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HYDROGEOLOGICAL INVESTIGATION OF CREOSOTE DISCHARGE TO THE ELM AVENUE STORM SEWER NSY PORTSMOUTH VA

5/1/1985

RUSSNOW KANE AND ASSOCIATES, INC.

HYDROGEOLOGIC INVESTIGATION OF CREOSOTE DISCHARGE TO THE ELM AVENUE STORM SEWER

ATLANTIC WOOD INDUSTRIES, INC.

PORTSMOUTH, VIRGINIA PLANT

MAY 1985

RussnowKane & Associates inc.

Geological, Soils and Environmental Consultants

11524 Jefferson Avenue, Newport News, Virginia 23601 · 804-595-5561

HYDROGEOLOGIC INVESTIGATION OF CREOSOTE DISCHARGE TO THE ELM AVENUE STORM SEWER

Atlantic Wood Industries, Inc.
Portsmouth, Virginia Plant

May 1985

Russnow-Kane and Associates, Inc.
11524 Jefferson Avenue
Newport News, Virginia 23601

INTRODUCTION

Creosote discharges through the Elm Avenue storm sewer, adjacent to the Atlantic Wood Industries Portsmouth Plant, have been a concern of the Virginia State Water Control Board since at least early 1979.

It is the purpose of this investigation to define the hydrogeologic framework in the vicinity of the storm sewer, the extent of creosote in the subsurface, and, to the extent possible, the source of the creosote. This report also presents options proposed to control the discharge of creosote through the storm sewer system.

LOCATION

Atlantic Wood Industries, Inc.,-Portsmouth Plant is located in Portsmouth, Virginia, on the south side of Elm Avenue. The site is adjacent to the Southern Branch of the Elizabeth River, immediately upstream from the Jordan Bridge (See Figure 1). Figure 1 also shows the extent of the new portion of the Elm Avenue storm sewer, based on plans prepared by Joe D. Glenn, Jr. and Associates, dated 16 February 1976.

SITE HISTORY - SUMMARY

The City of Portsmouth is shown on a topographic map surveyed in 1888, with cultural features revised in 1896, and published in 1902 as Folio 80, Geologic Atlas of the United States by the United States Geological Survey (See Figure 2). It is interesting to note that although no creosote plants were in existence in the vicinity of the Atlantic Wood Treating Plant, a building and railroad existed at the Norfolk Creosoting Company in the Buell section of South Norfolk. The 1888 shoreline and the adjacent low area, in the vicinity of the Atlantic Wood Treating plant, is shown of Figure 3. It is possible that the lagoon or tar bottom

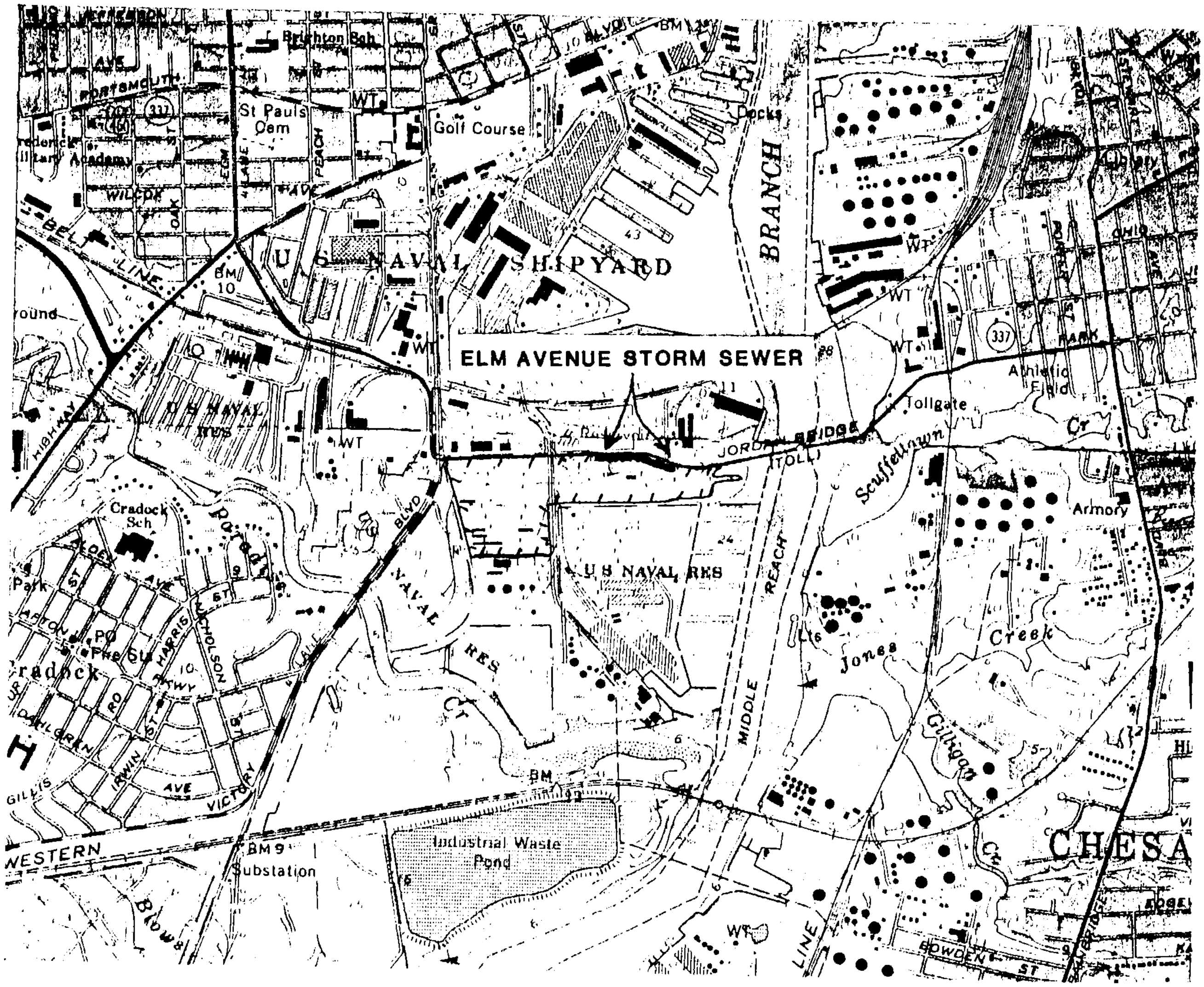


FIGURE 1

LOCATION MAP

ATLANTIC WOOD INDUSTRIES, INC.

PORTSMOUTH PLANT

SCALE: 1"=2000'

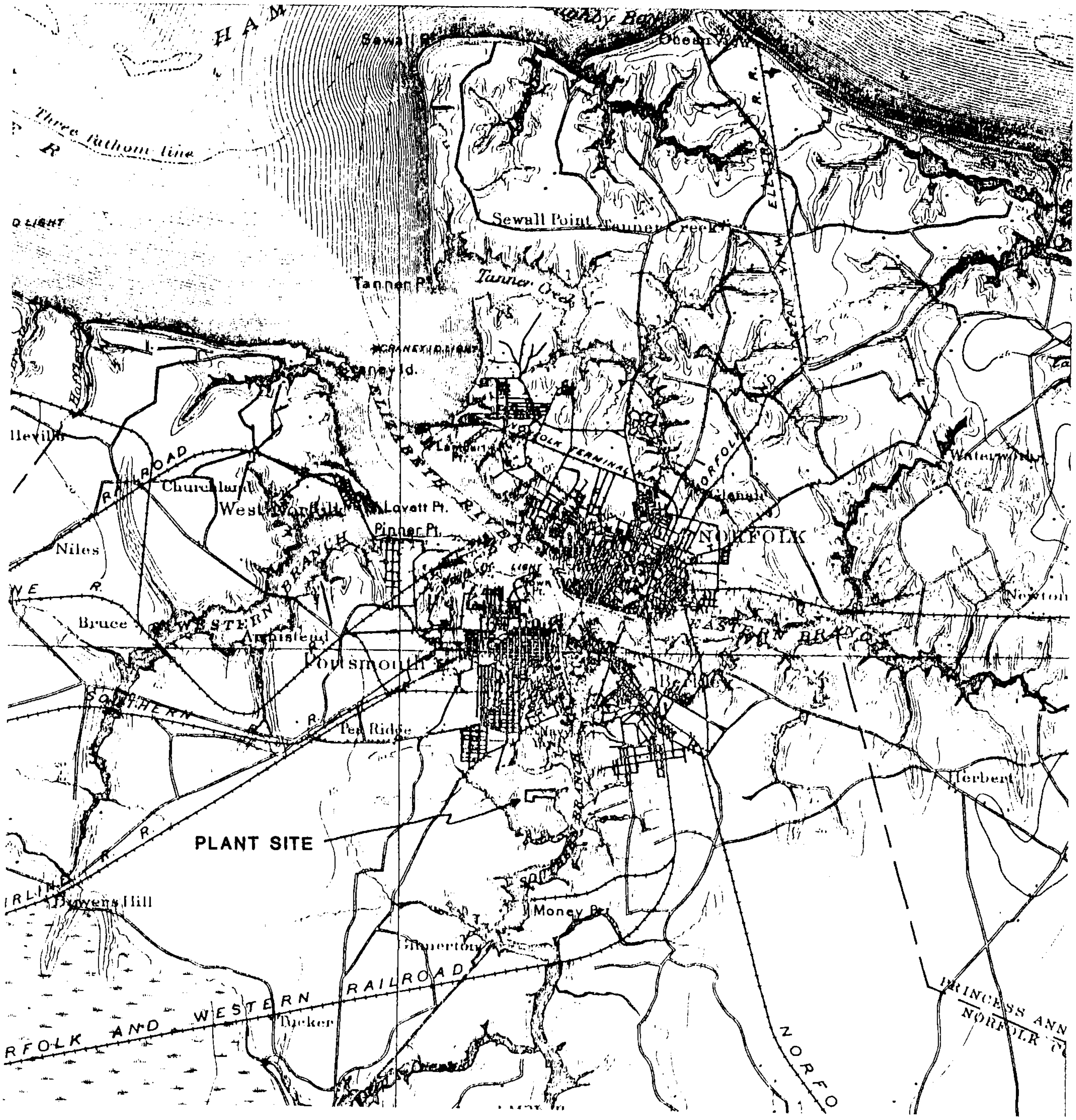


FIGURE 2

TOPOGRAPHY CIRCA 1888-91

CULTURE REVISED 1896

SCALE: 1:125000

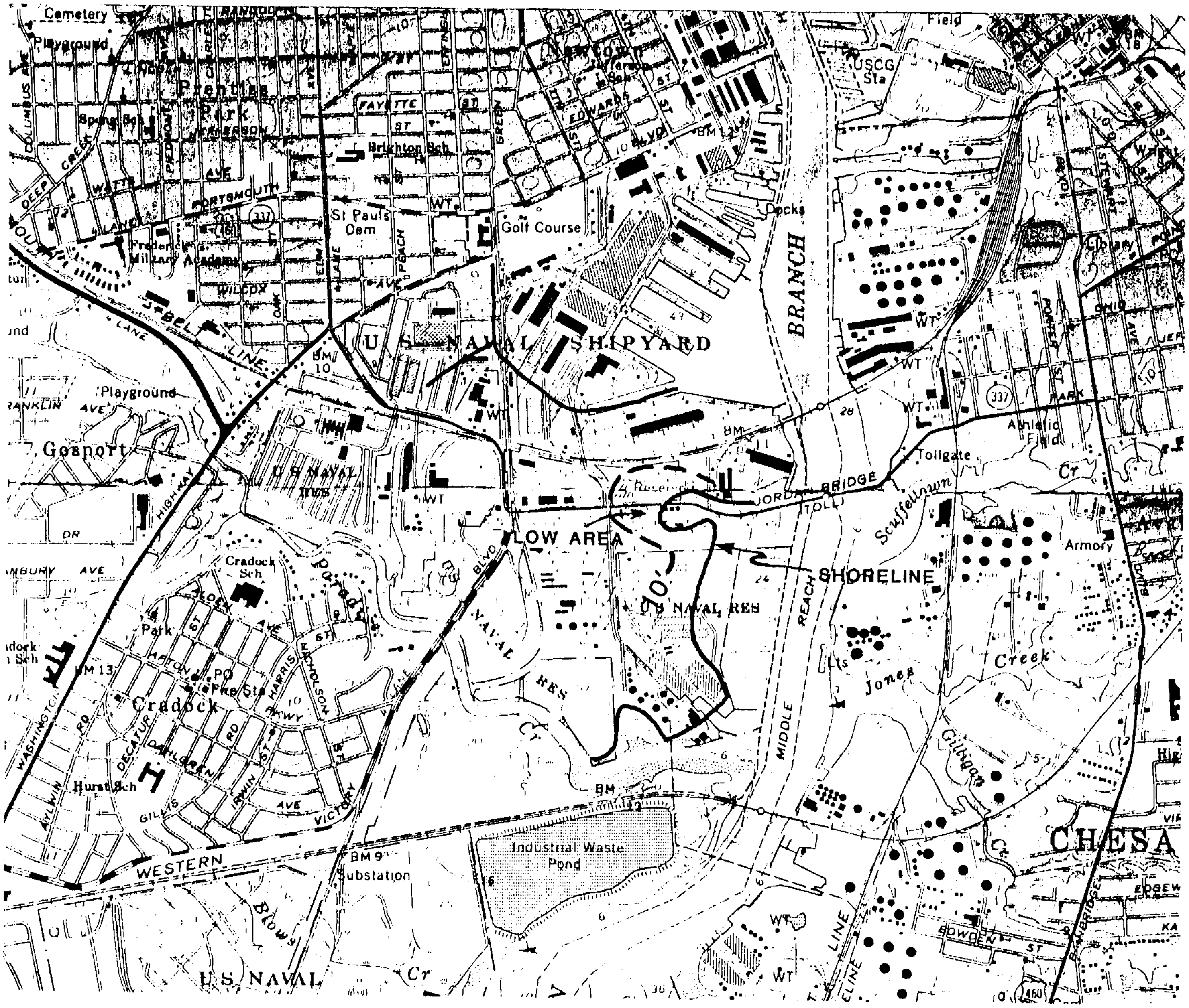


FIGURE 3

APPROXIMATE LOCATION

1888 SHORELINE AND LOW AREA

SCALE: 1"=2000'

pit reported to have been present when the plant was purchased by Atlantic Wood Industries was located within this low area.

Atlantic Wood Industries purchased the plant in the latter part of the 1920's. Reportedly, at the time 3 of the steel tanks and the concrete creosote recycling pit were in existance. In addition, the early operation (prior to the Atlantic Wood Industries purchase) included a tar distillery with a lagoon or pit, as previously mentioned. The low area and embayment shown on the 1888 topographic map was at least partially filled prior to the construction of the plant and steel tanks and further filled with the extension of Elm Avenue and construction of the Jordan Bridge during the period 1927-28.

An old storm sewer which ran along the south side of Elm Avenue, crossing Elm Avenue immediately east of the easternmost steel tank, was replaced in 1976. The old storm sewer (18" concrete pipe) was plugged in the vicinity of Test Boring 16, and the new sewer constructed along the south side of Elm Avenue to the present discharge point. According to the Portsmouth City Engineer, normal construction materials and techniques were used during construction of the new sewer. No special design or treatment was used to prevent future creosote discharges through the new sewer. Based on a State Water Control Board File memo dated 1 February 1979 (See Appendix A), creosote discharge to the new portion of the storm sewer was already taking place by that date. Subsequently, a dam filled with absorbent material was built east of the storm sewer discharge point to catch the discharging creosote and a floating boom placed in the Elizabeth River to control oil slicks.

SITE INVESTIGATION

In order to define the hydrogeologic conditions in the vicinity of the Elm Avenue storm sewer, and to determine the extent of creosote in the subsurface, test borings were made, geologic materials were described, degree of creosote saturation noted, and ground water levels measured. In addition, monitor wells were sampled and analyzed for creosote related parameters.

Geology

Geologic conditions were investigated by making test borings at selected locations adjacent to the storm sewer and subsequently, in the vicinity of the treating plant. A total of 23 borings were made by McCallum Testing Laboratories, Inc. At each boring, samples were taken continuously for the first 10 feet and at 5 foot intervals thereafter. At a few boring locations, deeper continuous samples were taken either to examine the depth of creosote penetration or to find the top of the deep clay horizon.

The depth of the borings ranged from 10 feet to 25.5 feet and slotted PVC casing was inserted in all borings except 12 and 18. Samples from each boring, except 5A (drilled in 1981) and 23, have been retained for further examination, if necessary. Boring logs are contained in Appendix B and locations shown on Figure 4.

In general, the geologic materials consist of surficial fill, exceeding 10 feet in places, underlain by clay or sandy clay at depths ranging from 4 to 10 feet. The thickness of this upper clay horizon is quite variable ranging from approximately 10 feet at boring 8 to approximately 1 foot at borings 12 and 18. This upper clay horizon disappears south of the treating plant, occurring in borings 24 and 28 but not in borings 25, 26, or 27.

The upper clay horizon is inturn underlain by a brown to gray, sand of variable thickness. Organics were noted within this unit at some locations as well as occasional, thin clay lenses which are apparently discontinuous.

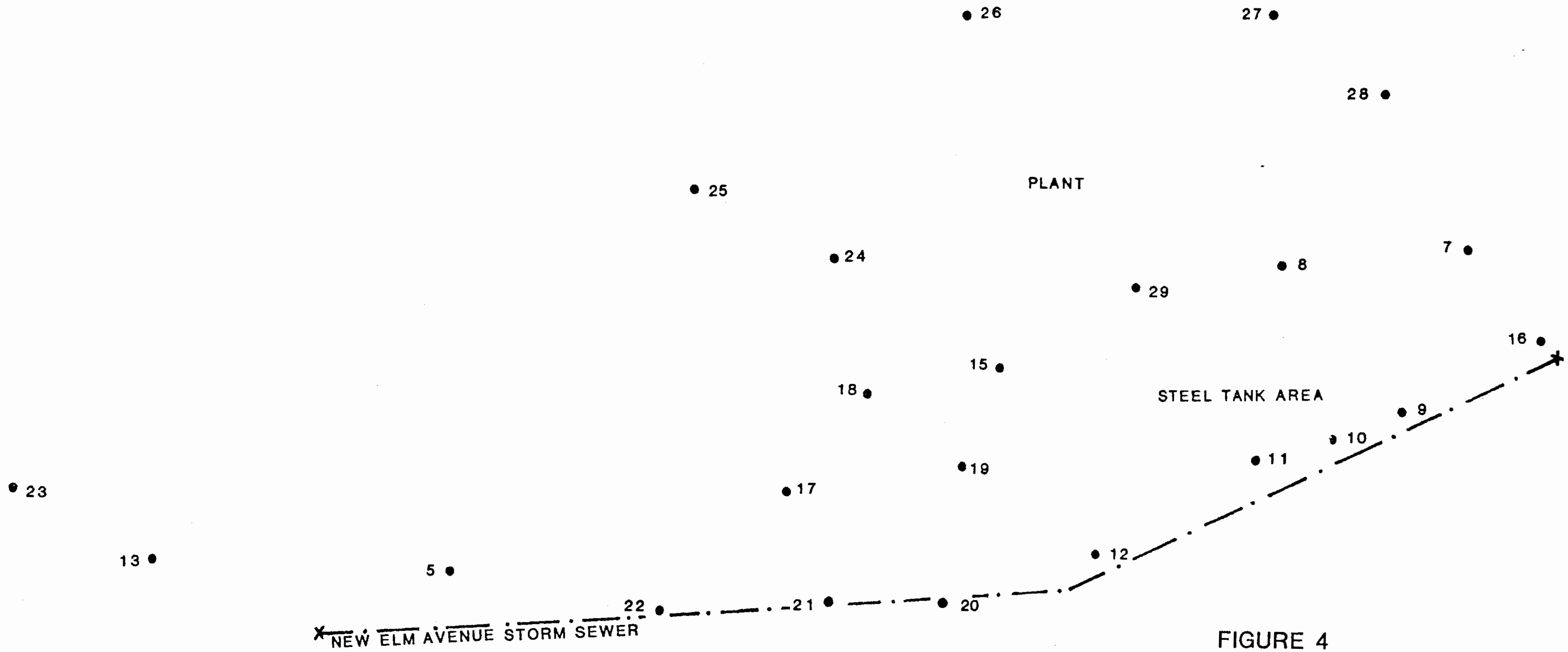


FIGURE 4

ATLANTIC WOOD INDUSTRIES, INC.

PORTSMOUTH PLANT

TEST BORING LOCATIONS

1"=100'   May 1985   #3407

The deepest unit encountered is a soft, gray to greenish gray silty clay. The top of this lower clay horizon is variable occurring from 18 to 20.5 feet below the surface of the ground although the actual contact was seldom observed. At boring 12 the top of the clay may have been as shallow as 16 feet based on the feel of the auger and change in the rate of penetration.

The general relationship between geologic units is shown on the fence diagram (Figure 5). For the purpose of this report, textural variation in the upper several feet is not shown. In the same sense, individual lenses, either clay in a sand unit or clay in a sand unit are shown.

Occurrence of Creosote

At each test boring location, samples were examined and creosote occurrence noted. The occurrence of creosote was generally separated into the following classes:

Saturated - containing obvious liquid creosote with strong odor.

Light - containing light phenolic odor and/or slightly oil appearance.

Partings - non-creosote saturated sediments (generally clays) with evidence of creosote and/or phenolic odor along partings, in sand lenses, or along root channels.

Clean - no odor or other evidence of creosote contamination.

Figure 6 showns, in a plan view, borings which contain zones saturated with creosote and the assumed limit of the extent of creosote in the subsurface as it applies to the Elm Avenue storm sewer. It is not possible at present to determine the extent of creosote saturation beneath or on the other side of Elm Avenue or, for that matter, if creosote which may occur in those areas is from the Atlantic Wood Treating site.

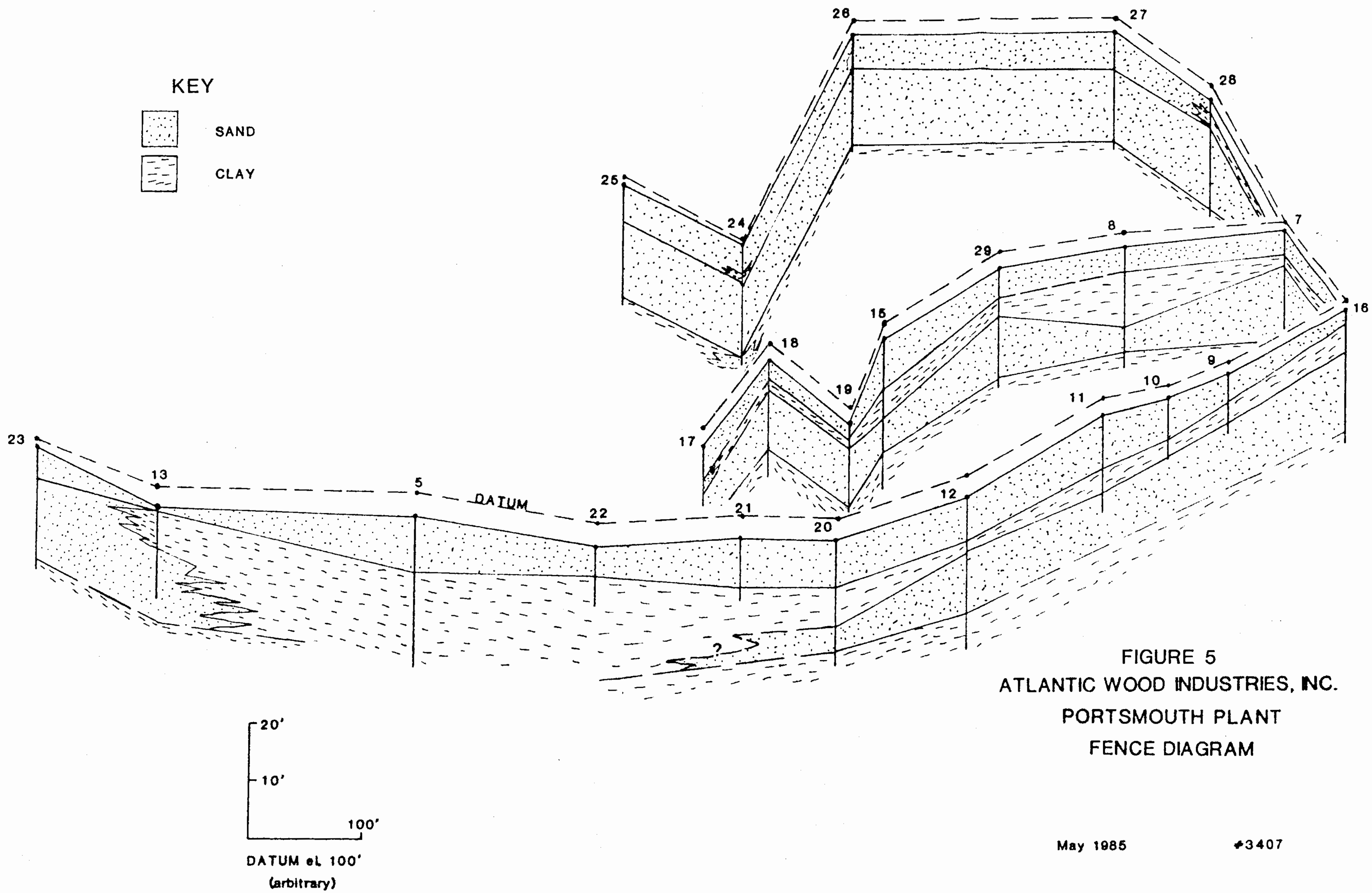


FIGURE 5
ATLANTIC WOOD INDUSTRIES, INC.
PORTSMOUTH PLANT
FENCE DIAGRAM

May 1985 #3407

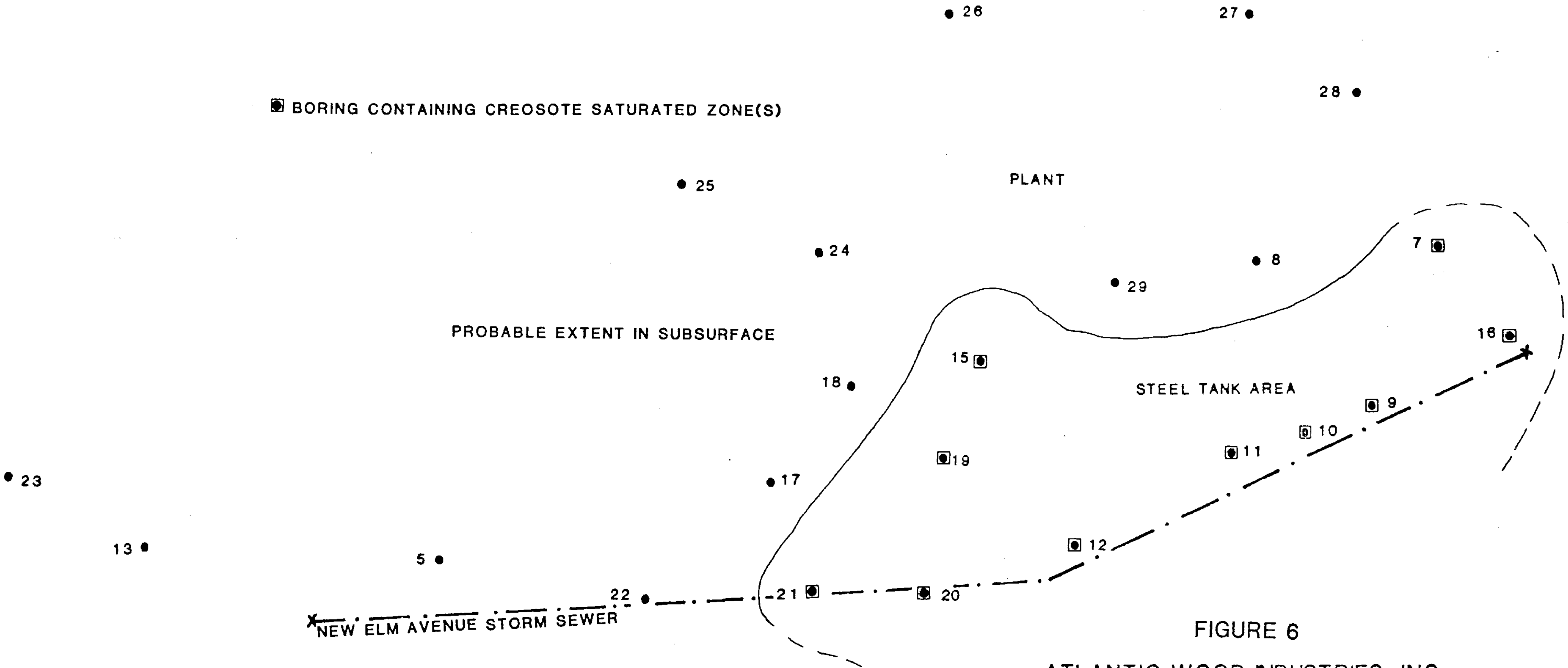


FIGURE 6

ATLANTIC WOOD INDUSTRIES, INC.

PORTSMOUTH PLANT

CREOSOTE OCCURRENCE

1"=100'   May 1985   #3407

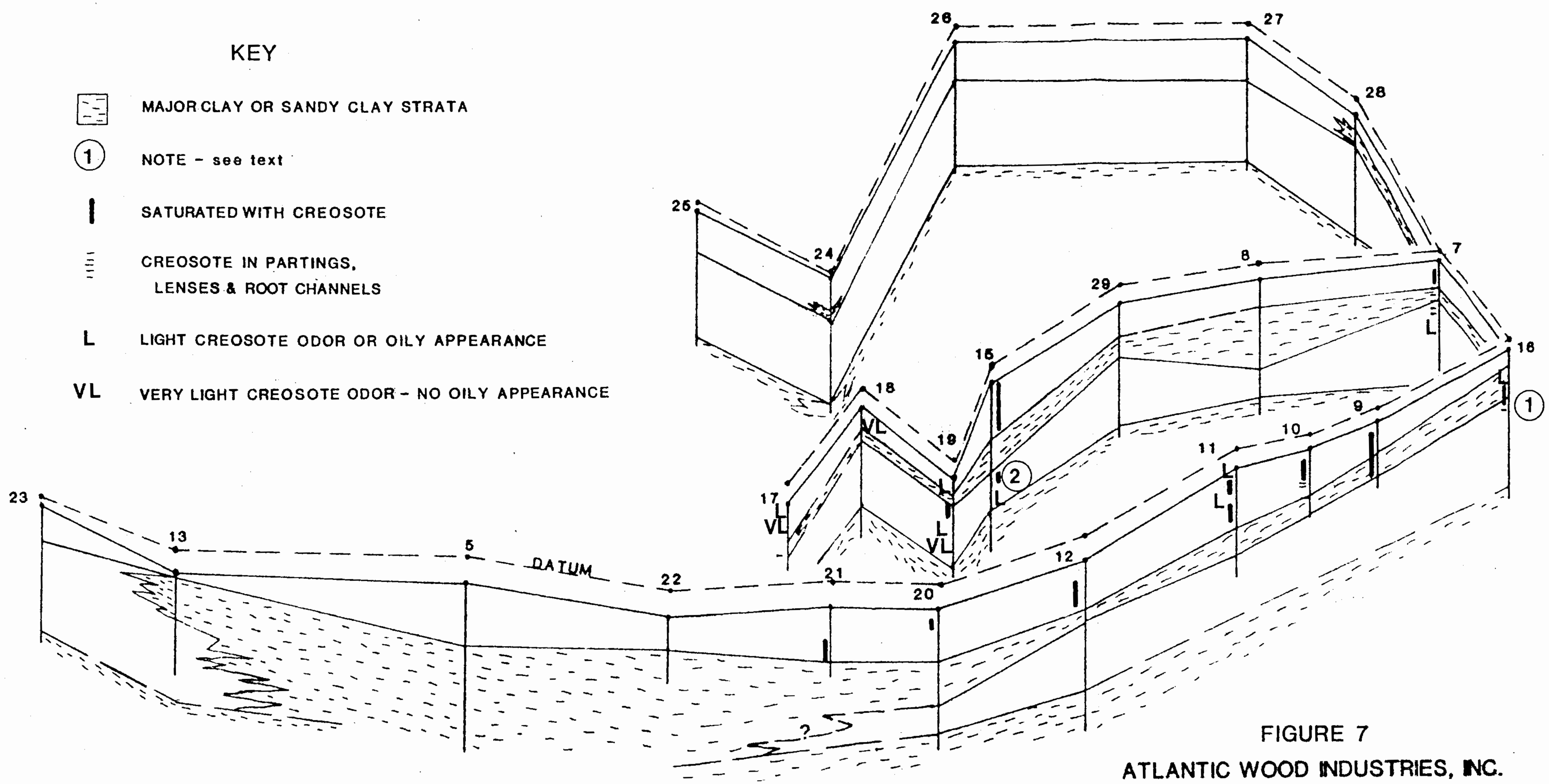
Figure 7 is a fence diagram which also depicts the extent of creosote contamination in the subsurface and indicates the observed degree of contamination. Note 1 indicates a 3 inch clay lense in the 8 to 10 foot sample at boring 16 which exhibited a small amount of free creosote both above and below the lense for a few inches. The remainder of the sand was clean. Note 2 pertains to approximately 0.5 feet of what appeared to be sandy rubble saturated with creosote at a depth of 14 feet. Clean sand occurred from 14.5 feet to 15 feet. However, sand from 16 to 17 feet had a detectable phenolic odor.

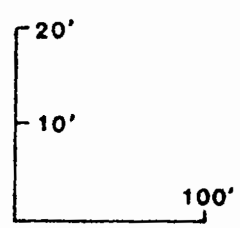
A comparison of Figures 6 and 7 leads to the conclusion that the source or sources of contamination are leaks from one or more of the old steel tanks and either from a leak at the 7 foot deep concrete creosote recycling pit or other operational losses at the same location in the past. It is important to note that although borings 7 and 16 did contain some liquid creosote, the degree of contamination was much less than at other borings north of the steel tanks or at borings 15 and 19. In a similar sense, the degree of contamination at boring 20 appeared much smaller than at borings 12 and 21, located to either side. These data points to 2 separate plumes of creosote; one migrating from the area of the steel tanks and one from the vicinity of the recycling pit. In addition, a hand auger hole placed in the center of the area where the steel tank closest to the river was removed contained several feet of liquid creosote.

It is also apparent that not all the liquid creosote is sitting on top of the clay horizons as expected. In several borings observable signs of contamination terminated sharply with not noticeable textural barrier. Creosote in the vicinity of several monitor wells did however enter the well and sink to the bottom.

KEY

- MAJOR CLAY OR SANDY CLAY STRATA
- (1) NOTE - see text
- SATURATED WITH CREOSOTE
- CREOSOTE IN PARTINGS, LENSES & ROOT CHANNELS
- L — LIGHT CREOSOTE ODOR OR OILY APPEARANCE
- VL — VERY LIGHT CREOSOTE ODOR - NO OILY APPEARANCE





DATUM el. 100'
(arbitrary)

FIGURE 7
ATLANTIC WOOD INDUSTRIES, INC.
PORTSMOUTH PLANT
FENCE DIAGRAM

OCCURRENCE OF CREOSOTE

May 1985 #3407

It is anticipated that creosote saturation also occurs in bedding material beneath both the old and new storm sewers if such bedding was used. Creosote may be discharging, in part, along this pathway. In addiition, it is probable that the plugged, old storm sewer contains a reservoir of liquid creosote. Both of these points requires some additional investigation.

Groundwater

All the test borings except numbers 12, 18, and 14 (a false start) were completed by installing 2 inch diameter, slotted PVC casing, gravel packing and placing a bentonite seal near the surface in the annular space. This was done to facilitate depth to groundwater measurements over a long period of time (See Table 1) and to allow samples to be taken periodically for chemical analysis.

Groundwater in the watertable aquifer beneath the site is found at very shallow depths. Figure 8, shows the depth to the watertable for measurements made on 13 October 1984. Depths range from greater than 4 feet at borings 24, 25, and 13 to less than 1 foot at boring 11. The shallowest area in general is in the vicinity of the steel tanks where surface water "ponds up". It is probable that the ponded surface water provides almost continuous recharge in this area and also exerts a mounding effect on the watertable aquifer.

Figures 9 and 10, show a generalized groundwater flow map for watertable elevations on 15 and 19 June 1984. In each case, groundwater to the northeast, crossing Elm Avenue and generally toward the Elizabeth River. At the time these measurements were made, borings 24 - 29 were not yet drilled. The datum for the elevations is benchmark on top of the wall

TABLE 1
WATERTABLE ELEVATIONS*

Well Number	6/15/84	6/29/84	7/26/84	10/23/84
5	92.30	93.12	94.39	93.03
7	96.26	95.92	97.00	95.59
8	96.24	95.79	96.95	95.76
9	95.66	95.46	96.40	96.02
10	95.65	95.48	96.48	96.05
11	95.62	95.47	96.62	96.10
13	92.39	92.13	93.17	91.34
15	95.59	95.15	96.28	94.95
16	96.04	95.63	96.59	95.41
17	94.65	93.73		94.16
19	95.10	94.77	95.74	94.86
20	93.58	93.87	94.88	94.25
21	93.85	93.63	94.75	93.73
22	93.02	92.92	94.68	92.98
23				
24				94.79
25				94.21
26				94.83
27				95.29
28				95.54
29				95.32

* All elevations in feet, referenced to assumed benchmark at 100 feet above mean sea level.

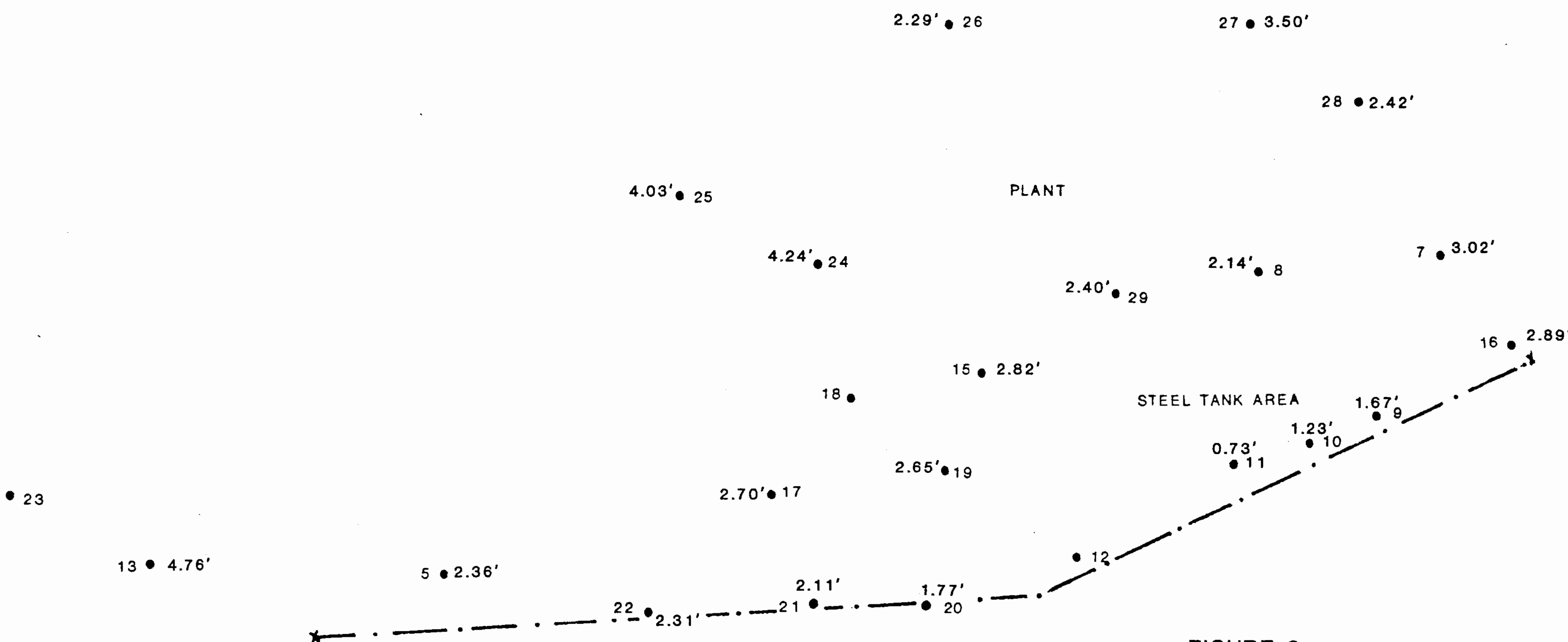


FIGURE 8
ATLANTIC WOOD INDUSTRIES, INC.

PORTSMOUTH PLANT

DEPTH TO WATER TABLE
10/23/84

1"=100' May 1985 #3407

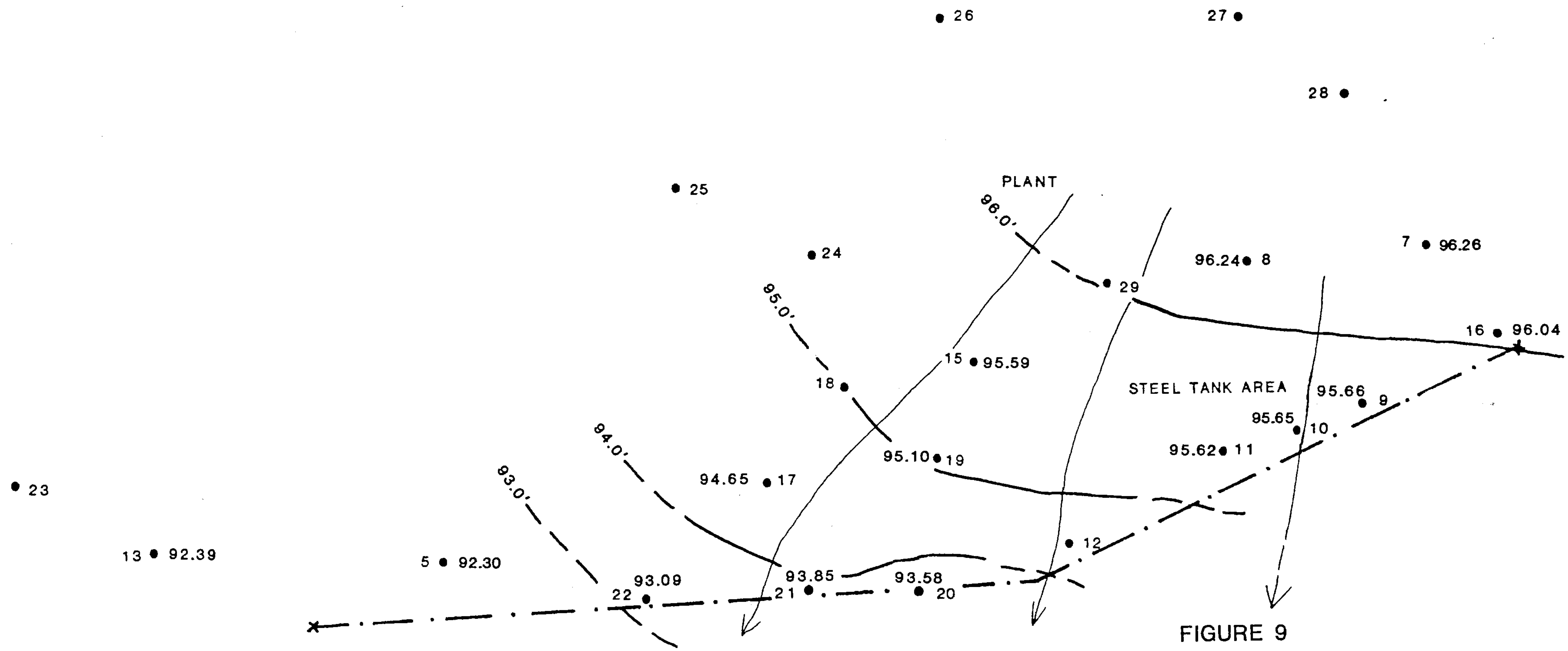


FIGURE 9
ATLANTIC WOOD INDUSTRIES, INC.

PORTSMOUTH PLANT

GROUND WATER FLOW MAP
6/15/84

1"=100'   May 1985   #3407

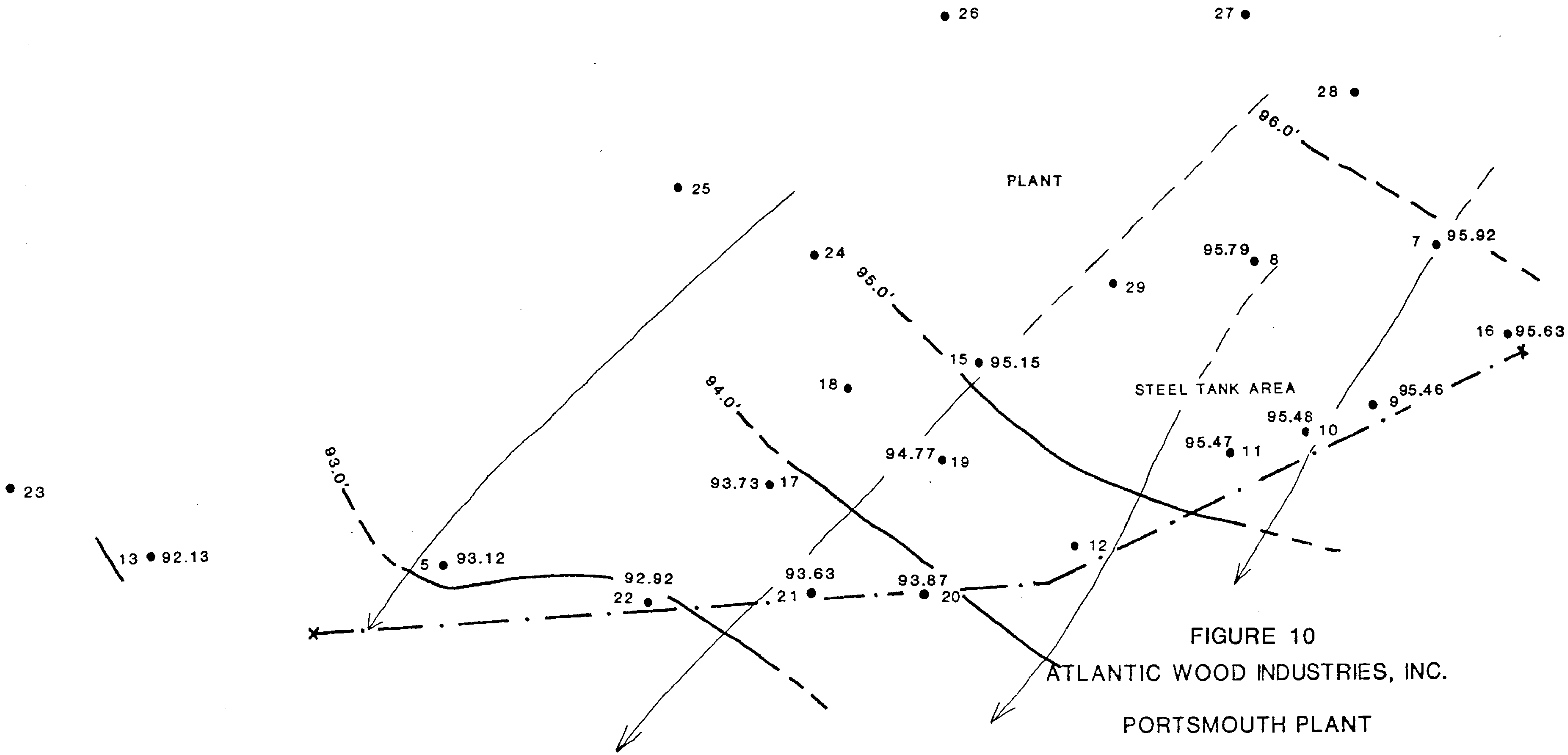


FIGURE 10
ATLANTIC WOOD INDUSTRIES, INC.

PORTSMOUTH PLANT

GROUND WATER FLOW MAP
6/29/84

1"=100' May 1985 #3407

at the creosote recycling pit with an assumed elevation of 100 feet above near sea level.

Figure 11, shows groundwater flow directions for a full set of measurements made on 23 October 1984 after completion of borings. The flow system includes flow to the northeast under Elm Avenue as shown for earlier measurements. However, gorundwater is also flowing to the southeast from a groundwater divide that probably trends eastwest in the vicinity of the treating plant. The extent of this divide further to the west cannot be determined with existing data. Figure 11 also shows secondary groundwater high in the vicinity of the steel tanks which is probably the result of recharge to ponded surface water as described previously.

Considering the pattern of creosote found in the test borings, if it is assumed that the source is the creosoterecycling pit and one or more of the steel tanks, groundwater flow is influencing the direction of creosote migration to some extent. The relationship between groundwater flow velocity and creosote migration has not been determined.

The magnitude and extent of tidal fluctuation on the watertable was assessed on 29 June 1984. Measurements taken at 11 a.m., 1:30, and 2:30 p.m. The data indicates that wells 5, 14, and 17 were affected. The fluctuation at wells 13 and 5 amounted to 0.07 feet, while at well 17, which is further from the water, the fluctuation was 0.46 feet. The greater fluctuation at well 17 may be due to the fact that it is immediately adjacent to a plugged subsurface drain that ran from the creosote recycling pit to the Elizabeth River.

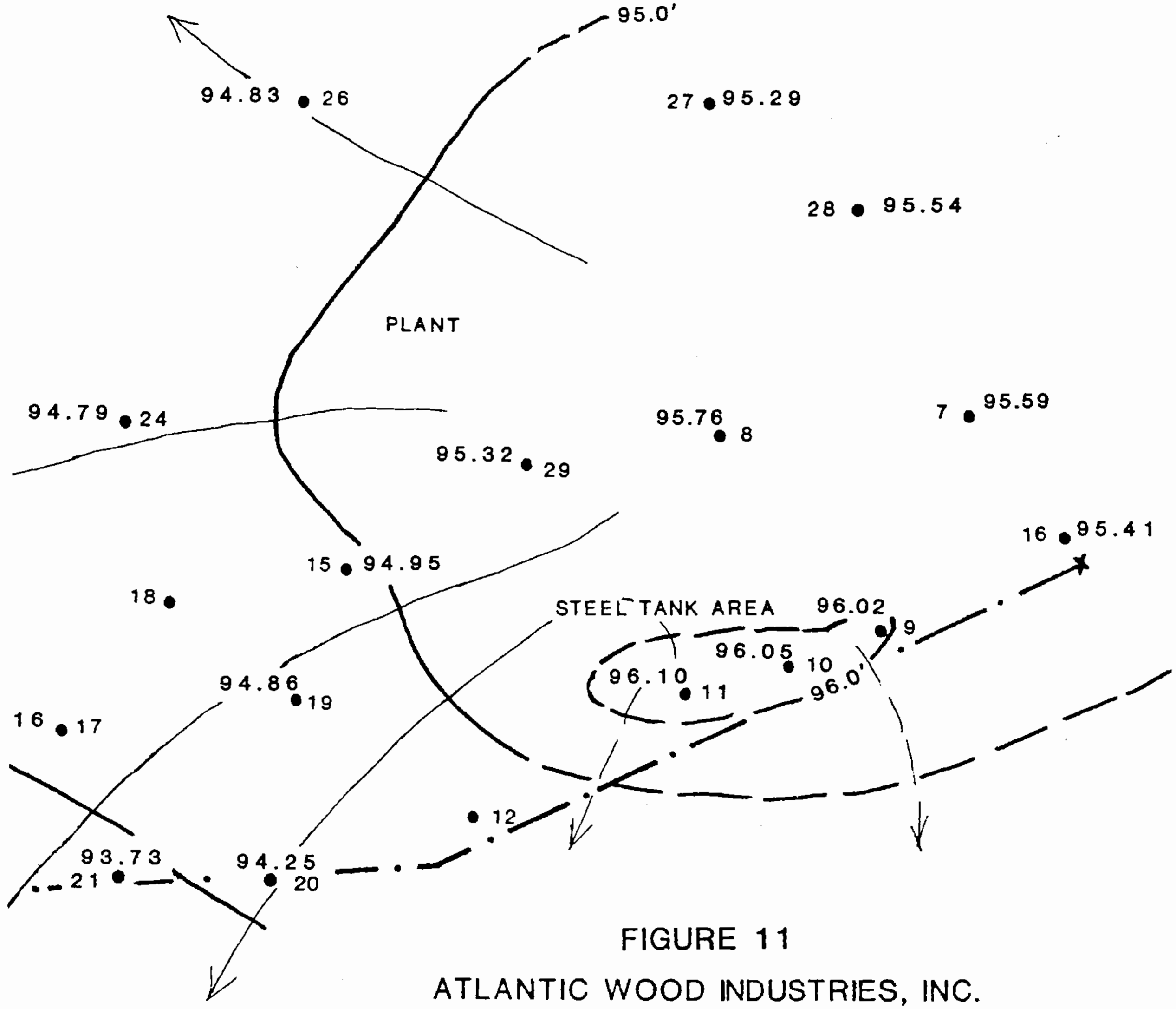


FIGURE 11

ATLANTIC WOOD INDUSTRIES, INC.

PORTSMOUTH PLANT

GROUND WATER FLOW MAP
10/23/84

1"=100'   May 1985   #3407

Groundwater was sampled at each monitor well after pumping to develop the wells and subsequently, after pumping a minimum of 3 casing volumes of water from the well. All analyses were performed by Savannah Laboratories and Environmental Services, Inc. Test results are found in Appendix C.

The results of the analytical testing indicates that, in general, wells that contained free creosote exhibit elevated levels of phenanthrene, a good indicator. Wells 24-29 which shows elevated levels should be pumped and retested. Well 19 which has the highest levels of naphthalene, phenanthrene, phenol and total recoverable phenolics was also the well which exhibited the greatest inflow of liquid or free creosote.

CONTROL OPTIONS

Several methods of stopping the creosote discharge to the Elizabeth River have been discussed, both verbally at several meetings and in outline form under cover of a letter to Atlantic Wood Industries dated 22 June 1984. The following discussion presents the positive and negative aspects of each. It does not, however, contain cost data.

OPTION 1 - Discharge Control Lagoon

This option would consist of building a sealed lagoon or pond between the storm sewer discharge point and the Elizabeth River. It would have to provide sufficient volume that small creosote globules transported during high flow regimes would settle out and would require periodic removal of contaminated sediment, creosote, and, either an effective floating boom at the discharge or a second, small "polishing" pond.

The advantage of using this type control is that existing drainage lines would not have to be removed thus reducing construction cost. Further, Atlantic Wood Industries would not have to develop a treatment system for the large volume of sediment expected to be removed with the storm sewer or, as the case may be, transport the contaminated sediment to a secure hazardous waste landfill.

The disadvantage of this system is primarily associated with permits. It is probable that a new NPDES permit would be required for the combined storm sewer - 002 discharge. Since the level of various creosote derived chemical constituents of the storm sewer discharge is not presently known, it is possible that some level of water treatment might be required, either on the basis of concentration or contaminant mass discharged.

OPTION 2 - Storm Sewer Replacement

This option would involve removing at least the new and probably the old Elm Avenue storm sewers, replacing them with a storm sewer that would remain tight in the presence of creosote.

The advantage of this option is that the primary goal of the State Water Control Board, the discharge of creosote globules, would be met.

There are several disadvantages. First, it is not clear that treatment of excavated, contaminated sediment can be performed on site; contaminated sediment may have to be transported to a secure hazardous waste landfill. In addition, it is possible that the chemical character of the sediments may render them unfit for disposal in a landfill.

The cost of sediment treatment on site appears to be considerably lower than removal to a secure landfill site. Secondly, storm sewers draining land to the north of the site would have to be reconnected and there is no guarantee that creosote is not entering those lines also. Thus it is possible that some creosote could continue to discharge placing Atlantic Wood Industries in the position of defending the tightness construction, proving where the creosote is entering the system, or proving, if possible, that it is not Atlantic Wood creosote.

Thirdly, free creosote and contaminated water which had been infiltrating into the storm sewer could continue to migrate beneath Elm Avenue and could, in the future, discharge at some other location. Fourth, because of the high watertable, the excavation will probably require shoring the sides and dewatering. In as much as the plant cannot handle a large volume of water, it would have to be stored or treated and discharged.

OPTION 3 - Construct an Open Ditch

This option would entail replacing the storm sewer or sewers with an open ditch constructed to resist creosote penetration. If the ditch is constructed in the area presently underlain by the storm sewers, they would have to be removed. Storm drainage entering the system from the north would have to be connected to the ditch or re-routed along the north side of El . Avenue to the old storm sewer discharge.

If the ditch has to be moved south to accomodate construction of two additional traffic lanes, there are several additional considerations. First, continuation of drainage from the area north of Elm Avenue would deepen the ditch due carrying the grade on those lines the extra distance. Second, it is probable that the ditch would then intercept drainage from the plant, possibly requiring a new NPDES appliation for a discharge that Atlantic Wood Industries does not entirely control. Third, if the drainage from the north is re-routed there seems to be no need for the ditch since only one area (the office) presently discharges to the storm sewer. Except for the possible continued discharge of creosote through the bedding material of the existing storm sewers, the new Elm Avenue storm sewer could be plugged.

The advantage to using an open ditch is primarily because continued discharge of creosote from lines entering the system from the north could be assessed visually.

The disadvantages center around the decision to remove the old sewers, as previously discussed, and the similar problem caused by additional excavated sediment along the north side of Elm Avenue.

OPTION 4 - Seal Storm Sewer Joints

This would entail location of pipe joints in the new Elm Avenue storm sewer, excavation of the joint and grouting with material that would resist creosote penetration. In addition, some special treatment of the manholes may be required.

The primary advantage here is the reduced amount of contaminated sediment to excavate. The disadvantage is that creosote may continue to discharge from other lines entering the system and creosote presently found in the subsurface would continue to migrate either under Elm Avenue or through the bedding material.

SECONDARY CONTROL OPTIONS

There are several methods available to control or reduce the future migration of creosote from the Atlantic Wood Industries Portsmouth Plant. These should be considered for use in conjunction with any primary control.

OPTION 5 - Slurry Wall

A slurry wall constructed to a depth of approximately 20 feet and extending eastward from the vicinity of boring 16 past boring 21 and then south or southwest to the vicinity of the plant (boring 15) would envelop the area presently containing liquid creosote in the subsurface.

OPTION 6 - Creosote Collection Sumps

Large diameter holes lined with slotted pipe would serve as a collection sump in the same manner that the creosote flows into some of the 2 inch wells. Creosote could be pumped periodically, from the bottom, without continuously pumping water. Some additional hydrogeologic testing would be necessary.

CONCLUSIONS

1. Test borings indicate that four basic geologic units exist beneath the Portsmouth Plant at depths of up to 25 feet. These are:

    1. Several feet of surficial fill that varies texturally from sandy clay to sand

    2. A shallow layer of clay to sandy clay that varies in thickness where it occurs, from a little over 1 foot to approximately 10 feet.

    3. A sand unit varying in thickness from 3 to 12 feet.

    4. A lower clay unit, the top of which is generally found at depths between 16 and 20 feet.

2. Contamination with liquid creosote is found in the upper, fill material, in the upper clay horizon (along partings and root channels), and in some cases, in the deeper sand horizon.

3. Test borings containing zones saturated with creosote are located primarily between the steel tanks on Elm Avenue. Other borings containing similar zones are downgradient from the creosote recycling pit.

4. The area underlain by saturated creosote and adjacent to the Elm Avenue storm sewer is approximatley 2 acres.

5. The source of the creosote, although unproven, appears to be the steel tanks and the concrete creosote recycling pit.

6. It is not possible, based on the present level of investigation, to determine exactly where along the storm sewer creosote enters.

7. It is probable that the old storm sewer and bedding material beneath both sewers acts as a reservoir for creosote.

8. Groundwater occurs at depths of less than 1 foot to greater than 4 feet.

9. In the vicinity of the area containing liquid creosote, groundwater flows toward the northeast beneath Elm Avenue and toward the Elizabeth River.

10. A groundwater divide of unknown extent and trending east-west occurs near the treating plant. A secondary groundwater mound has developed in the vicinity of the steel tanks due primarily to ponding of surface run-off.

11. Groundwater quality is generally poorer within the zone containing saturated creosote.

12. Of the control options, it appears that removal of both storm sewers and replacement by an open ditch will prove the most effective.

13. If it becomes necessary to construct controls to ensure that no creosote will migrate from the site in the future, a slurry wall or combination slurry wall/creosote sump will be effective.

RECOMMENDATIONS

1. Continue to measure groundwater levels on a periodic basis.

2. Resample groundwater from all borings and perform analyses for primary creosote indicators.

3. Investigate the degree to which the storm sewer bedding material and the plugged, old sewer are saturated with creosote.

4. Drill at least 2 borings between Monitor Well 16 and the plant office to ensure that the vicinity of Monitor Well 16 is the westward limit of the creosote saturation.

5. Determine the cost-effectiveness of the control options contained in this report.

6. Determine whether additional drilling, testing, or other engineering support activity will be required for the selected control option.

APPENDIX A

STATE WATER CONTROL BOARD MEMO

BRA -- Ward -- file

MEMORANDUM

State Water Control Board

2111 North Hamilton Street | P. O. Box 11143 | Richmond, VA. 23230

SUBJECT: Atlantic Wood Industries
Inspection Report

TO: File

FROM: D. A. Mashaw

DATE: February 1, 1979

COPIES: BAT(Willis), E.A. Siudyla, BSFS,BE

On January 23, 1979, Mr. Gene Siudyla (Geologist/TRO) and I inspected the subject plant site. Several items of concern were noted during this inspection.

In section F (see the attached map) we observed a heretofore unnoticed landfill and waste storage lagoon. A drainage ditch, flowing adjacent to these structures showed signs of oil and/or creosote leachate. This ditch also drains storm runoff from all of section F (storage yard) and the lower half of section E (storage yard) prior to emptying into a city storm sewer at the corner of Elm Avenue and Victory Boulevard. The northern half of section E drains into another drainage ditch flowing parallel to Elm Avenue into the same storm sewer.

Another unknown ditch was found to be flowing easterly along the southern portion of the Main Yard (through sections D and C). This ditch drains the runoff from sections C, D, and most of A, discharging into the Elizabeth River just north of the boundary between the Navy Yard and Altantic Wood Industries.

The remainder of section A and all of section B appear to drain into the Company's permitted discharge (002).

Several samples (water and soil) were taken to characterize the abovementioned areas. A description of the stations and sample types follows:

A-1 is a water sample taken from the drainage ditch south of the Main Yard;

E-1 is a water sample taken from the drainage ditch parallel to Victory Boulevard just prior to entering the city storm sewer;

F-1 is a soil sample (approximately 1 foot deep) taken between the existing waste storage lagoon and the adjacent ditch; and,

F-2 is a water sample taken from the drainage ditch adjacent to the landfill area.

Each sample will be analyzed for Phenols, Chromium, Copper, and Arsenic.

Two additional soil samples were taken at station B-1 (1 foot and 4 feet depths). These will be analyzed for Phenols. This area (between the creosote storage tank and a city storm sewer) has been implicated as possible leaching grounds for creosote which has been found in the city storm sewer outfall.

No evidence was seen of waste leaching directly into the River. In my opinion the only way that this Company's waste product can reach State waters is via storm runoff through one of the point sources discussed above, with one exception: the creosote leaching into the Elm Avenue storm drain.

Regarding NPDES Permit reissuance it appears that the Company's new permit will have limits, similar to those now existing for 002, imposed on each of these newly found sources. Monitoring of these streams in such a manner will control the total plant runoff. The problem of oil infiltration of the city storm sewer may be handled by the application of "Best Management Practices" requirements in the new permit.

APPENDIX B

TEST BORING LOGS

M[illegible]allum Testing Laboratories, Inc[illegible]

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 5A

LOCATION Portsmouth

PROJECT Atlantic Creo. SAMPLER ____ S.S. ____ CASING LENGTH ____ DIA. ____

SURF. ELEV. ____ WATER ELEV: IMMEDIATE 5' AFTER ____ HRS. ____

OUR FILE NO. L-875

CLIENT'S ORDER ____

DATE STARTED 6/81

DATE COMPLETED 6/81

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Mat'l. & Color Change	DESCRIPTION
				0		
		1	4-3-3	2		Black gravely sand with trace of clay and organics - moist - loose - SW
				4		
		2	3-4-6	6	5.0	Light grey fine and med. sand with trace of clay and organics and gravel - wet - loose - SP, SC
				8		
		3	1-0-1	10	9.5	Med. grey silty clay - wet - very soft - CL
		4	1-0-1	15		Same - dark grey with trace of sand
		5	woh woh woh	20		Same - dark grey with trace of sand
		6	woh woh woh	25	25.5	Same - med. grey with trace of sand and organics
						Bottom of Boring 25.5'

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED.

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FORM L-104-A-1 BATLINE BUSINESS FORMS CO., INC., NORFOLK, VA. 23502

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. B-7

LOCATION Portsmouth, VA

PROJECT Atlantic Creosote SAMPLER ______ S.S. ______ CASING LENGTH ______ DIA. ______ DATE STARTED 5/23/84

SURF. ELEV. ______ WATER ELEV: IMMEDIATE 2.5 ft AFTER ______ HRS. ______ DATE COMPLETED 5/23/84

OUR FILE NO. L-1148

CLIENT'S ORDER ______

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Mat'l. & Color Change	DESCRIPTION
				0		Topsoil 2"
		1	4-4-4-4	2		Dark brown silty clay w/fine sand - moist - med. stiff- CL
		2	6-3-2-3	4		Same - med. grey w/organics - wet - soft grayish clayey Sand
		3	3-2-1-3	6		Same Same
		4	3-4-5-6	8	8.5	Same - light grey and light brown same w/ slightly more clay
		5	2-3-3-4	10		Light brown silty fine sand - wet - loose - SM
		6	3-3-1	15	19.0	Same - med. grey 14.7' gray md/cs sand w silt
		7	1-1-1	20	20.5	Med. grey silty clay - wet - soft - CL
				25		20 ft. well installed w/screen from -15 ft. to -20 ft.

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED.

...tters and reports are for the exclusive use of the client to whom they are addressed. The use of our name must receive our prior written approval. Our ... and reports apply only to the sample tested and/or inspected, and are not necessarily indicative of the qualities of apparently identical or similar pro-

FORM L-104(A-1) BATSING BUSINESS FORMS CO., INC., NORFOLK, VA.

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 8
LOCATION Portsmouth, VA
PROJECT Atlantic Creosote SAMPLER ______ S.S. ______ CASING LENGTH ______ DIA. ______
SURF. ELEV. ______ WATER ELEV: IMMEDIATE 2.5 ft. AFTER ______ HRS. ______
OUR FILE NO. L-1148
CLIENT'S ORDER ______
DATE STARTED 5/23/84
DATE COMPLETED 5/23/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	4-3-3-3		1.0	Black silty gravelly fine to med. sand - moist - loose - SM-GM
					1.5	Light brown clayey silty fine sand-moist-loose- SM
				2	2.5	Med. grey silty clay - moist - med. stiff - CL
		2	5-4-3-2	4	4.5	Med. grey silty fine sand - wet - loose - SM
		3	1-2-3-3	6		Med. grey silty clay - wet - soft - CL
		4	2-3-3-4	8		Same - light grey - med. stiff
		5	4-4-1-1	10		Same - light grey
					14.5	
		6	4-8-11	15		Light grey silty fine sand - wet - med. compact - SM
		7	9-7-2		18.0	Same
		8	woh/18"		19.5	Med. grey silty clay - wet - soft - CL
				20		20 ft. well installed w/screen from -15.ft. to -20 ft.
				25		

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FORM L-100-A-1 GATLING BUSINESS FORMS CO., INC., NORFOLK, VA. 23502

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 9
LOCATION Portsmouth, VA
PROJECT Atlantic Creosote SAMPLER ____ S.S. ____ CASING LENGTH ____ DIA. ____ DATE STARTED 5/23/84
SURF. ELEV. ____ WATER ELEV: IMMEDIATE 3.5 ft AFTER ____ HRS. ____ DATE COMPLETED 5/23/84

OUR FILE NO. L-1148
CLIENT'S ORDER ____

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	2-3-3-4	2		Light and med. brown clayey silty fine sand w/ organics and brick fragments - moist - loose - SM
					2.5	
		2	3-5-4-6	4		Dark grey silty fine sand w/brick fragments - wet - loose - SM
					4.5	clay - 4 to 5
		3	1-0-0-1	6		Dark grey peat - wet - soft - PT
		4	4-4-6-6	8		
					8.5	
		5	1-2-2-4			Light grey silty fine sand - wet - loose - SM
				10	10.0	Same - light grey and light brown
						10.ft. well installed w/screen from - 3 ft. to -10 ft.
				15		
				20		
				25		

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FORM L-[illegible] [illegible] CO., INC., NORFOLK, VA. [illegible]

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 10

LOCATION Portsmouth, VA

PROJECT Atlantic Creosote SAMPLER ________ S.S. ________ CASING LENGTH ____ DIA. ______

SURF. ELEV. ________ WATER ELEV: IMMEDIATE 3.0 ft. AFTER ________ HRS. ________

OUR FILE NO. L-1148

CLIENT'S ORDER ________

DATE STARTED 5/23/84

DATE COMPLETED 5/23/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	3-3-3-4	2		Med. brown silty fine sand - wet - loose - SM
		2	6-3-1-1	4		Same - dark grey
		3	2-1-1-0	6		Same - med. grey fn/md sand
		4	woh/6"-1-1-6	8	7.5	- - - clayey sand
						Dark brown silty clay w/organics - wet - soft - CL
		5	1-1-3-6	10	9.5	Light grey silty fine sand -wet - loose - SM fn/md
					10.0	10 ft. well installed w/screen from -3 ft. to - 10 ft.
				15		
				20		
				25		

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FORM L-104-A-5 GATLING BUSINESS FORMS CO., INC., NORFOLK, VA. [illegible]

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 11

LOCATION Portsmouth, VA

PROJECT Atlantic Creosote SAMPLER ____ S.S. ____ CASING LENGTH ____ DIA. ____ DATE STARTED 5/25/84

SURF. ELEV. ____ WATER ELEV: IMMEDIATE 12.0 ft AFTER ____ HRS. ____ DATE COMPLETED 5/25/84

OUR FILE NO. L-1148

CLIENT'S ORDER ____

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		Topsoil 2"
		1	2-2-2-3		1.0	Light brown fine sand - moist - loose - SP
				2		Dark brown silty fine sand - moist - loose - SM
		2	2-3-4-2		2.5	Black silty fine sand w/trace of clay and gravel - saturated - loose - SM
				4	4.5	
		3	3-3-2-1	6		Med. brown silty fine sand - wet - loose - SM
		4	1-1-1-1	8		Same - med. grey w/clay
		5	1-1-2-1	10	8.5	Med. grey silty clay w/organics - moist - soft - CL
		6	1-1-1-2			dk brown, organic silty sand
		7	5-11-17		11.5	Dark brown organic silty clay w/wood - wet - soft - CL-PT gray silty sand
					13.0	Light brown silty fine sand - wet - med. compact - SM
		8	9-12-9	15		Same - light grey
					15.5	16 ft. well installed w/screen from -6.0 ft.
				20		
				25		

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED.

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FORM L-104-A-1 GATLING BUSINESS FORMS CO., INC., NORFOLK, VA. 23508

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 12 | OUR FILE NO. L-1148

LOCATION Portsmouth, VA | CLIENT'S ORDER

PROJECT Atlantic Creosote SAMPLER ______ S.S. ______ CASING LENGTH ______ DIA. ______ DATE STARTED 5/25/84

SURF. ELEV. ______ WATER ELEV: IMMEDIATE 3.5 ft. AFTER ______ HRS. ______ DATE COMPLETED 5/25/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	5-6-7-5	2	2.0	Black silty fine to coarse sandy gravel - moist - med. compact - SM
		2	3-3-2-1	4		Black silty fine to med. sand - wet - loose - SM
		3	1-2-0-1	6	5.5	clay lense
		4	1-2-2-2		7.5	Dark grey silty fine sand - wet - loose - SM - - - clayey sand
		5	4-6-6-7	8	9.0	Med. grey silty clay w/organics and shell fragments-wet - soft - CL . . .
				10		Light grey silty fine sand - wet - med. compact - SM
		6	5-2-1	15		Same - med. grey and tan ~ ~ ~ ~ ~ ~ clay by "auger feel"
		7	1-1-0	20	19.5	Light grey silty clay - wet - soft - CL
		8	woh/18"	25	25.5	Same

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED.

BOTTOM OF BORING 25.5 ft.

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FORM L-104-A-1 GATLING BUSINESS FORMS CO., INC., NORFOLK, VA. 23501

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 13
LOCATION Portsmouth, VA
PROJECT Atlantic Creosote SAMPLER ____ S.S. ____ CASING LENGTH ____ DIA. ____
SURF. ELEV. ____ WATER ELEV: IMMEDIATE 4.0 ft. AFTER ____ HRS. ____

OUR FILE NO. L-1148
CLIENT'S ORDER ____
DATE STARTED 5/25/84
DATE COMPLETED 5/25/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	2-2-1-1	2		Light grey silty clay - moist - soft - CL
		2	2-2-1-2	4		Same ~ sand stringer
		3	1-1-1-1	6		Same
		4	1-0-0-1	8	7.5	
						Med. grey silty fine sand - wet - loose - SM
		5	4-3-2-1	10		Same
		6	3-1-1	15	15.5	Same ~ bluish gray clay
						15.5 ft. well installed w/screen from -10.0 ft.
				20		
				25		

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FORM L-[illegible] [illegible]

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 15 — OUR FILE NO. L-1148

LOCATION Portsmouth, VA — CLIENT'S ORDER

PROJECT Atlantic Creosote SAMPLER ____ S.S. ____ CASING LENGTH ____ DIA. ____ DATE STARTED 5/25/84

SURF. ELEV. ____ WATER ELEV: IMMEDIATE 3.0 ft AFTER ____ HRS. ____ DATE COMPLETED 5/25/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	4-3-3-4	2		Black silty fine to coarse sand w/gravel - wet - loose - SM
		2	2-1-2-3	4		Same w/organics
		3	3-1-5-5	6		Same clayey sand
		4	5-4-1-1	8	7.0	Light grey silty fine sand - wet - loose - SM
		5	1-0-1-1	10	8.5	Med. grey silty clay - wet - soft - CL
		6	3-3-9	15	15.0	Med. brown silty fine sand w/trace of organics - wet - loose - SM
		7	6-2-2			Same
		8	woh/12"-1	20	18.5	Light grey fine sandy silty clay w/trace of shell fragments - wet - soft - CL
		9	1-1-1	25	24.5	Med. grey silty clay - wet - soft - CL
					25.5	25 ft. well installed w/screen from -15.0 ft.

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FORM L-166-A-1 BATLINE BUSINESS FORMS CO., INC., NORFOLK, VA.

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 16 OUR FILE NO. L-1148

LOCATION Portsmouth, VA CLIENT'S ORDER

PROJECT Atlantic Creosote SAMPLER ____ S.S. ____ CASING LENGTH ____ DIA. ____ DATE STARTED 5/25/84

SURF. ELEV. ____ WATER ELEV: IMMEDIATE 2.5 ft AFTER ____ HRS. ____ DATE COMPLETED 5/25/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	3-4-2-3	2	2.0	Dark brown silty fine to coarse sand w/organics - moist - loose - SM
		2	2-1-2-2	4		Med. grey silty clay - wet - soft - CL silty sand w/ clay lenses
		3	4-5-2-3	6		Same → fine sandy clay
		4	4-7-6-6	8	7.0	Light brown silty fine sand - wet - med. compact - SM
		5	3-3-1-5	10		Same - loose = 3" clay lense
		6	5-4-1	15		Same - light grey - loose
		7	1-1-1	20	20.5	Same - light grey - loose
						greenish gray clay 20 ft. well installed w/screen from -10.0 ft.
				25		

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED.

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FORM L-104-A

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 17
LOCATION Portsmouth, VA
PROJECT Atlantic Creosote SAMPLER ____ S.S. ____ CASING LENGTH ____ DIA. ____ DATE STARTED 5/31/84
SURF. ELEV. ____ WATER ELEV: IMMEDIATE 2.0 ft AFTER ____ HRS. ____ DATE COMPLETED 5/31/84
OUR FILE NO. L-1148
CLIENT'S ORDER ____

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		Asphalt 5"
		1	12-23-11-9	2		Black silty fine to med. sand w/trace of coarse sand and gravel - wet - med. compact - SM
		2	12-11-6-6	4	3.5	
		3	2-1-2-1	6	2"	Light grey silty fine sand w/trace of organics - wet - med. compact - SM Same - w/dark brown silty clay lenses
		4	1-1-1-1	8		Same w/clay grades to clayey sand & sandy clay
		5	2-2-2-1	10	10.0	Same - saturated silty fine to med sand
						10 ft. well installed w/screen from -2 ft. to - 10 f[t]
				15		
				20		
				25		

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FORM L-104-A-1 GATLING BUSINESS FORMS CO., INC., NORFOLK, VA. 23502

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 18

OUR FILE NO. L-1148

LOCATION Portsmouth, VA

CLIENT'S ORDER

PROJECT Atlantic Creosote SAMPLER ______ S.S. ______ CASING LENGTH ______ DIA. ______ DATE STARTED 5/31/84

SURF. ELEV. ______ WATER ELEV: IMMEDIATE 2.0 ft AFTER ______ HRS. ______ DATE COMPLETED 5/31/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	3-4-3-3	2		Light brown silty fine sand - wet - loose - SM
		2	3-1-2-3	4	3.0	Light grey silty clay - wet - soft - CL
		3	2-2-3-4	6	4.5	Light grey fine sand - wet - loose - SP
		4	4-5-4-4	8	8.0	Same
		5	4-4-8-8	10		Tan silty fine sand - wet - med. compact - SM
		6	5-2-1	15	15.0	Same - med. grey - loose
						Light grey silty clay - wet - soft - CL
		7	1-1-1	20	20.5	Same w/fine sand
						BOTTOM OF BORING 20.5 ft.
				25		

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED.

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FORM L-100-A-1 GATLING BUSINESS FORMS CO. INC., NORFOLK, VA. 23501

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 19

LOCATION Portsmouth, VA

OUR FILE NO. L-1148

CLIENT'S ORDER

PROJECT Atlantic Creosote SAMPLER ______ S.S. ______ CASING LENGTH ____ DIA. ____ DATE STARTED 5/31/84

SURF. ELEV. ______ WATER ELEV: IMMEDIATE 2.0 ft AFTER ______ HRS. ______ DATE COMPLETED 5/31/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Mat'l. & Color Change	DESCRIPTION
				0		
		1	AUGER SAMPLE	2		Black silty fine to coarse sandy gravel - moist - GM
		2	9-4-4-3	4	3.0	Black silty clay - moist - med. stiff - CL
		3	7-9-6-9	6	4.0	Light grey silty fine sand - wet - med. compact - SM
		4	6-8-7-6	8		Same
		5	4-5-5-3	10		Same
		6	1-2-1	15	14.0	Med. grey silty clay - wet - soft - CL
		7	4-5-3	20	19.5	Dark brown organic silty clay - wet - soft - OL
					20.5	20.0 ft. well installed w/screen from -3 ft. to -17 f
				25		

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED.

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FORM L-104-A-1 GATLING BUSINESS FORMS CO., INC., NORFOLK, VA. 23502

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 20
LOCATION Portsmouth, VA
PROJECT Atlantic Creosote SAMPLER ______ S.S. ______ CASING LENGTH ____ DIA. ______ DATE STARTED 5/31/84
SURF. ELEV. ______ WATER ELEV: IMMEDIATE 2.5 ft AFTER ______ HRS. ______ DATE COMPLETED 5/31/84

OUR FILE NO. L-1148
CLIENT'S ORDER ______

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	3-6-4-3	2	3.0	Black clayey silty fine sand - moist - loose - SM-SC
		2	2-4-3-2	4	4.0	Light grey silty fine sand w/trace of organics - moist - loose - SM
		3	1-1-1-3	6		Med. grey fine sandy silty clay - wet - soft - CL
		4	1-1-1-3	8	7.0 / 8.0	Light grey silty clayey fine sand - wet - loose - SM-SC
		5	woh/24"	10		Med. grey fine sandy silty clay - wet - soft - CL 5.8 – by md sand - clean
		6	7-7-8	15	14.5	Light grey silty fine sand - wet - med. compact - SM
		7	1-1-1	20	19.0 / 20.5	Light grey silty clay - wet - soft - CL
				25		20.0 ft. well installed w/screen from -4.ft. to -20 f

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FORM L-104-A-1 GATLING BUSINESS FORMS CO., INC., NORFOLK, VA. 23501

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 21 — OUR FILE NO. L-1148

LOCATION Portsmouth, VA — CLIENT'S ORDER

PROJECT Atlantic Creosote SAMPLER ____ S.S. ____ CASING LENGTH ____ DIA. ____ DATE STARTED 5/31/84

SURF. ELEV. ____ WATER ELEV: IMMEDIATE 2.0 ft AFTER ____ HRS. ____ DATE COMPLETED 5/31/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	4-6-4-2	2	2.0	Light grey and light brown silty fine sand w/clay and trace of shell fragments - moist - loose - SM
		2	2-2-3-9	4		Light grey silty fine sand w/organics - moist- loose - SM
		3	3-2-5-5	6	5.5	
		4	4-4-2-1	8	8.0	Med. brown clayey silty fine sand - wet - loose - SM Same - light grey
		5	2-1-1-1	10	10.0	Med. grey silty clay - wet - soft - CL
				15		10.0 ft. well installed w/screen from -2 ft. to -10
				20		
				25		

*STANDARD PENETRATION INDICATED FOR EACH 6 INCHES OF DRIVE OF SPLIT TUBE SAMPLED.

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FORM L-104-A-1 GATLING BUSINESS FORMS CO., INC., NORFOLK, VA. 23501

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 22
LOCATION Portsmouth, VA
PROJECT Atlantic Creosote SAMPLER ____ S.S. ____ CASING LENGTH ____ DIA. ____ DATE STARTED 5/30/84
SURF. ELEV. ____ WATER ELEV: IMMEDIATE 2.0 ft AFTER ____ HRS. ____ DATE COMPLETED 5/30/84

OUR FILE NO. L-1148
CLIENT'S ORDER ____

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1		2		
		2	4-3-2-7	4		Light grey silty fine sand - moist - loose - SM
		3	1-1-1-1	6	5.0	Light grey silty clay - wet - soft - CL
		4	1-1-1-1	8		fn-md sand w/ silty clay lenses Same w/med. grey silty fine sand lenses
		5	1-1-1-3	10	10.0	Same w/fine sand and organcis
						10.0 ft. well installed w/screen from -2 ft. to -10
				15		
				20		
				25		

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FORM L-104-A-1 GATLING BUSINESS FORMS CO., INC., NORFOLK, VA. 23502

McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 24
OUR FILE NO. L-1148
LOCATION Portsmouth, VA
CLIENT'S ORDER
PROJECT Atlantic Wood SAMPLER ____ S.S. ____ CASING LENGTH ____ DIA. ____ DATE STARTED 9/10/84
SURF. ELEV. ____ WATER ELEV: IMMEDIATE 8.5 ft AFTER ____ HRS. ____ DATE COMPLETED 9/10/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Mat'l. & Color Change	DESCRIPTION
				0		
		1	6-5-4-3	2	2.5	Dark brown clayey silty fine sand - moist - loose - SM
		2	4-2-1-3	4	4.5	Med. brown silty clayey fine sand - moist - loose - SC-CL
		3	2-2-4-4	6	6.5	Med. brown fine sandy silty clay - moist - med. stiff- CL
		4	3-3-2-3	8	9.0	Light brown silty fine sand - wet - loose - SM
		5	3-3-4-5	10		Light brown fine sand - wet - loose - SP
		6	4-4-6	15	19.0	Same - light grey - saturated
		7	2-1-1	20	20.5	Med. grey clayey silty fine sand and shell fragments- wet - very loose - SM
						20.0 ft well installed w/screen from -10.0' to -20.0'
				25		

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FORM L-104-A-1 GATLING BUSINESS FORMS CO., INC., NORFOLK, VA. 23502

McCallum Testing Laboratories, Inc.

BORING NO. 25 | CHESAPEAKE, VIRGINIA 23325 | OUR FILE NO. L-1148

LOCATION Portsmouth, VA | **LOG OF BORINGS** | CLIENT'S ORDER

PROJECT Atlantic Wood SAMPLER ____ S.S. ____ CASING LENGTH ____ DIA. ____ DATE STARTED 9/10/84

SURF. ELEV. ____ WATER ELEV: IMMEDIATE 7.0 ft AFTER ____ HRS. ____ DATE COMPLETED 9/10/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Mat'l. & Color Change	DESCRIPTION
				0		
		1	7-5-4-3	2	3.0	Dark brown and black silty fine sand - wet - loose - SM
		2	5-3-3-2	4		Light brown silty clayey fine sand - moist - loose - SC-CL
		3	2-3-3-4	6	5.5	
					6.5	Light brown silty fine sand - moist - loose - SM
		4	3-3-4-6	8		Light brown fine sand - wet - loose - SP-SM
		5	2-1-3-2	10		Same
		6	5-7-6	15	19.0	Same - light brown and light grey - med. compact
		7	2-1-1	20	20.0	Med. grey silty clay - wet - soft - CL
					20.5	Shell fragments w/med. grey silty clay-wet-very loose
						20.0 ft. well installed w/screen from -10' to -20'
				25		

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McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 26

LOCATION Portsmouth, VA

PROJECT Atlantic Wood SAMPLER ______ S.S. ______ CASING LENGTH ____ DIA. ______

SURF. ELEV. ______ WATER ELEV: IMMEDIATE 7.0 ft AFTER ______ HRS. ______

OUR FILE NO. L-1148

CLIENT'S ORDER ______

DATE STARTED 9/10/84

DATE COMPLETED 9/10/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	1-1-1-0		1.0	Dark brown silty fine sand - moist - very loose - SM
				2		Med. brown silty clayey fine sand - wet - very loose - Sc-CL
		2	1-1-1-1	4		Same
		3	2-1-1-0	6	6.0	Same
		4	2-4-6-6	8		Light brown silty fine sand - wet - loose - SM
		5	4-2-1-2	10		Same w/12" med. brown silty clay lens at 8.0 ft.
		6	8-10-12	15		Same - med. grey w/med. grey silty clay lenses - med. compact
					19.0	Med. grey silty clay - wet - soft - CL
		7	1-1-1	20	20.5	
						20.0 ft. well installed w/screen from -10.0' to -20
				25		

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McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 27

OUR FILE NO. L-1148

LOCATION Portsmouth, VA

CLIENT'S ORDER

PROJECT Atlantic Wood SAMPLER S.S. CASING LENGTH DIA. DATE STARTED 9/10/84

SURF. ELEV. WATER ELEV: IMMEDIATE 8.0 ft AFTER HRS. DATE COMPLETED 9/10/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	4-4-4-4	2		Dark brown clayey silty fine sand w/gravel - wet - loose - SM
		2	12-6-4-3	4	3.0	Med. brown silty fine sand w/wood - wet - loose - SM
		3	8-4-8-8	6		Same w/wood and organics
		4	9-7-6-6	8	6.5	Light brown fine sand - wet- med. compact - SP
		5	4-2-1-2	10	9.5	Light brown silty fine sand - wet - very loose - SM
		6	5-9-7	15		Same - light grey - med. compact
		7	1-1-1	20	19.0	Med. grey silty clay - wet - soft - CH
				25	20.5	20.0 ft. well installed w/screen from -10.0' to -20.0'

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McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 28 OUR FILE NO. L-1148

LOCATION Portsmouth, VA CLIENT'S ORDER

PROJECT Atlantic Wood SAMPLER S.S. CASING LENGTH DIA. DATE STARTED 9/11/84

SURF. ELEV. WATER ELEV: IMMEDIATE 2.5 ft AFTER HRS. DATE COMPLETED 9/11/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	2-2-1-1	2	2.0	Dark brown silty fine sand - moist - loose - SM
		2	2-2-2-2	4	4.5	Light grey silty clay - moist - soft - CL
		3	4-5-4-5	6		Light brown silty fine sand - wet - loose - SM
		4	4-4-3-2	8		Same
		5	3-4-4-4	10	14.0	Same - w/12" dark brown clayey silty fine sand lens at 8.0 ft
		6	woh/18"	15	19.0	Med. grey clayey silty fine to med. sand - wet - very loose - SM
		7	1-2-1	20	20.5	Med. grey silty clay w/shell fragments - wet - soft-CL
				25		20.0 ft. well installed w/screen from -10.0' to -20.0'

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McCallum Testing Laboratories, Inc.

CHESAPEAKE, VIRGINIA 23325

LOG OF BORINGS

BORING NO. 29 OUR FILE NO. L-1148

LOCATION Portsmouth, VA CLIENT'S ORDER

PROJECT Atlantic Wood SAMPLER S.S. CASING LENGTH DIA. DATE STARTED 9/11/84

SURF. ELEV. WATER ELEV: IMMEDIATE 3.0 ft AFTER HRS. DATE COMPLETED 9/11/84

Elev.	Casing Blows	Samp. No.	Std. Pent. (N)*	Depth	Matl. & Color Change	DESCRIPTION
				0		
		1	4-8-7-7	2	2.0	Dark brown silty fine sand - moist - med. compact- SM
		2	6-4-3-3	4		Light grey silty fine sand - saturated - loose - SM-S
		3	1-1-2-1	6	5.0	Light grey silty clay - wet - soft - CL
		4	2-2-5-6	8	7.5	Light brown silty fine sandy clay - wet - med. stiff- CL-SC
		5	2-3-3-1	10	8.5	Tan silty fine sand - wet - loose - SM
		6	5-6-9	15		Same - med. compact
		7	woh-1-0	20	19.0	Med. grey silty clay - wet - very soft - CH
					20.5	20.0 ft. well installed w/screen from -10.0' to -20.0'
				25		

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APPENDIX C

CHEMICAL ANALYSES

James W. Andrews, Ph.D.
President

Janette M. Davis
Chief Chemist, VP

SAVANNAH LABORATORIES AND ENVIRONMENTAL SERVICES, INC.

P.O. Box 13842 • Savannah, Ga. 31406
912/354-7858

REPORT OF ANALYSIS

TO: Atlantic Wood Industries
Attn: Charlie Kerr
P. O. Box 1608
Savannah, GA 31498-0301

REPORT NO. 7169

DATE RECEIVED 6/13/84

SAMPLED BY Richard Wallace, Savannah Laboratorie

IDENTIFICATION: Monitoring Well No. 5 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	7.5
Specific Conductance (μmhos/cm @ 25° C)	12200*
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	<0.05
Naphthalene	<0.005
Phenol	0.20
Phenanthrene	0.04
Total Recoverable Phenolics	0.80
Total Organic Carbon	150

*This value was determined in the laboratory.

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REPORT NO. 7169

DATE RECEIVED 6/13/84

SAMPLED BY Richard Wallace, Savannah Laboratori

IDENTIFICATION: Monitoring Well No. 7 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	6.0
Specific Conductance (µmhos/cm @ 25° C)	2600
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	<0.05
Naphthalene	1.3
Phenol	0.04
Phenanthrene	0.09
Total Recoverable Phenolics	0.29
Total Organic Carbon	72

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REPORT NO. 7169

DATE RECEIVED 6/13/84

SAMPLED BY Richard Wallace, Savannah Laborator

IDENTIFICATION: Monitoring Well No. 8 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	6.1
Specific Conductance (µmhos/cm @ 25° C)	5100
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	<0.05
Naphthalene	2.8
Phenol	0.02
Phenanthrene	0.23
Total Recoverable Phenolics	0.46
Total Organic Carbon	130

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DATE RECEIVED 6/13/84

SAMPLED BY Richard Wallace, Savannah Laboratories

IDENTIFICATION: Monitoring Well No. 9 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	6.2
Specific Conductance (μmhos/cm @ 25° C)	760
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	<0.05
Naphthalene	7.2
Phenol	0.04
Phenanthrene	0.30
Total Recoverable Phenolics	0.25
Total Organic Carbon	140

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SAMPLED BY Richard Wallace, Savannah Laboratories

IDENTIFICATION: Monitoring Well No. 10 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	6.0
Specific Conductance (μmhos/cm @ 25° C)	610
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	<0.05
Naphthalene	7.0
Phenol	0.17
Phenanthrene	0.47
Total Recoverable Phenolics	0.89
Total Organic Carbon	190

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SAMPLED BY Richard Wallace, Savannah Laboratories

IDENTIFICATION: Monitoring Well No. 11 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	6.6
Specific Conductance (μmhos/cm @ 25° C)	820
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	<0.05
Naphthalene	13
Phenol	1.6
Phenanthrene	0.56
Total Recoverable Phenolics	4.7
Total Organic Carbon	260

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REPORT NO. 7169

DATE RECEIVED 6/13/84

SAMPLED BY Richard Wallace, Savannah Laboratories

IDENTIFICATION: Monitoring Well No. 13 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	6.3
Specific Conductance (μmhos/cm @ 25° C)	800
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	<0.05
Naphthalene	<0.005
Phenol	<0.005
Phenanthrene	<0.01
Total Recoverable Phenolics	0.08
Total Organic Carbon	84

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REPORT NO. 7169

DATE RECEIVED 6/13/84

SAMPLED BY Richard Wallace, Savannah Laboratories

IDENTIFICATION: Monitoring Well No. 15 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	6.2
Specific Conductance (μmhos/cm @ 25° C)	2200
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	0.05
Naphthalene	3.2
Phenol	0.07
Phenanthrene	0.27
Total Recoverable Phenolics	1.0
Total Organic Carbon	130

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REPORT NO. 7169

DATE RECEIVED 6/13/84

SAMPLED BY Richard Wallace, Savannah Laboratories

IDENTIFICATION: Monitoring Well No. 16 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	6.3
Specific Conductance (μmhos/cm @ 25° C)	1400
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	<0.05
Naphthalene	9.8
Phenol	0.01
Phenanthrene	0.13
Total Recoverable Phenolics	3.7
Total Organic Carbon	120

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DATE RECEIVED 6/13/84

SAMPLED BY Richard Wallace, Savannah Laboratories

IDENTIFICATION: Monitoring Well No. 17 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	6.6
Specific Conductance (µmhos/cm @ 25° C)	600
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	13
Naphthalene	0.81
Phenol	0.17
Phenanthrene	0.05
Total Recoverable Phenolics	1.5
Total Organic Carbon	210

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DATE RECEIVED 6/13/84

SAMPLED BY Richard Wallace, Savannah Laboratories

IDENTIFICATION: Monitoring Well No. 19 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	6.6*
Specific Conductance (μmhos/cm @ 25° C)	2000*
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	9.2
Naphthalene	46
Phenol	3.1
Phenanthrene	31
Total Recoverable Phenolics	40
Total Organic Carbon	440

*These values were determined in the laboratory.

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912/354-7858

REPORT OF ANALYSIS

TO: Atlantic Wood Industries
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P. O. Box 1608
Savannah, GA 31498-0301

REPORT NO. 7169

DATE RECEIVED 6/13/84

SAMPLED BY Richard Wallace, Savannah Laboratories

IDENTIFICATION: Monitoring Well No. 20 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	6.2
Specific Conductance (μmhos/cm @ 25° C)	5600
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	0.09
Naphthalene	8.4
Phenol	0.13
Phenanthrene	0.13
Total Recoverable Phenolics	1.6
Total Organic Carbon	96

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Savannah, GA 31498-0301

REPORT NO. 7169

DATE RECEIVED 6/13/84

SAMPLED BY Richard Wallace, Savannah Laboratories

IDENTIFICATION: Monitoring Well No. 21 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	6.8
Specific Conductance (μmhos/cm @ 25° C)	1200
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	<0.05
Naphthalene	0.62
Phenol	0.08
Phenanthrene	<0.01
Total Recoverable Phenolics	0.24
Total Organic Carbon	120

James W. Andrews, Ph.D.

James W. Andrews, Ph.D.
President
Janette M. Davis
Chief Chemist, VP

SAVANNAH LABORATORIES AND ENVIRONMENTAL SERVICES, INC.

P.O. Box 13842 • Savannah, Ga. 31406
912/354-7858

REPORT OF ANALYSIS

TO: Atlantic Wood Industries
Attn: Charlie Kerr
P. O. Box 1608
Savannah, GA 31498-0301

REPORT NO. 7169

DATE RECEIVED 6/13/84

SAMPLED BY Richard Wallace, Savannah Laboratories

IDENTIFICATION: Monitoring Well No. 22 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	6.8
Specific Conductance (μmhos/cm @ 25° C)	940
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	<0.05
Naphthalene	0.01
Phenol	0.07
Phenanthrene	<0.01
Total Recoverable Phenolics	0.42
Total Organic Carbon	96

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President
Janette M. Davis
Chief Chemist V.P.

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REPORT OF ANALYSIS

TO: Atlantic Wood Industries
Attn: Charlie Kerr
P. O. Box 1608
Savannah, GA 31498-0301

REPORT NO. 7472

DATE RECEIVED 7-30-84

SAMPLED BY Client

IDENTIFICATION: Monitoring Well No. 23 at Portsmouth Plant

METHODS: EPA - SW 846 - All analysis were run on water layer of sample.

Parameters	Results - mg/l (unless stated)
pH (units)	7.2*
Specific Conductance (µmhos/cm @ 25° C)	2200*
Arsenic	<0.01
Chromium	<0.01
Copper	<0.05
Pentachlorophenol	<0.05
Naphthalene	<0.005
Phenol	<0.005
Phenanthrene	<0.01
Total Recoverable Phenolics	0.05
Total Organic Carbon	20

*These values were determined in the laboratory.

James W. Andrews, Ph.D.

Portsmouth

James W. Andrews, Ph.D.
President

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Chief Chemist, VP

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REPORT OF ANALYSIS

TO: Atlantic Wood Industries
Attn: Charlie Kerr
P. O. Box 1608
Savannah, GA 31498-0301

REPORT NO. 7820

DATE RECEIVED 9-24-84

SAMPLED BY Client

IDENTIFICATION: Monitoring Well No. 24 at Portsmouth Plant

METHODS: EPA - SW 846

Parameters	Results - mg/l (unless stated)
pH (units)	6.8
Specific Conductance (μmhos/cm @ 25° C)	1650
Arsenic	<0.01
Chromium	<0.01
Copper	<0.01
Pentachlorophenol	0.84
Naphthalene	5.5
Phenol	0.44
Phenanthrene	0.37
Total Organic Carbon	48
Total Recoverable Phenolics	0.92

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REPORT NO. 7820

DATE RECEIVED 9-24-84

SAMPLED BY Client

IDENTIFICATION: Monitoring Well No. 25 at Portsmouth Plant

METHODS: EPA - SW 846

Parameters	Results - mg/l (unless stated)
pH (units)	6.8
Specific Conductance (μmhos/cm @ 25° C)	900
Arsenic	0.01
Chromium	<0.01
Copper	0.06
Pentachlorophenol	1.6
Naphthalene	5.0
Phenol	<0.01
Phenanthrene	0.34
Total Organic Carbon	64
Total Recoverable Phenolics	0.09

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REPORT NO. 7820

DATE RECEIVED 9-24-84

SAMPLED BY Client

IDENTIFICATION: Monitoring Well No. 26 at Portsmouth Plant

METHODS: EPA - SW 846

Parameters	Results - mg/l (unless stated)
pH (units)	5.2
Specific Conductance (μmhos/cm @ 25° C)	400
Arsenic	<0.01
Chromium	<0.01
Copper	0.13
Pentachlorophenol	1.6
Naphthalene	25
Phenol	<0.01
Phenanthrene	1.4
Total Organic Carbon	83
Total Recoverable Phenolics	0.06

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REPORT NO. 7820

DATE RECEIVED 9-24-84

SAMPLED BY Client

IDENTIFICATION: Monitoring Well No. 27 at Portsmouth Plant

METHODS: EPA - SW 846

Parameters	Results - mg/l (unless stated)
pH (units)	6.0
Specific Conductance (μmhos/cm @ 25° C)	290
Arsenic	0.29
Chromium	0.06
Copper	0.53
Pentachlorophenol	0.80
Naphthalene	0.85
Phenol	<0.01
Phenanthrene	1.4
Total Organic Carbon	20
Total Recoverable Phenolics	0.07

James W. Andrews [signature]
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President

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REPORT NO. 7820

DATE RECEIVED 9-24-84

SAMPLED BY Client

IDENTIFICATION: Monitoring Well No. 28 at Portsmouth Plant

METHODS: EPA - SW 846

Parameters	Results - mg/l (unless stated)
pH (units)	5.3
Specific Conductance (μmhos/cm @ 25° C)	320
Arsenic	0.02
Chromium	0.02
Copper	0.59
Pentachlorophenol	<0.04
Naphthalene	0.009
Phenol	<0.004
Phenanthrene	<0.004
Total Organic Carbon	9.3
Total Recoverable Phenolics	<0.01

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REPORT NO. 7820

DATE RECEIVED 9-24-84

SAMPLED BY Client

IDENTIFICATION: Monitoring Well No. 29 at Portsmouth Plant

METHODS: EPA - SW 846

Parameters	Results - mg/l (unless stated)
pH (units)	6.0
Specific Conductance (µmhos/cm @ 25° C)	1050
Arsenic	<0.01
Chromium	<0.01
Copper	0.12
Pentachlorophenol	0.82
Naphthalene	<0.006
Phenol	0.01
Phenanthrene	0.22
Total Organic Carbon	15
Total Recoverable Phenolics	0.02

James M. Andrews, Ph.D.