PITS
A COMPARISON TO VARIOUS SCREENING CRITERIA
NAWC WARMINSTER, PENNSYLVANIA

Analyte	Frequency of Detection in Background Samples	Range of Detection in Background Samples (mg/kg)	Frequency of Detection in Site Samples	Range of Detection in Site Samples (mg/kg)	Migration to (1) Groundwater With 10 DAF (mg/kg)	PADEP (2) Screening Criteria (mg/kg)	Risk Based (3) Screening Residential Soil (mg/kg)	Risk Based (4) Concentration Residential Soil (mg/kg)	Exceeds Background Level	Exceeds Screening Criteria
Volatiles*										
METHYLENE CHLORIDE	0 / 6	Not Detected	2 / 18	0.002 - 0.0025	0.01	0.2	230	85	Yes	No
ACETONE	0 / 6	Not Detected	11 / 18	0.009 - 0.12	8	8000/400	780	7800	Yes	No
CARBON DISULFIDE	0 / 6	Not Detected	1 / 18	0.006	14	7000/0.8	780	7800	Yes	No
2-BUTANONE	0 / 6	Not Detected	4 / 18	0.016 - 0.032	NA	0.05	390	47000	Yes	No
TOLUENE	2 / 6	0.002	7 / 18	0.002 - 0.014	5	7000/100	1600	16000	Yes	No
CHLOROBENZENE	0 / 6	Not Detected	1 / 18	0.23	0.6	1000/10	160	1600	Yes	No
ETHYLBENZENE	0 / 6	Not Detected	8 / 18	0.002 - 0.04	5	7000/70	780	7800	Yes	No
XYLENE (TOTAL)	0 / 6	Not Detected	8 / 18	0.002 - 0.049	74	1000000/5	16000	160000	Yes	No
Semivolatiles*										
1,4-DICHLOROBENZENE	0 / 6	Not Detected	1 / 18	0.11	1	7	71	27	Yes	No
4-METHYLPHENOL	0 / 6	Not Detected	1 / 18	0.13	NA	0.4	39	390	Yes	No
NAPHTHALENE	0 / 6	Not Detected	3 / 18	0.047 - 0.15	30	600/8	310	3100	Yes	No
2-METHYLNAPHTHALENE	0 / 6	Not Detected	4 / 18	0.14 - 0.29	NA	1000/20	NA	NA	Yes	No
DIMETHYLPHTHALATE	0 / 6	Not Detected	1 / 18	0.054	1200	780000/30000	78000	780000	Yes	No
ACENAPHTHENE	1 / 6	0.06	1 / 18	0.06	200	4000/30	470	4700	No	No
FLUORENE	1 / 6	0.12	5 / 18	0.045 - 0.12	160	6000/100	310	3100	No	No
PENTACHLOROPHENOL	0 / 6	Not Detected	1 / 18	0.061	0.01	40/200	14	5.3	Yes	Yes
PHENANTHRENE	0 / 6	Not Detected	8 / 18	0.043 - 1.7	NA	200/80	230	NA	Yes	No
ANTHRACENE	0 / 6	Not Detected	4 / 18	0.056 - 0.3	4300	20000/1000	2300	23000	Yes	No
DI-N-BUTYLPHTHALATE	0 / 6	Not Detected	2 / 18	0.067 - 0.117	120	300	780	7800	Yes	No
FLUORANTHENE	0 / 6	Not Detected	8 / 18	0.086 - 2.4	980	3000/400	310	3100	Yes	No
CARBAZOLE	0 / 6	Not Detected	2 / 18	0.042 - 0.055	0.2	NA	85	32	Yes	No
PYRENE	0 / 6	Not Detected	10 / 18	0.052 - 2.7	1400	2000/300	230	2300	Yes	No
BENZ(A)ANTHRACENE	0 / 6	Not Detected	8 / 18	0.045 - 1.1	0.7	6/500	1.6	0.88	Yes	Yes
CHRYSENE	0 / 6	Not Detected	7 / 18	0.06 - 0.94	1	600/300	NA	88	Yes	No
BIS(2-ETHYLHEXYL)PHTHALATE	0 / 6	Not Detected	11 / 18	0.06 - 5.4	11	300/400	120	46	Yes	No
DI-N-OCTYLPHTHALATE	0 / 6	Not Detected	1 / 18	0.77	NA	1500/500	160	1600	Yes	No
BENZO(B)FLUORANTHENE	0 / 6	Not Detected	8 / 18	0.055 - 1.5	4	6/500	1.9	0.88	Yes	Yes
BENZO(K)FLUORANTHENE	0 / 6	Not Detected	6 / 18	0.059 - 0.45	4	60/500	4.4	8.8	Yes	No
BENZO(A)PYRENE	0 / 6	Not Detected	8 / 18	0.045 - 1.005	4	0.6/500	0.23	0.088	Yes	Yes
INDENO(1,2,3-CD)PYRENE	0 / 6	Not Detected	6 / 18	0.056 - 0.39	35	6/500	0.84	0.88	Yes	No
DIBENZ(A,H)ANTHRACENE	0 / 6	Not Detected	2 / 18	0.1 - 0.1015	11	0.6/500	0.21	0.088	Yes	Yes
BENZO(G,H,I)PERYLENE	0 / 6	Not Detected	6 / 18	0.06 - 0.47	NA	NA/50	11	NA	Yes	NA

NA = Not Available

DAF = Dilution and Attenuation Factor

The results of this table are based on combinations of duplicate sample values.

* = The only chemicals shown on this table are those that were detected in site samples.

References

1. EPA, 1994. Soil Screening Guidance.
2. PADEP, 1995. Technical Guidance Manual - Land Recycling Program. First number is for ingestion; second number is for soil to groundwater pathway. Some values are from PADEP, 1993. Cleanup Standards for Contaminated Soils.
3. EPA, 1993. Selected Exposure Routes and COCs by Risk-Based Screening Levels.
4. EPA, 1995. Risk-Based Concentration Table (January - June 1995).

TABLE 1 (Continued)
 SUBSURFACE SOIL RESULTS SUMMARY FOR SITE 4 - DATA COLLECTED FROM TEST PITS
 A COMPARISON TO VARIOUS SCREENING CRITERIA
 NAWC WARMINSTER, PENNSYLVANIA

Analyte	Frequency of Detection in Background Samples	Range of Detection in Background Samples (mg/kg)	Frequency of Detection In Site Samples	Range of Detection in Site Samples (mg/kg)	Migration to (1) Groundwater With 10 DAF (mg/kg)	PADEP (2) Screening Criteria (mg/kg)	Risk Based (3) Screening Residential Soil (mg/kg)	Risk Based (4) Concentration Residential Soil (mg/kg)	Exceeds Background Level	Exceeds Screening Criteria
Pesticides/PCBs*										
DIELDRIN	0 / 6	Not Detected	2 / 18	0.0054 - 0.022	0.001	0.3/90	0.11	0.04	Yes	Yes
4,4'-DDD	0 / 6	Not Detected	2 / 18	0.0043 - 0.0049	0.7	20/500	3.9	2.7	Yes	No
ENDOSULFAN SULFATE	0 / 6	Not Detected	1 / 18	0.68	4	NA	0.39	470	Yes	Yes
METHOXYCHLOR	0 / 6	Not Detected	3 / 18	0.0055 - 6.3	62	300/200	39	390	Yes	No
ALPHA-CHLORDANE	0 / 6	Not Detected	3 / 18	0.0125 - 0.033	2	500	0.47	0.49	Yes	No
AROCLOR-1248	0 / 6	Not Detected	9 / 18	0.046 - 3.5	NA	NA	0.22	0.083	Yes	Yes
AROCLOR-1254	0 / 6	Not Detected	1 / 18	0.51025	NA	NA	0.22	0.083	Yes	Yes
Inorganics*										
ARSENIC	6 / 6	3.2 - 6.1	18 / 18	1.9 - 5.2	15	20	0.97	0.37	No	Yes
BARIUM	5 / 5	42 - 67.7	18 / 18	31.6 - 660	32	5000	550	5500	Yes	Yes
BERYLLIUM	3 / 3	0.94 - 1.1	11 / 18	0.54 - 1.8	180	1	0.4	0.15	Yes	Yes
CADMIUM	0 / 6	Not Detected	1 / 18	4.2	6	20	3.9	39	Yes	Yes
CHROMIUM	6 / 6	13.2 - 25	18 / 18	11.3 - 23.3	19	1000	7800	78000	No	Yes
COPPER	6 / 6	8.5 - 16.6	18 / 18	7.6 - 61.5	NA	700	290	2900	Yes	No
LEAD	6 / 6	5.3 - 13.2	18 / 18	5.1 - 85.7	NA	200	NA	NA	Yes	No
MANGANESE	6 / 6	116 - 487	18 / 18	81.4 - 676	NA	400	780	390	Yes	Yes
MERCURY	0 / 6	Not Detected	1 / 18	1.3	3	20	2.3	23	Yes	No
NICKEL	5 / 5	8.7 - 12.1	18 / 18	7.6 - 21.1	21	200	160	1600	Yes	Yes
VANADIUM	6 / 6	22.6 - 37.9	18 / 18	16.9 - 35.8	NA	NA	55	550	No	No
ZINC	6 / 6	15.1 - 30.1	18 / 18	16.3 - 336	42000	1000	2300	23000	Yes	No

NA = Not Available

DAF = Dilution and Attenuation Factor

The results of this table are based on combinations of duplicate sample values.

* = The only chemicals shown on this table are those that were detected in site samples.

References

1. EPA, 1994. Soil Screening Guidance.
2. PADEP, 1995. Technical Guidance Manual - Land Recycling Program. First number is for ingestion; second number is for soil to groundwater pathway.
Some values are from PADEP, 1993. Cleanup Standards for Contaminated Soils.
3. EPA, 1993. Selected Exposure Routes and COCs by Risk-Based Screening Levels.
4. EPA, 1995. Risk-Based Concentration Table (January - June 1995).

TABLE 3
OCCURRENCE AND DISTRIBUTION OF ORGANICS AND INORGANICS IN SITE 4 SOILS (POST-REMOVAL)
NAWC WARMINSTER, PENNSYLVANIA

Parameter (mg/kg)	Frequency of Detection (1)	Range of Detection	Average	Location of Maximum	Target Concentration (TC)	95% UCL	Background	Exceed TC & Background
Volatile Organic Compounds								
Acetone	2/32	0.008	0.0052	TR04-09/TR04-19	0.03	0.008		N
Chlorobenzene	1/126	0.001	0.0025	TR07-01	3.6	0.001		N
Ethylbenzene	1/32	0.003	0.0025	TR04-08	64	0.003		N
Methylene chloride	11/126	0.003 - 0.006	0.0023	TR01-19	0.3	0.006		N
Toluene	1/32	0.14	0.0067	TR04-08	92	0.14		N
Trichlorofluoromethane	1/94	0.0002	0.0025	TR05-08	120	0.0002		N
Xylenes, total	1/32	0.023	0.008	TR04-08	920	0.023		N
Semivolatile Organic Compounds								
Acenaphthene	1/126	0.049	0.1641	TR00-16	30	0.049		N
Anthracene	1/126	0.09	0.1644	TR00-16	70	0.09		N
Benzo(a)anthracene	7/126	0.046 - 0.48	0.1654	TR00-16	1.5	0.48		N
Benzo(a)pyrene	6/126	0.046 - 0.42	0.1655	TR00-16	0.6	0.42		N
Benzo(b)fluoranthene	11/126	0.022 - 0.48	0.1622	TR00-16	4.5	0.48		N
Benzo(g,h,i)perylene	6/126	0.016 - 0.28	0.1618	TR00-16	500	0.28		N
Benzo(k)fluoranthene	8/126	0.012 - 0.21	0.1591	TR00-16	45	0.21		N
Bis(2-Ethylhexyl)phthalate	8/32	0.036 - 2.6	0.3421	TR00-18	300	2.6		N
Chrysene	7/126	0.049 - 0.48	0.1663	TR00-16	150	0.48		N
Dibenzo(a,h)anthracene	1/126	0.069	0.1642	TR00-16	0.6	0.069		N
Fluoranthene	10/126	0.052 - 0.66	0.1686	TR00-16	400	0.66		N
Indeno(1,2,3-Cd)pyrene	5/126	0.017 - 0.26	0.1629	TR00-16	6	0.26		N
Phenanthrene	9/126	0.02 - 0.4	0.1617	TR00-16	80	0.4		N
Pyrene	10/126	0.05 - 0.61	0.1707	TR00-16	300	0.61		N
Pesticide/PCBs								
4,4'-DDT	1/32	0.0045	0.0079	TR01-16	1.6	0.0045		N
Methoxychlor	2/32	0.0026 - 0.0027	0.0377	TR00-18	160	0.0027		N
Aroclor-1242	7/126	0.012 - 0.15	0.0226	TR07-04	1.6	0.15		N
Aroclor-1248	2/126	0.036 - 0.14	0.0211	TR00-01	1.6	0.14		N
Aroclor-1254	1/126	0.003	0.0199	TR01-14	1.6	0.003		N
Inorganics								
Aluminum	32/32	5700 - 15800	9827.1875	TR01-17	3400	10512.8862	18100	N
Antimony	6/32	0.58 - 1.25	0.4508	TR01-17	5.4	1.25	13.6	N
Arsenic	31/32	0.49 - 9.1	3.9278	TR04-09	3	9.1	12.1	N
Barium	32/32	27.7 - 200	71.2453	TR05-06	1700	87.3166	225	N

TABLE 3
OCCURRENCE AND DISTRIBUTION OF ORGANICS AND INORGANICS IN SITE 4 SOILS (POST-REMOVAL)
NAWC WARMINSTER, PENNSYLVANIA

Parameter (mg/kg)	Frequency of Detection (1)	Range of Detection	Average	Location of Maximum	Target Concentration (TC)	95% UCL	Background	Exceed TC & Background
Beryllium	30/32	0.6 - 1.7	0.8908	TR05-06	1	1.7	1.7	N
Calcium	32/32	424 - 34400	2285.2188	TR04-03	NA	34400	1910	N
Chromium	32/32	5.2 - 35.2	17.8781	TR05-07	10	19.3736	35.3	N
Cobalt	32/32	1.8 - 29.1	8.9172	TR00-05	202	29.1	21.1	N
Copper	32/32	3.9 - 134	26.5453	TR01-04	100	35.63	30.6	N
Iron	32/32	7890 - 35900	17616.5625	TR06-07	1010	19525.4873	39900	N
Lead	32/32	2 - 19.9	8.1672	TR05-06	1.4	9.8443	96.5	N
Magnesium	32/32	1280 - 21900	3038.9063	TR04-03	NA	21900	4960	N
Manganese	32/32	23.8 - 1340	425.2734	TR00-05	77	1340	2010	N
Nickel	32/32	5.8 - 24.3	11.9453	TR05-06	130	13.3615	19.1	N
Potassium	31/32	164 - 2400	897.0469	TR05-06	NA	1280.7319	3050	N
Selenium	26/32	0.72 - 2.5	1.2992	TR06-07	5.2	1.4885		N
Sodium	11/32	139 - 1620	206.2688	TR04-03	NA	242.936	86.7	N
Thallium	83/126	0.57 - 2.7	1.111	TR05-08	2.9	2.7	0.42	N
Vanadium	32/32	10.8 - 54.2	27.5781	TR04-09	5200	29.7818	45	N
Zinc	32/32	14.3 - 59.9	30.8109	TR03-08	1000	35.3736	60	N

Data is included from the following samples: W-TR00-08, W-TR00-01, W-TR00-02, W-TR00-03, W-TR00-04, W-TR00-05, W-TR00-06, W-TR00-07
W-TR00-09, W-TR00-10, W-TR00-11, W-TR00-14, W-TR00-15, W-TR00-16, W-TR00-17, W-TR00-18
W-TR00-18R, W-TR01-08, W-TR01-01, W-TR01-02, W-TR01-03, W-TR01-04, W-TR01-05, W-TR01-06
W-TR01-07, W-TR01-09, W-TR01-10, W-TR01-11, W-TR01-12, W-TR01-13, W-TR01-14, W-TR01-15
W-TR01-16, W-TR01-23, W-TR01-18, W-TR01-19, W-TR01-19R, W-TR01-20, W-TR01-21, W-TR01-22
W-TR02-06, W-TR02-01, W-TR02-02, W-TR02-03, W-TR02-04, W-TR02-05, W-TR02-07, W-TR02-08
W-TR02-09, W-TR02-10, W-TR02-11, W-TR02-12, W-TR02-13, W-TR02-14, W-TR02-15, W-TR02-16
W-TR02-21, W-TR02-18, W-TR02-19, W-TR02-20, W-TR03-01, W-TR03-02, W-TR03-03, W-TR03-05
W-TR03-06, W-TR03-07, W-TR03-08, W-TR03-09, W-TR03-10, W-TR03-11, W-TR03-24, W-TR03-23
W-TR03-15, W-TR03-16, W-TR03-17, W-TR03-19, W-TR03-20, W-TR03-21, W-TR03-22, W-TR04-00-AVG
W-TR04-00R, W-TR04-02, W-TR04-03, W-TR04-05, W-TR04-06, W-TR04-07, W-TR04-08, W-TR04-09
W-TR04-10, W-TR04-11, W-TR04-13, W-TR04-14, W-TR04-15, W-TR04-19, W-TR05-01, W-TR05-02
W-TR05-03, W-TR05-04, W-TR05-05, W-TR05-06, W-TR05-07, W-TR05-14, W-TR05-09, W-TR05-10
W-TR05-11, W-TR05-12, W-TR06-09, W-TR06-01, W-TR06-02, W-TR06-03, W-TR06-04, W-TR06-05
W-TR06-07, W-TR06-08, W-TR06-10, W-TR06-11, W-TR06-12, W-TR06-13, W-TR06-14, W-TR07-01
W-TR07-02, W-TR07-03, W-TR07-04, W-TR07-11, W-TR07-07, W-TR07-08, W-TR07-09, W-TR07-10
W-TR07-13

TABLE 4
SURFACE WATER RESULTS SUMMARY FOR SITE 4
A COMPARISON TO AMBIENT WATER QUALITY CRITERIA FOR SURFACE WATER
NAWC WARMINSTER, PENNSYLVANIA

Analyte	Frequency of Detection in Background Samples	Range of Positive Detection in Background Samples (ug/L)	Frequency of Detection in Downstream Samples	Range of Positive Detection in Downstream Samples (ug/L)	Surface Water (1) AWQC (ug/L)	Downstream Concentration exceeds Background Sample and AWQC Criteria
Inorganics* **						
BARIUM	2 / 3	60 - 93	5 / 7	39 - 88	NA	No
CADMIUM	1 / 4	4	1 / 9	2	1.15	No
CHROMIUM (III)	0 / 3	Not Detected	1 / 9	5.8K	210	No
COPPER	0 / 3	Not Detected	1 / 4	15.5L	12.48	Yes
LEAD	0 / 2	Not Detected	5 / 7	1.1K - 22.7	3.424	Yes
MANGANESE	2 / 3	83 - 159	9 / 10	25 - 364	NA	Yes
MERCURY	0 / 4	Not Detected	1 / 10	0.27L	0.012	Yes
NICKEL	0 / 3	Not Detected	2 / 10	7.2L - 7.6L	166.4	No
ZINC	0 / 1	Not Detected	4 / 5	25.1L - 49.6	114.4	No
Volatiles**						
CARBON DISULFIDE	0 / 4	Not Detected	1 / 10	2.5J	NA	Yes
Semivolatiles**						
DIETHYLPHTHALATE	0 / 3	Not Detected	2 / 7	0.3J - 2J	3	No
DI-N-OCTYLPHTHALATE	0 / 3	Not Detected	1 / 7	0.2J	3	No

NA = Not Available

Reference

1. EPA, 1994. Ambient Water Quality Criteria (AWQC) for Water.

* = The essential nutrients and minerals were not included in this table including aluminum, calcium, iron, magnesium, potassium, and sodium.

** = The only chemicals shown on this table are those that were detected in site samples.

TABLE 5
SEDIMENT RESULTS SUMMARY FOR SITE 4
A COMPARISON TO EFFECTS RANGE - LOW FOR SEDIMENT
NAWC WARMINSTER, PENNSYLVANIA

Analyte	Frequency of Detection in Background Samples	Range of Positive Detection in Background Samples (ug/kg)	Frequency of Detection in Downstream Samples	Range of Positive Detection in Downstream Samples (ug/kg)	Sediment (1) ER-L Criteria (ug/kg)	Downstream Concentration Exceed Background Samples and ER-L Criteria
Pesticides/PCBs*						
4,4'-DDT	0 / 2	Not Detected	1 / 5	5.6	1.58	Yes
AROCLOR 1254	0 / 4	Not Detected	1 / 7	74.5	22.7	Yes
Volatiles						
ACETONE	0 / 4	Not Detected	1 / 6	46J	NA	NA
2-BUTANONE	0 / 3	Not Detected	1 / 10	30J	NA	NA
TOLUENE	0 / 5	Not Detected	1 / 10	10J	NA	NA
Semivolatiles*						
ACENAPHTHENE	1 / 4	120J	1 / 7	77J	16	No
FLUORENE	1 / 4	140J	2 / 7	110J - 120J	19	No
PHENANTHRENE	3 / 4	340J - 1200	4 / 7	335J - 1100	240	Yes
ANTHRACENE	3 / 4	72J - 290J	3 / 7	55J - 320J	85.9	Yes
FLUORANTHENE	4 / 4	380J - 1200	4 / 7	620J - 1700	600	Yes
CARBAZOLE	1 / 2	49J	1 / 5	81J	NA	NA
PYRENE	4 / 4	330J - 1400	4 / 7	660J - 2000	685	Yes
BENZ(A)ANTHRACENE	4 / 4	210J - 720	4 / 7	270J - 880	261	Yes
CHRYSENE	4 / 4	190J - 740	4 / 7	290J - 670J	384	Yes
BIS(2-ETHYLHEXYL)PHTHALATE	1 / 2	93J	3 / 5	74J - 130J	NA	NA
BENZO(B)FLUORANTHENE	3 / 4	230J - 820	3 / 7	310J - 910	NA	NA
BENZO(K)FLUORANTHENE	3 / 4	200J - 370J	3 / 7	225J - 310J	NA	NA
BENZO(A)PYRENE	3 / 4	260J - 650	3 / 7	310J - 660	430	Yes
INDENO(1,2,3-CD)PYRENE	2 / 4	190J - 410	2 / 7	200J - 420	NA	NA
DIBENZ(A,H)ANTHRACENE	2 / 4	53J - 140J	2 / 7	80J - 86J	63.4	Yes
BENZO(G,H,I)PERYLENE	2 / 4	150J - 320J	2 / 7	245J - 480	NA	NA
Inorganics*						
		(mg/kg)		(mg/kg)	(mg/kg)	
ARSENIC	3 / 3	2.3 - 3.4	9 / 9	1.2 - 8.5	8.2	Yes
BARIUM	3 / 5	31.4 - 74.6	9 / 11	38.2 - 92.9	NA	Yes
BERYLLIUM	3 / 3	0.52 - 0.65	9 / 9	0.49 - 1.2	NA	Yes
CHROMIUM	5 / 5	7.7J - 20.5J	9 / 9	4.1 - 23.4J	81	No
COPPER	3 / 3	5.4J - 34.6J	7 / 7	5.5L - 29.7J	34	No
LEAD	4 / 5	9.8J - 30	11 / 11	8.6 - 42.2J	46.7	No
MANGANESE	5 / 5	144J - 848J	11 / 11	29.6 - 528	NA	No
NICKEL	3 / 3	4.4J - 10	9 / 10	7.3L - 17J	20.9	No
SELENIUM	0 / 5	Not Detected	1 / 11	0.82J	NA	Yes
SILVER	0 / 5	Not Detected	1 / 11	2.14J	NA	Yes
VANADIUM	5 / 5	11.8L - 34.2K	10 / 10	5.9K - 43.4	NA	Yes
ZINC	5 / 5	32.9 - 61.4J	11 / 11	13.8J - 310	150	Yes

NA = Not Available

Reference

1. Long and Morgan, 1991. Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program.

* = The only chemicals shown on this table are those that were detected in site samples.

Table_5.XLS 3/29/00 10:45 AM

TABLE 6
RECREATIONAL RISK ESTIMATES - SOIL INGESTION (POST-REMOVAL)
NAWC WARMINSTER, PENNSYLVANIA

Chemical of Potential Concern	Soil Conc. (mg/kg)	Cleanup Level Goal (mg/kg)	Reference Dose (mg/kg/day)	Slope Factor (kg-day/mg)	Hazard Quotient (Child)	Cancer Risk	Hazard Quotient (Adult)
					Soil Ingestion	Soil Ingestion	Soil Ingestion
Volatile Organics							
Acetone	0.008	0.03	1.00E-01	NA	6.34E-08	NA	1.16E-08
Chlorobenzene	0.001	3.6	2.00E-02	NA	3.96E-08	NA	7.27E-09
Ethylbenzene	0.003	64	1.00E-01	NA	2.38E-08	NA	4.36E-09
Methylene chloride	0.006	0.3	6.00E-02	7.50E-03	7.92E-08	3.58E-12	1.45E-08
Toluene	0.14	92	2.00E-01	NA	5.55E-07	NA	1.02E-07
Trichlorofluoromethane	0.0002	120	3.00E-01	NA	5.28E-10	NA	9.70E-11
Xylenes, total	0.023	920	2.00E+00	NA	9.11E-09	NA	1.67E-09
Semivolatile Organics							
Acenaphthene	0.049	30	6.00E-02	NA	6.47E-07	NA	1.19E-07
Anthracene	0.09	70	3.00E-01	NA	2.38E-07	NA	4.36E-08
Benzo(a)anthracene	0.48	1.5	NA	7.30E-01	NA	2.78E-08	NA
Benzo(a)pyrene	0.42	0.6	NA	7.30E+00	NA	2.44E-07	NA
Benzo(b)fluoranthene	0.48	4.5	NA	7.30E-01	NA	2.78E-08	NA
Benzo(g,h,i)perylene	0.28	500	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	0.21	45	NA	7.30E-02	NA	1.22E-09	NA
Bis(2-ethylhexyl)phthalate	2.6	300	2.00E-02	NA	1.03E-04	NA	1.89E-05
Chrysene	0.48	150	NA	7.30E-03	NA	2.78E-10	NA
Dibenzo(a,h)anthracene	0.069	0.6	NA	7.30E+00	NA	4.00E-08	NA
Fluoranthene	0.66	400	4.00E-02	NA	1.31E-05	NA	2.40E-06
Indeno(1,2,3-cd)pyrene	0.26	6	NA	7.30E-01	NA	1.51E-08	NA
Phenanthrene	0.4	80	NA	NA	NA	NA	NA
Pyrene	0.61	300	3.00E-02	NA	1.61E-05	NA	2.96E-06
Pesticides/PCBs							
4,4'-DDT	0.0045	1.6	5.00E-04	NA	7.13E-06	NA	1.31E-06
Methoxychlor	0.0027	160	5.00E-03	NA	4.28E-07	NA	7.86E-08
Aroclor-1242	0.15	1.6	NA	7.70E+00	NA	9.18E-08	NA
Aroclor-1248	0.14	1.6	NA	7.70E+00	NA	8.57E-08	NA
Aroclor-1254	0.003	1.6	2.00E-05	NA	1.19E-04	NA	2.18E-05
Inorganics							
Cobalt	29.1	202	6.00E-02	NA	3.84E-04	NA	7.06E-05
Copper	35.6	100	4.00E-02	NA	7.05E-04	NA	1.29E-04
Selenium	1.5	5.2	5.00E-03	NA	2.38E-04	NA	4.36E-05
Thallium	2.7	2.9	7.00E-05	NA	3.06E-02	NA	5.61E-03
Risk					3.21E-02	5.33E-07	5.90E-03

TABLE 7
RESIDENTIAL RISK ESTIMATES - SOIL INGESTION (POST-REMOVAL)
NAWC WARMINSTER, PENNSYLVANIA

Chemical of Potential Concern	Soil Conc. (mg/kg)	Cleanup Level Goal (mg/kg)	Reference Dose (mg/kg/day)	Slope Factor (kg-day/mg)	Hazard Quotient (Child)	Cancer Risk	Hazard Quotient (Adult)
					Soil Ingestion	Soil Ingestion	Soil Ingestion
Volatile Organics							
Acetone	0.008	0.03	1.00E-01	NA	1.02E-06	NA	1.10E-07
Chlorobenzene	0.001	3.6	2.00E-02	NA	6.39E-07	NA	6.85E-08
Ethylbenzene	0.003	64	1.00E-01	NA	3.84E-07	NA	4.11E-08
Methylene chloride	0.006	0.3	6.00E-02	7.50E-03	1.28E-06	7.05E-11	1.37E-07
Toluene	0.14	92	2.00E-01	NA	8.95E-06	NA	9.59E-07
Trichlorofluoromethane	0.0002	120	3.00E-01	NA	8.52E-09	NA	9.13E-10
Xylenes, total	0.023	920	2.00E+00	NA	1.47E-07	NA	1.58E-08
Semivolatile Organics							
Acenaphthene	0.049	30	6.00E-02	NA	1.04E-05	NA	1.12E-06
Anthracene	0.09	70	3.00E-01	NA	3.84E-06	NA	4.11E-07
Benzo(a)anthracene	0.48	1.5	NA	7.30E-01	NA	5.49E-07	NA
Benzo(a)pyrene	0.42	0.6	NA	7.30E+00	NA	4.80E-06	NA
Benzo(b)fluoranthene	0.48	4.5	NA	7.30E-01	NA	5.49E-07	NA
Benzo(g,h,i)perylene	0.28	500	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	0.21	45	NA	7.30E-02	NA	2.40E-08	NA
Bis(2-ethylhexyl)phthalate	2.6	300	2.00E-02	NA	1.66E-03	NA	1.78E-04
Chrysene	0.48	150	NA	7.30E-03	NA	5.49E-09	NA
Dibenzo(a,h)anthracene	0.069	0.6	NA	7.30E+00	NA	7.89E-07	NA
Fluoranthene	0.66	400	4.00E-02	NA	2.11E-04	NA	2.26E-05
Indeno(1,2,3-cd)pyrene	0.26	6	NA	7.30E-01	NA	2.97E-07	NA
Phenanthrene	0.4	80	NA	NA	NA	NA	NA
Pyrene	0.61	300	3.00E-02	NA	2.60E-04	NA	2.79E-05
Pesticides/PCBs							
4,4'-DDT	0.0045	1.6	5.00E-04	NA	1.15E-04	NA	1.23E-05
Methoxychlor	0.0027	160	5.00E-03	NA	6.90E-06	NA	7.40E-07
Aroclor-1242	0.15	1.6	NA	7.70E+00	NA	1.81E-06	NA
Aroclor-1248	0.14	1.6	NA	7.70E+00	NA	1.69E-06	NA
Aroclor-1254	0.003	1.6	2.00E-05	NA	1.92E-03	NA	2.05E-04
Inorganics							
Cobalt	29.1	202	6.00E-02	NA	6.20E-03	NA	6.64E-04
Copper	35.6	100	4.00E-02	NA	1.14E-02	NA	1.22E-03
Selenium	1.5	5.2	5.00E-03	NA	3.84E-03	NA	4.11E-04
Thallium	2.7	2.9	7.00E-05	NA	4.93E-01	NA	5.28E-02
Risk					5.19E-01	1.05E-05	5.56E-02

TABLE 8
RISKS FROM GROUNDWATER BASED ON SITE 4 SOIL CONCENTRATIONS
NAWC WARMINSTER, PENNSYLVANIA

Chemical of Potential Concern	Kd (1)	Site Concentration (mg/kg)	Estimated GW Conc. (mg/L) (2)	RBC (tap water) (mg/L) (3)	Cancer Risk (4)
Semivolatile Organics					
Benzo(a)anthracene	7.96E+02	0.48	3.02E-05	9.20E-05	3.28E-07
Benzo(b)fluoranthene	2.46E+03	0.48	9.76E-06	9.20E-05	1.06E-07
Benzo(k)fluoranthene	2.46E+03	0.21	4.27E-06	9.20E-04	4.64E-09
Benzo(g,h,i)perylene	3.20E+03	0.28	4.38E-06	1.50E+00	2.92E-12
Benzo(a)pyrene	2.04E+03	0.42	1.03E-05	9.00E-06	1.14E-06
Acenaphthene	1.42E+01	0.049	1.73E-04	2.20E+00	7.84E-11
Anthracene	5.90E+01	0.09	7.63E-05	1.10E+01	6.93E-12
Bis(2-ethylhexyl)phthalate	3.02E+04	2.6	4.30E-06	4.80E-03	8.97E-10
Chrysene	7.96E+02	0.48	3.02E-05	9.20E-03	3.28E-09
Dibenz(a,h)anthracene	7.60E+03	0.069	4.54E-07	9.20E-06	4.93E-08
Fluoranthene	2.14E+02	0.66	1.54E-04	1.50E+00	1.03E-10
Indeno(1,2,3-cd)pyrene	6.94E+03	0.26	1.87E-06	9.20E-05	2.04E-08
Phenanthrene	2.80E+01	0.4	7.14E-04	1.50E+00	4.76E-10
Pyrene	2.10E+02	0.61	1.45E-04	1.10E+00	1.32E-10
Volatile Organics					
Acetone	1.15E-03	0.008	3.48E-01	3.70E+00	9.40E-08
Chlorobenzene	4.38E-01	0.001	1.14E-04	3.90E-02	2.93E-09
Ethylbenzene	7.26E-01	0.003	2.07E-04	1.30E+00	1.59E-10
Methylene chloride	2.34E-02	0.006	1.28E-02	4.10E-03	3.13E-06
Toluene	3.64E-01	0.14	1.92E-02	7.50E-01	2.56E-08
Trichlorofluoromethane	3.18E-01	0.0002	3.14E-05	1.30E+00	2.42E-11
Xylenes, total	7.78E-01	0.023	1.48E-03	1.20E+01	1.23E-10
Pesticides/PCBs					
4,4'DDT	5.26E+03	0.0045	4.28E-08	2.00E-04	2.14E-10
Methoxychlor	1.95E+02	0.0027	6.91E-07	1.80E-01	3.84E-12
Aroclor-1242	6.18E+02	0.15	1.21E-05	8.70E-06	1.39E-06
Aroclor-1248	6.18E+02	0.14	1.13E-05	8.70E-06	1.30E-06
Aroclor-1254	6.18E+02	0.003	2.43E-07	7.30E-04	3.32E-10
Inorganics					
Cobalt	4.50E+01	29.1	3.23E-02	2.20E+00	1.47E-08
Copper	3.50E+01	35.6	5.09E-02	1.50E+00	3.39E-08
Selenium	5.00E+00	1.5	1.50E-02	1.80E-01	8.33E-08
Thallium	7.10E+01	2.7	1.90E-03	2.60E-03	7.31E-07
RISK					8.47E-06

(1) Kd value was obtained from the "Soil Screening Guidance: User's Guide" or calculated as Koc x 0.002.

(2) Estimated GW Concentration is the Soil Concentration/Kd/Dilution Attenuation Factor default of 20.

(3) RBC value is the RBC value for tap water.

The RBC tap water value for naphthalene was used as a surrogate for noncarcinogenic PAHs.

(4) Calculated from a ratio: Site Cancer Risk from GW = (Estimated GW Conc./RBC tap water) x 0.000001.

**TABLE 9
RISK ESTIMATES FOR SURFACE WATER AND SEDIMENT NEAR SITE 4
NAWC WARMINSTER, PENNSYLVANIA**

EXPOSURE ASSUMPTIONS:

SW ING	value units	SW DER	value units	SD ING	value units	SD DER	value units
CONC	max conc mg/L	CONC	max conc mg/L	CONC	max conc mg/kg	CONC	max conc mg/kg
IR	0.05 L/d	SA	3160 cm2	IR	100 mg/kg	CF	1.00E-06 kg/mg
EF	36 d	PC	see below	CF	1.00E-06 kg/mg	SA	3160 cm2
ED	6 yrs	ET	2.6 hr/d	FI	1	AF	1.45 mg/cm2
BW	15 kg	EF	36 d	ED	36 d	ABS (org)	0.1
ATcar	25550 d	ED	6 yrs	ED	6 yrs	ABS (met)	0.001
ATnon	2190 d	CF	1.00E-03 L/cm3	BW	15 kg	EF	36 d
		BW	15 kg	AT	25550 d	ED	6 yrs
		ATnon	25550 d	AT	2190 d	BW	15 kg
		ATcar	2190 d			AT	25550 d
						AT	2190 d

SEDIMENT CONCENTRATIONS, CDI ESTIMATIONS, AND HQ, HI, AND RISK ESTIMATES:

ANALYTE	ABS	SF	RfD	SD CONC	SEDIMENT INGESTION				SEDIMENT DERMAL			
					cdi-car	rsik	cdi-ncar	hq	cdi-car	rsik	cdi-ncar	hq
arsenic	1.00E-03	1.75E+00	3.00E-04	8.5	4.79E-07	8.38356E-07	5.59E-06	0.01863	2.20E-08	3.84E-08	2.56E-07	0.00085
barium	1.00E-03	NA	7.00E-02	92.9	NA	NA	6.11E-05	0.00087	NA	NA	2.80E-06	0.00004
beryllium	1.00E-03	4.30E+00	5.00E-03	1.2	6.76E-08	2.90818E-07	7.89E-07	0.00016	3.10E-09	1.33E-08	3.62E-08	0.00001
cadmium	1.00E-03	NA	5.00E-04	ND	NA	NA	NA	NA	NA	NA	NA	NA
chromium	1.00E-03	NA	5.00E-03	23.4	NA	NA	1.54E-05	0.00308	NA	NA	7.05E-07	0.00014
copper	1.00E-03	NA	3.71E-02	29.7	NA	NA	1.95E-05	0.00053	NA	NA	8.95E-07	0.00002
lead	1.00E-03	NA	NA	42.2	NA	NA	NA	NA	NA	NA	NA	NA
manganese	1.00E-03	NA	5.00E-03	528	NA	NA	3.47E-04	0.06944	NA	NA	1.59E-05	0.00318
mercury	1.00E-03	NA	3.00E-04	ND	NA	NA	NA	NA	NA	NA	NA	NA
nickel	1.00E-03	NA	2.00E-02	17	NA	NA	1.12E-05	0.00056	NA	NA	5.12E-07	0.00003
selenium	1.00E-03	NA	5.00E-03	0.82	NA	NA	5.39E-07	0.00011	NA	NA	2.47E-08	0.0000049
silver	1.00E-03	NA	5.00E-03	2.14	NA	NA	1.41E-06	0.00028	NA	NA	6.45E-08	0.00001
vanadium	1.00E-03	NA	7.00E-03	43.4	NA	NA	2.85E-05	0.00408	NA	NA	1.31E-06	0.00019
zinc	1.00E-03	NA	3.00E-01	310	NA	NA	2.04E-04	0.00068	NA	NA	9.34E-06	0.00003
Aroclor 1254	0.1	7.70E+00	NA	0.0745	4.20E-09	3.2331E-08	NA	NA	1.92E-08	1.48E-07	NA	NA
HQs:								0.09840				0.00451
Total Cancer Risks:						1E-06				2.00E-07		

SURFACE WATER CONCENTRATIONS, CDI ESTIMATIONS, AND HQ, HI, AND RISK ESTIMATES:

ANALYTE	PC	SF	RfD	SW CONC	SURFACE WATER INGESTION				SURFACE WATER DERMAL			
					cdi-car	risk	cdi-ncar	hq	cdi-car	risk	cdi-ncar	hq
arsenic	1.00E-03	1.75E+00	3.00E-04	ND	---	---	---	---	---	---	---	---
barium	1.00E-03	NA	7.00E-02	0.088	NA	NA	2.89E-05	0.00041	NA	NA	4.07E-04	0.00582
beryllium	1.00E-03	4.30E+00	5.00E-03	ND	---	---	---	---	---	---	---	---
cadmium	1.00E-03	NA	5.00E-04	0.002	NA	NA	6.58E-07	0.00132	NA	NA	9.26E-06	0.01852
chromium	2.00E-03	NA	5.00E-03	0.0058	NA	NA	1.91E-06	0.00038	NA	NA	2.69E-05	0.00537
copper	1.00E-03	NA	3.71E-02	0.0155	NA	NA	5.10E-06	0.00014	NA	NA	7.18E-05	0.00193
lead	4.00E-06	NA	NA	0.0227	NA	NA	NA	NA	NA	NA	NA	NA
manganese	1.00E-03	NA	5.00E-03	0.364	NA	NA	1.20E-04	0.02393	NA	NA	1.69E-03	0.33710
mercury	1.00E-03	NA	3.00E-04	0.00027	NA	NA	8.88E-08	0.00030	NA	NA	1.25E-06	0.00417
nickel	1.00E-04	NA	2.00E-02	0.0076	NA	NA	2.50E-06	0.00012	NA	NA	3.52E-05	0.00176
selenium	1.00E-03	NA	5.00E-03	ND	---	---	---	---	---	---	---	---
silver	6.00E-04	NA	5.00E-03	ND	---	---	---	---	---	---	---	---
vanadium	1.00E-03	NA	7.00E-03	ND	---	---	---	---	---	---	---	---
zinc	6.00E-04	NA	3.00E-01	0.0496	NA	NA	1.63E-05	0.00005	NA	NA	2.30E-04	0.00077
Aroclor 1254	0.71	7.70E+00	NA	ND	---	---	---	---	---	---	---	---
HQs:								0.02666				0.37545
Total Cancer Risks:						0				0		

ND = Not Detected
NA = Not Applicable

APPENDIX B

FIGURES

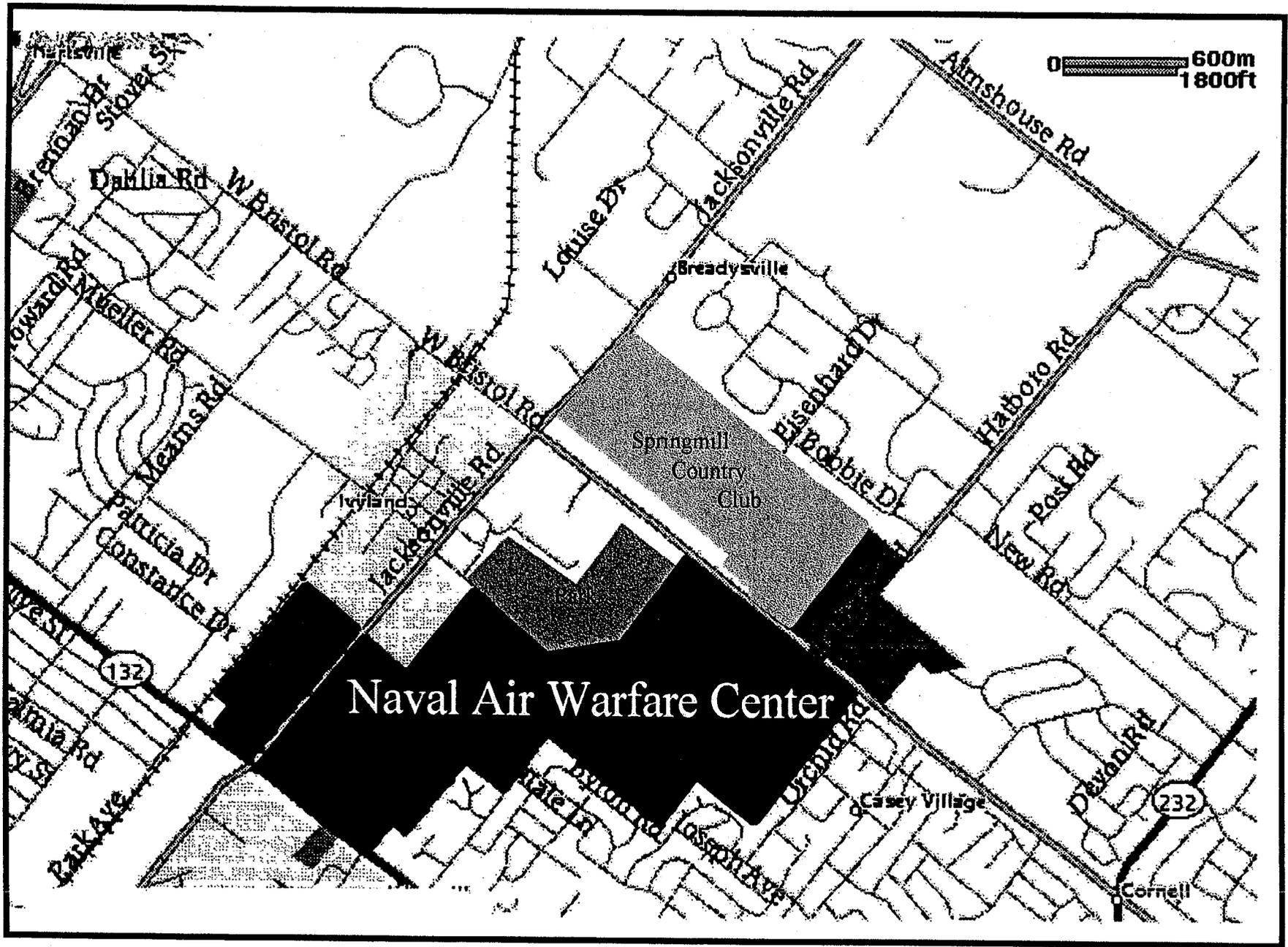


FIGURE 1. The Former NAWC, Warminster, Pennsylvania

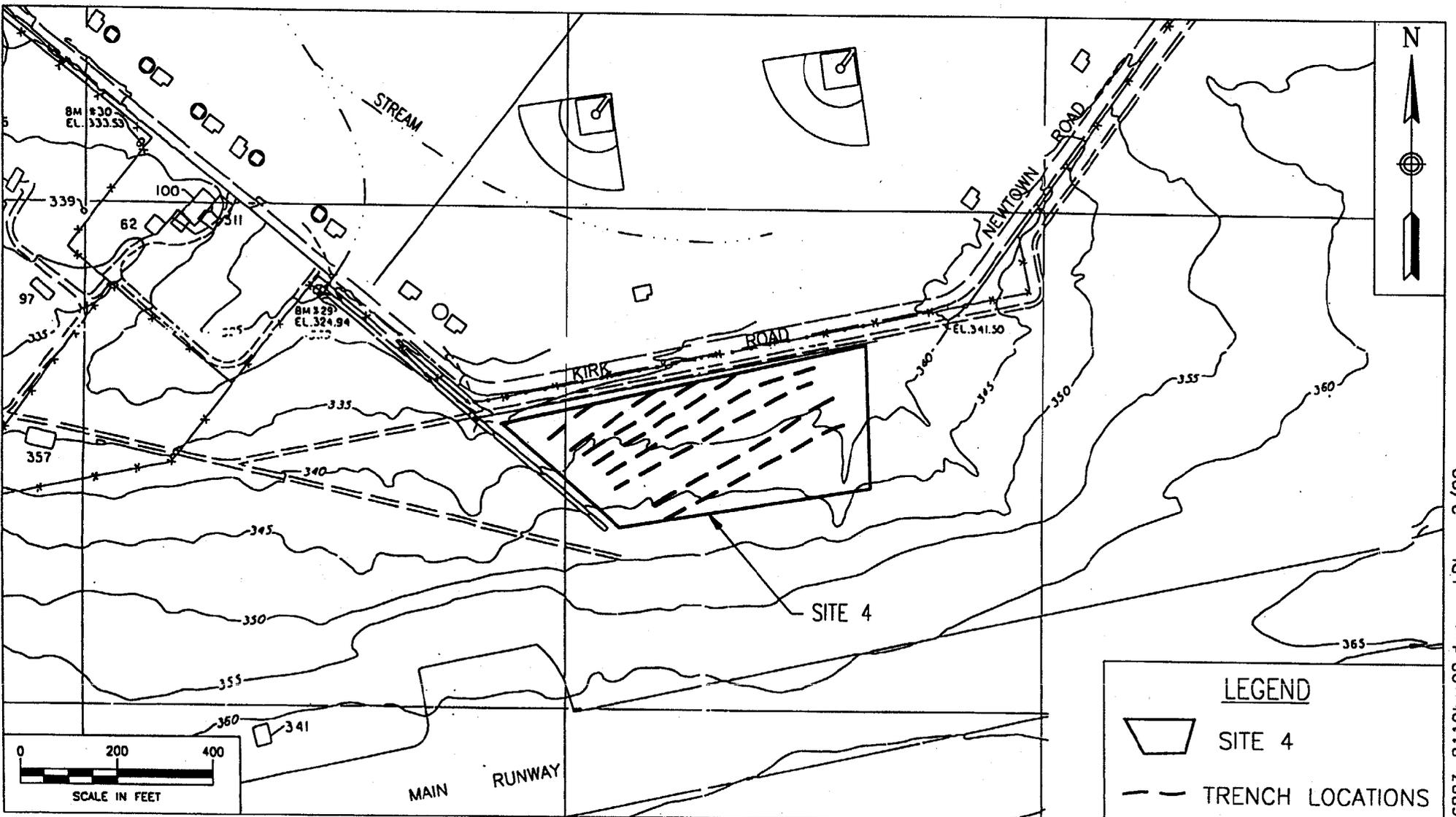


Figure 3. Site 4 Layout

AS-BUILT DIAGRAM FOR SITE 4 EXCAVATION WORK
NAWC WARMINSTER, PENNSYLVANIA

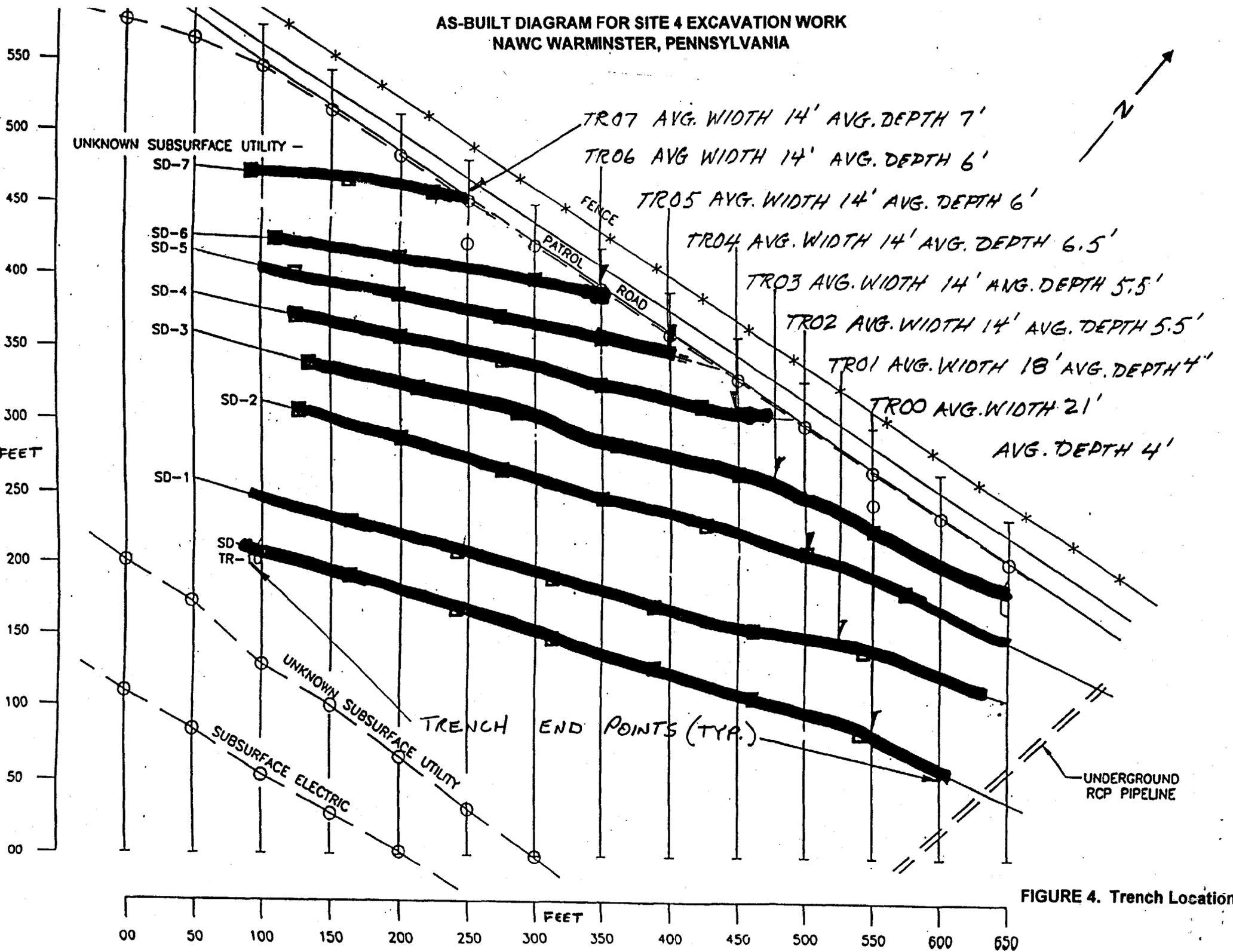
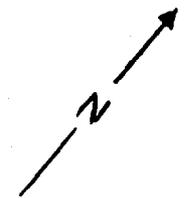
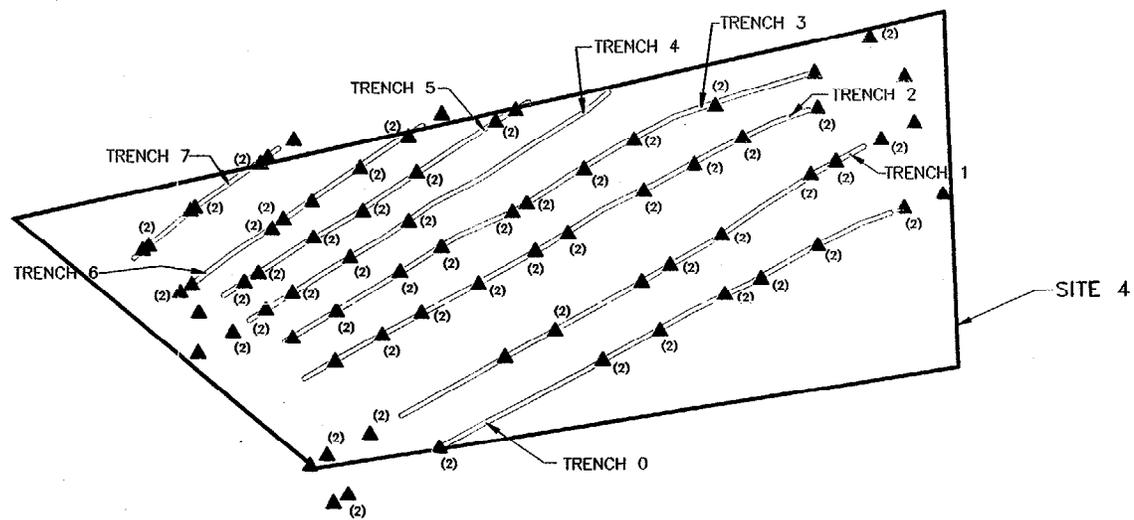
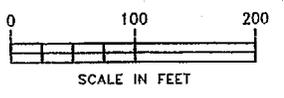


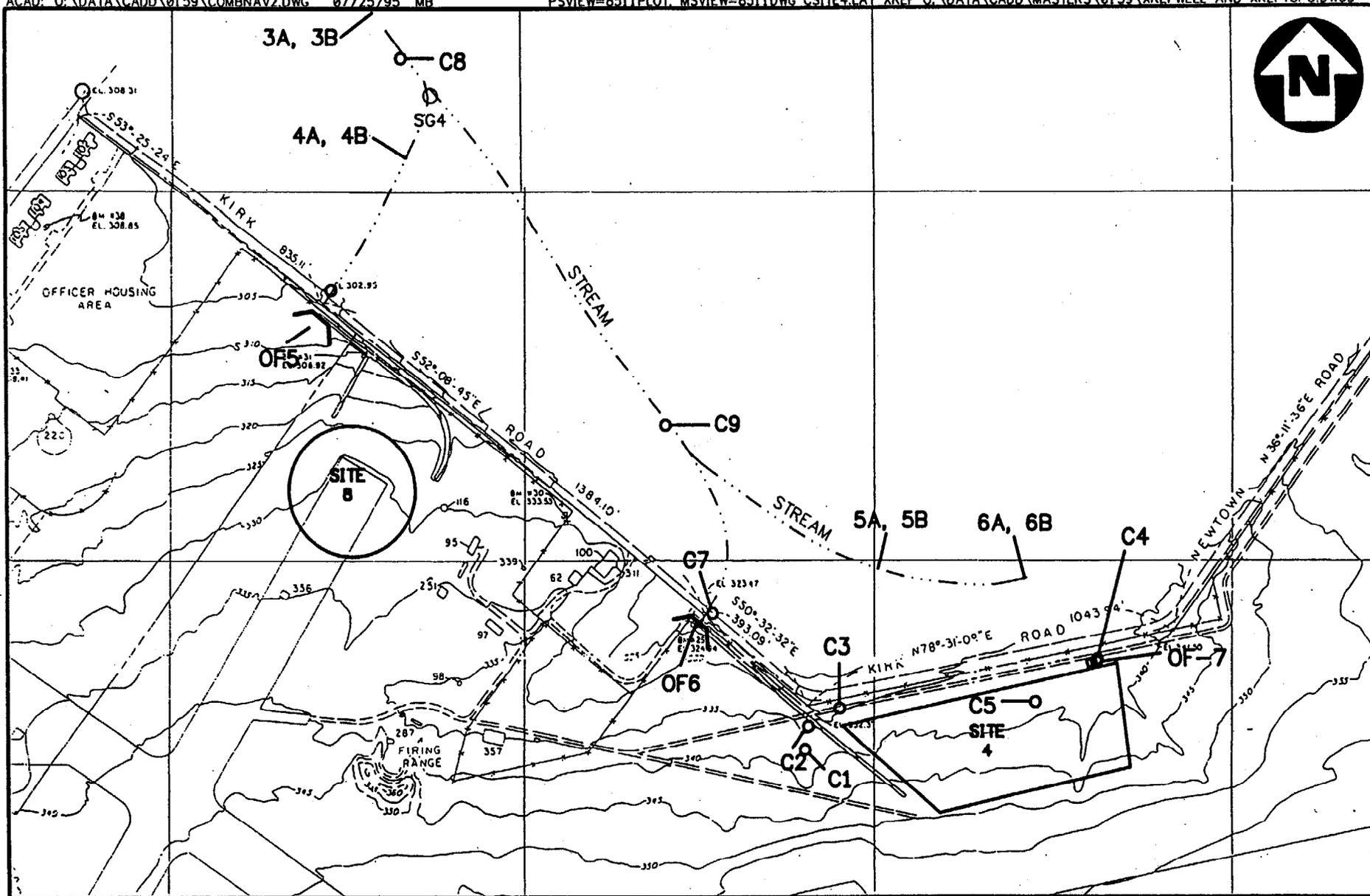
FIGURE 4. Trench Locations



LEGEND	
▲	SAMPLE LOCATION
(2)	NUMBER OF SAMPLES AT SAME LOCATION
══	EXCAVATED TRENCH LOCATION

LDL	4/7/00	SUBSURFACE SAMPLE LOCATIONS	6883
SITE 4			8120
FORMER NAWC WARMINSTER		FORMER NAWC WARMINSTER WARMINSTER, PENNSYLVANIA	FIGURE 5
AS NOTED			





SITE 4
SURFACE WATER/SEDIMENT SAMPLING LOCATIONS

NAWC WARMINSTER

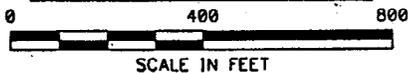


FIGURE 6. Site 4 Surface Water/Sediment Sampling Locations