DELAWARE RIVER
COMPREHENSIVE NAVIGATION STUDY

DESIGN MEMORANDUM

FOR

SALEM RIVER, NEW JERSEY

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT
CORPS OF ENGINEERS

FEBRUARY 1993

SYLLABUS

This Design Memorandum is in partial response to a resolution adopted by the House Committee on Public Works authorizing the Delaware River Comprehensive Navigation Study (2 December 1970) and a resolution by the Senate Committee on Public Works (20 September 1974) regarding disposal of dredged material. Additionally, the Memorandum is in response to Section 859 of the Water Resources Development Act 1986 (P.L. 99-662). The existing 12 foot MLW project was adopted in 1925 and provides for an entrance channel from the Delaware River to the fixed Route 45 highway bridge in Salem, New Jersey; a distance of about five miles. The existing authorized dimensions are 150 feet wide from the Delaware River through Salem Cove narrowing to 100 feet at the cutoff at Sinnickons Landing. The existing project does not provide adequate depths to permit efficient transit of vessels, necessitating costly shipping practices of lightloading, tidal delays and use of smaller ships than those which the terminal can accommodate.

Channel depths of 14 feet MLW to 24 feet MLW and corresponding widths ranging from 160 feet to 280 feet were examined in the Interim Feasibility Report, dated July 1990, as revised May 1991. Based on the findings of that report, the recommended plan of improvement included deepening the channel to 18 feet MLW, widening to 180 feet and providing for a turning basin. The recommended plan was then analyzed by use of a ship simulator model and coordination with the Sponsor and Pilots as part of Planning, Engineering and Design (P,E&D). The resulting recommendations were minor channel adjustments, with channel widths ranging from 150 feet to 250 feet and confirmation of the proposed turning basin.

The fully-funded total cost of the project is $11,462,000 of which $8,531,000 is Federal and $2,931,000 non-Federal. The figures are based on 90% Federal and 10% non-Federal cost sharing for the general navigation features ($9,456,000 : channel, turning basin, and mitigation) and additional provision of lands, easements, rights-of-way, relocations, and dredged material disposal areas (LERRD = $1,002,000) by the non-Federal sponsor. The sponsor is also responsible for associated project costs of $983,000 , which brings the total costs for the non-Federal sponsor to $2,931,000. An additional 10% of the cost of the general navigation features less credit for LERRD may be repaid by the non-Federal sponsor over a period of 30 years. However since the LERRD value exceeds 10% of the general navigation features, no additional payments are necessary. The Federal Government is responsible for the cost of navigation aids ($21,000). Based on average annual costs of $1,372,000 and average annual benefits of $2,380,000 the benefit to cost ratio is 1.7 to 1 (October 1992 Price Level). All operation and maintenance costs, exclusive of the berthing area costs would be borne by the Federal government.

Salem River, New Jersey
Design Memorandum

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INTRODUCTION

1. The Delaware River Comprehensive Navigation Study was established to address the problems of the Federal interest in the waterways within the Delaware River system. Because the current and projected commerce on the Salem River are not dependent on the other waterways of the Delaware River, the problems at this waterway and the recommended solution to the problems were considered separately. This Design Memorandum addresses the selected plan of improvements as recommended by the Interim Feasibility Report and Environmental Assessment, July 1990. The Division Engineer's Public Notice for that report was issued in September 1990. Upon issuance, the Preconstruction, Engineering, and Design (PED) studies were initiated. Thereafter, the July 1990 report was reviewed by the Washington Level Review Center (WLRC). In response to comments raised during that review process, the Interim Feasibility Report was modified (report dated May 1991) to incorporate additional data. The modified report did not alter previous recommendations and is referred to hereafter in this report as the Interim Feasibility Report and Environmental Assessment.

PERTINENT DATA

2. This section presents pertinent physical and economic data for the selected plan based on the results of PED studies.

Physical and Economic Data for the Selected Plan

3. The Port of Salem is located in Salem County, New Jersey, on the tidal portion of the Salem River. The Salem River enters the Delaware River at Mile 60, about 45 miles south of Philadelphia, Pennsylvania. Refer to Plates 1 and 2.

4. The selected plan as shown on Plates 3,4, and 5 consists of a five mile long navigation project extending about three miles up from the Delaware River main channel to the Salem Cove and then upstream to the Penns Neck highway bridge at Route 49, a distance of about two miles. The selected plan provides for a 150 to 250 foot wide one-way channel with an eighteen (18) foot MLW depth.

5. Channel dimensions are based on a design vessel of 50 feet wide by 330 feet long with a 21.5 foot draft, single screw propulsion thrusters and an accompanying tug with a

ten foot beam. Channel widths were originally based on EM 1110-2-1613, "Hydraulic Design of Deep Draft Navigation Projects", dated 8 April 1983, for one-way traffic with good vessel maneuverability. Bank clearances of 60% beam width and a channel width of 180% beam width are required. This design was then analyzed by the Waterways Experiment Station (WES) by use of a ship simulator model in accordance with the regulations set forth in ER 1110-2-1461, "Design of Navigation Channel Using Ship Simulation Technique" dated 31 October 1989. The resulting analysis indicated minor adjustments to the channel layout were required as documented in WES's letter report contained in Appendix B. Channel dimensions and alignment were further refined in consideration of input from the Sponsor and Pilots Association that resulted in the final selected plan.

6. Turning basin geometry was determined using EM 1110-2-1613 which requires a turning basin diameter of 1.5 times the design vessel length. The turning basin dimensions are based on a length of 495 feet in order to accommodate the design vessel. The resulting dimensions satisfy Corps criteria of 150% of the design vessel length for transit under design conditions. The dimensions were also confirmed by the simulator model and the Pilots. The selected plan incorporates a berth at Barber's Basin (Berth 1) and three berths at the municipal Port with the access areas as shown on Plate 5.

7. To widen the channel and construct the turning basin, it will be necessary to excavate shallows and wetlands. A mitigation site located within the Supawana Meadows Wildlife Refuge will be constructed. Using a combination of wetland creation and restoration techniques, a total of 6.0 acres of wetlands will be created and 11.2 acres restored to fulfill the Corps Mitigation requirements. (See Plates 9 and 10 and Appendix E).

8. Under improved conditions of an 18 foot channel depth, each of the berths would be deepened to 22 feet. The larger vessels in the fleet use high tide to navigate the Salem River Channel, and would require additional depth at the berths for loading and unloading operations that take place over the full tidal cycle. The total fully-funded cost of the project is $11,462,000 of which $8,531,000 is Federal and $2,931,000 is non-Federal. The figures are based on 90% Federal and 10% non-Federal cost sharing for the general navigation features ($9,456,000: channel, turning basin, and mitigation) and additional provision of lands, easements, rights-of-way, relocations, and dredge material disposal areas (LERRD = $1,002,000) by the non-Federal sponsor. The sponsor is also responsible

for associated project costs of $983,000, which brings the total costs for the non-Federal sponsor to $2,931,000. An additional 10% of the cost of the general navigation features less credit for LERRD may be repaid by the non-Federal sponsor over a period of 30 years. However since the LERRD value exceeds 10% of the general navigation features, no additional payments are necessary. The Federal government is responsible for the cost of aids to navigation ($21,000). Based on average annual costs of $1,372,000 and average annual benefits of $2,380,000 the benefit to cost ratio is 1.7 to 1 (October 1992 Price Level). All operation and maintenance costs, exclusive of the berthing area costs would be borne by the Federal government. Refer to Table 1, Summary of Physical Data for Selected Plan and Table 2, Summary of Economic Data for Selected Plan.

TABLE 1

SUMMARY OF PHYSICAL DATA
FOR SELECTED PLAN

Item	Data
Channel Length	5 miles
Channel Width	Variable (150 feet to 250 feet)
Channel Depth	-18 feet MLW
Dredging Quantities:	
Federal - Project	
Initial Construction	936,600 c.y.
Annual Maintenance	60,200 c.y.
(or 180,600 c.y. with a three year cycle)	
Non-Federal - Associated Cost	
Initial Construction	97,200 c.y.
Annual Maintenance	2,500 c.y.
(or 7,500 c.y. with a three year cycle)	
Turning Basin Width	495 ft.
Turning Basin Depth	-18 feet MLW
Mitigation	
Wetlands Created	6.0 acres.
Wetlands Restored	11.2 acres.
	17.2 acres.

TABLE 2

SUMMARY OF ECONOMIC DATA
FOR SELECTED PLAN
(OCTOBER 1992 PRICE LEVEL, 8-1/2% DISCOUNT RATE)

First Cost of Construction	
Federal Project:	$ 9,535,000
Associated Cost:	$ 877,000
Total	$10,412,000
Interest During Construction:	$ 362,000
Project Investment Cost	$10,774,000
Average Annual Cost	
First Costs	$ 932,000
Operation and Maintenance	$ 770,000
Total	$ 1,702,000
Average Annual Costs (Netting Out 12 Ft. W/O Project Condition)	$ 1,372,000
Total Average Annual Benefits	$ 2,380,000
Net Benefits	$ 1,008,000
Benefit - Cost Ratio	1.7 to 1

Costs in October 1992 Price Level for BCR analysis (See Tables 5 & 6).

PROJECT AUTHORIZATION

9. This Design Memorandum is in response to Section 859 of the Water Resources Development Act of 1986 (P.L. 99-662), which states:

> Subject to Section 903(b) of this Act, the project for navigation, Salem River, New Jersey, is modified to provide that the depth of such project shall be 20 feet.

Existing Project

10. The existing Salem River navigation project provides for an entrance from the Delaware River at Elsinboro Point, New Jersey to the State Route 45 highway bridge in the City of Salem with dimensions and limits as shown in Plate 2. The 12 foot authorized depth of the Salem River was authorized in 1925 and constructed in 1928 from the mouth to Penns Neck Bridge (Route 49). However, the channel was not maintained between 1961 and 1984 due to an absence of commercial navigation. The Little Salem River (also known as Fenwick Creek) portion, has never been constructed to a 12 foot depth. The Little Salem River was deauthorized in December 1989 under the provisions of Title X of the Water Resources Development Act of 1986. Under the provisions of the, Act the Little Salem River authorization reverts to the 9 foot depth constructed in 1907.

Selected Plan

11. In accordance with the May 1991 Interim Feasibility Report, economic development could not support the 20-foot project but optimized at 18-foot MLW. The selected plan deepens the existing project from 12-foot MLW to 18-foot MLW and widens the existing channel from 100 - 150 feet to 150 - 250 feet. Towards the upstream end, a 495-foot turning basin will be constructed to a depth of 18 feet MLW. Mitigation for shallows and wetlands lost due to the proposed channel construction will be at Supawna Meadows Wildlife Refuge, a location near the project site which is under the jurisdiction of the U.S. Fish and Wildlife Service.

LOCAL COOPERATION

12. Throughout the PED process, numerous coordination meetings were held to assure that the sponsor was aware of the progress of the project. As part of this coordination, they expressed their continued support for the project before the Board of Engineers for Rivers and Harbors in March 1991 and participated in the verification process of the Simulation Model. That model was developed by the Waterways Experiment Station to refine the design recommendations of the Feasibility Report.

13. In order to implement the project as proposed in this report, the project related costs and responsibilities are shared in accordance with the Water Resources Act of 1986 (PL 99-662). These are described in a Local Cooperation Agreement (LCA) which will be entered into by both the Port of Salem (the non-Federal sponsor for this project) and the Corps of Engineers (See Appendix F).

14. These requirements include:

Provision and maintenance at local expense such depths from the Federal channel line to and between the wharves at the terminal (berthing areas) as may be required for the accommodation of vessels at the terminal, consistent with the Federal project.

Provision to the United States of all lands, easements, rights-of-way, and relocations necessary for the construction, and subsequent operation and maintenance of the project including suitable areas, determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of dredged material and necessary retaining dikes, bulkheads, and embankments therefore, or the costs of such retaining works.

Holding and saving the United States free from damages due to construction, operation, and maintenance, except for damages due to the fault or negligence of the United States or its contractors.

Provision during the period of construction of 10 percent of the cost of construction associated with general navigation features and an additional 10 percent of the cost of the general navigation features of the project in cash over a period not to exceed 30 years, at an interest rate determined pursuant to Section 106 of Public Law 99-662. The value of lands, easements, rights-of-way, relocations, and dredged material disposal areas provided shall be credited toward the additional 10 percent payment.

Accomplishment without cost to the United States of all alterations and relocations as required in sewer, water supply, drainage, and other utility facilities.

Compliance with applicable provision of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1978 (P.L. 91-646) and implementing regulations.

Compliance with Section 601 of the Civil Rights Act of 1964 (P.L. 83-352).

Establishment of regulations prohibiting discharge of untreated sewage, garbage, industrial waste, and other pollutants into the water of the port by users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State, and local authorities responsible for pollution prevention control.

Assumption of financial responsibility for cleanup of hazardous material located on project lands and covered under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

15. The Port of Salem has been furnished a copy of the Draft Local Cooperation Agreement which follows the applicable guideline for navigation projects (refer to Appendix F). The funding source for the non-Federal financing of the project is the State of New Jersey as indicated in a letter from Governor Florio dated 11 March 1991. This was reiterated in a more recent letter from the Port of Salem dated 21 September 1992. Pertinent correspondence is included at Appendix A.

INVESTIGATIONS

16. All prior studies pertinent to the study project area are discussed in the following paragraphs:

<u>Salem River - Previous Studies</u>

17. The River and Harbor Act of July 11, 1870 provides for the first Federal surveys of the Salem River. Subsequently a nine foot MLW channel was adopted in 1907 at an authorized width of 100 feet. The existing 12 foot project, adopted as HD 68-110 in 1925, is five miles long and provides for an entrance channel from the Delaware River to the Route 49 highway bridge in Salem, New Jersey, south of the Little Salem River. The improved draft from 9 feet to 12 feet was recommended to accommodate vessels

utilizing the Chesapeake and Delaware Canal which was under reconstruction at the time. The Salem River dimensions are 150 feet wide from the Delaware River through Salem Cove and 100 feet wide along the cutoff from the "Horseshoe Bend" near Sinnicksons Landing to the port. This cutoff, constructed as part of the 1925 authorization, saves vessels one mile traveling from Salem to deep water in the Delaware River.

Salem River Port Redevelopment Plan

18. The Salem River Housing Authority and Community Development Agency completed a plan in 1982 for redeveloping the Port of Salem prior to the formation of the Salem Port Authority. This plan examined existing zoning statutes, land use patterns, cultural/historic areas, and transportation and utility networks and made a series of recommendations for port redevelopment, many of which were subsequently accomplished. The recommendations were intended to provide a framework for industrial land use associated with the proposed port.

Salem River Maintenance Dredging Environmental Assessment

19. The U.S. Army Corps of Engineers conducted an environmental assessment of the dredging and open water disposal of dredged material prior to the 1984 maintenance dredging of 350,000 c.y. of material from the lower Salem River. That environmental assessment determined that the maintenance project was in full compliance with all environmental protection statutes and environmental review requirements.

HYDROLOGY AND HYDRAULICS

General

20. The Salem River navigation project is located in the Delaware River estuary between river miles 58 and 61 (above the mouth). The Delaware River at this point drains over 11,000 square miles of New York, New Jersey, Pennsylvania, and Delaware. The study area is near the middle of the tidal zone of the Delaware estuary, with a mean tide range at the confluence of the Salem and Delaware Rivers of 5.6 feet, and a spring tide range of 6.1 feet.

21. Salem River discharges into Salem Cove, an embayment on the eastern side of the Delaware estuary. The total drainage area of Salem River above its mouth includes 117 square miles, consisting of upland areas and the broad, shallow tide-influenced area referred to as Mannington Meadow, all within Salem County, New Jersey.

22. The authorized navigation project occupies approximately two miles at the downstream end of the Salem River, and extends an additional three miles across Salem Cove to deep water in the Delaware River. Flows in the navigation project section of the Salem River are predominantly tidal, driven by the semi-diurnal tides of Delaware River. The National Ocean Service Tidal Current Tables report the average maximum flood current speed at the entrance to Salem River as 1.5 knots, with an average maximum ebb current speed of 1.6 knots. Currents upstream of the entrance, where flow is confined between banks only slightly wider than the authorized channel width are reported by river pilots to attain 6 to 7 knots under some conditions.

Salinity

23. The salinity of the Salem River project area is controlled by the combined effects of the ambient salinity of the Delaware River and rainfall over the Salem River drainage area. Delaware River salinity has been monitored by the U.S. Geological Survey since 1963 at the Reedy Island dike, approximately three miles southwest of the Salem River entrance. The salinity is computed from measurements of specific conductance and temperature of the river water, and daily minimum, maximum, and mean values are recorded. Although the long-term mean salinity at the

Reedy Island gage site is approximately 5 to 6 ppt (dissolved solids in parts per thousand by weight), variations in salinity occur due to semi-diurnal tidal effects on the Delaware River and Bay, as well as seasonal and flood/drought effects over the Salem and Delaware drainage basins. The maximum salinity observed at the gage over the period of record was approximately 23 ppt on 15 November 1978 with a minimum salinity of less than 0.1 ppt occurring on a number of occasions in 1969 and 1970.

24. Salinity in the navigation project area principally reflects ambient salinity of the adjacent Delaware River. The Mannington Meadow estuary lies above the upstream limit of the navigation project. Detailed salinity studies were conducted in Mannington Meadow by Rutgers University investigators in 1972 and 1973. Those salinity measurements reflect the dilution of ambient Delaware River water by freshwater inflow from the adjacent drainage area. Salinities in the Mannington Meadow area generally are in the range of 20 to 80 percent of the corresponding two-day mean salinities at the Reedy Island gage site.

25. The proposed deepening of the Salem River navigation channel will not induce any changes on the salinity regime of the Mannington Meadows estuary. The controlling section channel zone and Mannington Meadows consist of a approximately 1000 feet of channel centered approximately on the Route 49 bridge. This section will not be enlarged by the proposed navigation channel deepening. The controlling cross-section is substantially smaller than the channel area upstream and downstream of the bridge and is armored with stone in the immediate vicinity of the bridge for scour protection. This zone presently acts as the control on tidal exchange into Mannington Meadows and will continue to act in this manner with the recommended channel deepening in place.

Shoaling and Maintenance Dredging Analysis

26. The channel bottom sediments along the navigation project consist primarily of fine sand and silt, with minor fractions of gravel and clay-size present. The earliest reported improvement to Salem River in the interest of navigation was dredging across the bar in Salem Cove in 1878. Subsequent to that effort, the Salem River navigation project was enlarged in both width and depth. In 1928 the present authorized dimensions and new cut in the upstream reach of the project area were established. In 1934, 1937, and 1945, maintenance dredging was required in the uppermost portion of the project as authorized, in an area known as the Little Salem River. This is immediately upstream of the Route 49 bridge which serves as the upstream limit of the project as presently modified.

27. Due to the absence of commercial navigation in the Little Salem River section since 1945, subsequent maintenance dredging has involved only the portion of river downstream of the Route 49 bridge. Within the presently operated project area, shoaling and resulting maintenance dredging have been confined to a zone approximately 12,000 feet long where the channel transits Salem Cove. Upstream of the transition from Salem Cove into the Salem River proper, no maintenance dredging has been required since 1946, as depths in this portion of the project upstream to the Route 49 bridge have naturally exceeded the authorized depth of 12 feet and have exhibited no trend towards shoaling. The average annual maintenance dredging quantity necessary for the existing 12 foot project was determined to be 22,500 cubic yards per year, with a maintenance interval of four years.

28. The shoaling and maintenance dredging analysis performed for the Feasibility Study is considered to be valid for continuation into the Design Memorandum phase of this project. The analysis was based on procedures presented in ETL 1110-2-293, "ENTRANCE CHANNEL INFILL RATES" dated 15 March 1984. The specific technique adopted for this analysis is referred to as the "Volume of Cut Method". This method is the only one of the several methods presented in the referenced ETL applicable to the Salem project, given the physical environment of the project and the types of data available for the existing and proposed channels. The historic data base for this project consists of dredging quantity summaries and hydrographic surveys for maintenance dredging performed in 1946, 1960, 1984, and 1988. The most recent surveys performed between December 1990 and March 1991 were also obtained and analyzed.

29. The "volume of cut" method is an empirical technique which requires some period of record of maintenance dredging for a project at a given set of depth and width dimensions. The method assumes that modifications which deepen and/or widen the channel increase the shoaling rate by a factor related to the increased "volume of cut" beyond the natural equilibrium dimensions for the channel. Shoaling rates were first developed for the existing, authorized 12 foot by 150 foot channel. Then the factors corresponding to the channel alternative were developed to estimate the "with project" shoaling rate. The estimated average annual maintenance dredging requirement for the selected plan is 37,700 cubic yards per year, with a total three-year dredging cycle amount of 180,600 cubic yards, assuming maintenance of the existing 12-foot project (22,500 c.y.) is performed concurrently.

Salem River Navigation (Ship Simulation) Analysis

30. A ship simulator analysis was performed for the PED phase of this investigation in accordance with the requirements set forth in ER 1110-2-1461 dated 31 October 1989. The study was scoped with participation of the Philadelphia District, CECW-EH, and CEWES-HR. Representatives of each of the three organizations participated in a site visit including a boat transit of the project channel in December 1990. A formal proposal of study was prepared by CEWES-HR and submitted to Philadelphia District in April 1991. The study was accepted by the District and funded in April 1991, and recommendations and a final report were provided by WES in January 1992.

31. The ship simulator study consisted of the following principal tasks:

(A) Existing and proposed channel data base development.

(B) Ship model development.

(C) Hydrodynamic modeling.

(D) Radar based simulation testing.

(E) Data analysis.

(F) Letter report.

32. The channel data base was developed from hydrographic surveys of the project obtained by the District between December 1990 and March 1991. The surveys were marked to indicate the existing channel alignment as well as the alignment, width, and depth proposed in the Feasibility Study (180 foot wide X 18 foot deep channel).

33. Two ship models were developed for the study. The first represented the existing project design vessel (the Bermuda Islander), which is the most frequent user of the project. Its dimensions are length = 262 feet, beam = 43.3 feet, and draft = 15.5 feet. The second model represented the design vessel for the proposed project, and the dimensions and propulsion of this vessel were based on those of the Tajo, with dimensions of length = 327 feet, beam = 49.9 feet, and draft = 21.5 feet.

34. The hydrodynamic modeling was performed using the WES TABS-2 model. This is a two-dimensional finite-element model which simulates currents and stages derived from user-input tidal and wind boundary conditions. The conditions simulated in the TABS-2 model runs represented the typical spring tide range in the Delaware River with 20 knot winds from the south. As ship transits of the Salem channel are always accomplished on the flood tide, only flood conditions were applied in the ship simulations. Model verification data were obtained by the District under spring tide conditions in August 1991.

35. The radar-based simulation testing was performed by the three pilots who presently handle all ship traffic on the Salem River. The first pilot performed the ship model verification, while the other two pilots performed the model test runs. A total of 24 test runs were made, consisting of: three channel options (existing - 100 to 150 foot wide and 12 feet deep, proposed - 180 foot wide and 18 feet deep, and existing deepened to 18 foot); two directions (inbound and outbound); and two ships (<u>Bermuda Islander</u> for the existing channel and <u>Tajo</u> for the proposed and existing-deepened channel). The test pilots made two runs on each combination of channel option and transit direction. (The 24 model runs were derived as follows: 3 channel configurations X 2 directions X 2 pilots X 2 runs each test = 24).

36. Based on analysis of the vessel tracks made on the 24 test runs of the model, a number of minor adjustments were recommended to the channel dimensions of the Feasibility Study plan. The channel alignment and width recommendations resulting from this analysis are shown on Figure 25 of the WES report, included as Appendix B to this document.

37. The principal modifications to the uniform 18 X 180 foot plan from the Feasibility Study consisted of adjustments in channel width. At the southern limit of the proposed improvements in Salem Cove a widening to 280 feet was recommended, with the channel width reducing to 180 feet over a distance of 2000 feet. The central portion of the channel across Salem Cove was recommended for a reduction in width to 150 feet, where the alignment of the channel and the prevailing current directions are essentially parallel. The channel bends located at and upstream of the transition from Salem Cove into the Salem River proper were recommended for widening up to as much as 350 feet total width, to allow sufficient bank clearance on

the turns. The channel through the land cut portion of the project was recommended for a width reduction from 180 to 150 feet upstream to the turning basin. The modifications recommended by the WES ship simulation study are considered in total to have negligible net effect on the estimated maintenance dredging requirements, as the channel areas recommended for widening are approximately offset by the areas recommended for a narrower channel.

38. The WES Ship Simulation study was then coordinated with the Pilots of Salem River and the Study Sponsor. In response to the results of the WES modeling, the Pilots' Association for the Bay and River Delaware recommended the channel design currently contained in the DM. Their recommendations were based upon their actual experience in navigating Salem River under current conditions and their simulated experience in operating the WES model. Their recommendations were for minor channel adjustments, with channel widths ranging from 150 feet to 250 feet and confirmation of the proposed turning basin. Refer to Plates 3, 4, and 5 for the selected channel layout. The principal effect of these recommendations on channel width and alignment is to improve the safety and efficiency with which the design vessel is able to transit the improved channel and reducing quantities for initial dredging of the channel and turning basin. WES then superimposed the Pilots' recommended channel on the ship tracking plots from the modeling and generally concluded that the two designs differed primarily in transition areas (bends), and acknowledged that these were probably a function of differing pilot startegies for approaching turns, and could be avoided with modified navigation strategies and a clearly marked channel. The Pilot's Association believes, and the District concurs, that with proper aids to navigation (Channel buoys), the final design in the DM is a fully suitable, safe, and cost effective alignment for the recommended 18-foot channel.

SURVEYING AND MAPPING

39. Updated hydrographic surveys of the Salem River navigation channel, berthing area and turning basin and mapping for both the disposal area and mitigation site are required for plans and specifications. Previous dredging records will also be cited in the contract plans and specifications.

GEOLOGY AND SOILS

General

40. The project area lies entirely within the Atlantic Coastal Plain Physiographic Province. The geology of this province is characterized by a wedge of unconsolidated sediments which thicken and dip toward the Atlantic Ocean. These unconsolidated sediments, ranging in age from Cretaceous to Holocene, rest unconformably upon the crystalline basement of Precambrian schists and gneiss and consist of pervious and impervious materials which form a series of aquifers and aquicludes.

Site Geology

41. The Salem River Study area is underlain by roughly 1,400 feet of unconsolidated Quaternary, Tertiary, and Cretaceous sediments. These sediments overlie bedrock which consists of metamorphic and igneous rocks of the upper Precambrian age. The unconsolidated formations dip to the southeast and generally thicken oceanward. The older formations are at or near the surface in the vicinity of the Delaware River and are progressively deeper toward the Atlantic Ocean.

42. The primary aquifer units within the vicinity of Salem River belong to the Wenonah Formation and Mount Laurel Sand of Cretaceous age, the Vincentown Formation of Tertiary age, and the Cape May Formation of Pleistocene age. The Wenonah Formation and Mount Laurel Sand and the Vincentown Formation outcrop in and around the Salem River in bands trending southwest to northeast while the Cape May deposits blanket areas of the older formations. In some locations in or adjacent to the Salem River, these aquifer units are mantled by recent alluvial deposits.

43. The Wenonah Formation and overlaying Mount Laurel Sand function as a single hydrologic unit. They comprise a highly used aquifer and an important source of water for future development. The Wenonah Formation overlies the Cretaceous Marshalltown Formation, a leaky aquiclude composed of sandy clay. The Woodbury Clay, also a Cretaceous age, underlies the Marshalltown Formation and constitutes a widespread major aquiclude.

44. The Mount Laurel Sand is overlain by the Navesink Formation of Cretaceous age, which is in turn overlain by the scarcely distinguishable Hornerstown Sand of Tertiary age. These deposits are composed of sand with varying amounts of silt and clay, and function together as a leaky confining unit for the underlying Mount Laurel aquifer The Vincentown Sand overlies the Hornerstown Sand and is an important local source of water supply.

45. The Cape May Formation is predominantly composed of sands and gravels. In areas where the Cape May deposits are not thick enough to function as an aquifer, their chief hydrologic function is to absorb precipitation and transmit it to underlying formations. If these formations are pervious, a hydraulic connection exists between the shallow water table aquifers in the Cape May Formation and the underlying materials.

Groundwater Quality

46. Groundwater in the vicinity of Salem Cove generally has natural total dissolved solids concentrations of less than 500 mg/l; this corresponds with New Jersey Department of Environmental Protection (NJDEP) Groundwater Class GW2. Designated uses and quality criteria for this class are:

> Suitable for potable, industrial, or agricultural water supply, after conventional water treatment (for hardness, ph, Fe, Mn, and chlorination) where necessary, or for the continual replenishment of surface waters to maintain the quantity and quality of the surface waters of the State and other reasonable uses (NJDEP 1978).

47. Groundwater beneath the study area in the Cape May Formation, Mount Laurel Sand and Wenonah Formation, and Raritan Formation is influenced by the major recharge areas of the respective aquifers. The Cape May Formation receives induced recharge from the Delaware River between Wilmington and Trenton and is also recharged by rainwater infiltration. The formation's hydraulic gradient in the study area is generally toward the Delaware River. Tidal action and supply well pumpage can locally control or reverse groundwater gradients. The relatively impermeable Holocene alluvium acts as only a partial barrier to saltwater intrusion from the Delaware River.

48. The groundwater recharge area of the Mount Laurel Sand and Wenonah Formation is approximately parallel to and midway between the Delaware River and the Atlantic Ocean. The major source of recharge is rainwater infiltration and leakage from the overlying Cape May Formation. The hydraulic gradient is generally toward the southwest; however, local reversals occur due to the effect of pumping wells for water supply and tidal action. Leakage from the Cape May Formation has introduced salt water into this aquifer. In addition, iron concentrations are extremely high in the formation.

49. Because of the overlying aquiclude, groundwater in the Raritan Formation aquifer is recharged mainly in outcrops in urbanized areas immediately west of the Delaware River, including the City of Philadelphia, and by the Delaware River reach extending from Wilmington to Trenton. The aquifer hitorically has provided good quality water. However, in recent years groundwater quality has been degraded in portions of the aquifer upgradient of the study area. Changes have occurred in concentrations of dissolved solids, chlorides, alkalinity, iron, and manganese. Concentrations of iron and manganese greatly exceed the New Jersey groundwater standards. The changes in groundwater quality can be attributed in part to conditions characteristic of an urban recharge area and can be expected to eventually affect groundwater quality in the study area.

Subsurface Investigation

50. A subsurface exploration program was conducted in the Spring of 1985 which consisted of 22 borings throughout the proposed project in order to determine the nature of the material to be dredged. Plates 6 through 8 form a boring location plan and Appendix D contain the boring logs from the program. The majority of the borings revealed the dredge material to be a low plasticity clay mixed with some sand, silt and gravel. As part of the archaeological investigation, a diver surveyed the bottom in the vicinity of station 17+80. The report indicated that imbedded in the clay and silt of the river bottom were cobbles and boulders. The report describes the stone as "palm size to basketball size." These particular cobbles and boulders were discovered because they had a high iron content which showed up in the magnetometer survey. It is assumed that there will be occasional cobbles in parts of the excavated channel. The only appreciable granular material exists between stations 8+000 and 13+000 and consists of sand, gravel, intermixed with clays and silts.

Geotechnical Analysis

51. The implementation of the selected plan, to a depth of 18 feet, means the removal of silt and clay deposits in the upper channel and cutting a wider and deeper channel into the Mt. Laurel-Wenonah formation in the lower channel. A large portion of the Mt. Laurel-Wenonah formation is directly exposed to the waters of the Salem and Delaware Rivers in the vicinity of the project. The boring program confirms what the existing literature states about a thin layer of Holocene alluvium providing limited cover in some places for this aquifer. The recharge for the Mt. Laurel-Wenonah formation is provided by groundwater in the midsection of the state of New Jersey as detailed above and from the leaky Cape May aquifer overlying the formation.

52. A review of available literature suggests that the Mt. Laurel-Wenonah aquifer has already suffered some limited salt water intrusion, by vertical leakage from the overlying water table aquifer from the Vincentown and Cape May formations.

53. The hydraulic gradient of the aquifer runs from central New Jersey to the southwest and toward the Salem and Delaware Rivers. The potential for local reversal of this gradient exists due to overpumping, especially in times of drought. The selected plan will slightly increase the exposure of the Mt. Laurel-Wenonah aquifer especially in the lower channel by removing portions of the recent Holocene alluvium.

54. The potential for salt water intrusion into the Mt. Laurel-Wenonah aquifer in the vicinity of the project exists regardless of whether, or not the selected plan is constructed. The additional exposure of the aquifer to the potentially brackish water of the Salem River is considered negligible.

DESCRIPTION OF THE PROJECT

Selected Plan

55. The selected plan as shown on Plates 3,4 and 5 consists of a five mile long navigation project extending about three miles up from the Delaware River main channel to the Salem Cove and then upstream to the Penns Neck highway bridge at Route 49, a distance of about two miles. The selected plan provides for a one-way channel that varies in width from 150 feet to 250 feet (refer to Plates 3,4 and 5). Channel depth provided is 18 feet MLW. Channel dimensions are based on a design vessel of 50 feet x 330 feet with a 21.5 foot draft, single screw propulsion thrusters and an accompanying tug with a 10 foot beam. The channel dimensions were determined considering a ship simulator model in accordance with ER 1110-2-1461, "Design of Navigation Channel using Ship Simulation Techniques", dated 31 October 1989 as modified in accordance with imput from the project sponsor and Salem River Pilots Association. The turning basin dimensions are based on a length of 495 feet in order to accommodate the design vessel and the largest anticipated vessel, with a 350 foot length. The resulting turning basin dimensions satisfy Corps criteria of 150% of the design vessel length for transit under design conditions and was confirmed by the ship simulator model, and pilot's recommendations.

56. To widen the channel and construct the turning basin, it will be necessary to excavate shallows and wetlands. A mitigation site located within the Supawana Meadows Wildlife Refuge will be constructed. (See Plates 9-10 and Appendix E).

57. The selected plan incorporates a berth at Barber's Basin (Berth 1) and three berths at the municipal Port as shown with the access areas on Plate 5. Berth dimensions are shown on Table 3.

TABLE 3

BERTH DIMENSIONS

Berth	Depth	Length	Width
1. Barber's Basin	22'	270'	70'
2. Major's Wharf	22'	400'	80'
3. Grain Elevator	22'	350'	80'
4. Dry Storage Shed	22'	350'	80'

58. The initial dredging quantity necessary to increase channel depths from the currently authorized 12 foot channel has two components, initial and associated. The Federal project quantity refers to the materials from the channel and turning basin; the non-Federal or associated quantity refers to material from the berth areas. Quantities are listed below in Table 4.

TABLE 4

DREDGE QUANTITIES

Initial Dredging - cubic yards

Project Channel		936,600
Associated		97,200
	Total	1,033,800

Dredge Material Disposal Plan

59. Based on the disposal area formulation analysis as completed as part of the May 1991 Interim Feasibility Report, all initial and maintenance dredging material will be disposed at the Killcohook (Federal) disposal area throughout the 50 year project life. The Kilcohook (Federal) disposal site is located along the Delaware River approximately 4 miles north of the entrance to the Salem River channel (see Plate 9). The average annual maintenance quantities include 22,500 cubic yards annually for the existing 12-foot project and 37,700 cubic yards annually attributed to the 18-foot project for a total average annual maintenance dredging requirement of 60,200 cubic yards. Maintenance is expected to be performed on a three-year cycle of 180,600 cubic yards. The total (initial and maintenance) quantity of project and associated dredging over the 50 year project life is about 4.2 million cubic yards.

CONSTRUCTION PROCEDURE

60. Construction of the Federal project involves three elements: preparation of the disposal area to receive the material, dredging of the channel, and construction of the mitigation site. It was assumed that dredging and transport of the material from the channel will be done using hydraulic pipeline. Transportation of the material excavated from the mitigation site will be done using trucks.

ENVIRONMENTAL CONSIDERATIONS

Environmental Analysis

61. The evaluation of environmental impacts associated with the proposed project included review of pertinent literature, preparation of a Planning Aid Report and 2(b) Report by the U. S. Fish and Wildlife Service, preparation of an Environmental Assessment and a Finding of No Significant Impact during the 1990 interim feasibility study, and coordination of these documents with appropriate Federal, State and local agencies, as well as interested members of the public. The evaluation included consideration of biological impacts, physical and chemical impacts, socioeconomic impacts, cultural resources impacts, and applicable mitigative measures.

62. The proposed dredging will result in the destruction of benthic habitat, and the loss of the existing benthic community as well as the destruction of 8.6 acres of shallow water habitat and 3 acres of estuarine intertidal emergent wetlands. This loss of shallow water habitat and wetlands will be mitigated through the creation and restoration of intertidal wetlands. The proposed mitigation plan is discussed in greater detail in the Wetland Mitigation section of this report and the complete plan is found in Appendix E. The shallow water habitat previously mentioned is defined as the area between 0 feet and -10 feet at mean low water. Construction of a larger channel will remove existing bottom surface within this range. Some benthic organisms, such as worms, would not be able to leave the dredging area. These organisms would be removed with the sediments and would not be expected to survive. Typically, benthic organisms from adjacent areas begin to recolonize disturbed areas soon after completion of dredging operations. Because sediment type and depth would be similar before and after channel modification, the recreated shallow water habitat is expected to be similar to the existing shallows. Based on available data, the slope of the new channel side is projected to approximate the slope of the existing channel side. This would result in the creation of a nearly equivalent amount of channel side as currently exists, yet some area will be lost along the flatter surfaces where channel widening is taking place. This loss represents the 8.6 acres of shallow water habitat that was discussed above.

63. Water quality may be temporarily affected in the vicinity of a working dredge by resuspension of sediment. Sediment resuspension can cause increased turbidity, increase biochemical oxygen demand with corresponding reductions in dissolved oxygen, nutrient enrichment and release of chemical contaminants. Appropriate planning and precautions have and will be taken to insure that the deepening of the Salem River navigation channel would not result in unacceptable water quality degradation. The hydraulic dredging techniques and the

upland disposal of dredged material, which will be used during this project, are considered to be the least disruptive to the existing water quality. These methods are not seasonally restricted within the Salem River project area.

64. Disposal of sediments at the Federally owned Killcohook dredged material disposal site will not adversely affect fish and wildlife resources, nor will it adversely impact cultural resources since the site was and is currently used for disposal purposes. Upland disposal of dredged material minimizes impacts to the aquatic environment by permanently removing sediments from the aquatic system. During disposal operations, effluent flowing through the discharge weir can increase suspended sediment loads within the receiving body of water. Any water quality impacts associated with this increased turbidity will be minimized through the monitoring of effluent discharge and proper operation of the weir structure.

65. Consultation with the U.S. Fish and Wildlife Service indicates that except for occasional transient species (bald eagle and peregrine falcon), no Federally listed or proposed threatened or endangered species are known to occur within the Salem River project area. It has also been determined that the proposed project will not impact endangered or threatened species under the jurisdiction of the National Marine Fisheries Service. This is confirmed by a letter from the National Marine Fisheries Service, dated January 16, 1991. As required under Section 7 of the Endangered Species Act (87 Stat. 844, as amended; 16 U.S.C. 1531 et. seq.) no further consultation is necessary.

Cultural Resources

66. A remote sensing survey was conducted for the Corps (Cox 1988) in selected project areas adjacent to the Salem River channel from Buoy 10 east to the Highway 49 Bridge in Salem, New Jersey and a proposed overboard disposal area in Salem Cove. This study, utilizing both magnetometer and side-scan sonar, identified two targets suggestive of possibly significant cultural resources. One target, located in Salem Cove, will not be impacted since overboard disposal within the cove has not been selected. The other target yielded no sonar return, indicating that the material is buried in the bottom sediment. The magnetometer results for this target created a magnetic signature consistent with that derived from documented historically significant submerged sites. Further underwater investigations determined that the anomaly was not a significant cultural resource eligible for listing in the National Register of Historic Places. The results of the magnetometer survey and underwater investigation were coordinated with the Office of New Jersey Heritage (SHPO). A comment letter dated July 26, 1991 has been received from the New Jersey SHPO which indicates their approval of the work done

and that the project will have no impact on significant cultural resources in the areas investigated.

67. An additional remote sensing survey was conducted for the Corps (Greeley-Polhemus Group, Inc., August 1992) between July 13-15, 1992, in project areas not previously investigated. These include linear areas immediately adjacent to the Salem River channel from Buoy 10 southwest to the Delaware River channel entrance in New Castle County, Delaware and a proposed turning basin area located in the abandoned Salem River channel west of Salem, New Jersey. This additional survey effort was coordinated with the Delaware Bureau of Archaeology and Historic Preservation (SHPO) in a letter dated June 16, 1992. The study recorded a total of six magnetic and four acoustic targets utilizing side-scan sonar and magnetometer remote sensing techniques. The report concluded that of the ten targets identified, nine have signature characteristics suggestive of modern debris, or single source isolated objects, and require no further archaeological investigation. However, one acoustic target (IV 22:9), located in the proposed turning basin, area could represent the remains of a wooden barge, or section of pier. Draft reports of this study were submitted to the New Jersey and Delaware SHPO's August 26, 1992, for review and comment. A comment letter dated September 22, 1992 has been received from the Delaware SHPO which concurs with the reports findings that no significant submerged resources are present within the project area located in Delaware's jurisdictional waters.

68. An underwater diving investigation of target IV 22:9 was conducted for the Corps on September 5 1992 to identify the nature of the target and assess potential significance of the target. The investigation concluded that target IV 22:9 was a portion of a modern bridge tressle or pier structure and not eligible for listing in the National Register of Historic Places. A September 16, 1992 letter report detailing the results of this investigation was submitted to the New Jersey SHPO for review and comment on September 23, 1992. A comment letter from the New Jersey SHPO dated October 23, 1992 concurs with the letter report's findings that target IV 22:9 is not eligible for listing in the National Register and completes the review of submarine cultural resources for the project.

69. A Phase 1 cultural resource investigation of the 15 acre wetlands mitigation site, located in the Supawna Meadows National Wildlife Refuge, Salem County, New Jersey, was coordinated with the Office of New Jersey Heritage (SHPO) in a letter dated August 14, 1992. Fieldwork was completed September 18, 1992. Three prehistoric archaeological sites were identified within the mitigation site boundaries. A draft report of this investigation was submitted to the New Jersey SHPO on November 18, 1992 for Section 106 review and comment. The archaeological sites identified during this study exhibit extremely light artifact densities within limited and well

defined areas. Wetland mitigation plans have been revised to avoid these archaeological locations.

Mitigation Measures

70. Based on an analysis of the potential impacts associated with the proposed project, the following mitigation measures have been incorporated into the selected plan.

- To ensure that dredging activities do not adversely impact the water quality within the project area, hydraulic pipeline dredgingtechniques will be used throughout the project. Hydraulic pipeline dredging has been demonstrated to induce the lowest near- and far-field suspended material concentrations of the conventional dredging techniques. Correctly designed and conducted hydraulic dredging operations generally result in only temporary, localized impacts due to increased turbidity, and do not pose a significant long-term threat to the integrity of the aquatic environment. Hydraulic dredging is not seasonally restricted in the Salem River.

- Upland disposal of dredged material minimizes impacts to the aquatic environment by permanently removing sediments from the aquatic system. Proper monitoring and control of effluent discharged from the Killcohook site will minimize suspended sediment loads to the Delaware River as a result of disposal operations.

- To minimize the environmental effects that the loss of shallow water habitat and wetland habitat may have on the aquatic community and waterfowl population, 17.2 acres of wetland mitigation will be done in the Supawna Meadows National Wildlife Refuge. This mitigation will be a combination of wetland creation and restoration and will replace the valuable habitat that will be lost during the implementation of the project.

Status of Finding of no Significant Impact and Final Environmental Assessment

71. A review of the environmental impacts associated with the proposed widening and deepening of the Salem River was completed by preparation of a Final Environmental Assessment, and the signing of a Finding of No Significant Impact on May 13, 1991. These documents were prepared as part of the Salem River Interim Feasibility Study to the Delaware River Comprehensive Navigation Study. Subsequent review of the Final Environmental Assessment conducted during this phase of investigations, with respect to the detailed design of the plan of improvement, indicates that the environmental effects of the

plan as proposed have not changed significantly from that which was authorized, and that these effects were adequately and fully covered in the Final Environmental Assessment and Finding of No Significant Impact. As such, it has been determined that no further NEPA documentation is required.

Wetland and Shallows Mitigation

72. Wetland and aquatic habitats in the vicinity of the Salem River have been designated as a focus area for waterfowl habitat protection under the 1986 North American Waterfowl Management Plan. The Salem River is located on the Atlantic Flyway and provides a valuable stopover location for thousands of migratory waterfowl annually. The area is censused each year in early January to monitor waterfowl populations. Major species utilizing the area include Canada geese, black duck, mallard, American widgeon, scaup, bufflehead and tundra swan. The North American Waterfowl Management Plan targets 11,500 acres of wetland habitats in the vicinity of the Salem River for protection. The plan states: "A diversified complex of high-quality freshwater and brackish wetlands composed of wild rice, arrow arum, and salt marsh cordgrass makes the area a high-priority ecosystem for black ducks, mallards, teal, widgeon, pintail, and Canada geese. Important wetlands in need of protection along the Salem River include: Mannington, Pine Island, Kate Creek, Stoney Island, Supawna, Mill Creek, Elsinboro, Money Island, Abbott's and Fenwick Marshes."

73. Investigations of the 3 acres of wetlands which will be impacted along the cut-off have led to the determination that the wetlands are not used by waterfowl for nesting purposes. The wetland banks along the river are steep, and the area is vegetated with dense stands of common reed (Phragmites australis). The site does however provide valuable cover habitat for resting and feeding waterfowl during migrations. The U.S. Fish and Wildlife Service has classified this wetland habitat as category III habitat in accordance with the Fish and Wildlife Service Mitigation Policy (Federal Register Vol. 46, No. 15, January 23, 1981). Category III habitat is defined as habitat of high to medium value for fish and wildlife resources that is relatively abundant on a National or State basis. The Service recommends that loss of this category of wetland be mitigated by in-kind or out-of-kind replacement with no net loss of habitat value.

74. As previously stated, the proposed widening and deepening of the Salem River will result in the loss of 8.6 acres of shallow water habitat and 3 acres of estuarine intertidal emergent wetlands. The shallow water habitat is defined as the area between 0 feet and -10 feet at mean low water. Through coordination with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service it was determined that the shallow water habitat which will be lost due to the proposed plan can be mitigated through either the creation of intertidal emergent wetlands based on a 1:1 replacement ratio or restoration of intertidal emergent wetlands based on a 2:1 replacement ratio. It was also determined that the 3 acres of wetlands will be replaced in-kind by the creation of wetlands based on a 1:1 replacement ratio.

75. The original area proposed for the mitigation site, located in Supawna Meadows National Wildlife Refuge, has been rejected due to the fact that this location does not offer the characteristics needed to create an intertidal wetland system. As mentioned above, consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service determined that the mitigation should consist of in-kind habitat replacement of intertidal wetlands. The selected mitigation site, also located in Supawna Meadows National Wildlife Refuge lands, is capable of supporting intertidal wetlands and is located north of Goose Pond off of Lighthouse Road (See Plate 9). This site currently consists of upland fields, a dry pond bed and intertidal emergent wetlands which are dominated by common reed (Phragmites australis). The U.S. Fish and Wildlife Service has found this new site to be suitable for mitigation purposes.

76. Using a combination of wetland creation and restoration techniques, a total of 6.0 acres of wetlands will be created and 11.2 acres will be restored to fulfill the Corps mitigation requirements. Some wetland restoration is a desirable aspect of the plan of action for this site because the area is heavily dominated by common reed. The restoration of the wetlands which have been overrun by common reed will increase the habitat value of these areas while helping to insure that the common reed is not present to encroach on the mitigation site. The restoration of the wetlands will be done on a 2:1 replacement ratio and the creation will be done on a 1:1 ratio. By providing mitigation which will consist of 6.0 acres of wetland creation and 11.2 acres of restoration, the Corps will have effectively mitigated for the 11.6 acres of wetland and shallow water habitat which will be lost as a result of the proposed modifications.

77. The creation of intertidal wetlands at this site will require the excavation of approximately 41,301 cubic yards (cy) of material and the proper grading of the upland areas of the site to achieve an elevation of 2.9 feet n.g.v.d. In this area plantings of Scirpus pungens (common threesquare) and Scirpus validus (soft stemmed bulrush) will be done. The wetland restoration will require the excavation of approximately 30,460 cy of material to bring the elevation to 2.5 feet. This area is being graded to a lower elevation to help eliminate the presence of the common reed by eliminating the dense root mats which reach depths of at least 18 inches or more in this location. In addition, the lower grade will allow a greater inundation of water which should help to control the common reed once the mitigation is complete. This elevation is also within the middle growing range of Peltandra virginica (arrow arum), which means that it should grow quite well under these conditions. Coordination was conducted with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service and they find the mitigation plan to be acceptable. Their comments have been incorporated into the present mitigation plan and there are no outstanding issues on this subject. The complete mitigation plan, along with the coordination letters from the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, can be found in the Environmental Appendix of this report.

78. A transitional edge with a 4:1 slope will be created between the emergent wetlands and the adjacent uplands. From the lower design grades to slightly above the mean high water line, species such as Spartina cynosuroides (big cordgrass), Acorus calamus (sweet flag), Scirpus validus (soft stemmed bulrush), and Hibiscus Moscheutos (marsh hibiscus) will be planted. The abrupt slope along the wetland/upland transitional edge will help to limit the invasion of the Phragmites australis. To further minimize this possible invasion, the herbicide "Rodeo" (glyphosate), will be sprayed on the areas to be restored for two consecutive years prior to

excavation. Spraying will occur when there is maximum sugar transport through the leaves and stems into the rhizomes. This takes place when the plant is in full flower (late summer to early autumn).

Water Quality Control

79. Dredging activities result in increased levels of suspended sediment in the water column. This resuspension of material can degrade water quality and impact aquatic organisms by the release of chemical contaminants that were bound to sediment particles prior to bottom disturbance. Once contaminants are reintroduced to the oxygenated water column a variety of chemical reactions may occur. Resulting adverse impacts to water quality may include oxygen depletion and the release of contaminants, making them more available to aquatic organisms through ingestion or respiration. In order to predict the potential for contaminant release, chemical testing of bottom sediments can be employed to evaluate potential impacts to aquatic biota prior to dredging operations. Various testing procedures have been developed to characterize the chemical content of sediments and to mimic dredging operations to predict contaminant movement. Testing to evaluate sediments in the Salem River navigation channel include bulk analysis and elutriate analysis. In addition, water quality has been monitored during maintenance dredging utilizing overboard disposal to identify impacts that may be occurring.

80. In 1983 five sediment samples were collected from the Salem River approach channel and analyzed for pesticides, PCB's, purgeable halocarbons, purgeable aromatics and heavy metals using bulk and elutriate procedures. Bulk analysis is a direct analysis of sediments to quantify total contaminant concentrations. The results of the bulk testing indicate relatively low concentrations of metals and the absence of most EPA priority pollutants. One exception to this was the purgeable aromatic group. Significant concentrations of these contaminants, particularly dichlorobenzenes, were found at three of the five sample sites.

81. To predict short-term increases of contaminants in the water column during dredging, elutriate testing was also done on the sediments in the Salem River. Elutriate testing was completed on the five samples collected in 1983 and, like the bulk testing, the results show an absence of EPA priority pollutants. This is also true for the purgeable aromatics, which were detected in sediments with bulk testing results. Metals from the sediment elutriates were either not detected, or present at concentrations below the U.S. Environmental Protection Agency's marine acute and chronic criteria. Exceptions to this were lead and zinc, which met the marine acute criteria, but violated chronic criteria. Based on the testing which has been done to date, it is not likely that the

proposed dredging will have an adverse impact on the water quality of the Salem River. This information has been coordinated with the New Jersey Department of Environmental Protection and Energy (NJDEPE). Pursuant to Section 401 of the Clean Water Act, a Water Quality Certificate was obtained from the NJDEPE on September 19, 1989.

Hazardous, Toxic and Radioactive Waste

82. Hazardous, Toxic and Radioactive Wastes (HTRW) include any hazardous substance regulated under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). Hazardous substances regulated under CERCLA include "hazardous wastes" under the Resource Conservation and Recovery Act (RCRA), "hazardous substances" identified under Section 311, of the Clean Air Act, "toxic pollutants" designated under Section 307 of the Clean Water Act, "hazardous air pollutants" designated under Section 112 of the Clean Air Act, and eminently hazardous chemical substances or mixtures that EPA has taken action under Section 7 of the Toxic Substance Control Act, but does not include petroleum, unless already included in the above categories, or natural gas.

83. In accordance with the "Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Work Projects", dated June 26, 1992, a literature survey was conducted for the Salem River project area (see Appendix E). This survey looked at the historical background of the project area in order to identify any potential sources that may be suspected of introducing hazardous contaminants into the study area. The focus of the research was to find information that indicated whether or not a potential source of pollution may once have been located in the project area and whether or not such sites may still be present. This information was gathered from such sources as historical records, NJDEPE records, RCRA lists, real estate records and aerial photographs. From these sources, the locations of any landfills, disposal sites, lagoons, wastewater treatment plants or industrial facilities which were present, or which still are present in the study area, was determined.

84. The results of the literature survey indicated the presence of various commercial and industrial facilities during the initial visual inspection of the project area. Some of these facilities include a landfill, a warehouse, an electric substation, a wastewater treatment plant, the Salem Gas Light Co., the Anchor Glass Container Corp., and Gaynor Glass Works. The next phase of the study consisted of searching Federal and State databases such as the National Priorities List (NPL), Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS), Toxic Release Inventory (TRI), Resource Conservation and Recovery Act Notifiers (RCRA), Leaking Underground Storage Tank (LUST) list, The New Jersey Pollutant Discharge Elimination System (NJPDES), and the

Hazardous Waste Sites list. From these sources a list of facilities sited on more than one of these database lists was compiled. This list contained the names of 18 facilities which were judged to have the greatest potential for adding contaminants to the Salem River. Of these 18 sites, only 6 sites, Salem Coal Gas, Gaynor Glass Works, Anchor Hocking Corp., a gas station, Mid-Atlantic Shipping and Stevedoring, and a landfill are within the immediate project vicinity. With respect to the proposed plan for the Salem River navigation channel, it is not believed that the proposed project will have any impact on these facilities, nor is it likely that the facilities will pose any threat to the project in terms of possible contamination.

85. In addition to the investigations already mentioned, aerial photographs from 1940 to the present and Sanborn Insurance Maps for the project area from 1885, 1930, and 1947 were reviewed in order to identify the past uses of the sites within the project area. This aspect of the investigation did not indicate that any past uses of the area would affect the project.

Incremental Analysis of Fish and Wildlife Mitigation

86. As discussed in the Mitigation section of this report, a total of 17.2 acres of wetland mitigation will compensate for the losses of estuarine intertidal emergent wetlands and shallow water habitat which will be incurred during the construction of the proposed project. The mitigation will be accomplished through a combination of wetland creation (6.0 acres) and restoration (11.2 acres) at a site located on the Federally owned Supawna Meadows National Wildlife Refuge. The mitigation will be accomplished by grading and excavating existing land and planting wetland vegetation on the site (see Mitigation Plan in Appendix E).

87. In order to choose a mitigation plan, three alternatives were investigated that would adequately fulfill the mitigation requirements for this project. The first plan consisted of doing all wetland creation, a total of 11.6 acres, and included excavation and grading, as well as the planting of several plant species. The second plan, which is the selected plan for this project, consists of doing a combination of wetland creation and restoration for a total of 17.2 acres of mitigation. The third plan consisted of doing 3 acres of wetland creation to compensate for the 3 acres lost and 17.2 acres of wetland restoration as mitigation for the shallow water habitat being lost. Of these three plans, the first plan (creation of 11.6 acres of wetlands would be the cheapest to construct because it requires the least number of acres. This plan however would impact the cultural resources found in some of the upland areas and would also require the destruction of

several acres of cultivated clover fields which are managed by the U.S. Fish and Wildlife Service to benefit wildlife in the area. In addition, although this plan would result in 11.6 acres of high quality wetlands, it would not address the issue of controlling the common reed. Without some control of the common reed on the site, it would eventually take over the newly created wetlands. The second plan (11.2 acres of wetland restoration and 6.0 acres of wetland creation) would produce a total of 17.2 acres of high quality wetlands while at the same time ridding the site of some of the common reed which is present. This plan is slightly more expensive than the first plan but it is situated in such a way that no impacts to the clover fields or cultural resources will occur. The third plan (3 acres of creation and 17.2 acres of restoration) would produce 20.2 acres of high quality wetlands while destroying common reed on the site. This plan was not selected because it was felt that the more wetland creation that was accomplished the better it would be in terms of an overall increase of wetland acreage at the Supawna Meadows site. Based on these facts, plan number 2 was selected to mitigate wetland and shallow water habitat impacts that would result from implementing the proposed plan of improvement for the Salem River navigation channel. This plan will have the most environmental benefit since it will provide 17.2 acres of high quality wetlands without impacting either the cultural resources or the clover fields on the site. In addition, it will irradicate 11.2 acres of common reed from the site. The complete Incremental Analysis is located in Appendix E.

CORROSION MITIGATION

88. Corrosion mitigation is not required for the selected plan.

ACCESS ROADS

89. Access roads are not required for the dredging work in the selected plan because all work will be accomplished by floating plant. Existing access roads are available at the Federal disposal area and at the proposed mitigation site.

CONSTRUCTION MATERIAL

90. Construction materials are not required for the selected plan. Plantings required for the mitigation areas are as outlined in paragraphs 77 and 78.

PROJECT SECURITY

91. Project security is not required for the selected plan.

AIDS TO NAVIGATION

92. Existing aids to navigation for the existing 12-foot project are sufficient for the selected plan. However, one bouy will need to be moved to accommodate the width and alignment of the selected plan, and costs are included in initial project costs.

REAL ESTATE REQUIREMENTS

93. The Real Estate required for this project involves two separate areas. The first of these is the Real Estate required for the disposal of material excavated from the Federal project area. However, as fully explained and justified in the Interim Feasibility Report, disposal of this material is permitted to be placed in a Federal site provided that it is the most economical plan and full reimbursement for the use of such a site is made to the Federal Government. In the case of this project, the sponsor has opted to use the Federal site and will

reimburse the Federal Government as indicated in the Local Cooperation Agreement. The Federal site for this purpose, as previously indicated is Killcohook. The funds for the reimbursement will be borne by the sponsor in lieu of providing a site of their own choice.

94. The second area involving Real Estate is the acquisition of lands (wetlands) for construction of the project, and the acquisition of land rights for the mitigation site.

95. The Salem River Navigation Project was authorized in 1925 and constructed to a twelve foot depth in 1928 from the Delaware River at Elsinboro Point to the City of Salem, New Jersey. See Plate 2 and paragraphs 8 and 9 of this report for a complete description.

96. The real estate requirements for this project consist of the fee acquisition of approximately 3.12 acres of privately owned wetlands and the mitigation of 3 acres of wetlands. The mitigation area for this project is on Federally owned lands under the jurisdiction of the National Park Service, U.S. Fish and Wildlife Service located at the Supawna Meadows National Wildlife Refuge. (See Plate 9 and paragraphs 71-77)

Mitigation Area

3 Acres ($ 0/Acre; Federally-owned) 11.8 acres also required for shallows mitigation. See paragraph 73.

97. The mitigation area consists of marginal uplands and low grade wetlands which are owned in fee by the Federal Government and presently under the control of the U.S. Fish and Wildlife Service which has offered the land for wetland construction and rehabilitation.

98. The wetlands to be acquired are for a turning basin enlargement and are within the navigational servitude for project. Upon the completion of construction of the project modification the acquisition area will be fully within the general navigation features of the project and the project navigational servitude will not be diminished.

Wetlands Acquisition

3.12 Acres @ $300/Acre in fee

99. There are no PL 91-646 relocations for this project.

100. The local sponsor, the Port of Salem, New Jersey, has sufficient experience and the ability to acquire the necessary real estate. (See Paragraph 15).

101. Baseline Cost Estimate is included in this report in Table 7 and under Appendix D.

102. The selected plan is shown on Plates 3-5 and Plate 10 of this report.

103. There is no present or anticipated mineral activity contained within this project.

104. There are no non-standard estates for this project.

105. Real Estate acquisition will commence within thirty (30) days of the final execution of the LCA and should require no more than six (6) months to finalize. The underlying fee owner of the 3.12 acres of wetlands to be acquired has shown a very positive attitude in regard to selling the property.

RELOCATIONS

106. Relocations are not required as part of the selected plan.

COST ESTIMATES

Initial Project Cost

107. Estimates were prepared for initial dredging of the Federal and Non-Federal associated portions of the recommended plan. The cost estimates assume that the dredging of the Federal and Non-Federal associated portions of the projects will be done simultaneously by the same dredging contractor. The estimates assume that the dredging of the Federal and Non-Federal associated portion of the recommended project will be done using a hydraulic dredge. Material will be pumped to the Killcohook disposal area. Cost estimates were also prepared for disposal area replacement. This was based on a diking cost which was based on a per cubic yard cost to reimburse the government for the cost of the existing dikes in the disposal area. A replacement cost (LERRD) to reimburse the Government for the accelerated usage and replacement of the Federal disposal site disposal area work consists of site clearing, dike raisings and construction of sluices. This type of LERRD reimbursement is not an interest in real property, and therefore not a part of any real estate credits. All disposal area work will be done prior to initial dredging. Costs also include navigation aids, and mitigation as described in Appendix E.

108. Initial project costs reflect October 1992 price levels (for comparison to project benefits). Refer to Table 5, Initial Project Cost and Table 6, Initial Associated Cost. The fully-funded project cost

(Baseline Estimate) in October 1992 price level, escalated to the mid-point of construction (October 1994), is shown on Table 7.

Maintenance Costs

109. Estimates were prepared for maintenance dredging of the selected plan. The cost estimate assumes that dredging of the Federal project, including the existing 12 foot channel and the non-Federal berth areas, will be done simultaneously by the same dredging contractor. In order to develop incremental project cost, a separate estimate was also prepared for the existing project maintenance and this was annualized and deducted from the cumulative annual maintenance costs.

110. Maintenance cost is based on dredging on a four-year cycle for the 12 foot project and a three-year cycle for the 18 foot depth. It was assumed that all maintenance dredging of the Federal channel will be done using a hydraulic dredge pumping all dredged material into Killcohook disposal area. Based on the shoaling analysis conducted for this study, it was concluded that 188,100 cubic yards of material will be required to be dredged every three years (180,600 cy for the Federal project and 7,500 cy for associated berth maintenance). Maintenance dredging costs reflect October 1992 price levels, and reflect maintenance of the existing 12-foot project and recommended 18-foot project being performed concurrently. However, only the incremental cost of maintaining the recommended 18-foot project is included in the economic analysis. The summary of maintenance costs for the selected plan are shown in Tables 8 and 9.

Disposal

111. All initial and maintenance dredging material from the Federal channel will be disposed at Killcohook disposal area throughout the 50 year project life.

Contingencies

112. The estimated cost for each major subdivision or feature of the recommended plan includes an item for "contingencies". The item for "contingencies" is an allowance against some adverse or unanticipated condition not susceptible to exact evaluation from the data at hand but which must be expressed or represented in the cost estimate. The contingency allowances used in the development of the cost estimates for the recommended project were estimated as a lump sum amount . The contingency allowances used in the following major features of the cost estimate reflect the following uncertainties and concerns:

TABLE 5

SALEM RIVER

INITIAL PROJECT COSTS
DEPTH: 18 FT D/A: KILLCOHOOK ESTIMATOR: JOSE ALVAREZ
PRICE LEVEL: OCT 1992 DATE: 24 NOV 1992

ACCOUNT CODE	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
06.-.-.-	FISH AND WILDLIFE FACILITIES						
06.03.-.-	WILDLIFE FACILITIES AND SANCTUARIES	17.2	AC	$57,654.42	$991,656	$247,914	$1,239,570
06.-.-.-	TOTAL, FISH AND WILDLIFE FACILITIES				$991,656	$247,914	$1,239,570
12.-.-.-.	NAVIGATION, PORTS & HARBORS						
12.01.-.-	PORTS						
12.01.01.-	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK	------------------	JOB	L.S.	$368,740	$73,748	$442,488
12.01.16.-	PIPELINE DREDGING	936565	C.Y.	$5.11	$4,785,847	$1,196,462	$5,982,309
12.01.-.-	TOTAL, PORTS				$5,154,587	$1,270,210	$6,424,797
	TOTAL CONSTRUCTION COSTS				$6,146,243	$1,518,124	$7,664,367
30.-.-.-	PLANNING, ENGINEERING AND DESIGN				$525,000	$0	$525,000
31.-.-.-	CONSTRUCTION MANAGEMENT				$400,000	$0	$400,000
	SUBTOTAL				$7,071,243	$1,518,124	$8,589,367
01.-.-.-	LANDS AND DAMAGES						
01.02.-.-	ACQUISITIONS	------------------	JOB	L.S.	$15,300	$2,296	$17,596
01.03.-.-	CONDEMNATION	------------------	JOB	L.S.	$720	$108	$828
01.05.-.-	APPRAISALS	------------------	JOB	L.S.	$2,655	$397	$3,052
01.06.-.-	RELOCATION ASSISTANCE	------------------	JOB	L.S.	$1,110	$167	$1,277
01.11.-.-	WETLAND MITIGATION	------------------	JOB	L.S.	$4,935	$665	$5,600
01.18.-.-	REAL ESTATE PAYMENTS	------------------	JOB	L.S.	$936	$234	$1,170
01.19.-.-	REAL ESTATE RECEIPTS	------------------	JOB	L.S.	$739,874	$157,271	$897,145
01.-.-.-	TOTAL, LANDS AND DAMAGES				$765,530	$161,138	$926,668
09.-.-.-	CHANNEL AND CANALS						
09.01.-.-.-	CHANNELS						
09.01.13.-	TRAFFIC CONTROL						
09.01.13.02	NAVIGATION AIDS IN WATER	------------------	JOB	L.S.	$15,000	$3,750	$18,750
09.-.-.-	TOTAL, CHANNELS AND CANALS				$15,000	$3,750	$18,750
	TOTAL PROJECT COSTS				$7,851,773	$1,683,012	$9,534,785
	(ROUNDED)				$7,852,000	$1,683,000	$9,535,000

TABLE 6

SALEM RIVER

INITIAL ASSOCIATED COSTS

DEPTH: 18 FT D/A: KILLCOHOOK ESTIMATOR: JOSE ALVAREZ
PRICE LEVEL: OCT 1992 DATE: 24 NOV 1992

ACCOUNT CODE	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
12.-.-.-	NAVIGATION, PORTS & HARBORS						
12.01.-.-	PORTS						
12.01.01.-	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK	------------------	JOB	L.S.	$38,260	$7,652	$45,912
12.01.16.-	PIPELINE DREDGING	97178	C.Y.	$5.11	$496,580	$124,145	$620,725
12.01.-.-	TOTAL, PORTS				$534,840	$131,797	$666,637
	TOTAL CONSTRUCTION COSTS				$534,840	$131,797	$666,637
30.-.-.-	PLANNING, ENGINEERING AND DESIGN				$80,226	$20,057	$100,283
31.-.-.-	CONSTRUCTION MANAGEMENT				$53,484	$13,371	$66,855
	SUBTOTAL				$668,550	$165,225	$833,775
01.-.-.-	LANDS AND DAMAGES						
01.19.-.-	REAL ESTATE RECEIPTS	------------------	JOB	L.S.	$35,920	$7,637	$43,557
01.-.-.-	TOTAL, LANDS AND DAMAGES				$35,920	$7,637	$43,557
	TOTAL PROJECT COSTS				$704,470	$172,862	$877,332
	(ROUNDED)				$704,000	$173,000	$877,000

TABLE 7

SALEM RIVER, NEW JERSEY
BASELINE COST ESTIMATE
PROJECT COST SUMMARY
PRICE LEVEL: OCTOBER 1994

		ESTIMATED COST	CONTINGENCY	TOTAL COST
06.-.-.-	FISH AND WILDLIFE FACILITIES			
06.03.-.-	WILDLIFE FACILITIES AND SANCTUARIES	$1,089,830	$272,458	$1,362,288
06.-.-.-	TOTAL, FISH AND WILDLIFE FACILITIES	$1,089,830	$272,458	$1,362,288
12.-.-.-	NAVIGATION, PORTS & HARBORS			
12.01.-.-	PORTS			
12.01.01.-	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK (PROJECT)	$405,245	$81,049	$486,294
12.01.01.-	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK (ASSOCIATED)	$42,047	$8,409	$50,456
12.01.16.-	PIPELINE DREDGING (PROJECT)	$5,263,495	$1,315,874	$6,579,369
12.01.16.-	PIPELINE DREDGING (ASSOCIATED)	$546,140	$136,535	$682,675
12.01.-.-	TOTAL, PORTS	$6,256,927	$1,541,867	$7,798,794
	TOTAL CONSTRUCTION COSTS	$7,346,757	$1,814,325	$9,161,082
30.-.-	PLANNING, ENGINEERING AND DESIGN (PROJECT)	$541,125	$0	$541,125
30.-.-	PLANNING, ENGINEERING AND DESIGN (ASSOCIATED)	$97,475	$24,369	$121,844
31.-.-	CONSTRUCTION MANAGEMENT (PROJECT)	$486,000	$0	$486,000
31.-.-	CONSTRUCTION MANAGEMENT (ASSOCIATED)	$64,983	$16,246	$81,229
	SUBTOTAL	$8,536,340	$1,854,940	$10,391,280
01.-.-	LANDS AND DAMAGES			
01.02.-	ACQUISITIONS	$16,815	$2,296	$19,111
01.03.-	CONDEMNATION	$791	$108	$899
01.05.-	APPRAISALS	$2,918	$397	$3,315
01.06.-	RELOCATION ASSISTANCE	$1,220	$167	$1,387
01.11.-	WETLAND MITIGATION	$5,424	$665	$6,089
01.18.-	REAL ESTATE PAYMENTS	$1,029	$234	$1,263
01.19.-	REAL ESTATE RECEIPTS (PROJECT)	$813,122	$157,271	$970,393
01.19.-	REAL ESTATE RECEIPTS (ASSOCIATED)	$39,476	$7,637	$47,113
01.-.-	TOTAL, LANDS AND DAMAGES	$880,795	$168,775	$1,049,570
09.-.-	CHANNELS AND CANALS			
09.01.-	CHANNELS			
09.01.13.-	TRAFFIC CONTROL			
09.01.13.02	NAVIGATION AIDS IN WATER	$16,485	$4,121	$20,606
09.-.-	TOTAL, CHANNELS AND CANALS	$16,485	$4,121	$20,606
	TOTAL PROJECT COSTS	$9,433,620	$2,027,836	$11,461,456
	(ROUNDED)	$9,434,000	$2,028,000	$11,462,000

TABLE 8

SALEM RIVER

MAINTENANCE PROJECT COSTS

DEPTH: 18 FT D/A: KILLCOHOOK ESTIMATOR: JOSE ALVAREZ
PRICE LEVEL: OCT 92 CYCLE: 3 YEARS DATE: 24 NOV 1992

ACCOUNT CODE	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
12.-.-.-	NAVIGATION, PORTS & HARBORS						
12.01.-.-	PORTS						
12.01.01.-	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK	-------------------	JOB	L.S.	$390,770	$97,693	$488,463
12.01.16.-	PIPELINE DREDGING	180600	C.Y.	$6.39	$1,154,034	$288,509	$1,442,543
12.01.-.-	TOTAL, PORTS				$1,544,804	$386,202	$1,931,006
	TOTAL CONSTRUCTION COSTS				$1,544,804	$386,202	$1,931,006
30.-.-.-	PLANNING, ENGINEERING AND DESIGN				$231,721	$57,930	$289,651
31.-.-.-	CONSTRUCTION MANAGEMENT				$154,480	$38,620	$193,100
	TOTAL PROJECT COSTS				$1,931,005	$482,752	$2,413,757
	(ROUNDED)				$1,931,000	$483,000	$2,414,000

TABLE 9

SALEM RIVER

MAINTENANCE ASSOCIATED COSTS

DEPTH: 18 FT D/A: KILLCOHOOK ESTIMATOR: JOSE ALVAREZ
PRICE LEVEL: OCT 92 CYCLE: 3 YEARS DATE: 24 NOV 1992

ACCOUNT CODE	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
12.-.-.-	NAVIGATION, PORTS & HARBORS						
12.01.-.-	PORTS						
12.01.01.-	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK	------------------	JOB	L.S.	$16,230	$4,058	$20,288
12.01.16.-	PIPELINE DREDGING	7500	C.Y.	$6.39	$47,925	$11,981	$59,906
12.01.-.-	TOTAL, PORTS				$64,155	$16,039	$80,194
	TOTAL CONSTRUCTION COSTS				$64,155	$16,039	$80,194
30.-.-.-	PLANNING, ENGINEERING AND DESIGN				$9,623	$2,406	$12,029
31.-.-.-	CONSTRUCTION MANAGEMENT				$6,416	$1,604	$8,020
	TOTAL PROJECT COSTS				$80,194	$20,049	$100,243
	(ROUNDED)				$80,000	$20,000	$100,000

a. Mitigation Costs: Contingencies in this line item reflect concerns about working in wet conditions and how it will affect the dragline crane's production rate.

b. Mobilization, Demobilization and Preparatory Work: Contingencies in this line item reflect concerns about availability of dredges and probability of having to mobilize the dredge and attendant plant from a distance of more than 200 miles from the dredging site.

c. Pipeline Dredging: Contingencies for this line item reflect concerns about encountering boulders, timber piles and any other miscellaneous objects as previously encountered during the maintenance dredging operations of the existing project. In addition contingencies reflect concerns about the fluctuation of fuel prices, surveys, labor costs and size of the digging banks.

Planning, Engineering, and Design

113. Planning, Engineering and Design (P,E&D) related costs for the selected plan during the initial dredging stage were estimated as a lump sum item based on similar Corps of Engineers projects. The related costs consisted of PED in the amount of $450,000, and E&D during construction in the amount of $ 75,000 for a total lump sum cost of $525,000 (October 1992 Price Level). Planning, Engineering and Design (P,E&D) for the Non-Federal associated portion of the selected plan during the initial dredging stage were estimated at 15 percent of the direct construction cost. Planning, Engineering and Design (P,E&D) during the maintenance dredging stages for both the Federal and Non-Federal associated portions of the selected plan were estimated at 15 percent of the direct construction cost.

Construction Management

114. Construction Management (S&A) related costs for the selected plan during the initial dredging stage were estimated as a lump sum in the amount of $400,000 (October 1992 Price Level). Non-Federal associated portions of the work during the initial dredging stage were estimated at 10 percent. During the maintenance dredging stages, Construction Management (S&A) related costs for the Federal project and Non-Federal associated portions of the selected plan were estimated at 10 percent of the direct construction cost.

Real Estate Costs

115. To determine the value of lands and damages, lands were inspected in the field and a determination of value was estimated by comparing similar properties located within the geographical area of the project. Adjustments were made for use requirements, size, and physical features to establish the fair market value of parcels being evaluated. These included potential disposal areas, wetlands required for excavation of the channel and turning basin, and uplands required for mitigation work. Administration costs for the local sponsor and the Federal Government are based on estimated values determined to be relevant to the work required. The value of lands and damages are based on real estate gross appraisals prepared by the Appraisal Branch of the Baltimore District Real Estate Division. Refer to Appendix G.

116. The local sponsor's adminstrative cost was estimated from a previous navigation project and increased to the current price level. The Federal Government's computed value is based on past experience in performing required project tasks.

SCHEDULE FOR DESIGN AND CONSTRUCTION

117. Preparation of contract plans and specifications and subsequent review and approval by higher authority requires approximately five months. In addition, pre-contract actions (Advertisement and Award) will require two months. The initial dredging, disposal, and mitigation work will be accomplished in one contract, and requires a time period of one year for completion. The construction schedule is outlined on Plate 11.

SURVEILLANCE PLAN

118. The dredging and dredged material disposal will be accomplished by standard procedures set by the contract plans and specifications. These procedures and conditions will be the contractor's responsibility and routinely monitored and enforced by Government inspectors and field parties.

PROJECT BENEFITS

OVERVIEW

119. The complete, detailed economic analysis is presented in the Economic Appendix of this design memorandum. The economic analysis estimated the benefits that are anticipated to result from deepening the channel from 12 feet to the considered with-project condition alternative depths. Benefits will result from the decrease in the cost per ton of shipping commodities into or out of the port of Salem. These cost savings will occur in two ways: 1) a deeper channel depth will allow current vessels to carry more cargo, thus apportioning their operating costs over more tons, and 2) larger vessels with lower costs per ton will be able to call on the port.

120. In accordance with ER 1105-2-100, Chapter 6, Section 7, the guideline procedure for the estimation of deep-draft navigation benefits has been followed in the economic analysis.

121. The major commodities that moved through the port during its first ten years included general cargo/containers, grain, fertilizer, chemicals, peat moss, perishables, frozen food, scrap iron and steel, lumber, wastepaper, wire coils, and fish meal. During the first three years, barges were the primary vessel type; of particular significance were grain barge movements. Over the next seven years, only one barge shipment occurred, and the remainder of vessel trips have been by general cargo/container vessels and bulk vessels.

122. The benefits calculated in this analysis were based on a projection and annualization of commodity flows over the 50-year project life, defined to extend from 1994 through 2044. A number of different data sources were utilized (Salem Port Authority, Philadelphia Maritime Exchange, Mid-Atlantic and Salem Stevedoring (the two terminal operators), the Salem River pilot logs, Voigt Maritime, the shipping agent for the line using Mid-Atlantic's terminal, Waterborne Commerce Statistics Center, and PIERS, a computerized data base of import/export data). Data from the latest available complete calendar year, 1991, has been selected to represent the baseline existing condition from which tonnage has been projected and benefits estimated. Growth in container traffic for Bermuda has been projected for the first 20 years of the project life (1994-2014) and then held at a constant level for the remainder of the project life. Container traffic to the Azores has been held constant at the current contract level. Bulk movements are anticipated to grow at 2% per year for the first 20 years of the project life based on anticipated growth in income for the study area as reported by OBERS projection service. Commodity flows will not vary by channel depth. The FY 1992 Federal discount rate of 8 1/2% was applied for the calculations.

123. Containers to Bermuda and the Azores are currently the most significant commodity and trade routes. The local port operator, Mid-Atlantic, in combination with its shipping agent, has carved out a successful niche market for moving an aggregation of tonnage to Bermuda. Cargo is transported from inland origin points to Salem, mostly by truck and in small lots, for shipment on a weekly basis. Shipments originate predominantly from the local market radius in New Jersey, Delaware and Pennsylvania (although shipments from further origin points such as the U.S. Midwest and Canada are not unusual). Types of export cargo include transportation equipment, chemicals, electrical equipment, machinery, construction material, foodstuffs, consumer durable goods, and hotel products. For the Azores trade route, Salem acts as a load center for commerce from military installations such as Bayonne, N.J., Mechanicsburg, PA, and Norfolk, VA as well as cargo from the private sector. The tonnage is destined for the U.S. military base located on the Azores. Salem has achieved a niche to handle these small lots principally because it has successfully been able to make use of its capability to efficiently and quickly handle tonnage, no matter how relatively small the individual lots might be. Bulk tonnage is also an important commodity type moving through the port for various trade routes: specific examples in the years 1989-1991 are exports of wastepaper to Guatemala and Ecuador, steel coil exports to Jamaica, the export of vehicles to Haiti, and the import of cocoa butter from Mexico.

EXISTING VESSEL USE

124. Barge movements predominated in 1982-1984. A significant change occurred during 1985-1986, in which there were 49 vessel trips, only two of which were by barge. In 1987 through 1991, there were 404 vessel trips through Salem, all of which were by ship.

COMMODITY PROJECTIONS

125. Estimates of future commodity movements through the Port of Salem were based on the historical data base of vessel movements and tonnage, interviews with the local users and the Salem Port Authority, and projections from an economic consulting firm.

Container Exports to Bermuda

126. No single data source will capture traffic for a port in its entirety; errors in reporting and collection distort any data base. Also, different sources are interested in different measurements, for instance, one may focus on TEU's (twenty-foot equivalent units, the standard measure for container box size) while another is concerned with tonnage. Therefore, figures for Salem were collected from several sources.

127. Data collected for Salem indicated that its prorated share of the North Atlantic-Bermuda trade was approximately 20%, or 21,600 short tons in 1989, and 21%, or 22,900 short tons on 1990.

128. Projected growth of container traffic was obtained from two sources. The DRI/TBS World Sea Trade Service has been used as the major source for the projections of export tonnage from the U.S. North Atlantic Coast to Bermuda from 1991 through the year 2000. In 1989, as noted above, Salem had an approximate 20% share of the total U.S. North Atlantic market. However, Salem's market share increased to 21.2% for the full year of 1990, with the market share in the second half of 1990 rising to 24.4%. Also, in late 1990, Lloyd Bermuda, one of the two North Atlantic competitors to the Mid-Atlantic/BISL/Voigt operation, ceased operations. The Mid-Atlantic market share has continued to increase, reaching 28.7% for 1991.

129. By 1995, Mid-Atlantic is projected by the shipping agent, Voigt, to completely split the 25% market share vacated by Lloyd Bermuda with its one remaining competitor, Bermuda Container Lines (BCL), which operates out of the port of New York, and reach a 40% market share. This projection developed by Voigt is based on the reasonable expectation of Mid-Atlantic being able to capture half of the open market share as well as in-depth knowledge of the promising market conditions for the Bermuda market. The competitor operation, BCL, taking a naturally more conservative view of the growth potential for a competitor than Voigt, expects Mid-Atlantic's market share to remain at the 1991 level in the future. However, BCL did admit to the potential for Mid-Atlantic to show additional market share growth and capture as much as 32 percent of the total North Atlantic trade to Bermuda. The DRI 4.7% per annum growth rate has been used to forecast Salem's TEUs. Average annual tonnage for this commodity and trade route is equal to 67,200 tons.

Container Exports to the Azores

130. For the computation of benefits, the tonnage will be held constant over the project life at the existing contracted tonnage per year level of 12,500. Tonnage growth is possible but uncertain at this point, so it has not been incorporated into the benefit analysis.

Bulk Movements

131. Average bulk tonnage per year through the port of Salem in 1989-1991 was equal to 16,400 tons. The major commodity moved was wastepaper to the Caribbean and Central America. Also important were cocoa butter from Central America, and cement blocks and construction equipment to the Caribbean. Growth in tonnage, applying OBERS, will be at 2% per annum (held constant after year 20 of the project life). The OBERS projections for the region from the U.S. Dept. of Commerce, Bureau of Economic Analysis, 1985 OBERS Projections, Volume 2, "Metropolitan Statistical Area Projections to 2035", were applied. The most narrowly defined level of economic activity and population, the Wilmington, DE-NJ-MD PMSA, which includes Salem County, NJ, was used. Application of a linkage of bulk commodities with OBERS growth in personal income was utilized. This decision was made because total personal income was considered a reasonable indicator of bulk commodity growth at Salem. The bulk commodities moving through Salem are indirect goods that will ultimately be converted into consumer goods. Economic theory holds that consumption is a function of income. Thus, using personal income should give a reasonable indicator of growth for bulk commodities moving through Salem. Average annual bulk tonnage is equal to 21,500 tons.

Commodity Projections Summary

132. Commodity projections are anticipated to be the same for the without and with project condition channel depths. The port plans for additional berths to be available by the project base year will significantly increase the port's annual throughput capacity and assure that the growth in tonnage can be handled by the port users. The analysis of commodity projections for Salem was based only on existing commodities (with relevant trade routes) that have moved through the port historically. As stated, the commodity projections will be the same for all depths. No new commodities or diversions are included in the quantification of benefits, although a list of potential additional commodities were identified in the economic investigation. There will not be a throughput capacity constraint over the project life. This was determined by comparing projected tonnage to the capability of the port to handle this amount of tonnage over the project life.

FLEET CHARACTERISTICS, COSTS AND OPERATIONS

133. A fleet is influenced by many factors. The criteria for selecting ship sizes include the volume of trade, distance of transport, controlling depths at both the loading and discharge ports, and cargo handling and storage facilities. Generally, the most efficient vessel size for any trade route tends to be one of the largest, if not the largest, ship that can be accomodated on that route. So, as the Salem River is deepened, a shift to a larger chartered vessel size is projected in order to take advantage of cost efficiencies provided by the deeper navigational channel. The selected vessel size per channel depth was based on transportation costs per ton as a criteria.

134. As the channel becomes deeper, commodities would move by larger vessels. This assumption for the channel deepening is based on traditional navigational vessel operating decisions. As stated in Step 5 of ER 1105-2-100, Chapter 6, Section 7, "Transportation costs with a plan should reflect any efficiencies that can be reasonably expected such as use of larger vessels, increased load reductions in transit time and delays, etc."

135. The primary sources for vessel information included the two companies operating facilities on the Salem River, the Corps' Institute for Water Resources (and its consultant from the University of Michigan, whose position paper is described below), DRI/McGraw-Hill, Port of Salem officials, and the pilots association. The fleet distributions will not shift over the project life.

136. The following presents a summary of the paper, An Evaluation of Vessel Characteristics and Operations for Salem River, NJ Navigation Project, developed for the Philadelphia District by Dr. A.N. Perakis, Associate Professor, Department of Naval Architecture and Marine Engineering, University of Michigan. Dr. Perakis was recommended as a consultant by the Institute for Water Resources (IWR) based on the success of the August 1991 report that Dr. Perakis developed for that Corps office, An Evaluation of the Institute for Water Resources Vessel Cost Estimation Procedures.

137. The position paper developed technical and cost data for eight vessel classes (1500, 2500, 3000, 3500, 4000, 4500, 5000, and 6000 DWT) for foreign flag and U.S. flag containerships.

138. Dr. Perakis used two major sources to develop the paper: 1) the FY 1992 IWR data developed for vessels greater than 12,000 DWT, and 2) the Fairplay computerized world shipping database (1989 edition). The relevant vessels in the latter source were analyzed to obtain dimension, fuel cost, and newbuilding price information. Fairplay had two large general cargo files (each with more than 2000 vessels) and a smaller containership file. Dr. Perakis developed the database as

follows: 1) each general cargo file was separated into vessels with and without container carrying capability, and 2) the original container file was combined with the two general cargo files with container capability to finalize the overall container vessel file.

139. The resulting large file was then separated into eight groups corresponding to the DWT classes of interest for Salem River. For example, the first group considered containerships from 1000-2000 DWT (centered at 1500 DWT), the second from 2250-2750 DWT (focusing on 2500 DWT), etc, to the eighth and last from 5500-6500 DWT (keyed to the 6000 DWT vessel class). Statistical analyses were then performed for each group, deleting obvious outliers and developing average values for dimensions, newbuilding price, horsepower, and fuel consumption data, etc. The results were not always smooth functions of DWT, hence, smoothed values via regression were developed. Finally, Dr. Perakis applied a new formula for the TPI immersion factor, which in the opinion of his colleagues at the University of Michigan who specialize in ship design, gives superior results to the U.S. Maritime Administration-provided formula used to date by IWR.

140. Regarding future trends in the small containership category, no major changes in the technical characteristics of ships are anticipated by Dr. Perakis. Fuel efficiency of new vessel power plants could be somewhat better as compared to current average fleet fuel consumption. Speeds could go up or down by small amounts as oil prices fluctuate.

TRANSPORTATION COST AND SAVINGS ESTIMATION

Container Benefits: Exports to Bermuda

141. A transportation cost model was developed to analyze the actual operating practices of outbound container vessels to Bermuda (determined from the sailing drafts recorded in the Salem River pilot logs for the last fully available calendar year, 1991). Vessel movements on this trade route are port to port. The current Foreign Flag container vessel used on this trade route is the "Bermuda Islander", with a design draft of 16.33 feet, design deadweight tonnage of 2650 short tons, length of 262 feet, and beam of 43 feet. Using 1991 data, 49% of vessel movements have operated making full channel use, 32% have operated 1.5 feet lightloaded, and 19% have operated 2.5 feet lightloaded. The transportation cost model adjusted the design draft of lightloaded vessels to analyze the constraint of actual vessel operating practice versus channel depth on the cost of tonnage being moved. Thus, for example, 1.5 feet of lightloading is equivalent to a 1.5 foot reduction of vessel design draft, or a 1.5 foot operational constraint in the transportation cost model. Vessel classes are estimated to load to 65.1% of the design TEU carrying capacity (including TEU box weight) applying the average per trip for 1991 for the

"Bermuda Islander". This percentage nets out carrying capacity tonnage that must be allocated for ballast, fuel, freshwater tanks, stores, and crew. Based on historical movements, the average weight per container box is estimated to be three tons, and the average cargo carried per box equal to a weight of 8.41 tons. Taken together, the 65.1% cargo capacity utilization and the cargo weight per box determine the cargo tonnage on board for given drafts.

142. Vessel classes analyzed in the benefit analysis range from 1500 DWT to 5000 DWT. The tidal allowance is 5.5 feet with required underkeel clearance of 2 feet. Shut-out tonnage is determined by netting out constrained tonnage (based on the immersion factor) from the available channel depth in comparison to the average vessel carrying capacity utilization of 65.1%. Cargo tonnage carried nets out from the calculation the weight of the TEU boxes that hold the commerce. Cruising speeds (in knots) used were provided by the Perakis paper. Loading, dockage, wharfage, and tug costs are based on coordination with representatives of the Salem River facility. Operating costs at sea and in port applied a regression model developed by the Perakis position paper. Tidal delays are defined based on the channel depth, vessel characteristics, range of tide, and underkeel clearance. Pilotage costs, obtained from coordination with the local pilots, are calculated applying vessel design characteristics for length, beam, and draft. The round trip trade route distance was taken from the publication, <u>Distances Between Ports</u> (Dept. of the Navy). Total transportation costs are a summation of the total costs for a round-trip movement. Backhauling is a very insignificant part of the operations for this trade route. Ships to Bermuda are not always loaded to cubic capacity. Transportation costs per ton are determined by dividing total transportation costs by the amount of tons carried for each channel depth and vessel class.

143. The transportation savings models for the relevant vessels incorporated the cost per ton data, the most efficient chartered vessel size by channel depth, and the commodity projections.

Container Benefits: Exports to the Azores

144. A similar transportation cost model was developed to analyze the actual operating practice (based on the 1991 Salem River pilots logs) of outbound U.S. Flag container vessels to the Azores. The current vessel used on this trade route is the "Rainbow Hope", with a design draft of 16 feet, design deadweight tonnage of 2048 tons, length of 295 feet, and beam of 45 feet. The "Rainbow Hope" had a 1991 average TEU capacity utilization per trip of 64.6%, which has been applied in the transportation cost model for the range of vessel classes. The average cargo weight per box in 1991 was 8.62 tons, and 92% of vessel movements operated making full channel use, and the remaining 8% operated 1.5 feet lightloaded.

Bulk Benefits

145. This benefit estimation has applied, as a base, average tonnage at the 1989-1991 level for total bulk movements through the port of Salem (with 2% per annum growth for the first twenty years of the project life). The transportation savings model incorporates the most efficient vessel size per channel depth with the operating costs per ton for the bulk vessel classes.

LEAST-COST PORT ANALYSIS FOR BERMUDA TRADE ROUTE

Costs of Shipping out of the Port of Salem versus the Port of New York/New Jersey Under Existing Conditions (Bermuda Trade Route)

146. The primary and most substantial cost differential between the ports is for stevedoring. Stevedoring costs were calculated from the annual reports of the two shipping agents that handle shipments from the U.S. North Atlantic region to Bermuda. In 1990, 7,043 boxes moved out of the Port of New York/New Jersey at the cost of $919 a box. In 1991, 7,649 containers moved out of New York. During 1990, 2,489 boxes moved out of the Port of Salem at the cost of $540 a box. In 1991, 3,062 containers moved out of Salem. The difference in stevedoring costs between the two ports continues to rise, as wage increases were built into labor contracts at the Port of New York/New Jersey. Stevedoring costs in Salem are among the lowest in the Northeast.

147. Dockage fees at Salem have both a tangible and intangible advantage over New York/New Jersey. The terminal fees in New York/New Jersey are set by the Port Authority and are inflexible. These fees and any other incremental charges from the terminals themselves are passed on to the shippers. In Salem, dockage fees, which average $200/day, are approximately $1300/day less expensive than in New York/New Jersey.

148. Another incidental cost advantage of Salem over New York/New Jersey is line running charges. The charge for linemen in New York costs about $500, more than triple the cost per call over Salem at $150. Wharfage fees are marginally greater at the Port of New York/New Jersey than at the Port of Salem.

149. Other costs such as fuel and provisions are virtually identical. Costs of customs and other federal agency inspections are identical at both ports.

150. Another cost incurred originates from the costs of trucking into the ports. The shipping of goods to Bermuda is almost entirely a one way market - exporting to Bermuda. It is well recognized in the industry that the costs of trucking goods into the ports can have substantial impacts on the quantity of goods being exported out pf a port. The best way to handle this problem is to find shippers near the port of origination. Presently about half the goods going to Bermuda come from the New York/North Jersey area, and about half come from Philadelphia, Maryland, Delaware, and even farther south in Virginia and the Carolinas. Goods coming from the latter area can be trucked at lower cost into Salem, which is 8 miles from the Delaware Memorial Bridge, than into New York/New Jersey, which is an additional 125 miles from the bridge. The round trip differential is obviously even greater. Conversely, goods coming from the former area can be shipped into the Port of New York/New Jersey at lower cost than into Salem. A shift in suppliers and manufacturers of the exports could significantly impact the relative costs of operating out of the two ports, but at the present time the difference is minimal.

151. The only real cost disadvantage at the port of Salem is the pilotage costs. Vessels are required to have a Salem River pilot and a Delaware River pilot. The costs of the pilots are $1300 in and out and $1900 in and out, respectively. The average number of trips for the vessels travelling to Bermuda, historically, has been 49 per year. The pilots operating out of the Port of New York/New Jersey charge $1,570. The required use of tug boats at Salem is also a slight disadvantage of the Port of Salem versus the Port of New York/New Jersey. While the cost per tug is cheaper at Salem than New York/New Jersey, tugs are primarily used only during inclement weather for the latter. Due to the narrower channel at Salem, tugs must be used during each trip.

RESULTS OF ECONOMIC ANALYSIS FOR SELECTED PLAN

152. Average annual benefits and costs have been developed, at an October 1992 price level, applying the 8 1/2% discount rate. Table 10 presents average annual benefits, average annual costs, and the benefit-cost ratio of 1.7 for the 18 foot selected plan.

TABLE 10

SALEM RIVER ECONOMIC ANALYSIS FOR 18 FOOT DEPTH SELECTED PLAN F:SALCA92B

A) COST ANNUALIZATION 1)

DISCOUNT RATE= 8.500%

PRICE LEVEL= OCT 1992

	12 FT	18 FT
FIRST COST:		
PROJECT	$0	$9,535,000
ASSOC. COSTS	$0	$877,000
SUBTOTAL	$0	$10,412,000
INT DURING CONSTR 2)	$0	$361,668
TOTAL	$0	$10,773,668
CRF	0.086463	0.086463
AVG ANN FIRST COSTS	$0	$931,524
MAINTENANCE COSTS:		
DREDGING CYCLE-YEARS	4	3
PROJECT	$1,496,000	$2,414,000
ASSOC COSTS	$0	$100,000
TOTAL	$1,496,000	$2,514,000
SFF	0.220288	0.306539
AVG ANN MAINT COSTS 3)	$330,000	$770,639
CUMULATIVE AVG ANN COSTS (OCT 92)		$1,702,000
AVG ANN COSTS (NETTING OUT 12 FOOT W/O PROJECT CONDITION)		$1,372,000

1) INCLUDES MITIGATION, REPLACEMENT, AND NAVIGATION AID COSTS

2) NINE MONTH CONSTRUCTION PERIOD;FIRST COST APPORTIONED UNIFORMLY

3) W/O PROJECT CONDITION MAINTENANCE COSTS FROM FEASIBILITY REPORT

INTEREST DURING CONSTRUCTION CALCULATION (18 FEET):

MONTH 1-	$1,156,889	1.06310	$1,229,883	
MONTH 2-	$1,156,889	1.05590	$1,221,554	
MONTH 3-	$1,156,889	1.04874	$1,213,274	
MONTH 4-	$1,156,889	1.04163	$1,205,054	
MONTH 5-	$1,156,889	1.03458	$1,196,889	
MONTH 6-	$1,156,889	1.02757	$1,188,780	
MONTH 7-	$1,156,889	1.02060	$1,180,726	
MONTH 8-	$1,156,889	1.01369	$1,172,726	
MONTH 9-	$1,156,889	1.00682	$1,164,781	
TOTAL	$10,412,000		$10,773,668	TOTAL INV. COST
			$10,412,000	MINUS FIRST COST

			$361,668	INT. DURING CONSTR.

B) ECONOMIC ANALYSIS

AVG ANN BENEFITS (OCT 92)	$2,380,000
AVG ANN COSTS (OCT 92)	$1,372,000
BCR	1.7
NET BENEFITS	$1,008,000

COST ALLOCATION

153. All costs for the construction of the selected plan are allocated to commercial navigation.

COST COMPARISON

154. The project authorization in Section 859 of the Water Resources Development Act of 1986 (P.L. 99-662) did not cite a project cost (subject to Section 903 (b) of the Act). However, a comparison between the current, fully-funded cost estimate developed in this Design Memorandum, and the May 1991 Cost Estimate (Pb3, as last reported to Congress in the FY93 Budget Request) shows a decrease in project costs from $13,010,000 to $11,462,000 (rounded).

155. The decrease in costs (-$1,548,000) is attributable to price level rise($495,000), offset by a decrease due to refinement of design (-$1,187,000) and a decrease in recomputation of inflation through the construction period. (-$856,000).

COST APPORTIONMENT

156. Public Laws 99-662 (Water Resource Development Act of 1986) has established the basis for the Federal and non-Federal sharing of responsibilities in the construction, operation and maintenance of Federal water resources projects. Under the terms of Public Law 99-662, the non-Federal interest would pay at the outset of construction, 10% of the total costs of construction of General Navigation Features (GNF) which consists of the access channel. In addition, the non-Federal interests are to provide any lands, easements, rights-of-way, relocations and dredged material disposal areas or the costs thereof. The non-Federal sponsor is responsible for an additional 10% of the cost of GNF, less credit for lands, easements, rights-of-way, relocations and dredged material disposal areas (LERRD) which can be repaid with interest over a period not to exceed 30 years.

157. The Federal government is responsible for 90 percent of the cost of GNF as well as the cost of navigation aids. Operation and maintenance costs for the access channel, and navigation aids are a Federal responsibility.

158. Also, for this project replacement costs for the accelerated usage and replacement of the Federal property and diking costs for use of the existing dikes and provisions of the rights to develop the mitigation site at Supawna Meadows National Wildlife Refuge constitute the provision of LERRD. Cost sharing arrangements for the selected plan are displayed on Table 11.

159. The ultimate fully-funded project cost is $11,462,000 of which $8,531,000 is Federal and $2,931,000 is non-Federal. The non-Federal sponsor is responsible for 10% of the costs for general navigation features during construction ($946,000) and the costs of lands, easements, rights-of-way, relocations and dredged material disposal areas (LERRD) ($1,002,000). The Federal government is responsible for 90% of the GNF ($8,510,000) and Aids to Navigation ($21,000). The non-Federal sponsor is also responsible for an additional 10% of the GNF ($946,000) less credit for LERRD which may be repaid with interest over a period not to exceed 30 years. However since the LERRD value exceeds 10% of the GNF, no additional payments are necessary. The non-Federal sponsor will also be responsible for associated project costs of dredging berth areas, estimated at $983,000.

TABLE 11

COST SHARING FOR THE SELECTED PLAN
(18 ft. channel)

FEDERAL PROJECT COSTS (Rounded)	
General Navigation Features (GNF):	$ 9,456,000
LERRD	$ 1,002,000
TOTAL FEDERAL CHANNEL COSTS	$10,458,000
Associated Dredging Costs (Non-Federal)	$ 983,000
Aids to Navigation	$ 21,000
TOTAL COSTS	$11,462,000

COST SHARING

COSTS	FEDERAL	NON-FEDERAL	TOTAL
GNF	$ 8,510,000	$ 946,000	$ 9,456,000
Long Term Repayment	- 946,000	946,000	0
LERRD	N/A	1,002,000	1,002,000
Credit of LERRD	946,000	- 946,000	0
ULTIMATE COSTS	$ 8,510,000	$1,948,000	$10,458,000
Associated Costs	N/A	$ 983,000	$ 983,000
Aids to Navigation	$ 21,000	N/A	21,000
TOTAL COSTS	$ 8,531,000	$ 2,931,000	$11,462,000

Discount Rate: 8 1/2%

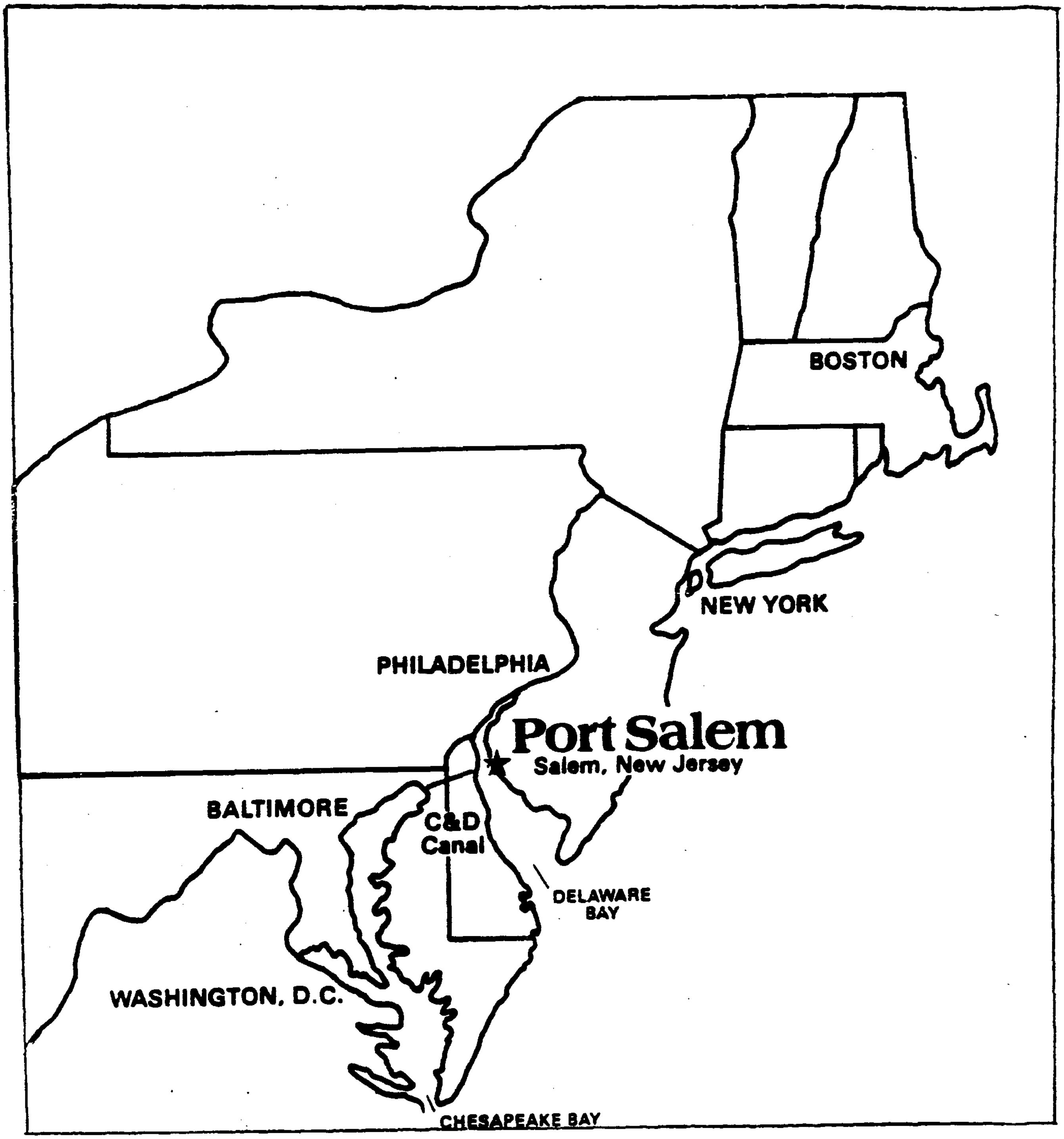
Price Level: October 1992, escalated to mid-point of construction (October 1994).

RECOMMENDATIONS

160. The modification of the Salem River, New Jersey Federal Navigation Project, as described in this Design Memorandum, is recommended to be constructed at an initial Federal cost of $8,531,000 and operation and maintenance cost of $1,512,000 (3 year cycle). This project consists of deepening of the existing Federal channel to a depth of 18 feet MLW, including realignment at Sinnicksons Landing, to provide for a channel from deep water in the Delaware River to the Port of Salem. The channel width will vary from 150 feet to 250 feet with appropriate bend widening. Mitigation will also be provided for the loss of shallows and wetlands. Provision for a 495-foot turning basin adjacent to the Port of Salem will be provided with a depth of 18 feet MLW. As part of the project, the local sponsor will be required to maintain the area between the southern limit of the Federal navigation channel and the berthing areas of the Port of Salem.

R F Sliwoski

R. F. SLIWOSKI, P.E.
Lieutenant Colonel, Corps of Engineers
Commanding



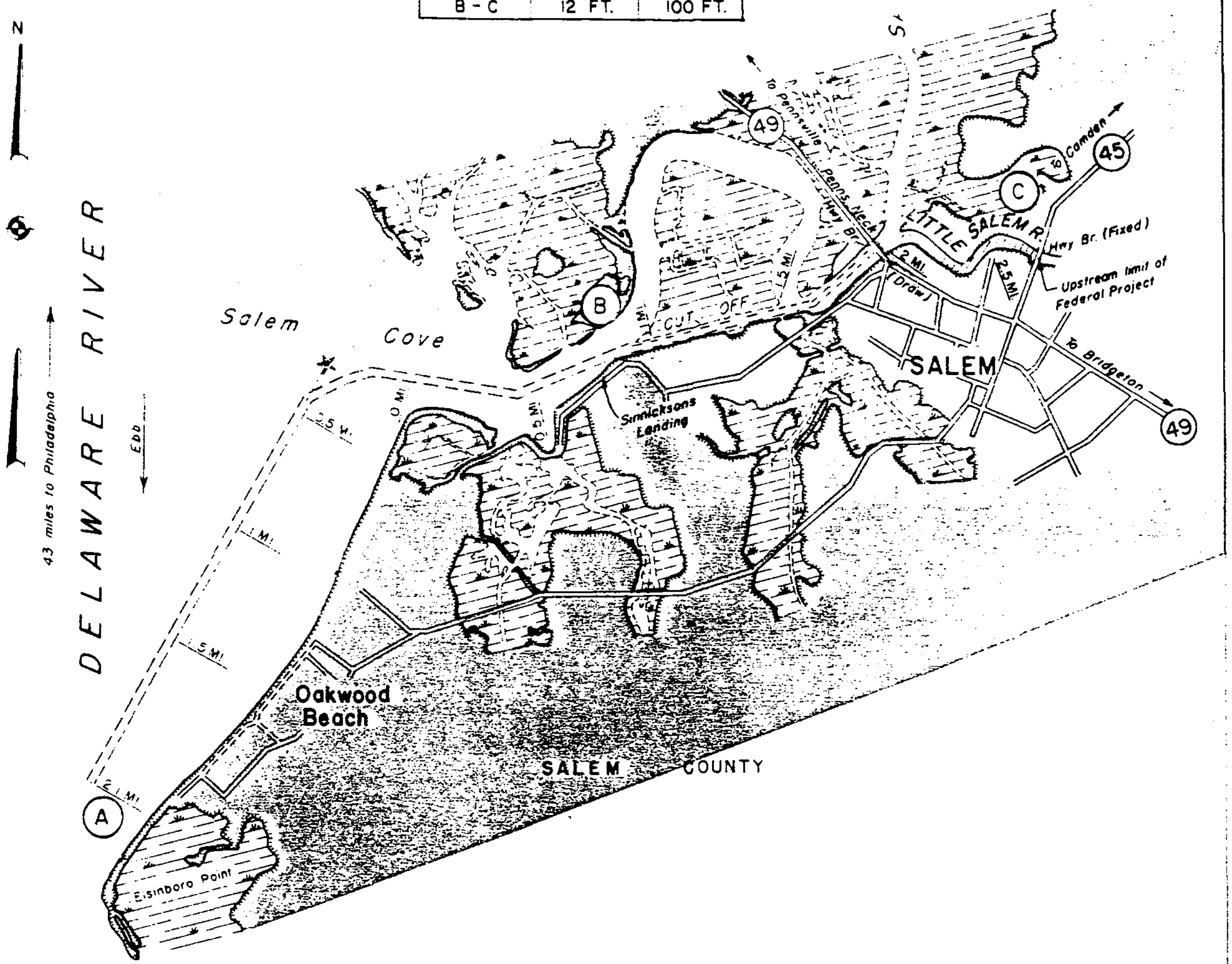
SALEM RIVER, NEW JERSEY

DESIGN MEMORANDUM
GEOGRAPHIC STUDY AREA

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

PLATE 1

CHANNEL DIMENSIONS		
LOCATION	DEPTH	WIDTH
A - B	12 FT.	150 FT.
B - C	12 FT.	100 FT.



EXISTING PROJECT

SALEM RIVER

NEW JERSEY

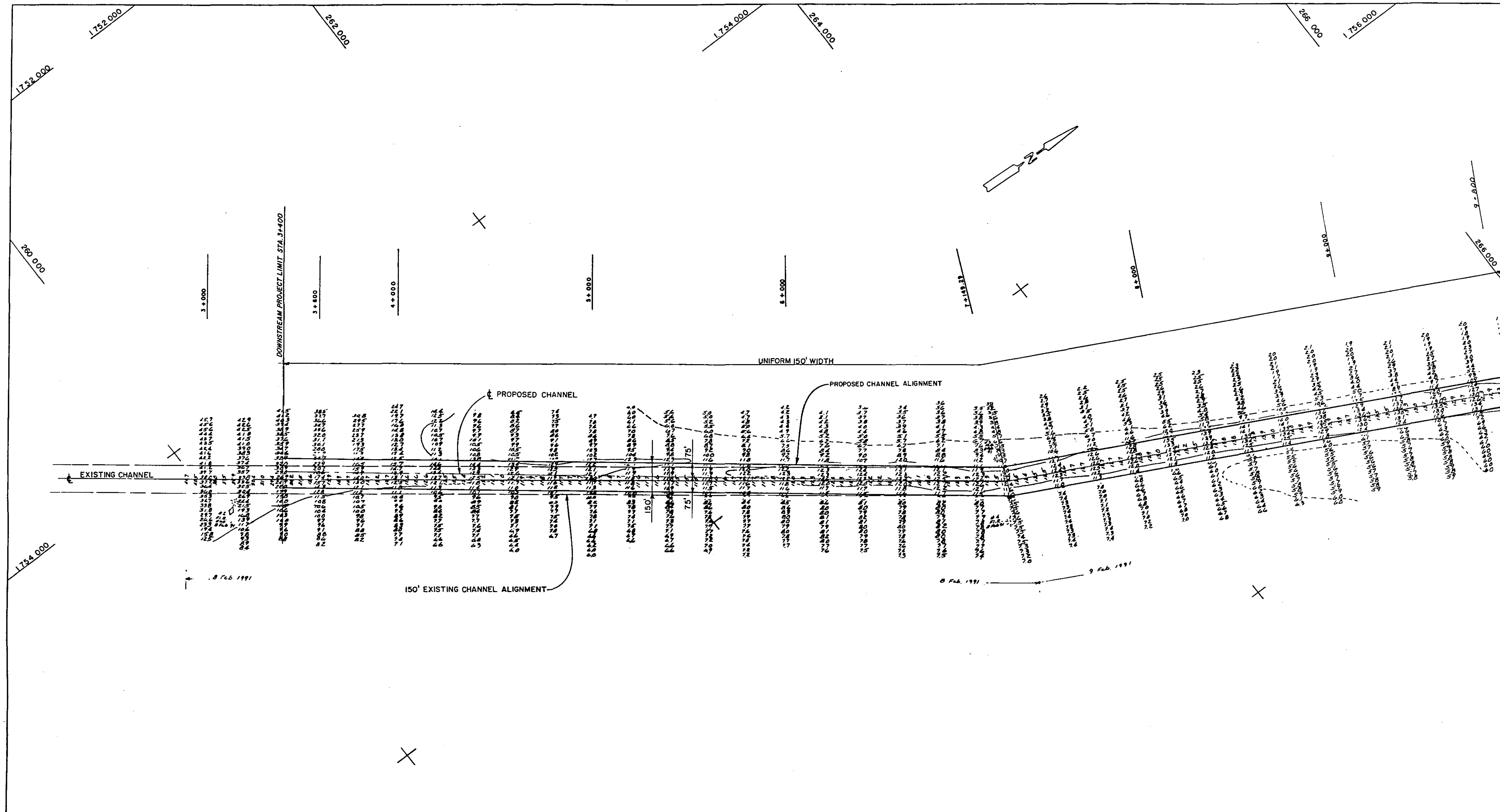
DESIGN MEMORANDUM

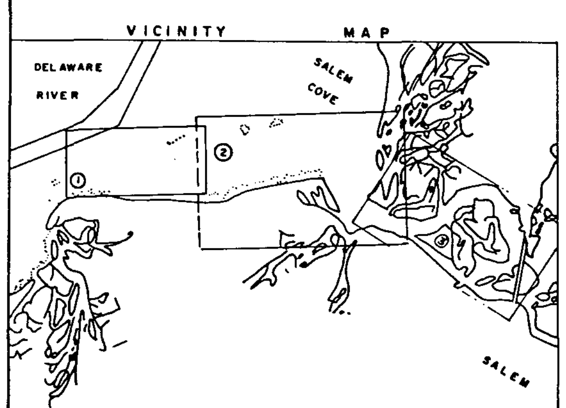
SCALE OF FEET

1000 0 1 2 3 4 5 6 7 8000

U.S. ARMY ENGINEER DISTRICT, PHILA.

PLATE 2





CAUTION:

The positions of aids to navigation shown on this drawing are indicative of the location of the aid at the time of the survey, and are intended for information only and should not be used for navigation

NOTE:

Soundings are expressed in feet and tenths and refer to Mean Low Water.

12' curve of depth is shown thus:
6' " " " " " "
0' " " " " " "

The information shown on this drawing represents the results of surveys made on the dates indicated and can only be considered as indicating the conditions existing at that time.

Stations shown correspond to the existing Channel Alignment.

SCALE IN FEET
200 0 200 400

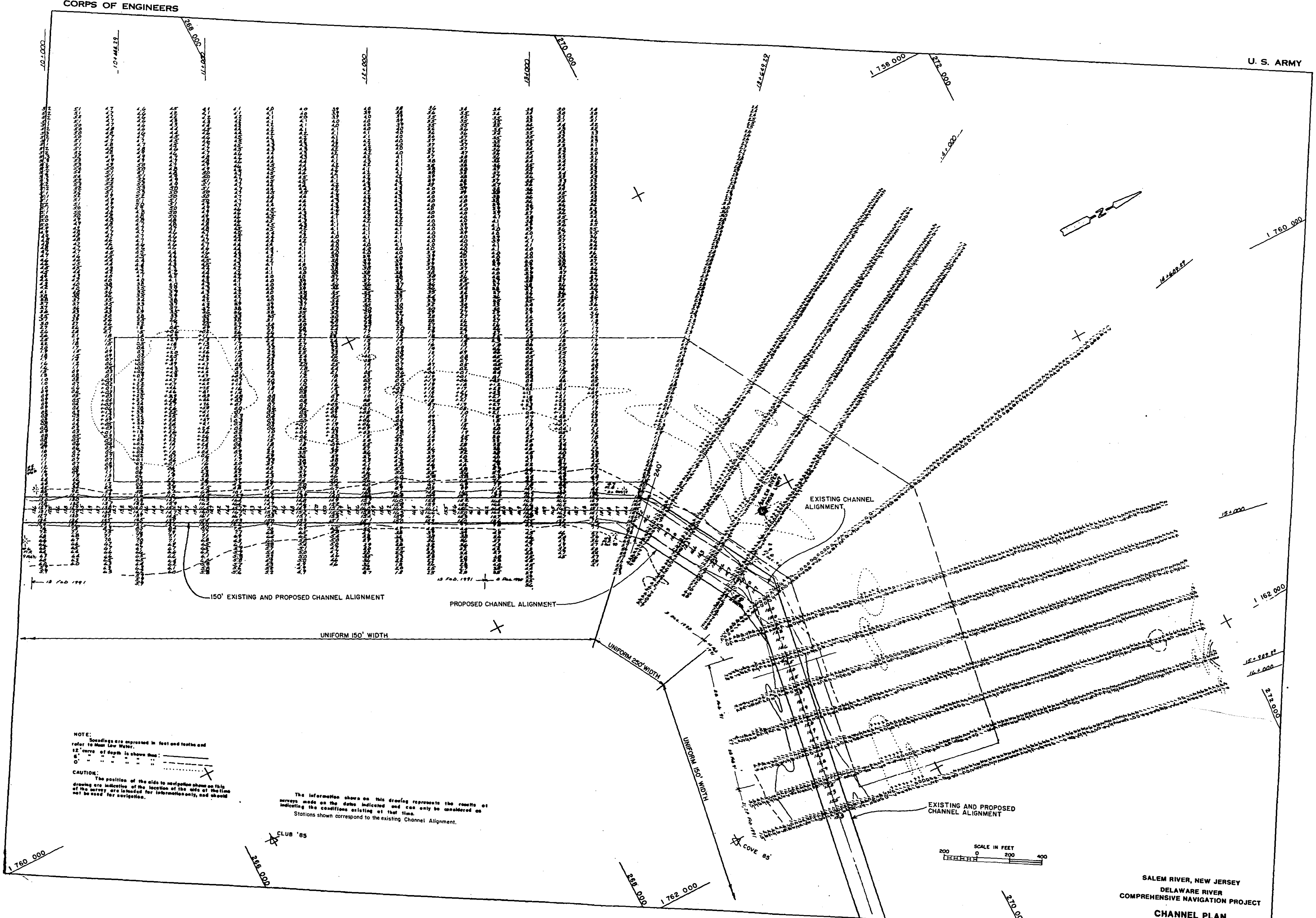
SALEM RIVER, NEW JERSEY

DELAWARE RIVER
COMPREHENSIVE NAVIGATION PROJECT

CHANNEL PLAN

PHILADELPHIA DISTRICT CORPS OF ENGINEERS

PLATE 3



NOTE:
Soundings are expressed in feet and tenths and refer to Mean Low Water.
12' curve of depth is shown thus:
6' " " " " " "
0' " " " " " "

CAUTION:
The position of the aids to navigation shown on this drawing are indicative of the location of the aids at the time of the survey are intended for information only, and should not be used for navigation.

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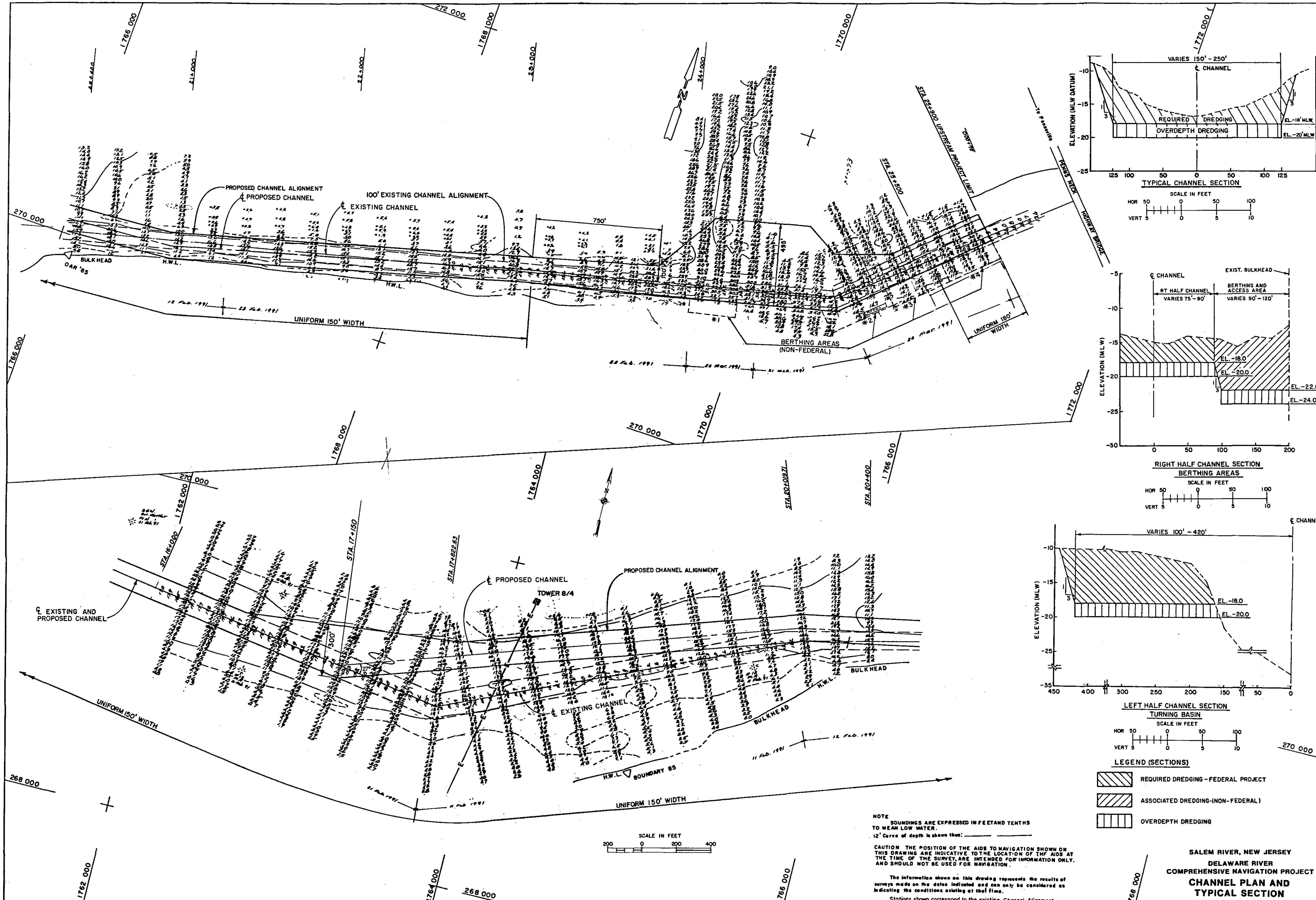
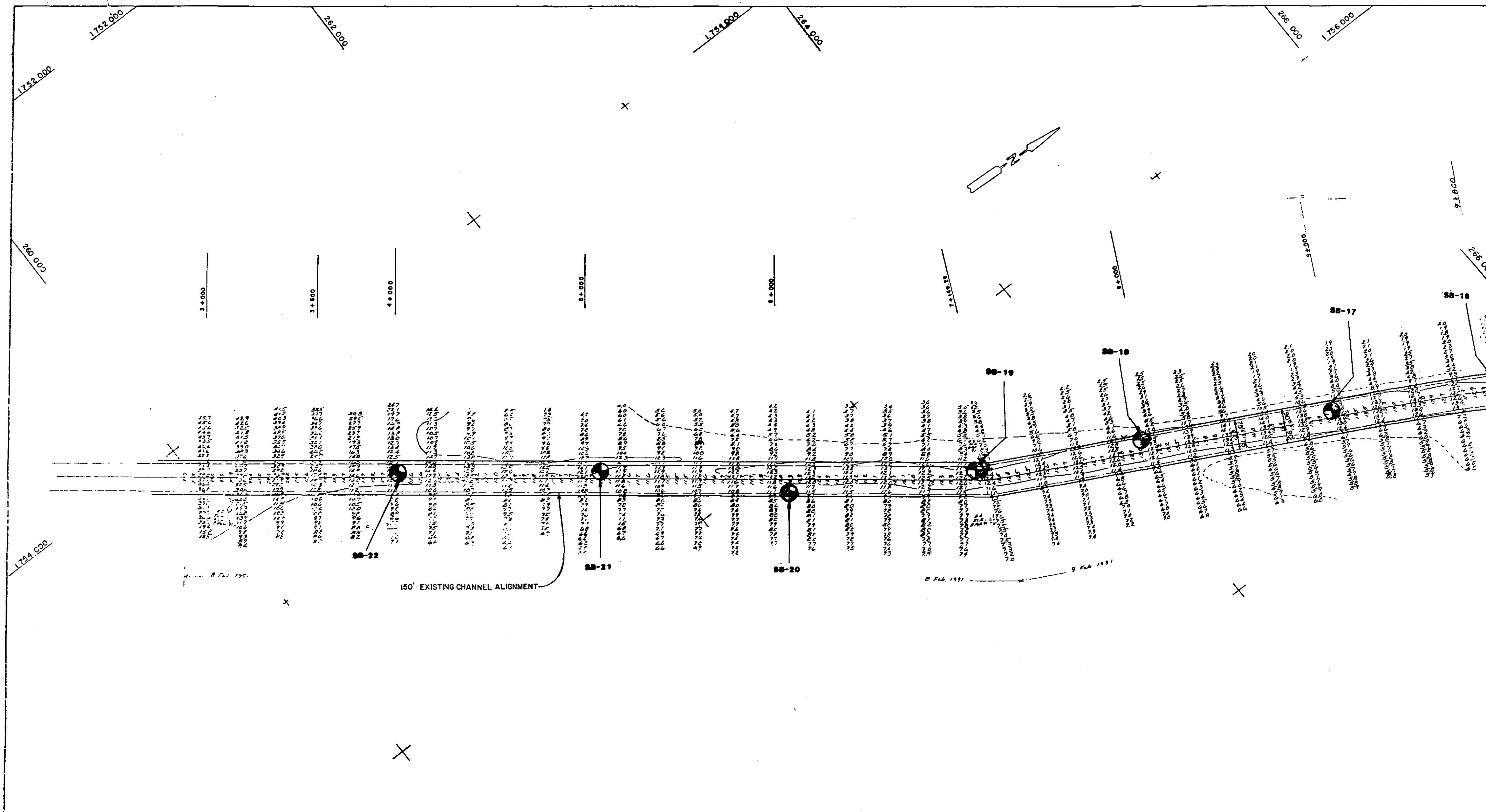
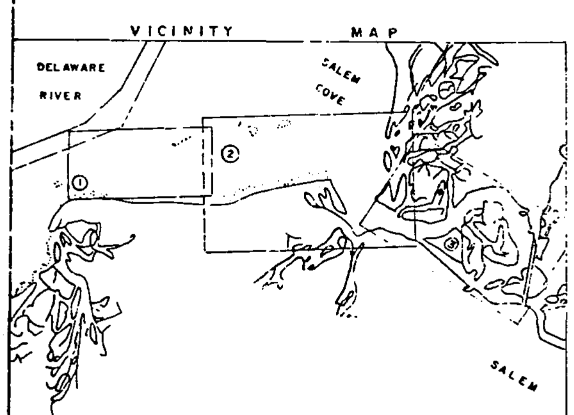
Stations shown correspond to the existing Channel Alignment.

SALEM RIVER, NEW JERSEY
DELAWARE RIVER
COMPREHENSIVE NAVIGATION PROJECT
CHANNEL PLAN


PROPOSED CHANNEL ALIGNMENT
℄ PROPOSED CHANNEL
100' EXISTING CHANNEL ALIGNMENT
℄ EXISTING CHANNEL
750'
BULKHEAD
H.W.L.
UNIFORM 150' WIDTH
BERTHING AREAS (NON-FEDERAL)
UNIFORM 180' WIDTH
STA 25+500
STA 25+920 UPSTREAM PROJECT LIMIT
HIGHWAY BRIDGE
VARIES 150' - 250'
℄ CHANNEL
REQUIRED DREDGING
OVERDEPTH DREDGING
EL.-18' MLW
EL.-20' MLW
ELEVATION (MLW DATUM)
TYPICAL CHANNEL SECTION
SCALE IN FEET
EXIST. BULKHEAD
RT HALF CHANNEL VARIES 75'-90'
BERTHING AND ACCESS AREA VARIES 90'-120'
EL.-18.0
EL.-20.0
EL.-22.0
EL.-24.0
ELEVATION (MLW)
RIGHT HALF CHANNEL SECTION BERTHING AREAS
℄ EXISTING AND PROPOSED CHANNEL
STA 16+000
STA 17+150
STA 17+822.63
℄ PROPOSED CHANNEL
TOWER 8/4
PROPOSED CHANNEL ALIGNMENT
℄ EXISTING CHANNEL
300'
STA 20+018.71
STA 20+400
BULKHEAD
H.W.L.
BOUNDARY 85
UNIFORM 150' WIDTH
VARIES 100' - 420'
LEFT HALF CHANNEL SECTION TURNING BASIN
LEGEND (SECTIONS)
REQUIRED DREDGING - FEDERAL PROJECT
ASSOCIATED DREDGING-(NON-FEDERAL)
OVERDEPTH DREDGING
SCALE IN FEET
NOTE
SOUNDINGS ARE EXPRESSED IN FEET AND TENTHS TO MEAN LOW WATER.
12' Curve of depth is shown thus:
CAUTION THE POSITION OF THE AIDS TO NAVIGATION SHOWN ON THIS DRAWING ARE INDICATIVE TO THE LOCATION OF THE AIDS AT THE TIME OF THE SURVEY, ARE INTENDED FOR INFORMATION ONLY. AND SHOULD NOT BE USED FOR NAVIGATION.
The information shown on this drawing represents the results of surveys made on the dates indicated and can only be considered as indicating the conditions existing at that time.
Stations shown correspond to the existing Channel Alignment.
SALEM RIVER, NEW JERSEY
DELAWARE RIVER
COMPREHENSIVE NAVIGATION PROJECT
CHANNEL PLAN AND TYPICAL SECTION
PHILADELPHIA DISTRICT CORPS OF ENGINEERS





CAUTION:
The positions of aids to navig on shown on this drawing are indicative of the l. ion of the aid at the time of the survey, and ar. ntended for information only and should not be used for navigation

NOTE:
Soundings are expressed in feet and tenths and refer to Mean Low Water.
12' curve of depth is shown thus: ————
6' " " " " " " — — —
0' " " " " " " ....

The information shown on this drawing represents the results of surveys made on the dates indicated and can only be considered as indicating the conditions existing at that time.

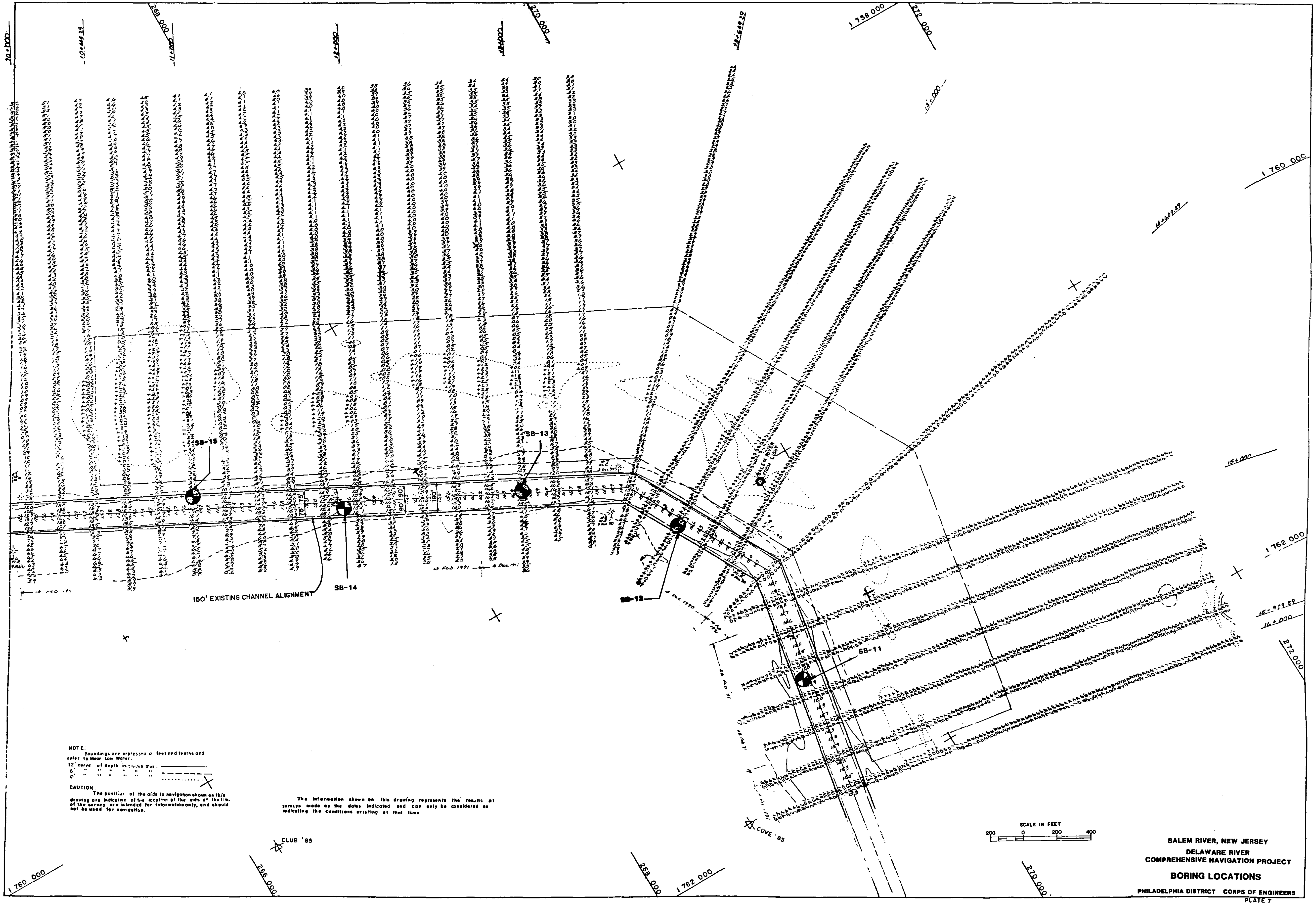
SCALE IN FEET
200 0 200 400

SALEM RIVER, NEW JERSEY

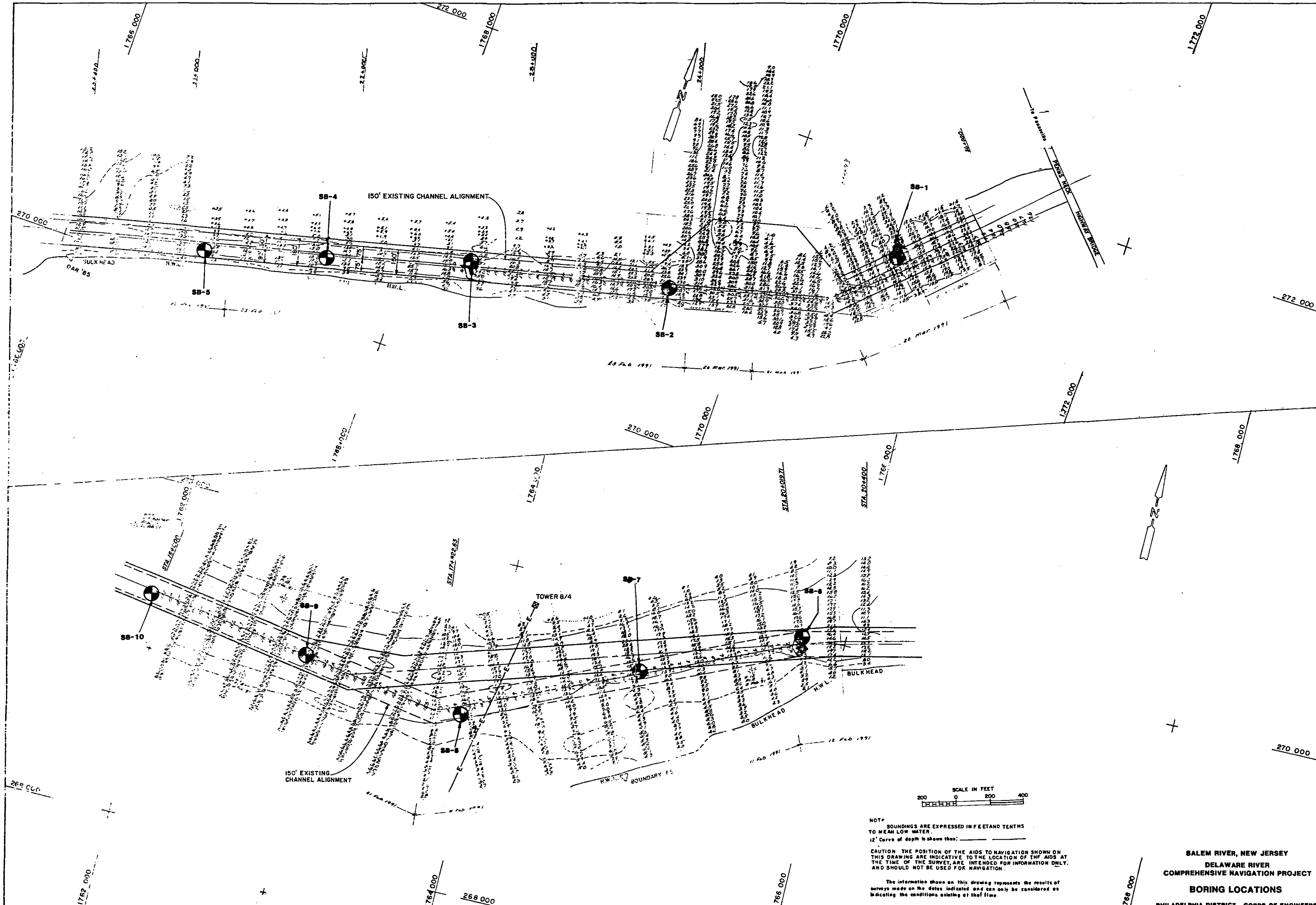
DELAWARE RIVER
COMPREHENSIVE NAVIGATION PROJECT

BORING LOCATIONS

PHILADELPHIA DISTRICT CORPS OF ENGINEERS



SB-15
SB-14
SB-13
SB-12
SB-11
150' EXISTING CHANNEL ALIGNMENT
SALEM RIVER FRONT LIGHT
CLUB '85
COVE '85
1 758 000
1 760 000
1 762 000
266 000
268 000
270 000
272 000
SCALE IN FEET
200 0 200 400
NOTE:
Soundings are expressed in feet and tenths and refer to Mean Low Water.
12' curve of depth is shown thus:
6' " " " " " "
0' " " " " " "
CAUTION.
The position of the aids to navigation shown on this drawing are indicative of the location of the aids at the time of the survey are intended for information only, and should not be used for navigation.
The information shown on this drawing represents the results of surveys made on the dates indicated and can only be considered as indicating the conditions existing at that time.
SALEM RIVER, NEW JERSEY
DELAWARE RIVER
COMPREHENSIVE NAVIGATION PROJECT
BORING LOCATIONS
PHILADELPHIA DISTRICT CORPS OF ENGINEERS
PLATE 7



SCALE IN FEET

200 0 200 400

NOTE

SOUNDINGS ARE EXPRESSED IN FEET AND TENTHS TO MEAN LOW WATER.

12' Curve of depth is shown thus: ——— ———

CAUTION THE POSITION OF THE AIDS TO NAVIGATION SHOWN ON THIS DRAWING ARE INDICATIVE TO THE LOCATION OF THE AIDS AT THE TIME OF THE SURVEY, ARE INTENDED FOR INFORMATION ONLY. AND SHOULD NOT BE USED FOR NAVIGATION.

The information shown on this drawing represents the results of surveys made on the dates indicated and can only be considered as indicating the conditions existing at that time.

SALEM RIVER, NEW JERSEY

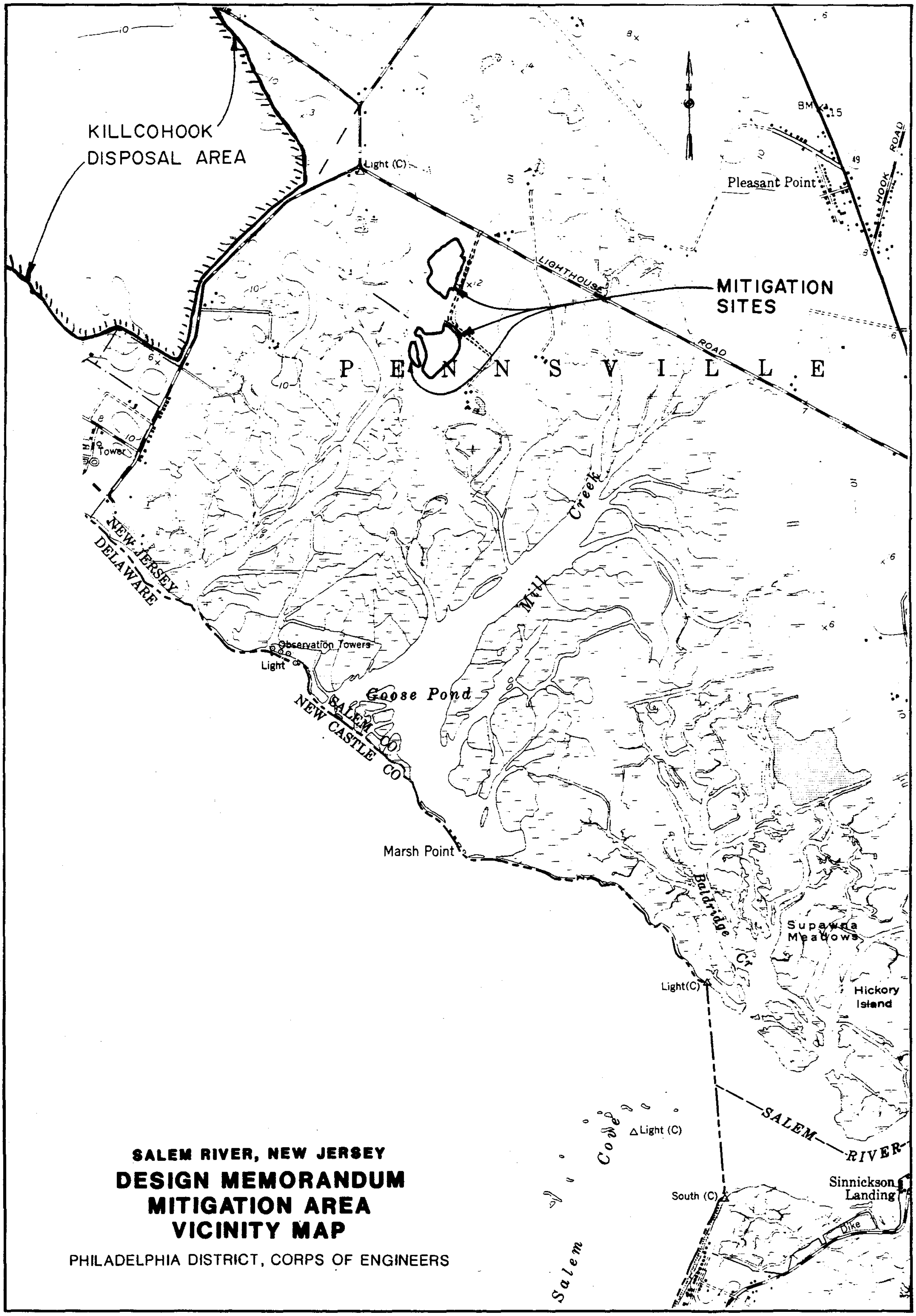
DELAWARE RIVER

COMPREHENSIVE NAVIGATION PROJECT

BORING LOCATIONS

PHILADELPHIA DISTRICT CORPS OF ENGINEERS

PLATE 8



SALEM RIVER, NEW JERSEY

DESIGN MEMORANDUM
MITIGATION AREA
VICINITY MAP

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

PLATE 9

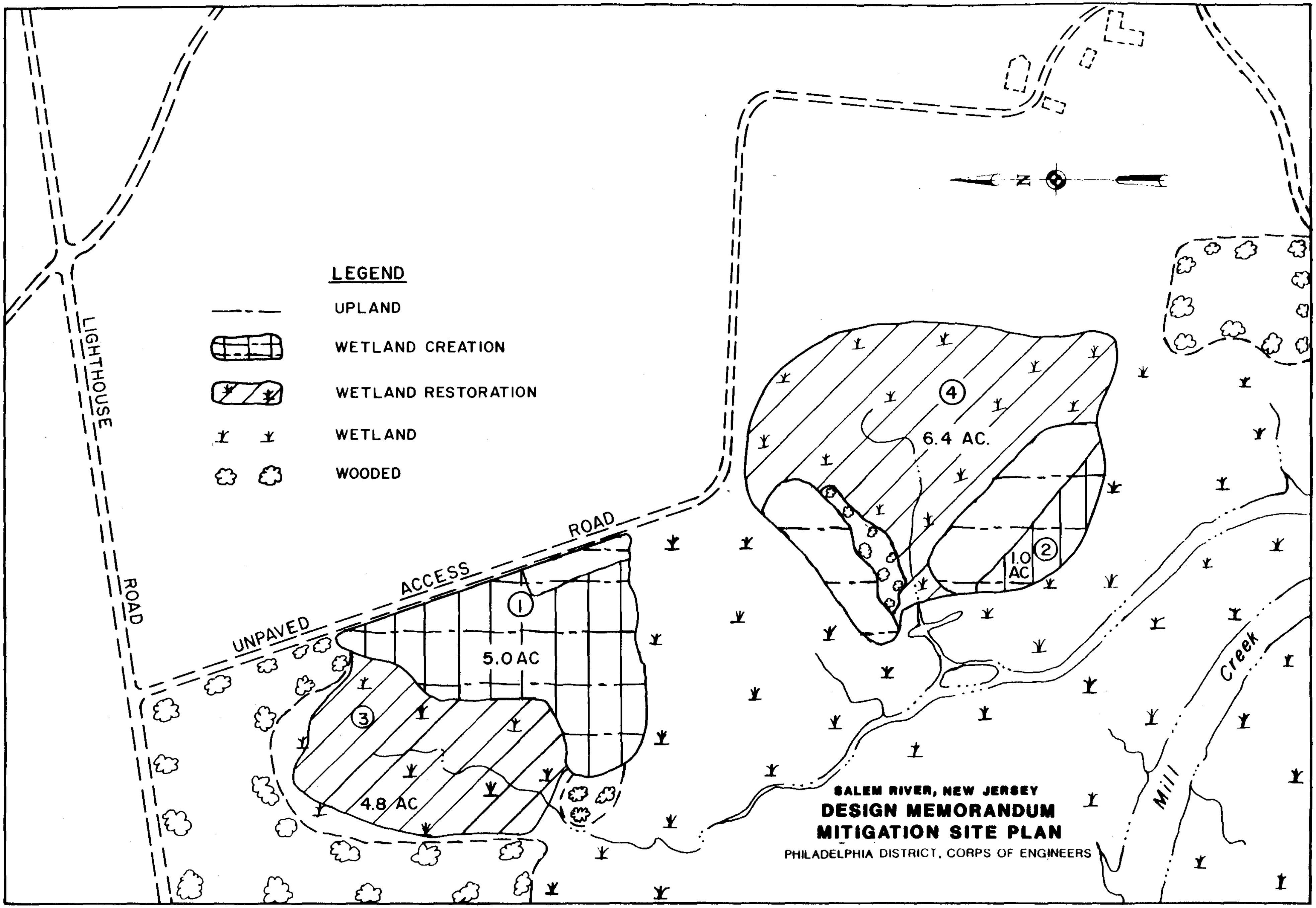
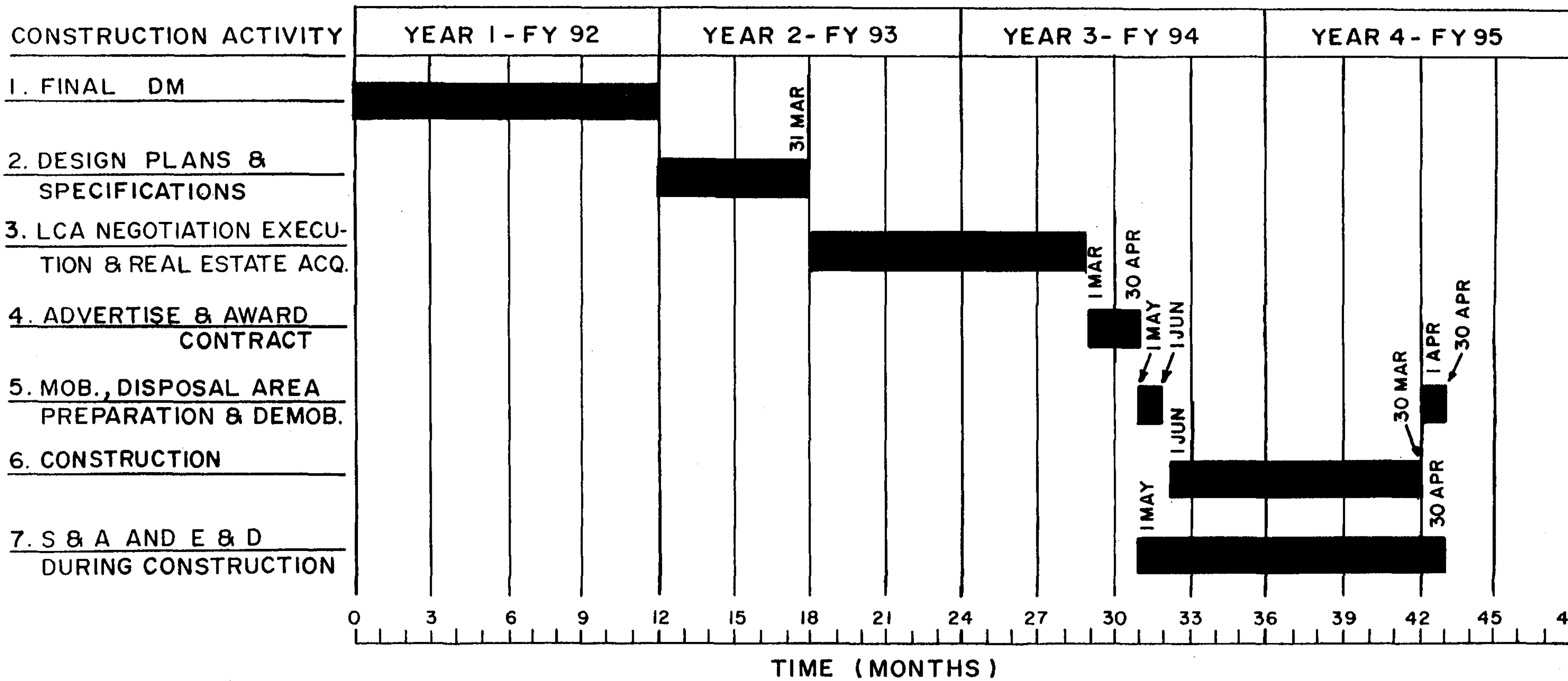

LEGEND
UPLAND
WETLAND CREATION
WETLAND RESTORATION
WETLAND
WOODED
LIGHTHOUSE ROAD
UNPAVED ACCESS ROAD
N
1
5.0 AC
3
4.8 AC
4
6.4 AC.
2
1.0 AC
Mill Creek
SALEM RIVER, NEW JERSEY
DESIGN MEMORANDUM
MITIGATION SITE PLAN
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

PLATE 10



SALEM RIVER, NEW JERSEY

DELAWARE RIVER
COMPREHENSIVE NAVIGATION PROJECT

SCHEDULE OF CONSTRUCTION

PHILADELPHIA DISTRICT CORPS OF ENGINEERS

PLATE 11

APPENDIX A

PERTINENT CORRESPONDENCE

STATE OF NEW JERSEY
OFFICE OF THE GOVERNOR
CN-001
TRENTON
08625

JIM FLORIO
GOVERNOR

March 11, 1991

Lieutenant Colonel Kenneth H. Clow
U.S. Army Corps of Engineers
Philadelphia District
U.S. Customs House
2nd and Chestnut Streets
Philadelphia, Pennsylvania 19106-2991

Dear Lt. Colonel Clow:

I am writing to you regarding the U.S. Army Corps Salem River Channel project in Salem City, New Jersey.

I understand that proposed preconstruction and engineering and design costs for this project are $10,000,000 for the federal share and $2,700,000 for non-federal.

At this time, I wish to assure the U.S. Army Corps of Engineers that the State of New Jersey supports this project, the Feasibility Study findings, and expresses an intent to fund the non-federal share of the above improvements at time of construction.

Very truly yours,

J. Florio

Jim Florio
GOVERNOR

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Fish and Wildlife Enhancement
927 North Main Street (Bldg. D1)
Pleasantville, New Jersey 08232

Tel: 609-646-9310
FAX: 609-646-0352

IN REPLY REFER TO:

FP-92/196

August 14, 1992

Robert L. Callegari, Chief
Planning Division
U.S. Army Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3396
ATTN: Environmental Resources Branch

Dear Mr. Callegari:

This responds to your letter of July 24, 1992, requesting Fish and Wildlife Service (Service) comments on the proposed mitigation plan for the Delaware River, Comprehensive Navigation Study, Salem River, New Jersey, Preconstruction, Engineering, and Design Project. The selected plan for improving navigation on the Salem River includes widening the existing navigation channel from the current width of 100 to 150 feet to a channel 150-feet-wide over the entire 5-mile length of the channel. The channel would also be deepened from the current authorized depth of 12 feet below mean low water to 18 feet below mean low water. The selected plan also provides for a 495-foot-wide turning basin opposite the berthing area at the Port of Salem, and bend widening. The proposed project would result in the loss of 3 acres of estuarine intertidal emergent wetlands, and 8.6 acres of shallow water habitat.

To mitigate unavoidable adverse impacts to wetlands and shallow water habitat, the Army Corps of Engineers (Corps) proposes to create 8.4 acres of estuarine intertidal emergent wetlands from uplands, and to enhance 6.4 acres of degraded wetlands dominated by common reed (*Phragmites communis*). The proposed mitigation site is located on the Supawna Meadows National Wildlife Refuge. Service biologists visited the proposed project site and the proposed mitigation site on August 15, 1991. Additional visits to the proposed mitigation site occurred on August 20, 1991, and May 18, 1992.

The following comments are provided as planning aid in accordance with a Fiscal Year-1991 scope-of-work agreement between the Service and the Philadelphia District, Corps of Engineers. This correspondence provides technical assistance only and is not the document required of the Secretary of the Interior pursuant to Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

Pursuant to the National Wildlife Refuge System Administration Act of 1966 (50 CFR Part 29.21), the Corps' use of the proposed mitigation site will require a special use permit from the Service. The information submitted via this formal request for a special use permit will be used to determine whether the proposed use is compatible with the purposes for which the refuge was established. Application for the special use permit should be made to the refuge manager at the following address:

Walter Ford, Assistant Refuge Manager
Supawna Meadows National Wildlife Refuge
R.D. #3, Box 540
Salem, New Jersey 08079
(609/935-1487)

The mitigation plan submitted to this office provides a narrative description of the proposed mitigation project. This description includes existing and proposed elevations on the mitigation site; existing and proposed vegetation on the mitigation site; the tidal range of the mitigation site; salinity of the water that would feed the proposed mitigation site; and, a proposed post-planting monitoring plan for the mitigation project. The mitigation plan also includes a site map showing the general boundaries of the mitigation site.

The Service has reviewed this information and supports the conceptual design for the proposed mitigation site. The following recommendations are provided to improve the chances of successfully implementing the proposed mitigation.

1. Provide detailed site plans depicting at least the following: existing and proposed contours; mean high and mean low water lines; areas of proposed plantings, by species, including densities; locations of monitoring wells; and, locations of any tidal ditches.

2. Revise the proposed monitoring plan to specify a goal of 85 percent areal coverage of planted herbaceous species, or other desirable hydrophytic vegetation, after five growing seasons. Specify that failure to achieve this goal will require an evaluation to determine the cause of the failure, and appropriate remedial action.

3. Revise the proposed monitoring plan to include quantitative methods to document encroachment of common reed on the mitigation site, and to remove common reed should it occur. Specify that if common reed is determined to be a persistent problem after five years, it will be necessary to evaluate the cause of the problem and take appropriate remedial action.

4. Provide annual summary reports of information obtained through the post-planting monitoring program to the Service for a period of five years following the completion of initial plantings.

We appreciate the opportunity to comment on this project and all efforts by the Corps to accept a shared responsibility to ensure adequate protection of our Nation's living resources. Should you have any questions regarding these comments, or require further technical assistance, please contact Peter Benjamin of my staff.

Sincerely,

Clifford G. Day

Clifford G. Day
Supervisor

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Habitat and Protected
Resources Division
Sandy Hook Laboratory
Highlands, New Jersey 07732

August 14, 1992

Robert L. Callegari, Chief
Planning Division
Philadelphia District
U.S. Army Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia PA 19107-3390

Dear Mr. Callegari:

The National Marine Fisheries Service has reviewed the Salem River Mitigation Plan. The plan is designed to compensate for the loss of 3 acres of estuarine, intertidal, emergent wetlands and 8.6 acres of shallow water habitat that would result from the widening and deepening of the Salem River channel in Salem County, New Jersey. The mitigation will consist of the construction of 8.4 acres of estuarine, intertidal, emergent wetlands from uplands (1:1 ratio) and the restoration of 6.4 acres of wetlands (2:1 ratio) which are presently dominated by monotypic stands of reed (Phragmites sp.) at the Supawna Meadows National Wildlife Refuge in Salem County, New Jersey. The mitigation plan appears to provide the necessary compensation for the habitat loss that will result from the channel improvements. However, we request that a control plan for Phragmites, and additional information concerning the post-planting monitoring of the mitigation site be provided as part of the mitigation plan.

According to the excavation and grading section of the mitigation plan, a 4:1 slope is planned for the transitional area between the uplands and the mitigation area. The purpose of the steep slope is to help limit the invasion of Phragmites into the mitigation site. We recommend that a control plan also be developed to eliminate any Phragmites that invades the site.

The plan should also be more specific about the goals of the mitigation plantings. The monitoring section of the plan states that the site shall attain a "minimum vegetative coverage survival" of 85% of the disturbed area after one complete growing season. The phrase "minimum vegetative coverage survival" is ambiguous. Is the goal of the planting to achieve 85% survival of the planted species, or 85% coverage? We recommend that 85% coverage, including volunteer wetland species other than Phragmites, be required.

The Salem River Mitigation Plan appears to provide adequate compensation for the wetland and shallow water habitat loss associated the widening and deepening of the Salem River. However, we request that additional information detailing the post-planting monitoring of the site and a Phragmites control plan be provided as part of the mitigation plan.

Thank you for the opportunity to comment. If you would like to discuss this project, please contact Karen Wurst at (908) 872-3015.

Sincerely yours,

Stanley W. Gorski
Assistant Coordinator
Habitat Program

cf: EPA, Region II
FWS, Pleasantville
NJ Land Use Regulation Element
NJ Div. of Fish, Game & Wildlife

K.Wurst:908-872-3015:8/14/92:kmw

PORT SALEM

P.O. Box 1001
Salem, New Jersey 08079

(609) 935-6380 FAX (609) 935-9113

Charles R. Sullivan
Director of Operations

September 21, 1992

Lt. Colonel R.F. Sliwoski
District Engineer
U.S. Army Corps of Engineers
100 Penn Square East
Philadelphia, PA 19107-3390

Dear Lt. Colonel Sliwoski:

This letter is in reference to the final Design Memorandum concerning the project for Salem River, New Jersey, changes since the Draft Design Memorandum (dated February 1992) and the District's proposed recommendations for the final report. This office continues to be in support of the project.

Our office has received a copy of the draft Local Cooperation Agreement (LCA) shown in the final report and is currently reviewing that document. I anticipate that the Port Authority would be prepared to execute the LCA at the proper time.

Governor Florio of the State of New Jersey has indicated his support for the project and his intent to fund the non-Federal share of this much needed project in his letter dated March 11, 1991. Since that time, I have continued to coordinate with his staff to work out the specific arrangements so that when the time comes, the funds will be available.

Sincerely,

John D. Burke (DH)

John D. Burke
Port Liaison

JDB/bh

APPENDIX B

SHIP SIMULATOR MODEL STUDY

Final Letter Report

NAVIGATION STUDY OF PROPOSED IMPROVEMENTS TO THE SALEM RIVER NAVIGATION CHANNEL, NEW JERSEY

Hydraulics Laboratory

DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
3909 Halls Ferry Road, Vicksburg, Mississippi 39180-6199

January 1992

Introduction

1. This report presents results and recommendations from the analysis of the radar-based navigation study of the Salem River. These tests involved all three professional pilots who operate on this waterway.

Background

Existing Condition

2. The Salem River Study addresses a study area surrounding the Salem River in Salem County, New Jersey, a tidal stream entering the Delaware River at mile 60, about 45 miles south of Philadelphia, Pennsylvania (see Figure 1). The present Salem River project provides an entrance channel from Delaware Bay to the fixed Route 49, Penn's Neck, highway bridge in Salem, a distance of about 5 miles. The existing authorized depth is 12 ft MLW with a width of 150 ft from the Delaware River through Salem Cove narrowing to 100 ft at the cutoff at Sinnickson's Landing. The existing Salem River channel is shown on Figure 2. Since the 1984 maintenance dredging to authorized dimensions, the most common size ship using the river is a 50-ft x 270-ft general cargo vessel with a 14.5-ft draft and 5,000 dwt. The longest ship taken up the river was 347 ft long with a beam of 60 ft. The widest vessel to use the port was 65 ft x 310 ft. The recommended draft restriction was adjusted by the pilots to 15.5 ft when maintenance dredging was completed in July 1988. Safe underkeel clearance is considered to be 2 ft.

3. Traffic is one-way and all vessels arriving or departing from the port must be tug-assisted and consider tidal conditions. According to the pilots, vessels currently transiting the river use the tide for efficient operation with the tide range being 5-6 ft. Ships using the channel at high tide have approximately 17 ft of depth with which to work. Since normal transit time is about 45 minutes, when the tide is high enough for the vessels requiring a 17-ft channel, the high tide window permits two vessels to move through the channel. General cargo and bulk vessels are navigated by Delaware River pilots to the Reedy Point Anchorage. Contract Salem River pilots take ships from Reedy Point to the Salem Port, turn, and dock the ships port-side-to.

Three licensed pilots are available.

4. Vessels normally encounter a 6- to 7-knot current and are subjected to wind forces which necessitate tug assistance. Tug service on the Salem River is presently provided by a 525-HP tug. Vessels over 330 ft in length or moving during adverse weather conditions sometimes require the use of two tugs or a larger tug (1,100 HP) unless the vessel has thrusters to enhance maneuverability.

5. As noted above, vessel transits on the Salem River are normally made on flood tide depending on the draft requirement of the vessel. To allow for turning and maneuvering during favorable current conditions, transits are timed to arrive at the port area near slack water on the flood tide. Presently, there is no designated maneuvering area; however, the deep water located between Penn's Neck Bridge and the old Salem River channel near the Mid-Atlantic Shipping Terminal (see Figure 3) is used for this purpose. When turning, the tug is positioned on the starboard bow perpendicular to the keel to rotate the ship to the left 180 degrees until it is facing downstream.

6. The U.S. Coast Guard has improved the navigation aids on the Salem River since the 1984 maintenance dredging. Two lights and 12 lighted navigation aids were added in 1989 to improve the system.

7. Channel dimensions, both width and depth, present problems at Salem River. The primary problem area for maneuvering is the bend in Salem Cove where the channel turns southward toward the Delaware Bay. There are difficult hydraulic conditions and shoaling in this area that result in frequent minor groundings. However, no extensive damage has been reported as a result of groundings. The Port of Salem has considered the possibility of docking ships up to 450 ft in length. According to the pilots, maneuvering and turning a ship of that size would be difficult without channel improvements. The opportunity exists to increase vertical clearance under the utility cable and reduce dredging requirements by realigning the channel at Sinnickson's Landing to follow naturally deep water. The Coast Guard has made extensive modifications to the marking of the existing channel to aid navigation in this area.

8. The selected plan (shown in Figure 3) consists of a 5-mile-long navigation project extending about 3 miles up from the Delaware River main channel to Salem Cove and then upstream to Penn's Neck Highway Bridge at Route 49, a distance of about 2 miles. The selected plan provides for a 180-ft, one-way channel with a 18-ft-MLW depth and an allowable dredging over-depth of 2 ft. Channel dimensions are based on a design vessel with a 50-ft beam, 330-ft length, 21.5-ft draft, and an accompanying tug with a 10-ft beam. This draft vessel will utilize a 5.5-ft tide with the recommended 2-ft underkeel clearance. The turning basin dimensions provide a width of 495 ft in order to accommodate the design vessel and the largest anticipated vessel, a 65-ft x 350-ft ship with a 27-ft design draft. The turning basin width satisfies Corps criteria of 150 percent of the design vessel length. The tidal operations will continue to maximize economic benefits.

Study Purpose

9. The purpose of this study is to determine what effects the proposed changes to the Salem River navigation channel will have on navigation. The new channel alignment and dimensions may alter the current patterns in the area significantly enough to affect navigation, particularly in the bend and the intersections of the cutoff channel. The navigation study will also aid in the refinement of widths of the recommended channel improvements. The design ship draft is being increased significantly and the behavior of this ship in the proposed channel alignment should be determined.

Test Conditions

10. The three conditions tested were the existing condition, the proposed condition, and the existing condition deepened to 18.0 ft MLW. The existing condition and the proposed condition, insets A and B, respectively, shown on Figure 4, were tested as previously discussed. The pilots documented that they presently bring in ships of the size of the proposed design vessel. Therefore, it was felt that if the existing condition were deepened, transits of this size vessel could occur with no widening. All runs were made with flood tide and a 20-knot wind from the south. These conditions were selected

based on a discussion with the senior local pilot. Both the existing channel and the existing channel deepened to 18.0 ft MLW utilized a 500-HP tug while turning. When the proposed condition was run, a 1000-HP tug was available.

11. Two ships were tested in the simulations. The **Bermuda Islander** was used to represent the existing traffic. This ship most frequently transits the Salem River. It is 262 ft long with a beam of 43.3 ft and the draft used was 15.5 ft. This represents the adjusted draft restriction after the completion of the 1988 maintenance dredging. The proposed traffic was represented by a ship with dimensions of 327 ft x 49.9 ft with a draft of 21.5 ft. The ship models were provided by BMT, International*. The Salem River pilots indicated that they bring ships larger than the proposed design ship into the existing channel. The District was notified of the pilots' opinions on this matter and it was decided to continue with the originally determined choice of design ship.

12. Current data for the simulation were provided by the TABS-MD hydrodynamic numerical model (RMA-2) developed at WES. The model was primarily composed of two-dimensional elements except for one-dimensional elements from Kelly Point to Trenton (see Figure 5). Because prototype field measurements were not available until near the end of the hydrodynamic modeling schedule, several conservative precautions were made to ensure the success of the project. Boundary conditions were deliberately placed far away from the study area. The use of 1-D elements from Kelly Point to the head-of-tide at Trenton prevented the possibility of tidal reflection problems. Good bathymetry was provided by the District which allowed for accurate resolution within the study area. Data provided by the District permitted the large shallow tidal storage area called Mannington Meadows to be incorporated into the model.

13. A mean discharge boundary condition of 18,000 cfs for Trenton was

* Ankudinov, V. 1991 (Dec). "Hydrodynamic and Mathematical Models for Ship Maneuvering Simulations of Two Small Cargo Ships in Support of WES Salem River Navigation Study." Report No. 9292-002, prepared under Contract No. CACW 39-91-D-006 by BMT, International, Incl, Columbia, Maryland, for the US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

obtained from previous physical modeling work on the Delaware River conducted at WES in the mid-70's*. The spring tide boundary condition was derived from predicted tide tables for 1 April 1991. Tidal phasing results within the model were checked between the ocean entrance and Trenton with data obtained from the work presented by Dr. Ippen**. A small computational time step, which varied between 15 and 30 minutes, was used in the numerical model. The model was run two tidal cycles to allow a full tidal cycle spin-up.

14. Field measurements were collected by NAP at five water-level stations and three velocity stations within the immediate study area. Data were collected for 2.5 hours on 15 August 1991 corresponding with low tide. The numerical model results were compared with the field current data and found to be reasonable given that the boundary conditions for the two comparisons did not match. The data also provided guidance concerning the distribution of flow near Sinnickson's Landing. Although the Salem River hydrodynamic model was not verified to a field data set, the precautions listed above provide reasonable confidence in the results for the purposes of a ship simulation study.

15. However, even with these precautions, velocity magnitudes and directions were adjusted during the validation to reflect the pilot's opinion of the current effects in the existing condition. The output of the TABS-2 model and the simulator input are shown on Figures 6 and 7, respectively. Changes had to be made in the current directions and magnitudes at the turn and through the cut during validation. The currents had to be increased in magnitude in both locations from that computed by TABS-2.

16. As previously stated three conditions were tested. Twenty-four runs were made of six run combinations. Table 1 shows a list of the runs made. All three of the Salem River Pilots participated in the study. Pilot A validated

* Letter, J. V., McAnally, W. H., 1975 (Jun). "Hydrodynamics of the Delaware River Estuary Model," Technical Report H-75-8, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

** Ippen, A. <u>Estuary and Coastline Hydrodynamics</u>, McGraw-Hill Book Company, Inc., New York, NY, pp 534-544.

the model and Pilots B and C made test runs. Pilot A's runs were not used in analysis; therefore, they are not shown on Table 1.

17. The procedure followed was to have the pilots make several runs of the existing condition for familiarization with the simulator. When testing began, the pilot was shown a diagram of the channel to be tested and told of the water depth, ship draft, and any other necessary information. The conditions were tested in a random order. After the run was over, the pilot completed a questionnaire in which he was asked to rate the difficulty of the run and the accuracy of the simulator. When the testing period was over, a final questionnaire was given to the pilot which asked his opinion of the project.

Test Results

Inbound Runs

18. Inbound runs began in the main Delaware River channel with a heading of 16 degrees and an initial speed of 10.0 knots. The ship was piloted into the Salem River channel, around the turn, under the power cable, and through the cut. The ship was then turned in either the naturally deep water in the existing condition or in the proposed turning basin. It should be noted that presently most traffic is export and inbound ships are ballasted not loaded. Loaded ships were tested because limited funding did not allow the development of coefficients of a ballasted ship. The loaded ships represent a more difficult navigating condition and it is anticipated that some imports may develop with the improved channel. Ballasted ships will not have significantly greater clearance.

19. Existing. As expected, the pilots are able to transit into the existing Salem River channel without incident. Figure 8 shows a composite ship-track plot of the inbound runs of the **Bermuda Islander** in the existing channel. A track plot shows all runs illustrated by snapshots of the ship taken every twenty-five seconds, plotted one after the other. Since the channel is five

miles long, it is difficult to see detail in the plot of the entire channel. For this reason, the channel was broken into three areas, shown on Figure 9. The southern-most area is called the Entrance, followed by the Turn reach, and finally the Cut. On the Cut detail (see Figure 10), the reach just inbound of Sinnickson's Landing where the Salem River forks away from the cut is shown to be an area of difficulty in the existing channel. As shown on Figure 8, the other reaches are satisfactory for the existing navigating conditions and do not require any special attention.

20. Proposed. The inbound runs of the proposed channel were made with a ship of dimensions 327 ft x 49.9 ft with a draft of 21.5 ft. These were the dimensions of a ship named the **Tajo**, which meet the criteria for the design ship. No maneuvering information was available on this ship so assumptions were made in developing input to represent it on the simulator. This could be done for this study since the ships that will call on this port during the project life are not known and this ship model is only required to be representative of this general class and size of ship. The pilots did indicate that, except when backing, the simulated ship represents a typical poor handling vessel that might enter Port Salem.

21. In the ship track plots, shown on Figure 11, the pilots demonstrate that generally they are able to maneuver within the channel boundaries without problems. As shown on the enlarged drawing of the entrance into the Salem River (Figure 12), two of the four runs exceeded the channel on the north edge as they entered the proposed channel. Since there is naturally deep water in this area, the pilots know they can go in this area and not ground. They followed the same strategy on the simulator. The Cut detail (Figure 13) shows one run exceeding the channel limits to the south at the power line. Much less difficulty is encountered approaching the cut in the proposed channel than was experienced in the existing channel. The ships were turned easily in the proposed turning basin; however, one track shows the ship hitting the Mid-Atlantic Dock. It should be noted that several trial runs were required to develop a successful strategy for turning in this turning basin since the current pattern in the proposed condition is very different from the existing

condition current pattern. The unfamiliarity with the ship also caused problems.

22. Existing Deepened. The ship-track plots of the inbound runs of the existing condition deepened to 18 ft MLW are shown on Figure 14. These runs were also made with the **Tajo** as the design vessel. The track plots are similar to the existing condition track plots in that successful transits are made except in the approach to the cut as shown on Figure 15. This figure also illustrates the difficulty encountered by the pilots when attempting to turn in the existing maneuvering area.

Outbound Runs

23. Outbound runs began at the Salem Port and proceeded through the cut, under the power cable, around the turn, and out to the Delaware River. Outbound runs began with a heading of 225 degrees and an initial speed of 4.1 knots. Turning is normally accomplished on the inbound transit and therefore it was not tested as part of the outbound run.

24. Existing. The ship track plots of the **Bermuda Islander** transiting outbound in the existing condition are shown on Figure 16. This track plot indicates a difficult run throughout the Cut area, shown on Figure 17, in spite of no significant excursion beyond the channel boundary. Figure 18 shows groundings occurred in the turn out to the Delaware River. The pilots were not satisfied with the simulation in this area. They said that they normally made one sweeping turn around the two buoys. On the simulator, they made one turn, held course, and then proceeded with a second turn. One pilot suggested, "the turn at marker numbers 8 and 10 should be shortened to be more realistic." However, no justification could be made for this since the buoys were located at the exact state planar coordinates shown on the navigation charts. The validation pilot complained that the currents in this area were not acting properly. Many changes were attempted but it seems that these changes did not correct the problem. The lack of data to verify the current model could have allowed significant error in this region. Figure 19 shows

that less difficulty was encountered in the entrance reach.

25. Proposed. The track plots of the proposed condition outbound runs with the Tajo are not as smooth as the existing condition. Groundings are seen on Figure 20 in the turning basin, at Sinnickson's Landing, just before the power line, and in the turn.

26. Existing Deepened. With the existing condition deepened to 18 ft MLW, the groundings are not as severe as in the proposed condition, as shown on Figure 21. This indicates that the pilots' unfamiliarity with the channel limits, bank conditions, and new current patterns may have caused these groundings. Figure 22 shows one trackline exceeding the channel limits on the north side at Sinnickson's Landing. This area has already been identified as needing improvement.

Pilot Questionnaires

27. To determine the pilots' thoughts about the simulator and proposed deepening, two questionnaires were prepared to document their comments and rate the runs. One was given to the pilots after each run and a final debriefing questionnaire was given to the pilots upon completion of the test period. For each run, the pilots were asked to give a rating on the difficulty of the run, the effect of the current on the ship, the amount of attention required, and the danger of grounding or hitting an object. The general trend of the pilots' ratings was that the existing channel got the lowest rating, indicating the easiest channel to navigate. The proposed channel was given a rating slightly higher than that of the existing channel and the existing deepened to 18 ft MLW received a rating much higher than either the existing or proposed channels.

28. Figure 23 shows the ratings for the inbound runs. Three of the four questions followed the expected pattern. The existing channel required more of the pilots' attention than the proposed channel. It seems the pilots felt they had more area in the proposed channel and did not have to concentrate on

staying in the channel. In this case, the existing channel rated more closely to the existing deepened channel then the proposed channel.

29. The same pattern is shown in the outbound runs (see Figure 24). The normal trend is followed for the questions regarding difficulty of run, the effects of the current on the ship, and danger of grounding or hitting an object. The only question that does not follow this pattern is amount of attention required. In the outbound case, the proposed channel, not the existing, rates higher than expected. The pilots seem to have to concentrate more on the proposed channel because of their unfamiliarity with the turn. It could also be possible that the pilots interpreted this question differently than intended. In this case, the proposed channel rating is the same as the existing channel deepened.

Discussion

30. The pilots felt that the radar-based simulation done in this study was similar to entering the port with zero visibility, (i.e., during a heavy rain, or fog). They emphasized that this would not be attempted. Therefore, the simulation was more difficult than actual navigating conditions. For this reason, the channel design may be conservative, i.e., wider than optimum.

31. The modeled existing condition was shown to be adequately represented for the present traffic into Port Salem. The need for improvement is recognized in the area of Sinnickson's Landing entering the cut when transiting inbound. Loaded inbound transits are not frequent in the existing channel.

32. The proposed channel width of 180 ft is acceptable in most areas. This was confirmed by the pilots who stated on their final questionnaires that widening the channel to 180 ft and enlarging the turning basin would provide the margin of safety necessary to negotiate vessels of 21.5-ft draft. The 180-ft channel is not adequate near Sinnickson's Landing between the power cable and the cut. Also, the turn outbound heading toward the Delaware River needs improvement. The existing channel deepened to 18 ft MLW illustrates the

ability of the pilots to navigate in a channel narrower than the proposed design.

33. Two areas were apparently not simulated as accurately as desired based on pilot evaluation. The first area is in the turn. The pilots' opinion was that the model ship did not handle in this area as they expected it should. While the currents were adjusted, it is not clear what is causing the unexpected behavior. There could be different bottom conditions than indicated on the maps and outside the detailed survey data available to us. This could change the currents or the bank effects in this local area. The proposed turn wideners of approximately 265 ft fit into the design guidance range of a ship with good controllability. Since no data were available on the maneuverability of the design ship a more conservative design may be required.

34. The second area where the simulation was not as accurate as planned is in the turning basin. No information on maneuvering was available on the Tajo so assumptions were made in developing a ship model for the simulator. The pilots felt this ship responded too efficiently to the rudder commands when backing. For this reason, it was much easier for the pilots to turn the ship. The proposed design, based on the Corps design criteria which is thought to be conservative, will not be modified. Despite these two areas the pilots rated the overall simulation 8.5 out of 10, 10 being the most accurate rating.

35. Based on experience in working with pilots, it seems that they attempt to stay at the center of the two banks on each side. This has been illustrated again in these data even though the north bank was cut back on a 1-vertical on 4-horizontal slope to show the added width. Therefore, the 80-ft widening to the north side of the cut is not efficient. A smaller widening symmetrical to the centerline between the banks would be more beneficial.

36. Proposed Modifications. Based on this study, it is recommended that the navigation channel be modified as shown on Figure 25. Figure 26 shows a comparison of the recommended channel versus the District's proposed design in

the cut. In the turning basin, it would be beneficial for the channel to extend south an extra 40 ft. This would cause the channel to be near the Mid-Atlantic Shipping Terminal. Also, a widener should be introduced entering the turning basin. The 100-ft measurement was made along the alignment of the proposed flare into the turning basin. This flare occurs over a distance of 750 ft. If the channel were rotated slightly so that the channel is 30 ft to the south of the proposed channel alignment at the entrance to the cut, this would be a great benefit to the pilots both when subjected to the flow of the old Salem River on inbound runs and in setting up for the anticipated currents on the outbound runs. However, there is no need to make this channel 180 ft wide; 150 ft would be sufficient if aligned correctly. The channel at Sinnickson's Landing, on the other hand, is not adequate at 180 ft. A 250-ft channel is recommended at this location. As shown on Figure 27, the majority of these areas of deepening already have depths of 12 ft or greater. This is the dredged channel plus naturally deep water in the turning basin and at Sinnickson's Landing. It is not anticipated that these channel widenings would increase dredging volumes significantly. Figure 28 shows the proposed tracklines in the recommended channel. In most cases, the recommended channel contains the tracklines with adequate clearance on either side.

37. The recommended channel has a southern boundary 550 ft from the tower supporting the overhead power line. As shown on Figure 29, the restricting air clearance would be 95 ft. The maximum air draft is set by the pilots at 85 ft. The existing channel provided a 100-ft clearance giving an extra 15-ft air clearance above that maximum air draft limit. The recommended channel provides only 10 ft of clearance. The design ship Tajo with a ballast draft of 11 ft would require that the height of the power cable be 104 ft. Thus, the present channel air clearance at 100 ft is not satisfactory for this ship in a ballast condition. The design ship will have to come into Salem with a heavier ballast load than normal. However, loaded design ships will be able to clear in the recommended channel.

38. On the turn plot (Figure 30), the turn widener at Sinnickson's Landing has been enlarged to 350 ft. This is shown on Figure 31 to be in water of a

depth of 12 ft or greater. The channel then returns to 180 ft. The turn heading toward the Delaware River has been widened to a constant width of 250 ft; however, the bend wideners have been removed (Figure 30). The channel then flares down from 250 ft to 150 ft over a distance of 1,900 ft and remains at 150 ft. Figure 32 shows the ship track plots of the existing channel deepened to 18 ft MLW. All tracklines are enclosed in the envelope of the recommended channel with sufficient clearance for most runs. The runs of the existing channel deepened were used since the pilots used about 450 ft in the turn in the proposed channel. As previously discussed, their unfamiliarity with the channel conditions caused them some confusion.

39. Figure 33 shows the channel returning to 180 ft over a distance of 2,600 ft. It remains at 180 ft until a flare at the intersection of the channel with the deep water at the Delaware River. At the intersection the width is 280 ft; the change was over a distance of 2,000 ft. Again, Figure 34 shows that in most of this area the depth is already greater than 12 ft; in some places the natural depths are as much as 40 ft. Figure 35 shows the track plots of the proposed channel in the recommended channel. In the reach that flares from 150 ft to 180 ft, there is insufficient clearance on the west side of the channel. In the proposed channel condition, the pilots had this area to work with. However, Figure 36 shows that with the tracks of the deepened existing channel there is adequate clearance.

40. Due to limited funding on this study, the conclusions were not as definitive as desired. It may be possible to further refine the channel design with more testing. Field data should be taken during a spring tide event. The TABS-2 model should be verified to these data. Finally, simulations should be made with the visual scene showing the normal view the pilot would see out of the bridge window while piloting the ship. This information could lead to further reduction in the channel dimensions.

41. Two locations have been identified as possible areas of further refinement to the channel. Figure 37 shows the ship track plots of the proposed channel runs in the recommended turning basin. This drawing shows that it may be possible to decrease dredging costs substantially by decreasing

the size of the turning basin. This has not been included in the recommendations since the simulated **Tajo** responded well to rudder commands when backing. Further testing will be needed to ensure that a larger turning basin is not required for a ship with a more typical backing response.

42. Further optimization could also address the overhead power line at Sinnickson's Landing. If the channel is realigned as shown on Figure 38, not only will the air draft be greater but the turn angle at this location will be decreased by 5 degrees making this, in general, an easier maneuver. Figure 39 shows that the air draft with this channel will be over 100 ft.

43. Also shown on Figure 38 is an alternate turn. The turn is designed to approach a single turn instead of two distinct turns. This was done by setting the curvature on the inside of the channel approximately equal to the steady turning diameter of the ship in shallow water. This was verified as a valid approach by comparing it with the latest information on turn widening. A cutoff bend of 70 degrees would require a 450-ft width. This is the approximate width that would be achieved by creating a cutoff bend (i.e., extending the outer edges of the straight reaches until they intersect). This turn is thought to be easier to navigate than the recommended turn. In the changes shown on Figure 38, the area is shallow and the additional dredging cost should not be incurred without evidence that this alignment will not cause navigating hazards. Since no available data illustrate this, further study is required.

RECOMMENDATIONS

44. The following recommendations are made beginning with the turning basin.

a. The turning basin should be widened on the southeast corner by 40 ft (Figure 26).

b. A 750-ft-long flair on the northwest corner of the turning basin should be included to provide a 100-ft wider approach (Figure 26).

c. A 150-ft channel should be relocated 30 ft south as the Old Salem River cutoff entrance is approached (Figure 26).

d. The channel should be widened to a 250-ft channel at Sinnickson's Landing (Figure 26).

e. The turn widener at Sinnickson's Landing should be increased to 350 ft (Figure 30).

f. The two three-point turns at the turn from the entrance channel should be replaced with two turns with no wideners and a 250-ft channel between the two turns (Figure 30).

g. A 1,900-ft flare should be provided on the east side of the south-western turn which would reduce the channel from 250 ft to 150 ft (Figure 30).

h. A 150-ft wide channel should be provided over most of the entrance channel (Figure 30).

i. A 2,600-ft flare should be provided at the turn immediately above the Delaware River to return the channel to a 180-ft width (Figure 33).

j. A 2,000-ft flare should be provided to bring the channel from a 280-ft width at the Delaware River to the 180-ft entrance channel section (Figure 33).

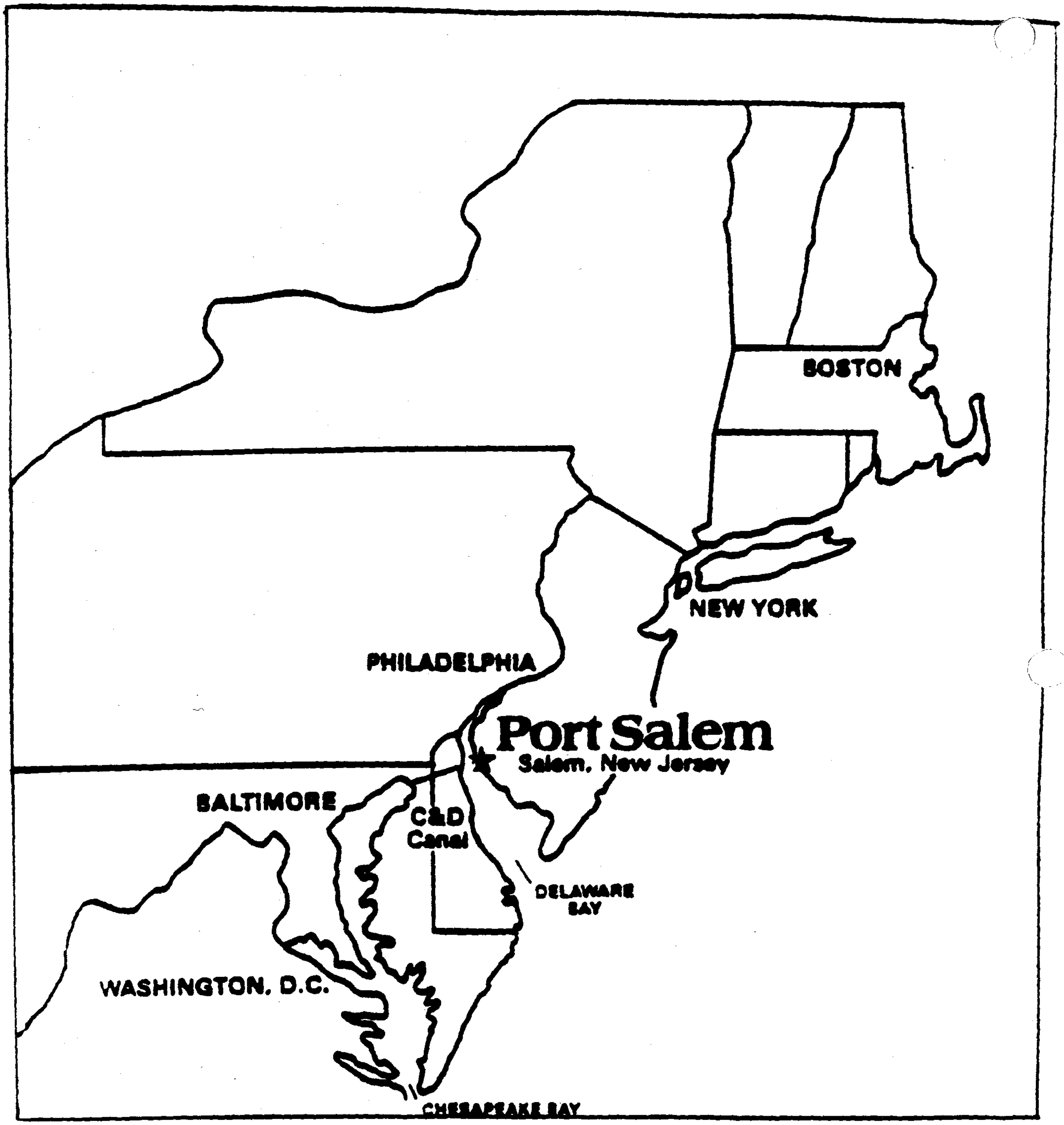
The channel could be further optimized with additional testing, particularly in the turning basin (Figure 37), through the power lines and the turn from the entrance channel (Figure 38).

1 Table
39 Figures

Table 1
Test Conditions

Test	Channel	Direction	Ship	Pilot B	Pilot C	Pilot Total
1	Existing	Inbound	Bermuda Islander	2	2	4
2	Existing	Outbound	Bermuda Islander	2	2	4
3	Proposed	Inbound	Tajo	2	2	4
4	Proposed	Outbound	Tajo	2	2	4
5	Existing Deepened	Inbound	Tajo	2	2	4
6	Existing Deepened	Outbound	Tajo	2	2	4
				12	12	24

* **All runs were made with maximum flood tide and a 20-knot wind from the** south.



GEOGRAPHIC STUDY AREA

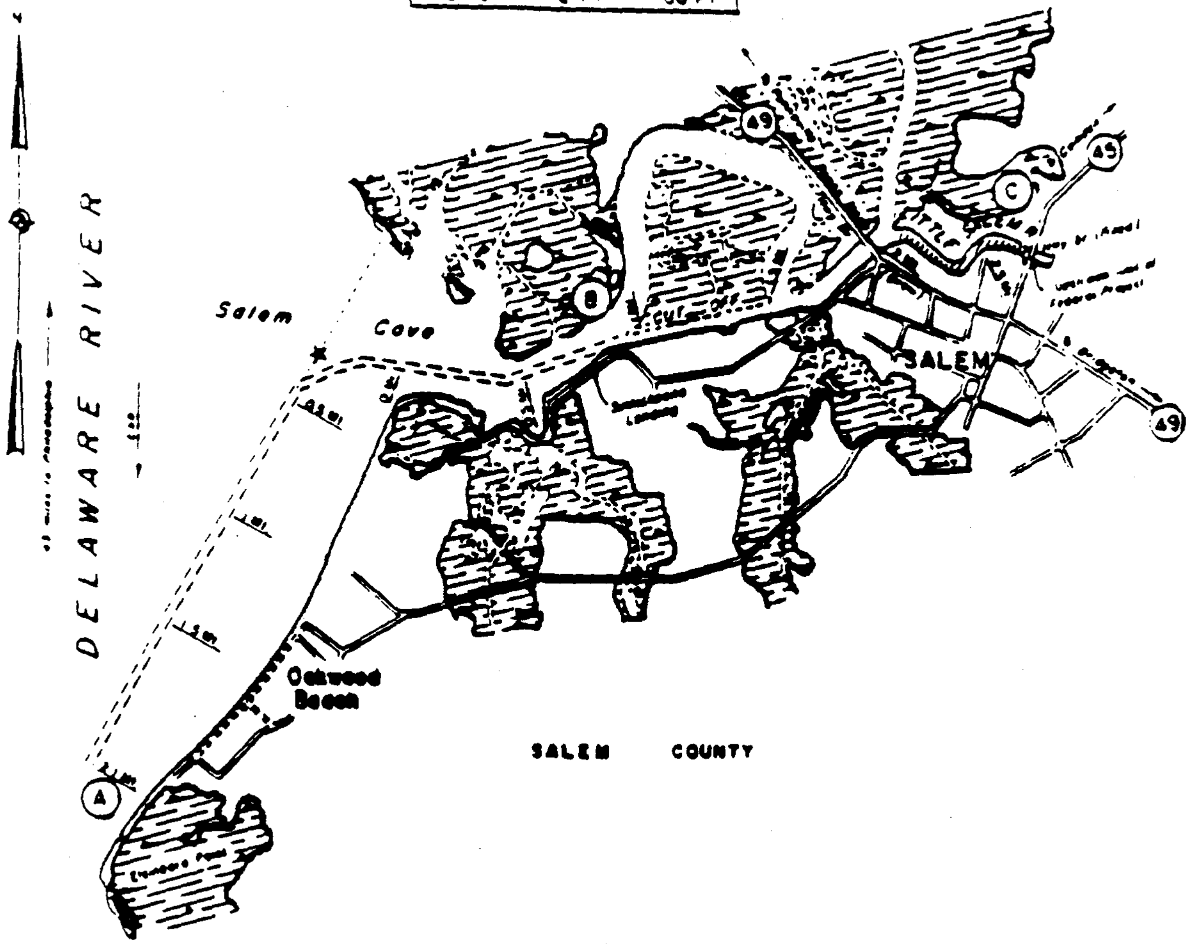
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

FIGURE 1

N32

CHANNEL DIMENSIONS

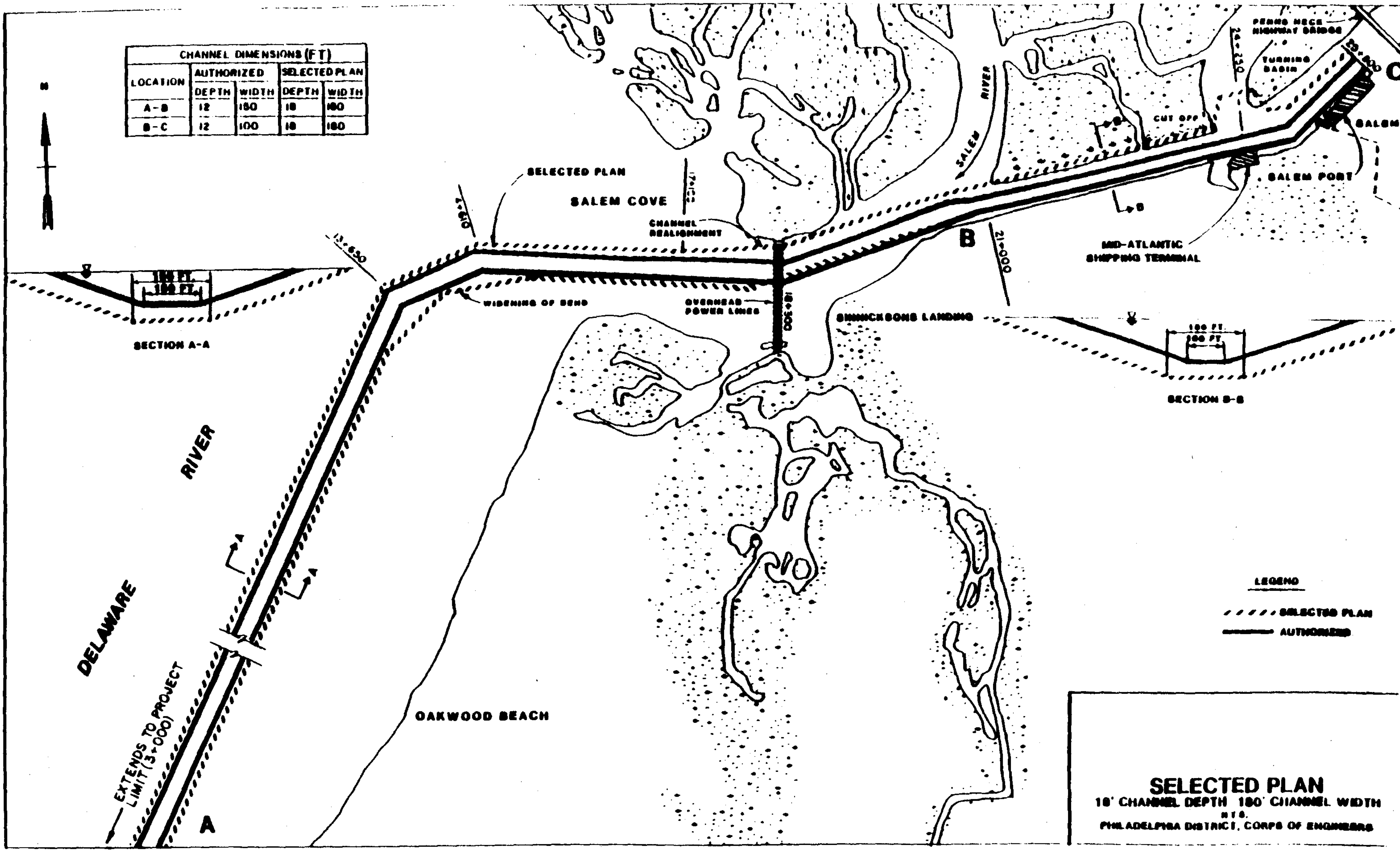
LOCATION	DEPTH	WIDTH
A - B	2 FT	50 FT
B - C	2 FT	00 FT



EXISTING PROJECT

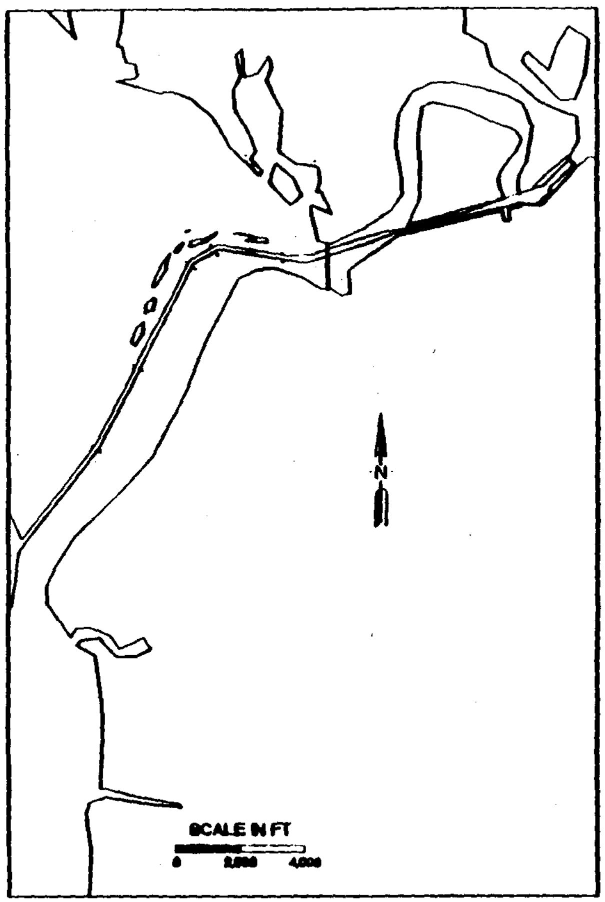
SCALE OF FEET

U.S. ARMY ENGINEER DISTRICT, PHILA.

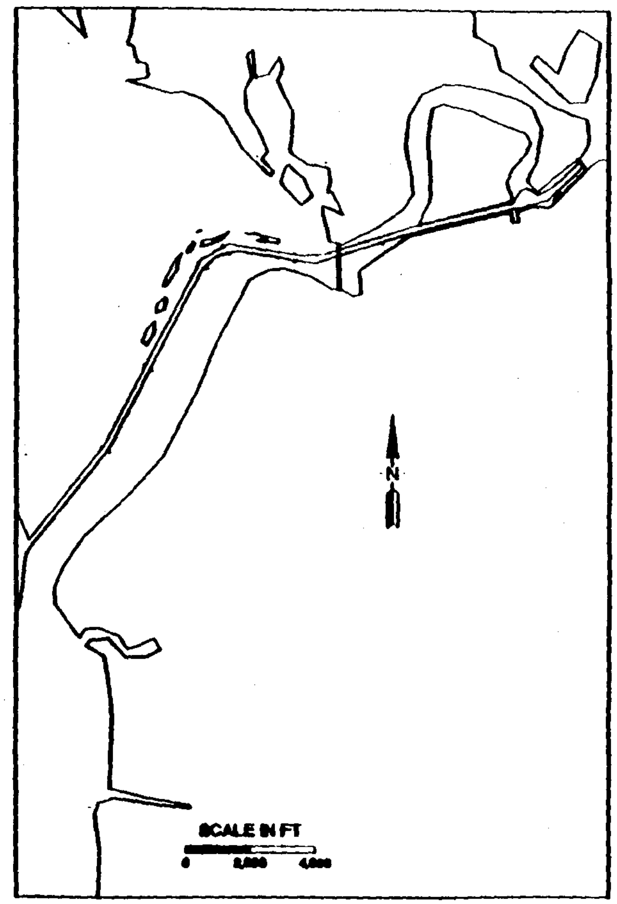


CHANNEL DIMENSIONS (FT)				
LOCATION	AUTHORIZED		SELECTED PLAN	
	DEPTH	WIDTH	DEPTH	WIDTH
A-B	12	150	18	180
B-C	12	100	18	180

SELECTED PLAN
18' CHANNEL DEPTH 180' CHANNEL WIDTH
NTS.
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

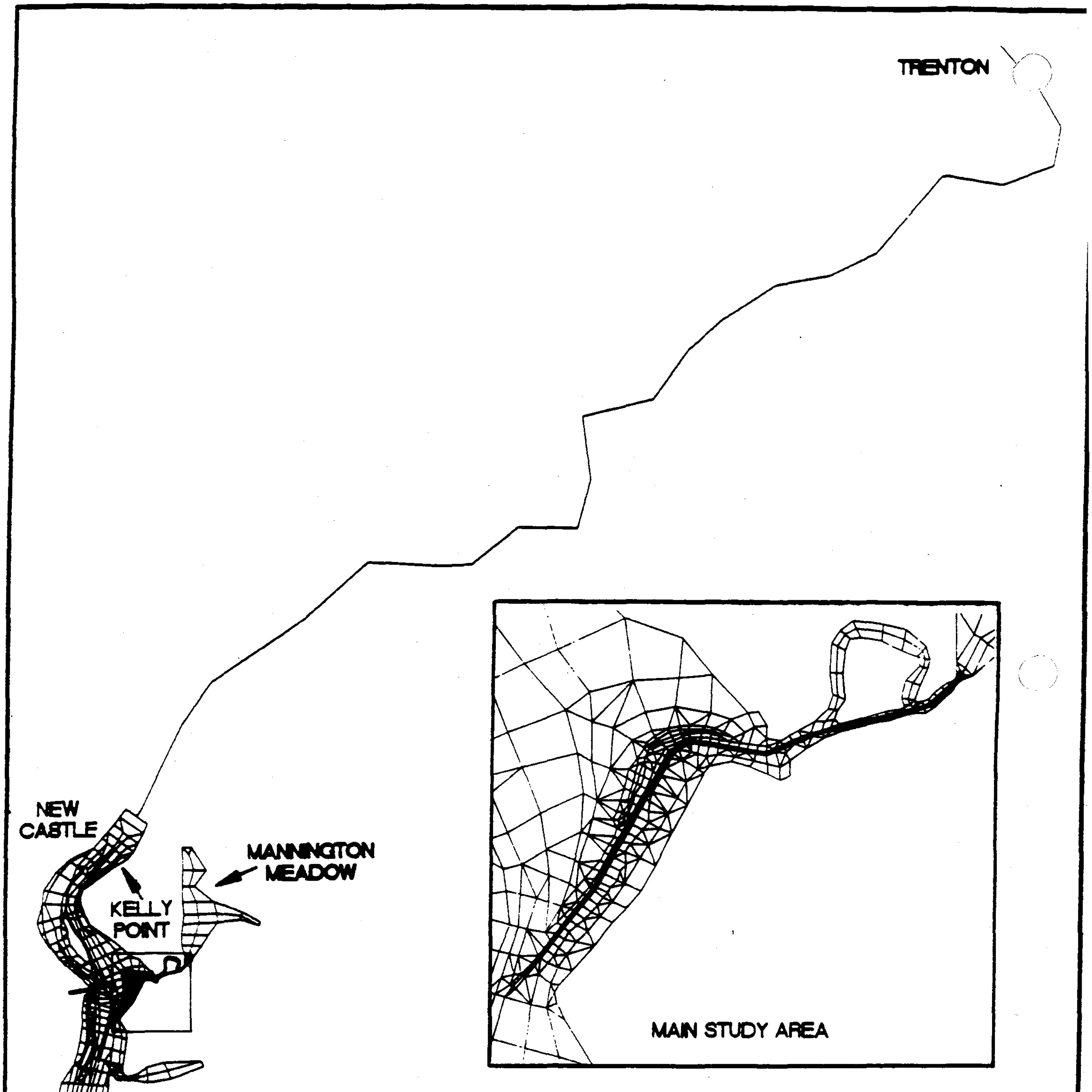


A. EXISTING CONDITION



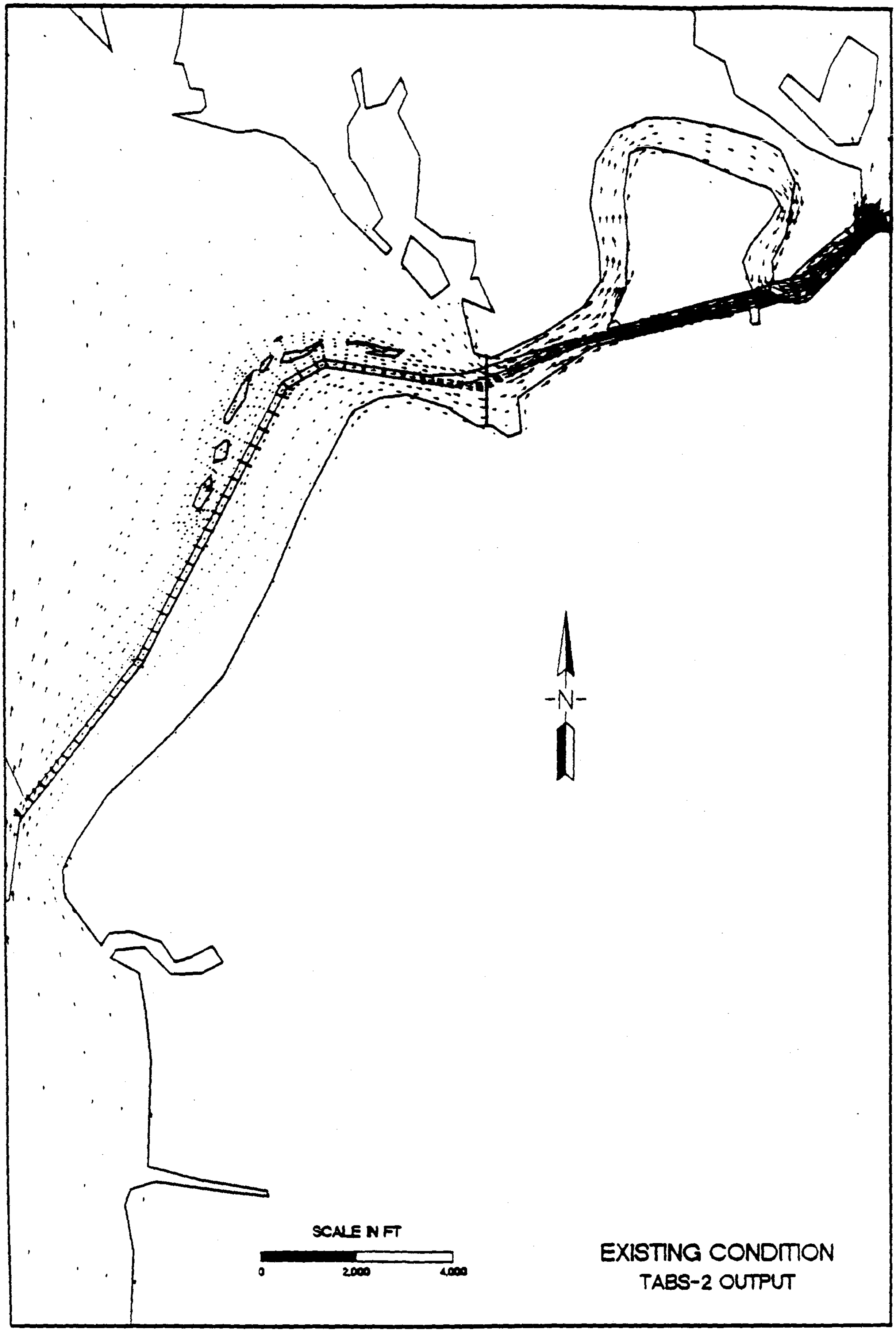
B. PROPOSED CONDITION

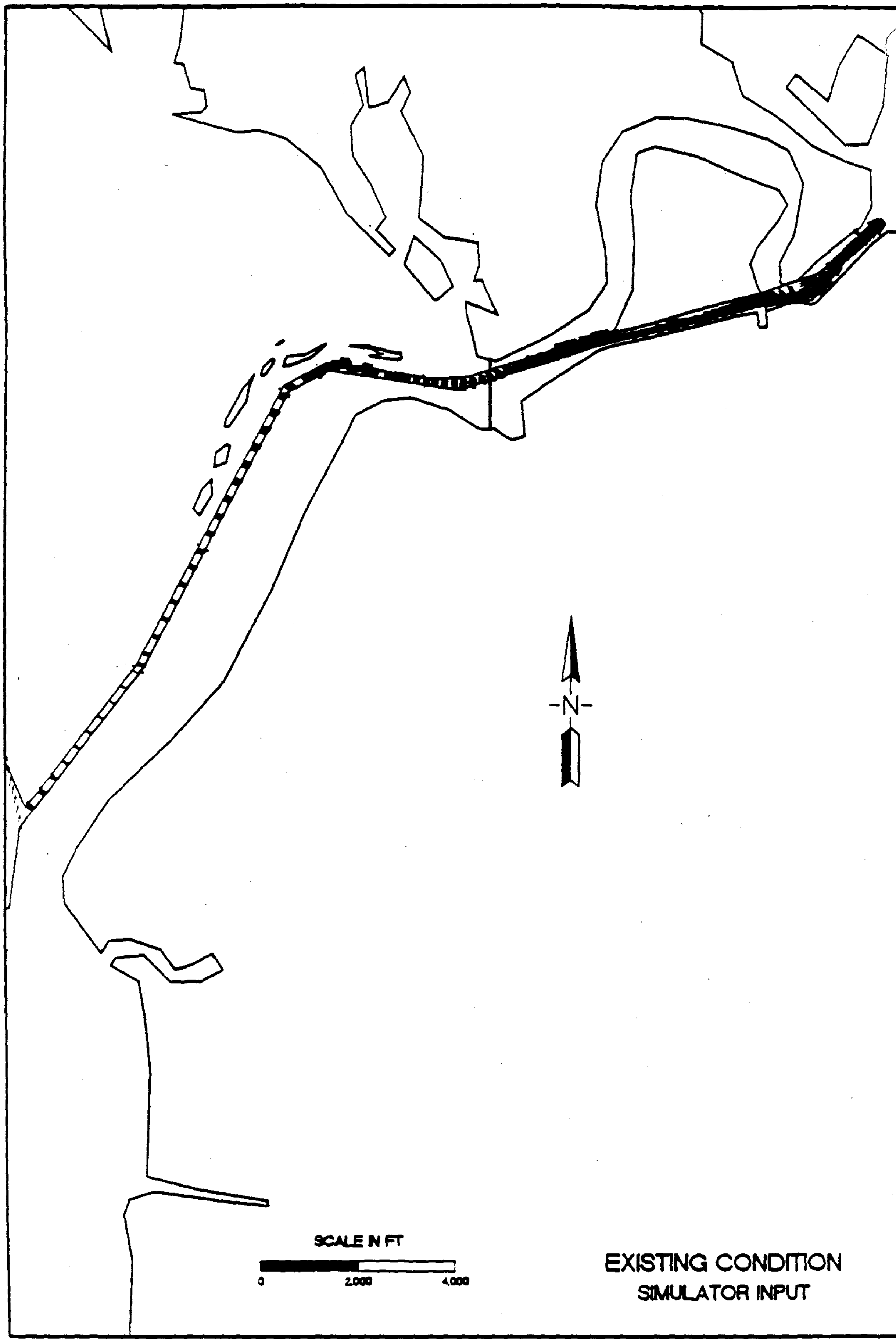
CHANNELS TESTED

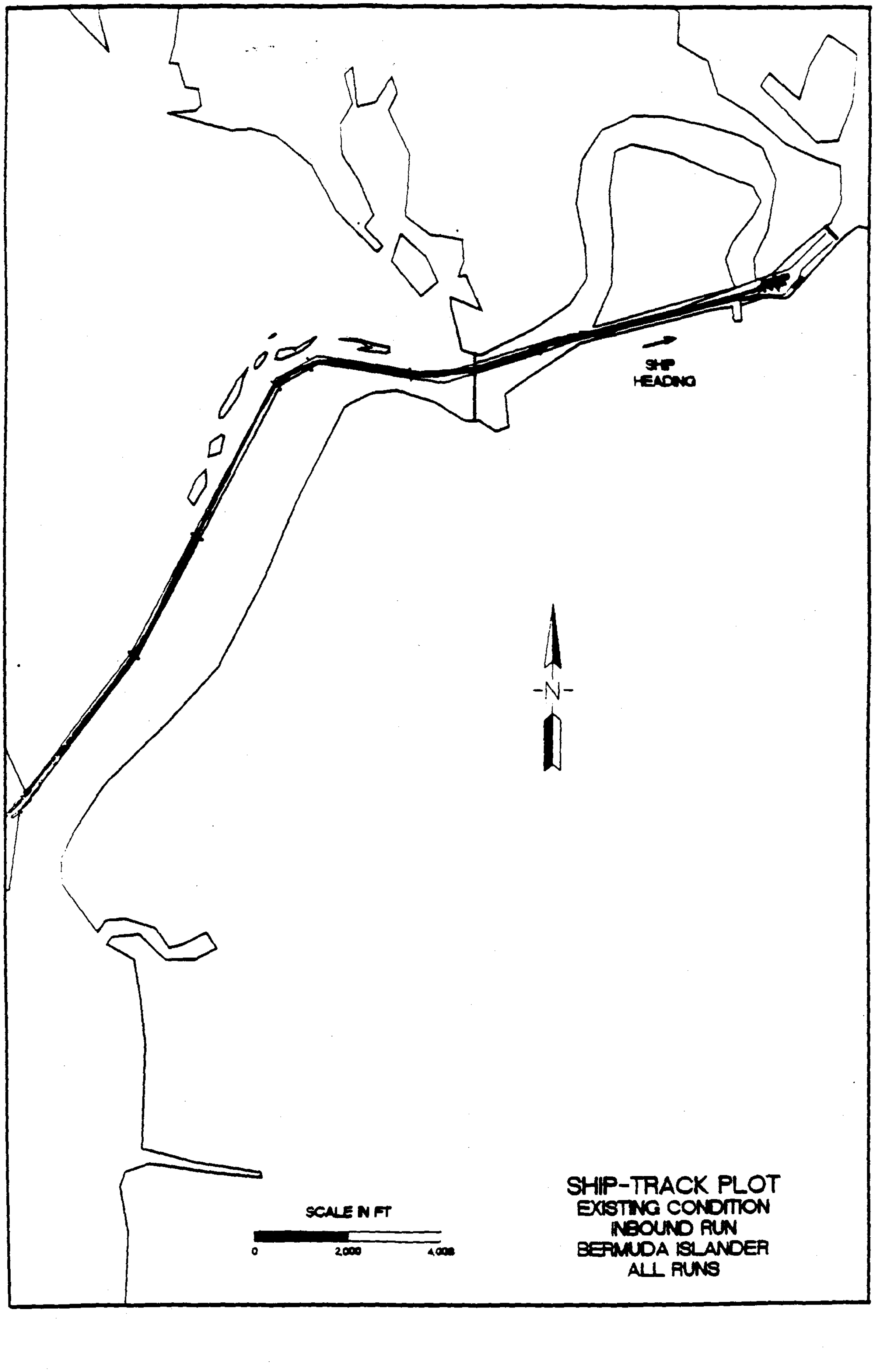


TABS-MD NUMERICAL MODEL COMPUTATIONAL MESH

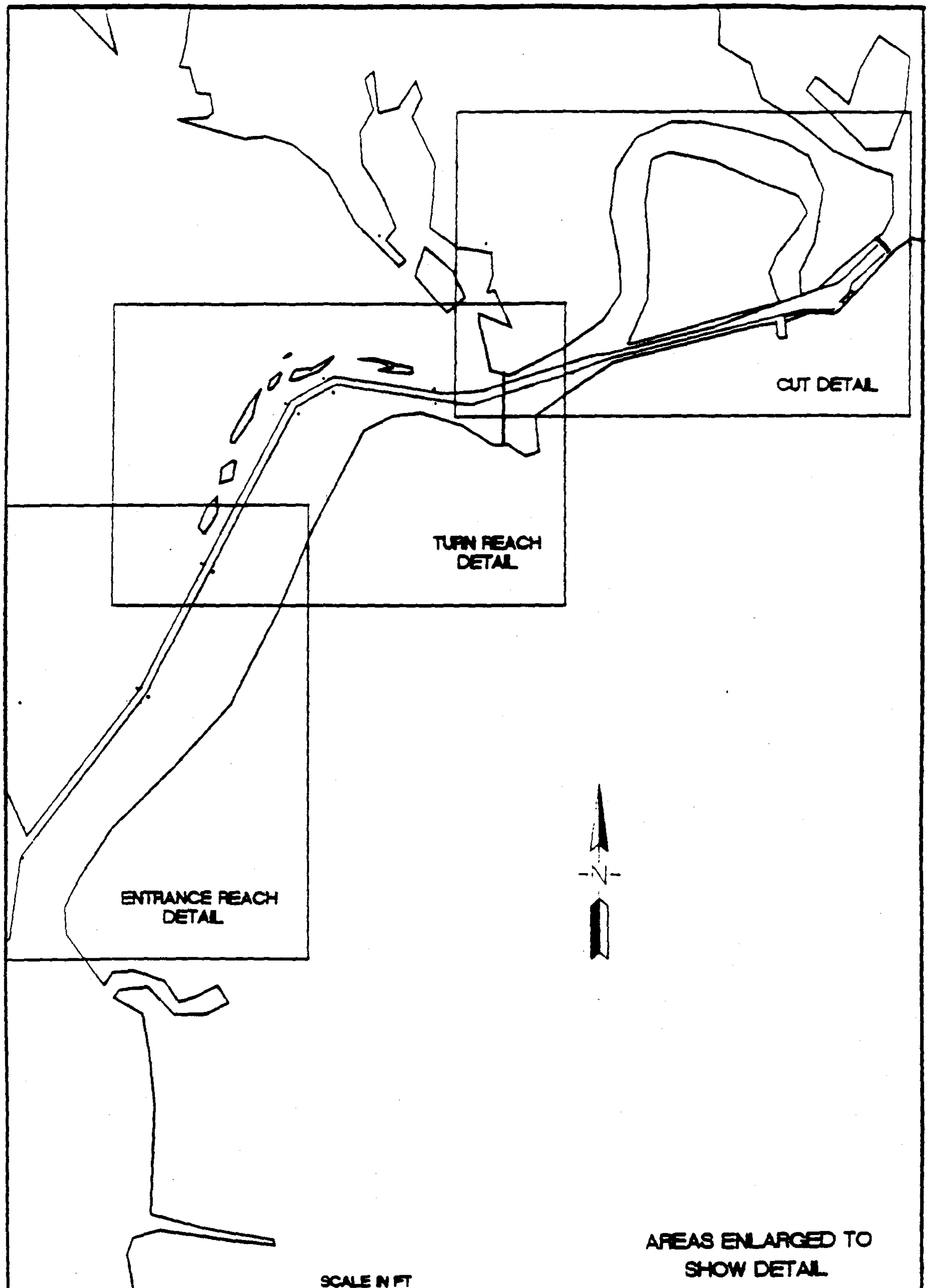
FIGURE 5

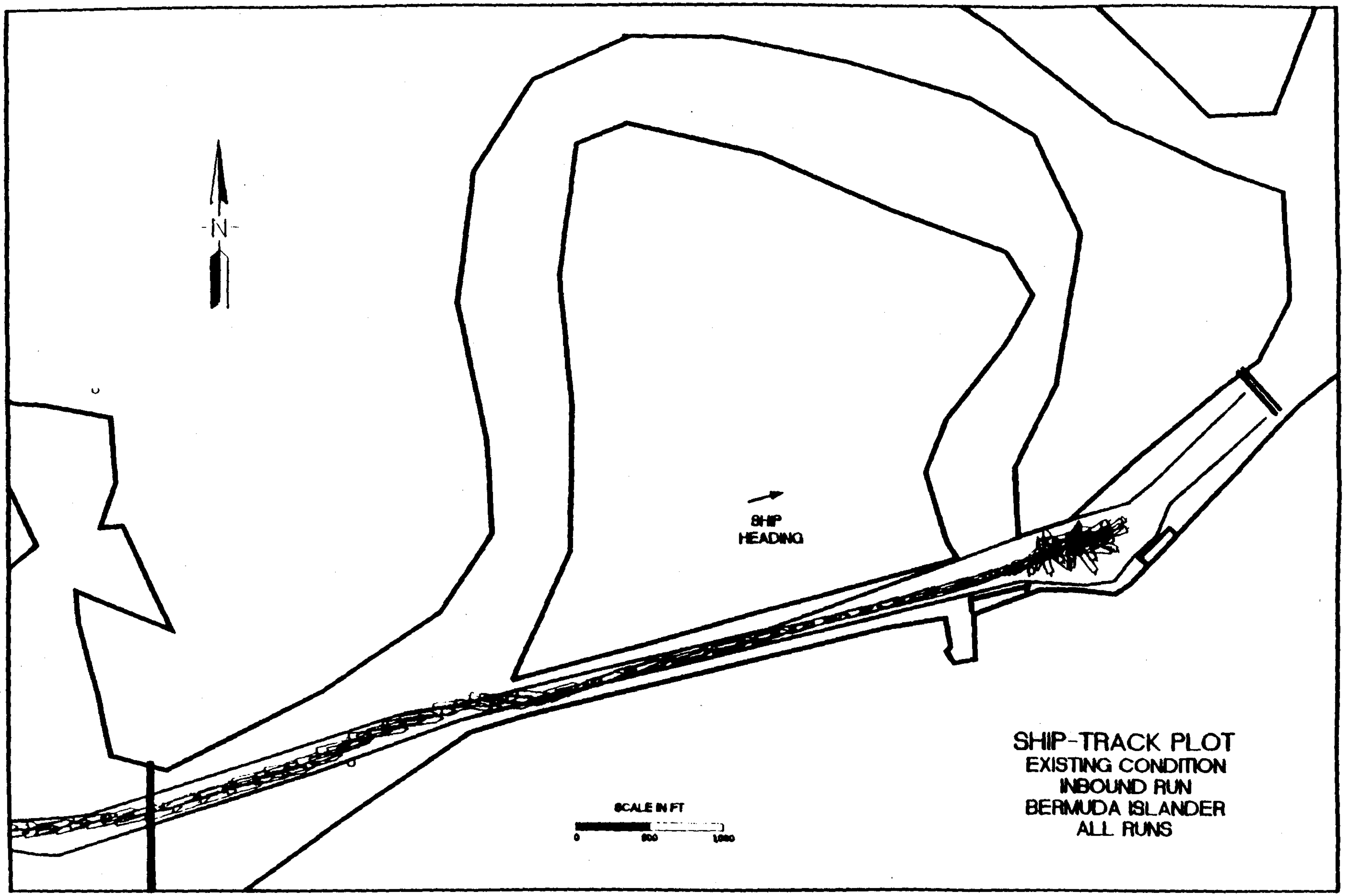

N
SCALE IN FT
0
2,000
4,000
EXISTING CONDITION
TABS-2 OUTPUT


N
SCALE IN FT
0
2,000
4,000
EXISTING CONDITION
SIMULATOR INPUT


SHIP HEADING
N
SCALE IN FT
0
2,000
4,000
SHIP-TRACK PLOT
EXISTING CONDITION
INBOUND RUN
BERMUDA ISLANDER
ALL RUNS

FIGURE


CUT DETAIL
TURN REACH DETAIL
ENTRANCE REACH DETAIL
N
AREAS ENLARGED TO SHOW DETAIL
SCALE IN FT
0
2,000
4,000


N
SHIP
HEADING
SCALE IN FT
0
500
1,000
SHIP-TRACK PLOT
EXISTING CONDITION
INBOUND RUN
BERMUDA ISLANDER
ALL RUNS

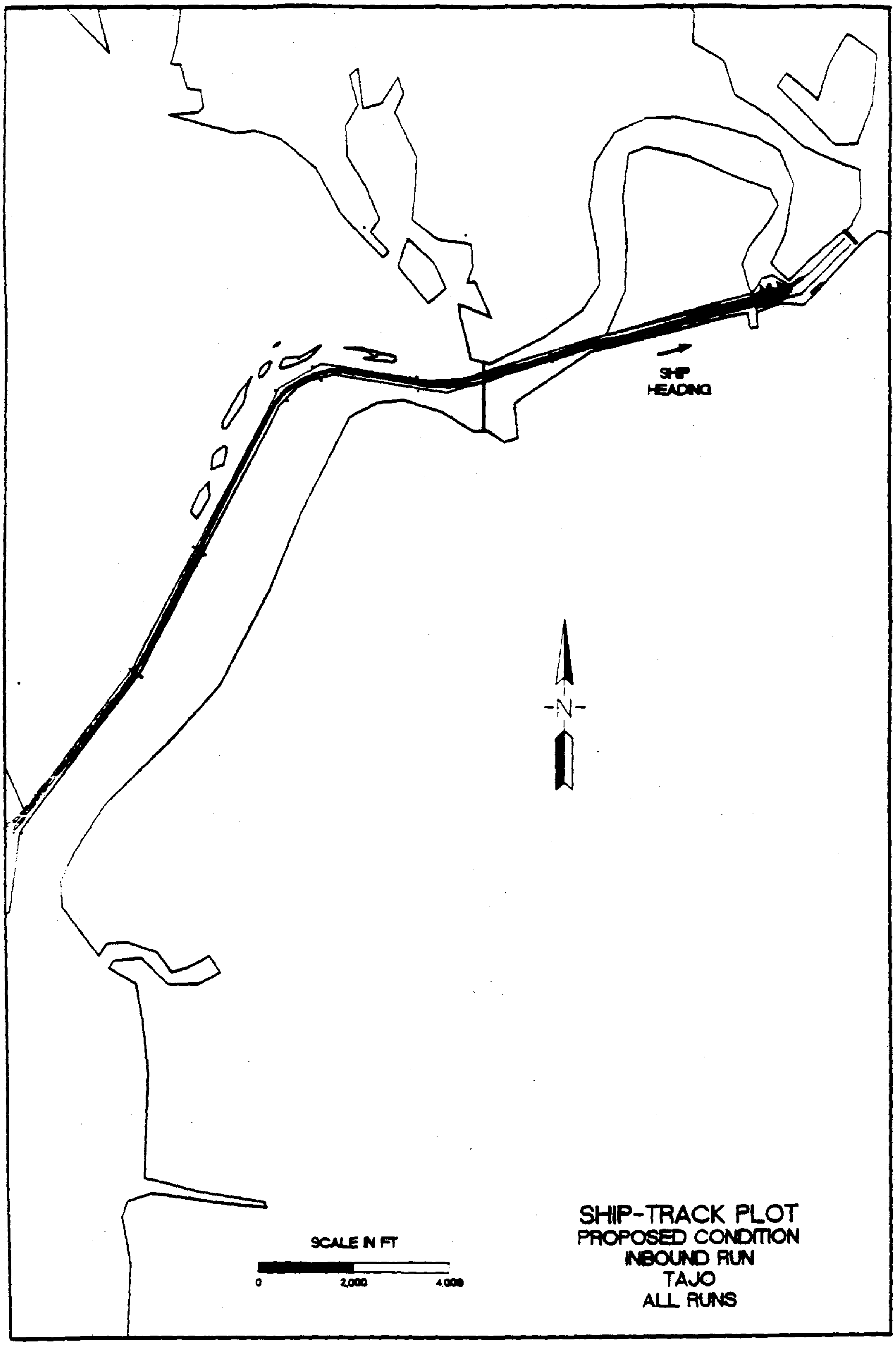

SHIP HEADING
N
SCALE IN FT
0
2,000
4,000
SHIP-TRACK PLOT
PROPOSED CONDITION
INBOUND RUN
TAJO
ALL RUNS

FIGURE 11

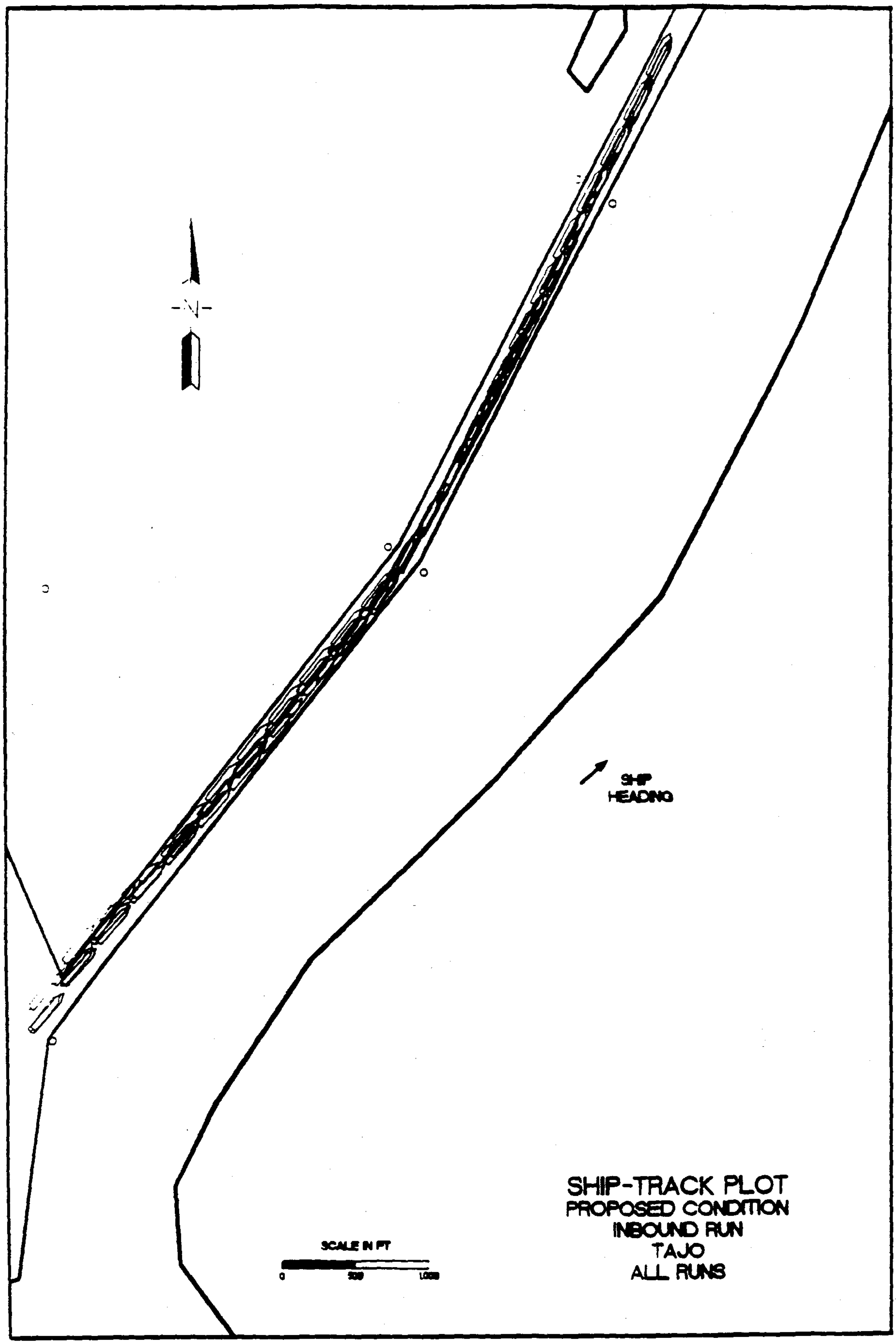
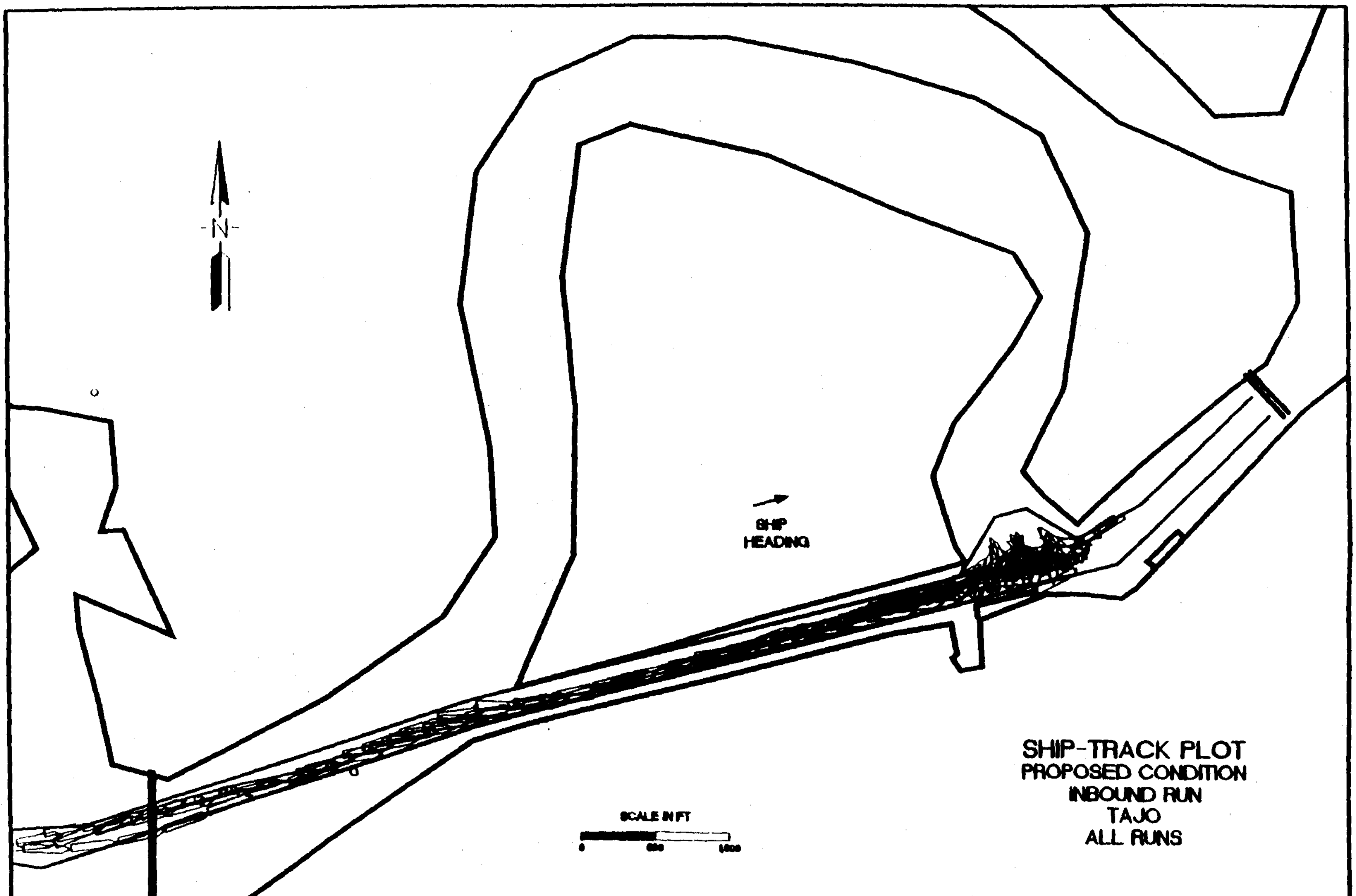

N
SHIP
HEADING
SCALE IN FT
0
500
1,000
SHIP-TRACK PLOT
PROPOSED CONDITION
INBOUND RUN
TAJO
ALL RUNS

FIGURE 12


N
SHIP HEADING
SCALE IN FT
0
800
1600
SHIP-TRACK PLOT
PROPOSED CONDITION
INBOUND RUN
TAJO
ALL RUNS

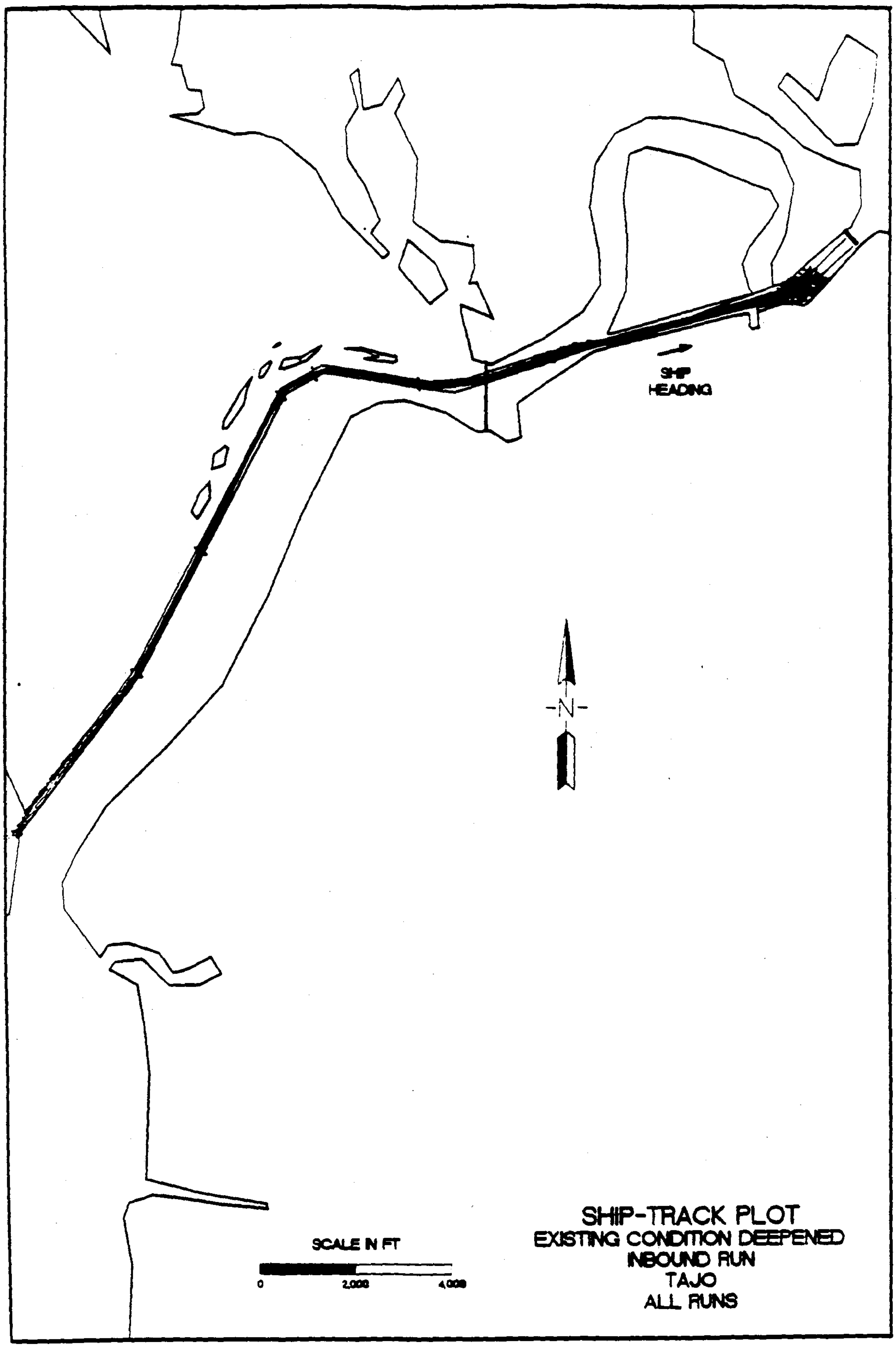

SHIP HEADING
N
SCALE IN FT
0
2,000
4,000
SHIP-TRACK PLOT
EXISTING CONDITION DEEPENED
INBOUND RUN
TAJO
ALL RUNS

FIGURE 14

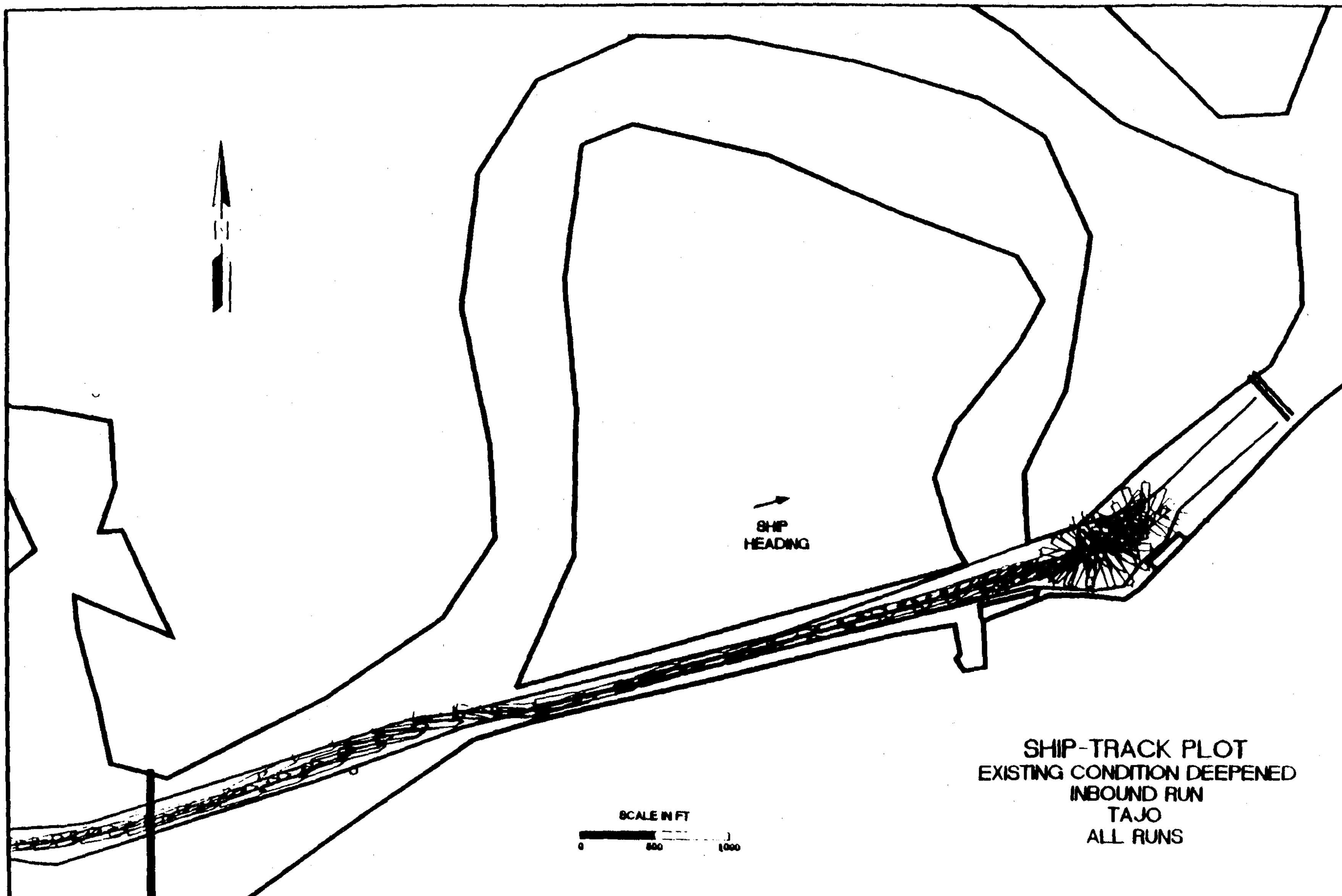
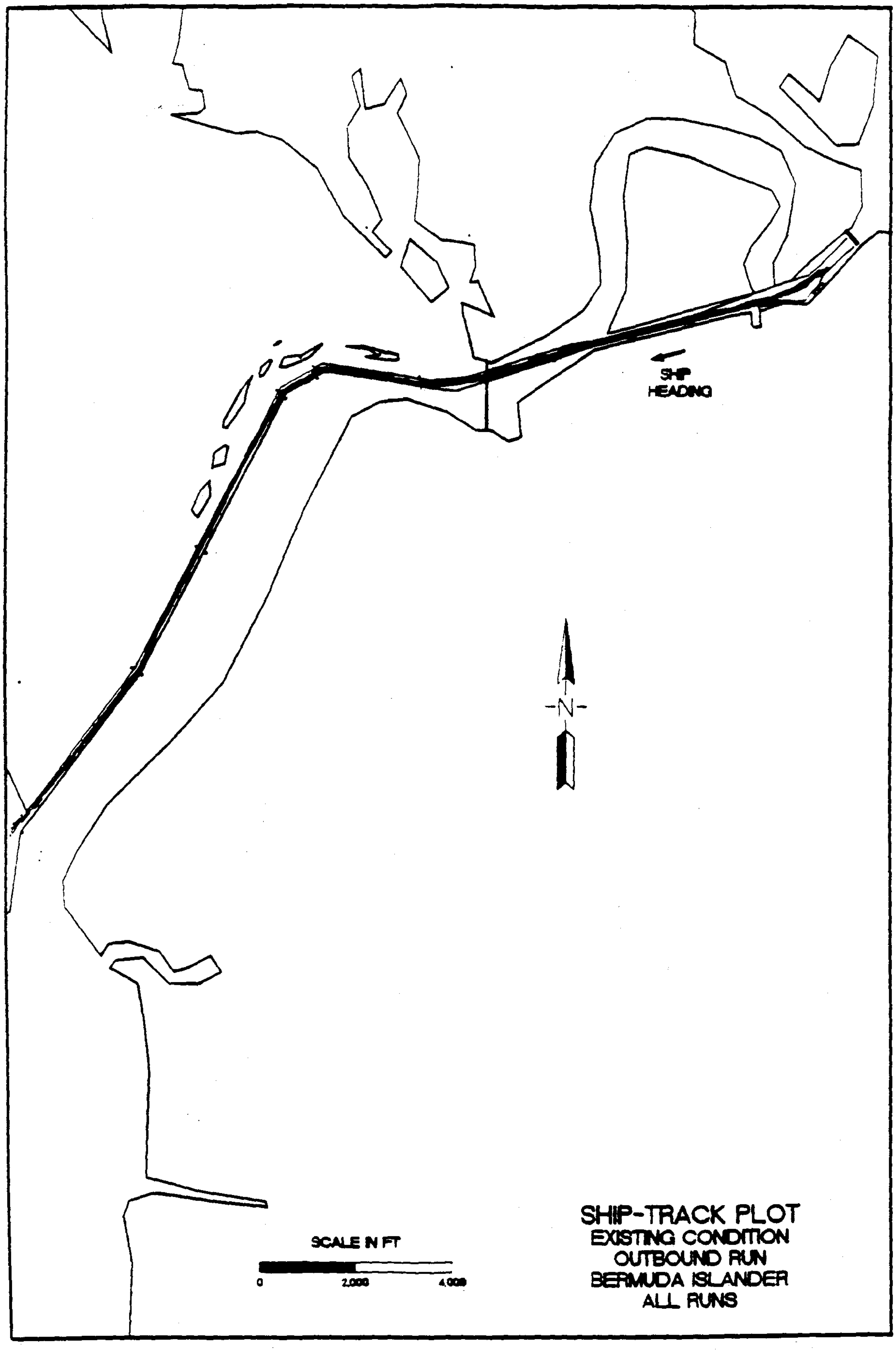

SHIP HEADING
SCALE IN FT
0
500
1000
SHIP-TRACK PLOT
EXISTING CONDITION DEEPENED
INBOUND RUN
TAJO
ALL RUNS

FIGURE 15



SHIP-TRACK PLOT
EXISTING CONDITION
OUTBOUND RUN
BERMUDA ISLANDER
ALL RUNS

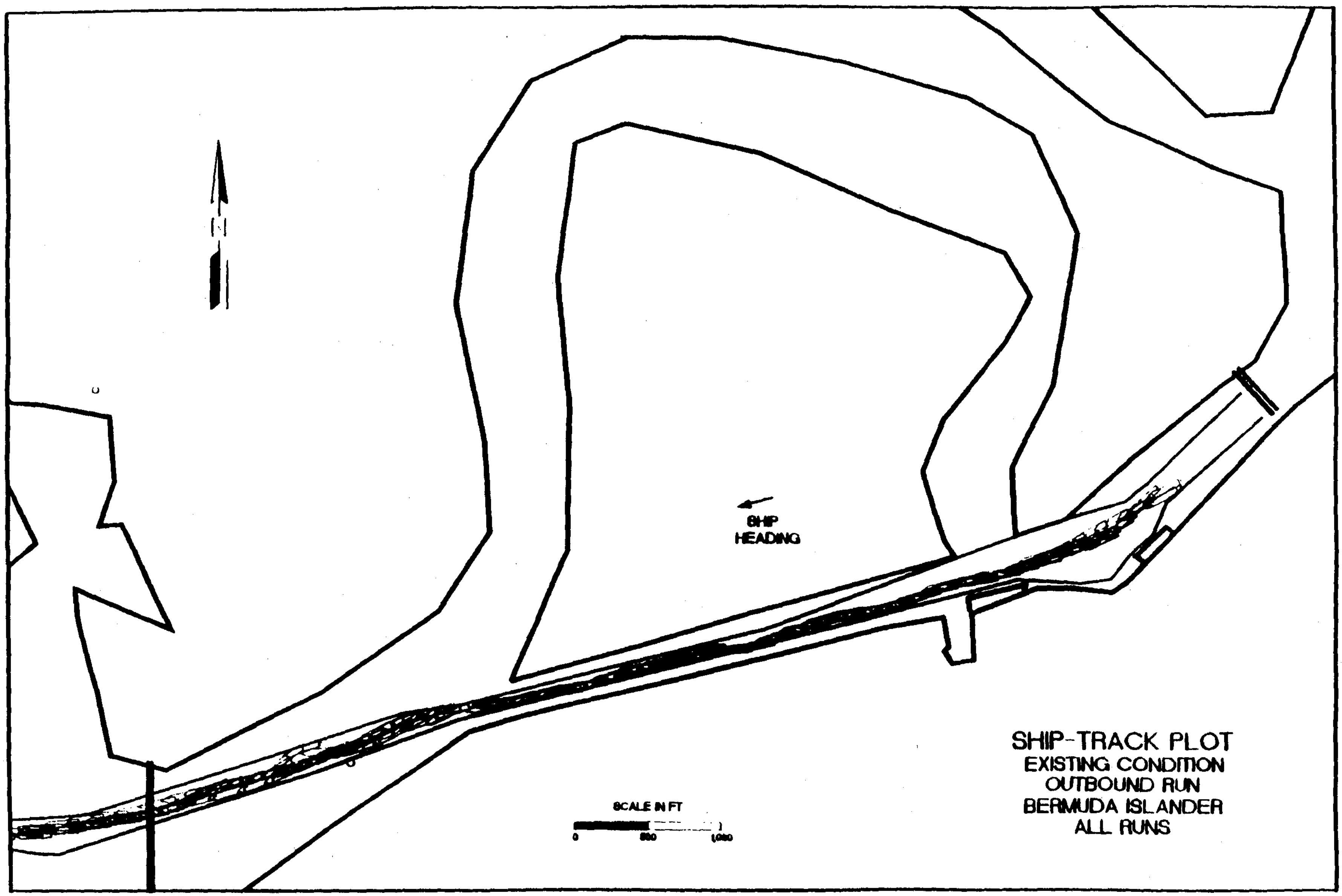

SHIP HEADING
SCALE IN FT
0
500
1,000
SHIP-TRACK PLOT
EXISTING CONDITION
OUTBOUND RUN
BERMUDA ISLANDER
ALL RUNS

FIGURE 17

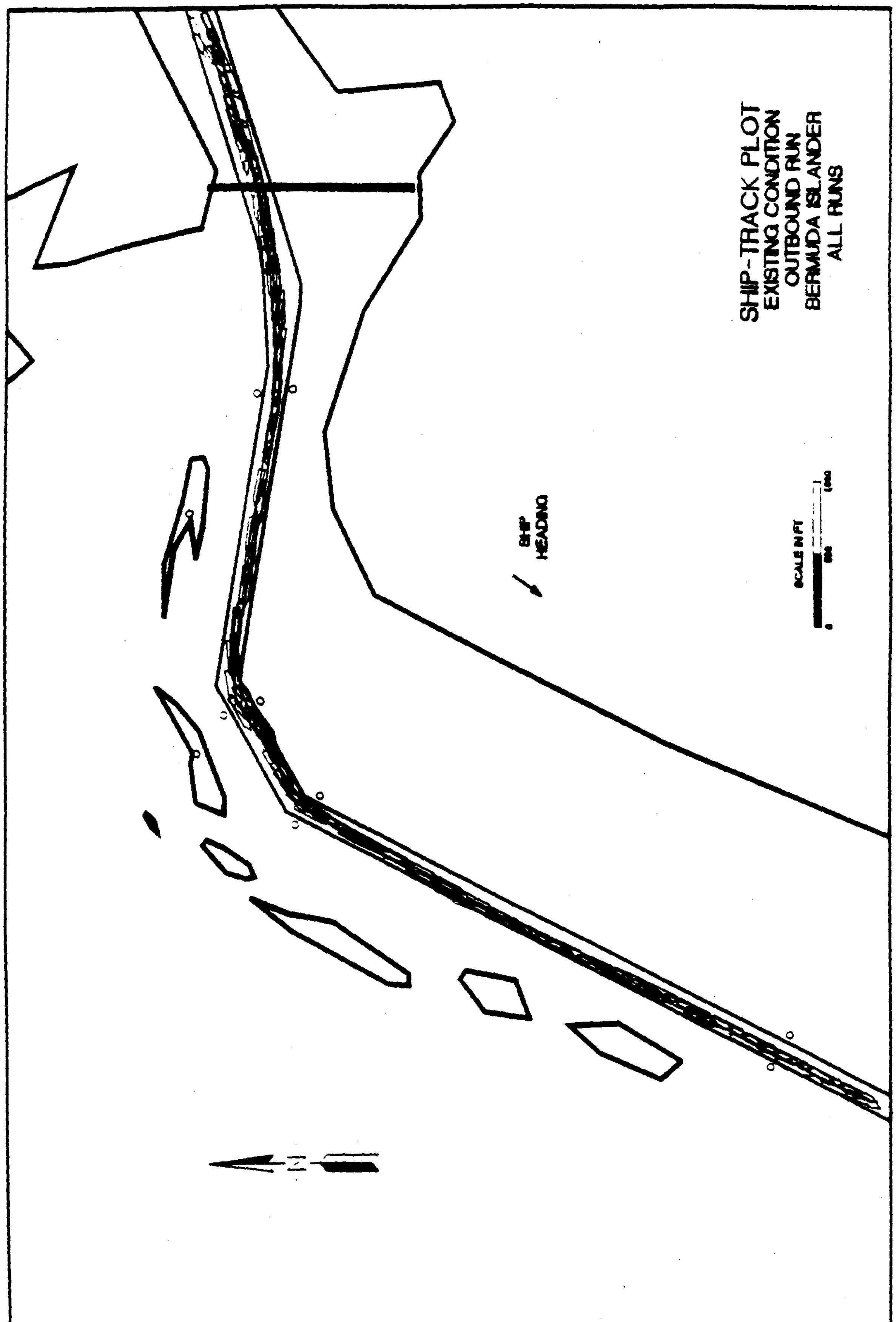

SHIP-TRACK PLOT
EXISTING CONDITION
OUTBOUND RUN
BERMUDA ISLANDER
ALL RUNS
SHIP
HEADING
SCALE IN FT
N

FIGURE 12

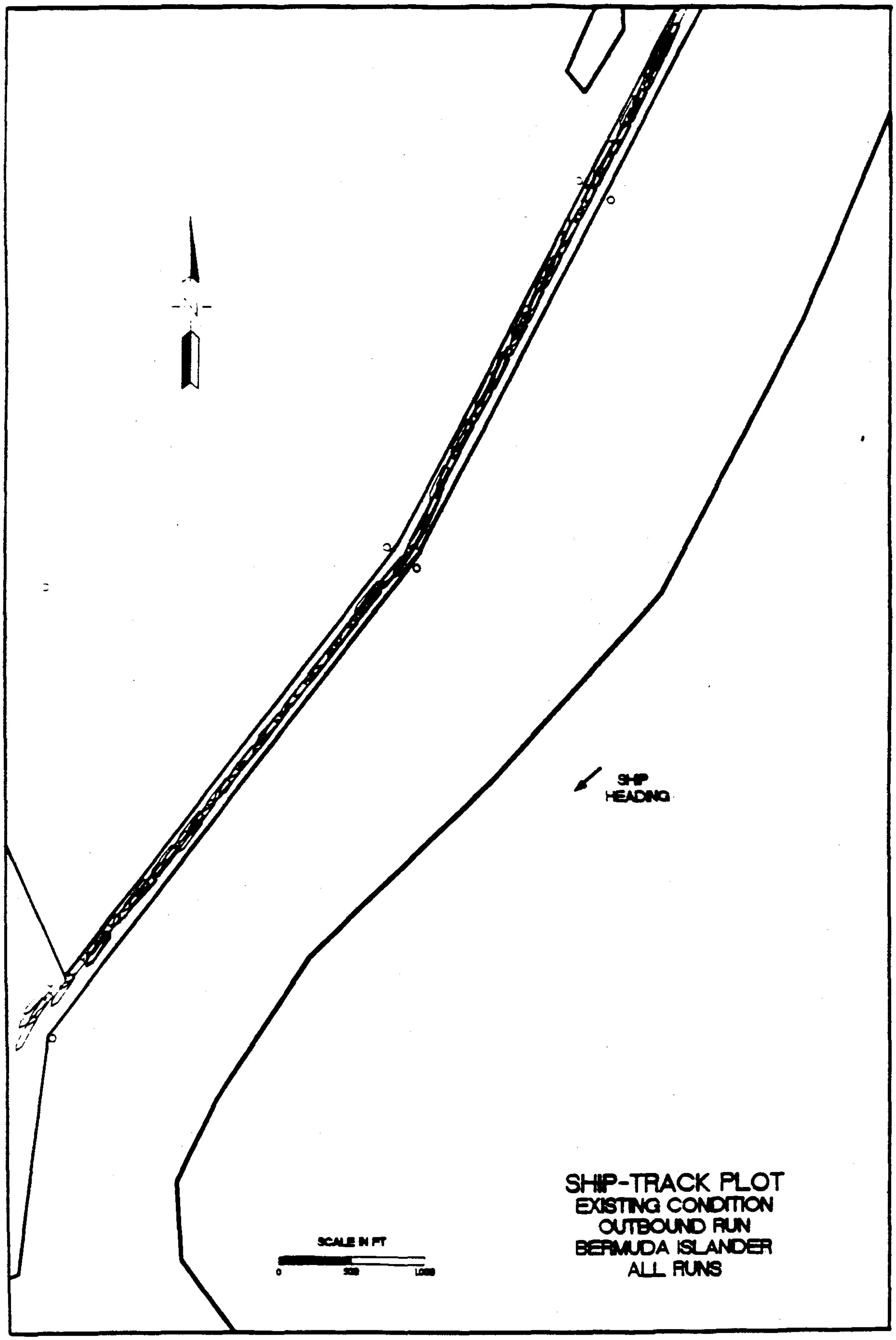
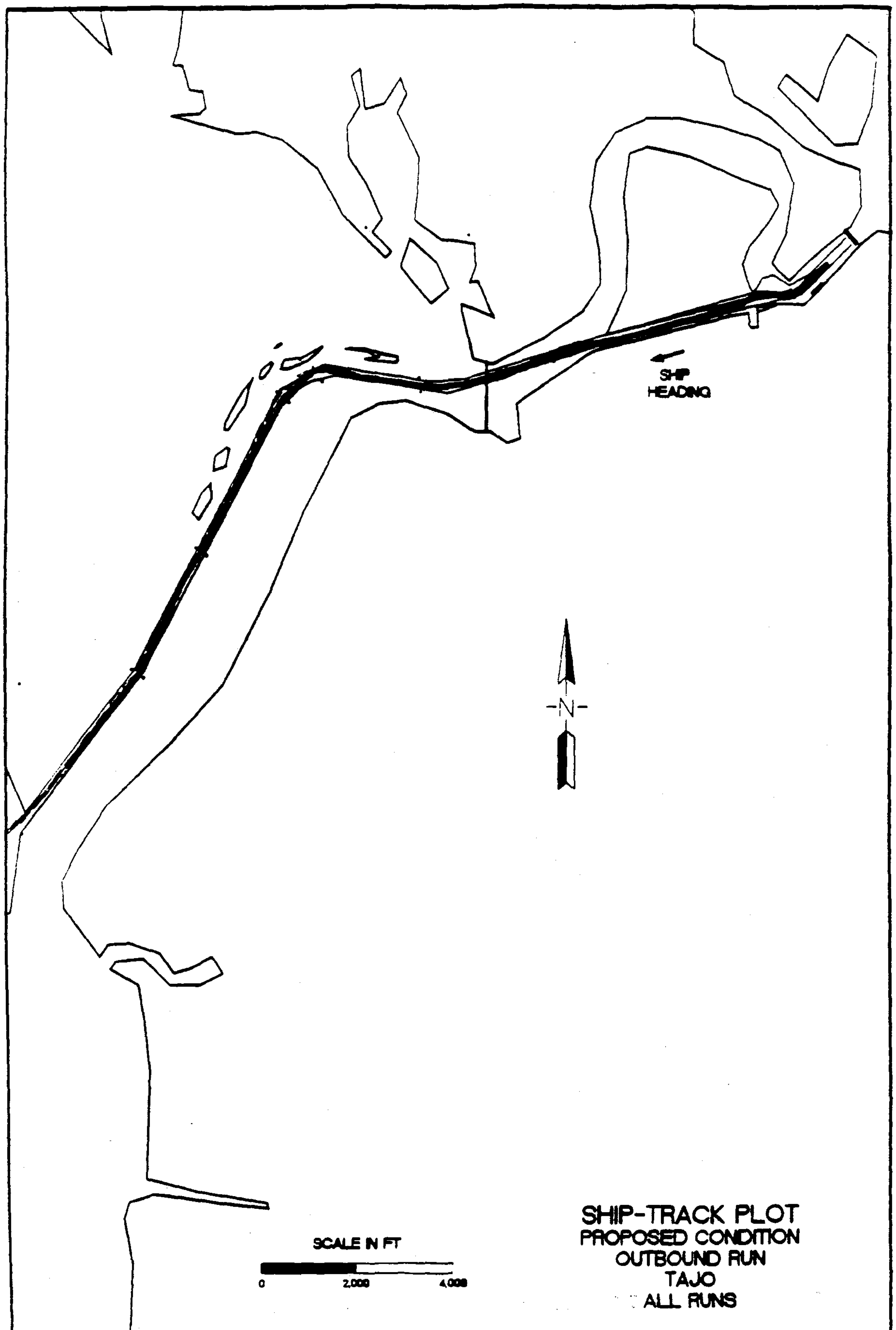

SHIP
HEADING
SCALE IN FT
0
500
1,000
SHIP-TRACK PLOT
EXISTING CONDITION
OUTBOUND RUN
BERMUDA ISLANDER
ALL RUNS

FIGURE 19



SHIP-TRACK PLOT
PROPOSED CONDITION
OUTBOUND RUN
TAJO
ALL RUNS

FIGURE 20

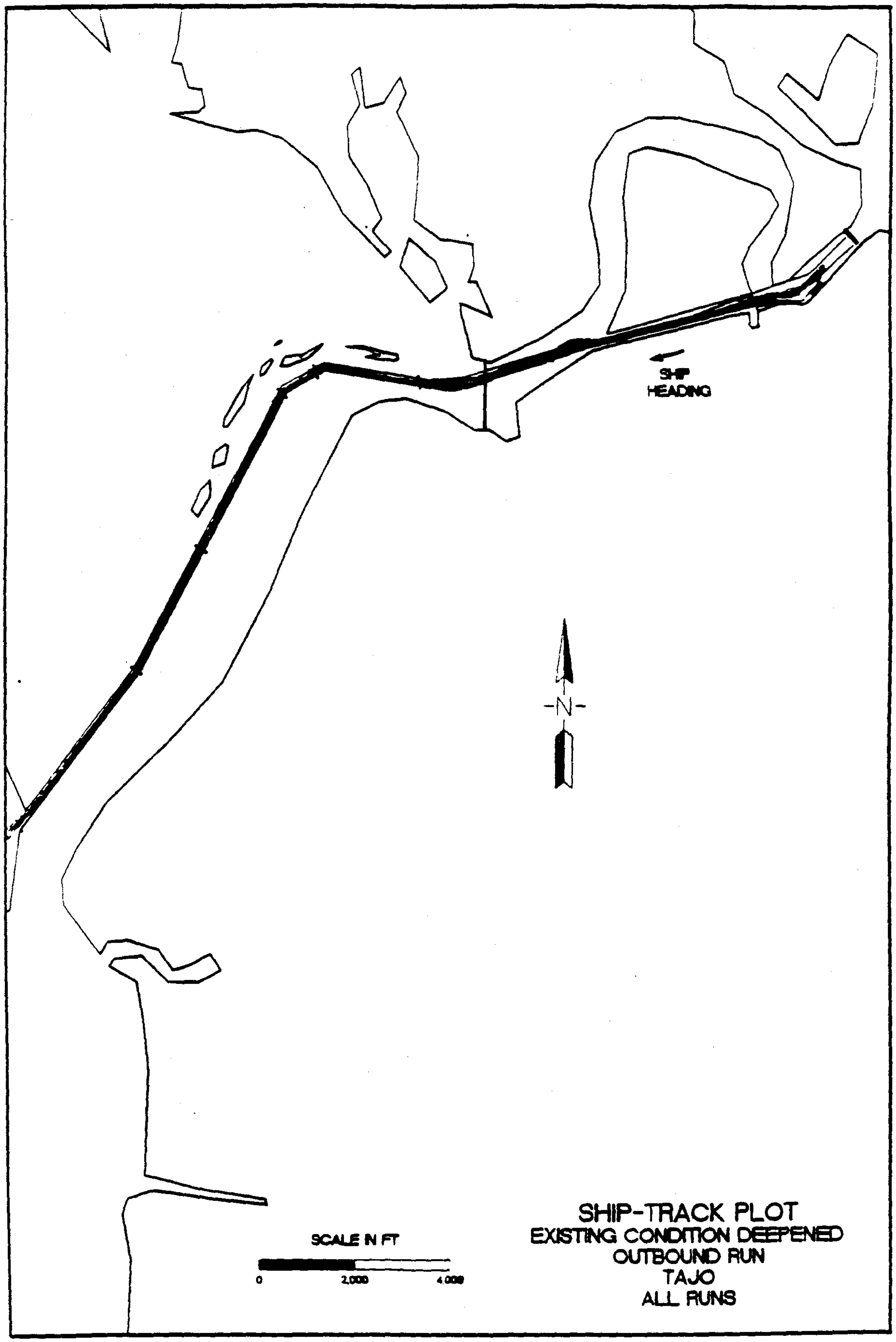
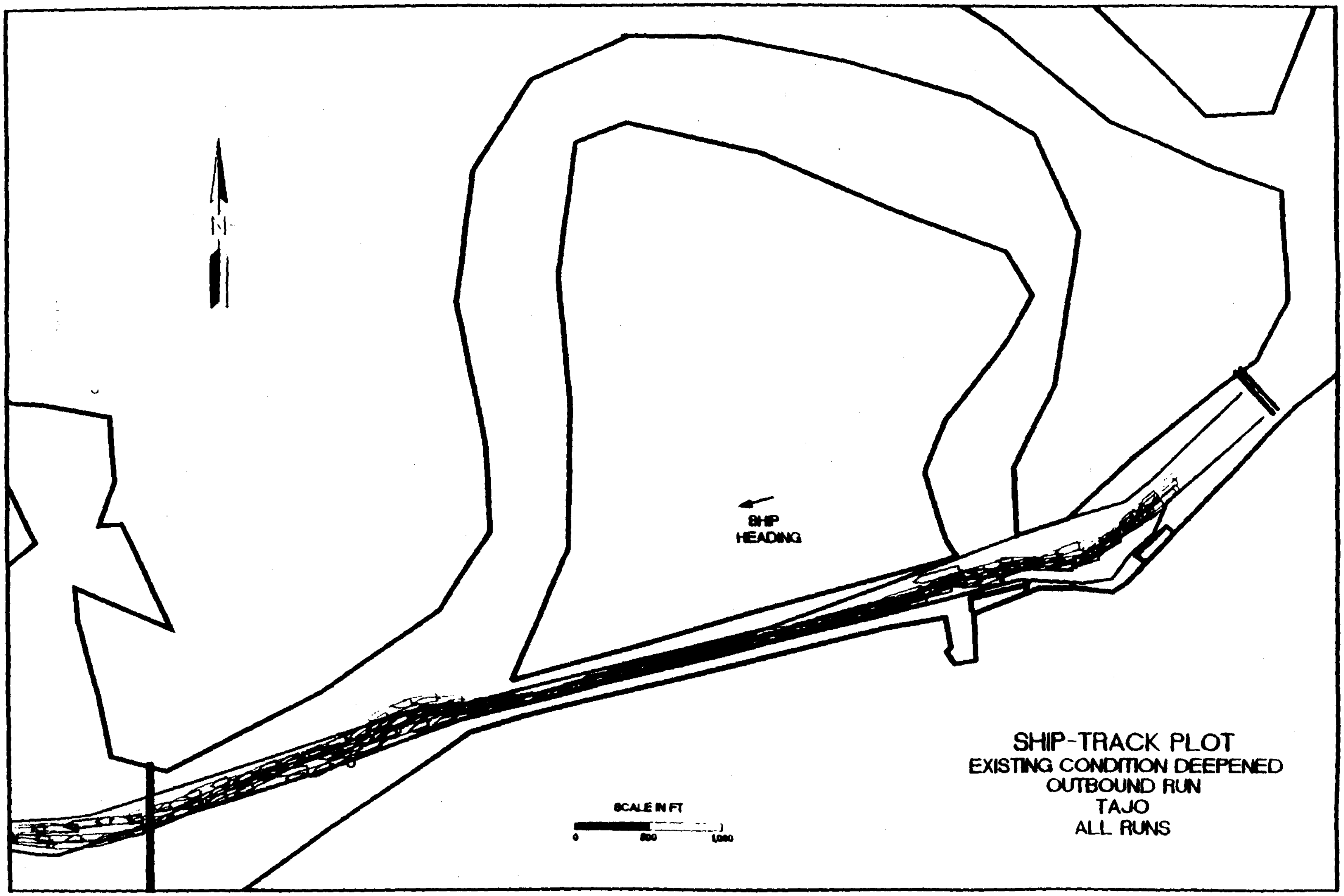
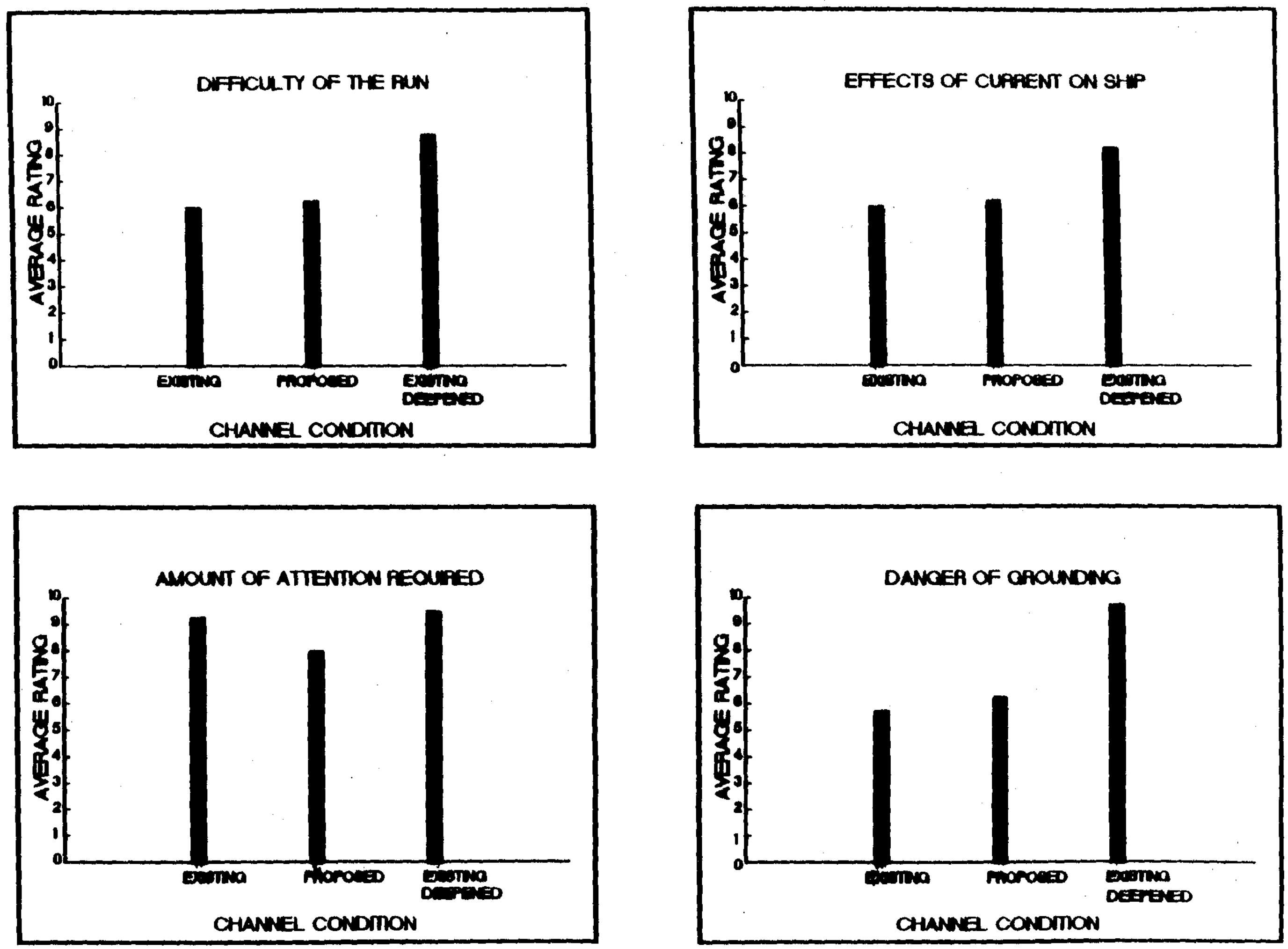

SHIP HEADING
N
SCALE IN FT
0
2,000
4,000
SHIP-TRACK PLOT
EXISTING CONDITION DEEPENED
OUTBOUND RUN
TAJO
ALL RUNS

FIGURE 21

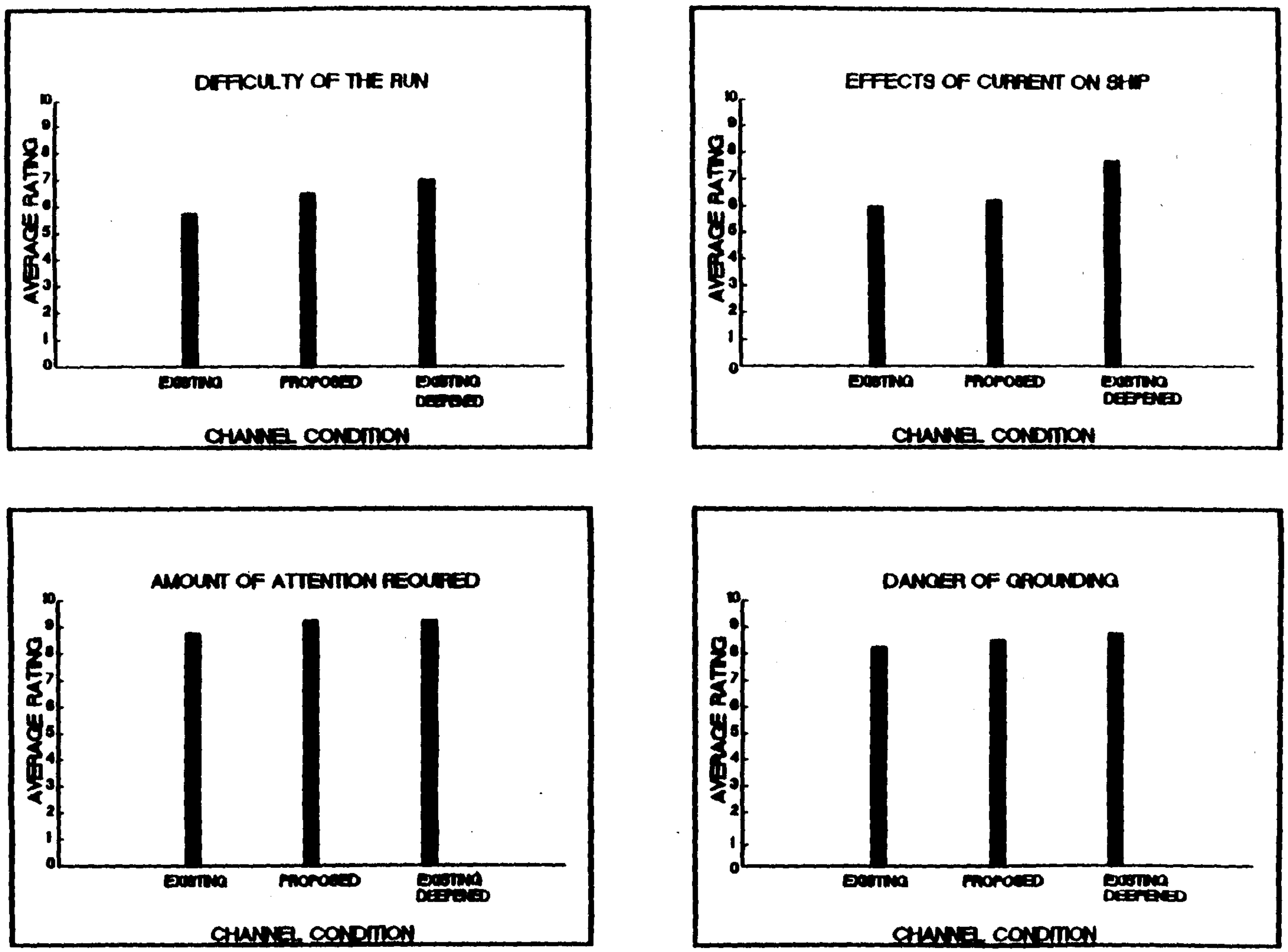


SHIP HEADING
SCALE IN FT
0
500
1,000
SHIP-TRACK PLOT
EXISTING CONDITION DEEPENED
OUTBOUND RUN
TAJO
ALL RUNS

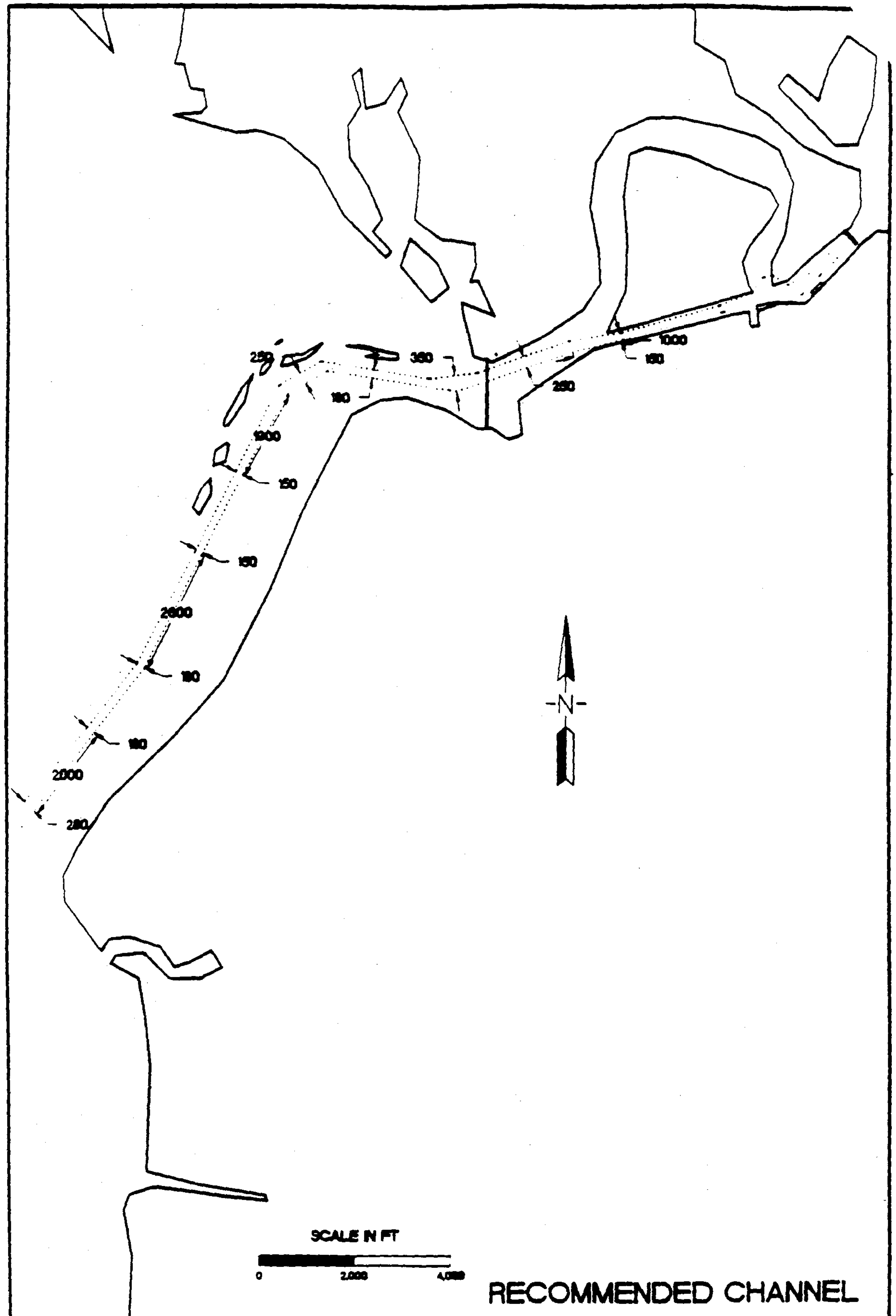


PILOT EVALUATION
INBOUND RUNS

FIGURE 23



PILOT EVALUATIONS
OUTBOUND RUNS



250
360
180
1000
160
260
1900
150
150
2600
180
180
2000
280
N
SCALE IN FT
0
2,000
4,000
RECOMMENDED CHANNEL

FIGURE 25

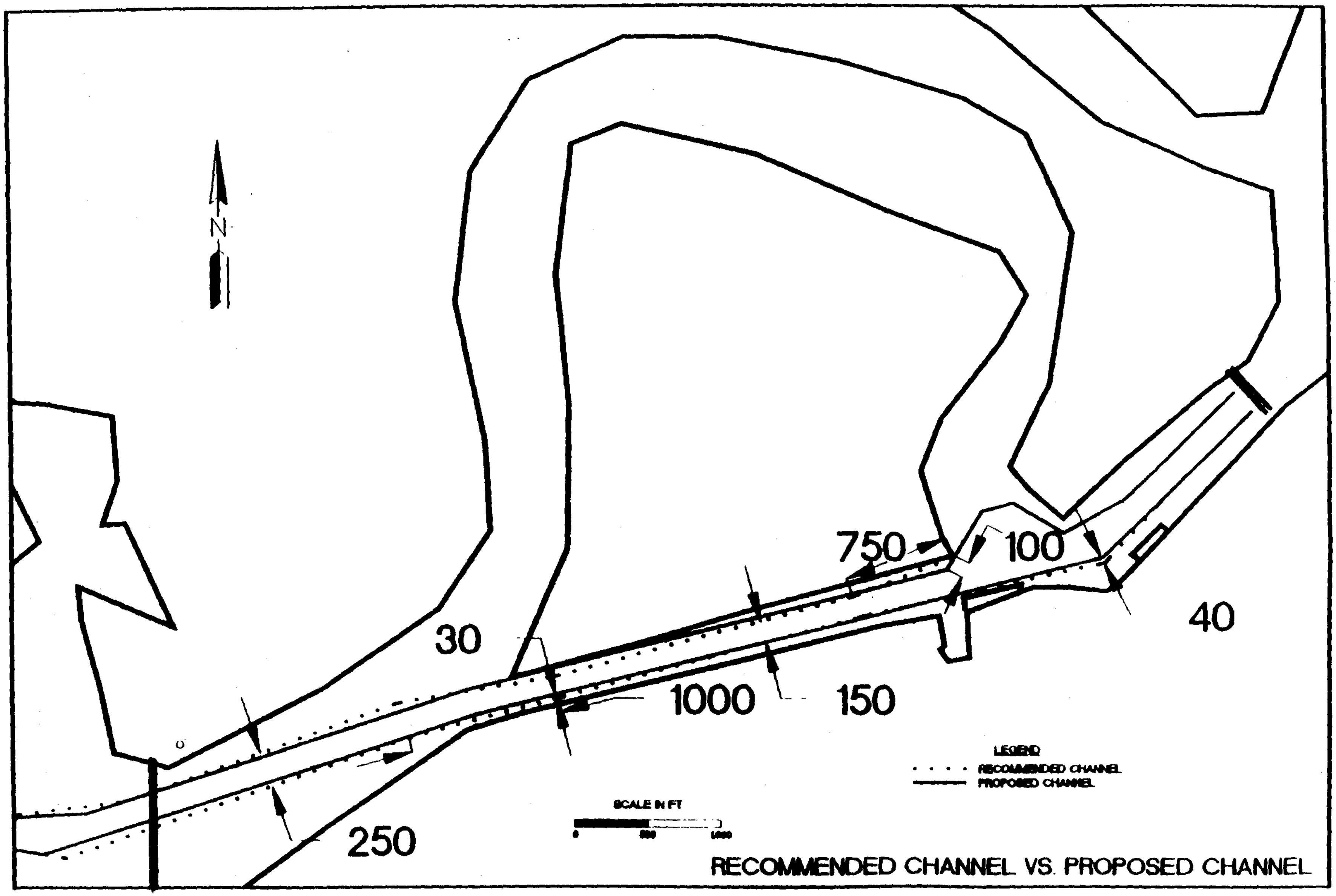

N
30
750
100
40
1000
150
250
LEGEND
RECOMMENDED CHANNEL
PROPOSED CHANNEL
SCALE IN FT
RECOMMENDED CHANNEL VS. PROPOSED CHANNEL

FIGURE 26

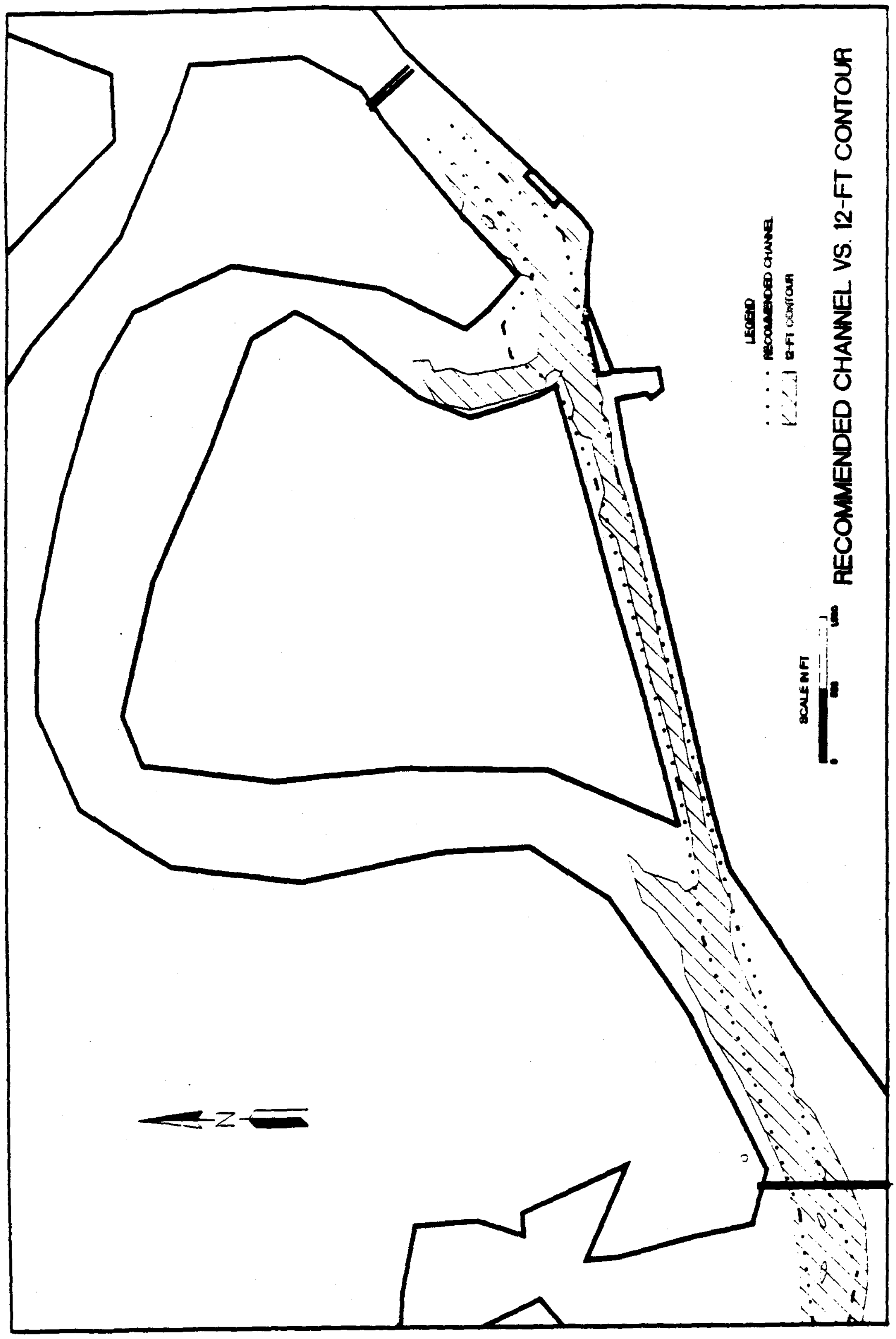
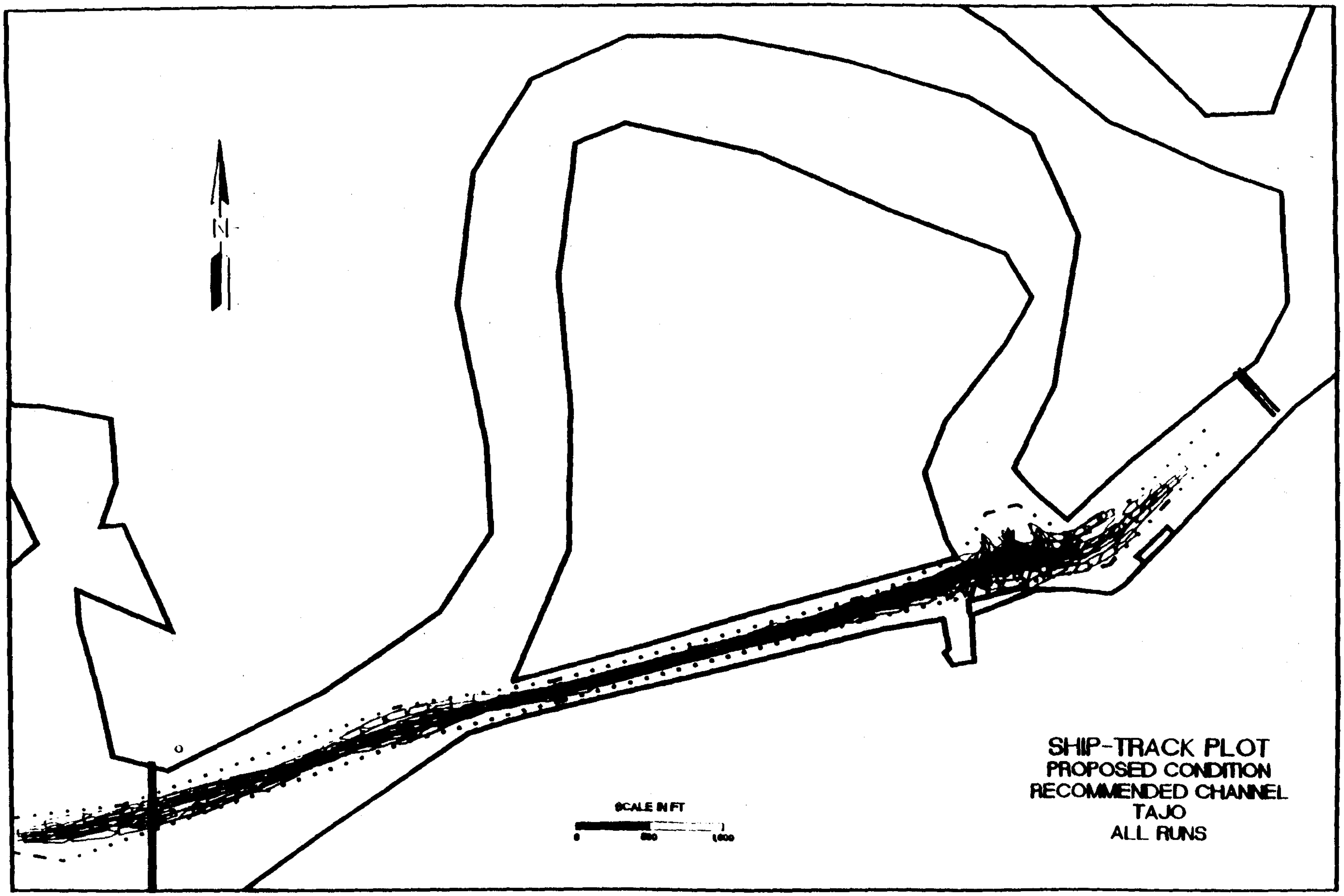
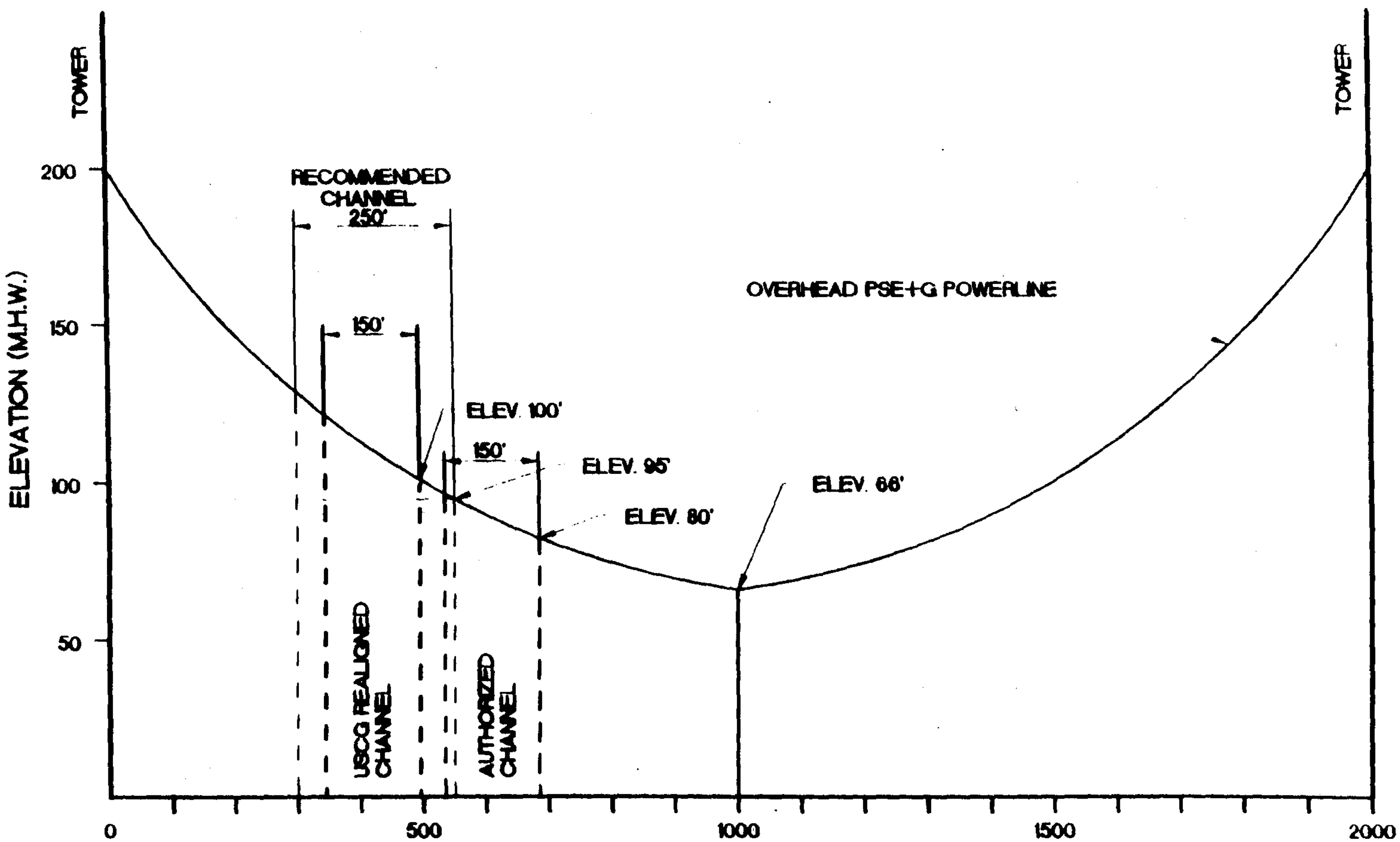

RECOMMENDED CHANNEL VS. 12-FT CONTOUR
LEGEND
RECOMMENDED CHANNEL
12-FT CONTOUR
SCALE IN FT

FIGURE 27


N
SCALE IN FT
0
500
1000
SHIP-TRACK PLOT
PROPOSED CONDITION
RECOMMENDED CHANNEL
TAJO
ALL RUNS



SCALE IN FEET

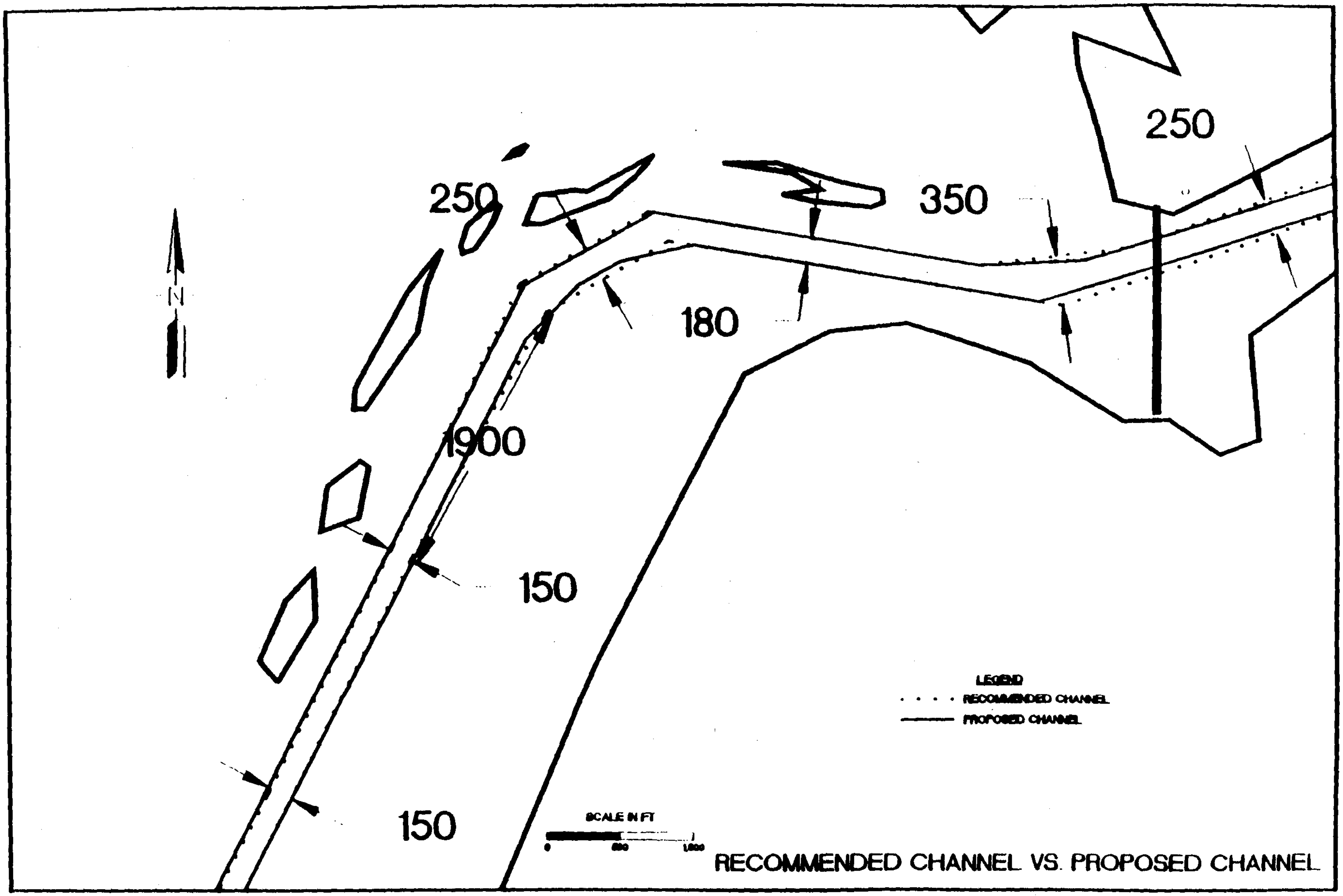
-20 0 20 40 VERTICAL

-100 0 100 200 HORIZONTAL

NOTE - TIDE CONDITIONS MUST BE CONSIDERED TO ESTABLISH VERTICAL CLEARANCE

POWER LINE CROSSING - SINNICKSONS LANDING

FIGURE 29


250
250
350
180
1900
150
150
N
LEGEND
RECOMMENDED CHANNEL
PROPOSED CHANNEL
SCALE IN FT
0
500
1,000
RECOMMENDED CHANNEL VS. PROPOSED CHANNEL

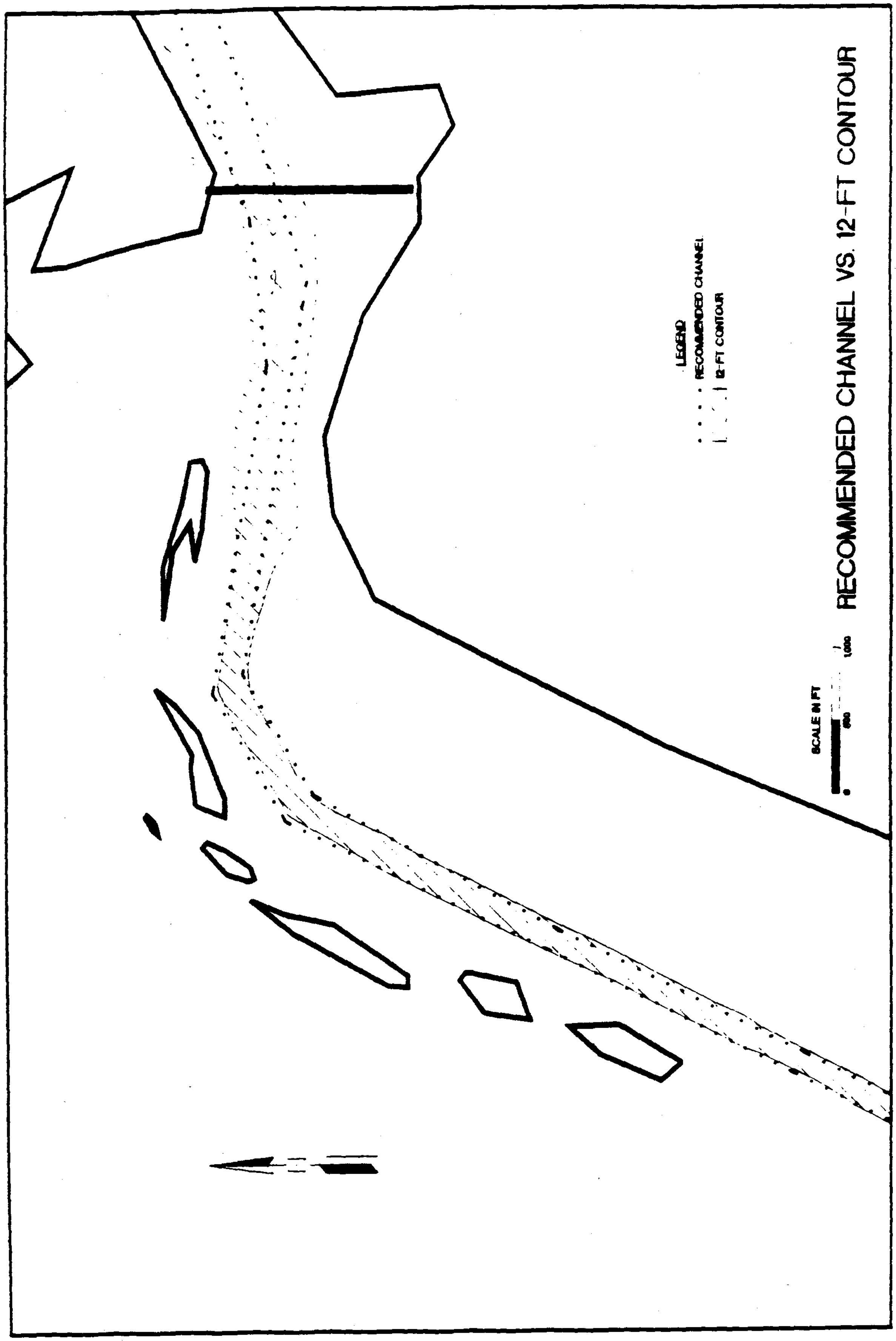
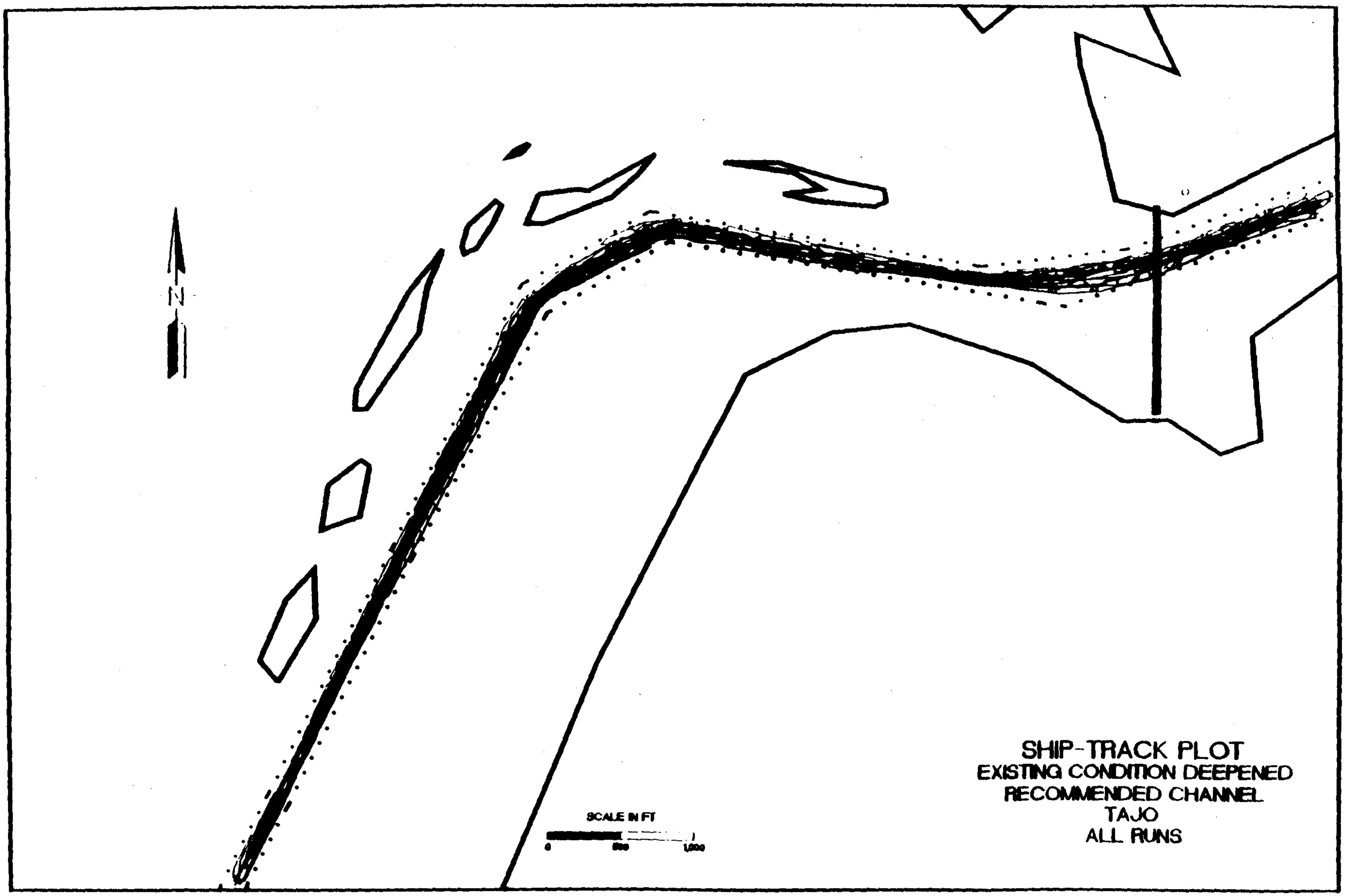
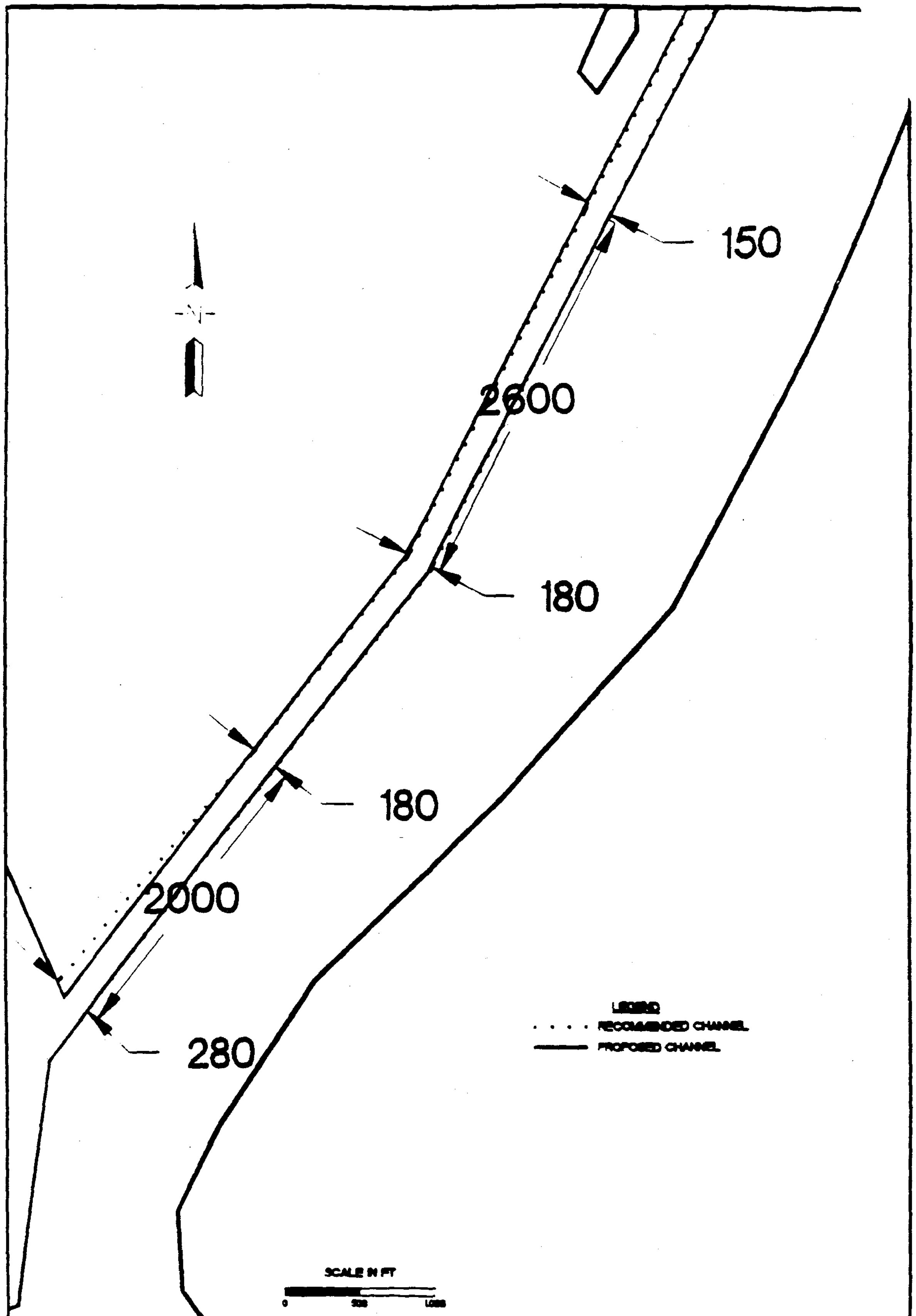

RECOMMENDED CHANNEL VS. 12-FT CONTOUR
LEGEND
RECOMMENDED CHANNEL
12-FT CONTOUR
SCALE IN FT
0
500
1,000

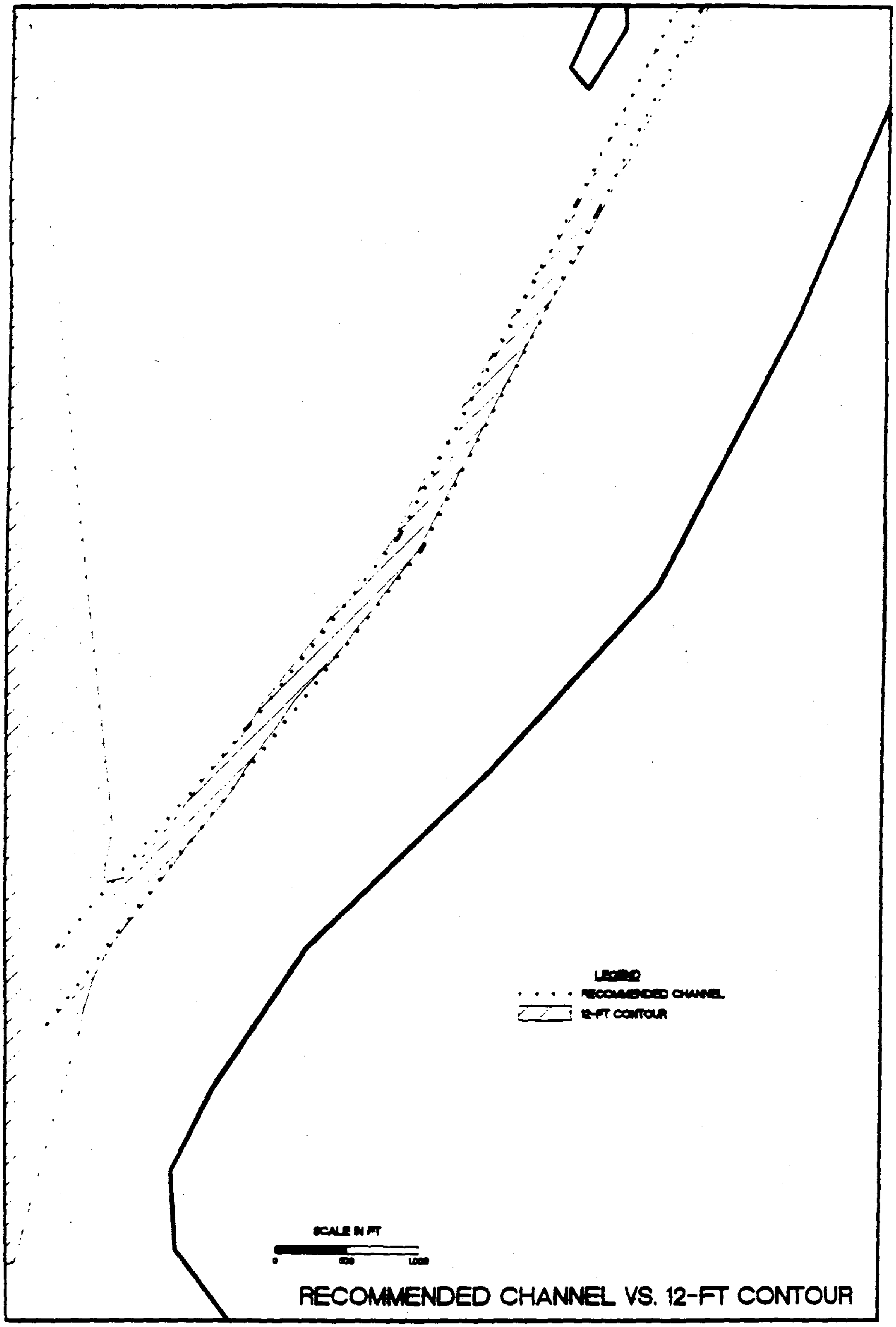
FIGURE 31


N
SCALE IN FT
0
500
1,000
SHIP-TRACK PLOT
EXISTING CONDITION DEEPENED
RECOMMENDED CHANNEL
TAJO
ALL RUNS



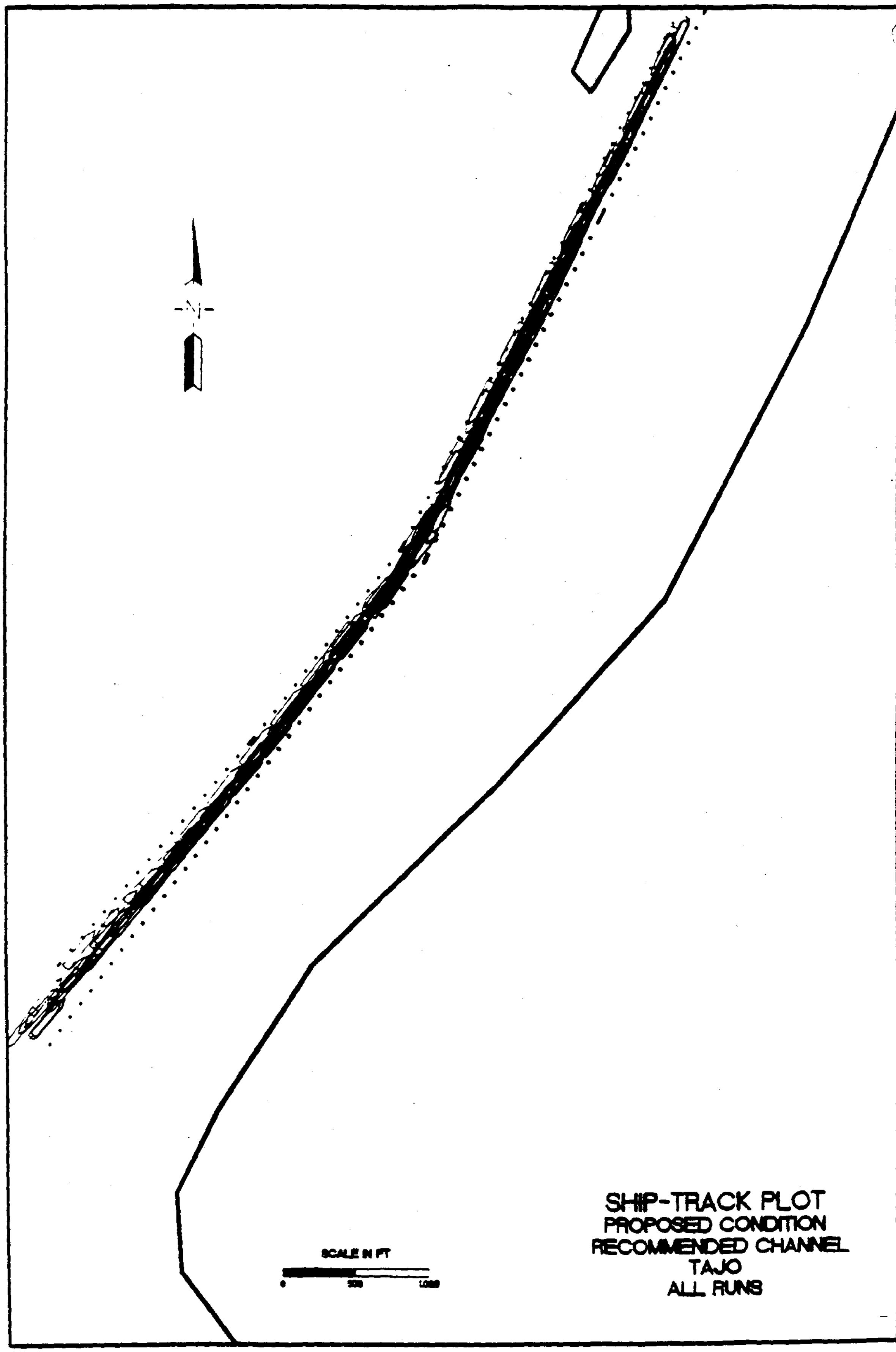
RECOMMENDED CHANNEL VS. PROPOSED CHANNEL

FIGURE 33



RECOMMENDED CHANNEL VS. 12-FT CONTOUR

FIGURE 34


N
SCALE IN FT
0
500
1,000
SHIP-TRACK PLOT
PROPOSED CONDITION
RECOMMENDED CHANNEL
TAJO
ALL RUNS

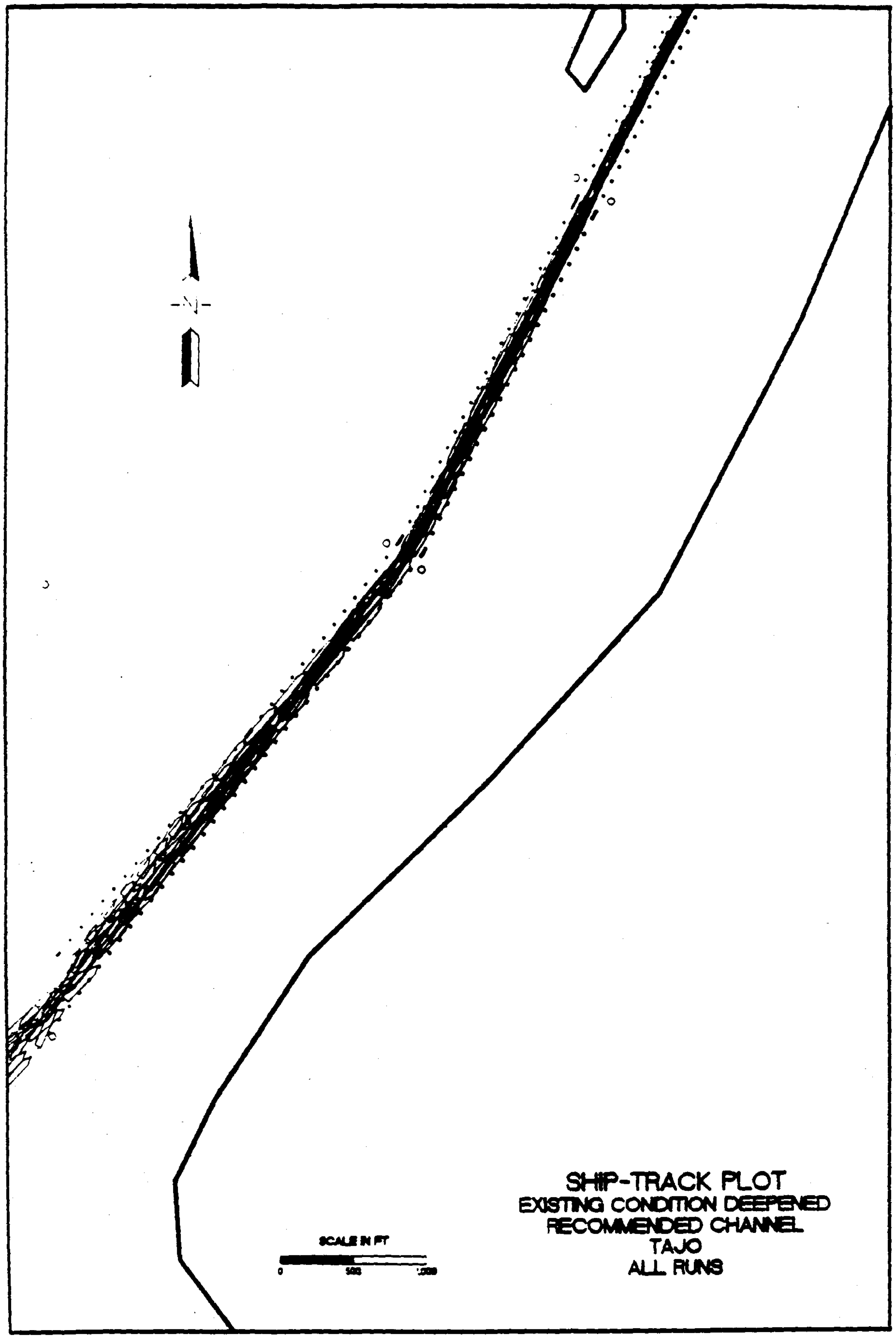
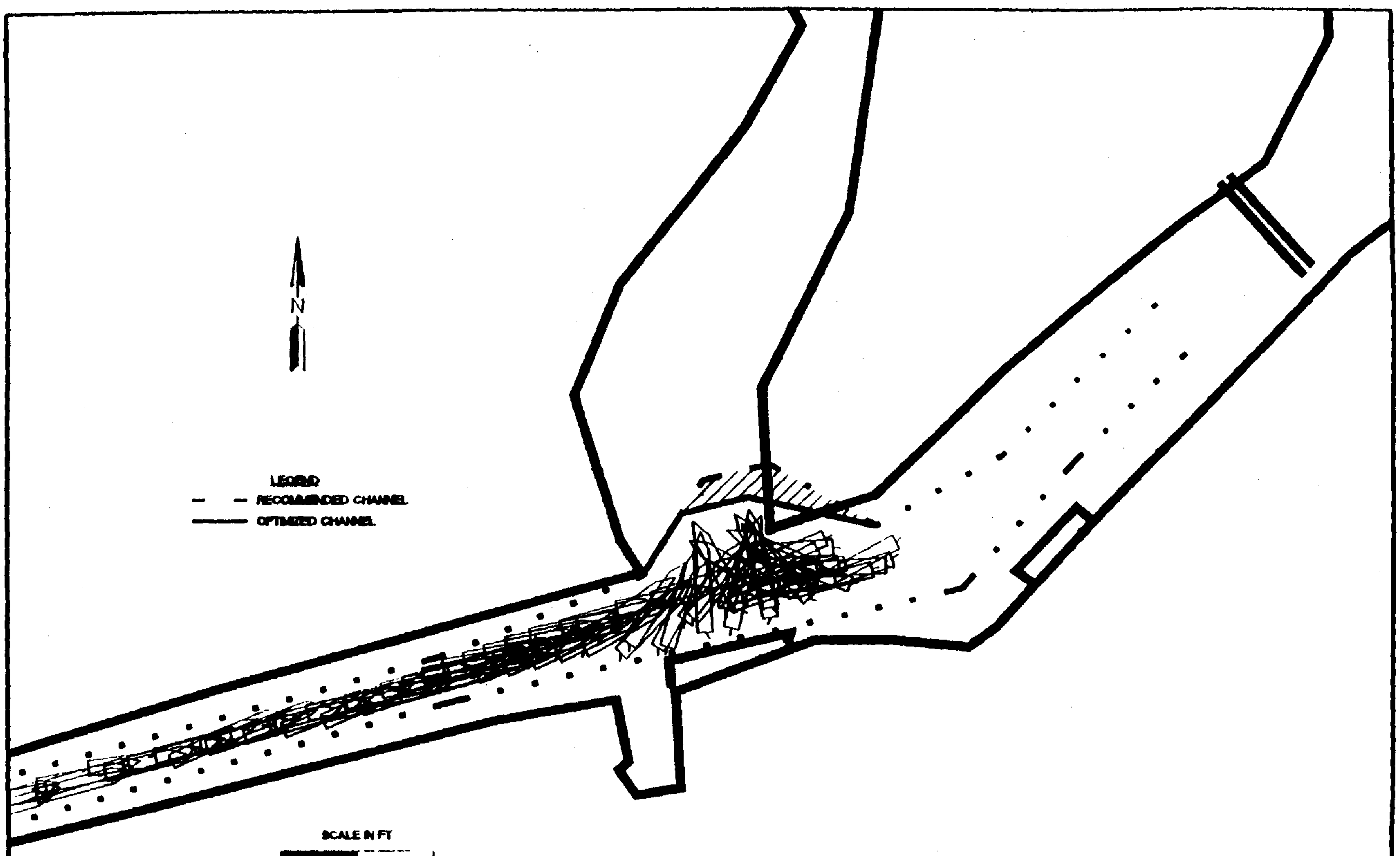
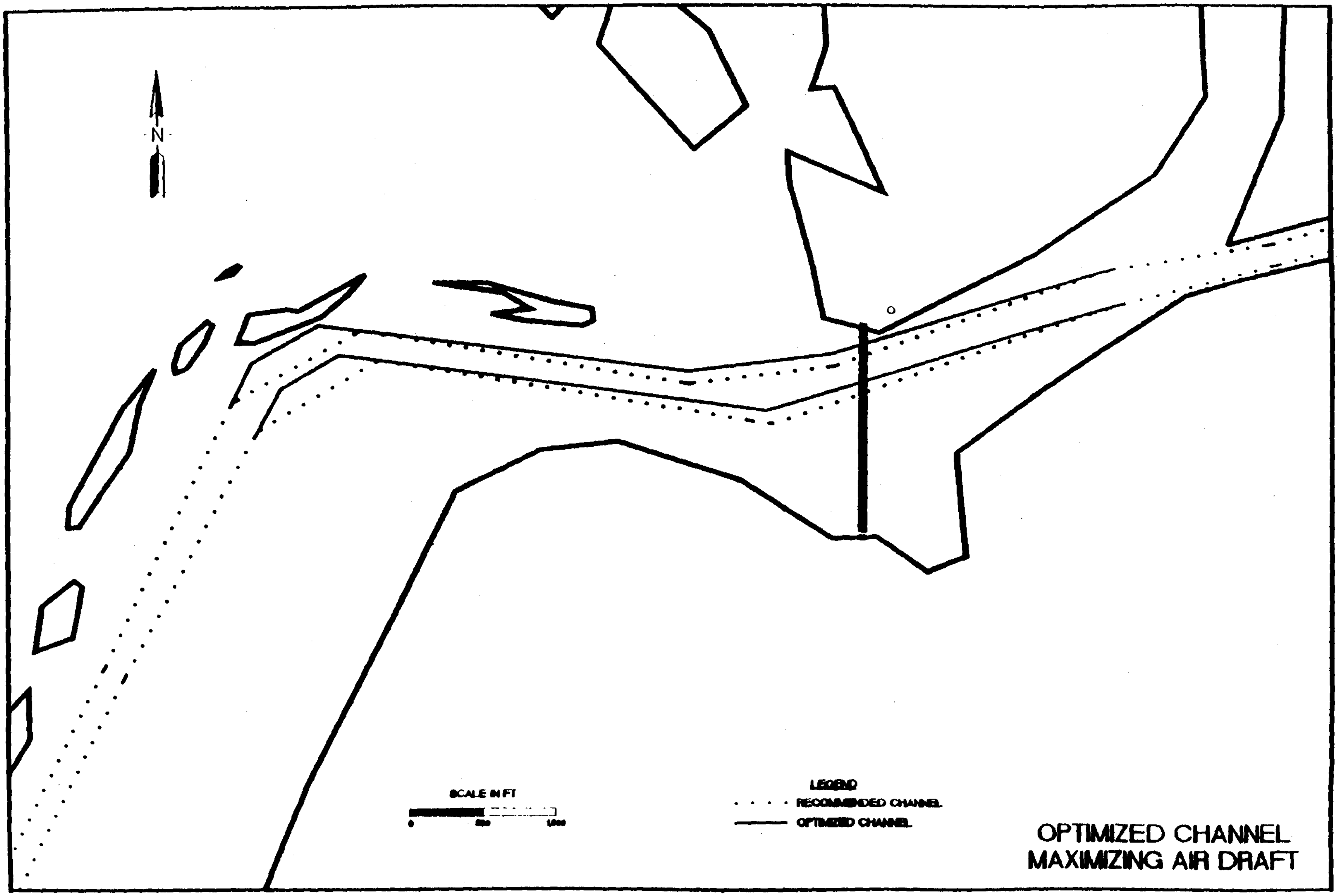

N
SHIP-TRACK PLOT
EXISTING CONDITION DEEPENED
RECOMMENDED CHANNEL
TAJO
ALL RUNS
SCALE IN FT
0
500
1000

FIGURE [illegible]

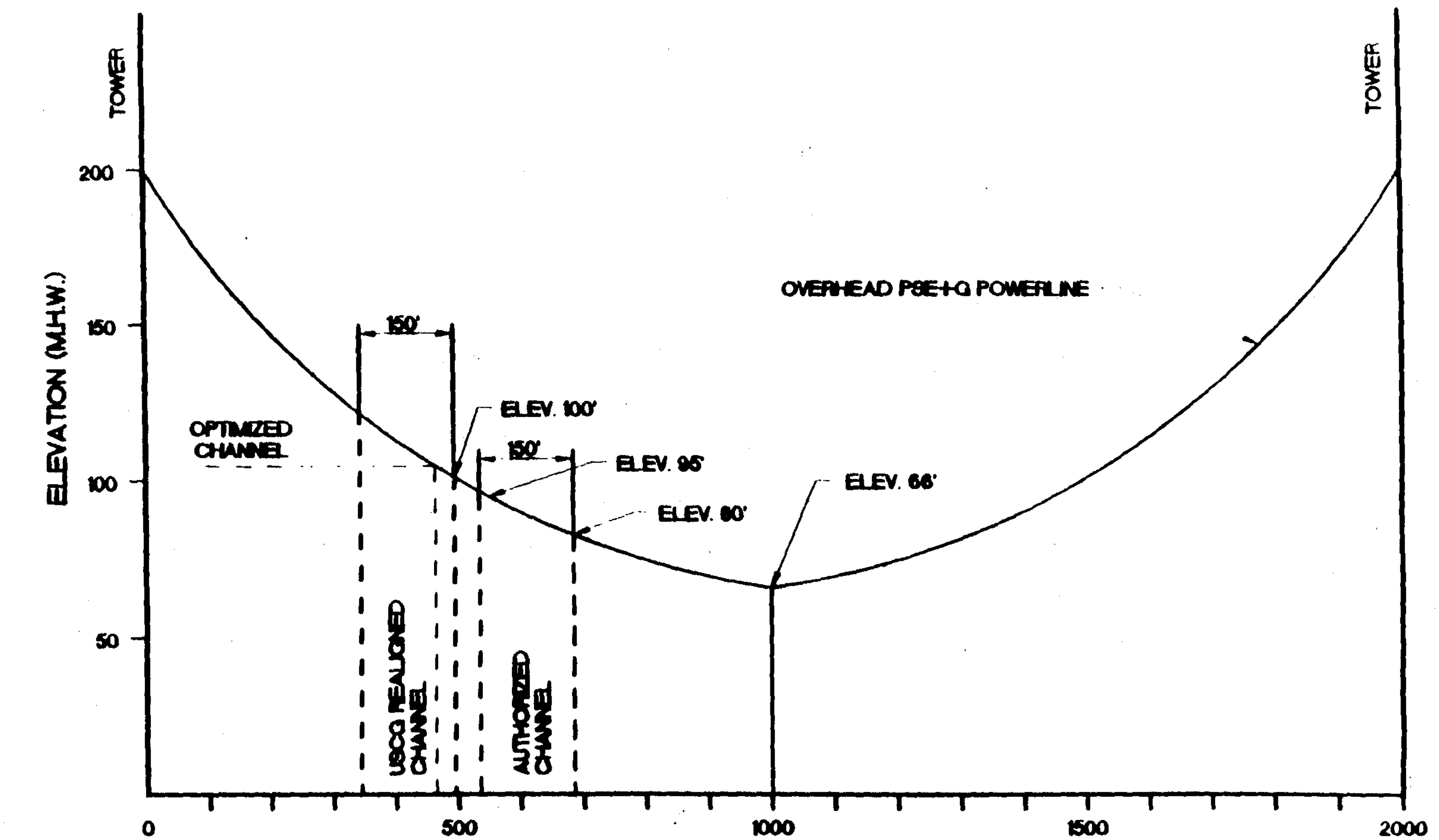


OPTIMIZED CHANNEL WITH PROPOSED CONDITION SHIP-TRACKS
MINIMIZING TURNING BASIN DIMENSIONS

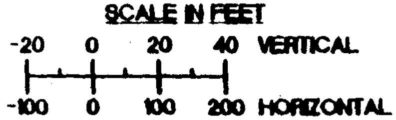
NOTE: ALL SHIP-TRACKS NOT INCLUDED



OPTIMIZED CHANNEL
MAXIMIZING AIR DRAFT



SCALE IN FEET



NOTE - TIDE CONDITIONS MUST BE CONSIDERED TO ESTABLISH VERTICAL CLEARANCE

POWER LINE CROSSING - SINNICKSONS LANDING

FIGURE 39

APPENDIX C

ECONOMICS

DELAWARE RIVER
COMPREHENSIVE NAVIGATION STUDY

SALEM RIVER, NEW JERSEY

ECONOMIC APPENDIX

FEBRUARY 1993

TABLE OF CONTENTS

TABLES

FIGURES

SALEM RIVER, NJ PED STUDY PHASE
ECONOMIC APPENDIX

INTRODUCTION

This economic appendix presents an analysis of the benefits that would result from deepening the Salem River, NJ federal navigation project. The Philadelphia District is analyzing deepening the Salem River navigation channel from its current authorized and maintained project depth of 12 feet to the following depths: 14 feet, 16 feet, 18 feet, 20 feet, 22 feet, and 24 feet. This range of depths was selected to establish, in conjunction with costs, the plan of improvement that maximizes net benefits. The economic analysis estimates the benefits that are anticipated to result from deepening the channel from 12 feet to the with-project condition alternative depths. Benefits will result from the decrease in the cost per ton of shipping commodities into or out of the port of Salem. These cost savings will occur in two ways: 1) a deeper channel depth will allow current vessels to carry more cargo, thus apportioning their operating costs over more tons, and 2) larger vessels with lower costs per ton will be able to call on the port.

In accordance with ER 1105-2-100, Chapter 6, Section 7, the application of the nine-step procedure for the estimation of deep-draft navigation benefits has been followed in this economic appendix.

The port of Salem has been in operation only since 1982 and, thus, does not provide a lengthy historical record to analyze. A total of 258,300 short tons of cargo have been handled by the port from 1982 to 1991. There have been a total of 476 vessel movements into or out of the port over that same period.

The major commodities that moved through the port during its first ten years included general cargo/containers, grain, fertilizer, chemicals, peat moss, perishables, frozen food, scrap iron and steel, lumber, wastepaper, wire coils, and fish meal. During the first three years, barges were the primary vessel type; of particular significance were grain barge movements. Over the next seven years, only one barge shipment occurred, and the remainder of vessel trips have been by general cargo/container vessels and bulk vessels. Grain movements stopped in 1984 because of operational problems with the grain elevator. Funding is anticipated in the near future which will be used to repair the grain elevator for the purpose of handling storage of bulk commodities.

The benefits calculated in this analysis were based on a projection and annualization of commodity flows over the 50-year project life, which extends from 1994 through 2044. A number of different data sources were referenced (Salem Port Authority, Philadelphia Maritime Exchange, Mid-Atlantic and Salem Stevedoring (the two terminal operators), the Salem River pilot logs, Voigt Maritime, the shipping agent for the line using Mid-Atlantic's terminal, Waterborne Commerce Statistics Center, and PIERS, a computerized data base of import/export data). Data from the latest available complete calendar year, 1991, has been selected to represent the baseline existing condition from which tonnage has been projected and benefits estimated. Growth in container traffic for Bermuda has been projected for the first 20 years of the project life (1994-2014) and then held constant for the remainder of the project life. Container traffic to the Azores has been held constant at the current contract level. Bulk movements are anticipated to grow at 2% per year for the first 20 years of the project life based on anticipated growth in income for the study area as reported by OBERS projection service. (Projections of future commerce are discussed in detail later in this appendix.) Commodity flows will not vary by channel depth. The FY 1992 Federal discount rate of 8 1/2% was applied for the calculations.

ECONOMIC STUDY AREA

This section presents a summary of the commodities (with trade routes) which historically have used the Salem River:

a. Containers
  (1) Salem to Bermuda
  (2) Salem to Azores
  (3) Salem to Jamaica
  (4) Salem to Trinidad
  (5) Salem to Barbados

b. Grain (originating from southern New Jersey agricultural region)
  (1) Salem to Jamaica
  (2) Salem to Nova Scotia

c. Fertilizer (destined for use in southern New Jersey agricultural region)
  (1) South Carolina to Salem
  (2) Nova Scotia to Salem

d. Perishables (originating from southern New Jersey agricultural region; processed in local irradiation facility; shipped to foreign destinations)
  (1) Salem to Trinidad
  (2) Salem to East Germany
  (3) Salem to United Kingdom

e. Scrap Iron/Steel (used locally in the manufacture of finished steel products)
  (1) Nova Scotia to Salem

f. Lumber (used in local construction industry)
  (1) Brazil to Salem

g. Fish Meal (used locally)
  (1) Maryland to Salem

h. Other Miscellaneous Bulk Commodities
  (1) Salem from Trinidad
  (2) Salem from Brazil
  (3) Salem from Mexico

i. Explosives
  (1) Salem to Australia

j. Glass
(1) Salem to Puerto Rico

Containers to Bermuda and the Azores are currently the most significant commodity and trade routes. The local port operator, Mid-Atlantic, in concert with its shipping agent, has carved out a successful niche market for moving an aggregation of tonnage to Bermuda. Cargo is transported from inland origin points to Salem, mostly by truck and in small lots, for shipment on a weekly basis. Shipments originate predominantly from the local market radius in New Jersey, Delaware and Pennsylvania (although shipments from further origin points such as the U.S. Midwest and Canada are not unusual). Types of export cargo include transportation equipment, chemicals, electrical equipment, machinery, construction material, foodstuffs, consumer durable goods, and hotel products. For the Azores trade route, Salem acts as a load center for commerce from military installations such as Bayonne, N.J., Mechanicsburg, PA, and Norfolk, VA as well as cargo from the private sector. The tonnage is destined for the U.S. military base located on the Azores. Salem has achieved a niche to handle these small lots principally because it has successfully been able to make great use of its capability to efficiently and quickly handle tonnage, no matter how relatively small the individual lots might be. Bulk tonnage is also an important commodity type moving through the port for various trade routes: specific examples in 1989-1991 are exports of wastepaper to Guatemala and Ecuador, steel coil exports to Jamaica, the export of vehicles to Haiti, and the import of cocoa butter from Mexico.

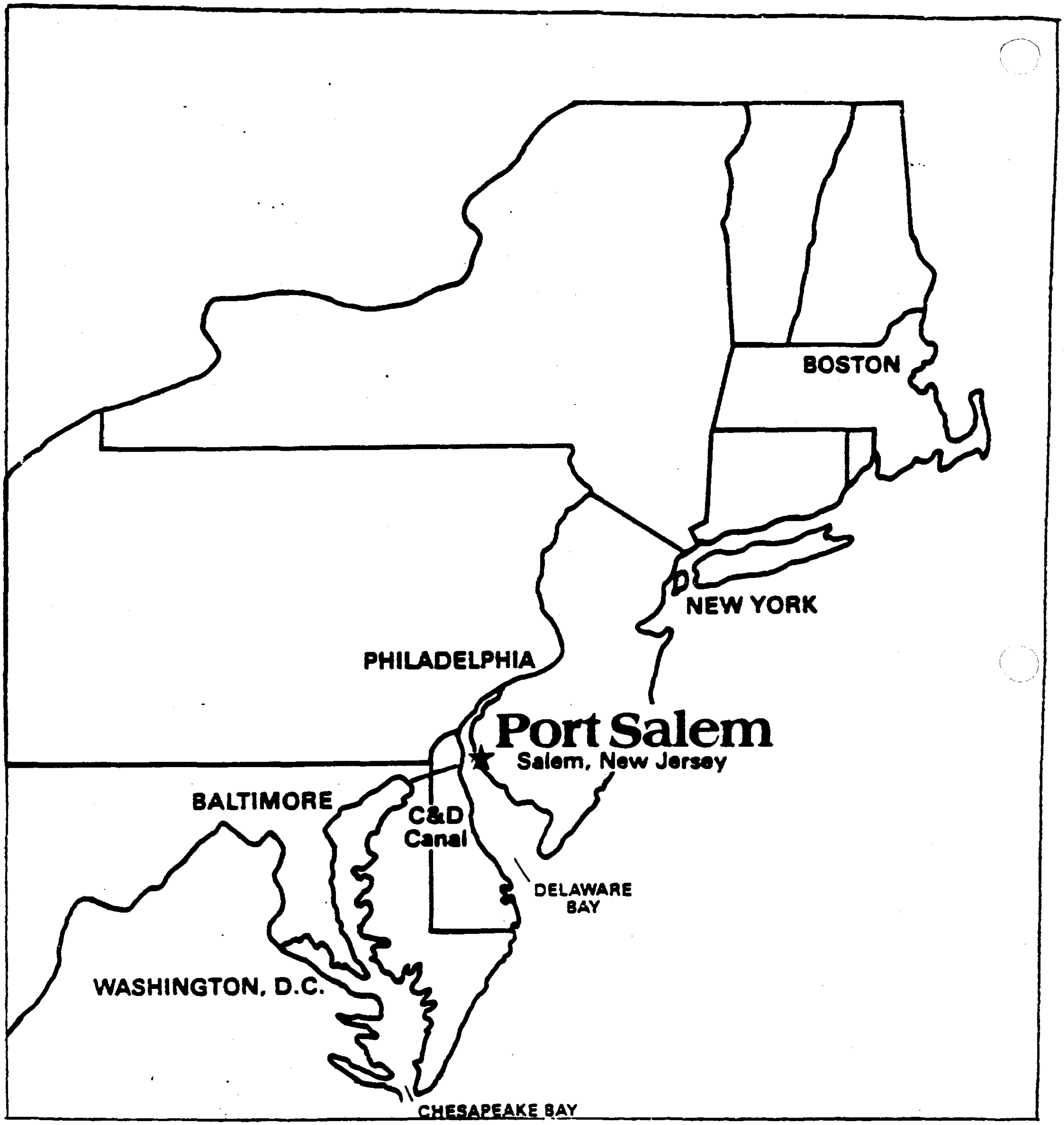
EXISTING CONDITIONS

The port of Salem is located in Salem County, NJ. As shown in Figure B-1 (regional map), the port is located approximately 50 miles south/southeast of the city of Philadelphia, PA. The port is located at almost exactly the same latitude as the Chesapeake and Delaware (C&D) Canal. As shown in Figure B-2, the port of Salem is located approximately two statute miles inland from the eastern shore of the Delaware River, and approximately 5 statute miles from where the navigation channel leading to the port branches off from the main Delaware River channel.

The authorized Salem River federal navigation project includes an entrance channel and a cutoff (as shown in Figure B-2). The project covers a distance of approximately 5 miles (entrance to the port of Salem). The authorized and currently maintained channel depth is 12 feet mean low water. The authorized and maintained width of the entrance channel is 150 feet (approximately 3 miles), with the remainder of the channel (approximately 2 miles) having an authorized and maintained width of 100 feet.

EXISTING FACILITIES

Figure B-3 shows the layout and boundaries of the port of Salem. The current berthing facility owned by the Salem Port



SALEM RIVER, NEW JERSEY
INTERIM FEASIBILITY REPORT

GEOGRAPHIC STUDY AREA

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

FIGURE B-1

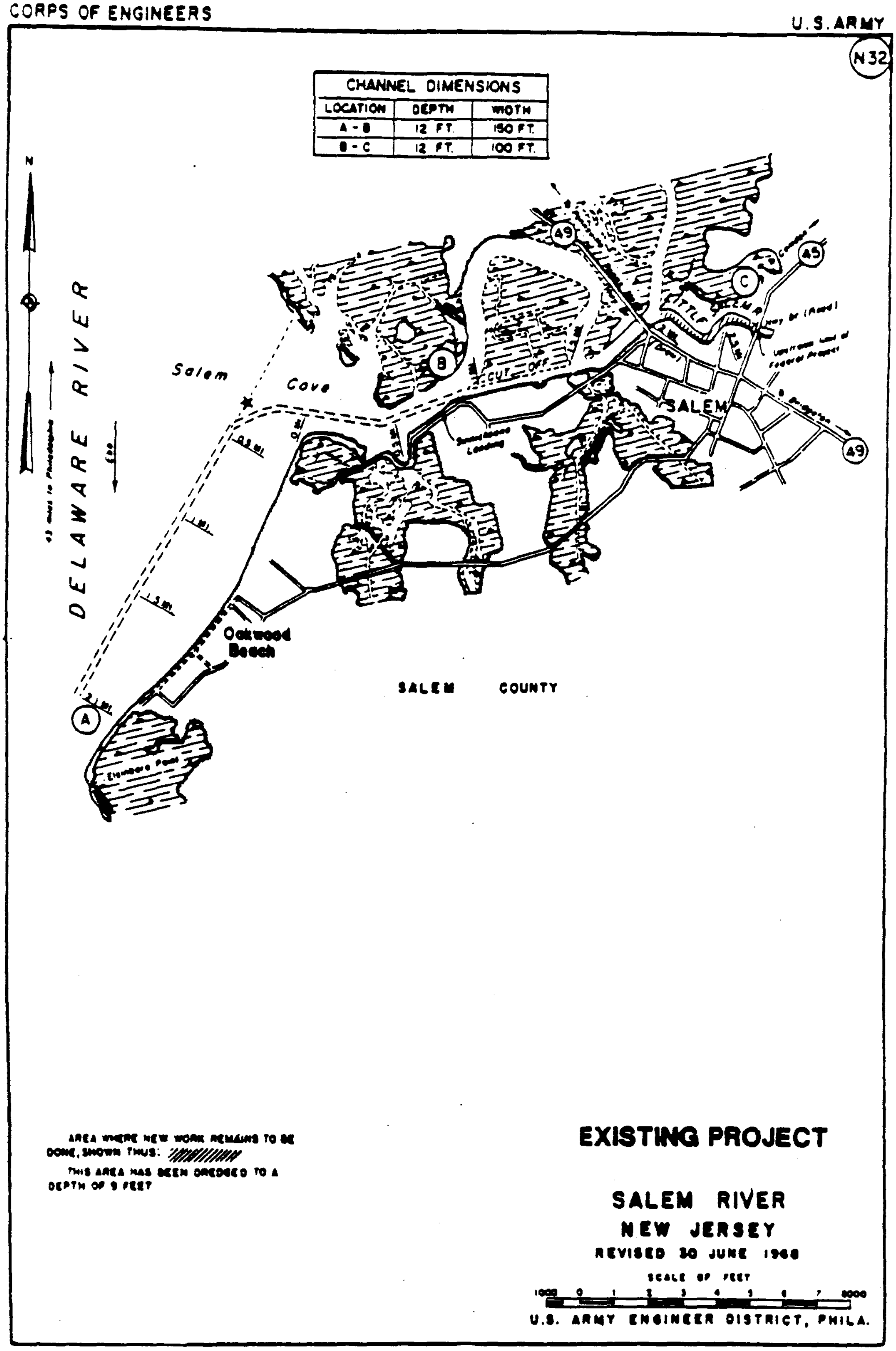
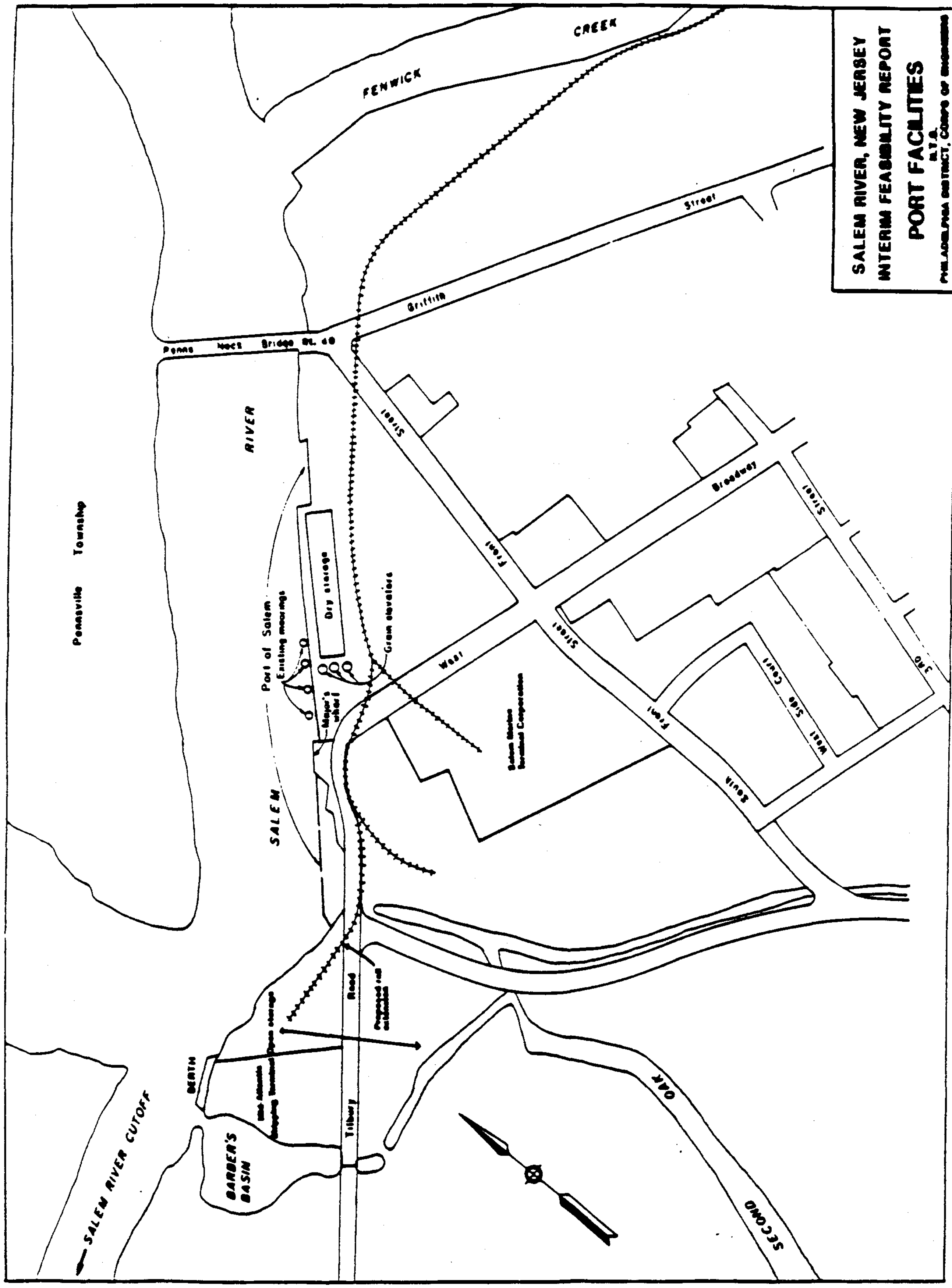

CORPS OF ENGINEERS
U.S. ARMY
N32
CHANNEL DIMENSIONS
LOCATION | DEPTH | WIDTH
A - B | 12 FT. | 150 FT.
B - C | 12 FT. | 100 FT.
N
DELAWARE RIVER
Salem Cove
CUT-OFF
SALEM
Oakwood Beach
SALEM COUNTY
49
45
A
B
C
AREA WHERE NEW WORK REMAINS TO BE DONE, SHOWN THUS:
THIS AREA HAS BEEN DREDGED TO A DEPTH OF 9 FEET
EXISTING PROJECT
SALEM RIVER
NEW JERSEY
REVISED 30 JUNE 1968
SCALE OF FEET
1000 0 1 2 3 4 5 6 7 8000
U.S. ARMY ENGINEER DISTRICT, PHILA.

FIGURE B-2



SALEM RIVER, NEW JERSEY
INTERIM FEASIBILITY REPORT
PORT FACILITIES
N.T.S.
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
FENWICK
CREEK
Griffith
Street
Penns Neck Bridge Rt. 49
SALEM
RIVER
Pennsville Township
Port of Salem
Existing moorings
Dry storage
Grain elevators
Mayor's wharf
Front
Street
Broadway
West
Street
West Side Court
South
Front
3RD
Street
Tilbury
Road
Proposed rail extension
Open storage
BERTH
BARBER'S BASIN
SALEM RIVER CUTOFF
OAK
SECOND

FIGURE B-3

Authority consists of a wharf 120 feet long and 100 feet wide. A work barge measuring 240 feet long and 48 feet wide is moored alongside the wharf. Another berth is situated at the Mid-Atlantic Shipping property directly downriver from the Salem Port Authority facilities. Below is a description of study area facilities.

A bulk crane located on the crane barge has a 100 ton lift capacity. The bulk crane is capable of making six lifts per hour, and is equipped with a three cubic yard bucket that can be lifted 10-12 times per hour.

Container cranes are leased on an as-needed basis. Three capacities of cranes have been used, 22 ton, 65 ton, and 100 ton. The cranes are self-propelled and mounted on rubber tires.

Storage facilities for cargo include a 60,000 square foot transit shed, a 28,000 square foot bulk warehouse, three dry grain tanks with a 1,700 ton capacity, and one wet grain tank that holds about 220 tons. Additional storage facilities include 190,000 square feet of open space for storing containers.

The design capacity of the Port's grain elevator is five million bushels, or 125,000 tons, per year. Its storage capacity is 85,000 bushels (2575 short tons). Approximately 8,000 bushels per hour of grain can be loaded into a ship at port. The Port's grain dryer has a capacity of 65 tons per hour, and sits alongside the grain storage tank.

The port has direct rail access via a rail spur of the West Jersey Short Line whose usable rail line ends just past the cold storage facility. Remnants of the rail spur extend to near the end of the Fire Parcel property (see Figure B-3) but would have to be reconstructed before being usable. This line is owned by Salem County and consists of 18 miles of rail line. The line is operated for the county by the West Jersey Short Line Railroad and connects to Conrail. The siding in the Port of Salem's boundaries has the capacity for ten cars, with additional capacity for 100 railcars present in the Short Line's yards which are located about ten minutes travel time from the port. The Short Line indicates that there is sufficient room available within the port for providing additional rail sidings.

EXISTING VESSEL OPERATING PRACTICES

PILOT RESTRICTIONS

Salem is a relatively new port. In 1982-1985, as the port was just commencing operations, the pilots did not have experience in navigating the channel. The deepest draft of a vessel during initial operations was approximately 16 feet. Over time, with further experience, the pilots limited the maximum draft of vessels under existing conditions to approximately 15.5 feet. The 12 foot (MLW) without project condition provides approximately 17.5 feet of depth at high tide. An allowance for two feet of underkeel clearance is based on the experience and professional expertise of the pilots. The actual operating practice of vessels based on data from the pilots logs has been incorporated into the economic analysis.

TIDAL USE

Vessels currently using the port of Salem operate using the tide, if necessary, based on the consideration of vessel draft versus channel depth. That is, based on discussions with the pilots, some ships transit the Salem River navigation channel only during periods of high tide. Figure B-4 presents a tidal chart for the port of Salem. The tidal fluctuation at Salem is 5.5 feet, meaning that ships using the channel at high tide have approximately 17.5 feet of depth with which to work. The time of the tidal cycle is approximately 12.4 hours.

Figure B-4 indicates the tidal "window" that is currently available for ships using the Salem channel whose required draft (vessel sailing draft plus 2 feet of underkeel clearance) exceeds the MLW channel depth. For example, a ship requiring a 17 foot channel depth has approximately 2.2 hours during which the channel is at least that deep. If the vessel misses its "window" it has to wait 10.1 hours for its next opportunity. Similarly, a vessel requiring a 16-foot channel depth has a "window" of 4.2 hours during which it could use the channel.

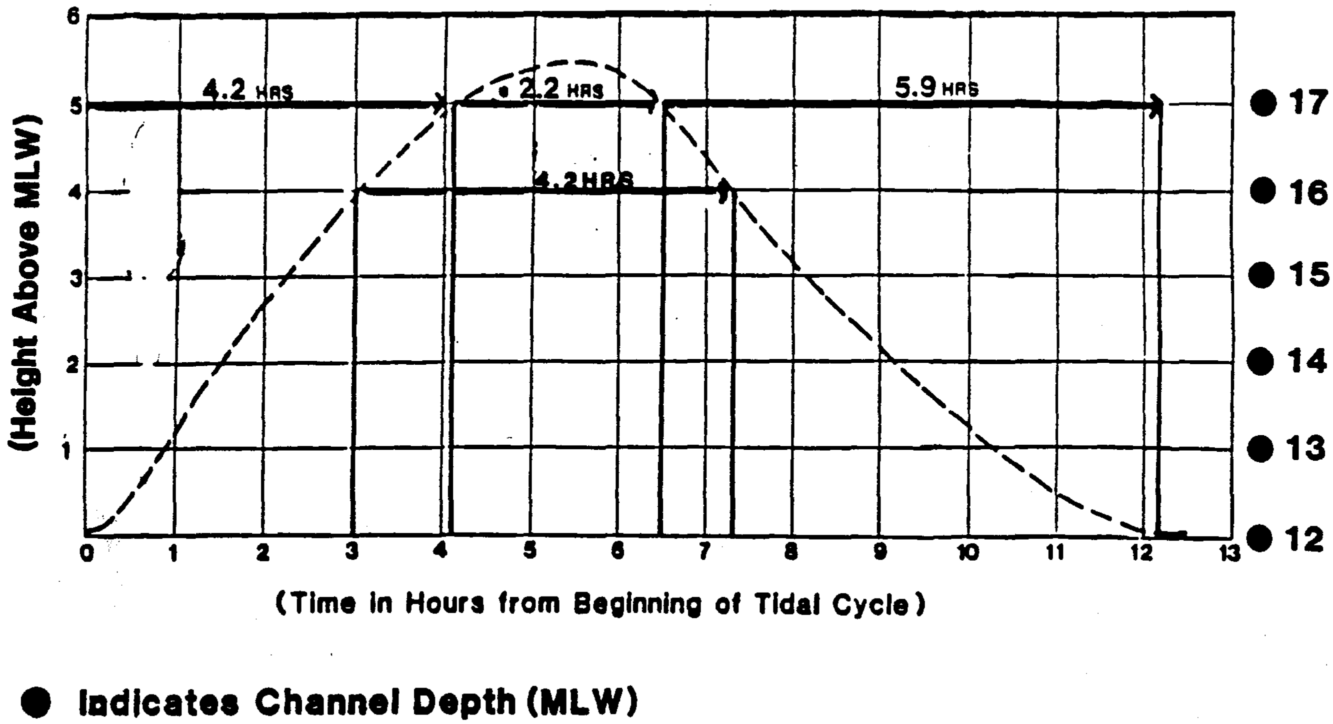
TUG USE

The current practice is to use one 525 horsepower tug, with a length of 46 feet, draft of six feet, and a beam of ten feet. This practice is expected to continue in the future at all potential channel depths. On an inbound trip, the tug precedes a ship up the Salem navigation channel and then ties onto it at the point where the channel width narrows from 150 feet to 100 feet. Until that point, the vessel has been proceeding under its own power. The tug is then positioned on the starboard side of the ship's bow. When the pair reach the turning basin, the tug positions itself perpendicular to the keel and turns the ship to the left (i.e., counter clockwise, with the bow turning to the left and the stern to the right). The ship is rotated 180 degrees until it is facing downstream. Turning ships to the left is required because of the unique dimensional and tidal characteristics of the port of Salem, even though most ships are "right propellered", and turn more easily to the right. The ship is then pushed into position with its port side next to the wharf. Tug costs are incorporated into the transportation cost model.

The pilots prefer to bring ships up the channel on the flood tide as the increasing depth provides more maneuverability for the ships.

EXISTING VESSEL USE

The number of vessel trips (including backhaul movements) historically through the port of Salem is shown in Table B-1. Barge movements predominated in 1982-1984. A significant change occurred during 1985-1986, in which there were 49 vessel trips, only two of which were by barge. In 1987 through 1991, there were 404 vessel trips through Salem, all of which were by ship. A vessel trip is defined as either an inbound or outbound usage of



SALEM RIVER, NEW JERSEY
INTERIM FEASIBILITY REPORT

Tidal Rise and Depth of the Salem River Navigation Channel

PHILADELPHIA DISTRICT, CORPS OF ENGINEERS

FIGURE B-4

TABLE B-1
HISTORIC PORT OF SALEM VESSEL TRIPS (INBOUND AND OUTBOUND)
1982-1991 1]

VESSEL TYPE AND COMMODITY	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	TOTAL
SHIPS											
CONTAINER (BERMUDA TRADE)	0	0	0	0	0	0	0	68	98	94	260
GENERAL CARGO/CONTAINER	0	0	0	24	21	26	18	0	0	24	113
BULK COMMODITIES	0	0	1	2	0	0	0	34	26	16	79
SUBTOTAL	0	0	1	26	21	26	18	102	124	134	452
BARGES											
GRAIN	3	0	11	0	0	0	0	0	0	0	14
FERTILIZER	0	4	2	0	1	0	0	0	0	0	7
CHEMICALS	2	0	0	0	0	0	0	0	0	0	2
SCRAP IRON & STEEL	0	0	0	1	0	0	0	0	0	0	1
SUBTOTAL	5	4	13	1	1	0	0	0	0	0	24
TOTAL	5	4	14	27	22	26	18	102	124	134	476

SOURCES: PORT OF SALEM, PORTS OF PHILADELPHIA MARITIME EXCHANGE, MID-ATLANTIC, WCSC, PIERS

1] PRIOR TO 1989, CONTAINERS WERE NOT A MAJOR FACTOR IN SALEM TRAFFIC AND ARE INSEPARABLE FROM GENERAL CARGO TRIPS. TRAFFIC IN 1989 MARKED THE BEGINNING OF THE CONTAINER TRADE TO BERMUDA. ALTHOUGH THEY ARE REPORTED SEPARATELY FOR 1989, IT SHOULD BE NOTED THAT "CONTAINER" TRIPS MAY ALSO CARRY GENERAL CARGO TONNAGE AND VICE VERSA.

the Salem River channel.

COMMODITY MOVEMENTS-HISTORICAL TONNAGE

The Salem City Council voted in 1982 to create a Municipal Port Authority to oversee the redevelopment of the port area and the construction of port facilities.

The first modern day shipment through the port of Salem occurred in May 1982, when 1,500 short tons of soybeans travelled by barge down the Salem River channel en route to Norfolk, VA, by way of the Chesapeake and Delaware Canal. Four additional barge shipments occurred that year, two for soybeans and two for chemicals. A summary of historical general cargo/container and bulk commodity movement categories from 1982-1991 is given in Table B-2.

Grain shipments comprised the majority of tonnage between 1982 and 1984. In 1985, the leading commodity, in terms of tonnage, was scrap iron and steel imported from Nova Scotia. The second largest commodity movement was wastepaper. General cargo amounted to 4,400 short tons and comprised the third largest commodity volume. Also, in 1986, general cargo/containers and lumber comprised the two largest commodity groups. Frozen food was the third largest commodity. Scrap iron and steel imports were fourth in significance. The years 1987 and 1988 were reported as entirely general cargo/container movements. The year 1989-1991 showed approximately 72% of total tonnage as container movements, with the other 28% consisting of bulk movements. Traffic is port to port. Table B-3 presents vessel movements by trade route for 1989-1991.

PORT OPERATIONS

Two facilities handle tonnage at the port of Salem: 1) Mid-Atlantic Shipping and Stevedoring and, 2) Salem Stevedoring (at the Salem Port Authority facility).

MID-ATLANTIC SHIPPING AND STEVEDORING OPERATIONS

Mid-Atlantic's site selection of Salem, after an extensive search of alternative sites was based on three major reasons. The Salem location offers excellent access to Interstate 95 and connecting interstate highways via the Delaware River Memorial Bridge; it has a relatively short navigation channel into the port, thereby minimizing maintenance requirements; and the site gives Mid-Atlantic the ability to use non-ILA stevedoring labor. A number of ports along the U.S. east coast were seriously considered for relocation of Mid-Atlantic's facilities from Winterport, Maine. These sites were eliminated because they were either: too far south which would make inland freight charges too expensive, had poor inland access, or had high labor charges. Mid-Atlantic serves as a "niche" market for moving an aggregation of relatively small lots. The willingness of Mid-Atlantic to accept small amounts of tonnage from different shippers and the ability to efficiently handle specialty movements, such as transport of horses and odd-

TABLE B-2
HISTORIC PORT OF SALEM TONNAGE
1982-1991

COMMODITY	1982	1983	1984	1985	1986	1987	1988	1989 1]	1990	1991
GENERAL CARGO/CONTAINERS	0	0	0	4,400	5,200	32,600	22,600	14,400	22,900	34,700
BULK	7,700	6,000	22,300	25,100	11,100	0	0	24,800	12,000	12,500
TOTAL 2]	7,700	6,000	22,300	29,500	16,300	32,600	22,600	39,200	34,900	47,200

SOURCES: PORT OF SALEM, PORTS OF PHILADELPHIA MARITIME EXCHANGE, MID-ATLANTIC, PIERS, WCSC

1] ALL GENERAL CARGO/CONTAINER TONNAGE MOVED PRIOR TO 1989 WAS ON TRADE ROUTES OTHER THAN BERMUDA; ALL GENERAL CARGO/CONTAINER TONNAGE FOR 1989 IS FOR BERMUDA TRADE ROUTE COMMENCED IN APRIL 1989; BASED ON SAME RATE OF TONNAGE FOR THIS TRADE ROUTE, PRORATION FOR FULL YEAR= 21,600

2] STRICTLY BARGE MOVEMENTS 1982-1984, ONLY ONE BARGE MOVEMENT IN BOTH 1985 AND 1986 (REMAINDER OF MOVEMENTS IN VESSELS); STRICTLY VESSEL MOVEMENTS 1987-1991

3] TOTAL TONNAGE FOR 1987-1988 REPORTED BY PORT OF SALEM IS CORRECT, HOWEVER BULK TONNAGE MOVED IS NOT CLEARLY SEPARABLE FROM THE GENERAL CARGO/CONTAINER CATEGORY IN THE DATA SOURCES.

TABLE B-3
VESSEL MOVEMENTS BY TRADE ROUTE
(INBOUND AND OUTBOUND) 1]
1989-1991

TRADE ROUTE	1989	1990	1991
BERMUDA	80	98	104
AZORES	0	0	24
JAMAICA	0	7	0
GUATEMALA	6	0	0
NEW YORK	4	1	0
FLORIDA	3	4	0
HONDURAS	2	0	0
MEXICO	1	4	0
COLOMBIA	1	0	0
NOVA SCOTIA	1	2	0
SAVANNAH	0	3	0
NORTH CAROLINA	0	2	0
NEW ORLEANS	0	1	0
AUSTRALIA	0	0	2
BALTIMORE	1	0	0
HAITI	0	0	1
EQUADOR	1	0	0
CANARY ISLANDS	1	0	0
GUYANA	0	0	3
VENEZUELA	1	1	0
AYMEN ISLANDS	0	1	0
TOTAL	102	124	134

SOURCES: PORTS OF PHILADELPHIA MARITIME EXCHANGE, WCSC, PIERS, MID-ATLANTIC, PORT OF SALEM

1] MOST MOVEMENTS INVOLVE EMPTY OR INSIGNIFICANT TONNAGE ON BACKHAUL shaped cargo, has been cited as an advantage compared to its competitors. Mid-Atlantic management has stated that they will provide specialized services on a continuing basis. Shippers are attracted because of the personalized handling of commodities, competitive service and competitive pricing.

<u>Bermuda Trade Route</u>. Containerized cargo destined for Bermuda is transported to Salem by truck in small lots for shipment on a weekly basis, currently using the foreign flag vessel, the "Bermuda Islander". Shipments originate predominantly from the local market radius in New Jersey, Delaware, and Pennsylvania, although shipments from further origin points such as the U.S. Midwest and Canada are not unusual. Types of cargo include transportation equipment, chemicals, electrical equipment, machinery, construction material, foodstuffs, consumer durable goods, and hotel products. It is important to note that advertisements in the Journal of Commerce/Royal Gazette that show departures from Montreal, Toronto, New York, and Salem are for bill of laden movements for container box origination and do not represent the port itinerary of the "Bermuda Islander". The "Bermuda Islander" operates strictly port to port between Salem and Bermuda. In 1991, 3062 TEUs, containing 25,800 short tons, were exported to Bermuda. Mid-Atlantic also moved 6000 tons of construction material in 1991 using the vessel, "Kuinder". This is an intermittent, unpredictable type of cargo to Bermuda and has not been included in the quantification of benefits for this trade route. However, significant movements of construction material are expected to occur in the future.

<u>Azores Trade Route</u>. A contract to ship 3000 TEUs of containers over a two year period for the Dept. of Defense to a military installation on the Azores was initiated in April 1991. The Azores base is part of the European Rapid Deployment Force which belongs to the Military Sealift Command. This contract, using a U.S. flag vessel, "Rainbow Hope", is for the containerized shipment of groceries, consumer goods, and other supplies. Since Mid-Atlantic was successful in obtaining the contract initially, it is reasonable that they will be able to successfully compete for renewal. From April 19, 1991 through Feb. 12, 1992, 14 trips have occurred carrying 1224 TEUs, containing 10,300 short tons. An extrapolation for the full calendar year equates to 1486 TEUs, containing 12,500 short tons.

<u>Potential Future Benefitting Trade Routes</u>. A new trade route, explosives to Australia, is currently moved in planned bi-monthly 600 ton shipments in chartered 1200-1600 DWT vessels. Two shipments have occurred through February 1992. These vessels are essentially fully loaded because of the compartmentalization of the explosives required for safety purposes. Mid-Atlantic reports that it is the only public terminal on the U.S. East Coast which has Coast Guard approval to handle the shipment of explosives. Two U.S. military terminals: Bayonne, NJ and Sunnypoint, NC, are also licensed by the Coast Guard. With a deeper channel, Mid-Atlantic

foresees the potential for the use of larger chartered vessels and carry general cargo/container cargo as well as the explosives to Australia.

Also, forest products and other bulk commodity imports from the Caribbean and South America are considered very possible by Mid-Atlantic with a significantly deeper channel, such as 18 feet. To make the shipments economical, the channel depth must allow shipment sizes of 3000-4000 tons. A yearly total of 40,000 tons is viewed as very possible by Mid-Atlantic with a deeper channel.

SALEM PORT AUTHORITY FACILITY

Salem Marine Terminal Corp. (SMTC) operated at the port authority facilities until July 1991. It was fully operational and made all lease payments on time to the Salem Port Authority until its sale of assets in July 1991. The assets of the company were sold in July 1991 to a joint Canadian interest of two companies, Quebec Stevedoring and Empire Stevedoring. Salem Stevedoring (for port operations) and Salem Port Development Corp. (for port marketing) are subsidiaries of this joint venture. The new company bought the 21-year lease from SMTC that had been contracted with the Salem Port Authority. Other SMTC assets are being acquired under a two-year purchase option.

Quebec Stevedoring operates at 14 ports on the St. Lawrence River. Empire Stevedoring operates at 25 ports in the St. Lawrence River, Great Lakes, and U.S. Gulf Coast ports. These companies are very healthy financially and were reported by Salem Stevedoring to have handled approximately 20 million tons of a wide variety of commodities (general cargo, breakbulk, grain, container) last year. Quebec Stevedoring has a history of developing small ports on the St. Lawrence River. One example is the port at Gros-Cacouna which is located on the southern shore of the St. Lawrence River about 100 miles east of Quebec City. This port is very similar to the port of Salem in terms of storage and staging areas. At the start in 1984, it originally had only one berth but Quebec Stevedoring built a second berth and is currently designing a third berth to handle its growth in cargo. 1984 tonnage was reported as 20,000 metric tons. By 1990, the tonnage was reported to have reached 700,000 metric tons.

Salem Stevedoring is paying monthly lease payments to the port authority and has already placed significant operational equipment (new crane, etc.) at the port. Planned development of wharf improvements, pending permit approval, is scheduled to start in the summer of 1992, to coincide with scheduled maintenance dredging for the project. A total of approximately $15 million is planned to be invested over a two-year time frame, with $7 million of that total planned for direct port site development. The proposed new dock facilities will be consistent with the improvements previously included in the without project condition. In addition, the existing 60,000 square foot warehouse will be brought "to code", the grain facility will be renovated and used to store bulk commodities, and an existing shed facility close to the wharf will be removed to allow for the development of increased open storage space for commodities.

Funding for development will be from a combination of private and public sources. Public sources being explored by Salem Stevedoring are the U.S. EDA, the Delaware River and Bay Authority, and the N.J. Dept. of Community Affairs.

By N.J. state law, municipal port authorities must use civil service labor for loading and unloading vessels. So, the Salem yStevedoring operation is conducted at a relatively low labor cost port, since ILA labor is not required.

From July 1991 to March 1992, there have been four movements by Salem Stevedoring. The first vessel movement consisted of 1521 short tons of paper exported to Guatemala by the "Meera"(design characteristics: 18 foot design draft, 3300 DWT, length: 335 feet, beam: 41 feet). The second vessel, "Blue Crown I" unloaded 551 short tons of paper from South America. The third vessel, "Southern Sky" (design characteristics: 12 foot design draft, 1133 DWT, length: 218 feet, beam: 34 feet), loaded 1000 short tons of vehicles bound for Haiti. Finally, in March 1992, an ocean-going tug with two 14 foot draft barges carried a shipment of 5793 short tons of glass and steel to Puerto Rico.

The activities at the Salem Port Authority facility, to update the situation to February 1993, are currently in transition. Salem Stevedoring is being replaced as the port operator by the South Jersey Port Corporation (SJPC). The SJPC currently operates two successful facilities in Camden, NJ: the Beckett Street and Broadway Terminals. The expectation is for the SJPC to sign with the Salem Port Authority to take over the operations of the facility in 1993 and develop the facility similar the plans of Salem Stevedoring. To start, the SJPC will become the port tenant for one year, with two one-year options to renew the lease.

FUTURE PORT IMPROVEMENTS

Port officials and the individual companies shipping out of Salem were contacted to identify planned expansions in port facilities and equipment. The facilities anticipated to be in place at the port by the base year, 1994, are shown in Table B-4. One berth is currently operational and managed by the Salem Port Authority under lease to Salem Stevedoring. A second berth, constructed by Mid-Atlantic Shipping, became operational in April 1989, with an additional berth extension planned to be in place by 1994. Salem Stevedoring is currently arranging for financing to build an additional berth on leased port property. Also, the company is actively developing plans for construction of another berth on additional port property. Thus, the project is expected to have a total of four berths available for usage by vessels by the project base year. Further, the County of Salem Economic Development Authority and Salem Port Authority are working together to expand the foreign trade zone (FTZ) designation. The potential impact of the FTZ has not been included in the projection of commodities.

COMMODITY PROJECTIONS

Estimates of future commodity movements through the Port of Salem were based on the historical data base of vessel movements and tonnage, interviews with the local users and the Salem Port Authority, and economic growth projections from a consulting firm service.

<u>Container Exports to Bermuda.</u> No single data source will capture traffic for a port in its entirety; errors in reporting and collection distort any data base. Also, different sources are interested in different measurements, for instance, one may focus on TEU's (twenty-foot equivalent units, the standard measure for container box size) while another is concerned with tonnage. Therefore, figures for Salem were collected from several sources.

Data collected for Salem indicated that its prorated share of the North Atlantic-Bermuda trade was approximately 20%, or 21,600 short tons in 1989, and 21%, or 22,900 short tons on 1990.

Projected growth of container traffic was obtained from two sources. The DRI/TBS World Sea Trade Service has been used as the major source for the projections of export tonnage from the U.S. North Atlantic Coast to Bermuda from 1991 through the year 2000. Table B-5 presents DRI/TBS projections for the total market in the left-hand columns at a 4.7% per annum growth rate as judged acceptable during the feasibility study review process. This analysis extrapolates DRI's figures from the year 2000 to the year 2014 to anticipate continued growth for the first 20 years of the project life. Tonnage has then been held constant in the benefit analysis for the remaining 30 years of the project life. Specific projections for Salem, shown in the right-hand columns, relied on a combination of DRI data, Mid-Atlantic data, and data from the shipping agent (Voigt Maritime) for the carrier (Bermuda International Shipping Ltd. (BISL)) using Mid-Atlantic terminal.

TABLE B-4
LOADING/UNLOADING AND STORAGE FACILITIES, 1994
(ALL CHANNEL DEPTHS)

Berths
-Three berths at the Salem Municipal Port Authority location
-One berth at the Mid-Atlantic Shipping location (with berth extension)

General Cargo/Container and Bulk
-88,000 sq. ft. of warehouse covered space
-190,000 sq. ft. of uncovered space available for staging containers
-Access to unlimited crane capacity on a lease basis. Current capacity of 180 tons per hour, and an available 3 cubic yard bucket which can be lifted 10-12 times per hour

Grain
-Three dry storage tanks holding a total of 1,700 tons
-One tank holding 220 tons of wet or dry grain
-Grain dryer with a capacity of 25 tons per hour
-Stack and reclaim capacity of 200 tons per hour

Rail
-Rail facility capable of handling 10,000 tons per month

TABLE B-5

COMMODITY PROJECTIONS
U.S. NORTH ATLANTIC EXPORTS OF CONTAINERS TO BERMUDA
GROWTH FOR FIRST 20 YEARS OF PROJECT LIFE (TO YEAR 2014) AT 4.7%/YEAR

TOTAL MARKET: U.S. NORTH ATLANTIC				SALEM:		
YEAR	DRI/TBS CONTAINER S.T.	DRI/TBS CONTAINER TEUS	TONS PER TEU	CONTAINER TONS	CONTAINER TEUS	TONS PER TEU
1991	90,080	10,711 1]	8.41 2]	25,761 2]	3,062 2]	8.41 2]
1992	94,313	11,214	8.41	29,709	3,533	8.41
1993	98,746	11,741	8.41	33,969	4,039	8.41
1994	103,387	12,293	8.41	38,460	4,573	8.41
1995	108,246	12,871	8.41	43,298	5,148	8.41
1996	113,334	13,476	8.41	45,334	5,390	8.41
1997	118,660	14,109	8.41	47,464	5,644	8.41
1998	124,238	14,773	8.41	49,695	5,909	8.41
1999	130,077	15,467	8.41	52,031	6,187	8.41
2000	136,190	16,194	8.41	54,476	6,478	8.41
2001	142,591	16,955	8.41	57,036	6,782	8.41
2002	149,293	17,752	8.41	59,717	7,101	8.41
2003	156,310	18,586	8.41	62,524	7,434	8.41
2004	163,656	19,460	8.41	65,463	7,784	8.41
2005	171,348	20,374	8.41	68,539	8,150	8.41
2006	179,402	21,332	8.41	71,761	8,533	8.41
2007	187,833	22,335	8.41	75,133	8,934	8.41
2008	196,662	23,384	8.41	78,665	9,354	8.41
2009	205,905	24,483	8.41	82,362	9,793	8.41
2010	215,582	25,634	8.41	86,233	10,254	8.41
2011	225,715	26,839	8.41	90,286	10,736	8.41
2012	236,323	28,100	8.41	94,529	11,240	8.41
2013	247,430	29,421	8.41	98,972	11,768	8.41
2014	259,060	30,804	8.41	103,624	12,322	8.41
2015-2044	259,060	30,804	8.41	103,624	12,322	8.41
			AVG ANN TONS	67,200		

1] SOURCE: VOIGT MARITIME
2] SOURCE: MID-ATLANTIC

In 1989, as noted above, Salem had an approximate 20% share of the total U.S. North Atlantic market. However, Salem's market share increased to 21.2% for the full year of 1990, with the market share in the second half of 1990 rising to 24.4%. Also, in late 1990, Lloyd Bermuda, one of the two North Atlantic competitors to the Mid-Atlantic/BISL/Voigt operation, ceased operations. The Mid-Atlantic market share has continued to increase, reaching 28.7% for 1991.

By 1995, Mid-Atlantic is projected by the shipping agent, Voigt, to completely split the 25% market share vacated by Lloyd Bermuda with its one remaining competitor, Bermuda Container Lines (BCL), which operates out of the port of New York, and reach a 40% market share. This projection developed by Voigt is based on the reasonable expectation of Mid-Atlantic being able to capture half of the open market share as well as in-depth knowledge of the promising market conditions for the Bermuda market. The competitor operation, BCL, taking a naturally more conservative view of the growth potential for a competitor than Voigt, expects Mid-Atlantic's market share to remain at the 1991 level in the future. However, BCL did admit to the potential for Mid-Atlantic to show additional market share growth and capture as much as 32 percent of the total North Atlantic trade to Bermuda. The figures on Table B-5 reflect TEU projections using the projected market share, converted to short tons using an average of 8.41 tons per TEU (average per TEU from 1991 data). The DRI 4.7% per annum growth rate has been used to forecast Salem's TEUs which were then converted to tonnage using the aforementioned 8.41 tons per TEU. Average annual tonnage for this commodity and trade route is equal to 67,200 tons.

Container Exports to the Azores. For the computation of benefits, the tonnage will be held constant over the project life at the existing contracted tonnage per year level of 12,500. Tonnage growth is possible but uncertain at this point, so it has not been incorporated into the benefit analysis.

Bulk Movements. Average bulk tonnage per year through the port of Salem in 1989-1991 was equal to 16,400 tons. The major commodity moved was wastepaper to the Caribbean and Central America. Also important were cocoa butter from Central America, and cement blocks and construction equipment to the Caribbean. Growth in tonnage, applying OBERS, will be at 2% per annum (held constant after year 20 of the project life). The OBERS projections for the region from the U.S. Dept. of Commerce, Bureau of Economic Analysis, 1985 OBERS Projections, Volume 2, "Metropolitan Statistical Area Projections to 2035", were applied. The most narrowly defined level of economic activity and population, the Wilmington, DE-NJ-MD PMSA, which includes Salem County, NJ, was used. Application of a linkage of bulk commodities with OBERS growth in personal income was utilized. This decision was made because total personal income was considered a reasonable indicator of bulk commodity growth at

Salem. The bulk commodities moving through Salem are indirect goods that will ultimately be converted into consumer goods. Economic theory holds that consumption is a function of income. Thus, using personal income should give a reasonable indicator of growth for bulk commodities moving through Salem. Average annual bulk tonnage is equal to 21,500 tons.

Summary. Commodity projections are anticipated to be the same for the without and with project condition channel depths. The port plans for additional berths to be available by the project base year will significantly increase the port's annual throughput capacity and assure that the growth in tonnage can be handled by the port users. In order to independently assess the level of potential future commodity movements, two ports located on the east coast of the U.S. with 24-foot channel depths were contacted (Port Royal, SC, and Richmond, VA). Discussions with representatives from both ports indicated that they are more heavily oriented towards bulk cargo than Salem is anticipated to be. However, the annual tonnage of these ports did provide excellent assurance on the potential for future tonnage that is projected to pass through the port of Salem. For example, Port Royal, in operation for four years, has already handled an average of 150,000 tons per year. Also, average annual tonnage through the port of Richmond for the last four years was 2.5 million tons. By comparison, total average annual tonnage through the port of Salem (container and bulk) is projected to be 101,200 tons.

The analysis of commodity projections for Salem was based only on existing commodities (with relevant trade routes) that have moved through the port historically. As stated, the commodity projections will be the same for all depths. No new commodities or diversions are included in the quantification of benefits, although a list of potential additional commodities were identified in the economic investigation and are discussed in the Risk and Uncertainty Analysis section of this economic appendix. There will not be a throughput capacity constraint over the project life. This was determined by comparing projected tonnage to the capability of the port to handle this amount of tonnage over the project life.

WITH PROJECT CONDITION

The project improvements studied consist of MLW channel depths of 14 feet, 16 feet, 18 feet, 20 feet, 22 feet, and 24 feet, with interpolation for one-foot increments as necessary. This range was selected to bracket the optimum channel depth. The with-project condition designed channel width will be sufficient to fully accomodate one-way ship traffic for the projected design vessels. The turning basin will also be enlarged as required to handle the dimensions of the design vessels. Berth depths will be sufficiently deeper than the channel depth to assure no constraint on vessel loading and unloading because of the tidal range. Commodity projections will be the same as for the 12 foot (MLW) without project condition channel depth.

The benefits from the proposed with project condition alternatives are defined as the transportation cost savings that would result primarily because of the following factors with a deeper channel:

-Ships will be loaded more fully, thus spreading costs over a larger load

-Cost savings will be achieved since larger ships offer economies of scale in shipping costs

The only benefits claimed for the proposed project are savings in transportation costs based on the assumption that with and without project condition tonnage moving through Salem are the same. Benefits are not claimed for savings in labor costs. The savings in labor costs by using non-union labor is reflected in the without project condition and is assumed to be the same under future with and without project conditions. No benefits for tonnage diverted from other ports is claimed. The largest vessel size anticipated to use the project is 5000 DWT.

FLEET CHARACTERISTICS, COSTS AND OPERATIONS

Overview. A fleet is influenced by many factors. The criteria for selecting ship sizes include the volume of trade, distance of transport, controlling depths at both the loading and discharge ports, and cargo handling and storage facilities. Generally, the most efficient vessel size for any trade route tends to be one of the largest, if not the largest, ship that can be accomodated on that route. So, as the Salem River is deepened, a shift to a larger chartered vessel size is projected in order to take advantage of cost efficiencies provided by the deeper navigational channel. The selected vessel size per channel depth was based on transportation costs per ton as a criteria.

As the channel becomes deeper, commodities would move by larger vessels. This assumption for the channel deepening is based on traditional navigational vessel operating decisions. As stated in Step 5 of ER 1105-2-100, Chapter 6, Section 7, "Transportation costs with a plan should reflect any efficiencies that can be reasonably expected such as use of larger vessels, increased load reductions in transit time and delays, etc."

The primary sources for vessel information included the two companies operating facilities on the Salem River, the Corps' Institute for Water Resources (and its consultant from the University of Michigan, whose position paper is described below), DRI/McGraw-Hill, Port of Salem officials, and the pilots association. Additional sources of information included shipping companies and ship brokers using the port of Salem. The fleet distributions will not shift over the project life.

Position Paper. The following presents a summary of the position paper, An Evaluation of Vessel Characteristics and Operations for Salem River, NJ Navigation Project, developed for the Philadelphia District by Dr. A.N. Perakis, Associate Professor, Department of Naval Architecture and Marine Engineering, University of Michigan. Dr. Perakis was recommended as a consultant by the Institute for

Water Resources (IWR) based on the success of the August 1991 report that Dr. Perakis developed for that Corps office, An Evaluation of the Institute for Water Resources Vessel Cost Estimation Procedures.

The position paper developed technical and cost data for eight vessel classes (1500, 2500, 3000, 3500, 4000, 4500, 5000, and 6000 DWT) for foreign flag and U.S. flag containerships. The IWR annual vessel data on ship costs and characteristics covers a wide range of ship sizes, but unfortunately, no information is provided for container vessels of less than 12,000 DWT, (which covers all current and future vessel use of the Salem River project).

Dr. Perakis used two major sources to develop the position paper: 1) the FY 1992 IWR data developed for vessels greater than 12,000 DWT, and 2) the Fairplay computerized world shipping database (1989 edition). The relevant vessels in the latter source were analyzed to obtain dimension, fuel cost, and newbuilding price information. Fairplay had two large general cargo files (each with more than 2000 vessels) and a smaller containership file. Dr. Perakis developed the database as follows: 1) each general cargo file was separated into vessels with and without container carrying capability, and 2) the original container file was combined with the two general cargo files with container capability to finalize the overall container vessel file.

The resulting large file was then separated into eight groups corresponding to the DWT classes of interest for Salem River. For example, the first group considered containerships from 1000-2000 DWT (centered at 1500 DWT), the second from 2250-2750 DWT (focusing on 2500 DWT), etc, to the eighth and last from 5500-6500 DWT (keyed to the 6000 DWT vessel class). Statistical analyses were then performed for each group, deleting obvious outliers and developing average values for dimensions, newbuilding price, horsepower, and fuel consumption data, etc. The results were not always smooth functions of DWT, hence, smoothed values via regression were developed. Finally, Dr. Perakis applied a new formula for the TPI immersion factor, which in the opinion of his colleagues at the University of Michigan who specialize in ship design, gives superior results to the U.S. Maritime Administration-provided formula used to date by IWR.

Regarding future trends in the small containership category, no major changes in the technical characteristics of ships are anticipated by Dr. Perakis. Fuel efficiency of new vessel power plants could be somewhat better as compared to current average fleet fuel consumption. Speeds could go up or down by small amounts as oil prices fluctuate.

Tables B-6 and B-7 present estimated foreign flag and U.S. flag container ship data, using regression analysis, for the vessel sizes pertinent to the Salem River navigation project. This data was applied in the transportation cost analyses for the Bermuda and Azores trade routes. The two tables follow the presentation format used by IWR in its development of annual vessel operating costs and characteristics for larger vessel classes.

TABLE B-6

ESTIMATED FOREIGN FLAG CONTAINER SHIP OPERATING COSTS

TEU		92	130	148	167	185	204	223	260
DWT		1,500	2,500	3,000	3,500	4,000	4,500	5,000	6,000
Machinery		Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Replacement Cost-1991		$8,431,199	$9,197,738	$9,581,007	$9,964,276	$10,347,545	$10,730,814	$11,114,083	$11,880,622
CFR *** 20 yrs	0.105671								
Fixed Annual Capital Costs		$890,933	$971,934	$1,012,435	$1,052,935	$1,093,435	$1,133,936	$1,174,436	$1,255,437
Wages, Benefits, and Subsistence		$705,151	$720,938	$728,832	$736,725	$744,619	$752,512	$760,406	$776,193
Stores and Supplies		$104,326	$112,460	$116,527	$120,594	$124,661	$128,728	$132,796	$140,930
Maintenance and Repair		$35,665	$59,317	$71,142	$82,968	$94,794	$106,619	$118,445	$142,096
Insurance		$134,130	$142,319	$146,413	$150,508	$154,602	$158,696	$162,791	$170,980
Other		$16,677	$27,796	$33,355	$38,914	$44,473	$50,032	$55,591	$66,710
Administration		$248,987	$265,707	$274,067	$282,427	$290,787	$299,147	$307,507	$324,227
Fixed Annual Operating Costs		$1,244,937	$1,328,537	$1,370,337	$1,412,136	$1,453,936	$1,495,736	$1,537,536	$1,621,135
Total Annual Fixed Costs		$2,135,870	$2,300,471	$2,382,771	$2,465,071	$2,547,372	$2,629,672	$2,711,972	$2,876,573
Total Daily Fixed Costs (350 days)		$6,102	$6,573	$6,808	$7,043	$7,278	$7,513	$7,748	$8,219
Daily Fuel Costs									
At Sea		$1,200	$1,379	$1,469	$1,558	$1,648	$1,738	$1,827	$2,007
In Port		$313	$323	$328	$333	$338	$343	$348	$358
Daily Total Cost									
At Sea		$7,302	$7,952	$8,277	$8,601	$8,926	$9,251	$9,576	$10,225
In Port		$6,668	$7,139	$7,374	$7,609	$7,845	$8,080	$8,315	$8,786
Hourly Cost (24 hrs/day)									
At Sea		$304	$331	$345	$358	$372	$385	$399	$426
In Port		$278	$297	$307	$317	$327	$337	$346	$366
Ship Characteristics - Regressed									
Crew									
LBP (FT)		239	256	265	274	282	291	300	317
Beam (FT)		39.2	43.1	45.0	47.0	48.9	50.9	52.8	56.7
Draft (FT)		13.1	15.0	16.0	17.0	18.0	18.9	19.9	21.9
Block Coefficient		0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.64
Immersion Factor (TPI)		17.2	20.7	22.5	24.2	25.9	27.7	29.4	32.9
Horsepower		1957	2770	3177	3584	3991	4398	4804	5618
Speed		11.8	12.4	12.6	12.9	13.2	13.5	13.7	14.3
Fuel Consumption (Tons/day)									
At Sea (FO/MDO)		8.3	9.9	10.7	11.5	12.2	13.0	13.8	15.4
In Port (FO/MDO)		1.4	1.5	1.5	1.5	1.6	1.6	1.6	1.7

TABLE 8-7

ESTIMATED US FLAG CONTAINER SHIP OPERATING COSTS - DOMESTIC TRADE

TEU		92	130	148	167	185	204	223	260
DWT		1,500	2,500	3,000	3,500	4,000	4,500	5,000	6,000
Machinery		Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Replacement Cost-1991		$32,284,230	$34,482,904	$35,599,474	$36,726,979	$37,865,010	$39,013,168	$40,171,059	$42,514,498
CFR *** 20 yrs	0.105671								
Fixed Annual Capital Costs		$3,411,507	$3,643,843	$3,761,832	$3,880,977	$4,001,234	$4,122,561	$4,244,916	$4,492,549
Wages, Benefits, and Subsistence		$2,629,795	$2,653,525	$2,665,390	$2,677,255	$2,689,120	$2,700,985	$2,712,850	$2,736,580
Stores and Supplies		$182,576	$186,401	$188,313	$190,225	$192,137	$194,049	$195,961	$199,785
Maintenance and Repair		$97,484	$118,595	$129,150	$139,706	$150,261	$160,817	$171,373	$192,484
Insurance		$792,916	$802,674	$807,553	$812,431	$817,310	$822,189	$827,068	$836,825
Other		$68,920	$109,195	$127,750	$145,299	$161,881	$177,533	$192,290	$219,263
Administration		$565,754	$580,558	$587,723	$594,737	$601,606	$608,336	$614,931	$627,741
Fixed Annual Operating Costs		$4,337,445	$4,450,948	$4,505,878	$4,559,653	$4,612,316	$4,663,908	$4,714,472	$4,812,678
Total Annual Fixed Costs		$7,748,952	$8,094,791	$8,267,710	$8,440,630	$8,613,549	$8,786,469	$8,959,388	$9,305,227
Total Daily Fixed Costs (350 days)		$22,140	$23,128	$23,622	$24,116	$24,610	$25,104	$25,598	$26,586
Daily Fuel Costs									
At Sea		$1,200	$1,379	$1,469	$1,558	$1,648	$1,738	$1,827	$2,007
In Port		$313	$323	$328	$333	$338	$343	$348	$358
Daily Total Cost									
At Sea		$23,340	$24,507	$25,091	$25,674	$26,258	$26,842	$27,426	$28,593
In Port		$22,439	$23,444	$23,947	$24,449	$24,951	$25,454	$25,956	$26,961
Hourly Cost (24 hrs/day)									
At Sea		$972	$1,021	$1,045	$1,070	$1,094	$1,118	$1,143	$1,191
In Port		$935	$977	$998	$1,019	$1,040	$1,061	$1,082	$1,123
Ship Characteristics - Regressed									
Crew									
LBP (FT)		239	256	265	274	282	291	300	317
Beam (FT)		39.2	43.1	45.0	47.0	48.9	50.9	52.8	56.7
Draft (FT)		13.1	15.0	16.0	17.0	18.0	18.9	19.9	21.9
Block Coefficient		0.66	0.66	0.66	0.65	0.65	0.65	0.65	0.64
Immersion Factor (TPI)		17.2	20.7	22.5	24.2	25.9	27.7	29.4	32.9
Horsepower		1957	2770	3177	3584	3991	4398	4804	5618
Speed		11.8	12.4	12.6	12.9	13.2	13.5	13.7	14.3
Fuel Consumption (Tons/day)									
At Sea (FO/MDO)		8.3	9.9	10.7	11.5	12.2	13.0	13.8	15.4
In Port (FO/MDO)		1.4	1.5	1.5	1.5	1.6	1.6	1.6	1.7

TRANSPORTATION COST AND SAVINGS ESTIMATION

Container Benefits: Exports to Bermuda. A transportation cost model was developed to analyze the actual operating practices of outbound container vessels to Bermuda (determined from the sailing drafts recorded in the Salem River pilot logs for the last fully available calendar year, 1991). Vessel movements on this trade route are port to port. The current Foreign Flag container vessel used on this trade route is the "Bermuda Islander", with a design draft of 16.33 feet, design deadweight tonnage of 2650 short tons, length of 262 feet, and beam of 43 feet. Using 1991 data, 49% of vessel movements have operated making full channel use, 32% have operated 1.5 feet lightloaded, and 19% have operated 2.5 feet lightloaded. The transportation cost model adjusted the design draft of lightloaded vessels to analyze the constraint of actual vessel operating practice versus channel depth on the cost of tonnage being moved. Thus, for example, 1.5 feet of lightloading is equivalent to a 1.5 foot reduction of vessel design draft, or a 1.5 foot operational constraint in the transportation cost model.

Table B-8 presents the transportation cost model for the unconstrained movements. Vessel classes are estimated to load to 65.1% of the design TEU carrying capacity (including TEU box weight) applying the average per trip for 1991 for the "Bermuda Islander" . This percentage nets out carrying capacity tonnage that must be allocated for ballast, fuel, freshwater tanks, stores, and crew. Based on historical movements, the average weight per container box is estimated to be three tons, and the average cargo carried per box equal to a weight of 8.41 tons. Taken together, the 65.1% cargo capacity utilization and the cargo weight per box determine the cargo tonnage on board for given drafts.

Vessel classes analyzed in the benefit analysis range from 1500 DWT to 5000 DWT.

' LOADED VESSEL OPERATING PRACTICE F:VCTPFF2 TABLE B-8

APPLYING DR. PERAKIS (UNIV. OF MICHIGAN NAVAL ARCHITECTURE) POSITION PAPER FOR VESSEL DATA

TRANSPORTATION COST MODEL

SALEM RIVER

65.1% CARRYING CAPACITY APPLIED BASED ON 1991 USAGE OF BERMUDA ISLANDER

Foreign Flag Container Vessels:

VESSEL/CHANNEL CHARACTERISTICS	VESSEL CLASSES:						
Design Deadweight Tonnage (tonnes)	1500	2500	3000	3500	4000	4500	5000
Vessel Carried Tonnage Capacity (S.T.)	1076	1794	2153	2512	2870	3229	3588
Design Draft	13.1	15.0	16.0	17.0	18.0	18.9	19.9
Immersion Factor (Tonnes/Inch)	17.2	20.7	22.5	24.2	25.9	27.7	29.4
Tidal Allowance	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Required Keel Clearance	2	2	2	2	2	2	2
Required Channel Depth	15.1	17	18	19	20	20.9	21.9
Shut Out Tonnage to Port (By Depth)							
12	0	0	97	313	558	811	1114
14	0	0	0	0	112	334	608
16	0	0	0	0	0	0	101
18	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
Cargo Tonnage (S.T.)-Net Box Wgt							
12	793	1322	1515	1621	1705	1782	1824
14	793	1322	1587	1851	2033	2134	2197
16	793	1322	1587	1851	2116	2380	2570
18	793	1322	1587	1851	2116	2380	2645
20	793	1322	1587	1851	2116	2380	2645
22	793	1322	1587	1851	2116	2380	2645
24	793	1322	1587	1851	2116	2380	2645
OCEAN VOYAGE PARAMETERS							
Cruising Speed (Statute MPH)	13.6	14.3	14.5	14.8	15.2	15.5	15.8
Cruising Speed (Nautical MPH)	11.8	12.4	12.6	12.9	13.2	13.5	13.7
Hourly Operating Cost at Sea	$304	$331	$345	$358	$372	$385	$399
CARGO TRANSFER COSTS							
In-Port							
In-Port Waiting Hours	9	9	9	9	9	9	9
In-Port Transfer Hours	11	18	21	25	28	32	35
Hourly In-Port Operating Cost	$278	$297	$307	$317	$327	$337	$346
In-Port Cargo Transfer Cost	$2,941	$5,236	$6,495	$7,825	$9,224	$10,695	$12,200
In-Port Waiting Time Cost	$2,502	$2,673	$2,763	$2,853	$2,943	$3,033	$3,114
Dockage							
Vessel Length	239	256	265	274	282	291	300
24 Hour Dockage Fee	$478	$512	$530	$548	$564	$582	$600
Days in Port (Rounded)	1	1	1	1	1	1	1
Dockage Costs	$478	$512	$530	$548	$564	$582	$600
Wharfage Fee per Net Ton	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
Wharfage Costs							
12	$992	$1,653	$1,894	$2,026	$2,131	$2,228	$2,279

TABLE B-8 (CONT.)

14	$992	$1,653	$1,983	$2,314	$2,542	$2,668	$2,746
16	$992	$1,653	$1,983	$2,314	$2,645	$2,975	$3,212
18	$992	$1,653	$1,983	$2,314	$2,645	$2,975	$3,306
20	$992	$1,653	$1,983	$2,314	$2,645	$2,975	$3,306
22	$992	$1,653	$1,983	$2,314	$2,645	$2,975	$3,306
24	$992	$1,653	$1,983	$2,314	$2,645	$2,975	$3,306
Total In-Port Costs							
12	$6,913	$10,074	$11,682	$13,252	$14,862	$16,538	$18,194
14	$6,913	$10,074	$11,772	$13,540	$15,273	$16,977	$18,660
16	$6,913	$10,074	$11,772	$13,540	$15,376	$17,285	$19,127
18	$6,913	$10,074	$11,772	$13,540	$15,376	$17,285	$19,220
20	$6,913	$10,074	$11,772	$13,540	$15,376	$17,285	$19,220
22	$6,913	$10,074	$11,772	$13,540	$15,376	$17,285	$19,220
24	$6,913	$10,074	$11,772	$13,540	$15,376	$17,285	$19,220
In-Port Travel Costs							
Tidal Delays							
Avg. Hrs. of Maximum Tidal Delay	6	6	6	6	6	6	6
Avg. Feet of Tidal Delay Per Depth							
12	3.1	5.0	5.5	5.5	5.5	5.5	5.5
14	1.1	3.0	4.0	5.0	5.5	5.5	5.5
16	0.0	1.0	2.0	3.0	4.0	4.9	5.5
18	0.0	0.0	0.0	1.0	2.0	2.9	3.9
20	0.0	0.0	0.0	0.0	0.0	0.9	1.9
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Avg. Hrs. of Tidal Delay Per Depth							
12	3.20	4.90	6.00	6.00	6.00	6.00	6.00
14	1.60	3.10	3.90	4.90	6.00	6.00	6.00
16	0.00	1.50	2.30	3.10	3.90	4.80	6.00
18	0.00	0.00	0.00	1.50	2.25	3.00	3.80
20	0.00	0.00	0.00	0.00	0.00	1.40	2.10
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Delay for Tide:							
Operating Cost at Sea	$304	$331	$345	$358	$372	$385	$399
Operating Cost at Port	$278	$297	$307	$317	$327	$337	$346
Tidal Delay Costs							
12	$890	$1,455	$1,842	$1,902	$1,962	$2,022	$2,076
14	$445	$921	$1,197	$1,553	$1,962	$2,022	$2,076
16	$0	$446	$706	$983	$1,275	$1,618	$2,076
18	$0	$0	$0	$476	$736	$1,011	$1,315
20	$0	$0	$0	$0	$0	$472	$727
22	$0	$0	$0	$0	$0	$0	$0
24	$0	$0	$0	$0	$0	$0	$0
Pilotage							
Vessel Length	239	256	265	274	282	291	300
Vessel Beam	39	43	45	47	49	51	53
Vessel Draft	13.1	15	16	17	18	18.9	19.9
Pilotage Units	93.21	110.08	119.25	128.78	138.18	148.41	159
Delaware River Pilot Fee	$1,230	$1,453	$1,574	$1,700	$1,824	$1,959	$2,099

Tug Costs

TABLE B-8 (CONT.)

Number of Tugs Used	1	1	1	1	1	1	1
Tug Rate	$650	$650	$650	$650	$650	$650	$650
Tug Costs	$650	$650	$650	$650	$650	$650	$650
In-Port & Cargo Transfer Costs							
12	$9,683	$13,633	$15,748	$17,503	$19,298	$21,169	$23,019
14	$9,238	$13,098	$15,193	$17,443	$19,709	$21,608	$23,485
16	$8,793	$12,623	$14,702	$16,872	$19,125	$21,512	$23,952
18	$8,793	$12,177	$13,996	$16,365	$18,586	$20,905	$23,284
20	$8,793	$12,177	$13,996	$15,889	$17,850	$20,366	$22,696
22	$8,793	$12,177	$13,996	$15,889	$17,850	$19,894	$21,969
24	$8,793	$12,177	$13,996	$15,889	$17,850	$19,894	$21,969

TOTAL COST AND COST PER NET CARGO TON BY TRADE ROUTE:

Bermuda

Total Cost:	12' Channel Depth	$55,742	$64,956	$70,159	$74,193	$78,389	$82,606	$87,161
	14' Channel Depth	$54,852	$63,887	$69,048	$74,071	$79,211	$83,485	$88,094
	16' Channel Depth	$53,963	$62,937	$68,066	$72,930	$78,043	$83,291	$89,027
	18' Channel Depth	$53,963	$62,046	$66,653	$71,916	$76,964	$82,078	$87,691
	20' Channel Depth	$53,963	$62,046	$66,653	$70,965	$75,493	$81,000	$86,514
	22' Channel Depth	$53,963	$62,046	$66,653	$70,965	$75,493	$80,056	$85,061
	24' Channel Depth	$53,963	$62,046	$66,653	$70,965	$75,493	$80,056	$85,061
Cost Per Ton:	12' Channel Depth	$70.26	$49.12	$46.30	$45.77	$45.98	$46.35	$47.80
	14' Channel Depth	$69.14	$48.32	$43.51	$40.01	$38.95	$39.12	$40.10
	16' Channel Depth	$68.02	$47.60	$42.90	$39.40	$36.89	$34.99	$34.64
	18' Channel Depth	$68.02	$46.92	$42.01	$38.85	$36.38	$34.48	$33.16
	20' Channel Depth	$68.02	$46.92	$42.01	$38.33	$35.68	$34.03	$32.71
	22' Channel Depth	$68.02	$46.92	$42.01	$38.33	$35.68	$33.63	$32.16
	24' Channel Depth	$68.02	$46.92	$42.01	$38.33	$35.68	$33.63	$32.16

Distances to Ports-Nautical Miles

Bermuda 706

The tidal allowance is 5.5 feet with required underkeel clearance of 2 feet. Shut-out tonnage is determined by netting out constrained tonnage (based on the immersion factor) from the available channel depth in comparison to the average vessel carrying capacity utilization of 65.1%. Cargo tonnage carried nets out from the calculation the weight of the TEU boxes that hold the commerce. Cruising speeds (in knots) used were provided by IWR's contractor. Loading, dockage, wharfage, and tug costs are based on coordination with representatives of the Salem River facility. Operating costs at sea and in port applied a regression model developed by IWR's contractor. Tidal delays are defined based on the channel depth, vessel characteristics, range of tide, and underkeel clearance. Pilotage costs, obtained from coordination with the local pilots, are calculated applying vessel design characteristics for length, beam, and draft. The round trip trade route distance was taken from the publication, Distances Between Ports (Dept. of the Navy). Total transportation costs are a summation of the total costs for a round-trip movement. Backhauling is a very insignificant part of the operations for this trade route. Ships to Bermuda are not always loaded to cubic capacity. Transportation costs per ton are determined by dividing total transportation costs by the amount of tons carried for each channel depth and vessel class. Total trip costs from the model appear reasonable when compared to revenues per box obtained from the shipping line on the Bermuda trade route. The tariff rate assessed by the shipping line averages $1700 per box, which translates into total revenues for an average 1991 trip of $110,700. The transportation cost model estimated a combination of water transport and port costs of approximately $65,000 for this vessel size for the current 12 foot channel.

The transportation savings model for unconstrained vessels, Table B-9, incorporated the cost per ton data from Table B-8, the most efficient chartered vessel size by channel depth, and the commodity projections from Table B-5. Average annual cumulative transportation savings, by channel depth, are displayed in the last row of the table.

Tables B-10 and B-11 represent comparable transportation cost models to Table B-8. The impact of 1.5 and 2.5 foot constraints on actual operating practice have been incorporated into these models. The greater the constraint, the less tonnage that is carried per channel depth.

Tables B-12 and B-13 are comparable transportation savings models to Table B-9. However, the transportation costs per ton and selected vessel class per depth differ in order to incorporate the shift in operational cost efficiencies between vessel classes due to the actual operating practice constraints.

Container Benefits: Exports to the Azores. A similar transportation cost model was developed to analyze the actual operating practice (based on the 1991 Salem River pilots logs) of outbound U.S. Flag container vessels to the Azores. The current vessel used on this trade route is the "Rainbow Hope", with a

SALEM RIVER TABLE B-9 F:TSTPFF2

TOTAL TRANSPORTATION SAVINGS DISCOUNT RATE= 8.5% PRICE LEVEL= MARCH 1992

TRADE ROUTE: CONTAINERS-BERMUDA

FULLY LOADED VESSELS, MOST EFFICIENT CHARTER VESSEL SIZE PER CHANNEL DEPTH

APPLYING HISTORIC TONNAGE AND COMMODITY PROJECTIONS F:DRIDBA4A

	12 FEET:		12 FEET:		14 FEET:	% OF	
		PCT.	AVG	TOTAL	AVG	TOTAL FLEET	TOTAL
DESDWT		OF FLEET	$/TON	TRANS COSTS	$/TON	$/TON	TRANS COSTS
1,500		0.0%	$70.26	$0	$69.14	0.00%	$0
2,500		0.0%	$49.12	$0	$48.32	0.00%	$0
3,000		0.0%	$46.30	$0	$43.51	0.00%	$0
3,500		100.0%	$45.77	$1,179,081	$40.01	0.00%	$0
4,000		0.0%	$45.98	$0	$38.95	100.00%	$1,003,391
4,500		0.0%	$46.35	$0	$39.12	0.00%	$0
5,000		0.0%	$47.80	$0	$40.10	0.00%	$0
TOTAL SHORT TONS (1991) 1]	25,761	100.0%				100.0%	
				$1,179,081			$1,003,391
CUMULATIVE SAVINGS							$175,690

1] SOURCE: MID-ATLANTIC SHIPPING CORP

TABLE B-9 (CONT.)

16 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$68.02	0.00%	$0
$47.60	0.00%	$0
$42.90	0.00%	$0
$39.40	0.00%	$0
$36.89	0.00%	$0
$34.99	0.00%	$0
$34.64	100.00%	$892,361
	100.0%	
		$892,361
		$286,720

18 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$68.02	0.00%	$0
$46.92	0.00%	$0
$42.01	0.00%	$0
$38.85	0.00%	$0
$36.38	0.00%	$0
$34.48	0.00%	$0
$33.16	100.00%	$854,235
	100.0%	
		$854,235
		$324,846

20 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$68.02	0.00%	$0
$46.92	0.00%	$0
$42.01	0.00%	$0
$38.33	0.00%	$0
$35.68	0.00%	$0
$34.03	0.00%	$0
$32.71	100.00%	$842,642
	100.0%	
		$842,642
		$336,439

TABLE B-9 (CONT.)

22 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$68.02	0.00%	$0
$46.92	0.00%	$0
$42.01	0.00%	$0
$38.33	0.00%	$0
$35.68	0.00%	$0
$33.63	0.00%	$0
$32.16	100.00%	$828,474
	100.0%	
		$828,474
		$350,607

24 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$68.02	0.00%	$0
$46.92	0.00%	$0
$42.01	0.00%	$0
$38.33	0.00%	$0
$35.68	0.00%	$0
$33.63	0.00%	$0
$32.16	100.00%	$828,474
		$828,474
		$350,607

TABLE B-9 (CONT.)

PREDICTED TONNAGE:		PERIOD	AVG ANN GROWTH/YR FOR PERIOD
1991	25,761		
1994	38,460	1991-1994	14.29%
2001	57,036	1994-2001	5.79%
2011	90,286	2001-2011	4.70%
2014	103,624	2011-2014	4.70%
2031	103,624	2014-2031	0.00%
2044	103,624	2031-2044	0.00%

YEAR	CUMULATIVE TRANS COSTS 12 FT	SPPW,8 1/2%	PRESENT WORTH TRANS COSTS 12 FT	PRESENT WORTH TRANS COSTS 14 FT	PRESENT WORTH TRANS COSTS 16 FT	PRESENT WORTH TRANS COSTS 18 FT	PRESENT WORTH TRANS COSTS 20 FT	PRESENT WORTH TRANS COSTS 22 FT	PRESENT WORTH TRANS COSTS 24 FT
1994	$1,760,314	1.00000	$1,760,314	$1,498,017	$1,332,254	$1,275,334	$1,258,027	$1,236,874	$1,236,874
1995	$1,862,236	0.92166	$1,716,347	$1,460,601	$1,298,979	$1,243,480	$1,226,605	$1,205,980	$1,205,980
1996	$1,970,060	0.84946	$1,673,478	$1,424,120	$1,266,534	$1,212,421	$1,195,968	$1,175,859	$1,175,859
1997	$2,084,126	0.78291	$1,631,679	$1,388,550	$1,234,900	$1,182,139	$1,166,096	$1,146,489	$1,146,489
1998	$2,204,797	0.72157	$1,590,925	$1,353,868	$1,204,056	$1,152,612	$1,136,971	$1,117,853	$1,117,853
1999	$2,332,455	0.66505	$1,551,189	$1,320,052	$1,173,982	$1,123,824	$1,108,573	$1,089,933	$1,089,933
2000	$2,467,504	0.61295	$1,512,445	$1,287,081	$1,144,660	$1,095,754	$1,080,884	$1,062,710	$1,062,710
2001	$2,610,373	0.56493	$1,474,668	$1,254,934	$1,116,070	$1,068,385	$1,053,887	$1,036,166	$1,036,166
2002	$2,761,513	0.52067	$1,437,836	$1,223,590	$1,088,194	$1,041,700	$1,027,564	$1,010,286	$1,010,286
2003	$2,921,405	0.47988	$1,401,923	$1,193,028	$1,061,014	$1,015,682	$1,001,899	$985,052	$985,052
2004	$2,610,538	0.44229	$1,154,603	$982,560	$873,835	$836,500	$825,149	$811,274	$811,274
2005	$2,733,233	0.40764	$1,114,165	$948,148	$843,231	$807,204	$796,249	$782,861	$782,861
2006	$2,861,695	0.37570	$1,075,144	$914,941	$813,698	$778,933	$768,362	$755,443	$755,443
2007	$2,996,195	0.34627	$1,037,489	$882,897	$785,200	$751,652	$741,452	$728,985	$728,985
2008	$3,137,016	0.31914	$1,001,153	$851,975	$757,700	$725,327	$715,484	$703,454	$703,454
2009	$3,284,455	0.29414	$966,089	$822,136	$731,163	$699,924	$690,426	$678,817	$678,817
2010	$3,438,825	0.27110	$932,254	$793,343	$705,556	$675,411	$666,245	$655,042	$655,042
2011	$3,600,450	0.24986	$899,604	$765,557	$680,845	$651,756	$642,911	$632,101	$632,101
2012	$3,769,671	0.23028	$868,097	$738,745	$657,000	$628,929	$620,394	$609,963	$609,963
2013	$3,946,845	0.21224	$837,693	$712,872	$633,989	$606,902	$598,666	$588,600	$588,600
2014	$4,132,347	0.19562	$808,355	$687,905	$611,785	$585,647	$577,699	$567,985	$567,985
2015	$4,132,347	0.18029	$745,027	$634,014	$563,857	$539,766	$532,442	$523,489	$523,489
2016	$4,132,347	0.16617	$686,661	$584,345	$519,684	$497,481	$490,730	$482,478	$482,478
2017	$4,132,347	0.15315	$632,868	$538,567	$478,972	$458,507	$452,285	$444,680	$444,680
2018	$4,132,347	0.14115	$583,288	$496,375	$441,448	$422,588	$416,853	$409,844	$409,844
2019	$4,132,347	0.13009	$537,593	$457,488	$40[illegible]65	$389,482	$384,196	$377,736	$377,736
2020	[illegible],132,347	0.11990	$495,477	$421,648	$37[illegible]1	$358,969	$354,098	$348,144	$348,144

TABLE B-9 (CONT.)

2021	$4,132,347	0.11051	$456,661	$388,616	$345,614	$330,847	$326,357	$320,870	$320,870
2022	$4,132,347	0.10185	$420,886	$358,171	$318,538	$304,928	$300,790	$295,733	$295,733
2023	$4,132,347	0.09387	$387,913	$330,112	$293,583	$281,040	$277,226	$272,565	$272,565
2024	$4,132,347	0.08652	$357,524	$304,250	$270,584	$259,023	$255,508	$251,212	$251,212
2025	$4,132,347	0.07974	$329,515	$280,415	$249,386	$238,731	$235,491	$231,531	$231,531
2026	$4,132,347	0.07349	$303,700	$258,447	$229,849	$220,028	$217,043	$213,393	$213,393
2027	$4,132,347	0.06774	$279,908	$238,200	$211,842	$202,791	$200,039	$196,676	$196,676
2028	$4,132,347	0.06243	$257,980	$219,539	$195,246	$186,904	$184,368	$181,268	$181,268
2029	$4,132,347	0.05754	$237,769	$202,340	$179,950	$172,262	$169,924	$167,067	$167,067
2030	$4,132,347	0.05303	$219,142	$186,489	$165,853	$158,767	$156,612	$153,979	$153,979
2031	$4,132,347	0.04888	$201,974	$171,879	$152,860	$146,329	$144,343	$141,916	$141,916
2032	$4,132,347	0.04505	$186,152	$158,414	$140,885	$134,865	$133,035	$130,798	$130,798
2033	$4,132,347	0.04152	$171,568	$146,004	$129,848	$124,300	$122,613	$120,551	$120,551
2034	$4,132,347	0.03827	$158,127	$134,566	$119,675	$114,562	$113,007	$111,107	$111,107
2035	$4,132,347	0.03527	$145,740	$124,024	$110,300	$105,587	$104,154	$102,403	$102,403
2036	$4,132,347	0.03251	$134,322	$114,307	$101,659	$97,315	$95,995	$94,381	$94,381
2037	$4,132,347	0.02996	$123,799	$105,352	$93,695	$89,692	$88,474	$86,987	$86,987
2038	$4,132,347	0.02761	$114,101	$97,099	$86,355	$82,665	$81,543	$80,172	$80,172
2039	$4,132,347	0.02545	$105,162	$89,492	$79,589	$76,189	$75,155	$73,891	$73,891
2040	$4,132,347	0.02345	$96,923	$82,481	$73,354	$70,220	$69,267	$68,103	$68,103
2041	$4,132,347	0.02162	$89,330	$76,020	$67,608	$64,719	$63,841	$62,767	$62,767
2042	$4,132,347	0.01992	$82,332	$70,064	$62,311	$59,649	$58,840	$57,850	$57,850
2043	$4,132,347	0.01836	$75,882	$64,575	$57,430	$54,976	$54,230	$53,318	$53,318
2044	$4,132,347	0.01692	$69,937	$59,516	$52,931	$50,669	$49,982	$49,141	$49,141
CUMULATIVE PRES WORTH: TRANS COSTS			$40,156,689	$34,173,105	$30,391,691	$29,093,201	$28,698,389	$28,215,842	$28,215,842
CRF, 50 YRS			0.0864630	0.0864630	0.0864630	0.0864630	0.0864630	0.0864630	0.0864630
AVG ANN CUMULATIVE TRANS COSTS			$3,472,068	$2,954,709	$2,627,757	$2,515,485	$2,481,349	$2,439,626	$2,439,626
AVG ANN CUMULATIVE TRANS SAVINGS (MARCH 1992)				$517,359	$844,311	$956,582	$990,719	$1,032,441	$1,032,441
AVG ANN CUMULATIVE TRANS SAVINGS (APRIL 1990)				$482,095	$786,763	$891,382	$923,192	$962,070	$962,070

TABLE B-10 F:VCTPFF3

APPLYING DR. PERAKIS (UNIV. OF MICHIGAN NAVAL ARCHITECTURE) POSITION PAPER FOR VESSEL DATA

TRANSPORTATION COST MODEL

SALEM RIVER

65.1% CARRYING CAPACITY APPLIED BASED ON 1991 USAGE OF BERMUDA ISLANDER

ACTUAL OPERATING CAPACITY: 1.5 FT CONSTRAINT

Foreign Flag Container Vessels:

VESSEL/CHANNEL CHARACTERISTICS	VESSEL CLASSES:						
Design Deadweight Tonnage (tonnes)	1500	2500	3000	3500	4000	4500	5000
Vessel Carried Tonnage Capacity (S.T.)	735	1383	1706	2031	2356	2680	3005
Design Draft	11.6	13.5	14.5	15.5	16.5	17.4	18.4
Immersion Factor (Tonnes/Inch)	17.2	20.7	22.5	24.2	25.9	27.7	29.4
Tidal Allowance	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Required Keel Clearance	2	2	2	2	2	2	2
Required Channel Depth	13.6	15.5	16.5	17.5	18.5	19.4	20.4
Shut Out Tonnage to Port (By Depth)							
12	0	0	0	0	223	453	734
14	0	0	0	0	0	0	228
16	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
Cargo Tonnage (S.T.)-Net Box Wgt							
12	542	1020	1258	1497	1573	1641	1673
14	542	1020	1258	1497	1737	1975	2047
16	542	1020	1258	1497	1737	1975	2215
18	542	1020	1258	1497	1737	1975	2215
20	542	1020	1258	1497	1737	1975	2215
22	542	1020	1258	1497	1737	1975	2215
24	542	1020	1258	1497	1737	1975	2215
OCEAN VOYAGE PARAMETERS							
Cruising Speed (Statute MPH)	13.6	14.3	14.5	14.8	15.2	15.5	15.8
Cruising Speed (Nautical MPH)	11.8	12.4	12.6	12.9	13.2	13.5	13.7
Hourly Operating Cost at Sea	$304	$331	$345	$358	$372	$385	$399
CARGO TRANSFER COSTS							
In-Port							
In-Port Waiting Hours	9	9	9	9	9	9	9
In-Port Transfer Hours	7	14	17	20	23	26	30
Hourly In-Port Operating Cost	$278	$297	$307	$317	$327	$337	$346
In-Port Cargo Transfer Cost	$2,008	$4,038	$5,148	$6,329	$7,573	$8,875	$10,217
In-Port Waiting Time Cost	$2,502	$2,673	$2,763	$2,853	$2,943	$3,033	$3,114
Dockage							
Vessel Length	239	256	265	274	282	291	300
24 Hour Dockage Fee	$478	$512	$530	$548	$564	$582	$600
Days in Port (Rounded)	1	1	1	1	1	1	1
Dockage Costs	$478	$512	$530	$548	$564	$582	$600
Wharfage Fee per Net Ton	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
Wharfage Costs							

TABLE B-10 (CONT.)

12	$677	$1,274	$1,572	$1,872	$1,966	$2,051	$2,092
14	$677	$1,274	$1,572	$1,872	$2,171	$2,469	$2,558
16	$677	$1,274	$1,572	$1,872	$2,171	$2,469	$2,768
18	$677	$1,274	$1,572	$1,872	$2,171	$2,469	$2,768
20	$677	$1,274	$1,572	$1,872	$2,171	$2,469	$2,768
22	$677	$1,274	$1,572	$1,872	$2,171	$2,469	$2,768
24	$677	$1,274	$1,572	$1,872	$2,171	$2,469	$2,768
Total In-Port Costs							
12	$5,666	$8,497	$10,013	$11,601	$13,046	$14,541	$16,023
14	$5,666	$8,497	$10,013	$11,601	$13,251	$14,958	$16,489
16	$5,666	$8,497	$10,013	$11,601	$13,251	$14,958	$16,699
18	$5,666	$8,497	$10,013	$11,601	$13,251	$14,958	$16,699
20	$5,666	$8,497	$10,013	$11,601	$13,251	$14,958	$16,699
22	$5,666	$8,497	$10,013	$11,601	$13,251	$14,958	$16,699
24	$5,666	$8,497	$10,013	$11,601	$13,251	$14,958	$16,699
In-Port Travel Costs							
Tidal Delays							
Avg. Hrs. of Maximum Tidal Delay	6	6	6	6	6	6	6
Avg. Feet of Tidal Delay Per Depth							
12	1.6	3.5	4.5	5.5	5.5	5.5	5.5
14	0.0	1.5	2.5	3.5	4.5	5.4	5.5
16	0.0	0.0	0.5	1.5	2.5	3.4	4.4
18	0.0	0.0	0.0	0.0	0.5	1.4	2.4
20	0.0	0.0	0.0	0.0	0.0	0.0	0.4
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
g. Hrs. of Tidal Delay Per Depth							
12	1.70	3.50	4.50	6.00	6.00	6.00	6.00
14	0.00	1.80	2.70	3.50	4.50	5.90	6.00
16	0.00	0.00	0.70	1.80	2.70	3.40	4.40
18	0.00	0.00	0.00	0.00	0.70	1.70	2.60
20	0.00	0.00	0.00	0.00	0.00	0.00	0.60
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Delay for Tide:							
Operating Cost at Sea	$304	$331	$345	$358	$372	$385	$399
Operating Cost at Port	$278	$297	$307	$317	$327	$337	$346
Tidal Delay Costs							
12	$473	$1,040	$1,382	$1,902	$1,962	$2,022	$2,076
14	$0	$535	$829	$1,110	$1,472	$1,988	$2,076
16	$0	$0	$215	$571	$883	$1,146	$1,522
18	$0	$0	$0	$0	$229	$573	$900
20	$0	$0	$0	$0	$0	$0	$208
22	$0	$0	$0	$0	$0	$0	$0
24	$0	$0	$0	$0	$0	$0	$0
Pilotage							
Vessel Length	239	256	265	274	282	291	300
Vessel Beam	39	43	45	47	49	51	53
Vessel Draft	11.6	13.5	14.5	15.5	16.5	17.4	18.4
Pilotage Units	93.21	110.08	119.25	128.78	138.18	148.41	159
Delaware River Pilot Fee	$1,230	$1,453	$1,574	$1,700	$1,824	$1,959	$2,099

TABLE B-10 (CONT.)

Tug Costs

Number of Tugs Used	1	1	1	1	1	1	1
Tug Rate	$650	$650	$650	$650	$650	$650	$650
Tug Costs	$650	$650	$650	$650	$650	$650	$650

In-Port & Cargo Transfer Costs

12	$8,019	$11,640	$13,619	$15,853	$17,482	$19,172	$20,848
14	$7,546	$11,135	$13,066	$15,061	$17,197	$19,556	$21,314
16	$7,546	$10,600	$12,452	$14,522	$16,608	$18,713	$20,970
18	$7,546	$10,600	$12,237	$13,951	$15,954	$18,140	$20,348
20	$7,546	$10,600	$12,237	$13,951	$15,725	$17,567	$19,656
22	$7,546	$10,600	$12,237	$13,951	$15,725	$17,567	$19,448
24	$7,546	$10,600	$12,237	$13,951	$15,725	$17,567	$19,448

TOTAL COST AND COST PER NET CARGO TON BY TRADE ROUTE:

Bermuda

Total Cost:	12' Channel Depth	$52,414	$60,970	$65,900	$70,892	$74,756	$78,612	$82,818
	14' Channel Depth	$51,469	$59,961	$64,795	$69,307	$74,186	$79,379	$83,751
	16' Channel Depth	$51,469	$58,891	$63,567	$68,229	$73,009	$77,694	$83,064
	18' Channel Depth	$51,469	$58,891	$63,137	$67,088	$71,701	$76,549	$81,818
	20' Channel Depth	$51,469	$58,891	$63,137	$67,088	$71,243	$75,403	$80,434
	22' Channel Depth	$51,469	$58,891	$63,137	$67,088	$71,243	$75,403	$80,019
	24' Channel Depth	$51,469	$58,891	$63,137	$67,088	$71,243	$75,403	$80,019
Cost Per Ton:	12' Channel Depth	$96.73	$59.80	$52.40	$47.35	$47.54	$47.90	$49.49
	14' Channel Depth	$94.99	$58.81	$51.52	$46.29	$42.71	$40.19	$40.92
	16' Channel Depth	$94.99	$57.76	$50.54	$45.57	$42.03	$39.34	$37.51
	18' Channel Depth	$94.99	$57.76	$50.20	$44.81	$41.28	$38.76	$36.94
	20' Channel Depth	$94.99	$57.76	$50.20	$44.81	$41.02	$38.18	$36.32
	22' Channel Depth	$94.99	$57.76	$50.20	$44.81	$41.02	$38.18	$36.13
	24' Channel Depth	$94.99	$57.76	$50.20	$44.81	$41.02	$38.18	$36.13

Distances to Ports-Nautical Miles

Bermuda 706

T B-11 F:VCTPFF4

AP...ING DR. PERAKIS (UNIV. OF MICHIGAN NAVAL ARCHITECTURE) POSITION PAPER FOR VESSEL DATA
TRANSPORTATION COST MODEL
SALEM RIVER
65.1% CARRYING CAPACITY APPLIED BASED ON 1991 USAGE OF BERMUDA ISLANDER
ACTUAL OPERATING CAPACITY: 2.5 FT CONSTRAINT

Foreign Flag Container Vessels:

VESSEL/CHANNEL CHARACTERISTICS	VESSEL CLASSES:						
Design Deadweight Tonnage (tonnes)	1500	2500	3000	3500	4000	4500	5000
Vessel Carried Tonnage Capacity (S.T.)	508	1109	1409	1711	2014	2313	2616
Design Draft	10.6	12.5	13.5	14.5	15.5	16.4	17.4
Immersion Factor (Tonnes/Inch)	17.2	20.7	22.5	24.2	25.9	27.7	29.4
Tidal Allowance	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Required Keel Clearance	2	2	2	2	2	2	2
Required Channel Depth	12.6	14.5	15.5	16.5	17.5	18.4	19.4
Shut Out Tonnage to Port (By Depth)							
12	0	0	0	0	0	215	481
14	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
Cargo Tonnage (S.T.)-Net Box Wgt							
12	374	818	1038	1261	1484	1547	1573
14	374	818	1038	1261	1484	1705	1928
16	374	818	1038	1261	1484	1705	1928
18	374	818	1038	1261	1484	1705	1928
20	374	818	1038	1261	1484	1705	1928
22	374	818	1038	1261	1484	1705	1928
24	374	818	1038	1261	1484	1705	1928
OCEAN VOYAGE PARAMETERS							
Cruising Speed (Statute MPH)	13.6	14.3	14.5	14.8	15.2	15.5	15.8
Cruising Speed (Nautical MPH)	11.8	12.4	12.6	12.9	13.2	13.5	13.7
Hourly Operating Cost at Sea	$304	$331	$345	$358	$372	$385	$399
CARGO TRANSFER COSTS							
In-Port							
In-Port Waiting Hours	9	9	9	9	9	9	9
In-Port Transfer Hours	5	11	14	17	20	23	26
Hourly In-Port Operating Cost	$278	$297	$307	$317	$327	$337	$346
In-Port Cargo Transfer Cost	$1,387	$3,238	$4,250	$5,331	$6,472	$7,661	$8,895
In-Port Waiting Time Cost	$2,502	$2,673	$2,763	$2,853	$2,943	$3,033	$3,114
Dockage							
Vessel Length	239	256	265	274	282	291	300
24 Hour Dockage Fee	$478	$512	$530	$548	$564	$582	$600
Days in Port (Rounded)	1	1	1	1	1	1	1
Dockage Costs	$478	$512	$530	$548	$564	$582	$600
Wharfage Fee per Net Ton	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
Wharfage Costs							

TABLE B-11 (CONT.)

12	$468	$1,022	$1,298	$1,577	$1,855	$1,933	$1,967
14	$468	$1,022	$1,298	$1,577	$1,855	$2,131	$2,410
16	$468	$1,022	$1,298	$1,577	$1,855	$2,131	$2,410
18	$468	$1,022	$1,298	$1,577	$1,855	$2,131	$2,410
20	$468	$1,022	$1,298	$1,577	$1,855	$2,131	$2,410
22	$468	$1,022	$1,298	$1,577	$1,855	$2,131	$2,410
24	$468	$1,022	$1,298	$1,577	$1,855	$2,131	$2,410
Total In-Port Costs							
12	$4,835	$7,446	$8,841	$10,309	$11,834	$13,209	$14,575
14	$4,835	$7,446	$8,841	$10,309	$11,834	$13,407	$15,019
16	$4,835	$7,446	$8,841	$10,309	$11,834	$13,407	$15,019
18	$4,835	$7,446	$8,841	$10,309	$11,834	$13,407	$15,019
20	$4,835	$7,446	$8,841	$10,309	$11,834	$13,407	$15,019
22	$4,835	$7,446	$8,841	$10,309	$11,834	$13,407	$15,019
24	$4,835	$7,446	$8,841	$10,309	$11,834	$13,407	$15,019
In-Port Travel Costs							
Tidal Delays							
Avg. Hrs. of Maximum Tidal Delay	6	6	6	6	6	6	6
Avg. Feet of Tidal Delay Per Depth							
12	0.6	2.5	3.5	4.5	5.5	5.5	5.5
14	0.0	0.5	1.5	2.5	3.5	4.4	5.4
16	0.0	0.0	0.0	0.5	1.5	2.4	3.4
18	0.0	0.0	0.0	0.0	0.0	0.4	1.4
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Avg. Hrs. of Tidal Delay Per Depth							
12	0.80	2.70	3.50	4.50	6.00	6.00	6.00
14	0.00	0.70	1.80	2.70	3.50	4.40	5.90
16	0.00	0.00	0.00	0.70	2.80	2.60	3.40
18	0.00	0.00	0.00	0.00	0.00	0.60	2.70
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Delay for Tide:							
Operating Cost at Sea	$304	$331	$345	$358	$372	$385	$399
Operating Cost at Port	$278	$297	$307	$317	$327	$337	$346
Tidal Delay Costs							
12	$222	$802	$1,075	$1,427	$1,962	$2,022	$2,076
14	$0	$208	$553	$856	$1,145	$1,483	$2,041
16	$0	$0	$0	$222	$916	$876	$1,176
18	$0	$0	$0	$0	$0	$202	$934
20	$0	$0	$0	$0	$0	$0	$0
22	$0	$0	$0	$0	$0	$0	$0
24	$0	$0	$0	$0	$0	$0	$0
Pilotage							
Vessel Length	239	256	265	274	282	291	300
Vessel Beam	39	43	45	47	49	51	53
Vessel Draft	10.6	12.5	13.5	14.5	15.5	16.4	17.4
Pilotage Units	93.21	110.08	119.25	128.78	138.18	148.41	159
Delaware River Pilot Fee	$1,230	$1,453	$1,574	$1,700	$1,824	$1,959	$2,099

TABLE B-11 (CONT.)

osts								
	Number of Tugs Used	1	1	1	1	1	1	1
	Tug Rate	$650	$650	$650	$650	$650	$650	$650
	Tug Costs	$650	$650	$650	$650	$650	$650	$650
	In-Port & Cargo Transfer Costs							
	12	$6,937	$10,350	$12,140	$14,085	$16,270	$17,840	$19,400
	14	$6,715	$9,756	$11,618	$13,515	$15,453	$17,499	$19,809
	16	$6,715	$9,549	$11,065	$12,881	$15,224	$16,892	$18,944
	18	$6,715	$9,549	$11,065	$12,659	$14,308	$16,218	$18,702
	20	$6,715	$9,549	$11,065	$12,659	$14,308	$16,016	$17,767
	22	$6,715	$9,549	$11,065	$12,659	$14,308	$16,016	$17,767
	24	$6,715	$9,549	$11,065	$12,659	$14,308	$16,016	$17,767
TOTAL COST AND COST PER NET CARGO TON BY TRADE ROUTE:								
Bermuda								
Total Cost:	12' Channel Depth	$50,252	$58,392	$62,942	$67,357	$72,334	$75,949	$79,924
	14' Channel Depth	$49,807	$57,204	$61,898	$66,216	$70,699	$75,266	$80,741
	16' Channel Depth	$49,807	$56,788	$60,793	$64,948	$70,241	$74,053	$79,011
	18' Channel Depth	$49,807	$56,788	$60,793	$64,504	$68,410	$72,705	$78,526
	20' Channel Depth	$49,807	$56,788	$60,793	$64,504	$68,410	$72,301	$76,658
	22' Channel Depth	$49,807	$56,788	$60,793	$64,504	$68,410	$72,301	$76,658
	24' Channel Depth	$49,807	$56,788	$60,793	$64,504	$68,410	$72,301	$76,658
Cost Per Ton:	12' Channel Depth	$134.31	$71.41	$60.62	$53.40	$48.73	$49.10	$50.79
	14' Channel Depth	$133.12	$69.95	$59.61	$52.50	$47.63	$44.14	$41.88
	16' Channel Depth	$133.12	$69.44	$58.55	$51.49	$47.32	$43.43	$40.98
	18' Channel Depth	$133.12	$69.44	$58.55	$51.14	$46.09	$42.64	$40.73
	20' Channel Depth	$133.12	$69.44	$58.55	$51.14	$46.09	$42.41	$39.76
	22' Channel Depth	$133.12	$69.44	$58.55	$51.14	$46.09	$42.41	$39.76
	24' Channel Depth	$133.12	$69.44	$58.55	$51.14	$46.09	$42.41	$39.76

Distances to Ports-Nautical Miles

Bermuda 706

SALEM RIVER TABLE B-12 F:TSTPFF3
TOTAL TRANSPORTATION SAVINGS DISCOUNT RATE= 8.5% PRICE LEVEL= MARCH 1992
TRADE ROUTE: CONTAINERS-BERMUDA
1.5 FOOT CONSTRAINT, MOST EFFICIENT CHARTER VESSEL SIZE PER CHANNEL DEPTH
APPLYING HISTORIC TONNAGE AND COMMODITY PROJECTIONS F:DRIDBA4A

	12 FEET:	12 FEET:			14 FEET:	% OF	
DESDWT		PCT. OF FLEET	AVG $/TON	TOTAL TRANS COSTS	AVG $/TON	TOTAL FLEET $/TON	TOTAL TRANS COSTS
1,500		0.0%	$96.73	$0	$94.99	0.00%	$0
2,500		0.0%	$59.80	$0	$58.81	0.00%	$0
3,000		0.0%	$52.40	$0	$51.52	0.00%	$0
3,500		100.0%	$47.35	$1,219,783	$46.29	0.00%	$0
4,000		0.0%	$47.54	$0	$42.71	0.00%	$0
4,500		0.0%	$47.90	$0	$40.19	100.00%	$1,035,335
5,000		0.0%	$49.49	$0	$40.92	0.00%	$0
TOTAL SHORT TONS (1991) 1]	25,761	100.0%				100.0%	
				$1,219,783			$1,035,335
CUMULATIVE SAVINGS							$184,449

1] SOURCE: MID-ATLANTIC SHIPPING CORP

TABLE B-12 (CONT.)

16 FEET:

AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$94.99	0.00%	$0
$57.76	0.00%	$0
$50.54	0.00%	$0
$45.57	0.00%	$0
$42.03	0.00%	$0
$39.34	0.00%	$0
$37.51	100.00%	$966,295
	100.0%	
		$966,295
		$253,488

18 FEET:

AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$94.99	0.00%	$0
$57.76	0.00%	$0
$50.20	0.00%	$0
$44.81	0.00%	$0
$41.28	0.00%	$0
$38.76	0.00%	$0
$36.94	100.00%	$951,611
	100.0%	
		$951,611
		$268,172

20 FEET:

AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$94.99	0.00%	$0
$57.76	0.00%	$0
$50.20	0.00%	$0
$44.81	0.00%	$0
$41.02	0.00%	$0
$38.18	0.00%	$0
$36.32	100.00%	$935,640
	100.0%	
		$935,640
		$284,144

TABLE B-12 (CONT.)

22 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS	24 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$94.99	0.00%	$0	$94.99	0.00%	$0
$57.76	0.00%	$0	$57.76	0.00%	$0
$50.20	0.00%	$0	$50.20	0.00%	$0
$44.81	0.00%	$0	$44.81	0.00%	$0
$41.02	0.00%	$0	$41.02	0.00%	$0
$38.18	0.00%	$0	$38.18	0.00%	$0
$36.13	100.00%	$930,745	$36.13	100.00%	$930,745
	100.0%				
		$930,745			$930,745
		$289,038			$289,038

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TABLE B-12 (CONT.)

PREDICTED TONNAGE:		PERIOD	AVG ANN GROWTH/YR FOR PERIOD
1991	25,761		
1994	38,460	1991-1994	14.29%
2001	57,036	1994-2001	5.79%
2011	90,286	2001-2011	4.70%
2014	103,624	2011-2014	4.70%
2031	103,624	2014-2031	0.00%
2044	103,624	2031-2044	0.00%

YEAR	CUMULATIVE TRANS COSTS 12 FT	SPPW,8 1/2%	PRESENT WORTH TRANS COSTS 12 FT	PRESENT WORTH TRANS COSTS 14 FT	PRESENT WORTH TRANS COSTS 16 FT	PRESENT WORTH TRANS COSTS 18 FT	PRESENT WORTH TRANS COSTS 20 FT	PRESENT WORTH TRANS COSTS 22 FT	PRESENT WORTH TRANS COSTS 24 FT
1994	$1,821,081	1.00000	$1,821,081	$1,545,707	$1,442,635	$1,420,712	$1,396,867	$1,389,560	$1,389,560
1995	$1,926,522	0.92166	$1,775,596	$1,507,100	$1,406,602	$1,385,227	$1,361,978	$1,354,853	$1,354,853
1996	$2,038,067	0.84946	$1,731,247	$1,469,458	$1,371,469	$1,350,629	$1,327,960	$1,321,013	$1,321,013
1997	$2,156,071	0.78291	$1,688,006	$1,432,755	$1,337,214	$1,316,894	$1,294,791	$1,288,018	$1,288,018
1998	$2,280,908	0.72157	$1,645,844	$1,396,969	$1,303,815	$1,284,002	$1,262,451	$1,255,847	$1,255,847
1999	$2,412,972	0.66505	$1,604,736	$1,362,077	$1,271,249	$1,251,931	$1,230,919	$1,224,480	$1,224,480
2000	$2,552,683	0.61295	$1,564,655	$1,328,057	$1,239,497	$1,220,662	$1,200,174	$1,193,896	$1,193,896
2001	$2,700,484	0.56493	$1,525,574	$1,294,886	$1,208,539	$1,190,174	$1,170,198	$1,164,076	$1,164,076
2002	$2,856,842	0.52067	$1,487,470	$1,262,543	$1,178,353	$1,160,447	$1,140,970	$1,135,001	$1,135,001
2003	$3,022,253	0.47988	$1,450,318	$1,231,009	$1,148,921	$1,131,462	$1,112,472	$1,106,652	$1,106,652
2004	$2,700,655	0.44229	$1,194,460	$1,013,841	$946,234	$931,855	$916,215	$911,422	$911,422
2005	$2,827,585	0.40764	$1,152,627	$978,333	$913,094	$899,219	$884,127	$879,501	$879,501
2006	$2,960,482	0.37570	$1,112,258	$944,069	$881,115	$867,726	$853,162	$848,699	$848,699
2007	$3,099,625	0.34627	$1,073,303	$911,004	$850,256	$837,335	$823,281	$818,975	$818,975
2008	$3,245,307	0.31914	$1,035,713	$879,098	$820,477	$808,009	$794,448	$790,292	$790,292
2009	$3,397,836	0.29414	$999,439	$848,310	$791,742	$779,710	$766,624	$762,613	$762,613
2010	$3,557,535	0.27110	$964,436	$818,599	$764,012	$752,403	$739,774	$735,904	$735,904
2011	$3,724,739	0.24986	$930,658	$789,929	$737,254	$726,051	$713,865	$710,131	$710,131
2012	$3,899,801	0.23028	$898,064	$762,264	$711,433	$700,623	$688,863	$685,260	$685,260
2013	$4,083,092	0.21224	$866,611	$735,567	$686,517	$676,085	$664,737	$661,260	$661,260
2014	$4,274,997	0.19562	$836,260	$709,805	$662,473	$652,406	$641,456	$638,100	$638,100
2015	$4,274,997	0.18029	$770,746	$654,198	$610,574	$601,296	$591,204	$588,111	$588,111
2016	$4,274,997	0.16617	$710,365	$602,948	$562,741	$554,190	$544,888	$542,038	$542,038
2017	$4,274,997	0.15315	$654,714	$555,712	$518,655	$510,774	$502,201	$499,574	$499,574
2018	$4,274,997	0.14115	$603,423	$512,177	$478,023	$470,759	$462,858	$460,437	$460,437
2019	$4,274,997	0.13009	$556,151	$472,053	$440,575	$433,880	$426,597	$424,366	$424,366
2020	$4,274,997	0.11990	$512,581	$435,072	$406,060	$399,889	$393,177	$391,121	$391,121

TABLE B-12 (CONT.)

2021	$4,274,997	0.11051	$472,425	$400,988	$374,248	$368,561	$362,375	$360,480	$360,480
2022	$4,274,997	0.10185	$435,415	$369,574	$344,929	$339,688	$333,987	$332,239	$332,239
2023	$4,274,997	0.09387	$401,304	$340,621	$317,907	$313,076	$307,822	$306,211	$306,211
2024	$4,274,997	0.08652	$369,865	$313,936	$293,002	$288,550	$283,707	$282,223	$282,223
2025	$4,274,997	0.07974	$340,890	$289,342	$270,048	$265,944	$261,481	$260,113	$260,113
2026	$4,274,997	0.07349	$314,184	$266,675	$248,892	$245,110	$240,996	$239,735	$239,735
2027	$4,274,997	0.06774	$289,571	$245,783	$229,394	$225,908	$222,116	$220,954	$220,954
2028	$4,274,997	0.06243	$266,885	$226,528	$211,423	$208,210	$204,715	$203,645	$203,645
2029	$4,274,997	0.05754	$245,977	$208,782	$194,860	$191,899	$188,678	$187,691	$187,691
2030	$4,274,997	0.05303	$226,707	$192,426	$179,594	$176,865	$173,897	$172,987	$172,987
2031	$4,274,997	0.04888	$208,947	$177,351	$165,525	$163,009	$160,273	$159,435	$159,435
2032	$4,274,997	0.04505	$192,578	$163,457	$152,557	$150,239	$147,717	$146,945	$146,945
2033	$4,274,997	0.04152	$177,491	$150,652	$140,606	$138,469	$136,145	$135,433	$135,433
2034	$4,274,997	0.03827	$163,586	$138,850	$129,591	$127,621	$125,479	$124,823	$124,823
2035	$4,274,997	0.03527	$150,771	$127,972	$119,438	$117,623	$115,649	$115,044	$115,044
2036	$4,274,997	0.03251	$138,959	$117,946	$110,081	$108,409	$106,589	$106,031	$106,031
2037	$4,274,997	0.02996	$128,073	$108,706	$101,458	$99,916	$98,239	$97,725	$97,725
2038	$4,274,997	0.02761	$118,040	$100,190	$93,509	$92,088	$90,543	$90,069	$90,069
2039	$4,274,997	0.02545	$108,792	$92,341	$86,184	$84,874	$83,449	$83,013	$83,013
2040	$4,274,997	0.02345	$100,269	$85,107	$79,432	$78,225	$76,912	$76,510	$76,510
2041	$4,274,997	0.02162	$92,414	$78,440	$73,209	$72,097	$70,887	$70,516	$70,516
2042	$4,274,997	0.01992	$85,174	$72,295	$67,474	$66,449	$65,333	$64,991	$64,991
2043	$4,274,997	0.01836	$78,502	$66,631	$62,188	$61,243	$60,215	$59,900	$59,900
2044	$4,274,997	0.01692	$72,352	$61,411	$57,316	$56,445	$55,498	$55,207	$55,207
CUMULATIVE PRES WORTH: TRANS COSTS			$41,542,915	$35,261,029	$32,909,709	$32,409,615	$31,865,653	$31,698,955	$31,698,955
CRF, 50 YRS			0.0864630	0.0864630	0.0864630	0.0864630	0.0864630	0.0864630	0.0864630
AVG ANN CUMULATIVE TRANS COSTS			$3,591,925	$3,048,774	$2,845,472	$2,802,233	$2,755,200	$2,740,787	$2,740,787
AVG ANN CUMULATIVE TRANS SAVINGS (MARCH 1992)				$543,151	$746,453	$789,692	$836,725	$851,138	$851,138
AVG ANN CUMULATIVE TRANS SAVINGS (APRIL 1990)				$506,130	$695,575	$735,867	$779,694	$793,125	$793,125

16P

SALEM RIVER | TABLE B-13 | F:TSTPFF4
TOTAL TRANSPORTATION SAVINGS | DISCOUNT RATE= 8.5% | PRICE LEVEL= MARCH 1992
TRADE ROUTE: CONTAINERS-BERMUDA
2.5 FOOT CONSTRAINT, MOST EFFICIENT CHARTER VESSEL SIZE PER CHANNEL DEPTH
APPLYING HISTORIC TONNAGE AND COMMODITY PROJECTIONS F:DRIDBA4A

	12 FEET:	12 FEET:			14 FEET:	% OF	
		PCT.	AVG	TOTAL	AVG	TOTAL FLEET	TOTAL
DESDWT		OF FLEET	$/TON	TRANS COSTS	$/TON	$/TON	TRANS COSTS
1,500		0.0%	$134.31	$0	$133.12	0.00%	$0
2,500		0.0%	$71.41	$0	$69.95	0.00%	$0
3,000		0.0%	$60.62	$0	$59.61	0.00%	$0
3,500		0.0%	$53.40	$0	$52.50	0.00%	$0
4,000		100.0%	$48.73	$1,255,334	$47.63	0.00%	$0
4,500		0.0%	$49.10	$0	$44.14	0.00%	$0
5,000		0.0%	$50.79	$0	$41.88	100.00%	$1,078,871
TOTAL SHORT TONS (1991) 1]	25,761	100.0%				100.0%	
				$1,255,334			$1,078,871
CUMULATIVE SAVINGS							$176,463

1] SOURCE: MID-ATLANTIC SHIPPING CORP

TABLE B-13 (CONT.)

16 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$133.12	0.00%	$0
$69.44	0.00%	$0
$58.55	0.00%	$0
$51.49	0.00%	$0
$47.32	0.00%	$0
$43.43	0.00%	$0
$40.98	100.00%	$1,055,686
	100.0%	
		$1,055,686
		$199,648

18 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$133.12	0.00%	$0
$69.44	0.00%	$0
$58.55	0.00%	$0
$51.14	0.00%	$0
$46.09	0.00%	$0
$42.64	0.00%	$0
$40.73	100.00%	$1,049,246
	100.0%	
		$1,049,246
		$206,088

20 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$133.12	0.00%	$0
$69.44	0.00%	$0
$58.55	0.00%	$0
$51.14	0.00%	$0
$46.09	0.00%	$0
$42.41	0.00%	$0
$39.76	100.00%	$1,024,257
	100.0%	
		$1,024,257
		$231,076

ILR

TABLE B-13 (CONT.)

22 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$133.12	0.00%	$0
$69.44	0.00%	$0
$58.55	0.00%	$0
$51.14	0.00%	$0
$46.09	0.00%	$0
$42.41	0.00%	$0
$39.76	100.00%	$1,024,257
	100.0%	
		$1,024,257
		$231,076

24 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$133.12	0.00%	$0
$69.44	0.00%	$0
$58.55	0.00%	$0
$51.14	0.00%	$0
$46.09	0.00%	$0
$42.41	0.00%	$0
$39.76	100.00%	$1,024,257
		$1,024,257
		$231,076

TABLE B-13 (CONT.)

PREDICTED TONNAGE:		PERIOD	AVG ANN GROWTH/YR FOR PERIOD
1991	25,761		
1994	38,460	1991-1994	14.29%
2001	57,036	1994-2001	5.79%
2011	90,286	2001-2011	4.70%
2014	103,624	2011-2014	4.70%
2031	103,624	2014-2031	0.00%
2044	103,624	2031-2044	0.00%

YEAR	CUMULATIVE TRANS COSTS 12 FT	SPPW,8 1/2%	PRESENT WORTH TRANS COSTS 12 FT	PRESENT WORTH TRANS COSTS 14 FT	PRESENT WORTH TRANS COSTS 16 FT	PRESENT WORTH TRANS COSTS 18 FT	PRESENT WORTH TRANS COSTS 20 FT	PRESENT WORTH TRANS COSTS 22 FT	PRESENT WORTH TRANS COSTS 24 FT
1994	$1,874,156	1.00000	$1,874,156	$1,610,705	$1,576,091	$1,566,476	$1,529,170	$1,529,170	$1,529,170
1995	$1,982,669	0.92166	$1,827,345	$1,570,474	$1,536,725	$1,527,350	$1,490,976	$1,490,976	$1,490,976
1996	$2,097,466	0.84946	$1,781,704	$1,531,249	$1,498,342	$1,489,201	$1,453,736	$1,453,736	$1,453,736
1997	$2,218,909	0.78291	$1,737,202	$1,493,003	$1,460,918	$1,452,006	$1,417,426	$1,417,426	$1,417,426
1998	$2,347,384	0.72157	$1,693,812	$1,455,712	$1,424,429	$1,415,739	$1,382,023	$1,382,023	$1,382,023
1999	$2,483,298	0.66505	$1,651,506	$1,419,353	$1,388,851	$1,380,378	$1,347,504	$1,347,504	$1,347,504
2000	$2,627,081	0.61295	$1,610,256	$1,383,902	$1,354,162	$1,345,901	$1,313,847	$1,313,847	$1,313,847
2001	$2,779,189	0.56493	$1,570,037	$1,349,336	$1,320,339	$1,312,284	$1,281,031	$1,281,031	$1,281,031
2002	$2,940,104	0.52067	$1,530,822	$1,315,634	$1,287,361	$1,279,507	$1,249,035	$1,249,035	$1,249,035
2003	$3,110,336	0.47988	$1,492,587	$1,282,773	$1,255,206	$1,247,549	$1,217,838	$1,217,838	$1,217,838
2004	$2,779,364	0.44229	$1,229,272	$1,056,473	$1,033,769	$1,027,463	$1,002,993	$1,002,993	$1,002,993
2005	$2,909,994	0.40764	$1,186,219	$1,019,472	$997,564	$991,478	$967,865	$967,865	$967,865
2006	$3,046,764	0.37570	$1,144,674	$983,767	$962,626	$956,753	$933,968	$933,968	$933,968
2007	$3,189,962	0.34627	$1,104,584	$949,312	$928,912	$923,245	$901,257	$901,257	$901,257
2008	$3,339,890	0.31914	$1,065,899	$916,065	$896,378	$890,910	$869,693	$869,693	$869,693
2009	$3,496,865	0.29414	$1,028,568	$883,981	$864,985	$859,708	$839,233	$839,233	$839,233
2010	$3,661,218	0.27110	$992,544	$853,022	$834,690	$829,598	$809,841	$809,841	$809,841
2011	$3,833,295	0.24986	$957,782	$823,146	$805,457	$800,543	$781,478	$781,478	$781,478
2012	$4,013,460	0.23028	$924,238	$794,317	$777,247	$772,506	$754,108	$754,108	$754,108
2013	$4,202,092	0.21224	$891,868	$766,498	$750,026	$745,450	$727,697	$727,697	$727,697
2014	$4,399,591	0.19562	$860,632	$739,653	$723,757	$719,342	$702,211	$702,211	$702,211
2015	$4,399,591	0.18029	$793,209	$681,707	$667,058	$662,988	$647,199	$647,199	$647,199
2016	$4,399,591	0.16617	$731,068	$628,302	$614,800	$611,049	$596,497	$596,497	$596,497
2017	$4,399,591	0.15315	$673,796	$579,080	$566,636	$563,179	$549,767	$549,767	$549,767
2018	$4,399,591	0.14115	$621,010	$533,714	$522,245	$519,059	$506,697	$506,697	$506,697
2019	$4,399,591	0.13009	$572,359	$491,903	$48[illegible]32	$478,395	$467,002	$467,002	$467,002
202[illegible]	[illegible],399,591	0.11990	$527,520	$453,366	$4[illegible]24	$440,917	$430,417	$430,417	$430,417

TABLE B-13 (CONT.)

2021	$4,399,591	0.11051	$486,194	$417,849	$408,870	$406,375	$396,697	$396,697	$396,697
2022	$4,399,591	0.10185	$448,105	$385,115	$376,838	$374,539	$365,620	$365,620	$365,620
2023	$4,399,591	0.09387	$413,000	$354,944	$347,317	$345,198	$336,977	$336,977	$336,977
2024	$4,399,591	0.08652	$380,645	$327,138	$320,107	$318,155	$310,578	$310,578	$310,578
2025	$4,399,591	0.07974	$350,825	$301,509	$295,030	$293,230	$286,247	$286,247	$286,247
2026	$4,399,591	0.07349	$323,341	$277,889	$271,917	$270,258	$263,822	$263,822	$263,822
2027	$4,399,591	0.06774	$298,010	$256,119	$250,615	$249,086	$243,154	$243,154	$243,154
2028	$4,399,591	0.06243	$274,664	$236,054	$230,981	$229,572	$224,105	$224,105	$224,105
2029	$4,399,591	0.05754	$253,146	$217,561	$212,886	$211,587	$206,548	$206,548	$206,548
2030	$4,399,591	0.05303	$233,314	$200,517	$196,208	$195,011	$190,367	$190,367	$190,367
2031	$4,399,591	0.04888	$215,036	$184,809	$180,837	$179,734	$175,453	$175,453	$175,453
2032	$4,399,591	0.04505	$198,190	$170,331	$166,670	$165,653	$161,708	$161,708	$161,708
2033	$4,399,591	0.04152	$182,664	$156,987	$153,613	$152,676	$149,040	$149,040	$149,040
2034	$4,399,591	0.03827	$168,354	$144,688	$141,579	$140,715	$137,364	$137,364	$137,364
2035	$4,399,591	0.03527	$155,165	$133,353	$130,487	$129,691	$126,603	$126,603	$126,603
2036	$4,399,591	0.03251	$143,009	$122,906	$120,265	$119,531	$116,685	$116,685	$116,685
2037	$4,399,591	0.02996	$131,806	$113,278	$110,843	$110,167	$107,543	$107,543	$107,543
2038	$4,399,591	0.02761	$121,480	$104,403	$102,160	$101,536	$99,118	$99,118	$99,118
2039	$4,399,591	0.02545	$111,963	$96,224	$94,156	$93,582	$91,353	$91,353	$91,353
2040	$4,399,591	0.02345	$103,192	$88,686	$86,780	$86,251	$84,197	$84,197	$84,197
2041	$4,399,591	0.02162	$95,107	$81,738	$79,982	$79,494	$77,601	$77,601	$77,601
2042	$4,399,591	0.01992	$87,657	$75,335	$73,716	$73,266	$71,521	$71,521	$71,521
2043	$4,399,591	0.01836	$80,790	$69,433	$67,941	$67,526	$65,918	$65,918	$65,918
2044	$4,399,591	0.01692	$74,460	$63,993	$62,618	$62,236	$60,754	$60,754	$60,754
CUMULATIVE PRES WORTH: TRANS COSTS			$42,753,669	$36,743,765	$35,954,142	$35,734,803	$34,883,765	$34,883,765	$34,883,765
CRF, 50 YRS			0.0864630	0.0864630	0.0864630	0.0864630	0.0864630	0.0864630	0.0864630
AVG ANN CUMULATIVE TRANS COSTS			$3,696,610	$3,176,976	$3,108,703	$3,089,738	$3,016,155	$3,016,155	$3,016,155
AVG ANN CUMULATIVE TRANS SAVINGS (MARCH 1992)				$519,634	$587,907	$606,872	$680,455	$680,455	$680,455
AVG ANN CUMULATIVE TRANS SAVINGS (APRIL 1990)				$484,216	$547,836	$565,508	$634,076	$634,076	$634,076

design draft of 16 feet, design deadweight tonnage of 2048 tons, length of 295 feet, and beam of 45 feet. The "Rainbow Hope" had a 1991 average TEU capacity utilization per trip of 64.6%, which has been applied in the transportation cost model for the range of vessel classes. The average cargo weight per box in 1991 was 8.62 tons, and 92% of vessel movements operated making full channel use, and the remaining 8% operated 1.5 feet lightloaded.

Table B-14 presents the transportation cost model for the unconstrained movements, and Table B-15 presents the model for vessel movements with a 1.5 foot constraint. The two transportation savings models for these operating practices are then shown in Tables B-16 and B-17.

Bulk Benefits. This benefit estimation has applied, as a base, average tonnage at the 1989-1991 level for total bulk movements through the port of Salem (with 2% per annum growth for the first twenty years of the project life). The transportation cost model has applied the feasibility report methodology for bulk vessels with the updated tonnage data. The transportation savings model incorporates the most efficient vessel size per channel depth with the operating costs per ton for the bulk vessel classes. Since bulk benefits are based on intermittent historic movements as well as speculative future movements, this category has not been used in the economic optimization as a determining factor to define the optimum depth. The average annual bulk benefits by channel depth are estimated as follows:

12 to 14 feet:	$ 89,600
12 to 16 feet:	$110,900
12 to 17 feet:	$116,300
12 to 18 feet:	$121,600
12 to 19 feet:	$125,400
12 to 20 feet:	$129,100
12 to 22 feet:	$136,100
12 to 24 feet:	$145,800

LEAST-COST PORT ANALYSIS FOR BERMUDA TRADE ROUTE

Costs of Shipping out of the Port of Salem versus the Port of New York/New Jersey Under Existing Conditions (Bermuda Trade Route). The primary and most substantial cost differential between the ports is for stevedoring. Stevedoring costs were calculated from the annual reports of the two shipping agents that handle shipments from the U.S. North Atlantic region to Bermuda. In 1990, 7,043 boxes moved out of the Port of New York/New Jersey at the cost of $919 a box. In 1991, 7,649 containers moved out of New York. During 1990, 2,489 boxes moved out of the Port of Salem at the cost of $540 a box. In 1991, 3,062 containers moved out of Salem. The difference in stevedoring costs between the two ports continues to rise, as wage increases were built into labor contracts at the Port of New York/New Jersey. Stevedoring costs in Salem are among the lowest in the Northeast.

F[illegible] LOADED VESSEL OPERATING PRACTICE F:VCTPUS2 TABLE B-14
APPLYING DR. PERAKIS (UNIV. OF MICHIGAN NAVAL ARCHITECTURE) POSITION PAPER FOR VESSEL DATA
TRANSPORTATION COST MODEL
SALEM RIVER
64.6% CARRYING CAPACITY APPLIED BASED ON 1991 USAGE OF RAINBOW HOPE

U.S. Flag Container Vessels:

VESSEL/CHANNEL CHARACTERISTICS	VESSEL CLASSES:						
Design Deadweight Tonnage (tonnes)	1500	2500	3000	3500	4000	4500	5000
Vessel Carried Tonnage Capacity (S.T.)	1076	1794	2153	2512	2870	3229	3588
Design Draft	13.1	15.0	16.0	17.0	18.0	18.9	19.9
Immersion Factor (Tonnes/Inch)	17.2	20.7	22.5	24.2	25.9	27.7	29.4
Tidal Allowance	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Required Keel Clearance	2	2	2	2	2	2	2
Required Channel Depth	15.1	17	18	19	20	20.9	21.9
Shut Out Tonnage to Port (By Depth)							
12	0	0	96	310	553	805	1105
14	0	0	0	0	111	331	603
16	0	0	0	0	0	0	100
18	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
Cargo Tonnage (S.T.)-Net Box Wgt							
12	793	1322	1516	1623	1708	1787	1830
14	793	1322	1587	1851	2034	2136	2200
16	793	1322	1587	1851	2116	2380	2571
18	793	1322	1587	1851	2116	2380	2645
20	793	1322	1587	1851	2116	2380	2645
22	793	1322	1587	1851	2116	2380	2645
24	793	1322	1587	1851	2116	2380	2645
OCEAN VOYAGE PARAMETERS							
Cruising Speed (Statute MPH)	13.6	14.3	14.5	14.8	15.2	15.5	15.8
Cruising Speed (Nautical MPH)	11.8	12.4	12.6	12.9	13.2	13.5	13.7
Hourly Operating Cost at Sea	$972	$1,021	$1,045	$1,070	$1,094	$1,118	$1,143
CARGO TRANSFER COSTS							
In-Port							
In-Port Waiting Hours	9	9	9	9	9	9	9
In-Port Transfer Hours	11	18	21	25	28	32	35
Hourly In-Port Operating Cost	$935	$977	$998	$1,019	$1,040	$1,061	$1,082
In-Port Cargo Transfer Cost	$9,891	$17,225	$21,115	$25,152	$29,338	$33,671	$38,153
In-Port Waiting Time Cost	$8,415	$8,793	$8,982	$9,171	$9,360	$9,549	$9,738
Dockage							
Vessel Length	239	256	265	274	282	291	300
24 Hour Dockage Fee	$478	$512	$530	$548	$564	$582	$600
Days in Port (Rounded)	1	1	1	1	1	1	1
Dockage Costs	$478	$512	$530	$548	$564	$582	$600
Wharfage Fee per Net Ton	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
Wharfage Costs							
12	$992	$1,653	$1,895	$2,028	$2,135	$2,234	$2,287

TABLE B-14 (CONT.)

14	$992	$1,653	$1,983	$2,314	$2,543	$2,670	$2,750
16	$992	$1,653	$1,983	$2,314	$2,645	$2,975	$3,213
18	$992	$1,653	$1,983	$2,314	$2,645	$2,975	$3,306
20	$992	$1,653	$1,983	$2,314	$2,645	$2,975	$3,306
22	$992	$1,653	$1,983	$2,314	$2,645	$2,975	$3,306
24	$992	$1,653	$1,983	$2,314	$2,645	$2,975	$3,306
Total In-Port Costs							
12	$19,776	$28,183	$32,521	$36,899	$41,396	$46,036	$50,778
14	$19,776	$28,183	$32,610	$37,185	$41,804	$46,472	$51,241
16	$19,776	$28,183	$32,610	$37,185	$41,906	$46,777	$51,704
18	$19,776	$28,183	$32,610	$37,185	$41,906	$46,777	$51,797
20	$19,776	$28,183	$32,610	$37,185	$41,906	$46,777	$51,797
22	$19,776	$28,183	$32,610	$37,185	$41,906	$46,777	$51,797
24	$19,776	$28,183	$32,610	$37,185	$41,906	$46,777	$51,797
In-Port Travel Costs							
Tidal Delays							
Avg. Hrs. of Maximum Tidal Delay	6	6	6	6	6	6	6
Avg. Feet of Tidal Delay Per Depth							
12	3.1	5.0	5.5	5.5	5.5	5.5	5.5
14	1.1	3.0	4.0	5.0	5.5	5.5	5.5
16	0.0	1.0	2.0	3.0	4.0	4.9	5.5
18	0.0	0.0	0.0	1.0	2.0	2.9	3.9
20	0.0	0.0	0.0	0.0	0.0	0.9	1.9
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Avg. Hrs. of Tidal Delay Per Depth							
12	3.20	4.90	6.00	6.00	6.00	6.00	6.00
14	1.60	3.10	3.90	4.90	6.00	6.00	6.00
16	0.00	1.50	2.30	3.10	3.90	4.80	6.00
18	0.00	0.00	0.00	1.50	2.25	3.00	3.80
20	0.00	0.00	0.00	0.00	0.00	1.40	2.10
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Delay for Tide:							
Operating Cost at Sea	$972	$1,021	$1,045	$1,070	$1,094	$1,118	$1,143
Operating Cost at Port	$935	$977	$998	$1,019	$1,040	$1,061	$1,082
Tidal Delay Costs							
12	$2,992	$4,787	$5,988	$6,114	$6,240	$6,366	$6,492
14	$1,496	$3,029	$3,892	$4,993	$6,240	$6,366	$6,492
16	$0	$1,466	$2,295	$3,159	$4,056	$5,093	$6,492
18	$0	$0	$0	$1,529	$2,340	$3,183	$4,112
20	$0	$0	$0	$0	$0	$1,485	$2,272
22	$0	$0	$0	$0	$0	$0	$0
24	$0	$0	$0	$0	$0	$0	$0
Pilotage							
Vessel Length	239	256	265	274	282	291	300
Vessel Beam	39	43	45	47	49	51	53
Vessel Draft	13.1	15	16	17	18	18.9	19.9
Pilotage Units	93.21	110.08	119.25	128.78	138.18	148.41	159
Delaware River Pilot Fee	$1,230	$1,453	$1,574	$1,700	$1,824	$1,959	$2,099

Tug Costs

TABLE B-14 (CONT.)

Number of Tugs Used		1	1	1	1	1	1	1
Tug Rate		$650	$650	$650	$650	$650	$650	$650
Tug Costs		$650	$650	$650	$650	$650	$650	$650
In-Port & Cargo Transfer Costs								
	12	$24,648	$35,073	$40,734	$45,363	$50,110	$55,011	$60,019
	14	$23,152	$33,315	$38,726	$44,528	$50,518	$55,447	$60,482
	16	$21,656	$31,752	$37,129	$42,694	$48,436	$54,479	$60,945
	18	$21,656	$30,286	$34,834	$41,063	$46,720	$52,569	$58,657
	20	$21,656	$30,286	$34,834	$39,535	$44,380	$50,872	$56,818
	22	$21,656	$30,286	$34,834	$39,535	$44,380	$49,386	$54,545
	24	$21,656	$30,286	$34,834	$39,535	$44,380	$49,386	$54,545

TOTAL COST AND COST PER NET CARGO TON BY TRADE ROUTE:

Azores

Total Cost:	12' Channel Depth	$465,938	$486,616	$500,960	$510,266	$519,422	$528,899	$542,030
	14' Channel Depth	$462,946	$483,099	$496,945	$508,596	$520,237	$529,771	$542,956
	16' Channel Depth	$459,954	$479,972	$493,752	$504,927	$516,073	$527,836	$543,882
	18' Channel Depth	$459,954	$477,041	$489,161	$501,666	$512,641	$524,016	$539,306
	20' Channel Depth	$459,954	$477,041	$489,161	$498,609	$507,961	$520,621	$535,628
	22' Channel Depth	$459,954	$477,041	$489,161	$498,609	$507,961	$517,650	$531,083
	24' Channel Depth	$459,954	$477,041	$489,161	$498,609	$507,961	$517,650	$531,083
Cost Per Ton:	12' Channel Depth	$587.28	$368.01	$330.47	$314.47	$304.13	$295.98	$296.21
	14' Channel Depth	$583.51	$365.35	$313.18	$274.73	$255.76	$248.03	$246.78
	16' Channel Depth	$579.74	$362.98	$311.17	$272.75	$243.93	$226.77	$231.58
	18' Channel Depth	$579.74	$360.77	$308.28	$270.99	$242.30	$220.16	$203.93
	20' Channel Depth	$579.74	$360.77	$308.28	$269.34	$240.09	$218.73	$202.54
	22' Channel Depth	$579.74	$360.77	$308.28	$269.34	$240.09	$217.49	$200.82
	24' Channel Depth	$579.74	$360.77	$308.28	$269.34	$240.09	$217.49	$200.82

Distances to Ports-Nautical Miles

Azores	2529

TABLE B-15 F:VCTPUS3

APPLYING DR. PERAKIS (UNIV. OF MICHIGAN NAVAL ARCHITECTURE) POSITION PAPER FOR VESSEL DATA

TRANSPORTATION COST MODEL

SALEM RIVER

64.6% CARRYING CAPACITY APPLIED BASED ON 1991 USAGE OF RAINBOW HOPE

ACTUAL OPERATING CAPACITY: 1.5 FT CONSTRAINT

U.S. Flag Container Vessels:

VESSEL/CHANNEL CHARACTERISTICS	VESSEL CLASSES:						
Design Deadweight Tonnage (tonnes)	1500	2500	3000	3500	4000	4500	5000
Vessel Carried Tonnage Capacity (S.T.)	727	1369	1690	2012	2334	2655	2977
Design Draft	11.6	13.5	14.5	15.5	16.5	17.4	18.4
Immersion Factor (Tonnes/Inch)	17.2	20.7	22.5	24.2	25.9	27.7	29.4
Tidal Allowance	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Required Keel Clearance	2	2	2	2	2	2	2
Required Channel Depth	13.6	15.5	16.5	17.5	18.5	19.4	20.4
Shut Out Tonnage to Port (By Depth)							
12	0	0	0	0	221	450	729
14	0	0	0	0	0	0	226
16	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
Cargo Tonnage (S.T.)-Net Box Wgt							
12	539	1016	1254	1493	1568	1636	1668
14	539	1016	1254	1493	1732	1969	2041
16	539	1016	1254	1493	1732	1969	2208
18	539	1016	1254	1493	1732	1969	2208
20	539	1016	1254	1493	1732	1969	2208
22	539	1016	1254	1493	1732	1969	2208
24	539	1016	1254	1493	1732	1969	2208
OCEAN VOYAGE PARAMETERS							
Cruising Speed (Statute MPH)	13.6	14.3	14.5	14.8	15.2	15.5	15.8
Cruising Speed (Nautical MPH)	11.8	12.4	12.6	12.9	13.2	13.5	13.7
Hourly Operating Cost at Sea	$972	$1,021	$1,045	$1,070	$1,094	$1,118	$1,143
CARGO TRANSFER COSTS							
In-Port							
In-Port Waiting Hours	9	9	9	9	9	9	9
In-Port Transfer Hours	7	14	17	20	23	26	29
Hourly In-Port Operating Cost	$935	$977	$998	$1,019	$1,040	$1,061	$1,082
In-Port Cargo Transfer Cost	$6,722	$13,234	$16,681	$20,280	$24,014	$27,860	$31,861
In-Port Waiting Time Cost	$8,415	$8,793	$8,982	$9,171	$9,360	$9,549	$9,738
Dockage							
Vessel Length	239	256	265	274	282	291	300
24 Hour Dockage Fee	$478	$512	$530	$548	$564	$582	$600
Days in Port (Rounded)	1	1	1	1	1	1	1
Dockage Costs	$478	$512	$530	$548	$564	$582	$600
Wharfage Fee per Net Ton	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25	$1.25
Wharfage Costs							

TABLE B-15 (CONT.)

12	$674	$1,270	$1,567	$1,866	$1,959	$2,045	$2,085
14	$674	$1,270	$1,567	$1,866	$2,165	$2,462	$2,551
16	$674	$1,270	$1,567	$1,866	$2,165	$2,462	$2,761
18	$674	$1,270	$1,567	$1,866	$2,165	$2,462	$2,761
20	$674	$1,270	$1,567	$1,866	$2,165	$2,462	$2,761
22	$674	$1,270	$1,567	$1,866	$2,165	$2,462	$2,761
24	$674	$1,270	$1,567	$1,866	$2,165	$2,462	$2,761
Total In-Port Costs							
12	$16,289	$23,809	$27,760	$31,865	$35,897	$40,036	$44,284
14	$16,289	$23,809	$27,760	$31,865	$36,102	$40,453	$44,750
16	$16,289	$23,809	$27,760	$31,865	$36,102	$40,453	$44,960
18	$16,289	$23,809	$27,760	$31,865	$36,102	$40,453	$44,960
20	$16,289	$23,809	$27,760	$31,865	$36,102	$40,453	$44,960
22	$16,289	$23,809	$27,760	$31,865	$36,102	$40,453	$44,960
24	$16,289	$23,809	$27,760	$31,865	$36,102	$40,453	$44,960
In-Port Travel Costs							
Tidal Delays							
Avg. Hrs. of Maximum Tidal Delay	6	6	6	6	6	6	6
Avg. Feet of Tidal Delay Per Depth							
12	1.6	3.5	4.5	5.5	5.5	5.5	5.5
14	0.0	1.5	2.5	3.5	4.5	5.4	5.5
16	0.0	0.0	0.5	1.5	2.5	3.4	4.4
18	0.0	0.0	0.0	0.0	0.5	1.4	2.4
20	0.0	0.0	0.0	0.0	0.0	0.0	0.4
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Avg. Hrs. of Tidal Delay Per Depth							
12	1.70	3.50	4.50	6.00	6.00	6.00	6.00
14	0.00	1.80	2.70	3.50	4.50	5.90	6.00
16	0.00	0.00	0.70	1.80	2.70	3.40	4.40
18	0.00	0.00	0.00	0.00	0.70	1.70	2.60
20	0.00	0.00	0.00	0.00	0.00	0.00	0.60
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Delay for Tide:							
Operating Cost at Sea	$972	$1,021	$1,045	$1,070	$1,094	$1,118	$1,143
Operating Cost at Port	$935	$977	$998	$1,019	$1,040	$1,061	$1,082
Tidal Delay Costs							
12	$1,590	$3,420	$4,491	$6,114	$6,240	$6,366	$6,492
14	$0	$1,759	$2,695	$3,567	$4,680	$6,260	$6,492
16	$0	$0	$699	$1,834	$2,808	$3,607	$4,761
18	$0	$0	$0	$0	$728	$1,804	$2,813
20	$0	$0	$0	$0	$0	$0	$649
22	$0	$0	$0	$0	$0	$0	$0
24	$0	$0	$0	$0	$0	$0	$0
Pilotage							
Vessel Length	239	256	265	274	282	291	300
Vessel Beam	39	43	45	47	49	51	53
Vessel Draft	11.6	13.5	14.5	15.5	16.5	17.4	18.4
Pilotage Units	93.21	110.08	119.25	128.78	138.18	148.41	159
Delaware River Pilot Fee	$1,230	$1,453	$1,574	$1,700	$1,824	$1,959	$2,099

TABLE B-15 (CONT.)

Tug Costs							
Number of Tugs Used	1	1	1	1	1	1	1
Tug Rate	$650	$650	$650	$650	$650	$650	$650
Tug Costs	$650	$650	$650	$650	$650	$650	$650
In-Port & Cargo Transfer Costs							
12	$19,759	$29,332	$34,475	$40,329	$44,611	$49,011	$53,525
14	$18,169	$27,671	$32,678	$37,781	$43,256	$49,322	$53,991
16	$18,169	$25,912	$30,682	$36,049	$41,384	$46,669	$52,469
18	$18,169	$25,912	$29,984	$34,215	$39,304	$44,866	$50,522
20	$18,169	$25,912	$29,984	$34,215	$38,576	$43,062	$48,358
22	$18,169	$25,912	$29,984	$34,215	$38,576	$43,062	$47,708
24	$18,169	$25,912	$29,984	$34,215	$38,576	$43,062	$47,708

TOTAL COST AND COST PER NET CARGO TON BY TRADE ROUTE:

Azores

Total Cost:	12' Channel Depth	$456,160	$475,132	$488,442	$500,197	$508,423	$516,899	$529,042
	14' Channel Depth	$452,981	$471,811	$484,849	$495,102	$505,714	$517,521	$529,974
	16' Channel Depth	$452,981	$468,293	$480,857	$491,638	$501,970	$512,216	$526,931
	18' Channel Depth	$452,981	$468,293	$479,460	$487,969	$497,810	$508,609	$523,035
	20' Channel Depth	$452,981	$468,293	$479,460	$487,969	$496,354	$505,001	$518,707
	22' Channel Depth	$452,981	$468,293	$479,460	$487,969	$496,354	$505,001	$517,409
	24' Channel Depth	$452,981	$468,293	$479,460	$487,969	$496,354	$505,001	$517,409
Cost Per Ton:	12' Channel Depth	$845.99	$467.68	$389.65	$335.11	$324.34	$316.00	$317.17
	14' Channel Depth	$840.10	$464.41	$386.78	$331.69	$292.02	$262.78	$259.70
	16' Channel Depth	$840.10	$460.95	$383.60	$329.37	$289.86	$260.09	$238.59
	18' Channel Depth	$840.10	$460.95	$382.48	$326.91	$287.46	$258.26	$236.83
	20' Channel Depth	$840.10	$460.95	$382.48	$326.91	$286.62	$256.43	$234.87
	22' Channel Depth	$840.10	$460.95	$382.48	$326.91	$286.62	$256.43	$234.28
	24' Channel Depth	$840.10	$460.95	$382.48	$326.91	$286.62	$256.43	$234.28

Distances to Ports-Nautical Miles

Azores 2529

SALEM RIVER — TABLE B-16 — F:TSTPUS2

TOTAL TRANSPORTATION SAVINGS — DISCOUNT RATE= 8.5% — PRICE LEVEL= MARCH 1992

TRADE ROUTE: CONTAINERS-AZORES

FULLY LOADED VESSELS, MOST EFFICIENT CHARTER VESSEL SIZE PER CHANNEL DEPTH

APPLYING HISTORIC TONNAGE

12 FEET: DESDWT		12 FEET: PCT. OF FLEET	AVG $/TON	TOTAL TRANS COSTS	14 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
1,500		0.0%	$587.28	$0	$583.51	0.00%	$0
2,500		0.0%	$368.01	$0	$365.35	0.00%	$0
3,000		0.0%	$330.47	$0	$313.18	0.00%	$0
3,500		0.0%	$314.47	$0	$274.73	0.00%	$0
4,000		0.0%	$304.13	$0	$255.76	0.00%	$0
4,500		100.0%	$295.98	$3,699,750	$248.03	0.00%	$0
5,000		0.0%	$296.12	$0	$246.78	100.00%	$3,084,750
TOTAL SHORT TONS (1991) 1]	12,500	100.0%				100.0%	
				$3,699,750			$3,084,750
CUMULATIVE SAVINGS							$615,000

1] SOURCE: MID-ATLANTIC SHIPPING CORP

TABLE B-16 (CONT.)

16 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$579.74	0.00%	$0
$362.98	0.00%	$0
$311.17	0.00%	$0
$272.75	0.00%	$0
$243.95	0.00%	$0
$226.77	100.00%	$2,834,625
$231.58	0.00%	$0
	100.0%	
		$2,834,625
		$865,125

18 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$579.74	0.00%	$0
$360.77	0.00%	$0
$308.28	0.00%	$0
$270.99	0.00%	$0
$242.30	0.00%	$0
$220.16	0.00%	$0
$203.93	100.00%	$2,549,125
	100.0%	
		$2,549,125
		$1,150,625

20 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$579.74	0.00%	$0
$360.77	0.00%	$0
$308.28	0.00%	$0
$269.34	0.00%	$0
$240.09	0.00%	$0
$218.73	0.00%	$0
$202.54	100.00%	$2,531,750
	100.0%	
		$2,531,750
		$1,168,000

TABLE B-16 (CONT.)

22 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$579.74	0.00%	$0
$360.77	0.00%	$0
$308.28	0.00%	$0
$269.34	0.00%	$0
$240.09	0.00%	$0
$217.49	0.00%	$0
$200.82	100.00%	$2,510,250
	100.0%	
		$2,510,250
		$1,189,500

24 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$579.74	0.00%	$0
$360.77	0.00%	$0
$308.28	0.00%	$0
$269.34	0.00%	$0
$240.09	0.00%	$0
$217.49	0.00%	$0
$200.82	100.00%	$2,510,250
		$2,510,250
		$1,189,500

TABLE B-16 (CONT.)

PREDICTED TONNAGE:		PERIOD	AVG ANN GROWTH/YR FOR PERIOD
1989	12,500		
1994	12,500	1989-1994	0.00%
2001	12,500	1994-2001	0.00%
2011	12,500	2001-2011	0.00%
2014	12,500	2011-2014	0.00%
2031	12,500	2014-2031	0.00%
2044	12,500	2031-2044	0.00%

YEAR	CUMULATIVE TRANS COSTS 12 FT	SPPW,8 1/2%	PRESENT WORTH TRANS COSTS 12 FT	PRESENT WORTH TRANS COSTS 14 FT	PRESENT WORTH TRANS COSTS 16 FT	PRESENT WORTH TRANS COSTS 18 FT	PRESENT WORTH TRANS COSTS 20 FT	PRESENT WORTH TRANS COSTS 22 FT	PRESENT WORTH TRANS COSTS 24 FT
1994	$3,699,750	1.00000	$3,699,750	$3,084,750	$2,834,625	$2,549,125	$2,531,750	$2,510,250	$2,510,250
1995	$3,699,750	0.92166	$3,409,908	$2,843,088	$2,612,558	$2,349,424	$2,333,410	$2,313,594	$2,313,594
1996	$3,699,750	0.84946	$3,142,772	$2,620,357	$2,407,887	$2,165,368	$2,150,608	$2,132,345	$2,132,345
1997	$3,699,750	0.78291	$2,896,564	$2,415,076	$2,219,251	$1,995,731	$1,982,128	$1,965,295	$1,965,295
1998	$3,699,750	0.72157	$2,669,644	$2,225,876	$2,045,393	$1,839,383	$1,826,846	$1,811,332	$1,811,332
1999	$3,699,750	0.66505	$2,460,502	$2,051,499	$1,885,154	$1,695,284	$1,683,729	$1,669,430	$1,669,430
2000	$3,699,750	0.61295	$2,267,744	$1,890,782	$1,737,469	$1,562,474	$1,551,824	$1,538,645	$1,538,645
2001	$3,699,750	0.56493	$2,090,086	$1,742,657	$1,601,354	$1,440,068	$1,430,252	$1,418,106	$1,418,106
2002	$3,699,750	0.52067	$1,926,347	$1,606,135	$1,475,903	$1,327,252	$1,318,205	$1,307,010	$1,307,010
2003	$3,699,750	0.47988	$1,775,435	$1,480,309	$1,360,279	$1,223,273	$1,214,935	$1,204,618	$1,204,618
2004	$3,699,750	0.44229	$1,636,345	$1,364,340	$1,253,713	$1,127,441	$1,119,756	$1,110,247	$1,110,247
2005	$3,699,750	0.40764	$1,508,153	$1,257,456	$1,155,496	$1,039,116	$1,032,033	$1,023,269	$1,023,269
2006	$3,699,750	0.37570	$1,390,002	$1,158,946	$1,064,973	$957,711	$951,183	$943,105	$943,105
2007	$3,699,750	0.34627	$1,281,108	$1,068,153	$981,542	$882,683	$876,666	$869,221	$869,221
2008	$3,699,750	0.31914	$1,180,745	$984,473	$904,647	$813,532	$807,987	$801,126	$801,126
2009	$3,699,750	0.29414	$1,088,244	$907,348	$833,776	$749,799	$744,689	$738,365	$738,365
2010	$3,699,750	0.27110	$1,002,990	$836,265	$768,457	$691,059	$686,349	$680,520	$680,520
2011	$3,699,750	0.24986	$924,415	$770,752	$708,256	$636,921	$632,580	$627,208	$627,208
2012	$3,699,750	0.23028	$851,995	$710,370	$652,770	$587,024	$583,023	$578,072	$578,072
2013	$3,699,750	0.21224	$785,249	$654,719	$601,632	$541,036	$537,348	$532,785	$532,785
2014	$3,699,750	0.19562	$723,732	$603,428	$554,499	$498,651	$495,252	$491,046	$491,046
2015	$3,699,750	0.18029	$667,034	$556,155	$511,059	$459,586	$456,453	$452,577	$452,577
2016	$3,699,750	0.16617	$614,778	$512,585	$471,022	$423,581	$420,694	$417,122	$417,122
2017	$3,699,750	0.15315	$566,615	$472,428	$434,122	$390,398	$387,737	$384,444	$384,444
2018	$3,699,750	0.14115	$522,226	$435,418	$400,112	$359,813	$357,361	$354,326	$354,326
2019	$3,699,750	0.13009	$481,314	$401,307	$368,767	$331,625	$329,365	$326,568	$326,568
2020	$3,699,750	0.11990	$443,608	$369,868	$339[illegible]8	$305,645	$303,562	$300,984	$300,984
2021	[illegible],699,750	0.11051	$408,855	$340,892	$31[illegible]1	$281,701	$279,781	$277,405	$277,405

TA E B-16 (CONT.)

2022	$3,699,750	0.10185	$376,825	$314,186	$288,711	$259,632	$257,862	$255,673	$255,673
2023	$3,699,750	0.09387	$347,304	$289,573	$266,093	$239,292	$237,661	$235,643	$235,643
2024	$3,699,750	0.08652	$320,096	$266,887	$245,247	$220,546	$219,043	$217,183	$217,183
2025	$3,699,750	0.07974	$295,019	$245,979	$226,034	$203,268	$201,883	$200,168	$200,168
2026	$3,699,750	0.07349	$271,907	$226,709	$208,326	$187,344	$186,067	$184,487	$184,487
2027	$3,699,750	0.06774	$250,606	$208,948	$192,006	$172,667	$171,490	$170,034	$170,034
2028	$3,699,750	0.06243	$230,973	$192,579	$176,964	$159,140	$158,056	$156,713	$156,713
2029	$3,699,750	0.05754	$212,878	$177,492	$163,100	$146,673	$145,673	$144,436	$144,436
2030	$3,699,750	0.05303	$196,201	$163,587	$150,323	$135,183	$134,261	$133,121	$133,121
2031	$3,699,750	0.04888	$180,831	$150,772	$138,546	$124,592	$123,743	$122,692	$122,692
2032	$3,699,750	0.04505	$166,664	$138,960	$127,693	$114,832	$114,049	$113,080	$113,080
2033	$3,699,750	0.04152	$153,608	$128,074	$117,689	$105,835	$105,114	$104,221	$104,221
2034	$3,699,750	0.03827	$141,574	$118,040	$108,469	$97,544	$96,879	$96,057	$96,057
2035	$3,699,750	0.03527	$130,483	$108,793	$99,972	$89,903	$89,290	$88,531	$88,531
2036	$3,699,750	0.03251	$120,261	$100,270	$92,140	$82,859	$82,295	$81,596	$81,596
2037	$3,699,750	0.02996	$110,839	$92,415	$84,921	$76,368	$75,848	$75,204	$75,204
2038	$3,699,750	0.02761	$102,156	$85,175	$78,269	$70,385	$69,906	$69,312	$69,312
2039	$3,699,750	0.02545	$94,153	$78,502	$72,137	$64,871	$64,429	$63,882	$63,882
2040	$3,699,750	0.02345	$86,777	$72,352	$66,486	$59,789	$59,382	$58,877	$58,877
2041	$3,699,750	0.02162	$79,979	$66,684	$61,277	$55,105	$54,730	$54,265	$54,265
2042	$3,699,750	0.01992	$73,713	$61,460	$56,477	$50,788	$50,442	$50,014	$50,014
2043	$3,699,750	0.01836	$67,938	$56,645	$52,052	$46,809	$46,490	$46,096	$46,096
2044	$3,699,750	0.01692	$62,616	$52,208	$47,974	$43,142	$42,848	$42,484	$42,484
CUMULATIVE PRES WORTH: TRANS COSTS			$53,137,569	$44,304,646	$40,712,232	$36,611,745	$36,362,197	$36,053,404	$36,053,404
CRF, 50 YRS			0.0864630	0.0864630	0.0864630	0.0864630	0.0864630	0.0864630	0.0864630
AVG ANN CUMULATIVE TRANS COSTS			$4,594,434	$3,830,713	$3,520,102	$3,165,561	$3,143,985	$3,117,285	$3,117,285
AVG ANN CUMULATIVE TRANS SAVINGS (MARCH 1992)				$763,721	$1,074,332	$1,428,872	$1,450,449	$1,477,148	$1,477,148
AVG ANN CUMULATIVE TRANS SAVINGS (APRIL 1990)				$711,666	$1,001,106	$1,331,480	$1,351,586	$1,376,466	$1,376,466

SALEM RIVER TABLE B-17 F:TSTPUS3
TOTAL TRANSPORTATION SAVINGS DISCOUNT RATE= 8.5% PRICE LEVEL= MARCH 1992
TRADE ROUTE: CONTAINERS-AZORES
1.5 FOOT CONSTRAINT, MOST EFFICIENT CHARTER VESSEL SIZE PER CHANNEL DEPTH
APPLYING HISTORIC TONNAGE

DESDWT	12 FEET:	12 FEET: PCT. OF FLEET	AVG $/TON	TOTAL TRANS COSTS	14 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
1,500		0.0%	$845.99	$0	$840.10	0.00%	$0
2,500		0.0%	$467.68	$0	$464.41	0.00%	$0
3,000		0.0%	$389.65	$0	$386.78	0.00%	$0
3,500		0.0%	$335.11	$0	$331.69	0.00%	$0
4,000		0.0%	$324.34	$0	$292.02	0.00%	$0
4,500		100.0%	$316.00	$3,950,000	$262.78	0.00%	$0
5,000		0.0%	$317.17	$0	$259.70	100.00%	$3,246,250
TOTAL SHORT TONS (1991) 1]	12,500	100.0%				100.0%	
				$3,950,000			$3,246,250
CUMULATIVE SAVINGS							$703,750

1] SOURCE: MID-ATLANTIC SHIPPING CORP

TABLE B-17 (CONT.)

16 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS	18 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS	20 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$840.10	0.00%	$0	$840.10	0.00%	$0	$840.10	0.00%	$0
$460.95	0.00%	$0	$460.95	0.00%	$0	$460.95	0.00%	$0
$383.60	0.00%	$0	$382.48	0.00%	$0	$382.48	0.00%	$0
$329.37	0.00%	$0	$326.91	0.00%	$0	$326.91	0.00%	$0
$289.86	0.00%	$0	$287.46	0.00%	$0	$286.62	0.00%	$0
$260.09	0.00%	$0	$258.26	0.00%	$0	$256.43	0.00%	$0
$238.59	100.00%	$2,982,375	$236.83	100.00%	$2,960,375	$234.87	100.00%	$2,935,875
	100.0%			100.0%			100.0%	
		$2,982,375			$2,960,375			$2,935,875
		$967,625			$989,625			$1,014,125

17 M

TABLE B-17 (CONT.)

22 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS	24 FEET: AVG $/TON	% OF TOTAL FLEET $/TON	TOTAL TRANS COSTS
$840.10	0.00%	$0	$840.10	0.00%	$0
$460.95	0.00%	$0	$460.95	0.00%	$0
$382.48	0.00%	$0	$382.48	0.00%	$0
$326.91	0.00%	$0	$326.91	0.00%	$0
$286.62	0.00%	$0	$286.62	0.00%	$0
$256.43	0.00%	$0	$256.43	0.00%	$0
$234.28	100.00%	$2,928,500	$234.28	100.00%	$2,928,500
	100.0%				
		$2,928,500			$2,928,500
		$1,021,500			$1,021,500

TABLE B-17 (CONT.)

PREDICTED TONNAGE:		PERIOD	AVG ANN GROWTH/YR FOR PERIOD
1989	12,500		
1994	12,500	1989-1994	0.00%
2001	12,500	1994-2001	0.00%
2011	12,500	2001-2011	0.00%
2014	12,500	2011-2014	0.00%
2031	12,500	2014-2031	0.00%
2044	12,500	2031-2044	0.00%

YEAR	CUMULATIVE TRANS COSTS 12 FT	SPPW,8 1/2%	PRESENT WORTH TRANS COSTS 12 FT	PRESENT WORTH TRANS COSTS 14 FT	PRESENT WORTH TRANS COSTS 16 FT	PRESENT WORTH TRANS COSTS 18 FT	PRESENT WORTH TRANS COSTS 20 FT	PRESENT WORTH TRANS COSTS 22 FT	PRESENT WORTH TRANS COSTS 24 FT
1994	$3,950,000	1.00000	$3,950,000	$3,246,250	$2,982,375	$2,960,375	$2,935,875	$2,928,500	$2,928,500
1995	$3,950,000	0.92166	$3,640,553	$2,991,935	$2,748,733	$2,728,456	$2,705,876	$2,699,078	$2,699,078
1996	$3,950,000	0.84946	$3,355,348	$2,757,544	$2,533,394	$2,514,706	$2,493,895	$2,487,630	$2,487,630
1997	$3,950,000	0.78291	$3,092,487	$2,541,515	$2,334,926	$2,317,702	$2,298,520	$2,292,746	$2,292,746
1998	$3,950,000	0.72157	$2,850,218	$2,342,411	$2,152,005	$2,136,130	$2,118,452	$2,113,130	$2,113,130
1999	$3,950,000	0.66505	$2,626,929	$2,158,904	$1,983,415	$1,968,784	$1,952,490	$1,947,586	$1,947,586
2000	$3,950,000	0.61295	$2,421,133	$1,989,773	$1,828,032	$1,814,547	$1,799,530	$1,795,010	$1,795,010
2001	$3,950,000	0.56493	$2,231,459	$1,833,892	$1,684,822	$1,672,394	$1,658,553	$1,654,387	$1,654,387
2002	$3,950,000	0.52067	$2,056,644	$1,690,223	$1,552,832	$1,541,377	$1,528,620	$1,524,780	$1,524,780
2003	$3,950,000	0.47988	$1,895,525	$1,557,809	$1,431,181	$1,420,624	$1,408,867	$1,405,328	$1,405,328
2004	$3,950,000	0.44229	$1,747,027	$1,435,769	$1,319,061	$1,309,331	$1,298,495	$1,295,233	$1,295,233
2005	$3,950,000	0.40764	$1,610,163	$1,323,289	$1,215,724	$1,206,756	$1,196,769	$1,193,763	$1,193,763
2006	$3,950,000	0.37570	$1,484,022	$1,219,622	$1,120,483	$1,112,218	$1,103,013	$1,100,242	$1,100,242
2007	$3,950,000	0.34627	$1,367,762	$1,124,075	$1,032,704	$1,025,086	$1,016,602	$1,014,048	$1,014,048
2008	$3,950,000	0.31914	$1,260,610	$1,036,014	$951,800	$944,779	$936,960	$934,607	$934,607
2009	$3,950,000	0.29414	$1,161,853	$954,852	$877,235	$870,764	$863,558	$861,389	$861,389
2010	$3,950,000	0.27110	$1,070,832	$880,048	$808,512	$802,548	$795,906	$793,907	$793,907
2011	$3,950,000	0.24986	$986,942	$811,104	$745,172	$739,675	$733,554	$731,711	$731,711
2012	$3,950,000	0.23028	$909,624	$747,561	$686,795	$681,728	$676,087	$674,388	$674,388
2013	$3,950,000	0.21224	$838,363	$688,996	$632,991	$628,321	$623,121	$621,556	$621,556
2014	$3,950,000	0.19562	$772,685	$635,020	$583,401	$579,098	$574,305	$572,863	$572,863
2015	$3,950,000	0.18029	$712,152	$585,272	$537,697	$533,731	$529,314	$527,984	$527,984
2016	$3,950,000	0.16617	$656,361	$539,421	$495,573	$491,918	$487,847	$486,621	$486,621
2017	$3,950,000	0.15315	$604,941	$497,162	$456,750	$453,380	$449,628	$448,499	$448,499
2018	$3,950,000	0.14115	$557,549	$458,214	$420,967	$417,862	$414,404	$413,363	$413,363
2019	$3,950,000	0.13009	$513,870	$422,317	$387,988	$385,126	$381,939	$380,980	$380,980
2020	$3,950,000	0.11990	$473,613	$389,232	$357,593	$354,955	$352,018	$351,133	$351,133
2021	$3,950,000	0.11051	$436,510	$358,739	$329,579	$327,148	$324,440	$323,625	$323,625

TABLE B-17 (CONT.)

2022	$3,950,000	0.10185	$402,313	$330,635	$303,759	$301,519	$299,023	$298,272	$298,272
2023	$3,950,000	0.09387	$370,796	$304,733	$279,962	$277,897	$275,597	$274,905	$274,905
2024	$3,950,000	0.08652	$341,747	$280,860	$258,030	$256,127	$254,007	$253,369	$253,369
2025	$3,950,000	0.07974	$314,974	$258,857	$237,816	$236,061	$234,108	$233,520	$233,520
2026	$3,950,000	0.07349	$290,299	$238,578	$219,185	$217,568	$215,767	$215,225	$215,225
2027	$3,950,000	0.06774	$267,557	$219,888	$202,014	$200,524	$198,864	$198,364	$198,364
2028	$3,950,000	0.06243	$246,596	$202,661	$186,188	$184,814	$183,285	$182,824	$182,824
2029	$3,950,000	0.05754	$227,277	$186,785	$171,602	$170,336	$168,926	$168,502	$168,502
2030	$3,950,000	0.05303	$209,472	$172,152	$158,158	$156,992	$155,692	$155,301	$155,301
2031	$3,950,000	0.04888	$193,062	$158,665	$145,768	$144,693	$143,495	$143,135	$143,135
2032	$3,950,000	0.04505	$177,937	$146,235	$134,348	$133,357	$132,254	$131,921	$131,921
2033	$3,950,000	0.04152	$163,998	$134,779	$123,823	$122,910	$121,893	$121,587	$121,587
2034	$3,950,000	0.03827	$151,150	$124,220	$114,123	$113,281	$112,344	$112,061	$112,061
2035	$3,950,000	0.03527	$139,309	$114,489	$105,182	$104,406	$103,542	$103,282	$103,282
2036	$3,950,000	0.03251	$128,395	$105,520	$96,942	$96,227	$95,431	$95,191	$95,191
2037	$3,950,000	0.02996	$118,336	$97,253	$89,348	$88,689	$87,955	$87,734	$87,734
2038	$3,950,000	0.02761	$109,066	$89,634	$82,348	$81,741	$81,064	$80,861	$80,861
2039	$3,950,000	0.02545	$100,521	$82,612	$75,897	$75,337	$74,714	$74,526	$74,526
2040	$3,950,000	0.02345	$92,647	$76,140	$69,951	$69,435	$68,860	$68,687	$68,687
2041	$3,950,000	0.02162	$85,389	$70,175	$64,471	$63,995	$63,466	$63,306	$63,306
2042	$3,950,000	0.01992	$78,699	$64,678	$59,420	$58,982	$58,494	$58,347	$58,347
2043	$3,950,000	0.01836	$72,534	$59,611	$54,765	$54,361	$53,911	$53,776	$53,776
2044	$3,950,000	0.01692	$66,851	$54,941	$50,475	$50,103	$49,688	$49,563	$49,563
CUMULATIVE PRES WORTH: TRANS COSTS			$56,731,778	$46,624,186	$42,834,288	$42,518,313	$42,166,433	$42,060,510	$42,060,510
CRF, 50 YRS			0.0864630	0.0864630	0.0864630	0.0864630	0.0864630	0.0864630	0.0864630
AVG ANN CUMULATIVE TRANS COSTS			$4,905,200	$4,031,267	$3,703,581	$3,676,261	$3,645,836	$3,636,678	$3,636,678
AVG ANN CUMULATIVE TRANS SAVINGS (MARCH 1992)				$873,933	$1,201,619	$1,228,939	$1,259,363	$1,268,522	$1,268,522
AVG ANN CUMULATIVE TRANS SAVINGS (APRIL 1990)				$814,366	$1,119,716	$1,145,174	$1,173,525	$1,182,060	$1,182,060

Dockage fees at Salem have both a tangible and intangible advantage over New York/New Jersey. The terminal fees in New York/New Jersey are set by the Port Authority and are inflexible. These fees and any other incremental charges from the terminals themselves are passed on to the shippers. In Salem, dockage fees, which average $200/day, are approximately $1300/day less expensive than in New York/New Jersey.

Another incidental cost advantage of Salem over New York/New Jersey is line running charges. The charge for linemen in New York costs about $500, more than triple the cost per call over Salem at $150. Wharfage fees are marginally greater at the Port of New York/New Jersey than at the Port of Salem.

Other costs such as fuel and provisions are virtually identical. Costs of customs and other federal agency inspections are identical at both ports.

Another cost incurred originates from the costs of trucking into the ports. The shipping of goods to Bermuda is almost entirely a one way market - exporting to Bermuda. It is well recognized in the industry that the costs of trucking goods into the ports can have substantial impacts on the quantity of goods being exported out of a port. The best way to handle this problem is to find shippers near the port of origination. Presently about half the goods going to Bermuda come from the New York/North Jersey area, and about half come from Philadelphia, Maryland, Delaware, and even farther south in Virginia and the Carolinas. Goods coming from the latter area can be trucked at lower cost into Salem, which is 8 miles from the Delaware Memorial Bridge, than into New York/New Jersey, which is an additional 125 miles from the bridge. The round trip differential is obviously even greater. Conversely, goods coming from the former area can be shipped into the Port of New York/New Jersey at lower cost than into Salem. A shift in suppliers and manufacturers of the exports could significantly impact the relative costs of operating out of the two ports, but at the present time the difference is minimal.

The only real cost disadvantage at the port of Salem is the pilotage costs. Vessels are required to have a Salem River pilot and a Delaware River pilot. The costs of the pilots are $1300 in and out and $1900 in and out, respectively. The average number of trips for the vessels travelling to Bermuda, historically, has been 49 per year. The pilots operating out of the Port of New York/New Jersey charge $1,570. The required use of tug boats at Salem is also a slight disadvantage of the Port of Salem versus the Port of New York/New Jersey. While the cost per tug is cheaper at Salem than New York/New Jersey, tugs are primarily used only during inclement weather for the latter. Due to the narrower channel at Salem, tugs must be used during each trip.

Table B-18 presents a cost comparison of operations per trip through Salem and New York. The cost per box is less expensive through Salem.

RESULTS OF ECONOMIC ANALYSIS

For the economic optimization, average annual costs developed

TABLE B-18
COSTS OF OPERATIONS PER TRIP
SALEM VS NEW YORK
CONTAINER EXPORTS TO BERMUDA

	NEW YORK	SALEM
Stevedoring	$143,364	$35,100
Pilotage	1570	3200
Tugs	263 1/	650
Line Running	520	150
Dockage	1500	200
Wharfage	7355	5330
Total	$154,572	$44,630
Boxes/Trip (1991)	156	65
Cost/Box	$991	$687

1/ $1,050 per tug charge
Tugs used only in adverse weather, about 25% of the trips.

2/ Trucking costs per box considered comparable for the two ports.

for the feasibility report have been annualized applying the 8 1/2% discount rate and an April 1990 price level in Table B-19. Table B-20 presents average annual benefits, average annual costs, and the economic optimization for the project. Average annual benefits have been deflated from a February 1992 price level to an April 1990 price level to match the price level for costs. Average annual benefits for containers to Bermuda and the Azores have been determined by taking a weighted average of the transportation savings quantified in Tables B-9, B-12, B-13, B-16, and B-17 based on an apportionment of the fleet for actual operating practice constraints (i.e., 49%: unconstrained, 32%: 1.5 foot constraint, and 19%: 2.5 foot constraint for Bermuda; 92%: unconstrained, 8%: 1.5 foot constraint for Azores). Bulk benefits are based on 2% growth in tonnage per annum for the first 20 years of the project life applying the existing 1989-1991 level as base tonnage. The optimal channel depth plan (at an 8 1/2% discount rate) is 18 feet, with a benefit-cost ratio (BCR) of 1.7 and net benefits of $902,000, with both container and bulk benefits included. With bulk benefits deleted, the project remains optimized at 18 feet, has a BCR of 1.6, and net benefits of $780,000. A multiport analysis is not necessary for Salem because of the procedure applied in the study. Salem must be recognized as a "niche" market which has targeted a specific strategy for bringing certain commodities through the port. The analysis has only evaluated commodities that have historically moved through the port and are expected to continue to do so in the future. The actual movement of these commodities through Salem at the present time clearly delineates the economic viability and cost competitiveness of Salem versus other competing ports. An increase in berths and facilities at Salem will continue to increase the capability of the port to handle the same commodities at an increased level of tonnage. No new commodities, diversions, or induced tonnage are claimed in the analysis, which precludes the need to undertake a multiport analysis for the movement of commerce through the port of Salem. Based on tonnage projections, the port/landside facilities will be sufficient to handle projected throughput capacity. However, a detailed analysis, as outlined in an above section, has analyzed the Bermuda trade route to compares costs of Salem and the competing North Atlantic port.

RISK AND UNCERTAINTY ANALYSIS

A risk and uncertainty analysis was conducted to vary the key parameter of tonnage growth to determine the impact that this would have on project justification. A breakeven analysis of growth in tonnage for the selected plan was accomplished, and potential new tonnage as a result of the project is also discussed.

A. NO GROWTH IN TONNAGE OVER PROJECT LIFE

Transportation savings have been quantified with tonnage held constant at the level for year one of the project, 1994 (containers= 51,000 tons and bulk= 17,400 tons). The results are

TABLE B-19 F:SALCA

SALEM RIVER COST ANNUALIZATION 1), 2)

DISCOUNT RATE= 8.500%

PRICE LEVEL= APRIL 1990

	12 FT	14 FT	16 FT	17 FT	18 FT	19 FT	20 FT	22 FT	24 FT
FIRST COST:									
PROJECT	$0	$4,330,000	$7,071,000	$8,914,000	$9,974,000	$14,493,000	$17,747,000	$23,431,000	$26,736,000
ASSOC. COSTS	$0	$164,000	$222,000	$239,000	$266,000	$276,000	$299,000	$398,000	$452,000
SUBTOTAL	$0	$4,494,000	$7,293,000	$9,153,000	$10,240,000	$14,769,000	$18,046,000	$23,829,000	$27,188,000
INT DURING CONSTR 2)	$0	$156,102	$253,327	$317,935	$355,693	$513,011	$626,840	$827,716	$944,393
TOTAL	$0	$4,650,102	$7,546,327	$9,470,935	$10,595,693	$15,282,011	$18,672,840	$24,656,716	$28,132,393
CRF	0.086463	0.086463	0.086463	0.086463	0.086463	0.086463	0.086463	0.086463	0.086463
AVG ANN FIRST COSTS	$0	$402,062	$652,478	$818,885	$916,135	$1,321,329	$1,614,510	$2,131,894	$2,432,411
MAINTENANCE COSTS:									
DREDGING CYCLE-YEARS	4	4	3	3	3	3	3	3	3
PROJECT	$1,394,000	$1,905,000	$1,909,000	$2,060,000	$2,215,000	$2,557,000	$2,865,000	$3,438,000	$3,794,000
ASSOC COSTS	$0	$88,000	$81,000	$86,000	$92,000	$91,000	$89,000	$90,000	$103,000
TOTAL	$1,394,000	$1,993,000	$1,990,000	$2,146,000	$2,307,000	$2,648,000	$2,954,000	$3,528,000	$3,897,000
SFF	0.220288	0.220288	0.306539	0.306539	0.306539	0.306539	0.306539	0.306539	0.306539
AVG ANN MAINT COSTS	$307,081	$439,034	$610,013	$657,833	$707,185	$811,715	$905,516	$1,081,470	$1,194,582
AVG ANN COSTS (12 FT)	$307,000								
CUMULATIVE AVG ANN COSTS		$841,000	$1,262,000	$1,477,000	$1,623,000	$2,133,000	$2,520,000	$3,213,000	$3,627,000
CUMULATIVE AVG ANN COSTS (NETTING OUT 12 FT AVG ANN COSTS)		$534,000	$955,000	$1,170,000	$1,316,000	$1,826,000	$2,213,000	$2,906,000	$3,[illegible],000

1) INCLUDES MITIGATION, REPLACEMENT, AND NAVIGATION AID COSTS

2) SOURCE FOR COST ESTIMATES: MAY 1991 SALEM RIVER INTERIM FEASIBILITY REPORT

3) NINE MONTH CONSTRUCTION PERIOD; FIRST COST APPORTIONED UNIFORMLY

EXAMPLE:

INTEREST DURING CONSTRUCTION CALCULATION (18 FEET):

MONTH 1-	$1,137,778	1.06310	$1,209,567	
MONTH 2-	$1,137,778	1.05590	$1,201,375	
MONTH 3-	$1,137,778	1.04874	$1,193,232	
MONTH 4-	$1,137,778	1.04163	$1,185,147	
MONTH 5-	$1,137,778	1.03458	$1,177,118	
MONTH 6-	$1,137,778	1.02757	$1,169,142	
MONTH 7-	$1,137,778	1.02060	$1,161,221	
MONTH 8-	$1,137,778	1.01369	$1,153,353	
MONTH 9-	$1,137,778	1.00682	$1,145,539	
TOTAL	$10,240,000		$10,595,693	TOTAL INV. COST
			$10,240,000	MINUS FIRST COST

			$355,693	INT. DURING CONSTR.

ABLE B-20
SALEM RIVER ECONOMIC OPTIMIZATION F:SAABTEMP
HIGHEST NET BENEFIT DEPTH FOR EACH SENSITIVITY NOTED BY ASTERISK
APPLYING TRANSPORTATION COST MODEL WITH IMPACT OF ACTUAL OPERATING PRACTICES
CONTAINER: BERMUDA AND AZORES TRADE ROUTES
BULK: AVERAGE BULK TONNAGE THROUGH SALEM 1989-1991 WITH 2% GROWTH FOR FIRST 20 YEARS OF PROJECT LIFE
COST ESTIMATES BY DEPTH FROM MAY 1991 FEASIBILITY REPORT
DISCOUNT RATE= 8.5%
PRICE LEVEL= APRIL 1990

CHANNEL IMPROVEMENT	CUMULATIVE AVG ANN BENEFITS	CUMULATIVE AVG ANN COSTS	BENEFIT-COST RATIO	NET BENEFITS	CONTAINER BENEFITS	BULK BENEFITS
12 TO 14 FT	$1,300,000	$534,000	2.4	$766,000	$1,210,100	$89,600
12 TO 16 FT	$1,834,000	$955,000	1.9	$879,000	$1,722,800	$110,900
12 TO 17 FT	$2,026,000	$1,170,000	1.7	$856,000	$1,909,550	$116,250
12 TO 18 FT	$2,218,000	$1,316,000	1.7	$902,000 *	$2,096,300	$121,600
12 TO 19 FT	$2,253,000	$1,826,000	1.2	$427,000	$2,128,000	$125,350
12 TO 20 FT	$2,289,000	$2,213,000	1.0	$76,000	$2,159,700	$129,100
12 TO 22 FT	$2,343,000	$2,906,000	0.8	($563,000)	$2,206,600	$136,100
12 TO 24 FT	$2,352,000	$3,320,000	0.7	($968,000)	$2,206,600	$145,800

SENSITIVITY ANALYSIS: BULK BENEFITS DELETED, SALEM STRICTLY A CONTAINER PORT:

CHANNEL IMPROVEMENT	CUMULATIVE AVG ANN BENEFITS	CUMULATIVE AVG ANN COSTS	BENEFIT-COST RATIO	NET BENEFITS	CONTAINER BENEFITS
12 TO 14 FT	$1,210,000	$534,000	2.3	$676,000	$1,210,100
12 TO 16 FT	$1,723,000	$955,000	1.8	$768,000	$1,722,800
12 TO 17 FT	$1,910,000	$1,170,000	1.6	$740,000	$1,909,550
12 TO 18 FT	$2,096,000	$1,316,000	1.6	$780,000 *	$2,096,300
12 TO 19 FT	$2,128,000	$1,826,000	1.2	$302,000	$2,128,000
12 TO 20 FT	$2,160,000	$2,213,000	1.0	($53,000)	$2,159,700
12 TO 22 FT	$2,207,000	$2,906,000	0.8	($699,000)	$2,206,600
12 TO 24 FT	$2,207,000	$3,320,000	0.7	($1,113,000)	$2,206,600

TABLE B-20 (CONT.)

BERMUDA	F:TSTPFF2	F:TSTPFF3	F:TSTPFF4
AVG ANN BENEFITS FOR ACTUAL OPERATING PRACTICE:	FULL	1.5 LIGHT	2.5 LIGHT
12 TO 14 FT	$482,095	$506,130	$484,216
12 TO 16 FT	$786,763	$695,575	$547,836
12 TO 18 FT	$891,382	$735,867	$565,508
12 TO 20 FT	$923,192	$779,694	$634,076
12 TO 22 FT	$962,070	$793,125	$634,076
12 TO 24 FT	$962,070	$793,125	$634,076

AZORES	F:TSTPUS2	F:TSTPUS3
AVG ANN BENEFITS FOR ACTUAL OPERATING PRACTICE:	FULLY LOADED	1.5 FT LIGHT
12 TO 14 FT	$711,666	$814,366
12 TO 16 FT	$1,001,106	$1,119,716
12 TO 18 FT	$1,331,480	$1,145,174
12 TO 20 FT	$1,351,586	$1,173,525
12 TO 22 FT	$1,376,466	$1,182,060
12 TO 24 FT	$1,376,466	$1,182,060

PERCENTAGE OF CONTAINER OUTBOUND FLEET SAILING DRAFTS(SOURCE:1991 SALEM PILOT LOGS):

BERMUDA		AZORES	
FULL: >15 FT	49.0%	>15 FT	92.0%
1.5 LIGHTLOADED: 14 FT	32.0%	14 FT	8.0%
2.5 LIGHTLOADED: 13 FT	19.0%	13 FT	0.0%
TOTAL	100.0%	TOTAL	100.0%

as follows:

Channel Depth Increment	Container Trans Savings	Bulk Trans Savings	Total Trans Sav	BCR
12-14 feet	$1,029,000	$ 73,000	$1,102,000	2.1
12-16 feet	$1,459,000	$ 90,000	$1,549,000	1.6
12-18 feet	$1,808,000	$ 99,000	$1,907,000	1.4
12-20 feet	$1,855,000	$105,000	$1,960,000	0.9
12-22 feet	$1,890,000	$110,000	$2,000,000	0.7
12-24 feet	$1,890,000	$118,000	$2,008,000	0.6

With no growth in container and bulk tonnage over the project life, the project would optimize at 16 feet.

B. NO GROWTH IN TONNAGE BEYOND THE EXISTING YEAR

Transportation savings have been quantified with no growth in tonnage beyond the level of the existing year, 1991 (containers= 38,300 tons, bulk= 16,400 tons). The results are as follows:

Channel Depth Increment	Container Trans Savings	Bulk Trans Savings	Total Trans Sav	BCR
12-14 feet	$ 932,000	$ 69,000	$1,001,000	1.9
12-16 feet	$1,318,000	$ 85,000	$1,403,000	1.5
12-18 feet	$1,653,000	$ 93,000	$1,746,000	1.3
12-20 feet	$1,692,000	$ 99,000	$1,791,000	0.8
12-22 feet	$1,725,000	$104,000	$1,829,000	0.6
12-24 feet	$1,725,000	$112,000	$1,837,000	0.6

With no growth in tonnage beyond the existing year level, the project would optimize at 14 feet.

C. GROWTH IN CONTAINER TONNAGE TO THE YEAR 2000

Transportation savings have been quantified with growth in container tonnage to the final year projected by DRI/TBS, the year 2000, or 67,000 tons. Bulk tonnage has been allowed to grow at 2% per annum for the first twenty years of the project life. The results are as follows:

Channel Depth Increment	Container Trans Savings	Bulk Trans Savings	Total Trans Sav	BCR
12-14 feet	$1,138,000	$ 90,000	$1,228,000	2.3
12-16 feet	$1,618,000	$112,000	$1,730,000	1.8
12-18 feet	$1,982,000	$122,000	$2,104,000	1.6
12-20 feet	$2,039,000	$129,000	$2,168,000	1.0
12-22 feet	$2,082,000	$136,000	$2,218,000	0.8
12-24 feet	$2,082,000	$146,000	$2,228,000	0.7

With growth in container tonnage only to the year 2000 (covering the first six years of the project life), the project depth would optimize at 18 feet.

D. BREAKEVEN ANALYSIS

Growth in tonnage through year 2 of the project life is required to remain above the breakeven point of economic optimization for the selected 18 foot plan.

E. INDUCED TONNAGE

Additional commodities were identified during the study investigation that could potentially move through Salem over the project life based on discussions with Port of Salem officials, shippers, and local industries. The potential commodities and trade routes are as follows:

a. Rolled Newsprint (for needs of local newspapers)
    (1) New Brunswick, Canada to Salem
b. Polyvinyl Chloride (used as a raw material by local plant to make vinyl resilient floor coverings)
    (1) Canada to Salem
    (2) Chile to Salem
c. New Perishables (originating from southern New Jersey agricultural region; processed in local irradiation facility; shipped to foreign destinations)
    (1) Salem to Trinidad
    (2) Salem to United Kingdom
    (3) Salem to Brazil
d. Wood Pulp (for local paper needs)
    (1) Georgia to Salem
    (2) Chile to Salem
    (3) Sweden to Salem
e. Cement Clinker (raw material used to make building products locally)
    (1) Spain to Salem
f. Bauxite (raw material used by local plant in the manufacturing of rubber, plastics)
    (1) Jamaica to Salem
g. Magnesium Oxide (raw material used by local plant to make magnesium oxide hybrid slurry for utility systems)
    (1) Greece to Salem
    (2) United Kingdom to Salem
    (3) Mexico to Salem
h. Copper (raw material used by local plant for mineral processing)
    (1) Canada to Salem
    (2) Chile to Salem
i. Zircon (raw material used by local plant for mineral processing)
    (1) Brazil to Salem
j. Epsom Salt (raw material used by local plant for mineral processing)
    (1) Mexico to Salem
k. Furniture (Swedish furniture manufacturer has distribution warehouse situated near port)
    (1) Sweden to Salem
l. Aluminum Oxide
    (1) Jamaica to Salem
m. Containers
    (1) South America to Salem (diverted from Miami as destination

port)

If this tonnage were to become reality in moving through Salem, total benefits for the project would be higher than the benefits as quantified for the commodities in Table B-20. However, due to the speculative nature of these potential commodities, they were not included in the benefit analysis.

RESULTS OF ECONOMIC ANALYSIS-SELECTED PLAN

Average annual benefits and average annual costs for the 18-foot selected plan have been developed, at an October 1992 price level, applying the 8 1/2% discount rate. Table B-21 presents the results, with a benefit-cost ratio of 1.7.

TABLE B-21

SALEM RIVER ECONOMIC ANALYSIS FOR 18 FOOT DEPTH SELECTED PLAN F:SALCA92B

A) COST ANNUALIZATION 1)

DISCOUNT RATE= 8.500%

PRICE LEVEL= OCT 1992

	12 FT	18 FT
FIRST COST:		
PROJECT	$0	$9,535,000
ASSOC. COSTS	$0	$877,000
SUBTOTAL	$0	$10,412,000
INT DURING CONSTR 2)	$0	$361,668
TOTAL	$0	$10,773,668
CRF	0.086463	0.086463
AVG ANN FIRST COSTS	$0	$931,524
MAINTENANCE COSTS:		
DREDGING CYCLE-YEARS	4	3
PROJECT	$1,496,000	$2,414,000
ASSOC COSTS	$0	$100,000
TOTAL	$1,496,000	$2,514,000
SFF	0.220288	0.306539
AVG ANN MAINT COSTS 3)	$330,000	$770,639
CUMULATIVE AVG ANN COSTS (OCT 92)		$1,702,000
AVG ANN COSTS (NETTING OUT 12 FOOT W/O PROJECT CONDITION)		$1,372,000

1) INCLUDES MITIGATION, REPLACEMENT, AND NAVIGATION AID COSTS

2) NINE MONTH CONSTRUCTION PERIOD;FIRST COST APPORTIONED UNIFORMLY

3) W/O PROJECT CONDITION MAINTENANCE COSTS FROM FEASIBILITY REPORT

INTEREST DURING CONSTRUCTION CALCULATION (18 FEET):

MONTH 1-	$1,156,889	1.06310	$1,229,883	
MONTH 2-	$1,156,889	1.05590	$1,221,554	
MONTH 3-	$1,156,889	1.04874	$1,213,274	
MONTH 4-	$1,156,889	1.04163	$1,205,054	
MONTH 5-	$1,156,889	1.03458	$1,196,889	
MONTH 6-	$1,156,889	1.02757	$1,188,780	
MONTH 7-	$1,156,889	1.02060	$1,180,726	
MONTH 8-	$1,156,889	1.01369	$1,172,726	
MONTH 9-	$1,156,889	1.00682	$1,164,781	
TOTAL	$10,412,000		$10,773,668	TOTAL INV. COST
			$10,412,000	MINUS FIRST COST

			$361,668	INT. DURING CONSTR.

B) ECONOMIC ANALYSIS

AVG ANN BENEFITS (OCT 92)	$2,380,000
AVG ANN COSTS (OCT 92)	$1,372,000
BCR	1.7
NET BENEFITS	$1,008,000

APPENDIX D

DESIGN/COST ESTIMATE

SECTION	DESCRIPTION
1	DESIGN CALCULATIONS
2	BORING LOGS
3	COST ESTIMATE

SECTION 1

DESIGN CALCULATIONS

DELAWARE RIVER
COMPREHENSIVE NAVIGATION STUDY
SALEM RIVER, NEW JERSEY

DESIGN MEMORANDUM

TECHNICAL APPENDIX

1.0 Utilities - There are no known utilities within the project limits that would be effected by construction of the project.

2.0 Channel Alignment and Geometry - The shape and alignment of the channel were based on ER 1110-2-1461, WES's ship simulator model, and recommendations from the Pilots of Salem River and the study Sponsor. Turning basin geometry was determined using EM 1110-2-1613. The total of the main stem, bend widening and turning basin quantities for the Federal navigation channel is shown on Table 1.

3.0 Non-Federal Requirements - Table 2 is a summary of the Non-Federal dredging requirements. The depths for Berths 1 thru 4 are based on anticipated vessel usage with continuous tidal operation.

4.0 Quantity Development - All quantities were developed using soundings from January 1991 Salem River Survey. Quantities, including the main stem, bend widening and turning basin, were computer generated using the "DREQUA" program average end method.

5.0 Planned Improvements - With project planned improvements funded by Non-Federal means, include deepening of existing berth areas.

TABLE 1

TOTAL FEDERAL PROJECT QUANTITIES

ITEM		INITIAL DREDGING
Required Dredging		690,527 CY
Overdepth Dredging		246,038 CY
TOTAL		936,565 CY
	SAY	936,600 CY

TABLE 2

NON-FEDERAL QUANTITIES
22 FOOT DEPTH - INITIAL DREDGING

BERTH AREA	REQUIRED	OVERDEPTH	TOTAL
No. 1	12,191 CY	1,618 CY	13,809 CY
No. 2	30,108	7,015	37,123
No. 3	28,008	3,463	31,471
No. 4	11,931	2,844	14,775
TOTAL	82,238 CY	14,940 CY	97,178 CY
		SAY	97,200 CY

TABLE 3

TOTAL FEDERAL AND NON-FEDERAL
PROJECT QUANTITIES - INITIAL DREDGING

Federal Project	936,600 CY
Non-Federal	97,200 CY
TOTAL	1,033,800 CY

TABLE 4

MITIGATION QUANTITIES

Planting	17.2 AC
Excavation	
Creation	41,301 CY
Restoration	30,460 CY
	71,761 CY

SECTION 2

BORING LOGS

Hole No. SB-1

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET 1 OF 1 SHEETS

1. PROJECT SALEM RIVER	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station) N 271 420 E 1770 790	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY NATIONAL FOUNDATION ENG.	12. MANUFACTURER'S DESIGNATION OF DRILL S & H 40C
4. HOLE NO. (As shown on drawing title and file number) SB-1	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 6 — UNDISTURBED
5. NAME OF DRILLER JIM RALSTON	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED 29 APR 1985 — COMPLETED 29 APR 1985
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE -12
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 12.0'	19. SIGNATURE OF INSPECTOR TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 12'			
-12	0	CL	Top 0.3' SAND & gravel silty, black CLAY, sandy, fine to med. rust colored	2-8 11-14	S-1	
-14	2		SAME AS S-1	12-25 39 100/0.25	S-2	
-16	4		SAME AS S-1	10-22 35-64	S-3	
-18	6		SAME AS S-1	13-23 39 100/0.4	S-4	
-20	8		SAME AS S-1	5-19 55 100/0.4	S-5	
-22	10		SAME AS S-1	9-20 20-34	S-6	
-24	12					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT SALEM RIVER — HOLE NO. SB-1

Hole No. SB-2

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET 1 OF 1 SHEETS

1. PROJECT SALEM RIVER	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station) N 270 870 E 1769 450	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY NATIONAL FOUNDATION ENG.	12. MANUFACTURER'S DESIGNATION OF DRILL S&H 40C
4. HOLE NO. (As shown on drawing title and file number) SB-2	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 6 — UNDISTURBED
5. NAME OF DRILLER JIM RALSTON	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED 29 APR 1985 — COMPLETED 29 APR 1985
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE -19
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 12.0'	19. SIGNATURE OF INSPECTOR TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 19'			
-19	0		CLAY, dark grey, soft organics	PUSH / 2'	S-1	
-21	2		SAME AS S-1	WR / 1' PUSH / 1'	S-2	
-23	4	CL	SAME AS S-1	PUSH / 2'	S-3	
-25	6		SAME AS S-1	PUSH / 2'	S-4	
-27	8		SAME AS S-1	WR / 1' PUSH / 1'	S-5	
-29	10		SAME AS S-1	PUSH / 2'	S-6	
-31	12					

Hole No. SB-3

DRILLING LOG	DIVISION: NAD	INSTALLATION: PDO	SHEET 1 OF 1 SHEETS

1. PROJECT: SALEM RIVER	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station): N 270 600 E 1768 360	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: NATIONAL FOUNDATION ENG.	12. MANUFACTURER'S DESIGNATION OF DRILL: S & H 40C
4. HOLE NO. (As shown on drawing title and file number): SB-3	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED: 4 — UNDISTURBED:
5. NAME OF DRILLER: JIM RALSTON	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED: 29 APR 1985 — COMPLETED: 29 APR 1985
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE: -15
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE: 7.5'	19. SIGNATURE OF INSPECTOR: TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 15'			
-15.0	0		Top 0.1' SILTY sandy black with organics CLAY and sand, red rust brown, sand fine to med.	10-19 37-66	S-1	
	2	CL	CLAY, sandy, dark red brown, sand fine to med. sand	12-43 100/0.45	S-2	
	4		SAME AS S-2	14-25 63 100/0.4	S-3	
	6		SAME AS S-2	16-29 100/0.5'	S-4	
	7.5					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: SALEM RIVER

HOLE NO. SB-3

Hole No. SB-4

DRILLING LOG	DIVISION: NAD	INSTALLATION: PDO	SHEET 1 OF 1 SHEETS

1. PROJECT: SALEM RIVER	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station): N 270 399 E 1767 515	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: NATIONAL FOUNDATION ENG.	12. MANUFACTURER'S DESIGNATION OF DRILL: S & H 40C
4. HOLE NO. (As shown on drawing title and file number): SB-4	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5 / UNDISTURBED
5. NAME OF DRILLER: JIM RALSTON	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 25 APR 1985 / COMPLETED 25 APR 1985
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE: -14
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE: 10.0	19. SIGNATURE OF INSPECTOR: TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 14'			
-14	0		Top 0.2' SANDKsiltyyblack, some gravel CLAY, sandy, rust-red med. sand	9-18 32-39	S-1	
-16	2		CLAY, sandy 2.0' - 3.5' some sand 3.5' - 4.0' rusty red alternating layers clay and yellow and brown sand	17-23 51-88	S-2	
-18	4	CL	SAME AS S-2 sandy	8-27 37-56	S-3	
-20	6		SAME AS S-3	12-26 33-35	S-4	
-22	8		SAME AS S-3	8-14 17-25	S-5	
-24	10					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT SALEM RIVER HOLE NO. SB-4

Hole No. SB-5

DRILLING LOG

DIVISION	NAD
INSTALLATION	PDO
SHEET 1 OF 1 SHEETS	
1. PROJECT	SALEM RIVER
2. LOCATION (Coordinates or Station)	N 270 183 E 1766 778
3. DRILLING AGENCY	NATIONAL FOUNDATION ENG.
4. HOLE NO. (As shown on drawing title and file number)	SB-5
5. NAME OF DRILLER	JIM RALSTON
6. DIRECTION OF HOLE	XX VERTICAL ☐ INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	
8. DEPTH DRILLED INTO ROCK	
9. TOTAL DEPTH OF HOLE	9.5'
10. SIZE AND TYPE OF BIT	
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	S & H 40C
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED: 5 UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED: 24 APR 1985 COMPLETED: 24 APR 1985
17. ELEVATION TOP OF HOLE	-14
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 14'			
-14	0		SAND, rust colored, fine to med. trace clay,occ. gravel	4-7 12-13	S-1	
-16	2		CLAY, rust colored ~~sandy~~ sandy fine to med. layers brown, green yellow sand	17-16 17-22	S-2	
-18	4	SC	SAME AS S-2 grades gradually into fine to med. sand some clay	9-13 11-30	S-3	
-20	6		CLAY, sandy, rust colored layers of brown, green yellow sand	16-17 19-29	S-4	
-22	8		SAND, clayey, rust colored fine to med.	8-17 27	S-5	
-23.5	9.5					

Hole No. SB-6

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET 1 OF 1 SHEETS

1. PROJECT SALEM RIVER	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station) N 269 956 E 1756 756	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY NATIONAL FOUNDATION ENG.	12. MANUFACTURER'S DESIGNATION OF DRILL S & H 40C
4. HOLE NO. (As shown on drawing title and file number) SB-6	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 6; UNDISTURBED
5. NAME OF DRILLER JIM RALSTON	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 24 APR 1985; COMPLETED 24 APR 1985
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE -14
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 10.0'	19. SIGNATURE OF INSPECTOR TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 14'			
-14	0			PUSH 1.2 2-2	S-1	No. rec. outside of spoon GREEN clay, trace sand trace gravel
-16	2		SAND, fine to med., green some clay	3-3	S-2	
			CLAY, sandy green and rust colored	2-4	S-3	
-18	4		SAND, clayey, fine to med. rust colored	5-4 6-7	S-4	
-20	6		SAME AS S-4 but some CLAY, occ clay layer	7-11 8-13	S-5	
-22	8	SP	SAND, fine to course trace clay	4-19 22-16	S-6	
-24	10					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT SALEM RIVER HOLE NO. SB-6

Hole No. SB-7

DRILLING LOG

DIVISION: NAD
INSTALLATION: PDO
SHEET 1 OF 1 SHEETS

1. PROJECT: SALEM RIVER
2. LOCATION (Coordinates or Station): N 269 510 E 1764 845
3. DRILLING AGENCY: NATIONAL FOUNDATION ENG.
4. HOLE NO. (As shown on drawing title and file number): SB-7
5. NAME OF DRILLER: JIM RALSTON
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED ______ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN:
8. DEPTH DRILLED INTO ROCK:
9. TOTAL DEPTH OF HOLE: 10.0'
10. SIZE AND TYPE OF BIT:
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: S & H 40C
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 6 | UNDISTURBED
14. TOTAL NUMBER CORE BOXES:
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 24 APR 1985 | COMPLETED 24 APR 1985
17. ELEVATION TOP OF HOLE: -13.5
18. TOTAL CORE RECOVERY FOR BORING: %
19. SIGNATURE OF INSPECTOR: TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 13.5'			
-13.5	0		SAND, clayey, fine to med. tan, occ. gravel grades into sandy clay	3-5 6-4	S-1	
-15.5	2		SAND, clayey, fine to course occ. gravel	12-7	S-2	
			CLAY, sandy, light grey sand is very fine	5-4	S-3	
-17.5	4	CL	CLAY, light grey-tan some fine sand at top trace at bottom	5-6 4-3	S-4	
-19.5	6		SAME AS S-4 no sand to 6.5 SANDY at bottom	PUSH / 1.2' 5 -6 / 0.3'	S-5	
-21.5	6		SAND, clayey, fine to course some gravel green	10-9 17-21	S-6	
-23.5	10					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: SALEM RIVER | HOLE NO.: SB-7

Hole No. SB-8

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET 1 OF 1 SHEETS

1. PROJECT: SALEM RIVER	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station): N 269 062 E1763 884	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: NATIONAL FOUNDATION ENG.	12. MANUFACTURER'S DESIGNATION OF DRILL: S & H 40C
4. HOLE NO. (As shown on drawing title and file number): SB-8	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED: 5 — UNDISTURBED:
5. NAME OF DRILLER: JIM RALSTON	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ______ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED: 23 APR 1985 — COMPLETED: 23 APR 1985
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE: -16.5
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE: 8.0'	19. SIGNATURE OF INSPECTOR: TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 16.5'			
16.5	0		CLAY, alternating layers of light brown and blue grey at top, all blue grey at bottom	1-2 2-4	S-1	
-18.5	2		SAND, clayey, lt. brown fine to med.		S-2	
		CL	SAME AS S-1, blue-gry	10-11 13-15	S-3	
-20.5	4		CLAY, blue-grey top 0.4' dark grey with occ. thin layers of very fine light grey sand	2-3 2-3	S-4	
-22.5	6		SAME AS S-4, dark grey	1-2 3-4	S-5	
-24.5	8					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT SALEM RIVER HOLE NO. SB-8

(TRANSLUCENT)

Hole No. SB-9

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET 1 OF 1 SHEETS

1. PROJECT SALEM RIVER	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station) N 269 189 E 1762 929	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY NATIONAL FOUNDATION ENG.	12. MANUFACTURER'S DESIGNATION OF DRILL S & H 40C
4. HOLE NO. (As shown on drawing title and file number) SB-9	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 3; UNDISTURBED
5. NAME OF DRILLER JIM RALSTON	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 23 APR 1985; COMPLETED 23 APR 1985
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE -17.5
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 6.0'	19. SIGNATURE OF INSPECTOR TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 17.5'			
-17.5	0	CL	CLAY, dark grey some med. sand	PUSH / 2'	S-1	
-19.5	2	SP	SAND, fine to med., dark brown and black, trace fines	2-3 1-1	S-2	very poor rec.
-21.5	4		CLAY, light grey, some sand	WR / 1' PUSH / 1'	S-3	
-23.5	6					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT SALEM RIVER | HOLE NO. SB-9

Hole No. SB-10

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET 1 OF 1 SHEETS
1. PROJECT SALEM RIVER		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station) N 269 322 E 1761 991		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY NATIONAL FOUNDATION ENG.		12. MANUFACTURER'S DESIGNATION OF DRILL S & H 40C	
4. HOLE NO. (As shown on drawing title and file number) SB-10		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 4 — UNDISTURBED	
5. NAME OF DRILLER JIM RALSTON		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE — STARTED 23 APR 1985 — COMPLETED 23 APR 1985	
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE -16	
9. TOTAL DEPTH OF HOLE 8.0'		18. TOTAL CORE RECOVERY FOR BORING %	
		19. SIGNATURE OF INSPECTOR TRB	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 16'			
-16	0	CL	CLAY, dark grey, occ. layers of fine to med. light grey sand	PUSH-1 1-1	S-1	
-18	2		CLAY, dark grey grades into alternating layers of clay and sand	PUSH-3 0.8 0.2 7-6	S-2	
-20	4		SAND, fine to med., light grey, some clay	3-10 20-14	S-3	
-22	6	SC	SAND, fine to med., clayey dark grey and black	5-4 2-1	S-4	
-24	8					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT SALEM RIVER — HOLE NO. SB-10

Hole No. SB-22

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET 1 OF 1 SHEETS

1. PROJECT SALEM RIVER	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station) N 260 900 E 1754 840	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY NATIONAL FOUNDATION ENG.	12. MANUFACTURER'S DESIGNATION OF DRILL S & H 40C
4. HOLE NO. (As shown on drawing title and file number) SB-22	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 5 — UNDISTURBED
5. NAME OF DRILLER JIM RALSTON	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED 26 APR 1985 — COMPLETED 26 APR 1985
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE -12
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 10.0'	19. SIGNATURE OF INSPECTOR TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 12'			STA 4+060 20' R of ℄
-12	0		CLAY and sand layers alternating, dark grey dark grey, sand fine to med.	1/1' 1/1'	S-1	
-14	2		CLAY, grey, soft sticky	PUSH/2'	S-2	
-16	4	CL	CLAY, grey-blue grey occ. thin layers of fine light grey sand toward bottom	WR/1' PUSH/1'	S-3	
-18	6		SAME AS S-3	WR/0.8' PUSH/1.2'	S-4	
-20	8		SAME AS S-3	PUSH/2'	S-5	
-22	10					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) PROJECT SALEM RIVER HOLE NO. SB-22

Hole No.

DRILLING LOG	DIVISION NAD	INSTALLATION FUO	SHEET 1 OF 1 SHEETS

1. PROJECT: Salem River	10. SIZE AND TYPE OF BIT: 2" Split Spoon
2. LOCATION (Coordinates or Station): N 269 411 E 1761 223	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: National Foundation Eng.	12. MANUFACTURER'S DESIGNATION OF DRILL: S+H 40 C
4. HOLE NO. (As shown on drawing title and file number): SB-11	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 4; UNDISTURBED
5. NAME OF DRILLER: Jim Ralston	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER: Tidal
7. THICKNESS OF OVERBURDEN: 12.0	16. DATE HOLE: STARTED 23 Apr 1985; COMPLETED 23 Apr 1985
8. DEPTH DRILLED INTO ROCK: -	17. ELEVATION TOP OF HOLE: -12
9. TOTAL DEPTH OF HOLE: 12.0'	18. TOTAL CORE RECOVERY FOR BORING %
	19. SIGNATURE OF INSPECTOR: TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 12'			STA 15+280 45' S of ℄
-12.0'	0	SP	SAND, some silt and weathered, soft rock fragment w/black mica flakes	Push-2 3-6	S-1	
	2	CL	CLAY, sandy, light grey-tan	8-10 12-8	S-2	
	4			5-9 5-8		No Rec. In two attemps wash looks same as S-2
	6			16-13 20-17		" "
	8	SC	SAND, fine to coarse, clayey, light brown	16-14 20-17	S-3	
	10		SAND, fine to coarse clayey, rust colored	4-12 13-16	S-4	
-24.0	12		Bottom of hole			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT: SALEM RIVER — HOLE NO.: SB-11

Hole No.

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET OF 1 SHEETS

1. PROJECT Salem River	10. SIZE AND TYPE OF BIT 2" Split Spoon
2. LOCATION (Coordinates or Station) N 269 243 E 1760 056	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY National Foundation Eng.	12. MANUFACTURER'S DESIGNATION OF DRILL S+H 40 C
4. HOLE NO. (As shown on drawing title and file number) SB-12	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 4 — UNDISTURBED
5. NAME OF DRILLER Jim Ralston	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER Tidal
	16. DATE HOLE — STARTED 22 Apr 1985 — COMPLETED 22 Apr 1985
7. THICKNESS OF OVERBURDEN 10.0	17. ELEVATION TOP OF HOLE -13
8. DEPTH DRILLED INTO ROCK -	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 10.0	19. SIGNATURE OF INSPECTOR TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 13'			STA 14+000 25' S of ℄
-13.0'	0			Push		No Rec. Wash - med. brown sand
	2		Alternating layers of grey CLAY and light grey fine SAND	8-9 8-12	S-1	
	4	CL & SP	Alternating very thin layers of dark grey CLAY and light grey very fine SAND	WOH-1 2-6	S-2	
	6		CLAY, dark grey occ. very thin layers of very fine light grey SAND	WOH WOH 2-3	S-3	
	8		Same as S-3	3-5 8-10	S-4	
-23.0'	10		Bottom of hole			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT Salem River HOLE NO. SB-12

Hole No.

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET 1 OF 1 SHEETS

1. PROJECT Salem River	10. SIZE AND TYPE OF BIT 2" Split Spoon
2. LOCATION (Coordinates or Station) N 268 510 E 1759 420	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY National Foundation Eng.	12. MANUFACTURER'S DESIGNATION OF DRILL S+H 40C
4. HOLE NO. (As shown on drawing title and file number) SB-13	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 8 — UNDISTURBED
5. NAME OF DRILLER Jim Ralston	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER Tidal
	16. DATE HOLE — STARTED 05 May 1985 — COMPLETED 05 May 1985
7. THICKNESS OF OVERBURDEN 12.0'	17. ELEVATION TOP OF HOLE -12
8. DEPTH DRILLED INTO ROCK –	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 12.0'	19. SIGNATURE OF INSPECTOR TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 12'			STA 12+980 10' S of ℄
-12'	0	SP	SAND, fine to med, trace fines	~~Push~~-2 3-5	S-1	Poor Rec. Gravel blocks spoon
	2		Same as S-1, No gravel	3-5	S-2	
			SAND, very fine, grey, some clay, blue-grey	8-11	S-3	
	4		Same as S-3 Occ. small gravel	11-9 10-13	S-4	
	6		Same as S-3, fine to coarse SAND	10-9	S-5	
		SC	SAND, fine to med., clayey	12-18	S-6	
	8	SP	SAND, fine to very coarse trace fines Top 0.5' Fine Sand	7-14 15-17	S-7	
	10		Same as S-7	7-15 20-25	S-8	
-24'	12		Bottom of hole			

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE — PROJECT Salem River — HOLE NO. SB-13

Hole No.

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET 1 OF 1 SHEETS

1. PROJECT Salem River	10. SIZE AND TYPE OF BIT 2" Split Spoon
2. LOCATION (Coordinates or Station) N 267 560 E 1 758 960	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY National Foundation Eng.	12. MANUFACTURER'S DESIGNATION OF DRILL S+H 40C
4. HOLE NO. (As shown on drawing title and file number) SB- 14	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 6; UNDISTURBED
5. NAME OF DRILLER Jim Ralston	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER Tidal
	16. DATE HOLE: STARTED 04 May 1985; COMPLETED 04 May 1985
7. THICKNESS OF OVERBURDEN 10.0	17. ELEVATION TOP OF HOLE -14
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 10.0	19. SIGNATURE OF INSPECTOR TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 14'			STA 11+930 15' E of ℄
-14'	0	SC	SAND, fne to med, clayey brown, occ. dark grey clay layer	6-7 7-8	S-1	
	2		Same as S-1 No clay layers	16-12 10-20	S-2	
	4		Same as S-2	5-4 2-1	S-3	
		CL	CLAY, blue-grey		S-4	
	6		Same as S-4 but with occ. very thin layers of very fine light grey sand	1-1 1-2	S-5	
	8		Same as S-5	1-2 2-3	S-6	
-24'	10		Bottom of hole			

Hole No.

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET 1 OF 1 SHEETS

1. PROJECT Salem River	10. SIZE AND TYPE OF BIT 2" Split Spoon
2. LOCATION (Coordinates or Station) N 266 750 E 1758 480	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY National Foundation Eng.	12. MANUFACTURER'S DESIGNATION OF DRILL S+H 40C
4. HOLE NO. (As shown on drawing title and file number) SB- 15	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 8; UNDISTURBED
5. NAME OF DRILLER Jim Ralston	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER Tidal
	16. DATE HOLE: STARTED 04 May 1985; COMPLETED 04 May 1985
7. THICKNESS OF OVERBURDEN 10.0	17. ELEVATION TOP OF HOLE -13.5
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 10.0	19. SIGNATURE OF INSPECTOR TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 13.5'			STA 11+000, 40' W of ℄.
-13.5'	0	CL	CLAY, dark, grey v. soft trace sand	2-3	S-1	
		SP	SAND, fine to med., some fines, light brown	3-3	S-2	
	2	SP	Same as S-2	4-2 3-6	S-3	
	4	SC	CLAY and sand, green and grey, gravel 2" size blocks spoon	6-7 9-11	S-4	Poor Rec. Wash - fine clayey sand
	6	SP	SAND, fine to coarse, trace fines, brown	9-8 11-10	S-5	
	8		Same as S-5		S-6	
		CL	CLAY, brown	3-5	S-7	
		CL	CLAY, dark grey, alternatting very thin layers of very fine sand	3-8	S-8	
-23.5'	10		Bottom of hole			

Hole No.

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET 1 OF 1 SHEETS

1. PROJECT Salem River	10. SIZE AND TYPE OF BIT 2" Split Spoon
2. LOCATION (Coordinates or Station) N265 810 E 1758 020	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY National Foundation Eng.	12. MANUFACTURER'S DESIGNATION OF DRILL S+H 40C
4. HOLE NO. (As shown on drawing title and file number) SB- 16	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 7 — UNDISTURBED
5. NAME OF DRILLER Jim Ralston	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER Tidal
	16. DATE HOLE — STARTED 04 May 1985 — COMPLETED 04 May 1985
7. THICKNESS OF OVERBURDEN 12.0	17. ELEVATION TOP OF HOLE -12
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 12.0	19. SIGNATURE OF INSPECTOR TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 12'			STA 9+945 35' W of ℄
-12'	0	CL	CLAY, dark grey very soft sandy		S-1	
			CLAY and sand, very fine sand, light blue grey clay	8-7 6-6	S-2	
	2	SC	Same as S-2	4-5 4-7	S-3	
	4		Same as S-2	7-6 7-7	S-4	
	6		CLAY, sand top 0.1' blue-grey, stiff	1-2 2-5	S-5	
	8	CL	Same as S-5 but with occ. sandy layers in top 1.0'	1-2 4-8	S-6	
	10		Same as S-5	2-4 6-9	S-7	
-24'	12		Bottom of hole			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT SALEM RIVER HOLE NO. SB-16

Hole No.

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET 1 OF 1 SHEETS

1. PROJECT: Salem River	10. SIZE AND TYPE OF BIT: 2" Split Spoon
2. LOCATION (Coordinates or Station): N264 970 EI 757 560	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: National Foundation Eng.	12. MANUFACTURER'S DESIGNATION OF DRILL: S+H 40C
4. HOLE NO. (As shown on drawing title and file number): SB- 17	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5; UNDISTURBED
5. NAME OF DRILLER: Jim Ralston	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER: Tidal
	16. DATE HOLE: STARTED 04 May 1985; COMPLETED 04 May 1985
7. THICKNESS OF OVERBURDEN: 10.0	17. ELEVATION TOP OF HOLE: -14
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE: 10.0	19. SIGNATURE OF INSPECTOR: TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 14'			STA 8+960 45' W of ℄
-14'	0	CL	CLAY, very soft dark grey, trace sand	5-10	S-1	
			SAND, clayey, fine to med trace gravel, light grey-tan	11-9	S-2	
	2	SC	SAND, clayey, fine to med. brown and green clay layers	4-4 7-7	S-3	Poor Rec.
	4		SAND, clayey, fine to med. brown, occ thin clay layers	13-14 13-13	S-4	
	6		SAND, fine, light brown trace fines	11-25	S-5	
	8	SP		3-13 18-19		No Rec.
-24'	10		Bottom of hole			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT SALEM RIVER HOLE NO. SB-17

Hole No.

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET 1 OF 1 SHEETS

1. PROJECT: Salem River
2. LOCATION (Coordinates or Station): N 264 060 E 1757 080
3. DRILLING AGENCY: National Foundation Eng.
4. HOLE NO. (As shown on drawing title and file number): SB-18
5. NAME OF DRILLER: Jim Ralston
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 10.0
8. DEPTH DRILLED INTO ROCK: -
9. TOTAL DEPTH OF HOLE: 10.0
10. SIZE AND TYPE OF BIT: 2" Split Spoon
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: S+H 40C
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 7 | UNDISTURBED
14. TOTAL NUMBER CORE BOXES
15. ELEVATION GROUND WATER: Tidal
16. DATE HOLE: STARTED 30 Apr 1985 | COMPLETED 30 Apr 1985
17. ELEVATION TOP OF HOLE: -13
18. TOTAL CORE RECOVERY FOR BORING: %
19. SIGNATURE OF INSPECTOR: TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 13.5'			STA 7+945 45' W of
-13.5'	0	CL	CLAY, dark grey, very soft trace sand		S-1	
		SC	SAND, clayey, med. to coarse grey-green	3-4 4-14	S-2	
	2	CL	CLAY, sandy, med to coarse some gravel, dark red, green brown	27-16 11-12	S-3	
	4	SC	SAND, clayey, fine to coarse rust colored	13-9 9-4	S-4	
		CL	CLAY, layered, red and tan		S-5	
	6	CL & SP	CLAY and SAND, med to coarse occ. gravel, brown and rust	10-11 9-11	S-6	
	8	SC	SAND, fine to med., brown some clay	4-4 4-5	S-7	
-23.5'	10		Bottom of hole			

Hole No.

DRILLING LOG	DIVISION NAD	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT Salem River	10. SIZE AND TYPE OF BIT 2" Split Spoon
2. LOCATION (Coordinates or Station) N 263 260 E 1 756 640	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY National Foundation Eng	12. MANUFACTURER'S DESIGNATION OF DRILL S+H 40C
4. HOLE NO. (As shown on drawing title and file number) SB-19	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED 8 — UNDISTURBED
5. NAME OF DRILLER Jim Ralston	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER Tidal
	16. DATE HOLE — STARTED 30 Apr 1985 — COMPLETED 30 Apr 1985
7. THICKNESS OF OVERBURDEN 12.0	17. ELEVATION TOP OF HOLE -12
8. DEPTH DRILLED INTO ROCK -	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 12.0	19. SIGNATURE OF INSPECTOR TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 12'			STA 7+030 45' W of ℄
-12'	0	CL	CLAY, dark grey, very soft grades gradually into:	4-6	S-1	
			SAND, med. to coarse, some brown clay	10-9	S-2	
	2	SC	Same as S-2 but trace clay	5-10 32-27	S-3	
	4	SP	SAND, med. to coarse Loose	4-6 7-9	S-4	
	6	SC	SAND and grey clay	4-4	S-5	
			CLAY, grey, layered	3-3	S-6	
	8	CL	CLAY, grey-blue grey layered	1-2 2-3	S-7	
	10		Same as S-7	2-4 5-5	S-8	
-24'	12		Bottom of hole			

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

Hole No.

DRILLING LOG	DIVISION: NAD	INSTALLATION: PDO	SHEET 1 OF 1 SHEETS

1. PROJECT: Salem River	10. SIZE AND TYPE OF BIT: 2" Split Spoon
2. LOCATION (Coordinates or Station): N 262 440 E 1 756 140	11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
3. DRILLING AGENCY: National Foundation Eng.	12. MANUFACTURER'S DESIGNATION OF DRILL: S+H 40C
4. HOLE NO. (As shown on drawing title and file number): SB-20	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 8; UNDISTURBED
5. NAME OF DRILLER: Jim Ralston	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.	15. ELEVATION GROUND WATER: Tidal
7. THICKNESS OF OVERBURDEN: 12.0	16. DATE HOLE: STARTED 26 Apr 1985; COMPLETED 26 Apr 1985
8. DEPTH DRILLED INTO ROCK: -	17. ELEVATION TOP OF HOLE: -12
9. TOTAL DEPTH OF HOLE: 12.0	18. TOTAL CORE RECOVERY FOR BORING: %
	19. SIGNATURE OF INSPECTOR: TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 12'			STA 6+120 60' E of ℄
-12'	0	CL	CLAY, dark grey, very soft	WOR-2	S-1	
			CLAY, green and rust, some fine to med. sand	4-7	S-2	
	2		Same as S-2, sandy		S-3	
			CLAY and SAND, alternating layers, rust and yellow fine to med.	5-5 9-14	S-4	
	4		Same as S-4 with occ. layers of green CLAY	6-8 9-10	S-5	
	6	SP & CL	Same as S-4	5-10 17-38	S-6	
	8		Same as S-4 No green clay	13-53 56-92	S-7	
	10	SC	Same as S-4 top 0.5' Red CLAY some sand	3-8 16-28	S-8	
-24'	12		Bottom of hole			

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

Hole No.

DRILLING LOG	DIVISION NAD	INSTALLATION PDO	SHEET 1 OF 1 SHEETS

1. PROJECT Salem River	10. SIZE AND TYPE OF BIT 2" Split Spoon
2. LOCATION (Coordinates or Station) N 261 720 E 1 755 500	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY National Foundation Eng.	12. MANUFACTURER'S DESIGNATION OF DRILL S+H 40C
4. HOLE NO. (As shown on drawing title and file number) SB-21	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 5; UNDISTURBED
5. NAME OF DRILLER Jim Ralston	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER Tidal
	16. DATE HOLE: STARTED 26 Apr 1985; COMPLETED 26 Apr 1985
7. THICKNESS OF OVERBURDEN 10.0	17. ELEVATION TOP OF HOLE -13
8. DEPTH DRILLED INTO ROCK -	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE 10.0	19. SIGNATURE OF INSPECTOR TRB

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			WATER DEPTH 13'			STA 5+110 10' W of ℄
-13.0'	0	CL	CLAY, dark grey, very soft	WOR	S-1	
		SC	SAND, clayey, very fine grey	10-16	S-2	
	2		SAND, med. to coarse, clayey at top, trace at bottom, occ. gravel	23-24 28-37	S-3	
	4	SP		7-18 36-54		No Rec. Wash - Clean Sand
	6		SAND, fine to coarse brown, occ. gravel	11-29 55-40	S-4	
	8		Same as S-4	10-15 27-42	S-5	
-23.0'	10		Bottom of hole			

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT HOLE NO.

SECTION 3

COST ESTIMATE

A. BASELINE ESTIMATE

B. MCACES ESTIMATE

A. BASELINE ESTIMATE

(October 1992 Price Level escalated to mid-point of construction, October 1994)

SALEM RIVER, NEW JERSEY
BASELINE COST ESTIMATE
PROJECT COSTS
PRICE LEVEL: OCTOBER 1994

ACCOUNT CODE	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
06.-.-.-	FISH AND WILDLIFE FACILITIES						
06.03.-.-	WILDLIFE FACILITIES AND SANCTUARIES	17.2	AC	$63,362.21	$1,089,830	$272,458	$1,362,288
06.-.-.-	TOTAL, FISH AND WILDLIFE FACILITIES				$1,089,830	$272,458	$1,362,288
12.-.-.-	NAVIGATION, PORTS & HARBORS						
12.01.-.-	PORTS						
12.01.01.-	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK	------------------	JOB	L.S.	$405,245	$81,049	$486,294
12.01.16.-	PIPELINE DREDGING	936565	C.Y.	$5.62	$5,263,495	$1,315,874	$6,579,369
12.01.-.-	TOTAL, PORTS				$5,668,740	$1,396,923	$7,065,663
	TOTAL CONSTRUCTION COSTS				$6,758,570	$1,669,381	$8,427,951
30.-.-.-	PLANNING, ENGINEERING AND DESIGN				$541,125	$0	$541,125
31.-.-.-	CONSTRUCTION MANAGEMENT				$486,000	$0	$486,000
	SUBTOTAL				$7,785,695	$1,669,381	$9,455,076
01.-.-.-	LANDS AND DAMAGES						
01.02.-.-	ACQUISITIONS	------------------	JOB	L.S.	$16,815	$2,296	$19,111
01.03.-.-	CONDEMNATION	------------------	JOB	L.S.	$791	$108	$899
01.05.-.-	APPRAISALS	------------------	JOB	L.S.	$2,918	$397	$3,315
01.06.-.-	RELOCATION ASSISTANCE	------------------	JOB	L.S.	$1,220	$167	$1,387
01.11.-.-	WETLAND MITIGATION	------------------	JOB	L.S.	$5,424	$665	$6,089
01.18.-.-	REAL ESTATE PAYMENTS	------------------	JOB	L.S.	$1,029	$234	$1,263
01.19.-.-	REAL ESTATE RECEIPTS	------------------	JOB	L.S.	$813,122	$157,271	$970,393
01.-.-.-	TOTAL, LANDS AND DAMAGES				$841,319	$161,138	$1,002,457
09.-.-.-	CHANNEL AND CANALS						
09.01.-.-	CHANNELS						
09.01.13.-	TRAFFIC CONTROL						
09.01.13.02	NAVIGATION AIDS IN WATER	------------------	JOB	L.S.	$16,485	$4,121	$20,606
09.-.-.-	TOTAL, CHANNELS ANS CANALS				$16,485	$4,121	$20,606
	TOTAL PROJECT COSTS				$8,643,499	$1,834,640	$10,478,139
	(ROUNDED)				$8,644,000	$1,835,000	$10,479,000

SALEM RIVER, NEW JERSEY
BASELINE COST ESTIMATE
PROJECT COST SUMMARY
PRICE LEVEL: OCTOBER 1994

		ESTIMATED COST	CONTINGENCY	TOTAL COST
06.-.-.-	FISH AND WILDLIFE FACILITIES			
06.03.-.-	WILDLIFE FACILITIES AND SANCTUARIES	$1,089,830	$272,458	$1,362,288
06.-.-.-	TOTAL, FISH AND WILDLIFE FACILITIES	$1,089,830	$272,458	$1,362,288
12.-.-.-	NAVIGATION, PORTS & HARBORS			
12.01.-.-	PORTS			
12.01.01.-	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK (PROJECT)	$405,245	$81,049	$486,294
12.01.01.-	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK (ASSOCIATED)	$42,047	$8,409	$50,456
12.01.16.-	PIPELINE DREDGING (PROJECT)	$5,263,495	$1,315,874	$6,579,369
12.01.16.-	PIPELINE DREDGING (ASSOCIATED)	$546,140	$136,535	$682,675
12.01.-.-	TOTAL, PORTS	$6,256,927	$1,541,867	$7,798,794
	TOTAL CONSTRUCTION COSTS	$7,346,757	$1,814,325	$9,161,082
30.-.-	PLANNING, ENGINEERING AND DESIGN (PROJECT)	$541,125	$0	$541,125
30.-.-	PLANNING, ENGINEERING AND DESIGN (ASSOCIATED)	$97,475	$24,369	$121,844
31.-.-	CONSTRUCTION MANAGEMENT (PROJECT)	$486,000	$0	$486,000
31.-.-	CONSTRUCTION MANAGEMENT (ASSOCIATED)	$64,983	$16,246	$81,229
	SUBTOTAL	$8,536,340	$1,854,940	$10,391,280
01.-.-	LANDS AND DAMAGES			
01.02.-	ACQUISITIONS	$16,815	$2,296	$19,111
01.03.-	CONDEMNATION	$791	$108	$899
01.05.-	APPRAISALS	$2,918	$397	$3,315
01.06.-	RELOCATION ASSISTANCE	$1,220	$167	$1,387
01.11.-	WETLAND MITIGATION	$5,424	$665	$6,089
01.18.-	REAL ESTATE PAYMENTS	$1,029	$234	$1,263
01.19.-	REAL ESTATE RECEIPTS (PROJECT)	$813,122	$157,271	$970,393
01.19.-	REAL ESTATE RECEIPTS (ASSOCIATED)	$39,476	$7,637	$47,113
01.-.-	TOTAL, LANDS AND DAMAGES	$880,795	$168,775	$1,049,570
09.-.-	CHANNELS AND CANALS			
09.01.-	CHANNELS			
09.01.13.-	TRAFFIC CONTROL			
09.01.13.02	NAVIGATION AIDS IN WATER	$16,485	$4,121	$20,606
09.-.-	TOTAL, CHANNELS AND CANALS	$16,485	$4,121	$20,606
	TOTAL PROJECT COSTS	$9,433,620	$2,027,836	$11,461,456
	(ROUNDED)	$9,434,000	$2,028,000	$11,462,000

SALEM RIVER, NEW JERSEY
BASELINE COST ESTIMATE
ASSOCIATED COSTS
PRICE LEVEL: OCTOBER 1994

ACCOUNT CODE	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
12.-.-.-	NAVIGATION, PORTS & HARBORS						
12.01.-.-	PORTS						
12.01.01.-	MOBILIZATION, DEMOBILIZATION AND PREPARATORY WORK	------------------	JOB	L.S.	$42,047	$8,409	$50,456
12.01.16.-	PIPELINE DREDGING	97178	C.Y.	$5.62	$546,140	$136,535	$682,675
12.01.-.-	TOTAL, PORTS				$588,187	$144,944	$733,131
	TOTAL CONSTRUCTION COSTS				$588,187	$144,944	$733,131
30.-.-.-	PLANNING, ENGINEERING AND DESIGN				$97,475	$24,369	$121,844
31.-.-.-	CONSTRUCTION MANAGEMENT				$64,983	$16,246	$81,229
	SUBTOTAL				$750,645	$185,559	$936,204
01.-.-.-	LANDS AND DAMAGES						
01.19.-.-	REAL ESTATE RECEIPTS	------------------	JOB	L.S.	$39,476	$7,637	$47,113
01.-.-.-	TOTAL, LANDS AND DAMAGES				$39,476	$7,637	$47,113
	TOTAL PROJECT COSTS				$790,121	$193,196	$983,317
	(ROUNDED)				$790,000	$193,000	$983,000

B. MCACES ESTIMATE

(October 1992 Price Level)

PIPELINE DREDGE ESTIMATE

A   BID ITEM # 2

YARDAGE ESTIMATE

1 PROJECT	SALEM RIVER - HYD DREDG - 18'
2 LOCATION	SALEM, NJ INVIT. NO. >
3 DESCRIPTION OF WORK	INITIAL DREDGING; DISPOSAL AREA - KILLCOHOOK
PRICE LEVEL - OCT 1992	

4 EXCAVATION		REMARKS
A. REQUIRED	772,765 C.Y.	4,104,000 s.f. of Dredging Area
B. PAY OVERDEPTH	+ 260,978 C.Y.	
C. MAX. PAY YARDAGE	= 1,033,743 C.Y.	(YARDAGE USED ON BID FORM)
D. O.D. NOT DREDGED	- 0 C.Y.	
E. NET PAY YARDAGE	= 1,033,743 C.Y.	(YARDAGE USED TO FIGURE UNIT PRICE PER C.Y.)
F. NON-PAY YARDAGE	+ 507,700 C.Y.	3.3 Average feet of overdigging
G. GROSS YARDAGE	= 1,541,443 C.Y.	(YARDAGE USED TO FIGURE PRODUCTION TIME & COST)

Estimated by: Jose Alvarez   31 Aug 1992   Checked by: ________

Salem, Nj > Sheet ____ of ____

PRODUCTION WORK SHEET

B

BID ITEM # 2

PIPELINE DREDGE TIME

REMARKS

1 SIZE OF DREDGE....PIPELINE.........>		27 INCH	
2 POWER OUTPUT......MAIN PUMP........>		4,000 HP	Chart is based on 4000 Horsepower.
3 MAXIMUM LINE LENGTH		36,000 L.F.	
4 AVERAGE LINE LENGTH		26,000 L.F.	Actual Pipeline
5 NUMBER OF BOOSTERS IN LINE		1	Each Booster is 4200 Horsepower.
6 PRODUCTION.........(BASED ON)......>		27,000 L.F.	26,000 L.F. + 1000 Equiv. feet of pipe.
A. CHART PRODUCTION		710 C.Y./HR	Adjusted Chart is based on 8200 Total Horsepower in line.
B. BOOSTER FACTOR	x	0.9	10% LOSS IN PUMPING TIME PER BOOSTER
C. MATERIAL FACTOR	x	1.55	SAND (MUD >= 2.0 > SAND >= 0.7 > ROCK)
D. BANK FACTOR	x	1.1	10.14 FT. AVERAGE BANK HEIGHT
E. OTHER FACTOR	x	0.9	
F. NET PRODUCTION	=	980 CY/HR	
G. OPERATING HRS/DAY	x	16	
H. OPERATING DAYS/MONTH	x	28	
I. CUBIC YARDS/MONTH	=	439,201	
J. DREDGE TIME		3.51 MONTHS	1,541,443 C.Y.(GROSS) DIVIDED BY 439,201 C.Y./MONTH
K. CLEANUP	+	0.35 MONTHS	10% ADDITIONAL DREDGING TIME
7 TOTAL DREDGE TIME	=	3.86 MONTHS	267,766 Pay c.y. per month

Estimated by: Jose Alvarez 31 Aug 1992 Checked by: ________

PRODUCTION WORK SHEET
C
EXCAVATION COSTS
BID ITEM # 2

REMARKS

1 PLANT OWNERSHIP COSTS			$71,086 PER MO	
2 OPERATING COSTS		+	$646,343 PER MO	
3 PIPELINE COSTS BASED ON SAND				DETERMINED BY MATERIAL FACTOR ON SHEET B, ITEM 6 D.
A. FLOATING PIPELINE		+	$53,600 PER MO	8,000 LIN. FEET @ $6.70 PER L.F./MO
B. SUBMERGED PIPELINE		+	$79,200 PER MO	18,000 LIN. FEET @ $4.40 PER L.F./MO
C. SHORELINE		+	$0 PER MO	0 LIN. FEET @ $3.00 PER L.F./MO
D. PARTIALLY UTILIZED PIPELINE		+	$23,500 PER MO	10,000 LIN. FEET @ $2.35 PER L.F./MO(50% OF RATE)
4 BOOSTER(S)		+	$156,000 PER MO	1 BOOSTERS @ $156,000 EACH
5 SPECIAL COSTS		+	$70,000 PER MO	
6 TOTAL MONTHLY COST		=	$1,099,729	
7 DREDGE TIME		x	3.86 MO	
8 SUBTOTAL		=	$4,245,637	
9 ADDITIONAL COSTS		+	$0 L.S.	
10 SUBTOTAL		=	$4,245,637	
11 OVERHEAD	12.0%	+	$509,476	SUBTOTAL---> $4,755,113
12 PROFIT	10.0%	+	$475,511	SUBTOTAL---> $5,230,624 Planning Estimate
13 BOND	1.0%	+	$52,306	
14 NET PAY YARDAGE COST		=	$5,282,930	
15 NET PAY YARDAGE		/	1,033,743 CY	FROM SHEET A, ITEM 4 E.
16 UNIT COST		=	$5.11 PER CY	
17 MAX PAY YARDAGE		x	1,033,743 C.Y.	FROM BID SCHEDULE (SEE SHEET A, ITEM 4 C.)
18 TOTAL DREDGING COST		=	$5,282,427	FOR BID SCHEDULE

Estimated by: Jose Alvarez 31 Aug 1992 Checked by: ________

M MONTHLY OWNERSHIP & OPERATING COSTS

REMARKS

1 CURRENT FUEL PRICE		$0.75 /GAL	
2 AVERAGE PLANT USEAGE		7 MO/YR	
3 CURRENT INTEREST RATE		8.375 % /YR	
4 MENU ITEM SELECTED..................>		27 " DREDGE	Planning Estimate
4,000 HP	MAIN PUMP CHART HORSEPOWER		
5 DREDGE COSTS......................>		$71,086 /MO	PLANT OWNERSHIP COSTS
+ $646,343 /MO	OPERATING COSTS	(	$305,137 /MO PAYROLL)
= $717,429 /MO	TOT. DREDGE COSTS	(AVE. CREW RATE=	$28.85 /MANHOUR INCLUDING FRINGE BENEFITS & TAXES)
6 BOOSTER INFORMATION		4,200 HP	PUMP MOTOR
7 COST PER BOOSTER		$156,000 /MO	(INCLUDES LABOR, OPER. & OWNERSHIP)
8 NUMBER OF BOOSTERS	x	1	(MOBILIZATION & DEMOB. INFORMATION)
9 TOTAL BOOSTER COST	=	$156,000 /MO	(MOBILIZATION & DEMOB. INFORMATION)

10 FLOATING PIPELINE		8,000 LIN. FEET @	$4.90 PER L.F./MO (MUD RATE) =	$39,200 PER MONTH
11 SUBMERGED PIPELINE	+	24,000 LIN. FEET @	$3.40 PER L.F./MO (MUD RATE) =	$81,600 PER MONTH
12 SHORELINE	+	4,000 LIN. FEET @	$2.10 PER L.F./MO (MUD RATE) =	$8,400 PER MONTH
13 TOTAL PIPELINE	=	36,000 LIN. FEET	(MOBILIZATION & DEMOB. INFORMATION)	$129,200 PER MONTH

>DREDGE SIZE = 27 in. pipeline >MAIN PUMP = 4,000 H.P.

>ANNUAL % = 4.731875 % >LIFE = 30 yrs >SALV = 10% >USE = 7 working months per year

PIPELINE COSTS PER L.F. PER MONTH

TYPE OF PIPELINE	MUD	SAND	ROCK
FLOATING	$4.90	$6.70	$10.40
SUBMERGED	$3.40	$4.40	$7.10
SHORELINE	$2.10	$3.00	$4.90

MATERIAL FACTORS

DESCRIPTION	INPLACE DENSITY		FACTOR
MUD & SILT	1200	GR/L	3
MUD & SILT	1300	GR/L	2.5
MUD & SILT	1400	GR/L	2
LOOSE SAND	1700	GR/L	1.1
LOOSE SAND	1900	GR/L	1
COMPACTED SAND	2000	GR/L	0.9
STIFF CLAY	2000	GR/L	.5-.7
COMPACTED SHELL	2300	GR/L	.4-.6
SOFT ROCK	2400	GR/L	.3-.5
BLASTED ROCK	2000	GR/L	.2-.3

STANDARD DREDGE PRODUCTION BASED ON PIPELINE LENGTH

5,500 L.F. OF PIPE	1500 C.Y. PER HOUR
11,000 L.F. OF PIPE	980 C.Y. PER HOUR
15,500 L.F. OF PIPE	420 C.Y. PER HOUR

BANK FACTORS

BANK HEIGHT	1	2	3	4	5	6	7	8	9
FACTOR	NA	0.43	0.55	0.65	0.78	0.9	1	1.1	1.1

PLANT OWNERSHIP

	NO.	TOTAL VALUE $	DEPRECIATION RATE %	A AMOUNT $	INTEREST RATE %	B AMOUNT $	CFC RATE %	C AMOUNT $
DREDGE	1	$5,000,000	3.00	$150,000	4.73	$236,594	3.79	$189,275
TUGS	2	$500,000	4.50	$22,500	4.79	$23,958	4.24	$21,200
DERRICK BARGE	1	$120,000	4.50	$5,400	4.79	$5,750	4.24	$5,088
WORK BARGE	2	$200,000	4.75	$9,500	4.60	$9,191	3.68	$7,352
FUEL/WATER BARGE	1	$110,000	4.75	$5,225	4.60	$5,055	3.68	$4,044
YARD EQUIP(MISC.)	LS	$80,000	10.00	$8,000	4.61	$3,687	3.69	$2,950
CREW/WORKBOAT	1	$75,000	9.50	$7,125	4.79	$3,594	4.24	$3,180
SKIFF w/MOTOR	2	$16,000	7.92	$1,267	4.73	$757	3.78	$606
TOTALS			A=	$209,017	B=	$288,584	C=	$233,694

BID ESTIMATE A + B = $497,601 per year divided by 7 months/year= $71,086 per month (Bid Est.)

MOD. ESTIMATE A + C = $442,712 per year divided by 7 months/year= $63,245 per month (Mod. Est.)

Estimated by: Jose Alvarez 31 Aug 1992 Checked by: ________

>DREDGE SIZE = 27 in. (menu items 6 & 14)

OPERATING COSTS

PAYROLL (24 HR OPR)	NO.	RATE	AMOUNT	
PROJECT MGR				
SUPERINTENDENT				
CAPTAIN	1	per month	$3,000	
CHIEF ENGR.	1	"	$2,800	
CIVIL ENGR.	1	"		
OFFICE MGR				
OFFICE PERSONNEL	1	"	$1,800	
LAY UP				$12,320
SUBTOTAL....			$7,600	
TAXES,INS.,FRINGES......	40.5%	$3,081		
+ PAYROLL COSTS..........>				$305,137
MANAGEMENT PAYROLL.....>	$10,681 per w/mo			

	NO.	RATE	AMOUNT
LEVERMAN	3	$18.91	$56.73
WATCH ENGINEER	3	$18.03	$54.09
DREDGE MATES	2	$16.61	$33.22
TUG MASTERS	2	$17.50	$35.00
TUG MATES	3	$14.49	$43.47
MAINTENANCE ENGINEERS		$17.77	$0.00
EQUIPMENT OPERATORS	3	$19.00	$57.00
WELDERS	2	$17.50	$35.00
OILERS	2	$14.85	$29.70
DECKHANDS	12	$14.31	$171.72
ELECTRICIAN	1	$17.50	$17.50
GENERAL DUMP FOREMAN	1	$17.77	$17.77
DUMP FOREMAN	2	$16.34	$32.68
YARD AND SHORE MEN	6	$14.31	$85.86
CREW TOTAL (3 SHIFTS)	42 MEN		$669.74 per hour

WAGES (UNION)
WORK 56 HRS /WK
PAY 64 HRS /WK 4.34WKS/WMO $186,027
TAXES,INS.,FRINGES...... 52.5% $97,748

CREW PAYROLL...........> $294,456 per w/mo (ave. gross crew wage = $28.85 per manhour)
+ MANAGEMENT PAYROLL.....> $10,681 per w/mo

PAYROLL COSTS..........> $305,137 per w/mo

BOOSTER 4,200 HP $156,000

PLANT	
EST. TOTAL PLANT	5,800 HP
FUEL	$80,485
WATER,LUBE,SUPPLIES	$30,000
DREDGE WEAR(PUMP,PIPE,CUTTER)	$85,000
REPAIR & DRYDOCK	$95,800
YARD COST	$17,770
INSURANCE	$19,830
PLANT COSTS............>	$341,205

****
MONTHLY OPERATING COSTS= $646,343
****

Taxes, insurance and fringes on labor:
(based on Decision Number 91-NY)

Social Security		7.7%
Workman's Compensation		8.4%
State Unemployment Comp.		6.2%
Federal Unemployment Comp.		0.8%
Fringes...	$3.75 per hour	20.6%
(Not based 8 paid hol.	1.9%	
on O.T.)	8.0%vacation	7.0%
TAXES,INS.,FRINGES......CREW...		52.5%
-(BENEFIT DIFERENTIAL)		12.0%
TAXES,INS.,FRINGES......MANAGEMENT..		40.5%

****

PRODUCTION WORK SHEET

P

BID ITEM # 2

PRODUCTION FACTOR COMPUTATIONS

****

PRODUCTION FACTORS FOR A 27 " DREDGE

STANDARD DREDGE PRODUCTION BASED ON CHART HORSEPOWER

UP TO	5,500 L.F. OF PIPE	1,500 C.Y./HR
AT	11,000 L.F. OF PIPE	980 C.Y./HR
AT	15,500 L.F. OF PIPE	420 C.Y./HR

Chart Horsepower from information sheet = 4000
Total Available Horsepower = 4000
Number of Boosters = 1
Booster H.P. from information sheet = 4200

(Total Available Horsepower +
Number of Boosters x Booster H.P.) / Chart H.P) =
Chart Adjustment Factor

(4000 H.P. + 1 Booster(s) x 4200 H.P.) / 4000 H.P. =
2.05 Chart Adjustment Factor (C.A.F.)

ADJUSTED DREDGE PRODUCTION CHART BASED ON C.A.F.

UP TO	11,275 L.F. OF PIPE	1,500 C.Y./HR
AT	22,550 L.F. OF PIPE	980 C.Y./HR
AT	31,775 L.F. OF PIPE	420 C.Y./HR

27,000 L.F. OF PIPE
710 CY/HR

BANK FACTORS 10.14 FT. AVERAGE BANK HEIGHT
1.1 BANK FACTOR

BANK (FROM CHART)	FACTOR (FROM CHART)	IF (INTERPOLATIONS FROM CHART)	USE
0	NA		
		(bank<1)	NA
1	NA		
		(1<=bank<2)	NA
2	0.43		
		(2<=bank<3)	1.4068
3	0.55		
		(3<=bank<4)	1.264
4	0.65		
		(4<=bank<5)	1.4482
5	0.78		
		(5<=bank<6)	1.3968
6	0.9		
		(6<=bank<7)	1.314
7	1		
		(7<=bank<8)	1.314
8	1.1		
		(8<=bank<9)	1.1
9	1.1		
		(9<=bank)	1.1

MATERIAL FACTOR CHOSEN = 1.55 SAND
(MUD >= 2.0 > SAND >= 0.7 > ROCK)

MENU ITEMS: 0 MUD, 1 SAND, 2 ROCK

MENU ITEMS: 0 BID ESTIMATE, 1 MOD. ESTIM.

PIPELINE COSTS PER L.F. PER MONTH

TYPE OF PIPELINE	MATERIAL PUMPED MUD	SAND	ROCK
FLOATING	$4.90	$6.70	$10.40
SUBMERGED	$3.40	$4.40	$7.10
SHORELINE	$2.10	$3.00	$4.90

MENU ITEM AUTOMATICALLY CHOSEN:
(0 MUD,1 SAND,2 ROCK) 1 SAND

FLOATING	$6.70 PER L.F./MO
SUBMERGED	$4.40 PER L.F./MO
SHORELINE	$3.00 PER L.F./MO

Estimated by: Jose Alvarez 31 Aug 1992 Checked by: ________

Salem, Nj > Sheet _____ of _____

D MOB & DEMOB BID ITEM # 1

27 " Dredge

	MOBILIZATION				DEMOBILIZATION			
	# DAYS		$/DAY	TOTAL	# DAYS		$/DAY	TOTAL
1. PREPARE DREDGE FOR TRANSFER	3	x	$11,380	= $34,141	3	x	$12,005	= $36,016
2. PREPARE PIPELINE FOR TRANSFER	5	x	$4,701	= $23,504	5	x	$4,926	= $24,629
3. TRANSFER ALL PLANT 200 MILES @ 100 miles/day =	2	x	$30,412	= $60,824	2	x	$30,412	= $60,824
4. MARINE INSURANCE	L.S.			= $1,500	L.S.			= $1,500
5. PERMANENT PERSONNEL & MISC.	L.S.			= $842	L.S.			= $842
6. PREPARE DREDGE AFTER TRANSFER	2	x	$11,924	= $23,848	2	x	$11,299	= $22,598
7. PREPARE PIPELINE AFTER TRANSFER	2	x	$4,926	= $9,852	2	x	$4,701	= $9,402
8. OTHER				= $0	L.S. (CLEANUP)			= $16,763
SUBTOTAL	SUBTOTAL MOBILIZATION			$154,512	DEMOBILIZATION			$172,575

9. SUBTOTAL MOBILIZATION & DEMOBILIZATION		= $327,086		
10. OVERHEAD	12.0%	+ $39,250	$366,336 <--SUBTOTAL	
11. PROFIT	10.0%	+ $36,634	$402,970 <--SUBTOTAL	Planning Estimate
12. BOND	1.0%	+ $4,030		
13. TOTAL MOBILIZATION & DEMOBILIZATION		= $407,000		

Estimated by: Jose Alvarez 31 Aug 1992 Checked by: _________

****

E MOB & DEMOB BID ITEM # 1

****

27 " Dredge

1. PREPARE DREDGE FOR TRANSFER	MOBILIZATION	DEMOBILIZATION
25 men @ 8 hr/day refurbishing @ $28.85 per hour =	$5,770	$5,770
Supplies & small tools @ $91 /day	$91	$91
Support equipment with operators @ $500 /day	$500	$500
Plant ownership		
Basic plant $71,086 /month		
Booster(s) $51,480 /month (1 @ $156,000 x 33%)		
$122,566 /month divided by 30.42 days/month =	$4,029	$4,029
Fuel (plant idle) @ $990 /day	$990	$990
Subsistence 25 men @ $25.00 per day =	----	$625
COST PER DAY	$11,380	$12,005

2. PREPARE PIPELINE FOR TRANSFER	MOBILIZATION	DEMOBILIZATION
9 men @ 8 hrs/day @ $28.85 per hour =	$2,077	----
9 men @ 8 hrs/day @ $28.85 per hour =	----	$2,077
Supplies & small tools @ $500 /day	$500	$500
Pipeline ownership $129,200 /month		
divided by 30.42 days/month x 50% =	$2,124	$2,124
Subsistence 9 men @ $25.00 per day =	----	$225
COST PER DAY	$4,701	$4,926

****

F MOB & DEMOB BID ITEM # 1

****

27 " Dredge

		MOBILIZATION	DEMOBILIZATION
3. TRANSFER PLANT			
13 men/shift (2-12 hour shifts/day) @	$28.85 per manhour =	$9,001	$9,001
Plant ownership per day =		$4,029	$4,029
Pipeline ownership per day =		$2,124	$2,124
Plant costs	$341,205 /month (Operating costs minus payroll)		
	divided by 30.42 days/month x 50% =	$5,608	$5,608
Subsistence	26 men @ $25.00 per day =	$650	$650
Towing vessel(s):	750 H.P. Rental Tug @		
	$6,000 per day (towing)		
	$3,000 per day (return to port)		
	$9,000 per day x 1 towing vessel(s) =	$9,000	$9,000
	COST PER DAY	$30,412	$30,412
4. MARINE INSURANCE	$1,500 each tow (MOB & DEMOB)		

		MOBILIZATION	DEMOBILIZATION
5. PERMANENT PERSONNEL & MISC.			
3 men @	8 hrs/day @ $28.85 per hour @ 1 DAY	$692	$692
Travel Expenses	$50 per man	$150	$150
Local hire @	$0 /day	$0	----
	TOTAL	$842	$842

Estimated by: Jose Alvarez 31 Aug 1992 Checked by: ________

****

G MOB & DEMOB BID ITEM # 1

****

27 " Dredge

				MOBILIZATION	DEMOBILIZATION
6. PREPARE DREDGE AFTER TRANSFER					
25 men @	8 hrs/day @	$28.85 per hour =		$5,770	$5,770
Support equipment with operators @		$500 /day		$500	$500
Plant ownership per day =				$4,029	$4,029
Fuel (plant idle) @		$1,000 /day		$1,000	$1,000
Subsistence	25 men @	$25.00 per day =		$625	----
			COST PER DAY	$11,924	$11,299

7. PREPARE PIPELINE AFTER TRANSFER					
9 men @	8 hrs/day @	$28.85 per hour =		$2,077	$2,077
Pipeline ownership per day =				$2,124	$2,124
Subsistence	9 men @	$25.00 per day =		$225	----
Support equipment with operators @		$500 /day		$500	$500
			COST PER DAY	$4,926	$4,701

PIPELINE DREDGE ESTIMATE

A

YARDAGE ESTIMATE

BID ITEM # 2

1 PROJECT SALEM RIVER - HYD DREDG - 18'

2 LOCATION SALEM, NJ INVIT. NO. >

3 DESCRIPTION OF WORK MAINTENANCE DREDGING; DISPOSAL AREA - KILLCOHOOK

CYCLE: 3 YEARS

4 EXCAVATION			REMARKS
A. REQUIRED		188,100 C.Y.	4,000,000 s.f. of Dredging Area
B. PAY OVERDEPTH	+	0 C.Y.	
C. MAX. PAY YARDAGE	=	188,100 C.Y.	(YARDAGE USED ON BID FORM)
D. O.D. NOT DREDGED	-	0 C.Y.	
E. NET PAY YARDAGE	=	188,100 C.Y.	(YARDAGE USED TO FIGURE UNIT PRICE PER C.Y.)
F. NON-PAY YARDAGE	+	103,700 C.Y.	0.7 Average feet of overdigging
G. GROSS YARDAGE	=	291,800 C.Y.	(YARDAGE USED TO FIGURE PRODUCTION TIME & COST)

Estimated by: Jose Alvarez 31 Aug 1992 Checked by: ________

PRODUCTION WORK SHEET

B PIPELINE DREDGE TIME

BID ITEM # 2

REMARKS

1 SIZE OF DREDGE....PIPELINE.........>		27 INCH	
2 POWER OUTPUT......MAIN PUMP........>		4,000 HP	Chart is based on 4000 Horsepower.
3 MAXIMUM LINE LENGTH		36,000 L.F.	
4 AVERAGE LINE LENGTH		26,000 L.F.	Actual Pipeline
5 NUMBER OF BOOSTERS IN LINE		1	Each Booster is 4200 Horsepower.
6 PRODUCTION.........(BASED ON)......>		27,000 L.F.	26,000 L.F. + 1000 Equiv. feet of pipe.
A. CHART PRODUCTION		710 C.Y./HR	Adjusted Chart is based on 8200 Total Horsepower in line.
B. BOOSTER FACTOR	x	0.85	15% LOSS IN PUMPING TIME PER BOOSTER
C. MATERIAL FACTOR	x	3	MUD (MUD >= 2.0 > SAND >= 0.7 > ROCK)
D. BANK FACTOR	x	0.43	2 FT. AVERAGE BANK HEIGHT
E. OTHER FACTOR	x	1	
F. NET PRODUCTION	=	778 CY/HR	
G. OPERATING HRS/DAY	x	16	
H. OPERATING DAYS/MONTH	x	28	
I. CUBIC YARDS/MONTH	=	348,708	
J. DREDGE TIME		0.84 MONTHS	291,800 C.Y.(GROSS) DIVIDED BY 348,708 C.Y./MONTH
K. CLEANUP	+	0.08 MONTHS	10% ADDITIONAL DREDGING TIME
7 TOTAL DREDGE TIME	=	0.92 MONTHS	204,349 Pay c.y. per month

Estimated by: Jose Alvarez 31 Aug 1992 Checked by: ________

Salem, Nj > Sheet ____ of ____

PRODUCTION WORK SHEET

C BID ITEM # 2

EXCAVATION COSTS

REMARKS

1 PLANT OWNERSHIP COSTS			$79,085 PER MO	
2 OPERATING COSTS		+	$657,891 PER MO	
3 PIPELINE COSTS BASED ON MUD				DETERMINED BY MATERIAL FACTOR ON SHEET B, ITEM 6 D.
A. FLOATING PIPELINE		+	$39,200 PER MO	8,000 LIN. FEET @ $4.90 PER L.F./MO
B. SUBMERGED PIPELINE		+	$61,200 PER MO	18,000 LIN. FEET @ $3.40 PER L.F./MO
C. SHORELINE		+	$0 PER MO	0 LIN. FEET @ $2.10 PER L.F./MO
D. PARTIALLY UTILIZED PIPELINE		+	$17,333 PER MO	10,000 LIN. FEET @ $1.73 PER L.F./MO(50% OF RATE)
4 BOOSTER(S)		+	$156,000 PER MO	1 BOOSTERS @ $156,000 EACH
5 SPECIAL COSTS		+	$59,000 PER MO	
6 TOTAL MONTHLY COST		=	$1,069,709	
7 DREDGE TIME		x	0.92 MO	
8 SUBTOTAL		=	$984,650	
9 ADDITIONAL COSTS		+	$0 L.S.	
10 SUBTOTAL		=	$984,650	
11 OVERHEAD	12.0%	+	$118,158	SUBTOTAL---> $1,102,808
12 PROFIT	10.0%	+	$110,281	SUBTOTAL---> $1,213,089 Planning Estimate
13 BOND	1.0%	+	$12,131	
14 NET PAY YARDAGE COST		=	$1,225,220	
15 NET PAY YARDAGE		/	188,100 CY	FROM SHEET A, ITEM 4 E.
16 UNIT COST		=	$6.51 PER CY	
17 MAX PAY YARDAGE		x	188,100 C.Y.	FROM BID SCHEDULE (SEE SHEET A, ITEM 4 C.)
18 TOTAL DREDGING COST		=	$1,224,531	FOR BID SCHEDULE

Estimated by: Jose Alvarez 31 Aug 1992 Checked by: ________

M MONTHLY OWNERSHIP & OPERATING COSTS

REMARKS

1 CURRENT FUEL PRICE	$0.95 /GAL	
2 AVERAGE PLANT USEAGE	7 MO/YR	
3 CURRENT INTEREST RATE	10 % /YR	
4 MENU ITEM SELECTED.................>	27 " DREDGE	Planning Estimate
4,000 HP MAIN PUMP CHART HORSEPOWER		
5 DREDGE COSTS......................>	$79,085 /MO	PLANT OWNERSHIP COSTS
+ $657,891 /MO	OPERATING COSTS	($295,223 /MO PAYROLL)
= $736,976 /MO	TOT. DREDGE COSTS	(AVE. CREW RATE= $27.93 /MANHOUR INCLUDING FRINGE BENEFITS & TAXES)
6 BOOSTER INFORMATION	4,200 HP	PUMP MOTOR
7 COST PER BOOSTER	$156,000 /MO	(INCLUDES LABOR, OPER. & OWNERSHIP)
8 NUMBER OF BOOSTERS	x 1	(MOBILIZATION & DEMOB. INFORMATION)
9 TOTAL BOOSTER COST	= $156,000 /MO	(MOBILIZATION & DEMOB. INFORMATION)

10 FLOATING PIPELINE		8,000 LIN. FEET @	$4.90 PER L.F./MO (MUD RATE) =	$39,200 PER MONTH
11 SUBMERGED PIPELINE	+	24,000 LIN. FEET @	$3.40 PER L.F./MO (MUD RATE) =	$81,600 PER MONTH
12 SHORELINE	+	4,000 LIN. FEET @	$2.10 PER L.F./MO (MUD RATE) =	$8,400 PER MONTH
13 TOTAL PIPELINE	=	36,000 LIN. FEET	(MOBILIZATION & DEMOB. INFORMATION)	$129,200 PER MONTH

Estimated by: Jose Alvarez 31 Aug 1992 Checked by: ________

>DREDGE SIZE = 27 in. pipeline >MAIN PUMP = 4,000 H.P.

>ANNUAL % = 5.65 % >LIFE = 30 yrs >SALV = 10% >USE = 7 working months per year

PIPELINE COSTS PER L.F. PER MONTH

TYPE OF PIPELINE	MATERIAL PUMPED MUD	SAND	ROCK
FLOATING	$4.90	$6.70	$10.40
SUBMERGED	$3.40	$4.40	$7.10
SHORELINE	$2.10	$3.00	$4.90

MATERIAL FACTORS

DESCRIPTION	INPLACE DENSITY		FACTOR
MUD & SILT	1200	GR/L	3
MUD & SILT	1300	GR/L	2.5
MUD & SILT	1400	GR/L	2
LOOSE SAND	1700	GR/L	1.1
LOOSE SAND	1900	GR/L	1
COMPACTED SAND	2000	GR/L	0.9
STIFF CLAY	2000	GR/L	.5-.7
COMPACTED SHELL	2300	GR/L	.4-.6
SOFT ROCK	2400	GR/L	.3-.5
BLASTED ROCK	2000	GR/L	.2-.3

STANDARD DREDGE PRODUCTION BASED ON PIPELINE LENGTH

5,500 L.F. OF PIPE	1500 C.Y. PER HOUR
11,000 L.F. OF PIPE	980 C.Y. PER HOUR
15,500 L.F. OF PIPE	420 C.Y. PER HOUR

BANK FACTORS

BANK HEIGHT	1	2	3	4	5	6	7	8	9
FACTOR	NA	0.43	0.55	0.65	0.78	0.9	1	1.1	1.1

PLANT OWNERSHIP

	NO.	TOTAL VALUE $	DEPRECIATION RATE %	A AMOUNT $	INTEREST RATE %	B AMOUNT $	CFC RATE %	C AMOUNT $
DREDGE	1	$5,000,000	3.00	$150,000	5.65	$282,500	4.52	$226,000
TUGS	2	$500,000	4.50	$22,500	5.72	$28,606	4.24	$21,200
DERRICK BARGE	1	$120,000	4.50	$5,400	5.72	$6,865	4.24	$5,088
WORK BARGE	2	$200,000	4.75	$9,500	5.49	$10,974	4.39	$8,779
FUEL/WATER BARGE	1	$110,000	4.75	$5,225	5.49	$6,036	4.39	$4,828
YARD EQUIP(MISC.)	LS	$80,000	10.00	$8,000	5.50	$4,402	4.40	$3,522
CREW/WORKBOAT	1	$75,000	9.50	$7,125	5.72	$4,291	4.24	$3,180
SKIFF w/MOTOR	2	$16,000	7.92	$1,267	5.65	$904	4.52	$723
TOTALS			A=	$209,017	B=	$344,578	C=	$273,320

BID ESTIMATE A + B = $553,595 per year divided by 7 months/year= $79,085 per month (Bid Est.)

MOD. ESTIMATE A + C = $482,338 per year divided by 7 months/year= $68,905 per month (Mod. Est.)

Estimated by: Jose Alvarez 31 Aug 1992 Checked by: _________

>DREDGE SIZE = 27 in. (menu items 6 & 14)

OPERATING COSTS

PAYROLL (24 HR OPR)	NO.	RATE	AMOUNT
PROJECT MGR			
SUPERINTENDENT			
CAPTAIN	1	per month	$3,000
CHIEF ENGR.	1	"	$2,800
CIVIL ENGR.	1	"	
OFFICE MGR			
OFFICE PERSONNEL	1	"	$1,800
LAY UP			$12,320
SUBTOTAL....			$7,600
TAXES,INS.,FRINGES......	33.7%	$2,564	
+ PAYROLL COSTS..........>			$295,223
MANAGEMENT PAYROLL.....>	$10,164 per w/mo		

	NO.	RATE	AMOUNT
LEVERMAN	3	$18.85	$56.55
WATCH ENGINEER	3	$18.15	$54.45
DREDGE MATES	2	$16.76	$33.52
TUG MASTERS	2	$17.63	$35.26
TUG MATES	3	$14.83	$44.49
MAINTENANCE ENGINEERS		$17.89	$0.00
EQUIPMENT OPERATORS	3	$19.00	$57.00
WELDERS	2	$17.63	$35.26
OILERS	2	$15.18	$30.36
DECKHANDS	12	$14.65	$175.80
ELECTRICIAN	1	$17.63	$17.63
GENERAL DUMP FOREMAN	1	$17.89	$17.89
DUMP FOREMAN	2	$16.50	$33.00
YARD AND SHORE MEN	6	$14.65	$87.90
CREW TOTAL (3 SHIFTS)	42 MEN		$679.11 per hour

WAGES (UNION)
WORK 56 HRS /WK
PAY 64 HRS /WK 4.34WKS/WMO $188,630
TAXES,INS.,FRINGES...... 45.7% $86,266

CREW PAYROLL...........> $285,059 per w/mo (ave. gross crew wage = $27.93 per manhour)
+ MANAGEMENT PAYROLL.....> $10,164 per w/mo

PAYROLL COSTS..........> $295,223 per w/mo

BOOSTER	4,200 HP	$156,000

PLANT		
EST. TOTAL PLANT	5,800 HP	
FUEL		$101,948
WATER,LUBE,SUPPLIES		$30,000
DREDGE WEAR(PUMP,PIPE,CUTTER)		$85,000
REPAIR & DRYDOCK		$95,800
YARD COST		$17,770
INSURANCE		$19,830
PLANT COSTS............>	$362,668	

MONTHLY OPERATING COSTS= $657,891

Taxes, insurance and fringes on labor:
(based on Decision Number 88-FL-0196)

Social Security			7.7%
Workman's Compensation			7.5%
State Unemployment Comp.			6.2%
Federal Unemployment Comp.			0.8%
Fringes...	$2.71 per hour		14.7%
8 paid hol.	1.9%	(Not based on O.T.)	
vacation	8.0%		7.0%
TAXES,INS.,FRINGES......CREW...			45.7%
-(BENEFIT DIFERENTIAL)		12.0%	
TAXES,INS.,FRINGES......MANAGEMENT..		33.7%	

Estimated by: Jose Alvarez   31 Aug 1992   Checked by: ________

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PRODUCTION WORK SHEET

P BID ITEM # 2

PRODUCTION FACTOR COMPUTATIONS

****

PRODUCTION FACTORS FOR A 27 " DREDGE

STANDARD DREDGE PRODUCTION BASED ON CHART HORSEPOWER

UP TO	5,500 L.F. OF PIPE	1,500 C.Y./HR
AT	11,000 L.F. OF PIPE	980 C.Y./HR
AT	15,500 L.F. OF PIPE	420 C.Y./HR

Chart Horsepower from information sheet = 4000
Total Available Horsepower = 4000
Number of Boosters = 1
Booster H.P. from information sheet = 4200
2 0.43
(Total Available Horsepower +
Number of Boosters x Booster H.P.) / Chart H.P) =
Chart Adjustment Factor
4 0.65
(4000 H.P. + 1 Booster(s) x 4200 H.P.) / 4000 H.P. =
2.05 Chart Adjustment Factor (C.A.F.)
5 0.78

ADJUSTED DREDGE PRODUCTION CHART BASED ON C.A.F.

UP TO	11,275 L.F. OF PIPE	1,500 C.Y./HR
AT	22,550 L.F. OF PIPE	980 C.Y./HR
AT	31,775 L.F. OF PIPE	420 C.Y./HR

27,000 L.F. OF PIPE
710 CY/HR

9 1.1

BANK FACTORS 2 FT. AVERAGE BANK HEIGHT
0.43 BANK FACTOR

FROM CHART BANK	FACTOR	INTERPOLATIONS FROM CHART IF	USE
0	NA		
		(bank<1)	NA
1	NA		
		(1<=bank<2)	NA
		(2<=bank<3)	0.43
3	0.55		
		(3<=bank<4)	0.45
		(4<=bank<5)	0.39
		(5<=bank<6)	0.42
6	0.9		
		(6<=bank<7)	0.5
7	1		
		(7<=bank<8)	0.5
8	1.1		
		(8<=bank<9)	1.1
		(9<=bank)	1.1

MATERIAL FACTOR CHOSEN = 3 MUD
(MUD >= 2.0 > SAND >= 0.7 > ROCK)

MENU ITEMS:
0 MUD
1 SAND
2 ROCK

MENU ITEMS:
0 BID ESTIMATE
1 MOD. ESTIM.

PIPELINE COSTS PER L.F. PER MONTH

TYPE OF PIPELINE	MATERIAL PUMPED MUD	SAND	ROCK
FLOATING	$4.90	$6.70	$10.40
SUBMERGED	$3.40	$4.40	$7.10
SHORELINE	$2.10	$3.00	$4.90

MENU ITEM AUTOMATICALLY CHOSEN:
(0 MUD,1 SAND,2 ROCK) 0 MUD

FLOATING	$4.90 PER L.F./MO
SUBMERGED	$3.40 PER L.F./MO
SHORELINE	$2.10 PER L.F./MO

Estimated by: Jose Alvarez 31 Aug 1992 Checked by: ________

D MOB & DEMOB BID ITEM # 1

27 " Dredge

	MOBILIZATION					DEMOBILIZATION				
	# DAYS		$/DAY		TOTAL	# DAYS		$/DAY		TOTAL
1. PREPARE DREDGE FOR TRANSFER	3	x	$11,459	=	$34,378	3	x	$12,084	=	$36,253
2. PREPARE PIPELINE FOR TRANSFER	5	x	$4,635	=	$23,173	5	x	$4,860	=	$24,298
3. TRANSFER ALL PLANT 200 MILES @ 100 miles/day =	2	x	$30,741	=	$61,482	2	x	$30,741	=	$61,482
4. MARINE INSURANCE	L.S.			=	$1,500	L.S.			=	$1,500
5. PERMANENT PERSONNEL & MISC.	L.S.			=	$820	L.S.			=	$820
6. PREPARE DREDGE AFTER TRANSFER	2	x	$12,003	=	$24,006	2	x	$11,378	=	$22,756
7. PREPARE PIPELINE AFTER TRANSFER	2	x	$4,860	=	$9,719	2	x	$4,635	=	$9,269
8. OTHER				=	$0	L.S. (CLEANUP)			=	$15,630
SUBTOTAL	SUBTOTAL MOBILIZATION				$155,078	DEMOBILIZATION				$172,008

9. SUBTOTAL MOBILIZATION & DEMOBILIZATION		= $327,086		
10. OVERHEAD	12.0%	+ $39,250	$366,336 <--SUBTOTAL	
11. PROFIT	10.0%	+ $36,634	$402,970 <--SUBTOTAL	Planning Estimate
12. BOND	1.0%	+ $4,030		
13. TOTAL MOBILIZATION & DEMOBILIZATION		= $407,000		

Estimated by: Jose Alvarez 31 Aug 1992 Checked by: ________

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E MOB & DEMOB BID ITEM # 1

****

27 " Dredge

1. PREPARE DREDGE FOR TRANSFER	MOBILIZATION	DEMOBILIZATION
25 men @ 8 hr/day refurbishing @ $27.93 per hour =	$5,586	$5,586
Supplies & small tools @ $91 /day	$91	$91
Support equipment with operators @ $500 /day	$500	$500
Plant ownership		
Basic plant $79,085 /month		
Booster(s) $51,480 /month (1 @ $156,000 x 33%)		
$130,565 /month divided by 30.42 days/month =	$4,292	$4,292
Fuel (plant idle) @ $990 /day	$990	$990
Subsistence 25 men @ $25.00 per day =	----	$625
COST PER DAY	$11,459	$12,084

2. PREPARE PIPELINE FOR TRANSFER	MOBILIZATION	DEMOBILIZATION
9 men @ 8 hrs/day @ $27.93 per hour =	$2,011	----
9 men @ 8 hrs/day @ $27.93 per hour =	----	$2,011
Supplies & small tools @ $500 /day	$500	$500
Pipeline ownership $129,200 /month		
divided by 30.42 days/month x 50% =	$2,124	$2,124
Subsistence 9 men @ $25.00 per day =	----	$225
COST PER DAY	$4,635	$4,860

F MOB & DEMOB BID ITEM # 1

27 " Dredge

3. TRANSFER PLANT			MOBILIZATION	DEMOBILIZATION
13 men/shift (2-12 hour shifts/day) @	$27.93 per manhour =		$8,714	$8,714
Plant ownership per day =			$4,292	$4,292
Pipeline ownership per day =			$2,124	$2,124
Plant costs	$362,668 /month (Operating costs minus payroll)			
	divided by 30.42 days/month x 50% =		$5,961	$5,961
Subsistence	26 men @	$25.00 per day =	$650	$650
Towing vessel(s):	750 H.P. Rental Tug @			
	$6,000 per day (towing)			
	$3,000 per day (return to port)			
	$9,000 per day x 1 towing vessel(s) =		$9,000	$9,000
		COST PER DAY	$30,741	$30,741

4. MARINE INSURANCE $1,500 each tow (MOB & DEMOB)

5. PERMANENT PERSONNEL & MISC.			MOBILIZATION	DEMOBILIZATION
3 men @	8 hrs/day @ $27.93 per hour @ 1 DAY		$670	$670
Travel Expenses	$50 per man		$150	$150
Local hire @	$0 /day		$0	----
		TOTAL	$820	$820

****

G MOB & DEMOB BID ITEM # 1

****

27 " Dredge

6. PREPARE DREDGE AFTER TRANSFER				MOBILIZATION	DEMOBILIZATION
25 men @	8 hrs/day @	$27.93 per hour =		$5,586	$5,586
Support equipment with operators @		$500 /day		$500	$500
Plant ownership per day =				$4,292	$4,292
Fuel (plant idle) @	$1,000 /day			$1,000	$1,000
Subsistence	25 men @	$25.00 per day =		$625	----
			COST PER DAY	$12,003	$11,378

7. PREPARE PIPELINE AFTER TRANSFER					
9 men @	8 hrs/day @	$27.93 per hour =		$2,011	$2,011
Pipeline ownership per day =				$2,124	$2,124
Subsistence	9 men @	$25.00 per day =		$225	----
Support equipment with operators @		$500 /day		$500	$500
			COST PER DAY	$4,860	$4,635

Salem River Navigation Project
New Jersey
Updated Real Estate
Cost Estimate

Designed By:
Estimated By: Jose Alvarez

Prepared By: Sterling H. Johnson

Date: 09/11/92

M C A C E S G O L D E D I T I O N

Release 5.20J

No errors detected...

* * * END OF ERROR REPORT * * *

SUMMARY REPORTS SUMMARY PAGE

No Detailed Estimate...

No Backup Reports...

* * * END TABLE OF CONTENTS * * *

	QUANTITY UOM	CONTRACT	OTHER	ESCALATN	OWN FURN	CONTINGN	SIOH	TOTAL CST	UNIT
01 Lands and Damages									
01.02 Acquisitions									
01.02.02 By Local Sponsor									
01.02.02.01 Mapping		6,720	0	0	0	1,008	0	7,728	
01.02.02.02 Title Evidence		2,715	0	0	0	407	0	3,122	
01.02.02.03 Negotiations		2,880	0	0	0	432	0	3,312	
01.02.02.04 Condemnation		1,935	0	0	0	290	0	2,225	
By Local Sponsor		14,250	0	0	0	2,138	0	16,388	
01.02.03 By Govt On Behalf Local Sp									
01.02.03.01 Mapping		225	0	0	0	34	0	259	
01.02.03.02 Title Evidence		150	0	0	0	23	0	173	
01.02.03.03 Negotiations		450	0	0	0	68	0	518	
01.02.03.04 Condemnation		225	0	0	0	34	0	259	
By Govt On Behalf Local		1,050	0	0	0	158	0	1,208	
Acquisitions		15,300	0	0	0	2,295	0	17,595	
01.03 Condemnation									
01.03.02 By Local Sponsor									
01.03.02.01 Contract Costs	1.00 EA	165	0	0	0	25	0	190	189.75
01.03.02.02 Admin Costs		480	0	0	0	72	0	552	
By Local Sponsor		645	0	0	0	97	0	742	
01.03.03 By Govt On Behalf Local Sp									
01.03.03.02 Admin Costs		75	0	0	0	11	0	86	
By Govt On Behalf Local		75	0	0	0	11	0	86	
Condemnation		720	0	0	0	108	0	828	
01.05 Appraisals									
01.05.03 By Local Sponsor									
01.05.03.01 Contract Costs	3.00 EA	990	0	0	0	149	0	1,139	379.50

	QUANTITY UOM	CONTRACT	OTHER	ESCALATN	OWN FURN	CONTINGN	SIOH	TOTAL CST	UNIT
01.05.03.02 Admin Costs		1,440	0	0	0	216	0	1,656	
By Local Sponsor		2,430	0	0	0	365	0	2,795	
01.05.04 By Govt On Behalf Local Sp									
01.05.04.02 Admin Costs		225	0	0	0	34	0	259	
By Govt On Behalf Local		225	0	0	0	34	0	259	
Appraisals		2,655	0	0	0	398	0	3,053	
01.06 PL 91-646 Assistance									
01.06.02 By Local Sponsor									
01.06.02.02 Admin Costs		960	0	0	0	144	0	1,104	
By Local Sponsor		960	0	0	0	144	0	1,104	
01.06.03 By Govt On Behalf Local Sp									
01.06.03.02 Admin Costs		150	0	0	0	23	0	173	
By Govt On Behalf Local		150	0	0	0	23	0	173	
PL 91-646 Assistance		1,110	0	0	0	167	0	1,277	
01.11 Disposals - Mitigation Area									
01.11.02 By Local Sponsor									
01.11.02.01 Mapping		2,240	0	0	0	336	0	2,576	
01.11.02.02 Title Evidence		905	0	0	0	136	0	1,041	
01.11.02.03 Negotiations		960	0	0	0	144	0	1,104	
01.11.02.04 Appraisals		330	0	0	0	50	0	380	
By Local Sponsor		4,435	0	0	0	665	0	5,100	
01.11.03 By Govt On Behalf Local Sp									
01.11.03.02 Admin Costs		500	0	0	0	0	0	500	
By Govt On Behalf Local		500	0	0	0	0	0	500	
Disposals - Mitigation		4,935	0	0	0	665	0	5,600	

		QUANTITY UOM	CONTRACT	OTHER	ESCALATN	OWN FURN	CONTINGN	SIOH	TOTAL CST	UNIT
01.18 Real Estate Payments										
01.18.01 Land Payments										
01.18.01.03	By Govt On Behalf Local		936	0	0	0	234	0	1,170	
	Land Payments		936	0	0	0	234	0	1,170	
	Real Estate Payments		936	0	0	0	234	0	1,170	
	Lands and Damages	1.00 EA	25,656	0	0	0	3,867	0	29,523	29523
	Salem River Navigation	1.00 EA	25,656	0	0	0	3,867	0	29,523	29523

	QUANTITY UOM	CONTRACT	OTHER	ESCALATN	OWN FURN	CONTINGN	SIOH	TOTAL CST	UNIT
01 Lands and Damages									
01.02 Acquisitions									
01.02.02 By Local Sponsor									
01.02.02.01 Mapping									
01.02.02.01.01 Contract Costs	3.00 EA	5,280	0	0	0	792	0	6,072	2024.00
01.02.02.01.02 Admin Costs		1,440	0	0	0	216	0	1,656	
Mapping		6,720	0	0	0	1,008	0	7,728	
01.02.02.02 Title Evidence									
01.02.02.02.01 Contract Costs	3.00 EA	1,755	0	0	0	263	0	2,018	672.75
01.02.02.02.02 Admin Costs		960	0	0	0	144	0	1,104	
Title Evidence		2,715	0	0	0	407	0	3,122	
01.02.02.03 Negotiations									
01.02.02.03.02 Admin Costs		2,880	0	0	0	432	0	3,312	
Negotiations		2,880	0	0	0	432	0	3,312	
01.02.02.04 Condemnation									
01.02.02.04.01 Contract Costs	1.00 EA	495	0	0	0	74	0	569	569.25
01.02.02.04.02 Admin Costs		1,440	0	0	0	216	0	1,656	
Condemnation		1,935	0	0	0	290	0	2,225	
By Local Sponsor		14,250	0	0	0	2,138	0	16,388	
01.02.03 By Govt On Behalf Local Sp									
01.02.03.01 Mapping									
01.02.03.01.02 Admin Costs		225	0	0	0	34	0	259	
Mapping		225	0	0	0	34	0	259	
01.02.03.02 Title Evidence									

	QUANTITY UOM	CONTRACT	OTHER	ESCALATN	OWN FURN	CONTINGN	SIOH	TOTAL CST	UNIT
01.02.03.02.02 Admin Costs		150	0	0	0	23	0	173	
Title Evidence		150	0	0	0	23	0	173	
01.02.03.03 Negotiations									
01.02.03.03.02 Admin Costs		450	0	0	0	68	0	518	
Negotiations		450	0	0	0	68	0	518	
01.02.03.04 Condemnation									
01.02.03.04.02 Admin Costs		225	0	0	0	34	0	259	
Condemnation		225	0	0	0	34	0	259	
By Govt On Behalf Lo		1,050	0	0	0	158	0	1,208	
Acquisitions		15,300	0	0	0	2,295	0	17,595	
01.03 Condemnation									
01.03.02 By Local Sponsor									
01.03.02.01 Contract Costs									
Contract Costs	1.00 EA	165	0	0	0	25	0	190	189.75
01.03.02.02 Admin Costs									
Admin Costs		480	0	0	0	72	0	552	
By Local Sponsor		645	0	0	0	97	0	742	
01.03.03 By Govt On Behalf Local Sp									
01.03.03.02 Admin Costs									
Admin Costs		75	0	0	0	11	0	86	
By Govt On Behalf Lo		75	0	0	0	11	0	86	
Condemnation		720	0	0	0	108	0	828	

	QUANTITY	UOM	CONTRACT	OTHER	ESCALATN	OWN FURN	CONTINGN	SIOH	TOTAL CST	UNIT
01.05 Appraisals										
01.05.03 By Local Sponsor										
01.05.03.01 Contract Costs										
Contract Costs	3.00	EA	990	0	0	0	149	0	1,139	379.50
01.05.03.02 Admin Costs										
Admin Costs			1,440	0	0	0	216	0	1,656	
By Local Sponsor			2,430	0	0	0	365	0	2,795	
01.05.04 By Govt On Behalf Local Sp										
01.05.04.02 Admin Costs										
Admin Costs			225	0	0	0	34	0	259	
By Govt On Behalf Lo			225	0	0	0	34	0	259	
Appraisals			2,655	0	0	0	398	0	3,053	
01.06 PL 91-646 Assistance										
01.06.02 By Local Sponsor										
01.06.02.02 Admin Costs										
Admin Costs			960	0	0	0	144	0	1,104	
By Local Sponsor			960	0	0	0	144	0	1,104	
01.06.03 By Govt On Behalf Local Sp										
01.06.03.02 Admin Costs										
Admin Costs			150	0	0	0	23	0	173	
By Govt On Behalf Lo			150	0	0	0	23	0	173	

		QUANTITY	UOM	CONTRACT	OTHER	ESCALATN	OWN FURN	CONTINGN	SIOH	TOTAL CST	UNIT
	PL 91-646 Assistance			1,110	0	0	0	167	0	1,277	
01.11	Disposals - Mitigation Area										
01.11.02	By Local Sponsor										
01.11.02.01	Mapping										
01.11.02.01.01	Contract Costs	1.00	EA	1,760	0	0	0	264	0	2,024	2024.00
01.11.02.01.02	Admin Costs			480	0	0	0	72	0	552	
	Mapping			2,240	0	0	0	336	0	2,576	
01.11.02.02	Title Evidence										
01.11.02.02.01	Contract Costs	1.00	EA	585	0	0	0	88	0	673	672.75
01.11.02.02.02	Admin Costs			320	0	0	0	48	0	368	
	Title Evidence			905	0	0	0	136	0	1,041	
01.11.02.03	Negotiations										
01.11.02.03.02	Admin Costs			960	0	0	0	144	0	1,104	
	Negotiations			960	0	0	0	144	0	1,104	
01.11.02.04	Appraisals										
01.11.02.04.01	Contract Costs	1.00	EA	330	0	0	0	50	0	380	379.50
	Appraisals			330	0	0	0	50	0	380	
	By Local Sponsor			4,435	0	0	0	665	0	5,100	
01.11.03	By Govt On Behalf Local Sp										
01.11.03.02	Admin Costs										
	Admin Costs			500	0	0	0	0	0	500	
	By Govt On Behalf Lo			500	0	0	0	0	0	500	
	Disposals - Mitigati			4,935	0	0	0	665	0	5,600	

	QUANTITY	UOM	CONTRACT	OTHER	ESCALATN	OWN FURN	CONTINGN	SIOH	TOTAL CST	UNIT
01.18 Real Estate Payments										
01.18.01 Land Payments										
01.18.01.01 By Govt										
01.18.01.02 By Local Sponsor										
01.18.01.03 By Govt On Behalf Local										
By Govt On Behalf Lo			936	0	0	0	234	0	1,170	
01.18.01.04 Review of Local Sponsor										
Land Payments			936	0	0	0	234	0	1,170	
Real Estate Payments			936	0	0	0	234	0	1,170	
Lands and Damages	1.00	EA	25,656	0	0	0	3,867	0	29,523	29523
Salem River Navigati	1.00	EA	25,656	0	0	0	3,867	0	29,523	29523

SALEM RIVER-WETLANDS MITIGATION
Wetland Creation/Restoration
93SRWM
Codes of Accounts included
06._._._ Fish&Wildlife Facility

Designed By: BORIS S.
Estimated By: BORIS S.

Prepared By: SONNY M.

Date: 09/01/92
Est Construction Time: 365 Days

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SUMMARY REPORTS SUMMARY PAGE

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** PROJECT OWNER SUMMARY - LEVEL 4 **

	QUANTY	UOM	CONTRACT	CONTINGN	P,E & D	SIOH/S&A	TOTAL CST	UNIT COST
06 Fish and Wildlife Facilities								
06.03 Wildlife Facilities & Sanctuary								
06.03.01 Mobilization, Demobilization and								
Mobilization, Demobilization and			50,000	12,500	0	0	62,500	
06.03.73 Habitat and Feeding Facilities								
06.03.73.02 Site Work			911,656	227,914	0	0	1,139,570	
Habitat and Feeding Facilities			911,656	227,914	0	0	1,139,570	
06.03.99 Associated General Items								
06.03.99.02 Site Work			30,000	7,500	0	0	37,500	
Associated General Items			30,000	7,500	0	0	37,500	
Wildlife Facilities & Sanctuary			991,656	247,914	0	0	1,239,570	
Fish and Wildlife Facilities	1.00	EA	991,656	247,914	0	0	1,239,570	1239570
SALEM RIVER-WETLANDS MITIGATION	1.00	EA	991,656	247,914	0	0	1,239,570	1239570

		QUANTY UOM	CONTRACT	CONTINGN	P,E & D	SIOH/S&A	TOTAL CST	UNIT COST
06 Fish and Wildlife Facilities								
06.03 Wildlife Facilities & Sanctuary								
06.03.01 Mobilization, Demobilization and								
	Mobilization, Demobilization and		50,000	12,500	0	0	62,500	
06.03.73 Habitat and Feeding Facilities								
06.03.73.02 Site Work								
06.03.73.02.01	Excavatation, Wetland Creation	41302 CY	330,410	82,603	0	0	413,013	10.00
06.03.73.02.02	Excavatation, Wetland Restoratio	30460 CY	426,394	106,599	0	0	532,993	17.50
06.03.73.02.03	Planting	17.20 AC	154,852	38,713	0	0	193,565	11253.76
	Site Work		911,656	227,914	0	0	1,139,570	
	Habitat and Feeding Facilities		911,656	227,914	0	0	1,139,570	
06.03.99 Associated General Items								
06.03.99.02 Site Work								
06.03.99.02.01	Monitoring Plan		30,000	7,500	0	0	37,500	
	Site Work		30,000	7,500	0	0	37,500	
	Associated General Items		30,000	7,500	0	0	37,500	
	Wildlife Facilities & Sanctuary		991,656	247,914	0	0	1,239,570	
	Fish and Wildlife Facilities	1.00 EA	991,656	247,914	0	0	1,239,570	1239570
	SALEM RIVER-WETLANDS MITIGATION	1.00 EA	991,656	247,914	0	0	1,239,570	1239570

PED PROJECT, SALEM RIVER, N.J.
ACTIVITY COST AND SCHEDULE

Designed By: U.S. ARMY CORPS OF ENGINNERS
Estimated By: JOSE ALVAREZ

Prepared By: STERLING H. JOHNSON

Date: 01/24/91

M C A C E S G O L D E D I T I O N

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SUMMARY REPORTS SUMMARY PAGE

No Detailed Estimate...

No Backup Reports...

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** PROJECT OWNER SUMMARY - LEVEL 2 **

		QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	OTHER	TOTAL COST	UNIT
30	Planning, Engineering & Design							
30.01	Planning		98,000	0	0	0	98,000	
30.02	Engr & Design Prior to 1 Oct 89		5,000	0	0	0	5,000	
30.04	Environment-Regulatory Activity		67,000	0	0	0	67,000	
30.06	General Design Memorandum (GDM)		122,000	0	0	0	122,000	
30.07	Feature Design Memorandum (FDM)		28,000	0	0	0	28,000	
30.08	Plans and Specifications		70,000	0	0	0	70,000	
30.10	Engineering During Construction		75,000	0	0	0	75,000	
30.13	Cost Engineering		10,000	0	0	0	10,000	
30.14	Const-Supply Contract Award Acty		5,000	0	0	0	5,000	
30.20	Project Management		45,000	0	0	0	45,000	
	Planning, Engineering & Design		525,000	0	0	0	525,000	
31	Construction Management (S&I)							
31.01	Construction Management		400,000	0	0	0	400,000	
	Construction Management (S&I)	1.00 EA	400,000	0	0	0	400,000	400000
	PED PROJECT, SALEM RIVER, N.J.		925,000	0	0	0	925,000	

** PROJECT OWNER SUMMARY - LEVEL 3 **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	OTHER	TOTAL COST	UNIT
30 Planning, Engineering & Design							
30.01 Planning							
30.01.01 Without Project Conditions		7,000	0	0	0	7,000	
30.01.02 Study Management		70,000	0	0	0	70,000	
30.01.03 Economic Analysis		21,000	0	0	0	21,000	
Planning		98,000	0	0	0	98,000	
30.02 Engr & Design Prior to 1 Oct 89							
30.02.09 Real Estate		5,000	0	0	0	5,000	
Engr & Design Prior to 1 Oct 89		5,000	0	0	0	5,000	
30.04 Environment-Regulatory Activity							
30.04.01 Environmental Analysis		8,000	0	0	0	8,000	
30.04.02 Cultural Resources		25,000	0	0	0	25,000	
30.04.03 Chemical Testing		7,000	0	0	0	7,000	
30.04.04 Fish and Wildlife		15,000	0	0	0	15,000	
30.04.05 Environmental Assessment		8,000	0	0	0	8,000	
30.04.06 Coordination for Env. Assessment		2,000	0	0	0	2,000	
30.04.07 Water Quality Certification		2,000	0	0	0	2,000	
Environment-Regulatory Activity		67,000	0	0	0	67,000	
30.06 General Design Memorandum (GDM)							
30.06.01 Ship Simulation		50,000	0	0	0	50,000	
30.06.02 Surveys		20,000	0	0	0	20,000	
30.06.03 Verify Disposal Areas		6,000	0	0	0	6,000	
30.06.04 Shoaling Study		10,000	0	0	0	10,000	
30.06.05 Groundwater Analysis		5,000	0	0	0	5,000	
30.06.06 Design Analysis		25,000	0	0	0	25,000	
30.06.07 Prepare for E2 Meeting		6,000	0	0	0	6,000	
General Design Memorandum (GDM)		122,000	0	0	0	122,000	
30.07 Feature Design Memorandum (FDM)							
30.07.01 Draft DM		20,000	0	0	0	20,000	
30.07.02 Final DM		8,000	0	0	0	8,000	
Feature Design Memorandum (FDM)		28,000	0	0	0	28,000	

** PROJECT OWNER SUMMARY - LEVEL 3 **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	OTHER	TOTAL COST	UNIT
30.08 Plans and Specifications							
Plans and Specifications		70,000	0	0	0	70,000	
30.10 Engineering During Construction							
30.10.09 All other EDC		75,000	0	0	0	75,000	
Engineering During Construction		75,000	0	0	0	75,000	
30.13 Cost Engineering							
Cost Engineering		10,000	0	0	0	10,000	
30.14 Const-Supply Contract Award Acty							
30.14.01 Construction and Supply		5,000	0	0	0	5,000	
Const-Supply Contract Award Acty		5,000	0	0	0	5,000	
30.20 Project Management							
30.20.01 Verify Plan		2,000	0	0	0	2,000	
30.20.02 Coordination		33,000	0	0	0	33,000	
30.20.03 Value Engineering (Prelim.)		5,000	0	0	0	5,000	
30.20.04 Value Engineering (Final)		5,000	0	0	0	5,000	
Project Management		45,000	0	0	0	45,000	
Planning, Engineering & Design		525,000	0	0	0	525,000	
31 Construction Management (S&I)							
31.01 Construction Management							
Construction Management		400,000	0	0	0	400,000	
Construction Management (S&I)	1.00 EA	400,000	0	0	0	400,000	400000
PED PROJECT, SALEM RIVER, N.J.		925,000	0	0	0	925,000	

No errors detected...

* * * END OF ERROR REPORT * * *

	QUANTITY	UOM	CONTRACT	OTHER	ESCALATN	OWN FURN	CONTINGN	SIOH	TOTAL CST	UNIT
01.05 Appraisals										
01.05.03 By Local Sponsor										
01.05.03.01 Contract Costs										
Contract Costs	3.00	EA	990	0	0	0	149	0	1,139	379.50
01.05.03.02 Admin Costs										
Admin Costs			1,440	0	0	0	216	0	1,656	
By Local Sponsor			2,430	0	0	0	365	0	2,795	
01.05.04 By Govt On Behalf Local Sp										
01.05.04.02 Admin Costs										
Admin Costs			225	0	0	0	34	0	259	
By Govt On Behalf Lo			225	0	0	0	34	0	259	
Appraisals			2,655	0	0	0	398	0	3,053	
01.06 PL 91-646 Assistance										
01.06.02 By Local Sponsor										
01.06.02.02 Admin Costs										
Admin Costs			960	0	0	0	144	0	1,104	
By Local Sponsor			960	0	0	0	144	0	1,104	
01.06.03 By Govt On Behalf Local Sp										
01.06.03.02 Admin Costs										
Admin Costs			150	0	0	0	23	0	173	
By Govt On Behalf Lo			150	0	0	0	23	0	173	

	QUANTITY UOM	CONTRACT	OTHER	ESCALATN	OWN FURN	CONTINGN	SIOH	TOTAL CST	UNIT
PL 91-646 Assistance		1,110	0	0	0	167	0	1,277	
01.11 Disposals - Mitigation Area									
01.11.02 By Local Sponsor									
01.11.02.01 Mapping									
01.11.02.01.01 Contract Costs	1.00 EA	1,760	0	0	0	264	0	2,024	2024.00
01.11.02.01.02 Admin Costs		480	0	0	0	72	0	552	
Mapping		2,240	0	0	0	336	0	2,576	
01.11.02.02 Title Evidence									
01.11.02.02.01 Contract Costs	1.00 EA	585	0	0	0	88	0	673	672.75
01.11.02.02.02 Admin Costs		320	0	0	0	48	0	368	
Title Evidence		905	0	0	0	136	0	1,041	
01.11.02.03 Negotiations									
01.11.02.03.02 Admin Costs		960	0	0	0	144	0	1,104	
Negotiations		960	0	0	0	144	0	1,104	
01.11.02.04 Appraisals									
01.11.02.04.01 Contract Costs	1.00 EA	330	0	0	0	50	0	380	379.50
Appraisals		330	0	0	0	50	0	380	
By Local Sponsor		4,435	0	0	0	665	0	5,100	
01.11.03 By Govt On Behalf Local Sp									
01.11.03.02 Admin Costs									
Admin Costs		500	0	0	0	0	0	500	
By Govt On Behalf Lo		500	0	0	0	0	0	500	
Disposals - Mitigati		4,935	0	0	0	665	0	5,600	

	QUANTITY	UOM	CONTRACT	OTHER	ESCALATN	OWN FURN	CONTINGN	SIOH	TOTAL CST	UNIT
01.18 Real Estate Payments										
01.18.01 Land Payments										
01.18.01.01 By Govt										
01.18.01.02 By Local Sponsor										
01.18.01.03 By Govt On Behalf Local										
By Govt On Behalf Lo			936	0	0	0	234	0	1,170	
01.18.01.04 Review of Local Sponsor										
Land Payments			936	0	0	0	234	0	1,170	
Real Estate Payments			936	0	0	0	234	0	1,170	
Lands and Damages	1.00	EA	25,656	0	0	0	3,867	0	29,523	29523
Salem River Navigati	1.00	EA	25,656	0	0	0	3,867	0	29,523	29523

SALEM RIVER-WETLANDS MITIGATION
Wetland Creation/Restoration
93SRWM
Codes of Accounts included
06._._._ Fish&Wildlife Facility

Designed By: BORIS S.
Estimated By: BORIS S.

Prepared By: SONNY M.

Date: 09/01/92
Est Construction Time: 365 Days

M C A C E S G O L D E D I T I O N

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** PROJECT OWNER SUMMARY - LEVEL 4 **

	QUANTY	UOM	CONTRACT	CONTINGN	P,E & D	SIOH/S&A	TOTAL CST	UNIT COST
06 Fish and Wildlife Facilities								
06.03 Wildlife Facilities & Sanctuary								
06.03.01 Mobilization, Demobilization and								
Mobilization, Demobilization and			50,000	12,500	0	0	62,500	
06.03.73 Habitat and Feeding Facilities								
06.03.73.02 Site Work			911,656	227,914	0	0	1,139,570	
Habitat and Feeding Facilities			911,656	227,914	0	0	1,139,570	
06.03.99 Associated General Items								
06.03.99.02 Site Work			30,000	7,500	0	0	37,500	
Associated General Items			30,000	7,500	0	0	37,500	
Wildlife Facilities & Sanctuary			991,656	247,914	0	0	1,239,570	
Fish and Wildlife Facilities	1.00	EA	991,656	247,914	0	0	1,239,570	1239570
SALEM RIVER-WETLANDS MITIGATION	1.00	EA	991,656	247,914	0	0	1,239,570	1239570

		QUANTY	UOM	CONTRACT	CONTINGN	P,E & D	SIOH/S&A	TOTAL CST	UNIT COST
06 Fish and Wildlife Facilities									
06.03 Wildlife Facilities & Sanctuary									
06.03.01 Mobilization, Demobilization and									
	Mobilization, Demobilization and			50,000	12,500	0	0	62,500	
06.03.73 Habitat and Feeding Facilities									
06.03.73.02 Site Work									
06.03.73.02.01	Excavatation, Wetland Creation	41302	CY	330,410	82,603	0	0	413,013	10.00
06.03.73.02.02	Excavatation, Wetland Restoratio	30460	CY	426,394	106,599	0	0	532,993	17.50
06.03.73.02.03	Planting	17.20	AC	154,852	38,713	0	0	193,565	11253.76
	Site Work			911,656	227,914	0	0	1,139,570	
	Habitat and Feeding Facilities			911,656	227,914	0	0	1,139,570	
06.03.99 Associated General Items									
06.03.99.02 Site Work									
06.03.99.02.01	Monitoring Plan			30,000	7,500	0	0	37,500	
	Site Work			30,000	7,500	0	0	37,500	
	Associated General Items			30,000	7,500	0	0	37,500	
	Wildlife Facilities & Sanctuary			991,656	247,914	0	0	1,239,570	
	Fish and Wildlife Facilities	1.00	EA	991,656	247,914	0	0	1,239,570	1239570
	SALEM RIVER-WETLANDS MITIGATION	1.00	EA	991,656	247,914	0	0	1,239,570	1239570

PED PROJECT, SALEM RIVER, N.J.
ACTIVITY COST AND SCHEDULE

Designed By: U.S. ARMY CORPS OF ENGINNERS
Estimated By: JOSE ALVAREZ

Prepared By: STERLING H. JOHNSON

Date: 01/24/91

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SUMMARY REPORTS SUMMARY PAGE

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Fri 19 Feb 1993 U.S. Army Corps of Engineers TIME 07:19:01

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** PROJECT OWNER SUMMARY - LEVEL 2 **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	OTHER	TOTAL COST	UNIT
30 Planning, Engineering & Design							
30.01 Planning		98,000	0	0	0	98,000	
30.02 Engr & Design Prior to 1 Oct 89		5,000	0	0	0	5,000	
30.04 Environment-Regulatory Activity		67,000	0	0	0	67,000	
30.06 General Design Memorandum (GDM)		122,000	0	0	0	122,000	
30.07 Feature Design Memorandum (FDM)		28,000	0	0	0	28,000	
30.08 Plans and Specifications		70,000	0	0	0	70,000	
30.10 Engineering During Construction		75,000	0	0	0	75,000	
30.13 Cost Engineering		10,000	0	0	0	10,000	
30.14 Const-Supply Contract Award Acty		5,000	0	0	0	5,000	
30.20 Project Management		45,000	0	0	0	45,000	
Planning, Engineering & Design		525,000	0	0	0	525,000	
31 Construction Management (S&I)							
31.01 Construction Management		400,000	0	0	0	400,000	
Construction Management (S&I)	1.00 EA	400,000	0	0	0	400,000	400000
PED PROJECT, SALEM RIVER, N.J.		925,000	0	0	0	925,000	

** PROJECT OWNER SUMMARY - LEVEL 3 **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	OTHER	TOTAL COST	UNIT
30 Planning, Engineering & Design							
30.01 Planning							
30.01.01 Without Project Conditions		7,000	0	0	0	7,000	
30.01.02 Study Management		70,000	0	0	0	70,000	
30.01.03 Economic Analysis		21,000	0	0	0	21,000	
Planning		98,000	0	0	0	98,000	
30.02 Engr & Design Prior to 1 Oct 89							
30.02.09 Real Estate		5,000	0	0	0	5,000	
Engr & Design Prior to 1 Oct 89		5,000	0	0	0	5,000	
30.04 Environment-Regulatory Activity							
30.04.01 Environmental Analysis		8,000	0	0	0	8,000	
30.04.02 Cultural Resources		25,000	0	0	0	25,000	
30.04.03 Chemical Testing		7,000	0	0	0	7,000	
30.04.04 Fish and Wildlife		15,000	0	0	0	15,000	
30.04.05 Environmental Assessment		8,000	0	0	0	8,000	
30.04.06 Coordination for Env. Assessment		2,000	0	0	0	2,000	
30.04.07 Water Quality Certification		2,000	0	0	0	2,000	
Environment-Regulatory Activity		67,000	0	0	0	67,000	
30.06 General Design Memorandum (GDM)							
30.06.01 Ship Simulation		50,000	0	0	0	50,000	
30.06.02 Surveys		20,000	0	0	0	20,000	
30.06.03 Verify Disposal Areas		6,000	0	0	0	6,000	
30.06.04 Shoaling Study		10,000	0	0	0	10,000	
30.06.05 Groundwater Analysis		5,000	0	0	0	5,000	
30.06.06 Design Analysis		25,000	0	0	0	25,000	
30.06.07 Prepare for E2 Meeting		6,000	0	0	0	6,000	
General Design Memorandum (GDM)		122,000	0	0	0	122,000	
30.07 Feature Design Memorandum (FDM)							
30.07.01 Draft DM		20,000	0	0	0	20,000	
30.07.02 Final DM		8,000	0	0	0	8,000	
Feature Design Memorandum (FDM)		28,000	0	0	0	28,000	

** PROJECT OWNER SUMMARY - LEVEL 3 **

	QUANTY UOM	CONTRACT	CONTINGN	ESCALATN	OTHER	TOTAL COST	UNIT
30.08 Plans and Specifications							
Plans and Specifications		70,000	0	0	0	70,000	
30.10 Engineering During Construction							
30.10.09 All other EDC		75,000	0	0	0	75,000	
Engineering During Construction		75,000	0	0	0	75,000	
30.13 Cost Engineering							
Cost Engineering		10,000	0	0	0	10,000	
30.14 Const-Supply Contract Award Acty							
30.14.01 Construction and Supply		5,000	0	0	0	5,000	
Const-Supply Contract Award Acty		5,000	0	0	0	5,000	
30.20 Project Management							
30.20.01 Verify Plan		2,000	0	0	0	2,000	
30.20.02 Coordination		33,000	0	0	0	33,000	
30.20.03 Value Engineering (Prelim.)		5,000	0	0	0	5,000	
30.20.04 Value Engineering (Final)		5,000	0	0	0	5,000	
Project Management		45,000	0	0	0	45,000	
Planning, Engineering & Design		525,000	0	0	0	525,000	
31 Construction Management (S&I)							
31.01 Construction Management							
Construction Management		400,000	0	0	0	400,000	
Construction Management (S&I)	1.00 EA	400,000	0	0	0	400,000	400000
PED PROJECT, SALEM RIVER, N.J.		925,000	0	0	0	925,000	

No errors detected...

* * * END OF ERROR REPORT * * *

APPENDIX E

ENVIRONMENTAL

INCREMENTAL ANALYSIS OF FISH AND WILDLIFE MITIGATION

The proposed plan of improvement for the Salem River Federal navigation project consists of widening and deepening the existing channel through hydraulic dredging operations. All material dredged for initial construction and a 50-year maintenance program would be placed in the existing Killcohook dredged material disposal site. Widening the channel would result in the loss of 3 acres of estuarine intertidal emergent wetlands and 8.6 acres of shallow water habitat. The dominant species of vegetation within the area of impacted wetlands is common reed (Phragmites australis).

Wetland and aquatic habitats in the vicinity of the Salem River have been designated as a focus area for waterfowl habitat protection under the 1986 North American Waterfowl Management Plan. The Salem River is located on the Atlantic Flyway and provides a valuable stopover location for thousands of migratory waterfowl annually. The area is censused each year in early January to monitor waterfowl populations. Major species utilizing the area include Canada geese, black duck, mallard, American widgeon, scaup, bufflehead and tundra swan. The North American Waterfowl Management Plan targets 11,500 acres of wetland habitats in the vicinity of the Salem River for protection. The plan states: "A diversified complex of high-quality freshwater and brackish wetlands composed of wild rice, arrow arum, and salt marsh cordgrass makes the area a high-priority ecosystem for black ducks, mallards, teal, widgeon, pintail, and Canada geese. Important wetlands in need of protection along the Salem River include: Mannington, Pine Island, Kate Creek, Stoney Island, Supawna, Mill Creek, Elsinboro, Money Island, Abbott's and Fenwick Marshes."

Investigations of the 3 acre wetland site to be impacted during construction have led to the determination that the site is not used by waterfowl for nesting purposes. The wetland banks along the river are steep, and the area is vegetated with dense stands of common reed. The site does however provide valuable cover habitat for resting and feeding waterfowl during migrations. The U.S. Fish and Wildlife Service used black duck and snowy egret as indicator species to evaluate the habitat value of the wetland site. Based on these evaluations, the Service classified the wetland site as resource category III habitat, relative to their 1981 mitigation policy. Category III habitat is defined as habitat of high to medium value for fish and wildlife resources, which is relatively abundant on a National or State basis. The Service recommends that loss of category III habitat be mitigated by replacement either in-kind or out-of-kind with no net loss of habitat value.

The 3 acre wetland site is part of a larger wetland island located along the channel. The banks of the island are utilized as dens by muskrats. The Service reports that during the 1986/1987 trapping season the island yielded 600-700 muskrats. The Service has indicated that the island can sustain a yearly harvest of 1,000-1,200 muskrats.

As previously stated, implementation of the proposed plan of improvement for the Salem River navigation channel would result in the loss of 3 acres of estuarine intertidal emergent wetlands and 8.6 acres of shallow water habitat. These wetlands and shallows would be lost through excavation due to the need to widen the channel. The primary attribute of wetlands within the project area is the resting and feeding habitat provided for migratory waterfowl. Based on the value placed on wetlands within the Salem River area under the North American Waterfowl Management Plan, it is important to maintain wetland acreage in order to maintain waterfowl carrying capacity. As such, the selected unit of measurement for this analysis is the acre.

The primary mitigation objective associated with the proposed Salem River project is to replace 3 acres of wetlands and 8.6 acres of shallow water habitat and their waterfowl and aquatic habitat values.

Wetland replacement can be accomplished by either creation or restoration of wetlands through the excavation of uplands and existing wetlands or filling in aquatic habitat. Aquatic habitats in the vicinity of the project area, (including the 8.6 acres of shallow water habitat being lost in this project), have been documented as valuable spawning, nursery and foraging habitat for a number of fishery species of commercial and/or recreational importance. For this reason it was determined that the shallows lost during construction of this project should be compensated through mitigation. In addition, it was determined that filling of aquatic habitat to create wetlands in the vicinity of the project area was not a desirable alternative because of the additional impacts that would be incurred.

Construction of wetlands from uplands (wetland creation) would entail excavation and grading to achieve site elevations sufficient to support wetland vegetation. Aspects of the plan would include acquisition, excavation and grading, and planting. Activities necessary for achieving the desired surface elevations and planting vegetation are viewed as dependent features of a single mitigative action. Both steps are required to construct an ecologically functional system.

Wetland restoration would entail the excavation and grading of a wetland, which has been degraded by monotypic stands of common reed (<u>Phragmites</u> <u>australis</u>), to achieve site elevations sufficient to support desirable wetland vegetation while at the same time keeping the common reed from thriving. The aspects of this plan also includes acquisition, excavation and grading, and planting.

Through coordination with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service it was determined that the mitigation for the 3 acres of estuarine intertidal emergent wetlands, which would be lost during this project, should be accomplished through the in-kind replacement of habitat with a 1:1 replacement ratio. It was also determined that the mitigation for the 8.6 acres of shallow water habitat could be accomplished by either wetland creation on a 1:1 replacement ratio or wetland restoration on a 2:1 replacement ratio.

Based on these recommendations and further coordination with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service a suitable intertidal mitigation site within the Federally owned Supawna Meadows National Wildlife Refuge was identified (refer to Plate 9). The site is adjacent to a series of channels which branch off of the Delaware River. These channels will be utilized to carry water into the mitigation site when construction is completed. The site grades down from upland areas to wetland areas dominated by common reed, to the branches of the channel. Within this site, 3 alternatives were investigated that would adequately fulfill the mitigation requirements for this project. The first plan consisted of doing all wetland creation, a total of 11.6 acres, and included excavation and grading, as well as the planting of several plant species. The second plan, which is the selected plan for this project, consists of doing a combination of wetland creation and restoration for a total of 17.2 acres of mitigation. The third plan consisted of doing 3 acres of wetland creation to compensate for the 3 acres lost and 17.2 acres of wetland restoration as mitigation for the shallow water habitat being lost. The mitigation site picked in Supawna Meadows National Wildlife Refuge has the capability of accommodating any of these three plans. Due to the fact that the cost of wetland creation per acre is more than double that of wetland restoration, since more material must be excavated per acre, the difference in cost between the three plans is not great. Of these three plans, the first plan (creation of 11.6 acres of wetlands) would be the cheapest to construct ($1,092,044) because it requires the least number of acres. This plan however would impact the cultural resources found in some of the upland areas and would also require the destruction of several acres of cultivated clover fields which are managed by the U.S. Fish and Wildlife Service to benefit wildlife in the area. In addition, although this plan would not result in 11.6 acres of high quality wetlands, it would not address the issue of controlling the common reed. Without some control of the common reed on the site, it would eventually take over the newly created wetlands. The second plan (6 acres of wetland restoration and 11.2 acres of wetland creation) would produce a total of 17.2 acres of high quality wetlands while at the same time ridding the site of some of the common reed which is present. This plan is slightly more expensive ($1,239,570) than the first plan but it is situated in such a way that no impacts to the clover fields or cultural resources will occur. The third plan (3 acres of creation and 17.2 acres of restoration) would product 20.2 acres of high quality wetlands while destroying common reed on the site. This plan would be the most expensive ($1,318,740) and was not selected for this reason and because it was felt that the more wetland creation that was accomplished the better it would be in terms of an overall increase of wetland acreage at the Supawna Meadows site. Even though plan number 2 is slightly more expensive than plan number 1, it will have the greatest environmental benefit since it will provide 17.2 acres of high quality wetlands without impacting either the cultural resources or the clover fields on the site. In addition, it will eradicate 11.2 acres of common reed from the site. Based on these facts, plan number 2 was selected to mitigate wetland and shallow water habitat impacts that would result from implementing the proposed plan of improvement for the Salem River navigation channel.

SALEM RIVER MITIGATION PLAN

Project: The project requiring the proposed mitigation is the Delaware River Comprehensive Navigation Study, Salem River, Salem County, Salem, New Jersey. The proposed plan of improvement for the Salem River navigation channel consists of widening and deepening the existing channel through dredging operations. This action will result in the loss of 3 acres of estuarine intertidal emergent wetlands and 8.6 acres of shallow water habitat.

Based on information and recommendations received from a site survey conducted by Environmental Resources, Inc. (1992), and coordination with the U.S. Fish and Wildlife Service and National Marine Fisheries Service, the following mitigation plan was developed.

Mitigation Size and Location: The mitigation site is to be constructed on a 17.2 acre section of the Supawna Meadows National Wildlife Refuge, Salem, New Jersey (Figure 1). The mitigation will be accomplished through the creation of 6.0 acres of estuarine intertidal emergent wetlands from existing uplands and the restoration of 11.2 acres of wetlands from existing wetland areas which are presently dominated by monotypic stands of *Phragmites australis*.

Tide Information: The mean high water elevation at the proposed site is 4.0 feet n.g.v.d. The tidal range in this area is 5.5 feet using the mean low water datum and 5.6 feet using mean lower low water datum. A time correction of 10 minutes (for high tide) can be added to the predictions for Reedy Point, Delaware (nearest NOAA station), to obtain tide information for the mitigation site. Some of the existing channels on site will be modified and new channels constructed, if necessary, in order to carry water to the site to properly inundate the wetlands that will be created and restored.

Water Salinity: On May 18, 1992, the salinity of the water at the proposed mitigation site was measured at 1.0 part per thousand (ppt). Somewhat higher salinities can probably be expected at the site, depending on weather conditions and the time of the year. For this reason, it was determined that brackish tolerant emergent plantings should be used at this location. Based on site investigations which observed only brackish to somewhat freshwater emergent plant communities in the vicinity of the mitigation area, it was determined that plantings tolerant of salinities between at least 1 and 5 ppt. should be used for this project.

Plantings: Based on the salinity tolerances discussed above, the following plants meet the criteria for planting on this site:

Peltandra virginica	Arrow arum
Scirpus pungens	Common threesquare
Spartina cynosuroides*	Big cordgrass
Acorus calamus*	Sweet flag
Scirpus validus*	Soft stemmed bulrush
Hibiscus moscheutos*	Marsh hibiscus

*These plants will be located at the higher elevations near mean high water along the edge of the mitigation site.

The above mentioned plants will be planted in a 3' X 3' planting grid with the Peltandra virginica being the most prominent species planted, especially in areas where the elevation will be lowered to 2.5'.

Excavation and Grading: It will be necessary to excavate approximately 71,761 cubic yards (cy) of material from the proposed mitigation site to create and restore the desired 17.2 acres of wetlands. In order to create wetlands from uplands, approximately 41,301 cy of material will have to be removed to bring this portion of the site to the desired elevation of 2.9 feet n.g.v.d. In this area plantings of Scirpus pungens (common threesquare) and Scirpus validus (soft stemmed bulrush) will be done. The wetland restoration will require the excavation of approximately 30,460 cy of material to bring the elevation to 2.5 feet. This area is being graded to a lower elevation to help eliminate the presence of Phragmites australis by eliminating the dense root mats which reach depths of at least 18 inches or more in this location. In addition, the lower grade will allow a greater inundation of water which should prevent re-establishment of the Phragmites australis after the mitigation is complete. This elevation is also within the middle growing range of Peltandra virginica (arrow arum), which means that it should grow quite well under these conditions.

A transitional edge with a 4:1 slope will be created between the emergent wetlands and the adjacent uplands. From the lower design grades to slightly above the mean high water line, species such as Spartina cynosuroides (big cordgrass), Acorus calamus (sweet flag), Scirpus validus (soft stemmed bulrush) and Hibiscus moscheutos (marsh hibiscus) will be planted. The abrupt slope along the wetland/upland transitional edge will help to limit the invasion of the Phragmites australis. To further minimize this possible invasion, the herbicide "Rodeo" (glyphosate), will be sprayed on the areas to be restored for two consecutive years prior to excavation. Spraying will occur when there is maximum sugar transport through the leaves and stems into the rhizomes. This takes place when the plant is in full flower (late summer to early autumn).

Site Plan: As stated previously, 17.2 acres of wetlands will be created and restored to mitigate for the 3 acres of wetlands and 8.6 acres of shallow water habitat that will be lost during the modifications to the Salem River navigation channel. Through coordination with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service it was determined that wetland creation will be done on a 1:1 replacement ratio while the wetland restoration will be done on a 2:1 replacement ratio. Based on these ratios it was determined that 6.0 acres of creation will be done at a 1:1 ratio (6.0 acres total) and that 5.6 acres of restoration will be done at a ratio of 2:1 (11.2 acres total).

Due to the existing topography of the Supawna Meadows National Wildlife Refuge, the mitigation site will be split into two sections. One section will consist of 5.0 acres of created wetlands and 4.8 acres of restored wetlands. The other section, located to the south of the first section, will be made up of 6.4 acres of restored wetlands and 1.0 acre of created wetlands (Figure 2). The site was split into these sections to help to maximize the benefits gained from the mitigation and to avoid the cultural resources and cultivated clover fields, which the U.S. Fish and Wildlife Service maintains, on the site.

Monitoring: A post-planting monitoring plan will be conducted twice yearly, once during the month of June and then again during the month of September. These sampling dates will allow for the documentation of both the annual and the perennial components of the plant communities. The post-monitoring plan will continue for a minimum of 5 growing seasons following the completion of all wetland creation and restoration activities. It is required that the site attains a minimum vegetative coverage of 85% of the disturbed area after the first complete growing season. Failure to achieve this survival rate will require the arrangement of a meeting with the involved agencies to examine the causes of failure and develop a remediation plan.

If the annual monitoring reveals that the Phragmites has begun to re-invade the mitigation site steps will be taken to bring the spread of the common reed under control. The most feasible method of suppressing the re-establishment of Phragmites would be the use of herbicide (Rodeo) spot treatments on invading plants. These spot treatments would be based on a mid-summer evaluation of the extent of Phragmites recruitment. Spot treatments would be directed to avoid any mortality of planted and desirable voluntary species. These spot treatments will be conducted annually until desired wetland vegetation attains vigorous growth and complete cover (>85% cover) during the 5-year monitoring period. If herbicide spot treatments for Phragmites control are ineffective other control methods such as mowing, plowing or cutting, will be evaluated and put into use as necessary.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Fish and Wildlife Enhancement
927 North Main Street (Bldg. D1)
Pleasantville, New Jersey 08232

Tel: 609-646-9310
FAX: 609-646-0352

IN REPLY REFER TO:

FP-92/196

August 14, 1992

Robert L. Callegari, Chief
Planning Division
U.S. Army Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3396
ATTN: Environmental Resources Branch

Dear Mr. Callegari:

This responds to your letter of July 24, 1992, requesting Fish and Wildlife Service (Service) comments on the proposed mitigation plan for the Delaware River, Comprehensive Navigation Study, Salem River, New Jersey, Preconstruction, Engineering, and Design Project. The selected plan for improving navigation on the Salem River includes widening the existing navigation channel from the current width of 100 to 150 feet to a channel 150-feet-wide over the entire 5-mile length of the channel. The channel would also be deepened from the current authorized depth of 12 feet below mean low water to 18 feet below mean low water. The selected plan also provides for a 495-foot-wide turning basin opposite the berthing area at the Port of Salem, and bend widening. The proposed project would result in the loss of 3 acres of estuarine intertidal emergent wetlands, and 8.6 acres of shallow water habitat.

To mitigate unavoidable adverse impacts to wetlands and shallow water habitat, the Army Corps of Engineers (Corps) proposes to create 8.4 acres of estuarine intertidal emergent wetlands from uplands, and to enhance 6.4 acres of degraded wetlands dominated by common reed (*Phragmites communis*). The proposed mitigation site is located on the Supawna Meadows National Wildlife Refuge. Service biologists visited the proposed project site and the proposed mitigation site on August 15, 1991. Additional visits to the proposed mitigation site occurred on August 20, 1991, and May 18, 1992.

The following comments are provided as planning aid in accordance with a Fiscal Year-1991 scope-of-work agreement between the Service and the Philadelphia District, Corps of Engineers. This correspondence provides technical assistance only and is not the document required of the Secretary of the Interior pursuant to Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

Pursuant to the National Wildlife Refuge System Administration Act of 1966 (50 CFR Part 29.21), the Corps' use of the proposed mitigation site will require a special use permit from the Service. The information submitted via this formal request for a special use permit will be used to determine whether the proposed use is compatible with the purposes for which the refuge was established. Application for the special use permit should be made to the refuge manager at the following address:

Walter Ford, Assistant Refuge Manager
Supawna Meadows National Wildlife Refuge
R.D. #3, Box 540
Salem, New Jersey 08079
(609/935-1487)

The mitigation plan submitted to this office provides a narrative description of the proposed mitigation project. This description includes existing and proposed elevations on the mitigation site; existing and proposed vegetation on the mitigation site; the tidal range of the mitigation site; salinity of the water that would feed the proposed mitigation site; and, a proposed post-planting monitoring plan for the mitigation project. The mitigation plan also includes a site map showing the general boundaries of the mitigation site.

The Service has reviewed this information and supports the conceptual design for the proposed mitigation site. The following recommendations are provided to improve the chances of successfully implementing the proposed mitigation.

1. Provide detailed site plans depicting at least the following: existing and proposed contours; mean high and mean low water lines; areas of proposed plantings, by species, including densities; locations of monitoring wells; and, locations of any tidal ditches.

2. Revise the proposed monitoring plan to specify a goal of 85 percent areal coverage of planted herbaceous species, or other desirable hydrophytic vegetation, after five growing seasons. Specify that failure to achieve this goal will require an evaluation to determine the cause of the failure, and appropriate remedial action.

3. Revise the proposed monitoring plan to include quantitative methods to document encroachment of common reed on the mitigation site, and to remove common reed should it occur. Specify that if common reed is determined to be a persistent problem after five years, it will be necessary to evaluate the cause of the problem and take appropriate remedial action.

4. Provide annual summary reports of information obtained through the post-planting monitoring program to the Service for a period of five years following the completion of initial plantings.

We appreciate the opportunity to comment on this project and all efforts by the Corps to accept a shared responsibility to ensure adequate protection of our Nation's living resources. Should you have any questions regarding these comments, or require further technical assistance, please contact Peter Benjamin of my staff.

Sincerely,

Clifford G. Day

Clifford G. Day
Supervisor

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Habitat and Protected
Resources Division
Sandy Hook Laboratory
Highlands, New Jersey 07732

August 14, 1992

Robert L. Callegari, Chief
Planning Division
Philadelphia District
U.S. Army Corps of Engineers
Wanamaker Building
100 Penn Square East
Philadelphia PA 19107-3390

Dear Mr. Callegari:

The National Marine Fisheries Service has reviewed the Salem River Mitigation Plan. The plan is designed to compensate for the loss of 3 acres of estuarine, intertidal, emergent wetlands and 8.6 acres of shallow water habitat that would result from the widening and deepening of the Salem River channel in Salem County, New Jersey. The mitigation will consist of the construction of 8.4 acres of estuarine, intertidal, emergent wetlands from uplands (1:1 ratio) and the restoration of 6.4 acres of wetlands (2:1 ratio) which are presently dominated by monotypic stands of reed (Phragmites sp.) at the Supawna Meadows National Wildlife Refuge in Salem County, New Jersey. The mitigation plan appears to provide the necessary compensation for the habitat loss that will result from the channel improvements. However, we request that a control plan for Phragmites, and additional information concerning the post-planting monitoring of the mitigation site be provided as part of the mitigation plan.

According to the excavation and grading section of the mitigation plan, a 4:1 slope is planned for the transitional area between the uplands and the mitigation area. The purpose of the steep slope is to help limit the invasion of Phragmites into the mitigation site. We recommend that a control plan also be developed to eliminate any Phragmites that invades the site.

The plan should also be more specific about the goals of the mitigation plantings. The monitoring section of the plan states that the site shall attain a "minimum vegetative coverage survival" of 85% of the disturbed area after one complete growing season. The phrase "minimum vegetative coverage survival" is ambiguous. Is the goal of the planting to achieve 85% survival of the planted species, or 85% coverage? We recommend that 85% coverage, including volunteer wetland species other than Phragmites, be required.

The Salem River Mitigation Plan appears to provide adequate compensation for the wetland and shallow water habitat loss associated the widening and deepening of the Salem River. However, we request that additional information detailing the post-planting monitoring of the site and a Phragmites control plan be provided as part of the mitigation plan.

Thank you for the opportunity to comment. If you would like to discuss this project, please contact Karen Wurst at (908) 872-3015.

Sincerely yours,

Stanley W. Gorski
Assistant Coordinator
Habitat Program

cf: EPA, Region II
FWS, Pleasantville
NJ Land Use Regulation Element
NJ Div. of Fish, Game & Wildlife

K.Wurst:908-872-3015:8/14/92:kmw

28 Sept 92

STATE OF DELAWARE
DEPARTMENT OF STATE
DIVISION OF HISTORICAL AND CULTURAL AFFAIRS
HISTORIC PRESERVATION OFFICE
15 THE GREEN
DOVER • DE • 19901-3611

TELEPHONE: (302) 739-5685

FAX: (302) 739-5660

September 22, 1992

Mr. Michael Swanda
Archaeologist
Environmental Resources Branch
Philadelphia District, Corps of Engineers
100 Penn Square East
Philadelphia, PA 19107-3390

Dear Mike:

This letter is a follow up to our September 21 phone conversation regarding my review and comments on the August 1992 draft report entitled **Aquatic Cultural Resources Investigation, Salem Cove - Delaware River, Salem County, New Jersey and New Castle County, Delaware.** As I indicated, the report provides sufficient information for us to conclude there are no significant submerged resources in the project area which lies in Delaware's jurisdictional waters. Such a conclusion will complete our formal Section 106 review for this project.

I, however, must advise you that the draft report does not meet the Standards for Preservation Planning, Identification and Archaeological Documentation as found in Secretary of the Interior's **Standards and Guidelines for Archeology and Historic Preservation** (48 FR 44716) and, as such, we cannot accept it as a final document. I have prepared a list of comments that should be conveyed to the consultant for making the necessary revisions. I have also enclosed copies of the evaluation forms which we use when reviewing reports against the Secretary's Standards. These should also be forwarded to the consultant for his consideration. My comments are as follows:

1. A location map of the entire project which delineates the DE/NJ boundary is needed. Appropriate USGS Quad sheets would suit.

2. The report fails to cite, reference or excerpt relevant information from our three State Plans. The consultant must use these as a basis for all discussions on historic contexts and property types.

3. There is no discussion on the prehistory of the project area or the potential for any property types to be present from the specific time periods represented therein.

4. The discussion on background history and the subtopics included therein are not always complete in the sense that the subject matter may have some historic relevance into the 20th century. For example, the discussion on the shipping industry stops circa 1880. Also, there is no discussion on 20th century naval history of the area. If possible property types which represent that aspect of our history may be present, this context must be established as a frame of reference.

5. The importance of non-shipping economies are not discussed. Specifically, the small-scale 'watermen economy' is ignored yet the possibility of finding submerged resources associated with this aspect of our history is very real.

6. 'Fixed' resources such as piers, which are important property types, are not discussed in any fashion within an historic context or in the discussion "4.0 Potential Submerged Cultural Resources Types" yet the recommendation section notes the possibility of just such a property being present. All of the small shallow draft vessels which are noted as potential resources need to have a more detailed 'property type' discussion. Moreover, this property type discussion must also be linked with an historic context.

7. The success and adequacy of the research, field methodology and analysis and interpretation of data contained within this investigation are inferred rather than stated. Additionally, how the results of this investigation reflects on the respective State Plans is absent. If there is a need to revise or modify any of the State Plans, this should be spelled out. Criticism of the State Plans provides opportunities for modification. Without these comments, we have no way of knowing how or where improvement is needed.

After considering these comments, please do not hesitate to contact me if you wish to discuss any of them. I look forward to receiving a revised report for review. Thank you.

Sincerely,

Faye L. Stocum

Faye L. Stocum
Archaeologist

Enclosures

State of New Jersey
Department of Environmental Protection and Energy
Natural and Historic Resources
Division of Parks and Forestry
Office of New Jersey Heritage
CN 404
Trenton, NJ 08625-0404
Tel. # 609-292-2023
Fax. # 609-292-8115

Scott A. Weiner
Commissioner

James F. Hall
Assistant Commissioner

ONJH-J92-17

October 23, 1992

Lt. Colonel R. F. Sliwoski
District Engineer
U. S. Army Corps of Engineers
100 Penn Square East
Philadelphia, PA 19107-3390

Dear Colonel Sliwoski:

As Deputy State Historic Preservation Officer for New Jersey, in accordance with 36 C.F.R. Part 800: Protection of Historic Properties, as published in the Federal Register, 2 September 1986 (Volume 51, Number 169, pages 31115-31125), I am commenting officially upon the project designated below:

NATIONAL HISTORIC PRESERVATION ACT OF 1966 as amended

SECTION 106: SHPO Consultation and Comments (36 CFR Part 800)

PROJECT TITLE: Salem County, New Jersey [+ New Castle County, Delaware]
Salem River [+ Delaware River, Salem Cove]
Channel Widening and Deepening, Delaware River, Elsinboro Point to New Jersey Route 49 Bridge
Water Resources Act of 1986, P.L. 99-662, Section 859
Delaware River Comprehensive Navigation Study

FEDERAL AGENCY: Philadelphia District
U. S. Army Corps of Engineers

I. 800.4 Identifying Historic Properties

Basing myself on a letter from J. Lee Cox Jr., Director, Dolan Research, Incorporated, Philadelphia to Michael Swanda, September 16, 1992, I am of the opinion that Target IV 22:9 in the Salem River, does not meet National Register of Historic Places Criteria of Eligibility.

This completes review of submarine cultural resources for the project.

Sincerely,

Nancy L. Zerbe

Nancy L. Zerbe
Deputy State Historic
Preservation Officer

NLZ/vs

c: Mr. Robert Callegari, Planning Division
Mr. Michael Swanda, Environmental Resources

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DESIGN RECOMMENDATIONS

LIGHTHOUSE ROAD WETLAND MITIGATION SITE

SUPOWNA MEADOWS WILDLIFE REFUGE

PENNSVILLE, SALEM COUNTY, NEW JERSEY

June 1992

Prepared for:

Environmental Resources Branch
Philadelphia District
U.S. Army Corps of Engineers
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ERI Project No. 154A001

INTRODUCTION

Environmental Resources, Inc. (ERI), was contacted in April 1992 by the Philadelphia District Corps of Engineers and requested to provide design recommendations for a proposed wetland mitigation site. The site is part of a U.S. Fish and Wildlife Service refuge area located east of Lighthouse Road (Salem County Route 632) and along an unnamed tidal tributary approximately one mile north of Mill Creek.

The proposed wetland mitigation site consists of mainly upland agricultural fields and wetland areas dominated by monotypic stands of *Phragmites australis*. Due to the degraded condition of these wetlands by virtue of *Phragmites australis* growth and the limited nature of tidal action throughout this area, restoration of portions of these existing wetlands will be considered for mitigation purposes.

In this report ERI will provide guidance with regard to the elevations necessary for establishment of desirable emergent wetlands. Suitable species for planting of the wetland mitigation site and a suggested concept plan sized to provide the necessary wetland mitigation credit (±20 acres) will be provided.

METHODOLOGY

ERI reviewed existing maps of the site provided by the Philadelphia District. These included aerial photography, National Wetlands Inventory maps, USGS Delaware City topographic quadrangle, and a tract survey by the U.S. Fish & Wildlife Service. The Fish & Wildlife survey plan showed and corresponded with various survey transects as shown by a 1" = 100' scaled survey plan with elevations along these transects as prepared by the Corps of Engineers, dated January 1992.

After review of mapping resources, ERI conducted an intensive, 2-day, on-site investigation both at the site and throughout the surrounding area on May 18 and 19, 1992. Near predicted normal mean high tide events were forecast for these days. Weather conditions prior to and during these days were dry and calm, so the confidence in actual measured tide ranges was excellent.

ERI sampled the height of mean high water events on May 18 and 19, 1992. The area of focus for wetland creation and restoration was also evaluated for design considerations. Wetland vegetation communities at the site were also reviewed in an effort to understand site conditions and make recommendations.

As the emergent wetlands of Supowna Meadows Wildlife Refuge were degraded by monotypic stands of Phragmites australis with little other emergent wetland species found, other off-site locations in the project vicinity were investigated with regard to types of wetland vegetation and their elevation ranges in relation to mean high water. These areas included, but were not limited to, Fort Mott State Park, Salem River at Salem, and Hancocks Bridge at Alloways Creek.

DESIGN RECOMMENDATIONS

All reported results and recommendations are based upon elevation bench marks provided by the Philadelphia District. The bench mark utilized for our study and, therefore, the bench mark to be used for a future marsh creation and restoration was obtained from Corps' survey notes dated 26 January 1992 entitled "Baseline, Bench Run" for their Wetland Reclamation Project Survey. The bench mark is a P.K. nail set at the base of Utility Pole Number 30636 which is located between Station 17+00 and 22+00 on the Corps' survey. The bench mark elevation is 12.29 feet n.g.v.d. 1929.

Tide Study Results - Based upon our investigation of two near normal mean high water predicted tides at the site, ERI would confirm a mean high water elevation at this site of 4.0 feet n.g.v.d.

The high tide of 18 May 1992 had an observed elevation of 3.53 feet. This tide was predicted to be 0.4 foot below a normal mean high tide event, thus, the correct mean high water elevation is 3.93 feet.

The high tide of 19 May 1992 had an observed elevation of 3.63 feet. This tide was predicted to be 0.5 foot below a normal mean high tide event, thus, the corrected mean high water elevation would be 4.13 feet.

Averaging the two data points a result of 4.03 feet is achieved, which for our purposes is reasonably rounded off to 4.0 feet.

The tidal range of the project is 5.5 feet using the mean low water datum and 5.6 feet using mean lower low water datum.

A time correction of 10 minutes (for high tide) can be added to the predictions for Reedy Point, Delaware (nearest NOAA station), for the project site.

ERI also established the elevation of a PVC plastic pipe set along the creek edge of the Corps' study transect located at Station 22+00. The elevation of the top of the pipe is 6.31 feet. The elevation of any tide can be obtained by subtracting the height difference between the observed water elevation and the top of the PVC pipe.

Water Salinity - A water sample collected at high tide on 18 May 1992 at the creek edge within the proposed wetland mitigation site, transect at Station 22+00, was 1.0 part per thousand. Depending on weather conditions and time of year, somewhat higher salinities should be expected. Accordingly, brackish tolerant emergent plantings should be used at this location. This is confirmed by our site investigations which concluded that brackish to only somewhat freshwater emergent plant communities occur at and upstream of the Salem power plant and Alloways Creek (Hancock Bridge) portions of the Delaware River estuary system then upstream to Fort Mott. More typical common freshwater species exemplified by <u>Sagitarius</u> <u>latifolia</u> (duck potato) appear to be absent from the project area. Therefore, plantings tolerant of salinities between at least 1 and 5 ppt. should be used for this project.

Emergent Wetland Plantings - We recommend the following plant list for primary emergent wetland planting. All species are reasonably available from commercial nurseries.

Peltandra virginica*	Arrow arum
Scirpus pungens[1]	Common threesquare
Spartina cynosuroides[2]	Big cordgrass
Acorus calamus[2]	Sweet flag
Scirpus validus[2]	Soft stemmed bulrush
Hibiscus moscheutos[2]	Marsh hibiscus

* Found at project site

[1] Found at Fort Mott State Park

[2] Plant at higher elevation near mean high water along edge of wetland mitigation site

The following secondary plantings of emergent wetlands which could be considered are:

Scirpus robustus[3]	Salt marsh bulrush
Typha angustifolia[4]	Narrow-leaved cattail

[3] Can be used along with common threesquare, however, may not be generally commercially available, special order

[4] Can be used along edges of the wetland mitigation site bordering common threesquare, however, may not be desirable due to invasive nature

For economy, some planting of Spartina alterniflora (salt marsh cordgrass) could also be done. This plant is found above the Delaware Memorial Bridge; however, as water salinity declines it appears to be excluded by more freshwater-loving species. Its benefit is that of having a wide range of suitable elevation (elevation ±1.3 to 3.4 feet) requirements and lower plant material cost. In some cases it can also be established by seeding.

Emergent Wetland Grading - Recommendations for grading of the proposed restoration and creation areas within the proposed wetland mitigation site require careful consideration, especially due to the need to eradicate Phragmites australis. Excavation of the site to the lowest possible elevation will improve success toward this goal by maximizing the time of tidal inundation and removal of existing root mat. However, when considering the cost of earthmoving and spoil disposal, the amount of excavation must be reduced as much as possible.

Vigorous monotypic coverage of Phragmites australis occurs within the proposed mitigation site at elevations between 3.0 and 5.7 feet. Within areas of Phragmites australis near elevation 4.0 feet and above, a dense root mat 18 inches or greater in depth generally occurs. Of course, finer root hairs extend to a even greater depth.

ERI also looked at the elevation at which Phragmites australis declined in vigor along the swales and creek edges as shown by the Corps' survey. A marked change or absence of Phragmites australis occurred at about elevation 2.0 feet and below.

ERI also noted the occasional occurrence of Peltandra virginica at elevations between 2.7 and 2.5 feet (depth of swale along Station 22+00 transect) where density of Phragmites australis declined.

ERI also conducted design and elevation studies at a site on the Salem River along Route 47 just northwest of Salem. This location provided the opportunity to study an emergent wetland area which had a variety of elevations and other wetland types not dominated by Phragmites australis. In addition, this location had the same tidal range, time and duration characteristics and relative position along the estuary system as the proposed wetland mitigation site.

The lower elevational limit of Phragmites australis at the Salem site was 3.3 feet. However, this was along a sloping bank. This fact is mentioned as it is evident that excavation of Phragmites australis at the proposed mitigation site would need to be well below this elevation.

Our grading recommendation for the balance of the wetland mitigation proposed for restoration would be the establishment of a relatively flat grade, excavated to elevation 2.25 feet n.g.v.d. with a tolerance of $\pm$0.25 feet. Areas proposed for wetland creation (agricultural fields) can have a somewhat higher grade. Excavation to this depth would accomplish several goals within proposed restoration areas. First, a significant amount of Phragmites australis root mat would be removed. The finish grade, based upon both on-site observation and the Salem River site, would be at a level at which the occurrence of _Phragmites_ _australis_ is either absent or at a low vigor.

In regard to establishment of desirable emergent wetland plantings, an elevation of 2.25 feet is middle range of _Peltandra_ _virginica_ (arrow arum). Furthermore, this plant is recommended to be the primary species planted within the mitigation site. While this plant was found at a low elevation of 1.3 feet and a high elevation of 3.4 feet, use of its mid-range elevation will afford the most vigorous growth.

On portions of the site being excavated from upland agricultural field, the problem of existing _Phragmites_ rhizomes will not occur. In these areas a somewhat higher finish grade would be acceptable. We would recommend a relatively flat elevation of 2.9 feet n.g.v.d. ±0.25 feet. In these zones plantings of _Scirpus_ _pungens_ (common threesquare) and _Scirpus_ _validus_ (soft stemmed bulrush) are suggested.

ERI recommends a relatively steep transitional edge between emergent wetlands and adjacent uplands (4:1 slope). From lower design grades to slightly above the mean high water line, species such as big cordgrass, sweet flag, soft stemmed bulrush and marsh hibiscus should be used. An abrupt slope along the wetland/upland transitional edge will serve to limit the invasion by _Phragmites_ _australis_. We also suggest that a 10-foot-wide channel to a minimum depth of elevation 1.0 foot n.g.v.d. be located around the perimeter of the wetland mitigation site for similar reasons.

As previously mentioned, _Spartina_ _alterniflora_ could also be used within all the elevational ranges recommended; however, over time this species may be replaced by plant species more favoring the freshwater end of the brackish water spectrum.

ERI would also suggest consideration that existing Phragmites australis areas to be restored be treated with a herbicide application of *Reodo* prior to excavation. Treatment is ideally done in late August, early September. Once treated, the Phragmites australis would be left until after the end of the growing season (about 1 November) before excavation was begun. It should be recognized that, because of the well-established nature of Phragmites australis areas to be restored, every measure possible to restrict its reestablishment should be undertaken.

Mitigation Site Design - A concept sketch plan for a possible design of the wetland mitigation site was prepared as part of this study. This concept plan is enclosed with this report. The plan is at approximately 1-inch = 200-foot scale. As the plan is a compilation of various photo-reduced or enlarged plans, scale is approximate.

This wetland mitigation site location is as generally presented to ERI by Corps' representatives. The goal of achieving 20 acres of mitigation credit through a combination of wetland creation (upland to emergent wetland yields 1:1 credit) and wetland restoration (Phragmites australis wetland to emergent wetland yields 2:1 credit) is demonstrated by the concept plan.

A summary of various acreage provided by the concept plan is as follows:

Area Type	Acreage of Emergent Wetlands Constructed	Mitigation Credit
Uplands (mainly agricultural fields)	13.1	13.1
Uplands (wooded)	1.4	1.4
Phragmites (mainly degraded wetlands)	11.5	5.7

Existing tidal channels within site	0.4	0
Phragmites and ponded area noted as very wet *	2.1	0
	28.5	20.2

* The portions of this area may be sufficiently wet to remain undisturbed as per the Corps' survey. Potential additional credit could be obtained by restoration of all or portions of this area. However, no excavation of this site is presumed by the concept plan.

ERI has estimated that a project site approximately 28.5 acres in size is needed to accomplish the project goal. A very rough estimate of earthwork volume over the site is 200,000 cubic yards.

The average earthwork volume generated on a per acre basis by the concept plan for wetland creation (uplands to wetlands) is approximately 9,500 cubic yards. The average earthwork volume generated on a per acre basis for wetland restoration is approximately 6,000 cubic yards.

Considering the cost effectiveness of any design approach, recognize that restoration is two times the planting cost of creation. Planting cost of eighteen thousand dollars per acre of emergent wetlands (assuming a 2' X 2' plant grid throughout) should be used for budget purposes. A 3' X 3' planting grid would reduce this cost by a factor of one half.

In addition, while restoration results in a lower per acre earthwork volume, only 2:1 credit is provided. In comparison with creation, the per acre earthwork volume for restoration should be doubled (i.e., 12,000 cubic yards per acre of credit). Restoration earthwork will also be more complicated and costly, likely requiring special excavation methods such as drag lines and mat roads for trucks.

Considering this information the cost/benefit with regard to creation versus restoration is clearly weighted toward wetland creation from uplands. Accordingly, our proposed concept plan is weighted to using creation. Any final design could be weighted further in favor of creation. Such an approach could be developed by relocation of the existing farm road and expanding creation further to the north.

As part of our design ERI also suggests several tidal channels be part of the design. As earlier discussed one channel should be around the perimeter of the site. This would aid in controlling debris accumulation and phragmites invasion. The channel should be at least 10 feet wide at its base with 3:1 side slopes with a minimum depth to elevation 1.0 foot n.g.v.d. ERI would also propose a central channel constructed in part by using the already existing channel leading to the "very wet area."

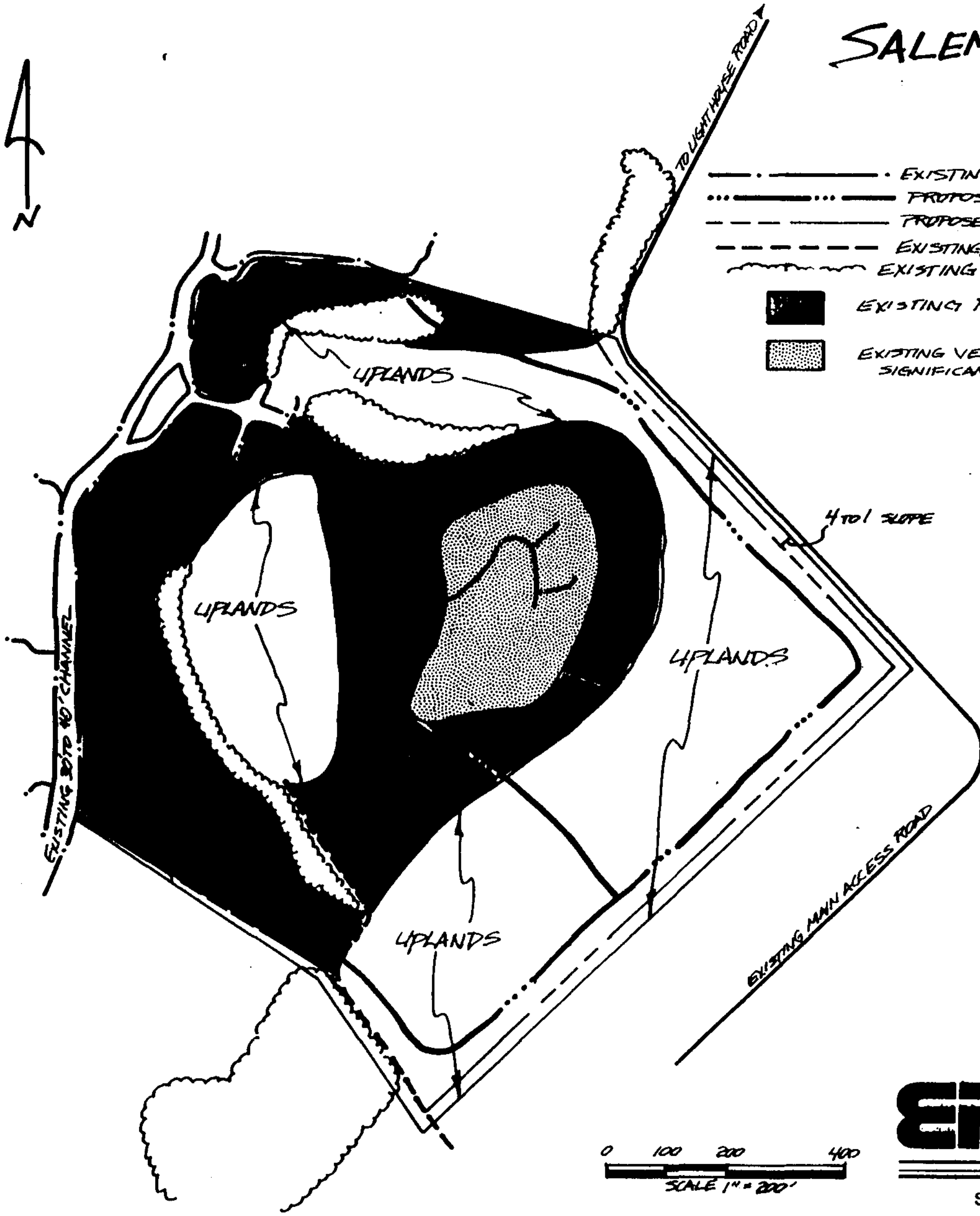
The creek providing tidal flow to the downstream point mitigation area is approximately 30 feet wide with a depth to elevation minus 1.2 feet as shown by the Corps' survey. ERI roughly estimates about 9.3 million gallons of water will be required to inundate the mitigation site to the level of mean high water.

The Corps should give some thought to the capacity of the existing creek toward complete filling of the wetland mitigation site over the period when tide rises between elevation 2.25 feet and elevation 4.0 feet. While we do not feel this should be a problem, some investigation into this issue is likely warranted.

Finally, a presently unknown, but major, factor in determining the feasibility and cost of this project will be the issue of spoil disposal methodology and location.

SALEM RESTORATION/MITIGATION SITE

SALEM COUNTY, NEW JERSEY



- EXISTING CHANNELS
- PROPOSED EXTENSION OF TIDAL CHANNELS
- PROPOSED TOE OF MITIGATION EXCAVATION
- EXISTING FIELD ROAD
- EXISTING TREE LINE
- EXISTING PHRAGMITES INVASION
- EXISTING VERY WET AREA (WITH SIGNIFICANT PHRAGMITES)

AREA TYPE	ACREAGE OF EMERGENT WETLANDS CONSTRUCTED	MITIGATION CREDIT
UPLANDS (MAINLY AGRICULTURAL FIELDS)	13.1	13.1
UPLANDS (WOODED)	1.4	1.4
PHRAGMITES (MAINLY DEGRADED WETLANDS)	11.5	5.7
EXISTING TIDAL CHANNELS WITHIN SITE	0.4	0
PHRAGMITES AND PONDED AREA NOTED AS VERY WET *	2.1	0
	28.5	20.2

* The portions of this area may be sufficiently wet to remain undisturbed as per the Corps' survey. Potential additional credit could be obtained by restoration of all or portions of this area. However, no excavation of this site is presumed by the concept plan.

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REPORT

LITERATURE SURVEY OF THE SALEM RIVER PROJECT AREA

U.S. Army Corps of Engineers
Philadelphia District
Philadelphia, Pennsylvania

May 1992

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LITERATURE SURVEY OF THE SALEM RIVER PROJECT AREA

Prepared for

THE U.S. ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT

CONTRACT NO. DACW61-91-D-0009
DELIVERY ORDER NO. 0014

Prepared By

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May 1992

LITERATURE SURVEY OF THE SALEM RIVER PROJECT AREA

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1.0 INTRODUCTION

The U.S. Army Corps of Engineers, Philadelphia District (Corps) retained The Greeley-Polhemus Group, Inc., to conduct an assessment (literature survey) of the area surrounding the Salem River near the City of Salem, Salem County, New Jersey to identify sources with the potential to contribute pollutants to the stream. The Corps is conducting a feasibility study to investigate the adequacy of the authorized channel dimensions of the Salem River waterway in Salem County New Jersey.

The scope of this investigation included documentary research into the historical use of the project area surrounding the Salem River, to identify potential sources that may be suspected of introducing contaminants into the study area. This investigation included the use of aerial photographs and site plans of the project area from previous years to identify the historical use of the site, a visual site inspection of the project area, review of Federal and state environmental databases, review of New Jersey Pollutant Discharge Elimination System (NJPDES) records to identify facilities with state permits to discharge wastewater to the Salem River, review of New Jersey Hazardous Waste Management Program records to identify sites in the project area undergoing hazardous waste remediation, and a title search of selected properties in the project area. The following sections present the results of the investigations of these areas.

2.0 SITE DESCRIPTION

2.1 STUDY AREA DESCRIPTION

The Corps of Engineers' Salem River Study addresses a study area surrounding the Salem River in Salem County, New Jersey, a tidal stream entering the Delaware River at mile 60, about 40 miles south of Philadelphia, Pennsylvania (Figure 1). The study area includes portions of six municipalities in Salem County: the City of Salem, Elsinboro Township, Lower Alloways Creek Township, Mannington Township, Quinton Township, and Lower Penns Neck Township.

2.2 VISUAL INSPECTION OF PROJECT AREA

The Salem River project area was visually inspected to identify sources that may have the potential to contribute pollutants to the stream. The project area includes residential, commercial and industrial facilities located throughout the six municipalities. The City of Salem contains the majority of residential developments although some additional residential areas are located outside of the City's corporate limits along the Salem River and along the major streets/roads exiting the City. Commercial facilities are located throughout the City and along the major roads in and outside the City. Major industrial facilities are located along the Salem River and Fenwick Creek in and outside of the City.

A list of the facilities in the project area which appear to have potential to contribute pollutants to the Salem River is shown in Table 1. The facility number is keyed to the facility location shown in Figure 2.

TABLE 1
FACILITIES IN PROJECT AREA

NUMBER	FACILITY	APPROXIMATE LOCATION
1	Sand Quarry	u/s on Fenwick Creek off Quaker Neck Road
2	Dump/Landfill	Keasbey Street
3	Erdner's Busy Corner - Warehouse Previously: H.J. Heinz Co. Warehouse Salem City Milling Company	Hubbell Avenue
4	Railroad Siding	Hubbell Avenue
5	Mannington Mills	Mannington Mills Road

TABLE 1 (con't.)

6	Mannington Mills Landfill	Mannington Mills Road
7	Tri-County Oil Terminal	Route 45
8	National Freight, Inc. Previously: Salem Gas Light Co. Salem Gas Works	Hancock Street
.	Atlantic City Electric Substation Previously: Substation and Salem Coal, Ice & Storage Company, William H. Dunn & Co. Lime Kiln, Ayers & Jones Canning Factory	Hancock Street
10	Anchor Glass Container Corporation Previously: Anchor Hocking Glass Corp. Salem Glass Works	Route 49/Griffith Street
11	Abandoned Industrial Building Previously: H. J. Heinz Company Hiles & Hilliard Canning Factory	Route 49/Griffith Street
12	Falcon Power, Inc.	Route 49/Griffith Street
13	Currier Systems, Inc.	Route 49/Griffith Street
14	Amoco Oil Terminal Previously: American Oil Company F. H. Lloyd Flour Mill	Front Street
15	Salem Stevedoring Corporation Previously: Congoleum Nairn, Inc. Steam Boat Co. Freight Starr Brothers Canning Facility Salem Oil Cloth Works	Tilbury Road
16	Wire Pro Industries Previously: Congoleum Nairn, Inc.	Front Street
17	Salem Wastewater Treatment Plant	Tilbury Road
18	Aluchem, Inc. (custom metal processing) Previously: Gaynor's Glass Works Pardessus & Gaynor Glass Blowers	Front Street & Salem River
19	PSEG Nuclear Training Center	Salem Road
20	Warren Crane Service (equipment storage yard)	Penns Grove Salem Road
21	Marlboro Machine Co., Inc.	Penns Grove Salem Road

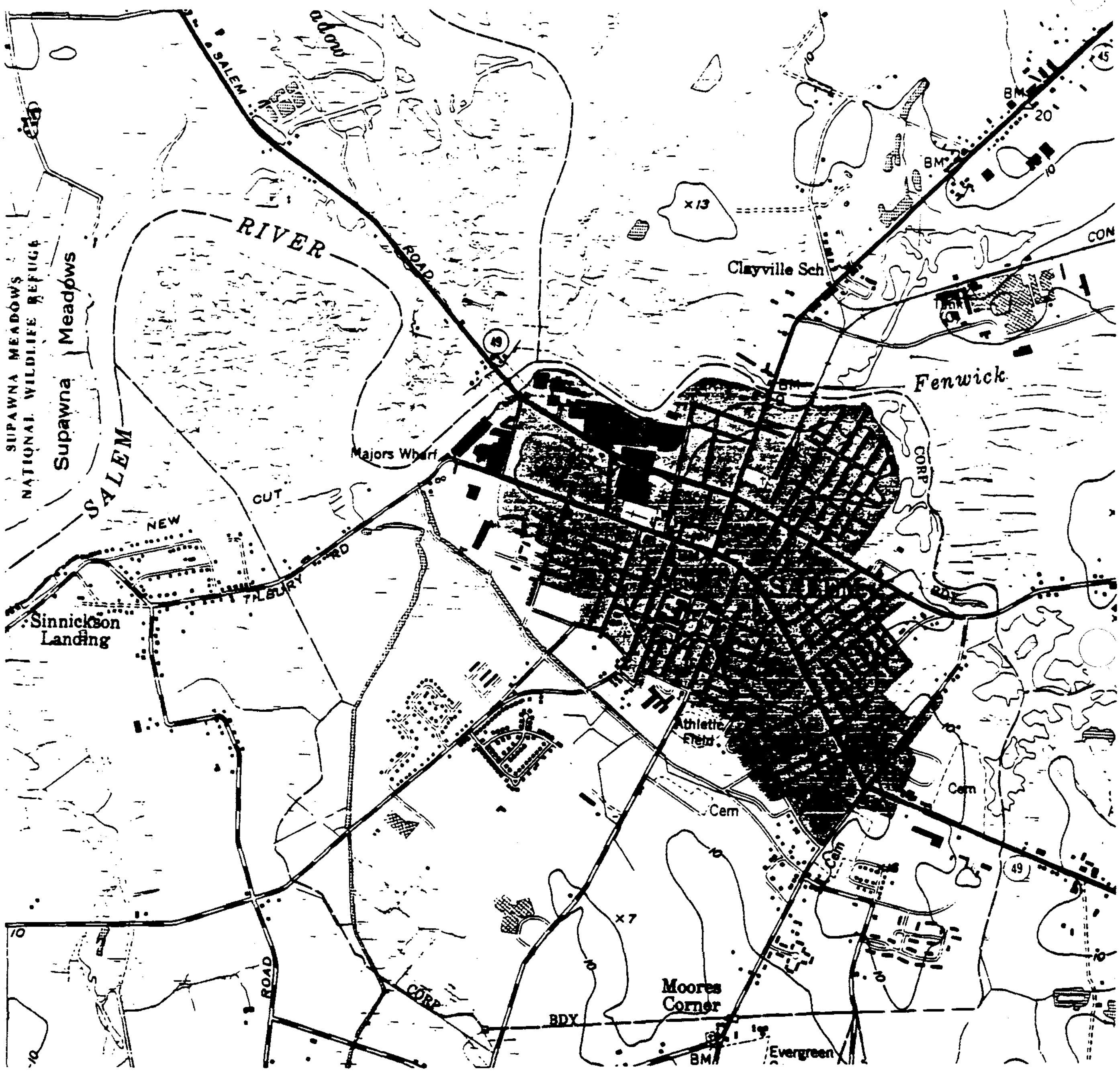


FIGURE 1: SALEM RIVER PROJECT AREA LOCATION MAP

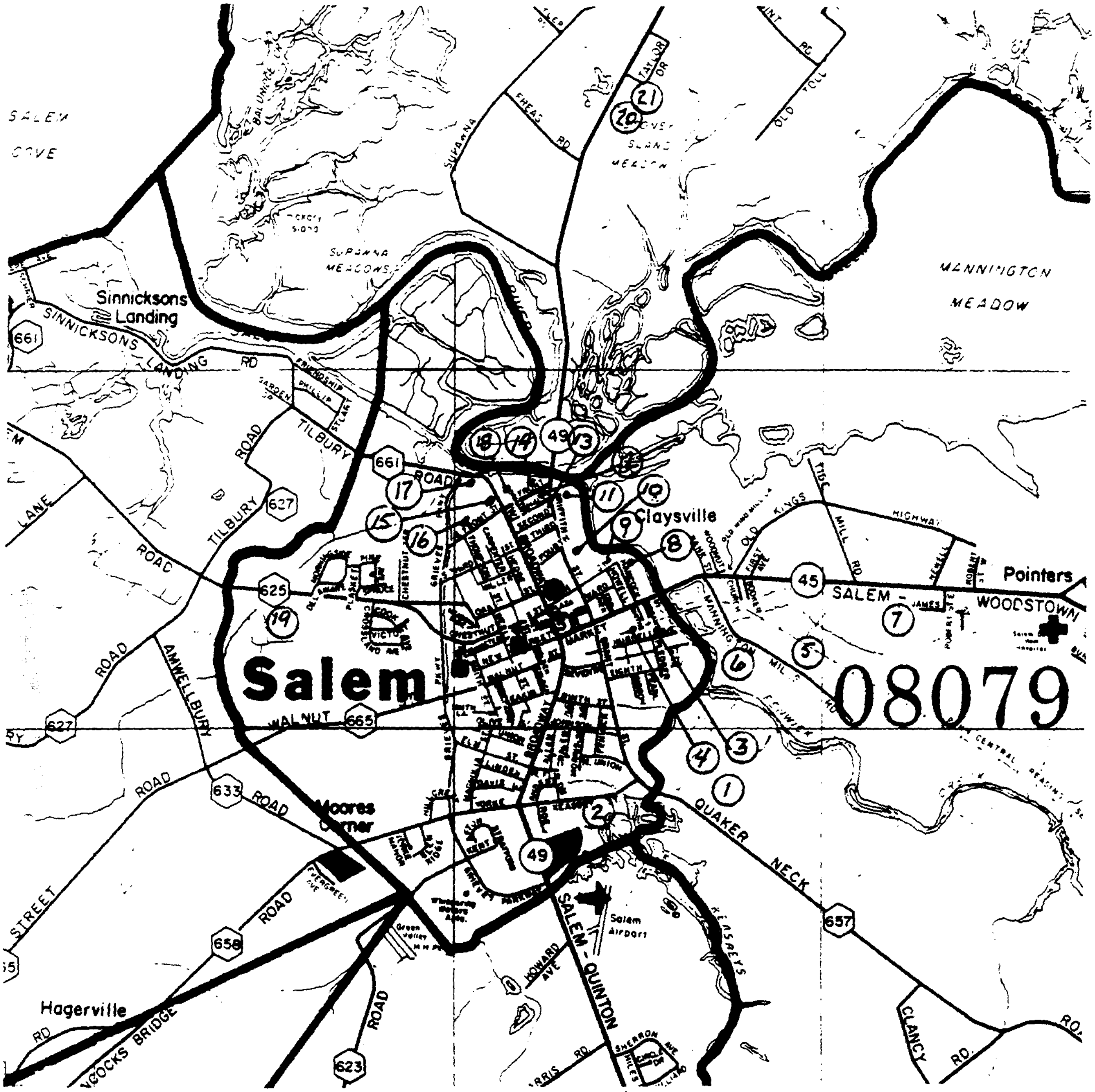


FIGURE 2: SALEM RIVER PROJECT AREA FACILITY LOCATION MAP

3.0 FEDERAL AND STATE DATABASE REVIEW

3.1 INTRODUCTION

A review of Federal and state computer databases was performed to identify sources with the potential to contribute pollutants to the Salem River. The Federal databases that were reviewed are shown on the following table.

DATA SOURCE
National Priorities List (NPL)
Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS)
Toxic Release Inventory (TRI)
Resource Conservation and Recovery Act Notifiers (RCRA)
Nuclear Facilities
Open Dumps

The National Priorities List (NPL) or Superfund is EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) List is a compilation by EPA of known or suspected uncontrolled or abandoned hazardous waste sites which the EPA has investigated, or is currently investigating for a release or threatened release of hazardous substances pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. The Toxic Release Inventory (TRI) contains information on the annual estimated releases of toxic chemicals to the environment. Data includes maximum amount stored on-site, the estimated quantity emitted into the air, discharged into bodies of water, injected underground, or released to land, methods used in waste treatment and their efficiency, and data on the transfer of chemicals off-site. The Resource Conservation and Recovery Act (RCRA) Notifiers are those sites which have filed notification forms with the EPA in accordance with the RCRA requirements regarding their generation, storage, transportation, treatment, or disposal of hazardous waste.

The state environmental databases that were reviewed to identify sites of concern in the project area are shown in the following table. The sites included in the state databases are those sites located in zip code areas that fall within a one-mile radius of the approximate centerpoint of the project area. The state database includes sites both within and outside the project area. The number of sites in the state database that are within the project area are shown below.

DATA SOURCE	APPLICABLE SITES
State RCRA	32
DWR Pollution Investigation	21
Pollutant Discharge	16
Hazardous Waste Sites	3
Landfills	8
Lust	9

The state RCRA List includes those facilities that filed a notification form with the state regarding their generation, storage, transportation, treatment or disposal of hazardous waste. The Division of Water Resources Ground Water Pollution Investigation in New Jersey List identifies facilities where investigations have or are currently being performed to identify ground-water pollution. The New Jersey Pollutant Discharge Elimination System (NJPDES) List identifies facilities that discharge pollutants into the national or state waters. The Hazardous Waste Sites List identifies known and suspected hazardous sites in the project area. The Landfills List identifies facilities that handle solid waste in the project area. The Leaking Underground Storage Tank (LUST) List identifies facilities in the project area with known leaking underground storage tanks.

Summary Reports of environmental databases were also reviewed. The EPA Facility Index System (FINDS) database is a compilation of any property on-site which the EPA has investigated, reviewed or been made aware of in connection with its various regulatory programs. The Emergency Response Notification System (ERNS) database identifies sites in the project area that have initiated an emergency response action.

The sites or facilities within the project area included in each of these Federal and state databases are identified in the following sections.

3.2 CERCLIS

A search of the 1991 CERCLIS database identified 3 sites within the zip code areas surrounding the project area. The sites include:

FACILITY OR SITE NAME	STREET ADDRESS OR LOCATION	CITY
Mannington Mills, Inc.	Mannington Mills Rd.	Mannington Township
Salem Coal Gas	Fifth & Howell Sts.	Salem
AKA Salem Gas Light Company		
Salem Gas Works		
Gayner Glass Works	Front and Broadway	Salem

3.3 TRI

The Toxic Release Inventory Summary Report identified 2 facilities within the zip code areas surrounding the project area that release toxic chemicals to the environment. The sites include:

FACILITY OR SITE NAME	STREET ADDRESS OR LOCATION	CITY
Mannington Mills, Inc.	Mannington Mills Rd.	Mannington Township
Aluchem, Inc.	62 Front St.	Salem

Data contained in the TRI for the Mannington facility is presented below:

Mannington Mills, Inc.
Substances Released: Butyl Benzyl Phthalate
Sodium Hydroxide (Solution)

Data on the substances released from the Aluchem facility were not provided in the TRI list.

3.4 RCRA SITES

A review of the RCRA database indicates that 46 sites are within the zip code areas surrounding the project site. Thirty-two of these sites are located within the project area. The sites include:

FACILITY OR SITE NAME	STREET ADDRESS OR LOCATION	CITY
The Sherwin-Williams Co.	318-320 E. Broadway	Salem
Sunoco Service Station	Rts. 540, 541 & 45	Mannington Twp.
Sunoco Service Station	Market & Griffith Sts.	Salem
Mannington Mills	Mannington Mills Rd.	Mannington Twp.
Anchor Hocking Corp., Plant 6	83 Griffith St.	Salem
Wire Pro, Inc.	23 Front St.	Salem

South Jersey Colonial Nurseries	Rt. 45, Salem-Woodstown	Mannington Twp.
Salem Machine Co.	25 W. Broadway	Salem
Salem High School	Walnut Street Rd.	Salem
Frank H. Wheaton III, c/o Salem Cargo Corp.	45 Griffith St.	Salem
Salem Amoco	1 Front St.	Salem
K. Jang Cleaners	204 Griffith St.	Salem
New Jersey Bell Telephone Co.	Lower Alloways Creek Necks Rd.	Salem
New Jersey Bell Telephone Co.	Lower Alloways Creek Necks Rd.	Salem
Salem Central Office	86 W. Broadway	Salem
PSE&G Nuclear Training Center	244 Chestnut St.	Salem
Salem Port Authority	62 Front St.	Salem
Salem Operations	5th St.	Salem
F. Bell Chevrolet, Inc.	197 Woodstown Rd.	Salem
Nippon Chevrolet	197 Woodstown Rd.	Salem
Bosco Cleaning Services, Inc.	Nuclear Generating Station	Salem
Keen's Auto Repair, Inc.	352 E. Broadway	Salem
Vineland Construction	5 Hancock St.	Salem
Salem Auto Mall	197 Woodstown Rd.	Salem
Joe & Sandy's Country Store	986 Main St.	Salem
Mannington Twp. Board of Education	45 Woodstown Rd.	Salem
Swedesboro NJ Repeater Station	Rt. 49	Quinton
Quinton Rep. Sta.	Bridgeton Salem Pk.	Quinton
T.E. Warren, Inc.	Rt. 49	Quinton
Butch's Paint on Wheels	Salem-Quinton Rd.	Quinton
Butch's Paint on Wheels	Rt 49, Salem-Quinton Rd.	Quinton
I.S. Smick Lumber	Rt. 49	Quinton

3.5 NEW JERSEY DWR POLLUTION INVESTIGATIONS

Review of the New Jersey Division of Water Resources Ground Water Pollution Investigation database indicates that 64 sites in Salem County have or are currently undergoing investigations to identify the presence or extent of ground water pollution. Twenty-one of these sites are located in Salem, Elsinboro, Lower Alloways, Mannington and Quinton Townships in the vicinity of the project area. No sites were identified in Lower Penns Neck Township. The table included below identifies the site name, address, township, lead NJDEPE Program Unit and the Program in which the investigation is located.

FACILITY OR SITE NAME	LOCATION/ADDRESS	TOWNSHIP	LEAD	PROGRAM
Presidente Rivera Spill	Delaware River		BFO	BFO
South Jersey Rad. Contam.			SBRE	A-280
Elsinboro Twp. Sanitary Landfill	Sinnickson Landing Rd.	Elsinboro	BGWDC	NJPDES

Leisure Arms Complex		Lower Alloways Creek	BSDW	A-280
PSE&G Hancock's Br. Gen. Station	P.O.Box 236 Hancock's Bridge	Lower Alloways Creek	BUST	UST
PSE&G Hope Creek Gen. Station		Lower Alloways Creek	BGWDC	NJPDES
Mannington Twp. Sanitary Landfill	Mannington Mills Rd.	Mannington	BGWDC	NJPDES
Green Valley Mobile Home Pk.		Quinton	BSDW	A-280
Quinton Landfill		Quinton	BFO	BFO
Quinton Twp. SWDA	RD #2 Schepps Valley	Quinton	BGWDC	NJPDES
Quinton Twp. SWDA	S. Burden Hill Rd. Blk 34, Lt. 30	Quinton	BGWDC	NJPDES
Atlantic Electric	17-25 Fifth St.	Salem	BUST	UST
Bader Property	Salem	Salem City	BFO	BFO
Hassler & Davis Sanitary Landfill	Keasbey & Grant Sts.	Salem City	BGWDC	NJPDES
Mannington Mills, Inc.	Mannington Mills Rd.	Salem City	BGWDC	NJPDES
Mid-Atlantic Shipping & Stevedoring	128 Tilbury Rd.	Salem City	BGWDC	NJPDES
S. Jersey - Salem City		Salem City	BCM	ENF
Salem City Sanitary Landfill	Tilbury Rd.	Salem City	BGWDC	NJPDES
Salem Machine Corp.	25 W. Broadway St.	Salem City	BEECRA	ECRA
Salem Water Dept.		Salem City	BSDW	A-280
Coastal Oil Property	Griffith & Market Sts.	Salem	BUST	UST

DATABASE LEGEND: NJ Department of Environmental Protection and Energy Program Unit

BFO: Bureau of Field Operations
SBRE: Southern Bureau Regional Enforcement
BGWDC: Bureau of Groundwater Discharge Control
BSDW: Bureau of Safe Drinking Water
BUST: Bureau of Underground Storage Tanks
BCM: Bureau of Case Management
BEECRA: Bureau of Environmental Evaluation and Cleanup Responsibility Assessment

3.6 NJPDES

A search of the NJPDES database identified 16 sites within the project area that have discharge permits. The facility name, address, standard industrial classification and discharge category of each site is shown below.

NJPDES: NJ0052400
Facility: Aluchem Inc.
Address: 62 Front St., Salem NJ 08079
SIC: Industrial Inorganic Chemicals
Discharge Cat: C Thermal Surface Water Discharge

NJPDES: NJ0005151
Facility: Anchor Glass Container Corp.
Address: 83 Griffith Street, Salem NJ 08079
SIC: Glass Containers
Discharge Cat: B Industrial/Commercial Surface Water
C Thermal Surface Water Discharge
L Indirect Discharge to POTW (SIU)

NJPDES: NJ0062201
Facility: Canton Village Sewage Treatment Plant
Address: Main Street - Canton, Salem NJ 08079
SIC: N/A
Discharge Cat: A Sanitary Surface Water Discharge

NJPDES: NJ0063428
Facility: Cloverdale Diary Farm
Address: Woodstown Rd. Salem NJ 08079
SIC: N/A
Discharge Cat: D Land Application of Residuals

NJPDES: NJ0056481
Facility: Elsinboro Township Sanitary Landfill
Address: Sinnickson Landing Rd., Elsinboro NJ
SIC: N/A
Discharge Cat: O Landfill-Municipal/Sanitary

NJPDES: NJ0005614
Facility: Mannington Mills, Inc.
Address: Mannington Mills Rd., Salem NJ 08079
SIC: Hard Surface Floor Coverings
Discharge Cat: C Thermal Surface Water Discharge
F Landfill-Industrial/Commercial
I Infiltration/Percolation Lagoon-Industrial
J Surface Impoundment - Industrial
W Oil/Water Separators
05 Group I - Stormwater Runoff

NJPDES: NJ0056561
Facility: Mannington Township Sanitary Landfill
Address: Mannington Mills Rd. Mannington NJ 08079
SIC: N/A
Discharge Cat: O Landfill - Municipal/Sanitary

NJPDES: NJ0067831
Facility: Mid-Atlantic Shipping and Stevedoring
Address: 128 Tilbury Rd., Salem NJ 08079
SIC: Stevedoring
Discharge Cat: F Landfill - Industrial/Commercial

NJPDES: NJ0054909
Facility: Quinton Township Sanitary Landfill
Address: S. Burden Hill Rd., Quinton Twp. NJ 08072
SIC: N/A
Discharge Cat: O Landfill - Municipal/Sanitary

NJPDES: NJ0054917
Facility: Salem City Sanitary Landfill
Address: Tilbury Rd., Salem NJ 08079
SIC: N/A
Discharge Cat: F Landfill - Industrial/Commercial
O Landfill - Municipal/Sanitary

NJPDES: NJ0028797
Facility: Salem County Voc. Tech. School
Address: Rt 45., Woodstown-Salem Rd., Mannington, NJ 08098
SIC: Elementary & Secondary Schools
Discharge Cat: A Sanitary Surface Water Discharge

NJPDES: NJ0072010
Facility: Salem Packing Company
Address: 697 Salem-Quinton Rd., Salem NJ 08079
SIC: N/A
Discharge Cat: E Land Application Industrial Waste Residuals

NJPDES: NJ0024856
Facility: Salem Sewage Treatment Plant
Address: Tilbury Rd., Salem NJ 08079
SIC: Sewerage Systems
Discharge Cat: A Sanitary Surface Water Discharge

NJPDES: NJ0035742
Facility: Salem Water Treatment Plant, City of
Address: 520 Grieves Pkwy, Salem NJ 08079
SIC: Water Supply
Discharge Cat: B Industrial/Commercial Surface Water

NJPDES: NJ0076597
Facility: Service Station (Former)
Address: Front St & W. Broadway, Salem NJ 08079
SIC: Candy, Nut & Confection Stores
Discharge Cat: 07 Underground Storage Tank

NJPDES: NJ0075370
Facility: Service Station (Inactive)
Address: 285 Broadway & Olive Dr., Salem NJ 08079
SIC: Gasoline Service Stations
Discharge Cat: 07 Underground Storage Tank

3.7 HAZARDOUS WASTE SITES

A search of the list of Known and Suspected Hazardous Sites in New Jersey indicates that 20 sites are located in Salem County of which 1 site is in Mannington township and 2 sites are located in the City of Salem. The balance of the sites are located in Alloway Township (1), Carney's Point Township (3), Elmer Boro (1), Oldmans Township (6), Penns Grove Boro (1), Pennsville Township (1), Pittsgrove Township (2) and Woodstown Boro (2). The 3 sites in the project area are the following:

Mannington Mills, Inc.
Mannington Mills Rd.
Salem, NJ

Gayner Glass Works
Front St.
Salem, NJ

Salem Coal Gas, AKA Salem Gas Light Company, Salem Gas Works
Harwell St.
Salem, NJ

3.8 LANDFILLS

A search of the New Jersey Department of Environment and Energy, Solid Waste Facility Directory, indicates 35 facilities in Salem County that are currently operating, are terminated or are not yet open. Eight of these facilities are located within the project area. The facility name, location, type of operation, authorized waste and status of these sites is shown below:

Name: Elsinboro Twp. Sanitary Landfill
Location: Tilbury Rd. Elsinboro Twp.
Type: Solid Waste Landfill
Status: Terminated

Name: Mannington Mills, Inc. Sanitary Landfill
Location: Mannington Mills Rd., Mannington Twp.
Type: Solid Waste Landfill
Auth. Waste: Dry Industrial Waste
Status: Not Operating

Name: Mannington Twp. Sanitary Landfill
Location: Mannington Mills Rd., Mannington Twp.
Type: Solid Waste Landfill
Auth. Waste: Municipal (Household, Commercial & Institutional Waste), Bulky Waste and Vegetative Waste
Status: Terminated

Name: Quinton Twp. Sanitary Landfill
Location: S. Burden Hill Rd., Quinton Twp.
Type: Solid Waste Landfill
Auth. Waste: Municipal (Household, Commercial & Institutional Waste), Bulky Waste; and Vegetative Waste
Status: Not Operating

Name: Quinton Twp. Solid Waste Landfill Location: Rd #2, Schepps Valley, Quinton Twp.	Type: Solid Waste Landfill Auth. Waste: Municipal (Household, Commercial & Institutional), Dry Sewage Sludge; Bulky Waste; and Vegetative Waste Status: Not Operating
Name: Quinton Twp. Leaf Compost Facility Location: S. Burden Hill Rd., Quinton Twp.	Type: Compost Facility Auth. Waste: Vegetative Waste Status: Operating
Name: Salem City, Sanitary Landfill Location: Tilbury Rd., Salem City	Type: Solid Waste Landfill Auth. Waste: Municipal (Household, Commercial & Institutional Waste), Bulky Waste; Vegetative Waste; Animal & Food Processing Waste; and Dry Industrial Waste Status: Not Operating
Name: Mid-Atlantic Shipping & Stevedoring Location: Tilbury Rd. Block 97, Lot 9.01 Salem City	Type: Disruption Auth. Waste: Status: Not Operating

3.9 LUST

A search of the Leaking Underground Storage Tank database indicates 9 facilities are located in the project area. The facility name, address and municipality are shown below:

FACILITY OR SITE NAME	STREET ADDRESS OR LOCATION	MUNICIPALITY
I.S. Smick Lumber	Rt. 49 Main St.	Quinton Twp.
Anchor Glass Corp.	Griffith St.	Salem
Atlantic Electric	17-25 Fifth St.	Salem
Bader Gas Station	W. Broadway & Front St.	Salem
Coastal Mart Inc. #7217	Market & Griffith Sts.	Salem
Heinz Plant	Griffith St.	Salem
Mannington School	Rt. 45	Salem
Abandoned Service Station	Broadway & Oliver Dr.	Salem City
Coastal Oil Property	Griffith & Market Sts.	Salem Twp.

3.10 FINDS DATABASE

The Facility Index System (FINDS) is a compilation of any property or site which the EPA has investigated, reviewed or been made aware of in connection with its various regulatory programs. A search of the FINDS Site Summary Report for New Jersey for the zip code areas surrounding the project area indicates 66 sites or facilities that EPA has investigated, reviewed or identified. The list of these facilities, their location and the EPA program codes is shown in Appendix A. A description of the program codes follows the facility list.

3.11 ERNS DATABASE

A search of the Emergency Response Notification System Database identified two sites in the project area that required an emergency response. The sites are identified below:

P.C.
169 Locust Ave.
Oakwood Beach, NJ 08079

Anchor Glass Containers
83 Griffith St.
Salem, NJ 08079

The Salem County Department of Health was contacted to identify spills or other emergency events that have occurred in the project area. Review of the Daily Activity Complaint Log and the Hazardous Substances Files for Salem City and Mannington Township for 1992, 1991 and 1990 indicated numerous spills or other contamination have occurred or been identified in the project area, most of which occurred at the large industrial facilities along Salem River and Fenwick Creek. Records of the spills indicated that many were cleaned up on-site. It is not known how many of these spills impacted the Salem River. A listing of the spills and contaminated sites identified in the above referenced sources is provided below:

Date	Location	Problem
03/30/90	Salem - Rt. 49	Waste oil discharged
05/14/90	Salem - Carpenter St.	Sewage overflow to Carpenter Street
07/17/90	Anchor Glass	Hydraulic fluid spilled and cleaned-up
08/03/90	Salem - Tilbury Rd.	Oil tanks partially buried
08/13/90	Rt. 49	Oil spilled
09/24/90	Public works Dept. Salem Co.	Gasoline vapor odor
10/12/90	Mannington Mills	Emitted carbon monoxide at 140 ppm for 1.5 hours. Permit level 100 ppm
01/28/91	Burkett Property 143, 145 & 147 Thompson St.	Leaking above ground tanks
	Salem River - Mid-Atlantic Terminal	~ 10-gallons hydraulic oil spilled into Salem River Spill contained.

02/18/91	Gravel pit off Dubois Rd., Mannington Twp.	Abandoned containers: 2 leaking 55-gallon drums
	Salem Machine Corp. 25 W. Broadway St.	Cessation of operation/sale of property; Salem Machine shall seal all monitor wells installed for compliance with ECRA. Submit abandonment forms to Bureau of Water Allocation.
04/06/91	Rt. 45 & Rt. 540	Nandelli Produce truck - broken fuel line
05/21/91	Heinz Plant Griffith Street	Soil contamination identified during a site assessment/investigation
05/22/91	Wire Pro, Inc.	Contaminated soil identified on-site; petroleum hydrocarbons
05/24/91	Anchor Glass	Ruptured hydraulic line on truck; truck on paved area; clean-up performed
	Salem Machine Corp. 25 W. Broadway St.	ECRA case Drum storage area clean-up required.
	Gayner Glass Works Aluchem	Abandoned gas underground storage tank
05/28/91	Anchor Glass	Hydraulic oil spill
05/28/91	Wire Pro	Contaminated soil
06/04/91	Anchor Glass	#2 oil fuel leak corrected and cleaned-up on 6/5. Soil clean-up under present ECRA clean-up.
07/03/91	Anchor Glass	Monitor wells confirm contamination
07/22/91	Rt. 49 & Burden Hill Rd., Quinton	Diesel crankcase oil and hydraulic fluid spill
09/12/91	Atlantic Electric Swedesboro, Woodstown	Spill due to line leak, clean-up performed by Company
09/16/91	Marshalltown Rd. Mannington	Hydraulic oil spill
09/23/91	Mannington	Possible hazardous waste on property; trailer with 2 fuel tanks stored - 1 diesel, 1 unleaded gas. No spillage noted around tanks. Atlantic Electric is renting property and using as parking area.
11/08/91	Anchor Glass	#6 fuel oil spill; clean-up performed by company
	Southland Properties 385 Broadway & Olive	Total benzene, ethylbenzene, toluene and xylenes identified in groundwater. However, considered de minimis because of lack of potential receptors in area - levels degraded.
11/12/91	Anchor Glass	5-gallon release of #6 fuel oil
11/13/91	Mid-Atlantic Stevedore Tilbury Rd.	#6 fuel oil spill on dock while tanker truck was transferring fuel to ship. Clean-up performed.
11/15/91	Salem Port	~30-gallon release of fuel oil
12/26/91	Anchor Glass	Release of hydraulic oil
01/21/92	Coastal Mart Market & Griffith	8,000-gallon tank removed; contaminated soil to be removed
02/05/92	Anchor Glass	#6 fuel oil release due to ruptured pipe filling contained within dike area
	Anchor Glass/Heinz	Soil and groundwater contamination on-site
	South Jersey Gas L&J Market, Salem	Broken gas meter - gas release to air

4.0 HISTORICAL RECORDS

4.1 AERIAL PHOTOGRAPHS

Aerial photographs of the project area were obtained to assess changes in land use in the vicinity of the Salem River. Aerial photographs were obtained for five time periods from 1940 to the present. The dates of the photographs obtained for the project area are shown below:

AERIAL PHOTOGRAPHY DATES

March 11, 1940
February 18, 1951
January 13, 1962
March 13, 1974
March 6, 1987

The aerial photographs are included in this report as Appendix B.

Review of the aerial photographs of the area indicate that the City of Salem was extensively developed by 1940 and continued essentially the same through the present. Some areas along roads exiting Salem developed as residential areas and light commercial/institutional facilities during the period 1940 through the present. The type of land use in the city remained essentially the same except in areas along the Salem River and Fenwick Creek. These areas include the industrial and commercial facilities that were the primary employers in the city.

The 1940 photograph shows the areas along the Salem River and Fenwick Creek to be extensively developed with industrial/commercial facilities. The names and types of these facilities are presented in Section 4.2, Insurance Maps. The photographs show the changes in the extent of development in these areas over the fifty year period. Comparison of the 1940, 1951, and 1962 photographs show only minor changes in most of the facilities along the stream channels. The Gayner Glass Works facility along the Salem River and the Anchor Hocking facility along Fenwick Creek show expansion and development of new structures and facilities on their sites. Review of the 1974 photographs show additional changes to these facilities as well as significant changes to the land bordered by Front Street, Griffith Street, West Broadway and 5th Street. This area in the 1940 to 1962 photographs shows residential and commercial facilities whereas the 1974 photographs shows two large industrial/commercial facilities with surrounding parking areas on the property.

Review of the 1987 photograph indicates that larger facilities remained essentially the same with some changes to individual structures on the sites.

4.2 INSURANCE MAPS

Sanborn Fire Insurance Maps of the project area were obtained to further characterize the historical use of the area surrounding the Salem River. Sanborn Maps are prior-use site plans that were originally developed for insurance purposes but now represent a documentation of structures and facilities in specific areas. A search of available mapping indicated that Sanborn Maps for the project area were prepared in 1885, 1891, 1896, 1902, 1909, 1915, 1923, 1930 and 1947. The maps developed in 1885, 1930 and 1947 were obtained for use in this investigation. These maps are included herein as Figures C-1 through C-36 in Appendix C.

Development in the project area intensified by 1947 with additional residential, commercial and industrial facilities located throughout. Table 2 lists the changes in development and land use, in the project area on a street by street basis. The table shows the development in the area in 1885, 1930, 1947 and the present (1992).

Review of the Sanborn Maps shows the area along the Salem River and Fenwick Creek was utilized by commercial and industrial facilities as early as 1885. Development of the commercial and industrial facilities along the stream channels continued through the period as shown on the 1930 and 1947 maps.

In 1885 the major facilities in the area included Salem Oil Cloth Works and Starr Brothers Canning facility on Broadway; Pardessus & Gayner Glass Blowers on Front Street; Hiles & Hillard Canning Factory, H. Lambert Canning Factory and Salem Glass Works, on Griffith Street; and Ayers & Jones Canning Factory and Salem Gas Works on 5th Street. The 1930 maps show the Congoleum Nairn Co., Gayner Glass Works and F.H. Lloyd facilities on Front Street; H.J. Heinz Co. and Salem Glass Works on Griffith Street; Atlantic City Electric, Salem Coal, Ice & Storage Company, and Salem Gas Light Company on 5th Street; and Standard Oil Co., Texas Oil Co. and Lippincott Coal Yard on Hancock Street. The Mannington Mills facility on Mannington Mills Road is also shown on the 1930 maps. By 1947 the major facilities included Congoleum Nairn, Inc., Gayner Glass Works and American Oil Co. on Front Street and Salem River; H.J. Heinz Co. and Anchor Hocking Glass Works on Griffith Street; Atlantic City Electric, Salem Coal, Ice & Storage Co. and

Salem Gas & Light Co. on 5th Street; Standard Oil Co. on Hancock Street; and Mannington Mills on Mannington Mills Road. Several other major facilities are also located within the City away from the Salem River and Fenwick Creek.

TABLE 2
CHANGES IN DEVELOPMENT AND LAND USE IN PROJECT AREA

LOCATION	SITE DEVELOPMENT 1885	1930	1947	PRESENT
Route 49 & Front St.	Vacant Grist Mill/Grain Warehouse	F.H. Lloyd Flour Mill	American Oil Company - Gas Station - Gas Storage Tanks - Oil Pumps -Oil/Gas Transfer Station - Railroad Siding	Amoco Oil Terminal
Front St.		Abbott's Alberney Dairies, Inc.	H.J. Heinz Bunk House	Aluchem, Inc.
Front St. at River	Storage Areas - Lime - Straw - Hay - Coal - Fertilizer	W.H. Harris Boat Shop - Railroad siding	W.H. Harris, Jr. Boat Shop - Facility - Boat storage yard	Aluchem, Inc.
Front St. & W. Broadway @ River	J. Gayner's Bldgs. occupied by: Pardessus & Gayner Glass Blowers - Furnaces - Annealing ovens - Storage Residential	Gayner's Glass Works - Oil Storage - Machine Shops - Water Tank - Storage Facility - Furnaces/ovens - Railroad siding Residential	Gayner's Glass Works - Oil tanks & pumps - Domestic pump house - Cullet Bins - Furnace Building - Paint shops - Railroad siding Residential	Aluchem, Inc.
Front St. (Tilbury Ave) South of W. Broadway	Steam Boat Co's. Freight Starr Brothers Canning Facility - Gasoline used bldg. - Storage/work rooms Salem Oil Cloth Works - 120,000 gal. oil tank - Brick benzine tank - 85,000 gal. linseed oil tank - Coal storage - Printing & sizing facility - Storage bldgs.	Congoleum Nairn Co., Inc. - Water tank - Print room - Drying - Machine rooms -Iron Oil tanks - Paint storage	Congoleum Nairn, Inc. - Oil tanks - Pump houses - Paint room - Coal fuel - Chemical Exchangers - Railroad siding	Wire Pro, Inc. Salem Stevedoring Corp. - Warehouse
New Tilbury Rd. @ Salem River		Gayner Glass Works - Storage Fertilizer storage Boat Shop Sewage Pumping Station	Gayner Glass Works - Storage facility -brick shed Storage Boat yard Sewage Pumping Station	Salem Wastewater Treatment Plant

W. Broadway @ Front Street (Tilbury Ave.)		Gas Station	Gas Station	Vacant
Griffith St. @ Salem River	Hiles & Hilliard Canning Factory - Storage - Shipping - Tin Shop/Soldering - Coal Storage - Gasoline Tanks H. Lambert Canning Factory - Gasoline Tank - Tin shop - Storage	H.J. Heinz Co. Canning & Bottling - Cover reservoir 110,000 gal. - Filter tanks - Paint house - Factory bldgs. - Railroad Siding	H.J. Heinz Co. Canning & Bottling - Coal yard - Filter tanks -110,000 gal. reservoir - Oil tanks - Propane tanks - Factory bldgs. - Railroad siding	Anchor Glass Container Corp.
Griffith St. to Fenwick Creek 3rd to 5th Ave.	Salem Glass Works Craven Brothers - Furnace/ovens - Storage Bacon & Woodnutt Sash & Blind Factory Residential Warehouse sheds Grain & fertilizer warehouse	Salem Glass Works - Furnace - Storage -Railroad siding - Fuel oil tanks - storage - iron fuel oil tank Salem Sash Factory	Anchor Hocking Glass Corp. - Oil tanks - 200,000 gal. reservoir - Machine shop - Paint shop - Furnaces - Railroad siding	Anchor Glass Container Corp.
5th St. @ Fenwick Creek	Ayers & Jones Canning Factory & Bone Mill - Tin shop - Storage - Coal - Gasoline Tank Wm. H. Dunn & Co. Lime Kiln - Phosphate storage house - Kiln - Coal Storage - Sheds	Salem Coal Ice & Storage Co. - Coal Shed Atlantic City Electric Co. - Substation - Coal	Salem Coal Ice & Storage Co. - Coal storage yard Atlantic City Electric Co. - Substation - Switchyard	Atlantic City Electric Co. - Substation and other bldgs.
Front St. @ Griffith St.		Storage facilities	Auto repair & Gas station	Vacant
Front St. @ W. Broadway Avenue	Residential Buildings	Residential Buildings Gayner Glass Works - Storage facility - 2 facilities	Residential Buildings Gayner Glass Works - Storage facility - 2 facilities Gas Station	Falcon Power, Inc. Currier Systems, Inc. - Shipping Vacant
W. Broadway @ Front St.		Vacant	Gas Station	
55 Griffith St.		Slaughterhouse	Slaughterhouse	Residential
83 Griffith St.			Anchor Hocking Glass Corp. - Office & Parking	Anchor Glass Corp. - Office & Parking

Griffith & 4th St.	Salem Glass Works Craven Brothers - Annealing - Ovens - Furnaces - Storage facilities H.D. Hall Salem Iron Foundry - Furnace/oven - Storage	Salem Glass Works - Storage yard - Railroad siding Welding Facility	Anchor Hocking Glass Corp. 4th St. Plant - Machine shop - Storage bldgs. - Furnace - Storage yards - Railroad siding	Anchor Glass Container Corp.
W. Broadway & 5th St.			Gas Station	
W. Broadway & Chestnut St.			Salem Electric Co./Atlantic City Electric Co. Building	Commercial
New Market & Carpenter			Auto sales & service facility	
Howell & 5th St.	Salem Gas Works - Iron Gasometer covered w/tank - Iron Gasometer - Coal storage - Retorts	Salem Gas Light Co. - Gas storage - Gas stove - Storage - Tar well - Gas holder tanks - Purifying room - Retorts	Salem Gas Light Co. - Gas storage - Coal shed - Tar tank - Oil tank - Furnace - Iron/Ash Hopper - Gas Tanks - Railroad siding	National Freight Inc. - Abandoned building
Hancock, between Market & 5th St.			Standard Oil Co. - Gasoline Tanks - Oil pump house	
Hancock St.		Junkyard	Junkyard	
Hancock St. @ Fenwick Cr.		Texas Oil Co. Oil Station - Oil storage - Pump room - Oil tanks	Texas Oil Co. Oil Station - Oil tanks - Pump room - Oil storage	Commercial
Fenwick Creek @ Market St.		Storage Facilities - Corn - Grain - Farmer's Exchange C.G. Lippincott Coal Yard - Coal bins	Storage Facilities - Corn - Grain - Farmer's Exchange - Coal yard - Fertilizer	Commercial
Rt 45 @ Fenwick Creek		Garage Farm Implements	Motor Freight Station Warehouse Facility	Vacant
43 Ward St.			Machine Shop	Residential
Market & Griffith Sts.			Gas Station	Gas Station

Market & Grant Sts.	J.S. Green Carriage Factory - Paint facility	Wistar & Woodnutt Lumber - Storage Buildings - Oil storage - Garage	Salem Lumber Co. - Gas station - Paints - Storage - Garage Gas Station	Commercial
W. Broadway			Auto repair	Commercial
W. Broadway & Market St.			Furniture facility	Commercial
Chestnut & Hires Aves. (Hedge)		Auto storage	Auto storage	
Hires Ave.			Plumbing Co.	
New Market @ Hires Ave.		Armory Company of NJ	Armory Company of NJ	
11 Walnut St.		Auto service station	Auto repair	
5 Walnut St.		Auto service station	Auto sales/service - Paint facility - Repair	
W. Broadway & Walnut St.		Sunbeam Publishing Co.	Sunbeam Publishing Co.	
E. Broadway & Walnut St.			Auto repair	
231 E. Broadway		Gas station	Gas station	
235 E. Broadway		Gas station	Gas station	
Market & E. Broadway		Water tank - 450,000 gal. tank	City water facility - Water tank 450,000 gals. - Groundwater well/pump 200 gpm	City water facility City & County offices
221 Grant Ave.			Auto sales and service/Gas station	
38 Market St.		Green Brothers - Coal silos - Farm implements - Storage facilities - Railroad siding	Green Brothers - Coal silos - Farm implements - Storage facilities - Railroad siding	Residential Commercial
Hubbell @ Fenwick Creek		Salem Supply Co. Canning Factory - Coal pile - Storage - Railroad siding Horner Foundry Co. - Casting room - Furnace - Machine Shop - Storage	Vacant Vacant	Vacant

Hubbell & Pledge Rd.		Railroad siding - Water tanks	Railroad siding - Water tanks	Railroad siding
Hubbell Ave		Vacant	H.J. Heinz Co. Warehouse	Erdner's Busy Corner
Hubbell & Gibbon Aves.		Salem City Milling Co. - Grist mill - Feed storage - Storage	Salem City Milling Co. - Grist mill - Feed storage - Storage	Erdner's Busy Corner
Hubbell & Grant Aves.		Freight House - Railroad siding Passenger station	Freight House - Railroad siding	Railroad siding
Hubbell & Gibbon Aves.		Ayers Machine Co. - Coal bin - Paint room - Boiler - Cleaning room - Machine shop	Ayers Machine Co. - Coal bin - Paint room - Boiler - Cleaning room - Machine shop	Vacant
Rt. 45 & Mannington Rd.		Sinclair Refining Co. - Oil tanks	C.G. Andrews Oil Depot - Oil tanks	
Rt. 45 & Mannington Rd.		Salem Glass Co. - Storage bldg.	Vacant	Vacant
Rt. 45 & Tide Mill Rd.			Gas station	
E. Broadway & Elm			Gas station	
Keasbey & Quinton Sts.		Gas station	Gas station	
Keasbey & Quinton Sts.		Gas station	Gas station	
E. Broadway & York		Gas station	Gas station	
426 Quinton St.		Auto Sales & Service - Gas tanks	Auto Sales & Service - Gas tanks	
450 Quinton St.		Auto Sales & Service - Gas tanks	Gas station	
450 Quinton St.		Vacant	Gas station	
Rt. 49			Salem Airport	Salem Airport

Manning...a Rd.		Mannington Mills, Inc. - 50,000 gal water tank - Machine shop - Paint room - Dryers	Mannington Mills, Inc. - Asphalt tanks - Oil storage - Dryers - Coatings Bldg. - Machine shops - Linseed oil tanks	Mannington Mills, Inc.

5.0 HAZARDOUS WASTE SITES IN PROJECT AREA

5.1 GENERAL

The NJDEPE, Bureau of Site Assessments was contacted to obtain a listing of known hazardous waste sites in the project area that are currently undergoing remediation. The information requested included the facility name, type of operation, status of current investigations, location of facility and environmental impact for hazardous waste sites in the project area.

Representatives of the Bureau of Site Assessments identified two sites in the project area for which case-files and Site Inspection Reports had been developed to describe the presence of hazardous waste. The two sites include Mannington Mills, Inc. facility in Mannington Township and the Salem Coal Gas facility (aka Salem Gas Light Company and Salem Gas Works) in the City of Salem. The Site Inspection Reports for both sites were reviewed to identify the extent of reported contamination on each site. A summary of the findings of each report is provided in the following paragraphs.

5.2 MANNINGTON MILLS, INC.

The Mannington Mills, Inc. facility on Mannington Mills Road, Salem County, New Jersey was inspected by the NUS Corporation Superfund Division for the U.S. EPA Environmental Services Division. The results of that inspection are contained in a Final Draft Site Inspection Report, dated April 27, 1990 and are summarized as follows.

The Mannington Mills facility is located on 328 acres in Mannington Township, Salem County, New Jersey. The facility was constructed in 1923, and vinyl floor production and hazardous waste storage began in 1957. Dry waste from the manufacturing processes were disposed of at an 8-acre on-site landfill from approximately 1955 until April 1988. Previously chemical wastes generated on-site had been either placed in 55-gallon drums and pumped to bulk tankers for off-site disposal, or drummed and stored on an asphalt pad, according to the Site Investigation Report. Currently, hazardous wastes, including resins, pigments and solvents, are stored in either an 8,500-gallon portable trailer tank or in 55-gallon drums; with off-site shipment within 90 days of generation.

The site contains a series of seven active lagoons that receive noncontact cooling water and stormwater runoff. Three additional inactive lagoons are located south of the active lagoons. A surface impoundment, inactive since 1985, was used to store sludges from the cleanup of the latex plant operation. The surface impoundment has a hypalon liner. The facility has a NJPDES permit for discharge to groundwater from the landfill and for discharge to surface water from the active lagoon sites.

The dry nonchemical industrial waste deposited in the landfill consists of "solid, inert, nontoxic discards from the sheet flooring operation" and "does not contain garbage, human or animal waste, liquids, oils or grease", according to the Site Investigation Report. However, coliform, volatile organics, chromium, lead and phenols at concentrations above permit limits were identified in samples obtained in 1985, 1986 and 1987 from monitoring wells near the landfill.

Other potential sources of contamination at the Mannington facility include the primary wastewater treatment plant, the hazardous waste drum storage area and the tank storage area.

During the 1980's, NJDEP personnel collected groundwater samples from monitoring wells near the landfill to assure compliance with the facility's NJPDES permit. Results of samples collected from monitoring wells, 1, 3, 4, and 6 in January 1985, indicate that permit levels were exceeded in several samples for the following parameters: hexavalent chromium, iron, maganese, lead, cadmium, phenols, chloride, ammonia nitrogen, sodium, and total dissolved solids.

Results of sampling in January 1990, conducted as part of the Site Inspection Report, indicated the presence of low levels of volatile organics in wells 4, 6, and 8 (near the inactive lagoons) and high levels of volatile and semivolatile organics in well 11 (near the surface impoundment). Arsenic was detected above permit levels in well 12 (near the surface impoundment) and chromium was detected above the Federal maximum contaminant level (MCL) for chromium in drinking water in wells 3, 7 (near the inactive lagoons) and 12. Water samples collected from the surface impoundment indicated low levels of volatile organics and 4,4-DDT, and sludge samples from the impoundment indicated elevated levels of volatiles, semivolatiles and pesticides. Sludge samples from the westernmost active lagoon contains total xylenes and semivolatiles including phthalates and polycyclic aromatic hydrocarbons (PAHs).

5.3 SALEM COAL GAS SITE

The Salem Coal Gas Site (AKA Salem Gas Light Company or Salem Gas Works) on Howell and 5th Streets, Salem, New Jersey was inspected by the NUS Corporation Superfund Division for the U.S. EPA Environmental Services Division. The results of that inspection are contained in a Final Draft Site Inspection Report, dated September 6, 1990, which describes the previous activities on-site and the known soil and groundwater contamination on the property. The results of that investigation are summarized below.

The Salem Coal Gas Site is located on the northern fringe of the city in a mixed residential/industrial area. The site is near Fenwick Creek, which is approximately 500 feet north of the site and flows west, past the site to join the Salem River. The site is approximately 2 acres in size and comprised of three to four parcels of land. The site was previously occupied by Salem Gas Works and later the Salem Gas Light Company (SGLC), according to the Sanborn Maps of the area. SGLC operated the site as a coal-gasification plant for 91 years until 1945 according to the Site Investigation Report. At an unknown date after 1945, a propane-air system was installed to produce natural gas at the site and operated until November 1955. In June 1955, South Jersey Gas Company purchased the site and planned to operate the existing propane-air gas system until construction of a new natural gas pipeline to Salem was completed; it was scheduled for completion in November 1955, according to the Site Inspection Report. Currently the site is owned by the Vineland Construction Company (National Freight, Inc.), block 2, lots 1 and 4; Atlantic City Electric Company, block 2, lot 2, and South Jersey Gas Company, block 5, lot 20.

The actual wastes on site are unknown; however, suspected wastes associated with 19th century coal gasification plants include coal tar pitches, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) and heavy metals such as cadmium, chromium, mercury, and lead according to the Site Inspection Report.

The results of site sampling conducted as part of the Site Inspection Report investigations indicate that high concentrations of SVOCs, as well as VOCs, pesticides and heavy metals, such as arsenic, barium, chromium, and lead were detected in the surficial and subsurface soils at the site. Visual observations indicated the presence of coal tar wastes at the water-table interface (about 13 inches below ground surface) on South Jersey Gas Company property. High concentrations of SVOCs were detected in surficial and subsurface soils in samples collected from Vineland Construction Company property. Also the presence of one PCB compound was detected in the transformer storage area on the Atlantic City Electric-Salem Operations property.

6.0 CONCLUSION

An assessment (literature survey) of the area surrounding the Salem River was performed to identify sources with the potential to contribute pollutants to the stream. The assessment included a visual inspection of the project area, review of aerial photographs, review of Federal and state environmental databases, discussion with agency personnel and a title search of selected properties to identify sources in the project area with the potential to contribute pollutants to the stream. The visual inspection of the study area indicated that the City of Salem contains the majority of residential developments in the area and that commercial facilities are located throughout the City and along the major roads in and outside of the City. Major industrial facilities are located along the Salem River and Fenwick Creek in and outside of the City. The industrial facilities appear to have the potential contribute pollutants to the stream.

Several major industrial facilities are located along the Salem River and Fenwick Creek. The facilities include the Salem Wastewater Treatment Plant, Salem Stevedoring Corp., Aluchem, Inc., Amoco Oil Terminal, Anchor Glass Container Corp., Atlantic City Electric and Mannington Mills. Other facilities which have the potential to contribute pollutants to the stream are also located away from the stream within and outside of the City. Several of these facilities have documented releases of contaminants to the soil and groundwater on their properties and also to the surrounding surface waters (i.e., oil spills to Salem River).

Review of the Federal and state environmental databases has identified several facilities in the project area where ground or surface water contamination has occurred. The search of facilities in the project area identified three known and suspected hazardous waste sites, all of which are on the CERCLIS List; sixteen sites that have or are currently undergoing investigations to identify the presence or extent of groundwater pollution; one site that releases toxic chemicals to the environment in their production process; thirty-two RCRA sites; sixteen NJPDES sites; eight solid waste facilities; and several sites in the project area that have had spills or emergencies, some of which have impacted the Salem River. The facilities that are identified on more than one of these databases are shown below in Table 3.

TABLE 3
FACILITIES LISTED IN MULTIPLE DATABASES

Mannington Mills, Inc.	Mannington Mills Road Mannington	CERCLIS, TRI, RCRA, NJDWR, NJPDES, KSHSNJ, SWFD
Salem Coal Gas AKA Salem Gas Light Co. Salem Gas Works	Fifth & Howell Salem	CERCLIS, KSHSNJ
Gayner Glass Works AKA Aluchem Inc.	Front & Broadway Salem	CERCLIS, KSHSNJ, TRI, NJPDES
Sunoco Service Station AKA Coastal Mart, Inc.	Market & Griffith Streets Salem	RCRA, LUST
Coastal Oil Property	Griffith & Market Streets Salem	NJDWR, LUST
Anchor Hocking Corp.	83 Griffith Street Salem	RCRA, NJPDES, LUST
Salem Machine	25 West Broadway Salem	RCRA, NJDWR
I.S. Smick Lumber	Route 49 Quinton	RCRA, LUST
Elsinboro Twp. Sanitary Landfill	Sinnickson Landing Road Elsinboro	NJDWR, NJPDES, SWFD
Mannington Twp. Sanitary Landfill	Mannington Mills Road Mannington	NJDWR, NJPDES, SWFD
Quinton Twp. Sanitary Landfill	South Burden Hill Road Quinton	NJDWR, NJPDES, SWFD
Quinton Twp. Solid Waste Landfill	RD 2, Schepps Valley Quinton	NJDWR, SWFD
Atlantic Electric	17-25 Fifth Street Salem	NJDWR, LUST
Bader Property (Gas Station)	West Broadway & Front Salem	NJDWR, LUST, NJPDES
Mid-Atlantic Shipping & Stevedoring	128 Tilbury Road Salem	NJDWR, NJPDES, SWFD

Salem City Sanitary Landfill	Tilbury Road Salem	NJDWR, NJPDES, SWFD
Salem Water Treatment Plant	520 Grieves Parkway Salem	NJDWR, NJPDES
Service Station	285 Broadway & Olive Drive Salem	NJPDES, LUST

DATABASE LEGEND

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System
TRI: Toxic Release Inventory
RCRA: Resource Conservation and Recovery Act Notifiers
NJDWR: New Jersey Division of Water Resources Ground Water Pollution Investigation
NJPDES: New Jersey Pollutant Discharge Elimination System
KSHSNJ: Known and Suspected Hazardous Sites in New Jersey
SWFD: New Jersey Department of Environment and Energy, Solid Waste Facility Directory
LUST: Leaking Underground Storage Tank

Aerial photographs of the project area were obtained for five time periods from 1940 to the present. The photographs show the changes in land use in the area since 1940. Most of the residential, commercial and industrial facilities in the City of Salem were developed prior to 1940. Changes in some of the commercial/industrial areas are documented on the photographs and show an increase in land use of specific properties.

The 1940 photograph shows the areas along the Salem River and Fenwick Creek to be extensively developed with industrial and commercial facilities. Comparison of the 1940, 1951 and 1962 photographs show only minor changes to most of these facilities. The Gayner Glass Works facility along the Salem River and the Anchor Hocking facility along Fenwick Creek show expansion and development of new structures on their sites. Review of the 1974 photographs show additional changes to these facilities as well as significant changes to adjacent property across Griffith Street. Review of the 1987 photograph indicates that larger facilities remained essentially the same with some changes to individual structures on the sites.

Review of the Sanborn Insurance Maps for the project area from 1885, 1930 and 1947 identified the changes in land use and the intensification of development in the area. Review of the Sanborn Maps show the area along the Salem River and Fenwick Creek was utilized by commercial and industrial facilities as early as 1885. Development along these stream channels continued through the period as shown on the 1930 and 1947 maps. These areas continued as industrial areas throughout the period according to the maps.

Review of information maintained by the NJDEPE, Bureau of Site Assessments, indicated that the Mannington Mills, Inc. and Salem Coal Gas facilities are undergoing some type of remediation activity due to hazardous waste contamination. Various investigations and analyses of the facility have documented ground and surface water contamination as well as wastewater spills from these facilities.

The results of the assessment (literature survey) of the Salem River project area indicates that most of the facilities along the Salem River and Fenwick Creek have the potential to contribute pollutants to the stream. This area is industrial with several facilities having known soil and groundwater contamination on-site. Investigations of the extent of contamination are ongoing at several of these facilities. Several other commercial/industrial facilities are also located within and outside the City which have the potential to contribute pollutants to the stream. These facilities include gas stations, oil terminals, storage areas and landfills. Some of these facilities have had releases of contaminants to the groundwater, although the impact on the Salem River was not identified.

APPENDIX A

FACILITY INDEX SYSTEM SUMMARY REPORT

EPA ID	FACILITY	ADDRESS/CITY	ZIP	PROGRAM CODES
NJD982723272	BOSCO CLEANING SERVICES INC	NUCLEAR GENERATING STATION PO BOX 236 C/O HANCOCKS BRIDGE SALEM	08079	01
NJ9960009901	CE-SALEM CHANNEL PRJ	GSA 9600-09901 SALEM	08079	
NJ5960014756	CE-SALEM DREDGING	GSA_9600-14756 SALEM	08079	
NJD981877681	GAYNOR GLASS WORKS	FRONT & BROADWAY SALEM	08079	05
NJD986586980	GULF SERVICE STATION - FORMER	RTE 30 & E MAIN ST PENNS GROVE	08079	02
NJD980652242	LEISURE ARMS	HANCOCKS BRIDGE SALEM	08079	02
NJD980642789	NEW JERSEY BELL TELEPHONE CO	LOWER ALLOWAY CREEK NECKS RD SALEM	08079	01
NJD980647325	NEW JERSEY BELL TELEPHONE CO	LOWER ALLOWAY CREEK NECKS RD SALEM	08079	01
NJD986590578	PHILLIPS PETROLEUM	FOOT OF LAFAYETTE ST NO CITY NAME	08079	
NJD000581603	ROSS FOGG OIL	182 HANDCOCKS BRIDGE SALEM	08079	03 03
NJD980649867	SALEM CENTRAL OFFICE	86 W BWY SALEM	08079	01

EPA ID	FACILITY	ADDRESS/CITY	ZIP	PROGRAM CODES
NJD981084775	SALEM COAL GAS	FIFTH & HOWELL STREETS SALEM	08079	05
NJD100907880	SALEM HIGH SCHOOL	WALNUT STREET ROAD 223 EAST BROADWAY SALEM	08079	01
NJD982531386	SALEM MUNICIPAL PORT AUTHORITY	WEST BROADWAY SALEM RIVER SALEM	08079	03
NJD011721354	SOUTH JERSEY COLONIAL NURSERIE	RT 45, SALEM-WOODSTOWN RD #1, RT 45, BOX 144 MANNINGTON TWP	08079	01
NJD000705608	SUNOCO SERVICE STATION	MARKET & GRIFFITH STS SALEM	08079	01
NJD000700534	SUNOCO SERVICE STATION	RTES 540 541 & 45 MANNINGTON TP	08079	01
NJ8143599001	WILDLIFE REFUGE	KILLCOHOOK SALEM	08079	03
NJD000323998	SALEM WTP, CITY OF	520 GRIEVES PKY SALEM	08079-	02
NJD986602969	MARTS SERVICE INC	PO BOX 73 SALEM	08079-0073	01
NJD981184419	SALEM OPERATIONS	5TH ST SALEM	08079-1002	01

EPA ID	FACILITY	ADDRESS/CITY	ZIP	PROGRAM CODES
NJD986567212	VINELAND CONSTRUCTION	5 HANCOCK ST SALEM	08079-1017	01
NJD162330625	K. JANG CLEANERS	204 GRIFFITH ST 204 GRIFFITH STREET SALEM	08079-1043	01
NJD162330591	SALEM AMOCO	1 FRONT ST SALEM	08079-1047	01
NJD011297959	WIRE PRO INC	23 FRONT ST SALEM	08079-1047	01
NJD000594325	WOODSTOWN GAS & OIL COMPANY	1 FRONT ST SALEM	08079-1047	14 03
NJD012297032	ALUCHEM INC	FRONT ST SALEM	08079-1048	02
NJD012997037	ALUCHEM INC	62 FRONT ST SALEM	08079-1048	03
NJD091641902	FOSTER GLASS/ALU CHEM	62 FRONT ST SALEM	08079-1048	03
NJD981140247	SALEM PORT AUTHORITY	62 FRONT ST SALEM	08079-1048	01
NJD000550202	STAR CITY GLASS CO	62 FRONT ST SALEM	08079-1048	03
NJD147021869	FRANK H WHEATON III C/O SALEM	45 GRIFFITH ST SALEM	08079-1056	01

EPA ID	FACILITY	ADDRESS/CITY	ZIP	PROGRAM CODES
NJD002324952	HEINZ H J CO	57 GRIFFITH ST SALEM	08079-1056	02 03
NJD980761258	HEINZ USA SALEM NJ PLT	GRIFFITH ST SALEM	08079-1061	01
NJD986590560	SUNBEAM PUBLISHING	93-107 5TH ST SALEM	08079-1093	03
NJD002385615	ANCHOR HOCKING CORP PL	83 GRIFFITH ST SALEM	08079-1099	01 02 13 07 07 07 03 03
NJD982742835	KEEN'S AUTO REPAIR INC	352 E BROADWAY 352 EAST BROADWAY SALEM	08079-1141	01
NJD000693325	THE SHERWIN-WILLIAMS CO	318-320 E BROADWAY SALEM	08079-1184	01
NJD073722977	SALEM MACHINE CO	25 W BROADWAY SALEM	08079-1348	01
NJD981561459	CITY OF SALEM SEWAGE TREATMENT	TILBURY RD SALEM	08079-1514	07
NJD981173727	ELSINBORO TOWNSHIP SANITARY LA	TILBURY RD SALEM	08079-1514	14
NJD981173974	SALEM CITY SANITARY LANDFILL	TILBURY RD SALEM	08079-1514	14

EPA ID	FACILITY	ADDRESS/CITY	ZIP	PROGRAM CODES
NJD000557991	SALEM, CITY OF	TILBURY RD SALEM	08079-1514	02
NJD981130545	PSE&G NUCLEAR TRAINING CENTER	244 CHESTNUT ST SALEM	08079-1699	01
NJD002349256	MANNINGTON MILLS	MANNINGTON MILLS RD SALEM	08079-2010	02 01 14 14 05 17 07 03 03
NJD981173750	MANNINGTON MILLS INC SLF	MANNINGTON MILLS RD SALEM	08079-2010	14
NJD981173768	MANNINGTON TOWNSHIP SLF	MANNINGTON MILLS RD SALEM	08079-2010	14
NJD000531293	ANDREWS OIL COMPANY	204 WOODSTOWN RD SALEM	08079-2027	03
NJD986585347	MANNINGTON TWP BD OF ED	45 WOODSTOWN RD RTE SALEM	08079-2032	01
NJD982277618	F. BELL CHEVROLET, INC.	197 WOODSTOWN RD 197 WOODSTOWN ROAD SALEM	08079-2094	01
NJD982536880	NAPPEN CHEVROLET	197 WOODSTOWN RD 197 WOODSTOWN ROAD SALEM	08079-2094	01
NJD986585214	SALEM AUTO MALL	197 WOODSTOWN RD SALEM	08079-2094	01

EPA ID	FACILITY	ADDRESS/CITY	ZIP	PROGRAM CODES
NJD100052604	LOWER ALLOWAYS CREEK TOWNSHIP	967 MAIN ST CANTON SALEM	08079-3411	02
NJD986585305	JOE & SANDYS COUNTRY STORE	984 MAIN ST SALEM	08079-9439	01
NJ6360031037	NATL CEMTRY-FINN'S	RURAL ROUTE 3 SALEM	08079-9803	11 03
NJ4180000081	US POSTAL SERVICE	120 W BROADWAY SALEM	08079-9998	11 03

ENVIRONMENTAL RISK INFORMATION CENTER
FINDS SITE SUMMARY REPORT FOR THE STATE OF NJ

EPA ID	FACILITY	ADDRESS/CITY	ZIP	PROGRAM CODES
NJD982717324	BUTCH'S PAINT ON WHEELS	ROUTE 49 SALEM QUINTON RD PO BOX 398 QUINTON	08072	01
NJD981173966	CHARLES S HARRIS	JERICHO ROAD QUINTON TWP	08072	14
NJD986576700	I S SMICK LUMBER	RTE 49 QUINTON	08072	01
NJD981173958	Q T SOLID WASTE DISPOSAL AREA	ROAD #2 SCHEPPS VALLEY QUINTON TWP	08072	14
NJD980649644	QUINTON REP STA	BRIDGETON SALEM PIKE QUINTON TWP OF	08072	01
NJD981173941	QUINTON TOWNSHIP SLF	SOUTH BURDEN HILL ROAD QUINTON TWP	08072	14
NJD986603660	QUINTON TWP SWDA	GRAVELLY HILL RD QUINTON TWP	08072	05
NJD980642094	SWEDESBORO NJ REPEATER STATION	RTE 49 QUINTON	08072	01
NJD982529232	T E WARREN INC	RTE 49 QUINTON	08072	01
NJD048045066	VINELAND TRANSIT MIX CONCRETE	RT. 49 & BURDEN HILL RD. QUINTON TWP	08072	14 03

OGRAM CODES: 01 - HWDMS 02 - PCS 03 - CDS/AIRS 04 - FATES 05 - CERCLIS 07 - DOCKET 08 - FUR 09 - FRDS 10 - SIA
11 - FFSI 13 - CICS 14 - STATE 15 - PADS 16 - RCRA-J 17 - TRIS 18 - CUS 19 - NCDB

FINDS DESCRIPTION

The FINDS report is a national database which serves as a cross reference, a link with other EPA data systems, index on a facility basis to point to media-specific EPA databases to acquire additional data. Listed below are the descriptions of several databases that are involved in a FINDS report.

AIRS (Aerometric Information Retrieval System) Facilities which are monitored or permitted for air emissions under the Clean Air Act. Includes compliance status and enforcement actions.

CDS (Compliance Data System) Contains compliance information including compliance status, agency actions (e.g., inspections), etc. for major sources of the five primary air pollutants.

CICIS (Chemicals In Commerce Information System) Contains chemical manufacturers who submitted chemical production information in response to the 1977 TSCA inventory rule.

CUS (Chemical Update System) Facilities which manufactured or importe excess of 10,000 pounds of specific toxic chemicals during the preceding fis year.

DOCKET A national system containing all pertinent information regarding a civil or administrative enforcement action taken by EPA or designated state against violators of all Federal environmental statues. This can be used to produce reports on enforcement actions in a geographical area, a specific statute or media of a specific source classification.

FATES (FIFRA and Section 7 Tracking System) This tracking system is in conjunction with the Federal Insecticide, Fungicide, and Rodenticide Act, Section 7. It monitors all corporations or facilities involved with pesticide production.

FFIS (Federal Facility Information System) Federal facilities that have submitted specific environmental project budget plans under Executive Order of 12088.

FRDS (Federal Reporting Data System) A national database containing an inventory of public water supplies, type of data collected or monitored and analytical procedures. This data can determine whether public water supplies are located in the vicinity of hazardous waste or other pollution sources and retrieve specific information about such supplies.

F RS (Federal Underground Injection Control) National database that manages in mation (such as inventory, permit, inspection, mechanical integrity, and compli ce enforcement) of underground injection wells.

HWDMS (Hazardous Waste Database Management System) The HWDMS contains data on approximately 180,000 large and small quantity generators. Information stored in the database includes: Facility Name, EPA Identification Number, Owner, Permit and Closure Action Events, and Other Part A and B Permitting Information.

NCDB (National Compliance Database) Pesticides and TSCA enforcement tracking.

PADS (PCB Activity Data System) This data system provides information on PCB generator, storer, transporter, or permitted disposer.

PCS (Permit Compliance System) PCS is a computerized management information system for tracking permit, compliance, and enforcement (NPDES) programs under the Clean Water Act, the Federal Waster Pollution control Act Amendments of 1972, and the Waster Quality Act of 1987. PCS contains information on more than 63,000 active water discharge permits issued to facilities throughout the nation. The Office of Water Enforcement Protection Agency (EPA) is responsible for the operation and maintenance of PCS.

RCRA-J (Resource Conservation and Recovery Act - J System) Transporters and on-site incinerators of regulated medical waste.

STATE This particular category in FINDS shows if the facility is regulated by a state environmental program.

SIA (Surface Impoundment) Inventory of various liquids that are that are placed into surface openings.

TRIS (Toxic Release Information System) TRI contains information on the annual estimated releases of toxic chemical to the environment. TRI was mandated by Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986, The Inventory contains provisions for the reporting, by industry, on the releases of over 300 toxic chemicals into the air, water, and land.

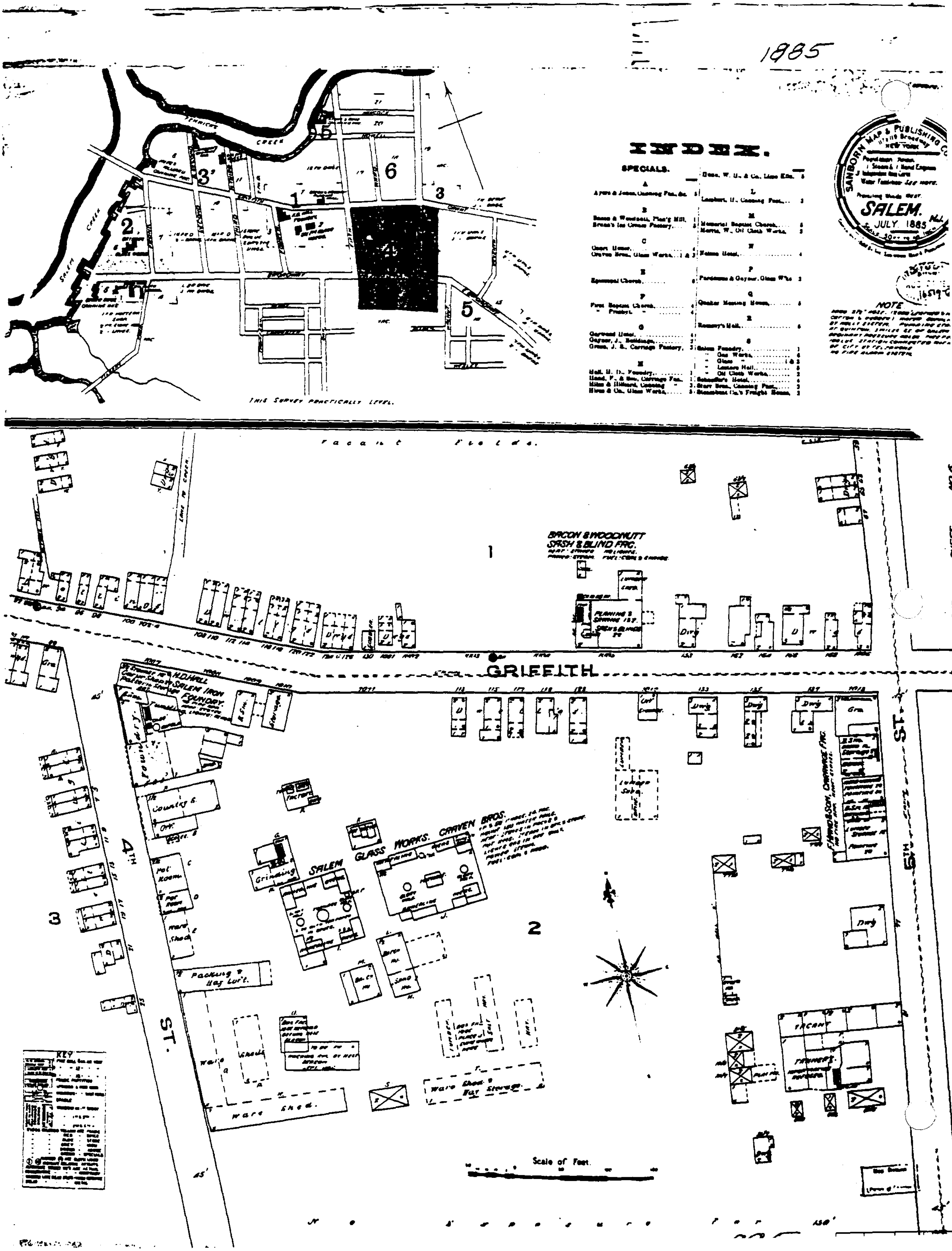
APPENDIX B

AERIAL PHOTOGRAPHS OF THE SALEM RIVER PROJECT AREA

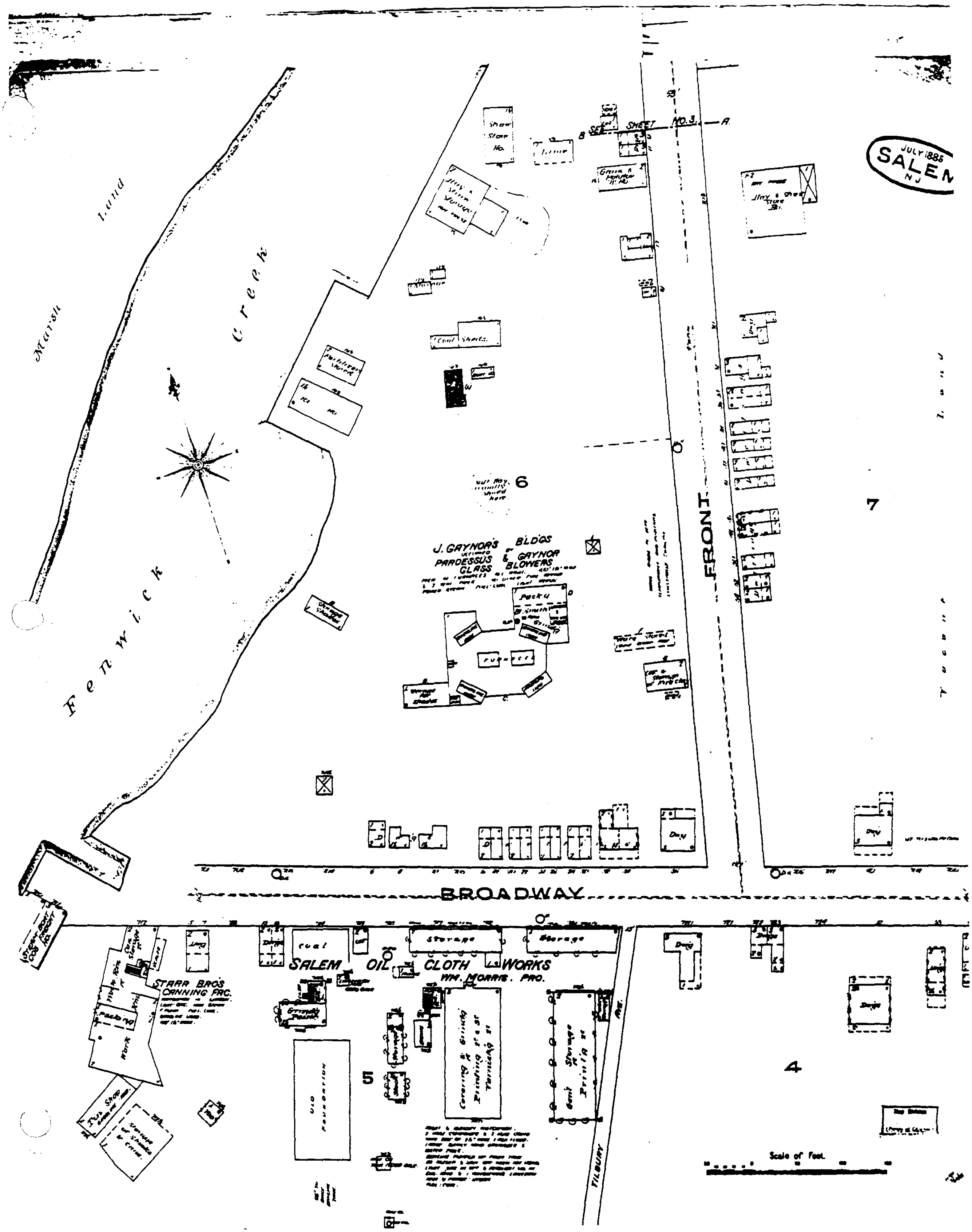
(Enclosed under separate cover)

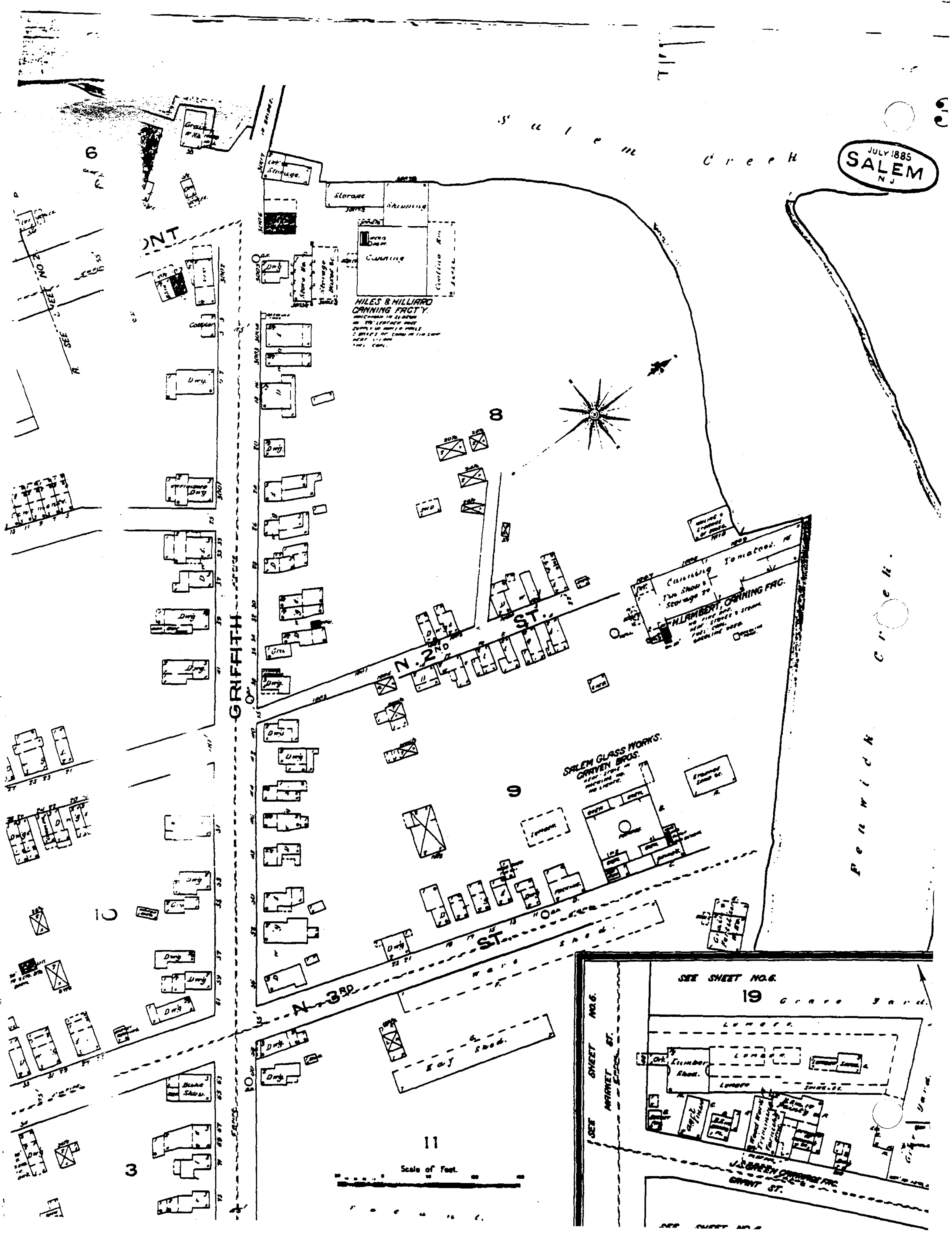
APPENDIX C

SANBORN INSURANCE MAPS

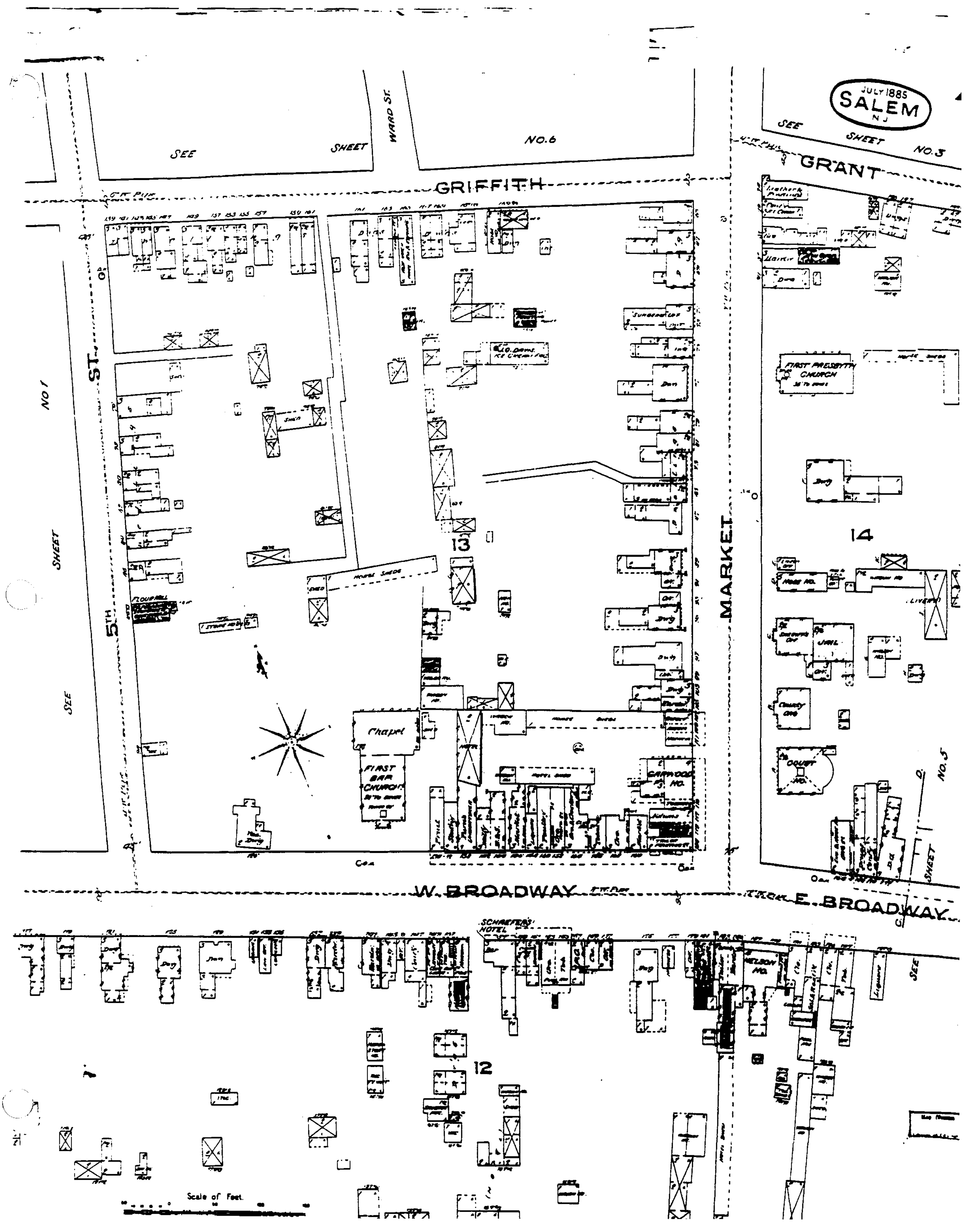


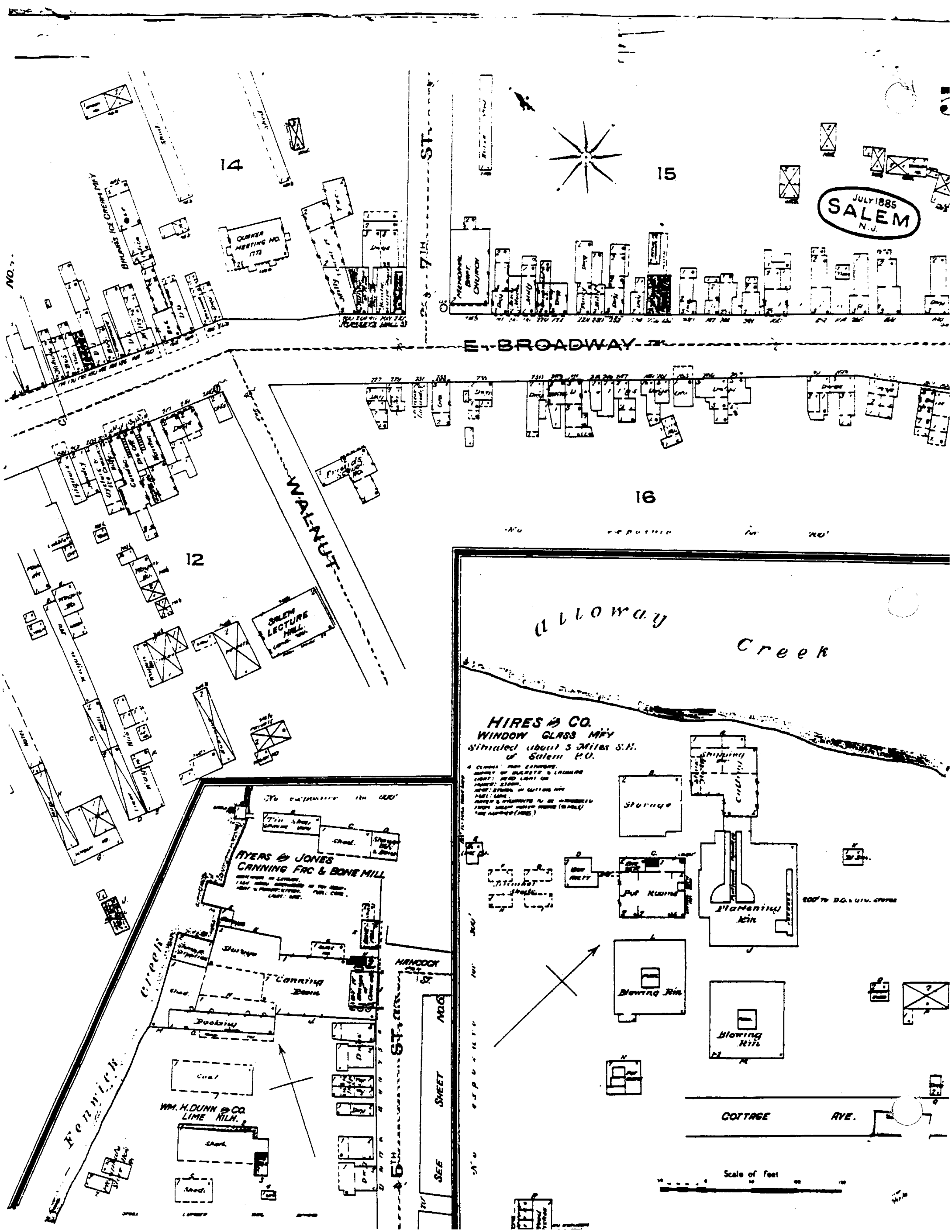
1885
INDEX.
SPECIALS.
SANBORN MAP & PUBLISHING CO.
NEW YORK
SALEM
JULY 1885
NOTE
THIS SURVEY PRACTICALLY LEVEL.
Vacant Fields
BACON & WOODNUTT
SASH & BLIND FAC.
GRIFFITH
H.D. HALL
SALEM IRON FOUNDRY.
SALEM GLASS WORKS. CRAVEN BROS.
Grinding
Pot Room
Packing & Hay Loft
Ware Shed
Ware Shed & Hay Storage
4TH ST.
5TH ST.
KEY
Scale of Feet.


JULY 1885
SALEM
N.J
SEE SHEET NO. 3
Marsh Land
Fenwick Creek
6
7
J. GAYNOR'S BLDGS
PARDESSUS & GAYNOR GLASS BLOWERS
FRONT
BROADWAY
TILBURY AVE.
STARR BROS CANNING FAC.
SALEM OIL CLOTH WORKS
WM. MORRIS. PRO.
Storage
Coal
Packing
5
4
Scale of Feet

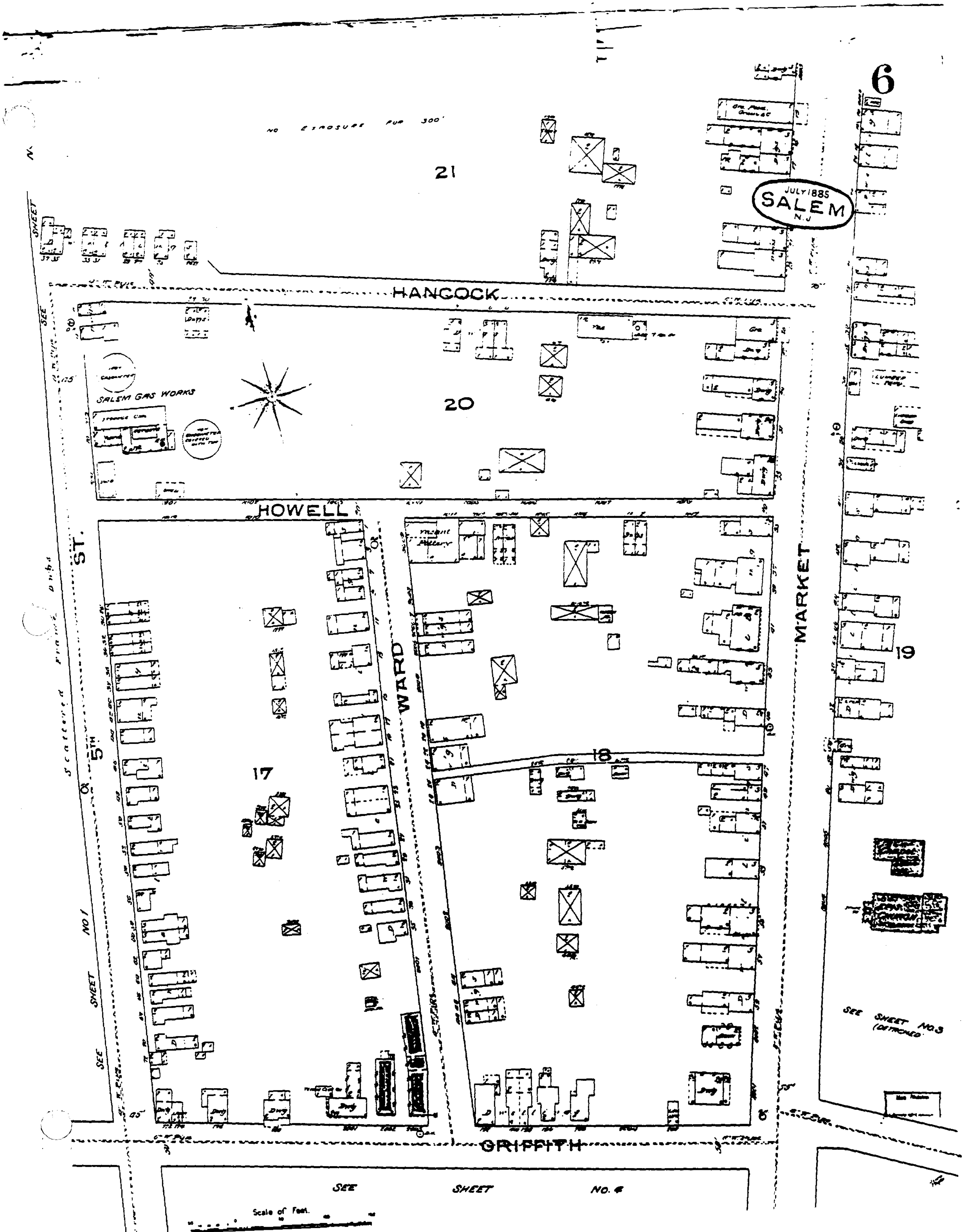


JULY 1885
SALEM
N J
Salem Creek
HILES & HILLIARD
CANNING FACT'Y.
Storage
Canning
GRIFFITH
N. 2ND ST.
Tomatoes
Canning
H.L. LAMBERT CANNING FAC.
SALEM GLASS WORKS.
CRAVEN BROS.
N. 3RD ST.
Ware Shed
Hay Shed
Fenwick Creek
SEE SHEET NO. 6
19
Grave Yard
Lumber
Lumber Shed
MARKET ST.
J.S. GREEN CARRIAGE FAC.
GRANT ST.
Scale of Feet.
8
9
6
3
11

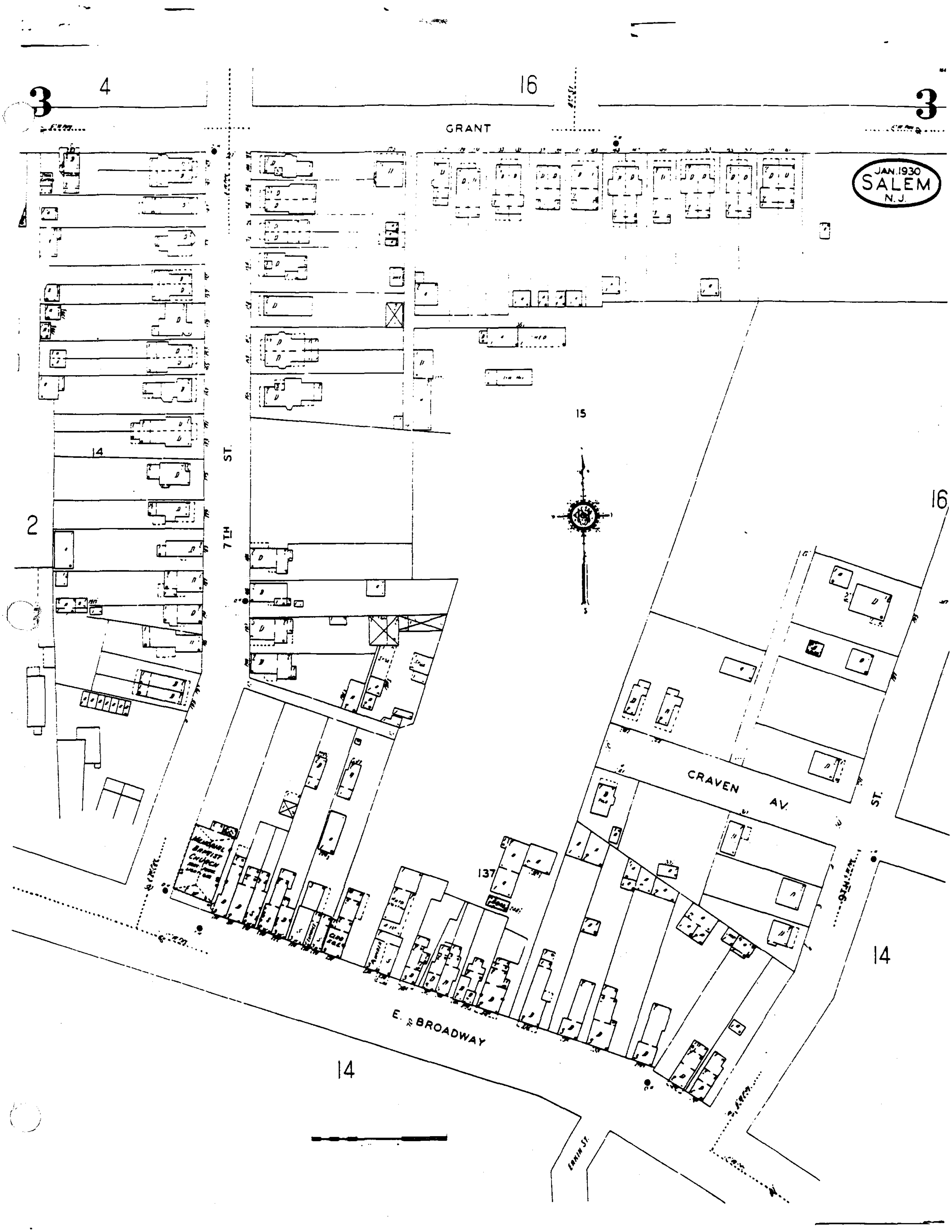

JULY 1885
SALEM
N.J.
SEE SHEET NO.6
WARD ST.
GRIFFITH
GRANT
SEE SHEET NO.3
NO 1 SHEET SEE
5TH ST.
MARKET
13
14
12
FIRST PRESBYTN CHURCH
Chapel
FIRST BAP. CHURCH
HOUSE SHEDS
FLOUR MILL
JAIL
COURT HO.
County Offs.
Hose Ho.
Livery
CARWOOD HO.
SCHREFER'S HOTEL
NELSON HO.
W. BROADWAY
E. BROADWAY
SEE SHEET NO.5
Scale of Feet.



JULY 1885
SALEM
N.J.
14
15
16
12
7TH ST.
E. BROADWAY
WALNUT
QUAKER MEETING HO.
MEMORIAL BAPT. CHURCH
SALEM LECTURE HALL
Alloway Creek
HIRES & CO.
WINDOW GLASS MFY
Situated about 3 Miles S.E. of Salem P.O.
Storage
Pot Rooms
Flattening Kiln
Blowing Kiln
Blowing Kiln
COTTAGE AVE.
Scale of Feet
RYERS & JONES
CANNING FAC & BONE MILL
Tin Shop
Shed
Storage
Canning Room
Coal
WM. H. DUNN & CO.
LIME KILN.
Fenwick Creek
HANCOCK ST.
6TH ST.
SEE SHEET NO. 6

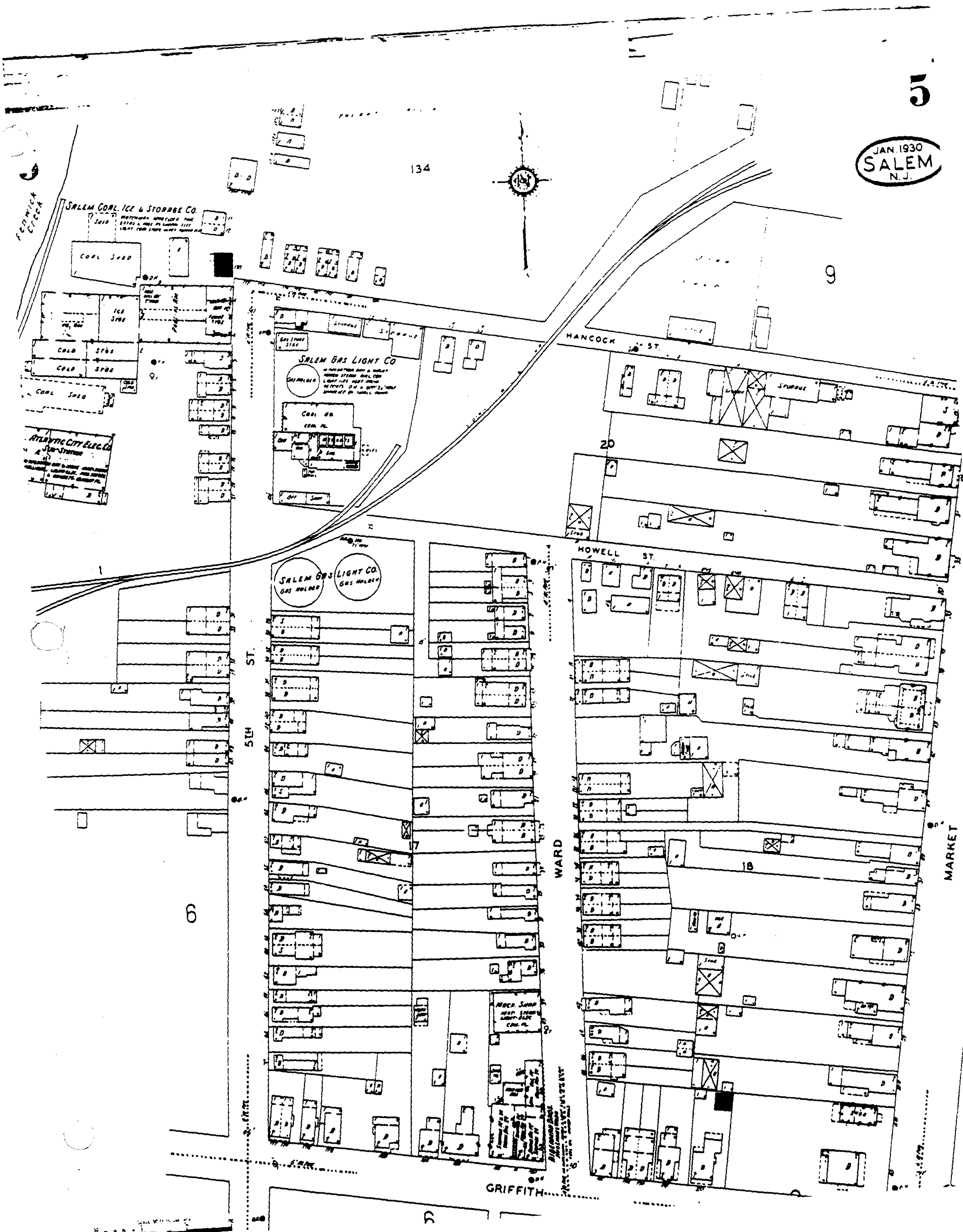

6
JULY 1885
SALEM
N.J.
NO EXPOSURE FOR 300'
21
HANCOCK
SALEM GAS WORKS
20
HOWELL
5TH ST.
WARD
MARKET
19
18
17
Scattered Frame Dwgs.
SEE SHEET NO 1
SEE SHEET NO.3 (DETACHED)
GRIFFITH
SEE SHEET NO. 4
Scale of Feet.

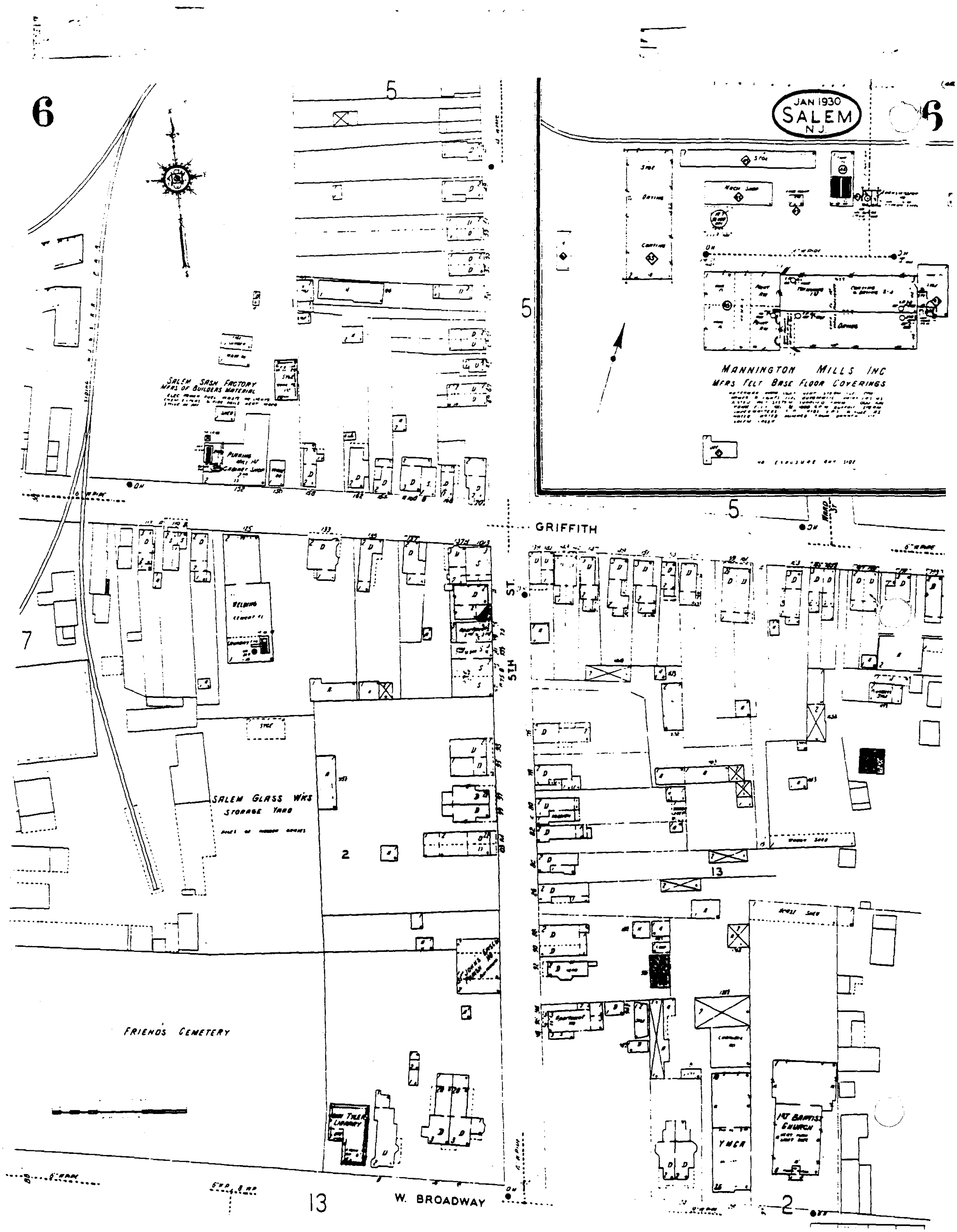
JAN. 1930
SALEM
N.J.
2
5
4
GRANT
GRIFFITH
FENWICK INN
SALEM GRADED SCHOOL
1ST PRESBYTN CHURCH
COUNTY OFFICE BUILDING
MARKET
14
SALEM COUNTY MEMORIAL HOSPITAL
13
JAIL
COUNTY OFFICES
SALEM COUNTY COURT HO.
FRIENDS MEETING HO.
CITY NATIONAL BANK & TRUST CO.
E. BROADWAY
W. BROADWAY
POST OFFICE
PRINCE THEATRE
NEW JOHNSON HOTEL
FENWICK THEATRE
CITY OF SALEM MUNICIPAL BLDG.
NEW MARKET
323
(12C)
322
112A
WALNUT
14
HEDGE
13

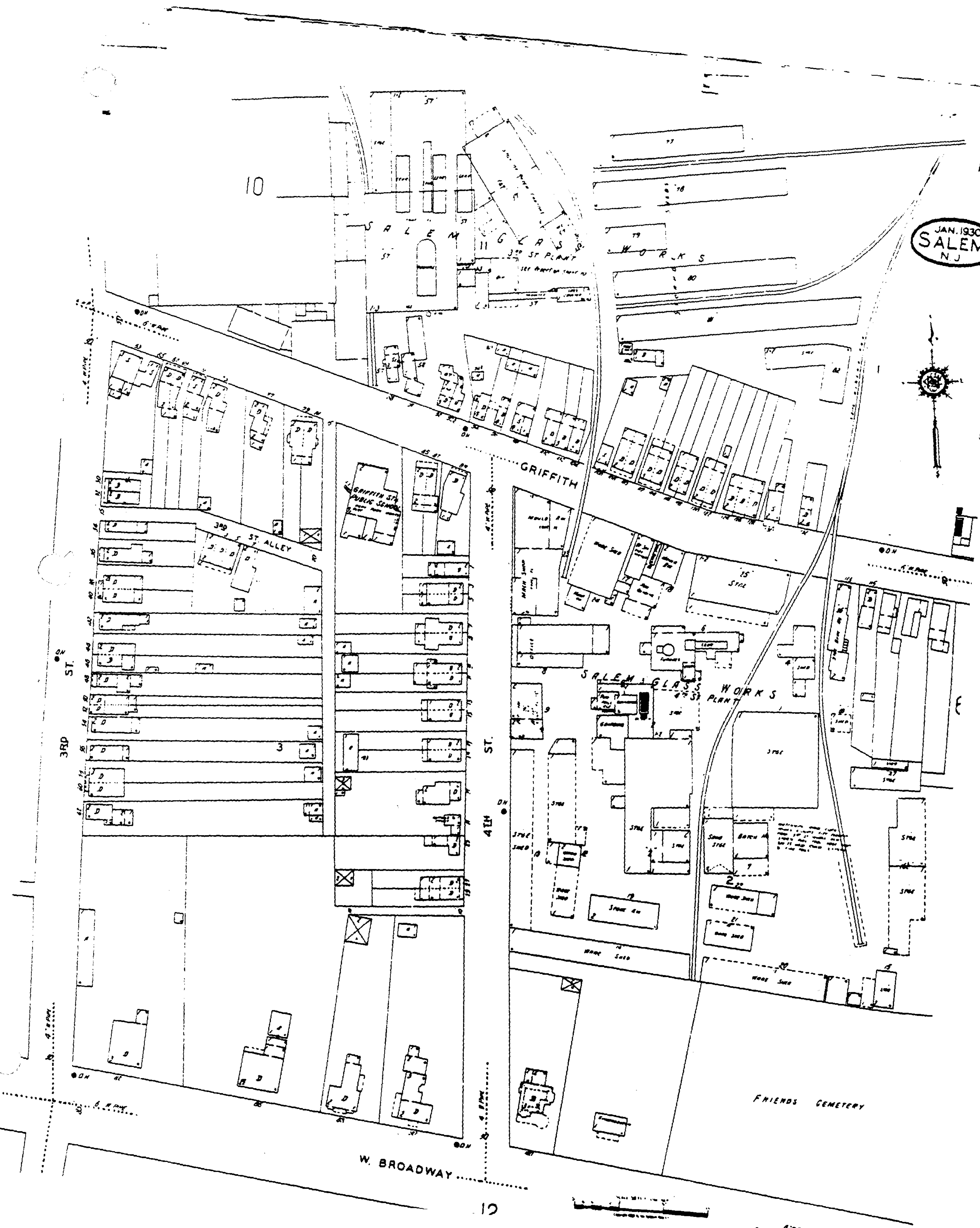


3
4
16
GRANT
3
JAN. 1930
SALEM
N.J.
15
14
2
7TH
ST.
16
CRAVEN
AV.
ST.
137
14
E. BROADWAY
14

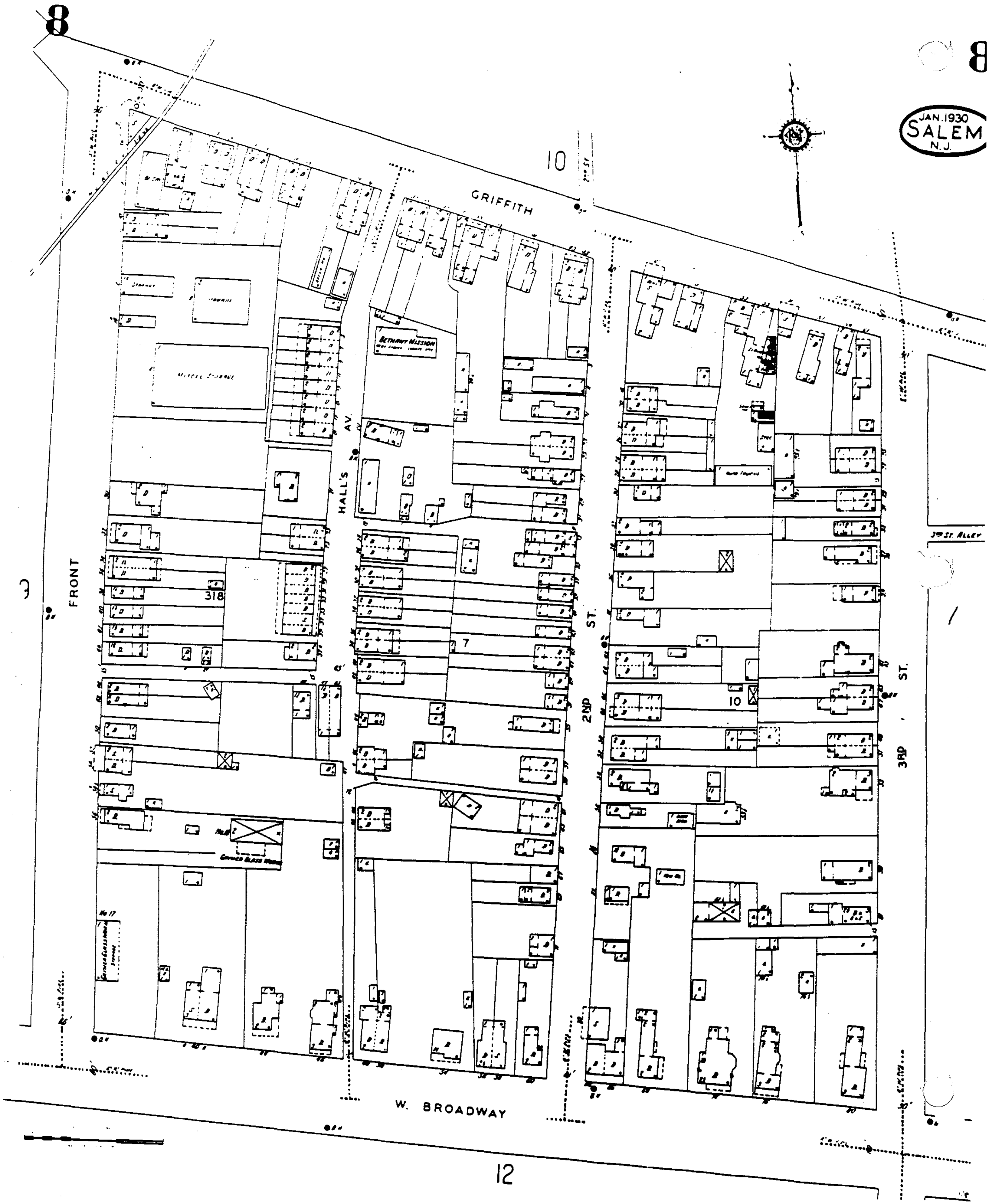

JAN. 1930
SALEM
N.J.
4
16
PLEDGER
9
GREEN BROS
19
19½
AYRES MACHINE CO
SALEM CITY MILLING CO
GRIST MILL
HUBBELL AV
GIBBON
5
MARKET
CEMETERY
ST. JOHN'S EPIS. CHURCH
41
WISTAR & WOODNUTT. LUMBER
PASSENGER STATION
FREIGHT HO
GRANT
2
3


5
JAN. 1930
SALEM
N.J.
134
9
FENWICK CREEK
SALEM COAL, ICE & STORAGE CO.
COAL SHED
ICE STGE.
COLD STGE.
COAL SHED
ATLANTIC CITY ELEC. CO.
SUB-STATION
SALEM GAS LIGHT CO.
GAS HOLDER
HANCOCK ST.
20
HOWELL ST.
SALEM GAS LIGHT CO.
GAS HOLDER
GAS HOLDER
1
5TH ST.
17
WARD
18
MARKET
6
MACH. SHOP
GRIFFITH
6


6
JAN 1930
SALEM
N.J.
6
5
5
5
7
2
13
13
2
GRIFFITH
ST.
5TH
W. BROADWAY
SALEM SASH FACTORY
MFRS OF BUILDERS MATERIAL
PLANING MILL & CABINET SHOP
WELDING
MANNINGTON MILLS INC
MFRS FELT BASE FLOOR COVERINGS
SALEM GLASS WKS
STORAGE YARD
FRIENDS CEMETERY
Y.M.C.A.
1ST BAPTIST CHURCH



10
11
SALEM GLASS WORKS
3RD ST PLANT
JAN. 1930
SALEM
N.J.
GRIFFITH
GRIFFITH ST. PUBLIC SCHOOL
3RD ST. ALLEY
3RD ST.
4TH ST.
SALEM GLASS WORKS
4TH ST. PLANT
FRIENDS CEMETERY
W. BROADWAY
12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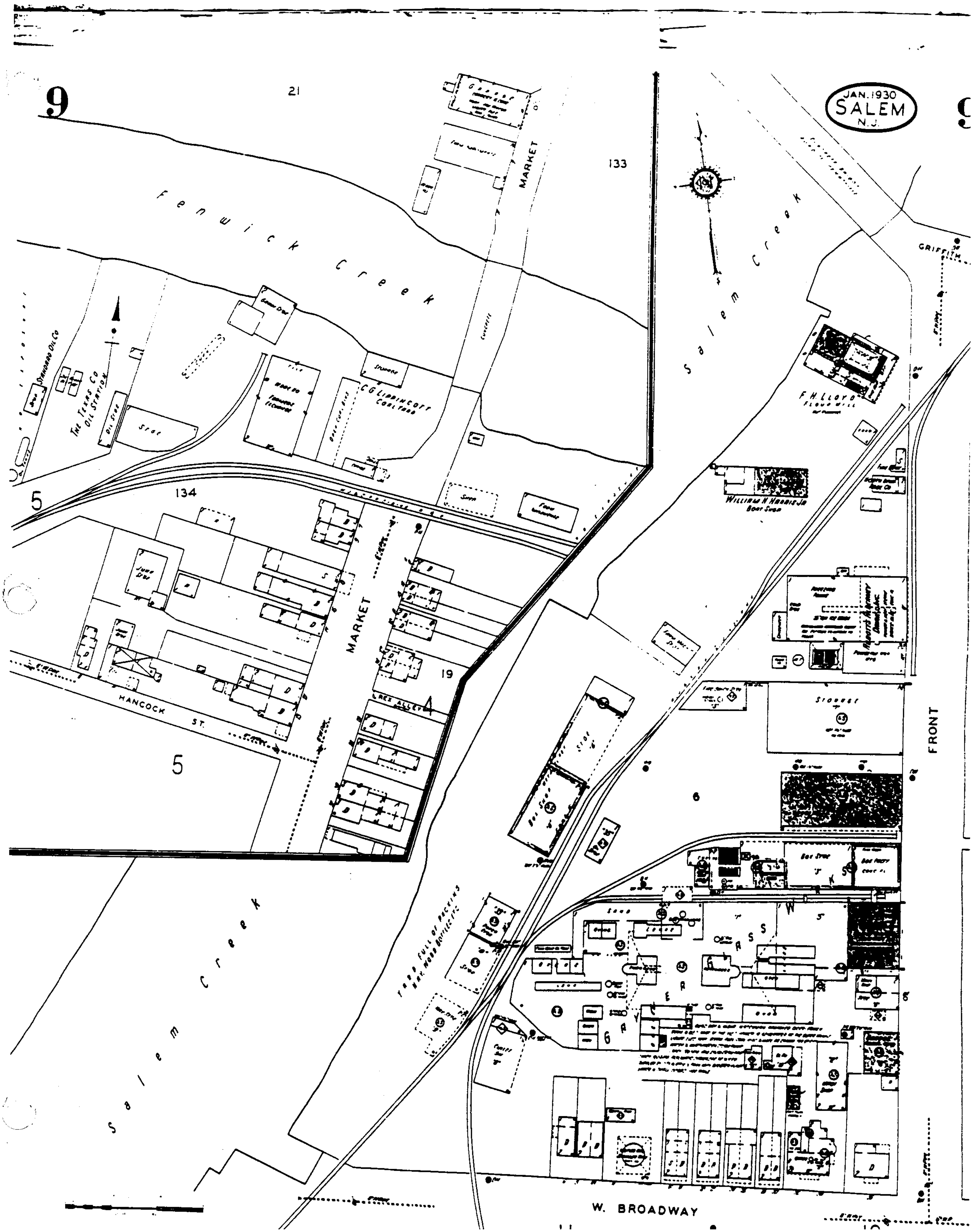
SALEM
N.J.
10
GRIFFITH
FRONT
HALL'S AV.
BETHANY MISSION
2ND ST.
3RD ST.
3RD ST. ALLEY
318
7
10
W. BROADWAY
12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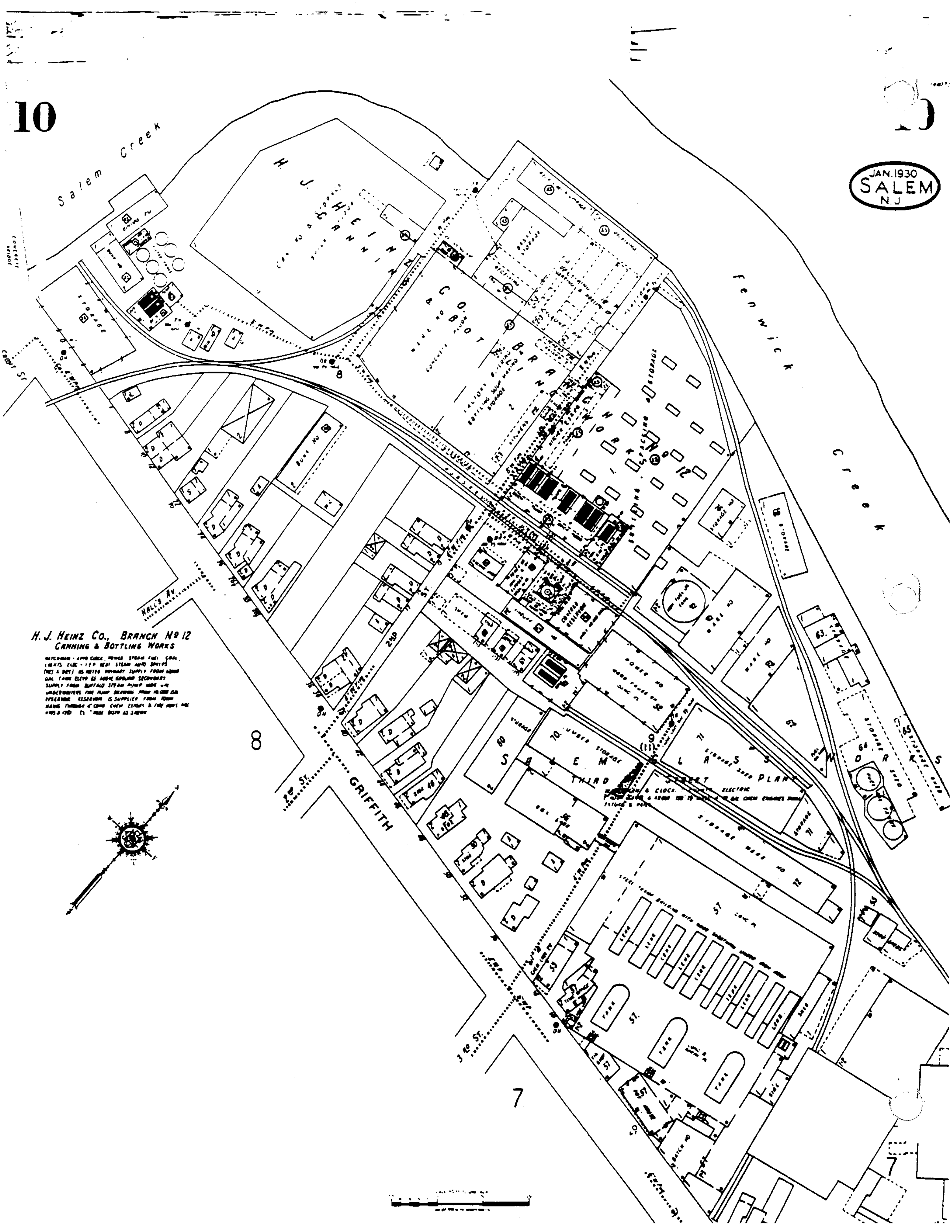
JAN. 1930
SALEM
N.J.
Fenwick Creek
Salem Creek
MARKET
133
134
21
5
19
4
6
STANDARD OIL CO
THE TEXAS CO
OIL STATION
C.G.LIPPINCOTT
COAL YARD
F.H.LLOYD
FLOUR MILL
WILLIAM H HARRIS JR
BOAT SHOP
HANCOCK ST.
GRIFFITH
FRONT
W. BROADWAY
GAYNER GLASS WORKS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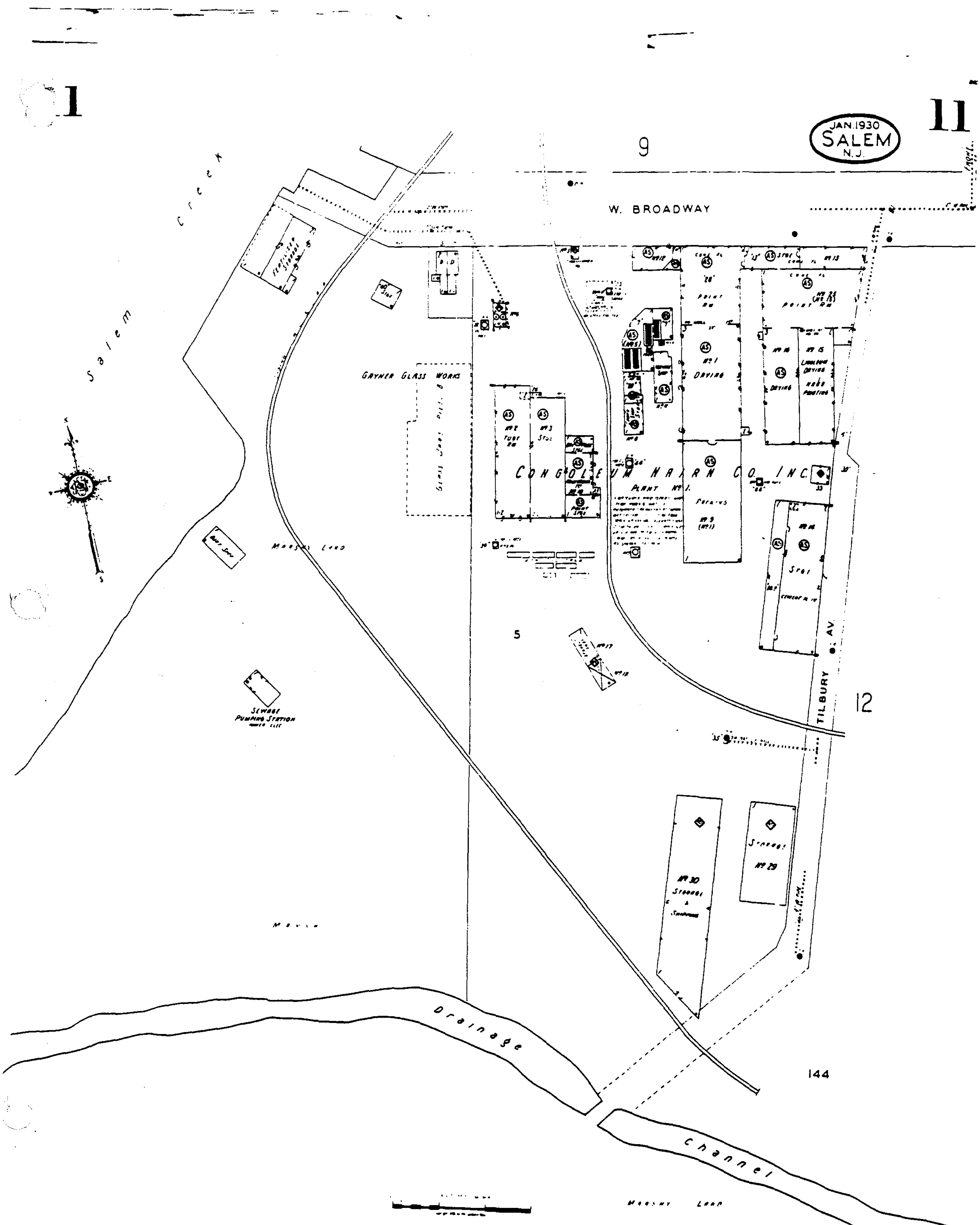
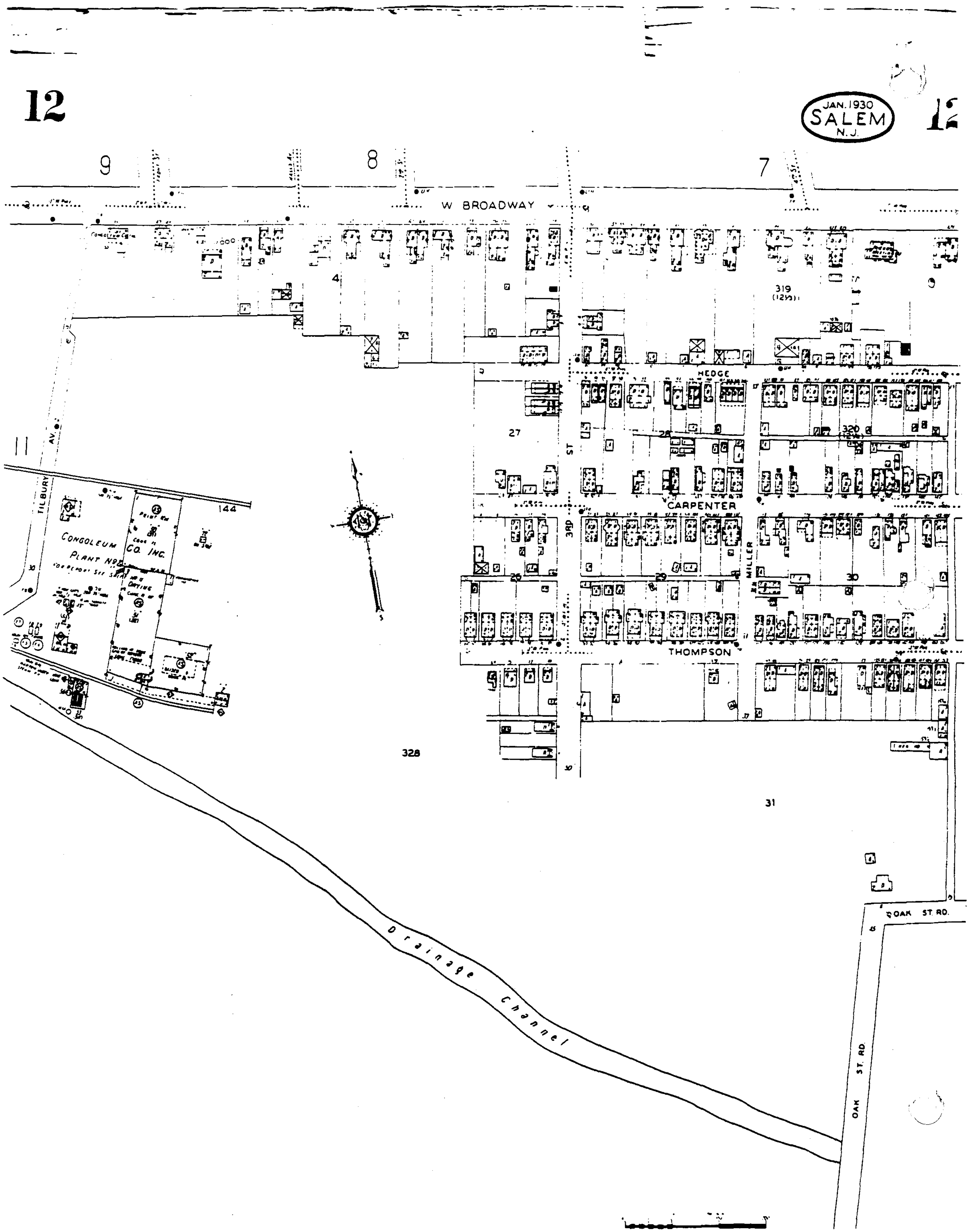
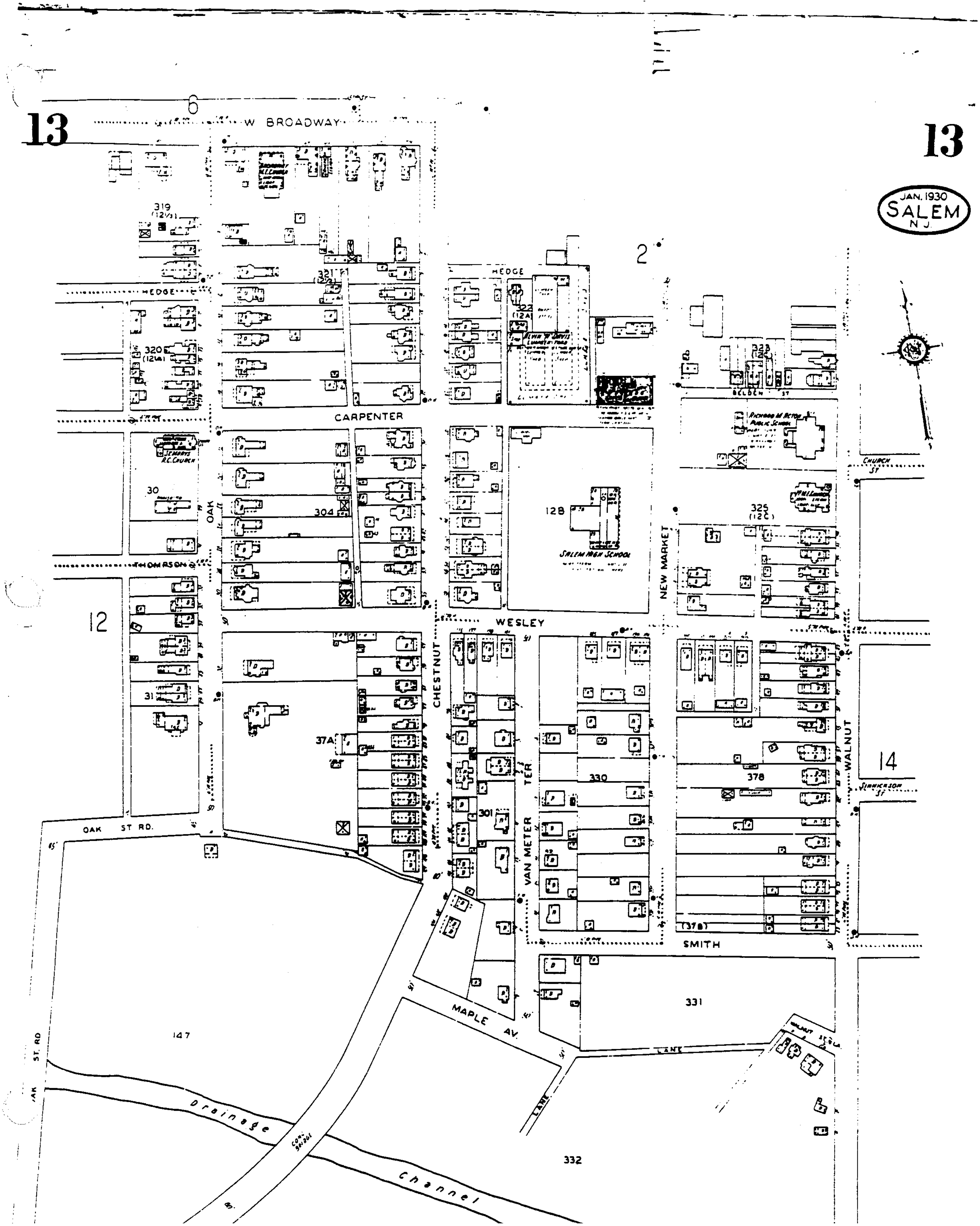
JAN. 1930
SALEM
N.J.
Salem Creek
Fenwick Creek
H. J. Heinz Co., Branch No 12
Canning & Bottling Works
GRIFFITH
THIRD STREET
2ND ST.
3RD ST.
CODY ST.
HALL'S AV.
8
7



1
11
JAN. 1930
SALEM
N.J.
9
W. BROADWAY
Salem Creek
GAYNER GLASS WORKS
CONGOLEUM NAIRN CO. INC.
PLANT No. 1
Drying
Paint Rm
Storage
No 29
No 30
Storage & Shipping
SEWAGE PUMPING STATION
Marsh Land
TILBURY AV.
5
12
144
Drainage
Channel
Marsh Land


JAN. 1930
SALEM
N.J.
9
8
7
W BROADWAY
HEDGE
CARPENTER
THOMPSON
3RD ST
MILLER
TILBURY AV.
CONGOLEUM CO. INC.
PLANT NO 2
144
27
28
29
30
26
319
320
328
31
11
OAK ST. RD.
OAK ST. RD.
Drainage Channel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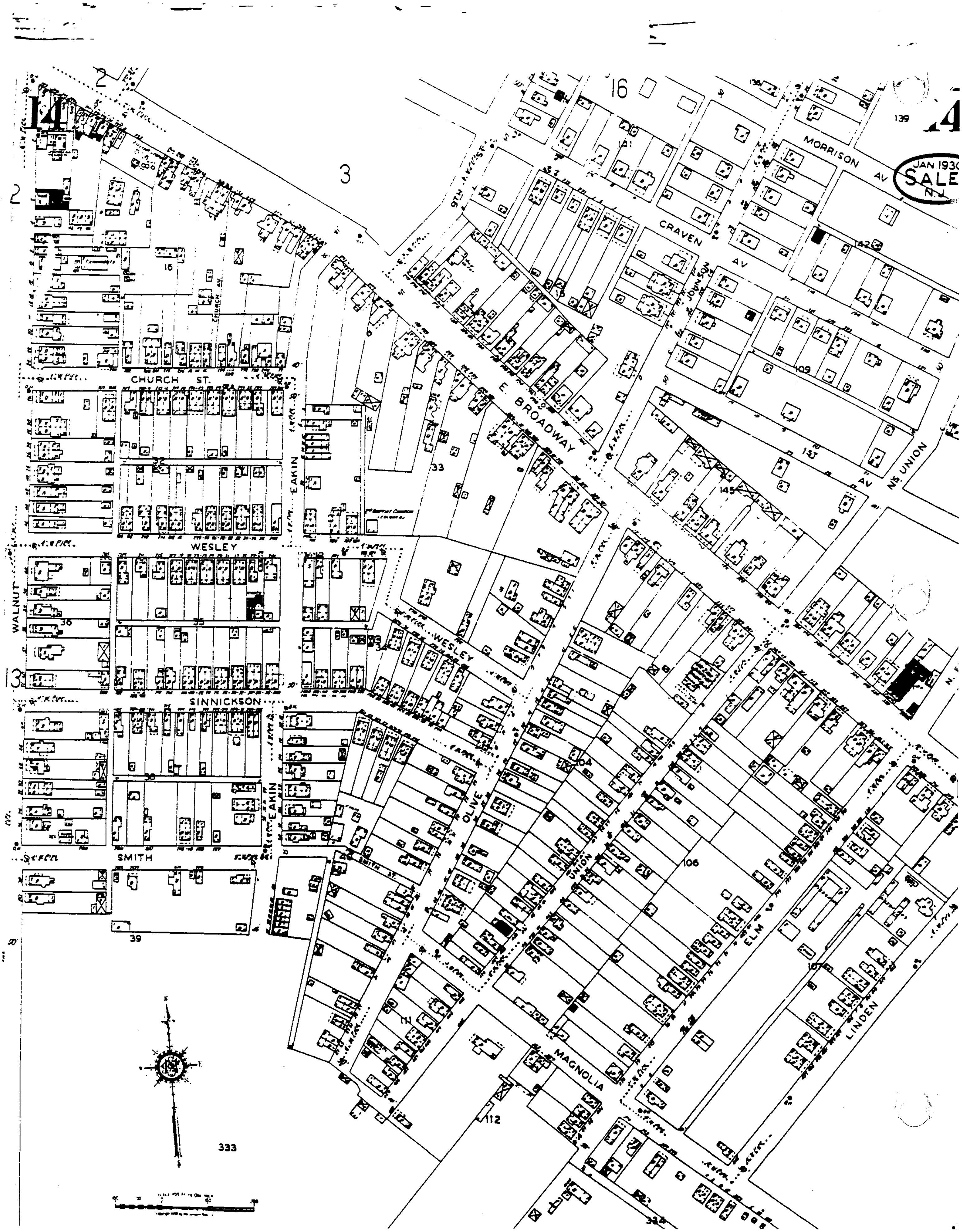
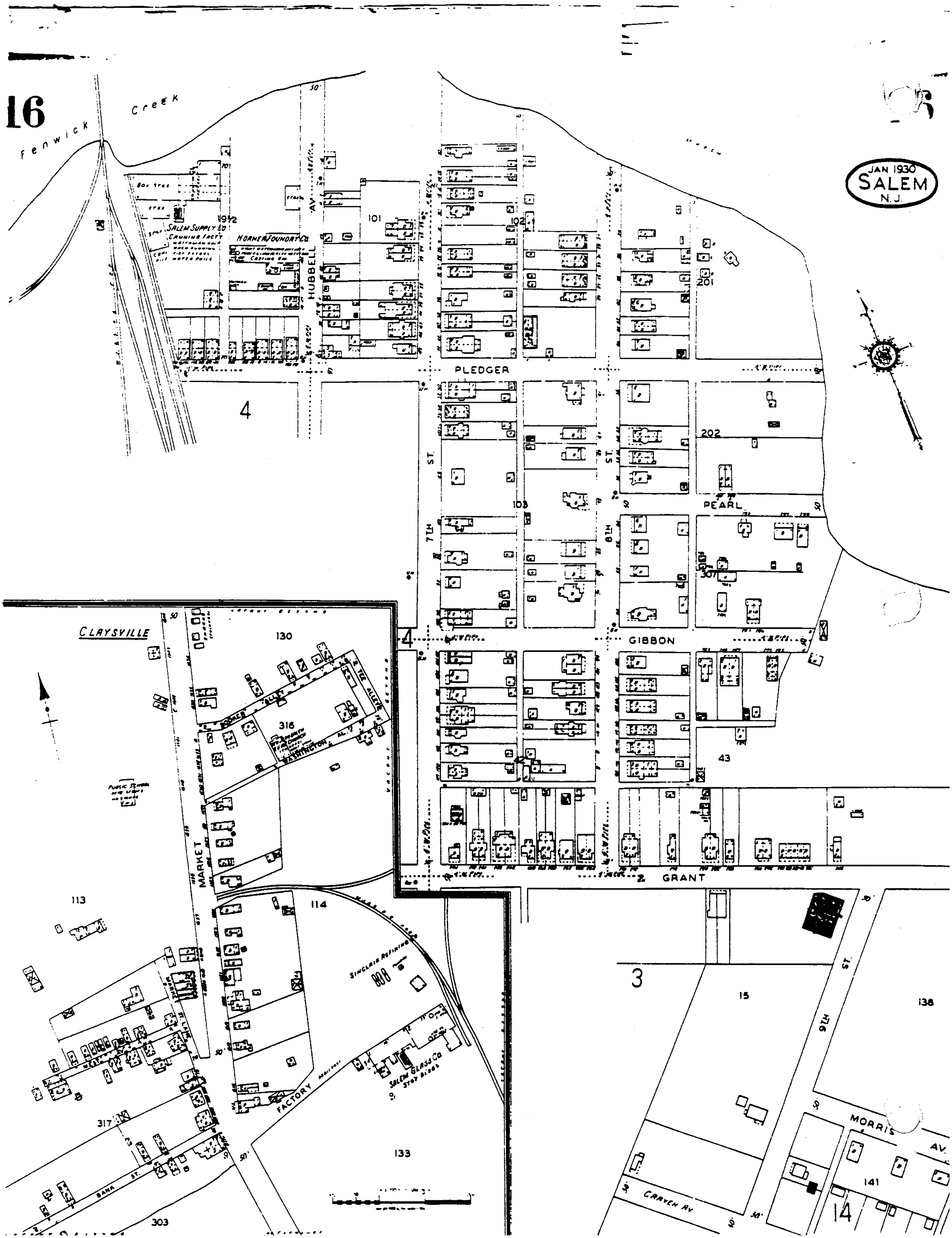
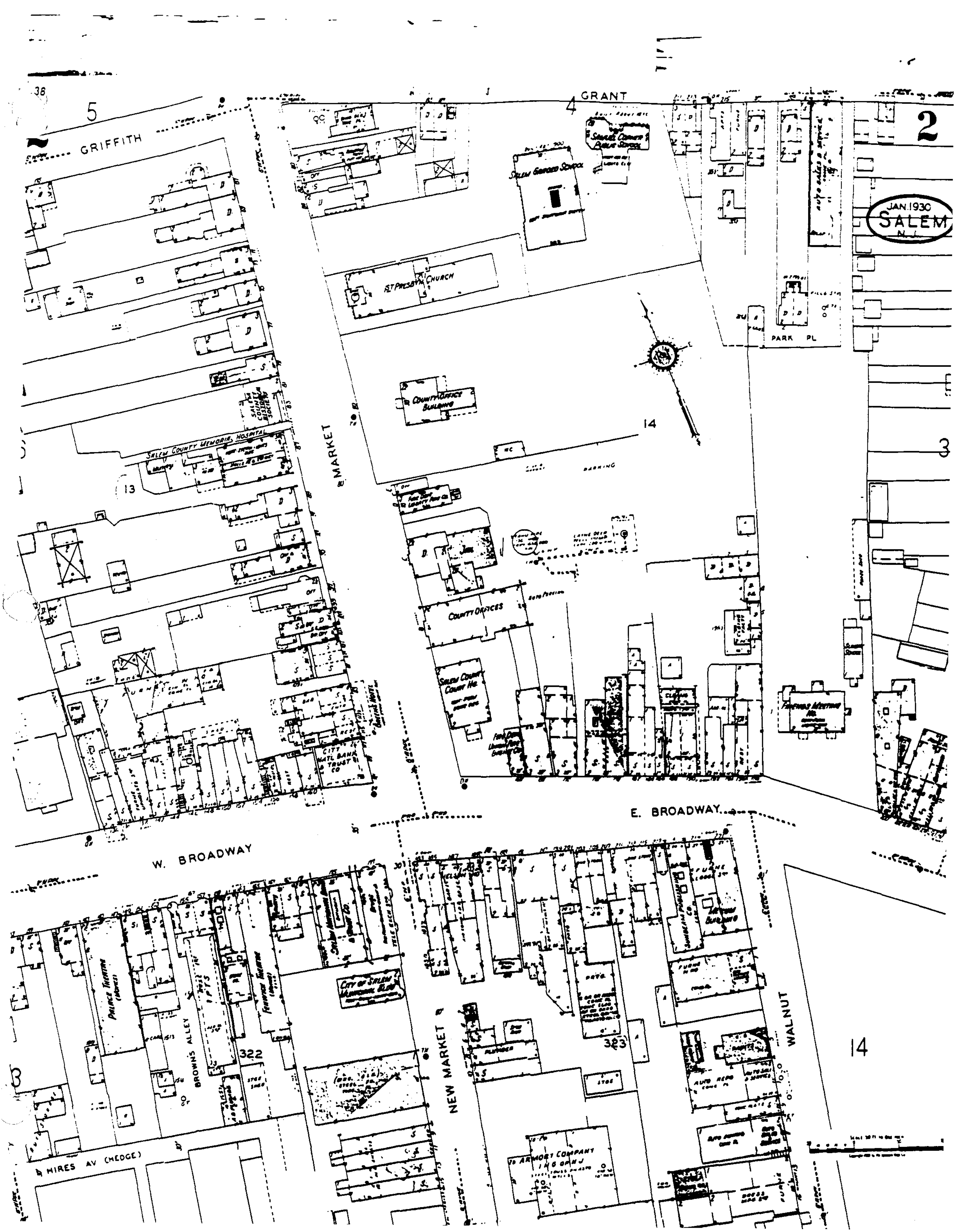
13
JAN. 1930
SALEM
N.J.
W BROADWAY
HEDGE
CARPENTER
THOMPSON
OAK
WESLEY
CHESTNUT
NEW MARKET
BELDEN ST
CHURCH ST
WALNUT
SINNICKSON ST
VAN METER TER.
SMITH
MAPLE AV.
LANE
OAK ST RD.
Drainage Channel
SALEM HIGH SCHOOL
ST. MARY'S R.C. CHURCH
RICHARD M. ACTON PUBLIC SCHOOL
319
320
321
322
323
325
128
30
31
304
37A
301
330
378
331
332
147
12
14
2
6



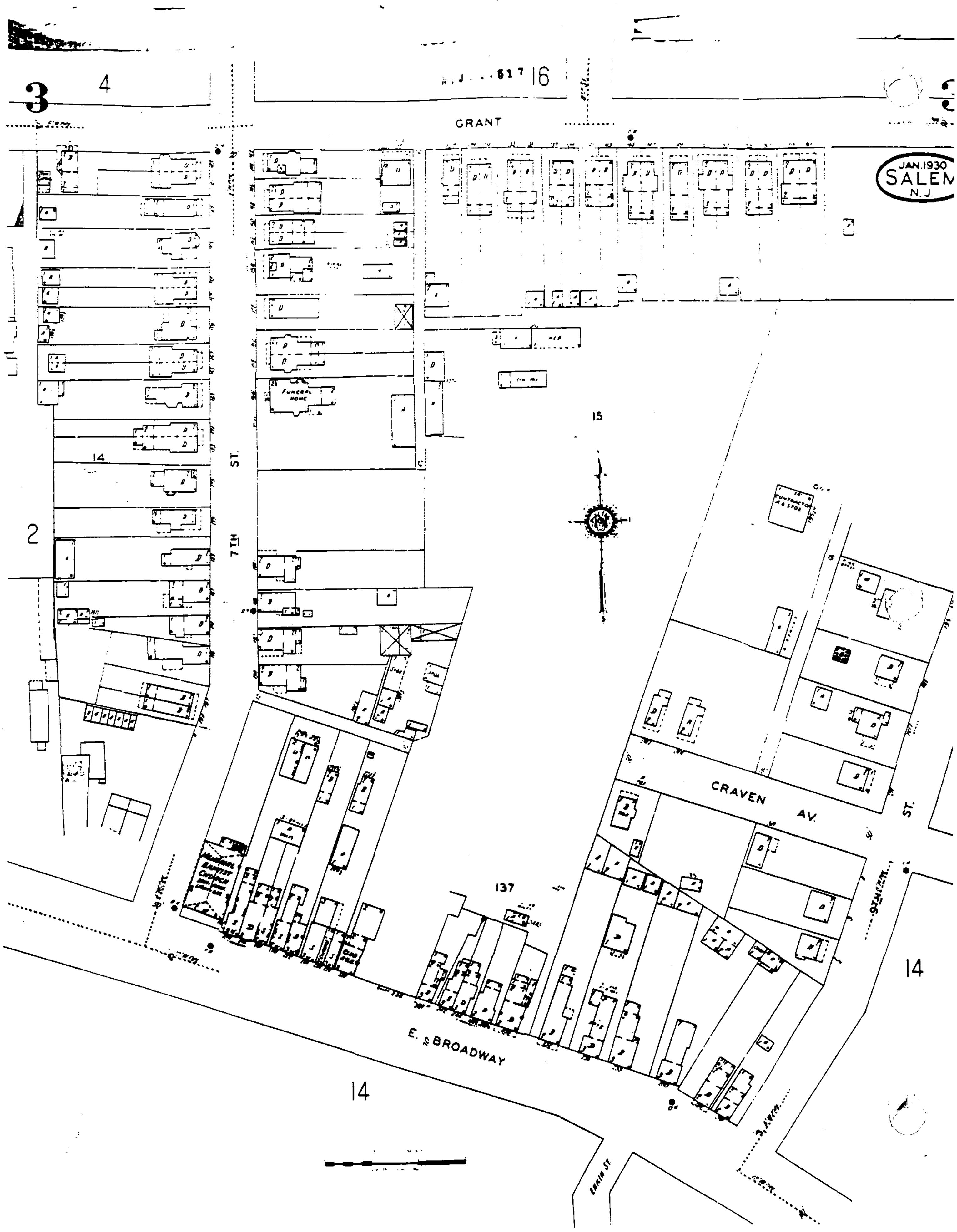
14
2
3
16
141
139
14
MORRISON AV
JAN 1930
SALEM
N.J.
CRAVEN AV
142
JOHNSON
109
E. BROADWAY
1ST AV
N.S. UNION
145
CHURCH ST.
16
32
33
EAKIN
WESLEY
WALNUT
36
35
34
13
SINNICKSON
38
OLIVE
104
UNION
106
ELM
107
LINDEN
SMITH
SMITH ST.
40
39
111
MAGNOLIA
112
333


JAN. 1930
SALEM
N. J.
14
N. ELM
ELM ST.
MT. HOPE M.E. CHURCH
105
E. BROADWAY
LINDEN
KEASBEY
ROE
AV
151
110
QUINTON
108
MAGNOLIA
YORK
BAPTIST CEMETERY
FARM LAND
109
112
KENT
204

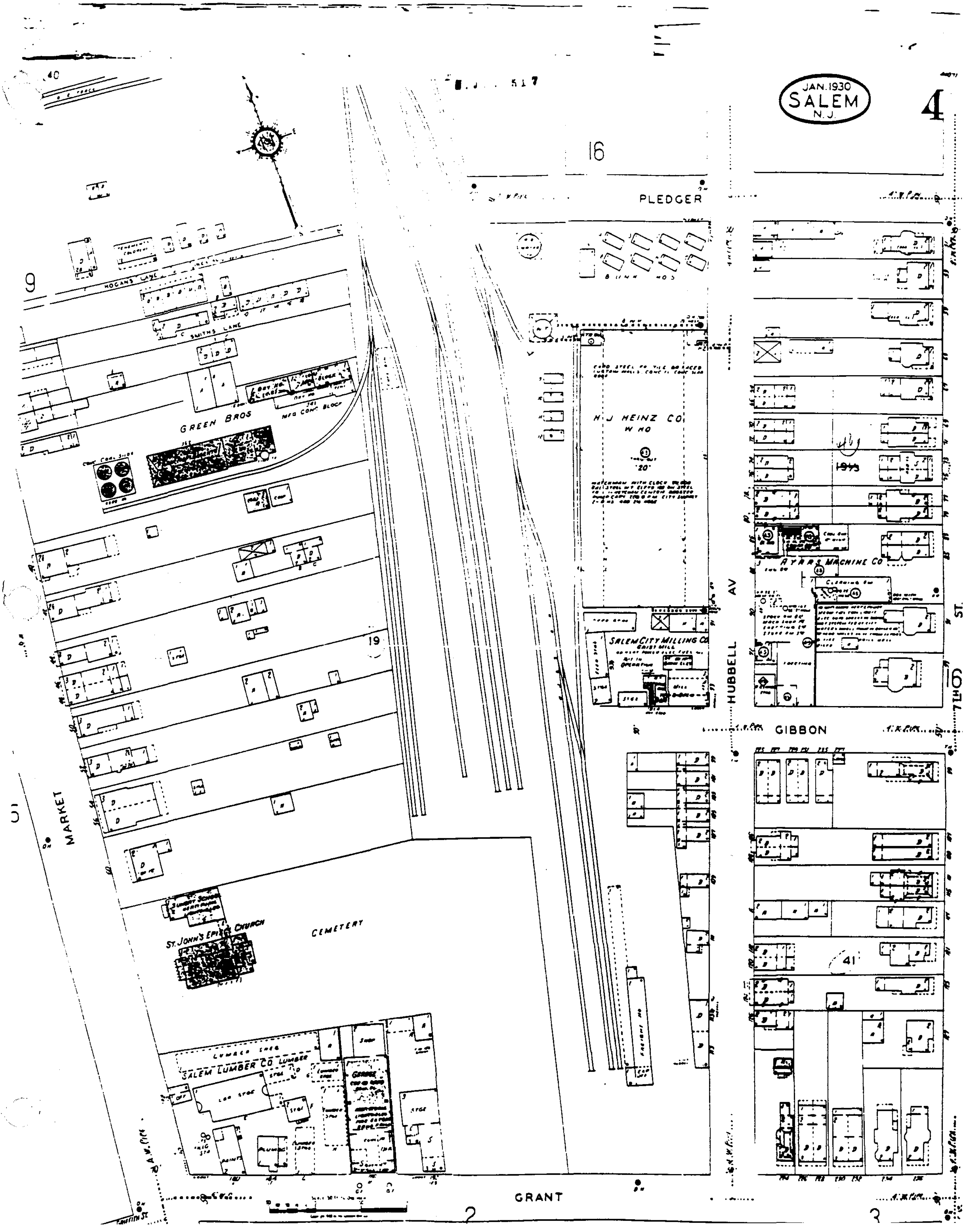

16
Fenwick Creek
JAN 1930
SALEM
N.J.
SALEM SUPPLY CO
CANNING FACTY
HORNER FOUNDRY CO
HUBBELL AV.
101
102
201
PLEDGER
4
202
7TH ST.
8TH ST.
103
PEARL
307
CLAYSVILLE
130
GIBBON
316
WASHINGTON
43
MARKET
GRANT
113
114
SINCLAIR REFINING
3
15
9TH ST.
138
SALEM GLASS CO
FACTORY
317
133
MORRIS AV.
BANK ST.
141
CRAVEN AV
14
303

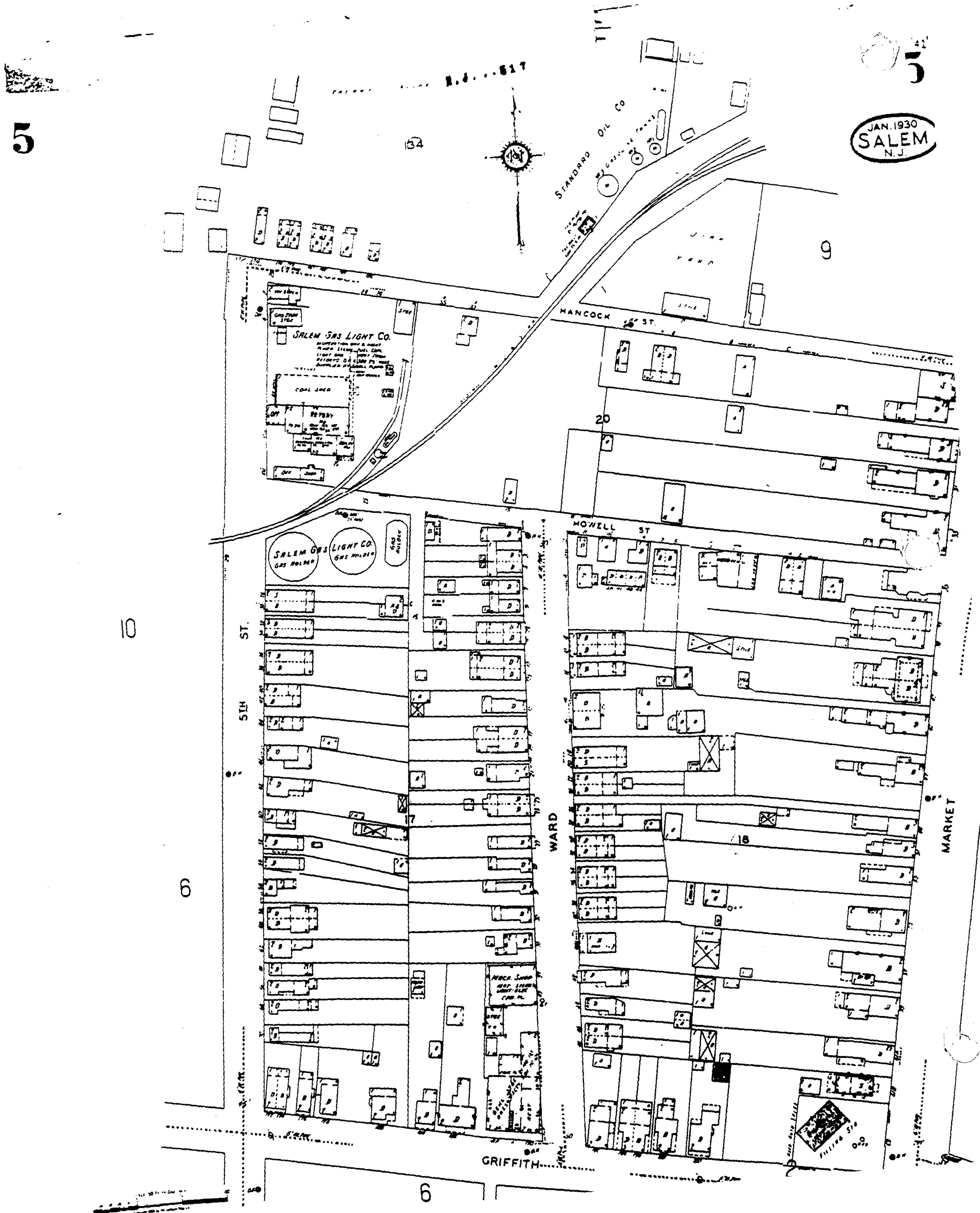


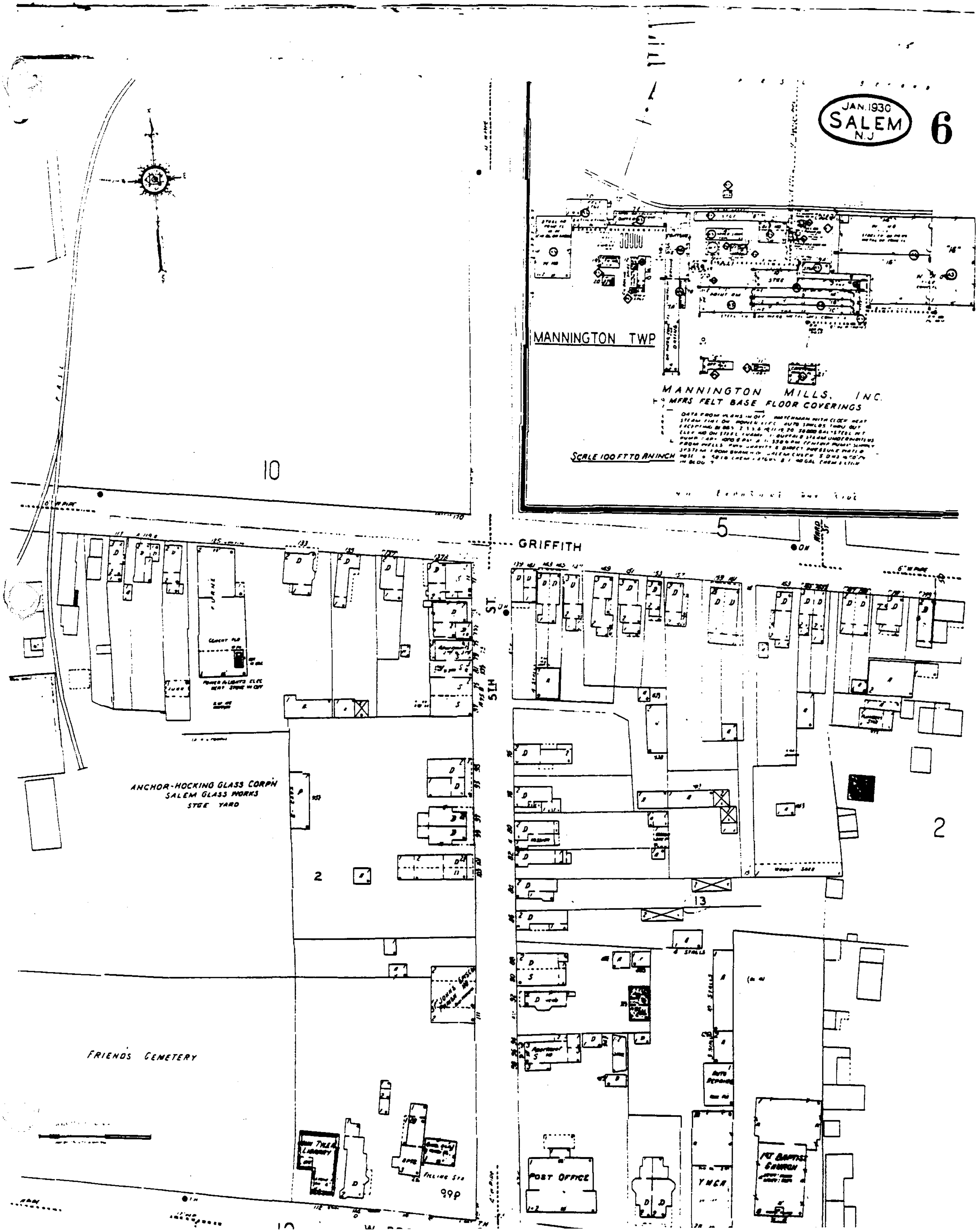
GRANT
GRIFFITH
5
4
2
3
38
JAN. 1930
SALEM
N.J.
SALEM GRADED SCHOOL
1ST PRESBYN CHURCH
COUNTY OFFICE BUILDING
14
SALEM COUNTY MEMORIAL HOSPITAL
13
MARKET
PARK PL
PARKING
COUNTY OFFICES
SALEM COUNTY COURT HO.
CITY NAT'L BANK TRUST CO
FRIENDS MEETING HO.
E. BROADWAY
W. BROADWAY
PALACE THEATRE
FENWICK THEATRE
BROWNS ALLEY
322
323
NEW MARKET
WALNUT
14
CITY OF SALEM MUNICIPAL BLDG
ARMORY COMPANY
HIRES AV (HEDGE)



3
4
16
GRANT
JAN. 1930
SALEM
N.J.
FUNERAL HOME
15
14
7TH ST.
2
MEMORIAL BAPTIST CHURCH
CRAVEN AV.
ST.
137
14
E. BROADWAY
14

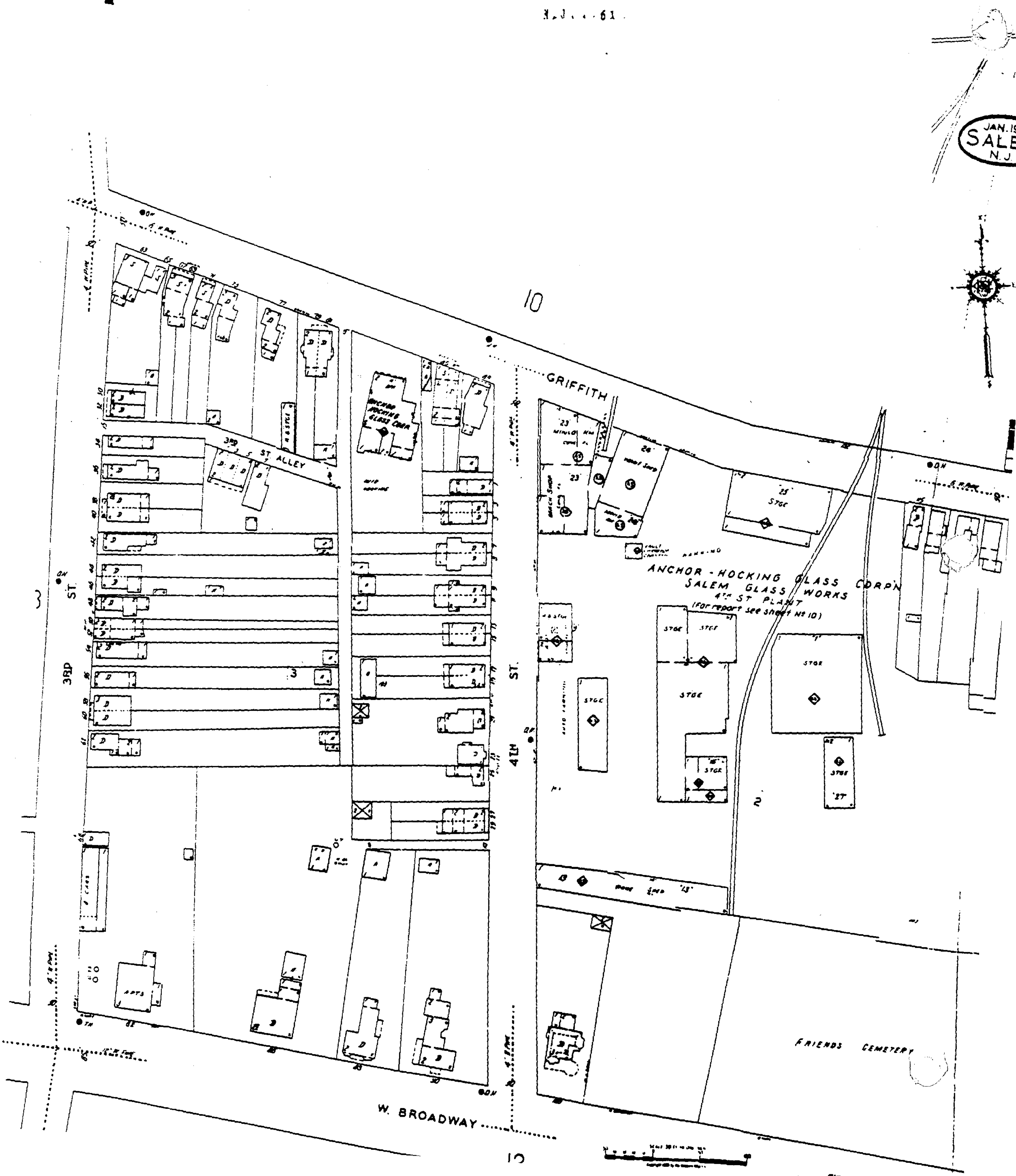

JAN. 1930
SALEM
N.J.
4
16
PLEDGER
HOGANS LANE
SMITHS LANE
GREEN BROS
H.J. HEINZ CO.
W HO
BUNK HOS
SALEM CITY MILLING CO
AYARS MACHINE CO
HUBBELL AV
GIBBON
7TH ST.
19
MARKET
CEMETERY
ST. JOHN'S EPISC. CHURCH
SALEM LUMBER CO. LUMBER
LUMBER SHED
GRANT
41
2
3


5
JAN. 1930
SALEM
N.J.
134
STANDARD OIL CO
9
HANCOCK ST.
SALEM GAS LIGHT CO.
COAL SHED
RETORT
20
HOWELL ST
SALEM GAS HOLDER
LIGHT CO. GAS HOLDER
GAS HOLDER
10
5TH ST.
WARD
MARKET
17
18
6
MECH. SHOP
GRIFFITH
6

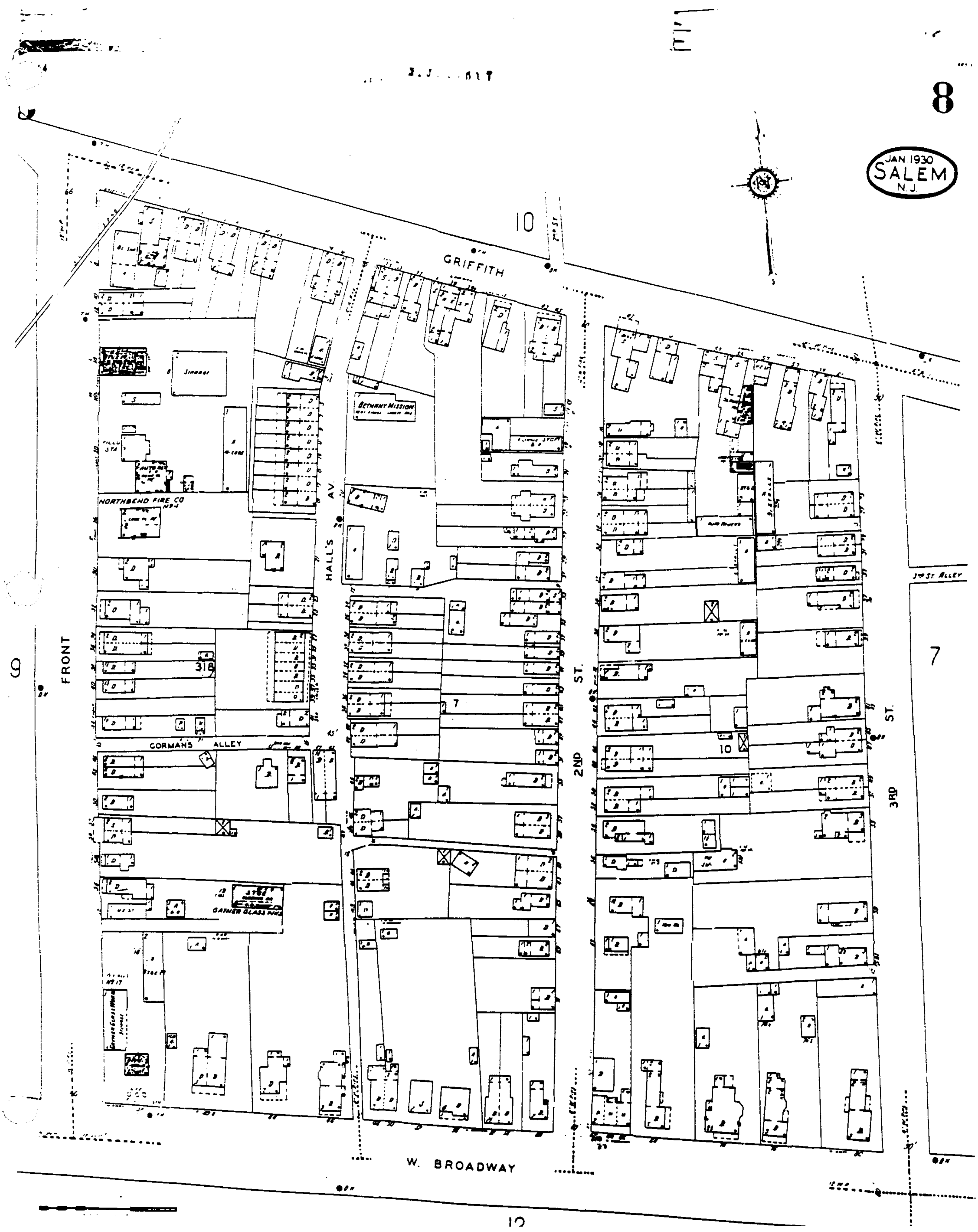


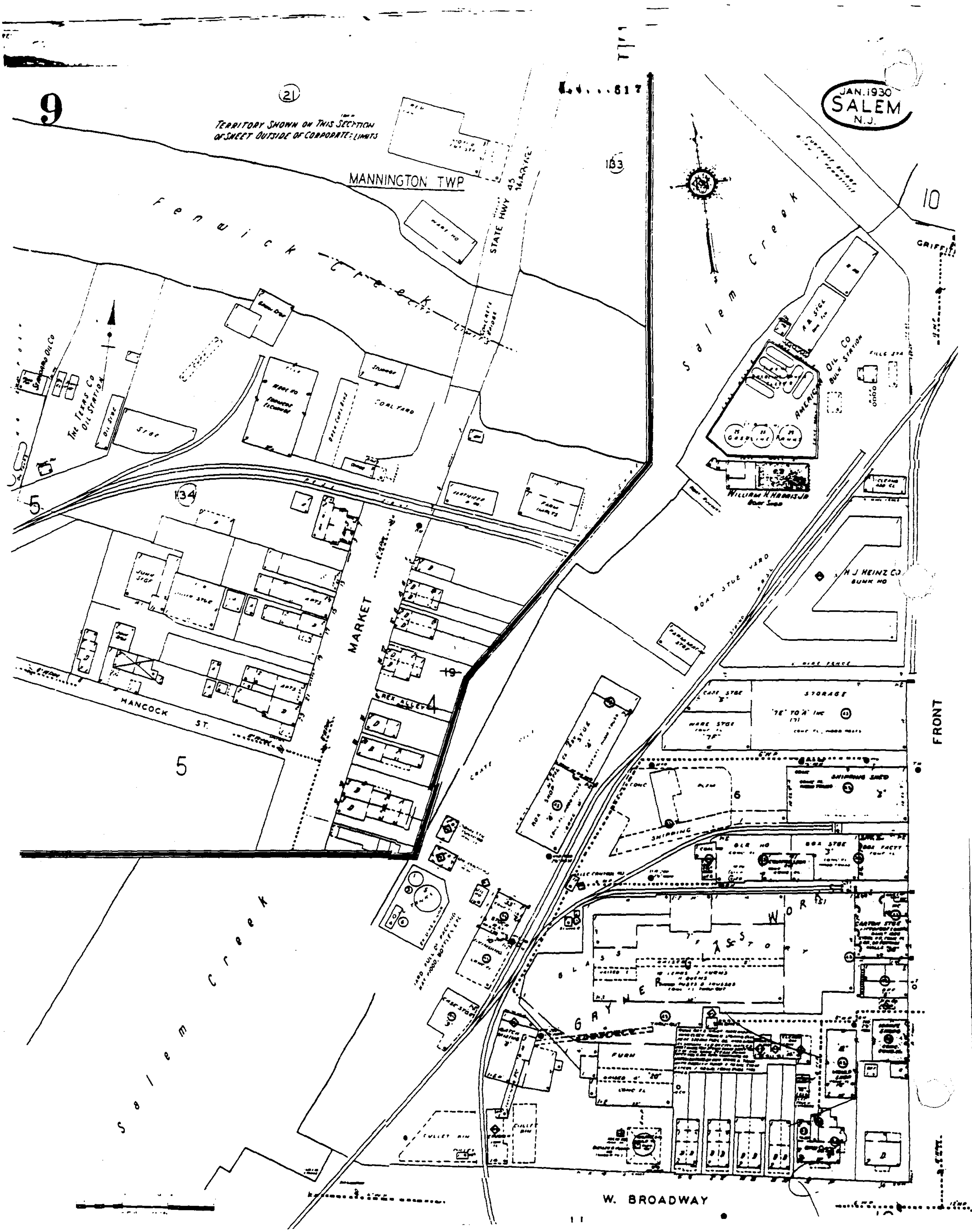
JAN. 1930
SALEM
N.J.
6
MANNINGTON TWP
MANNINGTON MILLS, INC.
MFRS FELT BASE FLOOR COVERINGS
SCALE 100 FT TO AN INCH
10
5
GRIFFITH
ST.
5TH
2
13
ANCHOR-HOCKING GLASS CORP'N
SALEM GLASS WORKS
STGE YARD
FRIENDS CEMETERY
POST OFFICE
Y.M.C.A.
1ST BAPTIST CHURCH
FILLING STA
99P

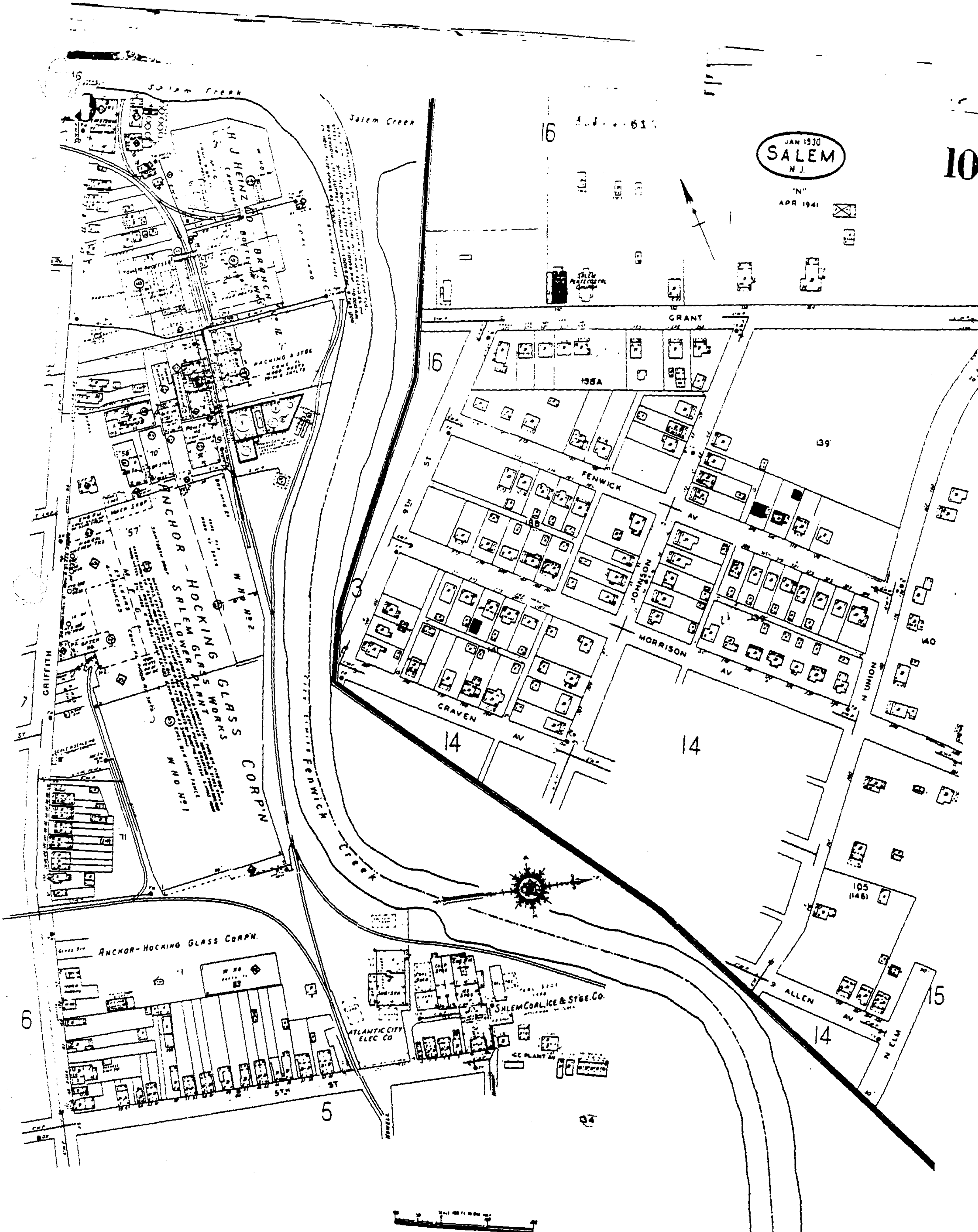
7



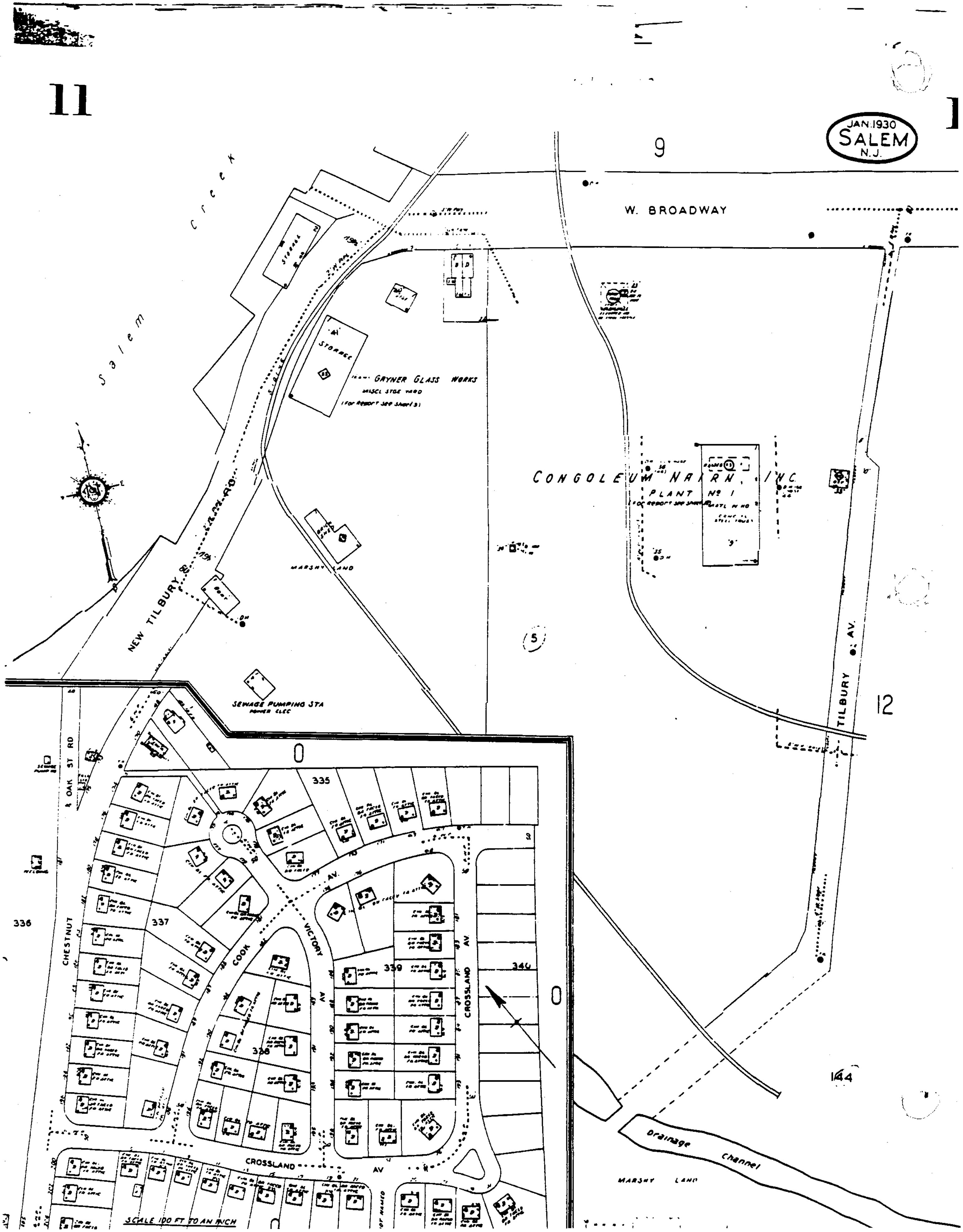
JAN. 19
SALE
N.J.
10
GRIFFITH
3RD ST ALLEY
3RD ST.
4TH ST.
ANCHOR-HOCKING GLASS CORP'N
SALEM GLASS WORKS
4TH ST PLANT
(For report see sheet No 10)
STGE
FRIENDS CEMETERY
APTS
W. BROADWAY


8
JAN. 1930
SALEM
N.J.
10
GRIFFITH
BETHANY MISSION
NORTHBEND FIRE CO
HALL'S AV.
FRONT
9
318
7
GORMAN'S ALLEY
2ND ST.
10
3RD ST.
7
3RD ST. ALLEY
W. BROADWAY
12

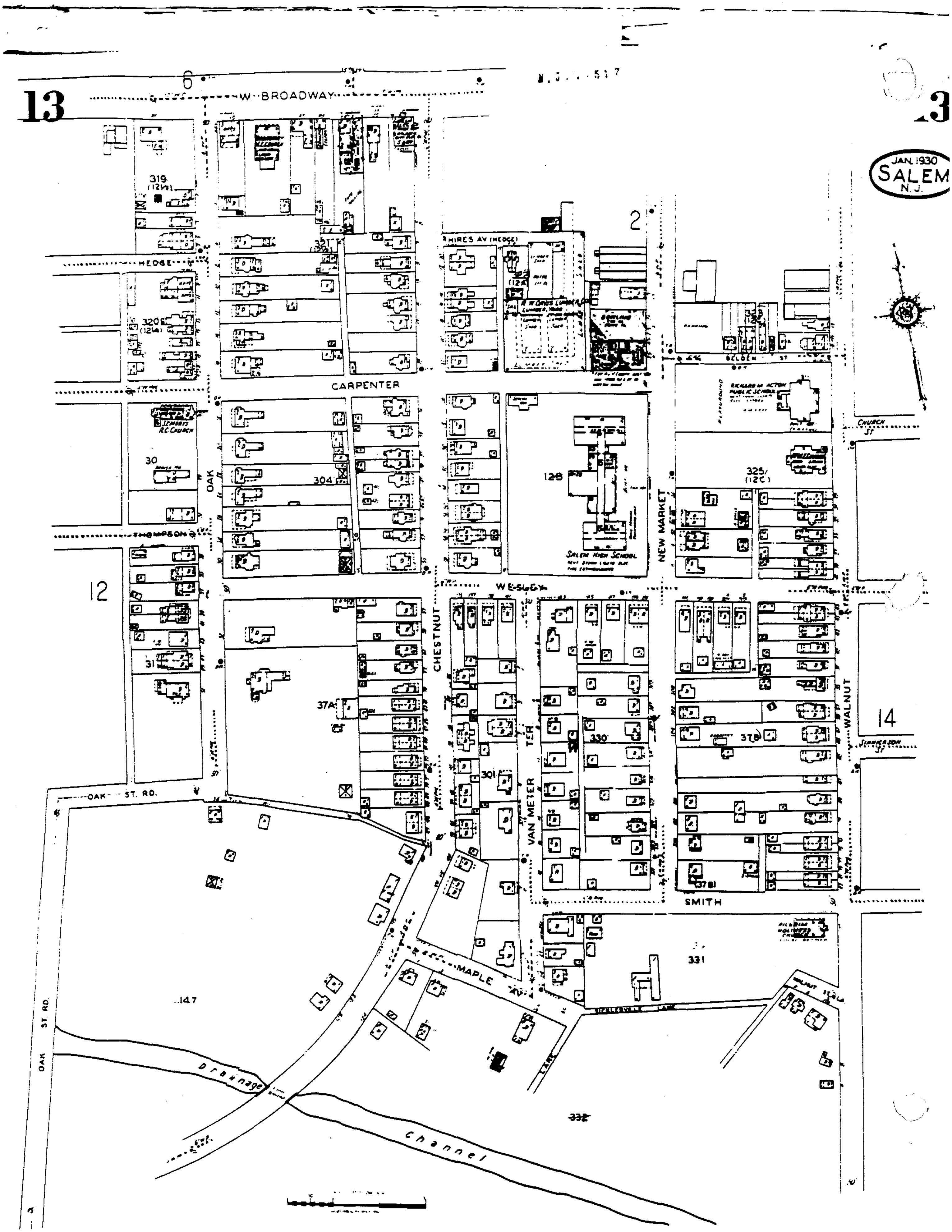

9
JAN. 1930
SALEM
N.J.
TERRITORY SHOWN ON THIS SECTION OF SHEET OUTSIDE OF CORPORATE LIMITS
MANNINGTON TWP
Fenwick Creek
STATE HWY 45
Salem Creek
10
GRIFFITH
AMERICAN OIL CO BULK STATION
WILLIAM H. HARRIS JR BOAT SHOP
H.J. HEINZ CO. BUNK HO
BOAT STGE YARD
STANDARD OIL CO
THE TEXAS CO OIL STATION
COAL YARD
FARM IMPLTS
JUNK STGE
APTS
MARKET
REX ALLEY
HANCOCK ST.
5
4
6
STORAGE
WARE STGE
SHIPPING SHED
SHIPPING
BOX FACTY
GAYNER GLASS WORKS
CULLET BIN
FRONT
W. BROADWAY



JAN 1930
SALEM
N.J.
"N"
APR 1941
10
Salem Creek
16
H J HEINZ CO BRANCH
PACKING & STGE
GRANT
16
138A
139
FENWICK
AV
9TH ST
JOHNSON
MORRISON
AV
CRAVEN
AV
N UNION
140
14
14
3
GRIFFITH
ST
7
'57'
'56'
'70'
ANCHOR-HOCKING GLASS CORP'N
SALEM LOWER PLANT
GLASS WORKS
W HO No 2
W HO No 1
71
Fenwick
Creek
105
(146)
ALLEN
AV
N ELM
15
14
ANCHOR-HOCKING GLASS CORP'N
SALEM COAL, ICE & STGE. CO.
ATLANTIC CITY ELEC CO
ICE PLANT
6
5TH
ST
5


JAN.1930
SALEM
N.J.
9
W. BROADWAY
Salem Creek
STORAGE
STORAGE
GAYNER GLASS WORKS
MISCL STGE YARD
(For Report see Sheet 3)
CONGOLEUM NAIRN, INC.
PLANT No 1
MARSHY LAND
NEW TILBURY RD
(5)
SEWAGE PUMPING STA
POWER ELEC
TILBURY AV.
12
0
335
336
337
338
339
340
0
CHESTNUT
OAK ST RD
COOK
VICTORY AV
CROSSLAND AV
CROSSLAND AV
144
Drainage Channel
MARSHY LAND
SCALE 100 FT TO AN INCH


12
JAN 1930
SALEM
N.J.
12
9
8
7
W BROADWAY
HEDGE
CARPENTER
THOMPSON
MILLER
ST.
TILBURY
AV.
CONGOLEUM NAIRN INC
PLANT No 2
144
319
27
28
29
30
320
328
31
Drainage Channel
OAK ST. RD
OAK ST. RD.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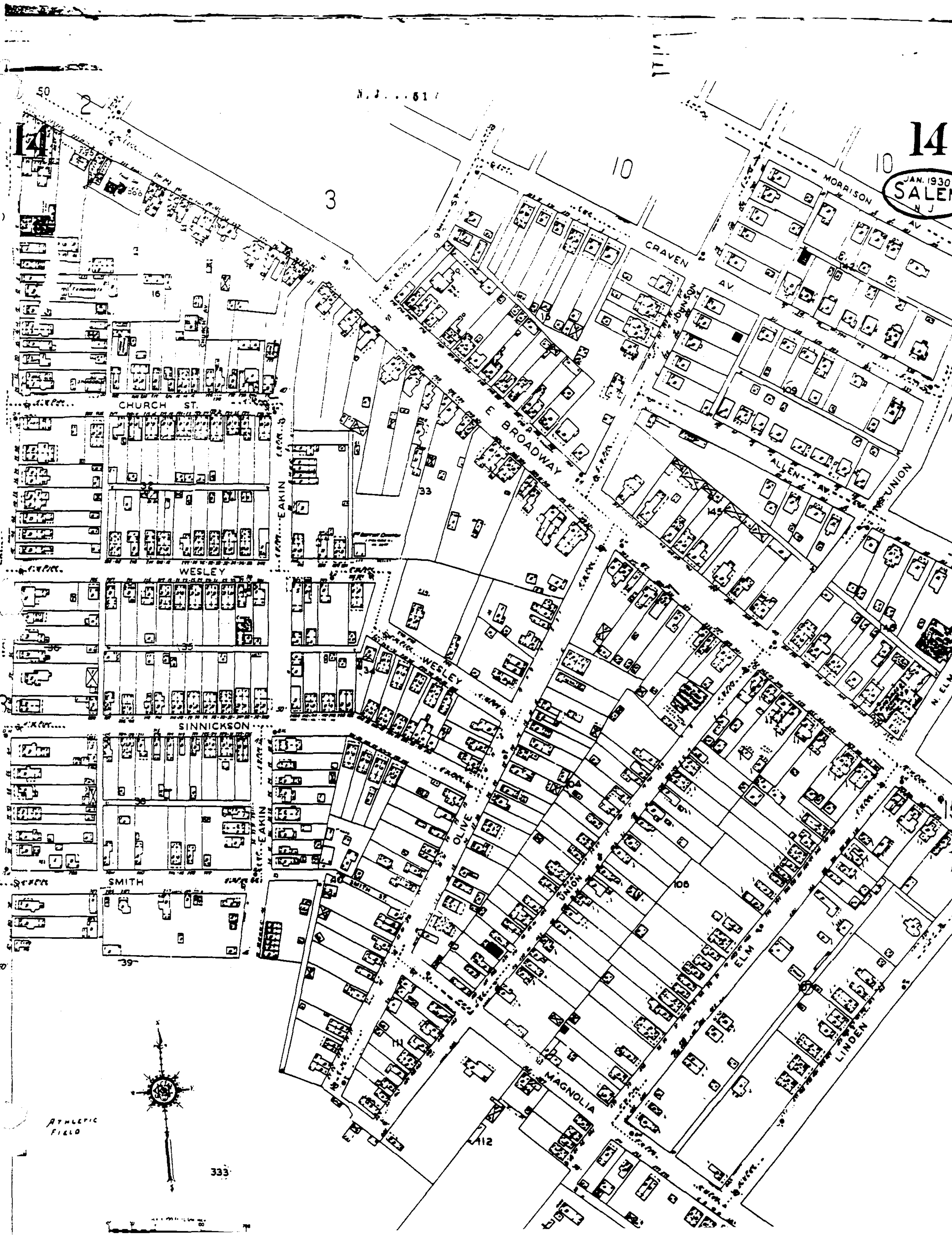
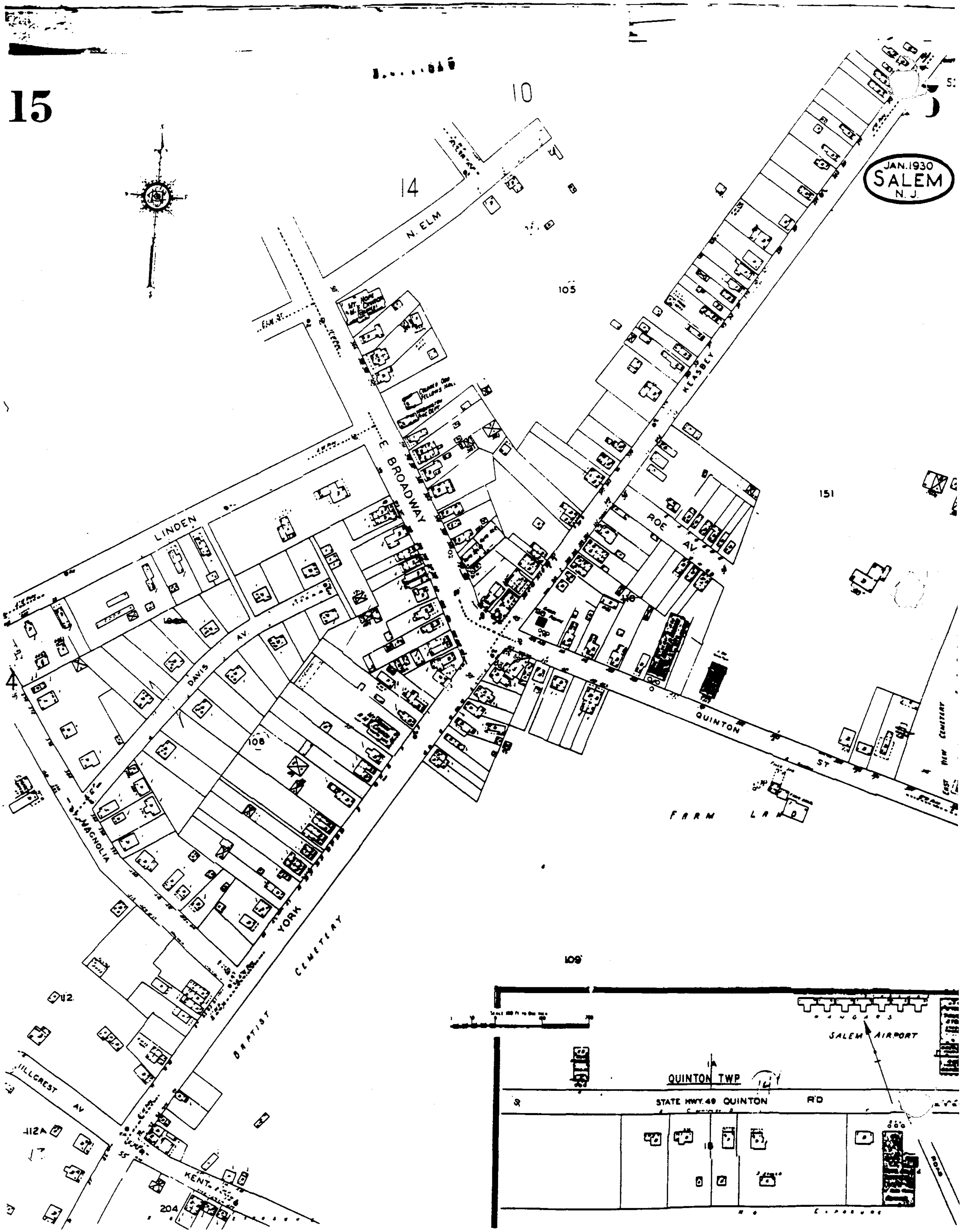
JAN. 1930
SALEM
N.J.
W. BROADWAY
HEDGE
HIRES AV (HEDGE)
CARPENTER
THOMPSON
OAK
OAK ST. RD.
CHESTNUT
WESLEY
VAN METER TER
NEW MARKET
WALNUT
SMITH
MAPLE AV
BELDEN ST
CHURCH ST
Salem High School
St. Mary's R.C. Church
Drainage
Channel
6
2
12
14
319
320
30
31
304
128
325
330
301
331
147
332
37A


14
JAN. 1930
SALEM
N J
MORRISON AV
CRAVEN AV
JOHNSON
ALLEN AV
UNION
N. ELM
E BROADWAY
CHURCH ST.
WESLEY
SINNICKSON
SMITH
EAKIN
OLIVE
SMITH ST.
ELM
LINDEN
MAGNOLIA
ATHLETIC FIELD
2
3
10
16
33
34
35
36
38
39
108
109
111
112
145
15
333


15
JAN. 1930
SALEM
N. J.
10
14
N. ELM
ELM ST.
105
E. BROADWAY
LINDEN
DAVIS AV.
KEASBEY
ROE AV.
151
QUINTON ST
FARM LAND
NEW CEMETERY
108
110
MAGNOLIA
YORK
BAPTIST CEMETERY
109
112
HILLCREST AV
112A
KENT
204
4
HANGARS
SALEM AIRPORT
QUINTON TWP
STATE HWY. 49 QUINTON RD


52
6
16
JAN 1930
SALEM
N.J.
Fenwick Creek
HUBBELL AV.
101
102
PLEDGER
4
7TH ST.
8TH ST.
201
202
103
PEARL
307
GIBBON
130
CLAYSVILLE
MANNINGTON TWP
316
MARKET ST EXTN
43
GRANT
113
114
STATE HWY. 45
10
3
317
FACTORY
BANK ST
133
303

GAI CONSULTANTS

PHASE I CULTURAL RESOURCES INVESTIGATION OF WETLAND MITIGATION AREAS SALEM RIVER NAVIGATION PROJECT, PENNSVILLE TOWNSHIP, SALEM COUNTY, NEW JERSEY

CONTRACT NUMBER DACW61-90-D-0019/0013

DRAFT REPORT

by

BENJAMIN RESNICK
JOEL S. DZODIN

U.S. ARMY CORPS OF ENGINEERS, PHILADELPHIA DISTRICT
WANAMAKER BUILDING
100 PENN SQUARE EAST
PHILADELPHIA, PENNSYLVANIA 19107

GAI CONSULTANTS, INC.
570 BEATTY ROAD
MONROEVILLE, PENNSYLVANIA 15146

GAI PROJECT 90-300-20

NOVEMBER 1992

PHASE I CULTURAL RESOURCES INVESTIGATION OF WETLAND MITIGATION AREAS SALEM RIVER NAVIGATION PROJECT, PENNSVILLE TOWNSHIP, SALEM COUNTY, NEW JERSEY

CONTRACT NUMBER DACW61-90-D-0019/0013

DRAFT REPORT

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GAI CONSULTANTS, INC.
570 BEATTY ROAD
MONROEVILLE, PENNSYLVANIA 15146

GAI PROJECT 90-300-20

NOVEMBER 1992

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TABLE OF CONTENTS
(continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF PHOTOGRAPHS

ABSTRACT

GAI Consultants, Inc., of Monroeville, Pennsylvania, has recently completed a Phase I cultural resources investigation of three parcels located within the Supawna Meadows National Wildlife Refuge, Pennsville Township, Salem County, New Jersey. These investigations were conducted for the U.S. Army Corps of Engineers, Philadelphia District, and included a literature review, pedestrian reconnaissance, and field testing in connection with the Salem River Navigation project. The project area includes the proposed creation and restoration of wetlands involving approximately 15 acres of tidal and upland areas located at the headwaters of an unnamed creek; this drainage empties into the Delaware River one mile to the southwest. Investigated portions of the project area include three spatially segregated fallow fields (upland areas), measuring approximately 9 acres, in addition to an associated nineteenth-century farm complex situated to the south of the project area.

Initially the Phase I study involved documentary research, including a review of cartographic sources, cultural resource survey reports, and site record files, as well as an on-the-ground surface inspection and excavation of shovel test pits in order to determine the potential of the project area for containing archaeological and historical remains. Background investigations suggested that both historic and prehistoric sites were located within the immediate project vicinity. Geomorphological testing of existing wetlands determined that these areas are typical of an Estuarine Type marsh, and were formed as a result of recent accumulation of sediments in stream channels and estuarine meanders. Consequently, they do not represent potentially habitable surfaces for historic or prehistoric sites.

A total of 183 systematic shovel test pits was excavated throughout the project area, resulting in the identification of three prehistoric sites (28-Sa-121 through 123) and a diffuse scatter of historic/modern artifacts. The prehistoric sites represent low-density plowzone assemblages of ceramics, lithic debitage, and tools identified in each of three respective parcels (Areas A-C). Whereas the prehistoric sites identified in Areas A and C (28-Sa-121 and 123) occurred as small, isolated artifact scatters, in contrast, subsurface testing in Area B (28-Sa-122) revealed a larger, more spatially extensive artifact distribution. The recovery of a Levanna point from Area A and a cord-marked sherd from Area B, tentatively identified as Minguannan, both suggest a Late Woodland cultural affiliation for these sites. Except for a concentration of charcoal, burned organic material, and a possible ochre fragment, no potentially significant soil anomalies or cultural features were identified.

Based on the identification of three prehistoric sites during the Phase I survey and the scheduled impacts to these areas, GAI recommends that additional Phase II archaeological investigations be conducted. Although nearly all artifacts were recovered from plowzone contexts, this does not rule out the possibility of identifying intact subsurface features at the sites. Notwithstanding the need for conducting additional research to place these sites in their appropriate chronological and functional context, based on the artifacts recovered to date it is likely that they represent a series of Late Woodland procurement camps associated with the exploitation of wetland and wetland-related resources. Goals of Phase II fieldwork include defining the sites' overall size orientation, and chronology; identifying potential areas containing intact cultural deposits; and if possible, determining the temporal and spatial patterning of activities represented [illegible] the site. Providing answers to these questions will help determine the sites' potential for inclusion in the National Register of Historic Places.

Additionally, a nineteenth-century farm complex containing a farmhouse, well, barn/ cottage, large frame barn, garage, and privy is located at the end of the dirt road, adjacent to and south of the project area. Based on the architectural qualities of the farmhouse (Vernacular, five-bay, I-house) and large frame barn, in conjunction with its association with Samuel Urion, a prominent local public servant, the farm complex is considered potentially eligible for nomination to the National Register of Historic Places. If at a later date any of the farm buildings or associated grounds are to be impacted, a Phase I archaeological survey and additional architectural research is highly recommended.

INTRODUCTION

The following report summarizes a Phase I cultural resources investigation of three parcels located within the Supawna Meadows National Wildlife Refuge, Pennsville Township, Salem County, New Jersey (Figure 1). The study area measures approximately 15 acres and consists of tidal (6.4 acres) and upland (9 acres) areas, located south of Lighthouse Road and west of Fort Mott Road. This study was undertaken by GAI Consultants, Inc., of Monroeville, Pennsylvania for the U.S. Army Corps of Engineers, Philadelphia District, in connection with the Salem River Navigation project. The proposed project calls for the mitigation of shallow and wetland areas lost as a result of improvements to the Salem River channel. The study areas are located at the headwaters of an unnamed creek that empties into the Delaware River a little over one mile to the southwest. The subject of this study includes three fallow fields comprising upland areas, which are scheduled to be transformed into estuarine intertidal emergent wetlands, and an associated nineteenth-century farm complex situated to their south. Goals of the Phase I study were to identify all prehistoric, historic, and historic architectural remains within project areas, and to evaluate, if possible, their potential eligibility for nomination to the National Register of Historic Places.

In order to meet the above objectives, the Phase I study consisted of background research and field testing. The background study included a review of cartographic sources, cultural resource survey reports, and site record files at the Office of New Jersey Heritage, Department of Environmental Protection; the New Jersey State Museum; and New Jersey State Library, Trenton, New Jersey. In addition, all pertinent information including historical maps and county histories were reviewed at the Salem County Historical Society in Salem, New Jersey. Moreover, important information regarding the history of the farm complex was provided by Robert C. Butcher, Salem County Historian. Field investigations included a pedestrian reconnaissance of the entire project area and the excavation of shovel test pits throughout the three fallow fields.

Results of the background study indicate that both prehistoric and historic sites have been documented in the immediate project area vicinity. Moreover, the location of well-drained landforms adjacent to wetlands and in proximity to the Delaware River suggests that there is a high potential for locating prehistoric sites within the project area. Historically, this area was settled as early as the seventeenth century, and given the location of the farm complex, indicates the potential for identifying additional historic archaeological and architectural resources.

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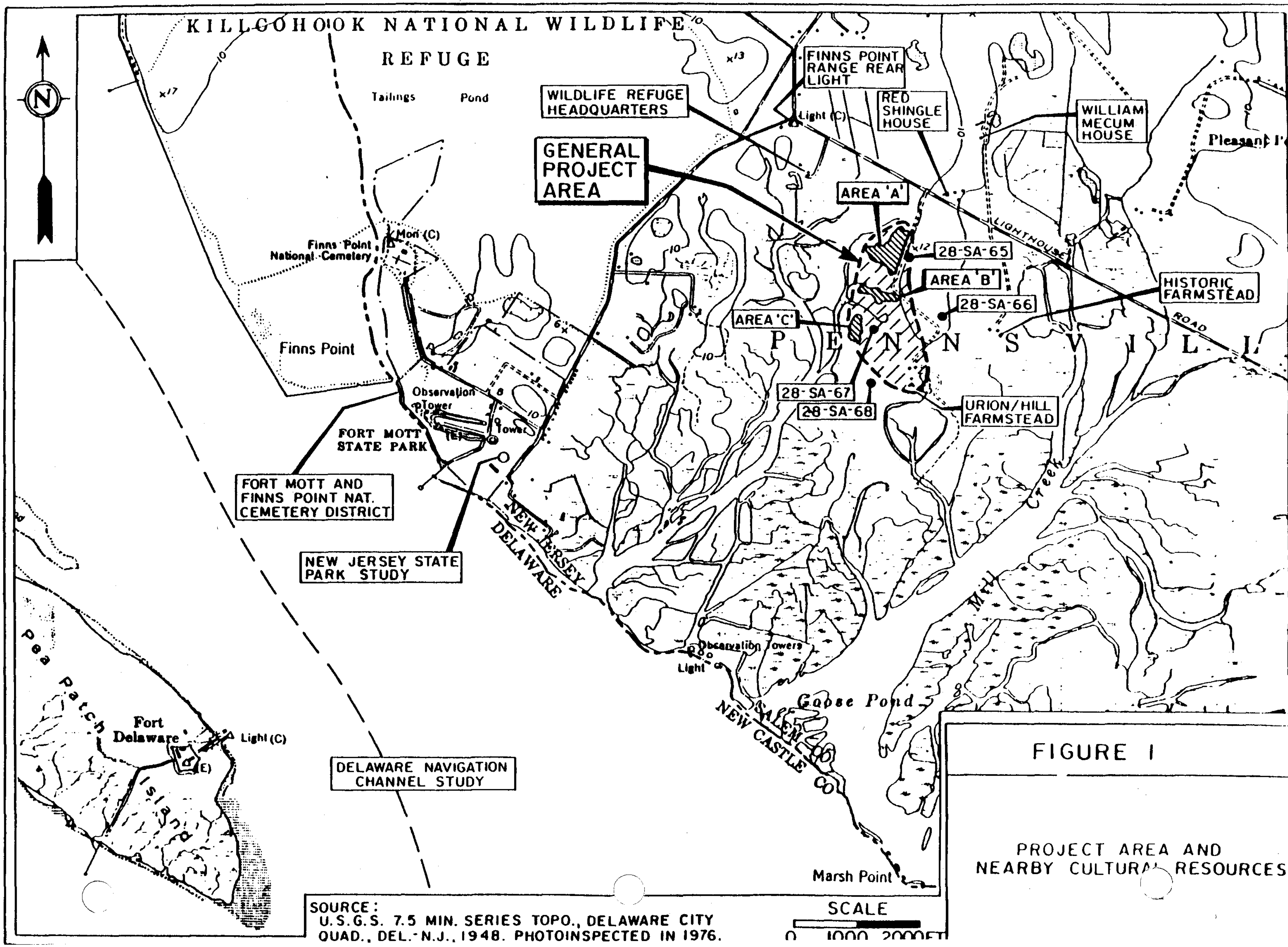


SOURCE:
U.S.G.S. 7.5 MIN. SERIES TOPO., DELAWARE CITY QUAD., DEL.-N.J., 1948. PHOTOINSPECTED IN 1976.

FIGURE 1

PROJECT AREA AND NEARBY CULTURAL RESOURCES

A total of 183 shovel test pits was excavated during Phase I fieldwork, which resulted in the identification of three prehistoric sites in as many parcels (28-Sa-121 through 123, i.e., Areas A-C). This includes the recovery of low-density scatters of ceramics, lithics, and tools from primarily plowzone contexts. Whereas Areas A and C (28-Sa-121 and 123) revealed a light scatter of prehistoric artifacts, Area B (28-Sa-122) yielded a larger, more concentrated artifact distribution. Diagnostic artifacts recovered from Areas A and B; i.e., a Levanna point, and a cord-marked sherd tentatively identified as Minguannan, respectively, indicate a Late Woodland affiliation. Although additional Phase II archaeological research is necessary to place the site in its appropriate chronological and functional context, based on the artifacts recovered to date, it is likely that these sites represent a series of procurement camps associated with the exploitation of wetland and wetland-related resources. Except for a concentration of charcoal, burned organic material, and a possible ochre fragment, no potentially significant soil anomalies or cultural features were identified. Additionally, a nineteenth-century farm complex, located at the southern end of the project area, was also documented during Phase I fieldwork; based on the architectural qualities of the farmhouse and barn and their association with a prominent local public servant, the farmstead is considered potentially eligible to the National Register of Historic Places.

All work conducted conforms to the letter and spirit of the National Historic Preservation Act of 1966, as amended, the regulations of the Advisory Council on Historic Preservation (36 CFR 800), the National Environmental Policy Act of 1969, as amended, and Corps of Engineers regulations pertaining to Section 106 compliance. In addition, all work complies with the *Guidelines for Archaeological Investigations* established by the Office of New Jersey Heritage (McCarthy 1984; amended by the Office of New Jersey Heritage 12/10/90), and the Department of Interior's Standards and Guidelines for Archaeology and Historic Preservation (1983).

The following sections present, successively, the environmental setting of the project area; a prehistoric and historical overview; results of background research; methods and results of archaeological testing; and conclusions and recommendations.

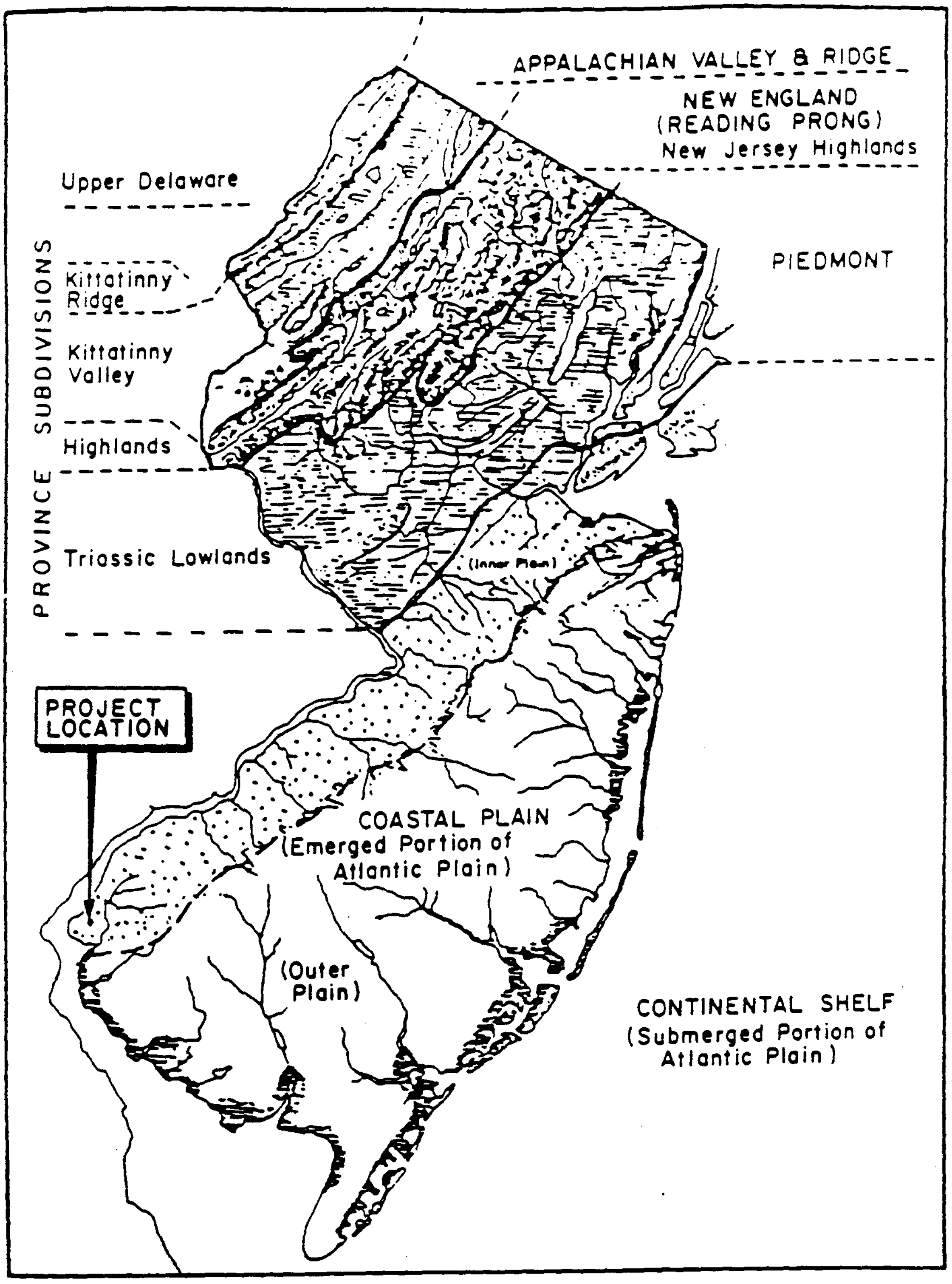
ENVIRONMENTAL SETTING

PHYSIOGRAPHY

The project area is situated in Salem County within the Inner Plain of the Coastal Plain Physiographic Province of New Jersey (Figure 2). The Coastal Plain, which extends from Cape Cod to Mexico, comprises approximately 60 percent of the total land area within the state and generally ranges from sea level to approximately 400 feet above sea level (Robichaud and Buell 1973). The Inner Coastal Plain contains sedimentary deposits composed of unconsolidated sands, clays, marls, and gravels several hundred feet in thickness which date to the Cretaceous Period (136 to 65 million years ago). These deposits contain overlying patches of sand and gravel that date to Pleistocene interglacial times.

The Inner Coastal Plain stretches from Long Island Sound to northeastern Virginia and forms the boundary between the Coastal Plain and Piedmont physiographic provinces (Thornbury 1965; Wolfe 1977). In New Jersey, it occupies a 15-mile wide area along the Delaware River that extends from Raritan Bay in the north to Salem County to the southwest. It is dissected to a much greater extent than the Outer Coastal Plain. Cuestas, or sloping uplands form the geological boundary between the state's Inner and Outer Coastal Plain, and as such create a division between the Atlantic and Delaware watersheds. Specifically, cuestas represent areas of more resistant sediments, as compared to the softer sediments of the Coastal Plain. The level to gently rolling topography of the Inner Coastal Plain is related to the erosion of unconsolidated sediments which trend toward the southeast. These sediments have their origin in both marine and nonmarine environments, and demonstrate a series of invasions and transgressions by the sea. The terrain within the Inner Coastal Plain varies in elevation from the tidewater to approximately 50 feet above mean sea level. Within the project area, elevation ranges from sea level to approximately 12 feet above mean sea level.

Although no portion of the project area was ever covered by Pleistocene ice sheets, it has been profoundly affected by the presence and subsequent movement of glacial ice in areas to the north. Pleistocene environments would have been significantly colder and wetter than the present Holocene environment (Carbone 1976; Custer 1984a:31). Lowering of the world sea levels approximately 40,000 years ago resulted in the exposure of the continental shelf for a distance of 75-100 kilometers from the present shoreline. Interglacial periods resulted in the deposition of Pleistocene "yellow gravels," which now cap older unconsolidated sediments throughout various areas of the Coastal Plain. A dramatic shift in climate occurred at the end of the Pleistocene as the Laurentide ice sheet retreated farther to the north. With the onset of the Holocene Epoch (10,000 years ago), the climate of the Middle Atlantic region became both warmer and drier. Rising ocean levels, and the encroachment of salt-water tolerant species and tidal marshes have restricted human settlement along the Delaware River and Bay shore. Estimates



Not to Scale

FIGURE 2

PHYSIOGRAPHIC PROVINCES OF NEW JERSEY

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of changing sea level have been placed at two feet per year for the retreating of barrier islands toward the New Jersey mainland (Robichaud and Buell 1973:283; Wolfe 1977:277,287,306-309). In addition, erosion of coastal areas has to some extent been hastened by the construction of man-made jetties during the mid-twentieth century.

A number of broad estuaries have been formed by the drowning of the lower course of the Delaware River after the Pleistocene. Submergence has broken the Inner Plain into a number of peninsular tracks separated by broad estuaries (Thornbury 1965). The bedrock of the Inner Plain, close to the Piedmont, near the heads of the Potomac, Chesapeake, and Delaware estuaries, consists of the lower Cretaceous Raritan Formation and Potomac Group of clays, sands and gravels. (Thornbury 1965; Walker and Coleman 1987). During the late Pleistocene the Delaware, Susquehanna, and other northeastern streams were fed with glacial meltwater and sediments. These rivers also entrenched themselves as sea level lowered and developed glaciofluvial terraces (Walker and Coleman 1987). In addition, geologically ephemeral streams developed on the newly exposed surfaces. Substantial amounts of outwash added to the Delaware River and subsequent cycles of erosion have resulted in the formation of several Pleistocene terraces (Peltier 1959; Flint 1971). The Pennsauken Formation, thought by some to be of Cretaceous age (Jablonski 1972), has been described as being of Illinoian age by Flint (1971). At Philadelphia, the Illinoian terrace occurs at 18 m above mean sea level. A late Wisconsinan terrace occurs at 6 m above mean sea level and a Holocene terrace occurs at 3 m above mean sea level.

Loess deposits have been identified in the northeast United States adjacent to major rivers. Thin loess deposits in New Jersey were derived from glacial sediments carried by the Delaware River (Foss et al. 1978). Loess deposits occur along the eastern side of Chesapeake Bay into the lower Eastern Shore of Maryland, as evidenced by the extensive occurrences of Mattapex and other silty soils. During deposition of loess, local sands are apparently mixed into the silty materials by wind action and by faunal pedoturbation. Foss and others (1978) identified a buried A horizon beneath the loess (radio-carbon dated to 10520 + 240 YBP) approximately 37 miles (60 kilometers) southeast of the current study area. Thus, the loess deposition dates to the beginning of the Holocene.

HYDROLOGY

The study areas are located at the headwaters of an unnamed tidal creek which empties into the Delaware River, approximately one mile to the southwest. Extensive tidal marshes covered in phragmites are located adjacent to the project areas and between these locations and the Delaware River (Figure 1). Other prominent drainages include Mill Creek, which is located less than one mile to the southeast of the project area. Historically, significant portions of this region were in cultivation owing to banking and the construction of ditches, but through natural processes have since been reclaimed by marshland.

SOILS

According to the USDA soil survey for Salem County, soils mapped within the project area include Mattapex silt loam (MqA) and Tidal Marsh (Tm) (Figure 3) (Powley 1969). The upland Mattapex soils are formed in a silty loess mantle overlying partially weathered beds of coarse sediments. Tidal Marsh soils are mostly organic matter and alluvial silts over beds of sand, clay or gravel.

In order to characterize the soils within the project area, test borings were conducted by GAI Staff Soil Scientist David L. Cremeens, Ph.D., on September 16, 1992. Project area soils were observed to a depth of one meter below the surface using a stainless steel hand-held probe; representative soil profile descriptions for typical upland and Tidal Marsh soils in Area A are outlined in Appendix A.

GAI's pedological testing indicates that the upland soil profile of Area A resembles the Mattapex series described in the Salem County Soil Survey (Powley 1969). This profile consists of a 77-centimeter (cm) thick mantle of silty loess underlain by a loamy textured material. Low chroma mottles at 62 cm indicate that this soil is moderately well drained, similar to the Mattapex series. In downslope portions of Area A, loamy and sandier textured soils occur at shallower depths indicating that the loess mantle is thinner downslope, probably as a result of erosion due to cultivation. Alternatively, it may indicate thinner loess deposition than on the ridgetop. The mottles also occurred at shallower depths in these downslope locations, as the soils graded to somewhat poorly and poorly drained as exemplified by the Othello Series (Powley 1969).

A similar pattern of upland soils was observed in Areas B and C. In low-lying portions of Area B, the silty mantle of loess was over 100 cm thick. The drainage characteristics were of a moderately-well drained soil but silt loam textures occurred throughout the core sample; this is interpreted as indicating the presence of a gully or stream channel that developed prior to the loess deposition.

Tidal Marsh soils were identified in Area A and exhibited a thin layer of black peat or peaty silt overlying a poorly drained, weakly developed mineral soil. The mineral soil had a loam A horizon overlying a gray sandy loam to a sand Cg horizon, which extended to depths exceeding 100 cm. Water was encountered between 70 and 80 cm below the surface. The Tidal Marsh soils in Area C contained Oi and A horizons with occasional thin silt bands, probably resulting from upslope cultivation. The C horizon occasionally had thin bands of clay loam.

Based on the above descriptions, GAI concludes that the landscape at the project area is similar to the low salinity Estuarine Type marsh as described by Darmody and Foss (1979). Estuarine Type marshes were formed as a result of recent accumulation of sediments in stream channels and estuarine meanders. The uplands associated with the marsh consist of the

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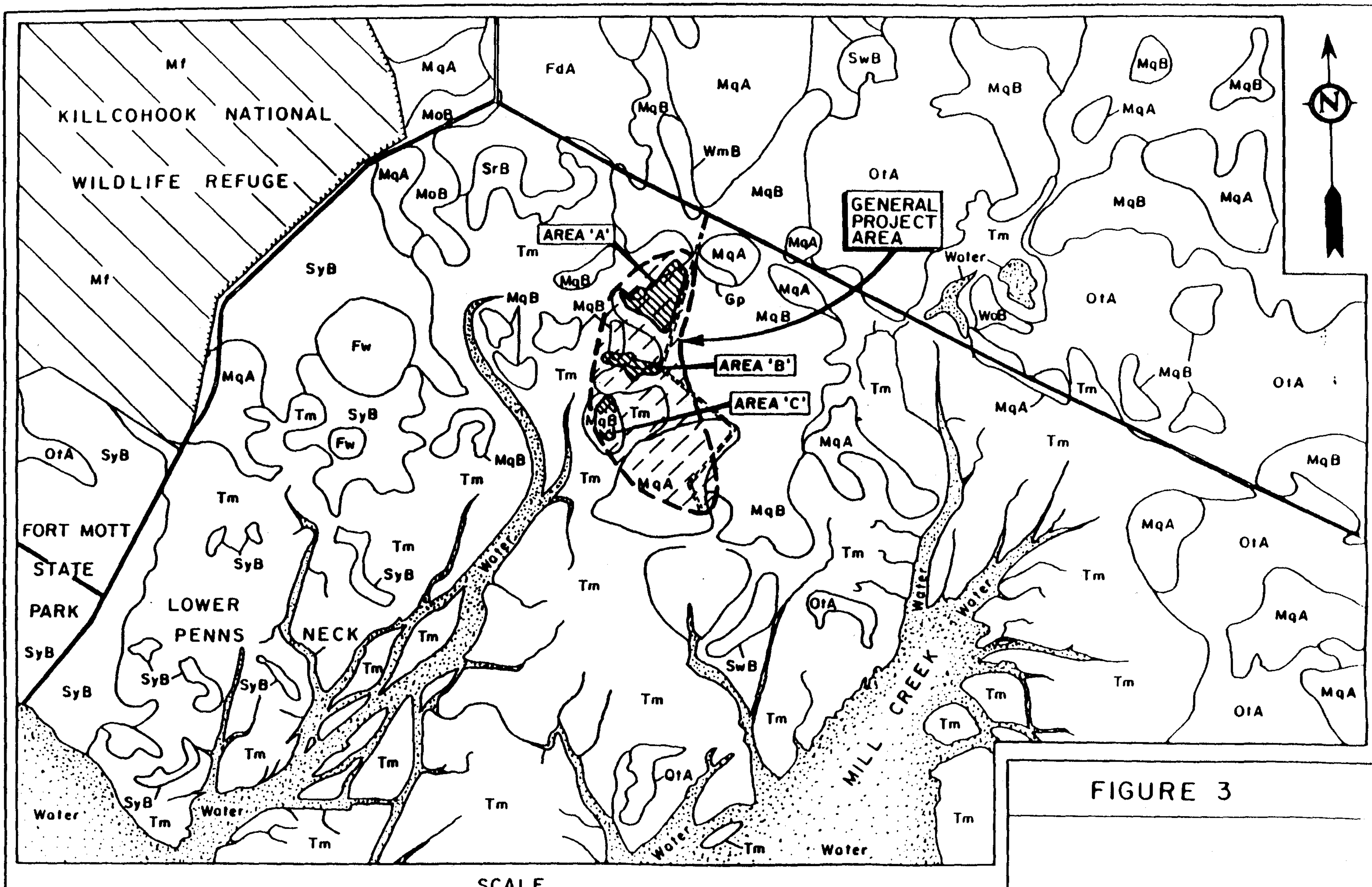

SOURCE:
VAN R. POWLEY, 1969, SHEETS 13, 14, 20 & 27.

FIGURE 3

PROJECT AREA SOILS

Mattapex soils with an oak-hickory forest cover. Cultivation of these silty soils accelerated the accumulation of sediments in the streams and estuarine meanders.

The upland landscape in the project area is a late Pleistocene/early Holocene geomorphic surface. Early Holocene loess was deposited on a late Wisconsinan terrace surface (Peltier 1959; Flint 1971; Foss et al. 1978). The materials comprising the late Wisconsinan terrace may be glacial outwash or the eroded and weathered Cretaceous sediments of the Inner Coastal Plain. According to Ciolkosz et al. (1989), Coastal Plain soils show a progressive profile development from the youngest (30 ka) to the oldest (>1Ma) soils. The sediments in the Tidal Marsh areas are probably younger than early Holocene and some of them may date to the historic period.

VEGETATION

Boreal forest communities typified the region during the Pleistocene Epoch (10,000 to 2 million years ago), but were gradually replaced by deciduous climax species during the early Holocene. Wolfe (1977:173) estimates that between about 9,500 and 5,750 years ago, oak, hemlock, and beech became the dominant tree species throughout New Jersey, replacing the earlier fir- and spruce-dominated parkland. During the prehistoric and early historic periods, the Inner Coastal Plain of New Jersey was typified by a mixed oak forest community containing chestnut, hickory, and pine. The region was abundant in highly diverse aquatic and terrestrial biota and biomass including, in part, deer, turkey, muskrats, beavers, waterfowl, snakes, and a variety of fish.

Originally, all of Salem County except for tidal marshes was covered in forests (Powley 1969:40). The present tree environment of Salem County, where loamy, fertile soils predominate, may include various hardwoods such as oaks, chestnut, yellow poplar, hickory, beech and red cedar. In other portions of the county where soils are sandier, drier, and less fertile, pitch pine mixed with oak, short-leaf pine, chestnut, and hickory are more common. The dominant trees in swampy areas include Atlantic white cedar, red maple, blackgum, and sweetbay magnolia. Wetland areas are presently dominated by monotypic stands of phragmites within the project vicinity. Wildlife include various types of birds and mammals that frequent wetlands, such as ducks, herons, shore birds, muskrats, and beavers, in addition to white-tailed deer, cottontail rabbits, red foxes, squirrels, and raccoons.

CLIMATE

The present climate of Salem County may be classified as humid and temperate (Powley 1969:82-84); it is strongly affected by coastal factors and the Appalachian Mountains situated to the west. Summer temperatures range into the low to mid- 80s (Fahrenheit). Winter temperatures do not often go into the single digits, and the snow in winter is usually thin; as a result, soils are seldom frozen for long periods. The average temperature in January is 24 degrees. Precipitation is relatively well distributed throughout the year with the average being about 40 inches. Rainfall is heaviest during the summer months of July and August, and often comes in the form of thunderstorms. Coastal storms, together with abnormally high tides, are responsible for flooding low areas along the Delaware Bay, Delaware River, and its tributaries. Heavy rainfall, in conjunction with sandy soils in the area, accounts for periodic erosion and flooding. Wind erosion is at its worst in March, when the wind velocity can approach 15 to more than 25 miles per hour.

CULTURAL SETTING

CULTURE HISTORY

The following section provides an overview of the prehistory of southern New Jersey and the history of Salem County and the project area, and is intended to serve as background for the development of expectations for site locations within the project area. As such, this discussion focuses more on settlement/subsistence patterns for the various periods of New Jersey prehistory than on material culture.

Paleoindian Period (ca. 12,000 to 8,000 B.P.)

The Paleoindian period begins when humans first entered North America and ends with the shift from Pleistocene glacial conditions to the warmer Holocene climate. Radiocarbon dates recorded at Meadowcroft Rockshelter in western Pennsylvania have conservatively placed the site occupation between 10,600 to 12,000 years ago (Adovasio et al. 1990); the occupation of the Shawnee-Minisink site in eastern Pennsylvania has been placed between 10,000 to 11,000 years ago (McNett 1985). While the exact date of human entry into the New World remains obscure, it is generally agreed that people arrived from Asia via the Bering land bridge, exposed as a result of Pleistocene glaciation. The relative paucity of known sites from this period probably results from both a low Paleoindian population density and from the submergence of once-inhabited coastlines during the last 12,000 years (Kraft 1977).

Paleoindian populations subsisted in highly mobile bands of hunters and gatherers who inhabited major river valleys and utilized cryptocrystalline lithic materials for most of their stone tools. Cryptocrystallines are an extremely fine-grained material that provide a high degree of "plasticity" in tool manufacture, maintenance, and recycling (Goodyear 1979:5). As such, their use by Paleoindian hunters involved a strategy of recycling lithic resources in areas of limited availability (Goodyear 1979; Custer 1984a).

Paleoindians have traditionally been viewed as having subsisted on a mixed regimen of Pleistocene megafauna, such as mastodon, sloth, moose, and giant beaver, and on gathering. Most interpretations of the tool kits of the Paleoindians posit an orientation toward the procurement and processing of these faunal resources. Recent evaluations of the evidence for this type of subsistence base have suggested a more generalized hunting and gathering economy (e.g., Meltzer 1988). Investigations at the Shawnee-Minisink Site indicate the procurement and processing of seeds, berries and fish reflecting seasonally based procurement activities (McNett 1985). The Turkey Swamp site near Freehold, New Jersey is associated with various activities that included hunting, tool manufacturing, butchering, wood and/or bone working, and cooking (Cavallo 1981).

Although Paleoindian sites were first identified in the western plains area of the United States, greater quantities of fluted Paleoindian projectile points have been recovered from areas in the Midwest and Southeast (Jennings 1978:27; Hand et al. 1988). Numerous early Paleoindian Clovis points have been recovered below the glacial margin near the Ohio River, especially in Kentucky, Alabama, and Georgia (Dragoo 1976:9; Hand et al. 1988:12).

Gardner (1974, 1977) has defined a functional site typology for Paleoindian settlement in western Virginia; his categories include quarry sites, lithic reduction stations, base camps, base camp maintenance stations, outlying hunting sites, and isolated point finds. A high degree of seasonality would have been associated with hunting sites and base camps, due to the seasonal fluctuation of edible resources and the concomitant changes in carrying capacity of a given location throughout the year.

Over 200 fluted points have been recovered throughout New Jersey, 15 percent of which have been collected within the Inner Coastal Plain (Marshall 1982:31). As of 1982, 22 fluted points reported for the state were recovered in Salem County (>10%), several of which were recovered in proximity to the Salem River; the majority of these artifacts are surface finds (Barber 1979:234-235 and Kraft 1977:267, as cited in Marshall 1982:25-32). More than 70 percent of the total assemblage of New Jersey Paleoindian points are made of jasper, which is followed in frequency by black chert, gray chert, quartz, and quartzite.

Archaic Period (ca. 10,000 to 3,000 B.P.)

The Archaic period in eastern North America is generally associated with a series of adaptations to newly emerging Holocene conditions, which occurred at the end of the Pleistocene glaciation. It was marked by a rise in sea level with concomitant changes in flora and fauna. The rise in sea level resulted in the raising of the local water table, which in turn stimulated the creation of numerous large swamps in interior areas. The shift from relatively drier and colder conditions during Paleoindian times to a warmer and wetter climate during the Archaic period resulted in the reduction of open grassland areas and the florescence of mesic forests of oak and hemlock. These radically altered conditions led to extinction of many grassland fauna and to their replacement by browsing species, such as deer (Custer and Cunningham 1986:16). Cultural changes gradually occurred as groups began to adapt to the newly emerged Holocene environment. These adaptations included changes in the scheduling of seasonal resource extraction in response to the existence of a more diversified resource base.

The presence of a more generalized Archaic artifact assemblage is representative of a shift from the Paleoindian emphasis on the hunting of megafauna to a reliance on more diverse faunal and floral species. The recovery of grinding stones, mortars, and pestles from Archaic sites all point to an increased emphasis on the exploitation of vegetal resources during this period.

Archaic period settlement probably involved a highly mobile lifestyle as bands moved across a wide range of environmental settings in pursuit of seasonally restricted resources. A functional typology for Archaic sites proposed by Gardner and Custer (1978) identifies three types of Archaic settlement: macroband base camps (representing habitations of multiple family units in areas of maximum overlap of adjacent microenvironments); microband base camps (representing smaller habitations of individual family units or a restricted number of families in areas near adjacent microenvironments possessing lower carrying capacities); and procurement sites (short-term habitations involved in the extraction of resources from source locations) (Gardner 1978; Custer 1979, 1980, 1984b). The size and temporal duration of these occupations are directly related to the range and abundance of exploitable resources in a given area. In general, New Jersey Archaic sites tend to be small, suggesting short-term and intermittent occupations (Mounier 1982:73).

Alan Mounier (1979) has recovered a variety of Archaic projectile points along the drainage divide to the north in nearby Gloucester County. In fact, many of the drainages in the general region of the project area contain evidence of Archaic period settlement (Kraft and Mounier 1982). The excavation of the Harry's Farm site, located north of Tocks Island in the Delaware River Valley, resulted in the recovery of charcoal and a Kirk Stemmed point from a hearth feature located in the subsoil (Kraft 1975, as cited in MAAR 1987:20). This and other similar sites in the region may represent the movement of small bands of hunter-gatherers from the southeastern United States.

Late Archaic sites are considerably more common than Early Archaic sites in the region. This is most likely a result of environmental changes which led to larger population aggregations and more permanent settlements, especially in association with wetlands and waterways. Overall, sites from this period tend to be small, suggesting short-term and intermittent occupations, and include those related to the procurement of local terrestrial and aquatic resources. The Late Archaic period is represented by a variety of stemmed projectile types, including narrow-bladed and broad-bladed forms. Late Archaic lithic technology is characterized by intense utilization of argillite, which was rarely used by earlier populations who preferred cryptocrystalline stone material. The end of the Archaic period, sometimes referred to as the Transitional period, is represented by the appearance of soapstone bowls and fishtail points. One of more prominent Late Archaic sites excavated in New Jersey is the Savich Farm site located near Marlton in Burlington County, northeast of the project area. This site represents a Late Archaic cemetery containing the remains of more than 50 cremated skeletons with associated grave goods, including Lehigh and Koens-Crispin points, atlatl weights, and adze-like tools (Regensburg 1971; Pinelands Commission 1980:89). Radiocarbon dates place this site circa 4300 to 3900 B.P.

Woodland Period (ca. 3,000 B.P. to A.D. 1700)

The Woodland period is traditionally associated with the appearance of ceramics. The introduction of ceramics in the Early Woodland, circa 3,000-2,400 B.P., however, does not necessarily represent a break with the lifeway patterns established during the Archaic. Hunting, gathering, and fishing appear to have concentrated on high-yield species, such as deer, nuts, and anadromous fish, characteristic of subsistence specialization. Early Woodland groups similarly exploited riverine and coastal areas (e.g., bayside marshes), and may also have experimented with Native American cultigens. The Coastal Plain offered a variety of exploitable estuarine and marine resources. Although no burial mounds have been identified in New Jersey, an Early Woodland site, the Rosenkrans site in Sussex County, yielded the remains of 13 cremated and uncremated skeletal remains along with copper and shell artifacts (Kraft 1976;26, as cited in MAAR 1987:22).

Middle Woodland cultures, circa 2,500 B.P. to A.D. 700, are characterized by increasing sedentism and social complexity, reflected in long-distance trade, mortuary ceremonialism, and mound building. During this period, net-impressed pottery replaced the earlier cord-marked variety. Artifacts diagnostic of this period include processing tools such as hammerstones, anvilstones, and pestles, and netsinkers reflecting the exploitation of fish.

Archaeological evidence from the Early and Middle Woodland in New Jersey appears to support Kinsey's (1974) hypothesis that states that, during this period, subsistence patterns involved a spring-through-fall occupation of floodplains and shorelines by large groups, in addition to a winter occupation of inland rock shelters (Gimigliano et al. 1980: III-4). Many Woodland sites have been found along the tributaries of the Delaware River. Among the best examples are the Pedricktown Site situated in Salem County north of the project area; the Kimble site on Rancocas Creek and the Florence site, both of which are located in Burlington County to the northeast of the project area; and the Unami Camp sites on Pennsauken Creek, which are located along the boundary of Camden and Burlington Counties north of the project area (Gimigliano et al. 1980: III-5).

The Raccoon Point site, located along the Delaware River in adjacent Gloucester County, represents an intensive Early and Middle Woodland occupation. A number of activities were featured at the site, including fish procurement, and the production of pottery and stone tools (Kier and Calverly 1957; Williams and Thomas 1982:119-120). According to the site analysis, there was an early pottery tradition consisting of the manufacture of steatite-tempered ceramics. Other recovered artifacts include net sinkers, hammerstones, gorges, drills, bolas, stones, pit features, and projectile points. The site was used as both a fishing station and for shellfish gathering and processing.

The Late Woodland period, circa A.D. 700 to A.D. 1700, is characterized by the appearance of large villages (some of which are fortified) and a greater emphasis on farming. The most prominent Late Woodland sites are situated along major waterways, and presumably represent base camps. The investment in larger, more permanent agricultural processing and storage facilities near the point of production and consumption resulted in a greater degree of sedentism than was required during earlier periods. Increasing population growth and density led to efforts to intensify agricultural production (Custer 1986). In addition to the above, sites of this period also tend to cluster along river systems and coastal areas, apparently functioning as temporary or seasonal extractive camps. Late Woodland populations in southern New Jersey probably comprised several relatively small bands composed of related families that occupied recognized territories (Mounier 1982:159). Although there are many similarities among Middle and Late Woodland tool kits, differences exist in several artifact classes (MAAR 1987:24). Projectile points dating to the Late Woodland period lack stems and are composed of either equilateral or isosceles triangular points made of chert, mainly for use with the bow and arrow. Moreover, ceramic vessel collars at this stage become more prominent and incised geometric designs more dominant.

Contact period settlement in the vicinity of the Delaware River area shows a preference for aquatic resources, with the greatest frequency of sites occurring in the Outer Coastal Plain (Kraft and Mounier 1982:168). At the time of European contact, the project area was inhabited by various Lenape groups (renamed Delaware) who were characterized linguistically as southern Unami or Algonquian speakers (Goddard 1978:214-215). In terms of their artifacts and settlement patterns, the Delaware were quite similar to the Iroquois. The Delaware consisted generally of loosely structured autonomous bands living in small, dispersed settlements (Kraft 1974:32; Goddard 1978:215). During the seventeenth century, a subgroup of the Delawares known as the Little Siconese were distributed in the area at the headwaters of Salem Creek, northeast of the project area. Moreover, a Minguannan community was located across the Delaware River less than 20 miles (32 kilometers) from the project area.

Archaeological evidence of the Contact period in New Jersey includes village sites such as the Abbott Farm National Landmark District located north of the project area near Trenton; and the National Register of Historic Places Salisbury site. Both of these sites have components dating between A.D. 1600-1700 (Williams and Kardas 1982). Historical records also indicate that additional villages were situated along the Delaware River and its tributaries. By the end of the Contact period, the Native American population was decimated as a result of European diseases and increased warfare. By 1758, the few remaining Delawares in the state, numbering several hundred, were placed on the Brotherton Reservation at Indian Mills, located in Shamong Township in the Pinelands (Pinelands Commission 1980:103). Unfortunately, evidence of this site has yet to be identified.

HISTORICAL OVERVIEW

The proposed project is located in the over-2,000-acre Supawna Meadows National Wildlife Refuge, Pennsville Township, Salem County, New Jersey. Salem County is bordered by the Delaware River to the south and west, and Gloucester County and Cumberland County to the north and east. Swedish settlers, expanding their control of Delaware Bay from Wilmington (est. 1638), were among the first Europeans to inhabit the Salem area. Nearby Fort Elfsborg was established at present-day Elsinboro Point in 1648, several miles south of the project area. The region later came under the control of the Dutch in New Amsterdam in 1655. After the Dutch defeat in 1664, the area became part of the British colony of West Jersey (Thompson and Dickey 1984:6).

It is probable that the first European settlement in the immediate project vicinity was established by Finnish settlers who crossed to the New Jersey side of the Delaware River from New Sweden in circa 1660-1661 (Harper 1978:27). The Finns had previously arrived in Delaware (near present-day Wilmington) with Peter Minuit, founder of New Sweden, and were looking to escape Swedish persecution. Finnish settlers were attracted to the area's fertile farmlands and the transportation access afforded by creeks and the nearby Delaware River. Their success in establishing communities in the region is attested by such place names as Finns Point and the Finnish River located just west and northwest of the project area, respectively. During this time, landholdings acquired a characteristic pattern with long narrow tracts extending from riverbank to riverbank.

A small group of Englishman from New Haven, Connecticut, established a settlement, the New Haven Colony, as early as 1641 along the Salem River. The first permanent settlement in the county and the first permanent English speaking colony in the Delaware Valley, however, was established at Salem by Quakers headed by John Fenwick in 1675 (Cushing and Sheppard 1883:316-321). Fenwick was the first settler to negotiate a peace treaty with the local Indians, which was ratified in the shade of a giant oak tree known as the Salem Oak. The Salem Oak still stands in the Friends' Burial Ground, within the Broadway Historic District in downtown Salem.

Salem County was created in 1682 and became a legal port of entry for the colony of West Jersey; it was ranked in importance with Boston and New York. The colony grew slowly, however, in part due to competition from settlers among contemporary colonies in Pennsylvania, East Jersey, and the town of Burlington, which is located to Salem's north. Fenwick's poor relationship with other proprietors and his insistence on establishing manorial propriety in an age of popular opposition to feudalism may have contributed to the slow growth of the colony (Thompson and Dickey 1984: 8).

Furthermore, many of the original owners of the town lots had also purchased land in the country and moved to a number of dispersed rural settlements to raise families and practice farming.

Despite its slow growth, the town of Salem was incorporated in 1695 (Cushing and Sheppard 1883: 377). Its shipping industry, based on the wharves along Market Street, expanded throughout the next century. Shipments were received from Philadelphia, New York, Boston and the Caribbean. Merchants specialized in the sale of dry goods, groceries, provisions, household goods, and liquors, including New England rum, applejack, sherry wine, and aniseed cordial (Cushing and Sheppard 1883: 383). Shortly after the Revolutionary War, a ferry service was established between Market Street and the Delaware River shore. The City of Salem continued to serve as an important depot for imports as well as an outlet for the county's agricultural and manufactured products until the late nineteenth century.

In 1820, Col. Robert Johnson, a life-long resident of Market Street, introduced the growing of tomatoes, which became one of the county's staple crops. The success of the tomato crop was largely due to the sandy soils in the region. Johnson, who is considered the father of the tomato industry in the state, also began the county's first agricultural and horticultural society in 1826. By the late nineteenth century, Salem supported extensive factories devoted exclusively to the canning of tomatoes. One of these was the Fogg and Hires Canhouse, which operated in Pennsville from 1887-1925 (Blakely 1991:4).

Shipbuilding has been an important component of the Salem economy since the seventeenth century. Shipbuilding activities have been documented along the Delaware River by Swedish settlers in 1644 and by English settlers during the 1670s and 1680s. There were four commercial shipyards in operation along the Delaware River by 1700. Several family shipyards were responsible for producing the majority of vessels in the Delaware Valley during the early eighteenth century. In the nineteenth century Delaware River shipyards were prominent in the production of iron-hulled vessels. During the Civil War at least 36 naval vessels were constructed at Delaware Valley yards (Cox 1988: 6-7).

The earliest Euro-American shipping in the Delaware River/Bay was associated with the seventeenth-century fur trade. During the eighteenth century, trade became integrated into a more complex colonial and international system. With the rise of Philadelphia as the major commercial port by 1772, smaller ports along the Delaware River, like Salem, declined. As a result, Salem became almost exclusively engaged in ferrying goods between Philadelphia and other New Jersey ports. Regular steamboat service reached Salem during the nineteenth century. Most of Salem's waterborne trade was connected with Philadelphia and was associated with the Pennsylvania Railroad (Cox

1988: 7-8). The first railroad to reach Salem, the Woodstown-Salem Railroad, was laid in 1890 (Salem County Historical Society 1991: personal communication).

The project area is located in Lower Penns Neck, which along with Upper Penns Neck was originally part of the township known as West Fenwick (Everts and Stewart 1876:78-79). The name was changed circa 1721 to honor William Penn, one of the proprietary management members of Fenwick's Salem Colony. Historically, this area contained some of the finest marsh meadows and cattle in the county, and by the late nineteenth century contained over 100 farms. Lower Penns Neck is bounded on the north by Upper Penns Neck, on the west by the Delaware River, and on the east and south by the Salem River. In 1965 the name of Lower Penn's Neck was changed to Pennsville, following its principal town located several miles north of the project area.

Given its location, it is easy to see that water played an important part in the history of Pennsville Township. A ferry operated from the town of Pennsville to New Castle, Delaware, from the time of its founding until 1951, when the Delaware Memorial Bridge was constructed (Blakely 1991:3). Present-day Route 49 was in use by 1810 following the completion of the Penn's Neck Bridge. Until that time, it was necessary to take a ferry into downtown Salem. Although originally conceived in 1800, the Deepwater or Salem Canal, extending from the Salem River to Delaware River in the northern portion of the township, was not completed until 1872. Its original purpose was to provide farmers with an east-west route to transport their crops to such places as Wilmington, Delaware; Baltimore, Maryland; and Philadelphia, Pennsylvania. However, by the time of its completion, other more efficient modes of transportation were available, including the railroad; consequently, the canal was never used to its fullest extent. During the nineteenth and early twentieth century, fishing was an important part of the local economy. The predominant species were sturgeon and shad, with the latter providing caviar which was cured and packed for market.

As early as the late eighteenth century, farmers in the area of Pennsville Township cultivated the valuable meadows or marshlands located along the Delaware River. Marshlands were a valuable source of hay and pasture. Whereas the higher elevations provided freshwater marsh grasses for grazing cattle, salt hay was used for packing and bedding. The method of diking and draining lands for cultivation began following the enacting of legislation which permitted local farmers to incorporate "meadow companies" in order to reclaim area swamps. Each affected farmer was assessed a fee for the construction and maintenance of dikes (banks) and sluice gates (ditches). Over 70 "meadow bank companies" were eventually located in Salem County , the earliest established in 1794. These companies managed to reclaim thousands of acres of swampland. Meadow bank farming continued until the 1930s when the banks began to wash out owing to heavy rains and high tides. Due to the great expense of maintaining the banks and the lack of qualified laborers, bank companies went out of business and the banks were never rebuilt. Consequently, wetlands eventually inundated the former fields and settlements as well as the roads which led to them (Widmer 1964:138-139; Heite and Heite 1986b; Butcher 1992).

In addition to the above, it should be mentioned that a U.S. government battery was planned at Finns Point as early as 1870, west of the project area. Although construction of the batteries began in 1875, it was not until 1896, during the Spanish-American War, that the construction of the existing gun emplacements and associated buildings was begun. The system of defensive earthworks came to be known as Fort Mott, and was part of a master planned defense of the Delaware River that included Fort Delaware, located on nearby Pea Patch Island, and Fort DuPont, located on the Delaware mainland. Fort Mott was decommissioned after World War II. It should be noted that Fort Delaware served as a prisoner of war camp for confederate soldiers during the Civil War. Over 2,000 Confederate soldiers are buried at Finns Point National Cemetery located just north of Fort Mott.

RESULTS OF BACKGROUND RESEARCH

ARCHAEOLOGICAL SITES

Although Skinner and Schrabisch (1913:58-59) and Spier (1915:94) do not make any specific reference to Mill Creek or the project area, they do note the location of several village sites bordering Salem Cove in Lower Penns Neck, situated several miles to the north and south of the study area. Additionally, it is noted generally that many artifacts were reported from the Salem vicinity and that "several hatchets" had been recovered from the bottom of Salem Creek. Cross (1941) corroborates this information as she depicts many sites located along Salem Creek several miles east/southeast of the project area.

As a result of a more recent cultural resources investigation (Heite & Heite 1986a), four archaeological sites were previously recorded on the grounds of the Supawna Meadows National Wildlife Refuge in the immediate vicinity of the project area (Figure 1). Site 28-Sa-67 consists of a scatter of historic trash, including a rim fragment of an eighteenth-century white saltglaze stoneware platter, a pearlware ceramic sherd, six redware ceramics, a mold-blown purplish glass bottle neck, and two green free-blown glass fragments. Site 28-Sa-65 represents the location of a demolished nineteenth-century house located adjacent and east of Area A, on the opposite side of the dirt farm road. Artifacts recovered in this area include nineteenth-century glass and pearlware, stoneware, and redware ceramics, a button, and a chert prehistoric core. Although this general area was resurveyed during Phase I fieldwork, the only evidence identifying the site was a small brick scatter. Another identified trash scatter, Site 28-SA-66, contains white earthenware, pearlware, and redware ceramics, glass fragments, and three prehistoric ceramics. Additionally, a probable Woodland camp site containing prehistoric ceramics and a red chert flake (Site 28-SA-68) was also identified to the project area's south. Historic/modern artifacts were also recovered at this location, including a pipestem fragment, a piece of pink dressed stone, and several redware and whiteware ceramics (Heite & Heite 1986a). Two additional cultural loci in this general vicinity include an isolated chert triangular projectile point and six prehistoric ceramics, a fragment of a retouched flake tool, six redware sherds, one modern flowerpot fragment, and one cream-colored earthenware sherd, located south of farmstead complex on the edge of the wetlands (Heite & Heite 1986a).

Based in part on the work of Stewart and Cavallo (1983), environmental settings which are associated with the location of Late Archaic through Late Woodland sites in the Inner Coastal Plain include: (1) river and marsh associations; (2) junctions of rivers with streams; (3) association of marsh with second or higher order streams; (4) junctions of first or higher order streams; (5) junctions of second or higher order streams with extinct or seasonal drainage patterns; (6) high quality lithic resources; (7) drainage headwaters, including springheads; and (8) drainage divides associated with active or extinct drainage heads. The project area's proximity to wetlands, and the Delaware River and its tributaries indicate that this region would have provided an array of potentially exploitable resources to prehistoric groups, primarily those dating to the Archaic and Woodland periods. This is supported by the documentation of several prehistoric sites in the immediate project vicinity.

HISTORICAL

Examination of the files at the Office of New Jersey Heritage and New Jersey State Museum indicates that there are two sites listed on the National Register of Historic Places located within one mile of the project area (Figure 1): Fort Mott and Finn's Point National Cemetery Historic District and Finn's Point Rear Range Light (both listed in 1978).

Fort Mott is located on the Delaware River at Finn's Point, six miles from Salem and a little over one mile southwest of the project area. The federal government acquired the land on which Fort Mott is presently situated from John C. Mason in 1838. As early as 1870, a fort was planned at this location to complement the construction of Forts Dupont and Delaware for protecting the mouth of the Delaware River (Chidley 1977a).

Construction of a permanent battery at the site began in 1872 and was completed in 1878. As a result of the impending Spanish-American War, the fort was redesigned in 1896, attaining its present form. Fort Mott was named for Major General Gersham Mott, a Burlington, New Jersey native and veteran of the Mexican and Civil Wars. The fort had a regular garrison until 1922, and a caretaker contingent until 1943. The State of New Jersey acquired Fort Mott in 1947 and opened it as a state park four years later (Chidley 1977a).

Fort Mott represents a fine example of a period fortification complex exhibiting early poured concrete construction. The fort consists of a series of batteries laid out along a longitudinal axis. It is surrounded on two sides and along the front by an earthen rampart capped by a cement parapet under which are ammunition magazines and a power plant. Other features include a pill box southeast of the main battery, a calculating room, chief's battery station, observation stand, gun fire control towers, parados, moat, main ammunition magazine, headquarters building (a two-story, 1890 Greek Revival structure), ordinance building, and officers quarters.

In 1863 two acres of the Fort Mott property were set aside for use as a cemetery for confederate prisoners who had died while interned at nearby Fort Delaware. Presently, Finn's Point National Cemetery contains the graves of 2,436 Confederate, 165 Union, and 144 other soldiers. As such, it represents the largest Confederate cemetery in the North.

The cemetery complex contains a Confederate Monument, Union Monument, and a circa 1920 caretaker's house (Chidley 1977a).

Finn's Point Rear Range Light, erected in 1876-77 by the Kellogg Bridge Company, is composed of a wrought iron skeletal tower (115 feet high) resting on a masonry foundation. The tower consists of a platform reached by a cast iron spiral staircase enclosed by a wrought iron cylinder. A small, round room, which once served as the light apparatus, is situated on top of the cylinder and platform. This light, originally a fixed beacon kerosene-vapor light, was operated in conjunction with a shorter front range light 1.4 miles to the south. The lighthouse is unusual because of its wrought iron construction and its status as a rear range light. The lighthouse was restored in 1983 and is now part of the Supawna Meadows National Wildlife Refuge (Chidley 1977b; Taylor 1986).

In addition to the above, there is a total of 10 structures that were recorded as part of the New Jersey Historic Site Inventory within approximately one mile of the project area (Figure 1). The Isaac Johnson House, located southeast of the project area, is a frame, two-story Vernacular/Federal residence built in two stages during the early eighteenth and early nineteenth century. The William Mecum House, located north/northeast of the project area, is a brick, two-story, Vernacular Georgian style residence, originally constructed in 1737 as a one-story, gambrel-roofed structure. A second story and addition were added in the late eighteenth century. The Cornelius Copner House, located north/northeast of the project area, consists of a brick, two-story Vernacular residence, built in 1740. The Red Shingle House, located directly across Lighthouse Road, is a frame, two-story Vernacular house, originally constructed in 1780.

Additional unnamed historic structures in the vicinity of the project area include a frame, two-story Vernacular square plan house, constructed in the late nineteenth century; a frame, two-story, Vernacular L-plan house, built in the mid-nineteenth century; two adjacent frame, cross-gabeled, two-story Vernacular square plan double houses, constructed in the mid-nineteenth century; a frame, two-story, Vernacular L-plan turn-of-the-century house; a frame, two-story late nineteenth-century Vernacular L-plan house; and a brick, three-story, three bay, Vernacular Greek Revival I-house, constructed in the mid-nineteenth century.

Cartographic Data

Several historic maps were examined for information concerning the history of land use and potential for locating historical sites within the project area. The earliest identified map of the area was Stansbie and Keiley's 1849 A Map of the Counties of Salem and Gloucester, New Jersey (Figure 4). This rendition indicates that the two major roads in the project vicinity, Fort Mott Road to the west and Lighthouse Road to the north, were already present in their current alignment by this time. In addition, the

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FIGURE 4

PROJECT AREA AND VICINITY, 1849

SOURCE:
STANSBIE, A.C., J. KEILEY & S.M. REA, A MAP OF THE COUNTIES OF SALEM AND GLOUCESTER, NEW JERSEY. SMITH & WISTER, 1849, PHILADELPHIA.

dirt farm access road extending south from Lighthouse Road and crossing through the project area had also achieved its present form by this period. Three unidentified structures are depicted along this road in proximity to the three tested parcels; one is located adjacent to the northeastern section of the project area, east of the road, and two are clustered adjacent to the project area's south, at the apparent terminus of the road. A road is depicted between the project area and the Delaware River shore, extending across Baldridge's and Mill Creeks, undoubtedly to exploit the rich meadows for the cultivation of salt hay.

The 1861 Lake and Beers *Map of the Vicinity of Philadelphia and Camden* (Figure 5) depicts two of the aforementioned structures. It assigns the southernmost occupation, known as "Pleasant Hill," to "S. Urion." This structure is associated with the existing nineteenth-century farmstead located adjacent to the southern portion of the project area. "A.B", assigned to the structure to the project area's northeast, appears to be the location of Site 28-Sa-65, a demolished nineteenth-century house and trash scatter recorded by Heite and Heite (1986a), directly east of Area A. "A.B." may possibly represent another property belonging to "A. Bilderback" who is associated with a structure located a short distance east of the project tract. By this period, meadows or marshland occupies only a narrow strip directly along the Delaware River waterfront, which attests to the success of the many meadow bank companies in operation by this time.

Information provided by Robert Butcher, Salem County Historian, suggests that Samuel Urion ("S. Urion") (1818-1884) occupied the farmstead referred to as Pleasant Hill directly south of the project area. Urion was a single farmer in 1850 with land holdings of $14,000. He was later married to Elisha Wheaton and had an adopted daughter, Rebecca S. Dunham. Samuel Urion was very active in local politics serving several posts during the mid to late nineteenth century, including Freeholder (1854-55), Justice of the Peace (1869-1883), member of the Lower Penn's Neck Township Committee (1869-1877), and Commissioner of Appeal (1872-1877). Upon his death his farmstead passed to his wife, Sarah, who continued to manage the farm until sometime after 1900.

The 1876 Everts and Stewart *Combination Atlas Map of Salem and Gloucester Counties, New Jersey* (Figure 6) refers to Samuel Urion's property as "S. Drion" and is said to number 274 acres. Although the above referenced "A.B." structure is no longer present by this period, three additional structures are situated directly west of the project area. Similar to the 1861 Lake and Beers map, the 1876 rendition depicts marshland only along the Delaware River waterfront.

By 1904, the dirt farm road traversing the project area had joined a network of roads leading to the lighthouse, situated along the northern Delaware River shore to the

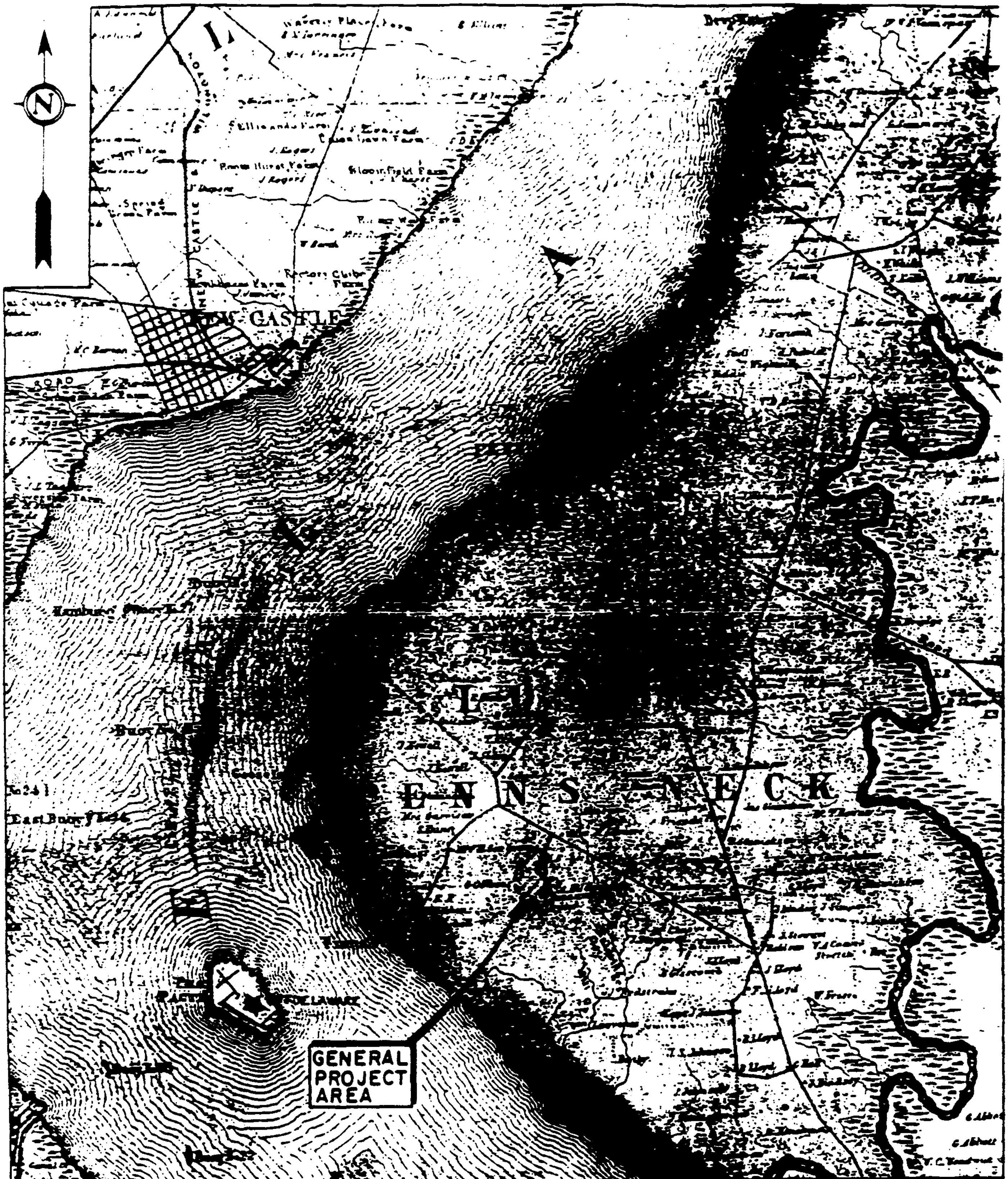

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FIGURE 5

PROJECT AREA AND VICINITY, 1861

SOURCE:
D. J. LAKE AND S.N. BEERS, MAP OF THE

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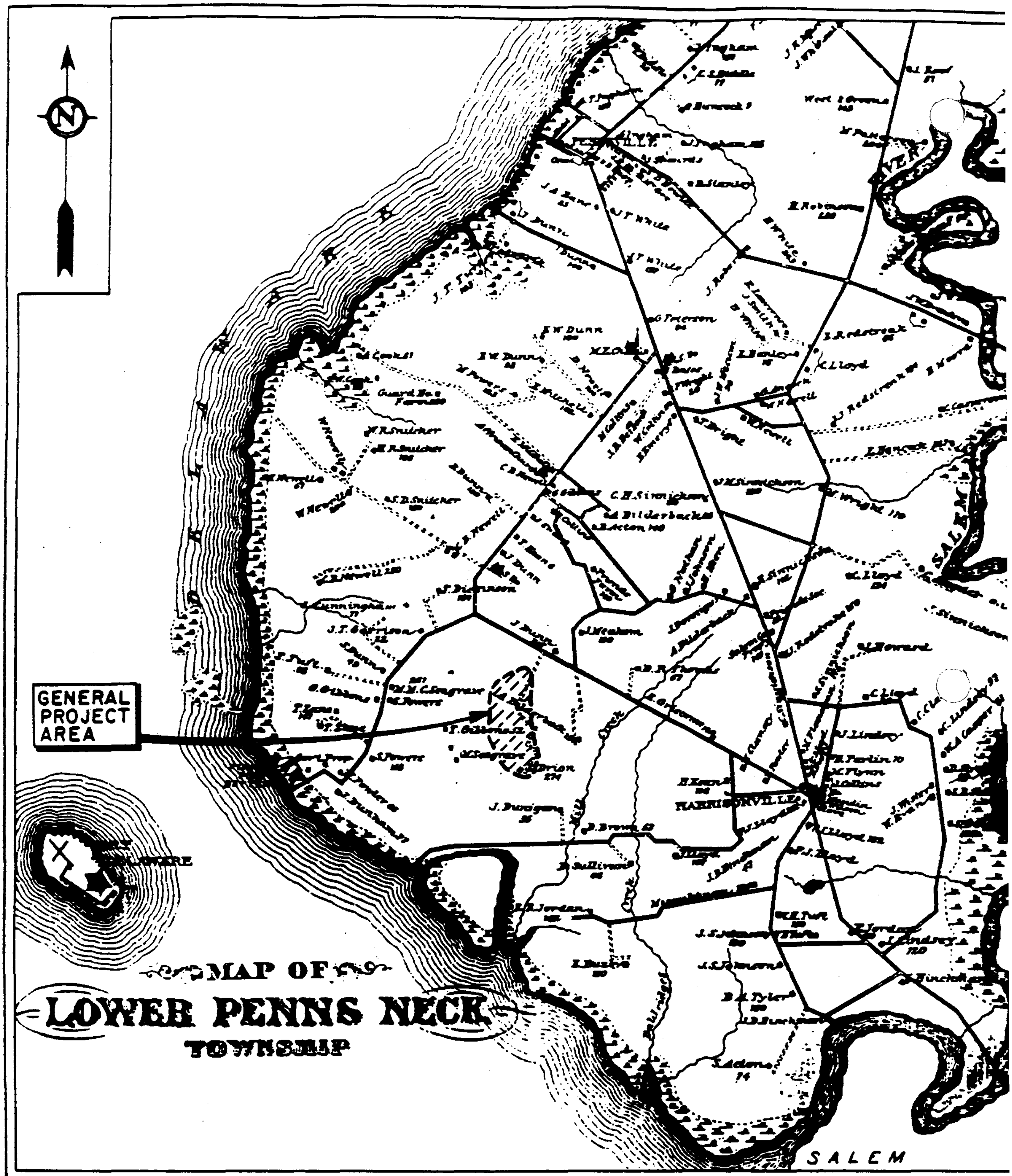

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FIGURE 6

PROJECT AREA AND VICINITY, 1876

SOURCE:
EVERTS & STEWART, COMBINATION ATLAS MAP OF SALEM AND GLOUCESTER COUNTIES, NEW JERSEY. EVERTS & STEWERT. 1876. PHILADELPHIA.

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project area's south (Figure 7). This map also provides clues to the recession of the marshland as it depicts an extensive network of ditches and banks used to drain the area for cultivation. This system of "meadow banking" resulted in the eventual reclaiming of several thousands of acres of swampland for agricultural purposes.

A comparison of the 1904 and 1951 USGS quadrangles reveals the extensive areas south of the project tract that had been inundated by the mid-twentieth century, especially along Mill Creek (Figures 7 and 8). As noted earlier, this was a direct consequence of the "washing out" of the meadow banks during the 1930s and the subsequent flooding of former fields, roads, and settlements. A close inspection of the 1951 USGS quadrangle clearly indicates the remnants of the roads and ditches which once drained this general area. By 1970, the extent of the marshland had significantly been increased in this location owing, in part, to the growth of phragmites (Figure 1).

PREVIOUS ARCHAEOLOGICAL RESEARCH

Five previous archaeological surveys have been undertaken in proximity to the project area (Figure 1). These include the following: *Stage I Cultural Resource Survey for Proposed Sanitary Facilities in Seven New Jersey State Parks* (Rotsch & Morrell 1979); *Preliminary Cultural Resource Reconnaissance Investigation in connection with Comprehensive Navigation Study, Delaware River, Delaware and New Jersey* (Heite & Heite 1986a); *Cultural Resource Investigation at New Cut, Salem River, in Connection with Proposed Dredging of Salem River, City of Salem, Elsinsboro Township, and Pennsville Township, Salem County, New Jersey* (Heite & Heite 1986b); *Submerged Cultural Resources Investigations, Delaware River, Main Navigational Channel, Philadelphia, PA. to Artificial Island, NJ.* (Cox 1988); and *Phase II Underwater Archaeological Testing of Anomaly SR 01, Salem River, Salem County, New Jersey, Final Report* (Irion 1992). The limited examination of Fort Mott State Park involved a background study of site files, historic maps, and early histories of Salem County. Conclusions of the study are limited and suggest only that the area of Fort Mott was bordered by a wetland environment to its southeast and occupied a higher level in the past than at present.

As previously noted, the Delaware River navigation study (Heite & Heite 1986a) resulted in the identification of several archaeological sites located within the immediate vicinity of the project area, on the grounds of the Supawna Meadows National Wildlife Refuge. The project encompassed thirteen proposed disposal areas along the Delaware River, and generally involved pedestrian, windshield, and aerial surveys. The New Cut proposed dredge disposal project encompassed a boat and pedestrian reconnaissance, as well as shovel testing. Although no significant cultural resources were identified, the high ground of the island created by the New Cut was concluded to possess a high probability

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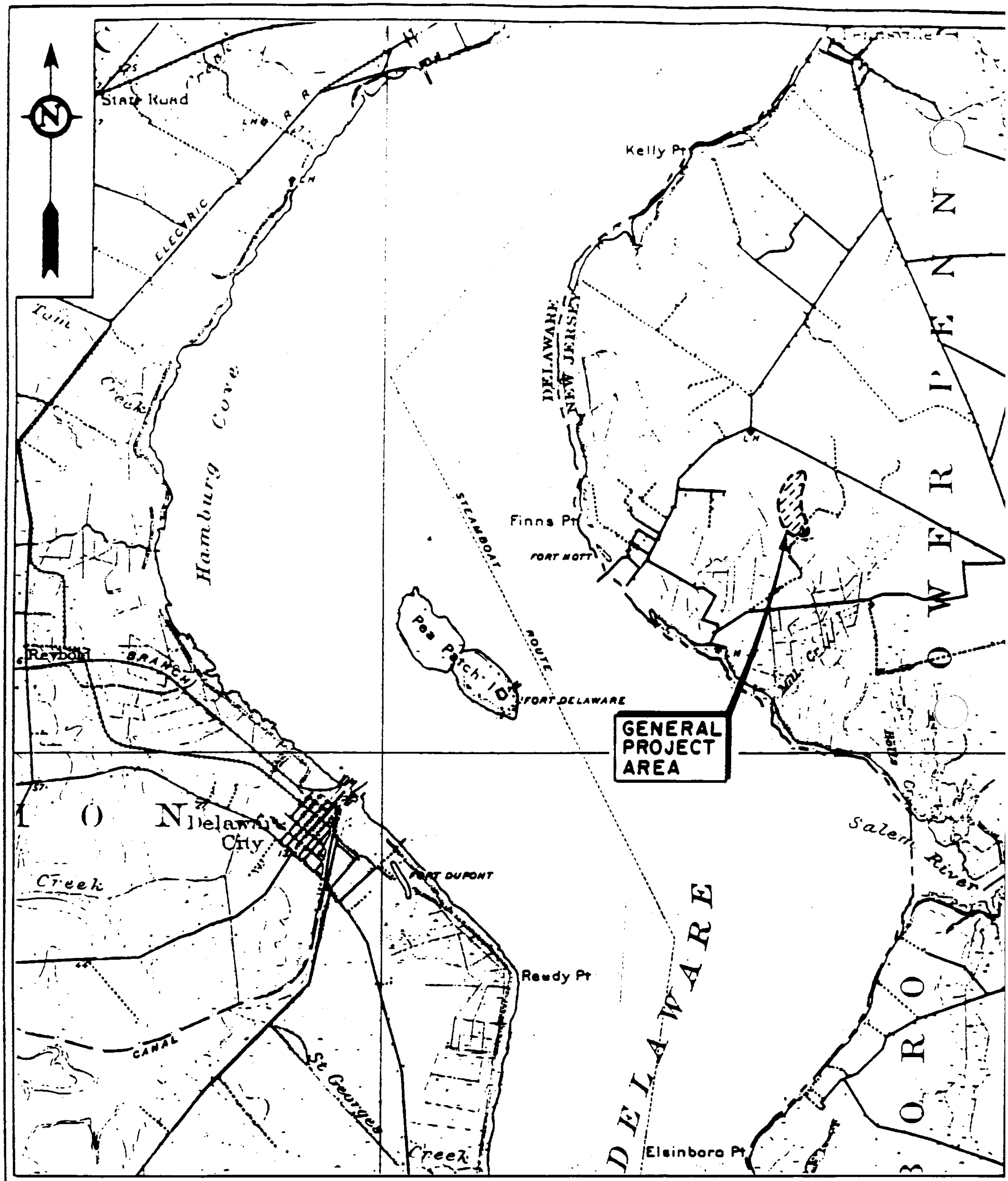

SCALE

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SOURCE:
U.S.G.S. 15 MIN. SERIES TOPO., WILMINGTON, DEL.-N.J. QUADRANGLE, 1904.

FIGURE 7

PROJECT AREA AND VICINITY, 1904

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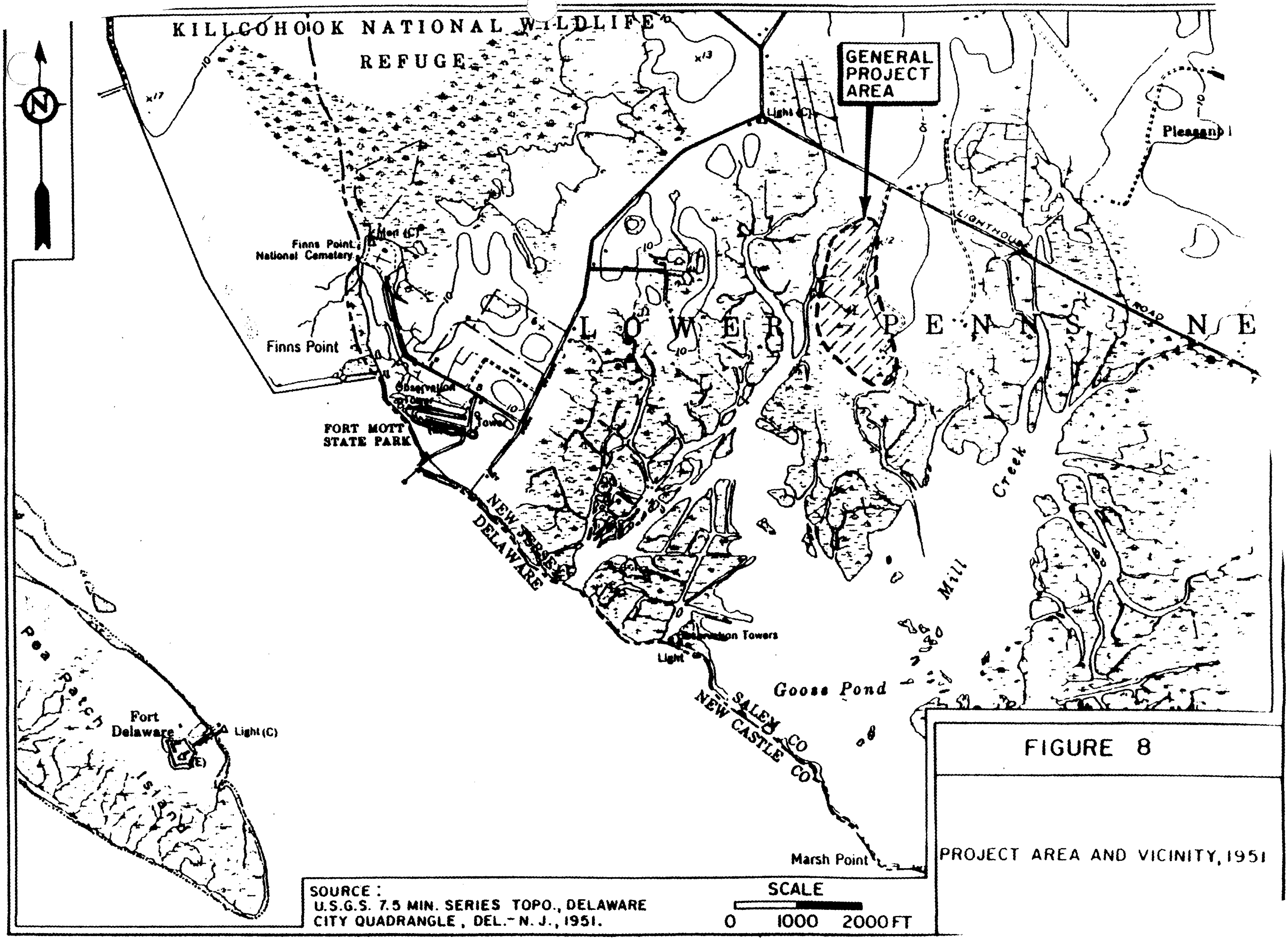

SOURCE: U.S.G.S. 7.5 MIN. SERIES TOPO., DELAWARE CITY QUADRANGLE, DEL.-N.J., 1951.

FIGURE 8

PROJECT AREA AND VICINITY, 1951

for containing the remains of early Euro-American settlements (Heite & Heite 1986b: D9-10).

Fourteen locations were considered during the submerged cultural resources study in the Delaware River channel, between Artificial Island and League Island (Cox 1988). The survey involved a magnetometer and side-scan sonar analysis of underwater targets. Sixty-four targets were identified in the project area, six of which produced a signature indicative of significant cultural remains. Phase II testing of anomaly SR 01 was undertaken to assess the nature of a previously identified magnetic target located in the Salem River (Irion 1992).The project involved a magnetometer survey for an area totalling over 300,000 square feet. The anomaly proved to be a low-intensity disturbance with two ridges of positive deflection separated by a low-intensity corridor. A Phase II underwater investigation revealed that the target was produced by a natural exposure of glacial-borne, iron-bearing cobbles. A modern steel anchor, which was considered to be insignificant, was the only cultural item found in the target area.

ARCHAEOLOGICAL FIELD INVESTIGATIONS

FIELD METHODOLOGY

GAI's Phase I archaeological investigation of the Salem River Navigation study area consisted of a pedestrian reconnaissance and the systematic excavation of 183 shovel test pits placed within three parcels located in the west-central portion of the Supawna Meadows National Wildlife Refuge (Areas A, B, and C) (Figures 1 and 9). Subsurface testing in each of the three upland areas consisted of the investigation of a staggered, 15-meter (50-foot) systematic shovel test pit grid (systematic unaligned) across open, recently mowed areas; two judgmental shovel probes were also excavated in the wooded margins of Area B. Excessively wet locations and areas covered by phragmites (i.e., wetlands) were excluded from subsurface testing. Of the total of 183 shovel test pits excavated during Phase I fieldwork, 101 were placed in Area A; 28 in Area B, and 54 in Area C (Figure 9).

Fieldwork was conducted from September 17 to September 21, 1992, in the three upland areas (ca. 9 acres) scheduled for wetland creation. The goal of Phase I fieldwork was to identify the presence, nature, and extent of all cultural resources and/or features within the project area that will be subject to impacts, and to evaluate, if possible, their potential eligibility for nomination to the National Register of Historic Places. Archaeological investigations followed procedures recommended by the Office of New Jersey Heritage Guidelines for Archaeological Investigations (McCarthy 1984; revised Office of New Jersey Heritage 12/10/90), and the Department of Interior's *Standards and Guidelines for Archaeology and Historic Preservation* (1983).

Shovel test pits (STP) measured approximately 50 x 50 cm (ca. one foot in diameter) and were excavated by natural soil stratigraphy, as determined by soil color (Munsell) and texture. In all cases, STPs were dug to culturally sterile soils. In several locations, the base of shovel test pits were augured in order to penetrate the sandy C horizon, which was generally encountered at 80+ cm below ground surface. Pleistocene surfaces were observed generally at the interface of the B and C Horizons throughout the project areas.

All excavated soils were screened through 1/4-inch hardware mesh. Standardized shovel test pit forms containing provenience data, depth of soil horizons, soil descriptions, and a list of any recovered artifacts were completed for each excavation. All shovel test pits were backfilled at the completion of the excavations. All artifacts recovered from these excavations were placed in bags and labeled with appropriate provenience information. The locations of all excavations were referenced to available landmarks and noted on project area maps with the use of a compass and metric hand tapes. Field conditions

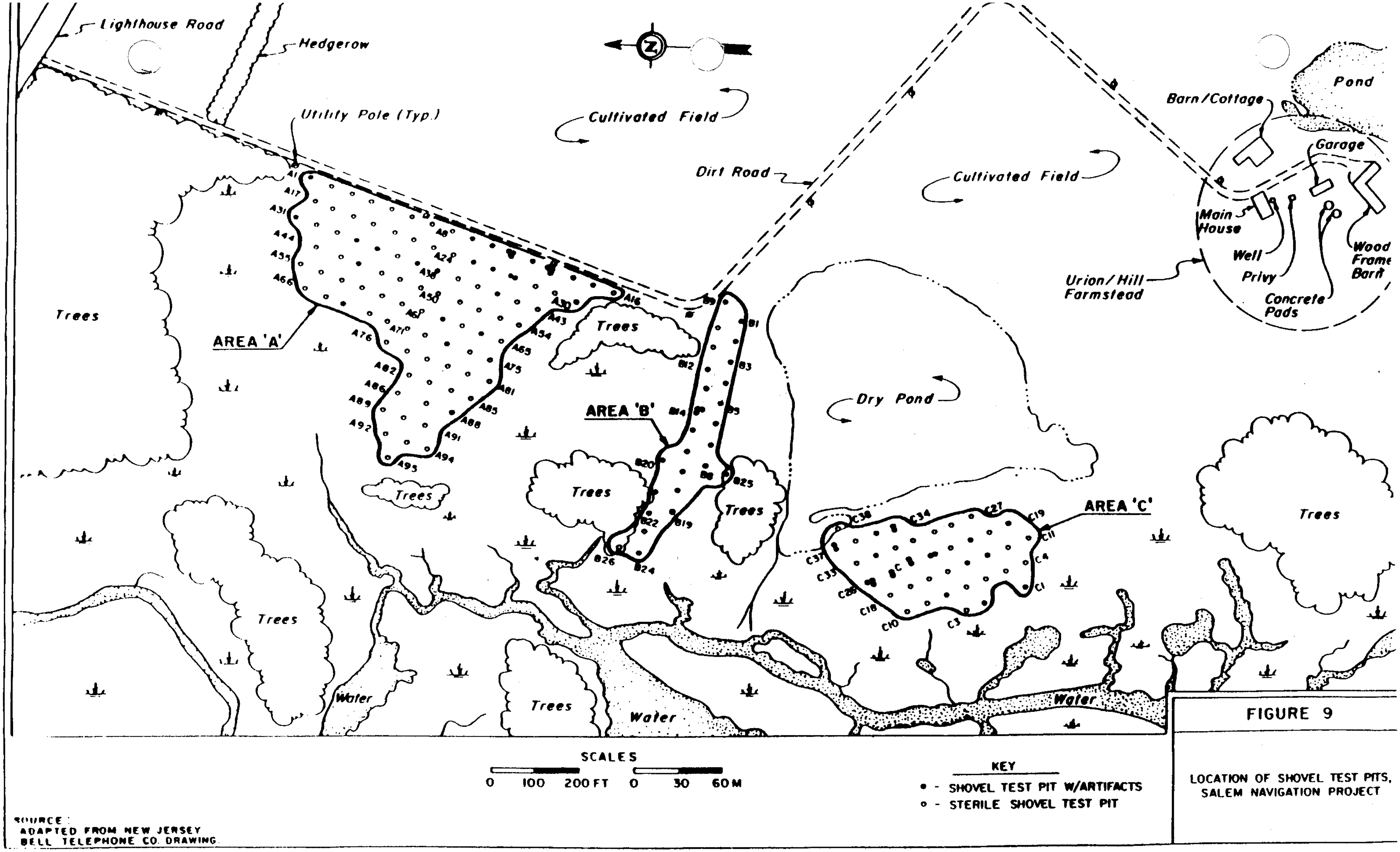

FIGURE 9

LOCATION OF SHOVEL TEST PITS, SALEM NAVIGATION PROJECT and representative soil profiles were recorded with color slides and black-and-white prints.

In addition to the above, a nineteenth-century farm complex located adjacent to the southern end of the project area was recorded (Figure 9). This included general background research, photo-documentation, architectural description, completion of an Office of New Jersey Heritage architectural survey form, and a determination of its potential National Register eligibility. Since this area was not scheduled to be impacted as a result of the proposed wetland project, no subsurface testing was conducted in this location.

FINDINGS

GAI's excavation of 183 shovel test pits resulted in the identification of three prehistoric sites (28-Sa-121 through 123) and the recovery of 92 prehistoric and 64 historic/modern artifacts (Appendices B and C) (Figure 10). Table 1, below, indicates that approximately 97 percent of all Phase I prehistoric artifacts were recovered from the plowzone; only one pottery sherd and two pieces of debitage were recovered from sub-plowzone contexts. As shown in Table 2, lithic debris included a variety of raw material types such as chert, jasper, silicified sandstone, quartz, quartzite, and chalcedony. The greatest concentration of prehistoric artifacts (55%) occurred in Area B (Site 28-Sa-122), the smallest of the three investigated parcels. This included 23 lithic debitage, one fire-cracked rock, and 27 pottery sherds. This was followed by Area C (Site 28-Sa-123) which contained one biface, 10 pieces of debitage, and 19 pottery sherds (33%). Although the largest of the three parcels, Area A (Site 28-Sa-121) yielded the lowest number of prehistoric artifacts (12%); these include one biface, one Levanna point (Late Woodland), eight lithic debitage, and one pottery sherd.

Table 1: Stratigraphic Distribution of Prehistoric Artifacts.

	Debris		Tools		Ceramics		Totals	
	n	%	n	%	n	%	n	%
Plowzone	39	95.12	3	100	46	97.87	88	96.7
Sub-Plowzone	2	4.88	0	0	1	2.13	3	3.3
Total	41	100	3	100	47	100	91	100

Table 2. Distribution of Raw Material Classes for Debris.

Debris	Dark/Gr Chert	Grey Chert	Light Chert	Chert	Yellow/ Caraml Jasper	Jasper	Red Jasper (heated)
#	5	1	1	2	6	4	1
Percent	15.4	2.4	2.4	4.9	14.6	9.8	2.4

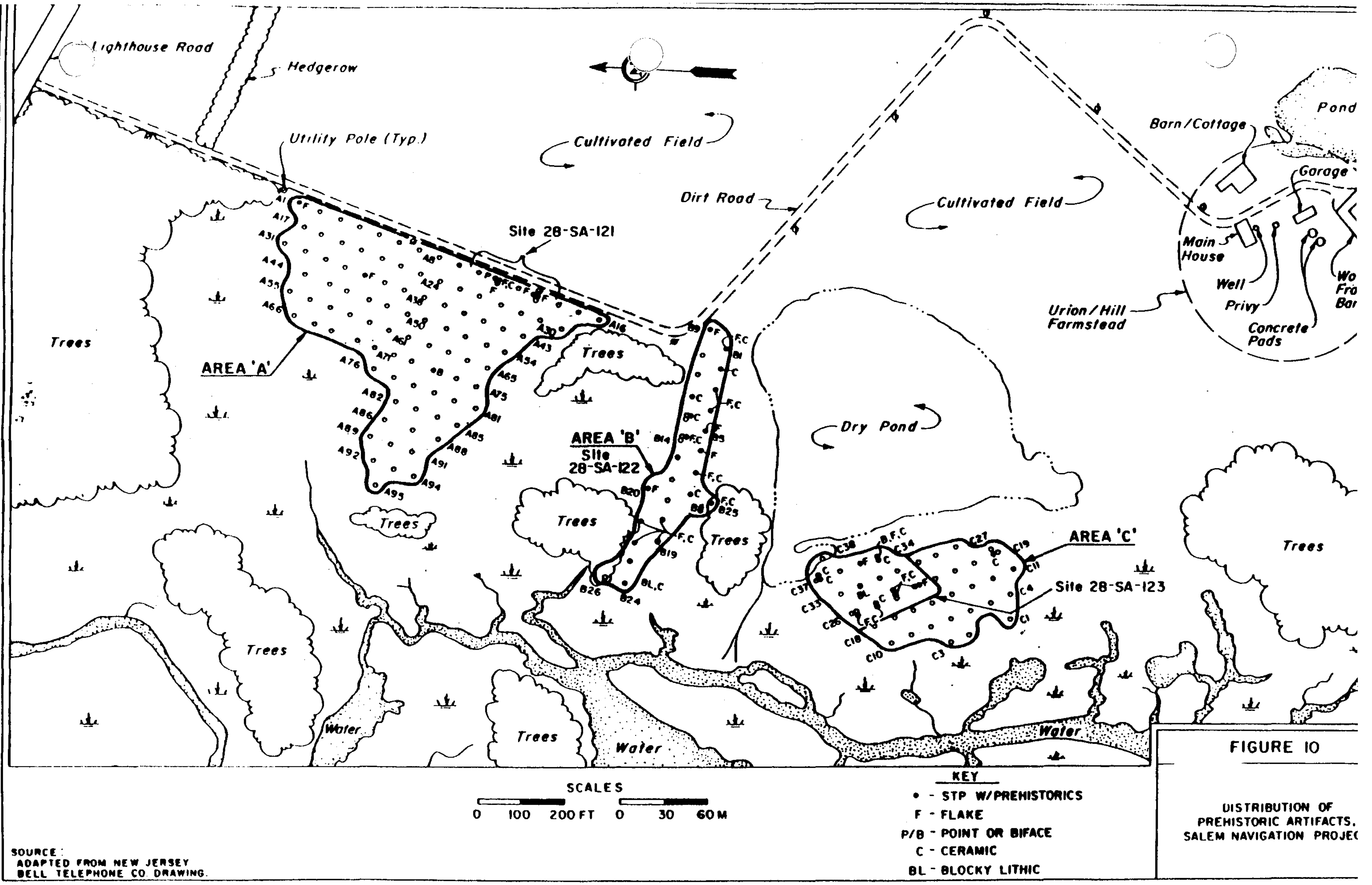

FIGURE 10

DISTRIBUTION OF PREHISTORIC ARTIFACTS, SALEM NAVIGATION PROJEC

Table 2. Distribution of Raw Material Classes for Debris. (Cont.)

Debris	Grainy Jasper	Smth Jasper	Black/ Grey Chalcny	Quart	Ortho-quartze	Silicified Sandstne	Total
#	1	1	3	8	2	4	39
Percent	2.4	2.4	7.3	20.5	5.1	9.8	99.4

Note: Tables do not include an obsidian-like flake from STP B9

A majority (55%) of the 64 historic/modern artifacts recovered during Phase I fieldwork consist of ceramic tablewares (n=15), cinders/slag (n=12), and small brick fragments (n=8). The remaining debris include small quantities of bottle, window, and miscellaneous glass, and miscellaneous metal. Fifty-five per cent of all historic/ modern artifacts were collected from Area A (n= 35); Areas B and C yielded 10 (15%) and 19 (30%) historic/modern artifacts, respectively. With one possible exception in Area B, no evidence of intact stratified deposits or potentially important historic or prehistoric archaeological features was identified. Representative soils identified in the three investigated areas are illustrated in Figure 11 and closely resemble the soil types mapped for the project area (Powley 1969). The artifact inventory is presented in Appendix B. Brief descriptions of the soils and artifacts encountered in the various testing segments are presented below.

Testing in Area A

Area A consists of a relatively flat parcel of fallow land surrounded by a dirt farm road to the east, wooded areas to the north and south, and phragmites to the west (i.e., wetlands) (Photograph 1). As shown in Figure 9, a total of 90 staggered shovel test pits, placed at 50-foot intervals, and 11 ancillary STPs were excavated in this area. Soils encountered in Area A were generally consistent across the parcel and closely resemble the Mattapex silt loam (MqA) soils recorded by the USDA for the study area (Powley 1969:24). This included a plowzone which ranged from yellowish-brown (10YR5/4) to brown to dark brown (10YR4/3) silt loam (Figure 11), which generally extended to depths of 14 to 30 cm below ground surface (bgs); atypically deep plowzone strata were recorded in STPs A31 and A40, where it extended to depths of 35 and 40 cm bgs, respectively.

The plowzone stratum was underlain by a dark yellowish-brown (10YR4/6) or yellowish-brown (10YR5/4 - 5/6, 5/8) silt loam or clay loam B horizon that generally extended to depths of 55 to 65 cm bgs. In STP A73, this stratum extended to the base of

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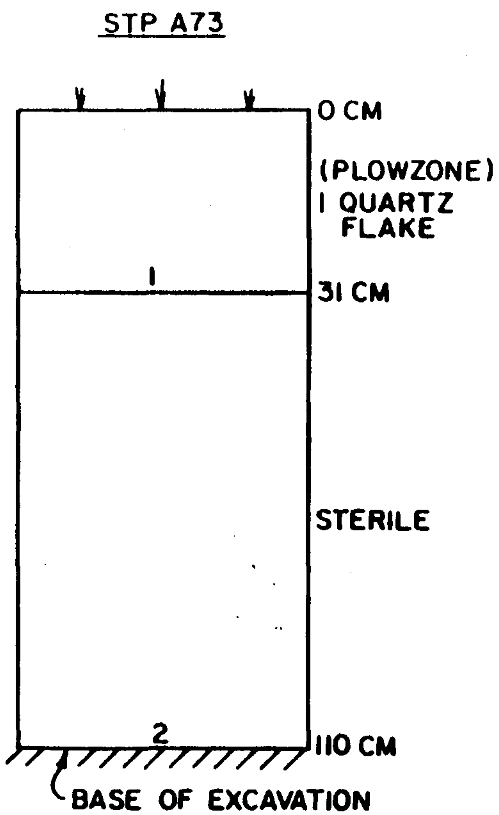
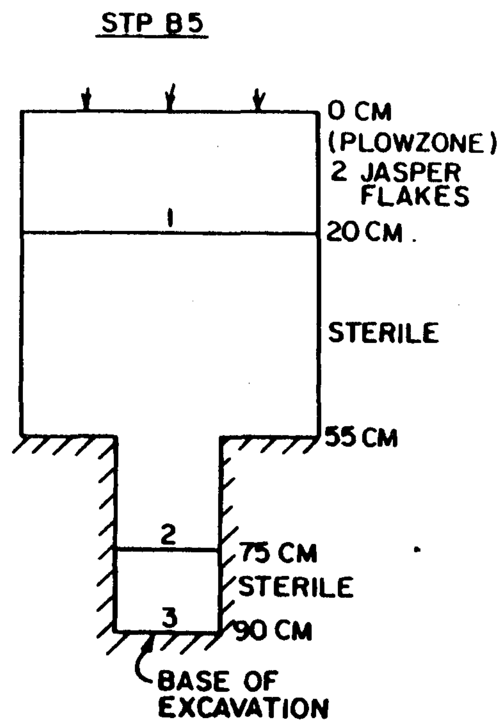


1 - DARK YELLOW-BROWN (10 YR 4/4) SILT LOAM.

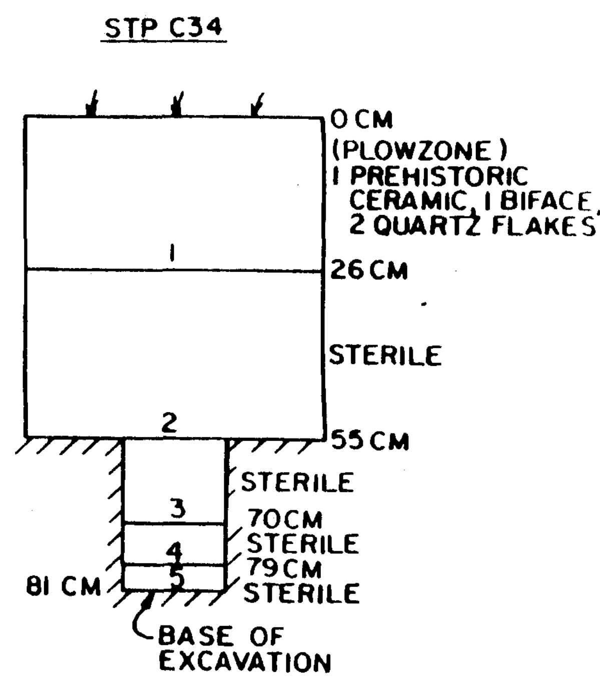
2 - DARK YELLOW-BROWN (10 YR 4/6) SILT LOAM.



1 - BROWN (10 YR 5/3) SILT LOAM.

2 - STRONG BROWN (7.5 YR 4/6) SANDY SILT LOAM.

3 - STRONG BROWN (7.5 YR 4/6 - 5/6) SILTY SAND.



1 - YELLOW-BROWN (10 YR 5/4) SILT LOAM.

2 - DARK YELLOW-BROWN (10 YR 4/6) SILT LOAM.

3 - DARK YELLOW-BROWN (10 YR 4/6) SILT LOAM.

4 - DARK YELLOW-BROWN (10 YR 4/6) CLAY LOAM.

5 - DARK YELLOW-BROWN (10 YR 4/6) SAND.

FIGURE 11

SALEM NAVIGATION PROJECT: REPRESENTATIVE PHASE I SHOVEL TEST PIT SOIL PROFILES

Photograph 1: General view of Area A, facing north. Photographed by Benjamin Resnick on September 17, 1992.

excavation at 110 cm bgs. Several shovel test pits (e.g. A7-9) contained a third stratum of yellowish-brown (10YR5/6) silty clay loam that extended from about 40 cm to the base of excavation at 65 cm bgs. This stratum was also observed in augur samples from STPs A69 and A39; in the latter unit it extended down to 98 cm bgs. The upper face of the sandy C horizon was also exposed in STPs A10-A12 at depths ranging from 76 to 121 cm bgs. Deep probing of STP A50 exposed the yellowish-red (5YR5/8) sandy C horizon at a depth of 135 cm bgs. In all cases, excavation extended an additional 25 to 35 cm below the deepest point of artifact recovery. As discussed below, all of the prehistoric artifacts from Area A were produced from plowzone contexts. As indicated in Appendix B, only one brick fragment and two cinders were found below the plowzone (STPs A9, A26, and A41).

The recovery of prehistoric artifacts in Area A (Site 28-Sa-121) was mainly restricted to locations immediately adjacent to the existing farm access road (Figure 10) (Appendix B). Artifacts from this zone include one prehistoric ceramic, one dark gray chert flake, and one yellow jasper flake from STP A11 (plowzone), and one dark gray chert flake from STP A13 (plowzone). An ancillary shovel test pit excavated 16 feet (4.8 meters) north of STP A11 contained a Late Woodland period Levanna point, made of jasper (Figure 12), and two historic ceramics, both of which were produced from the plowzone. A second ancillary STP excavated 16 feet (4.8 meters) west of A11 yielded one dark gray cortical, chert flake and one jasper flake, also from the plowzone. Of two ancillary STPs excavated 16 feet (4.8 meters) north and west of A13, only one contained prehistoric artifacts, in the form of one caramel jasper flake and one mollusc shell fragment.

In addition to the recovery of prehistoric artifacts near STPs A11 and A13, two isolated flakes were recovered from the plowzone in STPs A1 and A35. Two ancillary STPs excavated 16 feet (4.8 meters) to the east and west of STP A35 were sterile. Finally, one heat-modified red chert biface was recovered from the plow-zone in STP A73 (Figure 12). Two ancillary STPs excavated to the north and south of the find-spot were sterile.

Comparatively few historic/modern artifacts (n=35) were recovered from Area A (Appendix B). These include a thin scatter of 14 ceramic tablewares, four cinder/slag fragments, and six small brick fragments. Of these 14 highly fragmented ceramics, seven were whiteware, five were redware, and two were yellowware, spanning the period from the early nineteenth century through the present. The remaining historic/modern debris includes small quantities of bottle, window, and miscellaneous glass, miscellaneous metal, and coal.

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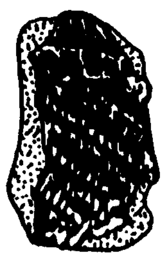
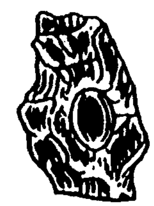


CORD-MARKED SHERD
(MINGUANNAN ?)
LATE WOODLAND
SITE 28-SA-122
STP B-3, LEVEL I

LEVANNA POINT
JASPER, LATE WOODLAND
SITE 28-SA-121
STP AII 16' NORTH, LEVEL I

IRONSTONE BIFACE
SITE 28-SA-123
STP 34, LEVEL I



RED CHERT BIFACE,
HEAT TREATED
SITE 28-SA-121
STP 73, LEVEL I

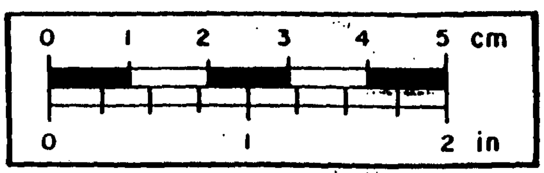


FIGURE 12

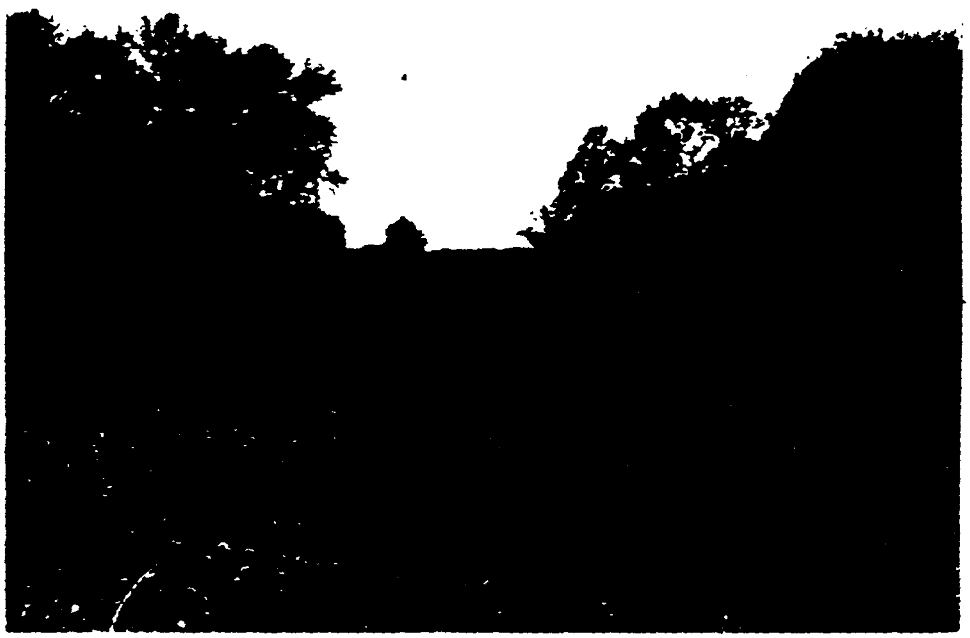
SELECTED PREHISTORIC ARTIFACTS
RECOVERED FROM
SALEM NAVIGATION PROJECT

Testing in Area B

Like Area A, Area B consists of a flat, open fallow parcel surrounded by dense stands of phragmites and deciduous trees (Photograph 2). As shown in Figure 9, 26 staggered shovel test pits, placed at 50-foot intervals, and two ancillary STPs were excavated in Area B. Soils were generally consistent across the parcel and closely resemble the Mattapex silt loam (MqA) soils recorded by the USDA for this area (Powley 1969:24). Most soil profiles in Area B consisted of a brown to dark brown (10YR4/3) or brown (10YR5/3) silt loam plowzone that generally extended to depths of 20 to 30 cm bgs; a relatively deep plowzone was recorded in STP B1, which extended to 36 cm bgs.(Figure 11).

In general, the plowzone was underlain by a yellowish-brown (10YR5/6 & 5/8) or strong brown (7.5YR4/6) sandy silt loam or silty clay loam B horizon that extended to depths of 55 to 68 cm bgs. Several shovel test pits (e.g. B10, B11 and B26) contained a third stratum of yellowish-brown (10YR5/8 & 5/6) silty clay loam that extended from about 44 cm to the base of excavation at 55-60+ cm bgs. Deep coring of STP B18 exposed the strong brown (7.5YR4/6) sandy C horizon from 81 cm to the base of excavation at 97 cm bgs. The upper face of the sandy C horizon was also exposed in STP B25 at 45 cm bgs to the base of excavation at 62 cm bgs. In all cases, excavation extended an additional 25 to 40 cm below the deepest point of artifact recovery. As discussed below, nearly all Area B artifacts were recovered from plowzone contexts (Appendix B). Only one window glass fragment (STP B12) was recovered below the plowzone.

Phase I shovel testing in Area B revealed a low-density, spatially extensive scatter of prehistoric artifacts from the plowzone (Site 28-Sa-122) (Appendix B). As shown in Figure 10, 19 of the 28 systematically staggered shovel test pits contained prehistoric material (68%). Although no artifact concentrations were identified in this area, there was a continuous horizontal distribution of lithics and ceramics across the testing zone. Of the 51 prehistoric artifacts recovered from Area B, 49 (96%) were collected from the plowzone or upper soil horizon contexts. STP B9 contained a small opaque, black "obsidian-like" flake from the plowzone, in addition to one quartz flake and one cortical jasper flake below the plowzone. Twenty-seven of the 51 prehistoric artifacts (53%) from the parcel consisted of pottery sherds, several of which were cord-marked or exhibited other surface treatments. Abrasion has reduced the visibility of decoration in most cases. Except for one small, grit-tempered broad-band, incised, cord-marked sherd from STP B3 (plowzone), tentatively identified as Minguannan (Late Woodland) (Figure 12), all Phase I prehistoric ceramics were undiagnostic (Griffith and Custer 1985:5-12; Custer 1987:13-27). Lithic debris (22 flakes and one block) constitute the second most frequent artifact type, comprising 47% of the prehistoric inventory. Additionally, a single fragment of fire-



Photograph 2: General view of Area B, facing west. Photographed by Benjamin Resnick on September 17, 1992.

cracked rock was recovered from the plowzone of STP B8, along with one grit-tempered pottery sherd.

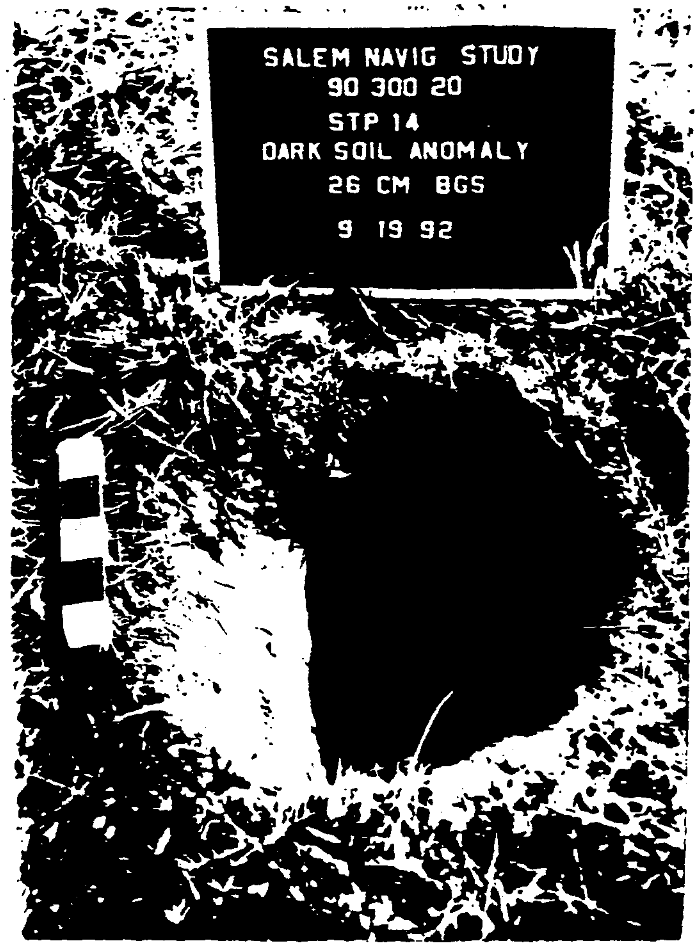
Given the widespread distribution of artifacts across Area B, no systematic ancillary shovel testing was conducted around the original find spots. However, two ancillary STPs were excavated 16 feet (4.8 m) south and west of STP B14, which contained an anomalous concentration of charcoal, burned organic material, and a possible ochre fragment at the plowzone/B Horizon interface (Photograph 3). No artifacts were recovered from this soil stain. One of the ancillary STPs (B14-16 feet south) contained prehistoric artifacts, including one quartz flake and one grit-tempered pottery sherd; these artifacts were recovered from the plowzone along with two glass fragments. The other ancillary STP contained only one threaded glass finish. Following the documentation of the feature, the STP was backfilled.

A single STP (B25) was excavated in the wooded zone south of Area B, to determine whether an intact portion of the site extended into this area. It exhibited no evidence of a plowzone and contained an upper intact, but sterile humus which extended from the surface to 10 cm bgs. This stratum was underlain by a brown (10YR 5/3) silt loam (A Horizon, 10-35 bgs) which contained one gray chalcedony flake and two grit-tempered prehistoric ceramics. A sterile brown (10YR5/3) silt loam, containing strong brown (7.5YR4/6) silt loam mottles and sterile strong brown (7.5YR4/6) silty clay loam, was encountered below the A Horizon; it extended to the base of excavation at 62 cm bgs.

As with Area A, comparatively few historic/modern artifacts (n=10) were recovered from Area B (Appendix B). These include two miscellaneous glass fragments, three bottle and one window glass fragment, one lead-glazed redware body sherd, one small brick fragment, and one unidentified concretion. Except for a single window glass fragment collected from the B horizon in STP B12, all of these artifacts were produced from the plowzone.

Testing in Area C

Area C comprises a large, relatively open fallow field surrounded by deciduous trees and phragmites (Photograph 4). As shown in Figure 9, 38 staggered shovel test pits, placed at 50-foot intervals, and 16 ancillary STPs were excavated in Area C. Similar to Areas A and B, soils were generally consistent throughout the parcel and closely resemble the Mattapex silt loam (MqA+ MqB) soils recorded by the USDA for this area (Powley 1969:24). Most soil profiles in Area C contained an uppermost plowzone of yellowish-



Photograph 3: South wall profile of anomalous soil stain in STP B14 (plowzone-B horizon interface). Facing south. Photographed by Joel S. Dzodin on September 19, 1992.

Photograph 4: General view of Area C, facing west. Photographed by Joel S. Dzodin on September 19, 1992.

brown (10YR5/4), dark yellowish-brown (10YR4/4), or brown (10YR5/3) silt loam, which extended to depths of 21 to 26 cm bgs (Figure 11). A relatively deep plowzone stratum was observed in STPs C11 and C31, extending to 31 cm bgs.

The plowzone was generally underlain by a yellowish-brown (10YR5/6 & 5/8) or dark yellowish-brown (10YR4./6) silt loam or silty clay loam B horizon that extended to the base of shovel test pits at depths of 55 to 68 cm bgs. Hand-auguring of several STPs (i.e., C1, C9, C15, C19, C23, C30, C34) exposed two or more underlying soil horizons. This includes a light yellowish-brown (10YR6/4) or dark yellowish-brown (10YR4/6) silt loam or silty clay loam (70-110 cm bgs) superimposing a dark yellowish-brown (10YR4/4) to light brownish-gray (10YR6/2) sandy C horizon, the upper face of which was exposed at depths of 79 to 142 cm bgs. In all cases, excavation was extended an additional 25 to 40 cm below the deepest point of artifact recovery. As discussed below, artifacts in Area C were almost entirely restricted to the plow-zone, with the exception of a single prehistoric pottery sherd recovered in the B horizon (STP C24). In addition, prehistoric artifacts were recovered from the interface of the plowzone/B horizon in STPs C19, C25, C35, and C37.

A low-density artifact scatter (Site 28-Sa-123), almost exclusively limited to the plowzone (99%), was focused in the northern half of Area C (Appendix B) (Figure 10). Eight of the 38 staggered shovel test pits contained prehistoric material (i.e., 21%). An additional 16 ancillary STPs were excavated around find spots at STPs C23-C26, C34, and C37; an ironstone biface was recovered from the plowzone of STP C34 (Figure 12). Although a possible flake recovered from STP C23 was later identified as a slag fragment, an ancillary shovel test pit placed in the area (C23, 16 feet south) contained a prehistoric pottery sherd, one heat-altered chert flake, a cinder, and one miscellaneous metal fragment from the plowzone. Twenty of the 30 prehistoric artifacts from the parcel (66.6%) consisted of pottery sherds, none of which were diagnostic. Lithic debris (nine flakes and one block) represent the second most frequent artifact category and account for 33% of the Area C prehistoric artifact inventory.

Comparatively few historic/modern artifacts (n=19) were recovered from Area C; these include five pieces of slag, three cinders, one fragment each of bottle, window, and miscellaneous glass, and single specimens of bone, brick, a nail, and a concretion (Appendix B). All of this debris was recovered from the plowzone.

FARM COMPLEX

As noted earlier a farm complex, associated with Samuel Urion during the mid-nineteenth century, is located at the end of a dirt road adjacent to the southern portion of the project area. It was occupied by the "Hill Brothers" until the early 1960s, who operated a slaughter/meat business at this time (Butcher 1992: personal communication). The farmstead resembles a variation of a linear, bisected plan, and consists of a farmhouse, well, barn/cottage, large frame barn, garage, and privy (Appendix D; Figure 13).

The farmhouse is a 5x2-bay, two and one-half story, Vernacular, central hall, I-house with two internal end brick chimneys, dormers, and a kitchen lean-to addition, located along the east elevation (Photographs 5 and 6). The aluminum-sided dwelling contains an asphalt- shingled, gable roof, two-over-two sash, and cemented stone (granite) and brick foundation; the kitchen addition contains a concrete block foundation. Enclosed double doors with broken transom lights are located along the north facade of the dwelling indicating that it once served as the front of the building.

A close inspection of the dwelling's basement was conducted in order to help interpret the construction sequence of the building. Based on this cursory analysis, it appears that the dwelling may have been constructed in three stages. The identification of hand-hewn sills beneath two rooms, exclusively in association with a brick floor and cemented stone foundation in the dwelling's center, suggests that this is the original structure. This section of the building may conceivably date from as early as the eighteenth century. It is also important to note that the location of a bay window on the northern facade of the structure (Victorian addition) corresponds to a brick foundation and concrete floor identified in the basement. The kitchen addition is the only part of the house that contains a concrete foundation and probably dates to the early twentieth century.

Two stairways are located in the dwelling; one is situated in the center or original part of the structure and another (spiral-like) staircase is situated at the east end of the house, adjacent to the kitchen addition. Although most of the fireplaces are Victorian in character, it is worthwhile to note that a fireplace mantel in the attic exhibits punch-and-gouge work, popular during the mid-nineteenth century.

Photograph 5: North and east facades, farmhouse, facing south. Notice kitchen addition along east facade. Photographed by Benjamin Resnick on September 17, 1992.

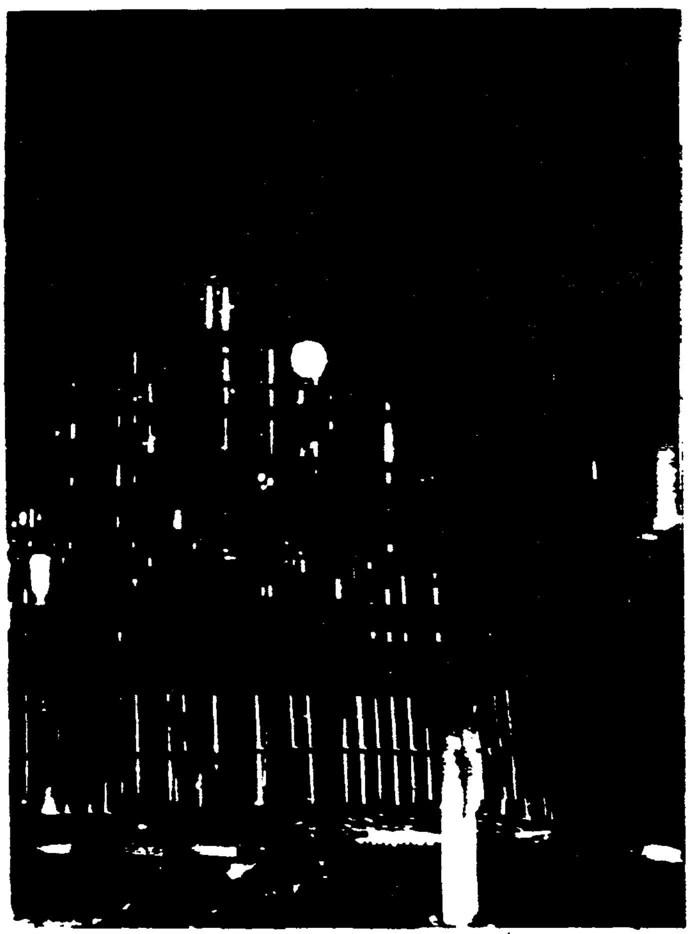
Photograph 6: South facade, farmhouse, facing north. Photographed by Benjamin Resnick on September 17, 1992.

The large frame barn is a transverse, 3x3-bay, vertical plank structure set on a concrete pier foundation with corrugated tin roof; in some places, the barn sills are set directly on the ground surface (Photographs 7 and 8). This structure appears to date to the mid-to-late nineteenth to early twentieth century, and is situated at the end of the dirt road which traverses the project area, a short distance to the south of the farmhouse. It appears that the northern elevation of the structure is original, as it contains sockets for floor joists and center posts set directly in the ground. Moreover, the northwest corner of the structure contains a pegged corner post and downbrace. An apparent addition, located to the south, contains center posts set into concrete piers and a concrete and cinderblock foundation, which also constitute a portion of the siding. Wooden pegs were observed in both the original barn section and its addition. Two large doors are located along the north and east facades of the structure, in addition to an embrasure in the upper gable end to accommodate the loft.

The barn/cottage is a gable-roofed structure that is located directly across from the farmhouse, on the opposite side of the dirt road (Photograph 9). The barn, which comprises the original structure, is situated in the central portion of the building. It is wooden-pegged in several locations and contains clapboard siding, an asphalt-shingled roof, and two large doors positioned along its west elevation. A portion of its interior was modified for use as a cooler for the Hill Brothers' meat business (chickens, hogs, turkey), sometime in the early twentieth century (Butcher 1992: personal communication). An apparent chicken pen is attached to the structure's northern elevation. The cottage is a modern residential, lean-to addition, located along the south facade of the structure; it contains a concrete foundation, aluminum siding, and a corrugated tin roof. This section was constructed to house seasonal employees of the Supawna Meadows National Wildlife Refuge. An earlier and smaller lean-to addition, containing a brick chimney at its northeast corner, is situated along the east facade of the structure.

In addition to the above, a covered well is situated directly behind or south of the farmhouse. Located a bit further to the south is a two-seater, cinderblock privy containing a concrete foundation and a sheet tin over plank roof (Photograph 10). The privy was apparently used well into the twentieth century; i.e., until the early 1950s (Butcher 1992: personal communication). Other structures/features located within the farmstead include a modern aluminum-sided garage, situated between the farmhouse and the large frame barn, and two circular concrete pads that ostensibly served as silo foundations.

Photograph 7: Overview, large frame barn and modern garage, pond in foreground, facing northwest. Photographed by Benjamin Resnick on September 17, 1992.



Photograph 8: Interior, large frame barn, facing southwest. Photographed by Benjamin Resnick on September 17, 1992.

Photograph 9: West elevation, barn/cottage, facing northeast. Cottage addition is to right of photograph. Photographed by Benjamin Resnick on September 17, 1992.

Photograph 10: East and south elevation, cinder-block privy, facing northwest. Photographed by Benjamin Resnick on September 17, 1992.

SUMMARY

GAI's Phase I archaeological survey of the Salem River Navigation Study area consisted of a pedestrian reconnaissance of three upland areas (i.e., fallow fields) and the systematic excavation of 183 shovel test pits. Based on the recovery of low-density plowzone assemblages containing ceramics and lithic debris, three prehistoric sites were identified (Sites 28-Sa-121 through 123), one in each field tested. Despite its small size, Area B (Site 28-Sa-122) contained the largest number of prehistoric artifacts recovered during Phase I fieldwork. This includes 23 pieces of lithic debitage, one fire-cracked rock, and 27 pottery sherds. The recovery of a Levanna point from Area A and cord-marked pottery from Area B both suggest a Late Woodland cultural affiliation for these sites. Except for a concentration of charcoal, burned organic material, and a possible ochre fragment at the plowzone/B horizon interface (STP B14), no potentially significant soil anomalies or cultural features were identified. It should be noted, however, that STPs placed in a wooded area near Area B suggest that an intact portion of the site may be present at this location.

CONCLUSIONS AND RECOMMENDATIONS

This report presents a Phase I cultural resources investigation of the Salem River Navigation Study Area located in the Supawna Meadows National Wildlife Refuge, Salem County, New Jersey. This study was undertaken by GAI Consultants, Inc. of Monroeville, Pennsylvania for the U.S. Army Corps of Engineers, Philadelphia District, in connection with a proposed wetland creation and restoration project. The proposed undertaking calls for the mitigation of shallow and wetland areas lost as a result of improvements to the Salem River channel. The mitigation site, located at the headwaters of an unnamed creek, includes approximately 15 acres, 9 acres of which are in uplands and are to be transformed into estuarine intertidal emergent wetlands. Three fallow fields constitute the uplands and it is these areas that were the subject of the archaeological study. Geomorphological testing of existing project area wetlands (ca. 6 acres) determined that these areas are typical of an Estuarine Type marsh and were formed as a result of recent accumulation of sediments in stream channels and estuarine meanders. Consequently, they do not represent potentially habitable surfaces for historic or prehistoric sites and were not tested. Goals of the Phase I study were to identify all prehistoric, historic, and historic architectural remains within the project area that will be subject to impacts, and to evaluate, if possible, their potential National Register of Historic Places eligibility.

Initially the Phase I study involved documentary research, including a review of cartographic sources, cultural resource survey reports, and site record files, in order to determine the potential of the project area for containing archaeological and historical remains. These background investigations suggested that the project area's proximity to wetlands, and the Delaware River and its tributaries would have provided an array of potentially exploitable resources to prehistoric groups, primarily those dating to the Archaic and Woodland periods. Although cultivation may have altered the integrity of sites, a high potential exists for locating potentially significant prehistoric archaeological resources. Additionally, the documentation of several nineteenth-century farmsteads within the immediate vicinity of the project area suggests the potential for locating historic architectural and/or historic archaeological remains.

The Phase I field testing strategy was implemented following consultations with Michael Swanda of the Philadelphia District, and included the examination of three spatially segregated fallow fields, measuring approximately 9 acres. These areas were investigated via a pedestrian reconnaissance and the excavation of 183 systematic shovel test pits. Additionally, a nineteenth-century farm complex located at the southern end of the project area was documented. This included general background research, photo-documentation, architectural description, completion of an Office of New Jersey Heritage architectural survey form, and a determination of its potential National Register eligibility. Since this area was not scheduled to be impacted as a result of the proposed wetland project, no subsurface testing was conducted in this location.

Phase I fieldwork resulted in the identification of three prehistoric sites (one in each of the three testing parcels, Areas A, B, and C, Sites 28-Sa-121 through 123). These sites were identified on the basis of low-density plowzone assemblages containing lithic and ceramic debris. Despite its small size, Area B (Site 28-Sa-122) contained the largest number of prehistoric artifacts recovered during fieldwork and included 23 pieces of lithic debitage, one fire-cracked rock, and 27 pottery sherds. Diagnostic artifacts include one jasper Levanna point from Area A (Site 28-Sa-121) and one cord-marked pottery sherd from Area B, tentatively identified as Minguannan; these were recovered from plowzone contexts and suggest a Late Woodland period cultural affiliation. Although additional Phase II archaeological research is necessary to place these sites in their appropriate chronological and functional context, based on the artifacts recovered to date, it appears that they may represent a series of procurement camps dating to the Late Woodland period. It is likely that they were formerly associated with the exploitation of wetland and wetland-related resources such as deer and mast.

In general, few historic/modern artifacts were recovered during the course of fieldwork. These include a diffuse historic/modern assemblage containing small quantities of ceramics (i.e., whiteware, redware), cinder/slag, brick fragments, bottle, window and miscellaneous glass, miscellaneous metal, and coal, which date collectively from the early nineteenth century to the present. No historic period features or potentially significant historic cultural deposits were identified during the Phase I archaeological survey. These items are likely related to the manuring of the fields; as such, they do not represent a historic archaeological site per se. Therefore, no additional work is recommended for the historic/modern component identified within the project areas.

Except for a possible feature identified in STP B14, no potentially significant soil anomalies or cultural features were identified in the three study parcels. The soil anomaly consisted of an otherwise sterile concentration of charcoal, burned organic material, and a possible ochre fragment identified at the plowzone/B Horizon interface. One of two ancillary STPs placed in this area contained prehistoric artifacts from the plowzone, including one quartz flake, one pottery sherd, and two glass fragments. It is worthwhile to mention that STPs placed in a wooded area near Area B (Site 28-Sa-122) suggest that an intact portion of the site may be present at this location.

In addition to the above a nineteenth-century farmstead, known as "Pleasant Hill" was documented during the course of the Phase I survey. It consists of a farmhouse, well, barn/cottage, large frame barn, garage, and privy, and is located at the end of the dirt road, adjacent to and south of the project area. Based on the architectural qualities of the farmhouse (Vernacular, five-bay, I-house) and large frame barn, in conjunction with its association with Samuel Urion, a prominent local public servant during the mid to late nineteenth century, the farm complex is considered potentially eligible for inclusion in the National Register of Historic Places. If at a later date any of the farm buildings or associated grounds are to be impacted, a Phase I archaeological survey and additional architectural research is highly recommended.

In conclusion, based on the identification of three prehistoric archaeological sites during Phase I fieldwork, GAI recommends that the U.S. Army Corps, Philadelphia District, avoid proposed impacts to these resources. If this is not feasible, Phase II investigations are recommended. Although nearly all artifacts were recovered from the plowzone, this does not rule out the possibility of identifying intact subsurface features at the site. The goals of the Phase II archaeological investigation include: (1) obtaining a larger sample to define the sites' overall size, orientation, and chronology; (2) identifying potential areas containing intact cultural deposits; and (3) if possible, determining the temporal and spatial patterning of activities represented at the sites. These goals will help determine the sites' potential for inclusion in the National Register of Historic Places. GAI recommends the use of several strategies in evaluating these sites involving a combination of surface collection, mechanical stripping of the plowzone, and subsurface testing including the sampling, profiling, and excavation of possible features. Particular attention should be paid to Area B, where a possible feature was identified at the plowzone/B horizon interface.

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APPENDIX A

REPRESENTATIVE SOIL PROFILES, GEOMORPHOLOGICAL TESTING, AREA A

APPENDIX A: REPRESENTATIVE SOIL PROFILES, GEOMORPHOLOGIAL TESTING, AREA A

TEST NUMBER Area A 1 — Project 90-300-20

SOIL DESCRIPTION BY: D. L. Cremeens

DATE: 9/16/92
LOCATION: Salem Wetlands

HORIZON DEPTH (cm)	SOIL COVER MATRIX MOTTLING	TEXTURE	STRUCTURE	CONSISTENCE	BOUNDARY	COMMENTS
Ap 0-25	Brown (10YR 4/3)	Silt loam	Weak, medium granular	Very friable	Abrupt, wavy	
BE 25-40	Yellowish brown (10YR 5/4) and light yellowish brown (10YR 6/4)	Silt loam	Weak, medium platy	Friable	Clear	Very few, very faint brown (10YR 4/3) clay films
Bt1 40-62	Yellowish brown (10YR 5/6)	Silt loam	Moderate, medium subangular block	Friable	Clear	Common, distinct brown (7.5YR 4/4) clay films
Bt2 62-77	Yellowish brown (10YR 5/6) with few prominent grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2 mottles)	Silt loam	Moderate, medium subangular blocky	Friable	Gradual	Common, distinct dark yellowish brown (10YR 4/4) clay films
2BC 77-100	Strong brown (7.5YR 5/6) with few prominent light brownish gray (10YR 6/2) and few faint strong brown (7.5YR 5/8) mottles	Loam	Weak, medium subangular blocky	Very friable		

ADDITIONAL NOTES:

TEST NUMBER Area A 4 Project 90-300-20

SOIL DESCRIPTION BY: D. L. Cremeens

DATE: 9/16/92
LOCATION: Salem Wetlands

HORIZON DEPTH (cm)	SOIL COVER MATRIX	MOTTLING	TEXTURE	STRUCTURE	CONSISTENCE	BOUNDARY	COMMENTS
Oi 0-10	Black (10YR 2/1)		Fibrous peat			Clear, smooth	
A 10-30	Dark gray (5Y 4/1)		Loam	Weak, fine granular	Friable	Clear, smooth	Many roots
Cg1 30-45	Gray (N6/ and 5Y 6/1)		Sand	Single grain	Non-sticky, non-plastic	Gradual	
Cg2 45-100	Gray (5Y 6/1) with common prominent light olive brown (2.5Y 5/4) mottles		Sand	Single grain	Non-sticky, non-plastic		Water at 75 cm

ADDITIONAL NOTES:

GAI CONSULTANTS, INC.
ENGINEERS, GEOLOGISTS, PLANNERS & ENVIRONMENTAL SPECIALISTS
570 BEATTY ROAD, MONROEVILLE, PA 15146

APPENDIX B

PHASE I ARTIFACT CATALOGUE - SALEM RIVER NAVIGATION STUDY

Appendix B: Phase I Artifact Catalogue-Salem River Navigation Study

FS#	STP	Strat	Lev	Elev (cm)	Artifacts
1	A1	PZ	1	0-14	1 dark chert flake
2	A9	B	3	45-65	1 cinder
3	A11	PZ	1	0-24	1 dark grey chert flake, cortex 1 yellow jasper flake 1 grit-tempered prehistoric ceramic 1 dk brown to black interior lead glazed redware body 1 brick fragment
4	A11, 16 feet north	PZ	1	0-24	1 jasper Levanna point 1 plain whiteware body 1 unglazed redware sherd
5	A11, 16 feet west	PZ	1	0-26	1 dark grey chert flake, cortex 1 jasper flake
6	A12	PZ	1	0-22	1 polychrome whiteware sherd 1 unglazed redware sherd 1 brick fragment 1 slag
7	A13	PZ	1	0-24	1 dark grey chert flake 1 plain whiteware sherd 1 brown to black interior lead glazed redware rim 1 brick fragment 1 cinder
8	A13, 16 feet north	PZ	1	0-21	1 caramel jasper flake 1 shell
9	A13, 16 feet west	PZ	1	0-26	1 reddish brown interior lead glazed redware body
10	A25	PZ	1	0-30	1 overglaze decal whiteware sherd
11	A26	B	2	24-55	1 brick fragment
12	A27	PZ	1	0-26	2 brick fragments 1 concretion
13	A27, 16 feet north	PZ	1	0-22	1 window glass
14	A31	PZ	1	0-35	1 plain whiteware base 1 clear curved miscellaneous glass body

FS#	STP	Strat	Lev	Elev (cm)	Artifacts
15	A34	PZ	1	0-32	1 coal
16	A35	PZ	1	0-34	1 black chalcedony flake
17	A35	PZ	1	0-34	charcoal sample
18	A37	PZ	1	0-38	1 Rockingham-like glazed yellowware sherd
19	A38	PZ	1	0-35	1 plain whiteware base
20	A41	B	2	30-57	1 cinder
21	A46	PZ	1	0-23	charcoal sample
22	A62	PZ	1	0-27	2 brown bottle glass bodies 1 chalk lump
23	A64	PZ	1	0-26	1 plain whiteware body 1 miscellaneous metal
24	A68	PZ	1	0-31	1 plain yellowware base
25	A73	PZ	1	0-31	1 red chert biface, heat treated
26	A88	PZ	1/2	interface at 24cm	1 clear curved miscellaneous glass body
27	B1	PZ	1	0-36	1 grey chalcedony flake, cortex 1 grit-tempered prehistoric ceramic
28	B2	PZ	1	0-26	2 grit-tempered prehistoric ceramics
29	B3	PZ	1	0-20	1 Late Woodland *Minguannan* cord-marked prehistoric ceramic
30	B4	PZ	1	0-23	1 grey chert flake, cortex 1 grainy jasper flake 1 smooth jasper flake 2 grit-tempered prehistoric ceramics
31	B5	PZ	1	0-20	2 caramel jasper flakes
32	B6	PZ	1	0-22	1 jasper flake
33	B7	PZ	1	0-28	1 red jasper flake 1 grit-tempered prehistoric ceramic

FS#	STP	Strat	Lev	Elev (cm)	Artifacts
34	B8	PZ	1	0-19	1 grit-tempered prehistoric ceramic 1 fire cracked rock
35	B9	PZ	1	0-20	1 black obsidian-like glass "flake"
36	B9	B	2	20-60	1 quartz flake 1 jasper flake, cortex
37	B12	PZ	1	0-25	1 reddish brown lead glazed redware body 1 brown to black lead glazed redware body
38	B12	B	2	25-55	1 bottle glass body
39	B13	PZ	1	0-28	1 grit-tempered prehistoric ceramic
40	B14	PZ/B	1/2	interface at 26cm	charcoal sample
41	B14, 16 feet south	PZ	1	0-27	1 quartz flake 1 grit-tempered prehistoric ceramic 1 window glass 1 miscellaneous melted glass
42	B14, 16 feet west	PZ	1	0-30	1 clear glass rim, threaded finish
43	B15	PZ	1	0-23	1 grit-tempered prehistoric ceramic 1 brick fragment
44	B18	PZ	1	0-20	1 quartzite flake 2 grit-tempered prehistoric ceramics
45	B19	PZ	1	0-23	1 caramel jasper flake 2 prehistoric ceramics
46	B20	PZ	1	0-21	1 silicified sandstone flake
47	B21	PZ	1	0-30	1 silicified sandstone flake 1 light chert flake 1 quartz flake 1 grit-tempered prehistoric ceramic
48	B22	PZ	1	0-27	2 quartz flakes 1 jasper flake, cortex 1 prehistoric ceramic 1 aqua bottle glass body

FS#	STP	Strat	Lev	Elev (cm)	Artifacts
49	B24	PZ	1	0-25	1 blocky chert lithic 8 prehistoric ceramics (incl. 3 grit tempered and 1 grog-tempered)
50	B25	A	2	10-35	1 grey chalcedony flake 2 grit-tempered prehistoric ceramics
51	C1	PZ	1	0-8	1 miscellaneous metal
52	C1	PZ	1	0-26	1 slag
53	C2	PZ	1	0-21	1 aqua bottle glass body
54	C8	PZ	1	0-23	1 clear curved miscellaneous glass body
55	C13	PZ	1	0-27	1 window glass
56	C14	PZ	1	0-23	1 cut nail
57	C19	PZ	1/2	interface at 24cm	2 grit-tempered prehistoric ceramics
58	C21	PZ	1	0-22	1 slag
59	C23	PZ	1	0-14	1 slag
60	C23, south	PZ	1	0-26	1 chert flake, heat treated 1 prehistoric ceramic 1 cinder 1 miscellaneous metal
61	C24	PZ	1	0-20	1 yellow jasper flake, cortex
		PZ	1	20-28	1 prehistoric ceramic
62	C24	B	2	29-43	1 grit-tempered prehistoric ceramic
64	C24, east	PZ	1	0-21	1 orthoquartzite flake 2 grit-tempered prehistoric ceramics 1 cinder 1 miscellaneous metal
65	C25	PZ	1	0-8	1 grit-tempered prehistoric ceramic
76	C25	PZ	1/2	interface at 26cm	1 coal

FS#	STP	Strat	Lev	Elev (cm)	Artifacts
66	C25, west	PZ	1	0-24	1 silicified sandstone flake 1 prehistoric ceramic 1 slag
67	C26	PZ	1	24-26	1 prehistoric ceramic 1 bone 1 slag
68	C26, west	PZ	1	0-19	1 dark chert flake, cortex 1 prehistoric ceramic 1 brick fragment 1 slag
69	C26, north	PZ	1	0-8	1 cinder
70	C32	PZ	1	0-29	1 silicified sandstone blocky
71	C34	PZ	1	0-26	1 ironstone biface, distal end 2 quartz flakes 1 prehistoric ceramic
72	C34, west	PZ	1	0-25	3 prehistoric ceramics
73	C35	PZ	1/2	interface at 27cm	1 quartz flake
74	C37	PZ	1/2	interface at 18cm	1 cord-marked prehistoric ceramic 1 charcoal
75	C37, east	PZ	1	0-22	3 prehistoric ceramics

APPENDIX C

ARCHAEOLOGICAL SITE FORMS

SITE REGISTRATION PROGRAM
NEW JERSEY STATE MUSEUM
Bureau of Archaeology
205 West State Street
Trenton, N.J. 08625
(609) 292-8594

SITE NO.: 28-SA-121
Site Name: Salem Wetlands Site #1
Atlas Coordinates:
U.S.G.S. Coordinates: N4384490E454613
National Register Status:
State Register Status:
Date:
File:

County: Salem

Municipality: Pennsville

Location (descriptive):
Located in the Supawna Meadows National Wildlife Refuge, approx. 600 feet south of Lighthouse Road.

Period of Site: Late Woodland

Type of Site: Lithic scatter of debitage and tools.

Cultural affiliation(s) (if known):

Owner's Name: U.S. Fish and Wildlife Service
Address: Supawna Meadows National Wildlife Refuge, RD3, Box 540, Salem, NJ 08079
Phone: (609) 935-1487
Attitude toward preservation:

Tenant's Name:
Address:
Phone:

Surface Features: None

Prominent Landmarks: None

Vegetation Cover: Low scrub and brush

Nearest Water Source: wetlands

Distance: circa 100 feet north and west of site

Soil Type: Mattapex (MqA)

Erosion: No

Stratified (if known): ——————

THREAT OF DESTRUCTION (if known): Scheduled for wetlands creation by Philadelphia District United States Army Corps of Engineers.

PREVIOUS WORK (list below):

By whom	Date	Collection Stored	Previous Designation
Heite & Heite (Preliminary Cultural Resource Reconnaissance in Conjunction with Comprehensive Navigation Study, Delaware River, Delaware and New Jersey).	1986		

(Prehistoric & Historic loci identified during Heite & Heite survey in close proximity of 28-SA121 includes 28-SA-65, 28-SA-66, 28-SA-67 & 28-SA-68)

Recorders Name: Joel S. Dzodin / GAI Consultants, Inc.
Address: 570 Beatty Rd., Monroeville, PA 15146
Phone: (412) 856-6400
Collection stored: NJ State Museum, Trenton
Date recorder at site: September 19, 1992

(Please complete reverse side)

SITE REGISTRATION PROGRAM
NEW JERSEY STATE MUSEUM
Bureau of Archaeology
205 West State Street
Trenton, N.J. 08625
(609) 292-8594

SITE NO.: 28-SA-122
Site Name: Salem Wetlands Site #2
Atlas Coordinates:
U.S.G.S. Coordinates: N4384360E454540
National Register Status:
State Register Status:
Date:
File:

County: Salem

Municipality: Pennsville

Location (descriptive):
Located in the Supawna Meadows National Wildlife Refuge, approx. 1800 feet south of Lighthouse Road.

Period of Site: Late Woodland

Type of Site:

Cultural affiliation(s) (if known): Minguannan (tentative)

Owner's Name: U.S. Fish and Wildlife Service
Address: Supawna Meadows National Wildlife Refuge, RD3, Box 540, Salem, NJ 08079
Phone: (609) 935-1487
Attitude toward preservation:

Tenant's Name:
Address:
Phone:

Surface Features: None

Prominent Landmarks: None

Vegetation Cover: Low scrub and brush

Nearest Water Source: Wetlands

Distance: circa 100 feet

Soil Type: Mattapex (MqA)

Erosion: No

Stratified (if known):

THREAT OF DESTRUCTION (if known): Scheduled for wetlands creation by Philadelphia District United States Army Corps of Engineers.

PREVIOUS WORK (list below):

By whom	Date	Collection Stored	Previous Designation
Heite & Heite	1986		

(Preliminary Cultural Resource Reconnaissance in Conjunction with Comprehensive Navigation Study, Delaware River, Delaware and New Jersey) (Prehistoric & Historic loci identified during Heite & Heite survey in close proximity to 28-SA-122 includes 28-SA-65, 28-SA-66, 28-SA-67 & 28-SA-68)

Recorders Name: Joel S. Dzodin
Address: 570 Beatty Rd., Monroeville, PA 15146
Phone: (412) 856-6400
Collection stored: NJ State Museum, Trenton
Date recorder at site: September, 1992

(Please complete reverse side)

SITE REGISTRATION PROGRAM
NEW JERSEY STATE MUSEUM
Bureau of Archaeology
205 West State Street
Trenton, N.J. 08625
(609) 292-8594

SITE NO.: 28-SA-123
Site Name: Salem Wetlands Site #3
Atlas Coordinates:
U.S.G.S. Coordinates: N4384140E45446
National Register Status:
State Register Status:
Date:
File:

County: Salem

Municipality: Pennsville

Location (descriptive):
Located in the Supawna Meadows National Wildlife Refuge, approx. 2200 feet south of Lighthouse Road.

Period of Site: Late Woodland (Based on diagnostics from nearby sites 28-SA-121 & 122)

Type of Site:

Cultural affiliation(s) (if known):

Owner's Name: U.S. Fish and Wildlife Service
Address: Supawna Meadows National Wildlife Refuge, RD3, Box 540, Salem, NJ 08079
Phone: (609) 935-1487
Attitude toward preservation:

Tenant's Name:
Address:
Phone:

Surface Features: None

Prominent Landmarks: None

Vegetation Cover: Low scrub and brush

Nearest Water Source: Wetlands

Distance: circa 100 feet

Soil Type: Mattapex (MaA)

Erosion: No

Stratified (if known): ——

THREAT OF DESTRUCTION (if known): Scheduled for wetlands creation by Philadelphia District United States Army Corps of Engineers.

PREVIOUS WORK (list below):

By whom	Date	Collection Stored	Previous Designation
Heite & Heite (Preliminary Cultural Resource Reconnaissance in Conjunction with Comprehensive Navigation Study, Delaware River, Delaware and New Jersey)	1986		

(Prehistoric & Historic loci identified during Heite & Heite survey in close proximity to 28-SA-123 includes 28-SA-65, 28-SA-66, 28-SA-67, & 28-SA-68)

Recorders Name: Joel S. Dzodin / GAI Consultants, Inc.
Address: 570 Beatty Rd., Monroeville, PA 15146
Phone: (412) 856-6400
Collection stored: NJ State Museum
Date recorder at site: September, 1992

(Please complete reverse side)

APPENDIX D

ARCHITECTURAL SURVEY FORM

DEF-054
8/86

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
OFFICE OF NEW JERSEY HERITAGE
INDIVIDUAL STRUCTURE SURVEY FORM

HISTORIC SITES INVENTORY NO

HISTORIC NAME: Urion/Hill Farm: "Pleasant Hill"
COMMON NAME: Yerkes Farm
LOCATION: Along dirt road, ca.3200 ft. S. of Lighthouse Rd., ca.5300 ft. E. of Fort Mott Rd.
BLOCK/LOT
MUNICIPALITY: Pennsville Township
COUNTY: Salem
USGS QUAD: Delaware City, Del.-N.J.
UTM REFERENCES
Zone/Easting/Northing
OWNER/ADDRESS: U.S. Fish and Wildlife
Supawna Meadows National Wildlife Refuge, RD 3
~~Box 540, Salem, N.J.~~

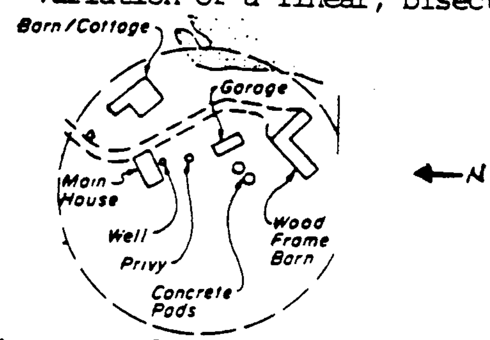
DESCRIPTION

Construction Date: Pre-1849
Source of Date: 1849, 1861, 1876 maps

Architect: Unknown
Builder: Unknown

Style: Vernacular

Form/Plan Type:
House: Central hall, I-house with kitche[n]
lean-to addition along east elevation.
Farmstead: Variation of a linear, bisect[ed]
plan.



Number of Stories: 2½

Foundation: Cemented stone-original; brick.
Kitchen addition: concrete block.

Exterior Wall Fabric: Aluminum-siding.

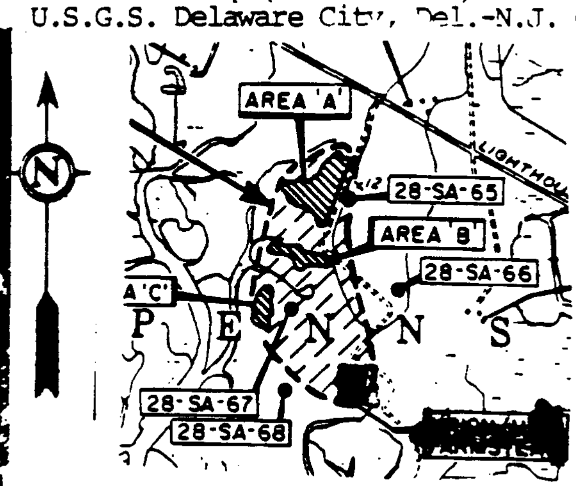
Fenestration: 5 x 2 bays; 2/2 sash.

Roof/Chimneys: Asphalt-shingled, gable roof/
two internal end brick chimneys. Dormers.

Additional Architectural Description:
Three building phases:
Hand-hewn sills beneath two rooms associated with brick basement floor and cemented granite foundation, apparently original, may date as early as eighteenth century
Bay window on northern facade associated with concrete basement floor and brick foundation, Victorian date
Kitchen addition with concrete block foundation, early twentieth century
One staircase located in original central part of structure; another, spiral, located adjacent to kitchen addition
Fireplaces mostly Victorian; one fireplace mantel in attic exhibits punch-and-gouge technique popular in mid-nineteenth century

PHOTO
Negative File No. B&W Roll 1, Frame

Map (Indicate North)
U.S.G.S. Delaware City, Del.-N.J. Quad



NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
CN 404, TRENTON, NEW JERSEY 08625 (609) 292-2023

SITING, BOUNDARY DESCRIPTION, AND RELATED STRUCTURES.

In addition to farmhouse, there is a well and several outbuildings, including a barn/cottage, large frame barn, garage, and privy (see attached sheets for further description).

SURROUNDING ENVIRONMENT: Urban ☐ Suburban ☐ Scattered Buildings ☐
Open Space ☐ Woodland ☐ Residential ☐ Agricultural ☒ Village ☐
Industrial ☐ Downtown Commercial ☐ Highway Commercial ☐ Other ☐

SIGNIFICANCE:

The farmstead was associated with a prominent local public servant, Samuel Urion, during the mid to late nineteenth century. Structure's location is depicted on the 1849 map, and is identified on the 1861 map as "S. Urion" and "Pleasant Hill". Architectural details (e.g., hand-hewn sills) suggest that the farmhouse may date as early as the eighteenth century.

ORIGINAL USE: Residential/Agricultural PRESENT USE: House abandoned/Supawna Me NWR
PHYSICAL CONDITION: Excellent ☐ Good ☒ Fair ☐ Poor ☐
REGISTER ELIGIBILITY: Yes ☐ Possible ☒ No ☐ Part of District ☐
THREATS TO SITE: Roads ☐ Development ☐ Zoning ☐ Deterioration ☐
No Threat ☒ Other ☐

COMMENTS:

Area to north is proposed for wetland creation and restoration by the Philadelphia District Army Corps of Engineers.

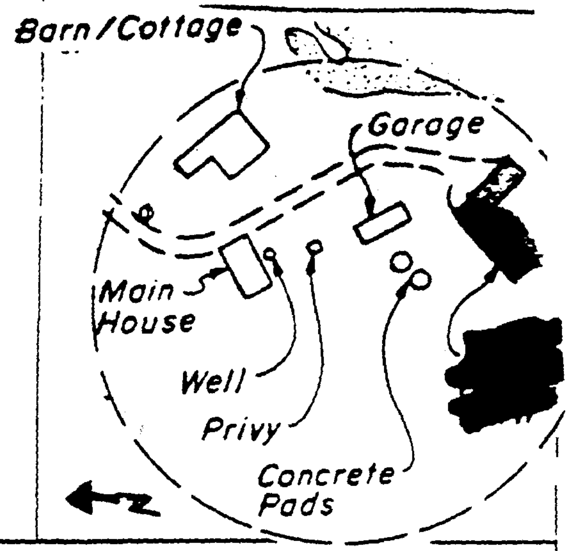
REFERENCES:

Butcher, Robert, Salem County Historian, 1992 Personal Communication.
Everts & Stewart, 1876, Combination Atlas of Salem and Gloucester Counties, New Jersey.
Lake & Beers, 1861, Map of the Vicinity of Philadelphia and Camden.
Stansbie & Keiley, 1849, Map of Salem and Gloucester Counties, New Jersey.

RECORDED BY: Ben Resnick DATE: 11/92
ORGANIZATION: GAI Consultants, Inc.
Monroeville, PA

INVENTORY #

NEG. FILE #



ESCRIPTION:

ENVIRONMENTAL

Residential/Agricultural

BUILDINGS

Large frame barn:

Transverse, 3 x 3 bay, verical plank, on concrete pier foundation, with corrugated tin roof

Some barn sills set directly on the ground surface

Northern elevation appears original; contains sockets for floor joists and center posts set directly in ground. Northwest coner contains pegged corner post and downbrace.

Apparent addition, located to the south, contains center posts set into concrete piers and a concrete and cinderblock foundation

Wooden pegs observed in both original and addition sections

Two large doors are located along north and esat facades

Embrasure in the upper gable end to accomodate the loft

Appears to date from mid-to-late nineteenth to early twentieth century

SECONDARY BUILDINGS SURVEY FORM

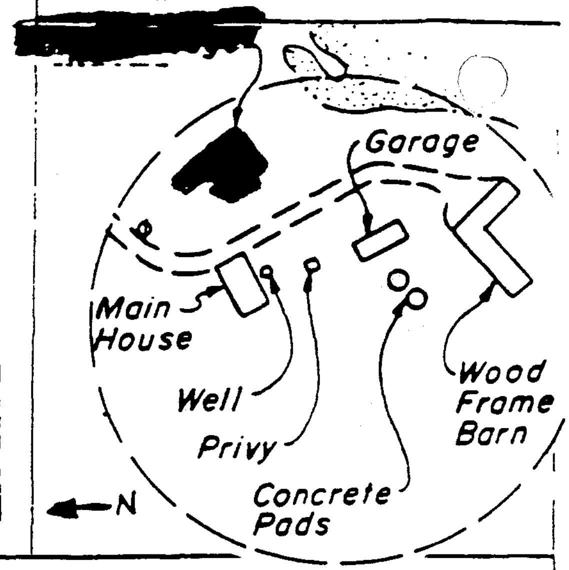
SURVEY: GAI Consultants, Inc.

DATE: 11/92

HOTO B&W Roll 2, Frame 9

INVENTORY #

NEG. FILE #



ESCRIPTION:

ENVIRONMENTAL

Residential/Agricultural

BUILDINGS

Barn/Cottage:

Barn is original structure, situated in central portion of building

Barn is wooden-pegged in several locations, contains clapboard siding, an asphalt shingled gable roof, and two large doors along its west elevation

Barn was modified in the interior to serve as a cooler for Hill Brothers' meat business in early twentieth century

Apparent chicken pen attached to northern elevation

Cottage is a modern, residential, lean-to addition, located along the south facade

Cottage contains a concrete foundation, aluminum siding, and a corrugated tin roof

An earlier lean-to addition, containing a brick chimney at its northeast corner, is situated along the east facade

SECONDARY BUILDINGS SURVEY FORM

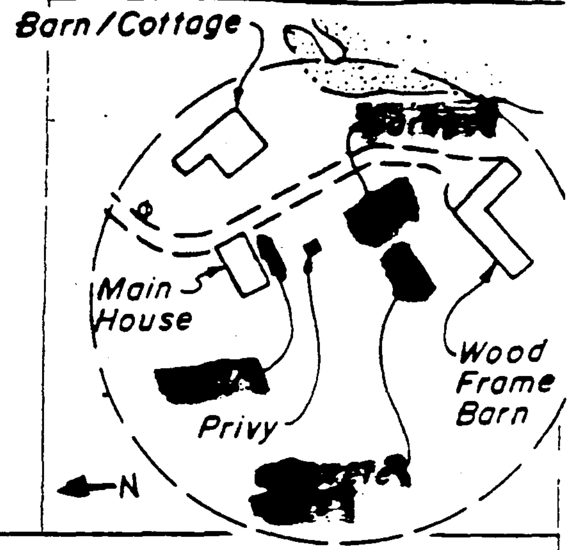
SURVEY: GAI Consultants, Inc.

DATE: 11/92

HOTO B&W Roll 4, Frame 9

INVENTORY #

NEG. FILE #



ESCRIPTION:

ENVIRONMENTAL

Residential/Agricultural

BUILDINGS

Other structures include a well, modern aluminum garage, two circular concrete pads that ostensibly served as silo foundations.

SECONDARY BUILDINGS SURVEY FORM

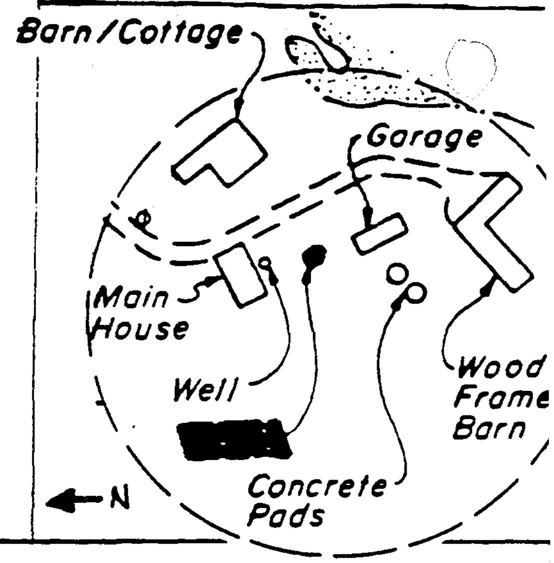
SURVEY: GAI Consultants, Inc.

DATE: 11/92

HOTO B&W Roll 2, Frame 10

INVENTORY #

NEG. FILE #



ESCRIPTION:

ENVIRONMENTAL

Residential/Agricultural

BUILDINGS

Privy:
Cinderblock, concrete foundation, sheet tin over plank roof
Apparently used until early 1950s

SECONDARY BUILDINGS SURVEY FORM

SURVEY: GAI Consultants, Inc.

DATE: 11/92

APPENDIX E

SCOPE OF WORK

SCOPE OF WORK
PHASE 1 CULTURAL RESOURCES INVESTIGATION
SALEM RIVER NAVIGATION PROJECT
SALEM COUNTY, NEW JERSEY

I [illegible]

The U.S. Army Corps of Engineers, Philadelphia District, has prepared plans to improve the Salem River channel to better accommodate current and future shipping traffic from Salem, New Jersey to the Delaware River. These plans call for deepening the 12 foot MLW channel to 18 feet, widening selected channel and bend locations not to exceed 260 feet in width and turning basin construction. Mitigation for shallow and wetland areas lost during project construction includes wetland creation and restoration within a 15 acre project area.

The services to be provided under this contract are those required to conduct a Phase 1 cultural resources survey, including both documentary and field investigations, according to the procedures and timetable specified below, and to furnish both an interim draft finding and a final professional quality report. This investigation involves documentary research, geomorphological analysis, ground surface inspection, subsurface testing, analysis and report preparation. This contract is to be accomplished to meet both the letter and the spirit of the National Historic Preservation Act of 1966, Advisory Council regulations (36 CFR 800) and Corps of Engineers regulations pertaining to Section 106 compliance.

This investigation must be conducted under the direct supervision of qualified individuals who meet, at a minimum, the appropriate qualifications presented in "Professional Qualifications" (36 CFR Part 66, Appendix C) and be preformed with reference to and consistent with the principles and standards contained in "Archeology and Historic Preservation; the Secretary of the Interior's Standards and Guidelines". The investigation should be planned, conducted and summarized according to the system of statewide "historic contexts" established by the Office of New Jersey Heritage as part of <u>The New Jersey Historic Preservation Plan</u>.

II. Project Area

The project area is a 14.8 acre section of the Supawna Meadows National Wildlife Refuge located in Pennsville Township, Salem County, New Jersey and lies approximately 4 miles northwest of Salem City, New Jersey (see Enclosures 1 and 2). The project area contains 8.4 acres of uplands and 6.4 acres of wetlands. These areas exhibit gently rolling topography containing small wooded lots, wetlands covered in phragmites, and once cultivated fields now planted in clover. A farmstead complex containing a house, barn and various ancillary structures is located adjacent to the project area.

III. Required Investigations

A. The contractor shall conduct Phase IA Documentary Research into the environmental and human history of the project area. The focus of the research should be to find information that indicates whether or not prehistoric or historic sites may once have been located in the project area and whether or not such sites may still be present. The contractor will conduct geomorphological analysis to interpret existing topography and reconstruct historic settlement, land-use, and modern development for the project area. At minimum, information gathered during documentary research will be analyzed to determine the following:

1) The potential that prehistoric and/or historic period sites may once have been present in the study area (e.g. historic maps may show structures that were present in the study area at one time)

2) The likelihood that any sites present in the past would still be present today, given any documented alterations to the landscape (e.g., filling in of lands, road construction, excavation of material) that have occurred over the years;

3) The location, description and extent of previously known prehistoric and/or historic sites within, or immediately adjacent to, the area under investigation;

B. The contractor will develop a Research Design using documentary research data, geomorphological analysis, land-use data and current site condition information to produce appropriate surface/subsurface field survey strategies for the investigation of specific project areas.

C. The contractor will conduct a Phase IB Field Investigation of the project area based on the strategies proposed in the Phase IA research design. At minimum, the areas to be shovel tested include 8.4 acres of uplands and, depending on the results of the research design, possibly some limited shovel testing in the wetland areas. All subsurface testing is to be conducted in accordance with the following specifications:

1) Shovel testing must be conducted at no greater than 50 foot intervals.

2) If archaeological resources are encountered, closer interval shovel testing will be required to clearly establish site boundaries and the nature of subsurface deposits.

3) Testing must be done by shovel or trowel. No mechanical equipment is to be used, unless first cleared, in writing, by the Corps.

4) All shovel test pits will be backfilled. Sod, if present, must be carefully removed and replaced.

5. Shovel tests must be excavated down to culturally sterile soils. A soil auger may be used, if necessary, to extend shovel tests to the required depth.

6. Soils excavated from each test should be screened through 1/4" hardware mesh.

7. Soil strata will be described with reference to the Munsell Soil Color Chart.

8. All shovel tests will be backfilled the same day they are excavated.

9. Any areas used for screening of dirt or used for any other purpose will be restored as near as possible to original condition.

10. All shovel tests must be carefully plotted on a map. Detail notes will be kept of any features or artifacts discovered.

11. Full documentation of all phases of testing is required in record photographs and drawings. All photographs and negatives shall be systematically documented as to date, location, vantage point, and subject of the photograph. Each site shall be photographed from at least two viewpoints.

12. All artifactual materials recovered must be retained until this contract is complete.

13. In the event that a site is identified during Phase 1B fieldwork, the location and boundaries of the site must be clearly delineated on USGS 7.5' quadrangle and appropriately scaled project maps. If any features or potentially important cultural deposits are identified, the Contractor shall immediately notify the Corps archaeologist. All cultural resources located during this survey must be documented with black & white photographs and color slides, field notes and relevant State of New Jersey site survey forms (architectural and/or archeological).

D. At minimum, the contractor will record the existing farmstead according to the following:

1. Prepare a general architectural description narrative for each standing building within the farmstead complex.

2. Photograph the principal elevations of each standing structure on the farmstead with B/W print film. General views of the entire farmstead complex is appropriate. A completed Office of New Jersey Heritage architectural survey form is required.

E. The contractor will [redacted] to [redacted] criteria for listing on the National Register of [redacted] 36 CFR Part 60). If cultural resources are present which do not meet National Register eligibility, the reasons should be stated.

F. The contractor will discuss [redacted] resources. Project impacts will be outlined in a Mitigation Plan Report (in preparation).

IV. Analysis and Report Production

A. The contractor shall undertake an analysis of all evidence uncovered during field evaluation and testing, including any necessary laboratory analyses. The analysis should be at a level sufficient to document potential National Register eligibility.

B. The contractor shall wash, sort, and if necessary, label with the appropriate state accession number, any artifacts recovered during the Phase 1B study. Prehistoric artifacts are to be organized into material types and functional classes (e.g., lithic tools, debitage, prehistoric pottery) and identified as to temporal and cultural affiliation, if possible. Historic artifacts shall be separated into various material groups including ceramics, glass, metal, faunal, etc. These artifacts must be cataloged according to established typologies using the class-type-variety method. All historic proveniences should be assigned date ranges based on the presence of diagnostic artifacts (e.g., bottle technological attributes, ceramic types). Selected proveniences may also be tabulated according to functional categories for more detailed analyses of assemblages. All recovered artifacts will be processed according to appropriate state agency/museum curation and storage standards. Prior consultation with the New Jersey State Museum concerning minimum curation standards is required.

C. The Contractor shall provide the Corps with the required number of copies, as specified in Section VI below, of a draft report and final report of this investigation. A written narrative of the results of the documentary and field investigations will be of sufficient scope and detail to address the nature and potential significance of any prehistoric or historic resources encountered in the project area.

V. Consultation/Liaison

A. Telephone contact will be maintained with the District archaeologist to report work performed and to discuss any problems which might impede meeting the schedule.

B. When justified, meetings will be held at the request of the Contractor or the District archaeologist. The Government reserves the right to schedule meetings with the contractor upon 24 hour notice. The District archaeologist only will coordinate meetings and any other interaction with the State Historic Preservation Officer and the Advisory Council on Historic

Preservation. [redacted] the State Historic Preservation Officer without the cons[redacted]

C. The Contractor will notify the Philadelphia District immediately if a burial is encountered. Excavation shall stop immediately and all efforts shall be undertaken to stabilize human remains in the field. Any losses caused by disregard of this stricture shall be fully the responsibility of the Contractor.

VI. Schedule of Work and Deliverables

The following schedule will be adhered to unless modified by the Corps.

A. The work under this contract shall start within two weeks of receipt of the Notice to Proceed.

B. Draft Report. Three copies of the draft report shall be delivered to the Corps within 6 weeks of the start of the contract. The draft report shall be a polished product and an accurate representation of the content of the final report. The draft shall include a description and interpretation of total site data. The draft must be clean typed, complete with all figures, tables, and sections of the report. Photographs and graphics shall be included to show details of sites, features, profiles, artifacts or other evidence of human occupation. Photographs, plates, drawings, and other graphics shall appear in the same size, format, and general location in the draft report as they will appear in the final report. The draft report will be reviewed by the Corps and the SHPO. A draft report will not be acceptable for review if, in the opinion of the Corps, it is not a complete draft, if it has not been properly edited, or if it does not conform to professional standards. Should the draft report not be acceptable, any additional costs to bring the report to acceptable standards will be at the contractor's own expense.

C. Final Report. The final report shall incorporate review comments submitted to the Contractor by the Corps. The Corps may request any changes necessary to meet contract or professional requirements. One reproducible, unbound and one bound original (with black and white photographs) and 3 copies of the final report must be submitted. A complete set of negatives must also be submitted. Due date for delivery of the final report is contingent upon the timing of the review of the draft. However, unless otherwise agreed upon, the final report copies are due 30 days after receipt of Corps review comments for the draft report.

VII. Report Format and Content

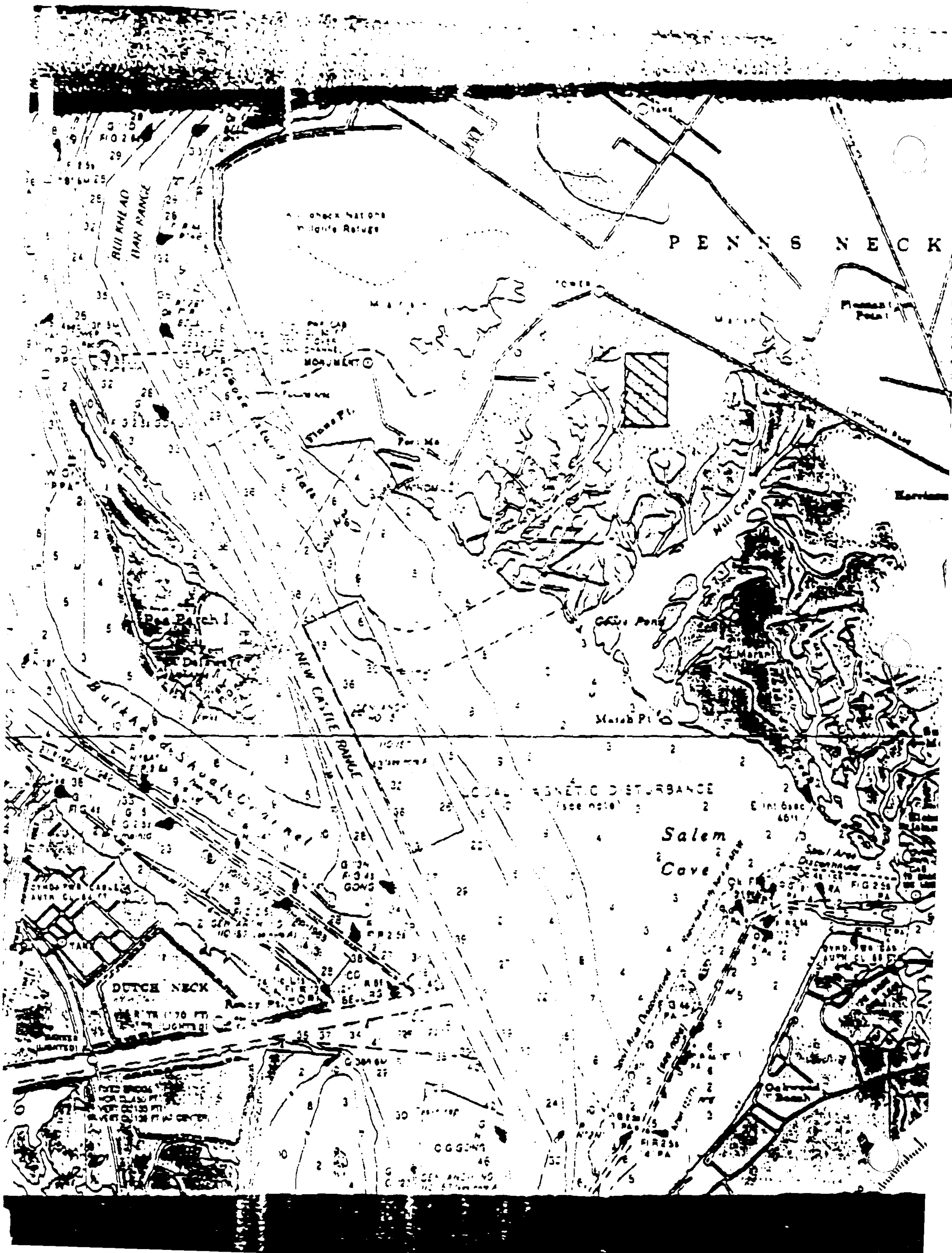
Draft and final copies of the report of investigations shall reflect and report the analysis outlined in Required Investigations. They shall be prepared with reference to and consistent with the principles and standards contained in "The Office of New Jersey Heritage Guidelines for the Preparation of Cultural Resources Management Archaeological Reports" (May, 1990). Strict adherence to the format requirements of the Office of New Jersey Heritage is a prerequisite for approval of the draft and final report.

VIII POINTS OF CONTACT

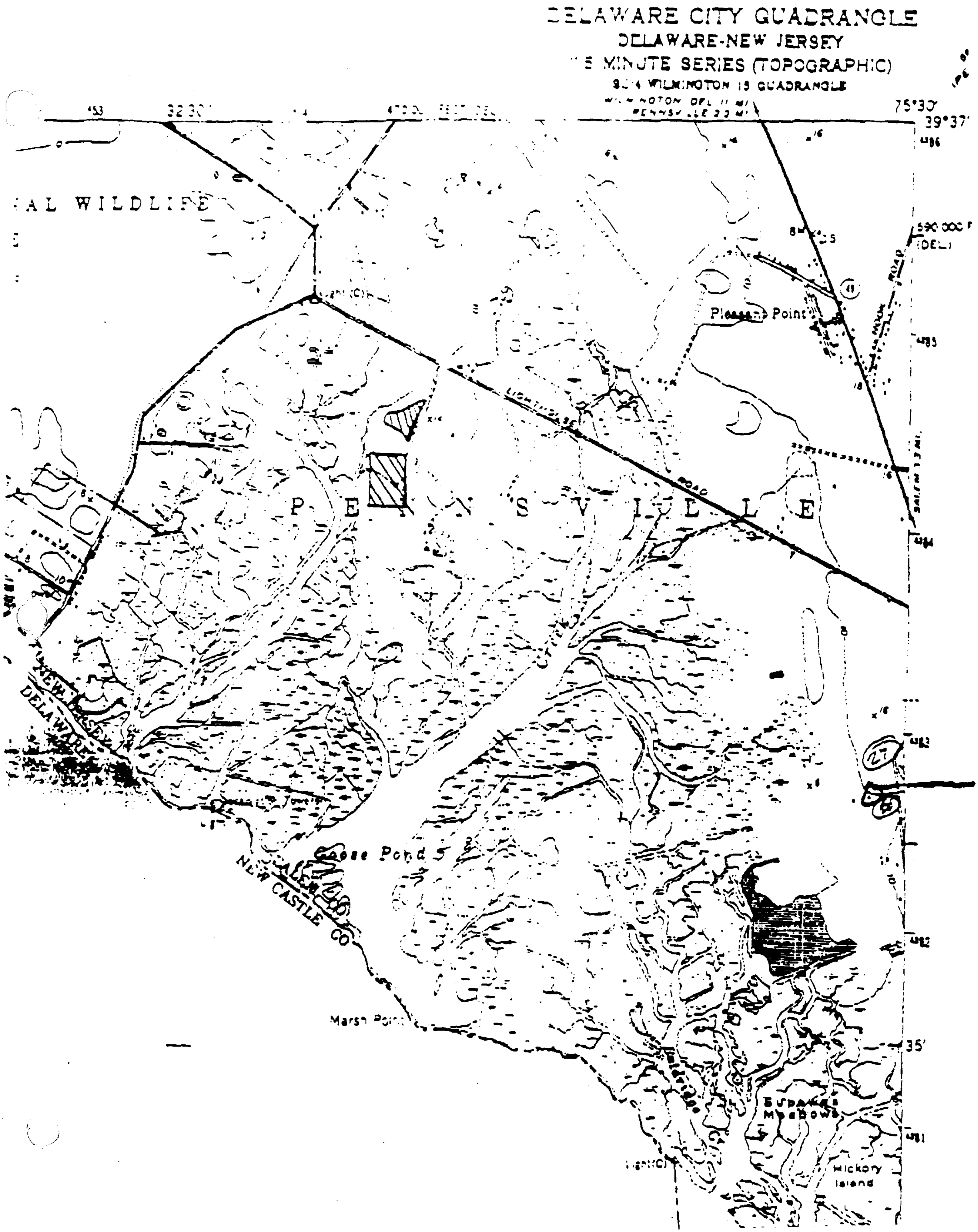
A. U.S. Army Corps of Engineers, Philadelphia District.
Michael Swanda (215) 656-6556.

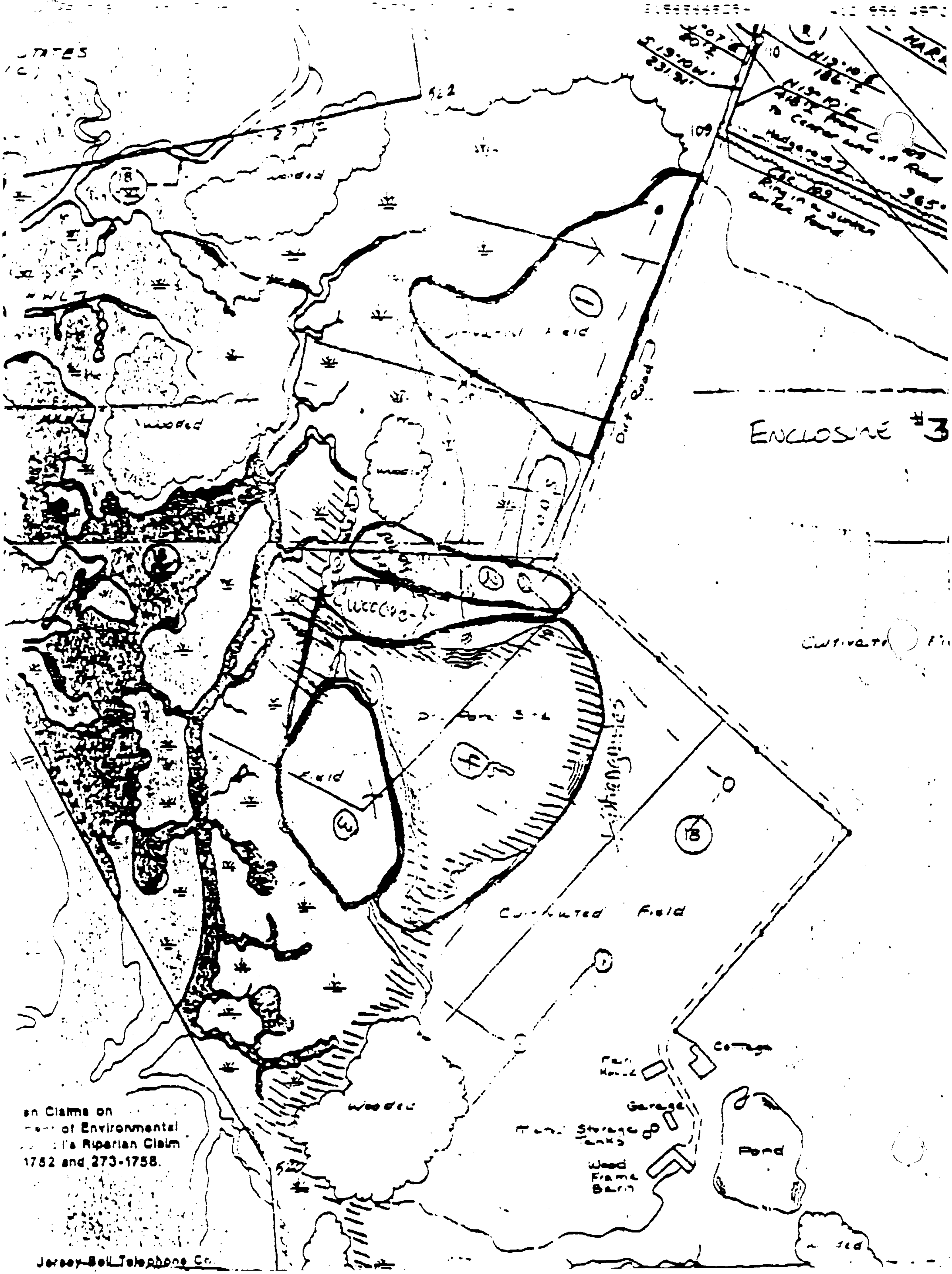
B. Office of New Jersey Heritage, Trenton.
Jonathan Gell, (609) 292-2023.

C. New Jersey State Museum, Trenton
Karen Flinn, (609) 292-8594.

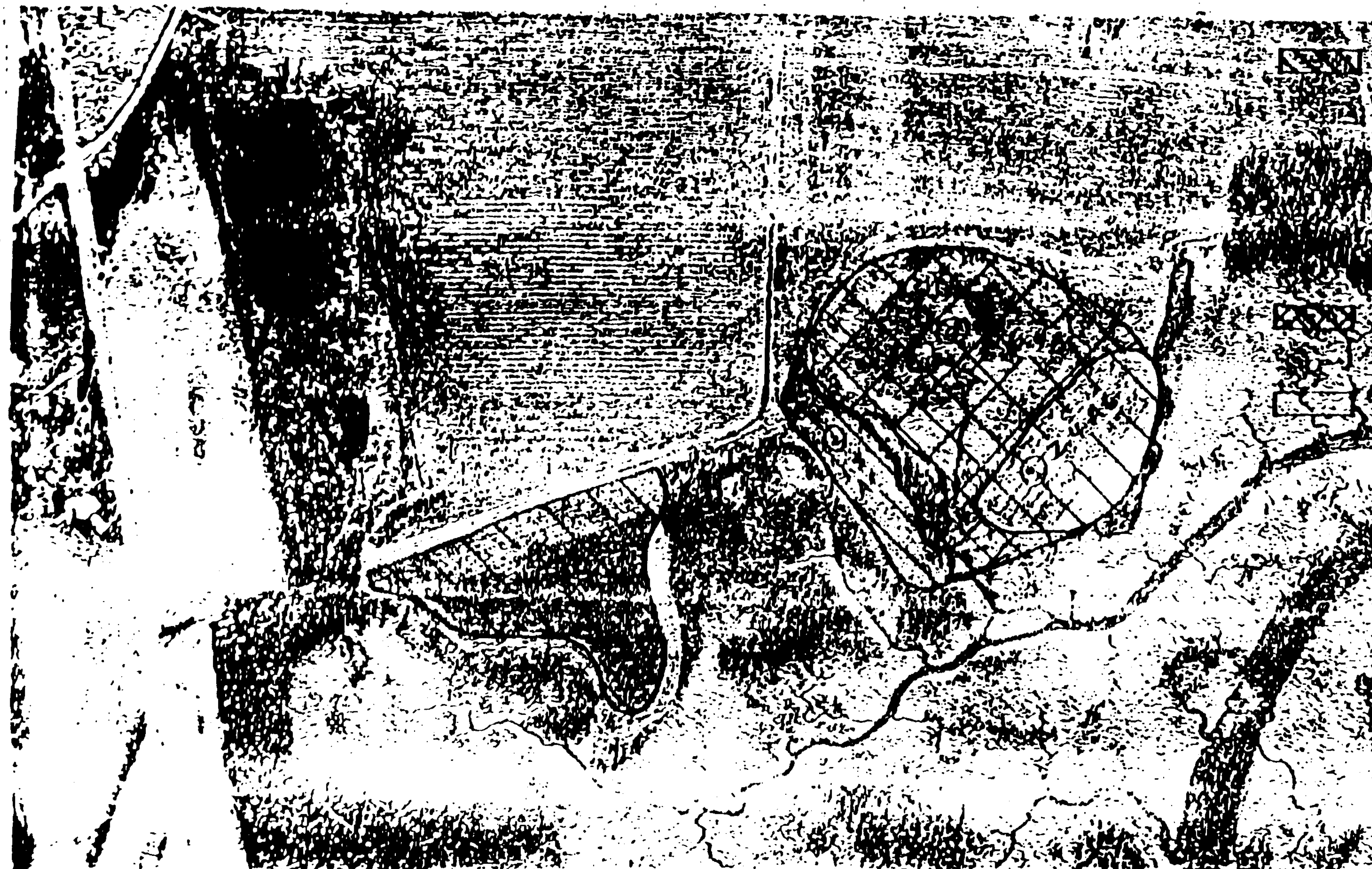


PENNS NECK
BULKHEAD BAR RANGE
MONUMENT
Pea Patch I.
NEW CASTLE RANGE
Mill Creek
Marsh
Salem Cove
DUTCH NECK
GONG


DELAWARE CITY QUADRANGLE
DELAWARE-NEW JERSEY
MINUTE SERIES (TOPOGRAPHIC)
WILMINGTON 15 QUADRANGLE
75°30'
39°37'
AL WILDLIFE
Pleasant Point
PENNSVILLE
ROAD
NEW JERSEY
DELAWARE
Goose Pond
SALEM CO
NEW CASTLE CO
Marsh Point
35'
Hickory Island



ENCLOSURE #3
Wooded
Dirt Road
Cultivated Field
Field
Cottage
Garage
Storage Tanks
Wood Frame Barn
Pond
Jersey Bell Telephone Co.
...an Claims on
...of Environmental
...'s Riparian Claim
1752 and 273-1758.



SALEM RIVER SHALLOWS/WETLANDS MITIGATION PLAN 7-8-92 BFM

Wetlands Creation at 1:1 (AC) for wetlands/shallows lo
Wetland Restoration at 2:1 (AC) for wetlands/shallo
lost

SALEM RIVER MITIGATION PLAN

Project: The project requiring the proposed mitigation is the Delaware River Comprehensive Navigation Study, Salem River, Salem County, Salem, New Jersey. The proposed plan of improvement for the Salem River navigation channel consists of widening and deepening the existing channel through dredging operations. This action will result in the loss of 3 acres of estuarine intertidal emergent wetlands and 8.6 acres of shallow water habitat.

Mitigation Size and Location: The mitigation site is to be constructed on a 14.8 acre section of the Supawna Meadows National Wildlife Refuge, Salem, New Jersey (Figure 1). The mitigation will be accomplished by the creation of 8.4 acres of estuarine intertidal emergent wetlands from existing uplands and the restoration of 6.4 acres of wetlands from wetland areas which are presently dominated by monotypic stands of *Phragmites australis*.

Tide Information: The mean high water elevation at the proposed site is 4.0 feet n.g.v.d. The tidal range in this area is 5.5 feet using the mean low water datum and 5.6 feet using mean lower low water datum. A time correction of 10 minutes (for high ti[illegible] can be added to the predictions for Reedy Point, Delaware (nearest NOAA station), to obtain tide information for the mitigation site. Some of the existing channels on site will be modified and new channels constructed, if necessary, in order to carry water to the site to properly inundate the wetlands that will be created and restored.

Water Salinity: On May 18, 1992, the salinity of the water at the proposed mitigation site was measured at 1.0 part per thousand. Somewhat higher salinities can probably be expected at the site, depending on weather conditions and the time of the year. For this reason, it was determined that brackish tolerant emergent plantings should be used at this location. Based on site investigations which observed only brackish to somewhat freshwater emergent plant communities in the vicinity of the mitigation area, it was determined that plantings tolerant of salinities between at least 1 and 5 ppt. should be used for this project.

Plantings: Based on the salinity tolerances discussed above, the following plants meet the criteria for planting on this site:

Peltandra virginica	Arrow arum
Scirpus pungens	Common threesquare
Spartina cynosuroides*	Big cordgrass
Acorus calamus*	Sweet flag
Scirpus validus*	Soft stemmed bulrush
Hibiscus moscheutos*	Marsh hibiscus

*These plants will be located at the higher elevations near

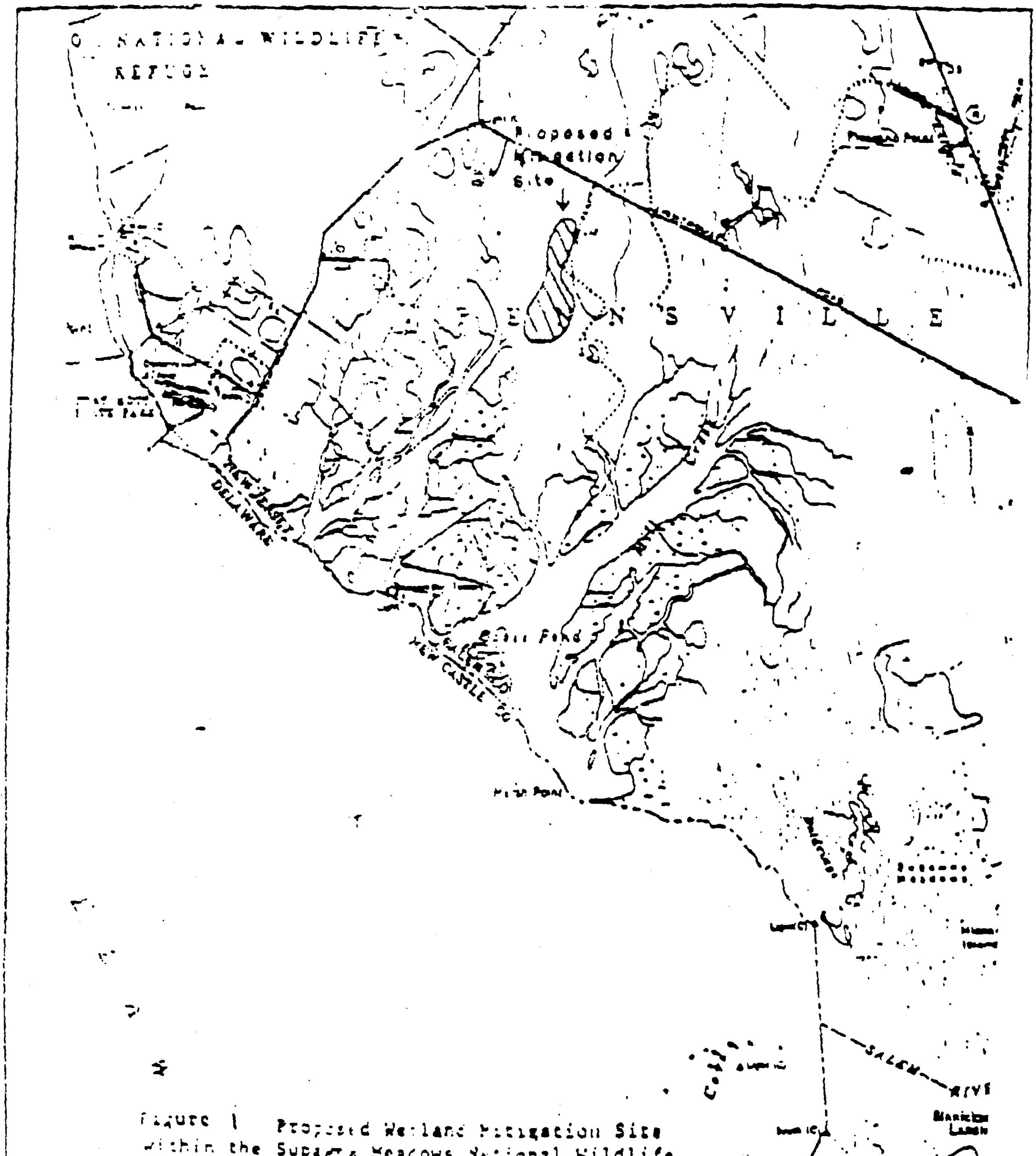


Figure 1 Proposed Wetland Mitigation Site within the Supawna Meadows National Wildlife Refuge.

mean high water along the edge of the mitigation site.

The above mentioned plants will be planted in a 3' X 3' planting grid with the _Peltandra virginica_ being the most prominent species planted, especially in the areas with the lower 2.5' elevation.

Excavation and Grading: It will be necessary to excavate approximately 61,443 cubic yards (cy) of material from the proposed mitigation site to create and restore the desired 14.8 acres of wetlands. In order to create wetlands from uplands, approximately 52,150 cy of material will have to be removed to bring this portion of the site to the elevation of 2.9 feet n.g.v.d. In this area plantings of _Scirpus pugens_ (common threesquare) and _Scirpus validus_ (soft stemmed bulrush) will be done. The wetland restoration will require the excavation of approximately 9,293 cy of material to bring the elevation to 2.5 feet. This area is being graded to a lower elevation to help eliminate the presence of _Phragmites australis_ by eliminating the dense root mats which reach depths of at least 18 inches or more in this location. In addition, the lower grade will allow a greater inundation of water which should help to control the _Phragmites australis_ once the mitigation is complete. This elevation also represents the middle growing range of _Peltandra virginica_ (arrow arum), which means that it should grow quite well under these conditions.

A transitional edge with a 4:1 slope will be created between the emergent wetlands and the adjacent uplands. From the lower design grades to slightly above the mean high water line, species such as big cordgrass, sweet flag, soft stemmed bulrush and marsh hibiscus will be planted. The abrupt slope along the wetland/upland transitional edge will help to limit the invasion of the _Phragmites australis_. To further minimize this possible invasion, the herbicide Rodeo will be sprayed on the areas to be restored prior to excavation.

Site Plan: As stated previously, 14.8 acres of wetlands will be created and restored to mitigate for the 3 acres of wetlands and 8.6 acres of shallow water habitat that will be lost during the modifications to the Salem River navigation channel. Through coordination with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service it was determined that wetland creation would be done on a 1:1 replacement ratio while the wetland restoration will be done on a 2:1 replacement ratio. Based on these ratios it was determined that 8.4 acres of creation will be done at a 1:1 ratio (8.4 acres total) and that 3.2 acres of restoration will be done at a ratio of 2:1 (6.4 acres total).

The mitigation site will be split into two sections with 4.5 acres of created wetlands making up one section and 6.4 acres of restored wetlands and 2 areas of created wetlands, measuring 1.5

was split into two sections to help to maximize the benefits gained from the mitigation and to avoid the cultivated clover fields which the U.S. Fish and Wildlife Service maintains on the site.

Monitoring: A post-planting monitoring plan will be conducted twice yearly, once during the month of June and than again during the month of September. These sampling dates will allow for the documentation of both the annual and the perennial components of the plant communities. The post-monitoring plan will continue for a minimum of 5 growing seasons following the completion of all wetland creation and restoration activities. It is required that the site attains a minimum vegetative coverage survival of 85% of the distributed area after the first complete growing season. Failure to achieve this survival rate will require the arrangement of a meeting with the involved agencies to examine the causes of failure and develop a remediation plan.

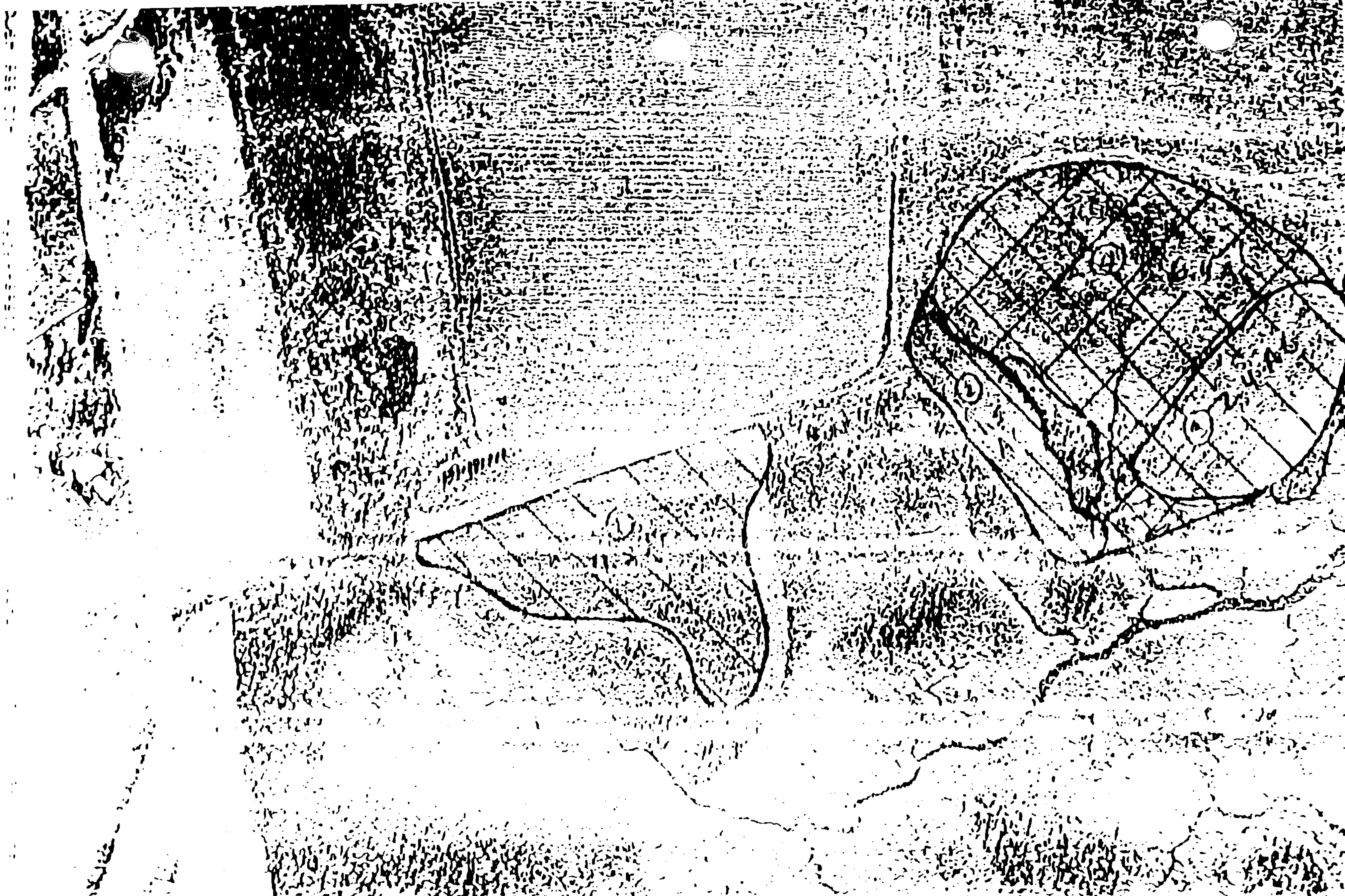


Figure 2
ALEIN RIVER SHALLOWS/ WETLANDS MITIGATION PLAN

WETLAND CREATION (2.9' ELEVATION
WETLAND RESTORATION (2.5' ELEVA

APPENDIX F

ANNOTATED BIBLIOGRAPHY FORM

ANNOTATED BIBLIOGRAPHY

Author(s): Benjamin Resnick, Joel S. Dzodin (GAI Consultants, Inc.)

Title: Phase I Cultural Resources Investigation of Wetland Mitigation Areas, Salem River Navigation Project, Pennsville Township, Salem County, New Jer

Location: Supawna Meadows National Wildlife Refuge, Pennsville Twp, New Jersey

Drainage Basin: Delaware River

USGS Quad: Delaware City, Del.-N.J., Photoinspected 1976

Project: Wetlands creation related to Salem River channel improvements.

Level of Survey: Phase I- background research, reconnaissance, shovel testing

Cultural Resources: 183 Shovel Test Pits excavated- no stratified deposits or intact cultural features. Low density artifact scatters in three testing locations led to the designation of three prehistoric sites: 28-SA-121 ("Area A" in report); 28-SA-122 ("Area B" in report); and 28-SA-123 ("Area C" in report). Diagnostics from Areas A and B include a Late Woodland cord-marked body sherd, tenatively identified as Minguannan, and a Levanna Point. Artifact recovery was almost exclusiv limited to the plowzone in all three sites. Lithics included chert and jasper debitage. The low-density character of artifact distribution suggests that the sites represent a series of Late Woodland procurement camps.

-Historic artifacts were also recovered in all three areas, but none were particularly diagnostic or significant. Historics were frequently recovered with prehistorics, reflecting the impacts of plowing.

-The Phase I survey also included the documentation of a nineteenth-century farmstead known as "Pleasant Hill". It includes a farmhouse, well, barn/cottage, large frame barn, garage, and privy. The complex is considered potentially eligible for th National Register of Historic Places on the basis of the architectural qualities of the farmhouse and for the property's association with Samuel Urion, a prominent mid to late nineteenth-century public servant. For this reason, it is recommended that a Phase I archaeological survey and additional architectural research be conducted before permitting any impacts to the farmstead.

APPENDIX G

RESUMES

BENJAMIN RESNICK

Lead Archaeologist

AREAS OF SPECIALIZATION

Historical archaeology; urban and mortuary archaeology. Specialized experience in the study of nineteenth-century farmsteads and plantations. Regional expertise in the mid-Atlantic states, the southeastern United States, and California. Analysis and interpretation of historic artifacts, especially ceramics, and documentary research.

EDUCATIONAL BACKGROUND

B.A. Anthropology 1980
University of Maryland

M.A. Anthropology/Public Service Archaeology 1984
University of South Carolina

EMPLOYMENT HISTORY

1989-present	GAI Consultants
1986-1989	Louis Berger and Associates, Inc.
1984-1986	Archaeological Advisory Group
1981-1984	University of South Carolina (graduate research assistantship)
1980-1981	Scientific Research Surveys, Inc.

PROFESSIONAL EXPERIENCE

Principal Investigator

- Phase IA cultural resources investigation of the North Branch of Newton Creek, Boroughs of Woodlynne and Collingswood, Camden County, NJ.
  U.S. Army Corps of Engineers, Philadelphia District
- Phase IB intensive archaeological investigations of the MD 100 wetland mitigation Buckingham Tree Nursery and Deep Run areas, Anne Arundel and Howard Counties, MD.
  Maryland Department of Transportation
- Phase IB intensive archaeological investigations of MD 228 wetland mitigation area, Charles County, MD.
  Maryland Department of Transportation
- Literature search and Phase I archaeological survey of the proposed North Huntingdon Square, North Huntington Township, Westmoreland County, PA.
  J. J. Gumberg Company
- Phase I cultural resources survey of alignment C-Prime, Kittanning By-Pass, State Route 6028, Section 015, Armstrong County, PA.
  Pennsylvania Department of Transportation
- Phase II archaeological investigations at the Legionville site (36Bv33), Harmony Township, Beaver County, PA.
  GenCorp
- Phase I archaeological survey of the access roads to the proposed Federal Bureau of Investigation sites, Simpson and Clay Districts, Harrison County, WV.
  Johnson, Johnson & Roy
- Environmental assessment - resource report 5, proposed GPU/DQE 250-mile transmission line, Beaver Falls-Three-mile Island, PA.
  GPU
- Phase I cultural resources investigations of Tract 103[illegible] Marsh Lake project area, Jefferson Township, Berks Co[illegible] PA.
  U.S. Army Corps of Engineers, Philadelphia District
- Field reconnaissance and background study, 10-mile transmission line, Cambria and Indiana counties, PA. Inter-Power of Pennsylvania, Inc.
- Archaeological survey of the Colver Reservoir expansion, Barr and Cambria townships, Cambria County, PA.
  Inter-Power of Pennsylvania, Inc.
- Literature search and preliminary archaeological reconnaissance of the proposed McDowell Shops, Peters Township, Washington County, PA.
  J. J. Gumberg Company
- Phase IA archaeological assessment of proposed Ahoskie Combustion Turbines, Ahoskie, NC.
  Virginia Electric Power Company
- Stage IA cultural resource investigation, Gateway Cathedra, Staten Island, NY.
  John W. Whitehead AIA and Associates
- Stage IA and Stage IB cultural resources study of proposed sewage improvements, Wayne Township, Passaic County, NJ.
  Township of Wayne
- Phase IA cultural resources survey, installation of propo[illegible] sewage regulators, Court and Anderson streets, Hacken[illegible] NJ.
  Clinton Bogert Associates
- Phase IA archaeological assessment of proposed Salem County Jail, Salem, NJ.
  County of Salem Board of Chosen Freeholders
- Phase I cultural resource survey, GSA Distribution Center, Burlington Township, Burlington County, NJ.
  Burlington GSA Partnership
- Phase I archaeological assessment of the proposed Submarine Electromagnetic Systems Laboratory, Naval Underwater Systems Center, New London, CT.
  Naval Facilities Engineering Command
- Phase IA archaeological assessment of the Flexivan site, Jersey city, NJ.
  U.S. Postal Service
- Phase IB archaeological investigations of the Exchange Building, New Haven, CT.
  Smith Edwards Architects
- Phase IA archaeological assessment of the Stouts Lane Development, South Brunswick, NJ.
  Hovnanian Enterprises
- Phase IA archaeological assessment of proposed prison facility, Talladega, AL.
  Department of Justice

- ... archaeological assessment of proposed prison facility, Atlanta, GA.
  Department of Justice

- Phase I testing, Lipari Landfill Superfund Offsite Remediation Area, NJ.
  U.S. Army Corps of Engineers, Philadelphia District

- Phase I and II testing, Logan Lane Site, Beaver County, PA.
  Beaver County Corporation for Economic Development

- Cultural resources investigation of the Delaware Bay Coastline, New Jersey-Delaware.
  U.S. Army Corps of Engineers, Philadelphia District

- Phase I survey of a proposed boat landing facility, Millville Hydroelectric Station, Jefferson County, WV.
  Allegheny Power Service

- Cultural resources investigation of the West Branch of Shabakunk Creek, Ewing Township, Mercer County, NJ.
  U.S. Army Corps of Engineers, Philadelphia District

- Phase I survey and testing, proposed Ford City Pipeline, Armstrong County, PA.
  T. W. Phillips Gas and Oil Company

- Phase I survey and testing, proposed pipeyard in Latimore Township, Adams County, PA.
  Texas Eastern Gas Pipeline Company

- Phase II testing, Heritage Heights Site, Howard County, MD.
  Maryland Department of Transportation

- Phase II testing, Northampton Plantation slave quarters, Largo, MD.
  Porteen Sullivan Corporation/Maryland National Capital Park and Planning Commission

- Phase I survey and testing, proposed federal correctional institution, Estill, SC.
  Department of Justice

- Phases I and II testing at 10 farmsteads, Fort Drum Military Reservation, Watertown, NY.
  National Park Service, Mid-Atlantic Region
  U.S. Army

- Phase I survey, proposed DMV Inspection Station, Winston, NJ.
  New Jersey Department of Motor Vehicles

- Phase I survey and testing, Ninth Square, New Haven, CT.
  City of New Haven

- Phase I testing, proposed Rego Park Mall, Queens, NY.
  Trump Organization

- Phase III mitigative excavation, Block 1192, Wilmington, DE.
  City of Wilmington

Field Supervisor

- Excavations of the Pio Pico Mansion State Historic Park, Whittier, CA.
  Pio Pico Docents Committee

- Excavations at the Mulberry Site, Camden, SC.
  University of South Carolina

- Archaeological Research Service Goldpoint Mapping Project, Goldpoint, NV.
  Bureau of Land Management

- Phase I survey, Upper Santa Ana Upstream Alternatives Study, San Bernadino County, CA.
  U.S. Army Corps of Engineers, Los Angeles District

- San Joaquin Hills Corridor Survey, Orange County, CA.
  County of Orange

Crew Member

- Excavation of missionized Indian burials, Santa Catalina de Guale Research Project, St. Catherine's Island, GA.
  American Museum of Natural History

- Field School in Mortuary Archaeology, Caesares Maritima, Israel.
  American School of Oriental Research

- Cultural resources reconnaissance, Federal Maintenance Dredging Project, Wicomico River East, MD.
  U.S. Army Corps of Engineers, Baltimore District

- Field School in Historical Archaeology, Alexandria, VA.
  University of Maryland

Publications

- Author or co-author of more than 40 technical reports, and several publications in historical archaeology.

Honors

South Carolina Department of Archives and History Survey and Planning Grant

Professional Affiliations

Society of Professional Archaeologists (Field Research and Historical Archaeology)
Society for Historical Archaeology
Society of American Archaeology
Southeastern Archaeological Conference
Archaeological Society of South Carolina
Council for Northeast Historical Archaeology

JOEL S. DZODIN

Senior Archaeologist

AREAS OF SPECIALIZATION

Cultural resource studies, including background research, fieldwork supervision, and report writing; laboratory analysis of archaeological materials; technical photography and videography, including macrophotography of archaeological specimens, HABS/HAER photorecordations, and the curation of historic photographic media.

EDUCATIONAL BACKGROUND

B.A.	Anthropology 1974 University of Michigan
M.A.	Anthropology 1980 Wayne State University
Doctoral Courses	Anthropology State University of New York at Binghamton

EMPLOYMENT HISTORY

1988-present	GAI Consultants, Inc.
1981-1988	Public Archaeology Facility, SUNY-Binghamton

PROFESSIONAL EXPERIENCE

Prehistoric Archaeology

- Principal investigator and/or field director for various Phase I and Phase II projects in Pennsylvania, West Virginia, and New York involving prehistoric cultural resources. Responsibilities included background research, field supervision, data analysis, and report writing.

- Archaeological Laboratory Director, Public Archaeology Facility, SUNY-Binghamton, responsible for the supervision and coordination of the laboratory processing, analysis, and curation of prehistoric artifacts recovered from various cultural resource management projects in New York.

Historic Archaeology

- Primary author and editor of a major report dealing with the mitigation of over 200 historic features on Pittsburgh's North Side. Analysis of over 47,000 eighteenth and nineteenth century artifacts.

- Analysis of mortuary artifacts recovered during the excavation of the Swiss-German Voegtly Cemetery (1830-1860) on Pittsburgh's North Side. Authorized artifact analysis sections of the Phase III project report.

- HABS/HAER recordations, including historic and technical research and large-format photography, of fixed and swing-span bridges in Pennsylvania and North Carolina.

- Principal investigator or field director for various Phase I and Phase II projects in Pennsylvania, West Virginia and New York involving historic cultural resources. Responsibilities included background research, field supervision, data analysis, and report writing.

- Archaeological Laboratory Director, Public Archaeolog Facility, SUNY-Binghamton, responsible for the coordina tion of laboratory processing, analysis, and curation c historic artifacts recovered from various cultural resourc management projects in New York.

- Staff excavator at various historic sites in Israel includin the byzantine synagogue at Ein-Gedi, Hasmonaean burials a Jericho, Tel Dan, Nabataean and Byzantine Elusia, th Byzantine synogogue of Ketzreen, Byzantine portions a Tiberias, and Iron-age Khirbet Hujah.

Professional Photography

- HABS-HAER recordations in Pennsylvania and Nortl Carolina, employing a large-format view camera fo perspective control and image quality.

- Phase II photographer of architecture, artifacts, anc stratigraphy at the eighteenth-century grist mill ruins a Simpsonville, Maryland.

- Area Supervisor and staff photographer at the SUNY-Binghamton Qsar-es-Seghir excavation and at other northern Morocco sites.

- Photographic Conservator, University of Michigan Museum of Anthropology. Created high quality archivally-stable duplicates of 5700 late nineteenth century gl plate negatives produced by the United States P pines Commission. Depicting numerous tribal groups, ritual activities, and the native flora and fauna of the islands, these photographs represent a significant historical ethnographic resource.

PUBLICATIONS

- Author of over 26 cultural resource management reports.

- Archaeological photographs for publication in six international journals and site reports.

HONORS

SUNY-Binghamton Southwest Asian and North African Studies Fellowship/Assistantship, 1980-82

Dean's Commendation for maintaining a 4.0 GPA in the Wayne State University Master's Anthropology Program, 1980

Wayne State University Graduate-Professional Scholarship, 1978-80

APPENDIX F

LOCAL COOPERATION AGREEMENT

DRAFT (9/92)

LOCAL COOPERATION AGREEMENT

BETWEEN

THE DEPARTMENT OF THE ARMY

AND

CITY OF SALEM PORT AUTHORITY

FOR CONSTRUCTION OF A NAVIGATION IMPROVEMENT AT

SALEM, NEW JERSEY

THIS AGREEMENT is entered into this _______day of ________, 1993, by and between the DEPARTMENT OF THE ARMY (hereinafter referred to as the "Government"), acting by and through the Assistant Secretary of the Army (Civil Works), and the CITY OF SALEM PORT AUTHORITY (hereinafter referred to as the "Local Sponsor"), acting by and through the Chairman of the Port Authority.

WITNESSETH, THAT:

WHEREAS, construction of the Salem River, New Jersey project, (hereinafter referred to as the "Project", as defined in Article I.a. of this Agreement), was authorized by Section 859 of the Water Resources Development Act of 1986 (Public Law 99-662), subject to section 903 (b) of that Act; and

WHEREAS, Section 101 of the Water Resources Development Act of 1986, Public Law 99-662, specifies the cost-sharing requirements applicable to the project; and,

WHEREAS, Section 221 of the Flood Control Act of 1970, Public Law 91-611, as amended, provides that the construction of any water resources project by the Secretary of the Army shall not be commenced until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project; and

WHEREAS, the Local Sponsor has the authority and capability to furnish the cooperation hereinafter set forth and is willing to participate in cost-sharing and financing in accordance with the terms of this Agreement;

NOW, THEREFORE, the parties agree as follows:

ARTICLE I - DEFINITIONS AND GENERAL PROVISIONS

For purposes of this Agreement:

a. The term "Project" shall mean the construction of all facilities necessary for the functioning of the project as provided for in the Design Memorandum dated September, 1992.

b. The term "general navigation features" shall mean the following project features as generally described in the Design Memorandum dated September 1992 and approved by the Commander, North Atlantic Division on ________ 1992: A five mile long navigation project extending from the Delaware River main channel to the Route 49 Highway bridge in Salem, New Jersey. The project includes channel deepening to 18 feet below mean low water, widening to 150-250 feet, and a 495 foot turning basin.

c. The term "total cost of construction of the general navigation features" shall mean all costs incurred by the Local Sponsor and the Government directly related to construction of the general navigation features of the Project. Such costs shall include, but not necessarily be limited to, continuing planning and engineering costs incurred after October 1, 1985; costs of applicable engineering and design; actual construction costs, including costs of relocations not performed by or on behalf of the Local Sponsor; supervision and administration costs; and costs of contract dispute settlements or awards, but shall not include the value of lands, easements and rights-of-way, and suitable borrow and dredged material disposal areas, relocations performed by or on behalf of the Local Sponsor, non-Federal dredging of public or private channels and berthing areas, and aids to navigation.

d. The term "period of construction" shall mean the time from the advertisement of the first construction contract to the time of acceptance of the general navigation features of the Project by the Contracting Officer.

e. The term "Contracting Officer" shall mean the U.S. Army Engineer for the Philadelphia District, or his designee.

f. The term "highway" shall mean any highway, thoroughfare, roadway, street, or other public or private road or way.

g. The term "relocations" shall mean alterations, modifications, lowering or raising in place, and/or new construction related to but not limited to, existing: railroads, highways, bridges, railroad bridges and approaches thereto, pipelines, public utilities (such as municipal water and sanitary sewer lines, telephone lines, and storm drains), aerial utilities, cemeteries, and other facilities, structures, and improvements determined by the Government to be necessary for the construction, operation and maintenance of the general navigation features.

h. The term "fiscal year" shall mean one fiscal year of the United States Government, unless otherwise specifically indicated. The Government fiscal year begins on October 1 and ends on September 30.

i. The term "involuntary acquisition" shall mean the acquisition of lands, easements, and rights-of-way by eminent domain.

ARTICLE II - OBLIGATIONS OF THE PARTIES

a. The Government, subject to and using funds provided by the Local Sponsor and appropriated by the Congress of the United States, shall expeditiously construct the general navigation features of the Project (including relocations of highway bridges and railroad bridges and approaches thereto), applying those procedures usually followed or applied in Federal projects, pursuant to Federal laws, regulations, and policies. The Local Sponsor will be afforded the opportunity to review and comment on all contracts, including relevant plans and specifications, prior to the issuance of invitations for bids. To the extent possible, the Local Sponsor also will be afforded the opportunity to review and comment on modifications and change orders prior to the issuance to the contractor of a Notice to Proceed. The Government will consider the comments of the Local Sponsor, but award of contracts and performance of all work on the Project (whether the work is performed under contract or by Government personnel), shall be exclusively within the control of the Government.

b. The Government shall operate and maintain the general navigation features of the Project.

c. The Local Sponsor shall provide and maintain, at its own expense, any features associated with the Project, other than the general navigation features, including assuring dredged depths in berthing areas and local access channels commensurate with depths in related general navigation features.

d. The Local Sponsor shall provide to the Government all lands, easements, and rights-of-way, including suitable borrow and dredged material disposal areas, and perform, or assure performance of, all alterations and relocations of facilities and utilities (except relocations or alterations of highway bridges and railroad bridges and approaches thereto), determined by the Government to be necessary for construction, operation, or maintenance of the general navigation features.

e. To fulfill its obligation to provide dredged material disposal areas under this Agreement, the Local Sponsor intends to use a Government owned or controlled disposal area. The Local Sponsor shall pay, prior to the award of the construction contract, a charge presently estimated at $ 0.99 per cubic yard for material dredged from the entrance channel for the terminal and placed in the Killcohook disposal area.

f. As further specified in Article VI hereof, the Local Sponsor shall provide, during the period of construction, a cash contribution equal to the following percentages of the total cost of construction of the general navigation features assigned to commercial navigation:

1. 10 percent of the costs attributable to the portion of the Project which has a depth not in excess of 20 feet;

2. 25 percent of the costs attributable to the portion of the Project which has a depth in excess of 20 feet but not in excess of 45 feet; and,

3. 50 percent of the costs attributable to the portion of the Project which has a depth in excess of 45 feet.

g. As further specified in Article VI hereof, the Local Sponsor shall repay with interest, over a period not to exceed 30 years following completion of the period of construction, an additional 0 to 10 percent of the total cost of construction of general navigation features, depending on the value of the credit, as calculated under Article IV hereof, of items provided pursuant to Article II.d. If the credit allowed for such items is less than 10 percent of the total cost of construction of the general navigation features, the Local Sponsor shall repay a percentage of said total cost equal to the difference between 10 percent of the total cost and the percentage of the total cost represented by the value of such items. If the credit allowed is equal to or greater than 10 percent of said total cost, the Local Sponsor shall not be required to repay any additional percentage of the total cost. The Local Sponsor may, at its option, prepay all or a portion of this sum any time before or during the period of construction, subject to a final determination of such sum at the time of the final accounting.

h. No Federal funds may be used to meet the Local Sponsor share of total construction costs under this Agreement unless the expenditure of such funds is expressly authorized by statute as verified in writing by the Federal granting agency.

ARTICLE III - LANDS, FACILITIES, AND PUBLIC LAW 91-646

RELOCATION ASSISTANCE

a. The Local Sponsor shall furnish to the Government all lands, easements and rights-of-way, including suitable borrow and dredged material disposal areas, as may be determined by the Government to be necessary for the construction, operation, and maintenance of the Project, and shall furnish to the Government evidence supporting the Local Sponsor's legal authority to grant rights-of-way to such lands. The necessary lands, easements, and rights-of-way may be provided incrementally, but all lands, easements, and rights-of-way determined by the Government to be necessary for work to be performed under a construction contract must be furnished prior to the advertisement of the construction contract.

b. The Local Sponsor shall provide, or pay to the Government the cost of providing, all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, determined by the Government to be necessary for construction, operation, or maintenance of the Project.

c. Upon notification from the Government, the Local Sponsor shall accomplish or arrange for accomplishment at no cost to the Government all relocations of highways, railroads, storm drains, and other facilities, structures, and improvements, determined by the Government to be necessary for construction, operation, or maintenance of the Project.

d. Upon notification from the Government, the Local Sponsor shall perform or assure performance of all necessary relocations of pipelines, cables, and other utilities. Nothing herein shall be deemed to affect the ability of the Local Sponsor to seek compensation from other non-Federal entities for costs it incurs under this paragraph.

e. The Local Sponsor shall comply with the applicable provisions of the Uniform Relocations Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way for construction and subsequent operation and maintenance of the Project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

ARTICLE IV - VALUE OF LANDS AND FACILITIES

a. The value of the lands, easements, and rights-of-way provided for the general navigation features of the Project to be credited towards the additional 10 percent of total costs the Local Sponsor must repay pursuant to Article II.g. will be determined in accordance with the following procedures:

1. If the lands, easements, or rights-of-way are owned by the Local Sponsor as of the date the first construction contract for the general navigation features of the Project is awarded, the credit shall be the fair market value of the interest at the time of such award. The fair market value shall be determined by an appraisal, to be obtained by the Local Sponsor, which has been prepared by a qualified appraiser who is acceptable to both the Local Sponsor and the Government. The appraisal shall be reviewed and approved by the Government.

2. If the lands, easements, or rights-of-way are to be acquired by the Local Sponsor after the date of award of the first construction contract for the general navigation features of the Project, the credit shall be the fair market value of the interest at the time such interest is acquired. The fair market value shall be determined as specified in Article IV.a.1. of this Agreement. If the Local Sponsor pays an amount in excess of the appraised fair market value, it may be entitled to a credit for the excess if the Local Sponsor has secured prior written approval from the Government of its offer to purchase such interest.

3. If the Local Sponsor acquires more lands, easements, or rights-of-way than are necessary for project purposes, as determined by the Government, then only the value of such portions of those acquisitions as are necessary for general navigation feature purposes shall be credited towards the Local Sponsor's share.

4. Credit for lands, easements, and rights-of-way in the case of involuntary acquisitions which occur within a one-year period preceding the date this Agreement is signed or which occur after the date this Agreement is signed will be based on court awards, or on stipulated settlements that have received prior written approval of the Government.

5. Credit for lands, easements, or rights-of-way acquired by the Local Sponsor within a five-year period preceding the date this Agreement is signed, or at any time after this Agreement is signed, will also include reasonable incidental costs of acquiring the interest, e.g., closing and title costs, appraisal costs, survey costs, attorney's fees, plat maps, and mapping costs, as well as the actual amounts expended for payment

of any Public Law 91-646 relocation assistance benefits provided in accordance with the obligations under this Agreement.

b. The costs of alterations or relocations of facilities and utilities incurred by the Local Sponsor for the general navigation features that will be credited towards the additional 10 percent of total costs the Local Sponsor must repay pursuant to Article II.g. of this Agreement shall be that portion of the actual costs determined as set forth below, and approved by the Government:

1. Highways: Only that portion of the cost as would be necessary to construct substitute highways to the design standard that the State of New Jersey would use in constructing a new highway under similar conditions of geography and traffic loads.

2. Utilities and facilities: Actual relocation costs, less depreciation, less salvage value, plus the cost of removal, less the cost of betterments. With respect to betterments, new materials shall not be used in any alteration or relocation if materials of value and usability equal to those in the existing facility are available or can be obtained as salvage from the existing facility or otherwise, unless the provision of new material is more economical. If, despite the availability of used material, new material is used, where the use of such new material represents an additional cost, such cost will not be credited to the Local Sponsor's share.

c. All payments made by the Local Sponsor pursuant to Article II.e. for use of a Government owned or controlled disposal area shall be credited toward the 10 percent of total costs that the Local Sponsor must repay pursuant to Article II.g.

ARTICLE V - CONSTRUCTION PHASING AND MANAGEMENT

a. To provide for consistent and effective communication between the Local Sponsor and the Government during the period of construction, the Local Sponsor and the Government shall appoint representatives to coordinate on scheduling, plans, specifications, modifications, contract costs, and other matters relating to construction of the Project. The Local Sponsor will be informed of any changes in cost estimates.

b. The representatives appointed above shall meet as necessary during the period of construction and shall make such recommendations as they deem warranted to the Contracting Officer.

c. The Contracting Officer shall consider the recommendations of the representatives in all matters relating to construction of the Project, but the Contracting Officer, having ultimate responsibility for construction of the Project, has complete discretion to accept, reject, or modify the recommendations.

ARTICLE VI - METHOD OF PAYMENT

a. The Local Sponsor shall provide, during the period of construction, the percentages of the total cost of construction of general navigation features specified in Article II.f. of this Agreement. The total cost of construction of the general navigation features is currently estimated to be $ 9,456,000. In order to meet its share of such costs, the Local Sponsor must provide an initial cash contribution currently estimated to be $ 946,000. The dollar amounts set forth in this Article are based upon the Government's best estimates which will reflect projections of costs, price level changes, and anticipated inflation. Such cost estimates are subject to adjustments based in cost actually incurred and are not to be construed as the total financial responsibilities of the Government and the Local Sponsor.

b. In accordance with Article II.e., the Local Sponsor shall pay a charge presently estimated at $ 0.99 per cubic yard of material deposited into the Killcohook disposal area. Payment will be made as part of the required cash contribution described below.

c. The required cash contribution shall be provided as follows: At least 90 calendar days prior to the award of the first construction contract, the Government shall notify the Local Sponsor of the Local Sponsor's estimated share of the total cost of construction of general navigation features of the project, including its share of costs attributable to the Project incurred prior to the initiation of construction. Within 45 calendar days thereafter, the Local Sponsor shall provide the Government the full amount of the required contribution by delivering a check payable to "Finance and Accounting Officer, U.S. Army Engineer Division, New England" to the Contracting Officer representing the Government. In the event that the total cost of construction of the general navigation features assigned to commercial navigation is expected to exceed the estimate given at the outset of construction, the Government shall immediately notify the Local Sponsor of the additional contribution it will be required to make to meet its share of the revised estimate. Within 45 calendar days thereafter, the Local Sponsor shall provide the Government the full amount of the additional required contribution.

d. The Government will draw on the funds provided by the local sponsor such sums as the Government deems necessary to cover contractual and in-house fiscal obligations attributable to the Project as they are incurred, as well as costs incurred by the Government prior to initiation of construction.

e. Upon completion of the general navigation features and resolution of all relevant claims and appeals, the Government shall compute the total cost of construction of the general navigation features and tender to the Local Sponsor a final accounting of the Local Sponsor's share of the total costs of construction of the general navigation features. In the event the total contribution by the Local Sponsor is less than its initial required share, the Local Sponsor shall, no later than 90 calendar days after receipt of written notice, make a cash payment to the Government of whatever sum is required to meet its initial required share.

f. In the event the Local Sponsor has made excess cash contributions which result in the Local Sponsor's having provided more than its initial required share of the cost of construction of general navigation features, the Government shall first credit the excess to the additional amount the Local Sponsor must repay pursuant to Article II.g. of this Agreement. In the event the excess cash contribution exceeds the additional amount the Local Sponsor must repay pursuant to Article II.g., the Government shall, no later than 90 calendar days after the final accounting is complete, subject to the availability of funds, return said excess to the Local Sponsor.

g. The Local Sponsor shall repay the additional amount required pursuant to Article II.g. of this Agreement, reduced by any excess cash contribution made during the period of construction, in equal annual installments over a period of not more than 30 years from the completion of the period of construction of the general navigation features. Such repayment shall include interest at a rate to be determined by the Secretary of the Treasury, taking into consideration the average market yields on outstanding marketable obligations of the United States with remaining periods to maturity comparable to the repayment period, during the month preceding the fiscal year in which costs for construction of the Project are first incurred, or, in the case of recalculating, the fiscal year in which the recalculation is made, plus a premium of one-eighth of one percentage point for transaction costs. The interest rate shall be recalculated by the Secretary of the Treasury at five-year intervals. Nothing herein shall preclude the Local Sponsor from repaying this additional amount in full upon receipt of the final accounting. Should this full repayment be made within 90 days from receipt of the final accounting, there shall be no charges for interest or transaction costs.

ARTICLE VII - DISPUTES

Before any party to this Agreement may bring suit in any court concerning an issue relating to this Agreement, such party must first seek in good faith to resolve the issue through negotiation or other forms of nonbinding alternative dispute resolution mutually acceptable to the parties.

ARTICLE VIII - OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION

a. The Local Sponsor shall operate, maintain, repair, replace, and rehabilitate all project features other than the general navigation features in accordance with regulations or directions prescribed by the Government.

b. The Government shall operate and maintain the general navigation features.

c. The Local Sponsor hereby gives the Government a right to enter, at reasonable times and in a reasonable manner, upon land which it owns or controls for access to the Project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project. If an inspection shows that the Local Sponsor for any reason is failing to fulfill its obligations under this Agreement without receiving prior written approval from the Government, the Government will send a written notice to the Local Sponsor. If the Local Sponsor persists in such failure for 30 calendar days after receipt of the notice, then the Government shall have a right to enter, at reasonable times and in a reasonable manner, upon lands the Local Sponsor owns or controls for access to the Project for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project. No completion, operation, maintenance, repair, replacement, or rehabilitation of the Project by the Government shall operate to relieve the Local Sponsor of responsibility to meet its obligations as set forth in this Agreement, or to preclude the Government from pursuing any other remedy at law or equity to assure faithful performance pursuant to this Agreement.

ARTICLE IX - RELEASE OF CLAIMS

The Local Sponsor shall hold and save the Government free from all damages arising from the construction, operation, and maintenance of the Project, except for damages due to the fault or negligence of the Government or its contractors.

ARTICLE X - MAINTENANCE OF RECORDS

The Government and the Local Sponsor shall keep books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to this Agreement to the extent and in such detail as will properly reflect total project costs. The Government and the Local Sponsor shall maintain such books, records, and documents, and other evidence for a minimum of three years after completion of construction of the Project and resolution of all relevant claims arising therefrom, and shall make available at their offices at reasonable times, such books, records, documents, and other evidence for inspection and audit by authorized representatives of the parties to this Agreement.

ARTICLE XI - GOVERNMENT AUDIT

The Government shall conduct an audit when appropriate of the Local Sponsor's records for the Project to ascertain the allowability, reasonableness, and allocability of its costs for inclusion as credit against the non-Federal share of project costs.

ARTICLE XII - FEDERAL AND STATE LAWS

In acting under its rights and obligations hereunder, the Local Sponsor agrees to comply with all applicable Federal and State laws and regulations, including section 601 of Title VI of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.II issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army".

ARTICLE XIII - RELATIONSHIP OF PARTIES

The parties to this Agreement act in an independent capacity in the performance of their respective functions under this Agreement, and neither party is to be considered the officer, agent, or employee of the other.

ARTICLE XIV - OFFICIALS NOT TO BENEFIT

No member of or delegate to the Congress, or resident commissioner, shall be admitted to any share or part of this Agreement, or to any benefit that may arise therefrom.

ARTICLE XV - COVENANT AGAINST CONTINGENT FEES

The Local Sponsor warrants that no person or selling agency has been employed or retained to solicit or secure this Agreement upon agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Local Sponsor for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this Agreement without liability, or, in its discretion, to add to the Agreement or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.

ARTICLE XVI - TERMINATION OR SUSPENSION

a. If at any time the Local Sponsor fails to make the payments required under this Agreement, the Secretary of the Army shall terminate or suspend work on the Project until the Local Sponsor is no longer in arrears, unless the Secretary of the Army determines that continuation of work on the Project is in the interest of the United States or is necessary in order to satisfy agreements with any other non-Federal interests in connection with the Project. Any delinquent payment shall be charged interest at a rate, to be determined by the Secretary of the Treasury, equal to 150 per centum of the average bond equivalent rate of the 13-week Treasury bills auctioned immediately prior to the date on which such payment became delinquent, or auctioned immediately prior to the beginning of each additional 3-month period if the period of delinquency exceeds 3 months.

b. If the Government fails to receive annual appropriations for the Project in amounts sufficient to meet project expenditures for the then-current or upcoming fiscal year, the Government shall so notify the Local Sponsor. After 60 calendar days either party may elect without penalty to terminate this Agreement pursuant to this Article or to defer future performance hereunder; however, deferral of future performance under this Agreement shall not affect existing obligations or relieve the parties of liability for any obligation previously incurred. In the event that either party elects to terminate this Agreement pursuant to this Article, both parties shall conclude their activities relating to the Project and proceed to a final accounting in accordance with Article VI. of this Agreement. In the event that either party elects to defer future performance under this Agreement, pursuant to this Article, such deferral shall remain in effect until such time as the Government receives sufficient appropriations or until either party elects to terminate this Agreement.

ARTICLE XVII - NOTICES

a. All notices, requests, demands, and other communications required or permitted to be given under this Agreement shall be deemed to have been duly given if in writing and delivered personally, given by prepaid telegram, or mailed by first-class (postage pre-paid), registered, or certified mail, as follows:

If to the Local Sponsor:

Chairman
City of Salem Port Authority
Suite 302,
Fenwick Plaza
Salem, New Jersey 08079

If to the Government:

District Engineer
U.S. Army Engineer District, Philadelphia
Wanamaker Building
100 Penn Square East
Philadelphia, Pennsylvania 19107-3396

b. A party may change the address to which such communications are to be directed by giving written notice to the other party in the manner provided in this Article.

c. Any notice, request, demand, or other communication made pursuant to this Article shall be deemed to have been received by the addressee at such time as it is personally delivered or seven days after it is mailed, as the case may be.

ARTICLE XVIII - CONFIDENTIALITY

To the extent permitted by the laws governing each party, the parties agree to maintain the confidentiality of exchanged information when requested to do so by the providing party.

ARTICLE XIX - SECTION 902 PROJECT COST LIMITS

The Local Sponsor has reviewed the provisions set forth in Section 902 of P.L. 99-662, as amended, and understands that Section 902 establishes a maximum construction cost for the project. For purposes of this Agreement, the Section 902 cost limit is $__________ as calculated using October 1990 Price Levels and allowances for future inflation. This amount shall be adjusted to allow for appropriate increases for inflation and changes in total project cost as provided in Section 902. Should this cost maximum be reached, no additional funds may be expended on the Project until additional authority is obtained from Congress.

ARTICLE XX - HAZARDOUS SUBSTANCES

a. After execution of this Agreement and upon direction by the Contracting Officer, the Local Sponsor shall perform, or cause to be performed, such environmental investigations as are determined necessary by the Government or the Local Sponsor to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 USC 9601-9675, on lands necessary for Project construction, operation, and maintenance. All actual costs incurred by the Local Sponsor which are properly allowable and allocable to performance of any such environmental investigations shall be included in total construction costs and cost shared as a construction cost in accordance with Section 101 of Public Law 99-662.

b. In the event it is discovered through an environmental investigation or other means that any lands, easements, rights-of-way, or disposal areas to be acquired or provided for the Project contain any hazardous substances regulated under CERCLA, the Local Sponsor and the Government shall provide prompt notice to each other, and the Local Sponsor shall not proceed with the acquisition of lands, easements, rights-of-way, or disposal areas until mutually agreed.

c. The Government and the Local Sponsor shall determine whether to initiate construction of the Project, or if already in construction, to continue with construction of the Project, or to terminate construction of the Project for the convenience of the Government in any case where hazardous substances regulated under CERCLA are found to exist on any lands necessary for the Project. Should the Government and the Local Sponsor determine to proceed or continue with construction after considering any liability that may arise under CERCLA, as between the Government and the Local Sponsor, the Local Sponsor shall be responsible for any and all necessary clean up and response costs, to include the costs of any studies and investigations necessary to determine an appropriate response to the contamination. Such costs shall not be considered a part of total costs of construction of the general navigation features as defined in this Agreement. In the event the Local Sponsor fails to provide any funds necessary to pay for clean up and response costs or to otherwise discharge its responsibilities under this paragraph upon direction by the Government, the Government may either terminate or suspend work on the Project or proceed with further work as provided in Article XVI.

d. The Local Sponsor and the Government shall consult with each other under the Construction Phasing and Management Article of this Agreement to assure that responsible parties bear any necessary clean up and response costs as defined in CERCLA. Any decision made pursuant to paragraph c of this Article shall not relieve any party from any liability that may arise under CERCLA.

e. The Local Sponsor shall perform its responsibilities under this Agreement, including the dredging of berthing areas or access channels, and operation and maintenance of any required disposal facilities, in a manner so that liability will not arise under CERCLA.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement, which shall become effective upon the date it is signed by the Assistant Secretary of the Army (Civil Works).

THE DEPARTMENT OF THE ARMY	CITY OF SALEM PORT AUTHORITY
BY:________________________	BY:____________________________
NANCY P. DORN Assistant Secretary of the Army (Civil Works)	JOHN D. BURKE Chairman, City of Salem Port Authority
DATE:______________________	DATE:___________________

CERTIFICATE OF AUTHORITY

I, ___________________________, do hereby certify that I am the principal legal officer of the City of Salem Port Authority, that the City of Salem Port Authority is a legally constituted public body with full authority and legal capability to perform the terms of the Agreement between the Department of the Army and the City of Salem Port Authority in connection with the Project, and to pay damages, if necessary, in the event of the failure to perform, in accordance with Section 221 of Public Law 91-611, and that the persons who have executed this Agreement on behalf of the City of Salem Port Authority have acted within their statutory authority.

IN WITNESS WHEREOF, I have made and executed this certification this _____________ day of _____________, 19___.

____

SALEM RIVER, NEW JERSEY
NAVIGATION PROJECT MODIFICATION

CERTIFICATION REGARDING LOBBYING

The undersigned certifies, to the best of his or her knowledge and belief that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

JOHN D. BURKE
Chairman
City of Salem Port Authority

APPENDIX G

REAL ESTATE

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, U.S. ARMY CORPS OF ENGINEERS
P.O. BOX 1715
BALTIMORE, MD 21203-1715

REPLY TO
ATTENTION OF

CENAB-RE-C (335-2-5c) 10 September 1992

MEMORANDUM FOR Commander, Philadelphia District, ATTN: CENAP-EN (Rohn)

SUBJECT: Updated Real Estate Cost Estimate for the Salem River Navigation Project, New Jersey

1. Reference memorandum, CENAP-EN-MC, 14 July 1992, subject: Real Estate Requirements for Salem River, New Jersey.

2. Subject cost estimate is provided as requested in the above reference:

a. Lands and Estates:

Fee:	
3.12 Acres @ $300/Acre	$ 936
Contingency (25%)	234
	$1,170

b. Estimates Takings (tracts) - 3

c. Administrative Costs - Local Sponsor

$3,200/site x 3	$ 9,600
Mapping - 15%	$ 1,440
Title Evidence - 10%	960
Negotiations - 30%	2,880
Pre-Condemnation - 15%	1,440
Post-Condemnation - 5%	480
Appraisals - 15%	1,440
Relocation Assistance - 10%	960
Subtotal	9,600
Contingency (15%)	1,440
Total Administrative Costs	$11,040

d. Local Sponsor Contract Costs

Mapping - 3 x $1,760	$ 5,280
Title Evidence - 3 x $585	1,755
Pre-Condemnation - 1 x $495	495
Post-Condemnation - 1 x $165	165
Appraisals - 3 x $330	990
Subtotal	$ 8,685
Contingency (15%)	1,303
Total LS Contract Costs	$ 9,988

CENAB-RE-C
SUBJECT: Updated Real Estate Cost Estimate for the Salem River Navigation Project, New Jersey

b. COE Real Estate Administrative Costs $500 x 3	$ 1,500
Mapping - 15%	225
Title Evidence - 10%	150
Negotiations - 30%	450
Pre-Condemnation - 15%	225
Post-Condemnation - 5%	75
Appraisals - 15%	225
Relocation Assistance - 10%	150
Subtotal	$ 1,500
Contingency (15%)	225
Total Administrative Costs	$ 1,725

Estimated Total Real Estate Costs = $23,923

3. Mitigation Area (Wetlands)

a. Land - Federally Owned - 0

b. Local Sponsor Administrative Costs	
Mapping	$ 480
Title Evidence	320
Negotiations	960
Subtotal	$ 1,760
Contingency (15%)	264
Total Administrative Costs	$ 2,024
c. Local Sponsor Contract Costs	
Mapping	$ 1,760
Title Evidence	585
Appraisals	330
Subtotal	$ 2,675
Contingency (15%)	401
	$ 3,076
d. COE Adminstrative Costs	$ 500
Total Admin for Mitigation	$ 5,600

4. The 01 Code of Accounts format for the Real Estate Costs, excluding mitigation, is enclosed for your information.

5. POC for this action is Michael Hewitt at (410) 962-4648.

FOR THE COMMANDER:

Encl

G. R. BOGGS
Chief, Real Estate Division

CF:
CENAP-DP-M w/encl

REAL ESTATE COST ESTIMATE
SALEM RIVER
NAVIGATION PROJECT
NEW JERSEY

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
01.-.-.-LANDS AND DAMAGES							
01.D.-.-ACQUISITIONS							
01.D.2.-MAPPING							
01.D.2.-LOCAL SPONSOR CONTRACT COSTS		3	EA	1760	$ 5,280	$ 792	$ 6,072
01.D.2.-LOCAL SPONSOR ADMIN COSTS			JOB	LS	$ 1,440	$ 216	$ 1,656
01.D.2.-COE ADMINISTRATIVE COSTS			JOB	LS	$ 225	$ 34	$ 259
01.D.3.-TITLE EVIDENCE							
01.D.3.-LOCAL SPONSOR CONTRACT COSTS		3	EA	585	$ 1,755	$ 263	$ 2,018
01.D.3.-LOCAL SPONSOR ADMIN COSTS			JOB	LS	$ 960	$ 144	$ 1,104
01.D.3.-COE ADMINISTRATIVE COSTS			JOB	LS	$ 150	$ 23	$ 173
01.D.4.-NEGOTIATIONS							
01.D.4.-LOCAL SPONSOR ADMIN COSTS			JOB	LS	$ 2,880	$ 432	$ 3,312
01.D.4.-COE ADMINISTRATIVE COSTS			JOB	LS	$ 450	$ 68	$ 518
01.D.5.-CONDEMNATION							
01.D.5.-LOCAL SPONSOR CONTRACT COSTS		1	EA	495	$ 495	$ 74	$ 569
01.D.5.-LOCAL SPONSOR ADMIN COSTS			JOB	LS	$ 1,440	$ 216	$ 1,656
01.D.5.-COE ADMINISTRATIVE COSTS			JOB	LS	$ 225	$ 34	$ 259
	SUBTOTAL				$15,300		
01.D.9.-CONTINGENCIES						$ 2,296	
	ACQUISITIONS TOTAL						$17,596
01.E.-.-CONDEMNATION							
01.E.-.-LOCAL SPONSOR CONTRACT COSTS		1	EA	165	$ 165	$ 25	$ 190
01.E.-.-LOCAL SPONSOR ADMIN COSTS			JOB	LS	$ 480	$ 72	$ 552
01.E.-.-COE ADMINISTRATIVE COSTS			JOB	LS	$ 75	$ 11	$ 86
	SUBTOTAL				$ 720		
01.E.9.-CONTINGENCIES						$ 108	
	CONDEMNATIONS TOTAL						$ 828
01.F.-.-APPRAISALS							
01.F.-.-LOCAL SPONSOR CONTRACT COSTS		1	EA	165	$ 990	$ 148	$ 1,138
01.F.-.-LOCAL SPONSOR ADMIN COSTS			JOB	LS	$ 1,440	$ 216	$ 1,656
01.F.-.-COE ADMINISTRATIVE COSTS			JOB	LS	$ 225	$ 33	$ 258
	SUBTOTAL				$ 2,655		
01.F.9.-CONTINGENCIES						$ 397	
	APPRAISALS TOTAL						$ 3,052

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL PROJECT COST
01.H.-.-	RELOCATION ASSISTANCE						
01.H.-.-	LOCAL SPONSOR ADMIN COSTS	1	JOB	LS	$ 960	$ 144	$ 1,104
01.H.-.-	COE ADMINISTRATIVE COSTS	1	JOB	LS	$ 150	$ 23	$ 173
	SUBTOTAL				$ 1,110		
01.H.9.-	CONTINGENCIES					$ 167	
	RELOCATION ASSISTANCE TOTAL						$ 1,277
01.M.-.-	REAL ESTATE RECEIPTS/PAYMENTS						
01.M.3.-	LAND PAYMENTS	1	JOB	LS	$ 936	$ 234	$1,170
	SUBTOTAL				$ 936		
01.M.9.-	CONTINGENCIES					$ 234	
	REAL ESTATE RECEIPTS/PAYMENTS TOTAL						$1,170