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Final Data Acquisition/ Summary Report

Penniman Shell Loading Plant Site Williamsburg, York County, VA

29 October 1999

Prepared for
U.S. Environmental Protection Agency Region III
Federal Facilities Section
Philadelphia, PA

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DATA ACQUISITION SUMMARY REPORT

Penniman Shell Loading Plant Site
Williamsburg, York County, Virginia

TDD No. 9901-45
Contract No. 68-S5-3002

1.0 INTRODUCTION

The Roy F. Weston, Inc. (WESTON®), Site Assessment Technical Assistance (SATA) team was directed by U.S. Environmental Protection Agency (EPA) Remedial Project Manager (RPM) Robert Thomson to complete a Data Acquisition/Summary Report (DASR) for the Penniman Shell Loading Plant (PSLP) Site located in Williamsburg, York County, Virginia. This DASR has been prepared as part of the Site Inspection activities outlined in Work Plan #1, dated March 1998.

1.1 Purpose

Following the initiation of a background investigation of the PSLP site, it was discovered that pertinent information regarding the site was uncategorized and widely distributed among several parties. As a result of the accelerated pace of construction of the PSLP, its short period of operation, the amount of time which had passed since its operation, and the fact that property ownership had been transferred several times through private and federal parties, information had been misplaced or simply never categorized in an adequate manner. This document was developed in order to compile and combine the currently available information regarding the PSLP Site from all identified information sources in a usable format.

Every effort has been made to include all of the currently available information regarding the PSLP site. It should be noted that additional information regarding this site continues to be generated as additional studies and investigations proceed. This DASR has been prepared in a manner which enables it to be updated or amended easily as new information is generated.

1.2 Document Organization

The remainder of this document is organized into five sections (2.0 through 6.0). Section 2.0 provides a general background of the site, a summary of previous investigation reports and background documents, and a description/background of each of the specific study areas within the site. Section 3.0 provides information on the site area, including climate, geology, hydrology, and other physical characteristics. Section 4.0 provides detailed descriptions of the previous investigations to determine the nature of contamination at the site. Section 5.0 contains information regarding the environmental setting of the site, including sensitive areas, endangered species, and wetlands information. Section 6.0 provides a complete, chronological listing of all currently identified documents, maps, diagrams, reports, papers, and photographs pertaining to the Penniman Shell Loading Plant Site.

In order to present the information acquired for this report as accurately as possible, some of this information has been duplicated verbatim from source documents. This ensures that the original detail and intent of these documents has been maintained. In order to facilitate future revisions of this report, a detailed table of contents has been developed and reference lists have been included at the end of each section. Section 6.0 is a listing of source documents in chronological order by document type for easy revision.

REFERENCES – SECTION 1.0

1. Roy F. Weston, Inc. 1998. Draft Work Plan #1 USN Supply Center. Cheatham Annex. 19 March.

2.0 BACKGROUND

This section provides general background information regarding the site, including its layout and history. In addition, a brief summary of all previous environmental studies and several background documents pertaining to the Penniman Shell Loading Plant Site is included.

2.1 Site Description

The Penniman Shell Loading Plant Site consists of approximately 3,300 acres just outside of Williamsburg, York County, Virginia. The approximate site coordinates are 37° 16' 49" north latitude and 76° 37' 03" west longitude (see Figure 2.1, Site Location Map). The site is currently divided between the United States Navy (USN) Supply Center Cheatham Annex (CAX), the United States Department of the Interior (DOI) National Park Service (National Colonial Park), and the Virginia Department of Emergency Services (VADES) (fuel farm). All of these parcels were, at one time, a part of the duPont de Nemours Company's U.S. Penniman Shell Loading Plant which operated during World War I. The site is bordered to the east by the York River, to the north by Queen Creek and the U.S. Naval Reservation Camp Peary, to the west by the Williamsburg Battlefield, and to the south by King Creek and the U.S. Naval Weapons Station.

2.2 Site History

The Penniman Shell Loading Plant Site was originally intended by the E.I. duPont de Nemours Company to be a dynamite (TNT) manufacturing plant operating in the southern United States. Construction of this TNT plant, designated as "Factory #37," began in 1916. In 1916 during construction, Factory #37 was renamed the Penniman TNT plant in honor of Russell S. Penniman, the inventor of ammonia dynamite. The Penniman TNT plant was completed in October 1916, however, it remained idle until 1917, at which time it was converted to a shell loading plant under contract to the United States government and was renamed the U.S. Penniman Shell Loading Plant. In 1918, following the end of World War I, the facility was re-designated as the Penniman General Ordnance Depot. Between the years of 1918 and 1926, the U.S. government operated the Penniman General Ordnance Depot, primarily in order to prepare manufactured ordnance and explosives for long-term storage and to ship these materials to other, more permanent ordnance depots in the United States. During this same period, the E.I. duPont de Nemours Engineering Company, a subsidiary of E.I. duPont de Nemours Company, operated at this same location decommissioning military ordnance and dismantling the former Shell Loading Plant and TNT plant structures.

In 1926, all of the property formerly known as the U.S. Penniman Shell Loading Plant, the Penniman General Ordnance Depot, and the Penniman TNT plant were sold to a private party and reverted to farmland.

In 1942, the United States Navy established the Cheatham Annex Supply Center on a portion of this property. In September 1979, a portion of this property, including a large portion to the north of Sanda Avenue and a right-of-way easement through the center of the property, was transferred to DOI, National Park Service, which subsequently established the National Colonial Historical Park. In 1981, an additional portion of this property, the former fuel farm located to the west of the National Colonial Parkway and south of Penniman Road, was sold to the Virginia Department of Emergency Services. According to available documentation, the actual sizes and boundaries of some of these parcels have not been accurately defined. The most accurate information available (see "Real Estate Summary Map, Naval Supply Center Cheatham Annex, Y & D Drawing Nos. 980058, 980059, and 980060") depicts the USN CAX property as 1,577.74 acres, the DOI property as 786 acres, and the VADES fuel farm property as 460 acres. Unfortunately, the map depicting the USN CAX and DOI properties identifies a portion of the boundary between these two areas as "subject to survey." No accurate information regarding the actual location of this boundary is available from the USN, DOI, or York County.

A detailed history of the site activities has been compiled based primarily upon the available documentation for the site. This detailed history is as follows:

1912 - The E.I. duPont de Nemours Company considered two locations for a new TNT production plant in the southern United States, one at Hopewell, VA and one along the York River, just outside of Williamsburg, VA. The decision was made by the duPont Company to construct the Hopewell Plant and abandon plans for the York River area.

1912 through 1916 - In response to war contracts entered by the E.I. duPont Company with European nations for the production of guncotton-based explosives for military explosives and artillery shells, changes were made at the Hopewell, VA plant to produce more nitro-cellulose and less TNT. These changes limited duPont's TNT production capability.

1916 - As the result of an increased war demand for TNT and a reduced production capability after changes had been made at the Hopewell, VA plant, E.I. duPont de Nemours Company selected the York River area just outside of Williamsburg, VA for the construction of a new "dynamite from nitro-starch" plant. In February, the duPont Company began purchasing property in the area that was to become "Factory #37."

In March, two construction crews began work on E.I. duPont Company's "Factory #37." One of these crews worked on building a new railroad spur from Williamsburg to the duPont owned property and the other began constructing housing and factory areas on the duPont property along the York River.

On 29 April, E.I. duPont purchased an additional 2,800 (+/-) acres outside of Williamsburg, VA from various private owners as specified in York County Deed Book 35A, p. 410.

In May, the duPont Company's TNT Factory #37 was officially named "Penniman," after Russel S. Penniman, the inventor of ammonia dynamite.

The railroad spur extending from Williamsburg to the duPont property was completed in June and construction of the plant intensified.

The construction of four TNT production lines at the Penniman Plant began in August. These four TNT production lines were completed in October 1916.

In November, construction activities at the Penniman Plant ceased. According to historical information, the Penniman Plant remained idle and did not produce TNT, although the four TNT production lines had been completed.

1917 - On 6 April, the United States declared war on the Imperial German government and the Imperial and Royal Austro-Hungarian governments.

On 23 May, the E.I. duPont Engineering Company (a subsidiary of the E.I. duPont de Nemours Company) submitted a proposal to the U.S. government outlining the costs associated with converting the existing, idle Penniman TNT plant into a shell loading plant.

On 24 October, the U.S. Ordnance Department solicited proposals from private companies for the construction and operation of a shell loading plant.

On 7 November, the E.I. duPont Company purchased 1,000 acres outside of Williamsburg, VA as specified in York County Deed Book 35, p. 594.

On 19 November, the E.I. duPont Engineering Company submitted a proposal to the U.S. government for the construction and operation of a high explosives shell loading plant at the Penniman location.

On 31 December, the E.I. duPont Engineering Company was awarded U.S. government contract number WAR-ORD-G-1320-732A to construct and operate a booster and shell loading plant at the Penniman site. The contract specified that the plant would consist of 12 units with the capacity to load 12,300,000 high explosive shells annually ranging in size from 77-mm and 3-inch to 240-mm and 9.2-inch.

1918 - On 12 April, the 31 December, 1917 contract between the U.S. government and E.I. duPont Engineering Company was revised to include the production of adapter and booster casings at the Penniman Shell Loading Plant.

In addition, the duPont Engineering Company agreed to lease 654.9 acres of the Penniman property to the United States government.

On 12 April, the duPont Engineering Company subcontracted the Hancock-Pettyjohn Company to construct an employee village at the Penniman Shell Loading Plant.

On 7 September, the United States government became vested in the property owned by duPont by virtue of the Proclamation of the President of the United States dated 7 August 1918. The Penniman site was designated to become the U.S. Navy Mine Depot, as fully delineated on the "Map of Government Survey of the Navy Mine Depot Area, Y&D #87046." This particular area was designated as Tract #7.

On 11 November, an armistice was signed between the Imperial German government, the Imperial and Royal Austro-Hungarian governments, and the Allied governments, ending World War I. Shell decommissioning at the Penniman Shell Loading Plant began shortly thereafter.

On 21 November, four men were killed in an explosion in the "large caliber line" of the Penniman Shell Loading Plant.

On 10 December, a generalized inventory list of government property on the Penniman "D" and "G" plant properties was sent to duPont Engineering Company by the U.S. Ordnance Department with instructions for preparation and storage of ordnance and explosives.

On 31 December, control of a portion of the Penniman Shell Loading Plant reverted back to the duPont Engineering Company from the U.S. Government.

1919 - On 1 January, a generalized inventory list was generated for the Penniman "D" plant by the U.S. Ordnance Department.

In February, shell decommissioning at the Penniman Shell Loading plant was completed.

On 19 February, the E. I. du Pont Engineering Company turned at least a portion (of unknown size) of the Penniman Shell Loading Plant over to the United States government. This portion of the property became the Penniman General Ordnance Depot. In addition, the duPont Engineering Company relinquished approximately 5,000,000 pounds of ammonium nitrate to the United States government.

In July, workers began dismantling portions of the Shell Loading Plant. Some of the material was sold locally for the construction of houses and other structures.

On 24 October, the first shipment of 800,000 pounds of ammonium nitrate, out of a total projected shipment of an estimated 5,000,000 pounds, was shipped from the Penniman General Ordnance Depot to the Navass-Guano company in Wilmington, NC.

In November, an estimated 100 people worked at the plant which formerly employed over 10,000 by one estimate.

1920 - On 5 March, the last shipment (of unknown size) of an estimated 5,000,000 pounds of ammonium nitrate was shipped from the Penniman General Ordnance Depot to an unspecified destination.

1923 - A total of 48,562 155-mm shells were shipped to the Pig Point General Ordnance Depot located in Suffolk, Virginia from the Penniman General Ordnance Depot.

1926 - On 22 April, all of the property owned by the E.I. duPont Company (as specified in York County Deed Book 35A, p. 410 and York County Deed Book 35, p. 594) was transferred to Mr. J. M. Dozier. This transaction completed E.I. duPont Company's disposition of all lands and structures associated with the Penniman Shell Loading Plant.

1942 - On 8 July, the United States government filed proceedings for the condemnation of 2,603 acres of land located along the York River in order to form the U.S. Naval Supply Center Cheatham Annex (CAX). Based upon the available historical records, it is believed that much of the former Penniman Shell Loading Plant property was included as part of these condemnation proceedings.

1943 - The construction of 10 storage houses and 1 cold storage house was completed at USN CAX.

1945 - USN CAX expanded to include 10 additional warehouses, a transit shed, and an additional cold storage building.

1976 - On 15 June, 544.96 acres of USN CAX west of Queen Creek were quitclaimed to York County, Virginia.

1979 - On 4 September, 786 acres of USN CAX located north of Sanda Avenue were transferred to the U.S. Department of the Interior.

1981 - On 6 May, the United States government, U.S. Naval Supply Center Cheatham Annex (CAX), through the General Services Administration (GSA), sold 460 acres of the former fuel tank area to the Commonwealth of Virginia for \$3,666,000.

2.3 Summary of Previous Study Reports and Background Documents

The environmental condition of the Penniman Shell Loading Plant has been investigated by several parties, including the United States Navy and the U.S. EPA. In addition, several other documents have been located which discuss the activities associated with the Penniman Shell Loading Plant. Previous environmental investigation reports, as well as other documents which provide useful information on the site, have been reviewed and summarized in this DASR. The following sub-sections provide a brief description of each of these reports and documents. More detailed descriptions of each of the environmental studies are presented in Section 2.5 of this DASR.

2.3.1 *A History of the duPont Company's Relations with the United States Government, 1802-1927.* E. I. duPont de Nemours and Company, Inc., Smokeless Powder Department. 1928.

This book includes information on duPont's activities including plants, production, processes, and costs on many U.S. government contracts. There is a small reference made to the cost and operation of the Penniman Plant in Chapter XI, pp. 89-90.

2.3.2 *Condemnation Proceedings.* District Court of the United States for the Eastern District of Virginia, Newport News Division. 1942.

This documentation of legal proceedings describes the fair compensation for approximately 1,243 acres of land condemned by the U.S. government for the construction of USN CAX.

2.3.3 *Quitclaim Deed.* United States of America. 21 May 1981.

This quitclaim deed documents the sale of the CAX fuel farm area to the Commonwealth of Virginia for the sum of \$3,666,000 on 6 May 1981.

2.3.4 *DuPont's Silk Purse Inspired Factory-City.* The Times Herald, Metro Section. 1983. 5 September. p. 15.

This article provides a general overview and summary of the activities before, during, and after the operation of the Penniman Shell Loading Plant in the Williamsburg, VA area. Quotes from a former Penniman Shell Loading Plant employee who was interviewed by the reporter are included.

2.3.5 *Initial Assessment Study of Naval Supply Center, Cheatham Annex and Yorktown Fuels Division.* C.C. Johnson & Malhotra, Inc./CH2M Hill. February 1984.

The Initial Assessment Study is the first environmental study prepared at USN CAX as part of the Installation Restoration Program initiated by the U.S. Navy. This study evaluates 12 potential site areas, and provides recommendations for future actions in these areas. The conclusions presented in this report

recommended that further investigations be conducted at Site 1 - Landfill Near Incinerator, Site 9 - Transformer Storage Yard, Site 10 - Decontamination Agent Area, and Site 11 - Bone Yard.

This document provided the basis for the future studies conducted at CAX as part of the Installation Restoration (IR) program. This is a U.S. Navy document.

- 2.3.6 *Confirmation Study, Step 1A (Verification) Round One.* Dames & Moore. June 1986.

Following the Initial Assessment Study (IAS) completed in 1984, the U.S. Navy began assessing the individual areas recommended for further investigation in that report. This report summarizes the first round of sampling conducted at all four of the sites identified in the 1984 IAS study as requiring further investigation. This report includes a summary of sampling results and recommendations for the future actions at these four IR sites. Following the issuance of this report, the U.S. Navy dropped the transformer storage area (Site 9) from the list of sites requiring additional investigation. This is a U.S. Navy document.

- 2.3.7 *Confirmation Study Step 1A (Verification) Round Two.* Dames & Moore. June 1988.

Following the Initial Assessment Study completed in 1984 and the first round of verification conducted in 1986, a second verification round of sampling was conducted to investigate the three sites remaining on the U.S. Navy's list as requiring further investigation (Sites 1, 10 and 11). This report summarizes the second round of sampling conducted at these sites to verify the potential contaminants and the threat posed by these sites. Analytical results from this sampling event were compared to applicable regulatory standards. No recommendations were presented in this report. This is a U.S. Navy document.

- 2.3.8 *Draft Remedial Investigation Interim Report.* Dames & Moore. March 1989.

The draft Remediation Investigation Interim Report was prepared in order to summarize the available data for Sites 1, 9, 10, and 11 and to provide recommendations for additional investigations or remediation efforts at these sites. This is a U.S. Navy document.

- 2.3.9 *Final Remedial Investigation Interim Report.* Environmental Science and Engineering, Inc. February 1991.

This report is a finalized version of the report presented in Section 2.3.8, written by Dames and Moore and issued under the ESE cover. This is a U.S. Navy document.

- 2.3.10 *Draft Architectural Survey and Assessment of the duPont Factory Structures at the Fleet Industrial Supply Center, Cheatham Annex.* R. Christopher Goodwin & Associates, Inc. 26 April 1994.

This report provides an extensive study of the architectural components of the Penniman Shell Loading Plant which still remain at the site today. This report evaluates these structures with regard to historical significance. A detailed summary of historical events of the Virginia peninsula and the Penniman Plant itself are included, as well as a study of the archive research results. This report concluded that the remaining structures at the site are not of historical significance because of their condition and because of the absence of additional intact WWI era structures at the site.

- 2.3.11 *Final Site Investigation for Sites 1, 10, 11.* Baker Environmental, Inc. November 1994.

This report summarizes the additional sampling effort conducted at these sites by Roy F. Weston, Inc. under contract to Baker Environmental, Inc. This report includes a summary of analytical results obtained during this additional sampling and provides recommendations for future investigations at these sites. This is a U.S. Navy document.

- 2.3.12 *Phase 1 Architectural & Archeological Survey.* R. Christopher Goodwin & Associates, Inc. 26 September 1996.

The architectural portion of this report provides an overview of the history of the Penniman Shell Loading Plant, as well as a description of the production process and the shell loading process. The archaeological portion of this report is restricted in its release as the result of archaeologically sensitive information.

- 2.3.13 *Site Screening Process Report, Sites 1, 10, & 11.* Baker Environmental, Inc. September 1997.

This report summarizes the results obtained during the sampling event conducted as part of this investigation. In addition, a human health and ecological risk assessment was prepared in order to evaluate the threat posed by this site to human health and the environment. Conclusions and recommendations were presented for each of the site areas. This is a U.S. Navy document.

- 2.3.14 *Aerial Photograph Analysis, United States Naval Supply Center Cheatham Annex.* United States Environmental Protection Agency, Environmental Photographic Interpretation Center (EPIC). May 1998.

This detailed photographic study of the site provides and evaluates aerial photographs taken between the years of 1937 and 1998. Individual photographs have been reviewed and included in this report, along with transparency overlays identifying significant ground disturbances, structures, changes from year to year, and other information.

- 2.3.15 *Records Research Trip Report Site 8 US Navy Fleet Industrial Supply Center Cheatham Annex (Penniman Shell Loading Plant).* BA & H. 22 May 1998.

This report summarizes the records research efforts conducted by a contractor for the U.S. EPA in relation to the Penniman Shell Loading Plant. A summary of research activities is included, as well as lists of contact agencies and names consulted during this research. Copies of numerous historical documents are included with this report as attachments.

2.3.16 *Shoreline Erosion Assessment Letter Report for Site 1 – Landfill Near Incinerator.* Baker Environmental, Inc. 14 August 1998.

This letter report was prepared in order to address the erosion of the York River bank in the vicinity of Site 1. Conclusions and recommendations were presented with regards to addressing this erosion. This is a U.S. Navy document.

2.3.17 *Trip Report for the Cheatham Annex Site Visit Conducted on 15 September 1998.* Roy F. Weston, Inc. 22 September 1998.

This three page report summarizes the chemical and biological warfare (CBW) munitions specialist's findings during the site visit conducted with the U.S. EPA and USN on 15 September 1998. This report includes recommendations for investigations and includes several support documents as attachments regarding container types, the TNT manufacturing process, warfare trench types from the civil war and WWI eras, shell filling materials, material safety data sheets for shell fillings, and chemical breakdown products from chemical warfare agents.

2.3.18 *Trip Report #1 USN Supply Center Cheatham Annex.* Roy F. Weston, Inc. 30 September 1998.

This trip report documents and summarizes the site reconnaissance visit conducted by WESTON® SATA and the WESTON CBW munitions specialist on 15 September 1998. A chronological narrative summary of the site visit, as well as the CBW munitions specialist's observations and recommendations are included. Photographs of several of the areas located at the site are included.

2.3.19 *Cheatham Annex Site Labeled 1918 Photographs.* Roy F. Weston, Inc. 21 October 1998.

Weston SATA digitally scanned the 12 original panoramic photographs, which were taken from the fire suppression water tower at the Penniman Shell Loading Plant in 1918 and were obtained from the Hagley Museum and Library in Wilmington, DE. Buildings and structures shown in these photographs were labeled on these digital images based on information from the WWI era engineering drawings of the Penniman Shell Loading Plant. A total of 12 panoramic photographs, showing a full 360° view of the plant, were included in this document.

2.3.20 *Sampling Plan #1, Penniman Shell Loading Plant Site.* Roy F. Weston, Inc. 27 October 1998.

This sampling plan specifies the sample types, number, objective, location, and analytical parameters proposed for the first sampling event conducted at the site by WESTON® SATA. This sampling event was originally scheduled to be conducted during the week of 7 December 1998; however, it was postponed and conducted during the week of 11 January 1999 at the request of the U.S. Navy.

2.3.21 *Report for Cheatham Annex Munitions and Material Review Request.* Roy F. Weston, Inc. 11 December 1998.

This report provides detailed information on the materials listed on the two inventories dating from 1918 for the Penniman Shell Loading Plant. An extensive amount of information on artillery shells, shell types, shell fillings, and other related artillery shell data has been provided as appendices by the WESTON® CBW munitions specialist. Based on these inventories, the CBW munitions specialist could not rule out the presence of chemical warfare agents at this site. It was found that at least two shell types listed on these inventories were used for chemical munitions during the WWI time period and period of Penniman operation. Information from the WWI era on these two shell types indicated that the only filling types used in these shells were FM Smoke and HS mustard, both of which were chemical munitions.

2.3.22 *Penniman Shell Loading Plant Site - LHP 1918 Panoramic Photograph Review.* Roy F. Weston, Inc. 2 March 1999.

This four page memorandum addresses each of the areas of concern identified by the WESTON CBW munitions specialist on the 1918 panoramic photographs taken from the fire suppression water tank during the Penniman Shell Loading Plant's operation. This memorandum summarizes WESTON SATA's findings in each of these areas following the 11 January 1999 Site Inspection sampling event, at which time the majority of these areas were reconnoitered by SATA.

2.3.23 *Penniman Shell Loading Plant - LHP 1918 Panoramic Photograph Review.* Roy F. Weston, Inc. 3 March 1999.

Following review of the digitally scanned 1918 panoramic photographs of the Penniman Shell Loading Plant by the WESTON CBW munitions specialist, several areas were identified which were considered areas of concern. SATA digitally labeled these areas of concern on these previously prepared digital 1918 photographic images. A total of 12 panoramic photographs, showing a full 360° view of the plant, were included in this document.

2.3.24 *CENTRACTS Report.* Frost Associates, Inc. April 1999.

This report provides demographic information for the area within a four-mile radius of the Penniman Shell Loading Plant Site. Population data and water supply information are presented for areas within ¼ mile, ½ mile, 1 mile, 2 miles,

3 miles, and 4 miles of the site. A central point within the USN CAX property was selected as the base for these distance ring measurements.

- 2.3.25 *Draft Final Field Investigation Report for Site 1 and Area of Concern 2 at the Fleet Industrial Supply Center (FISC), Cheatham Annex.* Coraopolis, PA. Baker Environmental, Inc. May 1999.

This extensive report summarizes the findings of the field investigation of Site 1, the landfill area near the incinerator, and AOC 2, the dextrose bottle dump area, conducted by Baker Environmental, Inc., in 1999. This report concluded that Site 1 has adversely impacted soil in the immediate area and provides recommendations for the appropriate long term actions in this area. It also concluded that AOC 2 has no apparent site-related contamination; however, it does have several significant magnetic anomalies. The report recommends further evaluation of these magnetic anomalies, including test pit excavations.

- 2.3.26 *Minutes for the 12 May 1999 Meeting Conducted at the Naval Weapons Station Yorktown, Cheatham Annex Site (CAX).* Baker Environmental, Inc. 18 June 1999.

This five page letter provides the minutes for the meeting held on 12 May 1999 regarding the USN CAX site. A wide range of topics were discussed at this meeting, including the status and proposed actions for Site 2, the contaminated food disposal area; Site 3, the submarine dye disposal area; Site 4, the medical supply disposal area; Site 5, the photographic chemical disposal area; Site 7, the old duPont disposal area; Site 9, the transformer storage yard; Site 10, the decontamination agent area; Site 11, the bone yard; Site 12, the disposal site near the water tank; Area of Concern (AOC) 1, the scrap metal dump; and AOC 2, the dextrose dump.

- 2.3.27 *Site Management Plan, Fiscal Year 2000, Naval Weapons Station Yorktown, Cheatham Annex Site.* CH2M Hill Federal Group, Ltd. July 1999.

This report provides a detailed description of the United States Naval Supply Center Cheatham Annex site from the U.S. Navy Installation Restoration Program perspective. This document clearly summarizes the currently available reports which have been generated as part of the Installation Restoration Program initiated by the U.S. Navy and beginning at this site with the Initial Assessment Study prepared for the U.S. Naval Supply Center, Cheatham Annex and Yorktown Fuels Division in February 1984. Detailed descriptions of each of the U.S. Navy IR Sites and Areas of Concern, along with useful summaries of past, present, and future actions at these areas. Much of this information has been reproduced in Section 2.4 of this document.

- 2.3.28 *Final Site Inspection Narrative Report, Penniman Shell Loading Plant Site.* Roy F. Weston, Inc. 9 August 1999.

This report provides a detailed summary of a Site Inspection performed in accordance with EPA guidances. This report focuses on U.S. EPA site areas, and does not consider many of the areas already under investigation by the U.S. Navy. The primary focus of this report includes the activities and wastes associated with the Penniman Shell Loading Plant Site and the Penniman TNT plant. A detailed summary of the sampling event conducted in January 1999 for this SI is included, as are numerous maps and diagrams of sampling locations, Penniman facility structures, wetlands areas, downstream targets, and site location. A summary of the analytical results from the January 1999 sampling event is also included.

2.4 Area Descriptions

Several areas have been investigated, or are currently under investigation, at the Penniman Shell Loading Plant Site. Many of these areas are related to U.S. Navy operations at the USN CAX, while relatively few are considered to date from the World War I era and the Penniman Shell Loading Plant period of operation. The following subsections provide a short summary and history of each of the areas which have been considered as potential areas of contamination. These areas are presented in numerical order according to the U.S. Navy's nomenclature. In some instances, the U.S. EPA has adopted a different name for these areas, an EPA area encompasses more than one U.S. Navy area, or an EPA area has not been identified in the Navy nomenclature. EPA named areas follow U.S. Navy named areas. In other instances, the U.S. EPA has not considered U.S. Navy areas for investigation. Differing nomenclature is presented in the narrative paragraphs associated with each individual area.

Figure 2.2 graphically depicts the location of each of the areas identified in this section. More detailed graphical depictions of the individual areas are presented in Figures 2.3 through 2.16.

Photographs of many of these areas are presented in the Section 2.0, Photographs subsection.

2.4.1 U.S. Navy Area of Concern (AOC) 1 - Scrap Metal Dump

This area has been reconnoitered by the U.S. Navy as "Area of Concern 1 - Scrap Metal Dump" and has been investigated by the U.S. EPA as the "Jones Pond Landfill." This area is located just west of Chapman Road within two ravines associated with the unnamed tributaries to Jones Pond (see Figure 2.3) and is approximately 1.25 acres in size. Various types of debris have been located in this area, including wood, automobile parts, large metal objects and machinery, empty metal drums, metal drums containing a grease-like product, gas cylinders, concrete, piping, and construction debris.

AOC 1 was not specifically identified in the 1998 U.S. EPA EPIC study. However, in 1942, the area had been cleared of trees and contained a large mound of light-toned material. The adjacent rail yard was under construction at that time.

In 1955, the area had been partially revegetated and in 1963 a large mound of fill material was noted. In 1975, the area had been completely revegetated.

This site was reconnoitered during a visit conducted by the U.S. EPA, U.S. Navy LANTDIV, CAX, VDEQ, and WESTON SATA in September 1998.

In January 1999, Weston SATA conducted a Site Inspection of the Penniman Shell Loading Plant Site which included the collection of two sediment samples from the ravines in this area. In addition, one sediment and two surface water samples were collected from Jones Pond downstream of these ravines. The sediment samples collected from the ravines in AOC 1 and Jones Pond were analyzed for Target Compound List (TCL) organics, Target Analyte List (TAL) inorganics, and nitroaromatics. One surface water sample collected from Jones Pond was analyzed for medium concentration TCL organics and medium concentration TAL inorganics. One surface water sample collected from Jones Pond was analyzed for low concentration TCL organics and low concentration TAL inorganics for comparison to drinking water standards.

The results from the January 1999 Site Inspection conducted by WESTON SATA are summarized in the Final Site Inspection Narrative Report for the Penniman Shell Loading Plant Site dated 9 August 1999. The analytical results from this sampling event indicated that:

- Cadmium, chromium, and manganese were detected at elevated levels in the medium concentration surface water sample collected from Jones Pond.
- Manganese was detected at an elevated level which exceeded the U.S. EPA Region III Risk-Based Concentration for drinking water in the low concentration surface water sample collected from Jones Pond.
- Chromium was detected at an elevated level in the sediment sample collected from Jones Pond.
- Manganese was detected at an elevated level in the northern portion of the ravine leading to Jones Pond.

The 1999 Site Inspection Narrative Report for the Penniman Shell Loading Plant Site concluded that hazardous substances, potentially attributable to AOC 1, appeared to be impacting Jones Pond and recommended that additional sampling be conducted in this area to confirm and more accurately define this impact. Specifically, WESTON® SATA recommended that:

- Soil samples should be collected from the Jones Pond Landfill area (AOC 1) to determine the presence of hazardous substances.

- A post-treatment water sample should be collected from the USN CAX treatment system for low concentration organic and inorganic analyses in order to determine the effectiveness of this system.
- A background drinking water sample should be collected from another reservoir utilized for drinking water (similar to Jones Pond) located in the site area.
- Additional surface water samples should be collected from Jones Pond in order to rectify discrepancies noted between the low concentration surface water and medium concentration surface water samples collected during the Site Inspection sampling event.

WESTON SATA concluded that, of the areas investigated during the 1999 Site Inspection, this area (U.S. Navy AOC 1, U.S. EPA Jones Pond Landfill) posed the most significant threat to human health and the environment based upon the potential wastes disposed here, the concentrations of chemical contaminants found in the samples collected from this area, and the use of Jones Pond (a drinking water reservoir). In conclusion, WESTON® SATA recommended that further investigation of this area be conducted in a timely manner.

A summary of significant environmental actions and activities to date for AOC 1 is presented in Table 2.1.

Current Status and Future Actions for AOC 1

Because the nature of the wastes potentially disposed in this area are unknown, LANTDIV considers this area a potentially significant source of contamination. LANTDIV is currently considering this area for further investigation and possible remediation. A Field Investigation study is currently scheduled to be conducted at AOC 1 in November 1999.

Further U.S. EPA actions at this site are pending and will be determined by the RPM in conjunction with the U.S. Navy.

2.4.2 U.S. Navy Area of Concern 2 - Dextrose Dump

This area has been investigated by the U.S. Navy, but has not yet been investigated by the EPA beyond a cursory reconnaissance. This area has been referred to as the "dextrose bottle area" in several letters and reports generated for the U.S. EPA by the WESTON® SATA team.

This area was discovered during site visits conducted by U.S. Navy LANTDIV, U.S. EPA, VDEQ, and Baker Environmental, Inc. in late 1997 and early 1998. It is located in a wooded area just north of Garrison Road along the southern perimeter of CAX (see Figure 2.4). This area consists of several rows of concrete foundation piers, which have been confirmed by WESTON SATA to have once

supported the Penniman Shell Loading Plant's Shipping House #77, and several areas of exposed buried materials including glass bottles containing a clear, colorless liquid confirmed to be dextrose. Several partially buried drums have also been located in this area. The origin of these wastes are unknown; therefore it has not been determined whether these materials were dumped here during the Penniman Shell Loading Plant and U.S. Penniman General Ordnance Depot era (1916 to 1926) or subsequently, either between the years 1926 and 1942 when the property was privately owned or since the inception of USN CAX in 1943.

Baker Environmental, Inc. conducted an investigation of this area in 1998. This investigation included conducting a geophysical survey, soil sampling, temporary monitoring well installation, and groundwater sampling. All of the samples collected during this investigation of this area were analyzed for TCL organics, TAL inorganics, and explosives (nitramines/nitroaromatics). This investigation concluded that no significant chemical contamination was present in this area; however, Baker recommended that six shallow test excavations be conducted to investigate the source of several significant magnetic anomalies detected in this area.

Baker's findings for this area are reported in the *Draft Final Field Investigation Report for Site 1 and AOC 2*, dated 14 May 1999 and prepared for the U.S. Navy.

In May 1998, Reactives Management, Inc. removed a total of 470 bottles from this area as part of a routine housekeeping operation. Approximately 5% of the bottles (24 total) were selected and analyzed to determine if they did indeed contain dextrose, as indicated on several of the bottles. Analytical results confirmed the presence of glucose at greater than 2,000 parts per million (ppm). The contents of these bottles were emptied into the Hampton Roads Sanitation District sanitary sewer system. The empty bottles were then rinsed, dried, and transported to a glass recycling facility. This operation was limited only to those bottles present at the ground surface. Partially buried dextrose bottles still remain at the site.

A summary of the samples collected to date at AOC 2 is presented in Table 2.2. A summary of significant environmental activities to date for AOC 2 is presented on Table 2.3.

Current Status and Future Actions for AOC 2

Although the Field Investigation study of this area did not identify significant chemical contamination in the soil or groundwater, several significant unexplained magnetic anomalies were identified in this area. Based upon the fact that the nature of the materials disposed of in this area are unknown, and the fact that significant magnetic anomalies are present, the U.S. Navy considers this area to be a potentially significant source of contamination. LANTDIV is currently considering this area for further investigation and possible remediation activities.

A Field Investigation study is scheduled to be conducted in this area in November 1999 which will include test excavations and sampling activities.

2.4.3 U.S. Navy Area of Concern 3 - CAD 11/12 Pond Bank

This area has not been investigated by the U.S. Navy nor the U.S. EPA beyond a cursory reconnaissance. This area is located along the north bank of the unnamed pond, between CAX Buildings 11 and 12 and north of D Street (see Figure 2.5). This area consists of an approximately 20 foot by 20 foot by 10 foot high pile of metal banding and a few empty drums adjacent to U.S. Navy Site 4.

A reconnaissance visit of this area was conducted by the U.S. EPA, LANTDIV, and VDEQ, at which point it was designated as AOC 3 by LANTDIV.

A summary of significant environmental activities to date for AOC 3 is presented in Table 2.4.

Current Status and Future Actions for AOC 3

Based upon the apparent non-hazardous property of the materials located in this area, the U.S. Navy does not consider it to be a significant source of contamination. LANTDIV will manage this site separately from Site 4, and has determined that further investigation of this area is warranted. As part of the Field Investigation study currently scheduled for Site 4 in November 1999, one soil sample will be collected from this area in order to determine the presence or absence of chemical contamination. The removal of the metals banding pile may be considered as part of a routine housekeeping operation following the results of the November 1999 Field Investigation study.

Currently, no other actions are anticipated for this site by either the U.S. Navy nor the U.S. EPA.

2.4.4 U.S. Navy Area of Concern 4 - IR Site 4 - Medical Supplies Disposal Area

LANTDIV designated this area as a new AOC in 1998. During preliminary investigations, which included the review of the site's history and other available information, it was determined that AOC 4 was actually the same area as Site 4 - Medical Supplies Disposal Area. AOC 4 will no longer be addressed as a separate entity.

2.4.5 U.S. Navy Area of Concern 5 - Debris Area

LANTDIV designated this area as a new AOC in 1998. AOC 5 is the large pile of debris located at the toe of the Site 1 Landfill which contains cables, conex boxes, an empty storage tank, automobiles, airplane/boat parts, and other miscellaneous items. Based upon the results of the 1998 Field Investigation study of Site 1 by Baker, which included a geophysical survey and soil and sediment sampling in the vicinity of this pile, LANTDIV determined that it was more appropriate to

manage these two areas (Site 1 and AOC 5) as one unit. VDEQ concurred with this decision. As a result, AOC 5 will no longer be addressed as a separate unit and will be managed as part of Site 1.

2.4.6 U.S. Navy Site 1 - Landfill Near Incinerator

This area has been investigated by the U.S. Navy, but has not yet been investigated by the EPA beyond a cursory reconnaissance. This area is located along the York River (see Figure 2.6), behind the former location of the old Navy incinerator in the eastern portion of the USN CAX property, approximately midway between Penniman Spit and Cheatham Landing.

Between the years of 1942 and 1951, this area was used as a landfill for the disposal of burning residues from the Navy incinerator and, between 1951 and 1972, was used as a general landfill for waste materials. Other wastes, including empty paint cans, waste pharmaceuticals, railroad ties, tar paper, rags, construction debris, and lumber were burned and buried in this area until 1981, at which time disposal in this area ceased.

Several investigations of this area have been conducted, including a confirmation study conducted by Dames and Moore in 1985, a Site Inspection conducted by Roy F. Weston, Inc. in 1992, and the most recent study conducted by Baker Environmental, Inc. for the U.S. Navy in 1998.

Based upon the 10 March 1981 landfill closure drawing, an aerial photograph analysis conducted by U.S. EPA EPIC, and geophysical and soil boring data collected during the 1998 investigation, Baker determined the estimated landfill boundary and graphically depicted this boundary in the *Draft Final Field Investigation Report for Site 1 and AOC 2*, dated 14 May 1999. The total landfill area has been estimated at 1.2 acres, which includes the landfill and a large metal debris pile in the landfill area. Along the York River, some landfill debris has been uncovered as the result of erosion, and some landfill debris is exposed along the western edge of the landfill along the edge of the marsh associated with the unnamed tributary to the York River.

The landfill boundary extends to the bank of the York River, where it forms a nearly vertical, unvegetated slope. The York River lies approximately 25 feet below the level of the landfill. Baker's 1998 investigation of this area determined that shoreline erosion along this bank does occur as the result of high water levels and wave action. The erosion in this area was determined to be enhanced by factors such as wind, poor vegetation, and the presence of large trees along the top of the bank. As an interim measure to control this erosion, Baker recommended clearing the trees located along the top and within approximately 50 feet of the slope, in addition to establishing low-growing vegetation in this area. Baker also recommended a long term solution, which consists of moderating the steep slope by cutting it back to a grade of 2 horizontal to 1 vertical and installing a stone revetment at the toe of the slope. Baker stated that these measures are "in general

agreement" with Virginia Department of Conservation and Recreation recommendations.

In February and March 1999, LANTDIV contracted a landscaping firm to clear the trees along the landfill perimeter as recommended by Baker.

A large area of debris, formerly designated by the U.S. Navy as AOC 5, is located north of the landfill perimeter. This area has been investigated and confirmed to contain cables, conex boxes, an empty storage tank, automobiles, airplane/boat parts, and other miscellaneous items. Currently, this area is being managed as a part of Site 1 and not as a separate area.

There are eight monitoring wells located in the landfill area. These monitoring wells were installed around this area on three separate occasions. In 1981, monitoring wells 1GW01 through 1GW04 (5-foot long, 1-1/4 inch diameter stainless steel wells with 4-inch galvanized steel risers) were installed as part of the landfill closure. In 1985 monitoring wells 1GW05 and 1GW06 (2-inch diameter polyvinyl chloride (PVC) pipe) were installed by Dames and Moore as part of the Confirmation Study. In 1992 monitoring wells 1GW07 and 1GW08 (4-inch diameter PVC pipe) were installed by Roy F. Weston, Inc. as part of the Site Inspection.

In July 1983, LANTDIV collected groundwater samples from each of the four monitoring wells present at that time and analyzed them for purgeable organics, engineering parameters, and selected metals. Although it does not appear that this sampling event was conducted as part of any formal investigation of this area, the results from this sampling event were compared with groundwater quality standards and groundwater quality criteria. It was found that total organic carbon, phenolics, iron, lead, and zinc were at elevated levels and that the pH was outside of the acceptable range. Although the metals detected were not unexpected based upon the well construction, two additional rounds of groundwater sampling were recommended in this area.

Further investigation of this area was recommended based upon the types of waste disposed in this landfill, which included paints, paint thinners, ether, and unspecified drugs.

The Confirmation Study Step 1A (Verification), Round One conducted by Dames and Moore in 1986 included the installation of two groundwater wells (1GW05 and 1GW06) and the collection of groundwater samples from these wells, in addition to the four existing wells. The Confirmation Study Step 1A (Verification) Round Two, conducted by Dames and Moore in 1987, included the collection of groundwater samples from the six existing groundwater wells in this area.

The Final Remedial Investigation Report written by Dames and Moore in 1991 summarized the findings of the Confirmation Study, and concluded that oil,

grease, and total phenols were detected in the groundwater samples and were potentially attributable to the landfill area. Dames and Moore recommended that this area be investigated further in order to more accurately define the magnitude and extent of the potential contamination. It was recommended that this investigation include an aerial photographic analysis of the area, additional groundwater sampling, and evaluation of the human health and environmental threat by performing a site-specific risk assessment.

In 1994, Roy F. Weston, Inc. conducted a Site Inspection of this area which included the installation of two new monitoring wells, groundwater sampling, and soil sampling. Soil samples were collected from both new well borings, groundwater samples were collected from seven of the eight monitoring wells (well 1GW01 was dry), and sediment samples were collected from three unspecified locations. Analytical results from this sampling confirmed elevated levels of metals, polychlorinated biphenyls (PCBs), and total petroleum hydrocarbons in the soils. Detectable levels of semi-volatile organic compounds (SVOC) were found in the soils, and the volatile organic compounds (VOC), 4-methyl-2-pentanone and trichloroethylene (TCE), total petroleum hydrocarbons (TPH), and metals were detected in the groundwater. Low levels of TCE, SVOCs, TPH, and metals were also found in the sediment samples. WESTON® concluded that no major release of contaminants had occurred to the groundwater in this landfill area and that the landfill was adequately covered. WESTON® recommended resampling the monitoring wells for VOCs and dissolved metals in addition to a file search to verify the closure status of the landfill.

Baker Environmental, Inc., collected groundwater samples from seven of the eight monitoring wells located in the Site 1 area (well 1GW03 could not be located) and analyzed these samples for TCL organics, TAL dissolved metals, and TAL total metals as part of a Site Screening Process (SSP) investigation in 1997. Analytical results from this sampling event indicated that no organic compounds were present at detectable levels and that some metals were present at elevated levels.

A human health and ecological risk screening was conducted as part of the 1997 SSP in order to determine the threat posed by the landfill to human receptors and/or the environment. Based upon the analytical data from several historic sampling events, Baker concluded that no unacceptable human health or ecological risks are posed by the landfill and no additional investigation or remedial action was warranted. In addition, Baker recommended that the soil cover of the landfill should be maintained, large trees growing through this cover should be removed, and that the monitoring wells which were drilled through the landfill itself should be abandoned in order to eliminate a potential future migration pathway for contaminants from the fill material.

The most recent study of this area was the Field Investigation study conducted by Baker Environmental, Inc., in 1998. This study included a geophysical survey in order to further delineate the landfill boundary, soil sampling, sediment sampling, groundwater sampling, and a limited tidal influence study in the landfill area. All

of the samples collected during the investigation of this area were analyzed for TCL organics, TAL inorganics, and explosives (nitramines/nitroaromatics). This investigation concluded that the edge of the landfill along the York River was being actively eroded, and that semivolatile organic compounds, metals, pesticides, and PCBs were adversely impacting the soil and sediment around this area as the result of leaching or migration from the landfill. Baker made several recommendations regarding potential remediation efforts in this area, including:

- Remove surficial debris that has collected on the flat, inter-tidal beach area in the vicinity of the eroding bank.
- Develop and implement interim measures that can be installed quickly (as a time critical removal action) to mitigate erosion in the 60-foot stretch of shoreline along the York River, including the use of sand filled geotextile tubes as revetment.
- Institute a periodic inspection program so that the condition of the slope can be monitored and documented.
- Remove the small, rusty container that outcrops along the northern perimeter of the landfill.
- Consider abandoning the monitoring wells which have been installed throughout the landfill (wells 1GW01, 1GW02, 1GW03, 1GW04, and 1GW07) to eliminate a potential future migration pathway for contaminants from the fill material.
- Develop and implement solutions for long-term management of the landfill.

Samples collected under previous investigations at Site 1 are tabulated in Table 2.5 and locations for these samples are graphically depicted on Figure 2.6. A summary of significant environmental actions/activities to date for Site 1 is presented in Table 2.6.

Current Status and Future Actions for Site 1

Based upon the analytical data collected during the 1998 Field Investigation study and previous investigations, Baker has determined that the soil and sediment in the vicinity of the landfill have been adversely impacted by contaminant migration and/or leaching. Baker has determined that the most significant contamination in this area consists of SVOCs (primarily polynuclear aromatic hydrocarbons) and metals (including lead and other heavy metals).

LANTDIV is actively addressing the contamination in the Site 1 area, and expects to implement a time critical removal action in late summer or early fall 1999.

2.4.7 U.S. Navy Site 2 - Contaminated Food Disposal Area

This area has been investigated by the U.S. Navy, but has not yet been investigated by the EPA. This area is located in a grassy area in the woods behind the cold storage warehouse (building CAD 40) as shown on aerial photographs 2.9 and 2.10. A disposal pit was located here which measured 50 feet in diameter and was approximately 12 to 15 feet deep. In 1970, wrapped and packaged food which had been contaminated during an ammonia leak in one of the cold storage rooms was buried here. It is estimated that approximately 100 cubic yards of food, worth an estimated \$300,000, was buried here. The location of the contaminated food burial site was selected by the CAX Ranger at the time, and historical information indicates that only contaminated food was buried here.

The 1984 IAS concluded that additional study of this area was not warranted for this site because the waste disposed here was decomposable food products.

Current Status and Future Actions for Site 2

Based upon the reported nature of the material buried here (ammonia-contaminated food), the U.S. Navy does not consider this to be a significant source of contamination. The Virginia Department of Environmental Quality has requested additional documentation from the U.S. Navy to confirm that only ammonia-contaminated food was buried in this location. LANTDIV is currently investigating the availability of this information and will provide it to VDEQ, if available. The U.S. Navy currently does not expect to conduct any further investigations or remedial actions in this area.

2.4.8 U.S. Navy Site 3 - Submarine Dye Disposal Area

This area has been investigated by the U.S. Navy, but has not yet been investigated by the EPA. This area is located at the northeast corner of building CAD 15 (see Figure 2.2) and is currently used as a storage lot. During the early 1970's, green fluorescein submarine dye was stored in 55-gallon drums in this area. Some of these storage drums corroded and began leaking dye, which would enter the sewer system and subsequently the York River. Following reports and concerns from the U.S. Coast Guard these drums were removed.

Fluorescein is prepared by heating phthalic anhydride with recorcinol and is used primarily for studying submarine areas. This type of dye is used for locating spring sources, stream-to-sea connections, and groundwater contamination sources. Fluorescein has been approved by the U.S. Food and Drug Administration for use in externally applied drugs and cosmetics.

The 1984 IAS report concluded that additional study of this area was not warranted for this site because the fluorescein dye no longer posed an environmental hazard.

Current Status and Future Actions for Site 3

Based upon the nature of the fluorescein dye, the U.S. Navy does not consider this area to be a significant source of contamination. The VDEQ has requested additional information on the chemical nature of the dye which was stored in this area and subsequently released. VDEQ has also requested that the U.S. Navy provide further documentation to confirm that no solvents were used in association with the dyes stored at this location. LANTDIV is currently investigating the availability of this information and will provide it to VDEQ, if available. The U.S. Navy currently does not expect to conduct any further investigations or remedial actions in this area.

2.4.9 U.S. Navy Site 4 - Medical Supply Disposal Area

This area has been investigated by the U.S. Navy, but has not yet been investigated by the EPA. This area is located between buildings CAD 11 and CAD 12 along the pond just upgradient of Youth Pond (see Figure 2.7). In 1968 or 1969, out-of-date medical supplies, possibly including syringes, empty intravenous (IV) bottles, and 1-inch metal banding, were dumped down a bank and covered with soil in this area. It is estimated that as much as 7,000 cubic yards of material were disposed at this location. Following reports of deer with syringe needles stuck in their hooves, an unspecified amount of this waste was removed from this area. Reports of syringe-like items floating in the adjacent pond, as well as Youth Pond, following heavy rains have persisted.

The 1984 IAS report concluded that additional study of this area was not warranted because of the inert nature of the wastes.

During a site visit conducted by VDEQ on 4 May 1998, several packages of what appeared to be unused needles wrapped in foil were located in the drainage swale leading to the unnamed pond.

In May 1998, Reactives Management, Inc. performed a routine housekeeping reconnaissance and clean up of this area to remove any surficial debris. During this clean up, no IV bottles or bags were encountered; however, it was determined that what had originally been reported as IV bottles or bags were IV injection sets. Many of these sets were found contained in aluminum or plastic bags. In addition to these materials, Reactives Management located plastic and metal sharps, 15 containers of injectable drugs, and other debris. The injectable drug containers were empty or contained minimal amounts of liquid and had illegible or no labels. Approximately 200 pounds of debris and 13 pounds of plastic and metal sharps were recovered using non-intrusive methods and incinerated. Other debris, which included metal banding, railroad ties, metal, corroded drums, and beverage containers were found during this clean up but were not removed.

A summary of significant environmental actions/activities to date for Site 4 is presented in Table 2.7.

Current Status and Future Actions for Site 4

Based upon the nature of the wastes reportedly disposed in this area, and the confirmation of the presence of these types of wastes, the U.S. Navy has determined that this area may be a significant source of contamination. LANTDIV is currently considering this area for further investigation and possible remediation. A Field Investigation study for this area is currently scheduled to be conducted in November 1999.

2.4.10 U.S. Navy Site 5 - Photographic Chemical Disposal Area

This area has been investigated by the U.S. Navy, but has not yet been investigated by the EPA. This area is reportedly located south of Antrim Road and east of 2nd Avenue, between the Penniman Gauge Pouring Houses (9.5-inch lines #2 and #3) and Penniman Lake (see aerial photographs 2.9 and 2.10). Reportedly, outdated photographic chemicals, including developers and fixers, were disposed in a pit of unspecified dimension in 1967 or 1968. Reports indicate that approximately "20 to 40 gallons" of photographic chemicals were disposed in a "marl" pit in this area. During the 1984 IAS investigation, hand-sketched maps were created depicting the locations of the site areas. These hand-sketched maps depict the photographic chemicals site at the south end of 2nd Avenue, which is not the same location as depicted in the final IAS report figures.

The 1984 IAS report concluded that additional study of this area was not warranted because of the relatively small quantity of non-hazardous chemicals disposed in this area.

In June 1998, LANTDIV and Baker representatives conducted a reconnaissance of this area in order to locate Site 5. During this visit, no signs of contamination, distressed areas, or evidence of a disposal pit were identified.

Current Status and Future Actions for Site 5

Based upon the nature and small quantity of chemicals reportedly buried in this area, the U.S. Navy does not consider this area to be a significant source of contamination. The VDEQ has requested that further attempts be made to identify the exact location of this site. The U.S. Navy currently does not expect to conduct any further investigations or remedial actions in this area.

2.4.11 U.S. Navy Site 6 - Spoiled Food Disposal Area

This area has been investigated by the U.S. Navy, but has not yet been investigated by the EPA. This area is located to the west of the Gauge Pouring House in Penniman 155-mm process line # 4 (see Figure 2.2). It has been reported that approximately 750 cubic yards of spoiled food from cold storage was buried in a 12 to 15 foot deep pit around 1970.

The 1984 IAS report concluded that additional study of this area was not warranted because of the non-hazardous nature of decomposed food.

Current Status and Future Actions for Site 6

Based upon the fact that only spoiled food was disposed of in this area, the U.S. Navy does not consider it to be a significant source of contamination. The VDEQ has requested additional information to confirm that only food was disposed at this location. LANTDIV is currently investigating the availability of this information and will provide it to VDEQ, if available. The U.S. Navy currently does not expect to conduct any further investigations or remedial actions in this area.

2.4.12 U.S. Navy Site 7 - Old duPont Disposal Area

This area has been investigated by the U.S. Navy, but has not been investigated by the EPA beyond a cursory reconnaissance. The exact location of this area has not been adequately defined. Currently, there are three possible areas which have been identified as Site 7. The 1984 IAS report identifies Site 7 as being located behind two recreational cabins along the York River northeast of building CAD 13. The Aerial Photographic Analysis conducted by U.S. EPA EPIC identified a disturbed area, possibly Site 7, in the 1937 aerial photograph along Queen Creek with an access road leading to the Penniman Shell Loading Plant. The third possible location for Site 7 is along the York River, approximately 500 feet south of the IAS location. This area was identified by USN CAX Butch Hogge as the true location of Site 7 during a site visit conducted by VDEQ, U.S. EPA, LANTDIV, CAX, and Baker Environmental. The U.S. EPA EPIC study identifies this area as an excavation area beginning in 1955 with re-establishment of vegetation in 1975. The debris identified in this third possible location for Site 7 is not indicative of the World War I era.

According to the 1984 IAS, Site 7 received wastes from the city of Penniman as well as from the duPont production facility. Specific information documenting the nature of the wastes disposed in this area is not available; however, the 1984 IAS report indicates that these materials were non-hazardous and/or inert. The 1984 IAS also indicates that ammunition was disposed in this area, although it is not clear on how this determination was made. Neither written documentation nor anecdotal information from duPont, or any other source, exists to confirm the types of wastes disposed here. The 1984 IAS report describes the Site 7 area as level and vegetated, with no evidence of stressed vegetation. The western, northern, and eastern boundaries of the area were identified in the 1984 IAS report as clearly defined by steep banks rising an estimated 10 feet to 20 feet in elevation. This description indicates that the true location of Site 7 is the currently accepted location (see Figure 2.8), and that the location depicted on the 1984 IAS maps was incorrect.

The 1984 IAS report concluded that additional study of this area was not warranted because of the non-hazardous nature of the wastes disposed here.

A summary of significant environmental actions and activities to date for Site 7 is presented in Table 2.8.

Current Status and Future Actions for Site 7

Based upon the potential nature of the wastes reportedly disposed in this area, the U.S. Navy has determined that this area may be a significant source of contamination. LANTDIV is currently considering this area for further investigation and possible remediation. A Field Investigation is currently scheduled to be conducted at Site 7 in November 1999.

2.4.13 U.S. Navy Site 8 - Landfill Near Building CAD 14

This area has been investigated by the U.S. Navy, but has not yet been investigated by the EPA. This area is located approximately 300 feet north of Building CAD 14 in a grassy area and is estimated to be less than ¼-acre in size (see Figure 2.9). It has been reported that, between the early 1940's and 1980, trenches approximately 10 feet deep and 2,000 square feet in area were dug in this area to dispose of waste such as spoiled food and clothing. The actual nature of the wastes disposed in this area has not been confirmed, although it has been reported as non-hazardous.

The 1984 IAS report concluded that additional study of this area was not warranted because of the non-hazardous nature of the wastes disposed here.

Current Status and Future Actions for Site 8

Because only food and other non-hazardous wastes were disposed of in this area, the U.S. Navy does not consider it to be a significant source of contamination. The VDEQ has requested additional information to confirm that only non-hazardous waste was disposed at this location. LANTDIV is currently investigating the availability of this information and will provide it to VDEQ, if available. The U.S. Navy currently does not expect to conduct any further investigations or remedial actions in this area.

2.4.14 U.S. Navy Site 9 - Transformer Storage Yard

This area has been investigated by the U.S. Navy, but has not yet been investigated by the EPA. This area is located adjacent to the northwest corner of building CAD 16 (see Figure 2.10) and is approximately 7,000 square feet in size. Between 1973 and 1980, approximately 6 to 30 electrical transformers awaiting repair or disposal were reportedly stored in this area. It is believed that some of these transformers may have contained PCBs. During its use, this area consisted of a dirt floor with an earthen containment berm surrounding it. Sometime after 1980, the storage of transformers in this area ceased, and the area was graded and

covered with gravel. It is not known if any PCB oil leaked or was spilled in this area during the time it was used to store electrical transformers.

The 1984 IAS recommended that further investigation of this area be conducted due to the potential for PCB contamination. The 1986 Confirmation Study (Round One) conducted by Dames and Moore included the collection of 13 soil samples from Site 9 for PCB analysis and 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) analysis. These sample locations are graphically depicted in Figure 2.13. Analytical results from this sampling event identified the PCB Aroclor 1260 in 8 of the 13 samples ranging from 21 $\mu\text{g}/\text{kg}$ to 321 $\mu\text{g}/\text{kg}$ (0.021 to 0.321 ppm). No other compounds were detected in this area. Dames and Moore compared the Aroclor 1260 levels detected in this area to the lowest action level under the Toxic Substances Control Act (TSCA), which was 1.0 ppm. Based upon the concentrations detected during this study, Dames and Moore did not recommend any further investigation of this area.

A summary of significant environmental actions and activities to date for Site 9 is presented in Table 2.9.

Current Status and Future Actions for Site 9

Based upon the low levels of contaminants detected in this area during the 1986 Confirmation Study (Round One) conducted by Dames and Moore, the U.S. Navy does not consider it to be a significant source of contamination. LANTDIV currently expects to complete a No Further Remedial Action Planned (NFRAP) document for this site.

2.4.15 U.S. Navy Site 10 - Decontamination Agent Area

This area has been investigated by the U.S. Navy, but has not yet been investigated by the EPA. This area is located to the south of and between the Penniman Gauge Pouring Houses, approximately near the location of the Penniman spot drilling and stenciling house (building #52 as identified in WWI era engineering drawings of the Penniman Shell Loading Plant) (see Figure 2.11). It has been reported that 75 to 100 gallons of decontamination agent DS-2 were buried in this area sometime prior to 1982, although the exact date is unknown. DS-2 is a decontamination agent used on equipment to remove nerve or blister chemical warfare agents. DS-2 is comprised of 70% diethylene triamine, 28% ethylene glycol monomethyl ether, and 2% sodium hydroxide and is toxic to humans and corrosive to metals. There is no information to indicate that this material was neutralized prior to disposal in this area.

The 1984 IAS report recommended that further investigation of this area be conducted because of the toxic nature of DS-2. The IAS report recommended that a magnetometer survey of this area be conducted to locate metallic containers which may contain DS-2, and to conduct excavation activities in these areas to

determine the contents of these containers, if found. Groundwater sampling was recommended if leaking containers of DS-2 were identified.

In December 1985, Geosight, Inc., conducted a magnetometer survey around this area and identified several magnetic anomalies. This magnetometer survey was summarized in the 1991 Dames and Moore Final Remedial Investigation Interim Report. This report recommended that historical aerial photographs be reviewed for this area and that a risk assessment be performed to evaluate the threat posed by this area.

In 1992, Roy F. Weston, Inc. conducted a Site Investigation for Site 10. During this investigation, 20 to 25, 3-inch tall bottles containing a small volume of unidentified, dry, yellow-brown material were found along the edge of the wooded area. The nature and contents of these bottles remain unknown.

WESTON® also installed three monitoring wells in this area into the shallow aquifer. One surface soil and three subsurface soil samples were collected from each well boring, and groundwater samples were collected from each monitoring well. Analytical results from these samples identified the VOCs, methylene chloride, TCE, and acetone at low concentrations in the soil samples. TPH levels were found to be elevated in two of the surface soil samples, and metals did not exceed background concentrations in the soil samples.

The VOC, dichloropropane, was detected in a duplicate groundwater sample at a level exceeding the EPA Maximum Contaminant Level (MCL) for that compound in drinking water. Dissolved mercury was found in the groundwater at levels exceeding the Virginia Groundwater Standards in all three wells. Acetone was also detected at low concentrations in the groundwater.

The 1992, Roy F. Weston, Inc., Site Investigation Report for Site 10 concluded that the low levels of contamination detected in the soil and groundwater did not appear to be related to the DS-2 disposal and were not suspected to be indicative of a significant source of contamination. WESTON® recommended that the monitoring wells be resampled to confirm the results identified in the SI report.

All samples collected to date at Site 10 are summarized in Table 2.10. A summary of significant environmental actions and activities to date for Site 10 is presented in Table 2.11.

Current Status and Future Actions for Site 10

Based upon the low levels of contaminants detected in the previous studies conducted in this area and the quantity of waste disposed there, the U.S. Navy does not consider this area to be a significant source of contamination nor a significant threat to human health. LANTDIV currently does not expect to complete a NFRAP document for this site because the source of the magnetic anomalies has not been confirmed and the buried containers of DS-2 have not

been located. LANTDIV currently does not consider this area to be a high priority for further investigation or remediation, and currently does not anticipate any further investigations or remediation activities in this area.

2.4.16 U.S. Navy Site 11 - Bone Yard

This area has been investigated by the U.S. Navy, but has not yet been investigated by the EPA. This area is located approximately 250 feet to the south of Antrim Road behind the CAX Public Works Building, and includes the foundation remains of the Penniman "Shops" Building #28 as determined from a review of the World War I era engineering drawings of the Penniman Shell Loading Plant (see Figures 2.12A and 2.12B). The total area of the site is approximately 8 acres. Between the years of 1940 and 1978, this site was reportedly used for the storage of debris such as metal objects, automobiles, old containers, and fence posts and wastes such as oil, asphalt, and gasoline. During the 1984 IAS investigation, liquid wastes were contained in metal barrels and 500-gallon above-ground storage tanks. Various other wastes and debris were found throughout this area. It has been reported that unknown wastes have been buried in this area, and that containers of liquid wastes have leaked in this area in the past.

The 1984 IAS report recommended further investigations of this area because of the presence of oil and gasoline at the site, the reports of liquid spills in the past, and the reported waste burial in this area.

The 1986 Dames and Moore Confirmation Study Step 1A (Verification), Round One included the collection of three surface water samples, three sediment samples, and the installation and sampling of three shallow aquifer groundwater monitoring wells. A total of nine soil samples were collected, including one composite sample from each of the monitoring well borings and six discrete samples located throughout the site. A total of 18 waste samples were collected from 15 drums (three of the drums contained a liquid phase which was sampled). These sample locations are graphically depicted on Figure 2.15.

The 1988 Dames and Moore Confirmation Study Step 1A (Verification) Round Two included the collection of three surface water samples and three sediment samples collected from the same locations as the Round 1 samples. This investigation also included the collection of three groundwater samples from the monitoring wells installed during Round One.

The 1991 Dames and Moore Final Remedial Investigation Interim Report summarized the findings from the Confirmation Study. The conclusions from the Confirmation Study provided in the Interim Report indicated that the following potentially site-related chemical contamination was present:

- Toluene, 1,1,1-TCE, phthalates, PAHs, oil and grease, and lead in the soils at Site 11.

- Total phenols, lead, and oil and grease in the groundwater.
- 1,1,1-TCE, methyl ethyl ketone, methylene chloride (a common laboratory contaminant), total phenols, and phthalates in the surface water samples.
- 1,1,1-Trichloroethane (1,1,1-TCA), lead, and oil and grease in the sediment.
- Leachable lead, cadmium, and barium in the drum samples.

Dames and Moore recommended this site for further investigation to better define the nature and extent of the contamination. At the time of the 1991 Interim Report, Dames and Moore indicated that most of the waste drums and scrap metal had been removed from the site.

The 1994 Site Investigation for Site 11 conducted by Roy F. Weston, Inc., included a soil gas survey, soil sampling, installation of two monitoring wells, groundwater sampling, sediment sampling, and surface water sampling. 14 surface soil samples, 2 subsurface soil samples (one from each well boring), 16 sediment samples (from 8 locations), 5 surface water samples, and groundwater samples (from each of the monitoring wells in the site area) were collected. The following potentially site-related chemical compounds were detected in the following media:

- Benzene, toluene, ethylbenzene, xylenes, and total volatile hydrocarbons in the soil gas.
- TCE, 1,1,1-TCA, toluene, xylene, PAHs, TPH, lead, and several other metals in the surface soil.
- TPH, lead, and other metals in the subsurface soil.
- TCE, 1,2-dichloroethene, carbon disulfide, lead, and other metals in the groundwater.
- TCE, 1,2-dichloropropane, iron, and manganese in the surface water.
- TPH, PAH, arsenic, beryllium, and lead in the sediment.

The 1994 Site Investigation concluded that the previous activities at Site 11 have had some impact on the shallow soils, marsh sediments, and lake sediments, but have had little or no impact on the groundwater and surface water around the site area. This report recommended that the drums and asphalt tank remaining at the site be removed, and that additional sampling be conducted to confirm the presence of TCE in the surface soil, the VOCs and dissolved metals in the groundwater, and the TCE in the surface water.

The 1997 Site Screening Process investigation conducted by Baker included the collection of groundwater samples from each of the Site 11 monitoring wells. This investigation detected no organic compounds in the groundwater and only low levels of unfiltered metals in the groundwater. This report concluded that no additional investigations of this area were warranted.

At the time of the 1997 SSP investigation (August 1997), approximately 60 drums (half empty and half containing tar, leaves, soil, or sludge) and three tanks containing tar were noted in the woods at Site 11. Industrial Marine Services, Inc., removed approximately 60 tons of material from this area including the drums, tanks, solidified tar, and miscellaneous debris in September 1997. Accumulated rainwater found in the largest tar tank was removed via vacuum truck and disposed at Industrial Marine's treatment facility in Norfolk, VA.

A summary of the samples collected to date is presented in Table 2.12, and a summary of significant environmental actions and activities for Site 11 is presented in Table 2.13.

Current Status and Future Actions for Site 11

The U.S. Navy has concluded that previous actions at Site 11 have eliminated the potential waste sources, and that previous investigations have indicated that no significant sources of contamination are present at the site. VDEQ has requested that further sampling be conducted in the former tar tank area in order to more accurately characterize the soils in this area. LANTDIV has considered this area for further study, and soil sampling will be conducted in this area as part of the Field Investigation in November 1999.

Beyond the November 1999 Field Investigation, LANTDIV currently does not anticipate any further investigation or remediation activities for Site 11.

2.4.17 U.S. Navy Site 12 - Disposal Site Near Water Tank

Currently, Site 12 does not exist. It has been speculated that the materials from Site 12 have been relocated to the area which has been named the "Area of Concern 1 - Scrap Metal Dump" by the U.S. Navy and the "Jones Pond Landfill" by the U.S. EPA.

Site 12 originally consisted of a scrap metal surface dump, which included old automobile parts and iron pipe, and was identified in the 1984 IAS report. This area contained approximately 10 to 110 cubic feet of scrap metal and debris and was located approximately 2,000 feet west of Jones Pond in the currently grassy clear area near the current location of the CAX water treatment facility.

The 1984 IAS report concluded that no further investigation of this area was warranted because only non-hazardous materials had been disposed here.

The 1998 U.S. EPA EPIC study identified a small mound of dark-toned material at the location of Site 12 in 1955. This material was not present in the subsequent 1963 aerial photograph.

Based upon the description of the debris formerly present at site 12, it has been speculated that this material has either been removed or relocated to the AOC 1 location.

Current Status and Future Actions for Site 12

Based upon the nature of the materials reportedly present at site 12, the U.S. Navy has concluded that this site is not a significant source of contamination. Any materials which have been relocated to AOC 1 are currently being considered by the U.S. Navy as part of the actions planned for AOC 1. LANTDIV currently does not anticipate any further investigations or remediation activities at Site 12.

2.4.18 U.S. EPA - TNT Production Area/"D" Plant Area

This area has been investigated by the U.S. EPA but has not been investigated in its entirety by the U.S. Navy. U.S. Navy Areas of Concern 3 - CAD 11/12 Pond Bank, 4 - IR Site 4 Medical Supplies Disposal, and 5 - Debris Area and Sites 1 - Landfill Near Incinerator, 2 - Contaminated Food Disposal Area, 3 - Submarine Dye Disposal Area, 4 - Medical Supply Disposal Area, 7 - Old duPont Disposal Area, 8 - Landfill Near Building CAD 14, and 9 - Transformer Storage Yard, all are located within the general boundaries of this area.

This area consists of approximately 18,874,474 square feet (433.3 acres) and includes the Penniman TNT production area, as well as the former Penniman "D" Plant, which loaded shells ranging in size from approximately 75-mm to 4.7-inch. This area is located north of Sanda Avenue on USN and DOI property (see Figure 2.13), and includes several of the large CAX warehouse buildings which were built over the former Penniman "D" Plant. Twenty-four earthen bunkers, identified on engineering drawings dating from World War I as nitro-starch dry houses, nitro-starch dry stores, dynamite mix houses, and pack houses still remain in this area today, mostly on the DOI property portion. Runoff from this area flows through manmade ditches into Cheatham Pond, a fishery.

The 1999 Site Inspection conducted by WESTON® SATA included sediment and surface water sampling in this area. One waste source sample was collected from a sump depression in the floor of one of the former nitrostarch dry houses, one surface water sample was collected from Cheatham Pond, one sediment sample was collected from Cheatham Pond, one sediment sample was collected from a drainage ditch leading away from the nitrostarch dry houses, and one sediment sample was collected from the confluence of this drainage ditch with the wetlands area along Cheatham Pond. All of these samples were analyzed for CLP TAL inorganics and CLP TCL organics at EPA CLP arranged laboratories. The waste

source samples and sediment samples were also analyzed for EPA SW-846 nitroaromatics.

Based upon the analytical results from the 1999 SI sampling event, WESTON® SATA concluded that elevated levels of lead and manganese were present in the nitrostarch dry house sumps, and that manganese from these sumps appears to be migrating through the drainage ditch leading into the wetland area along Cheatham Pond. WESTON® SATA concluded that these contaminants do not yet appear to be impacting the water quality or sediments in Cheatham Pond.

Current Status and Future Actions for the TNT Production Area/"D" Plant Area (EPA Site)

The future EPA actions at this site will be determined by the EPA RPM following consultation with VDEQ and U.S. Navy representatives. There are no future U.S. Navy actions anticipated for this site beyond those anticipated to address the U.S. Navy sites which fall within this large area. These potential future actions are presented within the area summaries for each of the aforementioned Navy sites.

2.4.19 U.S. EPA - Slag Area

This area has been investigated by the U.S. EPA but has not been investigated by the U.S. Navy beyond a cursory reconnaissance. There are no definitive boundaries to this area, because it consists of widely scattered, uncontained waste slag throughout the USN CAX and DOI property. The origin of this slag material is unknown; however, it has been speculated that this material may be slag broken out of steam locomotive boilers and dumped along the tracks during the Penniman Shell Loading Plant era. There is no evidence to support or deny this speculation other than the fact that this material can be found along former Penniman railroad beds.

The 1999 Site Inspection conducted by WESTON® SATA included the collection of a sample from a portion of this slag area for CLP TAL inorganics and CLP TCL organics analyses. Analytical results from this sampling event indicated that elevated levels of antimony, arsenic, chromium, lead, and manganese were present in this slag material.

Based upon the analytical results from the 1999 SI sampling event, WESTON® SATA concluded that the slag material found throughout the site contained high levels of several metals. WESTON® SATA indicated, however, that these results may not be indicative of the hazardous nature of this material. WESTON® SATA noted that this slag material is a hard, rock-like material with low migration potential. WESTON® SATA recommended that TCLP samples be collected from this slag material in the future in order to determine if the metal contaminants found in this material have the potential to leach into the environment. WESTON® SATA also recommended sampling the soil downgradient from one of these slag areas to determine if these contaminants are migrating.

Current Status and Future Actions for the Slag Area (EPA Site)

The future EPA actions at this site will be determined by the EPA RPM following consultation with VDEQ and U.S. Navy representatives. There are no future U.S. Navy actions anticipated for this site.

2.4.20 U.S. EPA - Shell Loading Area

This area has been investigated by the U.S. EPA but has not been investigated in its entirety by the U.S. Navy. U.S. Navy AOC 2 - Dextrose Dump and Sites 5 - Photographic Chemical Disposal Area, 6 - Spoiled Food Disposal Area, 10 - Decontamination Agent Area, and 11 - Bone Yard, all fall within the general boundaries of this area.

This area is approximately 11,245,924 square feet (258.2 acres) in size and is located south of Sanda Avenue (formerly duPont's "G" plant) on USN property (see Figure 2.14). A portion of this area includes eight concrete structures dating from the World War I era (Penniman Shell Loading Plant Gauge Pouring Houses) which are currently utilized by the USN for storage. The remainder of this area is overgrown and includes the foundation remains of the Penniman Shell Loading Plant's 9.5-inch shell loading lines, 155-millimeter shell loading lines, and 75-millimeter shell loading lines.

Other foundation remains in this area include the Penniman Shell Loading Plant's ammonia evaporating building, shipping houses, TNT graining house, and paint storage houses. This area also includes the underground storm drain mixer and the abandoned mixing tank in the 75-mm lines which were sampled during the 1999 WESTON® SATA Site Inspection. Several dirt roads traverse this area over former Penniman roads, tram lines, or rail beds. Garrison Road runs along the perimeter of this area.

Runoff from this area flows through manmade ditches and overland into King Creek and Penniman Lake. The shortest overland flow from one of these sources into King Creek is approximately 100 feet, and the shortest overland flow from one of these sources into Penniman Lake is approximately 20 feet. Two of the potential sources identified in this area (TNT Catch Boxes and Ammonia Settling Pits) are located within FEMA Flood Zone AE, which is identified as "special flood hazard areas within the 100-year flood plain with base flood elevations determined." All of the other sources in this area are located within FEMA Flood Zone X, which is identified as "areas determined to be outside of the 500 year flood plain".

The following foundations have been positively identified by WESTON® SATA during site reconnaissance visits in the former "G" plant area:

- TNT graining house.

- Ammonia evaporating building.
- Ammonia finishing building.
- Shipping houses.
- TNT and tetryl daily storage bunker.
- TNT daily storage bunker.
- Booster test pit.
- Assembly houses.
- Conveyors.
- Empty shell storage houses.
- Paint storage houses.

The 1999 Site Inspection conducted by WESTON® SATA included the collection of samples from this area. Samples were collected from the earthen ammonia settling pits, the TNT graining house sump, the TNT catch box ruins, the storm drain mixer, and the underground mixing tank. All of these samples were analyzed for CLP TCL organics and CLP TAL inorganics, as well as EPA SW-846 nitroaromatics.

The analytical results from the 1999 SI sampling event indicated that:

- The ammonia settling pits contain elevated levels of arsenic.
- The TNT graining house sump contains elevated levels of 2,4,6-TNT, arsenic, cadmium, lead, and manganese.
- The TNT catch box ruins contain elevated levels of 2,4,6-TNT, arsenic, and lead.
- The storm drain mixer contains elevated levels of arsenic.
- The underground mixing tank contains elevated levels of arsenic, lead, and manganese.

WESTON® SATA concluded that the levels of arsenic, lead, and 2,4,6-TNT exceeded the EPA Region III RBC screening levels for those contaminants when conservatively evaluated as residential soil areas. WESTON® SATA indicated that applying these RBC levels to these areas may not be appropriate, and

recommended that a site-specific health risk assessment be performed in order to evaluate the true threat posed to human health by these areas.

Current Status and Future Actions for the Shell Loading Area (EPA Site)

The future EPA actions at this site will be determined by the EPA RPM following consultation with VDEQ and U.S. Navy representatives. There are no future U.S. Navy actions anticipated for this site beyond those anticipated to address the U.S. Navy sites which fall within this large area. These potential future actions are presented within the area summaries for each of the aforementioned Navy sites.

2.4.21 U.S. EPA - Shipping Area

This area has been investigated by the U.S. EPA but has not been investigated by the U.S. Navy beyond a cursory reconnaissance. This area consists of approximately 22,441,566 square feet (515.2 acres) and is located on DOI property to the north of USN CAX (see Figure 2.15). This area currently includes several roadways built on old rail beds and tram car lines, one building identified in World War I era engineering drawings as finished ammunition magazine #6, numerous "blast" holes, and a metal drum suspected to be an FM smoke drum which may date from the World War I era. Runoff from this area flows overland into Cheatham Pond.

The 1999 Site Inspection conducted by WESTON® SATA included the collection of samples from this area. One sample was collected from the soil beneath the FM/FS smoke drum, one sample was collected from the soil downgradient of the FM/FS smoke drum, one sample was collected from the bottom of the large blast hole at a depth of 6-12 inches, and one sample was collected from the bottom of the large blast hole at a depth of 12-18 inches. The two samples collected around the FM/FS smoke drum were analyzed for CLP TCL organics, CLP TAL inorganics, EPA SW-846 nitroaromatics, and mustard decomposition products. The two samples collected from the large blast holes were analyzed for CLP TCL organics, CLP TAL inorganics, and EPA SW-846 nitroaromatics.

Analytical results from this sampling event indicated that the soil around the FM/FS smoke drum contains elevated levels of arsenic, and that the soil in the large blast holes contains elevated levels of arsenic and chromium.

WESTON® SATA concluded that the levels of arsenic and chromium exceeded the EPA Region III RBC screening levels for those contaminants when conservatively evaluated as residential soil areas. WESTON® SATA indicated that applying these RBC levels to these areas may not be appropriate, and recommended that a site-specific health risk assessment be performed in order to evaluate the true threat posed to human health by these areas.

Current Status and Future Actions for the Shipping Area (EPA Site)

The future EPA actions at this site will be determined by the EPA RPM following consultation with VDEQ and U.S. Navy representatives. There are no future U.S. Navy actions anticipated for this site beyond those anticipated to address the U.S. Navy sites which fall within this large area. These potential future actions are presented within the area summaries for each of the aforementioned Navy sites.

2.4.22 U.S. EPA - 1918 Drum Storage Area

This area has been evaluated by the U.S. EPA but has not been evaluated by the U.S. Navy. This area was originally identified during the review of the 1918 panoramic photographs by LANTDIV, VDEQ, EPA, and SATA in September 1998. These photographs were taken from the top of the fire suppression water tank in 1918 during the operation of the Penniman Shell Loading Plant and were obtained from the Hagley Museum and Library located in Wilmington, DE during a records search conducted by a U.S. EPA contractor. One of these photographs clearly shows a large open area containing a large pile of wooden barrels located approximately where the lawn area west of CAX Building 113 is located today (see Figure 2.16). EPA RPM Thomson targeted this area for sampling by WESTON® SATA during the SATA SI sampling event conducted in January 1999.

Two samples were collected from this area by WESTON® SATA, one from a depth of 6-12 inches and one from a depth of 12-24 inches. Both of these samples were analyzed for CLP TCL organics, CLP TAL inorganics, and EPA SW-846 nitroaromatics. Analytical results from this sampling event indicated that this area contained elevated levels of arsenic to a depth of at least 24 inches.

WESTON® SATA concluded that the level of arsenic detected in the soil samples from this area exceeded the EPA Region III RBC screening levels for those contaminants when conservatively evaluated as residential soil areas. WESTON® SATA indicated that applying these RBC levels to these areas may not be appropriate, and recommended that a site-specific health risk assessment be performed in order to evaluate the true threat posed to human health by these areas. Special concern was raised regarding this area because of the fact that it is located within 200 feet of two buildings occupied by CAX workers.

Current Status and Future Actions for the 1918 Drum Storage Area (EPA Site)

The future EPA actions at this site will be determined by the EPA RPM following consultation with VDEQ and U.S. Navy representatives. There are no future U.S. Navy actions anticipated for this site.

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Table 2.1
Significant Environmental Actions at U.S. Navy Area of Concern 1
Landfill Near Water Tank

| DATE | EVENT | COMMENTS |
|------------------|---|--|
| 1942 | EPIC Study notes area cleared of trees and contained a large mound of light-toned material. Adjacent railroad was under construction. | Not identified as a site or AOC in EPIC Study. |
| 1955, 1963, 1975 | EPIC Study notes that area is partially revegetated in 1955, and in 1963 a large mound of fill is noted. Area is revegetated by 1975. | Not identified as a site or AOC in EPIC Study. |

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Table 2.2
 Summary of Samples Collected at U.S. Navy Area of Concern 2
 Dextrose Dump

| Sample ID | Media | Analytical Parameters |
|-------------|-----------------|---|
| A2-HA01-00 | Surface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-HA02-00 | Surface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-DPB01-00 | Surface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-DPB02-00 | Surface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-DPB03-00 | Surface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-DPB04-00 | Surface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-HA01-02 | Subsurface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-HA02-01 | Subsurface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-DPB01-03 | Subsurface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-DPB01-15 | Subsurface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-DPB02-03 | Subsurface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-DPB02-10 | Subsurface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-DPB03-03 | Subsurface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-DPB03-09 | Subsurface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-DPB04-03 | Subsurface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-DPB04-09 | Subsurface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| A2-DPW01 | Groundwater | TCL organics, nitramines, TAL inorganics (filtered and unfiltered), and cyanide |
| A2-DPW02 | Groundwater | TCL organics, nitramines, TAL inorganics (filtered and unfiltered), and cyanide |
| A2-DPW03 | Groundwater | TCL organics, nitramines, TAL inorganics (filtered and unfiltered), and cyanide |
| A2-DPW04 | Groundwater | TCL organics, nitramines, TAL inorganics (filtered and unfiltered), and cyanide |

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Table 2.3
Significant Environmental Actions at U.S. Navy Area of Concern 2
Dextrose Dump

| DATE | EVENT | COMMENTS |
|--------------|---|---|
| 1915 to 1918 | Approximate date of construction of Penniman Facility Shipping House. | Shipping House demolished between 1918 and 1925. |
| 1970s | Estimated time frame of disposal of dextrose bottles. | Drums may have been disposed of previously. Disposal dates not well documented. |
| Late 1997 | Site discovered during site reconnaissance. | Identified as AOC 2. |
| May 1998 | Housekeeping by Reactives Management, Inc. | Dextrose bottles removed from surface. No intrusive activities. |
| 1998 | Field Investigation study (Baker). | Geophysical anomalies located. |

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Table 2.4
Significant Environmental Actions at U.S. Navy Area of Concern 3
CAD 11/12 Pond Bank

| AOC 3 - CAD 11/12 POND BANK | | |
|------------------------------------|--|---|
| DATE | EVENT | COMMENTS |
| 1968 or 1969 | Metal banding unloaded at site. | Medical supplies (Site 4) also disposed. |
| 1984 | IAS (NEESA). | Not recognized as a separate entity from Site 4. Site 4 recommended for no further study due to inert nature of materials disposed at site. |
| 1998 | Identified as a separate AOC from Site 4 by LANTDIV. | Will be managed separately from Site 4. |

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Table 2.5
Summary of Samples Collected at U.S. Navy Site 1
Landfill Near Incinerator

| Sample ID | Current Monitoring Well ID | Media | Analytical Parameters |
|---------------------------------------|----------------------------|--|--|
| JULY 1983 GROUNDWATER SAMPLING | | | |
| Well 1 through Well 4 | IGW01 through IGW04 | Groundwater | Purgeable organics, various engineering parameters, and metals |
| 1986 CONFIRMATION STUDY | | | |
| IEW01 | IGW01 | Groundwater | VOCs, SVOCs, pesticides/PCBs, inorganics, oil & grease |
| IEW02 | IGW02 | Groundwater | VOCs, SVOCs, pesticides/PCBs, inorganics, oil & grease |
| IEW03 | IGW03 | Groundwater | VOCs, SVOCs, pesticides/PCBs, inorganics, oil & grease |
| IEW04 | IGW04 | Groundwater | VOCs, SVOCs, pesticides/PCBs, inorganics, oil & grease |
| IEW05 | IGW05 | Groundwater | VOCs, SVOCs, pesticides/PCBs, inorganics, oil & grease |
| IEW06 | IGW06 | Groundwater | VOCs, SVOCs, pesticides/PCBs, inorganics, oil & grease |
| 1987 CONFIRMATION STUDY | | | |
| IEW01 | IGW01 | Groundwater | VOCs, SVOCs, pesticides/PCBs, inorganics, oil & grease |
| IEW02 | IGW02 | Groundwater | VOCs, SVOCs, pesticides/PCBs, inorganics, oil & grease |
| IEW03 | IGW03 | Groundwater | VOCs, SVOCs, pesticides/PCBs, inorganics, oil & grease |
| IEW04 | IGW04 | Groundwater | VOCs, SVOCs, pesticides/PCBs, inorganics, oil & grease |
| IEW05 | IGW05 | Groundwater | VOCs, SVOCs, pesticides/PCBs, inorganics, oil & grease |
| IEW06 | IGW06 | Groundwater | VOCs, SVOCs, pesticides/PCBs, inorganics, oil & grease |
| 1992 SITE INVESTIGATION | | | |
| ISB07-1A | IGW07 | Surface Soil (included incinerated fill material) 0-2 ft bgs | VOCs, SVOCs, TOC, TPH, and inorganics |
| ISB07-2A | IGW07 | Surface Soil 8-10 ft bgs | VOCs, SVOCs, TOC, TPH, and inorganics |
| ISB07-3A | IGW07 | Surface Soil 14-10 ft bgs | VOCs, SVOCs, TOC, TPH, inorganics, PCBs, and dioxins |
| ISB08-1A | IGW08 | Surface Soil 0-2 ft bgs | VOCs, SVOCs, TOC, TPH, and inorganics |

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Table 2.5 (Continued)
Summary of Samples Collected at U.S. Navy Site 1
Landfill Near Incinerator

| Sample ID | Current Monitoring Well ID | Media | Analytical Parameters |
|--|----------------------------|---------------------------------|--|
| 1992 SITE INVESTIGATION (Continued) | | | |
| 1SB08-2A | IGW08 | Subsurface Soil 10-12 ft bgs | VOCs, SVOCs, TOC, TPH, and inorganics |
| 1SB08-3A | IGW08 | Surface Soil 16-18 ft bgs | VOCs, SVOCs, TOC, TPH, inorganics, PCBs, and dioxins |
| 1EW02-1A | IGW02 | Groundwater | VOCs, SVOCs, TPH, TOC, total & dissolved inorganics |
| 1EW03-1A | IGW03 | Groundwater | VOCs, SVOCs, TPH, TOC, total & dissolved inorganics |
| 1EW04-1A | IGW04 | Groundwater | VOCs, SVOCs, TPH, TOC, total & dissolved inorganics |
| 1EW05-1A | IGW05 | Groundwater | VOCs, SVOCs, TPH, TOC, total & dissolved inorganics |
| 1EW06-1A | IGW06 | Groundwater | VOCs, SVOCs, TPH, TOC, total & dissolved inorganics |
| 1EW07-1A | IGW07 | Groundwater | VOCs, SVOCs, TPH, TOC, total & dissolved inorganics |
| 1EW08-1A | IGW08 | Groundwater | VOCs, SVOCs, TPH, TOC, total & dissolved inorganics |
| 1MS01-1A | NA | Marsh Sediment 0-2 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 1MS01-2A | NA | Marsh Sediment 2-3 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 1MS02-1A | NA | Marsh Sediment 0-2 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 1MS02-2A | NA | Marsh Sediment 2-3 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 1MS03-1A | NA | Marsh Sediment 0-2 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 1MS03-2A | NA | Marsh Sediment 2-3 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 1997 SITE SCREENING PROCESS INVESTIGATION | | | |
| 1GW01 | IGW01 | Groundwater | VOCs, SVOCs, pesticides/PCBs, total & dissolved inorganics |
| 1GW02 | IGW02 | Groundwater | VOCs, SVOCs, pesticides/PCBs, total & dissolved inorganics |
| 1GW04 | IGW04 | Groundwater | VOCs, SVOCs, pesticides/PCBs, total & dissolved inorganics |

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Table 2.5 (Continued)
Summary of Samples Collected at U.S. Navy Site 1
Landfill Near Incinerator

| Sample ID | Current Monitoring Well ID | Media | Analytical Parameters |
|--|----------------------------|-----------------|--|
| 1997 SITE SCREENING PROCESS INVESTIGATION (continued) | | | |
| 1GW05 | 1GW05 | Groundwater | VOCs, SVOCs, pesticides/PCBs, total & dissolved inorganics |
| 1GW06 | 1GW06 | Groundwater | VOCs, SVOCs, pesticides/PCBs, total & dissolved inorganics |
| 1GW07 | 1GW07 | Groundwater | VOCs, SVOCs, TPH, TOC, total & dissolved inorganics |
| 1GW08 | 1GW08 | Groundwater | VOCs, SVOCs, TPH, TOC, total & dissolved inorganics |
| 1998 FIELD INVESTIGATION REPORT | | | |
| I-HA01-00 | NA | Surface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| I-HA02-01 | NA | Surface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| I-HA01-02 | NA | Subsurface Soil | TCL organics, nitramines, TAL inorganics and cyanide |
| I-HA02-02 | NA | Surface Water | TCL organics, nitramines, TAL inorganics and cyanide |
| I-SW01 | NA | Surface Water | TCL organics, nitramines, TAL inorganics and cyanide |
| I-SW02 | NA | Surface Water | TCL organics, nitramines, TAL inorganics and cyanide |
| I-SW03 | NA | Sediment | TCL organics, nitramines, TAL inorganics and cyanide |
| I-SD01 | NA | Sediment | TCL organics, nitramines, TAL inorganics and cyanide |
| I-SD02 | NA | Sediment | TCL organics, nitramines, TAL inorganics and cyanide |
| I-SD03 | NA | Sediment | TCL organics, nitramines, TAL inorganics and cyanide |
| I-SD04 | NA | Sediment | TCL organics, nitramines, TAL inorganics and cyanide |

Notes:

Bgs = Below Ground Surface

NA = Not Applicable

PCB = Polychlorinated Biphenyl

SVOC = Semivolatile Organic Compounds

TOC = Total Organic Carbon

TPH = Total Petroleum Hydrocarbons

VOC = Volatile Organic Compound

Quality Assurance/Quality Control (QA/QC) samples are not listed.

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Table 2.6
Significant Environmental Activities at U.S. Navy Site 1
Landfill Near Incinerator

| DATE | EVENT | COMMENTS |
|--------------|---|---|
| 1942 to 1951 | Initial phase of landfill operation. | Primarily receiving incinerator burning residues. |
| 1951 to 1972 | Operating as a general landfill. | Receiving general wastes in addition to incinerator residue. |
| 1972 to 1981 | Final phase of operation. | Occasionally receiving masonry and wood. |
| 1981 | Landfill inactive. | No longer receiving waste, Soil cover placed over most of landfill. Four monitoring wells installed (1GW01 through 1GW04). |
| 8 July 1983 | Initial round of groundwater sampling. | U.S. Navy LANTNAVFACENCOM collects samples from the four existing monitoring wells. |
| 1984 | IAS (NEESA). | Recommends additional Study in form of Confirmation Study due to nature of wastes in landfill. |
| 1986 | Confirmation Study, Step 1A (Verification) Round One (Dames and Moore). | Two new monitoring wells installed (1GW05 and 1GW06). Groundwater samples collected from new and existing monitoring wells. |
| 1987 | Confirmation Study, Step 1A (Verification) Round One (Dames and Moore). | Additional round of groundwater samples collected from new and existing monitoring wells. |
| 1991 | Final RI Interim Report (Dames and Moore). | Summarizes Confirmation Study. Recommends additional RI efforts. |
| 1994 | Final Site Investigation Report (WESTON®). | Two new monitoring wells installed (1-GW07 and 1-GW08). Soil, groundwater, and sediment sampled. |
| 1997 | Final Site Screening Process Report (Baker) | PAH and lead contamination detected in soil and sediment. |
| March 1999 | Baker notices erosion of landfill perimeter | Landfill contents washing onto beach and into York River. |

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Table 2.7
 Significant Environmental Activities at U.S. Navy Site 4
 Medical Supplies Disposal Area

| DATE | EVENT | COMMENTS |
|------------------------|---|--|
| 1968 or 1969 | Syringes, empty IV bottles, metal banding and other miscellaneous debris unloaded and covered with soil. | Exact date and quantity of materials unknown. As much as 7,000 cubic yards of material may have been disposed. |
| Date unknown (pre-IAS) | A considerable volume of materials removed from the site. | Removal undertaken because syringes were getting stuck in deer's hooves. |
| 4 May 1998 | Site visit by LANTDIV and VDEQ representatives. | Packages of unused needles wrapped in foil noted in drainage swale. |
| May 1998 | Reactives Management, Inc. performed routine housekeeping activities to remove surficial debris. What was previously thought to be IV bags or bottles was determined to be IV injection sets. | Small quantity of unidentified injectable drugs also removed. |

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Table 2.8
Significant Environmental Actions at U.S. Navy Site 7
Old duPont Disposal Area

| DATE | EVENT | COMMENTS |
|------|---|---|
| 1937 | EPIC study reports that an old large possible dump was observed along Queen Creek. | No additional observations for this location are presented in the EPIC study. This is one possible location of the site. |
| 1955 | EPIC study shows an excavation area along the York River. | This is a second possible location for the site. |
| 1975 | EPIC study shows an excavation area along the York River. | This is a third possible location of the site. |
| 1984 | IAS (NEESA) reports that Site 7 received waste from the city of Penniman and the duPont facility. | On IAS mapping, site is shown north of excavation area depicted in the EPIC Study. However, site description described second location (excavation area). Recommends no further study due to the non-hazardous nature of the wastes disposed at the site. |

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Table 2.9
Significant Environmental Actions at U.S. Navy Site 9
Transformer Storage Area

| DATE | EVENT | COMMENTS |
|--------------|--|---|
| 1973 to 1980 | Electrical transformers awaiting repairs or disposal stored at site. | Some transformers may have had leaks. Spills may have occurred. As of 1980, transformers no longer stored at site, site regraded and covered with gravel. |
| 1984 | IAS (NEESA). | Recommends additional study due to the possibility of PCB contamination. |
| 1986 | Confirmation Study, Step 1 A Verification (Round One) (Dames and Moore). | Thirteen soil samples collected. Highest detection of PCB is 321 $\mu\text{g}/\text{kg}$, which is below lowest action levels. No further investigations or actions recommended. |

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Table 2.10
Summary of Samples Collected at U.S. Navy Site 10
Decontamination Agent Disposal Area Near First Street

| Sample ID | Media | Analytical Parameters |
|------------------------------------|----------------------------|--|
| 1992 SITE INVESTIGATION | | |
| 10SB01-1A | Surface Soil 0-2 ft bgs | VOCS, SVOCS, TOC, TPH, and inorganics |
| 10SB01-2A | Surface Soil 2-4 ft bgs | VOCS, SVOCS, TOC, TPH, and inorganics |
| 10SB01-3A | Surface Soil 4-6 ft bgs | VOCS, SVOCS, TOC, TPH, and inorganics |
| 10SB02-1A | Surface Soil 0-2 ft bgs | VOCS, SVOCS, TOC, TPH, and inorganics |
| 10SB02-2A | Surface Soil 4-6 ft bgs | VOCS, SVOCS, TOC, TPH, and inorganics |
| 10SB02-3A | Surface Soil 6-8 ft bgs | VOCS, SVOCS, TOC, TPH, and inorganics |
| 10SB03-1A | Surface Soil 0-2 ft bgs | VOCS, SVOCS, TOC, TPH, and inorganics |
| 10SB03-2A | Surface Soil 2-4 ft bgs | VOCS, SVOCS, TOC, TPH, and inorganics |
| 10SB03-3A | Surface Soil 6-8 ft bgs | VOCS, SVOCS, TOC, TPH, and inorganics |
| 10GW01-1A | Groundwater | VOCS, SVOCS, TOC, TPH, total and dissolved inorganics |
| 10GW02-1A | Groundwater | VOCS, SVOCS, TOC, TPH, total and dissolved inorganics |
| 10GW03-1A | Groundwater | VOCS, SVOCS, TOC, TPH, total and dissolved inorganics |
| 1992 SITE SCREENING PROCESS | | |
| 10GW01 through 10GW03 | Groundwater | VOCS, SVOCS, pesticides/PCBs, total and dissolved inorganics |

Notes:

- Bgs = Below ground surface
- VOC = Volatile Organic Compound
- SVOC = Semivolatile Organic Compounds
- TOC = Total organic carbon
- PH = Total petroleum hydrocarbons

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Table 2.11
 Significant Environmental Actions at U.S. Navy Site 10
 Decontamination Agent Disposal Area Near First Street

| DATE | EVENT | COMMENTS |
|---------------|--|---|
| Prior to 1982 | An estimated 75 to 100 gallons of DS -2 decontamination agent reportedly buried at site. | Exact date and location of burial not known. |
| 1984 | IAS (NEESA). | Recommends a magnetometer survey to locate buried containers; and additional activities once containers are located. |
| December 1985 | Magnetometer survey (Geosight). | Locates anomalistic areas which are not positively identified as buried containers. |
| 1991 | Final RI Interim Report (Dames and Moore). | Summarizes Confirmation Study. Recommends additional RI efforts and risk assessment. |
| 1994 | Final Site Investigation Report (WESTON®). | Three monitoring wells installed (10-GW01, 10-GW02, and 10-GW03). Soil and groundwater sampled. Recommends confirmatory re-sampling of groundwater. |
| 1997 | Final Site Screening Process Report (Baker). | Additional round of groundwater samples collected from all three monitoring wells. No further action recommended. |

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Table 2.12
Summary of Samples Collected at U.S. Navy Site 11
Bone Yard

| Sample ID | Media | Analytical Parameters |
|---|-----------------------------|---|
| STEP 1A – CONFIRMATION STUDY – ROUND 1 (1986) AND ROUND 2 (1987) | | |
| 11S01 through 11S09 (1986) | Soil | VOCs, SVOCs, total phenols, oil & grease, and inorganics |
| 11GW01 (1986 & 1987) | Groundwater | VOCs, SVOCs, total phenols, oil & grease, and inorganics |
| 11GW02 (1986 & 1987) | Groundwater | VOCs, SVOCs, total phenols, oil & grease, and inorganics |
| 11GW03 (1986 & 1987) | Groundwater | VOCs, SVOCs, total phenols, oil & grease, and inorganics |
| 11SW01 (1986 & 1987) | Surface Water | VOCs, SVOCs, total phenols, oil & grease, and inorganics |
| 11SW02 (1986 & 1987) | Surface Water | VOCs, SVOCs, total phenols, oil & grease, and inorganics |
| 11SW03 (1986 & 1987) | Surface Water | VOCs, SVOCs, total phenols, oil & grease, and inorganics |
| 11SD01 (1986 & 1987) | Sediment | VOCs, SVOCs, total phenols, oil & grease, and inorganics |
| 11SD02 (1986 & 1987) | Sediment | VOCs, SVOCs, total phenols, oil & grease, and inorganics |
| 11SD03 (1986 & 1987) | Sediment | VOCs, SVOCs, total phenols, oil & grease, and inorganics |
| Tank/Drum Content Sampling | NA | RCRA hazardous waste characteristics including EP toxicity, reactivity, corrosivity, and ignitability |
| 1992 SITE INVESTIGATION | | |
| 11SS01 through 11SS12 | Surface Soil | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11SB04-1A | Surface Soil 0 –2 ft bgs | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11SB04-2A | Surface Soil 2-4 ft bgs | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11SB04-3A | Surface Soil 6-8 ft bgs | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11SB05-1A | Surface Soil 0-2 ft bgs | VOCs, SVOCs, TOC, TPH, and inorganics |

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Table 2.12
Summary of Samples Collected at U.S. Navy Site 11
Bone Yard

| Sample ID | Media | Analytical Parameters |
|--|----------------------------|---|
| 11SB04-2A | Surface Soil 2-4 ft bgs | VOCs, SVOCs, TOC, TPH, and inorganics |
| 1992 SITE INVESTIGATION (continued) | | |
| 11SB05-3A | Surface Soil 4-6 ft bgs | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11GW01-1A | Groundwater | VOCs, SVOCs, TOC, TPH, total and dissolved inorganics |
| 11GW02-1A | Groundwater | VOCs, SVOCs, TOC, TPH, total and dissolved inorganics |
| 11GW03-1A | Groundwater | VOCs, SVOCs, TOC, TPH, total and dissolved inorganics |
| 11GW04-1A | Groundwater | VOCs, SVOCs, TOC, TPH, total and dissolved inorganics |
| 11GW05-1A | Groundwater | VOCs, SVOCs, TOC, TPH, total and dissolved inorganics |
| 11SW01 through 11SW05 | Surface Water | VOCs, SVOCs, TOC, TPH, and total inorganics |
| 11SD01-1A | Sediment 0-2 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11SD02-1A | Sediment 2-3 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11SD03-1A | Sediment 0-2 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11SD03-2A | Sediment 2-3 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11SD04-1A | Sediment 0-2 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11SD04-2A | Sediment 2-3 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11SD05-1A | Sediment 0-2 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11SD05-2A | Sediment 2-3 ft | VOCs, SVOCs, TOC, TPH, and inorganics |

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Table 2.12
Summary of Samples Collected at U.S. Navy Site 11
Bone Yard

| Sample ID | Media | Analytical Parameters |
|-----------|--------------------------|---------------------------------------|
| 11MS01-1A | Marsh Sediment 0-2 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11MS01-2A | Marsh sediment 2-3 ft | VOCs, SVOCs, TOC, TPH, and inorganics |

PENNIMAN SHELL LOADING PLANT SITE
DATA ACQUISITION SUMMARY REPORT
SECTION 2.0 TABLES

Table 2.12 (Continued)
Summary of Samples Collected at U.S. Navy Site 11
Bone Yard

| Sample ID | Media | Analytical Parameters |
|--|--------------------------|--|
| 1992 SITE INVESTIGATION (continued) | | |
| 11MS02-1A | Marsh Sediment 0-2 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11MS02-2A | Marsh Sediment 2-3 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11MS03-1A | Marsh Sediment 0-2 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| 11MS03-2A | Marsh Sediment 2-3 ft | VOCs, SVOCs, TOC, TPH, and inorganics |
| SG-1 through SG-16 | Soil | Soil Gas Survey Points |
| 1997 SITE SCREENING PROCESS INVESTIGATION | | |
| 11GW01 through 11GW05 | Groundwater | TCL organics, TAL inorganics (filtered and unfiltered) |

Notes:

| | |
|---------------------------------------|---|
| bgs = Below ground surface | TOC = Total organic carbon |
| NA = Not applicable | TPH = Total petroleum hydrocarbons |
| PCB = Polychlorinated biphenyl | VOC = Volatile organic compound |
| SVOC = Semivolatile organic compounds | RCRA = Resource Conservation and Recovery Act |

Quality Assurance/Quality Control (QA/QC) samples are not listed.

PENNIMAN SHELL LOADING PLANT SITE
DATA ACQUISITION SUMMARY REPORT
SECTION 2.0 TABLES

Table 2.13
Significant Environmental Actions at U.S. Navy Site 11
Bone Yard

| DATE | EVENT | COMMENTS |
|-------------------|---|--|
| 1940 to 1978 | Miscellaneous wastes stored at site. | Waste consists of old containers, fuel oil, sludge, gasoline, asphalt, mixing tanks and various scrap. |
| 1984 | IAS (NEESA). | Recommends additional study in form of Confirmation Study due to the presence of oil and gasoline and reported spills. |
| 1986 | Confirmation Study, Step 1A (Verification) Round One (Dames and Moore). | Three monitoring wells installed (11GW01, 11GW02, and 11GW03). Groundwater and soil samples collected from each well. Surface water, sediment, and drum samples also collected. |
| 1987 | Confirmation Study, Step 1A (Verification) Round Two (Dames and Moore). | Additional round of groundwater, surface water and sediment samples collected. |
| 1991 | Final RI Interim Report (Dames and Moore). | Summarizes Confirmation Study. Notes that majority of drums and scrap metal has been removed since the IAS. Recommends additional RI efforts. |
| 1994 | Final Site Investigation Report (WESTON®). | Two new monitoring wells installed (11-GW04 and 11-GW05). Soil gas survey performed and soil, groundwater, surface water and sediment samples collected. Recommends removal of tanks/drums and confirmatory resampling of soil, groundwater and surface water. |
| 1997 | Final Site Screening Process Report (Baker). | Additional round of groundwater samples collected from all five monitoring wells. |
| September 1997 | IMS removed drums, tanks, and miscellaneous scrap from site. | Removal performed as a housekeeping measure. |
| Future Activities | Characterization of soil in vicinity of removed tanks and drums. | In response to VDEQ's request, samples to be collected in the vicinity of the removal. Results will be documented in a closeout report (final submittal July 2000). |

Approximate Site Boundary



Williamsburg, VA
7.5 Minute USGS Topographic Map

Figure 2.1
Site Location Map

Clay Bank, VA
7.5 Minute USGS Topographic Map

ROAD CLASSIFICATION
ULR Route (red outline) State Route (red circle)

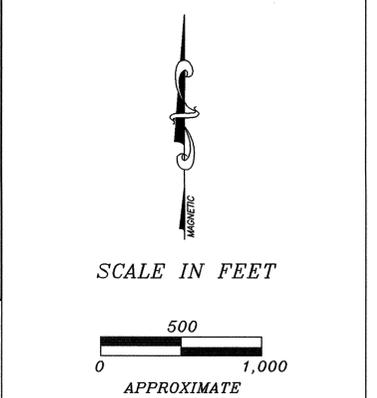
PENNIMAN SHELL LOADING PLANT SITE
0 1
APPROXIMATE SCALE (MILES)

ROAD CLASSIFICATION
Heavy-Duty (thick red line) Light-Duty (thin red line)
Medium-Duty (dashed red line) Unimproved Dist. (dashed black line)



- LEGEND**
- 1 U.S. NAVY SITE 1 - Landfill Near Incinerator
 - 2 U.S. NAVY SITE 2 - Contaminated Food Disposal Area
 - 3 U.S. NAVY SITE 3 - Submarine Dye Disposal Area
 - 4 U.S. NAVY SITE 4 - Medical Supplies Disposal Area
 - 5 U.S. NAVY SITE 5 - Photographic Chemicals Disposal Area
 - 6 U.S. NAVY SITE 6 - Spoiled Food Disposal Area
 - 7 U.S. NAVY SITE 7 - Old duPont Disposal Area (Current, IAS, and EPIC Locations Identified)
 - 8 U.S. NAVY SITE 8 - Landfill Near Warehouse 14
 - 9 U.S. NAVY SITE 9 - Transformer Storage Area
 - 10 U.S. NAVY SITE 10 - Decontamination Agent Disposal Area
 - 11 U.S. NAVY SITE 11 - Bone Yard
 - 12 U.S. NAVY SITE 12 - Disposal Site Near Water Tower
 - 1 U.S. NAVY AREA OF CONCERN 1 - Scrap Metal Dump
 - 2 U.S. NAVY AREA OF CONCERN 2 - Dextrose Dump
 - 3 U.S. NAVY AREA OF CONCERN 3 - CAD 11/12 Pond Bank
 - 4 U.S. NAVY AREA OF CONCERN 4 - (See Site 4) Medical Waste Disposal Area
 - 5 U.S. NAVY AREA OF CONCERN 5 - Debris Area (an Undifferentiated Portion of USN Site 1)

Cyan indicates former Penniman structures.
Black indicates current conditions.



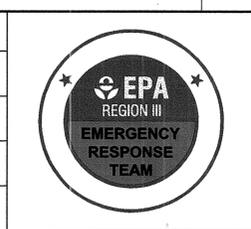
| NO. | DATE | APPR. | REVISION | NO. | DATE | APPR. | REVISION |
|-----|------|-------|----------|-----|------|-------|----------|
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U. S. ENVIRONMENTAL PROTECTION AGENCY - REGION III
PHILADELPHIA PENNSYLVANIA

WESTON FEDERAL PROGRAMS DIVISION
MANAGERS DESIGNERS/CONSULTANTS

DELTRAN NEW JERSEY

| | |
|------------|---|
| RPM | Robert Thomson |
| SATA LEAD | Robert McClade |
| PROJ. ENG. | |
| APPR. | |
| FILE NAME | SATA000135:/Sites/Cheatham/SATAAUTOCAD/DASR/DASR MAPS.dwg |



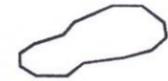
PENNIMAN SHELL LOADING PLANT
U.S. Navy and U.S. EPA Site Location Map

WILLIAMSBURG VIRGINIA

| | | |
|----------------------------|---------------------------|-------------|
| DRAWN BY ROBERT McCLADE | DATE 22 SEPTEMBER 1999 | DWG. NO. |
| SCALE AS INDICATED | PCS NO. 6045 | SHT. 1 OF 1 |

Figure 2.2
U.S. Navy and U.S. EPA Site Location Map

LEGEND



Approximate Area Boundaries



Unnamed Tributary with Flow Direction

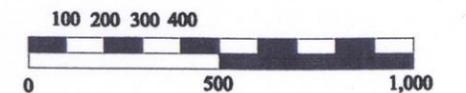
PEN1-SO-04

Roy F. Weston, Inc. 1/99 SI Sample
Locations with Identifiers



NORTH

APPROXIMATE SCALE (feet)



TDD NUMBER: 9901-45

SITE ASSESSMENT TECHNICAL ASSISTANCE - REGION III



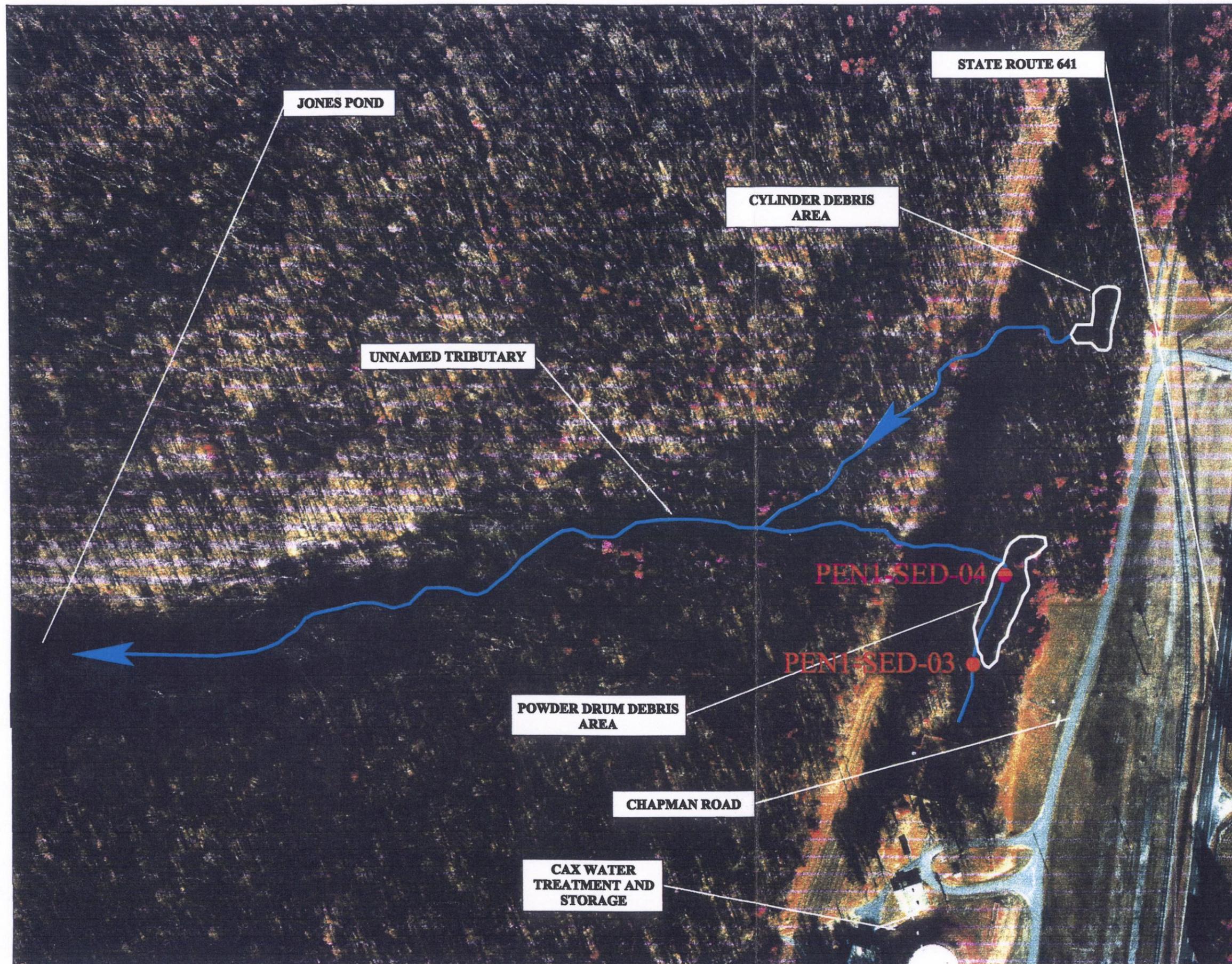
**PENNIMAN SHELL LOADING
PLANT SITE**

Figure 2.3

U.S. Navy AOC 1 Area Map

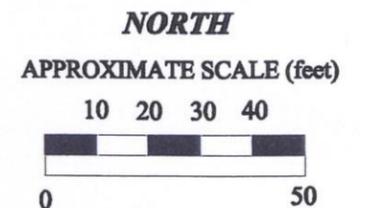
WILLIAMSBURG

VIRGINIA



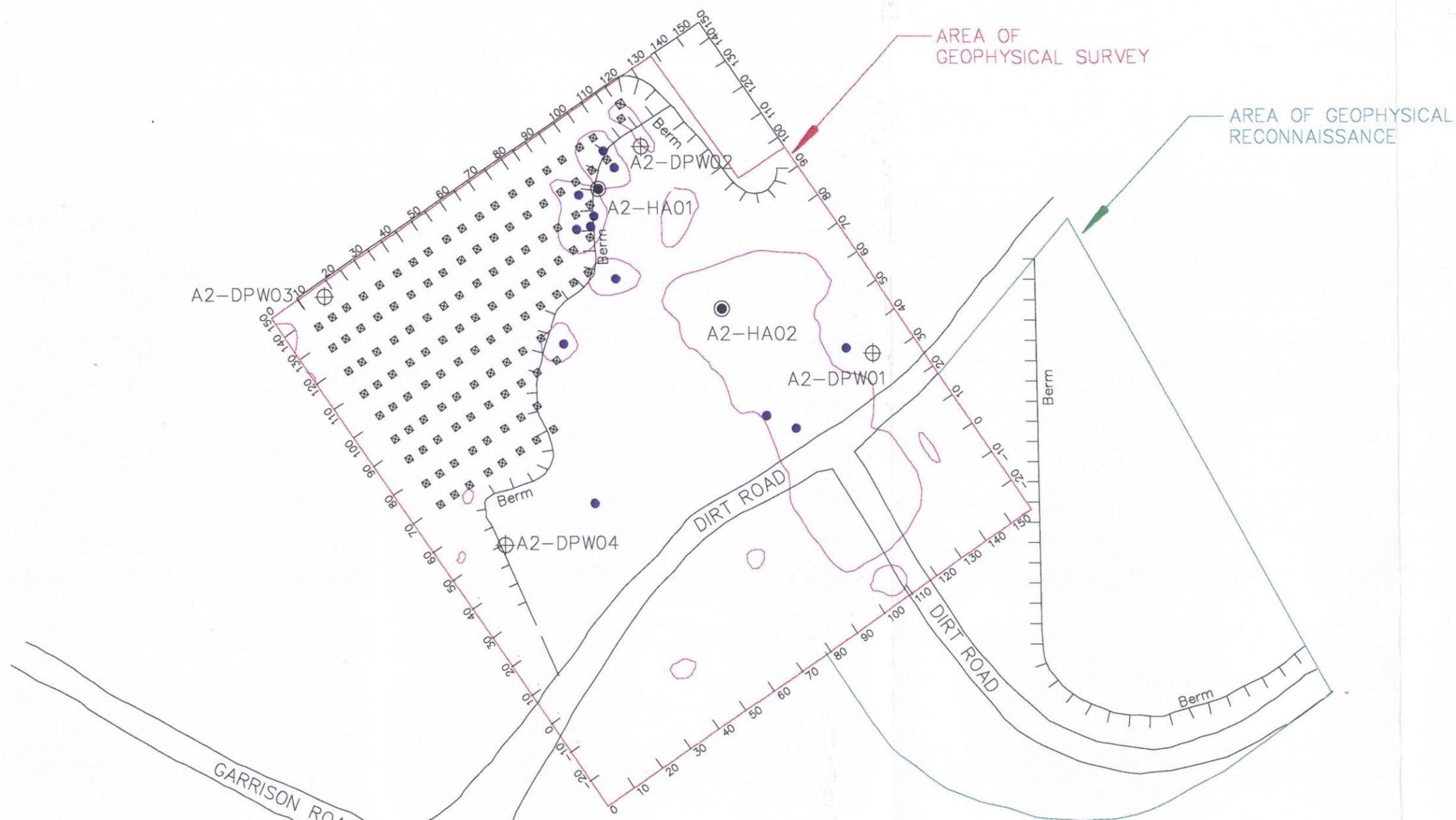
LEGEND

- ☒ Concrete Pier
- Surface Soil and Shallow Subsurface Soil Sample Location (1998 Baker Field Investigation)
- ⊕ Temporary Well (1998 Baker Field Investigation)
- Significant EM-61 Anomalies (Baker, Inc. 1998 Field Investigation)
- Exposed Drum (October 1998)



TDD NUMBER: 9901-45
 SITE ASSESSMENT TECHNICAL ASSISTANCE - REGION III
WESTON FEDERAL PROGRAMS DIVISION
MANAGERS ENGINEERS CONSULTANTS

PENNIMAN SHELL LOADING PLANT SITE
 Figure 2.4
 U.S. Navy AOC 2 Area Map
 WILLIAMSBURG VIRGINIA



NOTES:

- 1.) LOCATIONS FOR FENCE LINE, GARRISON ROAD, DIRT ACCESS ROAD LEADING TO SITE, AND TEMPORARY MONITORING WELLS SURVEYED BY PATTON, HARRIS, RUST AND ASSOCIATES. OCTOBER 1998.
- 2.) LOCATIONS FOR SURFACE/SHALLOW SUBSURFACE SOIL SAMPLE LOCATIONS SURVEYED BY MAKER VIA GPS. OCTOBER 1998.
- 3.) REMAINING FEATURES FIELD MAPPED BY NAEVA GEOPHYSICS, INC. OCTOBER 1998.
- 4.) ALL SAMPLES COLLECTED UNDER THE 1998 FIELD INVESTIGATION.
- 5.) ALL INFORMATION ON THIS MAP WAS DERIVED FROM THE DRAFT SITE MANAGEMENT PLAN, FY 2000, NAVAL WEAPONS STATION YORKTOWN, CHEATHAM ANNEX SITE, PREPARED BY BAKER ENVIRONMENTAL, INC. JULY 1999.

LEGEND

 Surface Water Flow Direction

 Drop Inlet

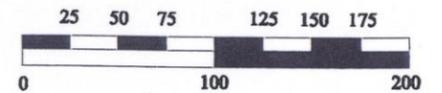
 Approximate Area Boundary

CMP - Corrugated Metal Pipe

All information on this map was derived from the *Draft Site Management Plan, FY 2000, Naval Weapons Station Yorktown, Cheatham Annex Site* prepared by Baker Environmental, Inc. July 1999.



APPROXIMATE SCALE (feet)



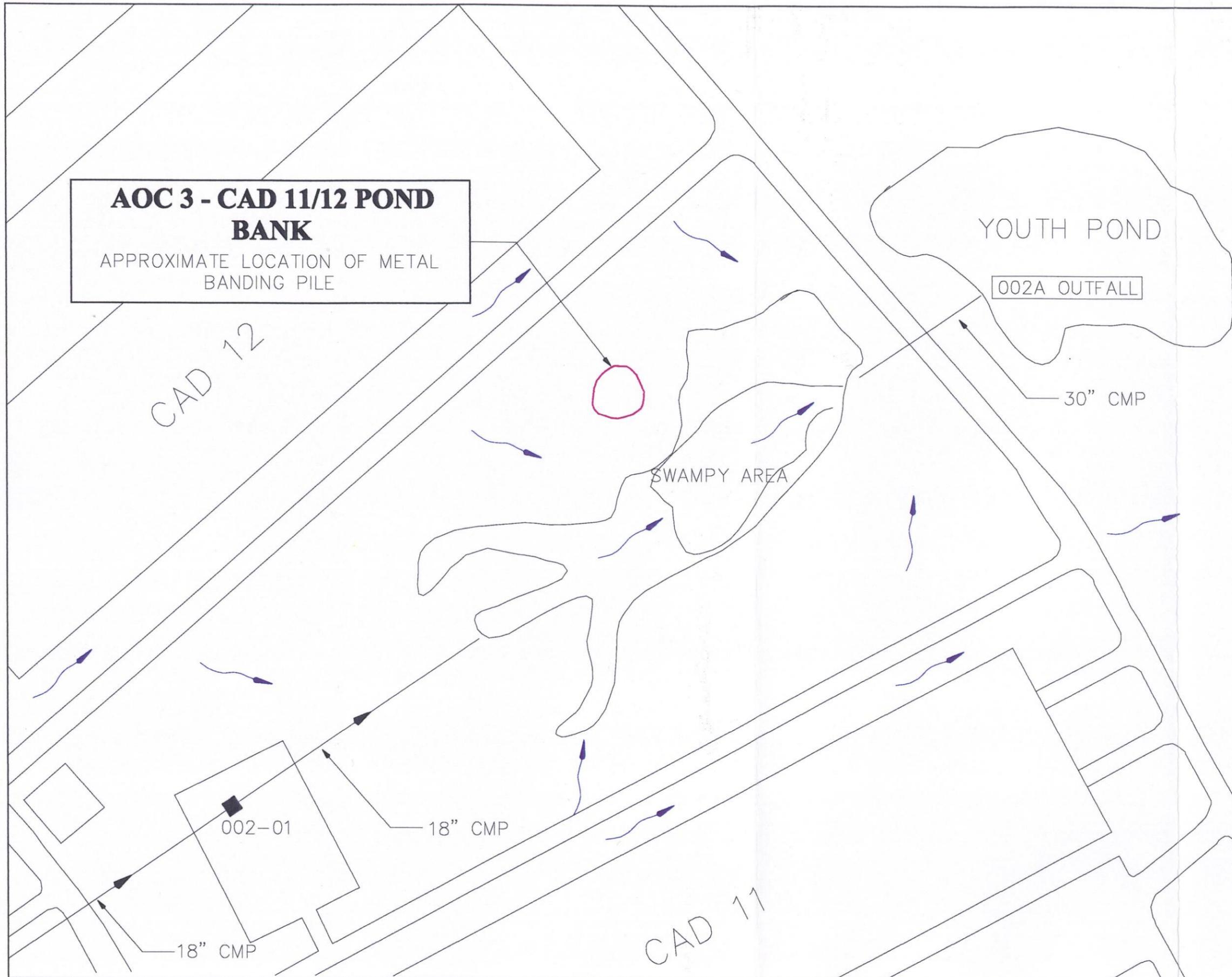
TDD NUMBER: 9901-45

SITE ASSESSMENT TECHNICAL ASSISTANCE - REGION III



**PENNIMAN SHELL LOADING
PLANT SITE**

Figure 2.5
U.S. Navy AOC 3 Area Map



**AOC 3 - CAD 11/12 POND
BANK**
APPROXIMATE LOCATION OF METAL
BANDING PILE

CAD 12

CAD 11

YOUTH POND

002A OUTFALL

30" CMP

SWAMPY AREA

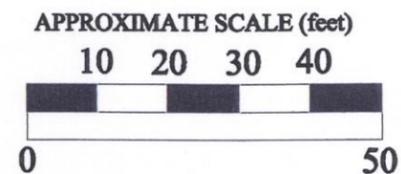
002-01

18" CMP

18" CMP

LEGEND

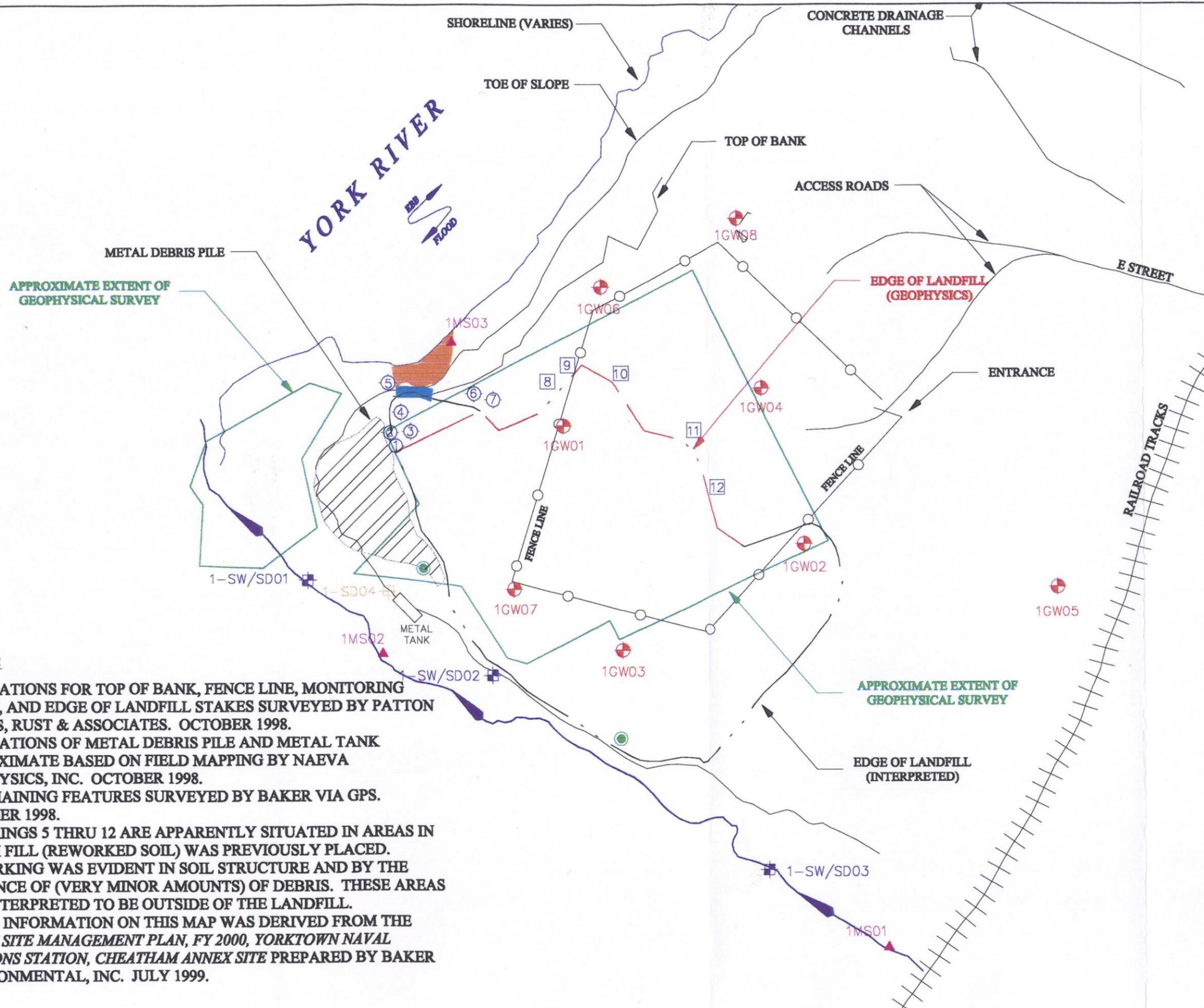
-  1992 SI Marsh Sample Location - Weston
-  1998 Surface Soil and Shallow Subsurface Soil Sample Location - Baker
-  1998 Sediment Sample Location - Baker
-  Monitoring Well Location
-  1998 Surface Water and Sediment Sample Location - Baker
-  Approximate Hand Auger Boring Location - Baker 1998
-  Approximate Direct Push Boring Location - Baker 1998
-  Approximate Extent of Exposed Thin Debris Layer on Top of Bank
-  Approximate Extent of Apparent Landfill Debris Sparsely Present on Beach



TDD NUMBER: 9901-45
 SITE ASSESSMENT TECHNICAL ASSISTANCE - REGION III
 WESTON
 FEDERAL PROGRAMS DIVISION

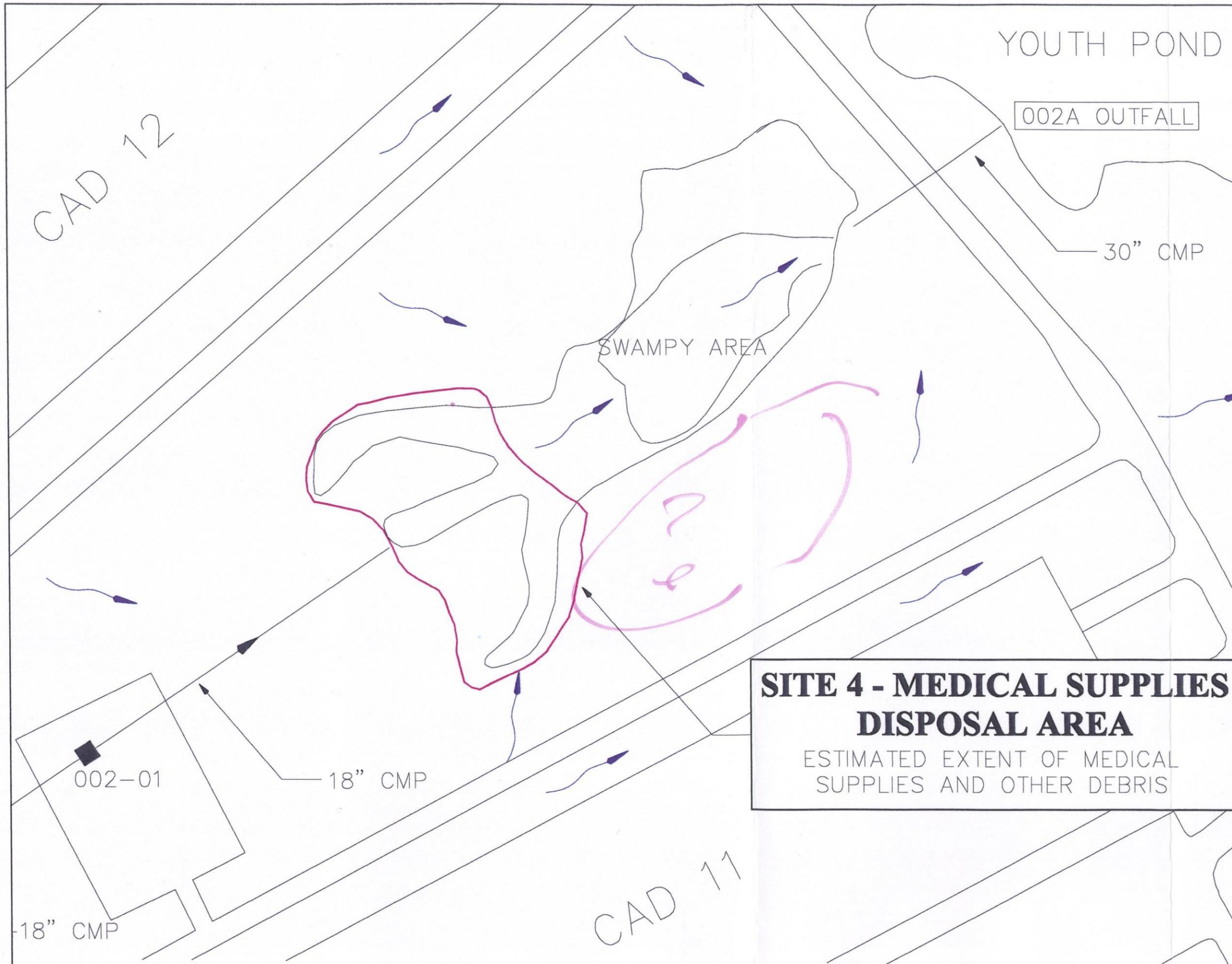
PENNIMAN SHELL LOADING PLANT SITE

Figure 2.6
 U.S. Navy Site 1 Area Map



NOTES:

- 1.) LOCATIONS FOR TOP OF BANK, FENCE LINE, MONITORING WELLS, AND EDGE OF LANDFILL STAKES SURVEYED BY PATTON HARRIS, RUST & ASSOCIATES. OCTOBER 1998.
- 2.) LOCATIONS OF METAL DEBRIS PILE AND METAL TANK APPROXIMATE BASED ON FIELD MAPPING BY NAEVA GEOPHYSICS, INC. OCTOBER 1998.
- 3.) REMAINING FEATURES SURVEYED BY BAKER VIA GPS. OCTOBER 1998.
- 4.) BORINGS 5 THRU 12 ARE APPARENTLY SITUATED IN AREAS IN WHICH FILL (REWORKED SOIL) WAS PREVIOUSLY PLACED. REWORKING WAS EVIDENT IN SOIL STRUCTURE AND BY THE PRESENCE OF (VERY MINOR AMOUNTS) OF DEBRIS. THESE AREAS ARE INTERPRETED TO BE OUTSIDE OF THE LANDFILL.
- 5.) ALL INFORMATION ON THIS MAP WAS DERIVED FROM THE DRAFT SITE MANAGEMENT PLAN, FY 2000, YORKTOWN NAVAL WEAPONS STATION, CHEATHAM ANNEX SITE PREPARED BY BAKER ENVIRONMENTAL, INC. JULY 1999.



U.S. ENVIRONMENTAL PROTECTION AGENCY
 REMEDIAL RESPONSE SECTION - REGION III
 3HS13
 PHILADELPHIA PENNSYLVANIA

LEGEND



Surface Water Flow Direction



Drop Inlet

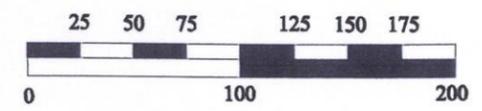
CMP - Corrugated Metal Pipe

All information on this map was derived from the Draft Site Management Plan, FY 2000, Naval Weapons Station Yorktown, Cheatham Annex Site prepared by Baker Environmental, Inc. July 1999.



NORTH

APPROXIMATE SCALE (feet)



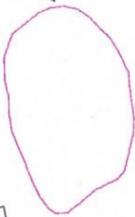
SITE 4 - MEDICAL SUPPLIES DISPOSAL AREA
 ESTIMATED EXTENT OF MEDICAL SUPPLIES AND OTHER DEBRIS

TDD NUMBER: 9901-45
 SITE ASSESSMENT TECHNICAL ASSISTANCE - REGION III
WESTON FEDERAL PROGRAMS DIVISION
MANAGEMENT ENVIRONMENTAL CONSULTANTS

PENNIMAN SHELL LOADING PLANT SITE

Figure 2.7
 U.S. Navy Site 4 Area Map

Approximate Location of Site 7 According to IAS Report



RECREATIONAL CABINS

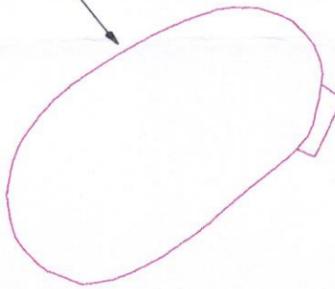
169

170

YORK RIVER



Approximate Location of Site 7 as Currently Depicted



Area of Limited Exposed Debris

SHORE LINE (VARIES)

RAILROAD TRACKS

CAD 13

CHASE ROAD

D STREET

PENNIMAN SHELL LOADING PLANT SITE

Figure 2.8
U.S. Navy Site 7 Area Map

TDD NUMBER: 9901-45

WILLIAMSBURG

VIRGINIA

SITE ASSESSMENT TECHNICAL ASSISTANCE - REGION III



FEDERAL PROGRAMS DIVISION

DELRAN

NEW JERSEY

U.S. ENVIRONMENTAL PROTECTION AGENCY

REMEDIAL RESPONSE SECTION - REGION III
3HS13

PHILADELPHIA

PENNSYLVANIA

LEGEND

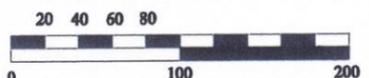


Approximate Area Boundaries



NORTH

APPROXIMATE SCALE (feet)



LEGEND



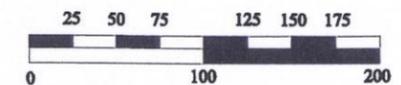
Approximate Boundary for Area

Information on this map was derived from U.S. Navy AutoCAD drawings as well as the Draft Site Management Plan, FY 2000, Naval Weapons Station Yorktown, Cheatham Annex Site prepared by Baker Environmental, Inc. July 1999.



NORTH

APPROXIMATE SCALE (feet)



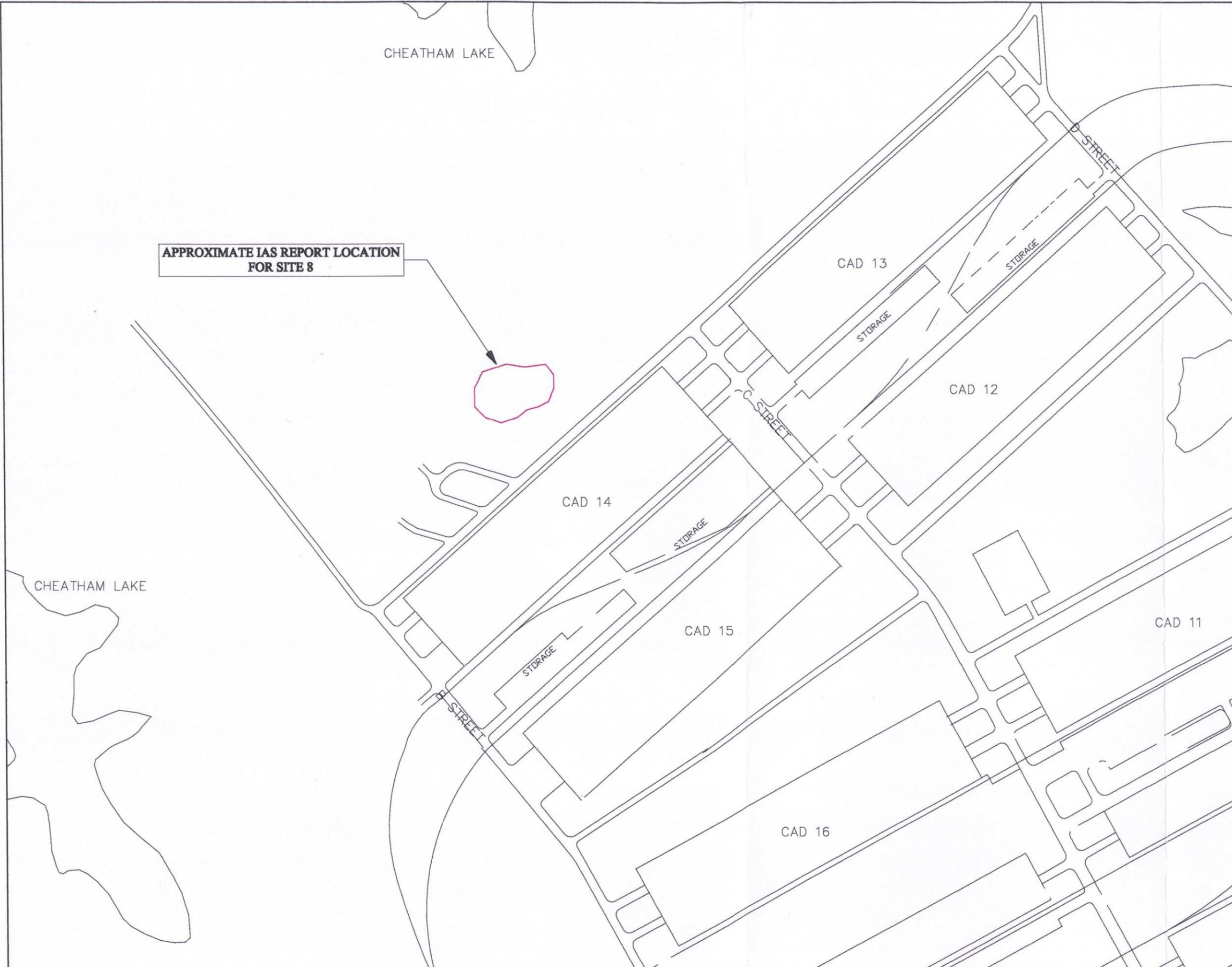
TDD NUMBER: 9901-45

SITE ASSESSMENT TECHNICAL ASSISTANCE - REGION III



**PENNIMAN SHELL LOADING
PLANT SITE**

Figure 2.9
U.S. Navy Site 8 Area Map



LEGEND



Approximate Boundary for Area



Dames and Moore Soil Sample Locations
(from Confirmation Study Step 1A -
Verification Round)

Information on this map was derived from
U.S. Navy AutoCAD drawings, the
Confirmation Study Step 1A (Verification)
prepared by Dames and Moore, and the
Draft Site Management Plan, FY 2000,
Naval Weapons Station Yorktown,
Cheatham Annex Site prepared by Baker
Environmental, Inc. in July 1999.



NORTH

NO SCALE

TDD NUMBER: 9901-45

SITE ASSESSMENT TECHNICAL ASSISTANCE - REGION III



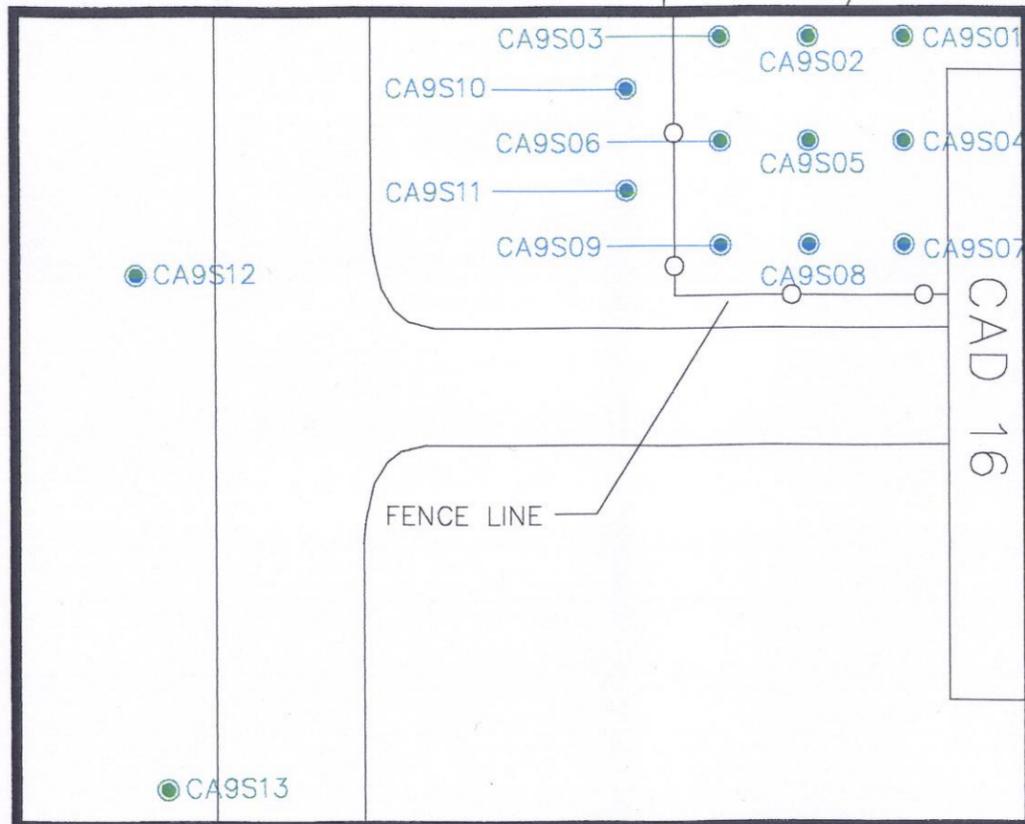
PENNIMAN SHELL LOADING
PLANT SITE

Figure 2.10
U.S. Navy Site 9 Area Map

WILLIAMSBURG

VIRGINIA

Site 9 Sample Location Detail



CAD 15

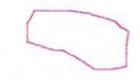
CAD 16

STREET
STORAGE

CAD 16

6

LEGEND



Magnetic Anomalies Reported in Figure 3, Appendix F, *Final Remedial Investigation Interim Report*, Dames and Moore, 1991



Monitoring Wells

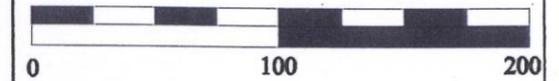
Information on this map was derived from the *Draft Site Management Plan, FY 2000, Naval Weapons Station Yorktown, Cheatham Annex Site* prepared by Baker Environmental, Inc. July 1999.



NORTH

APPROXIMATE SCALE (feet)

25 50 75 125 150 175



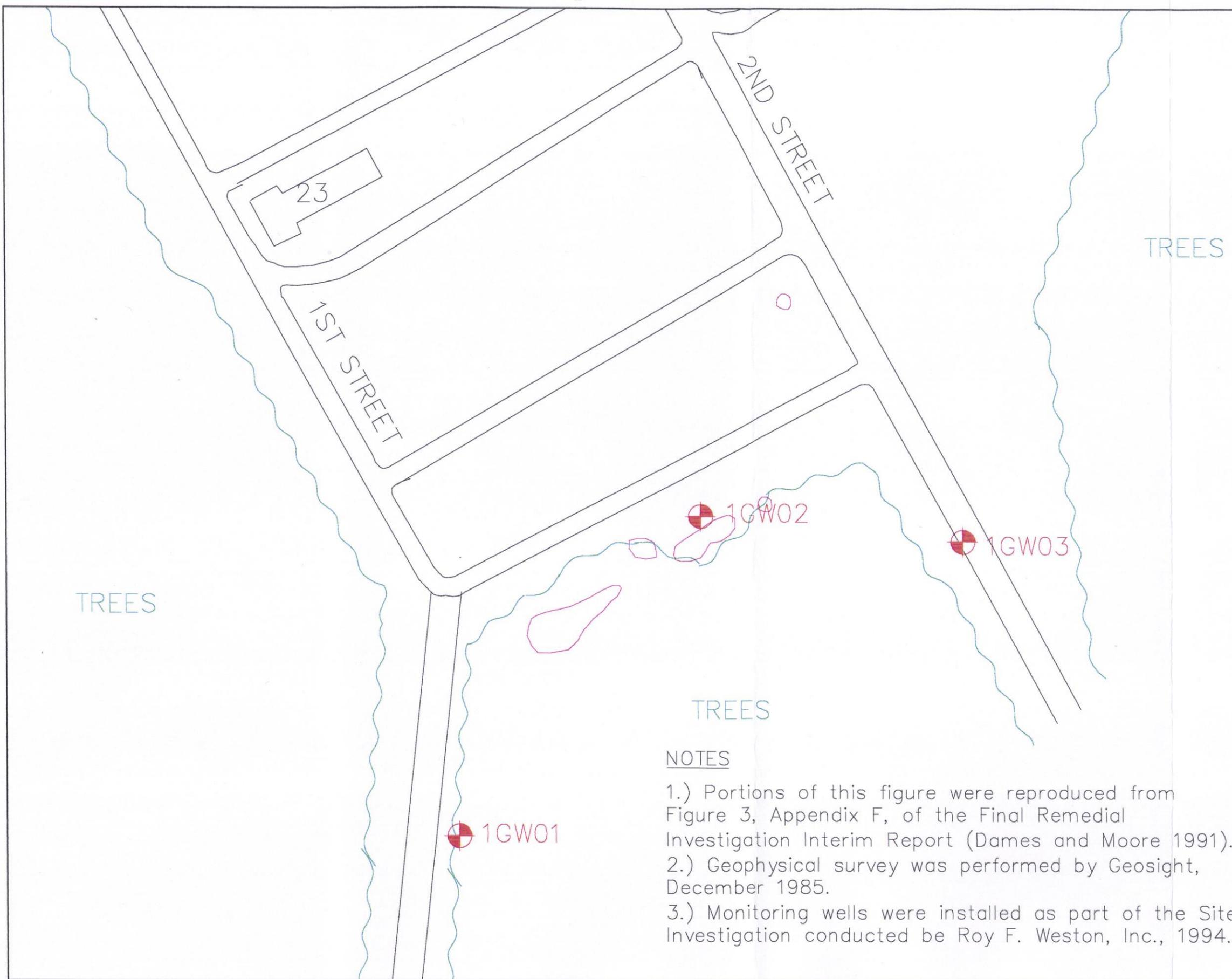
TDD NUMBER: 9901-45

SITE ASSESSMENT TECHNICAL ASSISTANCE - REGION III



PENNIMAN SHELL LOADING PLANT SITE

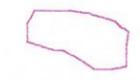
Figure 2.11
 U.S. Navy Site 10 Area Map



NOTES

- 1.) Portions of this figure were reproduced from Figure 3, Appendix F, of the *Final Remedial Investigation Interim Report* (Dames and Moore 1991).
- 2.) Geophysical survey was performed by Geosight, December 1985.
- 3.) Monitoring wells were installed as part of the Site Investigation conducted by Roy F. Weston, Inc., 1994.

LEGEND



Magnetic Anomalies Reported in Figure 3, Appendix F, *Final Remedial Investigation Interim Report*, Dames and Moore, 1991



Monitoring Wells

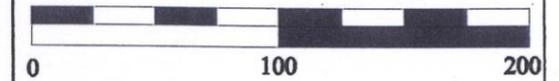
Information on this map was derived from the *Draft Site Management Plan, FY 2000, Naval Weapons Station Yorktown, Cheatham Annex Site* prepared by Baker Environmental, Inc. July 1999.



NORTH

APPROXIMATE SCALE (feet)

25 50 75 125 150 175



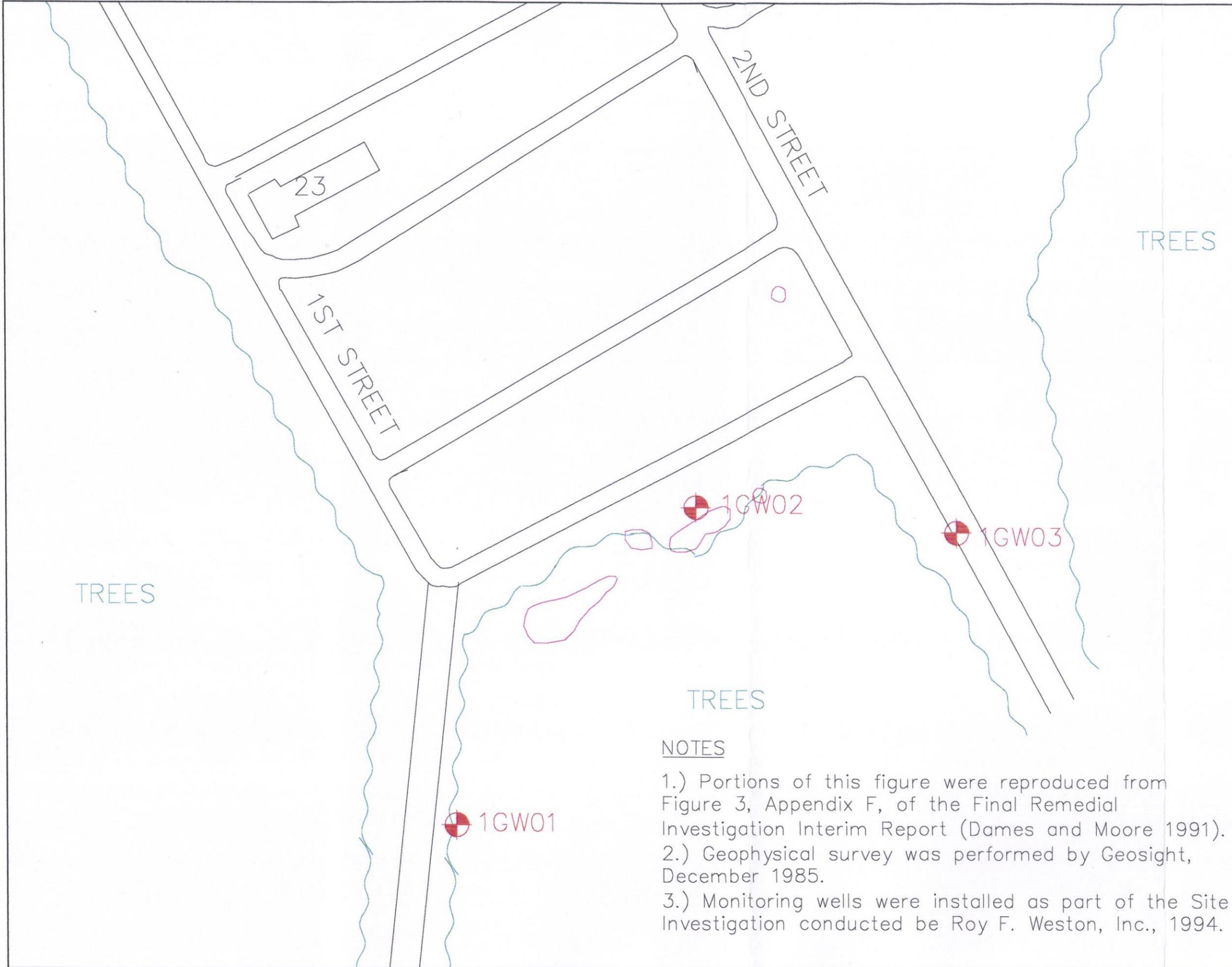
TDD NUMBER: 9901-45

SITE ASSESSMENT TECHNICAL ASSISTANCE - REGION III



PENNIMAN SHELL LOADING PLANT SITE

Figure 2.11
 U.S. Navy Site 10 Area Map



NOTES

- 1.) Portions of this figure were reproduced from Figure 3, Appendix F, of the Final Remedial Investigation Interim Report (Dames and Moore 1991).
- 2.) Geophysical survey was performed by Geosight, December 1985.
- 3.) Monitoring wells were installed as part of the Site Investigation conducted by Roy F. Weston, Inc., 1994.

LEGEND

-  Subsurface Soil Boring Sample Locations with Identifiers - 1994
-  Sediment Sample Locations with Identifiers - 1994
-  Monitoring Well Locations with Groundwater Sample ID - 1994
-  Surface Water Sample Locations with Identifiers - 1994
-  Marsh Sample Locations with Identifiers - 1994
-  Soil Gas Sample Locations with Identifiers - 1994
-  Surface Soil Sample Locations with Identifiers - 1994

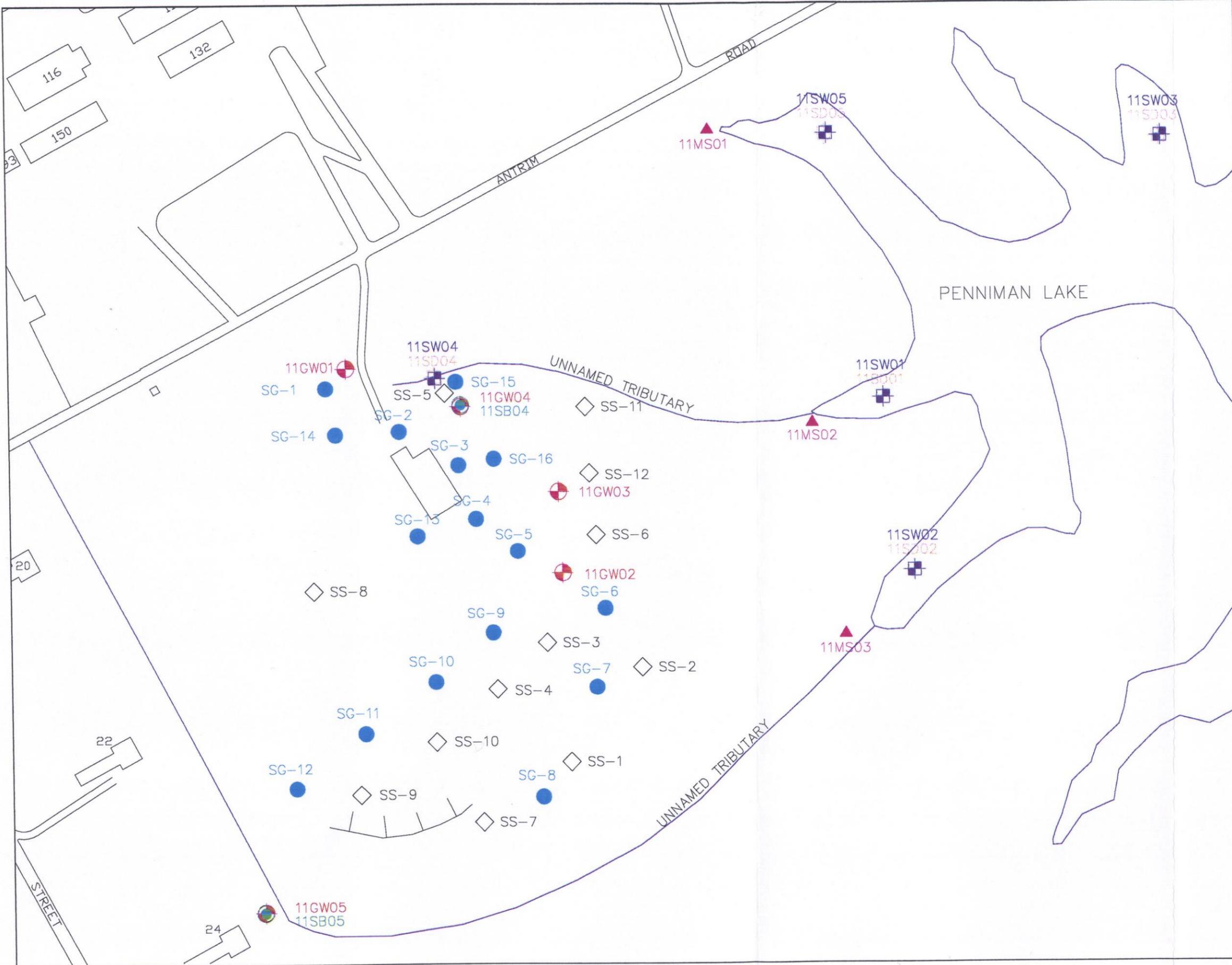
Information on this map was derived from the 1999 Draft Site Management Plan, FY 2000, Naval Weapons Station Yorktown, Cheatham Annex Site and the 1994 Site Investigation Report.

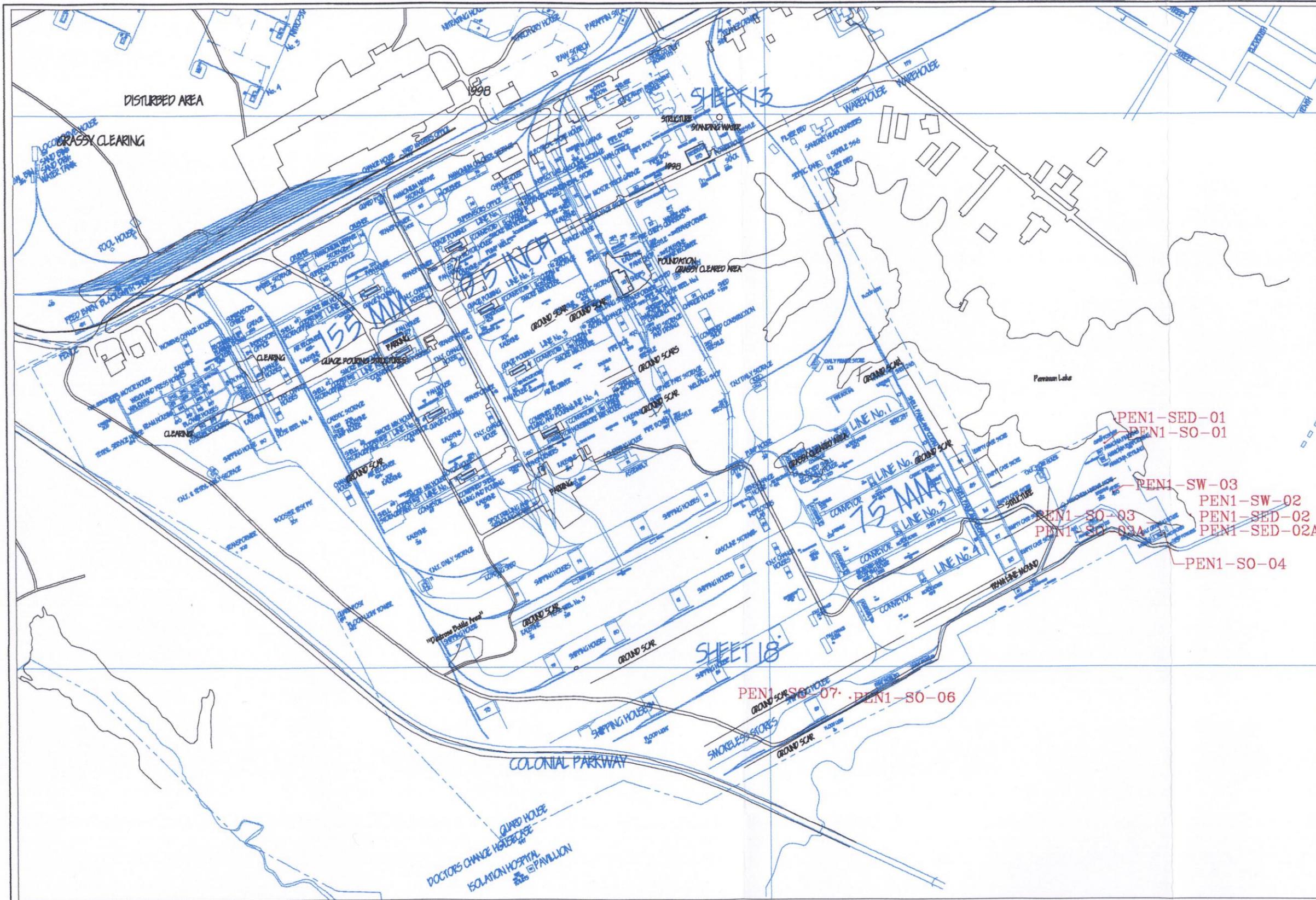


TDD NUMBER: 9901-45
 SITE ASSESSMENT TECHNICAL ASSISTANCE - REGION III
 FEDERAL PROGRAMS DIVISION

PENNIMAN SHELL LOADING PLANT SITE

Figure 2.12B
 U.S. Navy Site 11 Area Map #2





LEGEND

- UNDERGROUND WATER LINE
- - - PROPERTY BORDER
- ==== RAILROAD
- ==== ROADWAY - WIDTH VARIES BY ROAD DUTY
- ▭ STRUCTURE
- ▭ BUNKER - EXACT DESIGN VARIES
- GROUND FEATURE FROM AERIAL PHOTO (LABELED)
- TRAM CAR RAILS
- UNDERGROUND FUEL TANKS
- ABOVE GROUND TANKS
- BRIDGE OR TRESTLE
- SHEET 18
- USN, DuPONT, or PENNIMAN ENGINEERING SHEET NUMBER
- PEN1-SO-03
- SAMPLE LOCATIONS W/IDENTIFIERS

U. S. ENVIRONMENTAL PROTECTION
AGENCY - REGION III

PHILADELPHIA

PENNSYLVANIA



FEDERAL
PROGRAMS
DIVISION

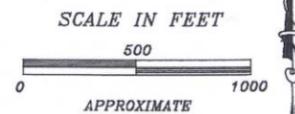
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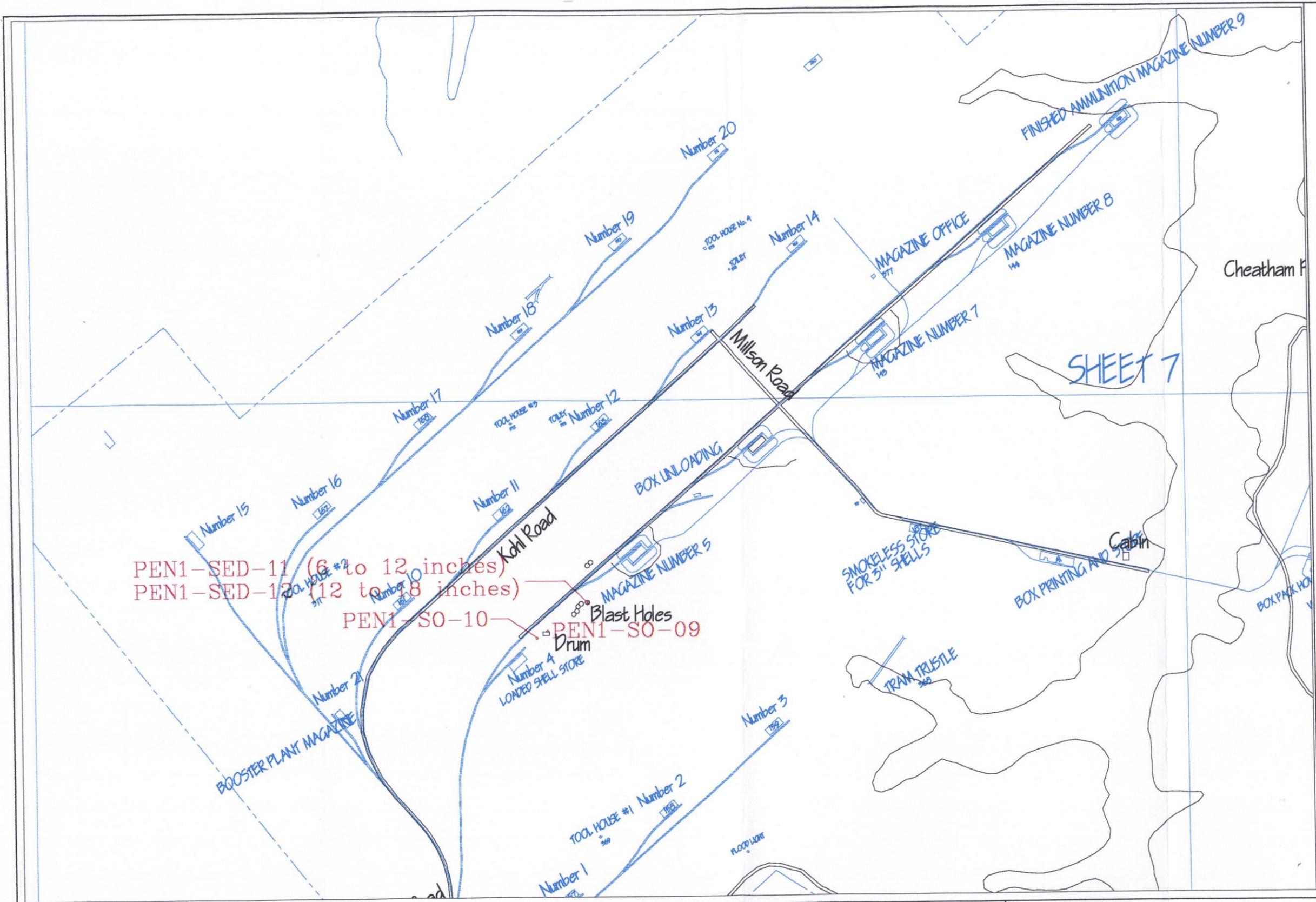
NEW JERSEY

PENNIMAN SHELL LOADING PLANT
FIGURE 2.14
U.S. EPA SHELL LOADING AREA MAP

WILLIAMSBURG

VIRGINIA





LEGEND

- UNDERGROUND WATER LINE
- - - PROPERTY BORDER
- ==== RAILROAD
- ==== ROADWAY - WIDTH VARIES BY ROAD DUTY
- ▭ STRUCTURE
- ▭ BUNKER - EXACT DESIGN VARIES
- ~ GROUND FEATURE FROM AERIAL PHOTO (LABELED)
- ⋈ TRAM CAR RAILS
- UNDERGROUND FUEL TANKS
- ABOVE GROUND TANKS
- ⋈ BRIDGE OR TRESTLE
- ▭ SHEET 18
- PENI-SO-05
- SAMPLE LOCATIONS W/IDENTIFIERS

SHEET 7

PEN1-SED-11 (6 to 12 inches)
 PEN1-SED-12 (12 to 18 inches)
 PEN1-SO-10
 PEN1-SO-09

U. S. ENVIRONMENTAL PROTECTION
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PENNSYLVANIA



FEDERAL PROGRAMS DIVISION

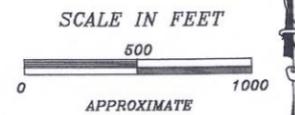
DELTRAN

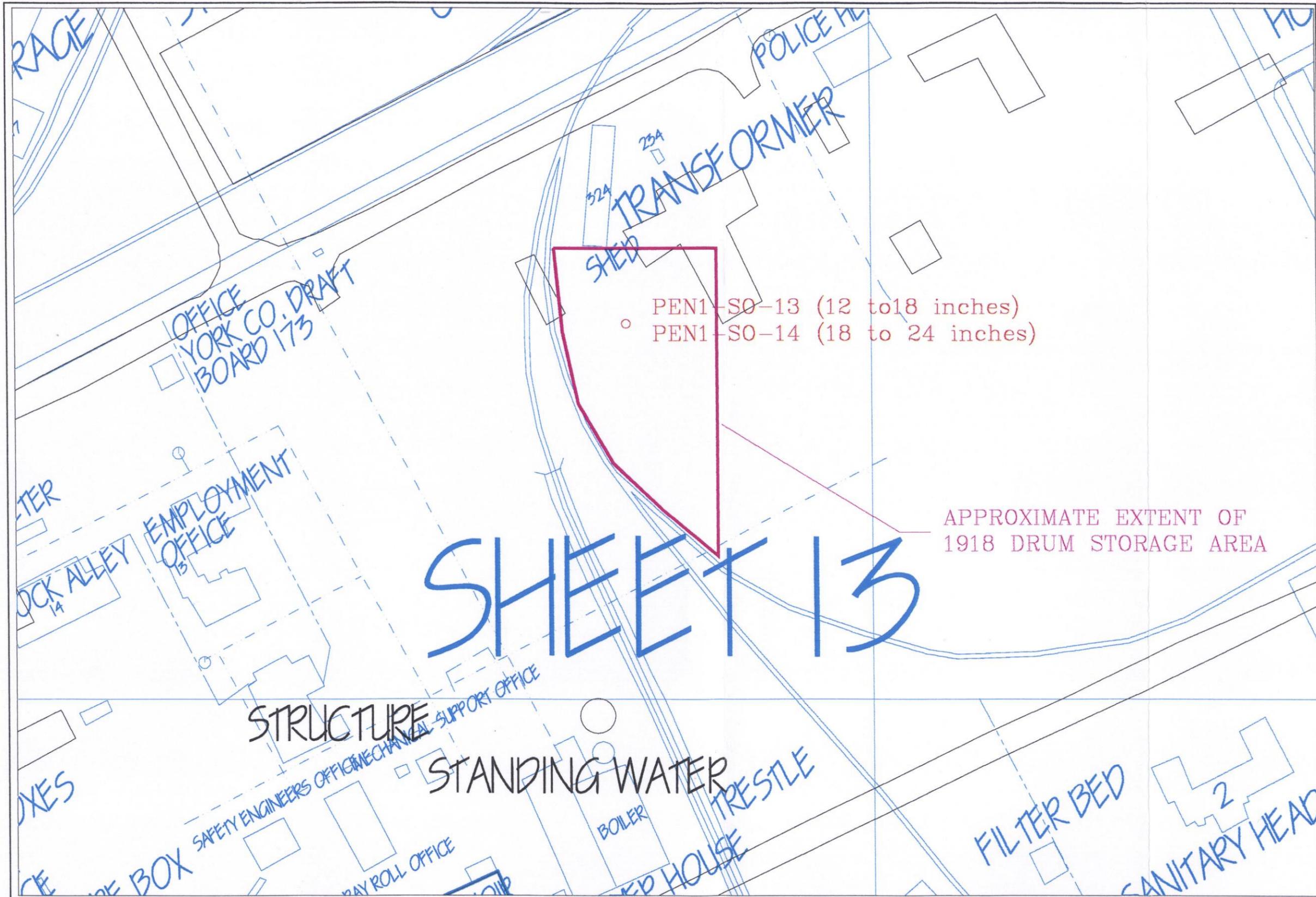
NEW JERSEY

PENNIMAN SHELL LOADING PLANT
 FIGURE 2.15
 U.S. EPA SHIPPING AREA MAP

WILLIAMSBURG

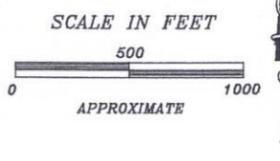
VIRGINIA





LEGEND

- UNDERGROUND WATER LINE
- - - PROPERTY BORDER
- ==== RAILROAD
- ==== ROADWAY - WIDTH VARIES BY ROAD DUTY
- [] STRUCTURE
- [] BUNKER - EXACT DESIGN VARIES
- ~ GROUND FEATURE FROM AERIAL PHOTO (LABELED)
- Y Y TRAM CAR RAILS
- (5) UNDERGROUND FUEL TANKS
- (O) ABOVE GROUND TANKS
- [] BRIDGE OR TRESTLE
- [] SHEET 18
- PENI-S0-05
- SAMPLE LOCATIONS W/IDENTIFIERS
- WWI ERA CONDITIONS
- CURRENT CONDITIONS
- APPROXIMATE AREA BOUNDARY



U. S. ENVIRONMENTAL PROTECTION
 AGENCY - REGION III
 PHILADELPHIA PENNSYLVANIA

WESTON FEDERAL PROGRAMS DIVISION
 MANAGERS DESIGNERS/CONSULTANTS
 DELRAN NEW JERSEY

PENNIMAN SHELL LOADING PLANT
 FIGURE 2.16
 U.S. EPA 1918 DRUM STORAGE AREA MAP
 WILLIAMSBURG VIRGINIA

Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs

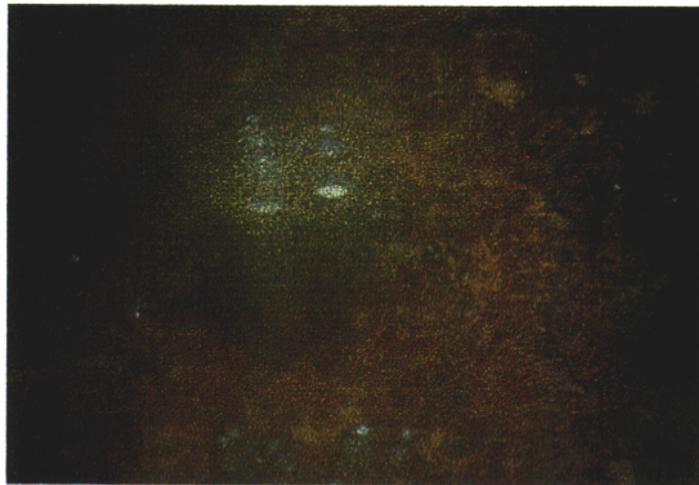


Date: February 1998 by Region III SATA
Remark: View of TNT Graining House bunker remains. Penniman Lake is located approximately 30 feet to the right of the photographer.



Date: February 1998 by Region III SATA
Remark: View of the remains of the Ammonia Evaporating Building. Penniman Lake is located approximately 50 feet to the right of the photographer.

Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs



Date: February 1998 by Region III SATA
Remark: Four bottles of 5% dextrose solution located at U.S. Navy Area of Concern 2.



Date: February 1998 by Region III SATA
Remark: Intra-venous bottles of 5% dextrose solution located at U.S. Navy Area of Concern 2.

Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs



Date: February 1998 by Region III SATA
Remark: View of a typical "blast hole" in the magazine portion of the U.S. EPA "Shipping Area". Large examples of these holes are over 15 feet in diameter and 6 feet deep.



Date: February 1998 by Reion III SATA
Remark: View, facing north, of the remains of the Booster Test Pit located in the U.S. EPA "Shell Loading" Area.

Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs



Date: February 1998 by Region III SATA
Remark: View of the remains of a railroad bed in the magazine portion of the U.S. EPA "Shipping Area."



Date: February 1998 by Region III SATA
Remark: View of a typical "blast hole" found in magazine portion of the U.S. EPA "Shipping Area." Many of these holes fill with water during rainstorms.

**Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs**



Date: February 1998 by Region III SATA
Remark: A view of the typical "blast holes" found in the magazine portion of the U.S. EPA "Shipping Area." In many instances, these holes are so close together, they overlap as shown here.



Date: 15 September 1998 by Region III SATA
Remark: View facing south along Chapman Road of the USN CAX Water Treatment Plant. U.S. Navy Area of Concern 1 "Scrap Metal Dump" (U.S. EPA "Jones Pond Landfill") is located to the right in wooded area. Jones Pond is also located to the right.

Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs



Date: 15 September 1998 by Region III SATA
Remark: View of the TNT graining house ruins with TNT catch basin in the foreground. Penniman Lake is located approximately 25 feet behind the photographer.



Date: 15 September 1998 by Region III SATA
Remark: View of the "Soldering House" area showing differing types of re-bar in poured concrete.

**Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs**



Date: 15 September 1998 by Region III SATA
Remark: View of a large "blast hole" in the magazine portion of the U.S. EPA "Shipping Area."



Date: 15 September 1998 by Region III SATA
Remark: View of the abandoned drum in the magazine portion of the U.S. EPA "Shipping Area." This drum is suspected to be a WW I or WW II era, FM/FS smoke drum.

Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs



Date: 15 September 1998 by Region III SATA
Remark: View of the Booster Test Pit remains in the U.S. EPA "Shell Loading" Area. According to CAX personnel, these ruins are frequently used by deer hunters during deer hunts on USN CAX Property.



Date: 15 September 1998 by Region III SATA
Remark: View of a typical example of the nitro-starch dry houses and dry storage bunkers located in the U.S. EPA "TNT Production" Area.

Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs



Date: 15 September 1998 by Region III SATA
Remark: View of a shallow ditch located in the U.S. EPA "Shell Loading" Area. This ditch contained 3-inch diameter steel pipes of undetermined origin.



Date: 12 January 1999 by Region III SATA
Remark: View of sample locations PEN1-SW-02 and PEN1-SED-02 (Penniman Lake).

Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs



Date: 12 January 1999 by Region III SATA
Remark: View of sample location PEN1-SO-03 (TNT graining house ruins sump). This area was found to be high in 2,4,6-TNT.



Date: 12 January 1999 by Region III SATA
Remark: View of sample location PEN1-SO-07 (slag pile near plant "G" 75-mm lines). This slag material is found throughout the site.

**Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs**



Date: 12 January 1999 by Region III SATA
Remark: View of sample location PEN1-SO-06 ("mixing" tank near plant "G" 75-mm lines). The purpose of this tank is unknown.



Date: 12 January 1999 by Region III SATA
Remark: View of sample location PEN1-SED-01 (Penniman Lake).

Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs



Date: 12 January 1999 by Region III SATA
Remark: View of sample location PEN1-SO-04 (TNT catch box ruins) in U.S. EPA "Shell Loading" Area. Penniman Lake is located directly behind the photographer.



Date: 12 January 1999 by Region III SATA
Remark: View of sample location PEN1-SO-01 (ammonia settling pits) in U.S. EPA "Shell Loading" Area.

**Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs**



Date: 12 January 1999 by Region III SATA
Remark: View of sample location PEN1-DW-01, SW-01, SW-01A, and SED-05 (Jones Pond).



Date: 13 January 1999 by Region III SATA
Remark: View of sample location PEN1-SED-07 (drainage ditch leading to Cheatham Pond from box pack houses) in U.S. EPA "TNT Production" Area.

Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs



Date: 13 January 1999 by Region III SATA
Remark: View of sample location PEN1-SED-08 (wetlands near pack houses) in U.S. EPA "TNT Production" Area. This wetlands leads directly into Cheatham Pond.



Date: 13 January 1999 by Region III SATA
Remark: View of sample location PEN1-SED-06 (nitro-starch dry house floor) in U.S. EPA "TNT Production" Area.

Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs



Date: 13 January 1999 by Region III SATA
Remark: View of background sample location PEN1-SW-03 (collected at fishing dock in Cheatham Pond).



Date: 13 January 1999 by SATA Region III
Remark: View of background sample location PEN1-SED-09 (collected from fishing dock in Cheatham Pond).

**Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs**



Date: 13 January 1999 by Region III SATA
Remark: View of sample location PEN1-SED-04 (northern portion of channel leading from the U.S. EPA "Jones Pond Landfill" Area and U.S. Navy AOC 1 to Jones Pond).



Date: 13 January 1999 by Region III SATA
Remark: View of sample location PEN1-SED-03 (southern portion of channel leading from U.S. EPA "Jones Pond Landfill" Area and U.S. Navy AOC 1 to Jones Pond).

Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs



Date: 13 January 1999 by Region III SATA
Remark: View of sample locations PEN1-SO-13 and SO-14 (U.S. EPA "1918 Drum Storage" Area). Note the proximity to CAX Building #113 in background.



Date: 13 January 1999 by Region III SATA
Remark: View of leaking drum in U.S. EPA "Jones Pond Landfill" Area (U.S. Navy AOC 1). Sample PEN1-SO-08 was not collected as no soil was present.

**Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs**



Date: 13 January 1999 by Region III SATA
Remark: View of sample locations PEN1-SO-11 and SO-12 (blast hole) in U.S. EPA "Shipping Area."



Date: 13 January 1999 by Region III SATA
Remark: View of sample blast hole containing sample locations PEN1-SO-11 and SO-12 (blast hole) from dirt access road (U.S. EPA "Shipping Area").

Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs



Date: 13 January 1999 by Region III SATA
Remark: View of sample locations PEN1-SO-09 and SO-10 (FM smoke drum and downgradient samples) in U.S. EPA "Shipping Area."



Date: 13 January 1999 by Region III SATA
Remark: View towards 90 degree turn in gravel road from area of sample location PEN1-SO-15 (background DOI property).

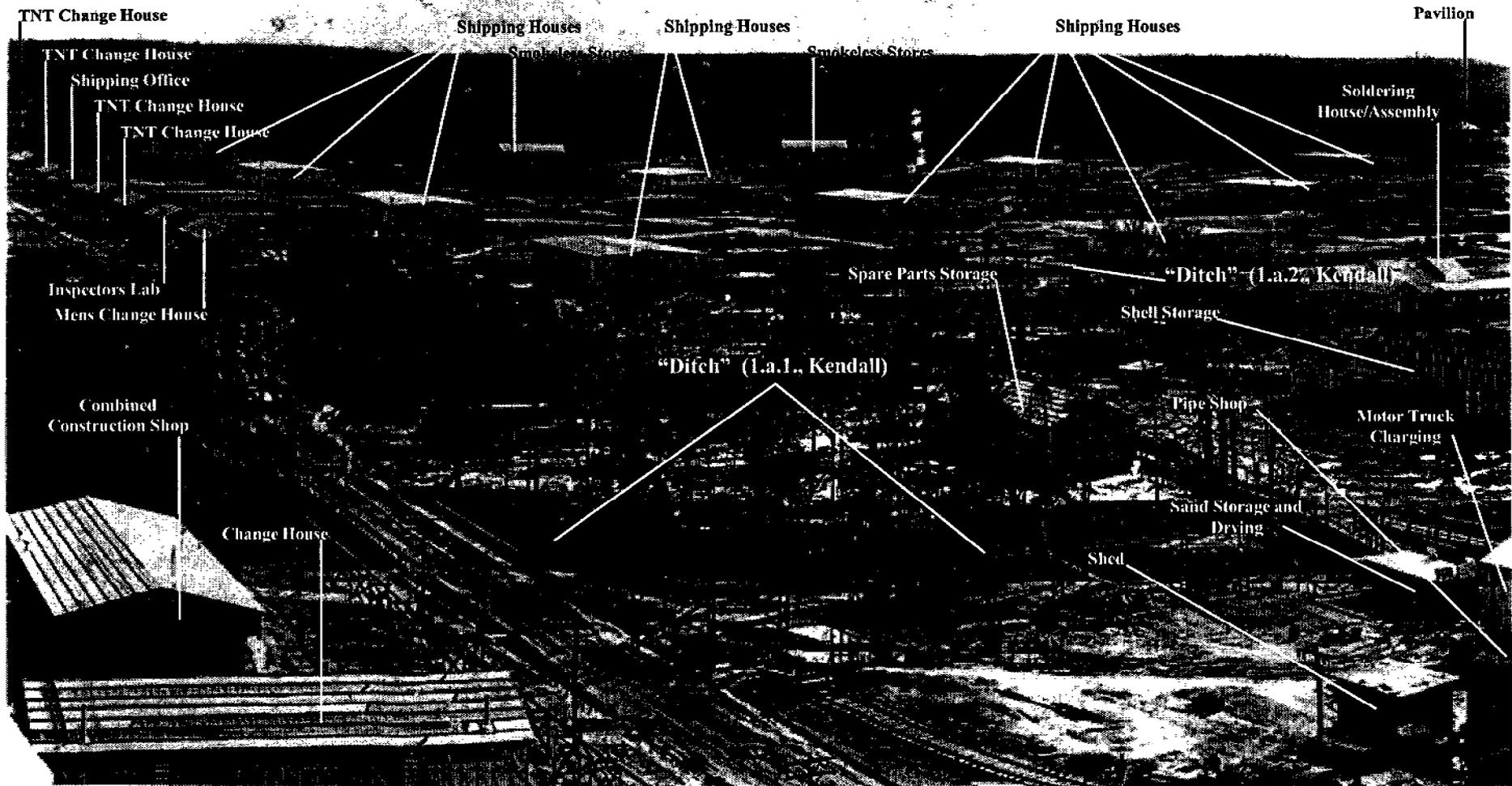
Penniman Shell Loading Plant Site
Data Acquisition/Summary Report - October 1999
Section 2.0 - Photographs



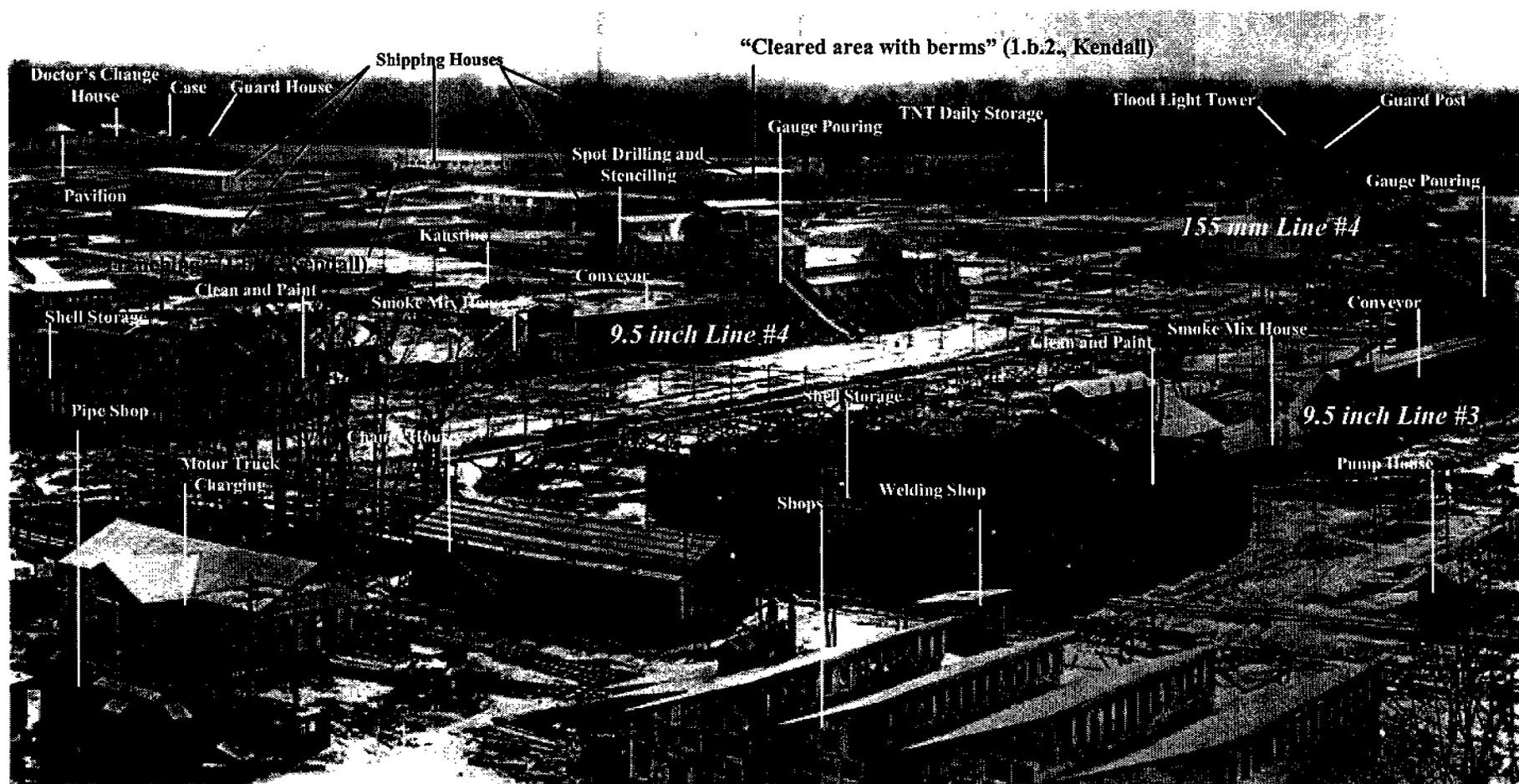
Date: 13 January 1999 by Region III SATA
Remark: View of sample location PEN1-SO-15 (background DOI property).



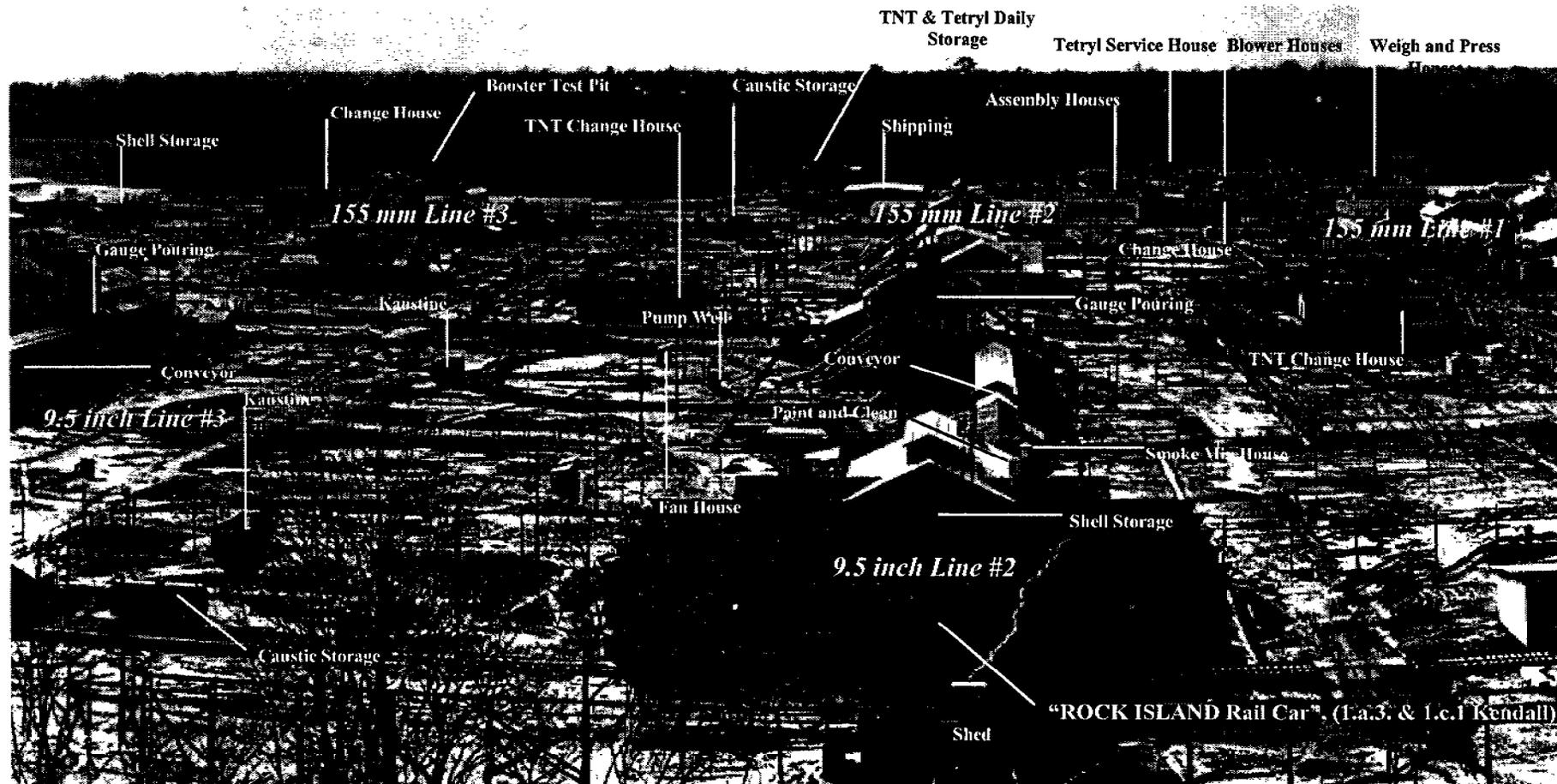
Date: 13 January 1999 by Region III SATA
Remark: View of sample location PEN1-SO-15 (taken from same location as previous picture).



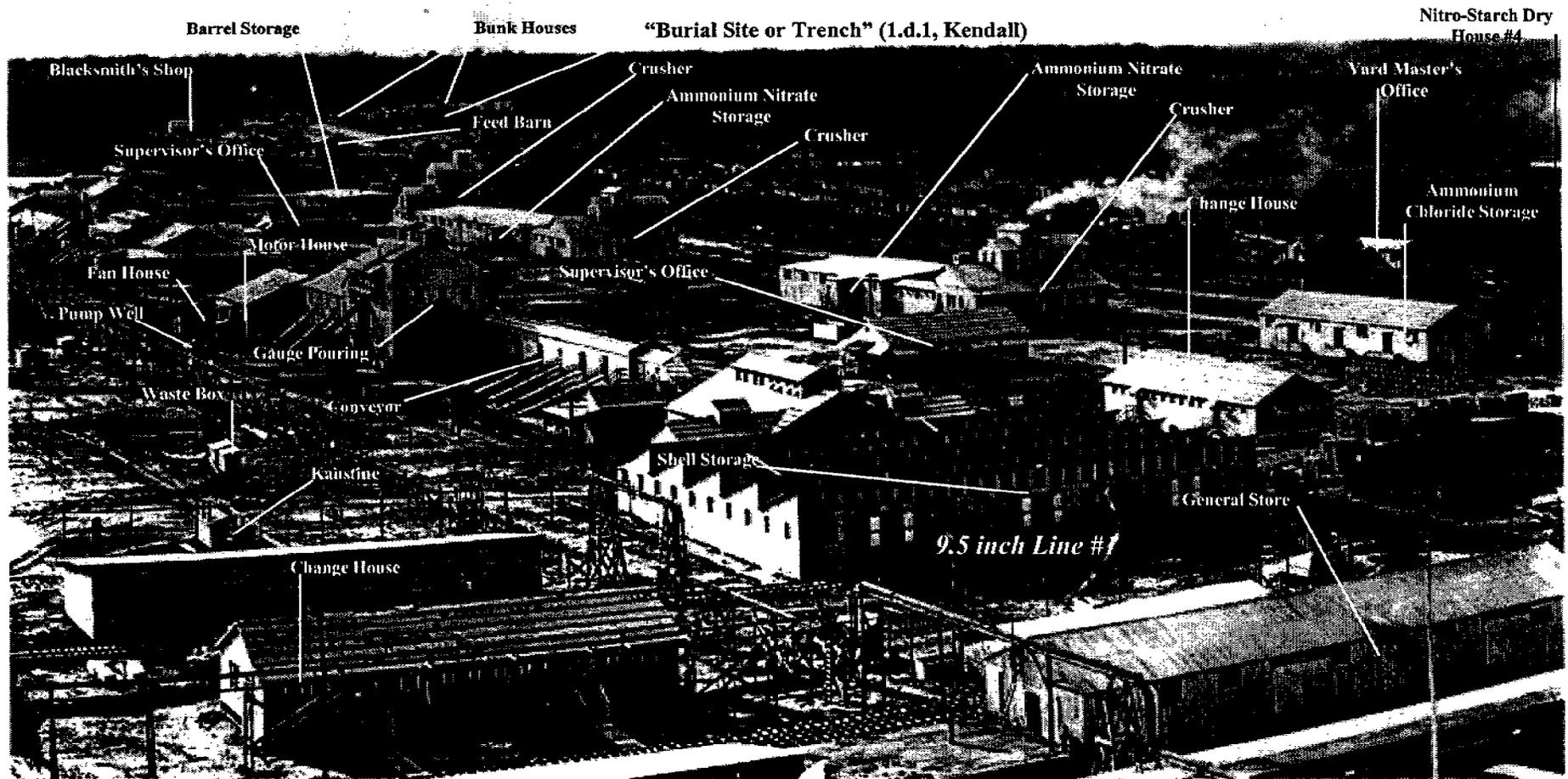
Penniman Shell Loading Plant, 1918
 Panoramic Photograph No. 1 of 12
 LHP Ordnance Expert Interpretations by J. Kendall (WESTON)
 (building labels derived from engineering drawings)



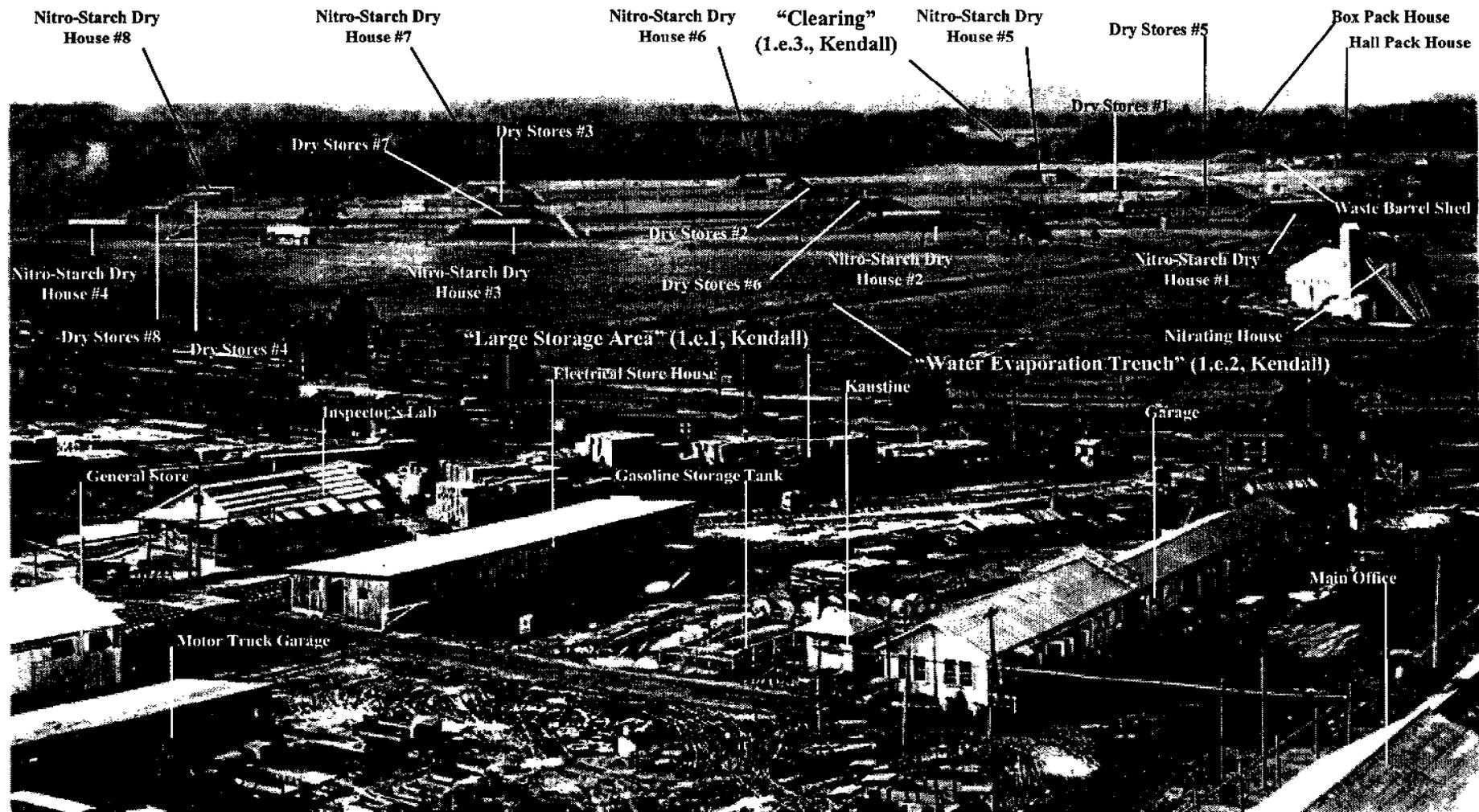
Penniman Shell Loading Plant, 1918
 Panoramic Photograph No. 2 of 12
 LHP Ordnance Expert Interpretations by J. Kendall (WESTON)
 (building labels derived from engineering drawings)



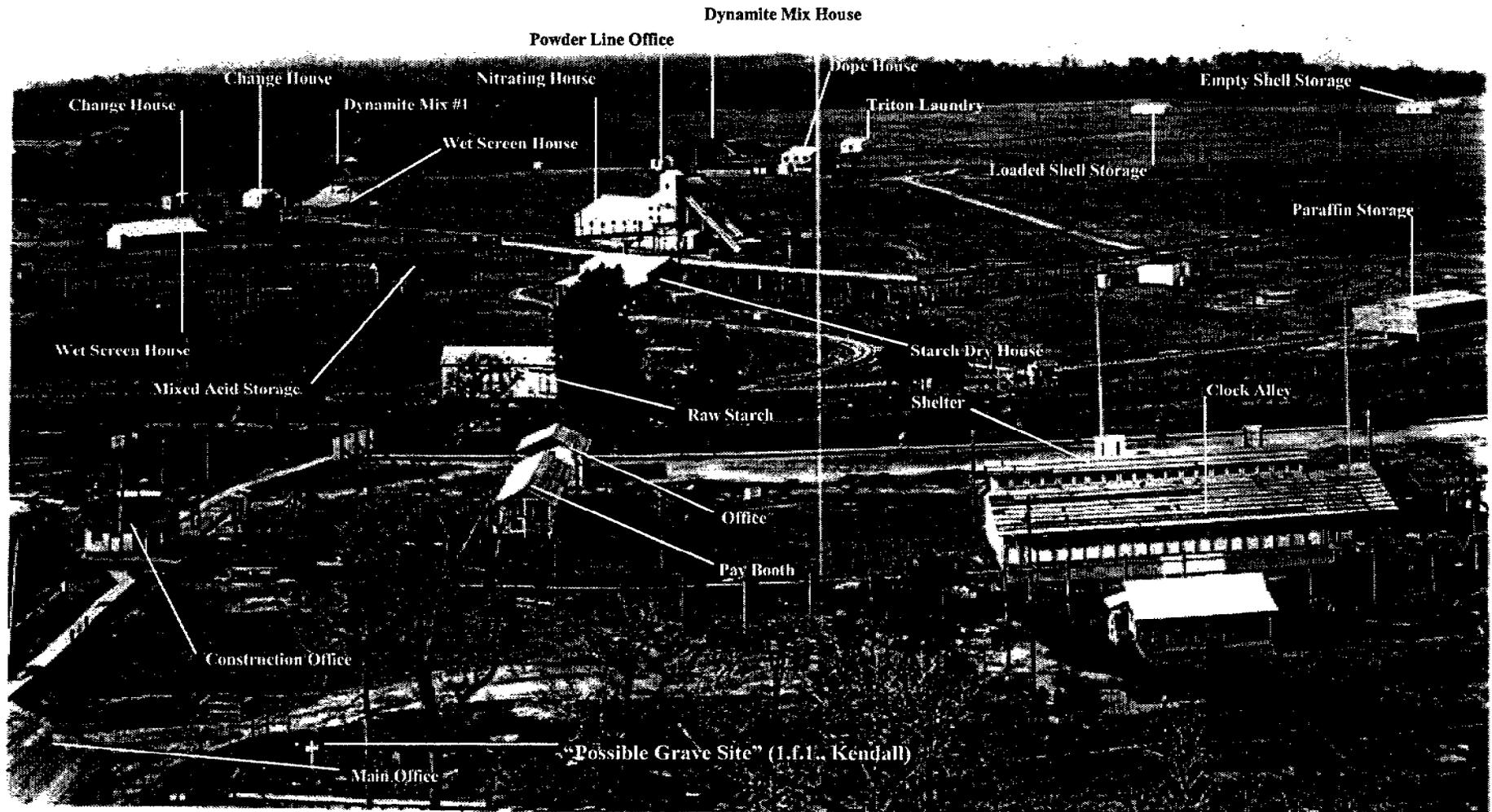
Penniman Shell Loading Plant, 1918
 Panoramic Photograph No. 3 of 12
 LHP Ordnance Expert Interpretations by J. Kendall (WESTON)
 (building labels derived from engineering drawings)



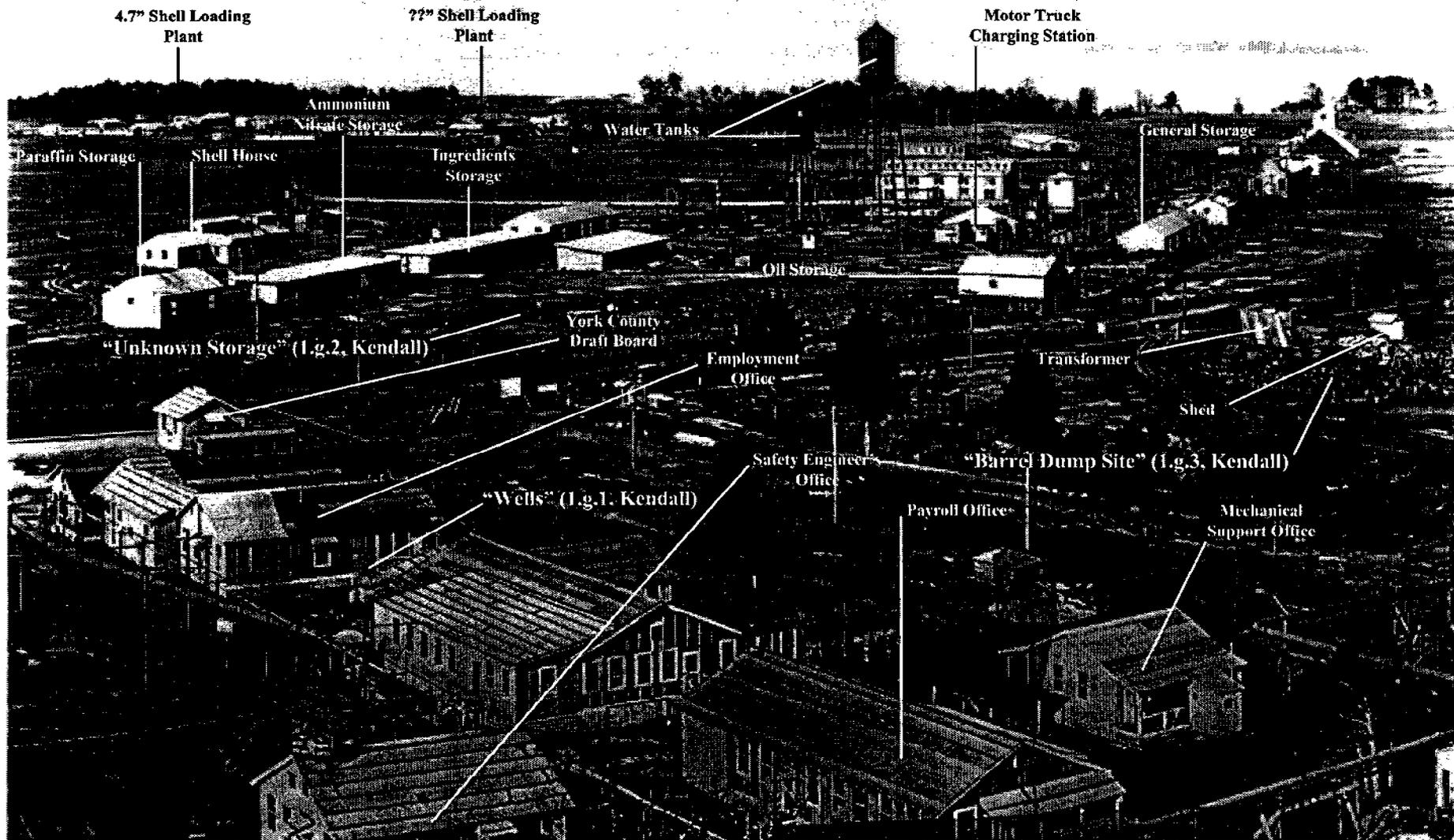
Penniman Shell Loading Plant, 1918
 Panoramic Photograph No. 4 of 12
 LHP Ordnance Expert Interpretations by J. Kendall (WESTON)
 (building labels derived from engineering drawings)



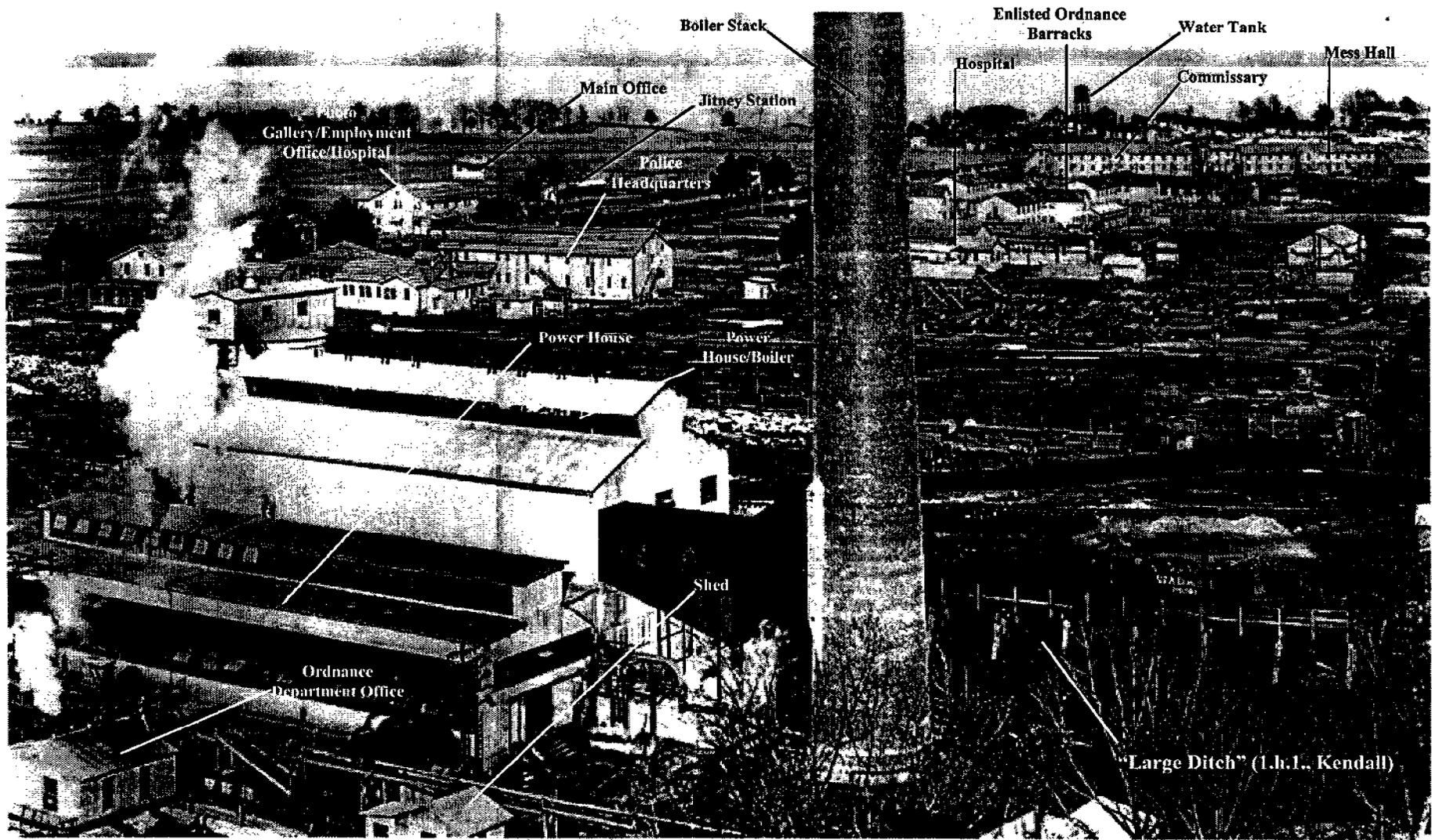
Penniman Shell Loading Plant, 1918
 Panoramic Photograph No. 5 of 12
 LHP Ordnance Expert Interpretations by J. Kendall (WESTON)
 (building labels derived from engineering drawings)



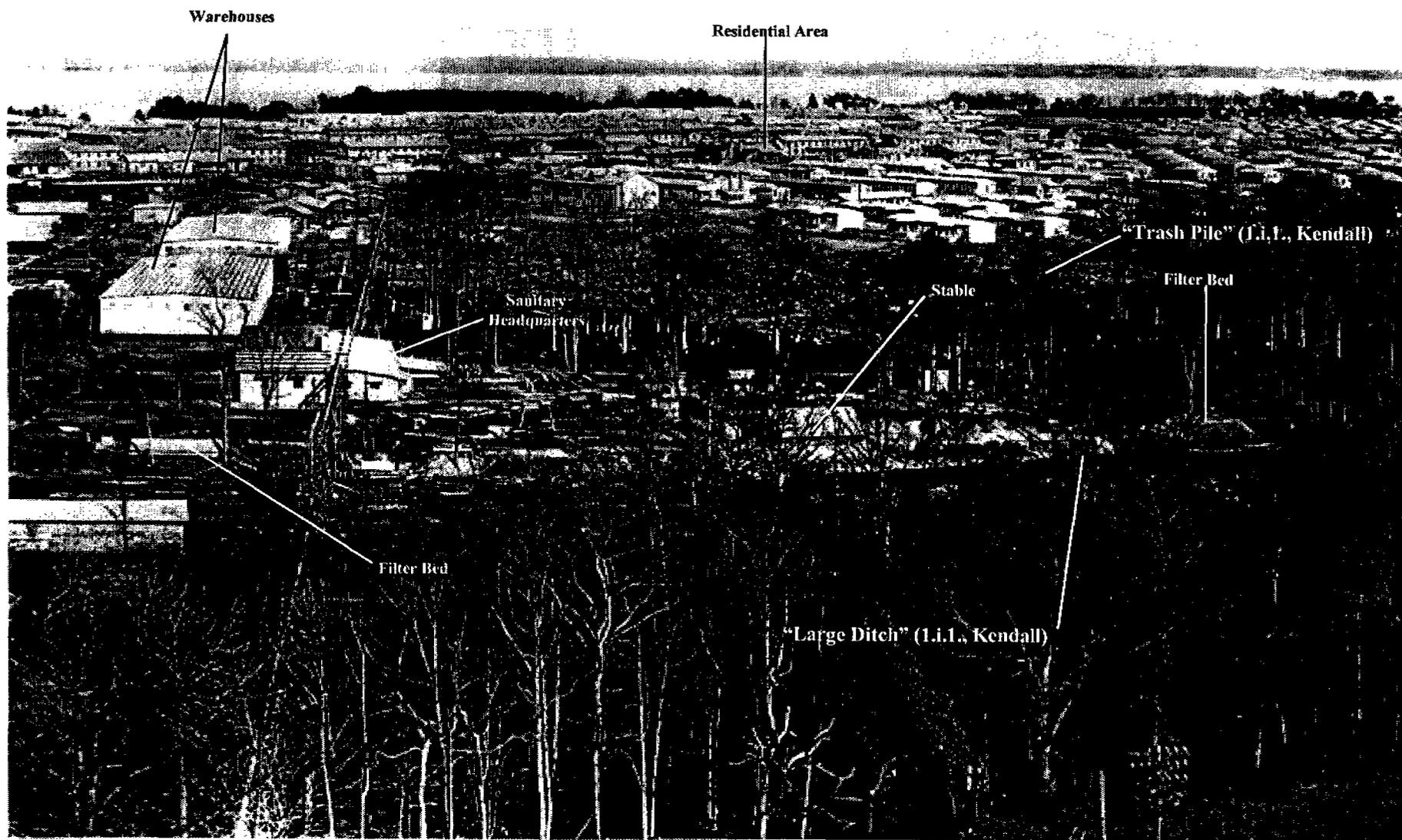
Penniman Shell Loading Plant, 1918
 Panoramic Photograph No. 6 of 12
 LHP Ordnance Expert Interpretations by J. Kendall (WESTON)
 (building labels derived from engineering drawings)



Penniman Shell Loading Plant, 1918
 Panoramic Photograph No. 7 of 12
 LHP Ordnance Expert Interpretations by J. Kendall (WESTON)
 (building labels derived from engineering drawings)



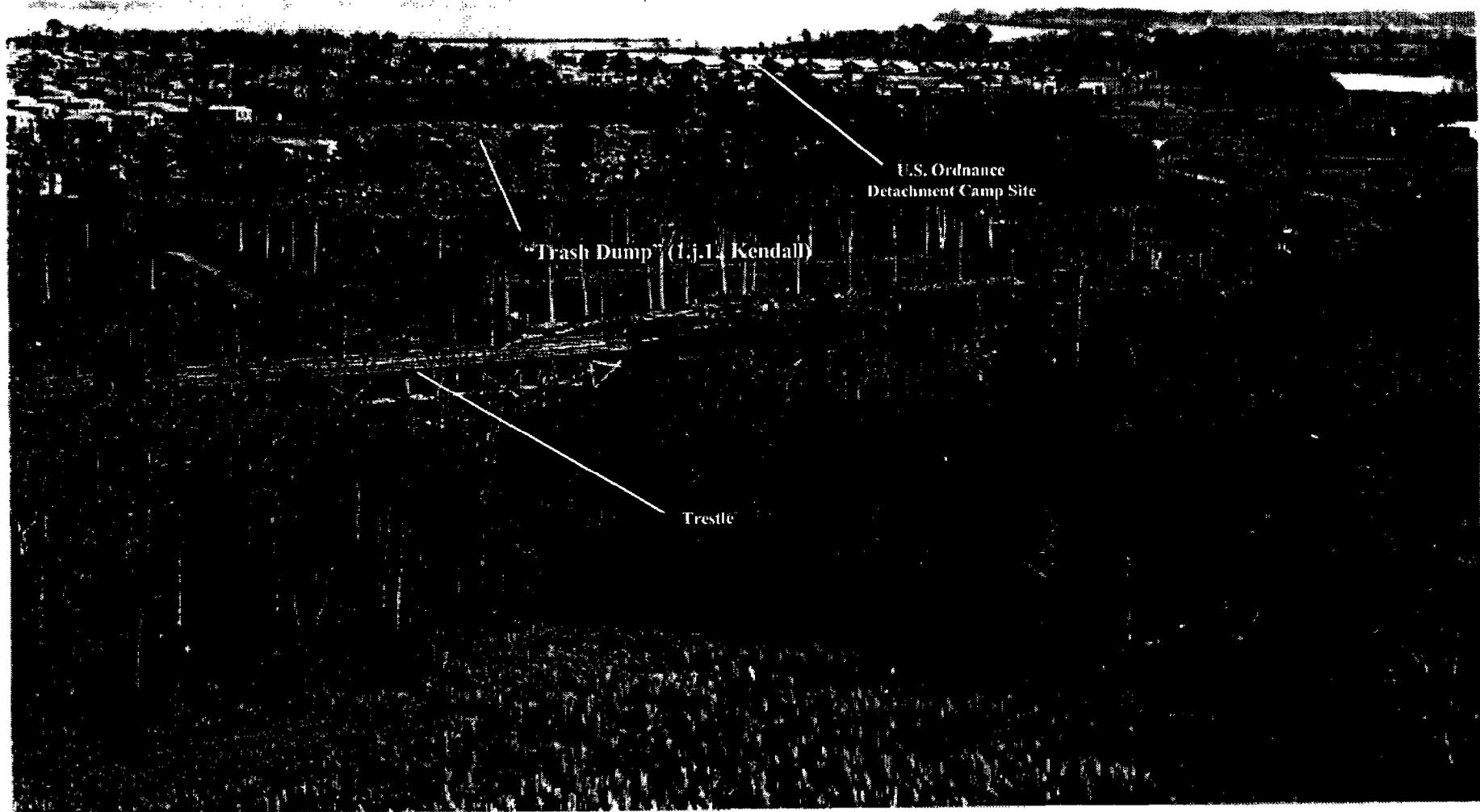
Penniman Shell Loading Plant, 1918
Panoramic Photograph No. 8 of 12
LHP Ordnance Expert Interpretations by J. Kendall (WESTON)
(building labels derived from engineering drawings)



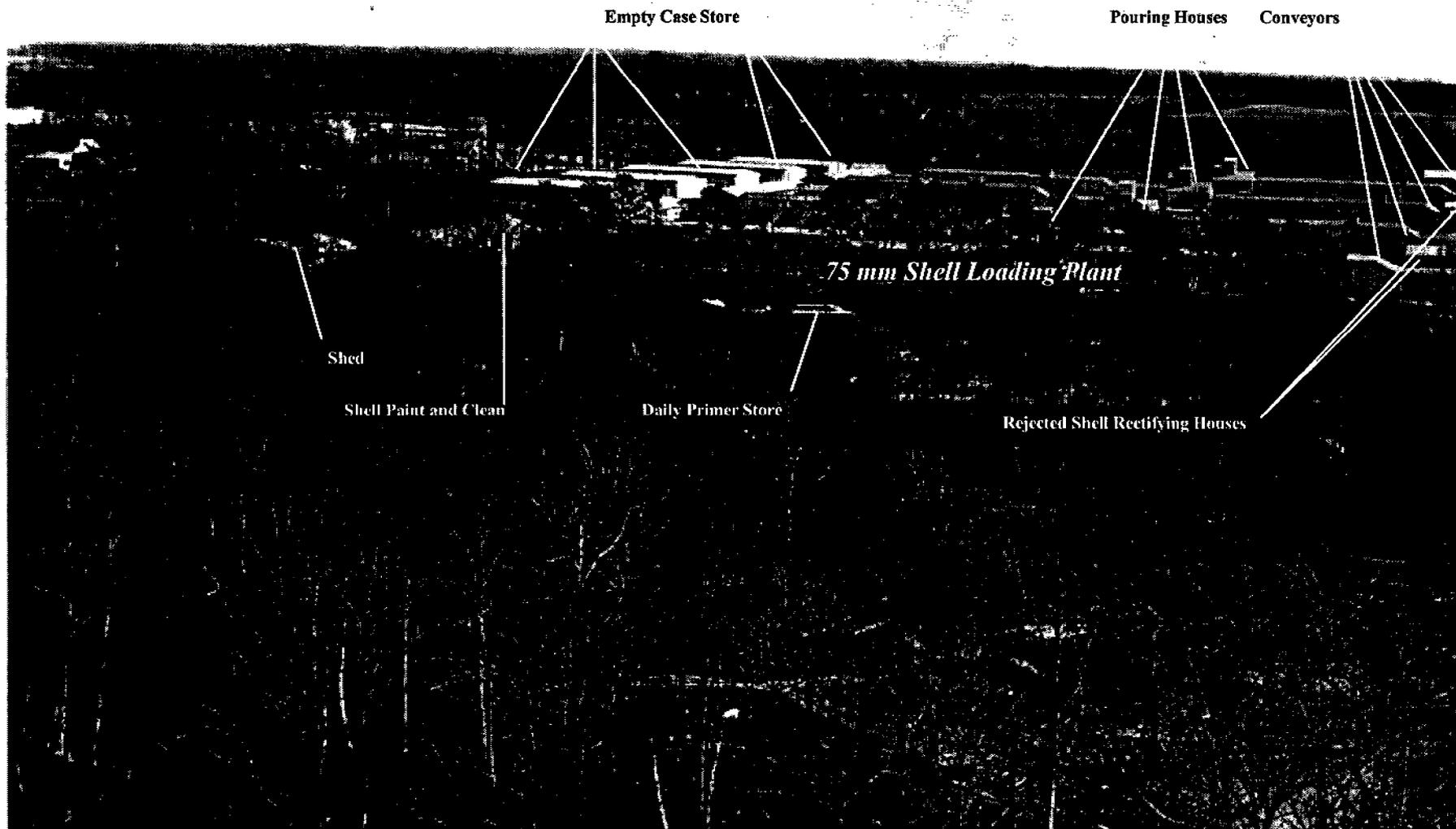
Penniman Shell Loading Plant, 1918

Panoramic Photograph No. 9 of 12

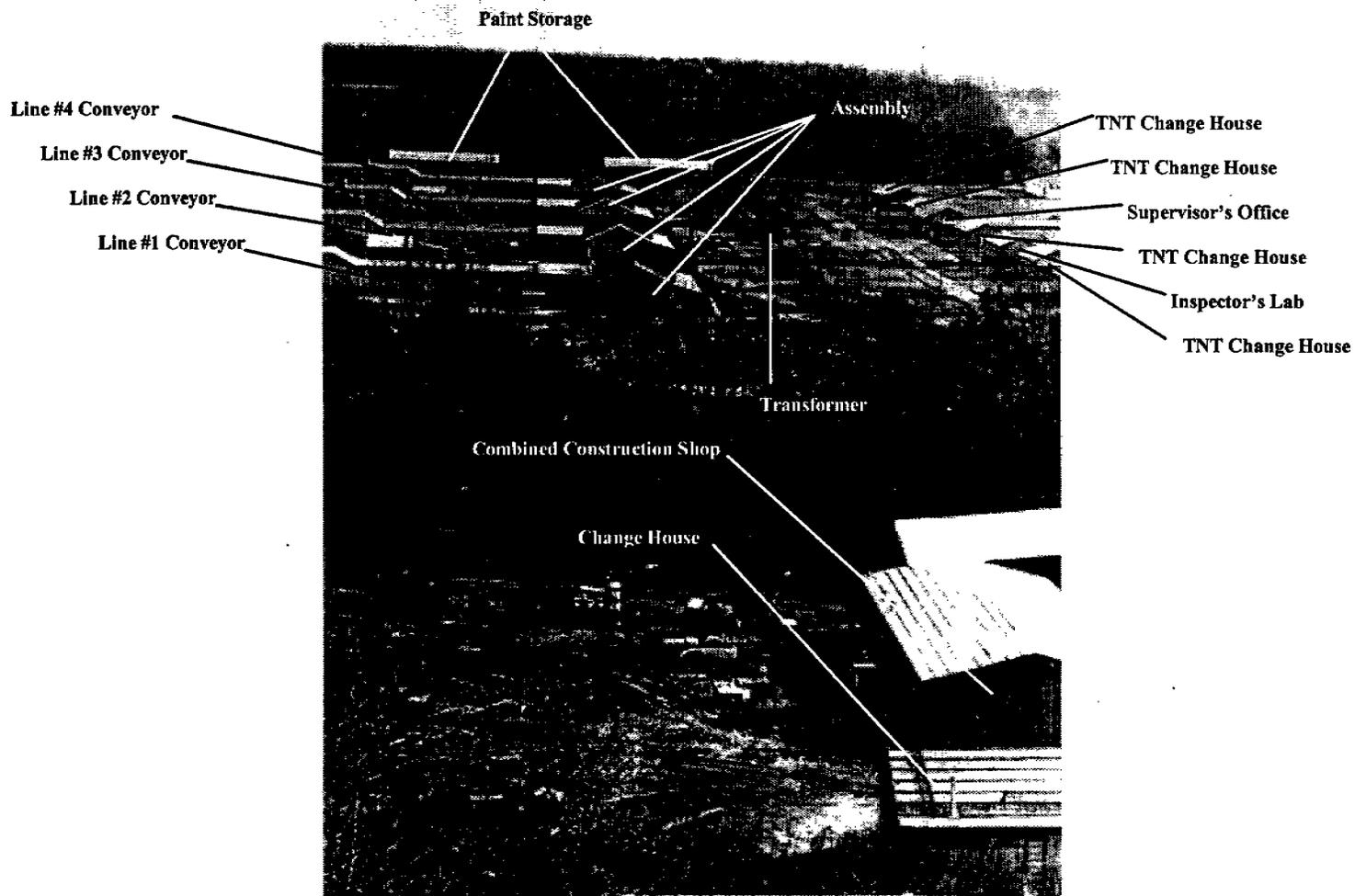
LHP Ordnance Expert Interpretations by J. Kendall (WESTON)
(building labels derived from engineering drawings)



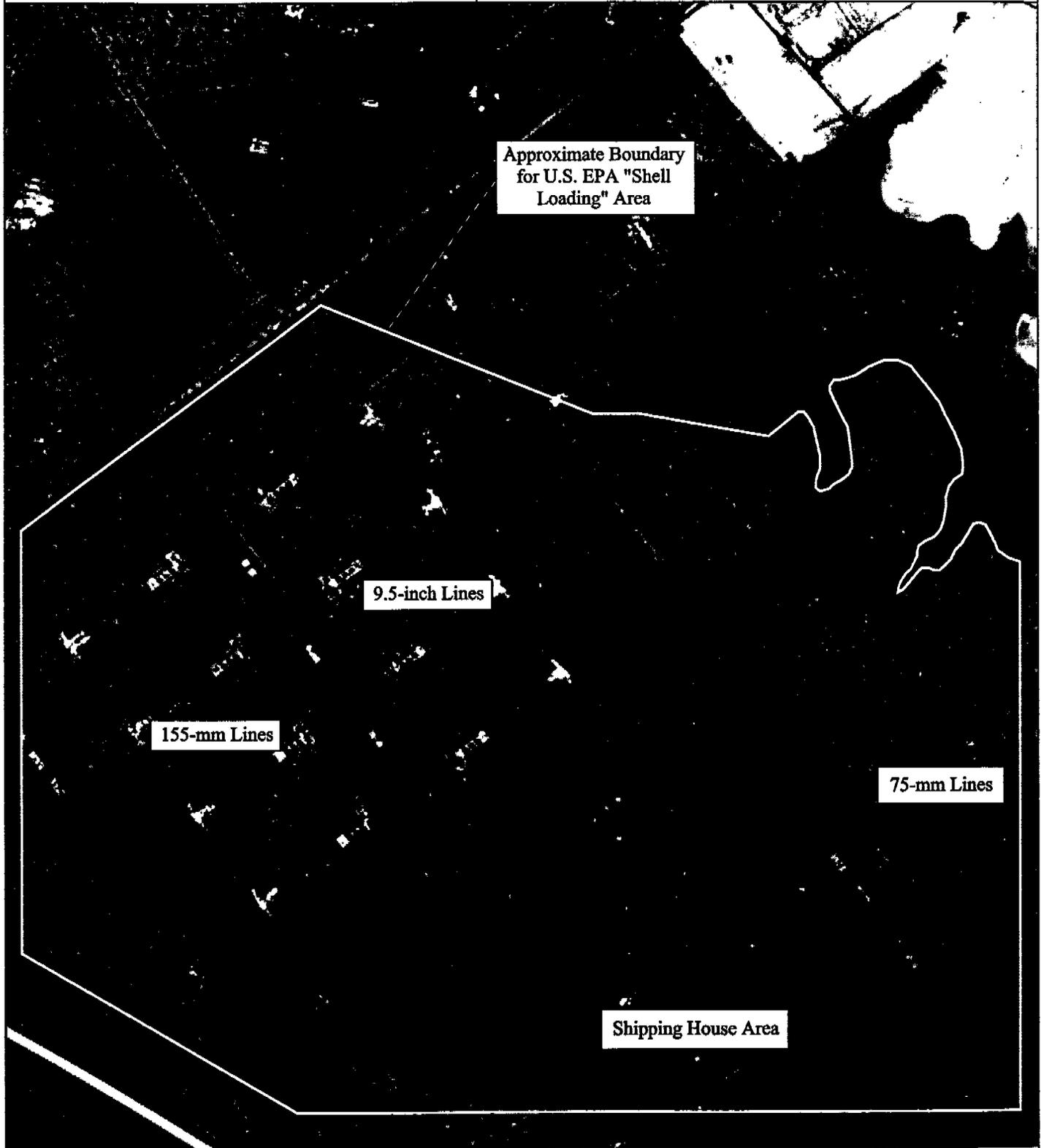
Penniman Shell Loading Plant, 1918
Panoramic Photograph No. 10 of 12
LHP Ordnance Expert Interpretations by J. Kendall (WESTON)
(building labels derived from engineering drawings)



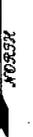
Penniman Shell Loading Plant, 1918
Panoramic Photograph No. 11 of 12
LHP Ordnance Expert Interpretations by J. Kendall (WESTON)
(building labels derived from engineering drawings) .

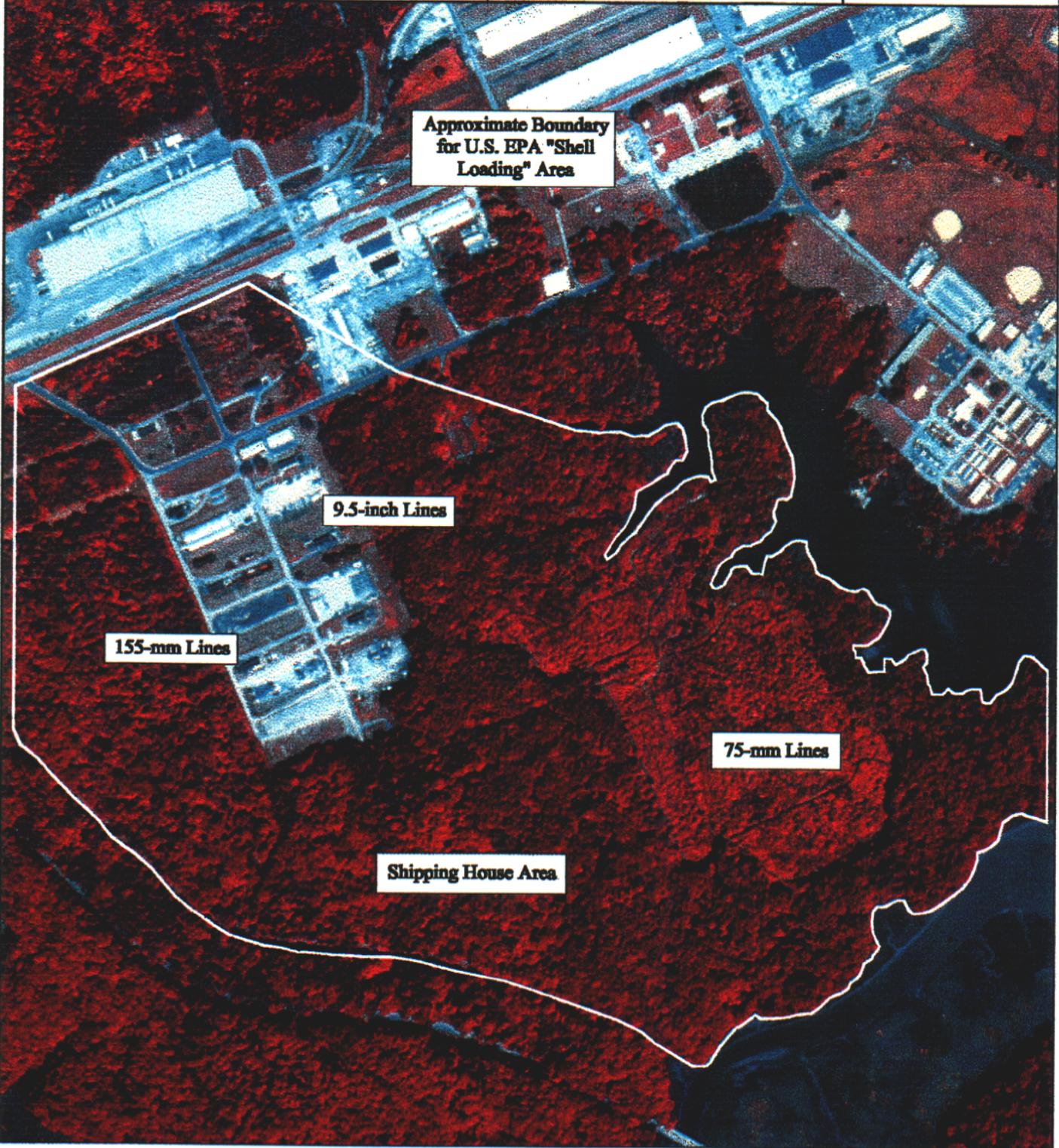


Penniman Shell Loading Plant, 1918
Panoramic Photograph No. 12 of 12
LHP Ordnance Expert Interpretations by J. Kendall (WESTON)
(building labels derived from engineering drawings)



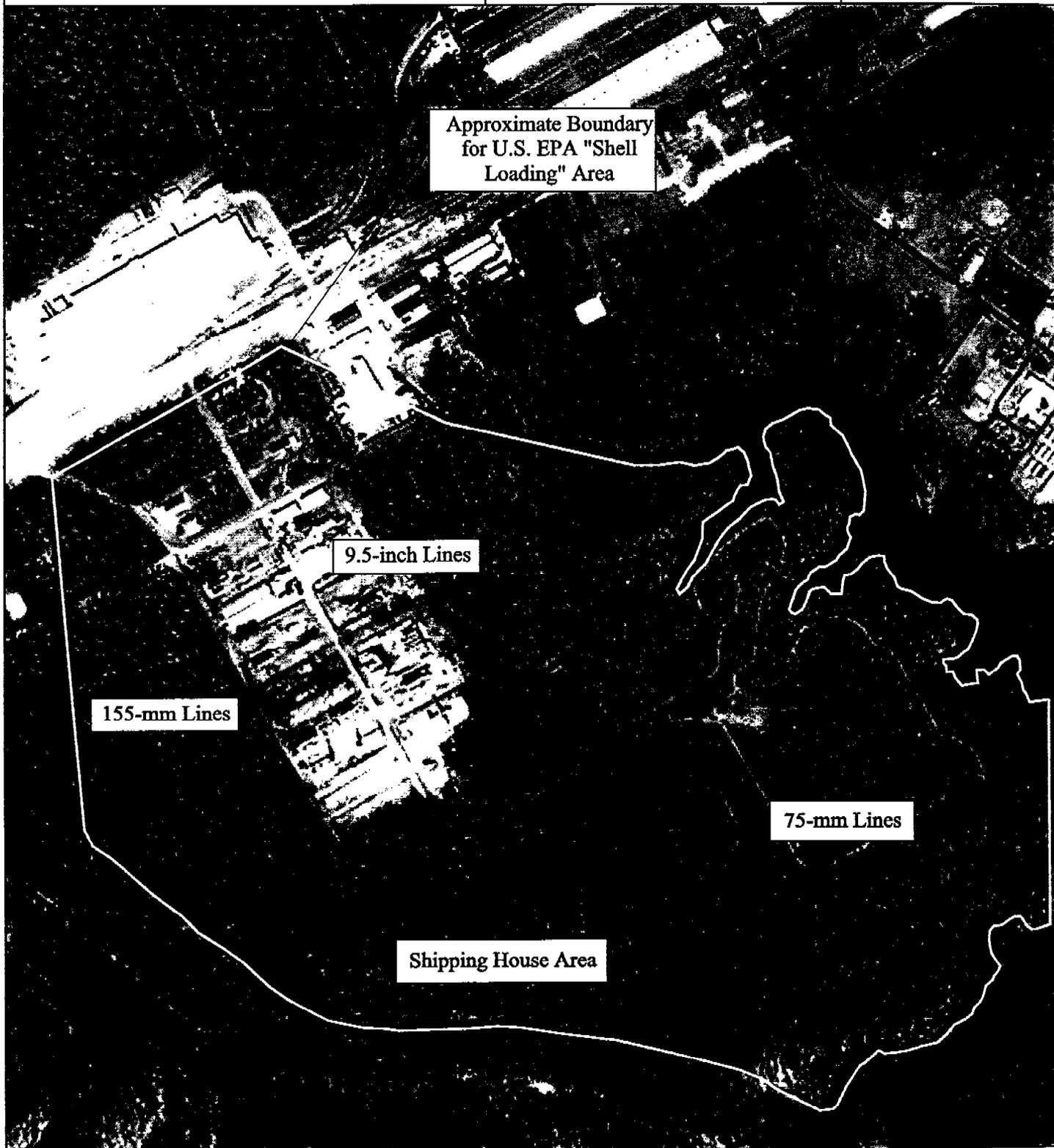
Aerial Photograph 2.1
U.S. EPA Shell Loading Area
1937





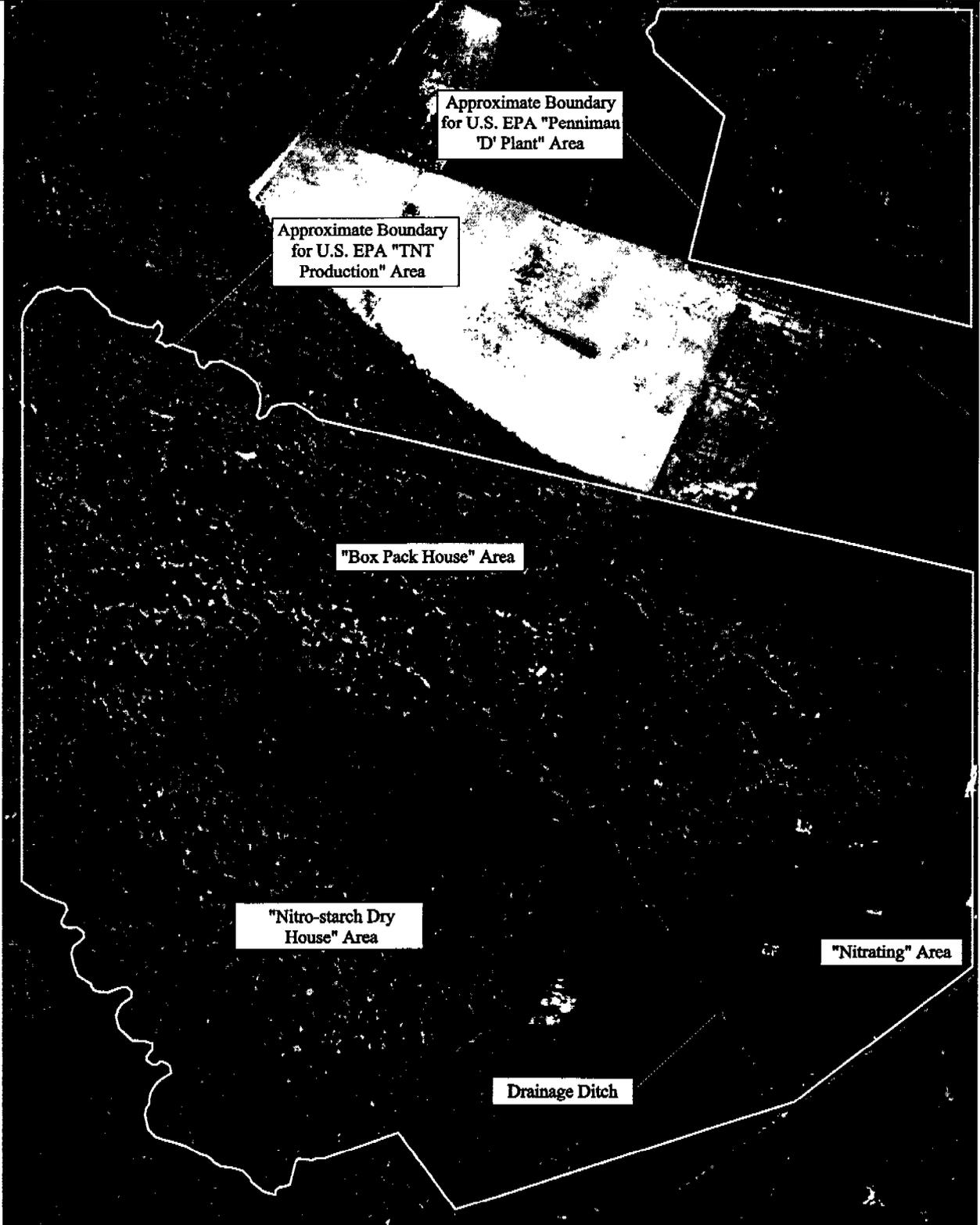
Aerial Photograph 2.2
U.S. EPA Shell Loading Area
1992 Infrared



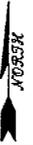


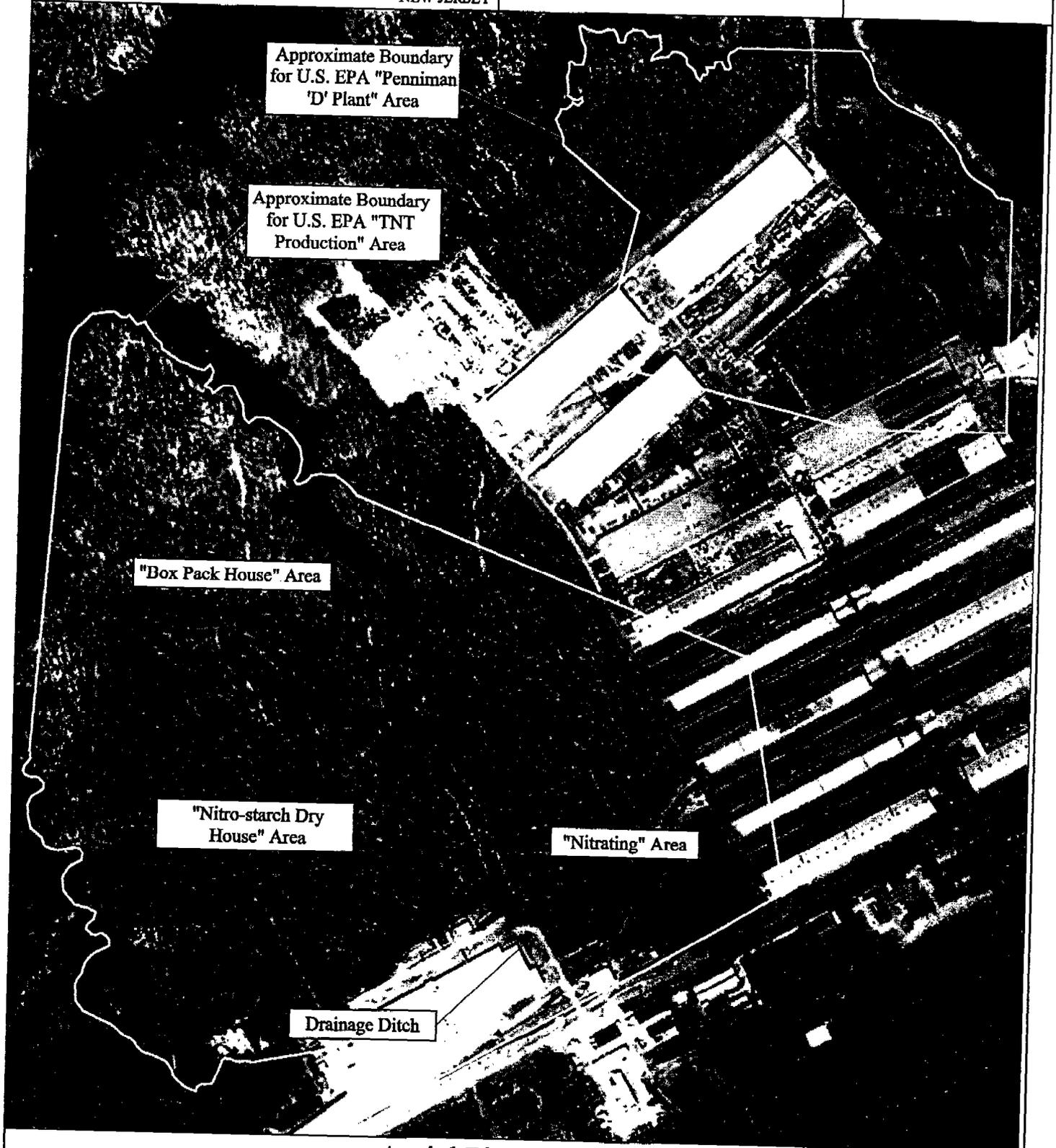
Aerial Photograph 2.3
U.S. EPA Shell Loading Area
1994





Aerial Photograph 2.4
U.S. EPA TNT Production and "D" Plant Areas
1937





Aerial Photograph 2.5
U.S. EPA TNT Production and "D" Plant Areas
1994



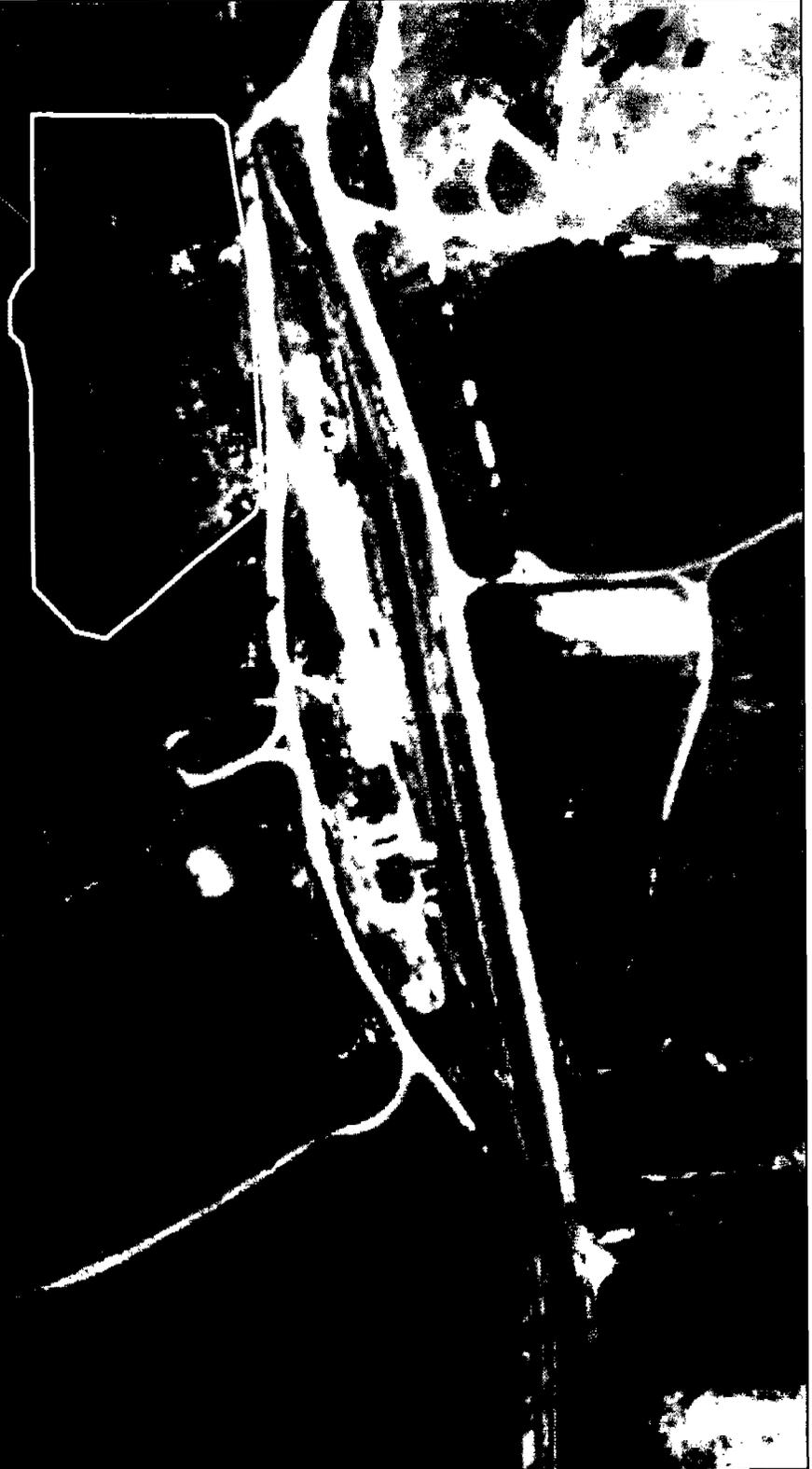


Aerial Photograph 2.6
U.S. EPA Shipping Area
1937





Approximate Boundary
for U.S. Navy Area of
Concern #1

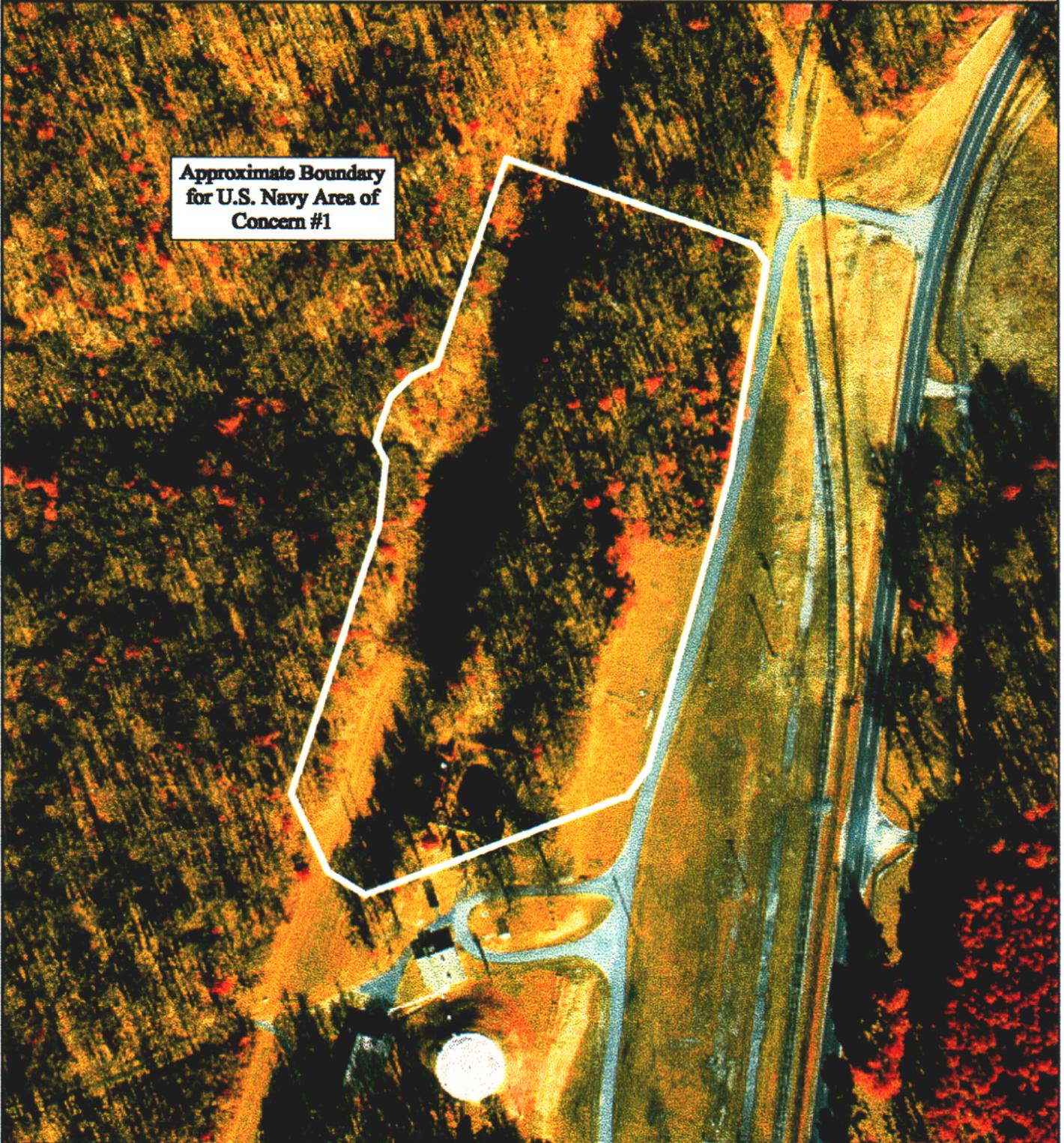


Aerial Photograph 2.7
U.S. Navy AOC #1 (U.S. EPA Jones Pond Landfill Area)
1960



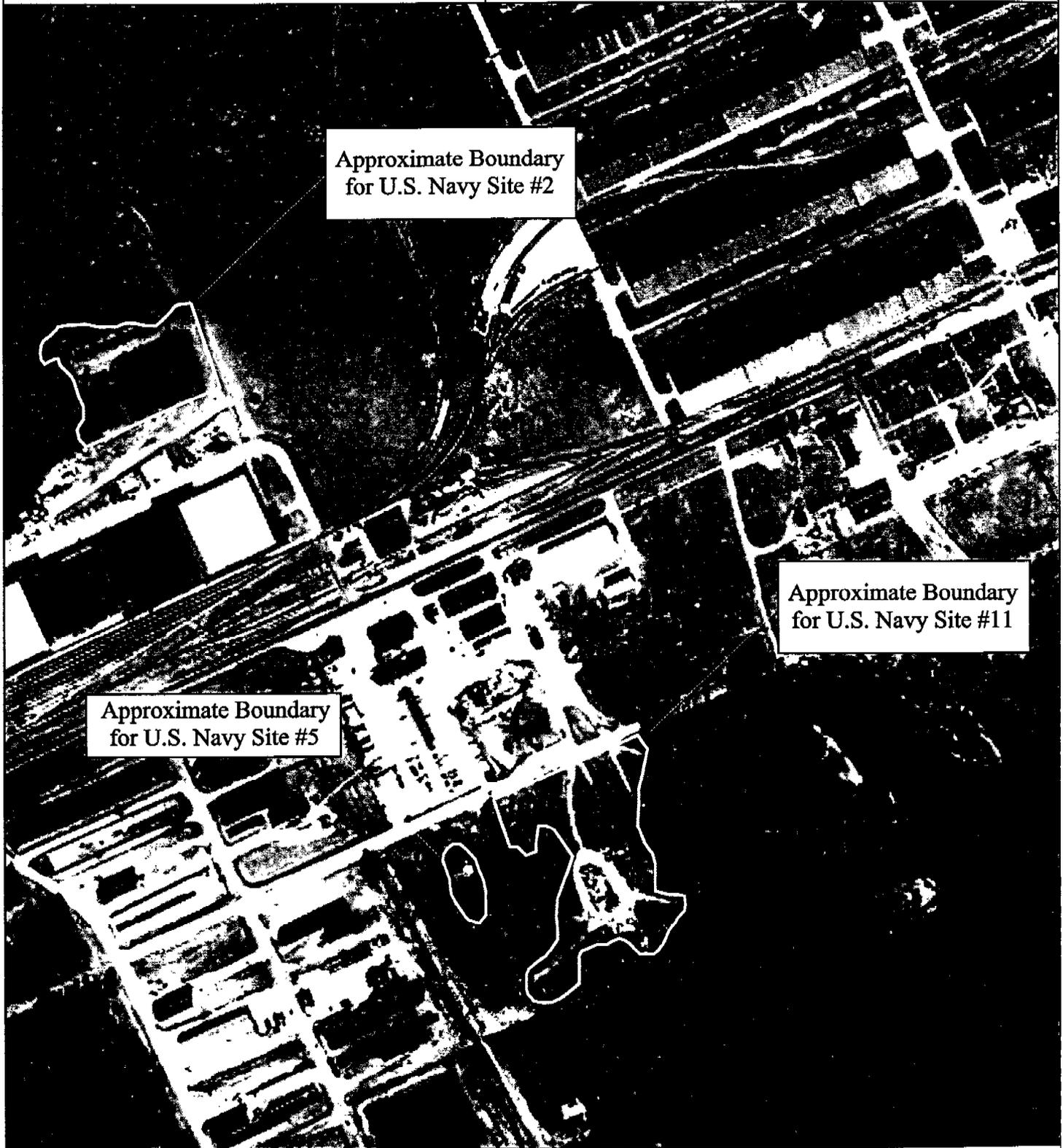


Approximate Boundary
for U.S. Navy Area of
Concern #1



Aerial Photograph 2.8
U.S. Navy AOC #1 (U.S. EPA Jones Pond Landfill Area)
1998





Approximate Boundary
for U.S. Navy Site #2

Approximate Boundary
for U.S. Navy Site #11

Approximate Boundary
for U.S. Navy Site #5

Aerial Photograph 2.9
U.S. Navy Sites #2, 5, and 11
1955





MANAGERS
DELTRAN

DESIGNERS/CONSULTANTS

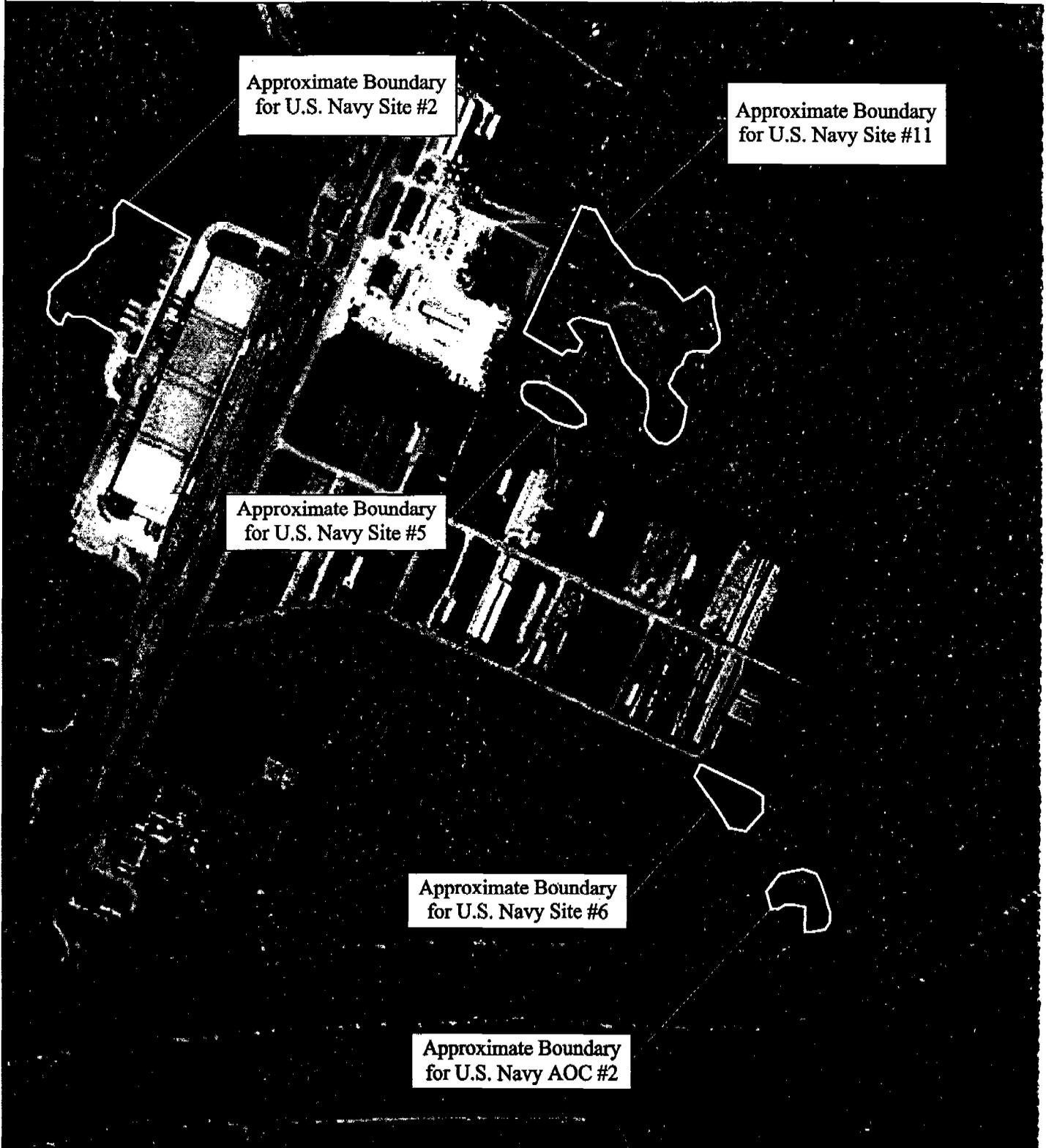
FEDERAL
PROGRAMS
DIVISION

NEW JERSEY

Penniman Shell Loading Plant Site

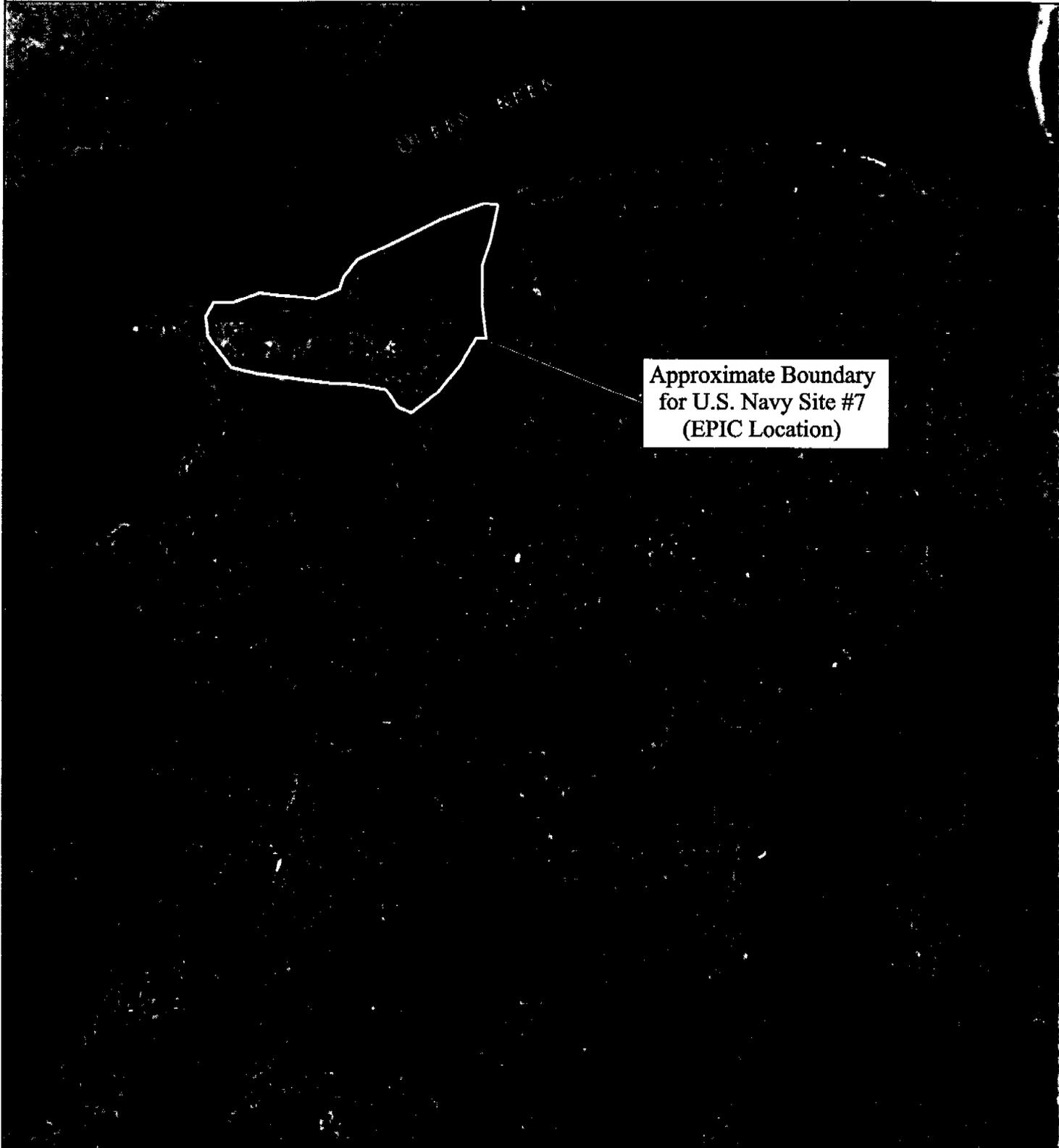
29 October 1999

TDD No. 9901-45



Aerial Photograph 2.10
U.S. Navy AOC #2 and Sites #2, 5, 6, and 11
1971





Approximate Boundary
for U.S. Navy Site #7
(EPIC Location)

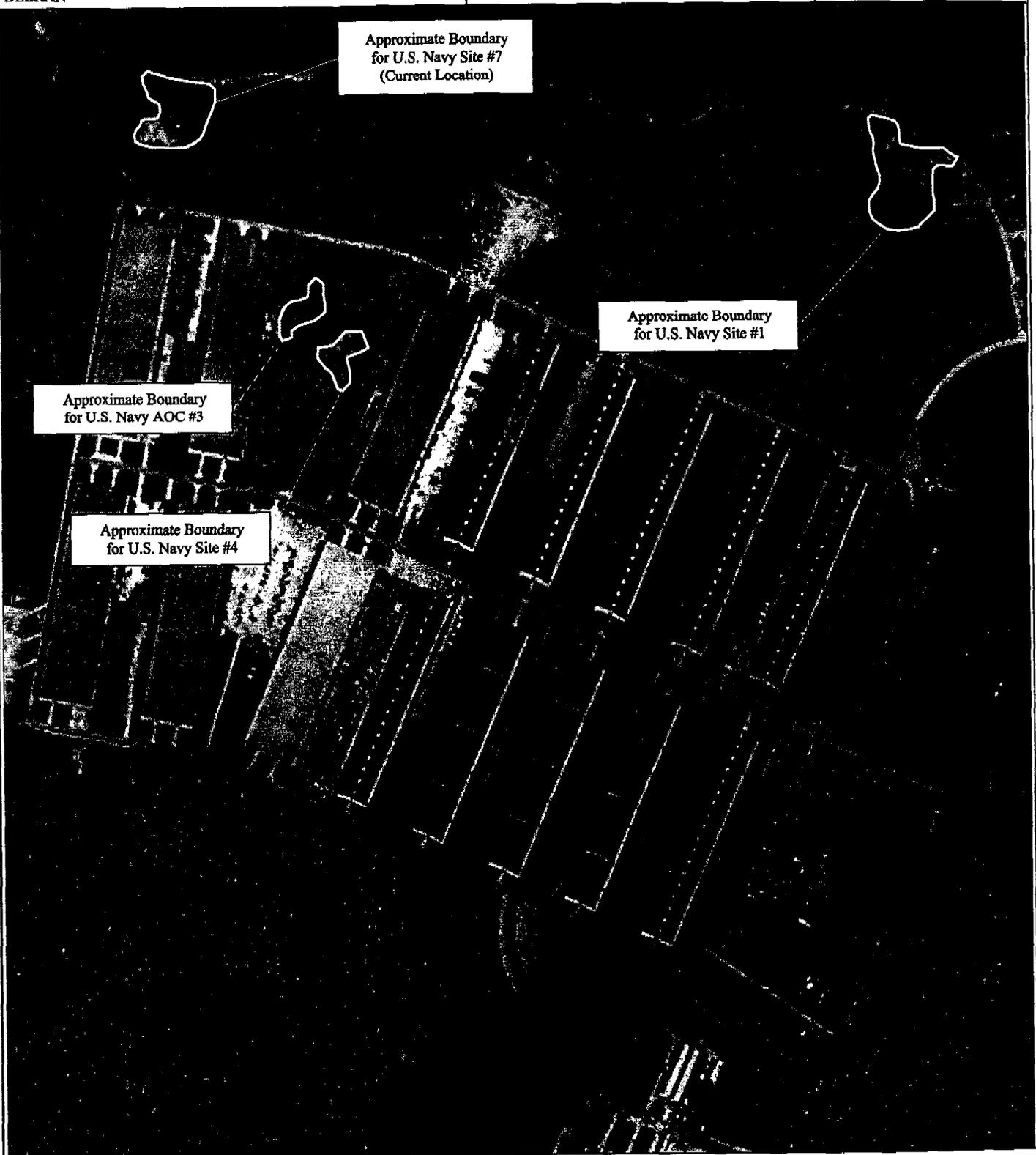
Aerial Photograph 2.11
U.S. Navy Site #7 (EPIC Location)
1937





Aerial Photograph 2.12
U.S. Navy Sites #1 and #7
1955

28882



Aerial Photograph 2.13
U.S. Navy AOC #3 and Sites #1, #4, and #7
1971



3.0 PHYSICAL CHARACTERISTICS

The following subsections provide information on the physical characteristics of the Penniman Shell Loading Plant Site and the surrounding area.

3.1 Climate

The climate of York County is temperate. A significant amount of weather data has been recorded at Williamsburg, Virginia between the years of 1951 and 1976, and this information has been utilized to provide this climate summary.

The winter average temperature for the Williamsburg, Virginia area is 41° F, with the average minimum daily temperature being 30° F. The lowest temperature on record, which occurred in Williamsburg on 22 January 1970, is 1° F.

The summer average temperature is 76° F, with the average daily maximum temperature being 87°. The highest temperature on record, which occurred in Williamsburg, Virginia on 26 June 1952, is 104° F.

The total annual precipitation is estimated at 47.25 inches, with 26 inches falling between the months of April and September. The heaviest 1-day rainfall on record, as measured in Williamsburg, Virginia, is 9.95 inches. The two-year, 24-hour rainfall is 3.35 inches, as recorded in the Rainfall Frequency Atlas of the United States for the Norfolk, Virginia Area.

The average seasonal snowfall is 9 inches, and the heaviest snowfall on record is 19 inches.

The average relative humidity at midafternoon is approximately 60 percent, with the humidity generally increasing at night to an average relative humidity of 80 percent at dawn. The prevailing wind is from the southwest, with the highest average wind speed of 12 miles per hour occurring in March.

3.2 Geology

The site is located in the Coastal Plain Physiographic province of Virginia approximately halfway between the Atlantic Ocean and the Fall Line. The Virginia Coastal Plain has a stairstep characteristic and is composed of a series of plains that are successively lower from west to east and are separated from one another by scarps. The Peary Scarp runs northwest to southeast and bisects the USN CAX property beginning approximately 2,500 feet north of the Jones Pond Dam and extending through the Colonial National Historical Parkway right-of-way at its crossing location over King Creek.

The area located northeast of the Peary Scarp, or essentially the main portion of USN CAX excluding the Jones Pond portion of the property, is underlain by

The area located northeast of the Peary Scarp, or essentially the main portion of USN CAX excluding the Jones Pond portion of the property, is underlain by alluvium and the Norfolk formation. The area located southwest of the Peary Scarp, including a portion of the DOI property, all of the Jones Pond property, and all of the VDES (Fuel Farm) property, is underlain by alluvium, the Windsor formation, the Bacons Castle formation, the Sedley formation, and the Yorktown formation (see Figure 3.1).

In the immediate site area, the oldest exposed rock unit is the Yorktown formation, which dates from the Miocene period. This formation overlies the older St. Mary's formation, which is not exposed in the immediate site area. The most extensive outcrops of this formation are found along the roadcuts immediately east of where Route 64 crosses King Creek. These outcrops indicate that the Yorktown formation dips 3 to 4 feet per mile to the southeast. The thickness of the Yorktown formation has been reported at 150 to 200 feet, with the upper 10 feet consisting of predominantly thinly parted clay. The Yorktown formation is unconsolidated and appears to represent an open-ocean deposit formed at a maximum ocean depth of about 300 feet, with a minimum formation depth undetermined.

The Sedley formation, which dates from either the Pliocene or Pleistocene period, unconformably overlies either the Yorktown formation or the St. Mary's formation and has a thickness ranging from 0 to 35 feet with an average of 10 feet. The Sedley formation dips southeasterly at approximately 2 feet per mile. In some areas, this formation has been completely removed by erosion. The Sedley formation is composed of unconsolidated materials ranging in size from clay to medium sand. In the immediate site area (the York-James Peninsula), the formation is generally thin and consists of a coarse grained component oxidized to dark brown or dark red, and a fine grained component of gray-brown to greenish-brown. The available evidence in the site area is consistent with a fluvial-estuarine origin for the Sedley formation.

The Bacons Castle formation unconformably overlies the Sedley formation, or, in areas where the Sedley has been completely eroded, directly overlies the Yorktown formation. This formation has a regional dip to the southeast of approximately 2 feet per mile, with a thickness ranging from 0 to 50 feet. The available evidence indicates that this formation is of fluvial origin, and consists of sand facies near the present major drainage lines, a bedded silt facies beneath interfluves, and a sand and silt facies that consists of the previous two facies interbedded in about equal portions.

The Windsor formation dates from the Pleistocene period and unconformably overlies the Bacons Castle formation. In some instances, the Windsor formation may lie directly upon Miocene era formations where the Bacons Castle formation is absent. The Windsor formation has a regional dip of 1 to 3 feet per mile to the east and southeast and ranges in thickness from 0 to 40 feet. The upper portion of

the Windsor formation is cohesive and characteristically forms nearly vertical cliffs, 5 to 10 feet high, in natural and artificial exposures. The lower member of this formation is fluvial estuarine and the upper member of this formation is littoral and of bay origin.

The youngest exposed rock unit in the site area is the Norfolk formation, which is found primarily northeast of the Peary Scarp and dates from the latter part of the Pleistocene period. The surface of the Norfolk formation slopes toward major drainage lines and ranges in thickness from a few feet near the Peary Scarp to over 45 feet near some creeks and rivers. Primarily, this formation is composed of cross-bedded medium to coarse grained sand, sandy pebble gravel, silty sand, and laminated silty clay units that have an orderly facies arrangement. This formation is a fluvial-estuarine complex that was deposited during a period of maximum relative sea levels of +45 to 50 feet and at a time when the morphology of the site area was similar to that of today, except that the York and James River estuaries were approximately twice as wide.

The alluvium that is present in the site area dates from the Holocene period of the Quaternary era and unconformably overlies the older stratigraphic units adjacent to the York River along all streams and valleys subject to tidal influence. This area would include the drainage valley of Queens Creek and King Creek, as well as their unnamed tributaries. The bulk of these sediments consists of tidal marsh deposits which are organic rich, dark gray, silty clays. Well developed beach deposits of fine to coarse grained sand occur along the York River and locally along its tributaries.

3.3 Hydrogeologic Setting

Groundwater is used extensively in the site area as a drinking water source. The primary aquifers found in the site area include, from shallowest to deepest, the Chesapeake Aquifer, the Castle Hayne-Aquia Aquifer, and the Potomac Aquifer. All of these aquifers are separated by clayey or silty confining layers (see Table 3.1).

Groundwater from the deeper aquifers east of Williamsburg generally has limited use as the result of high chloride content. In some areas, the shallow aquifers have a high iron content, although this has not been specifically identified in the site area. Well yields in the site area generally range from 0 to 10 gallons per minute for wells drilled to 150 feet deep, and 50 to 250 gallons per minute for wells drilled from 200 to 350 feet deep. The most productive and numerous wells in the general site area are those in the southern portion of James City County near Williamsburg. These wells are generally 350 to 550 feet deep and yield from 100 to 900 gallons per minute. The highest producing well in the Williamsburg area is a 524-foot well that yields 1,326 gallons per minute. Table 3.2 depicts the population dependent upon groundwater within a 4-mile radius of the site.

3.4 Hydrologic Setting

The elevation of the site ranges from sea level to approximately 90 feet above mean sea level (AMSL), with the highest portion of the site being found around Jones Pond. The site area consists of both wet, flat areas and well drained, nearly level to very steep areas. The drainage pattern in the site area is dissected and dendritic, with Route 64 running along the approximate southern water shed divide of the York River. Surface water runoff from the Penniman Shell Loading Plant Site flows either northerly into Cheatham Pond, Jones Pond, and Queen Creek, easterly into Penniman Lake, easterly into the York River, or southerly into King Creek. All of the runoff from the site eventually leads to the York River (see Figure 3.2). The drainage areas on the site are generally very steep and short, with tidally influenced brackish or saline marshes along their lower portions.

Several man-made reservoirs are located in the site area and are utilized for drinking water, including Jones Pond. According to the York County Department of Engineering, Design, and Surveying and the U.S. EPA Region III Inland Area Contingency Plan CDROM, there is only one surface water intake within 15-miles downstream or upstream of the site which could potentially receive runoff from the site. This drinking water intake draws water from Jones Pond and serves approximately 1,843 persons on USN CAX.

The York River is a tidally influenced, brackish surface water body which is considered a fishery and flows into the Chesapeake Bay approximately 16 miles downstream of the site.

3.5 Soils

Information on the soils in the site area has been compiled in the *Soil Survey of James City and York Counties and the City of Williamsburg, Virginia* prepared by the U.S. Department of Agriculture Soil Conservation Service in April 1985. The specific soil delineations for the site can be found on Plates 18, 19, 23, and 24 of that report; however, a large portion of this area remains unclassified presumably because these areas are military installations and could not be accessed by the soil survey teams. The two general soil types present on and around the site are the Emporia-Bohicket-Slagle and the Emporia-Craven-Uchee soil groups.

The Emporia-Bohicket-Slagle group is described as a "deep, well drained, very poorly drained, and moderately well drained soils that dominantly are loamy or clayey and are nearly level to very steep; on escarpments and side slopes and saline or brackish water marshes." The Emporia-Craven-Uchee group is described as "deep, well drained and moderately well drained soils that

dominantly are loamy or clayey and gently sloping to very steep; on upland ridges and side slopes.”

The Bohicket soils are very poorly drained and are along tidal rivers and creeks. They have a surface layer of dark muck and a substratum of dark clay and silty clay. The specific soil type found on the site within this sub group is classified as “6 - Bohicket muck.” No further descriptive information is available for this soil type.

The Craven soils are moderately well drained soils that are on narrow to medium, gently sloping ridges and strongly sloping side slopes. They have a surface layer of dark grayish brown fine sandy loam. The subsoil is yellowish brown clay in the upper part and mottled, yellowish brown sandy clay loam in the lower part. The specific soil types found on the site within this sub group include:

- 10C - Craven fine sandy loam, 2-6% slopes.
- 11C - Craven-Uchee complex, 6-10% slopes.

The Emporia soils are well drained and are mostly gently sloping to very steep. They are mostly on the side slopes, and have a surface layer of dark grayish brown fine sandy loam. The subsoil is yellowish brown loam with mostly strong brown mottles in the upper part, yellowish brown, firm sandy clay loam with strong brown and gray mottles in the middle part, and mottled gray and brown, firm sandy clay loam in the lower part. The specific soil types found on the site within this sub group include:

- 14B - Emporia fine sandy loam, 2-6% slopes.
- 15D - Emporia complex, 10-15% slopes.
- 15E - Emporia complex, 15-25% slopes.
- 15F - Emporia complex, 25-50% slopes.
- 19B - Kempsville-Emporia fine sandy loam, 2-6% slopes.

The Slagle soils, which are mostly nearly level and gently sloping, are moderately well drained and are on high terrace positions. They are separated from the marshes and from higher uplands by steep slopes and escarpments. They have a surface layer of dark grayish brown fine sandy loam. The subsoil is mostly mottled, yellowish brown clay loam in the upper part and mottled clay loam and sandy clay loam in the lower part. The specific soil type found on the site within this subgroup is the “29B - Slagle fine sandy loam, 2-6% slopes.”

The Uchee soils are well drained and are gently sloping and strongly sloping. The Uchee soils are on narrow to medium ridges and side slopes, and have a surface

layer of dark grayish brown loamy fine sand. The subsoil is strong brown sandy clay loam in the upper part and mottled, strong brown sandy clay loam and clay in the lower part. The specific soil type found on the site within this subgroup is the "11C - Craven-Uchee complex, 6-10% slopes."

The "12 - Dogue loam" soil type is also found on the site but does not fall into any of the above categories. This soil type is deep, nearly level, and moderately well drained. Most of the areas of this soil are irregularly oval or irregularly rectangular and range from about 2 to 40 acres. Slopes range from 0 to 3 percent, and the surface layer of this soil is dark grayish brown loam about 11 inches thick. The subsoil extends to a depth of 52 inches and is mostly yellowish brown loam and clay in the upper part, yellowish brown and reddish yellow clay in the middle part, and gray sandy clay loam in the lower part.

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PENNIMAN SHELL LOADING PLANT SITE
 DATA ACQUISITION SUMMARY REPORT
 SECTION 3.0 TABLES

Table 3.1
 Vertical Sequence of Aquifers

| System | Series | Specific Unit Name | Principal Lithology | Hydrologic Unit Name | | |
|-------------------------------|-----------------------|----------------------------------|--|------------------------------|--|---------------------|
| Tertiary | Pliocene | Yorktown Confining Unit | Clay and Silty Clay | Confining Unit | Northern Atlantic Coastal Plain Aquifer System | |
| | | Yorktown-Eastover Aquifer | Sand | Chesapeake Aquifer | | |
| | Miocene | St. Mary's Confining Unit | Silt and Clay | Chesapeake Aquifer | | |
| | | St. Mary's-Choptank Aquifer | Sand | | | |
| | | Calvert Confining Unit | Clay and Sandy Clay | Confining Unit | | |
| | Oligocene | Chickahominy-Piney Point Aquifer | Limestone and Fine to Coarse, Glauconitic Sand | Castle Hayne-Aquia Aquifer | | |
| | | | | | | Eocene |
| | Paleocene | Aquia Aquifer | Fine to Coarse, Glauconitic or Shelly Sand | | | |
| | | Cretaceous | | Upper Potomac Confining Unit | | Clay and Silty Clay |
| | Upper Potomac Aquifer | | | Fine to Medium Sand | | Potomac Aquifer |
| Middle Potomac Confining Unit | Clay and Sandy Clay | | | | | |
| Middle Potomac Aquifer | Fine to Medium Sand | | | | | |
| Lower Potomac Confining Unit | Clay and Sandy Clay | | | | | |
| Lower Potomac Aquifer | Fine to Coarse Sand | | | | | |
| Confining Unit | Clay and Silt | | | Confining Unit | | |

PENNIMAN SHELL LOADING PLANT SITE
DATA ACQUISITION SUMMARY REPORT
SECTION 3.0 TABLES

Table 3.2
Populations Dependent Upon Groundwater

| Radius Distance | Population Using Groundwater | Total Population |
|------------------|------------------------------|------------------|
| 0-1/4 mile | 0 | 5* |
| 1/4-1/2 mile | 0 | 16 |
| 1/2-1 mile | 0 | 64 |
| 1-2 miles | 128 | 662 |
| 2-3 miles | 668 | 2,367 |
| 3-4 miles | 1,269 | 5,282 |
| TOTAL POPULATION | 2,065 | 8,398* |

* Number does not reflect 1,843 CAX employees.

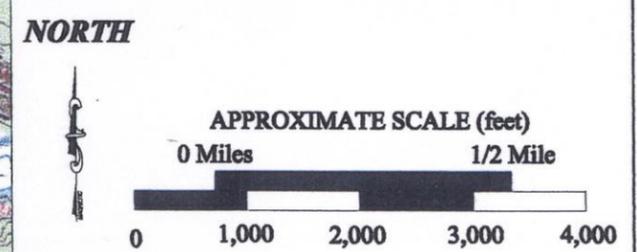
NOTE: Distance limit rings originate from a point located centrally between all sources at the site. These population numbers may be slightly larger or smaller depending upon the specific source evaluated.



GEOLOGY MAP NOT AVAILABLE

LEGEND

| | | |
|---------------------|---|--------------|
| Qal | Alluvium - Organic silt and clay; some sand. | HOLOCENE |
| Qn | Norfolk Formation - Interbedded sand, clay, and organic silt. | PLEISTOCENE |
| Qw | Windsor Formation - Upper part, poorly sorted mixture of sand, silt, and clay; lower part, chiefly cross bedded sand. | PLEISTOCENE |
| QTbc | Bacons Castle Formation - Intertongued red sand and clay; gravel at base. | PLIOCENE (?) |
| QTs | Sedley Formation - Brown sand and clay. | PLIOCENE (?) |
| <i>Unconformity</i> | | |
| Ty | Yorktown Formation - Gray clay and sand; many beds abundantly fossiliferous. | MIOCENE |
| Ts | St. Marys Formation - Sand with interbedded fossiliferous sand. | MIOCENE |



TDD NUMBER: 9901-45
 SITE ASSESSMENT TECHNICAL ASSISTANCE - REGION III
WESTON FEDERAL PROGRAMS DIVISION
MANAGEMENT CONSULTANTS

PENNIMAN SHELL LOADING PLANT SITE
 Figure 3.1
 Geology of the Penniman Shell Loading Plant Site Area
 WILLIAMSBURG VIRGINIA

Geologic information on this map was derived from the *Geology of the Williamsburg, Hog Island, and Bacons Castle Quadrangles, Report of Investigations 18, Commonwealth of Virginia Division of Mineral Resources, 1969.*

LEGEND

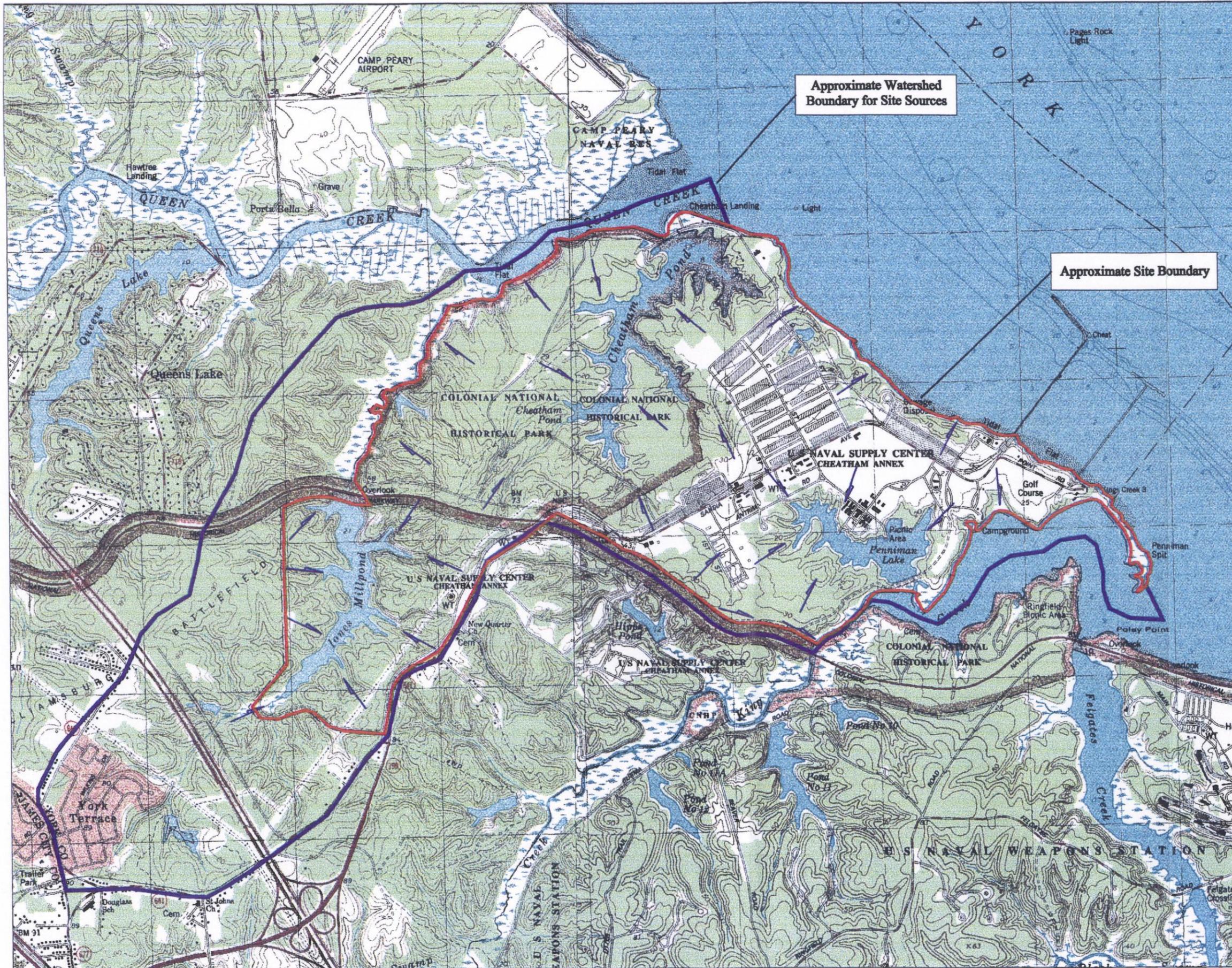
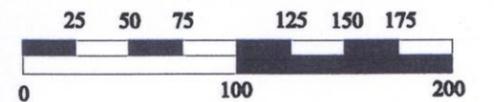


Surface Water Flow Direction



NORTH

APPROXIMATE SCALE (feet)



TDD NUMBER: 9901-45
 SITE ASSESSMENT TECHNICAL ASSISTANCE - REGION III
WESTON FEDERAL PROGRAMS DIVISION
MANAGEMENT ENGINEERS CONSULTANTS

**PENNIMAN SHELL LOADING
 PLANT SITE**

Figure 3.2
 Surface Water Drainage Map

4.0 PREVIOUS INVESTIGATIONS

This section presents a history of the previous investigations conducted at the Penniman Shell Loading Plant Site. Most of these studies were conducted as part of the U.S. Navy Installation Restoration (IR) Program, and are concerned primarily with USN activities since the inception of CAX; however, all studies, including those conducted by the U.S. EPA, are described in this section. A detailed description of each of the areas mentioned within this section can be found in Section 2.3 of this report.

The following environmental investigations or studies, presented in chronological order, have been conducted to date at the Penniman Shell Loading Plant Site and CAX:

- Initial Assessment Study (IAS) of Naval Supply Center, Cheatham Annex and Yorktown Fuels Division. February 1984. NEESA.
- Confirmation Study, Step 1A (Verification), Round One. June 1986. Dames and Moore.
- Confirmation Study, Step 1A (Verification), Round Two. June 1988. Dames and Moore.
- Draft Remedial Investigation (RI) Interim Report. March 1989. Dames and Moore.
- Final RI Interim Report. February 1991. Dames and Moore.
- Final Site Investigation for Sites 1, 10, and 11. November 1994. Roy F. Weston.
- Final Site Screening Process Report, Sites 1, 10, and 11. September 1997. Baker.
- Aerial Photographic Analysis. USN Supply Center - Cheatham Annex, Williamsburg, Virginia. United States Environmental Protection Agency Region III. May 1998.
- Shoreline Assessment Letter Report (Site 1). August 1998. Baker.
- Recommendations for Erosion Mitigation Measures Letter Report (Site 1). May 1999. Baker.
- Draft Final Field Investigation Report Site 1 and AOC 2. May 1999. Baker.
- Draft Action Memorandum - Time Critical Removal Action - Site 1. June 1999. Baker.
- Final Site Inspection Narrative Report, Penniman Shell Loading Plant Site. 9 August 1999. Roy F. Weston, Inc. SATA.

To date, environmental samples have been collected under the U.S. Navy's IR Program from Navy Sites 1, 9, 10, 11, and AOC 2. As part of the CERCLA Penniman Shell Loading Plant Site Inspection conducted by the U.S. EPA, samples have been collected from the Jones Pond Landfill (U.S. Navy AOC 1), the Shipping Area (blast hole, FM/FS smoke drum), the "G" Plant Process Line Area (TNT graining house, ammonia settling pits, slag area, storm drain mixer, in-ground mixing tank), the Drum Storage Area, the TNT Production Area (nitro-starch dry house, drainage swales), Jones Pond, Cheatham Pond, and Penniman Lake.

4.1 Initial Assessment Study

The purpose of the IAS was to identify and assess sites posing a potential threat to human health or the environment due to contamination from past operations. A total of 12 sites were considered in the study including:

- Site 1 - Landfill near Incinerator
- Site 2 - Contaminated Food Disposal Area
- Site 3 - Submarine Dye Disposal Area
- Site 4 - Medical Supplies Disposal Area
- Site 5 - Photographic Chemicals Disposal Area
- Site 6 - Spoiled Food Disposal Area
- Site 7 - Old DuPont Disposal Area
- Site 8 - Landfill near Warehouse 14
- Site 9 - Transformer Storage Area
- Site 10 - Decontamination Agent Disposal Area near First Street
- Site 11 - Bone Yard
- Site 12 - Disposal Site near Water Tower

Four potentially contaminated sites were identified based on information from historical records, aerial photographs, field inspections, and personnel interviews. Each site was evaluated for the type of contamination, migration pathways, and pollutant receptors. These four identified sites were recommended for a confirmation study and included:

- Site 1 - Landfill near Incinerator

- Site 9 - Transformer Storage Area
- Site 10 - Decontamination Agent Disposal Area near First Street
- Site 11 - Bone Yard

4.2 Confirmation Studies

The Confirmation Studies were conducted by Dames & Moore in two rounds. During the first round of sampling, conducted in the winter of 1986, environmental samples were collected from the four sites (Sites 1, 9, 10, and 11) identified in the IAS. This effort was documented in the report *Confirmation Study Step 1A (Verification), Round One*, submitted to LANTDIV on 11 June, 1986. The first round of work at these four sites included the installation of five new monitoring wells and the collection and analysis of groundwater samples. Groundwater samples were also collected from four existing monitoring wells installed for landfill closure at Site 1. This effort also involved the collection and analysis of three surface water samples plus bottom sediment samples from the same locations. Twenty-two surface soil samples were also collected and analyzed. The Transformer Storage Area (Site 9) was taken off the U.S. Navy site list based on the results of the sampling completed during Round One of the Confirmation Study. Additional investigations were recommended for the three remaining sites (Sites 1, 10, and 11) under the Confirmation Studies.

The second round of sampling for the Confirmation Study was conducted during November and December 1987. The Round Two effort for the three sites included the collection and analysis of nine groundwater samples (Sites 1 and 11), and three surface water and three sediment samples (Site 11). The results of the analyses performed on these samples and comparisons with applicable regulatory standards were presented in the report *Confirmation Study Step 1A (Round Two)*, submitted to LANTDIV 20 June 1988. No recommendations were presented.

4.3 Remedial Investigation Interim Report

A Draft RI Interim Report prepared by Dames & Moore was submitted to LANTDIV in March 1989. The report was finalized by Dames & Moore and submitted in February 1991 under Environmental Science and Engineering, Inc. (ESE) cover. The purpose of the RI Interim Report was to summarize available data for Sites 1, 9, 10, and 11 and, based on the data, provide recommendations for additional efforts to be conducted to complete the RI. The recommendations included aerial photographic interpretation, an off-base well inventory, limited biota sampling, and background sampling of soil, surface water, and sediment. Site-specific recommendations included collection of groundwater samples from Site 1, historical aerial photographic interpretation to gather information regarding disposal activities at Site 10, and collection of groundwater, surface water, sediment and soil samples from Site 11.

4.4 Site Investigation Report for Sites 1, 10, and 11

In July/August 1992, Roy F. Weston, as a subcontractor to Baker, conducted additional field activities at Sites 1, 10, and 11. These activities included well installation, a soil gas survey, and collection and analysis of soil, groundwater, surface water, and sediment samples. Results of this investigation are presented in the Final Site Inspection Report for Sites 1, 10 and 11.

The recommendations presented in the SI included limited actions as follows:

- Site 1 - Re-sampling of monitoring wells for volatile organic compounds (VOCs) and dissolved (filtered) metals and performance of a file search of past records to verify closure status of the landfill.
- Site 10 - Re-sampling of monitoring wells for VOCs and dissolved (filtered) metals.
- Site 11 - Re-sampling of shallow soils for VOCs, re-sampling of monitoring wells for VOCs and dissolved (filtered) metals, and re-sampling of surface water for VOCs.

4.5 Site Screening Process Report for Sites 1, 10, and 11

In August 1997, Baker collected groundwater samples from the existing monitoring wells at Sites 1, 10, and 11. The samples were analyzed for Target Compound List (TCL) volatiles, semivolatiles, pesticides/polychlorinated biphenyls (PCBs), and Target Analyte List (TAL) metals (total and dissolved).

As part of the Site Screening Process (SSP), human health and ecological risk screening was performed to determine whether contaminants detected in environmental media pose unacceptable risks to human receptors and/or the environment. The risk screening process was completed in accordance with the SSP Guidelines.

The following is a summary of the conclusions and results that were presented in the SSP Report for each site.

Site 1 - Landfill near Incinerator

- Based on the available analytical data, no unacceptable human health or ecological risks are posed by the site.
- Based on the available analytical data, no additional investigation or remedial action is warranted.

- The soil cover of the landfill should be maintained - trees that are growing through the cover should be removed.
- Monitoring wells that penetrate the landfill should be abandoned to eliminate a future potential pathway of contaminants from the fill material.

Site 10 - Decontamination Agent Disposal Area Near First Street

- No unacceptable human health or ecological risks are posed by the site.
- No additional investigation or remedial action is warranted.

Site 11 - Bone Yard

- Risks to human health were generally within acceptable ranges.
- Ecological risks were primarily associated with deep sediments (in Penniman Lake) that would not be contacted by aquatic ecological receptors.
- No additional investigation or remedial action is warranted.

This document was finalized prior to receipt of VDEQ comments. These comments were discussed with LANTDIV and VDEQ at a meeting conducted 12 May, 1999, and will be considered in preparation of subsequent documents for the IR Program at CAX.

4.6 Aerial Photographic Analysis

The Aerial Photographic Analysis report presents the results of an analysis of historical aerial photographs of CAX. Nine dates of black-and-white, color, and/or infrared photographs (1937, 1942, 1955, 1960, 1963, 1969, 1975, 1989, and 1998) were used to analyze the site. Environmentally significant hazardous waste-related features and conditions were identified. The purpose of the report was to provide remote sensing support to field investigations for U.S. EPA Region III under CERCLA.

Seven of the 12 IAS sites were located and documented in the report. The remaining five IAS sites were not located due to lack of visible features on the photographs. The following is a list of IAS sites (those denoted with an asterisk were located and significant features and changes observed in these areas were documented).

- Site 1 - Landfill near Incinerator*
- Site 2 - Contaminated Food Disposal Area*
- Site 3 - Submarine Dye Disposal Area*

- Site 4 - Medical Supplies Disposal Area*
- Site 5 - Photographic Chemicals Disposal Area
- Site 6 - Spoiled Food Disposal Area
- Site 7 - Old duPont Disposal Area
- Site 8 - Landfill near Warehouse 14*
- Site 9 - Transformer Storage Area
- Site 10 - Decontamination Agent Disposal Area near First Street
- Site 11 - Bone Yard*
- Site 12 - Disposal Site near Water Tower*

It should be noted that the IAS "Sites" are identified as "Areas of Concern" in the Aerial Photographic Analysis Report. These areas of concern should not be confused with the U.S. Navy Areas of Concern. There is no mention of AOC 1 (Scrap Metal Dump) or AOC 2 (Dextrose Dump). Observations for each site are summarized in Table 4.1.

Areas of Concern

A total of five AOCs have been identified at CAX, including:

- AOC 1 - Scrap Metal Dump
- AOC 2 - Dextrose Dump
- AOC 3 - CAD 11 /12 Pond Bank
- AOC 4 - IR Site 4 - Medical Waste Disposal Area
- AOC 5 - Debris Area

These AOCs were identified during site visits by LANTDIV, U.S. EPA, and VDEQ representatives in 1998.

AOC 3 is comprised of an approximately 20 foot by 20 foot by 10 foot high pile of metal banding, a few empty drums, and other miscellaneous debris present along the pond bank between buildings CAD 11 and 12. This AOC is adjacent to AOC 4/Site 4. AOC 4 is the same as Site 4.

AOC 5 is the metal debris pile along the northern perimeter of Site 1 and consists of automobiles, boat parts, metal cables, etc. AOC 5 is currently being managed as part of Site 1.

The Aerial Photographic Analysis report does not refer to any of the five AOCs by name, but does provide observations for the area that AOC 1 (Scrap Metal Dump) occupies as presented on Table 4.1.

4.7 Shoreline Assessment Letter Report

The 14 August 1998 Shoreline Erosion Assessment Letter Report (Baker, 1998) was prepared to address the erosion of the bank of the York River in the vicinity of Site 1. The assessment concluded that the erosion of the river bank is attributable to high water levels and wave action. The erosion is increased by factors such as wind, poor vegetation, and the presence of large trees along the top of the bank. As an interim measure, Baker recommended clearing trees within a distance of approximately two bank-heights (i.e., approximately 50 feet) from the toe of the slope, and establishing low-growing vegetation. The long-term solution entails cutting the slope back to 2 horizontal (H) to 1 vertical (V) and installing a stone revetment at the toe of the slope.

4.8 Recommendations for Erosion Mitigation Measures Letter Report (Site 1)

On 15 March 1999, during a Baker visit to inspect the progress of clearing activities at Site 1, an approximately 60-foot section of the landfill perimeter was noted to be partially exposed and a minor amount of apparent landfill debris was noted on the beach in the vicinity of the erosion. To address this erosion, LANTDIV tasked Baker to provide recommendations for mitigation of the erosion. Following is a summary of recommendations that were presented in the letter report dated 6 May 1999:

- Install a sand-filled Geotube revetment along the eroding area.
- Characterize and dispose of the debris that has collected on the beach area as well as the small container of yellow residue outcropping from the bank.
- Implement a program to routinely inspect the landfill perimeter.
- Develop strategies for the long-term management of the landfill.

4.9 Field Investigation Report - Site 1 and AOC 2

A field investigation was conducted at Site 1 and AOC 2 in October 1998. The findings of the investigation are documented in the Field Investigation Report. The Draft Final version of this document was submitted for government review 14 May 1999.

For Site 1, the Field Investigation Report recommended the following:

- Remove surficial debris that has collected on the flat inter-tidal beach area in the vicinity of the eroding bank.
- Develop and implement interim measures that can be quickly installed to mitigate erosion in the 60-foot stretch of shoreline where the landfill is being undermined. Baker developed recommendations for the interim erosion control measures for the small area of exposed debris at Site 1 in the letter report submitted 6 May, 1999. The recommendations included use of sand-filled geotextile tubes as a shoreline revetment. Construction should be implemented as a time critical removal action.
- Institute a periodic inspection program so that the condition of the slope can be monitored and documented.
- Remove the small, rusty container that outcrops along the northern perimeter of the landfill.
- Consider abandoning monitoring wells 1GW01, 1GW02, 1GW03, 1GW04, and 1GW07 due to the installation of these monitoring wells through the landfill and/or monitoring well integrity.
- Develop and implement solutions for long-term management of the landfill.

The Field Investigation study for AOC 2 consisted of a geophysical survey and soil and groundwater investigations including installation of temporary monitoring wells. VOCs, pesticides and inorganics were detected in the soil samples at low levels. Semivolatile organic compounds (SVOCs) and inorganics were detected in groundwater samples at low levels. The presence of these constituents was not suspected to be related to site activities.

The Field Investigation Report recommended that the sources of the geophysical anomalies and potential sources of contamination be identified by excavating a total of six shallow test pits in the vicinity of the most significant anomalies detected.

4.10 Final Site Inspection Narrative Report, Penniman Shell Loading Plant Site

U.S. EPA Remedial Project Manager Robert Thomson initiated a CERCLA investigation at the Penniman Shell Loading Plant Site in January 1998 under the U.S. EPA Region III Federal Facilities Section. The Roy F. Weston, Inc. SATA team completed a Site Inspection in accordance with the U.S. EPA "Guidance for Performing Site Inspections Under CERCLA" in August 1999. Because of the large size of the site, and the number of potential waste sources, the objective of this site inspection was limited by the RPM to evaluating the waste sources and

contaminants present at the site, and to determine if contaminant levels at the site posed an imminent and substantial threat to human health, welfare, or the environment. The intent was to identify significant areas of concern which could be further evaluated under focused Site Inspections in the future.

The findings of the WESTON® SATA Site Inspection are summarized in the 9 August 1999 *Final Site Inspection Narrative Report, Penniman Shell Loading Plant Site*. This SI included sampling of potential waste sources, selected target sampling, and review of background documentation and information.

The sampling event for this SI was conducted in January 1999, and consisted of the collection of a total of 29 samples, including 14 waste source (soil) samples, 9 sediment samples, 2 surface water samples, 1 drinking water sample, 3 background samples, and all associated QA/QC samples. All of the waste source samples, sediment samples, and surface water samples were analyzed at EPA Contract Laboratory Program (CLP) arranged laboratories for CLP medium concentration Target Compound List (TCL) organic and medium concentration Target Analyte List (TAL) inorganic parameters. The drinking water sample was sent to a Delivery of Analytical Services (DAS) arranged laboratory for low concentration CLP TAL inorganics and low concentration CLP TCL organic parameters. All of the soil and sediment samples were also analyzed at a DAS arranged laboratory for nitroaromatic compounds (EPA method SW-846). A selected portion of these samples were screened in the field using D-Tech® field screening kits for TNT. Two of the soil samples were also analyzed at a separate DAS arranged laboratory for mustard decomposition products using U.S. Army Treaty Laboratory APG-SOPs.

Based upon the analytical results from the January 1999 SI sampling event, WESTON® SATA concluded that:

- The inorganic compounds arsenic, cadmium, chromium, lead, and manganese were present in some of the waste source areas at elevated levels which exceeded U.S. EPA health risk-based screening levels.
- The nitroaromatic compound 2,4,6-trinitrotoluene was present in two of the waste source areas at elevated levels which exceeded U.S. EPA health risk-based screening levels.
- Manganese from the nitro-starch dry house sumps appears to be entering the drainage ditch leading into the wetlands around Cheatham Pond, but does not yet appear to be impacting the water quality or sediments in Cheatham Pond.
- Chromium and manganese from the Jones Pond Landfill Area (U.S. Navy AOC 1) appear to be entering Jones Pond, and therefore may be adversely impacting the drinking water quality of the sole source of potable water for CAX employees.

WESTON® SATA presented the following recommendations in the 9 August 1999 Final Site Inspection Narrative Report:

- A groundwater investigation should be conducted around the underground containers in the "G" plant 75-mm process line area.
- Additional samples should be collected around a concentrated area of the slag material found throughout the site, including a TCLP sample of the slag itself and soil samples downgradient of this slag to determine if contaminants from this material have the ability to migrate.
- A site-specific health risk assessment should be conducted for the 1918 drum storage area, the blast hole area, and the FM/FS smoke drum area.
- Additional sampling should be conducted of and around the Jones Pond Landfill (U.S. Navy AOC 1), including soil sampling of the landfill area itself, water and sediment samples in Jones Pond, a post-treatment water sample from the CAX water treatment system, and background water samples from another reservoir in the site area used for a drinking water supply.

4.11 Administrative Record for Cheatham Annex

The Administrative Record (AR) files for CAX are available for public review at the Newport News Public Library (Virgil I. Grissom Branch). Baker has converted the AR files into an electronic database, which is available as the August 1999 *Draft Administrative Electronic File, Naval Weapons Station Yorktown, Yorktown, VA, Cheatham Annex Site*. A list of the reports contained in the Administrative Record is presented in Table 4.2. The table does not include letters or newspaper/magazine clippings that are included in the Administrative Record files. A public declaration of the availability of the administrative record files was published in the 17 July 1999 Newport News Daily Press newspaper.

REFERENCES - SECTION 4.0

1. Baker Environmental, Inc. 1994. Final Site Investigation for Sites 1, 10, 11. November.
2. Baker Environmental, Inc. 1997. Site Screening Process Report, Sites 1, 10, & 11. September.
3. Roy F. Weston, Inc. 1998. Sampling Plan #1, Penniman Shell Loading Plant Site. Delran, NJ. 27 October.
4. Baker Environmental, Inc. 1999. Draft Final Field Investigation Report for Site 1 and Area of Concern 2 at the Fleet Industrial Supply Center (FISC), Cheatham Annex. Coraopolis, PA. May.
5. Baker Environmental, Inc. 1999. Minutes for the 12 May 1999 meeting conducted at the Naval Weapons Station Yorktown, Cheatham Annex Site (CAX). Coraopolis, PA. 18 June.
6. CH2MHill Federal Group, Ltd. Site Management Plan, Fiscal Year 2000, Naval Weapons Station Yorktown, Cheatham Annex Site. 1999. July.
7. Roy F. Weston, Inc. 1999. Final Site Inspection Narrative Report, Penniman Shell Loading Plant Site. 9 August.

PENNIMAN SHELL LOADING PLANT SITE
DATA ACQUISITION SUMMARY REPORT
SECTION 4.0 TABLES

Table 4.1
U.S. EPA Aerial Photographic Analysis Observations for Sites and Areas of Concern

| Photograph Date | Observation |
|--|---|
| Site 1 Landfill Near Incinerator | |
| 17 April 1937 | No observation regarding Site 1. |
| 1 October 1942 | Visible adjacent to small tributary. Solid waste visible on both banks of the tributary. |
| 21 November 1955 | Light and dark-toned solid wastes are visible. |
| 27 June 1960 | The area extent has increased compared with 1955. Dark-toned material is present. |
| 3 April 1963 | The area and vertical extent of solid waste is larger compared with 1960. |
| 13 May 1969 | Additional solid waste has been deposited at the site and the area extent has increased since 1963. |
| 23 October 1975 | The site is partially revegetated, indicating inactivity since 1969. |
| 17 March 1989 | The area extent of the landfill has increased since 1975 and one small dark stain is visible. |
| 1 January 1998 | The site is partially revegetated. Two small areas of standing liquid are present on the bare soil portion of the old landfill. |
| Site 2 Contaminated Food Disposal Area | |
| 21 November 1955 | Consists of a revegetated mound and a trench. |
| 13 May 1969 | Consists of revegetated mounded material and bare soil that appears to be a filled trench. |
| Site 3 Submarine Dye Disposal Area | |
| 23 October 1953 | Dark-toned material and staining are present. |
| 17 March 1989 | Dark-toned material is present. |
| Site 4 Medical Supplies Disposal Area | |
| 27 June 1960 | Probable disposal area. No revegetation has occurred since 1955 indicating probable continued use of the area for waste disposal. |
| 3 April 1963 | Revegetation has not occurred since 1960, possibly indicating continued waste disposal. Dark toned material noted at the site. |
| 13 May 1969 | Area now revegetated indicating that probable waste disposal activities ceased between 1960 and 1969. |
| Site 7 Old duPont Disposal Area (EPIC Study Location) | |
| 17 April 1937 | No visual evidence of a disposal area is observed in the area which is currently accepted as the location for this site (along the York River). A large possible dump is located adjacent to Queen Creek. An access road leads from the Penniman Plant to the possible dump. This possible dump area has not been identified as a U.S. Navy site or Area of Concern. This |

PENNIMAN SHELL LOADING PLANT SITE
DATA ACQUISITION SUMMARY REPORT
SECTION 4.0 TABLES

Table 4.1
U.S. EPA Aerial Photographic Analysis Observations for Sites and Areas of Concern

| Photograph Date | Observation |
|---|--|
| | are has not been investigated by the U.S. EPA. |
| Site 7 Old DuPont Disposal Area (Current Location) | |
| 21 November 1955 | Shown as an extensive excavation with partial revegetation. |
| 27 June 1960 | Excavation still visible. |
| 3 April 1963 | Excavation still visible. |
| 13 May 1969 | Excavation larger than 1963. |
| 23 October 1975 | Revegetated. |
| Site 8 Landfill Near Building CAD 14 | |
| 3 April 1963 | A small access road leads northwest from Building 14 to a shallow trench filled with liquid. Excavated soil is also present. |
| 13 May 1969 | Trench no longer present. |
| Site 11 Bone Yard | |
| 21 November 1955 | A small enclosure and several unidentified objects are noted. Drainage flows to Penniman Lake where a small excavation is noted. |
| 27 June 1960 | Enclosure is still present. Bare soil now present along with a small area of disturbed ground. |
| 3 April 1963 | A stain and two deposits of solid waste are noted. Another possible waste disposal area is seen south of the site in a wooded area at the end of an access road. |
| 13 May 1969 | Possible drums, associated stains, and standing liquid are noted. |
| 23 October 1975 | Partially revegetated and apparently inactive. |
| 17 March 1989 | Possible drums, associated stains, and standing liquid are noted. |
| 1 January 1998 | Partially revegetated, enclosure is visible. Bare soil and standing liquid are present. |
| Site 12 Disposal Site Near Water Tower | |
| 21 November 1955 | Site consisted of a small mound of dark-toned material. |
| 3 April 1963 | Dark toned material no longer present. |
| AOC 1 Scrap Metal Dump | |
| 1 October 1942 | Not specifically referenced, but the area has apparently been cleared of trees and contains a large mound of light-toned material. Railyard is under construction. |
| 21 November 1955 | Not specifically referenced, but area of light-toned material appears to be partially revegetated. |
| 3 April 1963 | Not referenced as an AOC, but area is noted to contain a large mound of |

PENNIMAN SHELL LOADING PLANT SITE
DATA ACQUISITION SUMMARY REPORT
SECTION 4.0 TABLES

Table 4.1
U.S. EPA Aerial Photographic Analysis Observations for Sites and Areas of Concern

| Photograph Date | Observation |
|-----------------|--|
| | fill. |
| 23 October 1975 | Not specifically referenced, but area appears to be revegetated. |

PENNIMAN SHELL LOADING PLANT SITE
 DATA ACQUISITION SUMMARY REPORT
 SECTION 4.0 TABLES

Table 4.2
 List of Reports Contained in the Administrative Record

| Date | Document | Prepared by |
|-----------------|---|----------------------|
| February 1984 | Initial Assessment Study of Naval Supply Center, Cheatham Annex and Yorktown Fuels Division | NEESA |
| June 1986 | Confirmation Study, Step 1A (Verification Round One) | Dames & Moore |
| June 1988 | Confirmation Study, Step 1A (Round Two) | Dames & Moore |
| February 1991 | Final RI Interim Report | Dames & Moore |
| 6 November 1992 | Final Community Relations Plan NSC Norfolk for Yorktown Fuels Division and Cheatham Annex | Baker |
| 26 April 1994 | Architectural Survey and Assessment of the duPont Factory Structures | Goodwin & Associates |
| November 1994 | Final Site Investigation Report for Sites 1, 10, and 11 | Baker |
| September 1997 | Site Screening Process Report for Sites 1, 10, and 11 | Baker |
| 1 May 1998 | Aerial Photographic Analysis | U.S. EPA |
| October 1998 | Final Project Plans, Field Investigation Report for Site 1 and Area of Concern (AOC) 1 | |
| 14 August 1998 | Shoreline Assessment Letter Report | Baker |
| 6 May 1999 | Recommendations for Erosion Mitigation Measures Letter Report (Site 1) | Baker |
| May 1999 | Draft Final Investigation Report for Site 1 and AOC 2 | Baker |

5.0 ENVIRONMENTAL SETTING

The entire site is composed of heavily vegetated woodlands, developed areas, wetlands, or vegetated grassland. There are unimproved roadways which meander through a majority of the site, some of which are gravel covered. There is at least one cabin located on site which is used by hunters and fisherman. Some of the site is secured with fencing; however, this fencing is either decrepit or non-existent in other areas of the site. From within USN CAX, access to the entire site is unrestricted.

5.1 Sensitive Environments and Endangered Species

Sensitive environments are located on the site and within a 1-mile radius of the site. These sensitive environments include both state and federally listed endangered species, a national historical park, a drinking water intake serving a population of 1,843 persons (Jones Pond), 550 acres of wetlands (see Figure 5.1), and six fisheries (the York River, King Creek, Queen Creek, Penniman Lake, Jones Pond, and Cheatham Pond). There are several federal and state listed endangered or threatened species located in the site area. These species are listed in Table 5.1.

5.1.1 Ecology

The terrestrial ecology of the site area consists primarily of woodland species which include three forest types: pine stands composed primarily of loblolly and Virginia pines, mixed pine and hardwood stands, and hardwood stands. Pine stands are located primarily on elevated level areas, while hardwood stands are found primarily on slopes and in ravines. These wooded areas provide habitat for wildlife and are important in reducing erosion. The native tree species found at the site include beech, black cherry, red maple, sweet gum, various pines, white ash, and white oak.

The woodland's understory is composed of various seedlings and vine species, such as Virginia creeper, briars, and honeysuckle. Ferns are found in moist shady areas and planted ornamental trees and shrubs can be found in improved areas and along major roadways.

The undeveloped portions of the site support a variety of wildlife species, including white-tailed deer, beavers, skunks, bobcats, red foxes, gray foxes, squirrels, raccoons, opossums, and rabbits. Game birds such as wild turkey, quail, duck, and pheasant are also found on the site property. Songbirds common to eastern Virginia are abundant at the site, along with a rapture population consisting of small hawks, owls, and osprey. Carrion-feeding birds such as crows and turkey vultures are also common. The southern bald eagle, a federally endangered species, is known to nest at the nearby Naval Weapons Station Yorktown. Suitable habitat exists at CAX for roosting and perching in the area;

however, only occasional sightings of bald eagles have been made. Infrequent sightings of several endangered or threatened species, including the peregrine falcon and Bachman's and Kirtland's Warblers, have been made in the general area.

5.1.2 Wetlands and Aquatic Biology

Over 550 acres of wetlands are located within a 1-mile radius of the site property (see Figure 5.1). A large portion of these wetlands are located along Queen Creek and King Creek, the combination of which receive all of the runoff from the site.

There are four major marsh types located on and around the site, including:

- Type I - Salt marsh cordgrass community.
- Type V - Big cordgrass community.
- Type VI - Cattail community.
- Type XII - Brackish water mixed community.

These wetlands are grouped into classifications based upon their estimated environmental value per acre. Group One marshes, of which Type I and Type XII are a part, have the highest productivity and use by wildfowl and wildlife, as well as close association with fish spawning and nursery areas. These marshes are also important to the shellfish industry and as shoreline erosion inhibitors. These wetlands merit the highest order of protection because of their value. Most of the wetlands on and around the site are of this type.

Type V and Type VI marshes are in Group Two and are considered only slightly less important than Group One marshes. The Group Two marshes are found at higher elevations, and therefore there is less opportunity for detritus to be washed into nearby waterways by the tides. This group of marshes are valuable as food buffers and merit a high order of protection. The wetlands and adjacent creeks located on the site are prime habitats for migrating waterfowl and serve as nursery areas for striped bass, white perch, and other aquatic species.

The habitat of aquatic floral species is generally determined by water salinity and bottom types. Along the York River in the vicinity of CAX, the following species are associated with certain salinity ranges:

- Hornwort - freshwater only.
- Water celery - freshwater only.
- Pondweed - fresh water to 5 parts per thousand (ppt) saline.

- Horned pondweed - fresh to 5 ppt saline.
- Water milfoil - fresh to 10 ppt saline.
- Eelgrass - 10 to 35 ppt saline.
- Widgeon grass - 5 to 40 ppt saline.

These species are commonly found growing at depths of 3 to 9 feet in soft bottom muds. Due to increased nutrient loading, waterweed and water milfoil have been plant pests at times. Eelgrass is most often found growing in soft mud. Widgeon grass is sensitive to both increased water temperature and turbidity.

Oysters, blue crabs, and hard and soft shelled clams are found in the York River offshore of CAX. This area of the York River is designated as a crab pot fishery. In addition, south of Queens Creek and immediately north of CAX, the river is a spawning and nursery ground for blue crabs. Fish species commonly found in the York River include hogchoker, white perch, white catfish, channel catfish, bay anchovy, oyster toadfish, striped bass, Atlantic croaker, weakfish, spotted hake, and spotted and silver perch. The first seven of these species are considered resident species, while the remaining five inhabit the waters only seasonally. No threatened or endangered aquatic fish or invertebrate species have been found on CAX or in the surrounding area; however, several species of endangered sea turtles (green, hawksbill, leatherback, loggerhead, and Atlantic ridley) are known to feed in the Chesapeake Bay and occasionally swim up the York River during summer.

REFERENCES - SECTION 5.0

1. CH2MHill Federal Group, Ltd. Site Management Plan, Fiscal Year 2000, Naval Weapons Station Yorktown, Cheatham Annex Site. 1999. July.
2. Baker Environmental, Inc. 1999. Minutes for the 12 May 1999 Meeting conducted at the Naval Weapons Station Yorktown, Cheatham Annex Site (CAX). Coraopolis, PA. 18 June.
3. Baker Environmental, Inc. 1999. Draft Final Field Investigation Report for Site 1 and Area of Concern 2 at the Fleet Industrial Supply Center (FISC), Cheatham Annex. Coraopolis, PA. May.
4. Roy F. Weston, Inc. Final Site Inspection Narrative Report, Penniman Shell Loading Plant Site. 1999. 9 August.
5. Roy F. Weston, Inc. 1999. Penniman Shell Loading Plant Site - LHP 1918 Panoramic Photograph Review. 2 March.
6. Roy F. Weston, Inc. 1998. Report for Cheatham Annex Munitions and Material Review Request. 11 December.
7. Roy F. Weston, Inc. 1998. Sampling Plan #1, Penniman Shell Loading Plant Site. Delran, NJ. 27 October.
8. Roy F. Weston, Inc. 1998. Trip Report #1 USN Supply Center Cheatham Annex. Delran, NJ. 30 September.
9. Roy F. Weston, Inc. 1998. Trip Report for the Cheatham Annex Site Visit Conducted on 15 September 1998. 22 September.
10. U.S. Department of Interior, Fish and Wildlife Service. 1995. Williamsburg, VA. National Wetlands Inventory Map.
11. U.S. Department of Interior, Fish and Wildlife Service. 1995. Claybank, VA. National Wetlands Inventory Map.
12. U.S. Department of Interior, Fish and Wildlife Service. 1993. Yorktown, VA. National Wetlands Inventory Map.
13. U.S. Department of Interior, Fish and Wildlife Service. 1993. Poquoson West, VA. National Wetlands Inventory Map.

14. U.S. Department of Interior, Fish and Wildlife Service. 1993. Poquoson East, VA. National Wetlands Inventory Map.
15. U.S. Department of Interior, Fish and Wildlife Service. 1995. Achilles, VA. National Wetlands Inventory Map.

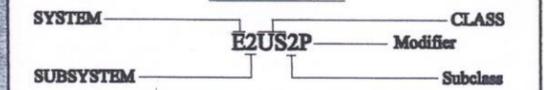
PENNIMAN SHELL LOADING PLANT SITE
DATA ACQUISITION SUMMARY REPORT
SECTION 5.0 TABLES

Table 5.1
Federal and State Endangered or Threatened Species

| Common Name | Scientific Name (Genus specific-epithet) | Organism Type | Federal or State Listing |
|-----------------------|---|----------------------|--|
| Peregrine Falcon | <i>Falco peregrinus</i> | Bird | Federal Endangered |
| Small Whorled Pogonia | <i>Isotria medeoloides</i> | Plant | Federal Threatened State Endangered |
| Bald Eagle | <i>Haliaeetus leucocephalus</i> | Bird | Federal Threatened |
| Sensitive Joint-Vetch | <i>Aeschynomene virginica</i> | Plant | Federal Threatened |
| Mabee's Salamander | <i>Ambystomatidae mabeei</i> | Amphibian | State Threatened |

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL RESPONSE SECTION - REGION III
 PHILADELPHIA 3HS13 PENNSYLVANIA

LEGEND



SYSTEM and SUBSYSTEM

- | | |
|-----------------------|-----------------------|
| L - LACUSTRINE | E - ESTUARINE |
| 1 - LIMNETIC | 1 - SUBTIDAL |
| 2 - LITTORAL | 2 - INTERTIDAL |
| R - RIVERINE | P - PALUSTRINE |
| 1 - TIDAL | No Subsystems |
| 2 - LOWER PERENNIAL | |
| 3 - UPPER PERENNIAL | |
| 4 - INTERMITTENT | |
| 5 - UNKNOWN PERENNIAL | |

CLASS and Subclass

- | | |
|---------------------------|-----------------------------------|
| AB - AQUATIC BED | SB - STREAMBED |
| 1 Algal | 1 Bedrock |
| 2 Aquatic Moss | 2 Rubble |
| 3 Rooted Vascular | 3 Cobble-gravel |
| 4 Floating Vascular | 4 Sand |
| 5 Unknown | 5 Mud |
| 6 Submergent | 6 Organic |
| 7 Unknown Surface | 7 Vegetated |
| EM - EMERGENT | SS - SCRUB-SHRUB |
| 2 Nonpersistent | 1 Broad-leaved Deciduous |
| FO - FORRESTED | 2 Needle-leaved Deciduous |
| 1 Broad-leaved Deciduous | 3 Broad-leaved Evergreen |
| 2 Needle-leaved Deciduous | 4 Needle-leaved Evergreen |
| 3 Broad-leaved Evergreen | 5 Dead |
| 4 Needle-leaved Evergreen | 6 Deciduous |
| 5 Dead | 7 Evergreen |
| 6 Deciduous | UB - UNCONSOLIDATED BOTTOM |
| 7 Evergreen | 1 Cobble-gravel |
| ML - MOSS-LICHEN | 2 Sand |
| 1 Moss | 3 Mud |
| 2 Lichen | 4 Organic |
| OW - OPEN WATER | US - UNCONSOLIDATED SHORE |
| Unknown Bottom | 1 Cobble-gravel |
| RB - ROCK BOTTOM | 2 Sand |
| 1 Bedrock | 3 Mud |
| 2 Rubble | 4 Organic |
| RF - REEF | |
| 2 Mollusc | |
| 3 Worm | |
| RS - ROCKY SHORE | |
| 1 Bedrock | |
| 2 Rubble | |



The information on this map was derived from the Williamsburg, VA and Clay Bank, VA National Wetlands Inventory Maps, developed by the U.S. Department of the Interior, Fish and Wildlife Service, as part of the National Wetlands Inventory.



TDD NUMBER: 9901-45 NO SCALE

| WATER REGIME | | MODIFIERS | | WATER CHEMISTRY | | SOIL | SPECIAL MODIFIERS |
|-----------------------------------|---------------------------|------------------------------------|------------------------|-------------------------|---------------|-----------------|-------------------|
| Non-Tidal | | Tidal | | Coastal Salinity | | Inland Salinity | pH Modifiers |
| A Temporarily Flooded | F Semipermanently Flooded | W Intermittently Flooded/Temporary | K Artificially Flooded | 1 Hyperhaline | 5 Mesohaline | 7 Hypersaline | a Acid |
| B Saturated | G Intermittently Exposed | Y Saturated/Semipermanent/Seasonal | L Subtidal | 2 Euhaline | 6 Oligohaline | 8 Euhaline | t Circumneutral |
| C Seasonally Flooded | H Permanently Flooded | Z Intermittently Exposed/Permanent | M Irregularly Exposed | 3 Mixohaline (Brackish) | 0 Fresh | 9 Mixosaline | i Alkaline |
| D Seasonally Flooded/Well Drained | J Intermittently Flooded | U Unknown | N Regularly Flooded | 4 Polyhaline | | 0 Fresh | (All Fresh Water) |
| E Seasonally Flooded/Saturated | K Artificially Flooded | | P Irregularly Flooded | | | | |

SITE ASSESSMENT TECHNICAL ASSISTANCE - REGION III



PENNIMAN SHELL LOADING PLANT SITE
 Figure 5.1 Wetlands Map

6.0 LISTING OF AVAILABLE INFORMATION SOURCES

The following sections provide a complete listing of all of the currently available documents, reports, articles, maps, diagrams, photographs, and other information for the Penniman Shell Loading Plant Site. These information sources are listed in chronological order, and are accompanied by a short description of their nature.

6.1 Documents, Reports, and Articles Listing

Table 6.1 lists the currently available written documents, reports, and articles which discuss the Penniman Shell Loading Plant Site, its history, the investigations conducted at that site, and the investigations and information relating to the environmental investigations conducted on USN CAX property.

Table 6.1
 Penniman Shell Loading Plant
 Documents, Reports, and Articles Table

| DOCUMENT TITLE | DATE | COMMENTS | TYPE CODE |
|---|------------------|--|-----------|
| E. I. duPont de Nemours and Company, Inc., Smokeless Powder Department. 1928. A History of the duPont Company's Relations with the United States Government, 1802-1927. Wilmington, DE. | 1 January 1928 | See Section 2.3 of this DASR for a summary of this document. | B |
| District Court of the United States for the Eastern District of Virginia, Newport News Division. Condemnation Proceedings. 1942. | 1 January 1942 | See Section 2.3 of this DASR for a summary of this document. | L |
| United States of America. 1981. Quitclaim Deed. 21 May. | 21 May 1981 | See Section 2.3 of this DASR for a summary of this document. | L |
| The Times Herald, Metro Section. 1983. DuPont's Silk Purse Inspired Factory-City. 5 September. p. 15. | 5 September 1983 | See Section 2.3 of this DASR for a summary of this document. | A |
| C.C. Johnson & Malhotra, Inc./CH2M Hill. 1984. Initial Assessment Study of Naval Supply Center, Cheatham Annex and Yorktown Fuels Division. February. | February 1984 | See Section 2.3 of this DASR for a summary of this document. | R |
| Dames & Moore. 1986. Confirmation Study, Step 1A (Verification Round One). June. | June 1986 | See Section 2.3 of this DASR for a summary of this document. | R |
| Dames & Moore. 1988. Confirmation Study Step 1A (Round Two). June. | June 1988 | See Section 2.3 of this DASR for a summary of this document. | R |
| Dames & Moore. 1989. Draft Remedial Investigation Interim Report. March. | March 1989 | See Section 2.3 of this DASR for a summary of this document. | R |
| ESE. 1991. Final Remedial Investigation Interim Report. February. | February 1991 | See Section 2.3 of this DASR for a summary of this document. | R |

Table 6.1
 Penniman Shell Loading Plant
 Documents, Reports, and Articles Table

| DOCUMENT TITLE | DATE | COMMENTS | TYPE CODE |
|--|-------------------|--|-----------|
| ESE. 1991. Draft Final Work Plan for Remedial Investigation/Feasibility Study & Environmental Risk Assessment. July. | July 1991 | This report describes the projected activities to be performed during the Remedial Investigation/Feasibility Study and Ecological Risk Assessment. | R |
| Roy F. Weston, Inc. 1992. Work Plan for Site Inspection, Sites 1, 10 and 11. July. | July 1992 | This report describes the projected activities to be performed during the Site Inspection for Sites 1, 10, and 11. | R |
| R. Christopher Goodwin & Associates, Inc. 1994. Draft Architectural Survey and Assessment of the duPont Factory Structures at the Fleet Industrial Supply Center, Cheatham Annex. Frederick, MD. 26 April. | 26 April 1994 | See Section 2.3 of this DASR for a summary of this document. | R |
| United States Navy Atlantic Division. 1994. Addendum to the Master Plan for USN Supply Center Cheatham Annex. August. | 9 August 1994 | This document was not available for review as part of this DASR. | R |
| Baker Environmental, Inc. 1994. Final Site Investigation for Sites 1, 10, 11. November. | November 1994 | See Section 2.3 of this DASR for a summary of this document. | R |
| United States Navy Atlantic Division. 1995. Environmental Assessment for the Construction of Bachelor Enlisted Quarters. February. | February 1995 | This document was not available for review as part of this DASR. | R |
| R. Christopher Goodwin & Associates, Inc. 1996. Phase 1 Architectural & Archeological Survey. 26 September. | 26 September 1996 | See Section 2.3 of this DASR for a summary of this document. | R |
| United States Navy Atlantic Division. 1997. Environmental Assessment for the Relocation of the Fleet Hospital Support Office. September. | September 1997 | This document was not available for review as part of this DASR | R |
| Baker Environmental, Inc. 1997. Site Screening Process Report, Sites 1, 10, and 11. September. | September 1997 | See Section 2.3 of this DASR for a summary of this document. | R |
| United States Environmental Protection Agency, Environmental Photographic Interpretation Center. 1998. Aerial Photo Analysis. May. | May 1998 | See Section 2.3 of this DASR for a summary of this document. | P |
| BA & H. 1998. Records Research Trip Report Site 8 US Navy Fleet Industrial Supply Center Cheatham Annex (Penniman Shell Loading Plant). 22 May. | 22 May 1998 | See Section 2.3 of this DASR for a summary of this document. | R |
| Baker Environmental, Inc. 1998. Shoreline Erosion Assessment for Site 1 – Landfill Near Incinerator. 14 August. | 14 August 98 | See Section 2.3 of this DASR for a summary of this document. | R |

Table 6.1
 Penniman Shell Loading Plant
 Documents, Reports, and Articles Table

| DOCUMENT TITLE | DATE | COMMENTS | TYPE CODE |
|--|-------------------|--|-----------|
| Roy F. Weston, Inc. 1998. Trip Report for the Cheatham Annex Site Visit Conducted on 15 September 1998. 22 September. | 22 September 1998 | See Section 2.3 of this DASR for a summary of this document. | R |
| Roy F. Weston, Inc. 1998. Trip Report #1 USN Supply Center Cheatham Annex. Delran, NJ. 30 September. | 30 September 1998 | See Section 2.3 of this DASR for a summary of this document. | R |
| Baker Environmental, Inc. 1998. Final Project Plans for the Field Investigation Report for Site 1 and AOC 2. October. | October 1998 | This document was not available for review as part of this DASR. | R |
| Roy F. Weston, Inc. 1998. Sampling Plan #1, Penniman Shell Loading Plant Site. Delran, NJ. 27 October. | 27 October 1998 | See Section 2.3 of this DASR for a summary of this document | R |
| United States Navy Atlantic Division. 1998. Environmental Assessment for Recreational Cabins. December. | December 1998 | This document was not available for review as part of this DASR. | R |
| Roy F. Weston, Inc. 1998. Report for Cheatham Annex Munitions and Material Review Request. 11 December. | 11 December 1998 | See Section 2.3 of this DASR for a summary of this document. | R |
| Roy F. Weston, Inc. 1999. Penniman Shell Loading Plant Site - LHP 1918 Panoramic Photograph Review. 2 March. | 2 March 1999 | See Section 2.3 of this DASR for a summary of this document. | R |
| Frost Associates, Inc. CENTRACTS Report. 1999. April. | April 1999 | See Section 2.3 of this DASR for a summary of this document. | R |
| Baker Environmental, Inc. 1999. Draft Final Field Investigation Report for Site 1 and Area of Concern 2 at the Fleet Industrial Supply Center (FISC), Cheatham Annex. Coraopolis, PA. May. | 1 May 1999 | See Section 2.3 of this DASR for a summary of this document. | R |
| Baker Environmental, Inc. 1999. Minutes for the 12 May 1999 meeting conducted at the Naval Weapons Station Yorktown, Cheatham Annex Site (CAX). Coraopolis, PA. 18 June. | 18 June 99 | See Section 2.3 of this DASR for a summary of this document. | R |
| CH2MHill Federal Group, Ltd. Site Management Plan, Fiscal Year 2000, Naval Weapons Station Yorktown, Cheatham Annex Site. 1999. July. | July 1999 | See Section 2.3 of this DASR for a summary of this document. | R |
| Roy F. Weston, Inc. Final Site Inspection Narrative Report, Penniman Shell Loading Plant Site. 1999. 9 August. | 9 August 1999 | See Section 2.3 of this DASR for a summary of this document. | R |

TYPE CODES: A = newspaper article, B = book, L = legal document, P = photograph(s), R = report

6.2 Maps and Diagrams Listing

Table 6.2 lists the currently available maps and diagrams which depict the Penniman Shell Loading Plant Site. These maps and diagrams include original engineering drawings of the site, as well as numerous maps and diagrams compiled and created during the U.S. EPA investigation of the site.

Table 6.2
 Penniman Shell Loading Plant
 Maps and Diagrams Table

| MAP NAME OR TITLE | DATE | COMMENTS |
|----------------------------------|-------------------|--|
| H.V.C. No. 2, Sheet 3 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #2. |
| H.V.C. No. 2, Sheet 7 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #2. |
| H.V.C. No. 2, Sheet 8 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #2. |
| H.V.C. No. 2, Sheet 9 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #2. |
| H.V.C. No. 2, Sheet 11 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #3. |
| H.V.C. No. 2, Sheet 12 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Do not have Copy. |
| H.V.C. No. 2, Sheet 12 (Revised) | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #3. |
| H.V.C. No. 2, Sheet 13 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #3. |
| H.V.C. No. 2, Sheet 14 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #3. |
| H.V.C. No. 2, Sheet 15 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #3. |
| H.V.C. No. 2, Sheet 16 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Revised 1 August 1942 by Associated Engineers, 1625 Conn Avenue NW, Washington D.C. Copy located in Map Tube #4. |

Table 6.2
 Penniman Shell Loading Plant
 Maps and Diagrams Table

| MAP NAME OR TITLE | DATE | COMMENTS |
|--|-------------------|--|
| H.V.C. No. 2, Sheet 17 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #4. |
| H.V.C. No. 2, Sheet 17 (revised) | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Revised 1 August 1942 by Associated Engineers, 1625 Conn Avenue NW, Washington D.C. Copy located in Map Tube #4. |
| H.V.C. No. 2, Sheet 18 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #4. |
| H.V.C. No. 2, Sheet 19 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #4. |
| H.V.C. No. 2, Sheet 20 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #4. |
| H.V.C. No. 2, Sheet 21 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #5. |
| H.V.C. No. 2, Sheet 21 (revised) | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #5. |
| H.V.C. No. 2, Sheet 22 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #5. |
| H.V.C. No. 2, Sheet 23 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #5. |
| H.V.C. No. 3, Sheet 13 | No date. WWI era. | Engineering drawing. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #3. |
| Topographical Map Penniman Works H.V.C. No. 2, Sheet 24 | January 1916 | Engineering topographical map. The original is located in the map room at USN CAX Maintenance Building. Revised 12/31/18 adding U.S. Penniman Layout. Revised 8/1/42 adding Colonial National Historical Parkway. Copy located in Map Tube #1. |
| Key Map of Penniman Property H.V.C. No. 8 | 14 December 1917 | Engineering site map. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #1. |
| Map of U.S. Penniman Shell Loading Plant H.V.C. No. 9 | 22 January 1918 | Engineering site map. The original is located in the map room at USN CAX Maintenance Building. Revised 22 March 1918 and 29 March 1918. Copy located in Map Tube #1. |

Table 6.2
 Penniman Shell Loading Plant
 Maps and Diagrams Table

| MAP NAME OR TITLE | DATE | COMMENTS |
|--|-------------------|---|
| Map of Vicinity of Penniman Plant H.V.C. No. 6 | 21 September 1918 | Engineering site map. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #1. |
| Map-358. Topography at Septic Tank for Plastered Houses. Topography at Septic Tank for Camp & Village. | 11 February 1918 | Engineering topographical drawing. The original is located in the map room at USN CAX Maintenance Building. Shows detail of underground septic systems for these areas. Copy located in Map Tube #5. |
| Real Estate Summary Map, Naval Supply Center Cheatham Annex. Y & D Drawing No. 980058. | 3 December 1980 | Real estate map (first of three in series). These maps (Y&D Nos. 980058, 980059, and 980060) provide the most detailed metes and bounds for the USN CAX property available to date, as well as those for the fuel farm area. Copy located in Map Tube #6. |
| Real Estate Summary Map, Naval Supply Center Cheatham Annex. Y & D Drawing No. 980059. | 3 December 1980 | Real estate map (second of three in series). These maps (Y&D Nos. 980058, 980059, and 980060) provide the most detailed metes and bounds for the USN CAX property available to date, as well as those for the fuel farm area. Copy located in Map Tube #6. |
| Real Estate Summary Map, Naval Supply Center Cheatham Annex. Y & D Drawing No. 980060. | 3 December 1980 | Real estate map (third of three in series). These maps (Y&D Nos. 980058, 980059, and 980060) provide the most detailed metes and bounds for the USN CAX property available to date, as well as those for the fuel farm area. Copy located in Map Tube #6. |
| Map of Cheatham Annex Naval Supply Center, Norfolk | January 1991 | Engineering site map. The original is located in the map room at USN CAX Maintenance Building. Copy located in Map Tube #1. |
| U.S. Naval Supply Center Cheatham Annex Site, 1918 Photograph Coverage. | 17 July 1998 | AutoCAD site map. This site map graphically depicts the coverage of the twelve 1918 panoramic photographs overlaid onto the digitized engineering drawings dating from the WWI era. Copy located in Map Tube #6. |
| USNSC Cheatham Annex Site 5" and 6" C.S. Shell Specifications, Circa 1918. | 17 July 1998 | AutoCAD engineering drawing. This diagram details the shell and marking specifications for the 5-inch and 6-inch common steel shells identified on Penniman inventory lists from 1918. These shells were loaded with FM smoke and HS mustard during the WWI era. Copy located in Map Tube #6. |

Table 6.2
 Penniman Shell Loading Plant
 Maps and Diagrams Table

| MAP NAME OR TITLE | DATE | COMMENTS |
|--|--------------|--|
| Penniman Shell Loading Plant, Weston Ordnance Expert Areas of Concern. | 17 July 1998 | AutoCAD site map. This site map depicts the areas of concern identified by the Weston CBW munitions expert after reviewing the 1918 panoramic photographs. These areas are overlaid in red onto a base map with WWI era engineering drawing information detailed in cyan and present day conditions detailed in black. Copy located in Map Tube #6. |
| Penniman Shell Loading Plant Overall Site Map, Drawing 1, Sheet 1 of 3. | 17 July 1998 | AutoCAD site map with transparency overlay. This map depicts the entire Penniman Shell Loading Plant Site, including the former CAX fuel farm area, Jones Pond, and the Penniman production areas. WWI era engineering drawing information is detailed in cyan and present day conditions are detailed in black. A transparency overlay contains digitized information from aerial photographs taken in 1937, 1942, 1955, 1959, 1971, 1992, 1994, and 1998. Each year is presented in a different color. Sheets 2 and 3 in this series detail blow-up portions of this map. Copy located in Map Tube #6. |
| Penniman Shell Loading Plant, duPont's "D" Plant and TNT Plant, Drawing 1, Sheet 2 of 3. | 17 July 1998 | AutoCAD site map with transparency overlay. This map depicts a blow-up portion of sheet 1 from this 3 sheet series, primarily covering the TNT plant and what is believed to be DuPont's "D" plant shell loading facility (north of Sanda Avenue). A transparency overlay contains digitized information from aerial photographs taken in 1937, 1942, 1955, 1959, 1971, 1992, 1994, and 1998. Each year is presented in a different color. WWI era engineering drawing information is detailed in cyan and present day conditions are detailed in black. Copy located in Map Tube #6. |
| Penniman Shell Loading Plant, duPont's Penniman "G" Plant, Drawing 1, Sheet 3 of 3. | 17 July 1998 | AutoCAD site map with transparency overlay. This map depicts a blow up portion of sheet 1 from this 3 sheet series, primarily covering what is believed to be duPont's "G" plant shell loading facility (south of Sanda Avenue). A transparency overlay contains digitized information from aerial photographs taken in 1937, 1942, 1955, 1959, 1971, 1992, 1994, and 1998. Each year is presented in a different color. WWI era engineering drawing information is detailed in cyan and present day conditions are detailed in black. Copy located in Map Tube #6. |

Table 6.2
Penniman Shell Loading Plant
Maps and Diagrams Table

| MAP NAME OR TITLE | DATE | COMMENTS |
|--|--------------------------------------|--|
| Penniman Shell Loading Plant Overall Site Map, Drawing 1, Sheet 1 of 3. | 17 July 1998 revised 16 July 1999 | AutoCAD site map. This map depicts the entire Penniman Shell Loading Plant Site, including the former CAX fuel farm area, Jones Pond, and the Penniman production areas. WWI era engineering drawing information is detailed in cyan and present day conditions are detailed in black. Sheets 2 and 3 in this series detail blow up portions of this map. Copy located in Map Tube #6. |
| Penniman Shell Loading Plant, duPont's "D" Plant and TNT Plant, Drawing 1, Sheet 2 of 3. | 17 July 1998 revised 16 July 1999 | AutoCAD site map. This map depicts a blow-up portion of sheet 1 from this 3 sheet series, primarily covering the TNT plant and what is believed to be duPont's "D" plant shell loading facility (north of Sanda Avenue). WWI era engineering drawing information is detailed in cyan and present day conditions are detailed in black. Copy located in Map Tube #6. |
| Penniman Shell Loading Plant, duPont's Penniman "G" Plant, Drawing 1, Sheet 3 of 3. | 17 July 1998 revised 16 July 1999 | AutoCAD site map. This map depicts a blow up portion of sheet 1 from this 3 sheet series, primarily covering what is believed to be duPont's "G" plant shell loading facility (south of Sanda Avenue). WWI era engineering drawing information is detailed in cyan and present day conditions are detailed in black. Copy located in Map Tube #6. |

6.3 Aerial Photographs Listing

Table 6.3 lists the currently available aerial photographs which cover the USN CAX property and Penniman Shell Loading Plant Site. These aerial photographs are all contained in the U.S. EPA EPPIC study.

Table 6.3
Penniman Shell Loading Plant
Aerial Photographs Table

| PHOTOGRAPH TITLE | DATE FLOWN | COMMENTS |
|--|----------------|---|
| USN Supply Center - Cheatham Annex Western Portion | 1 January 1998 | Frame #1-5, 1 of 4, 1" = 190 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Western Portion | 1 January 1998 | Frame #1-7, 2 of 4, 1" = 200 feet (from EPIC) |

Table 6.3
 Penniman Shell Loading Plant
 Aerial Photographs Table

| PHOTOGRAPH TITLE | DATE FLOWN | COMMENTS |
|--|------------------|--|
| USN Supply Center - Cheatham Annex Western Portion | 1 January 1998 | Frame #2-14, 3 of 4, 1" = 200 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Western Portion | 1 January 1998 | Frame #2-12, 4 of 4, 1" = 190 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Eastern Portion | 1 January 1998 | Frame #3-24, 1 of 14, 1" = 190 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Eastern Portion | 1 January 1998 | Frame #3-22, 2 of 14, 1" = 180 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Eastern Portion | 1 January 1998 | Frame #3-20, 3 of 14, 1" = 180 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Eastern Portion | 1 January 1998 | Frame #4-30, 4 of 14, 1" = 190 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Eastern Portion | 1 January 1998 | Frame #4-32, 5 of 14, 1" = 190 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Eastern Portion | 1 January 1998 | Frame #4-34, 6 of 14, 1" = 190 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Eastern Portion | 1 January 1998 | Frame #5-45, 7 of 14, 1" = 200 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Eastern Portion | 1 January 1998 | Frame #5-43, 8 of 14, 1" = 190 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Eastern Portion | 1 January 1998 | Frame #5-41, 9 of 14, 1" = 190 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Eastern Portion | 1 January 1998 | Frame #5-39, 10 of 14, 1" = 190 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Eastern Portion | 1 January 1998 | Frame #6-49, 11 of 14, 1" = 190 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Eastern Portion | 1 January 1998 | Frame #6-51, 12 of 14, 1" = 200 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Eastern Portion | 1 January 1998 | Frame #6-53, 13 of 14, 1" = 200 feet (from EPIC) |
| USN Supply Center - Cheatham Annex Eastern Portion | 1 January 1998 | Frame #6-55, 14 of 14, 1" = 190 feet (from EPIC) |
| USN Supply Center - Cheatham Annex | 6 March 1994 | Frame #169. 1"=650 feet (from EPIC) |
| USN Supply Center - Cheatham Annex | 6 March 1994 | Frame #169. 1"=400 feet (from EPIC) |
| USN Supply Center - Cheatham Annex | 8 July 1992 | Frame #57. 1"=620 feet (from EPIC) |
| USN Supply Center - Cheatham Annex | 8 July 1992 | Frame #55. 1"= 400 feet (from EPIC) |
| USN Supply Center - Cheatham Annex | 27 June 1960 | Frame #80. 1"=4,380 feet (from EPIC) |
| USN Supply Center - Cheatham Annex | 20 October 1959 | Frame #181. 1"= 680 feet (from EPIC) |
| USN Supply Center - Cheatham Annex | 21 November 1955 | Frame #70. 1"=500 feet (from EPIC) |
| USN Supply Center - Cheatham Annex | 21 November 1955 | Frame #24. 1"=300 feet (from EPIC) |
| USN Supply Center - Cheatham Annex | January 1942 | Frame #20-M34. 1"= 660 feet (from EPIC) |
| USN Supply Center - Cheatham Annex | January 1942 | Frame #20-M35. 1"= 650 feet (from EPIC) |
| USN Supply Center - Cheatham Annex | January 1942 | Frame #20-M34. 1"=160 feet (from EPIC) |
| USN Supply Center - Cheatham Annex | 17 April 1937 | Frame #177. 1"=360 feet (from EPIC) |

6.4 1918 Panoramic Photographs Listing

Table 6.4 lists the currently available 1918 panoramic photographs and associated interpretations conducted by WESTON® SATA. The originals of these photographs are located at the Hagley Museum and Library, Wilmington, DE.

Table 6.4
 Penniman Shell Loading Plant
 1918 Panoramic Photographs Table

| PHOTOGRAPH TITLE | DATE | COMMENTS |
|--|------|--|
| Penniman, VA Shell Loading Plant, P.O. 98-115, 69.161.3.1 | 1918 | Hagley Museum and Library. Photograph #1 of 12 panoramic photographs taken from the top of the fire suppression water tank. |
| Penniman, VA Shell Loading Plant, P.O. 98-115, 69.161.3.2 | 1918 | Hagley Museum and Library. Photograph #2 of 12 panoramic photographs taken from the top of the fire suppression water tank. |
| Penniman, VA Shell Loading Plant, P.O. 98-115, 69.161.3.3 | 1918 | Hagley Museum and Library. Photograph #3 of 12 panoramic photographs taken from the top of the fire suppression water tank. |
| Penniman, VA Shell Loading Plant, P.O. 98-115, 69.161.3.4 | 1918 | Hagley Museum and Library. Photograph #4 of 12 panoramic photographs taken from the top of the fire suppression water tank. |
| Penniman, VA Shell Loading Plant, P.O. 98-115, 69.161.3.5 | 1918 | Hagley Museum and Library. Photograph #5 of 12 panoramic photographs taken from the top of the fire suppression water tank. |
| Penniman, VA Shell Loading Plant, P.O. 98-115, 69.161.3.6 | 1918 | Hagley Museum and Library. Photograph #6 of 12 panoramic photographs taken from the top of the fire suppression water tank. |
| Penniman, VA Shell Loading Plant, P.O. 98-115, 69.161.3.7 | 1918 | Hagley Museum and Library. Photograph #7 of 12 panoramic photographs taken from the top of the fire suppression water tank. |
| Penniman, VA Shell Loading Plant, P.O. 98-115, 69.161.3.8 | 1918 | Hagley Museum and Library. Photograph #8 of 12 panoramic photographs taken from the top of the fire suppression water tank. |
| Penniman, VA Shell Loading Plant, P.O. 98-115, 69.161.3.9 | 1918 | Hagley Museum and Library. Photograph #9 of 12 panoramic photographs taken from the top of the fire suppression water tank. |
| Penniman, VA Shell Loading Plant, P.O. 98-115, 69.161.3.10 | 1918 | Hagley Museum and Library. Photograph #10 of 12 panoramic photographs taken from the top of the fire suppression water tank. |

Table 6.4
Penniman Shell Loading Plant
1918 Panoramic Photographs Table

| PHOTOGRAPH TITLE | DATE | COMMENTS |
|---|--------------------|---|
| Penniman, VA Shell Loading Plant, P.O. 98-115, 69.161.3.11 | 1918 | Hagley Museum and Library. Photograph #11 of 12 panoramic photographs taken from the top of the fire suppression water tank. |
| Penniman, VA Shell Loading Plant, P.O. 98-115, 69.161.3.12 | 1918 | Hagley Museum and Library. Photograph #12 of 12 panoramic photographs taken from the top of the fire suppression water tank. |
| Roy F. Weston, Inc. 1998. Cheatham Annex Site - Labeled 1918 Photographs. Delran, NJ. 21 October. | 21 October 1998 | This series includes all 12 panoramic photographs taken in 1918. These photographs have been digitally scanned and labeled with building and structure labels derived from the WWI era engineering drawings of the Penniman Shell Loading Plant. See Section 2.3 of this DASR for a summary of these photographs. |
| Roy F. Weston, Inc. 1999. Penniman Shell Loading Plant - LHP 1918 Panoramic Photograph Review. Delran, NJ. 3 March. | 3 March 1999 | This series includes all 12 panoramic photographs taken in 1918. These photographs have been digitally scanned and labeled with building and structure labels derived from the WWI era engineering drawings of the Penniman Shell Loading Plant. In addition, the areas of concern identified by the WESTON® CBW munition expert have also been labeled and identified on these photographs. See Section 2.3 of this DASR for a summary of these photographs. |

- ATTACHMENTS:
- 1 – Analytical Data from Previous Investigations (10 March 1989 and 11 November 1994 Reports)
 - 2 – Analytical Data from Previous Investigations (19 September 1997, 14 May 1999, and 9 August 1999 Reports)
 - 3 – Maps and Diagrams Tube #1
 - 4 – Maps and Diagrams Tube #2
 - 5 – Maps and Diagrams Tube #3
 - 6 – Maps and Diagrams Tube #4
 - 7 – Maps and Diagrams Tube #5
 - 8 – Maps and Diagrams Tube #6