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SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN NSY PORTSMOUTH VA
9/1/1991
KEYSTONE ENVIRONMENTAL RESOURCES

SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN ATLANTIC WOOD INDUSTRIES, INC. PORTSMOUTH, VIRGINIA SITE

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1.0 INTRODUCTION

Atlantic Wood Industries, Inc. (AWI) is performing a Remedial Investigation (RI) and Feasibility Study (FS) at their Portsmouth, Virginia facility. The RI/FS is intended to determine the nature and extent of contamination related to the wood preserving facility. Components of the field investigation conducted as part of the RI included sampling and analysis of soils, groundwater, sediment, surface water, and air over the site, and a determination of aquifer properties.

Data collected during the RI sampling events were presented to the U.S. EPA - Region III (EPA) and the Virginia Department of Waste Management (VDWM) as part of the draft Remedial Investigation Report (September 1990). The draft RI Report presented a summary and evaluation of the data collected. Based upon a review of this data, EPA determined that additional RI tasks were required to fully characterize the nature and extent of contamination. In a letter dated June 21, 1991, EPA provided a general suggested outline for additional tasks to fulfill the data requirements. This Supplemental Remedial Investigation Work Plan describes the additional sampling and analysis required to fulfill the data needs identified by EPA, in the June 21, 1991 letter. All sampling and analysis described in this Supplemental Work Plan are within the additional work provisions set forth in the Administrative Order of Consent, Article VIIIC.9. and not part of the work presented in the RI/FS Work Plan (March 1988) for the site.

1.1 Scope of Work

The work proposed within this Supplemental RI Work Plan has been developed in order to achieve the following goals:

- o Collect additional physical and chemical soils data which will be used to support any potential modelling efforts used to generate soil cleanup levels;
- o Determine the quality and extent of groundwater influence on offsite areas adjacent to the AWI site;

- Collect additional data which will better define the vertical permeability of the clay layer which separates the Columbia and Yorktown-Eastover aquifers;

- Confirm the groundwater flow direction and quality of the Yorktown-Eastover aquifer;

- Determine the extent of the clay confining layer in the historical disposal area; and

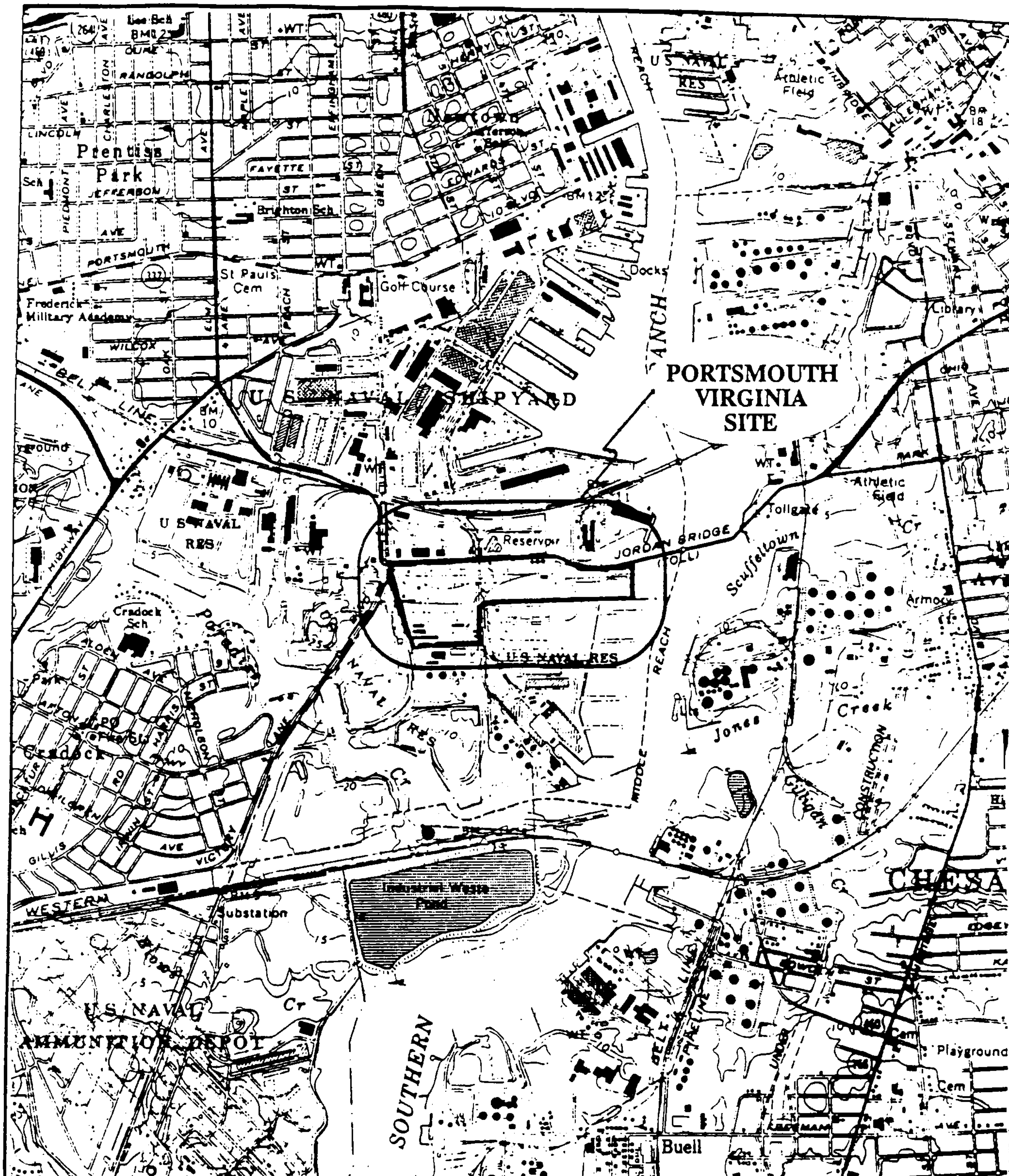
- Collect data that would ultimately be required during the Remedial Design phase.

The work proposed for this effort includes installing and sampling new shallow and deep monitoring wells in areas along Elm Avenue, Navy property south of the treatment area, and Portsmouth City School Board bus yard, conducting a pump test in the eastern area of the site, measuring site water levels to determine the extent of tidal influence, and sampling existing Navy landfill and SPSA monitoring wells (if available) to provide regional groundwater quality.

1.2 Site Location

The AWI facility currently occupies 47.5 acres of land in Portsmouth, Virginia (Figure 1-1). The site is bounded on the north by Elm Avenue and the United States Norfolk Naval Shipyard facilities, and on the west by a Virginia Electric Power Company right-of-way. To the south of the site is the south annex of the U.S. Navy Norfolk Naval Shipyard and land occupied by the Portsmouth City School Board. AWI is bounded on the east by the Southern Branch of the Elizabeth River. The site is split into eastern and western portions by the Norfolk and Portsmouth Beltline R.R. and Burtons Point Road. The eastern portion of the site contains the wood processing facilities and wood storage areas. The western portion of the site is used for the storage of treated and untreated wood.

West of the site, just beyond the 60 foot VEPCO power line right-of-way, there are several closed landfills and chemical waste pits including an underground waste oil



REFERENCE: NORTHFOLK SOUTH
U.S.G.S. QUADRANGLE

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SCALE (FEET)
0 2000

FIGURE 1-1

LOCATION
OF SITE

ATLANTIC WOOD INDUSTRIES, INC.

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tank. This property is owned and operated by the U.S. Navy's Norfolk Naval Shipyard. The Navy also operates a disposal landfill area south of the property owned by the Portsmouth City School Board. The Norfolk Veneer Mill is located immediately north across Elm Avenue from the eastern portion of the AWI facility. Although no wood treatment is currently performed at the veneer mill, a past owner, Wyckoff, may have performed pressure treating of wood using similar preservatives as those used by AWI. In addition, there are or were at least three wood treating facilities located upstream from AWI on the Elizabeth River: Eppinger and Russell, Republic Creosoting, and Bernuth Lembcke. These facilities handled many of the same wood treatment chemicals that have been used by AWI. Wood treating operations were performed at the first two facilities (which are currently inactive), and the third facility is an active terminal used for handling creosote. Eppinger and Russell discontinued treating wood in about 1980, and Republic Creosoting stopped treating wood in December 1971.

1.3 Site History

The original plant was constructed in 1926 by the Savannah Creosoting Company. The site has been used for various purposes during its history including a possible coal tar refinery, creosote treating plant, pentachlorophenol treating plant, and storage of treated lumber. Wood was never treated with chromated copper arsenate (CCA) at this site, although some CCA-treated wood is stored onsite. Before 1926, the grounds were undeveloped except for possibly a saw mill; however, the existence of this has not been confirmed. A review of maps showing the historic shoreline of the west bank of the Southern Branch of the Elizabeth River suggests that at least a portion of the AWI site was elevated with fill. Between 1978 and 1986, a significant amount of fill material was added to the general area, and filling activity occurred south of this area from 1944 to approximately 1971, in an inlet located along the southeastern site boundary (EPIC, 1989).

From 1926 until 1944, the site was operated as the Savannah Creosoting Company and was owned by the Savannah Creosoting Company, Inc., a Maryland corporation. On December 28, 1944, the name of the corporation was changed to Atlantic Creosoting Company, Inc. On July 21, 1978, the name of the corporation was changed to Atlantic Wood Industries, Inc. Finally, on October 25, 1985, the name of the corporation was changed to Atlantic Wood Assets, Inc. On June 19, 1985, a Georgia corporation named Atlantic Interim, Inc. was incorporated. Its name was changed on November 21, 1985 to Atlantic Wood Industries, Inc. On November 30, 1985, the operating assets of Atlantic Wood Assets, Inc., including the Portsmouth, Virginia wood preserving facility, were sold to Atlantic Wood Industries, Inc., the Georgia corporation. Since that time, Atlantic Wood Industries, Inc., the Georgia corporation, has owned and operated the plant. Since January 1, 1986, the site has been owned by AWI employees under an employee stock ownership plan.

The original Savannah Creosoting Company Site consisted of two of the existing four wood treatment retorts, the existing office building, several existing maintenance and storage buildings and the above-ground tank farm that was located adjacent to Elm Avenue (See Figures 1 and 2 of the RI/FS Work Plan, ESC, March 1988). The above-ground tank farm consisted of four storage tanks, installed in or about 1940, and were open top steel construction. These tanks were originally used to store wood preserving chemicals, including creosote. In the past, two of the four tanks were used occasionally to store process water which may have contained pentachlorophenol. Two of these tanks were removed in 1985, and the last two were removed by June 1986. Although the tanks have been removed, valves and piping associated with the tanks still exist and can be used to visually reconstruct the locations of the tanks.

The four tanks west of the retorts were previously associated with a tar distillation unit that was located east of the office building. There was also a shallow concrete basin associated with the tar distillation unit. The tar distillation unit was disassembled in the 1940s. The basin was filled in and the four tanks were moved to their present location. Portions of the retaining wall around the basin are currently exposed and can be examined. Additionally, from about 1940 until October 1985, there was a concrete process water recycle basin located immediately north of the retort building. This unit was used to recover preservative from process water and until 1972 some excess process water was discharged to an area immediately south of the railroad spur that juts out into the Southern Branch of the Elizabeth River.

AWI continued to use the unit to recover preservative and to recycle process water until it was removed in August 1985.

Retorts I and II were the original wood treatment units at the site and have been in use since approximately 1926. Both retorts were primarily used for creosote treatments, but from the late 1950s through the early to mid 1960s a pentachlorophenol-related product known as creo-penta may also have been used. Retort III was constructed in 1959 and was used for creosote treatment only. Pentachlorophenol (PCP) was first used at the site in about 1972 in Retort I. For approximately two years, the plant operator used Retort I at times for pentachlorophenol and other times for creosote treatments. In 1974, Retort IV was constructed and dedicated to PCP treatments. At this time, Retort I was used for creosote treatment only.

Until the early 1970s, operations included an open steaming process (the introduction of live steam into the retort to heat and condition the wood) which generated excess amounts of process water. Closed steaming (generating steam in the retort by means of steam heating coils covered with water) was instituted in the early 1970s to reduce the amount of process water handled.

In 1974, when Retort IV was constructed for PCP, a closed-loop recovery system was installed to recover PCP and process conditioning water for reuse. This operation ceased in 1985 when the use of PCP as a preservative was discontinued.

Until about 1985, the plant used a concrete closed-loop recovery system located just north of the retort building. This unit was used to recover creosote preservative and process conditioning water for reuse. This system was removed in 1985, but the process is now handled by a closed-loop recovery system located in the retort building.

When the Clean Water Act was implemented in the early 1970s, the plant was required to stop discharging effluent from the oil/water separator. At that time, a liquid incineration unit known as a "Liquidator" was constructed. This unit was fired with No. 6 fuel oil and incinerated excess process water that was previously discharged through the oil/water separator into the river. AWI stopped using the Liquidator unit in 1984.

From approximately 1966 until 1982, an area of the property was used as a disposal area. This area is located in the southwest corner of the property west of Burtons Point Road. This area, termed the historical disposal area, may contain up to 20,000 cubic feet of general debris, steel bands, untreated and treated wood waste, and cylinder and tank clean out material, which may contain creosote and pentachlorophenol.

2.0 BACKGROUND

The following sections provide a summary of site conditions for each sampling media as determined through the Remedial Investigation. Presentation of this data forms the basis for collection of additional data to satisfy data gaps.

2.1 Hydrogeology/Geology

A review of regional and site geology was conducted to evaluate the geologic setting and depositional environments in the vicinity of the site. The City of Portsmouth, as well as the surrounding land areas, lies within the Atlantic and Gulf Coastal Plain Groundwater Region. The southeastern Virginia area is underlain by approximately 2,000 to 4,000 feet of unconsolidated sedimentary strata, which consist mostly of gravel, sand, and clay. These deposits range in age from Cretaceous to Holocene, and overlie consolidated bedrock at depth.

According to Barker and Bjorken (1978), three prominent geomorphic features are present in this portion of southeastern Virginia. These are the Churchland Flat, the Deep Creek Swale, and the Fentress Rise. The Deep Creek Swale has a north-south trend, with the Southern Branch of the Elizabeth River near the center of the swale. The swale gradually widens to the south, and reaches its maximum width near the confluence of the Deep Creek and Southern Branch. According to Barker and Bjorken (1978), the Deep Creek swale is underlain by sand of the Sand Bridge Formation except for alluvial sands and organic silts that occur in tidal basins along the Elizabeth River. Abutting the Deep Creek Swale to the west is the Churchland Flat. This feature has a maximum elevation of 19 feet and slopes to the northeast less than 1.0 foot per mile (Barker and Bjorken, 1978). The Churchland Flat is also underlain by sands of the Deep Bridge Formation. To the east of the Deep Creek Swale is the Fentress rise. The Portsmouth area is underlain by sediments of Pleistocene age, which are generally the youngest major deposits. Holocene age alluvium is present as estuarine-beach and tidal-marsh deposits; however, these deposits are relatively scattered spatially within the Portsmouth area. The uppermost Pleistocene deposits consist of unconsolidated sand, silt and some gravel, and are part of the Columbia Group. Below these deposits are strata associated with the Cheasapeake Group. The unconsolidated strata in this area of Virginia dip gently and generally thicken to the east.

Based on the results from the various borings and monitoring wells drilled as part of the RI and prior investigations, three lithologic zones and two water-bearing zones (aquifers) have been identified beneath the AWI site. These materials are termed as follows:

Upper Water-Bearing Zone (Columbia Aquifer) - the uppermost soil is a brown to gray, organic-rich mixture of clayey silt and fine to medium sand, with a thickness ranging between 18 to 23 feet. This layer is continuous throughout the site.

Semi-Confining Unit - immediately underlying the Columbia Aquifer is a layer of gray clay, which acts as a semi-confining unit. This layer is often silty and contains shell fragments. This lower semi-confining clay layer was found to be continuous beneath the site. The total thickness of this unit is unknown; however, the thickness (as determined by three borings) was found to range between 8 and 27 feet.

Lower Water-Bearing Zone (Yorktown-Eastover Aquifer) - the clay unit overlies a fine to medium to coarse grained sand layer. Based on the data collected, as well as regional geologic reports, this unit is the Yorktown-Eastover Aquifer.

Evaluation of hydrogeology for the AWI site was developed primarily from installation of monitoring wells at varied depths across the site, and from stratigraphic information obtained during the soil boring program. Observations of water levels in wells installed as part of the RI, as well through the existing well network, provided data relative to the position of the potentiometric surface, water level fluctuations, and groundwater gradients across the site. Soil boring data was utilized to evaluate site hydrogeologic transmissive units and to characterize the lithology and geometry of the units.

The two uppermost aquifers encountered at the AWI site are composed of two water-bearing zones, which have been termed the Columbia Aquifer and Yorktown-Eastover Aquifer. The Columbia Aquifer is considered to extend from the ground surface to the top of the clay layer (Yorktown clay). This aquifer is not known to be a drinking water source. Groundwater is present at the site under unconfined conditions in the shallow zone (15 to 20 feet), and under semi-confined to confined conditions in the underlying sand zone (Yorktown-Eastover).

An assessment of the local hydrogeologic characteristics was made possible by the evaluation of groundwater data collected during the period between January 1989 and February 1990. Water levels measured at each of the wells during the various RI sampling events or site visits was used to calculate groundwater elevations.

Monitoring wells penetrating the shallow zone (Columbia Aquifer) indicate a range in water levels from elevations of approximately 0.18 feet to 10.07 feet mean sea level (msl). Groundwater elevation data for the shallow monitoring wells ("100"-series) screened in the upper silt, clay, and sand zone indicate a varied flow system, with several directions of groundwater flow. As indicated in the groundwater potentiometric contour figures presented in the RI Report, there are two prominent flow systems present at the site. Within the eastern portion of the site, groundwater flow is mainly to the east, toward the Southern Branch of the Elizabeth River. Within the western portion of the site, a groundwater mound is present, such that groundwater flow in this area is radial. The variation in flow directions or presence of two flow systems is believed to be due to: 1) the discontinuous nature of the deposits, which results in materials of varying hydraulic conductivity and interconnection, and 2) recharge of the groundwater system by the introduction of water from site drainage features.

Due to the presence of the groundwater mound in the western portion of the site, a wide range of groundwater elevations was obtained. In general, the groundwater potentiometric surface was the highest in wells MW-33 and MW-34, which are located centrally within this area. Monitoring wells along the periphery of the western site were found to be an average of two to three feet lower than wells MW-33 and MW-34. Groundwater movement in the shallow aquifer does not appear to be controlled or affected by the nearby shallow surface drainage feature, since the groundwater elevations are typically below the base of the nearby drainageways.

Contours of the potentiometric surface in the eastern portion of the site show that the overall direction of groundwater flow across the site is to the east. The hydraulic gradient measured during each of the sampling dates is extremely low, and ranges from 0.0059 ft/ft to 0.0068 ft/ft. In the western portion of the site, the hydraulic gradient was found to vary between 0.010 ft/ft and 0.0094 ft/ft.

Due to the presence of only three monitoring wells screened totally within the lower water-bearing zone (Yorktown-Eastover Aquifer - "200"-series wells), no detailed potentiometric surface map could be developed; however, regional geologic data indicates that flow within this system would be toward the east, discharging into the South Branch of the Elizabeth River.

Insitu rising- and falling-head hydraulic conductivity tests were performed at ten well locations across the site. Horizontal hydraulic conductivities were determined only for those monitoring wells screened within the shallow water-bearing zone (Columbia Aquifer). Horizontal hydraulic conductivity ranged from 1.3×10^{-2} cm/sec to 1.9×10^{-4} cm/sec. Average horizontal hydraulic conductivity value for the shallow zone was calculated to be 4.3×10^{-3} cm/sec using the Hvorslev method and 3.3×10^{-3} cm/sec using the method of Bouwer and Rice.

Based on water level measurements obtained during previous monitoring efforts, the direction and rate of groundwater movement can be approximated. Groundwater velocity calculations for the shallow Columbia Aquifer were based on an average hydraulic conductivity value of 4.3×10^{-3} cm/sec and an estimated effective porosity of 30 percent. Using a mean hydraulic gradient of 0.0062 ft/ft, an average linear velocity calculated for flow beneath the site in the eastern area is 0.25 ft/day (91 ft/year). This calculation represents a conservatively high estimate of the rate of groundwater migration of any site-related constituents in groundwater.

2.2 Groundwater Quality

Groundwater analytical data was generated during the RI through the sampling of 27 monitoring wells which are located primarily around the perimeter of the site. Analytical results obtained from several rounds of sampling indicate that degraded groundwater quality is present within two areas of the site, the eastern portion of the site which contains the treating operations and the southwestern portion of the site which is influenced by the historical disposal area. Presence of potential constituents of concern is mainly limited to those wells monitoring groundwater quality of the uppermost water-bearing zone (Columbia Aquifer). In general, there are no monitoring wells installed at the site within the upper aquifer (Columbia) which can be considered upgradient of the entire site, because of the varied flow system and the presence of two distinct groundwater mounds.

In assessing the rate and potential extent of dissolved contaminant migration at the AWI site, an evaluation was made of the distribution of contaminant concentrations to delineate a contaminant plume attributable to the site. In general, the groundwater contaminant plumes associated with the AWI site are relatively small and occur as isolated areas within the site. This may be the result of several factors:

- The layout of the AWI wood treating facility would not lead to large areas of groundwater contamination because treating operations took place in a centralized area of the site. The other areas where treated wood constituents could have been introduced into the groundwater system are limited by the length of time in which they were operated and the relatively small size of these areas. These areas would have tended to act as small, isolated source areas if constituents had been introduced.

- Different solubilities are associated with the organic and inorganic contaminants of concern. The differences in solubility products would control their ability to migrate within the aquifer system.

- The hydrogeology of the shallow aquifer would retard the migration of site constituents through the presence of small lenses or layers (silty or clayey materials) of low hydraulic conductivity within the sandier matrix of the Columbia Aquifer.

- A low hydraulic gradient exists at the site.

- o The presence of the underlying low permeability layer (clay) will prevent the rapid migration of constituents.

Acid extractable phenolic compounds, including pentachlorophenol (PCP), were detected in both the western and eastern regions of the site. Several acid extractable compounds (for example 2,4,6-trichlorophenol, 2,4-dimethlypehenol, 2-methylphenol, 4-methylphenol and pentachlorophenol) were detected in the groundwater system. In general, however, pentachlorophenol was the most dominant acid extractable compound present in groundwater.

Pentachlorophenol was detected in seven of the twenty-three shallow monitoring wells; these wells are located in the area of the treating plant and former tank farm (wells MW-114 and MW-115A), and the historical disposal area (wells MW-101A, MW-102, and MW-106). In addition, PCP was also detected in wells MW-112 and MW-117.

Within the historical disposal area of the site (southwest corner), the concentration of PCP was the most elevated in well MW-106 (490 ug/L and 350 ug/L). Wells MW-101A and MW-102, which are downgradient of this feature, show reduced PCP concentrations. The highest concentration of PCP was measured in well MW-112, which is located in the northeast corner of the western area of the site. In the area of the former treating plant and tank farm, PCP was detected in wells MW-114 (4 ug/L - second round only) and 30 ug/L in well MW-115A. Pentachlorophenol was not detected in the monitoring well immediately downgradient of the treating plant; however, it was detected during both sampling rounds in well MW-117. The presence of PCP in this well is probably the result of process related constituents migrating along the former process water discharge pipe and associated drop out boxes, rather than migration through the groundwater system.

Pentachlorophenol was not detected in any of the deep wells monitoring the Yorktown-Eastover aquifer.

Organic constituents (polycyclic aromatic hydrocarbons (PAHs) and other polycyclic aromatics) were detected in several of the monitoring wells at the site. The elevated concentrations of PAHs measured in the monitoring wells are indicative of creosote and/or coal tar residuals.

Concentrations of total PAH constituents were generally greatest in those wells which monitor the shallow groundwater zone in the areas of the treating plant and the historical disposal area. Polycyclic aromatic hydrocarbon concentrations ranged from at or below detection limits to 12,212 ug/L. In general, the wells located downgradient from the treating plant show the most elevated concentrations for the shallow groundwater zone. With the exception of well MW-117, total PAH concentrations were found to decrease in the downgradient direction. Concentrations of PAHs were also noted in several of the wells monitoring groundwater conditions around and downgradient of the historical disposal area. The most elevated PAH concentrations for wells monitoring this area were found in wells MW-106 and MW-102. Polycyclic aromatic hydrocarbon concentrations in wells MW-100 and MW-101A, which are the downgradient wells closest to the historical disposal area, have both shown PAH concentrations slightly above or below detection limits for both rounds of sampling.

PAHs were not detected in any of the deep wells monitoring the Yorktown-Eastover aquifer.

Several volatile aromatic compounds (VOCs) of potential concern were detected in site groundwater. These compounds include benzene, toluene, ethlybenzene, and xylenes (BTEX) and styrene. VOCs were detected in 11 of the 23 shallow monitoring wells, with the majority of the VOCs being detected in wells located within the eastern half of the site. Volatile constituents were also detected within several of the shallow monitoring wells located within the southern half of the western area of the AWI site. Toluene was detected in two of the deep wells which were sampled during February 1990. Concentrations of 5.2 ug/L and 23.1 ug/L were observed in wells MW-203 and MW-204, respectively, which does not exceed the proposed MCL.

Inorganic constituents were detected in groundwater samples throughout the study area. The presence of inorganics in groundwater is a natural phenomenon and is a direct function of soil chemistry and the physical-chemical behavior of the element of concern. The trace elements chromium, copper, and arsenic were not used at the site as wood preservatives (as CCA), but some CCA treated wood has been stored on site.

Arsenic concentrations in the shallow groundwater ranged from below minimum detection levels to 876 ug/L. Using the recommended drinking water quality standard for Virginia as a basis for comparison, arsenic concentrations in four wells (MW-101A, MW-105, MW-106, and MW-119) were found to exceed this standard. With the exception of well MW-119, these wells are all located within the western portion of the site, and can be considered to be representative of groundwater conditions around the location of the former historical disposal area located in the southwestern portion of the site. Concentrations observed in well MW-119, located along the southern property border, may reflect an offsite source(s). In general, arsenic concentrations were found to be more elevated in those wells within the western portion of the site, and may reflect the presence of treated wood storage within this area of the property. Arsenic was detected in only one of the four deep wells monitoring the Yorktown-Eastover aquifer. Arsenic was detected in well MW-201 during the September sampling event (12.8 ug/L), which is slightly above the MCL.

Total chromium was not detected in any of the shallow or deep site monitoring wells.

Total copper concentrations in the shallow groundwater were consistent throughout the site, with only a small, isolated plume near well MW-120 being noted. Using the recommended drinking water quality standard for Virginia as a basis for comparison, copper concentrations in two wells (MW-120 and MW-122) were found to exceed this standard. Both of these wells are located along the southeastern boundary of the site, adjacent to the Navy property. In general, copper concentrations were found to be more elevated in those wells within the western

Copper (dissolved) was not detected in any of the deep wells monitoring the Yorktown-Eastover aquifer.

The concentration of zinc within the shallow groundwater system is fairly consistent throughout the site. Zinc concentrations in the shallow groundwater ranged from 7.2 ug/L to 9500 ug/L (adjacent to the Navy property). Zinc (dissolved) was detected in only one of the deep wells (MW-203 - 96.8 ug/L) monitoring the Yorktown-Eastover aquifer.

During the July 1989 sampling event, groundwater samples were collected and analyzed for the presence of dioxin/furan homologs from seven of the shallow monitoring wells (MW-102, MW-112, MW-114, MW-115, MW-116, MW-117, and MW-119). These wells were chosen based on the pentachlorophenol analytical results obtained from the first round of sampling, as well as the data from wells which were downgradient of the treating plant. The majority of dioxin/furan homologs were below detection limits for each of the samples.

2.3 Soils Quality

In general, PAHs and PCP were detected in the nine areas of the site in surface and subsurface soils. PCP was used at the site in the past and PAHs are constituents of creosote, which was also used in the wood treating processes at the site. The highest levels of PAHs were detected in the wood treatment and historic disposal areas. The highest levels of PCP at the site were also detected in the historic disposal area. PAHs detected in the wood storage area are most likely associated with the wood treatment processes conducted in this area. PAHs and PCP detected in the historic disposal area are probably associated with the historical disposal activities.

Although wood was never treated with chromated copper arsenate (CCA) at this site, concentrations of metals were highest in the wood storage yard and along the southeastern boundary of the site, adjacent to Navy property. Arsenic and copper were detected above background levels in the wood storage yard area. Zinc was mostly detected below background levels across the site except for area adjacent to Navy property. It is believed that the observed zinc, arsenic and copper

Navy property. It is believed that the observed zinc, arsenic and copper concentrations are related to the acetylene sludge that has been disposed of by the U.S. Navy in this area, since AWI has not used these constituents in their wood treating operation.

Analyses for polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) were performed on 43 soil samples collected during the site investigations. Twenty five of the samples were collected in the vicinity of the storm sewer line and eighteen samples were collected in other areas of the site. No samples contained detectable levels of 2,3,7,8-TCDD. Two samples contained detectable levels of 2,3,7,8-TCDF. The hexa-, hepta-, and octa- isomers of dioxins and furans were the most frequently detected isomers. TCDD (non-2,3,7,8 forms) was detected in only one sample and TCDF (non-2,3,7,8 forms) was not detected in any sample.

2.4 Sediment Quality

Sediment samples were collected from five locations at the site to characterize the extent of impact on these areas from wood treating operations. The areas that were characterized include a stormwater runoff ditch in the CCA and PCP treated wood storage area, a ditch along the western boundary of the site, a ditch at the southeast edge of the site which discharges into the Elizabeth River, the inlet receiving discharge from Outfall 002, and the Elizabeth River.

The highest concentrations of total detected PAH were present in the inlet sediment, increasing as the samples were collected closer to the river. The PAH concentrations in the inlet ranged from 511 mg/kg to 38,437 mg/kg. The highest concentrations of PCP and chromium were detected in the stormwater runoff ditch flowing out of the CCA and PCP treated wood storage area, with concentrations ranging from 7.2 mg/kg to 12.0 mg/kg and 53 mg/kg to 54 mg/kg, respectively. The concentrations of arsenic, copper, and zinc were highest in the southeastern ditch, which is adjacent to the Navy property, with maximum concentrations of 364 mg/kg, 1350 mg/kg, and 1890 mg/kg, respectively.

Sediment sampling of the Elizabeth River revealed that total detected PAH concentrations ranged from 1,059 mg/kg to 5 mg/kg. Generally, PAH concentrations decreased directly across the river bottom as distance from the site increased; however, upstream PAH concentrations in sediments were higher than downstream results. PCP was not detected in the river sediment samples. The presence of these constituents may be associated with other wood preserving facilities which operated in the vicinity of and upstream of the AWI site.

3.0 ADDITIONAL FIELD INVESTIGATION PROGRAM

The purpose of the Supplemental RI Work Plan is to address data gaps which have been identified by EPA and were not addressed by previous work conducted as part of the RI. The proposed work scope addresses monitoring groundwater conditions in the shallow (Columbia) and deeper (Yorktown-Eastover) aquifers in several areas of the site (treating plant and historic disposal area), as well as offsite groundwater quality. As described in detail in Sections 3.1 through 3.10 of this Supplemental Work Plan, additional sampling and analysis will consist of the following tasks:

- o Review groundwater flow direction(s) and quality from existing offsite monitoring wells to establish a database to provide a comparison to the AWI site and determine regional groundwater conditions,

- o Generate soil cleanup levels through additional data collection and modelling efforts,

- o Install and sample groundwater from two deeper monitoring wells (Yorktown-Eastover aquifer) within two areas of the AWI site,

- o Install and sample offsite monitoring wells at several locations along Elm Avenue to determine if radial groundwater flow has migrated toward the Navy yard or the SPSA property,

- o Define the lateral and vertical extent of the confining clay layer in the area of the historical disposal area and south into the Portsmouth City School Board bus yard,

- o Conduct a pumping test in the eastern portion of the AWI site to determine aquifer properties, and

- o Conduct continuous monitoring of site water levels in response to tidal changes.

All drilling, sampling, installation and backfilling procedures will be performed according to the approved procedures described in the Remedial Investigation/Feasibility Study Work Plan for the Atlantic Wood Industries, Inc. Site in Portsmouth, Virginia (ESC, March 1988).

Health and safety procedures outlined in the Health and Safety Plan (HASP) will be followed for all site activities and data will be validated in accordance with the Data Management/Date Validation Plan approved by EPA.

The following paragraphs will describe the specific methodologies to be used to meet the investigation objectives.

3.1 Regional Data Review

During the initial scoping of the RI/FS Work Plan (ESC, 1988) and data gathering activities, regional geologic information from sites surrounding the AWI site was gathered. This information included the Norfolk Naval Yard Part B Application and the Norfolk Naval Shipyard RCRA Facility Assessment (RFA - Site Summary for Areas 2, 3-7, and 9). Of particular interest to the AWI site are areas 3-7 (Sanitary Landfill) and 9 (acetylene waste lagoons). Based on discussions with Navy personnel, several monitoring wells have been installed around the perimeter of the Sanitary Landfill and are located west, southwest and south of the AWI property. Discussions between AWI and SPSA personnel indicate that there are several monitoring wells located on SPSA property west of the AWI site. Informal discussions between AWI personnel and the City of Portsmouth have also indicated the presence of groundwater monitoring wells in the area of the present Norfolk Veneer Mill. However, no detailed information is known about any of these wells.

Prior to conducting any further monitoring well installation at the site, AWI will review the available hydrogeologic and environmental investigations which have taken place in the vicinity of the AWI site, to provide a better understanding of the regional hydrogeology, especially groundwater flow directions and quality in relation to the AWI site. A review of these investigations and/or discussion with the various [illegible] basis for deciding whether additional offsite [illegible] whether existing offsite wells can be used to [illegible] at the AWI site. Items of particular [illegible] will include: 1) the location of monitoring wells [illegible] construction logs and diagrams indicating the [illegible] 3) aquifer hydraulic properties, including the [illegible] Columbia and Yorktown-Eastover aquifers, and [illegible] completion of the data review, a short summary [illegible] any changes to the field monitoring program [illegible] will be proposed. AWI suggests that a data [illegible] results of these offsite investigations.

[illegible]

[illegible] goals which will be protective of groundwater [illegible] Focussed Feasibility Study. In addition, it is [illegible] centrations over time to a point downgradient [illegible] future impacts to the river. It has been [illegible] to be performed by applying U.S. EPA's [illegible] odel (Multimed).

[illegible] emical (constituent) release from the site soils, [illegible] ort in the saturated and unsaturated zones, and [illegible] ace plume by a surface stream, such as the [illegible] ort of a constituent(s) released form the site is [illegible] responses of the constituent to a number of [illegible] gical processes the constituent encounters as it [illegible] sponses are incorporated as chemical-specific [illegible] ut data, such as source-specific and aquifer- [illegible] y the user, as well. After the environmental [illegible] nt(s) has been simulated, the model produces [illegible] downgradient of the site where potential [illegible] al receptors may occur.

The following functions of Multimed will be utilized for application to the Atlantic Wood site:

- o Simulation of leachate flux emanating from the source;
- o Steady-state and transient modelling of flow and transport in the unsaturated and saturated zones;
- o Transient state modelling in the saturated zone over time;
- o Deterministic and Monte Carlo simulations of modelling efforts;
- o Generation of random numbers for the Monte Carlo simulations; and
- o Performance of statistical analyses of the Monte Carlo simulations.

Prior to implementing the field investigation described in this Work Plan, Multimed will be used to determine interim soil clean-up goals. Some of the model inputs used in this initial run will be assumed values, where actual site-specific data is not available. After completion of the investigation, the Multimed will be run again using more site-specific data.

3.3 Determination of Offsite Groundwater Quality

Based upon the results of the regional hydrogeologic data review summarized in Section 3.1, additional offsite monitoring wells will be installed. The locations presented in Figure 3-1 are the minimum number of wells to be installed. If sufficient offsite wells cannot be located and/or utilized in the offsite areas previously mentioned, installation of additional wells may be necessary to fully determine the extent of an offsite groundwater contaminant plume.

Four of the proposed monitoring wells will be located on the U.S. Navy property along Elm Avenue. These wells are designated as MW-123, MW-124, MW-125, and MW-126.

Monitoring well MW-123 will be located north of existing well MW-112. This well location will be used to determine whether pentachlorophenol has migrated offsite and provide an indication of the effects of the radial flow pattern which has been observed in the western portion of the AWI site. This well will be completed as a shallow well and will monitor the Columbia aquifer.

Three shallow wells are proposed to monitor groundwater conditions in the area northeast of the AWI treating plant. These well designations are MW-124, MW-125 and MW-126, and they will monitor the Columbia aquifer.

Monitoring wells MW-130 and MW-131 will be located south of existing well MW-119. These well locations will be used to assess potential metals migration onto the site from the U.S. Navy property. These wells will be shallow wells, monitoring the Columbia aquifer.

Shallow monitoring wells will be constructed using 2-inch inside diameter threaded flush joint PVC screen and riser. The screened interval for each well will be 10 feet in length, with 0.010-inch slots. The monitoring interval will be set so that the screened interval coincides with the position of the water table and the base of the Columbia aquifer.

Specific details regarding well installation and sampling depths are given in Section 3.5.

3.4 Onsite Characterization

Based upon the results of the RI, additional soil borings/monitoring wells will be required. Borings/monitoring wells are required to: 1) define the presence of the clay layer and its topography in the vicinity of the historic disposal area, and 2) determine groundwater quality within the Yorktown-Eastover aquifer to more fully characterize the aquifer. Monitoring well locations to address these data gaps are shown in Figure 3-1.

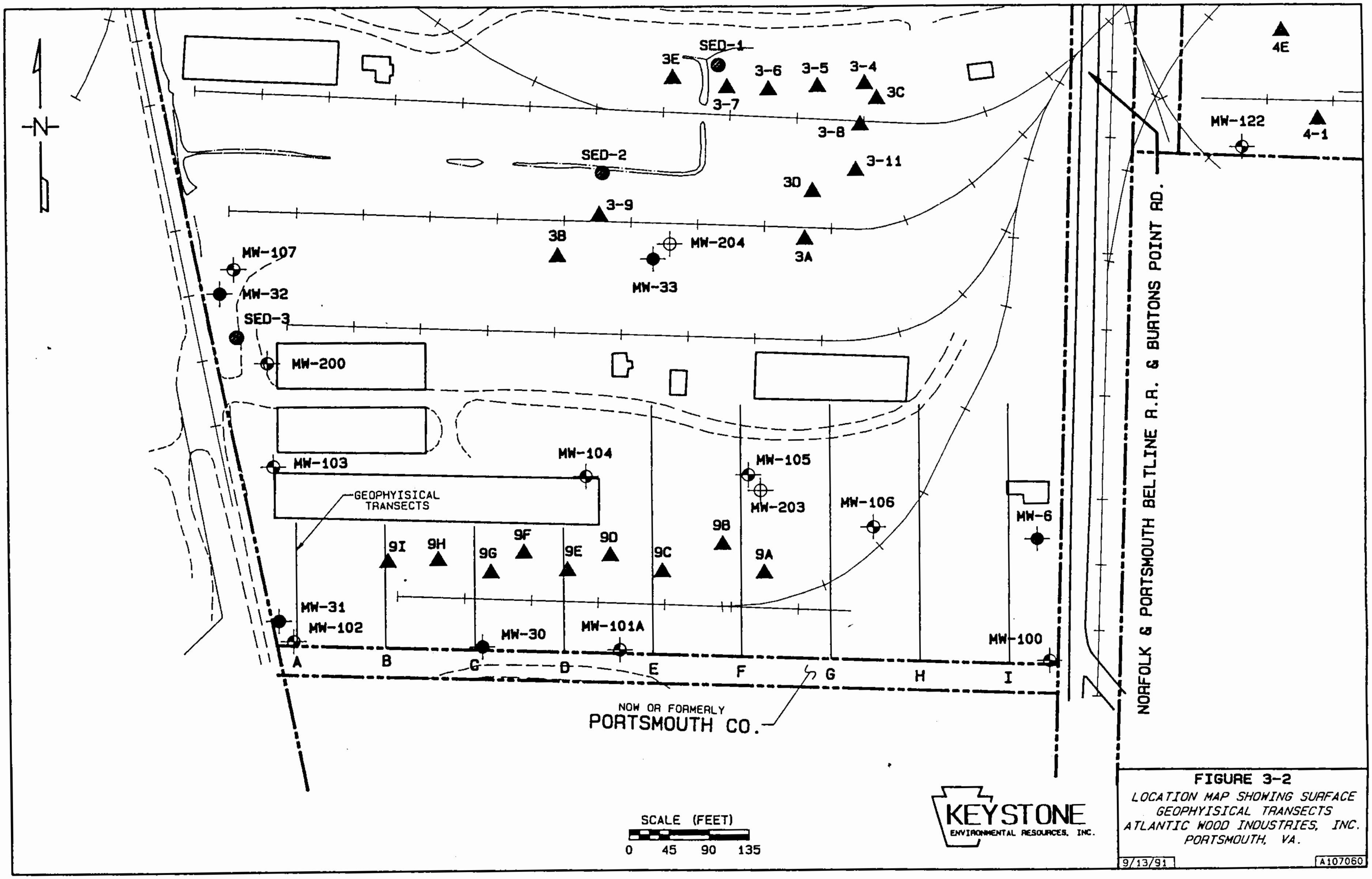


FIGURE 3-2

LOCATION MAP SHOWING SURFACE GEOPHYISICAL TRANSECTS ATLANTIC WOOD INDUSTRIES, INC. PORTSMOUTH, VA.

the hydrogeologist according to the Unified Soil Classification System and retained. Upon completion of the boring, the annular space will be grouted to the surface using a tremmie tube and a cement/bentonite mixture.

3.5 Monitoring Well Construction

A general overview of drilling, sampling and monitoring well installation procedures for wells monitoring both the Columbia and Yorktown-Eastover aquifers is provided below.

Soil samples will be collected from each new well location using a split-spoon sampler. The number of samples collected from each borehole will be decided by the site hydrogeologist based upon location and depth; it is anticipated that samples will be collected continuously until encountering the Yorktown-Eastover aquifer, and then at five-foot intervals to the terminus of the boring. At some locations it may be difficult to collect samples; overhead obstructions and/or excessive fill material may prevent hammering the split-spoon sampler.

Soil samples collected will be field classified by the site hydrogeologist in accordance with the Unified Soil Classification System before being placed in new, clean glass jars. Visible or odorous evidence of contamination will also be documented. The split-spoon sampler will be decontaminated between each sample collection to prevent the possibility of cross contamination. Decontamination procedures will consist of washing the spoon in soapy water, distilled water rinse, acetone rinse, and final distilled water rinse.

The proposed monitoring wells will be constructed of 2-inch inside diameter threaded flush joint PVC screen and riser. Keystone's experience at similar facilities has shown PVC suitable and compatible with the specific waste constituents for monitoring purposes. To remain consistent with the previous RI monitoring program, the screened interval for each well will be from the confining layer to several feet above unconfined layer, with 0.010-inch wide slots. The shallow monitoring wells will be set such that the screened interval extends approximately two feet above the water table to allow for seasonal fluctuations in the water levels.

The length and/or setting of the screen may be adjusted in the field depending on the site stratigraphy.

Wells completed in the upper, Columbia aquifer will be installed with a hollow-stem auger. The borehole will be advanced to the selected depth, and the well casing and screen will be installed through the center of the auger. If running sand conditions are encountered during drilling, it may be necessary to drill the location using the wash-rotary method. Wash-rotary drilling will allow the hole to stay open longer, as well as allow the removal of soil cuttings through better circulation. Coarse sand will be placed in the annulus around the screen to act as a formation stabilizer, extending approximately two feet above the top of the well screen section. A minimum of two feet of pelletized bentonite will be placed above the top of the formation stabilizer. After the bentonite has hydrated, the remaining annular space will be sealed to the surface with a cement/bentonite grout. A steel protective casing with locking cap will be installed around the PVC casing at the ground surface.

Wells completed in the lower, Yorktown-Eastover aquifer will be installed using a combination of hollow-stem augers and the wash rotary drilling methods. The borehole will be advanced to the confining clay layer using hollow stem augers and an outer casing (6-inch inner diameter) will be installed through the center of the augers and pressure grouted into the top of the clay layer (approximately one foot). The purpose of this casing will be to isolate the Columbia aquifer from the Yorktown-Eastover aquifer and thus prevent the possible downward migration of site-related constituents. A minimum of 24 hours will be allowed to elapse before drilling into the lower aquifer to ensure that the grout has hydrated properly. During the grout hydration period, periodic measurements/observations will be made to ensure that leakage of the grout through the casing does not occur. Wash-rotary drilling will be used to drill the borehole to the remaining depth (approximately 50 feet). The wash rotary drilling method will use a potable water supply as its source and will allow the hole to stay open longer, as well as allowing the removal of soil cuttings through better circulation. Coarse sand will be placed in the annulus around the screen to act as a formation stabilizer. This formation stabilizer will extend approximately two feet above the top of the well screen section. A minimum of two feet of pelletized bentonite will be placed above the top of the formation stabilizer. After the bentonite has hydrated, the remaining annular space will be sealed to the surface with a cement/bentonite grout. A steel protective casing with locking cap will be installed around the PVC casing at the ground surface.

All drilling equipment will be decontaminated after each hole where visible evidence of contamination is present. Decontamination will take place at an established decontamination pad located on the site. Equipment will be steam cleaned to prevent the possibility of cross contamination and the water will be collected and pumped into 55-gallon drums.

Following completion of the drilling phase, all newly installed wells and selected existing wells will be developed to improve efficiency, remove any foreign material introduced during drilling, and insure that representative groundwater samples are obtained. During development, a minimum of three to five casing volumes of water will be removed from the well by either bailing, pumping or airlifting methods. Purged water will be collected in 55-gallon drums and stored onsite for future disposal or treatment, if required.

A measuring point will be established on the top of each PVC well casing. The elevation of this point will be surveyed to mean sea level (accuracy of 0.01 feet) and correlated to an existing USGS benchmark near the site.

3.6 Pumping Test

To determine the rate of groundwater migration in offsite areas and/or propose potential remedial alternatives, it will be necessary to obtain further estimates of the hydraulic properties of the aquifer.

In situ slug tests will be conducted in each of the newly installed wells. Slug tests provide in situ values representative of a small volume of porous media in the immediate vicinity of the well's slotted section. The slug test will be used to estimate the hydraulic conductivity (K) of the aquifer and involves the sudden introduction or removal of a weighted slug (or suitable volume of water) which affects the static water level in the well. Rising or falling head tests will be used depending on the specific location tested. Recovery of the water level to static conditions will be recorded at specified time increments. Water level recovery data will be later evaluated using the methods of Hvorslev (1951) and Bouwer and Rice (1987); these are the methods which were used previously in the RI.

During the RI, a pumping test was conducted in the western portion of the AWI site, at well location PW-1, which is located approximately 25 feet from monitoring well MW-110. This pumping test served to provide an in situ measurement that was averaged over a larger aquifer volume. To further define the aquifer characteristics and potential hydraulic influences through pumping as well as providing an overall estimate of the homogeneity of the Columbia aquifer beneath the AWI site, an additional pumping test will be conducted in a large diameter stainless steel well (6-inch inner diameter) located near the treatment building/former tank farm area (Figure 3-1). The pumping well construction will be similar to that described in Section 3.5. This well will be designated as PW-3.

The pump test will be conducted by the measured withdrawal of groundwater from a well over a 48 to 72 hour period or until the drawdown in the pumping well has reached steady-state conditions and the site hydrogeologist has determined that sufficient data for evaluation purposes has been collected. Measurement of drawdown in the pumping well as well as several nearby observation wells (MW-7, MW-13, MW-15, MW-27, MW-29, MW-114, MW-115A, MW-116, MW-117, MW-124, MW-125, and MW-126) will be made throughout the test.

Resultant water level data will be tabulated and analyzed periodically throughout the length of the test. Upon completion of the test, calculations will be made to provide estimates of aquifer characteristics such as hydraulic conductivity, transmissivity, and specific capacity. The pump testing subtask will be performed after the installation of the additional monitoring wells and the sampling event.

In addition to the collection of water level measurements, groundwater will be collected from the pumping well at 24-hour increments in order to determine if changes in groundwater quality occur with time. Analytical data received during the pump test will aid in the development of remedial alternatives.

3.7 Tidal Influence Measurements

As part of the overall hydrogeologic field investigation tasks, a set of continuous water level measurements will be collected over a 24-hour period to determine the tidal influence of the Southern Branch of the Elizabeth River on the groundwater elevations at the site. Tidal influence in the wells will be examined for possible distance effects and the potential for vertical migration between the two aquifers. Tidal influence data will also aid in determining the overall site contaminant migration patterns and pathways.

Prior to beginning the tidal survey, water levels will be measured in each of the site monitoring wells and available offsite wells. Water levels in all wells selected for the tidal test will be measured hourly through the duration of the test. Where possible, water level measurements will be made using an electronic datalogger and pressure transducer assembly. All other water level measurements will be made using an electronic water level meter (i.e. M-scope). The wells which will be measured will include:

- Columbia Aquifer: MW-13, MW-112, MW-113, MW-114, MW-115A, MW-116, MW-117, and MW-118

- Yorktown-Eastover Aquifer: MW-201, MW-205, MW-206, and MW-207

3.8 Groundwater Sampling and Analysis

One round of groundwater samples will be collected from each of the proposed monitoring well locations. Sampling, sample handling and shipment will be performed in accordance with the procedures outlined in the RI/FS Work Plan (March 1988). Water level measurements will be taken from all wells sampled during this investigation, the previously installed AWI site monitoring wells, any wells identified on offsite locations (Section 3.1) and the existing benchmark located on the AWI pier. Water level measurements will serve as the basis for constructing potentiometric surface maps for the AWI site and offsite areas.

Samples will be analyzed for the parameters which were originally listed in the approved Work Plan (March 1988) and the QAPP (January 1988), using the analytical methods previously presented in the Work Plan. Analyses to be performed are:

- o Volatile Organics (SW 8240)
- o Acid Extractables (SW 8270)
- o Base/Neutral Extractables (SW 8270)
- o Arsenic
- o Copper
- o Zinc

Chromium was sampled as part of the analytical parameter list for the RI; however, chromium was not detected in groundwater during either of the two sampling rounds; therefore, chromium is not included in the analytical program.

Additionally, ten percent of the groundwater samples will be analyzed using CLP protocol.

Quality Assurance/Quality Control (QA/QC) samples to be collected during the additional sampling are provided in Table 3-1. QA/QC procedures will be performed in accordance with the QAPP.

3.9 Soil Analytical Testing

To determine the potential adsorption of organic chemicals to the soil matrix, the organic carbon content will be determined from several soil samples collected at three locations at the AWI site. According to Olsen and Davis (1990), values of an adsorption content (K_d) for a compound have been found to vary with the composition of the adsorbing media, and the amount of organic matter in the soil has been correlated to the adsorption of organic chemicals. This data will also be

TABLE 3-1

FIELD QA/QC SAMPLES FOR THE SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN

ATLANTIC WOOD INDUSTRIES, INC. PORTSMOUTH, VIRGINIA

Sample Event	Field Duplicate	Rinsate Blank	Trip Blank	Field Blank
Groundwater	1 per 20 samples	1 per 20 samples	Trip Blanks will accompany only VOC samples at a rate of one per day per cooler containing VOCs	1 sample per day

Note:

1) The description of field QC samples is contained in the project Quality Assurance Plan (rev. January 1988).

2) All samples will be collected blind.

3) 10% of all samples will be analyzed per CLP.

used for the modelling effort described in Section 3.2. Representative samples will be collected from both the Columbia aquifer and Yorktown Confining Bed at proposed well locations MW-206, MW-207, and a boring completed near the historical disposal area.

3.10 Geotechnical Laboratory Testing

In order to determine physical characteristics of the soils beneath the AWI site and to provide additional data for the modelling effort described in Section 3.2, representative samples will be collected from the Columbia aquifer, Yorktown Confining Bed, and the Yorktown-Eastover aquifer at several of the boring locations on the AWI property and offsite locations. Geotechnical tests to be performed are:

o	Grain Size with hydrometer	ASTM D 422
o	Bulk Density	ASTM D 698
o	Porosity	ASTM D 4404
o	Infiltration Rate	ASTM D 3385
o	Permeability	ASTM D 2434

Samples will be collected from locations MW-206, and MW-207 to provide a spatial representation of subsurface conditions for the site and offsite areas.

3.11 Data Validation

All data collected pursuant to this Supplemental Remedial Investigation Work Plan will be validated in accordance with the final, approved Data Management/Data Validation (DM/DV) Plan.

4.0 SUPPLEMENTAL RI REPORT

A Draft Supplemental RI Report will be prepared summarizing the work described in Section 3.0 of this Work Plan and submitted to U.S. EPA for comment. A general outline of the report is presented in Table 4-1. After receipt of comments from U.S. EPA, responses will be prepared and the Report will be submitted in final form.

TABLE 4-1

GENERAL OUTLINE
SUPPLEMENTAL RI REPORT

EXCEUTIVE SUMMARY

1.0 INTRODUCTION

2.0 DESCRIPTION OF FIELD INVESTIGATION PROGRAM

- Regional Data Review
- Offsite Groundwater Characterization
- Onsite Groundwater Characterization
- Pumping Test
- Tidal Study
- Geophysical Survey

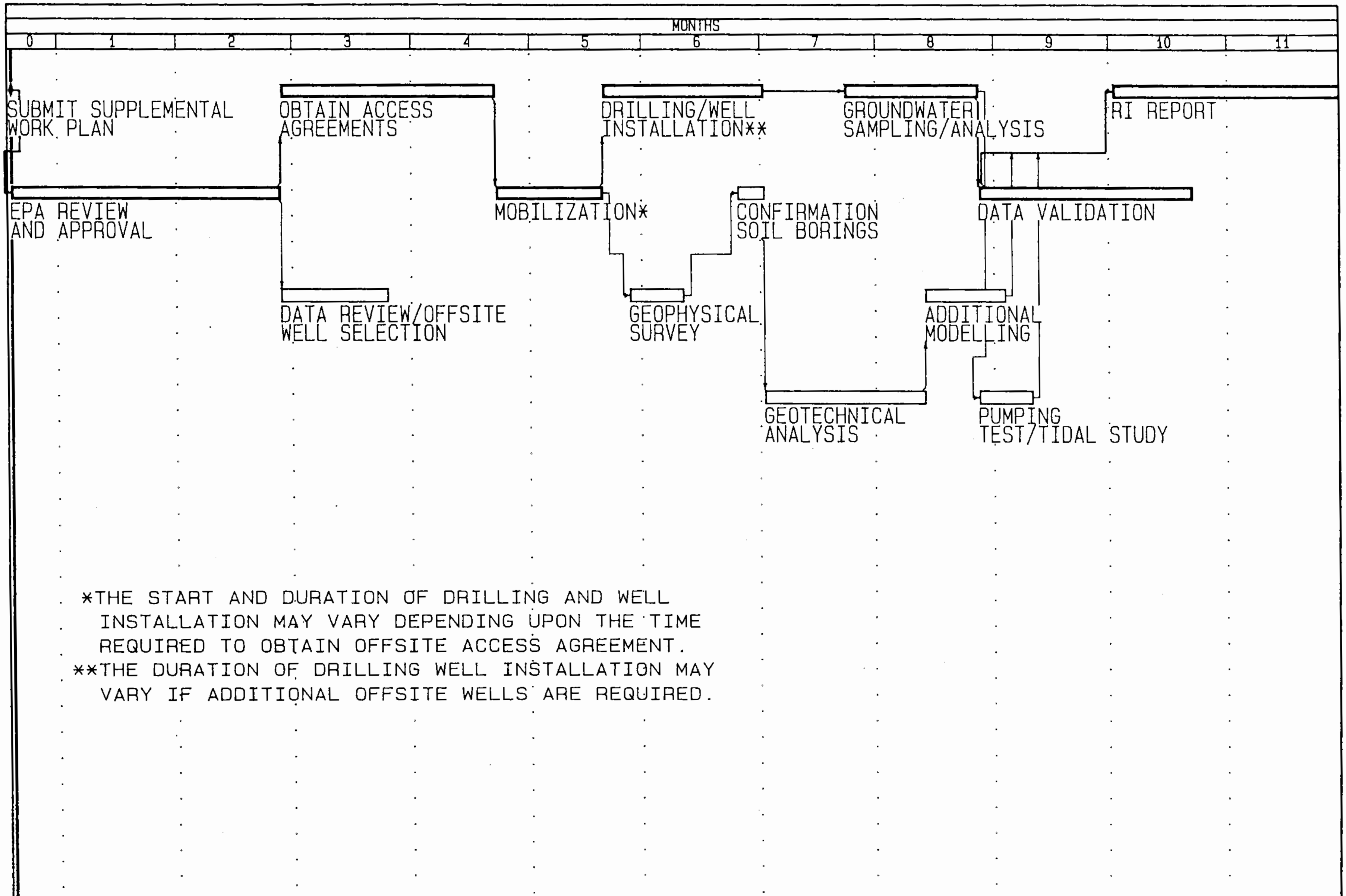
3.0 SITE ENVIRONMENTAL CONDITIONS

- Offsite Groundwater
- Onsite Groundwater
- Extent of Confining Clay Layer

4.0 SUMMARY

5.0 SCHEDULE

A proposed schedule for the completion of the Portsmouth, Virginia Supplemental Remedial Investigation is presented in Figure 5-1. Implementation of this schedule is dependent upon obtaining the offsite access agreements. Any delay in obtaining offsite access permission will delay the chracterization of offsite groundwater and completion of this project. The time for well installation may increase if additional wells are added to the program after review of regional data is complete.



Activity Bar/Early Dates
description
Critical Activity
Progress Bar

Primavera Systems, Inc. 1984-1991

FIGURE 5-1
WORK PLAN IMPLEMENTATION SCHEDULE
PORTSMOUTH, VIRGINIA SITE

Sheet 1 of 1

Plot Date: 20SEP91

PREPARED BY: D. McCAUSLAND 375600-09

Date	Revision	Checked	Approved