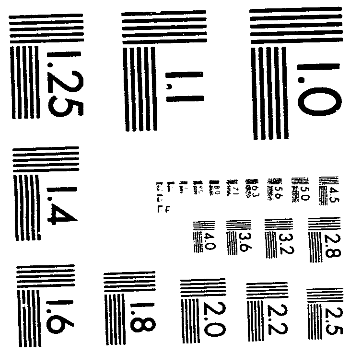
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0

ARGONNE NATIONAL LABORATORY
9700 South Cass Avenue, Argonne, Illinois 60439

Preliminary Assessment Report for Virginia Army National Guard Army Aviation Support Facility, Richmond International Airport, Installation 51230, Sandston, Virginia

Prepared for

National Guard Bureau, Army Directorate
Aberdeen, Maryland

September 1993

Prepared by

Applied Geosciences and Environmental Management Section
Environmental Research Division
Argonne National Laboratory

REPORT DOCUMENTATION PAGE		FORM APPROVED OMB No. 0704-0188
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302 and to the Office of Management and Budget, Paperwork Reduction Project (0704-01880), Washington, DC 20503.		
1. AGENCY USE ONLY (Leave Blank)	2. REPORT DATE September 1993	3. REPORT TYPE AND DATES COVERED Preliminary site visit to complete assessment.
4. TITLE AND SUBTITLE Preliminary Assessment Report for Virginia Army National Guard Army Aviation Support Facility, Richmond International Airport, Installation 51230, Sandston, Virginia		5. FUNDING NUMBERS MIPR-3788 MIPR-4188
6. AUTHOR(S) Clyde B. Dennis		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Candace M. Rose Argonne National Laboratory 9700 South Cass Avenue Argonne, IL 60439		8. PERFORMING ORGANIZATION REPORT NUMBER None
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) National Guard Bureau Army Directorate Aberdeen, MD 21010-5420		10. SPONSORING/ MONITORING AGENCY REPORT NUMBER IR-CR-93086
11. SUPPLEMENTARY NOTES None.		
12a. DISTRIBUTION/AVAILABILITY Distribution is to government agencies only. Outside requests must be made to the National Guard Bureau.		12b. DISTRIBUTION CODE
13. ABSTRACT (MAXIMUM 200 WORDS) This report addresses the information necessary to complete the PA.		
14. SUBJECT TERMS		15. NUMBER OF PAGES PA-72
		16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS REPORT	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

Contents

Contents (Cont.)

Figures

Figures (Cont.)

Tables

Notation

AASF	Army Aviation Support Facility
AST	aboveground storage tank
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COR	City of Richmond
CRAC	Capital Regional Airport Commission
DACS	Department of Agriculture and Consumer Services
DCR	Department of Conservation and Recreation
DGIF	Department of Game and Inland Fisheries
DOA	Department of the Army
EPA	U.S. Environmental Protection Agency
ESO	environmentally significant operation
FISP	Facility Inventory and Stationing Plan
gpm	gallons per minute
IPR	Installation Restoration Program
JP-4	jet fuel
MOGAS	gasoline
NGB	National Guard Bureau
OMS	Organizational Maintenance Shop
PA	preliminary assessment
ppm	parts per million
STI	Science & Technology, Inc.
UL	Underwriters Laboratory
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
UST	underground storage tank
VaANG	Virginia Air National Guard
VaARNG	Virginia Army National Guard
VDEQ	Virginia Department of Environmental Quality
VDMA	Virginia Department of Military Affairs
VDMR	Virginia Division of Mineral Resources
VGS	Virginia Geotechnical Services

Preliminary Assessment Report for Virginia Army National Guard Army Aviation Support Facility, Richmond International Airport, Installation 51230, Sandston, Virginia

Summary

This report presents the results of the preliminary assessment (PA) conducted by Argonne National Laboratory at the Virginia Army National Guard (VaARNG) property in Sandston, Virginia. The Army Aviation Support Facility (AASF) is contiguous with the Richmond International Airport. Preliminary assessments of federal facilities are being conducted to compile the information necessary for completing preremedial activities and to provide a basis for establishing corrective actions in response to releases of hazardous substances. The PA is designed to characterize the site accurately and determine the need for further action by examining site activities, quantities of hazardous substances present, and potential pathways by which contamination could affect public health and the environment. This PA satisfies, for the VaARNG property, the requirements of the Department of Defense Installation Restoration Program (IRP).

The AASF, originally constructed as an active Air Force interceptor base, provides maintenance support for VaARNG aircraft. Hazardous materials used and stored at the facility include JP-4 jet fuel, diesel fuel, gasoline, liquid propane gas, heating oil, and motor oil. Total storage capacity for these materials is approximately 73,000 gal. The jet fuel tank farm in the southern portion of the property is the location of the largest storage tanks. Two 25,000-gal aboveground tanks within an earthen, asphalt-covered berm contain JP-4 (jet fuel). Adjacent to the JP-4 fuel farm are two 5,000-gal tanks for diesel fuel and gasoline. These tanks and associated dispensing pumps are within metal containment basins. North of the fuel farm in the aircraft maintenance area, heating oil is stored in two underground storage tanks of 2,000-gal and 5,000-gal capacity. These tanks are of double-wall construction with automatic leak detection systems. Propane is stored in five 1,000-gal aboveground storage tanks.

Other measures are in place to reduce the potential for release and migration of hazardous materials away from the property. Drainage from the maintenance hangar, the aircraft/vehicle wash areas, and the aircraft and vehicle fuel areas flows through oil-water separators before it enters the sanitary sewer system. Motor oil and solvents are recycled or disposed of by private contractors. Cleanup procedures for inadvertent fuel or oil spills are defined in the site's *Spill Prevention Control and Countermeasure Plan.*

The review of both historical and current practices at the property indicated that containment measures already in place for the majority of the fuel and oil used at the facility are satisfactory and that activities at the AASF pose minimal risk to human health or the environment. Therefore, no further IRP action is considered necessary at this property.

1 Introduction

This document is a report of the preliminary assessment (PA) conducted by Argonne National Laboratory at the Virginia Army National Guard (VaARNG) Army Aviation Support Facility (AASF), located in Sandston, Virginia.

1.1 Authority for the Preliminary Assessment

The National Guard Bureau, Army Directorate, has engaged Argonne to perform PAs of selected National Guard properties. These assessments are being done in a manner consistent with both the Department of Defense Installation Restoration Program (IRP) and the U.S. Environmental Protection Agency's (EPA's) Potential Hazardous Waste Site Preliminary Assessment Guidance. Preliminary assessments of National Guard properties are conducted under the authority and direction of the IRP; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or, more commonly, Superfund); and the Superfund Amendments and Reauthorization Act of 1986 (Public Law 99-499).

1.2 Objectives

This PA report is based on existing information from the National Guard records that were made available to Argonne investigators and from other sources. Although this PA effort did not extend to the generation of new data, it nonetheless identifies areas where existing data are incomplete, unreliable, or ambiguous and recommends ways to address such shortcomings.

The objectives of the PA are to satisfy the requirements of the IRP and to

- Identify and characterize the environmentally significant operations (ESOs),
- Identify property areas or ESOs that may require a site investigation,
- Identify ESOs or areas of environmental contamination that may require immediate removal,

- Identify properties for which no further action is needed, and

- Provide information sufficient to prescore the site with the EPA's PA Scoresheets (September 1991).

1.3 Procedures

The PA began with a review of ARNG files located at the Virginia Division of Military Affairs Headquarters in Richmond, Virginia, on June 28, 1993. A site visit was conducted on June 29 to obtain additional information through direct observation and interviews with personnel familiar with the property and its operations (Dennis 1993). Through publications, correspondence, and interviews with agency officials, information relevant to the site assessment was obtained from several federal, state, and local agencies, including the U.S. Geological Survey (USGS), the U.S. Department of Agriculture (USDA) Soil Conservation Service, the Virginia Department of Environmental Quality, and the Capital Region Airport Commission (CRAC).

1.4 Report Format

This PA report presents a summary and evaluation of the data relevant to the PA for this property. Section 2 describes the property and its surrounding environment and land uses. Section 3 identifies and characterizes the ESOs at the site. Section 4 discusses known and suspected releases to the environment, and Section 5 discusses potential human and environmental receptors for such releases. Section 6 summarizes the findings and conclusions, discusses the quality and reliability of the supporting information, identifies areas requiring further action, and (as appropriate) suggests how such actions can be accomplished. Section 7 lists pertinent materials reviewed. The Appendix gives interview information.

2 Property Characterization

2.1 General Property Information

The AASF is located in the eastern portion of the Commonwealth of Virginia, in Henrico County. The city of Richmond, the state capital, is located approximately 5 mi west of the site. The small town of Sandston is approximately 1 mi north of the site. The federally leased property, owned by the Capital Regional Airport Commission and licensed to the VaARNG for military training, comprises 91.5 acres (CRAC 1984). The VaARNG property is contiguous with Richmond International Airport to the north and west. Major access routes to the AASF are Interstate Highway 64 and Virginia highways 60 and 33. Figure 1 shows the general location of the property, and Table 1 lists pertinent information about it.

2.2 Description of Facilities

The AASF is an aviation training facility for National Guard units located in Virginia, including its tenant organizations, Detachment 4 of HHC headquarters; Company A, Company B, and Company D of the 2nd Battalion, 224th Aviation; Detachment 1 of Company D of the 1st Battalion, 132nd Aviation; RAID Virginia (drug interdiction); and Detachment 1 of the 986th Medical Company (VDMA 1989). Training activities for the approximately 420 authorized personnel include the direction of crew member training and the operation of flight and ground school instruction emphasizing flight standardization, aircraft maintenance, and ground support operations. National Guard aviation safety, aviation life support, and fire and crash rescue programs are administered and maintained at the AASF. No fire and crash rescue burn pit is located on the VaARNG property (Williams 1993b). Maintenance support for military aircraft assigned to the facility is provided through the AASF. Figure 2 is a site plan of the AASF.

2.2.1 Aircraft Support

Building 3990, constructed in 1975, is the primary maintenance support facility for the AASF (NGB 1988). Operations in and around the 38,170-ft^2 hangar and adjacent support buildings include maintenance, washing, fueling, and technical inspection of the rotary and fixed-

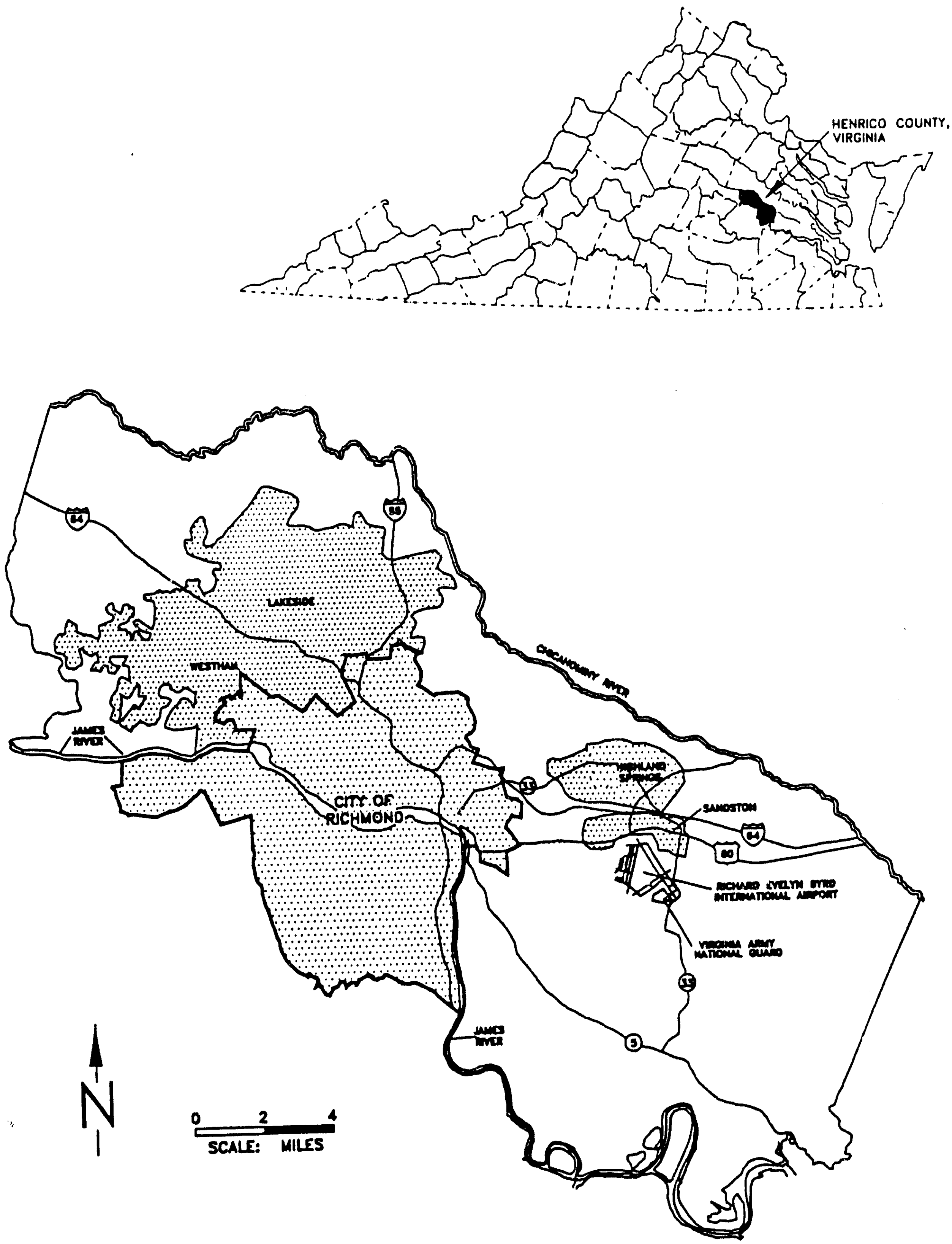

FIGURE 1 General Location of the Army Aviation Support Facility (Source: Adapted from USGS 1983)

TABLE 1 Identifying Information for the Army Aviation Support Facility

Installation address	Virginia Army National Guard Army Aviation Support Facility 700 Portugee Road Sandston, Virginia 23150-5050
Geographic location	
Latitude	37^{o} 27' N
Longitude	77^{o} 18' W
FISP[a] installation number	51230
Commander	Col. James D. Holden
Type of facility	Army Aviation Support Facility
License information	Owned by the Capital Regional Airport Commission, leased to the U.S. Army Corps of Engineers, licensed to the Commonwealth of Virginia
Principal contact	Col. James D. Holden (804) 236-7301

[a] Facility Inventory and Stationing Plan.

wing aircraft assigned to the facility. The aircraft inventory includes UH1 utility helicopters (29), UH60 utility helicopters (15), OH58 observation helicopters (7), and one C12 transport plane (VDMA 1989). Maintenance activities include fluid changes (e.g., oil, transmission fluid, and antifreeze); filter changes; brake repair; lubrication, greasing, and repair of axles and drive trains; engine repair and cleaning; body repair; welding; and minor spot painting.

Building 3990 is constructed of concrete blocks with joists. Four work bays are located in the main work area of the hangar. Drainage from the bays enters two trench drains running the length of the work area. Waste water is directed through an oil-water separator before it enters the sanitary sewer. Building 3990 also includes mechanical, electronic, and allied shops for the designated maintenance and inspection activities.

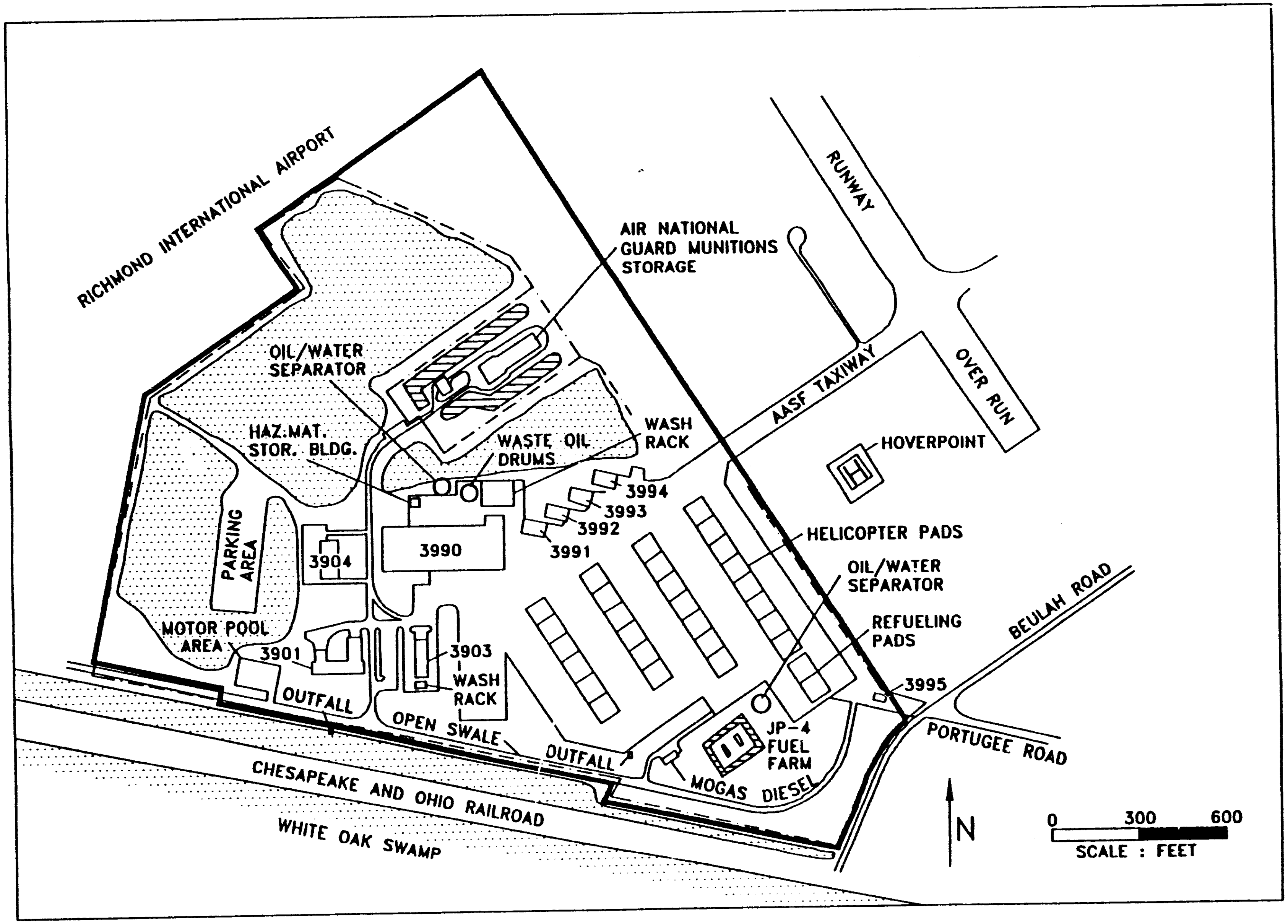

FIGURE 2 Layout of the Army Aviation Support Facility (Source: Adapted from VDMA 1992b)

2.2.2 Warehousing

Facility warehousing is available in four buildings numbered 3991-3994. These buildings were originally constructed in the mid 1960s for use by the U.S. Air Force as alert hangars for interceptor aircraft. Each structure is of metal construction on a concrete slab, with ceilings approximately 25 ft high and 4,000 ft^2 of interior floor space. Various materials and equipment, none of which is of a hazardous nature, are stored in these unheated structures.

2.2.3 Fuel Storage

Fuel stored and used at the AASF includes jet fuel (JP-4) for aircraft, diesel fuel for use in vehicles assigned to the units and to power an emergency generator, and gasoline for use in vehicles and grounds keeping equipment. Building and space heating needs are supplied by propane and heating oil. Fuel storage at the AASF is summarized in Table 2.

The JP-4 fuel farm is in the southern portion of the property. Two 25,000-gal aboveground storage tanks (ASTs) containing JP-4, numbered 3996 and 3997, are surrounded by an earthen berm (VDMA 1993). The sides of the berm, 3.5 ft in height, are covered with asphalt. A transfer station to refill the fuel farm tanks and also a fuel dispensing line to aircraft are located adjacent to the fuel farm. Near the fuel farm are two 5,000-gal ASTs containing diesel fuel and MOGAS (gasoline) for vehicles assigned to the unit. These tanks and the dispensing equipment are within metal containment basins.

Liquefied gas (propane) and fuel oil No. 2 and No. 5 are used for space and water heating at the AASF. Propane storage is provided by five 1,000-gal ASTs located north of Building 3904 and a single 100-gal AST at Building 3903. Building 3903 also uses a 550-gal underground storage tank (UST) for No. 2 fuel oil. To the south of Building 3901 is a 5,000-gal UST for fuel oil No. 5, as well as a 2,000-gal UST for fuel oil No. 2. A 550-gal UST adjacent to Building 3990 contains diesel fuel to supply an emergency generator (Scott 1992a).

A detailed description of fuel storage and dispensing locations is provided in Section 3.1.

TABLE 2 Fuel Storage at the Army Aviation Support Facility

Fuel	Number of Tanks	Storage Capacity[b] (gal)	Tank Type	Location
JP-4[a]	2	25,000	AST	Fuel farm
Gasoline	1	5,000	AST	Fuel farm
Diesel fuel	1	5,000	AST	Fuel farm
Propane	5	1,000	AST	Building 3904
Propane	1	100	AST	Building 3903
Fuel Oil No. 2	1	2,000	UST	Building 3901
Fuel Oil No. 2	1	550	UST	Building 3903
Fuel Oil No. 5	1	5,000	UST	Building 3901
Diesel fuel	1	550	UST	Building 3990

[a] Three 1,200-gal fuel tanker trucks are also available to transport JP-4.

[b] Total capacity is 73,200 gal.

2.2.4 Ground Support

Originally constructed in 1966 by the U.S. Air Force, Building 3903 is a 4,819-ft^2 prefabricated metal building on a concrete slab foundation (NGB 1988). Presently, the VaARNG uses this structure for ground support activities, including armory unit storage, physical plant maintenance, and security operations.

2.2.5 Administration and Security

Two structures support administrative functions: Building 3901 and Building 3904. Building 3901, constructed in 1966, is a 19,778-ft^2 wood-framed structure that houses tenant units. Building 3904, constructed in 1974, is a 3,867-ft^2 concrete block structure that houses the AASF administration along with flight operations for the facility. Temporary trailers provide additional administrative office space.

Building 3995 is a 35-ft^2 wood-framed structure housing the guard located at the main gate on Beulah and Portugee roads. The AASF is surrounded by a 6-ft-high chain-link fence, and the entrance gate is staffed continually. The fuel farm is surrounded by an 8-ft-high chain-link fence topped with three strands of barbed wire. Vandalism is deterred at the fuel storage area by locking the pump controls and by maintaining nighttime illumination and frequent patrols. Television cameras survey the area, and the fence was installed with vibration detection sensors.

2.2.6 Utilities

Two major utilities provide the majority of services supplied to the AASF. The CRAC maintains water and sewer service within the airport development area. Water service is provided via an 8-in. main running south from the airport property to the AASF. Building 3902, a 35-ft^2 concrete block structure on a slab, constructed in 1966, is the sewage collection station for the AASF, housing pumps feeding the 6-in. sewer main running north along Beulah Road. Electric power, supplied to the AASF by Virginia Power, is distributed throughout the site mainly via overhead lines with pole-mounted transformers.

Solid waste is collected on the site in dumpsters that are emptied on a regular schedule under contract to Browning Ferris Industries (VDMA 1992b).

2.2.7 Ammunition Storage

The Virginia Air National Guard maintains and operates a munitions storage facility within the AASF boundary. This storage facility is composed of a single row of back-to-back concrete cubicles, separated and covered with earth. Continuous earthen berms face each row of doorways. Access is controlled by an 8-ft chain-link fence surrounding the facility. This facility is not considered as a part of this PA.

2.3 Property History

In July 1942, the federal government leased from the Commonwealth of Virginia approximately 1,278 acres of land in Henrico County for the development of the Richmond Army Air Base. Except for the small Richard E. Byrd Flying Field, the region was generally undeveloped, rural, and wooded. After World War II, most of this property was declared excess to military needs and conveyed at no cost to the city of Richmond, Virginia, via a quit-claim deed dated July 1, 1947. The federal government retained the use of portions of the property to meet the nation's military requirements.

Approximately 81 acres of land were leased from the city of Richmond to the U.S. Army on July 1, 1964, for the construction of an active U.S. Air Force interceptor base (COR 1964). Construction for the airbase, including hangars, support buildings, utilities, taxiways, and an ammunition storage facility, makes up a large part of the existing AASF. Terms of the agreement specified the right of annual renewal of the lease until June 30, 1994. In 1967, the amount of property leased was increased to approximately 93 acres (COR 1967). A supplemental lease agreement in 1972 permitted the use of helicopters at the facility (COR 1972).

In the early 1970s the Air Force abandoned the site, and in the mid 1970s the U.S. Department of the Army leased the 93-acre property (License No. DACA65-3-81-15) to the Commonwealth of Virginia for use by the Army and Air National Guard (DOA 1980). The Commonwealth assigned the 6.2-acre ammunition storage facility to the Air National Guard, whose operations are located on property north of the AASF, and the remainder of the acreage and facilities to the Army National Guard. In 1974-1975, the aircraft maintenance hangar and operations building were constructed. In 1984 the amount of property covered in the lease agreement between the city of Richmond's CRAC and the U.S. Department of the Army (supplemental lease agreement No. 3) was decreased to 91.5 acres when land parcels were exchanged to allow construction of a new taxiway at Richmond International Airport (CRAC 1984). The license agreement between the U.S. Department of the Army and the Virginia Army and Air National Guard was subsequently modified (DOA 1985a) and renewed as License No. DACA65-3-85-58 to reflect the property changes (DOA 1985b).

To support the growing role of Army National Guard aviation, the VaARNG continued its renovation of the former interceptor base into a rotary-wing installation. Most notable was the construction of the 38,170-ft^2 maintenance hanger and associated aircraft hover lanes, taxiways, and pads (DOA 1987). Action has been initiated to extend lease DA-44-110-ENG-5654 for an additional 30 years beyond June 30, 1994, to June 30, 2024 (DOA 1989).

2.4 Permitting Status

The AASF installation has no ESOs requiring permits under the Resource Conservation and Recovery Act, and no ESOs are designated for CERCLA activities. Underground storage tanks are registered with the Virginia Department of Environmental Quality (VDEQ), formerly the Water Control Board (Scott 1992a). Storm water discharge from the Richmond International Airport is regulated by the VDEQ, and the AASF, as a tenant of the airport, is governed by the permit issued to that facility (Dale 1991). A *Spill Prevention Control and Countermeasure Plan* has been developed for the AASF, and an *Oil Discharge Contingency Plan* for the facility has been filed with the VDEQ (Queisser 1992).

2.5 Surrounding Environment and Land Use

2.5.1 Demographics and Land Use

The AASF is located near the southeastern corner of the Richmond International Airport in eastern Henrico County. A taxiway connects the tarmac of the AASF to the runways of the airport. Northeast of the AASF is the site (approximately 5 acres) of the VaARNG Organizational Maintenance Shop 1 (OMS 1) and OMS 2. North of the AASF, and sharing the airport facilities, is a 137-acre Air National Guard facility. Figure 3 identifies the AASF boundary and adjacent properties.

The independent city of Richmond (population 203,056) is approximately 5 mi west of the airport (Rand McNally 1992). The towns of Sandston (population 3,630) and Highland Springs (population 4,230) are adjacent to the airport to the north (Rand McNally 1992). The area around the airport to the west and north can be characterized as urban residential and commercial. The area south and east of the airport and the VaARNG property (most of eastern Henrico County) is rural with a few scattered residences.

Along the southern border of the AASF and running east-west are Portugee Road and the Chesapeake and Ohio Railroad. These transportation corridors separate the AASF from the White Oak Swamp, which is an undeveloped natural area forming the central portion of eastern Henrico County. White Oak Swamp Creek drains the swamp to the east.

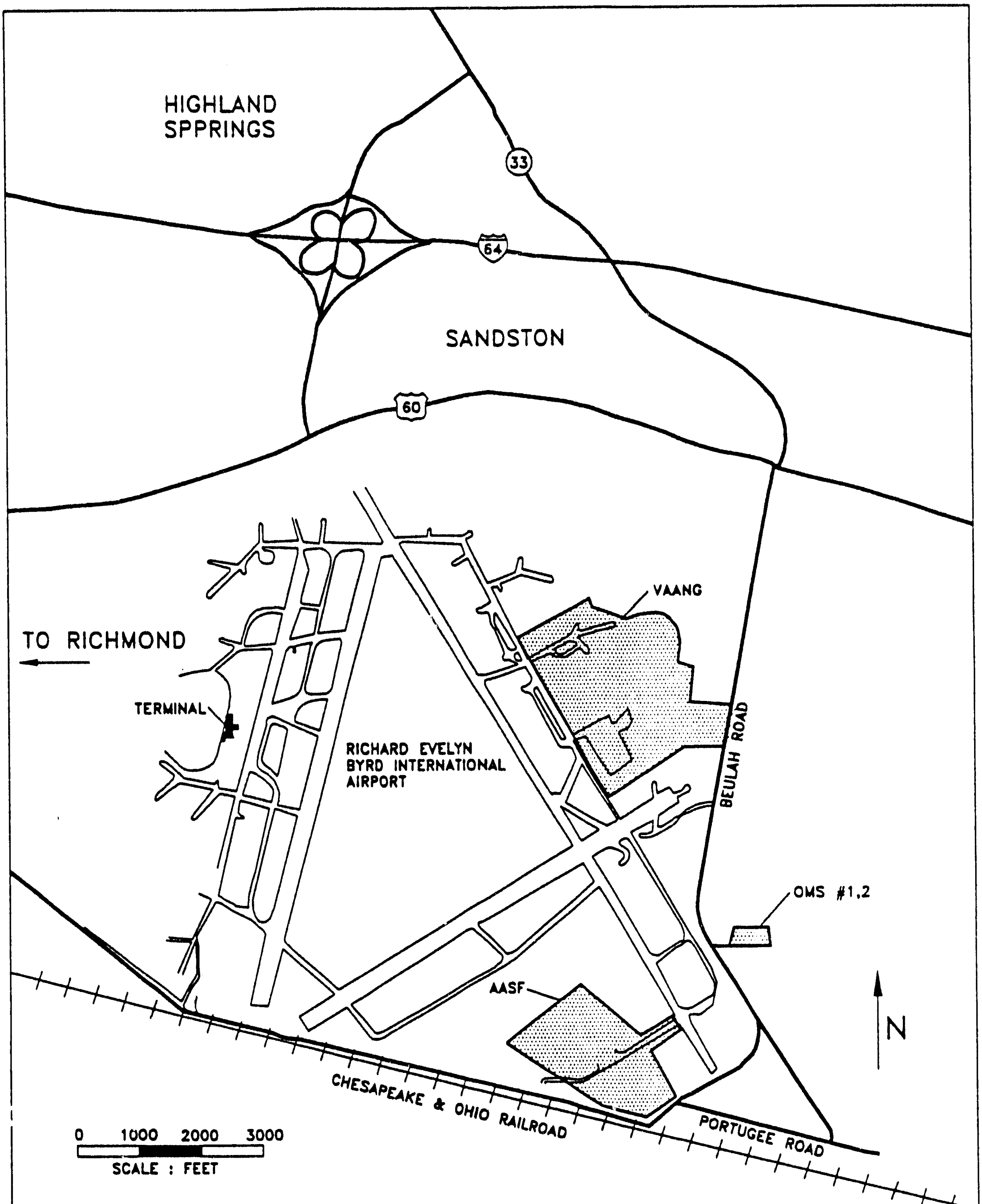

FIGURE 3 Vicinity of the Army Aviation Support Facility (Source: Adapted from USGS 1983)

2.5.2 Climate

The climate of east-central Virginia is temperate with moderately warm summers, relatively mild winters, and normally adequate rainfall. Temperature and precipitation data collected at Richmond International Airport indicate that the mean annual temperature is about 55-60°F, while the average total annual precipitation is 44.2 in. Maximum daily temperatures are 90°F or higher on an average of 48 days per year; infrequently temperatures reach 100°F or more. Minimum daily temperatures are 32°F or lower about 90 days per year. While hard freezes can occur in winter, prolonged temperatures of 0°F or below are very rare, and the frost-free growing season is about 200 days. Although the area is near the path of winter storms, the Appalachian Mountains to the west tend to lessen the intensity of storms (Clay 1975).

Precipitation is variable over both long and short periods. Average monthly precipitation ranges from 2.9 in. in February to 5.6 in. in July. Rainfall is greatest in the summer months, and thunderstorms occur on an average of 37 days per year. Some showers are heavy and result in considerable run-off (Clay 1975). Hurricanes pass inland though the area every few years and usually bring extremely heavy rains. Typically, snow accumulation to a depth of 1 in. or more is present only 10 days per year. The average depth of snow on days with snow cover is 4 in.

The prevailing wind direction is southerly, although winds are often from all directions because the area is in the path of both warm, moist air currents moving from the south and southwest and cold, dry air currents moving southward and eastward. Winds average about 7.7 mi/hr, ranging from 5.7 mi/hr in August to 9.1 mi/hr in March. Dispersion is generally good, with few periods of air stagnation (Clay 1975).

2.5.3 Surface Water and Physiography

The following sections describe the local and regional surface hydrology and physiography (Kull and Laczniak 1987; STI 1988; Wigglesworth et al. 1984; Clay 1975; USGS 1983, 1986, 1987).

2.5.3.1 Physiography

Virginia comprises five physiographic regions, as depicted in Figure 4 (Kull and Laczniak 1987). From west to east these are (1) the Appalachian Plateau, (2) the Valley and Ridge

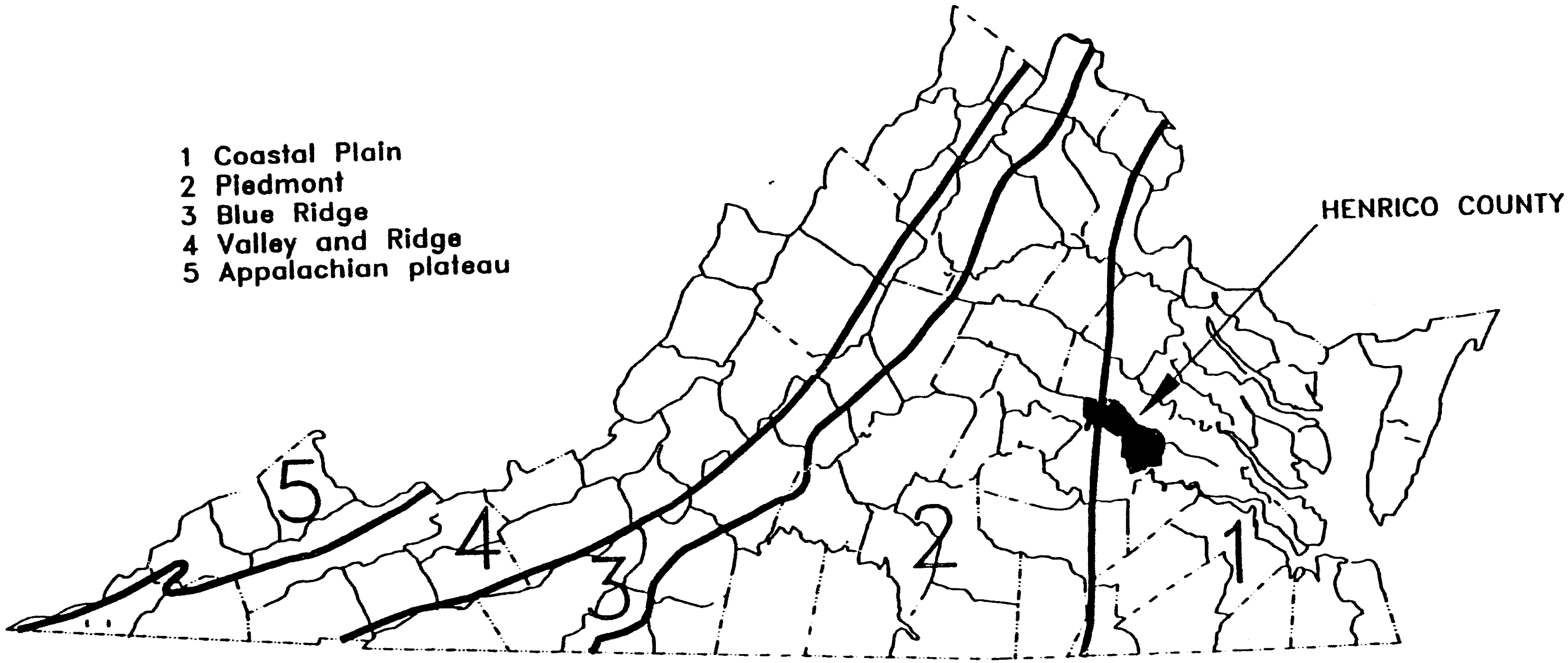

FIGURE 4 Major Physiographic Provinces of Virginia (Source: Adapted from Kull and Laczniak 1987)

Province, (3) the Blue Ridge, (4) the Piedmont Province, and (5) the Coastal Plain. Henrico County contains land in both the Piedmont and Coastal Plain physiographic provinces (Wigglesworth et al. 1984). The western portion of the county lies in the Piedmont Province, which is characterized by gently rolling hills underlain by igneous and metamorphic rocks such as granite, gneiss, and schist. The eastern portion of the county lies in the Coastal Plain Province, which is characterized by broad, nearly level and gently sloping ridges consisting of unconsolidated sediments such as clay, sand, and gravel. The sediments of the Coastal Plain increase in thickness as they dip gently to the east.

The Fall Zone (or Fall Line) marks the interface between the outcrop area of the eroding crystalline rocks of the western Piedmont plateau and the area where the crystalline rocks are overlain by relatively flat-lying marine and near-shore deposits of the Coastal Plain (Wigglesworth et al. 1984). At this point of significant topographic change, stream gradients steepen as the streams pass from the resistant crystalline rocks of the Piedmont to the easily eroded, unconsolidated sediments of the Coastal Plain. Elevations above mean sea level in the Piedmont portion of Henrico County range from about 300 ft in the west-central portion of the county to about 150 ft at Piedmont outcrops near the Fall Zone. Elevations above mean sea level in the Coastal Plain portion of Henrico County range from about 100 ft in drainageways near the Fall Zone to about 10 ft in the county's easternmost drainageways. By this point, the nearly flat topography and unconsolidated sediments of the Coastal Plain cause streams and rivers to meander. To the east, the land surface declines to sea level at Chesapeake Bay.

The topography of the AASF site is relatively flat with broad, gentle slopes. The elevation at the site is approximately 150 ft above mean sea level (USGS 1986, 1987). Earthen drainage ditches located throughout a large portion of the site collect rainwater, directing the drainage to the southern portion of the property.

2.5.3.2 Soils

Two major soil associations predominate in Henrico County near the VaARNG property, as shown in Figure 5 (Clay 1975). These are (1) the Lynchburg-Rains-Coxville Association in the northern part of the AASF and (2) the Kempsville-Atlee-Duplin Association to the south. The Lynchburg-Rains-Coxville Association is common on nearly level upland areas with slopes of 0-2%. The Kempsville-Atlee-Duplin Association can be found in broad, nearly level upland areas

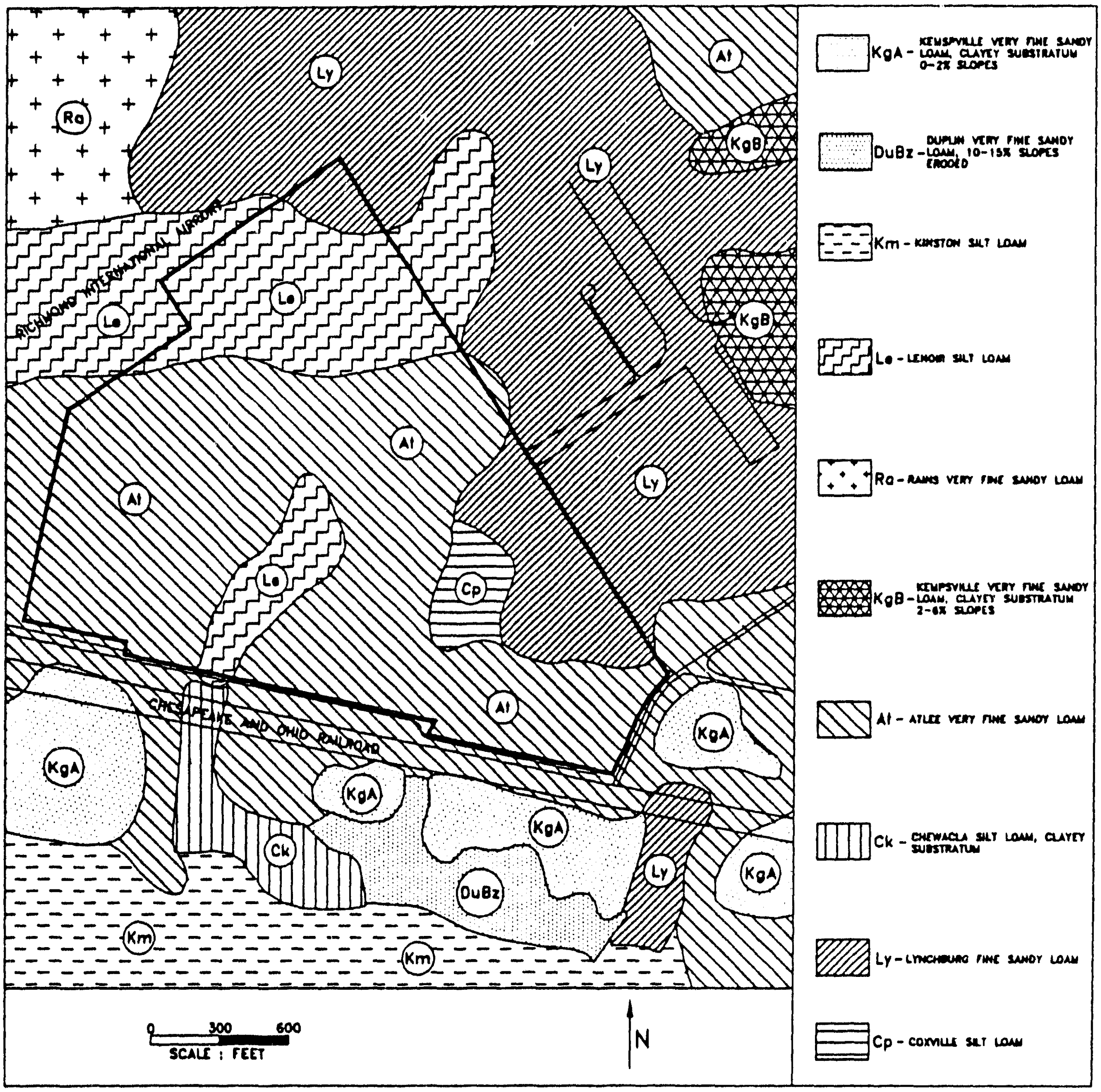

FIGURE 5 Major Soil Associations Present at the Army Aviation Support Facility (Source: Adapted from Clay 1975)

but is more common in gently rolling areas like ridge and side slopes (0-15%) and in drainageways. Soil characteristics such as water capacity, run-off potential, and permeability are important factors in determining the potential for contaminant migration in soils.

In a representative profile of the Lynchburg soil series (about 57% of the Lynchburg-Rains-Coxville Association), the surface layer is fine sandy loam 14 in. thick. This layer is black in the upper part and light yellowish brown in the lower part. The subsoil is 90 in. thick, with the upper 11 in. consisting of light olive-brown clay loam with gray mottles, changing to gray and brownish yellow clay loam in the next 22 in., then to gray clay loam with yellowish brown mottles in the lower 57 in. The substratum, at a depth of 104 in. and extending to a depth of 110 in. or more, is gray and brownish yellow loamy sand changing to gravel in the lower part. Water capacity is high in the Lynchburg soils, and run-off is slow. Permeability is moderate. A seasonal high water table occurs at a depth of 1-1.5 ft in wet seasons.

Rains soils, about 18% of the association, have a thick subsoil that is loamy to a depth of about 45-50 in. and clayey below that depth. The 11-in. surface layer is grayish brown, very fine sandy loam with yellowish brown mottles in the lower part. The subsoil is gray clay loam with strong brown mottles in the upper 38 in. and gray clay with yellowish brown mottles in the lower 47 in. The substratum, at a depth of 96 in. and extending to a depth of 102 in. or more, is gray sandy clay loam with yellow mottles. Water capacity is high in Rains soils, and run-off is slow. Permeability is moderate. A seasonal high water table occurs at a depth of 0-1 ft in wet seasons.

Coxville soils, about 14% of the association, have a surface layer of very dark gray silt loam 8 in. thick. The subsoil, about 85 in. thick or more is gray clay with yellowish brown and strong brown mottles. Coxville soils have water capacities of medium and moderately slow permeability. A seasonal high water table occurs at a depth of 0-1 ft for much of the year, and the soils are frequently flooded.

Approximately 11% of the Lynchburg-Rains-Coxville Association is composed of less common soil types including the Lenoir series and the Atlee series, predominant soils in the southern portion of the ARNG property. Lenoir soil characteristically has a surface layer of pale brown silt loam approximately 6 in. thick with approximately 64 in. of clayey subsoil. The upper 8 in. of the subsoil is light yellowish brown silty clay loam with gray and yellowish brown mottles. The next 29 in. is gray clay with strong brown mottles. The lower 27 in. is light gray and strong brown silty clay. The substratum, at a depth of 70 in. and extending to a depth of 110 in. or more, is gray, red, and yellowish brown clay. The water capacity is medium in Lenoir soils, and run-off is slow. Permeability is also slow. A seasonal high water table occurs at a depth of 1-1.5 ft in wet seasons.

The Kempsville-Atlee-Duplin soil association predominates in the southern portion of the VaARNG property and in areas to the south. The strongly acidic, moderately permeable soils of the Kempsville-Atlee-Duplin Association are deep and have a subsoil dominated by sandy clay loam or clay. The natural drainage pattern in this association is well developed, except in scattered, nearly level areas like that south of the VaARNG property. Poor drainage in those locations causes the soils to be excessively wet during winter and spring.

Kempsville soils, about 32% of the Kempsville-Atlee-Duplin Association, have a surface layer of brown, fine, sandy loam about 11 in. thick. The subsoil (approximately 40 in. thick) is yellowish brown, heavy, fine sandy loam, changing to yellowish brown sandy clay loam, then to strong brown sandy clay loam with pale brown mottles. A substratum of clay loam and clay lies below a depth of about 50 in. Water capacity is medium in Kempsville soils. In the broad ridge top area just north of the AASF site, with 2-5% slope, run-off from Kempsville soils is medium. In the broad, lower areas south of the VaARNG property (south of the fuel farm) with slope less than 2%, run-off is slow. The permeability of Kempsville soils is moderate.

As Figure 5 shows, Atlee soils, which compose about 19% of the Kempsville-Atlee-Duplin Association, predominate in the area of the AASF fuel farm. In a representative profile of the Atlee soils, the surface layer of very fine sandy loam and loam is 12 in. thick. The upper part is dark grayish brown, and the lower part is light yellowish brown. Below this surface layer is a 10-in.-thick layer of pale olive-brown light clay. Underlying this clay is a weak fragipan, approximately 32 in. thick, which is a pale yellow and brownish yellow clay loam with gray mottles in the upper part and a light yellowish brown, gray, and yellowish red clay loam in the lower part. The layer of subsoil below the fragipan is a light yellowish brown, gray, and yellowish red clay 12 in. thick. The substratum, at a depth of 66 in. and extending to a depth of 102 in. or more, is a light yellowish brown, gray, and yellowish red clay. Water capacity is medium in Atlee soils, and run-off is slow. Permeability is moderate above the fragipan but moderately slow in the fragipan. A seasonal high water table occurs at a depth of 1.5-2.5 ft in wet seasons.

Duplin soils, about 19% of the association, typically have a 7-in.-thick surface layer that is mostly a light yellowish brown, very fine sandy loam. The subsoil is about 103 in. thick with an upper 12 in. primarily of strong brown clay loam, followed by 24 in. of reddish yellow clay with light gray, strong brown, and red mottles and a lower 67 in. of light gray and yellow clay with red mottles. The substratum, at a depth of 110 in. and extending to a depth of 128 in. or more, is a strong brown, light sandy clay loam with pale gray and red mottles. Water capacity is medium in Duplin soils, and run-off is medium. Permeability is slow. A seasonal high water table occurs at a depth of 1.5-2.5 ft in wet seasons.

Typically, about 12% of the Kempsville-Atlee-Duplin Association is Caroline soils, which are deep, well-drained soils with a subsoil of clay loam and clay. Caroline soils, widely scattered in the association, are present on the narrower ridges and side slopes. A minor area of Caroline soils was identified northeast of the VaARNG property.

Less extensive soils in the Kempsville-Atlee-Duplin Association, including the Lynchburg and Lenoir soils (common in the northern portion of the VaARNG property), the Kinston series, and the Chewacla series, make up the remaining 18% of the association. The nearly level Kinston silt loam is present on stream floodplains and along large drainageways like that south of the VaARNG property. Kinston soils have a 6-in.-thick surface layer of silt loam that is dark gray in the upper part and gray with strong brown mottles in the lower part. The 68-in. subsoil consists of 34 in. of dark gray clay loam with yellowish brown mottles underlain by 34 in. of gray and reddish brown sandy clay loam. The substratum, at a depth of 74 in. and extending to a depth of 120 in. or more, consists of layers of gray sandy clay loam and fine sandy loam or sand and gravel. Water capacity is high in Kinston soils, and run-off is slow. These moderately permeable soils are frequently flooded in wet seasons.

Chewacla soils have also been identified south of the VaARNG property. These soils have a surface layer of dark brown silt loam 10 in. thick. The 34-in. subsoil is composed of brown silt loam with layers of light silty clay or clay loam. The substratum, at a depth of 44 in. and extending to a depth of 95 in. or more, is a dark yellowish brown loam with many gray mottles. Water capacity is high in Chewacla soils, and run-off is slow. These moderately permeable soils are frequently flooded in wet seasons.

2.5.3.3 Surface Hydrology

Henrico County is located in the James River basin. Drainage is eastward toward the Chesapeake Bay. The James River, forming the southern boundary of Henrico County with Chesterfield County, and the Chickahominy River, along the northern border of Henrico County with Hanover and Kent counties, drain Henrico County in equal proportions. Figure 6 identifies the regional surface waters. Major streams in eastern Henrico County that feed the James River are Cornelius Creek; Roundabout Creek; Fourmile Creek and its tributaries, Deerlick Brook and Brady Creek; Crewes Channel; and Western Run Creek. White Oak Swamp Creek drains White Oak Swamp, which is located south and east of the VaARNG property. White Oak Swamp Creek flows to the northeast to feed the Chickahominy River, which then flows south to merge with the James River. The Chickahominy-James River confluence is approximately 12 mi southeast of the VaARNG property (STI 1988).

Both the Chickahominy River and the James River have rather narrow floodplains carved into the sediments of the Coastal Plain (Clay 1975). Flooding of the Richmond International Airport is unlikely, but the vicinity has been identified as an area of weak drainage patterns. Substantial rainfalls disperse slowly.

Groundwater is less readily available as a source of drinking water near the Fall Line and to the west (i.e., in the Piedmont physiographic province), and the James River supplies water for much of the urban area of Henrico County as well as the city of Richmond. Intake positions are upgradient of the VaARNG property.

2.5.4 Groundwater and Hydrogeology

The following sections describe the regional and local geology and groundwater (Focazio et al. 1993; Kull and Laczniak 1987; Hamilton and Larson 1988; Wigglesworth et al. 1984; Wigglesworth 1993; VDMR 1973).

2.5.4.1 Regional Geology

The Coastal Plain physiographic province of southeastern Virginia is underlain by unconsolidated sediments ranging in age from early Cretaceous to Holocene (Hamilton and Larson 1988). The sediments, dipping and thickening eastward toward the Atlantic Ocean, consist primarily of sand, clay, silt, and gravel, with varying amounts of shell material. The sediments lie directly upon Precambrian granitic and metamorphic or Mesozoic sedimentary rock, commonly referred to as "basement." The westernmost extent of Coastal Plain sediments is at the Fall Line,

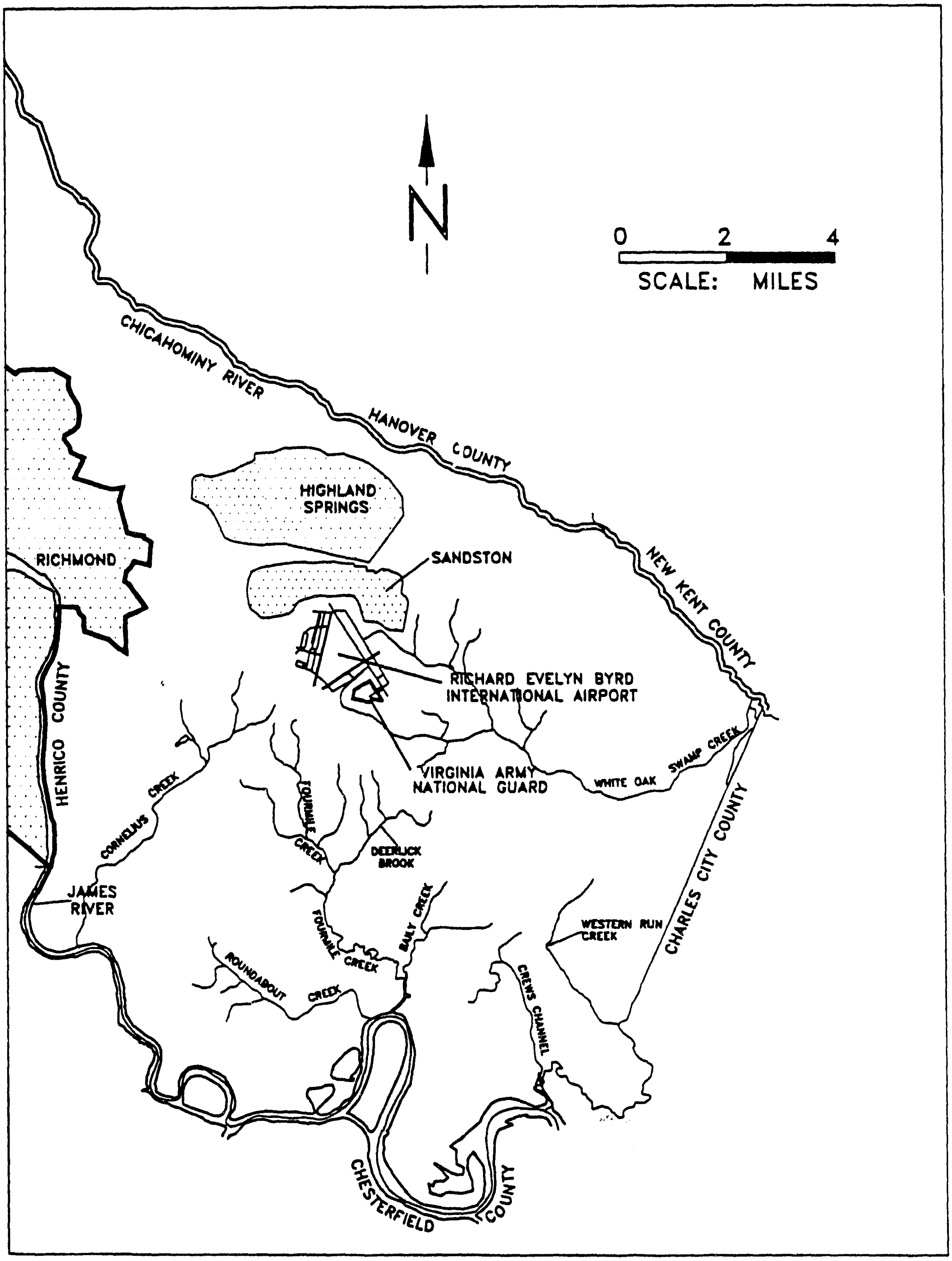

FIGURE 6 Location of Regional Surface Waters (Source: Adapted from USGS 1983)

beyond which the igneous and metamorphic rocks of the Piedmont physiographic province crop out. Sediment thickness in southeastern Virginia ranges from 0 ft at the Fall Line to > 3,500 ft at the southeastern tip of the commonwealth.

The deposition pattern of the Coastal Plain is complex, representing erosional forces coupled with a series of transgressions and regressions of the sea. About 70% of the sediments are of early Cretaceous age, generally consisting of interbedded arkosic quartz sand and clay. These deposits are of continental origin and consist of alternating channel sand deposits and interchannel clayey sediments. Weathered material was transported by streams from the highlands of the Piedmont Plateau and deposited in the lowlands in stream beds, along the shore, and in shallow bays. Sediments accumulated eastward, and large deltaic lobes formed. In the deltas, stream action produced interfingering within the accumulated sediments, resulting in variation in the deposited material ranging from clay and silty clay to sand and gravel. Because of this ebb and flow of deposition, the Cretaceous sediments vary laterally and may thicken, thin, or pinch out over short distances. Upper Cretaceous sediments are of marine origin, resulting from inundations of the seas over the deltas.

Tertiary sediments, deposited in transgressing seas that extended inland at least as far as the Fall Line, generally consist of a layered sequence of sand, clay, marl, and some shells. Because the inundations by the seas over the delta were relatively constant and widespread, these more recent sediments are more homogeneous and uniform than are the previously deposited Cretaceous sediments. Variability in deposition is evident near the westernmost extent of each transgressing sea in the decreasing thickness of each formational deposit approaching its western boundary and in the irregularity of each western boundary because of topographic barriers in place at the time. Figures 7-10 depict the stratigraphy of the Coastal Plain geologic formations, which, from oldest to youngest, are the Patuxent Formation (sometimes called the Potomac Formation), the Transitional Beds, the Aquia Formation (sometimes called the Mattaponi Formation), the Nanjemoy Formation, and the Calvert Formation (VDMR 1973). Figure 7 shows the limited extent of deposition of the Transitional Beds onto the Patuxent Formation. Figure 8 depicts the wide area of deposition of the Aquia Formation. Figure 9 outlines the area of deposition of the Nanjemoy Formation onto the Aquia Formation, and Figure 10 shows the aerial extent of the Calvert Formation.

The Patuxent Formation (or Potomac Formation), of early Cretaceous age, rests on the Petersburg granite and underlies most of the Coastal Plain of Virginia. The Patuxent Formation is

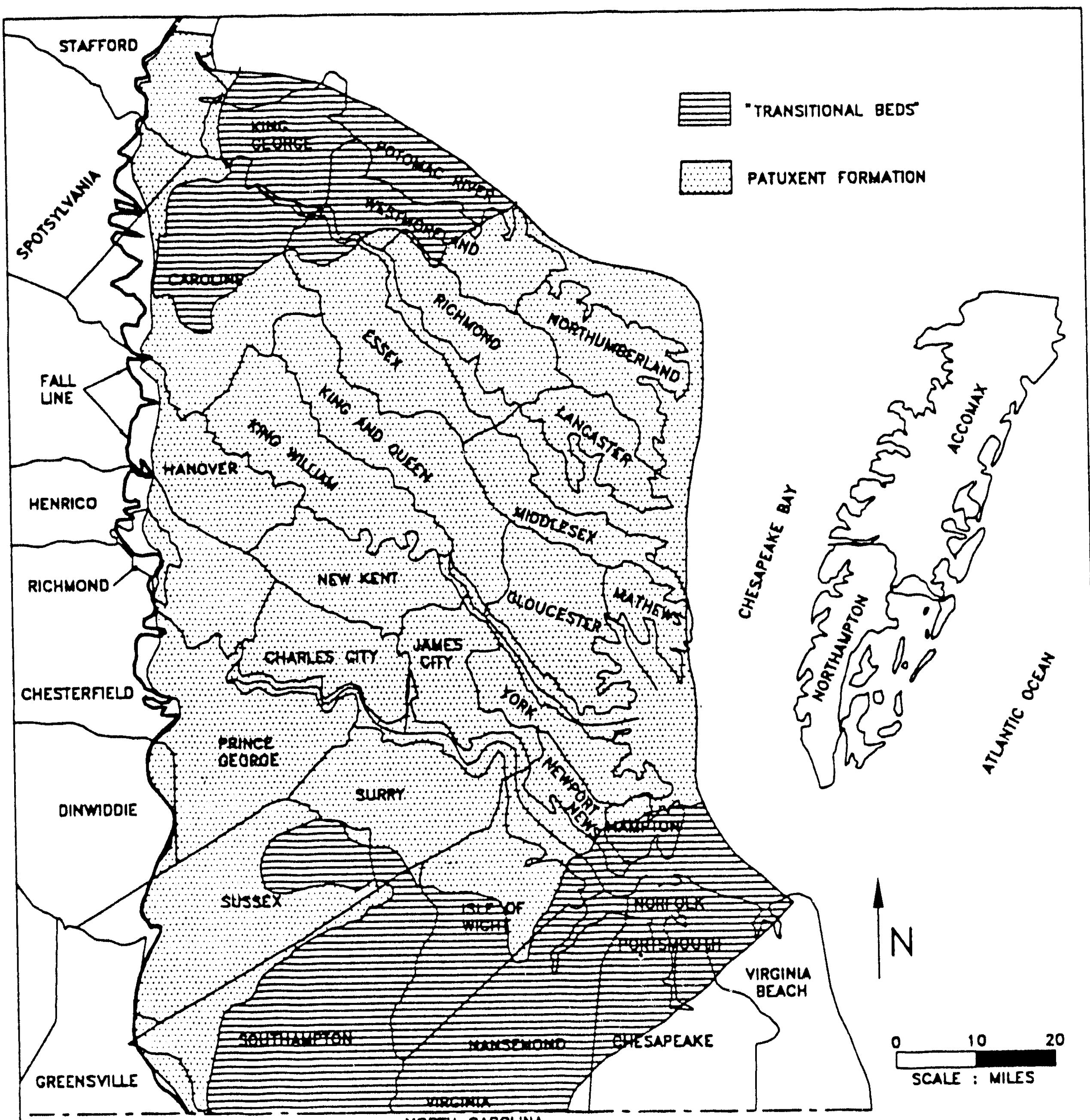

FIGURE 7 Extent of Transitional Beds and Patuxent Formation Deposition in the Coastal Plain (Source: Adapted from VDMR 1973)

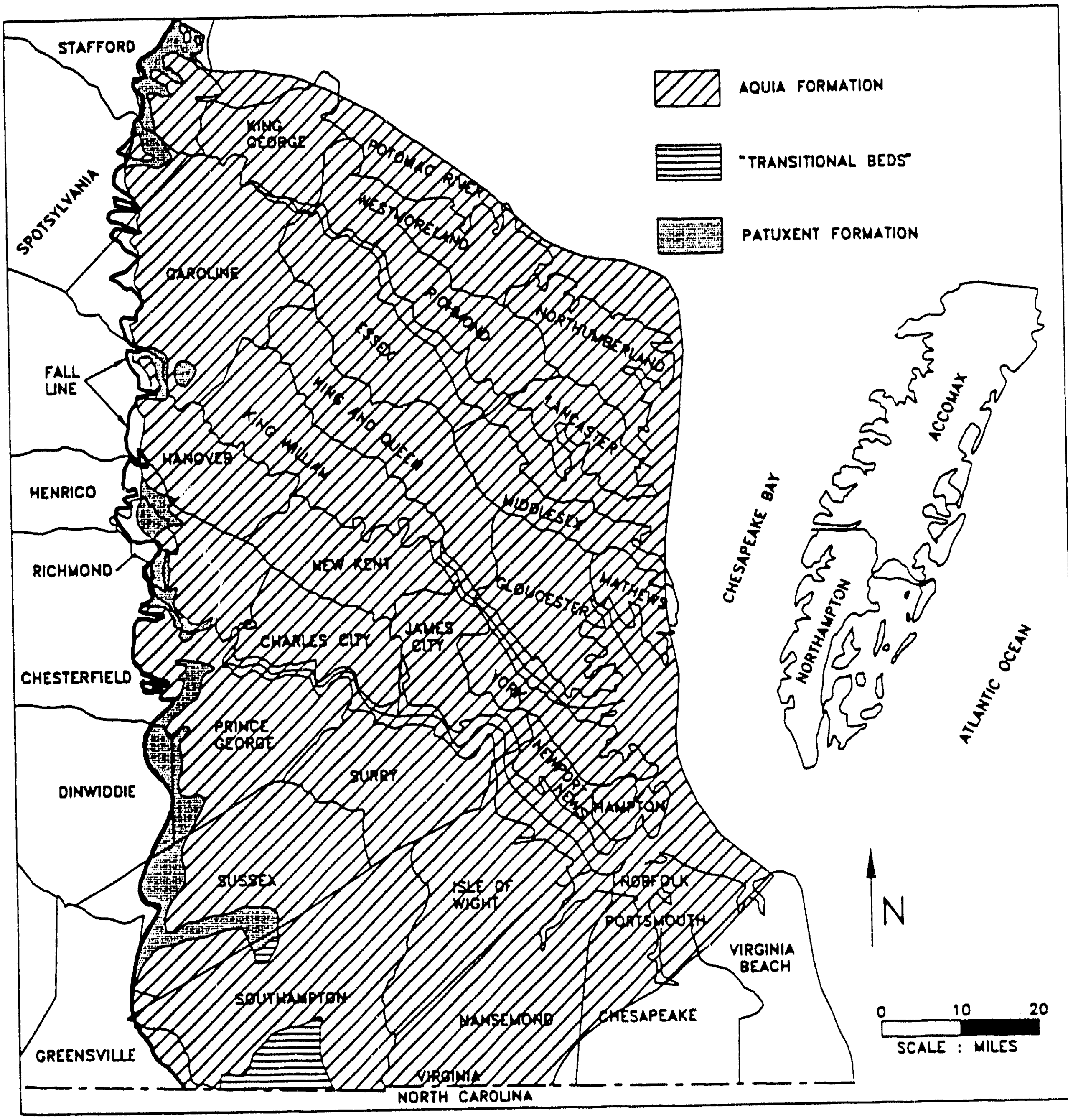

FIGURE 8 Extent of Aquia Formation Deposition in the Coastal Plain (Source: Adapted from VDMR 1973)

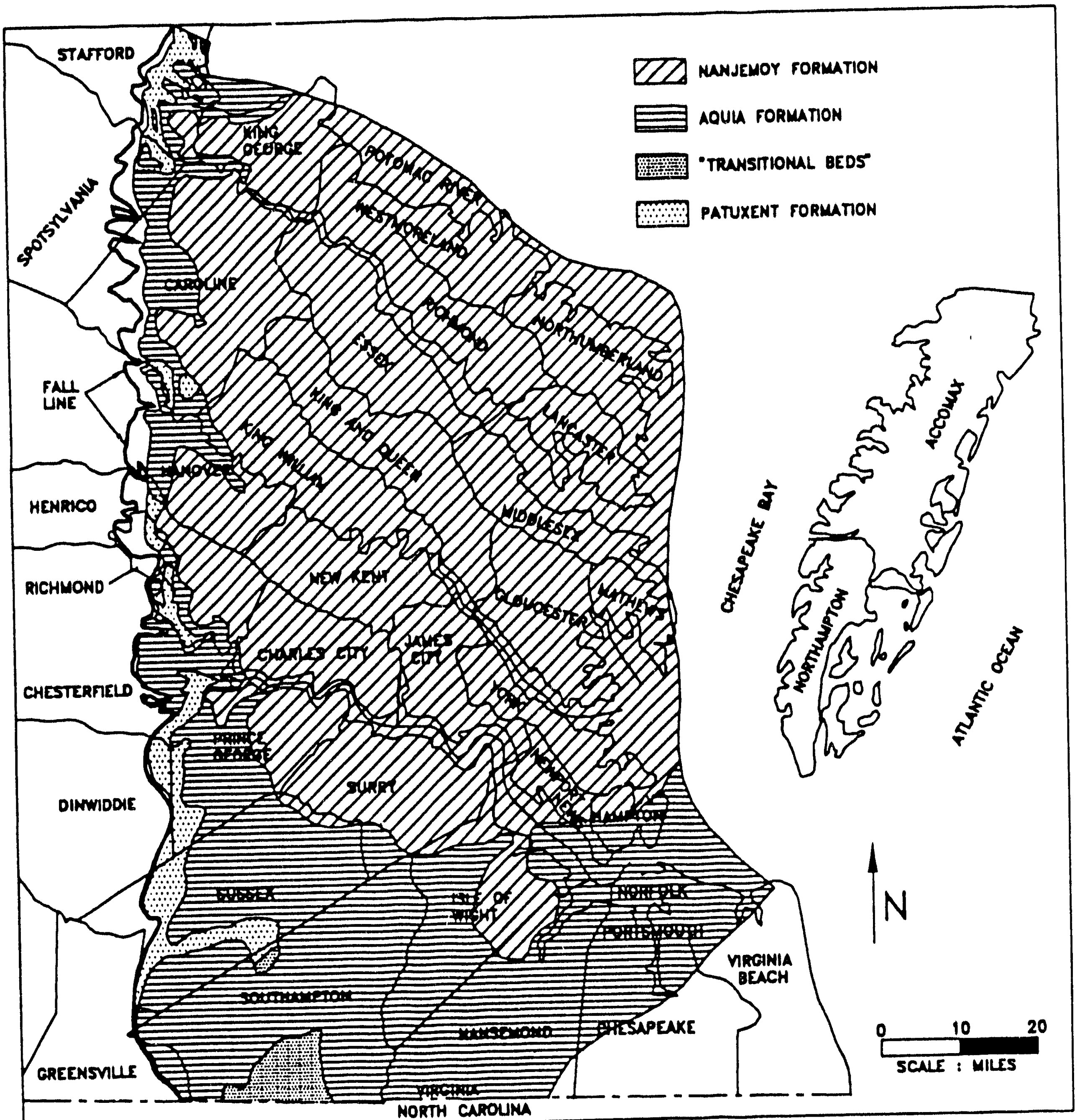

FIGURE 9 Extent of Nanjemoy Formation Deposition in the Coastal Plain (Source: Adapted from VDMR 1973)

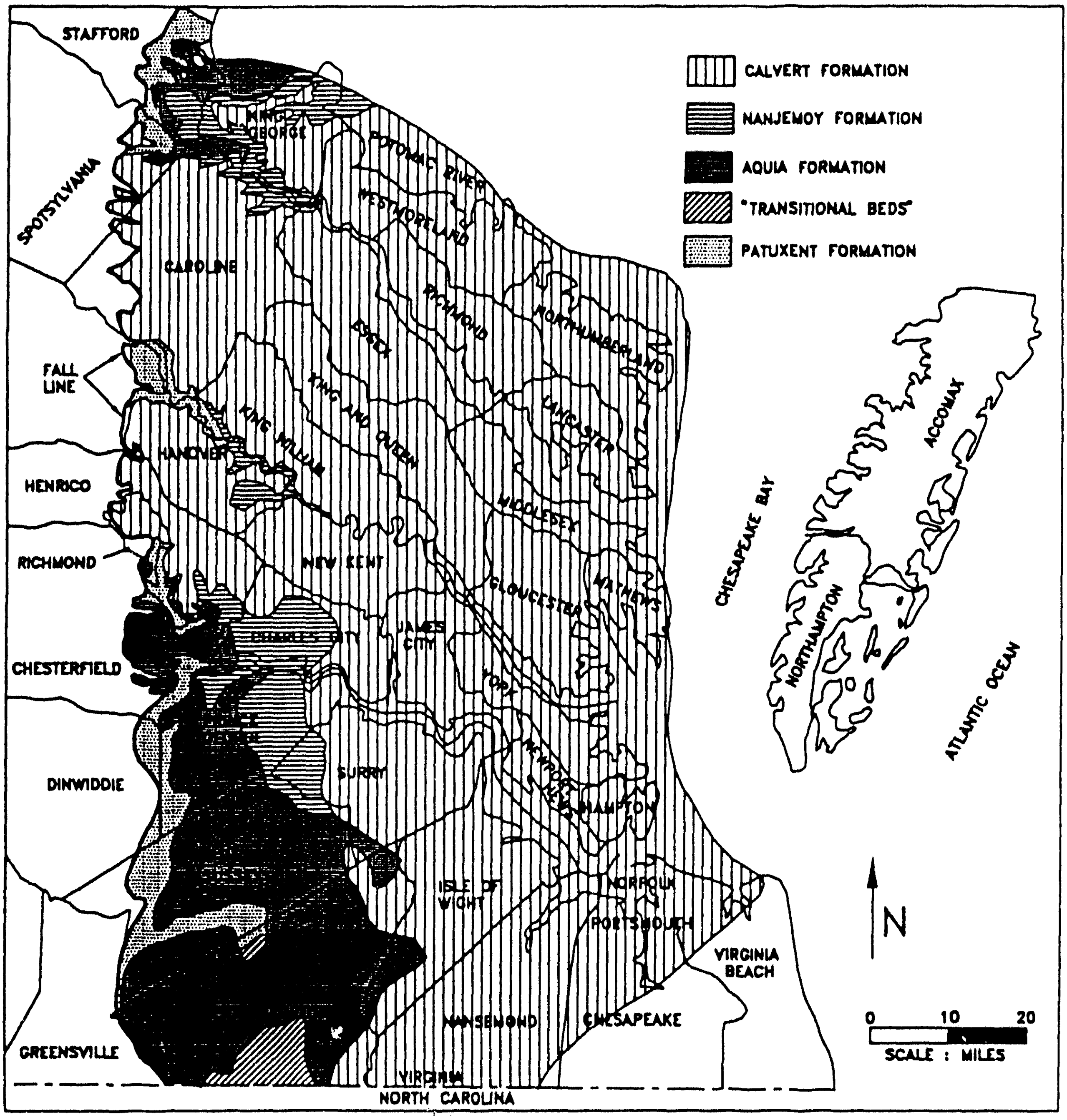

FIGURE 10 Extent of Calvert Formation Deposition in the Coastal Plain (Source: Adapted from VDMR 1973)

minimally exposed along its western margin, near the Fall Line. The Patuxent is an alternating sequence of fine gravels, coarse sands, and silty to sandy clays. The sands are mainly tan, gray, or white and are characteristically feldspathic. The percentage of feldspar is variable and commonly low, particularly near the top of the formation, but the essential absence of feldspar in the overlying units defines the contact (VDMR 1973).

Throughout the greater part of the mapped area, the Patuxent beds are overlain by the Aquia (or Mattaponi) Formation. In the northern and southern parts of the Coastal Plain in Virginia, the Patuxent is overlain by a succession of strata consisting of beds of sand, silt, and clay that have a lower sand:clay ratio, smaller gravel size, and more fossils than the Patuxent. These Transitional Beds contain more glauconite and less feldspar than the Patuxent but less glauconite and more feldspar than the overlying Aquia.

The Aquia Formation (or Mattaponi Formation) lies directly upon either the Patuxent or the Transitional Beds throughout the Coastal Plain of Virginia. The Aquia is overlain by the Nanjemoy Formation north of the James River. The Aquia is composed primarily of beds of quartz-glauconite sand, drab-colored glauconite-bearing clay, and shell material. Although glauconite appears in the Patuxent Formation, persists through the Transitional Beds, and is a major constituent of the overlying Nanjemoy Formation, the consistent and relatively concentrated presence of glauconite in the Aquia is the principal lithologic criterion used to identify the unit.

The Nanjemoy Formation (sometimes called the Piney Point Formation) comprises sediments generally considered to be of early to late Eocene age. The formation is an alternating succession of sands, clays, and calcitic units. Well cuttings show three distinct rock types: (1) a pink clay stratum; (2) brown speckled sands; and (3) drab, clayey silts and fine sands. The pink clay member (the Marlboro Clay) ranges in thickness from a few feet to as much as 30 ft of nonsandy clays and forms the base of the Nanjemoy Formation in the eastern part of Henrico County. In the western extent of the Nanjemoy toward the Fall Line, the Marlboro Clay member is less distinct. The lithologic similarities between the Nanjemoy and Aquia formations cause increasing difficulty in distinguishing the two.

The Calvert Formation is the most widespread unit in the Coastal Plain of Virginia, with thicknesses of 20-50 ft in eastern Henrico County near the Fall Line increasing to 345 ft at the mouth of the Chesapeake Bay. The basal sand member consists predominantly of sands with minor clay beds or lenses. An intermediate member is highly diatomaceous. The upper member of the Calvert Formation consists mainly of greenish gray to brownish gray silty clay with interbedded accumulations of mollusk shells.

Above the Calvert Formation, the Yorktown Formation constitutes the present land surface over wide areas of the Coastal Plain of Virginia. These sediments are distinguishable from the Calvert Formation by their more abundant and markedly coarser sand-gravel units and by more abundant and thicker shell beds. During rising sea levels in the more recent Holocene period, sediments consisting of oxidized clays, silts, sands, and gravels have been deposited in lagoons, beaches, and tidal flats in the eastern portion of the Coastal Plain. Where they are present in areas east of the Fall Line, the sediments of the Columbia Group contrast sharply with the marine formations they overlie.

2.5.4.2 Local Geology

Henrico County and the city of Richmond are bisected by the Fall Line, which marks the western extent of the Coastal Plain sediments (Wigglesworth et al. 1984). The ARNG property is about 6 mi east of the city of Richmond and the Fall Line, while the distance from the Fall Line to the eastern border of Henrico County is approximately 14 mi. Overall, the wedge of Coastal Plain sedimentary formations dips and thickens to the east, away from the Fall Line. This is especially evident in areas east of Henrico County. Near the Fall Line, because of the relative thinness of sediment deposition, differentiation between similar formations is more difficult.

Figure 11 summarizes the changing geology across the eastern portion of Henrico County. The three wells shown on Figure 11 were drilled in a rough line extending from the city of Richmond toward the eastern border of Henrico County (VDMR 1973). As the well log summaries show, deposition of the Columbia Group occurred only in the eastern portion of the county. The confining Calvert Formation, consisting mostly of clay, and the overlying, more permeable Yorktown Formation, consisting of coarser sand-gravel units, are evident across the region. No determination of the base of the Nanjemoy Formation was made in the central well (W-1177), probably because of lateral variations in the lithology of the formation and the localized absence of the confining Marlboro Clay member as described in Section 2.5.4.1. Only the easternmost well (W-2071) was drilled into the basement granite, beginning at a depth of 500 ft below mean sea level. Wells W-1247 and W-1177 were drilled into the Patuxent Formation, and the depth to the basement rock is undetermined.

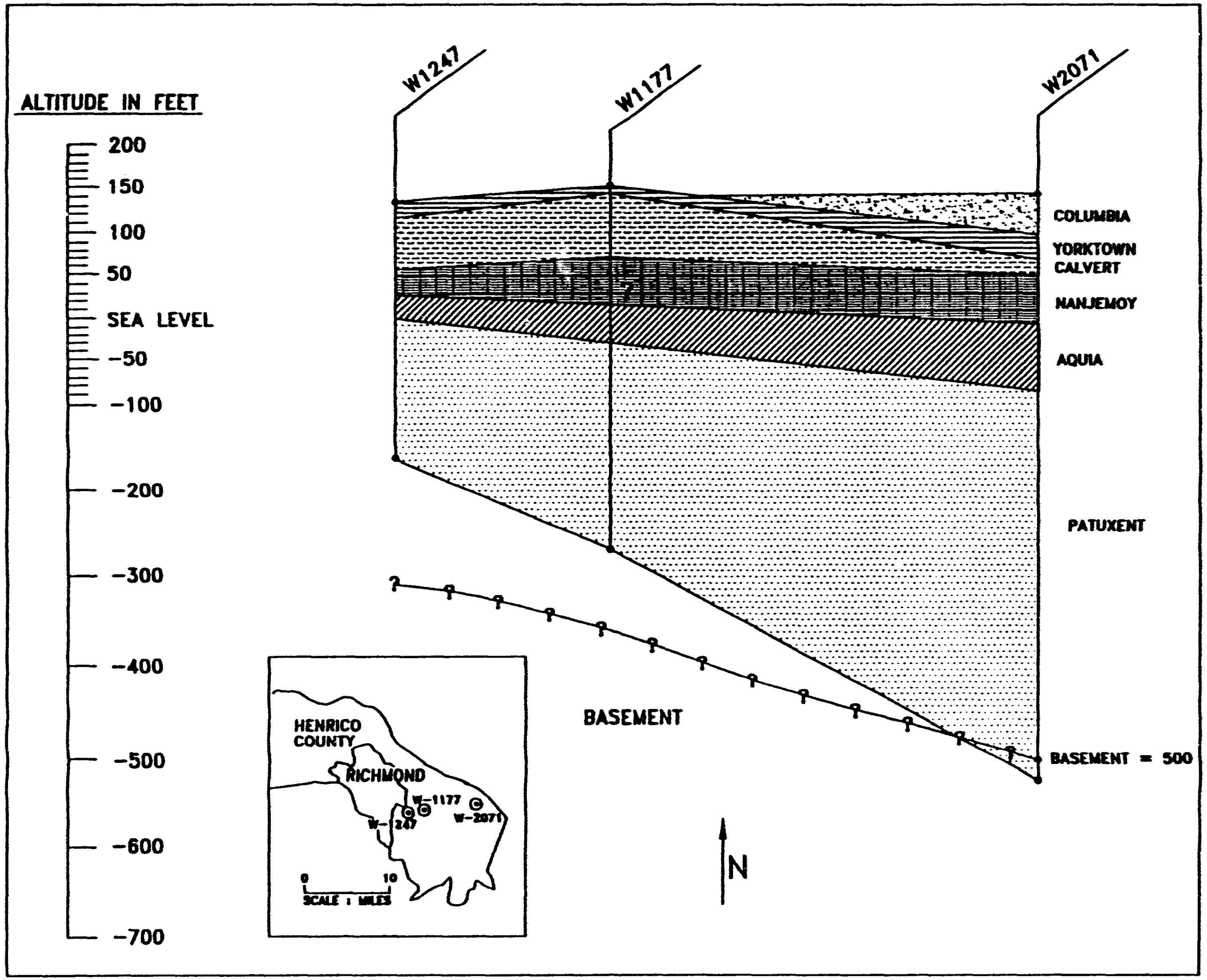

FIGURE 11 Generalized Cross Section of Geology in Eastern Henrico County (Source: Adapted from VDMR 1973)

2.5.4.3 Regional Groundwater

The hydrologic framework of southeastern Virginia is a series of aquifers and intervening confining units defined by the lithologic properties of the unconsolidated Coastal Plain sediments (Focazio et al. 1993; Kull and Laczniak 1987). The Coastal Plain sediments dip and thicken to the east and, as shown schematically in Figure 12, form a series of confined aquifers overlain by a single water table aquifer. Lower Cretaceous sediments include the lower and middle Potomac aquifers. Upper Cretaceous sediments include the upper Potomac aquifer and the Virginia Beach aquifer (present only near coastal areas). Tertiary sediments include the Aquia, Chickahominy-Piney Point, and Yorktown-Eastover aquifers. Quaternary sediments compose the Columbia aquifer.

The lower Potomac aquifer, in the lower part of the Patuxent (or Potomac) Formation, lies entirely on basement. The aquifer is thinnest along its western limit near the Fall Line (with a thickness near 0 ft) and thickens eastward to 882 ft near the coast (Hamilton and Larson 1988). A confining unit of sequences of brown, gray, or dark green carbonaceous clays, ranging in thickness from a thin edge to approximately 80 ft near the coast, separates the lower and middle Potomac aquifers. The middle Potomac aquifer is the second thickest confined unit, ranging in thickness from a thin edge near the Fall Line to approximately 500 ft near the coast. The middle Potomac is capable of supplying large quantities of water and is used by most large municipal and industrial users. As with the lower Potomac's confining unit, the middle Potomac's confining unit is highly variable in thickness, ranging from a feather edge in the west to 132 ft near the coast. The thin upper Potomac aquifer, present in eastern Virginia, and the Virginia Beach aquifer, present only in the southeastern portion of the commonwealth, are overlain by a relatively thick confining unit.

The Aquia aquifer, in the Aquia (or Mattaponi) Formation, is the deepest Tertiary aquifer. It is overlain by the Nanjemoy-Marlboro confining unit, which ranges in thickness from a thin edge at its western limit to approximately 62 ft toward the east. The Chickahominy-Piney Point aquifer is the middle Tertiary aquifer. It is overlain by the Calvert confining unit in the Calvert Formation. This confining unit forms an eastward-thickening wedge of dark green clay interbedded with sandy clay and marl, attaining a maximum thickness of 460 ft near the coast. The Yorktown-Eastover aquifer is the uppermost Tertiary aquifer. This aquifer is unconfined in a broad area of the western Coastal Plain near the Fall Line. In the central and eastern Coastal Plain, the Yorktown-Eastover aquifer is overlain by the Yorktown confining unit. This unit, ranging in

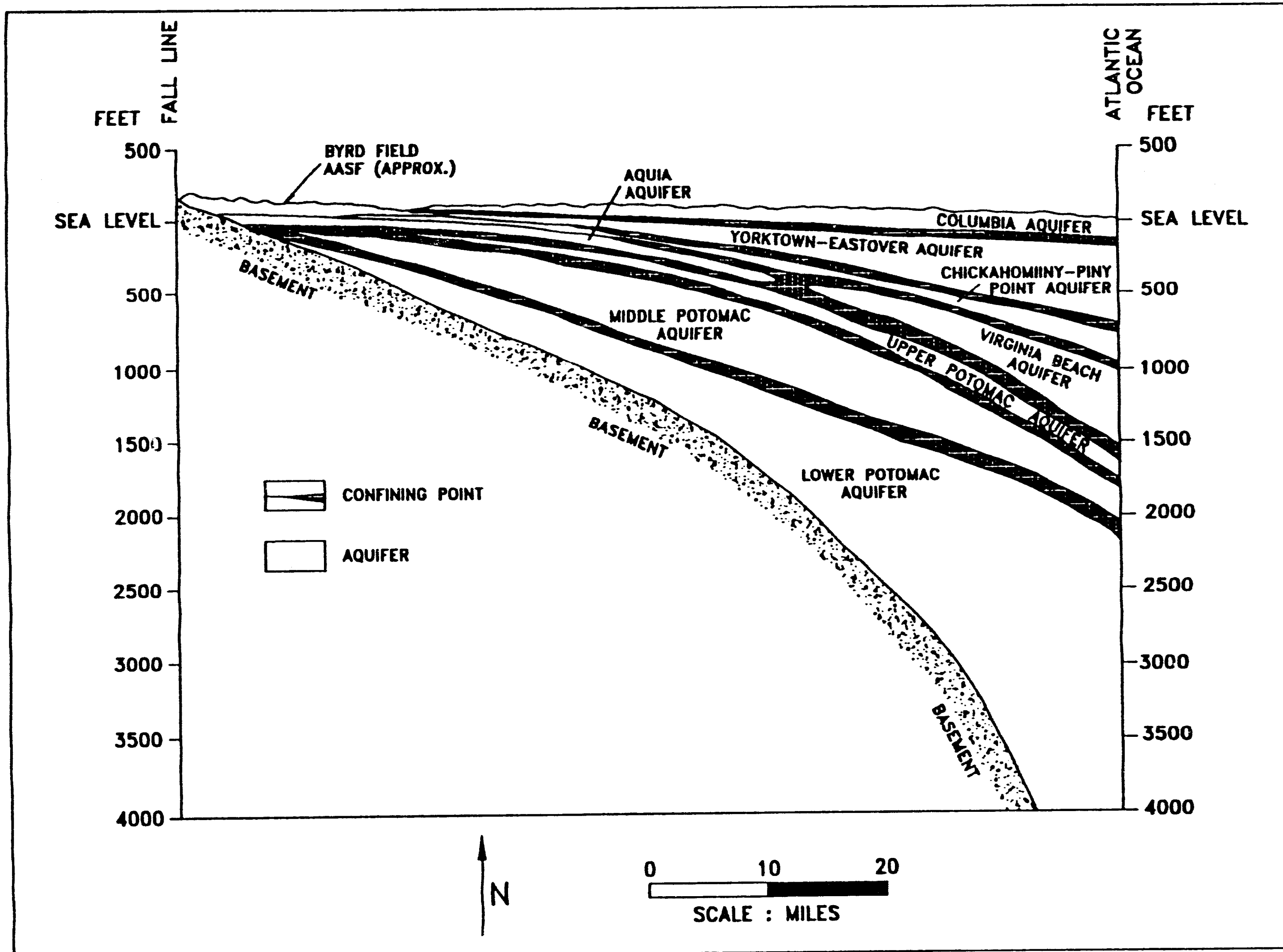

FIGURE 12 Conceptual Diagram of the Regional Hydrogeologic Framework (Source: Adapted from Hamilton and Larson 1988)

thickness from essentially 0 ft near the Fall Line to approximately 56 ft near the coast, is a massive, well-bedded clay and silty clay, containing shells and fine-grained sand. In areas near the Fall Line, the Yorktown confining unit is highly dissected. The Columbia aquifer, present in the central and eastern Coastal Plain and ranging in thickness from approximately 10 to 80 ft, is formed from the youngest sediments of the Virginia Coastal Plain.

2.5.4.4 Local Groundwater

In eastern Henrico County, water wells have been placed at all levels, from the near-surface water table aquifer to the basement complex rocks. The majority of water wells in the VDEQ files were drilled to supply communities or residential housing subdivisions (Wigglesworth et al. 1984). The best source of water in deep wells is the lowest Cretaceous sedimentary unit, the Patuxent Formation and the corresponding Potomac Aquifer. However, the thin area of the Patuxent near the Richmond International Airport produces a lower well yield, and no differentiation between a lower and middle Potomac aquifer is made. Yields from the Patuxent Formation range from 6 gpm (gallons per minute) to 700 gpm, with an average of 109 gpm. Wells drilled into the Patuxent average 294 ft in depth, ranging from approximately 166 ft in areas west of the airport to approximately 595 ft in areas east of the airport.

Individual shallow wells are a common source of water in areas of low-density housing development. Many of these wells are drilled into the coarse sand and gravel sediments of the late Tertiary and Quaternary periods. These wells, averaging a depth of 39 ft, provide adequate water supply for small farms and domestic uses (Wigglesworth et al. 1984). The VDEQ files are incomplete regarding the number and location of wells of this type.

Water wells located within a 4-mi radius of the AASF that are registered with the VDEQ are listed in Table 3. Locations of wells in the vicinity of the AASF are identified in Figure 13.

2.5.5 Sensitive Environments

The White Oak Swamp natural area is located south and east of the Richmond International Airport and the AASF. White Oak Swamp Creek drains the swamp eastward to the Chickahominy River, which then merges with the James River approximately 12 mi downstream. An unnamed tributary to White Oak Swamp Creek is located about 200 ft south of the AASF, and drainage

TABLE 3 Wells in the Vicinity of the Army Aviation Support Facility

Well No.[a]	Owner	Virginia Plane Coordinates: North	Virginia Plane Coordinates: East	Year Completed	Feet above Mean Sea Level: Elevation	Feet above Mean Sea Level: Depth	Feet above Mean Sea Level: Static Water Level	Geologic Formation[b]	Water Use[c]
1	The Flintkote Co.	430100	2335800	1959	160	285	147	PZPB	Ind
2	Fairfield Water Corp.	441700	2327300	1966	160	302	159	KPTX	Pws
3	Varina High School	420150	2328600	1961	142	266	89	KPTX	-
4	Varina High School	416700	2326100	1961	140	712	210	TRN	Pws
8	SHU-LU Corp.	445050	2336700	1966	160	314	157	KPTX	Ind
9	Baker Elementary School	420600	2328500	1962	147	287	138	KPTX	-
11	Varina Elementary School	406400	2332350	1963	142	234	96	KPTX	Pub
13	Henrico County 1	433100	2367650	1967	140	651	135	TRN	Pws
14	Fairfield Water Corp.	443000	2330500	1958	150	330	-	KPTX	Pws
15	Henrico County	440400	2338400	1964	170	375	152	KPTX	Pws
16	Fairfield Water Co. 1	442300	2327600	1957	-	297	102	KPTX	Pws
17	Lewis Gardens S C	432300	2336400	1967	160	290	150	KPTX	Pws
18	Lewis Gardens 3A	432500	2336800	1963	160	278	153	KPTX	Pws
19	Henrico County Schools	439100	2342000	1961	168	326	165	KPTX	Pub
20	Henrico County	438800	2334100	1965	150	340	137	KPTX	Pws
22	Sydnor	435500	2327500	1959	155	265	-	KPTX	Pws
25	Henrico County	445200	2340000	-	-	269	111	-	Pws
26	Henrico County	442900	2341300	1935	150	306	133	KPTX	Pws
28	Henrico County	441000	2339950	1958	157	350	163	KPTX	Pws
29	Henrico County 1	433920	2329200	1962	165	300	-	KPTX	Pws
30	Henrico County 2	435700	2330500	1957	140	292	120	KPTX	Pws
31	Henrico County	434250	2338000	1964	12	350	153	KPTX	Pws
32	Henrico County	435200	2336400	1963	150	370	175	KPTX	Pws
33	Henrico County	434950	2343850	1918	165	267	-	KPTX	Pws
34	Henrico County	435450	2343600	1918	165	272	128	KPTX	Pws
35	Henrico County	432200	2345275	1955	153	312	135	KPTX	Pws
36	Henrico County	432175	2346820	1961	158	322	152	KPTX	Pws
37	Henrico County	435100	2347900	1964	152	292	160	KPTX	Pws
38	L. M. Knight	411109	2357022	-	-	-	-	-	-

TABLE 3 (Cont.)

Well No.[a]	Owner	Virginia Plane Coordinates: North	Virginia Plane Coordinates: East	Year Completed	Feet above Mean Sea Level: Elevation	Feet above Mean Sea Level: Depth	Feet above Mean Sea Level: Static Water Level	Geologic Formation[b]	Water Use[c]
39	Henrico County	434550	2333300	1961	160	300	138	KPTX	Pws
41	Henrico County	434000	2334950	1955	160	340	154	KPTX	Pws
42	Henrico County	439450	2326250	1956	150	237	124	KPTX	Pws
54	Sydnor	432700	2323500	-	165	183	117	KPTX	Pws
60	B. C. Cobb	434000	2327300	1947	155	290	120	KPTX	Pws
61	B. C. Cobb	434700	2327350	1948	165	302	112	KPTX	Pws
62	Henrico County	436800	2346900	1969	150	540	155	KPTX	Pws
63	Kelly's Restaurant	443800	2329600	1969	150	286	162	KPTX	Com
68	Highland Springs School	442860	2339850	1961	160	350	164	KPTX	Pub
71	Air Reduction Sales	429800	2316900	1949	55	360	30	PZPB	Ind
76	Commonwealth of Virginia	422200	2367150	1950	130	392	7	KPTX	Pub
78	Henrico County Schools	406100	2332100	1950	138	213	-	KPTX	Pub
79	Henrico County	442300	2341850	1953	160	270	160	KPTX	Pws
82	Bessie Maney	414936	2339799	-	-	-	-	-	-
83	Sydnor, Pine Heights	434150	2353950	-	160	236	130	KPTX	Pws
87	McDonalds Restaurant	443650	2329300	1970	155	295	166	KPTX	Com
91	C&P Telephone	444250	2329300	1970	155	300	163	KPTX	Com
92	Fairfield Water Co.	440450	2329900	1971	135	310	152	KPTX	Pws
93	Nabisco Inc	424400	2332850	1972	155	345	60	KPTX	Ind
97	Henrico County	433200	2350600	1949	155	460	-	KPTX	Pws
100	Concrete Building	429300	2323550	1963	160	520	-	KPTX	Ind
101	Henrico County	434100	2354600	1972	160	610	-	KPTX	-
107	Henrico County Highland Springs	442860	2339550	-	-	-	-	-	-
118	OBS Well 55	434250	2337800	-	155	297	152	KPTX	Pub
123	C&P Telephone	438200	2344500	1972	164	330	-	KPTX	Com
126	Department of Buildings and Grounds	420600	2364900	-	140	-	132	-	Pub
130	Robinwood Sub 3	429400	2334100	1963	160	326	160	KPTX	-
158	Sydnor, National Heights	431050	2323350	1967	155	230	130	-	-

TABLE 3 (Cont.)

Well No.[a]	Owner	Virginia Plane Coordinates North	East	Year Completed	Feet above Mean Sea Level Elevation	Depth	Static Water Level	Geologic Formation[b]	Water Use[c]
159	Sydnor, Colonial Ct	432500	2324100	1940	159	166	108	KPTX	-
160	Sydnor, Robin Grey	433000	2325200	-	165	199	127	KPTX	-
161	Sydnor, Eastover	434300	2327900	1953	170	251	125	KPTX	-
162	Sydnor, Robinwood	431700	2334550	-	165	196	127	KPTX	-
164	Sydnor, Wedgewood	430150	2328500	1948	160	225	127	KPTX	-
169	Thompson	434250	2354650	1973	155	595	170	KPTX	Pws
170	Henrico County	434275	2354675	1973	155	595	170	KPTX	Pws
172	B. L. Bowery, Sr.	419500	2338300	1974	155	38	24	QS	Dom
177	Wayne Grubbs	422300	2338200	1974	165	32	19	QS	Dom
187	Jones & Robbins	430900	2334550	1953	165	244	135	KPTX	Pws
195	A. G. Davis	425000	2337800	1975	165	52	18	QS	Dom
197	R. L. Marsckak Realty	425000	2337800	1975	165	38	14	QS	Dom
200	Sydnor, Hydrodynamics	431700	2324000	1975	155	264	156	KPTX	Pws
215	Roberta Manuel	433700	2363500	1975	135	46	26	QS	Dom
218	Courtney	409200	2348300	1976	140	53	40	QS	Dom
221	Dunavent and William	417950	2355850	1975	165	55	35	QS	Dom
222	Hunter Whitlock	441000	2350500	1976	150	42	18	QS	Dom
228	L. A. Lubold	428200	2323400	1974	115	41	-	TRN	Dom
242	Mitchell Kambis	409000	2352800	1975	135	37	17	QS	Dom
262	Imogne Allen	427200	2359000	1961	-	-	-	QS	Dom
263	VFW	434000	2350750	-	-	45	-	QS	Dom
264	Jessie Lewis, Jr.	428750	2351500	-	-	100	-	QS	Dom
270	Jerry B. Winton	442300	2354750	-	-	-	-	QS	Dom
271	John Roysten, Sr.	442500	2348500	-	-	50	-	QS	Dom
272	Charles C. Hill	427750	2349750	-	-	43	-	QS	Dom
273	Irvin R. Green	423250	2351500	-	-	38	-	QS	Dom
284	Eacho	425000	2337800	-	-	38	-	QS	Dom
285	Bernarnina	444600	2354250	-	85	200	-	KPTX	Dom
289	W. M. Snowa	429250	2367000	1972	155	-	-	KPTX	Dom

TABLE 3 (Cont.)

Well No.[a]	Owner	Virginia Plane Coordinates North	Virginia Plane Coordinates East	Year Completed	Feet above Mean Sea Level: Elevation	Feet above Mean Sea Level: Depth	Feet above Mean Sea Level: Static Water Level	Geologic Formation[b]	Water Use[c]
301	Michel S. Youssef	416000	2339000	1979	135	244	120	KPTX	Pws
304	Doug Mitchell	435300	2363900	-	115	33	15	-	Dom

[a] All well numbers listed are in the 143 VDEQ number series.

[b] Abbreviations: PZPB, Petersburg granite; KPTX, Patuxent Formation; TRN, Triassic sediments; QS, Quaternary sediments.

[c] Abbreviations: Pws, public water system; Pub, public water supply; Ind, industrial; Com, commercial; Dom, domestic.

Source: Wigglesworth et al. (1984).

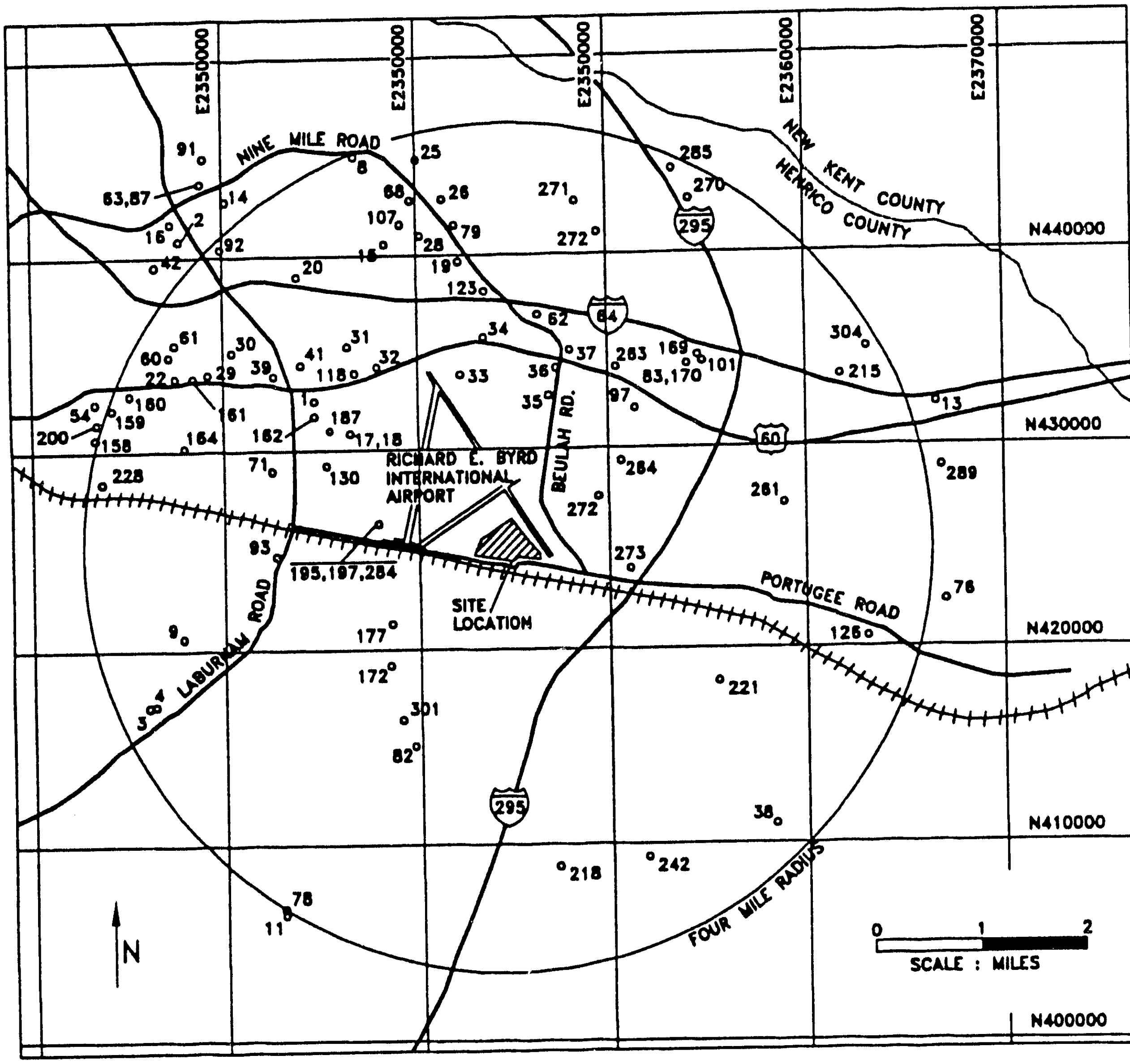

FIGURE 13 Locations of Wells in the Vicinity of the Army Aviation Support Facility (Source: Adapted from Wigglesworth 1993)

from the Richmond International Airport property (including the AASF) is diverted to this tributary. Downgradient of the site, a continuous riparian corridor is formed by wetlands along the White Oak Swamp Creek drainage pathway.

Vegetation in the undeveloped swamp area is typical of a mixed broadleaf deciduous eastern hardwood forest. Such forested habitats can be expected to support a diverse wildlife population including small mammals, birds, and reptiles. Table 4 is a list of plant and animal species expected to inhabit White Oak Swamp. No plant or insect species listed as threatened or endangered are known to occur in the AASF project area (DACS 1992). Likewise, no threatened or endangered animal species have been documented in the immediate project area. Federally endangered bald eagles (*Haliaeetus leucocephalus*) are known to nest along the James River and its tributaries in the southeastern portion of Henrico County and may forage in the vicinity. No nests are known to occur in the area of the AASF (DGIF 1992).

No designated natural heritage resources are documented in the project area (DCR 1992). However, three historic structures or archaeological sites registered by the commonweath are in the immediate vicinity. The White Tavern, the Beulah House Site, and the Beulah Church are located within 1 mi of the AASF. These cultural resources are not considered to be at risk from AASF activities because they are approximately 1,000-2,000 ft from the White Oak Swamp Creek, which is the only relevant contaminant migration pathway from the AASF to their locations (VDMA 1992a).

TABLE 4 Plant and Animal Species Likely Present in the White Oak Swamp Natural Area

Common Name	Scientific Name
Plant Species	
White oak	*Quercus alba* L.
Loblolly pine	*Pinus taeda* L.
Red maple	*Acer rubrum* L.
Sweet gum	*Liquidamber styraciflua* L.
Red oak	*Quercus falcata* Michx.
Sassafras	*Sassafras albidium* (Nuttall) Nees.
Blackjack oak	*Quercus marilandica* Meunch.
Low deerberry	*Vaccinium stamineum* L.
Sweet pepperbush	*Clethra alnifolia* L.
Dwarf sumac	*Rhus copallina* L.
Wild azalea	*Rhododendron nudiflorum* (L.) Torrey
Laurel-leaf smilex	*Smilex laurifolia* L.
Common greenbrier	*Smilex rotundifolia* L.
Catbrier	*Smilex hispida* L.
Japanese honeysuckle	*Lonicera japonica* Thunberg
Common blackberry	*Rubus argutus* Link
Poison ivy	*Toxicodendron radicans* L.
Bracken fern	*Pteridium aquilinum* (L.) Kuhn
Velvet grass	*Holcus lanatus* L.
Fescue	*Festuca spp.* L.
Cattail	*Typha latifolia* L.
Soft rush	*Juncus effusus* L.
Nut grass	*Cyperus spp.* L.
Mosses	Bryopsida
Animal Species	
Gray squirrel	*Sciurus carolinensis*
Virginia oppossum	*Didelphis virginianus*
Rodents	Rodentia
Perching songbirds	Passeriformes
Woodpeckers	Piciformes
Snakes	Ophidia
Turtles	Chelonia
Frogs/toads	Anura
Salamanders	Urodela

Source: VDMA (1992a).

3 Environmentally Significant Operations

The PA team from Argonne identified three ESOs at the AASF: (1) fuel storage and dispensing; (2) hazardous materials/hazardous waste storage; and (3) aircraft, vehicle, and equipment washing. Each ESO is described below.

3.1 Fuel Storage and Dispensing

Fuel stored and used at the AASF includes JP-4 for aircraft, diesel fuel for vehicles assigned to the unit and for an emergency generator, gasoline for vehicles and grounds keeping equipment, and propane and heating oil for building and space heating needs. Annual usage of JP-4 is 400,000 gal, while the annual usage of gasoline and diesel fuel are 2,300 gal and 600 gal, respectively (Williams 1993a). Aboveground and underground storage facilities are present at the AASF. Current and former fuel storage and dispensing locations are identified in Figure 14.

The potential exists for release of fuel to the environment as a result of leaking or rupture of the storage tanks or of the fill lines and valves. Inadvertent spills can also occur during tank refilling operations by overfilling of the storage tanks or as a result of a broken transfer line.

3.1.1 JP-4 Tank Farm

The JP-4 tank farm, on the south side of the site, consists of two 25,000-gal steel aboveground tanks, approved by Underwriters Laboratory (UL) and surrounded by a containment dike (VDMA 1993). Each tank is supported by four concrete cradles. Pressure and vacuum vents are provided on each tank, as is a sounding opening used to determine the liquid level. Fill-discharge lines, constructed of 4-in.-diameter steel piping, lead to a fuel transfer station outside the containment.

The dike that surrounds the two 25,000-gal tanks is approximately 3.5 ft high. The area of the enclosure at the top of the dike is approximately 9,700 ft^2, with a holding capacity of approximately 145,000 gal. The dike walls are constructed of compacted soil covered with 2 in.

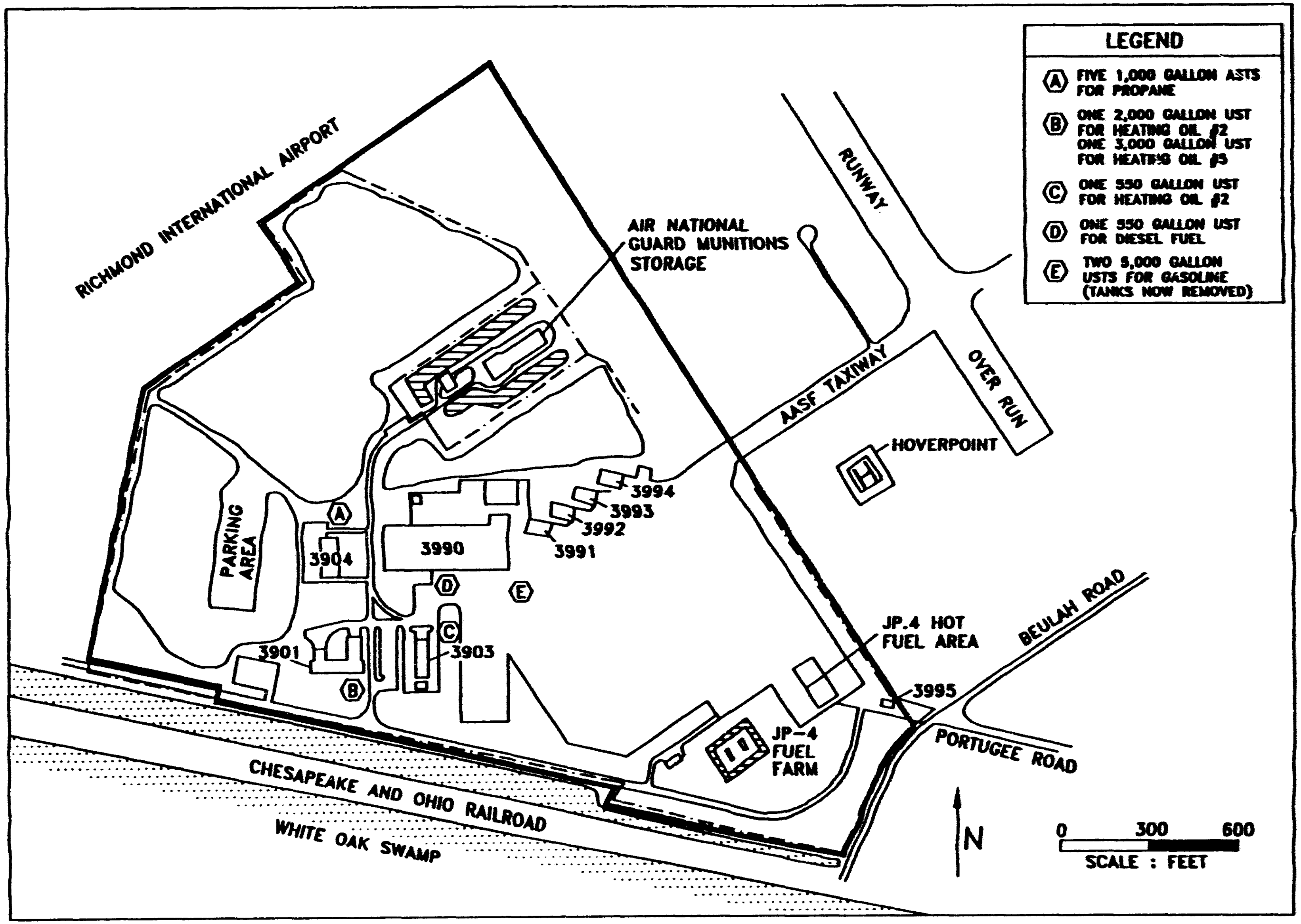

FIGURE 14 Locations of Current and Former Fuel Storage and Dispensing Activities at the Army Aviation Support Facility (Source: VDMA 1992b)

of bituminous concrete (asphalt). The bottom of the enclosure is earthen. As discussed in Section 2.5.3.2, near-surface soils in this area of the property consist of a layer of very fine sandy loam overlying several feet of clay. A 6-in. grated drain is located at the low point of the enclosure, which can be opened to allow drainage of accumulations of storm water. Storm water is discharged into a drainage ditch south of the property.

3.1.2 JP-4 Transfer Station

The JP-4 is delivered to the 25,000-gal storage tanks by commercial carriers in tanker trucks, each carrying 8,000 gal. The commercial carriers refill the JP-4 tanks about every six weeks. The transfer station consists of a recessed concrete pad surrounded by concrete curbing that acts as containment. The capacity of the containment area is approximately 1,200 gal. Two catch basins within the containment area collect surface water and any spilled fuel. Drainage passes through an oil-water separator before discharge to the sanitary sewer system (Section 3.1.1).

3.1.3 JP-4 Hot Fuel Line

Installation of a fuel dispensing line to the east from the bulk storage tanks was completed in 1993. A 4-in.-diameter stainless steel fuel line extends from the bulk storage tanks, through a pump house, and to the airfield fueling area. Belowground piping is wrapped in plastic sheeting, and all joints in the pipe are sealed. This pipe has no cathodic protection. The pump house is an enclosed metal building with a concrete slab floor sloped to a catch basin. In the event of a potential leak, drainage from the building can be directed from the catch basin to the fueling system's oil-water separator before it is discharged to the sanitary sewer system.

No physical containment structure surrounds the aircraft as it refuels at the hot fuel line. An emergency cutoff switch is present on the tarmac to stop the flow of fuel if a break in the fuel line occurs. The concrete pad at the hot refueling station slopes to a catch basin. In the event of a fuel spill, an 8,000-gal UST is present to contain the fuel. Surface drainage in the hot fuel area is directed through the fueling system's oil-water separator before discharge to the sanitary sewer system. A 5,000-gal underground holding tank is available to control drainage flow through the oil-water separator to ensure proper functioning.

3.1.4 Aboveground Storage Tanks for Gasoline and Diesel Fuel

Two 5,000-gal storage tanks for diesel fuel and gasoline are in the southern portion of the VaARNG property near the JP-4 bulk storage tanks. Each tank is located within a metal basin with 7,500 gal of containment capacity. Fuel dispensing pumps for the two tanks are located within the containment structures and are lockable. Drain spigots at the rear of each containment basin are also lockable. Both the pumps and the drains are kept locked except when in use. Fuel is transferred to the storage tanks manually by pumping fuel from a commercial tanker into a port at the top of each tank. Upon completion of the fuel transfer, excess fuel remaining in the transfer hose is drained into a bucket and poured into the tank (VDMA 1993). The storage tanks and metal containment basins are covered with a metal roof.

3.1.5 Fuel Tanker Trucks

Three 1,200-gal tanker trucks are available at the AASF to supply JP-4 to aircraft at the facility. These trucks refuel at the JP-4 transfer station and transport fuel to waiting aircraft on the tarmac. Future use of these trucks is expected to be minimal because of the recently completed hot refueling system.

3.1.6 Underground Fuel Storage

Four USTs located at the site are used for storage of heating oil or diesel fuel. A 2,000-gal UST adjacent to Building 3901 stores heating oil No. 2. A 5,000-gal UST adjacent to Building 3901 stores heating oil No. 5. Both tanks, installed in 1988, are double-walled steel tanks with automatic leak detection systems. A 550-gal single-walled UST adjacent to Building 3903 contains heating oil No. 2. A 550-gal single-walled UST adjacent to Building 3990 contains diesel fuel to supply an emergency generator.

Two 5,000-gal USTs for storage of gasoline were installed in 1966 east of Building 3903. Both tanks were removed in October 1991. Soil sampling when the USTs were excavated confirmed that no leakage had occurred (Levine 1991).

3.2 Storage of Hazardous Materials/Hazardous Waste

Maintenance activities performed at the AASF require the use of hazardous materials and the subsequent generation of hazardous waste. Except for fuel, the volume of hazardous materials used at the VaARNG facility is low. Annual usage of turbine engine oil is estimated at 480 gal, while the annual usage of hydraulic fluid is estimated at 200 gal (Williams 1993). New or unused hazardous materials are segregated in enclosed storage locations with concrete floors and concrete or metal sidewalls. These storage locations include the hazardous materials storage building north of Building 3990 and the battery storage room and flammables storage cabinet in Building 3990. Each of these locked storage areas is inspected daily by VaARNG personnel during normal maintenance activities. Waste oil generated at the AASF is stored behind the main hangar in 55-gal drums mounted on racks. The storage area is located on a concrete pad that slopes to a central drain. This drain collects both surface water run-off and oil drippings and conveys them to an oil-water separator. Filtered waste water is discharged to the sanitary sewer system. An average of ten drums are in this area at any one time (VDMA 1993).

3.3 Aircraft, Vehicle, and Equipment Washing

Two designated wash areas are at the AASF: (1) a concrete area north of the Building 3990 hangar used for periodic washing of aircraft and (2) a concrete-covered area south of the maintenance building (Building 3903) used for washing vehicles and grounds keeping equipment. With aircraft and equipment washing, the potential exists for release of hazardous chemicals (fuel, oil, solvents, etc.) to adjacent surface soils or nearby surface water. Drainage from the large concrete-covered wash areas at the AASF is directed into oil-water separators adjacent to the wash areas. Filtered waste water is directed into the sanitary sewer.

4 Known and Suspected Releases

4.1 Releases to Groundwater

The activities of the AASF pose a potential risk to the shallow groundwater in the vicinity because of potential subsurface leakage of fuel from USTs or infiltration of surface spills of fuel (or other contaminants) to the groundwater. The potential for subsurface release to groundwater via leakage from USTs has been minimized at the AASF by the installation of double-walled tanks with automatic leak detection systems for most of the heating oil in storage. Two single-walled 550-gal USTs, one containing heating oil and the other containing diesel fuel for an emergency generator, are regularly monitored to ensure early detection of leakage. Two older single-walled USTs containing gasoline were removed and replaced with aboveground storage. Sampling at the time of excavation showed that no subsurface contamination had occurred (Scott 1992a).

4.2 Releases to Surface Water

No surface water impoundments or flows are present on the property. The closest water body is the White Oak Swamp, whose headwaters southeast of the property are separated from the AASF by the Chesapeake and Ohio Railroad (VDMA 1992b).

Storm drainage on asphalt- or concrete-covered areas of the ARNG property is directed via catch basins into the Richmond International Airport storm drainage system. Storm water drainage collected from the AASF refueling and fuel storage area, as well as at the two wash areas used at the site, is filtered through oil-water separators before it is emptied into the storm sewer network. The airport's storm drainage system then discharges to an unnamed tributary to White Oak Swamp Creek, flowing south of the AASF property. Surface drainage in grass-covered areas of the property is also directed via shallow ditches to the southern edge of the property.

4.3 Releases to Soil

Infrequent spills of hazardous materials, primarily JP-4 fuel, have occurred during the years of VaARNG operations. Three spill events are described below as being typical of the volume and location of releases to site soils and the response actions taken.

1. During an aircraft refueling operation on May 5, 1990, approximately 50-100 gal of JP-4 were spilled onto the airfield when a bladder line coupling broke (Williams 1990a). Contaminated soil was removed from the spill site and placed in 100 drums (55-gal). The VDEQ was informed of the spill, and when composite soil sampling of the drummed soil determined the waste to be nonhazardous, proper disposal was undertaken (Williams 1990b).

2. During refilling of one of the 25,000-gal JP-4 storage tanks on June 19, 1990, approximately 40-50 gal of JP-4 spilled onto the surface soils (sandy loam overlying several feet of clay) within the bermed fuel farm area (Hodges 1990). The 25,000-gal aboveground tank was improperly gauged, causing the tanker to overfill the storage tank. The AASF personnel responded by removing the contaminated sandy soil and placing it on a plastic sheet. Over a number of weeks the contaminated sand was aerated to allow dissipation of the fuel. After evaporation of the fuel, when no odor or discoloration of the sand was evident, the sand was replaced in the bermed area (Percival 1990). The VDEQ was informed of this response action and concurred (Huxtable 1990).

3. During maintenance of an aircraft transmission and fuel line on March 9, 1992, approximately 15-20 gal of JP-4 were released to the airfield through a defective fuel filter (Davis 1992). Contaminated soil was removed from the spill site and placed in 12 drums (55-gal). After sampling of the drummed material, proper disposal was undertaken.

4.4 Releases to Air

Routine operations performed as part of VaARNG activities are associated with a number of air pollution sources such as (1) aircraft engine exhaust during operations and maintenance, (2) gasoline-fueled ground service equipment and vehicular traffic, (3) heating and air conditioning plants, and (4) fuel handling and storage systems. Pollutants emitted include carbon monoxide, hydrocarbons, sulfur oxide, nitrogen oxide, particulates, and aldehydes (VDMA 1992b). The proximity of the VaARNG facility to the Richmond International Airport makes it difficult to separate air quality impacts by source. Current and proposed operations at the AASF are not expected to have significant additional impact on regional air quality.

4.5 Other Releases

Operation of aircraft, vehicles, and grounds keeping equipment and aircraft and vehicle maintenance operations generate noise at the AASF. Helicopter landings and takeoffs are the primary contributor of noise. Richmond International Airport, directly northwest of the AASF, generates a much higher level of noise. The AASF is located within the airport's 70- to 75-dB noise pattern (Williams 1993b).

Fire and explosion could result from an accident involving a vehicle or aircraft assigned to the unit.

5 Human and Environmental Receptors

5.1 Groundwater

Groundwater is used in eastern Henrico County as a source of potable water. Municipal wells requiring high yields for communities or residential housing subdivisions are drilled to the lower Patuxent Formation. A number of low-yield shallow wells are present in the sparsely populated rural area south and east of the AASF. Groundwater downgradient of the AASF (east and southeast of the property) is at potential risk from fuel spills.

Shallow wells are at principal risk. Infiltration of precipitation is considered to be the dominant source of groundwater recharge in the region, and annual rainfall in Henrico County averages 3.68 ft (Wigglesworth et al. 1984). An estimated 80% of the precipitation goes to run-off, vegetation, and evaporation, while the remaining 20% recharges the groundwater supply. Most of this infiltrated water remains as the unconfined water table aquifer. Contaminants released at or near the ground surface in upgradient areas will be transported via lateral migration along surface drainage patterns. Therefore, shallow wells south and east of the AASF, along the flow of the White Oak Swamp Creek, are at the highest risk.

Deep wells in the vicinity of the AASF are at minimal risk from AASF-generated contaminants. A fraction of precipitation is available to enter the confined portion of the aquifer. Tested hydraulic conductivity values for the confining units above the Patuxent Formation are low, and it is probable that no more than 1% of the water available for deep infiltration actually enters the Potomac aquifer (in the Patuxent Formation geologic unit) by vertical recharge (Wigglesworth et al. 1984).

5.2 Surface Water

Storm drainage from the Richmond International Airport and the AASF is released to a tributary of the White Oak Swamp Creek about 200 ft south of the AASF. The downgradient surface waters are unlikely be significantly affected by ARNG activities. Drainage from the areas of the property with the highest potential for contamination (i.e., the JP-4 fuel farm and associated fueling areas, the aircraft maintenance area, and the wash areas) is filtered through oil-water separators before discharge to the airport's sanitary sewer system.

The James River is a source of potable water for residents of Richmond and western Henrico County. Intakes are upgradient of the AASF property. Drainage from the AASF and the airport first flows east to the Chickahominy River, then merges with the James River approximately 12 mi downstream.

5.3 Soil

Access to the AASF is restricted to VaARNG personnel and escorted visitors. Workers in areas where surface soil contamination is most likely present, such as at the JP-4 fuel farm, are appropriately trained about potential hazards.

A *Spill Prevention Control and Countermeasure Plan* and an *Oil Discharge Contingency Plan* have been developed for the AASF (VDMA 1992a, 1993). Site personnel receive training in appropriate, rapid response actions to be taken after a spill of fuel or other hazardous material to the ground surface, to localize the spill and remediate any soil contamination (Scott 1992b). This training greatly reduces the potential for contaminants released to site soils to migrate to areas outside the property boundary.

5.4 Air

Site personnel are exposed to minor releases of contamination to the air during regular aircraft/vehicle operations and maintenance activities. Dust masks or filters are used when appropriate (e.g., during welding, sanding, or painting) to reduce the level of exposure. Air dispersion in the region is generally good, and exposure of the off-site population to VaARNG-generated contamination via air is unlikely.

5.5 Other Receptors

Access to the AASF property by civilians is controlled by fencing to prevent unauthorized entry to hazardous areas. Noise levels at the AASF are consistent with noise produced by activities at Richmond International Airport.

6 Preliminary Assessment Findings and Conclusions

6.1 Summary of Preliminary Assessment Findings

The AASF is located at the Richmond International Airport in eastern Henrico County, Virginia. The city of Richmond is approximately 5 mi west of the AASF, and the small towns of Sandston and Highland Springs are about 1 mi north. Originally constructed in the 1960s as an active Air Force interceptor base, the 91.5-acre AASF is now used as an aviation maintenance and training facility by Army National Guard units located in Virginia, including its tenant organizations, Detachment 4 of HHC headquarters; Company A, Company B, and Company D of the 2nd Battalion, 224th Aviation; Detachment 1 of Company D of the 1st Battalion, 132nd Aviation; RAID Virginia (drug interdiction); and Detachment 1 of the 986th Medical Company. Approximately 420 personnel are assigned to the facility. The aircraft inventory includes UH1 utility helicopters (29), UH60 utility helicopters (15), OH58 observation helicopters (7), and one C12 transport plane.

Hazardous materials used and stored at the facility include JP-4, diesel fuel, gasoline, liquid propane gas, heating oil, and motor oil. Total storage capacity of these materials is approximately 73,000 gal. The jet fuel tank farm in the southern portion of the property is the location of the largest storage tanks. Two 25,000-gal aboveground tanks, enclosed within an earthen, asphalt-covered berm, contain JP-4. Adjacent to the JP-4 fuel farm are two 5,000-gal tanks for diesel fuel and gasoline. These tanks and associated dispensing pumps are within metal containment basins. North of the fuel farm, in the aircraft maintenance area, heating oil is stored in two USTs of 2,000-gal and 5,000-gal capacity. These tanks are of double-wall construction with automatic leak detection systems. Two small single-walled USTs of 550-gal capacity are located near Building 3903 and Building 3990 for storage, respectively, of heating oil No. 2 and diesel fuel to power an emergency electric generator. Five 1,000-gal and one 550-gal aboveground tanks store propane.

A preliminary assessment of Byrd Field AASF was performed to determine the potential for hazardous constituents present on site as a result of current or past operations to migrate beyond the property boundary to areas of human or environmental concern. The primary ESOs associated with the property are (1) fuel storage and dispensing; (2) hazardous materials/hazardous waste storage; and (3) aircraft, vehicle, and equipment washing. Groundwater is used in the vicinity of the AASF as a source of potable water. Surface water drainage from the property is to the White Oak Swamp Creek, which flows south of the property and feeds the Chickahominy River and the James River. These represent the principal receptors for potential contamination from ESOs at the AASF.

Shallow groundwater from the upper water table aquifer is used by many individuals in the region as a source of potable water. The primary migration pathway for contaminants to the shallow groundwater is via infiltration of precipitation transporting contaminants (principally fuel) released to the surface and near-surface soils of the site. Containment mechanisms are in place to reduce the potential for major releases of fuel through tank or fuel line rupture. Minor spills (primarily fuel) have occurred at the facility. Appropriate and rapid spill response actions have limited the potential for adverse impact to the shallow groundwater. Infiltration of contaminants to the deeper aquifers is effectively prevented by overlying confining clay units.

Of particular concern as a potential source of contamination are the two 25,000-gal aboveground JP-4 tanks enclosed in an earthen berm. The 3.5-ft-high sides of the berm are covered with asphalt, and the base is compacted soils. The compacted soil base of the containment berm is not impermeable, but it does form an effective barrier, adequately slowing migration of fuel from the spill location so that cleanup can proceed. Past sampling at the JP-4 fuel farm, located in the downgradient portion of the AASF property, in response to former fuel spill events, has indicated that no contamination of the groundwater has occurred. On August 23, 1989, after construction of a storm drainage ditch south of the fuel farm, water appeared to be seeping into the ditch from beneath the tank farm (Williams 1989a). Analytical results indicated that no petroleum hydrocarbons were present in the sample collected (Williams 1989b). On October 2, 1990, three piezometers were installed within the bermed fuel farm area (VGS 1990). The drilled holes, approximately 4 in. in diameter, ranged from 4.24 to 4.83 ft in depth. Water was not encountered. A photoionization detector (HNu) was used to detect the presence of contaminants in the cuttings from the borings and in the airspace within each piezometer. The HNu readings were 10 ppm or less in soils (i.e., within the range expected in the proximity of fuel-related activities) and substantially less than the action level criterion established by the EPA, at which a corrective measure study is recommended. The action level criteria in soil for the two fuel constituents toluene and xylene are 20,000 ppm and 200,000 ppm, respectively (EPA 1990). No fuel release to groundwater has been indicated during subsequent inspections of the monitoring locations.

The potential for migration of contaminants from the AASF via surface water flows has been minimized by the installation of oil-water separators to filter drainage from the areas of the facility with the highest potential for contamination, including the storm water drainage from the

JP-4 fuel farm. Drainage from the fuel transfer location, the hot refueling point, the aircraft/vehicle wash areas, the maintenance work bays, and the waste drum storage area is filtered through oil-water separators before discharge to the sanitary sewer system. Construction upgrading the facility fueling system has recently been completed. Monitoring of the facility's oil-water separator is underway to determine the appropriate cleaning schedule.

6.2 Recommendations for Further Action

The PA is designed to characterize the site accurately and determine the need for further action by examining site activities, quantities of hazardous substances present, and potential pathways by which contamination could affect public health and the environment. The primary objective of the PA is to identify and evaluate ESOs that would result in either (1) immediate action, (2) site investigation, or (3) no further PA/IRP action. The available information indicates that the AASF is generally well maintained and poses minimal potential threat to human health and the environment. No further PA/IRP action is warranted.

7 References

Clay, J.W., 1975, *Soil Survey of Henrico County, Virginia*, U.S. Department of Agriculture, Soil Conservation Service, October.

COR, 1964, *Lease No. DA-44-110-ENG-5654*, City of Richmond, Virginia, Lease of a portion of the Richard E. Byrd Flying Field to the United States of America for the exclusive use of the U.S. Air Force, July 1.

COR, 1967, *Lease No. DA-44-110-ENG-5654 Modification No. 1*, City of Richmond, Virginia, Supplemental lease agreement between the City of Richmond and the United States of America, increasing the amount of property covered in the lease agreement, July 1.

COR, 1972, *Lease No. DA-44-110-ENG-5654 Supplement*, City of Richmond, Virginia, Amendment to Lease No. DA-44-110-ENG-5654, expanding the use of the property leased to include helicopter service, July 1.

CRAC, 1984, *Lease No. DA-44-110-ENG-5654, Modification No. 3*, Capital Region Airport Commission, Supplemental agreement between the Capital Region Airport Commission and the U.S. Corps of Engineers, to modify the conditions of the original lease regarding the property covered in the lease, April 15.

Dale, W., 1991, Letter from Dale, Planning Coordinator, Capital Region Airport Commission, Richmond International Airport, to Lt. Col. James D. Holden, describing the status of the storm water discharge permit application to the Virginia State Water Control Board, November 20.

DACS, 1992, Letter from John R. Tate, Endangered Species Coordinator, Office of Plant Protection, Commonwealth of Virginia, Department of Agriculture and Consumer Services, Division of Product and Industry Regulation, *Endangered or Threatened Plant or Insect Species near the Virginia Army National Guard Facility in Henrico County, VA*, to David L. Davis, Resource International Limited, regarding the status of threatened or endangered plant or insect species in the vicinity of the AASF, October 15.

Davis, C.E., 1992, *Spill Accident Report 9Mar92*, Spill accident and cleanup report, Commonwealth of Virginia Department of Military Affairs, March 11.

DCR, 1992, Letter from Timothy J. O'Connell, Environmental Review Coordinator, Commonwealth of Virginia, Department of Conservation and Recreation, Division of Natural Heritage, to David Davis, Resource International Limited, regarding the status of natural heritage resources in the vicinity of the AASF, October 13.

Dennis, C.B., 1993, Unpublished site reconnaissance and interview notes about the preliminary assessment of the AASF, Sandston, Virginia, June.

DGIF, 1992, Letter from Rebecca K. Wajdo, Fish and Wildlife Information System Coordinator, Department of Game and Inland Fisheries, Commonwealth of Virginia, to David L. Davis, Resource International Limited, regarding status of endangered or threatened animal species in the vicinity of the AASF, October 12.

DOA, 1980, *License No. DACA65-3-81-15*, U.S. Department of the Army, License agreement between the U.S. Department of the Army and the Commonwealth of Virginia, granting use of a portion of Byrd Field to the Virginia Army National Guard until June 30, 1994, effective September 22, 1980. Accepted by Major General William J. McCaddin, Adjutant General of the Virginia Army National Guard, on February 2, 1981.

DOA, 1985a, *Supplemental Agreement No. 1 to License Contract No. DACA65-3-81-15*, U.S. Department of the Army, Amendment to the original license agreement to exchange land parcels covered in the license agreement and to reduce the land acreage covered, April 15.

DOA, 1985b, *License No. DACA65-3-85-58*, U.S. Department of the Army, License agreement between the U.S. Department of the Army and the Commonwealth of Virginia, granting use of 91.5 acres of Byrd Field to the Virginia Army National Guard until June 30, 1994. Accepted by Major General John G. Castles, Adjutant General of the Virginia Army National Guard, on October 4.

DOA, 1987, *Supplemental Agreement No. 1 to License Contract No. DACA65-3-85-58*, U.S. Department of the Army, Amendment to the original license agreement to allow construction, operation, and maintenance of the Byrd Field AASF maintenance hangar, March 3.

DOA, 1989, *Extension of Lease No. DA-44-110-ENG-5654 and License No. DACA65-3-85-58*, U.S. Department of the Army, Memo to the National Guard Bureau regarding action to extend the current lease agreement between the United States of America and the City of Richmond, as well as the license agreement between the U.S. Department of the Army and the National Guard Bureau, for the AASF property for an additional 30 years.

EPA, 1990, "Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities," *Code of Federal Regulations*, U.S. Environmental Protection Agency, Volume 55, Number 145, July 27.

Focazio, M.J., G.K. Speiran, and M.E. Rowan, 1993, *Quality of Groundwater in the Coastal Plain Physiographic Province*, U.S. Geological Survey Water Resources Investigations Report 92-4175.

Hamilton, P.A., and J.D. Larson, 1988, *Hydrogeology and Analysis of the Ground-water Flow System in the Coastal Plain of Southeastern Virginia*, U.S. Geological Survey Water Resources Investigations Report 87-4240.

Hodges, M., 1990, *JP-4 Spill at AASF 19Jun90*, Facilities Engineering and Management, Department of Military Affairs, Commonwealth of Virginia, Memorandum for Record, June 19.

Huxtable, S.L., 1990, *JP-4 Spill at AASF 19Jun90*, Facilities Engineering and Management, Department of Military Affairs, Commonwealth of Virginia, Memorandum for Record, June 21.

Kull, T.K., and R.J. Laczniak, 1987, *Groundwater Withdrawals from Confined Aquifers in the Coastal Plain of Virginia, 1891-1983*, U.S. Geological Survey Water Resources Investigations Report 87-4049.

Levine, L.J., 1991, *Certificate of Laboratory Analysis*, from Levine, Manager of Laboratory Services, Commonwealth Laboratory, Richmond, Virginia, regarding analytical results for six soil samples collected during removal of two underground storage tanks, December 17.

NGB, 1988, *Army National Guard Facility Inventory and Stationing Plan (FISP)*, U.S. Army National Guard Bureau, Aberdeen, Maryland, January.

Percival, H.P., 1990, *Cleanup at Fuel Farm 26Jun90*, Building and Grounds Superintendent, Department of Military Affairs, Commonwealth of Virginia, Memorandum for Record, June 26.

Queisser, J.C., 1992, Letter from Queisser, Environmental Program Planner, Virginia State Water Control Board, to Lloyd R. Scott, Department of Military Affairs, confirming receipt of the *Oil Discharge Contingency Plan for the Army Aviation Support Facility*, June 5.

Rand McNally, 1992, *Rand McNally 1992 Atlas*, Rand McNally and Company, Chicago, Illinois.

Schnabel, 1990, *Geotechnical Engineering Study, VaARNG Army Aviation Support Facility, Phase II*, Schnabel Engineering Associates, Richmond, Virginia, Contract V900095, March 22.

Scott, L.R., 1992a, Letter from Col. Scott, Assistant Chief of Staff, Facilities Engineering and Management, Virginia Department of Military Affairs, to Russ Ellison, Virginia Water Control Board, amending the AASF UST status and providing an amended *Notification for Underground Storage Tanks* form, February 19.

Scott, L.R., 1992b, *Oil Discharge Contingency Plan for AASF*, Memorandum from Col. Scott, Facilities, Engineering, and Management, Virginia Army National Guard, to Col. Holden regarding spill control review procedures in place, May 13.

STI, 1988, *Draft Installation Restoration Program Preliminary Assessment of Headquarters, 192nd Tactical Fighter Group, Virginia Air National Guard, Byrd International Airport, Sandston, Virginia*, Science & Technology, Inc., Oak Ridge, Tennessee, May.

USGS, 1983, *Henrico County and City of Richmond, Virginia*, U.S. Geological Survey, 1:50,000-scale metric topographic map 37077-E4-CM-050.

USGS, 1986, *Topographic Map - Dutch Gap, Virginia Quadrangle*, U.S. Geological Survey, 37077-D3-TF-024.

USGS, 1987, *Topographic Map - Seven Pines, Virginia Quadrangle*, U.S. Geological Survey, 37077-E3-TF-024.

VDMA, 1989, *Master Plan for VaARNG Army Aviation Support Facility, Sandston, Virginia*, 17 March 1989 Revision, Virginia Department of Military Affairs, Richmond, Virginia.

VDMA, 1992a, *Oil Discharge Contingency Plan for VaARNG Army Aviation Support Facility, Sandston, Virginia*, prepared by SEC Donohue, Richmond, Virginia, for Virginia Department of Military Affairs, Richmond, Virginia, SEC Job RM452, April.

VDMA, 1992b, *Draft On-Going Environmental Assessment for VaARNG Army Aviation Support Facility, Sandston, Virginia*, prepared by Resource International, Ashland, Virginia, for Virginia Department of Military Affairs, Richmond, Virginia, Job P.N.91057.A01, December 4.

VDMA, 1993, *Oil Spill Prevention Control and Countermeasure Plan for VaARNG Army Aviation Support Facility, Sandston, Virginia*, prepared by SEC Donohue, Richmond, Virginia, for Virginia Department of Military Affairs, Richmond, Virginia, SEC Job RM452, January.

VDMR, 1973, *Geologic Studies, Coastal Plain of Virginia*, Virginia Division of Mineral Resources, Department of Conservation and Economic Development, Bulletin 83, Parts 1 and 2.

VGS, 1990, *Report of Piezometer Installation at the Army Aviation Support Facility*, prepared by Virginia Geotechnical Services, Richmond, Virginia, for E.S. Williams, Virginia Department of Military Affairs, October.

Wigglesworth, H.A., T.W. Perry, and R.P. Ellison III, 1984, *Groundwater Resources of Henrico County, Virginia - Present Conditions and Prospects*, Commonwealth of Virginia, State Water Control Board, Piedmont Regional Office, Bureau of Surveillance and Field Studies, Planning Bulletin 328, March.

Wigglesworth, H.A., 1993, Personal communication from Wigglesworth, Geologist, Virginia Department of Environmental Quality, Piedmont Regional Office, Bureau of Surveillance and Field Studies, July 1.

Williams, E.S., 1989a, *Environmental Contamination at AASF on 23Aug89*, Memorandum from Williams, State Environmental Specialist, Facilities Engineering and Management, Department of Military Affairs, Commonwealth of Virginia, to Col. Timberlake and Bob Davis, August 25.

Williams, E.S., 1989b, *Environmental Sampling at AASF on 23Aug89*, Memorandum from Williams, State Environmental Specialist, Facilities Engineering and Management, Department of Military Affairs, Commonwealth of Virginia, to Col. Timberlake and Bob Davis, September 5.

Williams, E.S., 1990a, *AASF Spill 5May90*, State Environmental Specialist, Facilities Engineering and Management, Department of Military Affairs, Commonwealth of Virginia, Memorandum for Record, May 11.

Williams, E.S., 1990b, Letter from Williams, State Environmental Specialist, Facilities Engineering and Management, Department of Military Affairs, Commonwealth of Virginia, to K. Kontoponos, Virginia Geotechnical Services, Richmond, Virginia, regarding the May 5, 1990, spill cleanup, notification, and disposal, June 26.

Williams, E.S., 1993a, Facsimile transmittal from Williams, Virginia Department of Military Affairs, to C. Dennis, Argonne National Laboratory, providing an estimate of annual usage of petroleum, oils, and lubricants at the AASF, July 8.

Williams, E.S., 1993b, Telephone conversation between Williams, Virginia Department of Military Affairs, Richmond, Virginia, and C.B. Dennis, Argonne National Laboratory, Argonne, Illinois, September 17.

Appendix:

Interview Information

Appendix:

Interview Information

Individuals Interviewed

Environmental Officer
Virginia Department of Military Affairs
Richmond, Virginia

Architectural Project Manager
Virginia Department of Military Affairs
Richmond, Virginia

Maintenance Foreman
Army Aviation Support Facility
Sandston, Virginia

Hydrogeologist
Virginia Department of Environmental Quality
Piedmont Regional Office
Richmond, Virginia

Argonne Investigators

Clyde Dennis
(708) 252-5999

Candace Rose
(708) 252-3499

DATE
FILMED
12/01/93

END