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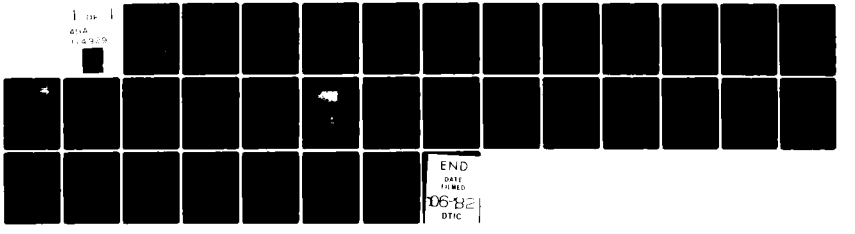

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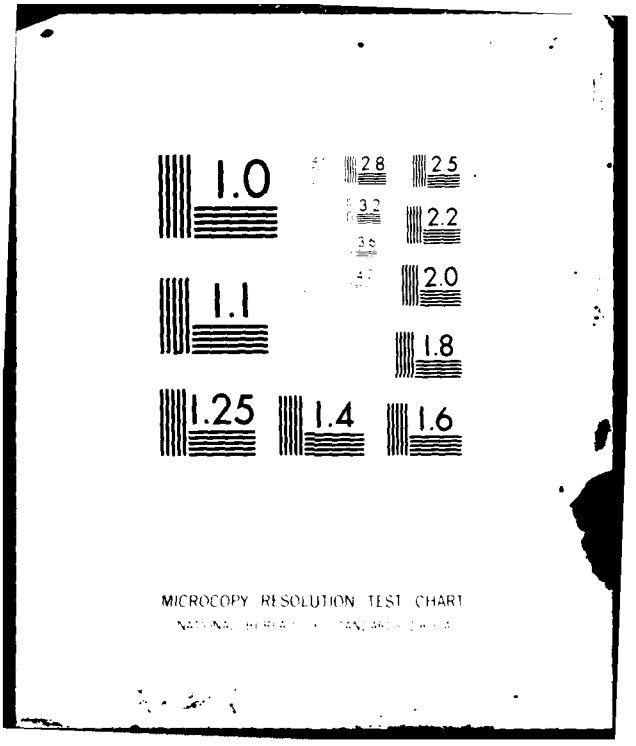
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REPORT NO. DRXTH-IS-TR-81-108

AD A114929

SURVEY OF THE FORMER NIKE SITES LOCATED AT NORTH SMITHFIELD, FOSTER AND COVENTRY, RHODE ISLAND

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Richard G. Roux
US Army Toxic and Hazardous Materials Agency
Aberdeen Proving Ground, MD 21010

June 1981

Final Report

Approved for Public Release; Distribution Unlimited

US ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

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The Army was requested to investigate allegations that canisters of UDMH, a missile starter fuel for the Nike-Ajax system, were buried at one or more of the five former Nike launcher sites in Rhode Island. This report documents the survey/cleanup operations conducted at Foster, Coventry, and North Smithfield. Three canisters containing liquid were found at North Smithfield and incinerated onsite. One empty canister was found at Foster. One full can and one empty can were found at Coventry; the full canister was incinerated onsite. Surveys are now complete.

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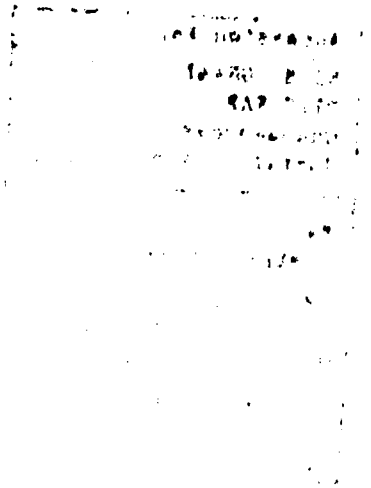


EXECUTIVE SUMMARY

In 1979, Rhode Island Congressman Edward Beard requested the Army to investigate allegations that containers of unsymmetrical dimethylhydrazine (UDMH), the starter fuel for the Nike-Ajax missile system, were buried at one or more of the five former Nike Sites in his state.

In November 1980, the Bristol Site was surveyed and no canisters were found. This work is documented in the Survey of the Former Nike Site, Bristol, Rhode Island, Report No. DRXTH-IS-TR-81088 (reference 1).

This report documents the follow-on surveys conducted at the North Smithfield, Foster, and Coventry, Rhode Island, Nike Sites, during May 1981. Three canisters with small amounts of liquid inside were found at North Smithfield and incinerated onsite. One empty canister was found at Foster. Two canisters, one almost full and the other empty, were found at Coventry; the full canister was incinerated onsite and burned with the characteristics of UDMH. The three sites are now considered clear of buried UDMH canisters. No evidence was found of UDMH canister burial at the Davisville Site. Accordingly, this site was not surveyed.

The project to survey Rhode Island Nike Launcher Sites has been closed.

I. INTRODUCTION

There are five former Nike Launcher Sites in Rhode Island: Coventry, Foster, North Smithfield, Davisville, and Bristol. The sites have been deactivated, and their current owners are as follows:

Site	Current Owner
Bristol	Roger William College
Davisville	Rhode Island Port Authority
Coventry	General Services Administration
North Smithfield	Fort Devens (leased to Rhode Island National Guard)
Foster	Rhode Island State Police

In 1971, Rhode Island National Guard personnel stationed at the former North Smithfield Nike Site accidentally excavated several containers of unsymmetrical dimethylhydrazine (UDMH) while clearing an area for a parking lot. In 1979, 17 UDMH containers were uncovered at the Rhode Island State Police Training Academy during construction of an athletic field at the former Foster Nike Site. Also in 1979, Mr. Allen Bestwick, a former Army enlisted man who had been stationed at the Coventry Nike Site, came forward and stated that he had witnessed the burial of six UDMH containers at the former Coventry Nike Site. When this latter information was made public, Congressman Edward Beard requested the Department of the Army to determine whether any UDMH containers remained buried on any of the former Rhode Island Nike Sites, and if so, to have them recovered.

The US Army Toxic and Hazardous Materials Agency (USATHAMA) was tasked to conduct the investigation. The Bristol Site was chosen by DARCOM as the first site to be investigated, since it was the only one occupied by a substantial number of civilians and it was the site of a college dormitory. The Bristol Survey was conducted in November 1980. The procedure utilized and survey findings were documented in reference 1. No UDMH canisters were found at the Bristol Site.

Survey and cleanups of the remaining Rhode Island Nike Sites were postponed until Spring, 1981, because of weather considerations.

II. DECISION ON DAVISVILLE SITE:

In December 1980, the USATHAMA Project Engineer, Ms. M. Bruce visited the launcher sites at Davisville, North Smithfield, Foster and Coventry, and spoke with Mr. Bestwick and other personnel who had worked on one or more of the sites during the time the Nike-Ajax missiles were present. This visit did not provide any evidence of canister burials at the Davisville Site; plans to survey this site were subsequently dropped. Ms. Bruce's visit did confirm evidence of canister burials at North Smithfield, Foster, and Coventry.

III. LOCATIONS:

The general locations of the launcher sites is shown in Figure 1. Specific site locations are as follows:

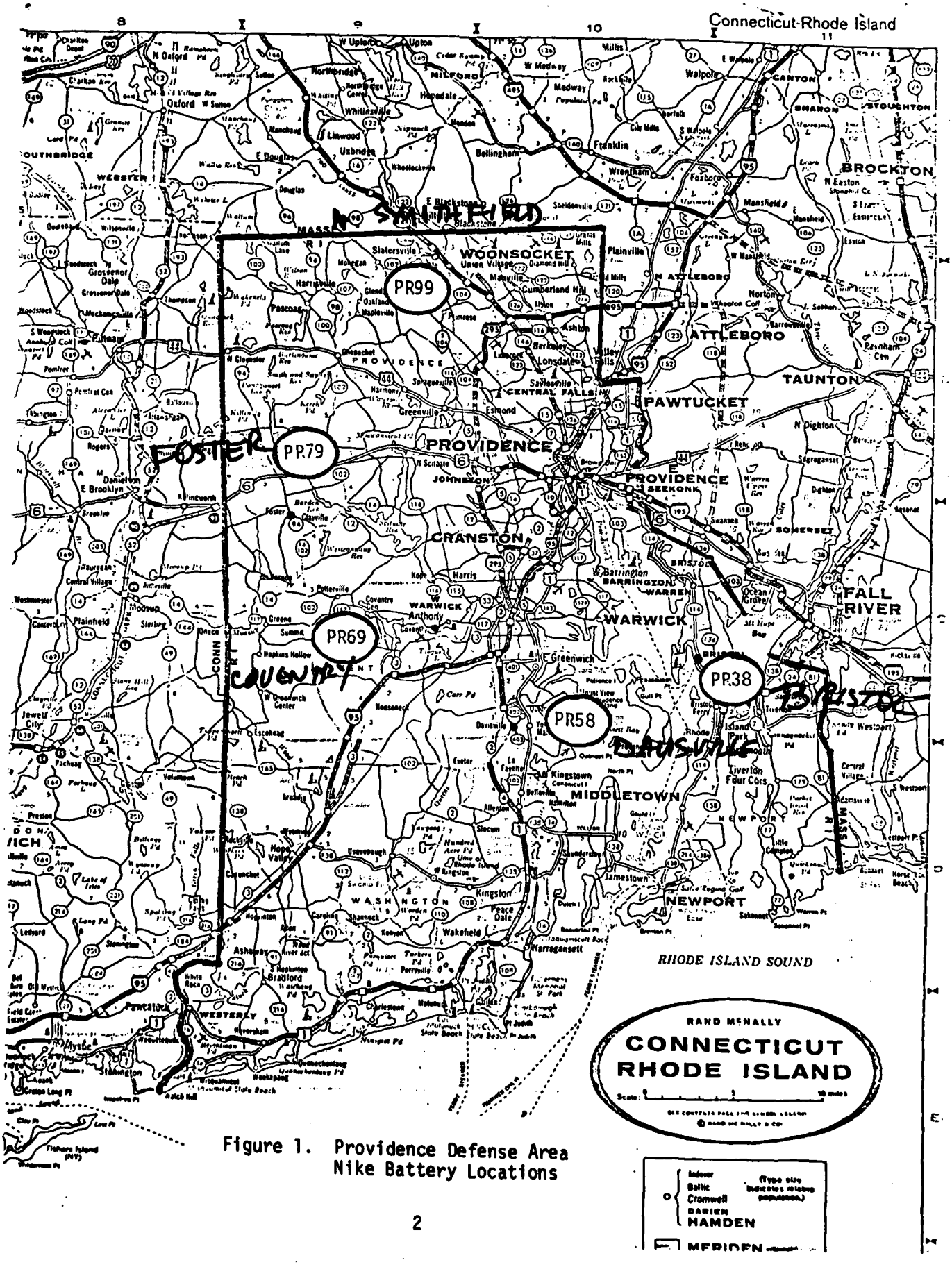


Figure 1. Providence Defense Area
Nike Battery Locations

North Smithfield. Located approximately 2 miles southwest of Woonsocket, RI, on Pound Hill Road between Black Plain Road and Oxford Turnpike (see Figure 2).

Foster. Located halfway between the towns of North Foster and South Foster on Winsor Road (see Figure 3).

Coventry. Located 1/2 mile south of the town of Coventry Center, south of Route 117 and east of Phillips Road (see Figure 4).

IV. NIKE-AJAX MISSILE SYSTEM:

The Nike-Ajax system was designed to acquire, intercept, and destroy high speed and high altitude enemy aircraft operating beyond the capabilities of conventional antiaircraft artillery. The Nike-Ajax battery consisted of three tactical areas: an assembly and test area, a battery control area, and a launching area. The assembly/test area and the launching area are termed the "launcher area" in this report. The battery control area was located several miles away and was not investigated, since the missiles were never physically present at the control area.

The Nike-Ajax antiaircraft guided missile M1 (see Figure 5 and 6) was a two stage surface-to-air missile fired from a monorail-type launcher. It was initially accelerated by a solid propellant jato unit which separated from the missile after burnout. A pressure-fed liquid propellant sustainer motor was activated upon separation of the jato unit and provided the missile with sustaining thrust. This motor was initially activated by the combination of UDMH starter fuel with nitric acid. An electronic guidance section was also present within the missile body.

V. LAUNCHER AREA - GENERAL DESCRIPTION:

Figure 7 shows a typical layout for a permanent, subsurface Nike-Ajax launcher area such as were installed in Rhode Island. Each launcher area contained an assembly/test building, an acid storage shed, a fueling area/building, and a generator building. In addition, it contained three launcher batteries containing four Nike-Ajax missiles each. The launch pads were concrete, surrounded by asphalt. The specific arrangements of the buildings and launcher batteries depended on local terrain, and, therefore, vary somewhat from site to site. Each of the Rhode Island sites also had an adjacent field for the possible future addition of another three launcher batteries. However, none of these additional batteries were ever constructed.

VI. PROPERTIES OF UDMH AND ITS USES IN THE NIKE MISSILE PROGRAM:

Unsymmetrical Dimethylhydrazine (UDMH): UDMH ($(CH_3)_2NNH_2$) is a hygroscopic, colorless liquid with an ammonia-like odor, and is water miscible. It has a flash point of approximately 0°C (32°F) in air and an auto ignition temperature of 249°C (480°F). UDMH is considered dangerous as a fire hazard when exposed to heat, flame, or oxidizers. When heated to decomposition, UDMH emits highly toxic vapors. UDMH can react with oxidizing materials such as air, hydrogen peroxide, nitric acid, and fuming nitric acid. A UDMH fire can be fought with alcohol foam, CO_2, and dry chemicals.

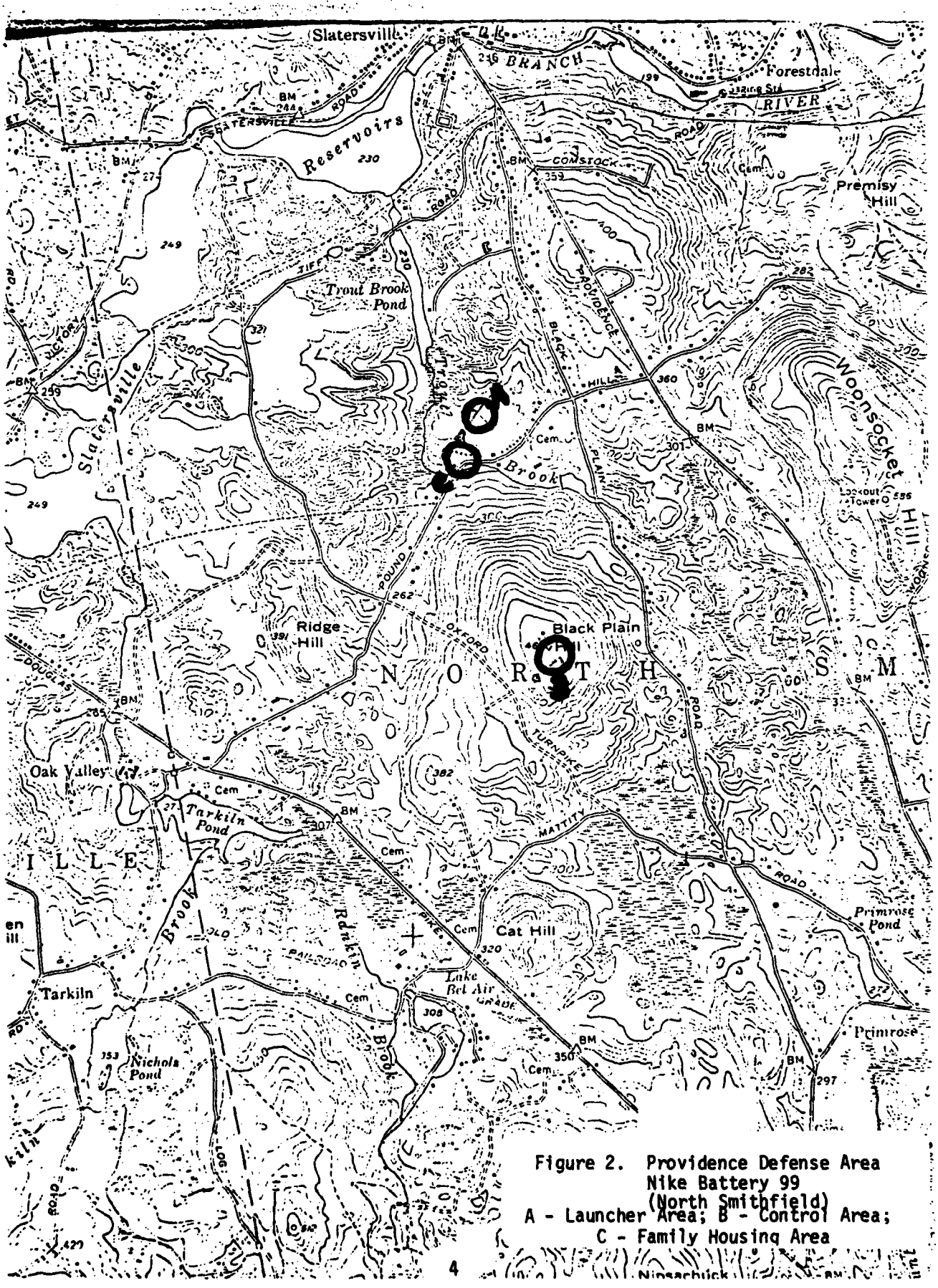


Figure 2. Providence Defense Area
Nike Battery 99
(North Smithfield)
A - Launcher Area; B - Control Area;
C - Family Housing Area

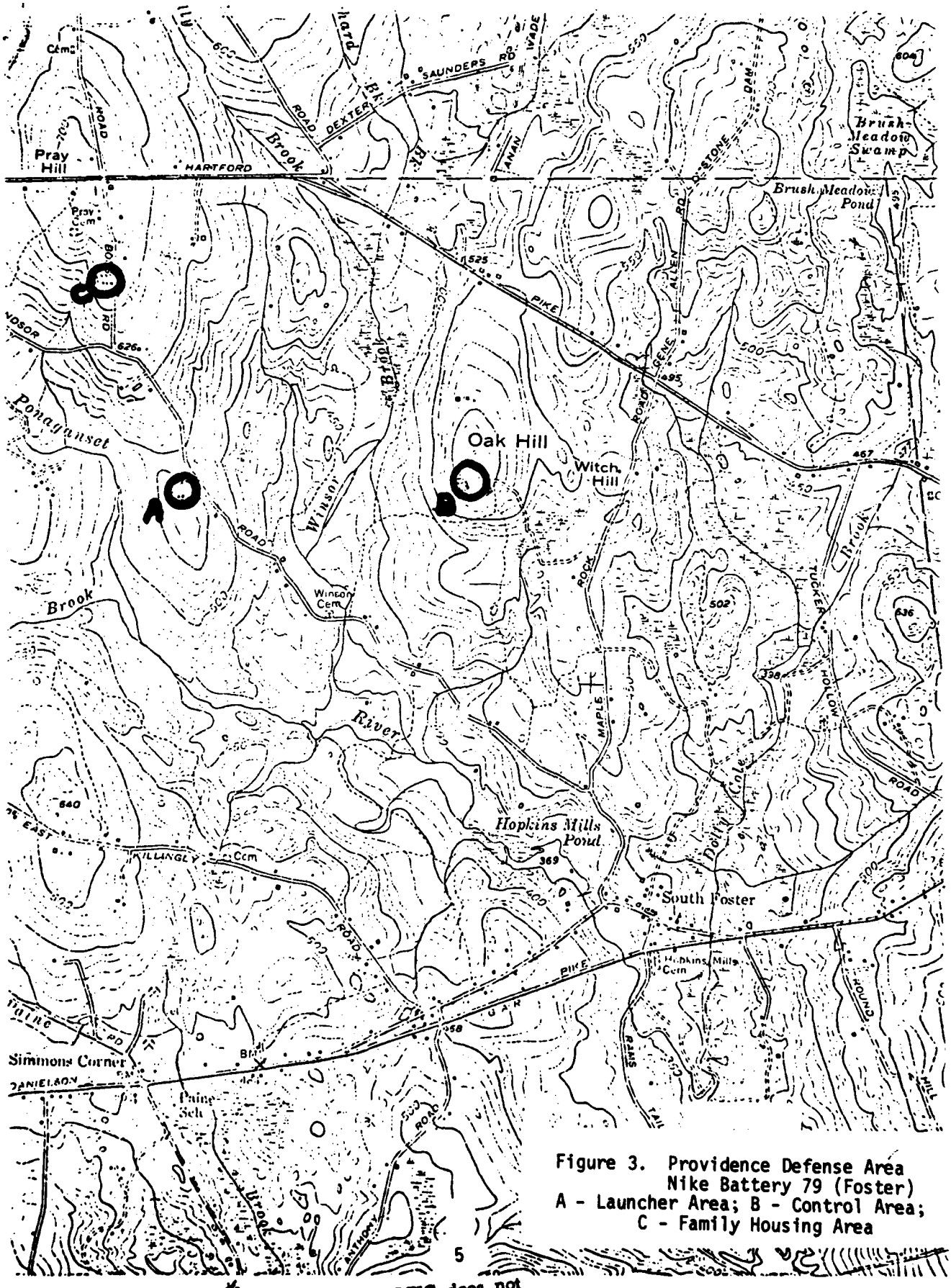


Figure 3. Providence Defense Area
Nike Battery 79 (Foster)
A - Launcher Area; B - Control Area;
C - Family Housing Area

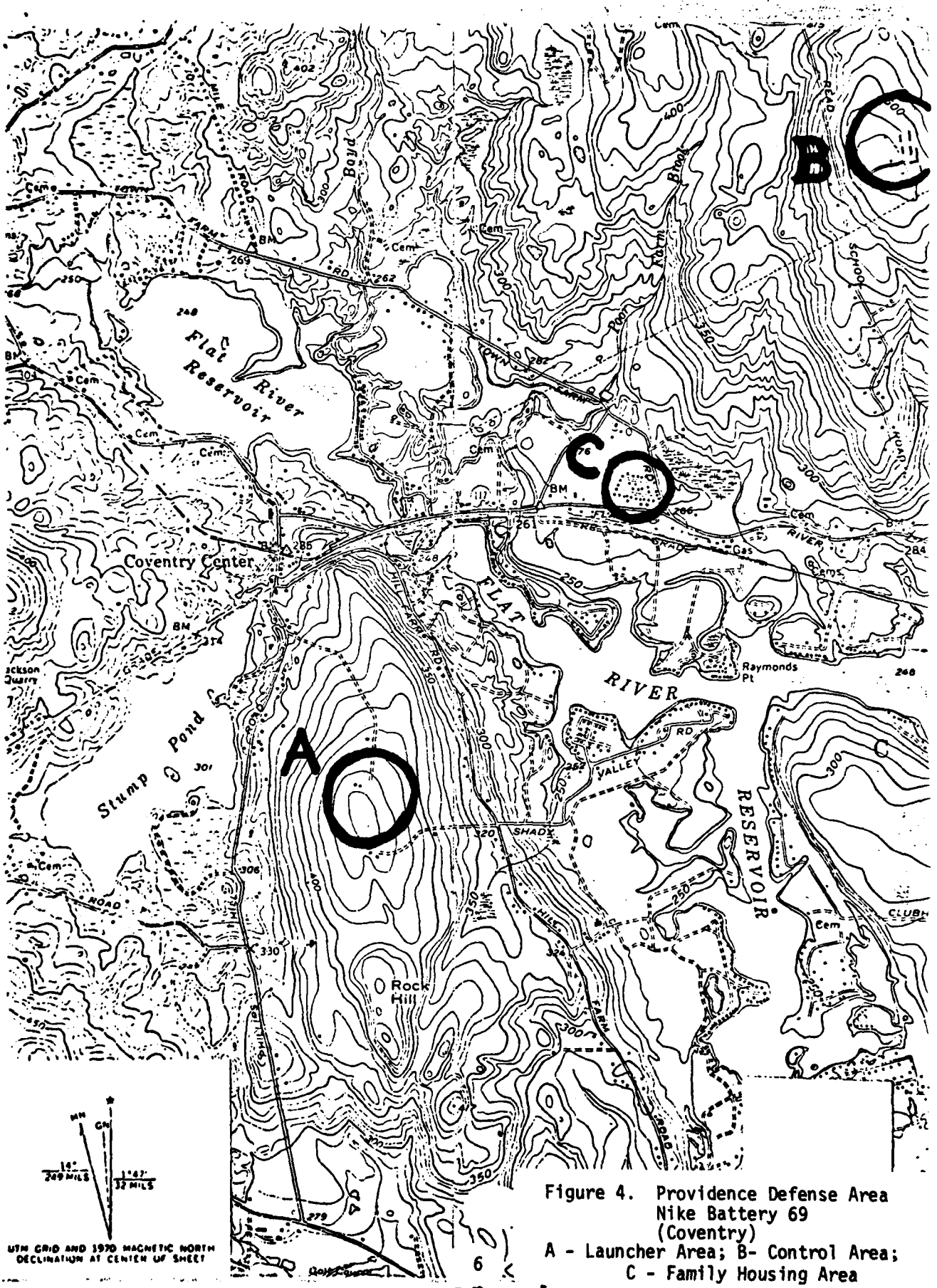


Figure 4. Providence Defense Area
Nike Battery 69
(Coventry)
A - Launcher Area; B- Control Area;
C - Family Housing Area

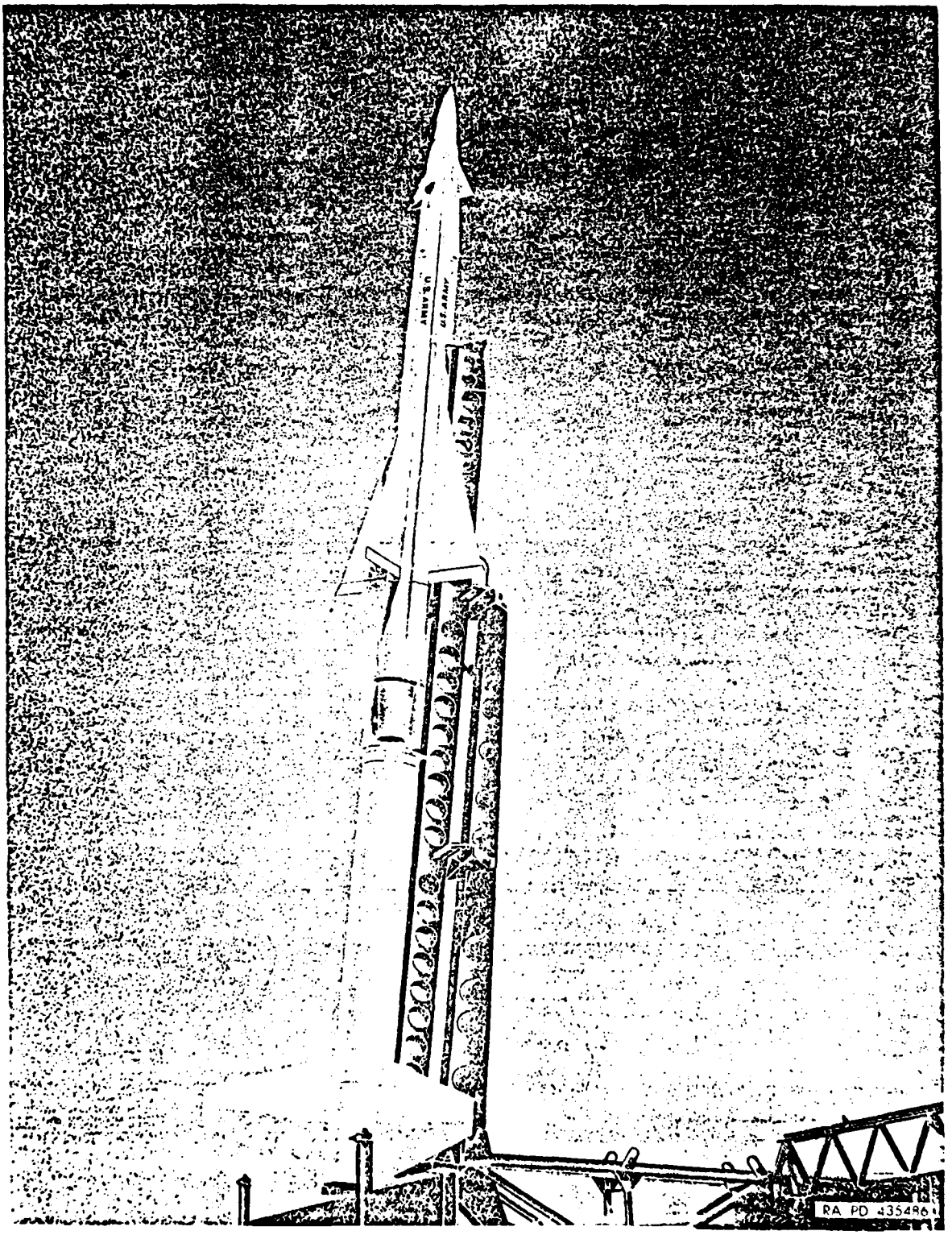


Figure 5. Antiaircraft Guided Missile M1 (Nike-Ajax) on Launcher-Loader M26

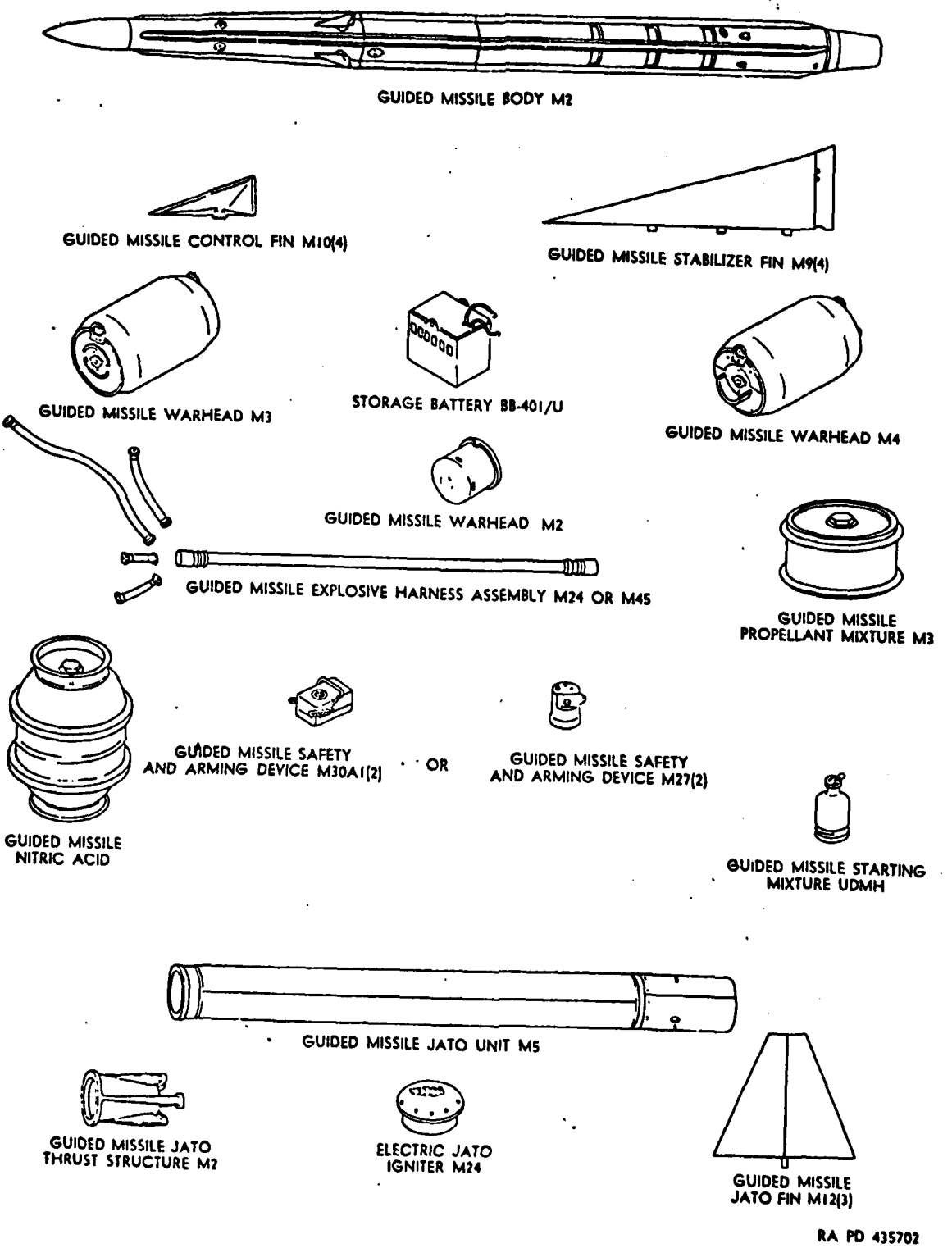


Figure 6. Separately Packaged Components of Antiaircraft Guided Missile M1

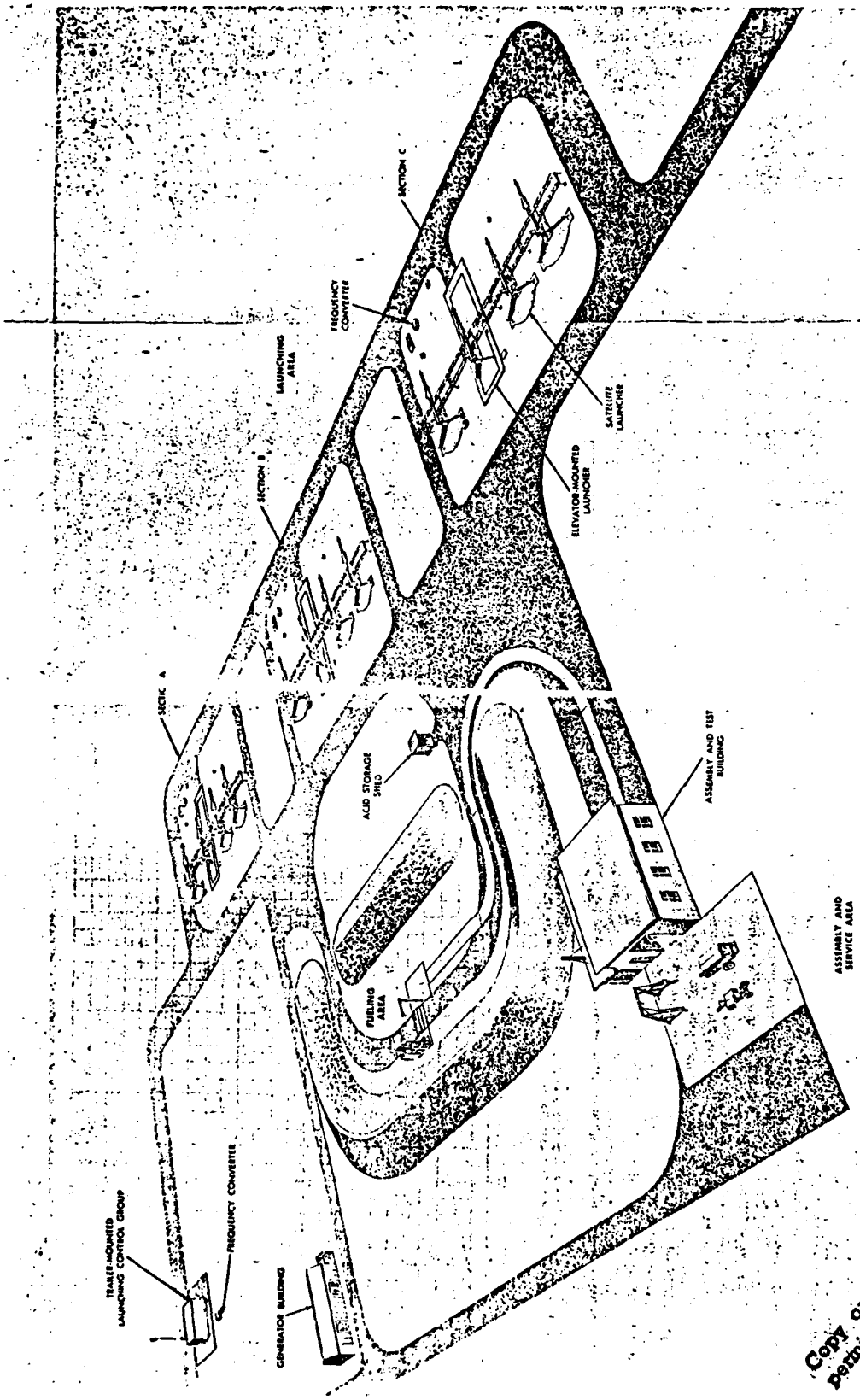


Figure 7. Launching Area-Subsurface

Dimethylhydrazine is highly reactive and, therefore, is covered by the extremely hazardous waste rules and regulations which prevent it from being landfilled. This chemical has a hazard rating of "high" for acute local and acute systemic exposure. It is highly dangerous when heated to decomposition because it emits highly toxic vapors. It also can react vigorously with oxidizing materials. It has a TWA of 0.1 mg/m^3 (skin contact) which makes it moderately toxic (reference 5) for an 8 hour exposure to workers.

UDMH Filling Operations: UDMH was used as the starter fluid in the Ajax version of the Nike missile. Fresh UDMH was delivered to the site in natural (unpainted) finished quart-size aluminum containers (shows in Figure 8). Each container held enough UDMH starter fluid for one missile. According to the 17 April 1955 edition of TM 9-5001-30, the disposal of the empty UDMH filling containers was to be left to the discretion of the using organization. Standard procedure was to neutralize any spillage of UDMH with water or alcohol, then flushed with large amount of sodium bicarbonate, boric acid, or mild acetic acid solutions. Usage of nitric or chromic acids was to be avoided. Personal protective clothing was required for both filling and draining UDMH from the missile.

UDMH Draining Operations: The UDMH had a 2-year shelf life, and was, therefore, replaced every 2 years. It was also replaced when major maintenance of the missile was required. The UDMH was drained from the missile into a quart-size, olive-drab painted aluminum container (shown in Figure 9). This container was similar in shape and construction to the container used in the filling operation, but was painted olive-drab to distinguish it from the filling canister which was unpainted. According to the January 1956 edition of FM 44-80, the UDMH was then drained into a hole previously dug in the ground and the container was decontaminated. No direction was provided to describe how and where the container was to be decontaminated and disposed of. There was also no record of any decontamination to be performed on the UDMH after it is drained into the hole. These disposal activities, however, were accomplished over 20 years ago and the risk to the environment or public health would be improbable because of the volatility and solubility of UDMH. Any risk that would have been present would have passed due to evaporation or movement through the groundwater.

VII. PARTICIPANTS:

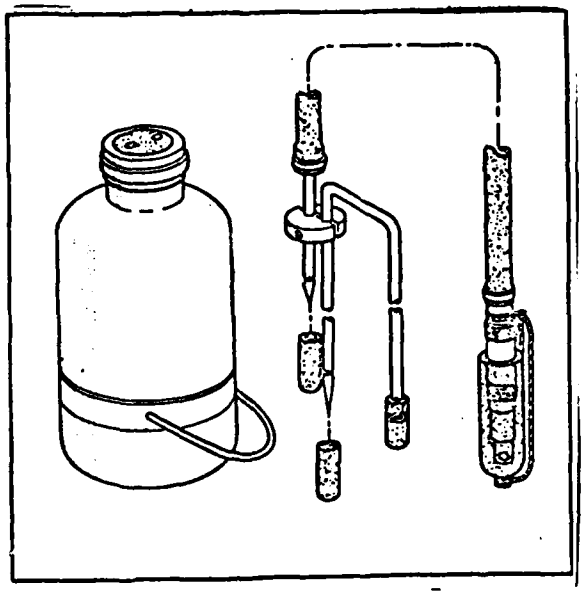
The following organizations participated in this survey effort:

(1) US Army Toxic and Hazardous Materials Agency (USATHAMA) - Responsible for planning and conducting the survey, coordinating with site owners and emergency personnel, and providing technical information and assistance to other participants.

(2) US Army Technical Escort Unit (USATEU) - Responsible for visual inspections during earth moving activities, and handling, removal, and destruction of all recovered chemical materials.

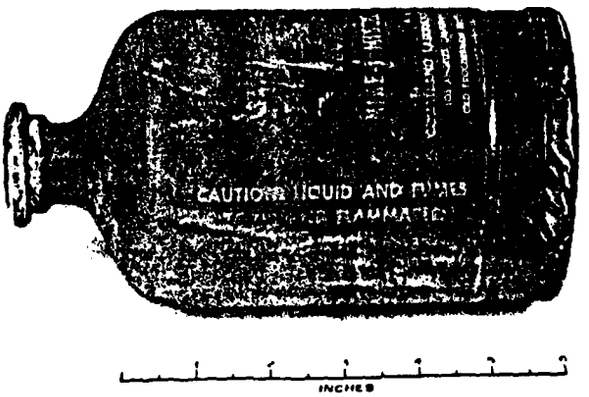
(3) 14th Explosive Ordnance Detachment (14th EOD), Fort Devens, MA - Participated in visual inspections and conducted metal detector surveys.

(4) 39th Engineer Battalion, CBT (39th Engr), Fort Devens, MA - Conducted all earth-moving operations.



NOTE: CONTAINER IS APPROXIMATELY 8 INCHES HIGH AND 4 INCHES OUTSIDE DIAMETER

Figure 8. Can of Unused UDMH and Its Draining Apparatus



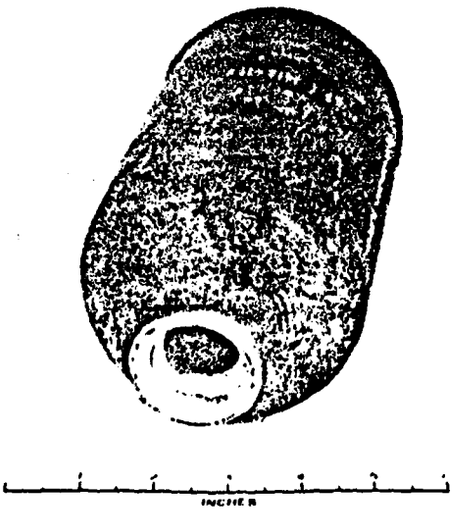


Figure 9. UDMH Container With Septum Removed

VIII. DELINEATION OF SEARCH AREAS:

The USATHAMA record search report (reference 2) was reviewed to obtain information on the locations within each site where UDMH canisters might have been buried. The report referred to Mr. Allen Bestwick (a former Army enlisted man who had worked at each of the sites and who had buried canisters at Coventry), Mr. John Leo (an employee of the Rhode Island Department of Environmental Management who investigated the incident when canisters of UDMH were found previously at the Foster site), and to the Rhode Island National Guard (who had uncovered canisters at North Smithfield). During follow-on discussions conducted with these sources, it became apparent that the most likely burial areas at North Smithfield and Foster would be in the open field opposite the launcher batteries, between A and B batteries, and near the fence. This information was confirmed by the previous finds of UDMH canisters in this area at both sites. Therefore, the search area for North Smithfield and Foster (see Figures 10 and 11) was defined as an area approximately 400 feet long (measured along the fence opposite A and B batteries), and 150 feet deep (measured from the fence into the open field).

The major source of burial information on the Coventry Site was Mr. Bestwick. He visited the site several times with USATHAMA personnel, and specified two search areas; one, where he personally buried canisters while in the Army, and the other, where an unidentified friend reported having seen canisters buried while he (the friend) was stationed there in the National Guard. These two areas are shown on Figure 12.

IX. DEPTH OF SEARCH:

Canisters which were found at North Smithfield and at Foster were located within 2 feet of the ground surface. In addition, Mr. Bestwick stated that canisters which he had buried were within 1-2 feet of the ground surface. From this information, it was determined that a search depth of 3 feet would be used; this provided a 1-foot "margin of safety" below the maximum expected burial depth of 2 feet.

X. DESCRIPTION OF SURVEY PROCEDURE:

The use of ground penetrating radar during the survey of the Bristol Nike Site demonstrated that this was not a cost-effective search tool for surveys in areas containing large numbers of rocks. Since the geology report (Appendix A) predicted the presence of rocky till throughout the remaining sites, it was decided that the most effective search technique would be to visually examine the dirt as it was removed from the area. Surveys were conducted with bulldozers, and where applicable, supplemented by metal detectors. The bulldozer survey was conducted by having the bulldozer remove the soil in 6-inch "slices" until the desired 3-foot depth was reached. During each "slice", observers (one on either side of the dozer blade) walked along with the blade to watch for canisters. When a canister was found, all personnel immediately evacuated upwind to await USATEU personnel. All removal operations were conducted by USATEU. The soil was removed throughout the target area(s) until a minimum depth of 3 feet was reached throughout the area. At the Foster site, many very large boulders had to be removed from the search area by the ripper on the back of one dozer before the actual search could begin.

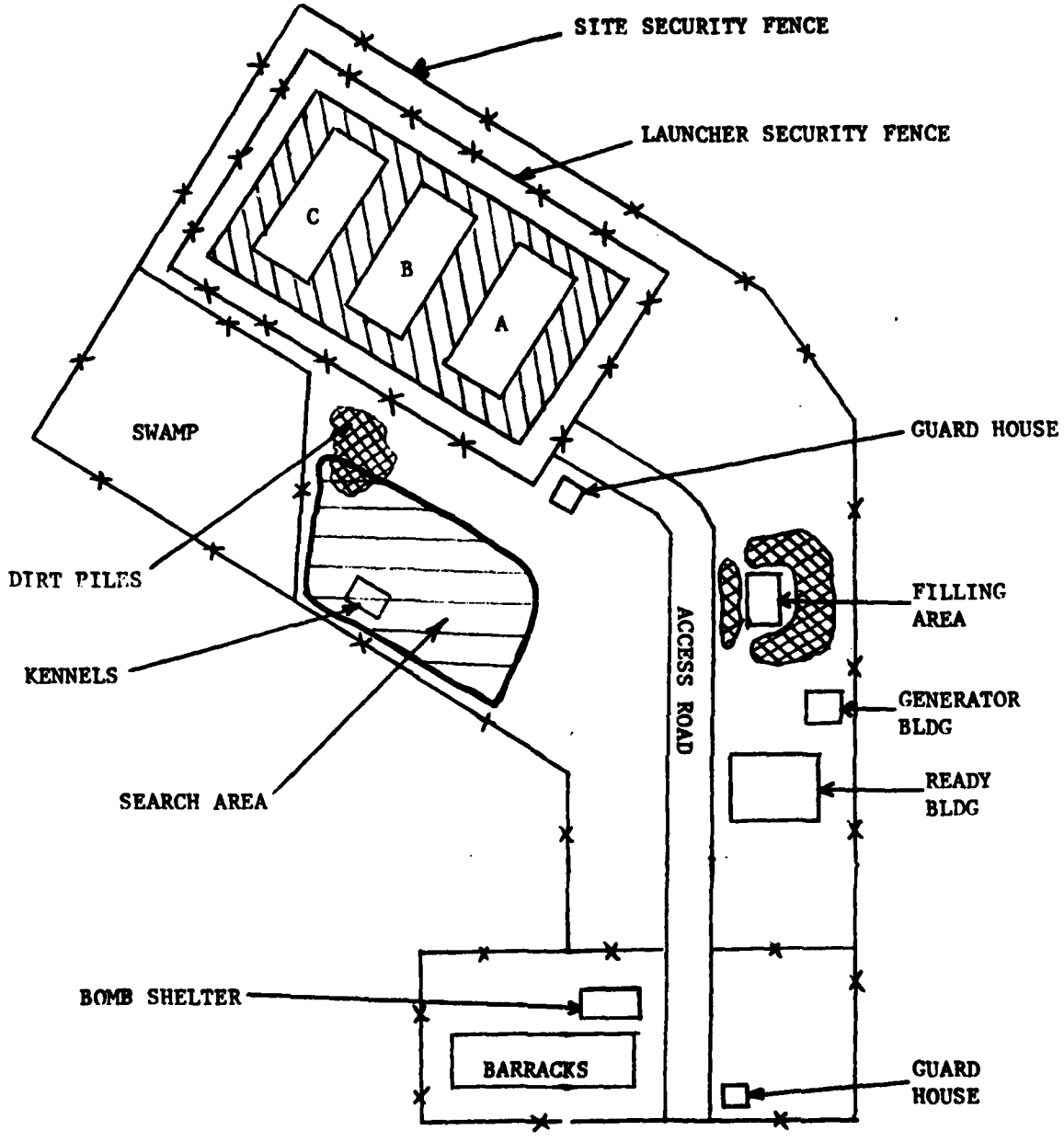


FIG. 10. NORTH SMITHFIELD LAUNCHER SITE

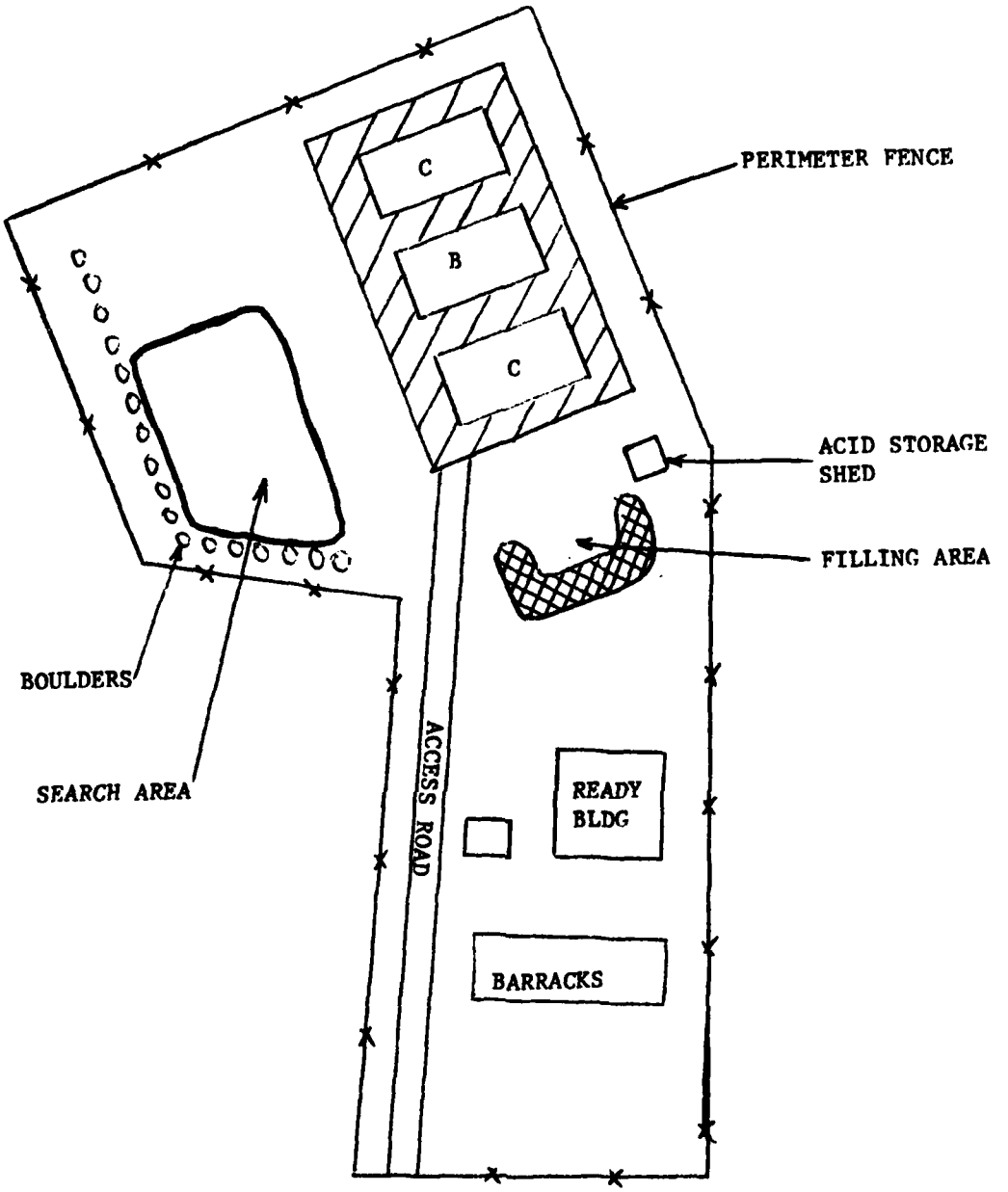


FIGURE 11. FOSTER LAUNCHER SITE

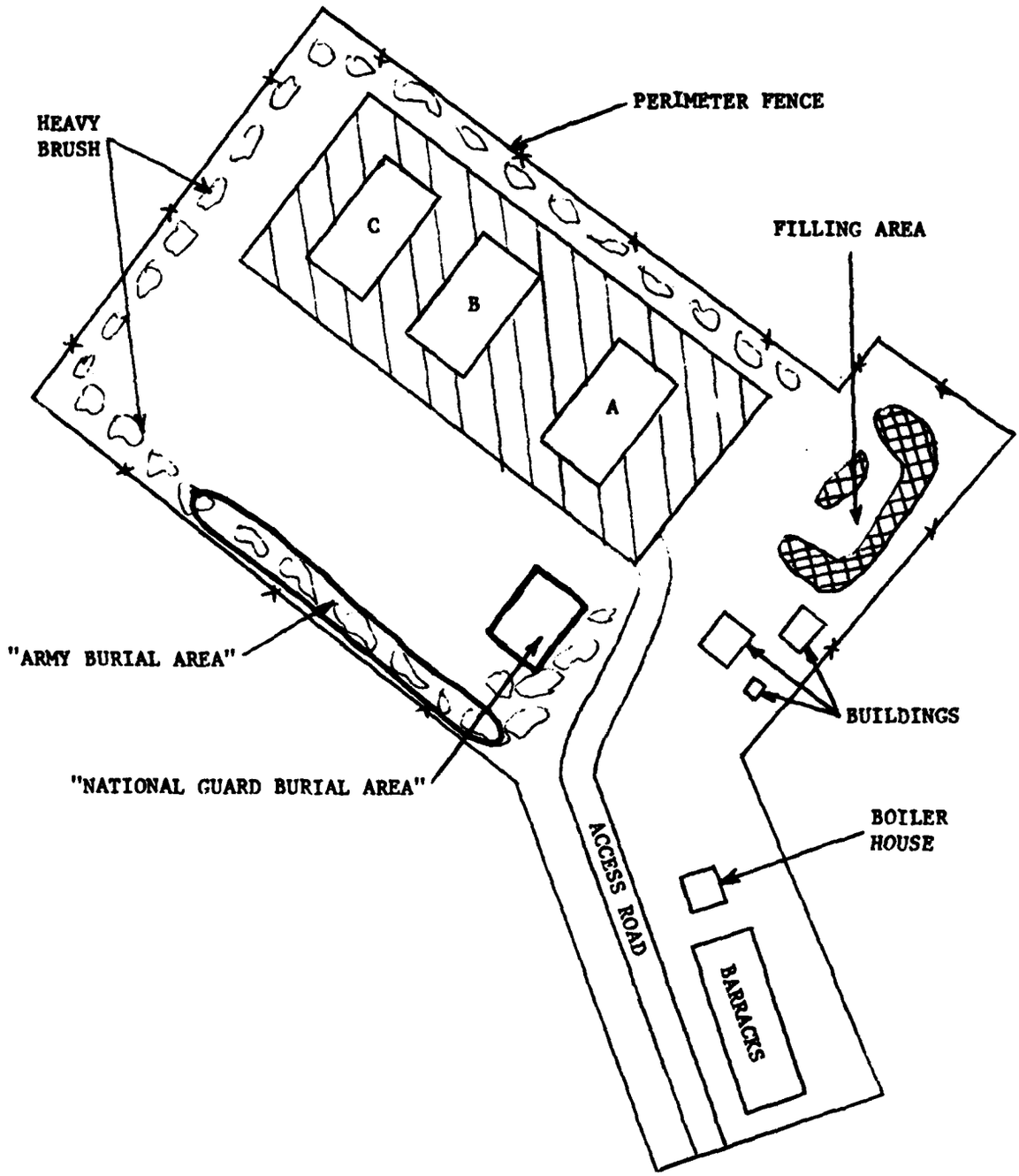


FIGURE 12. COVENTRY LAUNCHER SITE

XI. DESCRIPTION OF INCINERATION PROCEDURE:

The first step was to vent the air from the UDMH canisters to permit any pressurized air/vapor to escape. Venting was accomplished by inserting a puncture needle salvaged from an old set of UDMH filling tubes into the rubber septum of the canister. The septum was then removed and the canister's contents poured into the burn tank. The burn tank, made of Monel to prevent reaction with the UDMH, was located in a 25-foot radius zone clear of all rust and combustibles. (It should be noted that rust acts as an instantaneous oxidizer of UDMH and will, therefore, ignite any UDMH it contacts.) After the can was emptied, it too was placed into the burn tank. The fluid was ignited remotely by the simultaneous dumping of HTH into the fluid and the ignition of an electric squib, which was inside the tank in a small plastic bag, surrounded by smokeless powder. The HTH was used in addition to the squib since UDMH will not ignite from a flame source when it is diluted by more than 30 percent V/V of water (reference 3). HTH will react with UDMH even in very dilute solutions (reference 4). This combined disposal method, therefore, assured that all UDMH present would be incinerated. This emergency onsite disposal procedure was coordinated with the Rhode Island Department of Environmental Management and the Rhode Island State Fire Marshall's Office.

All UDMH canisters recovery and disposal operations were conducted by USATEU personnel utilizing Scott® positive-pressure airpacks and level B agent suits.

XII. SURVEY OF NORTH SMITHFIELD:

The first site investigated was North Smithfield. Prior to any actual survey work, many large dirt piles had to be removed from the search area. The dirt was reportedly topsoil from the excavation for a foundation of a new building installed approximately 5 years ago.

The search began with the incremental digging of a 3-foot deep trench immediately adjacent to the fence. Remaining passes were conducted perpendicular to the fence. A total of three canisters and one set of filling hoses were found, all near the kennel area. (This is the same area where other containers had been uncovered previously.) One can was olive drab, two were silver. Cans were collected in a covered barrel of water to await disposal. As an extra precaution, the kennel area was dug down to a total of nearly 5 feet. When the survey was complete, the cans were disposed of by incineration. They burned for approximately 4 minutes, with a intense yellow-orange flame which indicated the presence of UDMH. The site was then backbladed approximately level.

XIII. SURVEY OF FOSTER:

The next site investigated was Foster. Unlike the North Smithfield search area, the Foster area contained many large boulders (several feet in diameter) at all depths, and was surrounded on two sides (along the fence) by equally large or larger surface boulders, many of which were too large to be handled by the bulldozers. It was, therefore, decided that the search of the area between the fence and the surface boulders would be done by metal detector. Numerous "hits" were encountered. All targets were nails and other small metal scraps.

Before the search of the field could begin, the larger boulders had to be removed with the ripper on the back of one dozer. This removed all boulders greater than 3 feet in diameter. The incremental search (with the blade) was then conducted to an average depth of at least 3 feet. One silver UDMH canister was found between A and B batteries, approximately 45 feet from the fence. It had no cork, liquid, or odor, and was, therefore, considered inert. Finally, the site was backbladed; the backblading met with limited success due to the remaining boulders strewn throughout the field.

XIV. SURVEY OF COVENTRY:

The final site investigated was Coventry. The first area searched was the supposed "National Guard Burial Area," located at one edge of the open field. An additional, diagonal trench was dug in this area to a total depth of about 6 feet, and an additional shallow trench dug behind the area. No cans were found in these additional trenches. No metal targets could be found in the excavating. The search of the supposed "Army Burial Area" (along the fence) yielded two shiny aluminum cans, found together directly opposite B launcher. One can was full of liquid and the other was empty. The full can was incinerated and produced the characteristic, intense orange-yellow flame.

The site was also visited by Mr. Lee Ferguson, who claimed to have been present during the removal of the Nike Ajax missiles and to have knowledge of additional UDMH burial areas. Although he did not witness any actual burials, he "had a feeling" that they had been buried in both the berm sheltering the missile fueling area and near the acid fuel storage area. This seemed illogical, however, considering the safety hazard this would present by having unprotected fuel canisters in areas where they could come into contact with nitric acid, which could cause a fire/explosion. However, the area was checked with metal detectors, and the dozer was used to cut a swatch out of the outside edge of the berm and adjacent to the acid fuel storge areas. No canisters were found.

XV. CONCLUSIONS:

The launcher sites at North Smithfield, Foster, and Coventry have been thoroughly checked. All canisters found were successfully disposed of. The sites are considered clear of buried UDMH canisters, and no additional work is recommended. This completes the investigations of all Rhode Island Nike launcher areas.

APPENDIX A

NIKE SITE GEOLOGY

NIKE SITE GEOLOGY

Nike Site	Quad Reference	Surficial Soil Description	Depth to Rock & Type	Depth to Water
Bristol PR 38	Bristol	Glacial Deposits: ground moraine unstratified and poorly sorted sand, gravel, boulders with minor clay, local small lenses of stratified sand and gravel	40'± Granite gneiss	10-20'
Davisville PR 58	East Greenwich and Wickford	Glacial Deposits for East Greenwich: ground moraine of variable thickness; sand, gravel and cobbles with 20%± fines, scattered lenses of sand and gravel, many boulders on surface Wickford: Outwash of sand and gravel with interbedded fine sand, silt and clay	10-20'± Sandstone, shale, conglomerate and meta-anthracite with biotite and minor amount of magnetite <10-30'±	Unknown, although some wells do exist in moraine <5-20'± Average depth to water 14'; may locally contain excessive iron and manganese
Coventry PR 69	Coventry Center and Crompton	Glacial Deposits: ground moraine of sand, gravel, cobbles and boulders with 20%± fines, scattered lenses of sand and gravel	10-20'± Granite gneiss (for launcher site)	6'± (perched) (for launcher site)
Foster PR 79	Clayville	Glacial Deposits: till with boulders, gravel, sand, silt and clay forming a discontinuous mantle over the bedrock, 17'± average thickness	10-30'± Unknown type	1-26' Average depth: 11'; water low in iron in overburden, high in iron in bedrock

NIKE SITE GEOLOGY (CONT)

Nike Site	Quad Reference	Surficial Soil Description	Depth to Rock & Type	Depth to Water
North Smithfield PR 99	Georgiaville	Glacial Deposits: Northern Portion: kame terrace and plain of sand, gravel, and cobbles Black Plain Hill: ground moraine of sand with some gravel and, where bedrock is near, rock fragments, 10-15' thick, overlies lower till, bedrock, or glaciofluvial deposits	Unknown depth Northern Portion: granite Black Plain Hill: feldspathic quartz-biotite schist with 1-3% biotite and traces of magnetite	Unknown

APPENDIX B

EQUIPMENT AND MATERIAL REQUIRED FOR JOB COMPLETION

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Equipment and material required for these surveys fit into two categories: search equipment and removal/incineration equipment.

Search Equipment:

Earth-moving equipment included shovels for careful hand excavation of selected areas and two bulldozers, one equipped with a ripper for removal of large boulders, and the other equipped with a winch. Although the winch was not used during these surveys, it could be useful for assisting in the recovery of any vehicles which become mired in sand/mud.

Army PSS-11 metal detectors were used both to search areas the dozer was unable to work and to investigate specific areas of interest.

Because of the difficulty the dozer operator had in watching for hand signals from the observers accompanying him, and the impossibility of oral communication, a good-quality bullhorn was employed to communicate with the operators.

All observers and operators wore coveralls, boots and gloves to protect against possible UDMH splashes, and carried M17 masks in case respiratory protection was required. It should be noted that M17's are not rated for ammonia-type chemicals, such as UDMH, and were carried only for minimal, emergency protection.

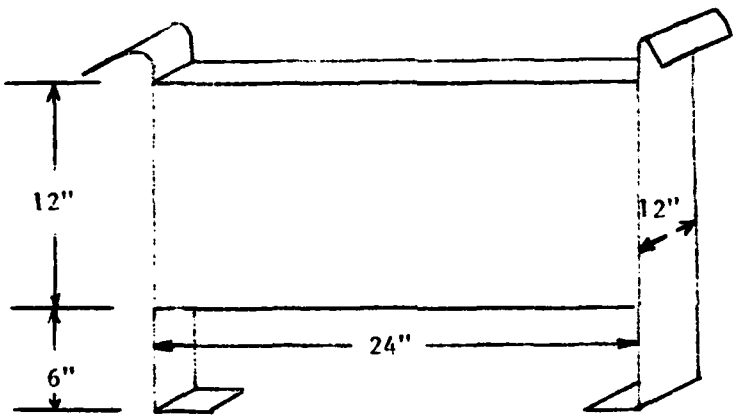
Removal/Incineration Equipment:

All personnel participating in the removal or disposal of the canisters wore level B protective clothing, including agent hoods, and positive-pressure Scott® airpacks.

All canisters awaiting disposal were kept in a water-filled drum. Local water supplies were available at North Smithfield and Foster, but a "water buffalo" holding approximately 300 gallons of water was trucked to the Coventry site. Immediately available water supplies were required for emergency washdown of personnel and equipment, to neutralize small UDMH spills that could have occurred during the search, and for very limited fire containment, should an accident allow the fire to spread beyond the burn tank.

Since Monel is one of the few metals compatible with burning UDMH, it was used to fabricate the burn tank, (see Figure 13). Two tanks were fabricated because it was possible that large numbers of canisters could be found which would require destruction. For safety reasons, it was planned to incinerate no more than 15 canisters at once, and it was anticipated that at least an hour would be required for the tank to cool to approximately ambient temperatures. (A hot tank could ignite the UDMH or its vapors as the next batch was being emptied into it.) The two tanks were, therefore, planned as alternates to each other so that while one was in use, the other would be cooling down.

Dumping of the HTH into the tank required a small Pyrex flask attached to a swivel holder on the side of the tank, which, in turn was connected to a 100 foot sash cord for remote dumping. Squib ignition was accomplished by placing the electic squib inside a small ziploc bag containing smokeless powder. The bag was attached to the side of the tank with duct tape. The squib was remotely fired.



NOTE: All dimensions are approximate. Edges and corners rounded to prevent snagging of protective clothing.

FIGURE 13. SIDE VIEW OF MONEL BURN TANK

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