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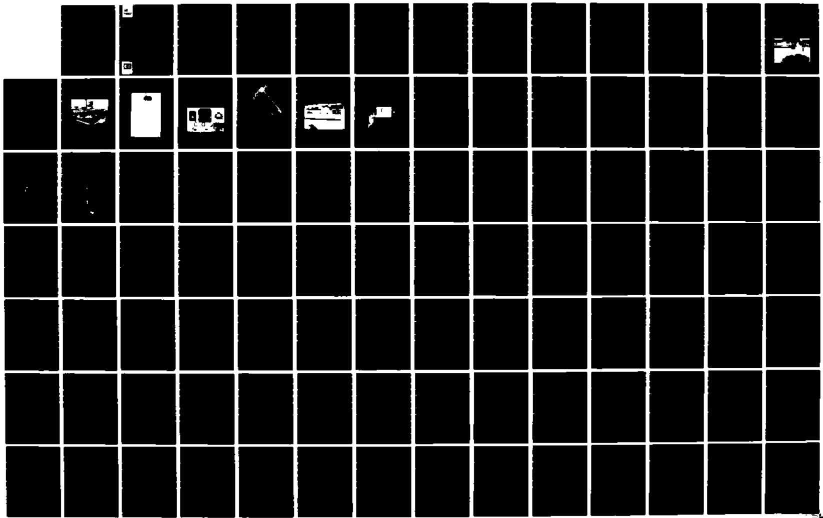

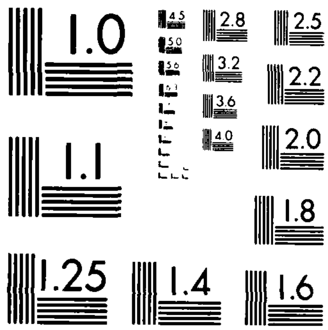

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TECHNICAL REPORT HL-79-1-2

US Army Corps of Engineers

NEWBURYPORT HARBOR, MASSACHUSETTS

Report 2

DESIGN FOR HYDRODYNAMICS, SALINITY, AND SEDIMENTATION

Hydraulic Model Investigation

by

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US ARMY ENGINEER WATERWAYS EXPERIMENT STATION

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Newburyport Harbor Model, a fixed-bed model with provisions for conversion to a movable-bed model, was constructed to scales of 1:300 horizontally and 1:100 vertically and reproduced all of Newburyport Harbor, the Merrimack River to the head of tidal influence, and a portion of the Atlantic Ocean adjacent to the harbor entrance. The model was equipped with the necessary appurtenances for accurate reproduction and measurement of tides, tidal

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20. ABSTRACT (Continued).

currents, salinities, freshwater inflows, density effects, and other important prototype phenomena. Verification tests were conducted to make certain that the model hydraulic and salinity regimens agreed with those of the prototype. The agreement attained between similar model and prototype values were considered satisfactory. A second verification phase was completed and accepted in which shoaling and scour patterns in the entrance area for periods of 6 months and 1 year were simulated.

The purpose of the model study was to determine the effects of proposed improvement plans on existing hydraulic, salinity, flushing, and entrance shoaling and scour conditions. Six plans were selected for extensive model testing. Test results consist of comparable measurements of tidal heights, current velocities, salinities, surface current patterns, dye dispersion, and shoaling and scouring for base and proposed improvement conditions. Analysis of these data indicates that none of the six plans would cause any significant overall effects to base condition tidal heights, salinities, or dye dispersion. The data analysis does indicate very significant changes in current patterns and magnitudes and in shoaling and scour in the entrance area and on the outer bar. Most effects were confined to the local area of the plan but generally influenced overall conditions throughout the estuary very little. Plans including the curved extension to the north jetty (Plans 3B, BE, and BX) would each result in a small reduction to the shoaling rates in the outer bar channel but would cause increased shoaling over the inner bar and seaward end of the channel to such a degree as to offset the gains realized in the outer bar channel. These three plans and Plan 2C would cause hazardous navigation conditions through the entrance due to the extremely high current velocities generated by the plans. Plans D and 3E had the least effects of any of the plans on entrance shoaling and scour. None of the six plans tested had any significant effect on shoaling and scour rates or patterns along the beaches and offshore areas. Each plan resulted in a general but small increase in shoaling along the eastern half of the north shoreline of Plum Island. Plan D provided complete protection of the north shoreline of Plum Island.

PREFACE

The model study reported herein was requested by the US Army Engineer Division, New England (NED), in a letter to the Office, Chief of Engineers, US Army, dated 28 June 1972, and was subsequently approved in a letter to NED dated 26 September 1972. Authority to initiate the investigation was granted by NED in a letter to the Director, US Army Engineer Waterways Experiment Station (WES), dated 8 August 1973.

Design and construction of the model were accomplished during the period August 1973-January 1975; hydraulic and salinity verifications were carried out during the period February 1975-October 1975. Hydraulic, salinity, and dye dispersion base tests were performed during the period November 1975-March 1976. Fixed-bed entrance shoaling verification was carried out during the period February 1977-July 1977. After completion of all fixed-bed model verifications and base tests, the general investigation was initiated. All programmed testing was completed in September 1977. This report describes the problems that necessitated the model investigation, the model and its appurtenances, verification and base tests, and studies conducted in the model.

This study was conducted in the Hydraulics Laboratory of WES under the general supervision of Messrs. H. B. Simmons, Chief of the Hydraulics Laboratory; F. A. Herrmann, Jr., Assistant Chief of the Hydraulics Laboratory; R. A. Sager, Chief of the Estuaries Division; G. M. Fisackerly, Chief of the Harbor Entrance Branch; and N. J. Brogdon, Jr., Project Engineer. Technicians of the Estuaries Division who assisted throughout the investigation included Messrs. D. M. White, J. J. Holman, and C. W. Dorman. This report was prepared by Messrs. Brogdon and White.

Commanders and Directors of WES during the course of the investigation and the preparation and publication of this report were COL G. H. Hilt, CE, COL John L. Cannon, CE, COL Nelson P. Conover, CE, COL Tilford C. Creel, CE, and COL Robert C. Lee, CE. Technical Director was Mr. F. R. Brown.

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CONVERSION FACTORS, US CUSTOMARY TO METRIC (SI)
UNITS OF MEASUREMENT

US customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
cubic feet per second	0.02831685	cubic metres per second
feet	0.3048	metres
feet per second	0.3048	metres per second
gallons per day	3.785412	cubic decimetres per day
inches	25.4	millimetres
miles (US statute)	1.609344	kilometres
square feet	0.09290304	square metres
square miles (US statute)	2.589988	square kilometres

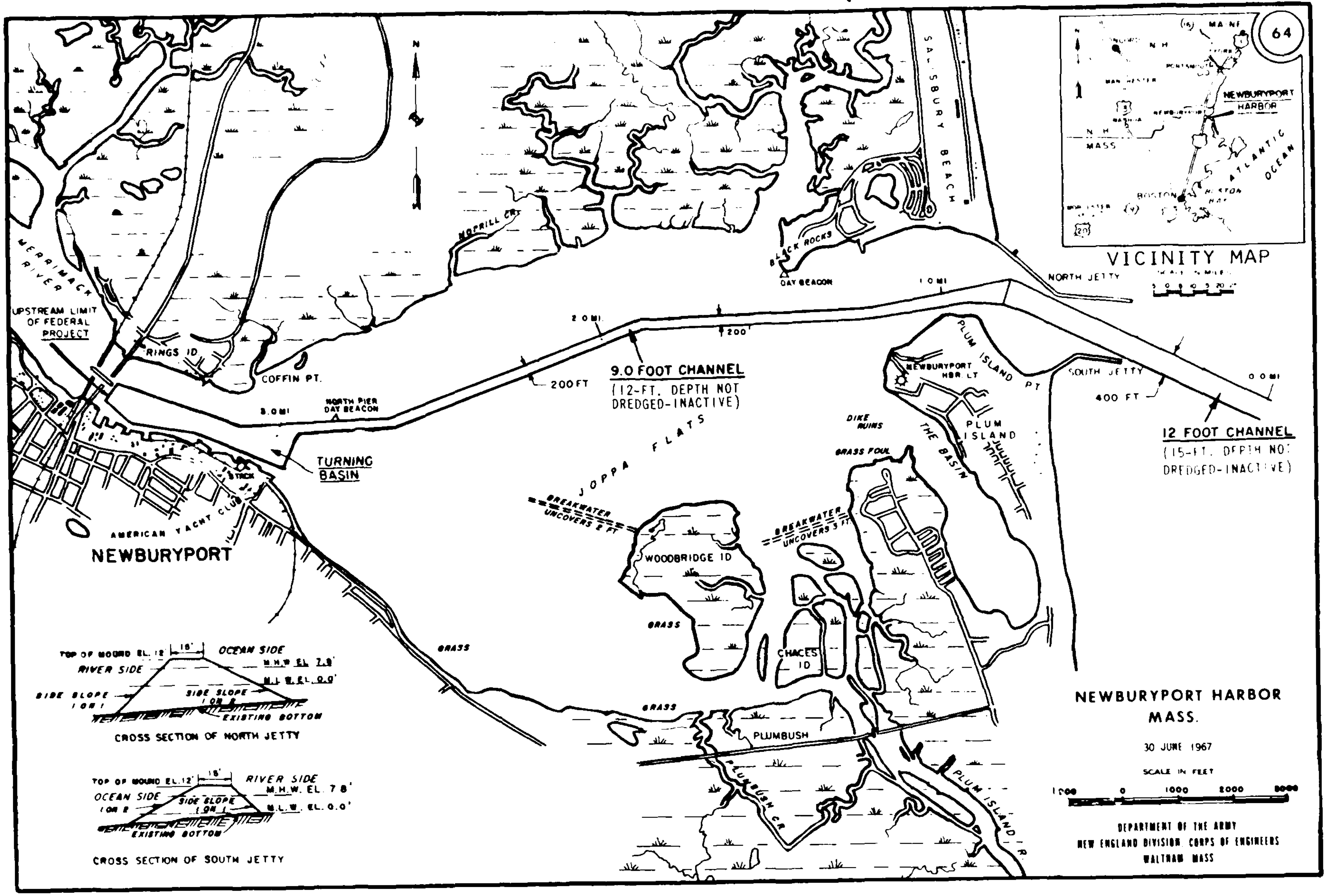


Figure 1. Location map

NEWBURYPORT HARBOR, MASSACHUSETTS

DESIGN FOR HYDRODYNAMICS, SALINITY, AND SEDIMENTATION

Hydraulic Model Investigation

PART I: INTRODUCTION

Background

1. Newburyport Harbor is located on the northern coast of Massachusetts about 54 miles* by water north of Boston and 20 miles southwest of Portsmouth, New Hampshire (Figure 1). Newburyport Harbor was constructed during the period July 1881-October 1914. The city of Newburyport is the principal business center for several nearby towns and the summer resorts of Plum Island and Salisbury Beach, which are situated on the south and north sides, respectively, of the entrance to Newburyport Harbor.

2. The initial navigation project for Newburyport Harbor adopted in 1880 provided for the construction of converging rubblestone jetties extending from Salisbury Beach on the north and Plum Island on the south. The south jetty was completed to full cross section (crest el +12.0 ft NGVD**) in 1905 and had a total length of about 2,415 ft. The north jetty was completed in 1914 to the same cross section and crest elevation as the south jetty for a total length of about 4,118 ft. The outer 1,000 ft of the north jetty was constructed parallel to the outer 1,000 ft of the south jetty, thereby providing an entrance width of about 1,000 ft. This project provided minimum depths of 12 ft during most favorable conditions. Modifications to above project completed in 1957 provided for a navigation channel 400 ft wide by 12 ft deep mlw (mean low water or -16 ft NGVD) over the outer bar and through the jetties, then 200 ft wide and 9 ft deep mlw (-13 ft NGVD) to the Route 1 Bridge. A turning basin was provided immediately downstream from the Route 1 Bridge.

3. Neither the above project nor periodic maintenance dredging has

* A table of factors for converting US customary units of measurement to metric (SI) units is presented on page 3.

** All elevations (el) cited herein are in feet referred to the National Geodetic Vertical Datum (NGVD).

proved satisfactory in maintaining an adequate channel entrance. Rehabilitation work on the jetties between the period 1968-1970 resulted in reduced wave heights in the entrance channel and reduced sand bypassing the jetty structures, thereby resulting in widening the adjacent beaches; however, the entrance channel continues to be unsatisfactory.

4. Very extensive erosion to the north shore (eastern half) of Plum Island began when a series of three severe storms struck the area in early 1969. This erosion continued to be a problem to the extent that the US Coast Guard Station and other property in this area are in danger. In 1970, a plan to extend the south jetty landward together with placing dredged material in the area was devised and implemented in an effort to check this erosion. However, erosion of the north shore of Plum Island continued to the extent that the extension of the south jetty was flanked. It is believed that the eroded material contributed to the growth of the inner bar resulting in the channel being forced against the north jetty.

5. Two hydraulic models were constructed and tested at the US Army Engineer Waterways Experiment Station (WES) to study plans designed to eliminate or minimize these problems. The distorted estuary model, reported herein, was used to determine probable effects of various improvement plans on the existing hydraulics, salinity, and entrance shoaling conditions. In addition to the model study reported herein, an undistorted model built to scale of 1:75 was used to study the effects of wave conditions on shoaling and erosion with the proposed improvement plans installed in the model and to determine the effects of various jetty crown elevations on wave overtopping, wave runup, etc.*

Purpose

6. The model study was conducted to determine the effects of 11 plans on subsurface current velocities, surface current patterns, salinity, dye dispersion, and entrance shoaling and scour.

* C. R. Curren and C. E. Chatham, Jr. 1979 (Feb). "Newburyport Harbor, Massachusetts; Design for Wave Protection and Erosion Control," Technical Report HL-79-1, Report 1, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Scope

7. Eleven proposed improvements plans were investigated during the course of this model study. Five of these plans were subjected to brief tests, primarily visual observations and surface current pattern photographs. Six plans were subjected to extensive testing to determine their effects on base condition hydraulics, salinities, dye dispersion, and entrance shoaling and scouring. This report contains the results of those tests.

The Prototype

8. The estuary diverges (Plate 1) from the Merrimack River at Newburyport, Mass., about 3.5 miles west of the entrance, to a maximum width of about 1.75 miles. Extensive mud flats exist on either side of the navigation channel. The estuary is separated from the Atlantic Ocean by two barrier islands, Plum Island on the south and Salisbury Beach to the north. The estuary is connected to Plum Island Sound located about 8.5 miles to the south by the Plum Island River.

9. The entrance to Newburyport Harbor is about 1,000 ft wide and is protected by two converging rubblestone jetties extending from Salisbury Beach on the north and Plum Island on the south. The authorized navigation channel connecting the Atlantic Ocean and the city of Newburyport is 400 ft wide and 16 ft deep (NGVD) over the outer bar and through the jetties, 200 ft wide and 13 ft deep (NGVD) from the landward end of the jetties to the wharves at Newburyport.

10. Average daily freshwater discharge for the Merrimack River is about 7,000 cfs, ranging from more than 23,000 cfs in the spring to about 1,700 cfs in the fall. The mean semidiurnal tide range at the harbor entrance is about 8.2 ft.

PART II: THE MODEL

Description

11. The Newburyport Harbor model reproduces approximately 55 square miles of the prototype area including the Merrimack River to head of tide; the Atlantic coast from about 2.5 miles north of the north jetty to about 2.5 miles south of the south jetty and offshore areas well beyond the -60 ft contour; and the system of sloughs and creeks that affect tidal action throughout the model area. The model upstream from Artichoke River was constructed in labyrinth form in order to conserve shelter space, thereby voiding the usefulness of any type of data, other than tidal data, collected therefrom. The limits of the area reproduced are shown in Plate 1. A general view of the model is shown in Figure 2.

12. The model was constructed to linear scale ratios, model to prototype, of 1:300 horizontally and 1:100 vertically. From these basic ratios the following scale relations were computed by the Froudian relations: slope 3:1, velocity 1:10, time 1:30, discharge 1:300,000, volume 1:9,000,000, area

Figure 2. General view of model

Figure 10. Shoaling and scour patterns, fall 197[illegible] to [illegible]

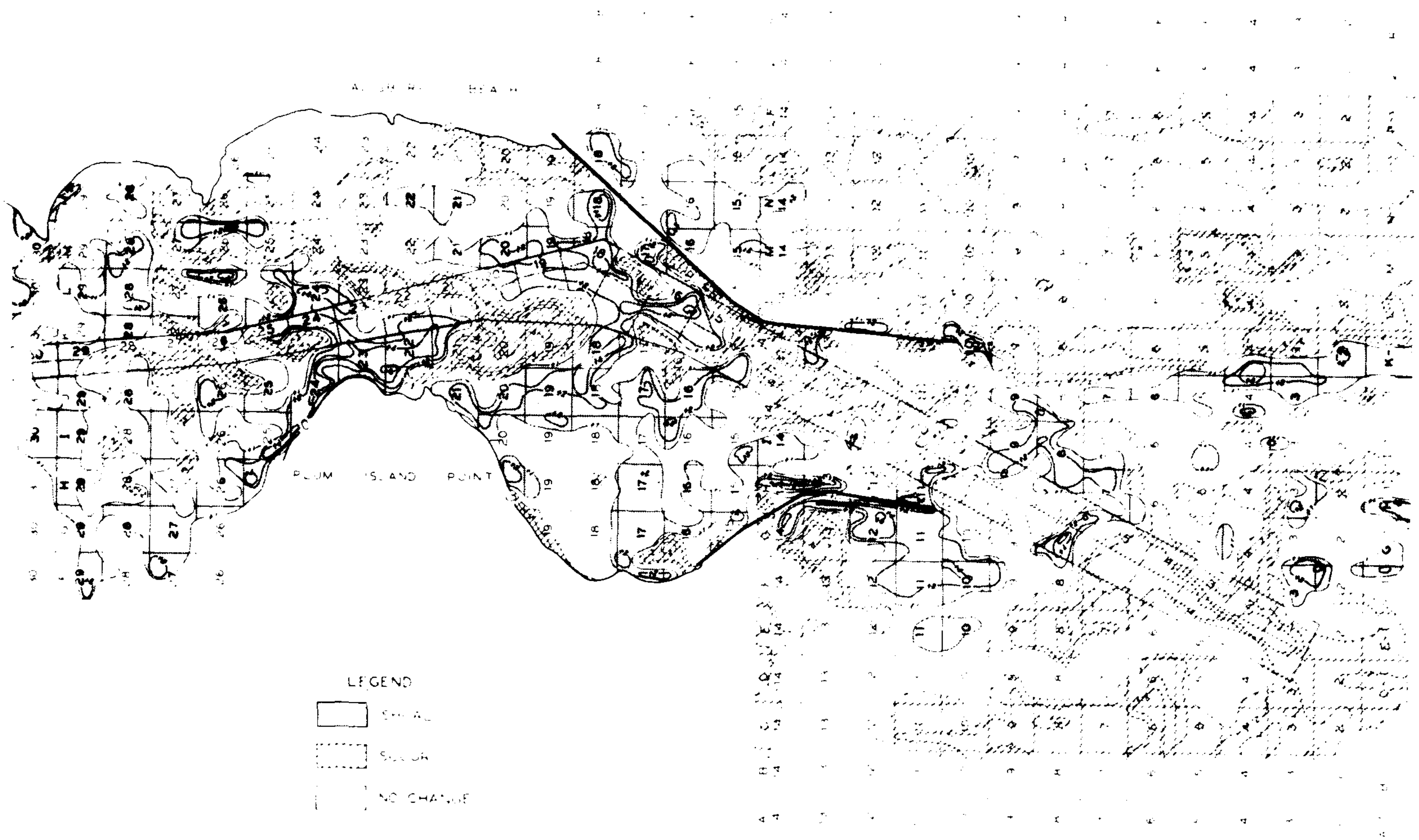


Figure 9. Shoaling and scour patterns, fall 1973 to spring 1974 (6 months)

salinities throughout the model. Reproduction of prototype salinity phenomena in the model required the maintenance of the proper salinity in the ocean water-supply system and the establishment of the proper mixing environment. The prototype salinity data used in this phase of the study were obtained simultaneously with the above prototype hydraulic data. Salinity observations were made at hourly (prototype) intervals in both the model and prototype. These data were plotted and smooth curves were drawn through the points and are compared with corresponding prototype curves in Plates 34-57. The agreement demonstrated between model and prototype is considered excellent. It is pointed out that no additional adjustment of the model was necessary to obtain the agreement shown in Plates 34-57. This substantiates the model adjustment of tides and currents and indicates that the upland fresh water was being properly mixed with salt water from the ocean supply.

Entrance Area Fixed-Bed Shoaling and Scour Verification

38. This phase of the verification involved a trial-and-error procedure to identify a model shoaling material and a model operating technique that attained the most satisfactory reproduction of the known prototype shoaling and scour distribution in the entrance area. During this phase of the model study, the entrance area was molded to conform to the fall 1973 prototype hydrographic survey. The entrance area, outer bar, and a portion of the adjacent beach areas were subdivided into 395 test sections as shown in Plate 58. This grid was painted on the model floor. Scour and shoaling patterns for the entrance area were determined for two prototype hydrographic surveys, fall 1973 to spring 1974, and fall 1973 to fall 1974, as shown in Figures 9 and 10, respectively. To facilitate a better comparison for the test (direct comparison later to plan test), scour and shoaling in each section for each period were weighed and labeled either scour or shoal as indicated in Figures 11 and 12. The fall 1973 survey was used as the base for determining changes during the above periods.

39. The initial step was to determine a material that would respond in the model as sand does in the prototype. Several materials were tried before the final selection was made. The material that responded best was granulated nylon with a mean grain size of 1/8 in. and a specific gravity of 1.14. This material was placed uniformly by hand over the entire test area at a rate of

and is due primarily to the artificial southern model limit discussed in paragraph 31. The prototype reading at tide sta 7 (Wallace Boat Yard) was unusually low during the high-water period on the 22 May 1974 sampling period. This station had previously been found in error and it appears that the high-water data are in error since they were about 1.0 to 1.5 ft lower than the preceding and following high-water elevations. Low-water elevations for the period preceding, during, and following the sampling period at this location were approximately the same; therefore the discrepancy shown in Plates 7 and 9 for this station is probably not as great as indicated. Plates 7 and 9 have not been corrected since no correction factor is known.

Adjustments of currents

35. The objective of the model current adjustment was to obtain an accurate reproduction of prototype current velocities and distributions throughout the model. Prototype current velocity data were available at 12 stations located on 4 ranges; locations of ranges and stations are shown in Plate 1. Prototype readings were made at the surface, middepth, and bottom elevations for a period of 13 hr at each station. Simultaneous readings at each of the 12 locations were made during each of the two prototype sampling periods.

36. The procedure followed for adjustment of current velocities was to reproduce each of the two tidal and discharge conditions in turn and adjust the model roughness until the current velocities at each metering station were reproduced in the model to an acceptable accuracy. The freshwater discharge values used during the current velocity verification were weighted averages of metered discharges observed on the date of the survey. Comparisons of model and prototype current velocities for all stations on each prototype date are shown in Plates 10-33. Measurements obtained at half-hour intervals were plotted for both model and prototype, and smooth curves were drawn through the points. No attempt will be made to discuss each comparison of prototype and model measurements, but the agreement obtained throughout the model is considered to be very satisfactory.

Salinity Verification

37. The objective of the model salinity adjustment was to obtain an accurate reproduction of the vertical and lateral distribution of prototype

31. The procedure followed was to adjust the tide generator in such a manner that the tides generated in the model ocean would cause an accurate reproduction of prototype tides at sta 4 (Coast Guard Station), then to adjust the model roughness until prototype tidal elevations and times were reproduced to scale throughout the model. Once an acceptable verification was achieved, the control station was relocated to the pit (sta 1) and thereafter remained the same throughout base and plan tests.

32. Comparison of model and prototype tidal data for the two tides reproduced in the model are presented in Plates 2-9. Plates 2-4 show tidal elevations for the 13 September 1973 tide conditions at the South Jetty (sta 2), Plum Island Bridge (sta 3), Coast Guard Station (sta 4), Butler's Toothpick (sta 5), Route 1 Bridge (sta 6), Wallace Boat Yard (sta 7), and Bates Bridge (sta 8) tide stations. High-, mean-tide, and low-water levels and range of tide profiles are presented in Plate 5 for the 13 September 1973 tide condition. The greatest discrepancy in tidal range and high- and low-water levels occurred at the Plum Island Bridge sta 3. This station is located near the southern limits of the model. In the prototype, Plum Island River connects Newburyport Harbor to Plum Island Sound about 10 miles to the south. This condition was not reproduced in the model as only about 3 miles of the Plum Island River was reproduced. Although tidal effects extend beyond the station location in the prototype, there was no supplemental provision for the passage of tidal flow at the southern model limits. Since the tidal flow in this area is quite small, and since this area is sufficiently far enough away from the potential problem areas that might have been subject to model investigations, provision for such tidal flow would have involved an unnecessary expense.

33. Another notable discrepancy occurred at Route 1 Bridge (sta 6); however, it is believed that the recording pen or staff gage zero was set about 0.5 ft too low in the prototype on this particular date. This correction has not been made in Plate 3 or 5 but should be taken into consideration in the final analysis. Sta 7 and 8 were located in the labyrinth section of the model and are considered to be within acceptable range of accuracy for model tidal adjustment. Prototype data at sta 7 were incomplete on this date of data collection.

34. Plates 6-9 show the verification results for the 22 May 1974 prototype tide condition. Sta 3 (Plate 6) again reflects the maximum discrepancy

PART III: VERIFICATION OF THE MODEL

27. The verification of the Newburyport Harbor fixed-bed model was accomplished in three phases: (a) hydraulic verification, which ensured that tidal elevations and times, and current velocities and directions were in proper agreement with the prototype; (b) salinity verification, which ensured that salinity phenomena in the model corresponded to those of the prototype for similar conditions of tide, ocean salinity, and freshwater inflow; and (c) fixed-bed entrance shoaling and scour verification, which ensured acceptable reproduction of prototype shoaling and scour distribution and patterns within the entrance area and over the outer bar.

28. The accurate reproduction of hydraulic and salinity phenomena in an estuary model is an important phase in the preparation of the model for its ultimate use in evaluating the effects of proposed improvement works. Every effort was made to obtain a comprehensive verification of all pertinent phenomena.

Hydraulic Verification

Prototype data

29. In September 1973 and May 1974 the US Army Engineer Division, New England (NED), in conjunction with the WES Hydraulics Laboratory undertook a prototype metering program in the Newburyport Harbor to obtain data with which to adjust and verify the Newburyport Harbor estuary model. Two prototype surveys were conducted to secure data covering two widely varying prototype conditions. The survey conducted on 13 September 1973 represented a period of low freshwater inflow, while the 22 May 1974 survey represented the period of high freshwater inflow. Simultaneous observations were made at 12 locations on 4 ranges during the above periods.

Tidal adjustment

30. The objective of the model tidal adjustment was to obtain an accurate reproduction of prototype tidal elevations and tidal phases throughout the model. Prototype tidal data from seven recording tide gages (Plate 1) were available to verify the accuracy of the model tidal adjustment. These gages recorded essentially continuously for a period of about two weeks prior to each prototype metering period to one week following.

material was carefully measured and then placed in the model test sections by hand while the model test reproduction was held at higher water levels. At the end of each model test, the shoaling material deposited within the limits of the navigation channel and prescribed test sections was recovered and measured volumetrically.

tank. The tank was equipped with a system of valves and tubes to control the desired discharge at the injection locations. Water samples were collected at locations throughout the model with a sampling device identical with the multi-depth salinity sampler described in paragraph 17. Concentrations of the samples were measured by means of a Turner Model III fluorometer (Figure 8).

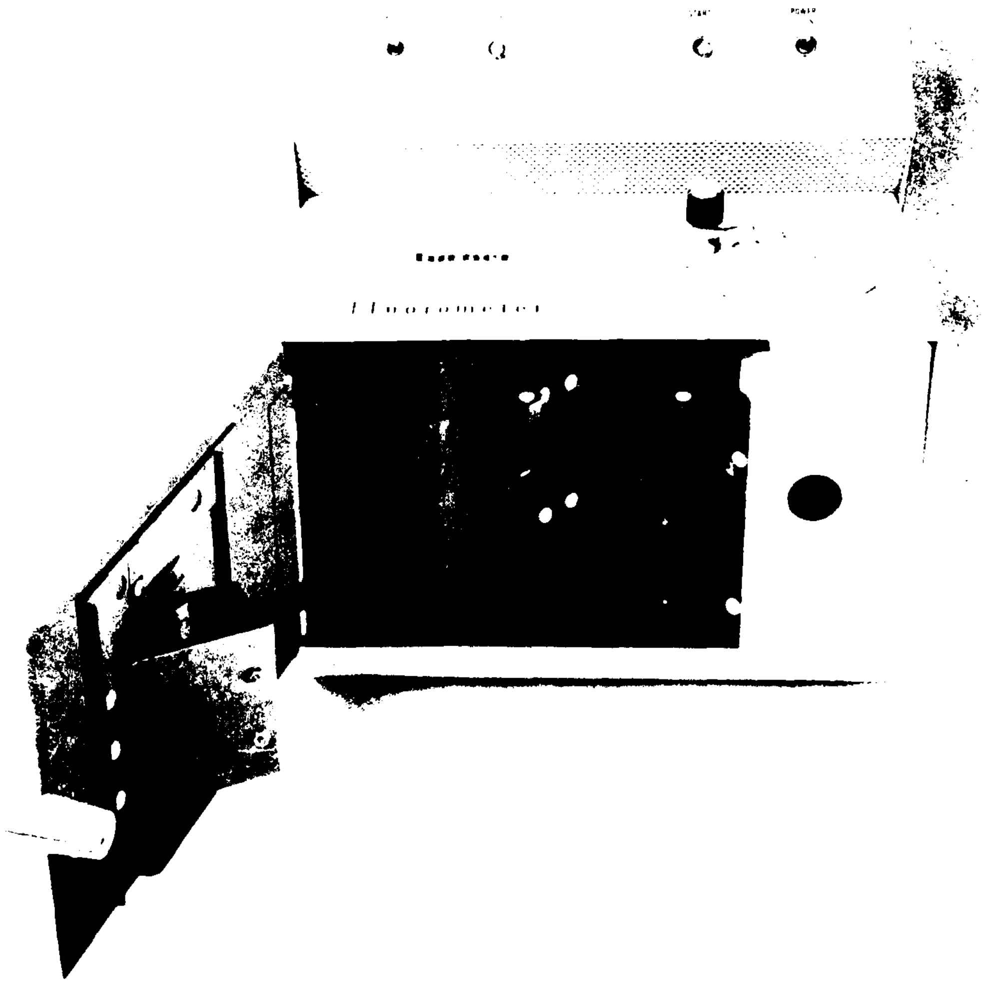


Figure 8. Fluorometer

Shoaling injection
and recovery apparatus

26. Shoaling was reproduced in the model by injecting granulated (1/8 in. by 1/8 in.) nylon particles. The specific gravity of the model sediment used in the entrances fixed-bed shoaling and scour tests was 1.14. The

ocean had to be removed to maintain a constant volume and a constant source salinity. This was accomplished by means of skimming weirs that removed a quantity of mixed water from the surface layer equal to the freshwater inflow to the estuary. Precise measurement of the combined discharge from the skimming weirs was made by use of a Van Leer weir.

Wave generators

24. The model ocean was equipped with two 30-ft-long wave generators to produce the effects of ocean waves on the transportation and deposition of sediments. The wave generators were of the plunger type and could be adjusted to produce the desired wave height and period so that the model waves would move the model bed material to simulate movement of bed material in the prototype. A section of the wave generator is shown in Figure 7.

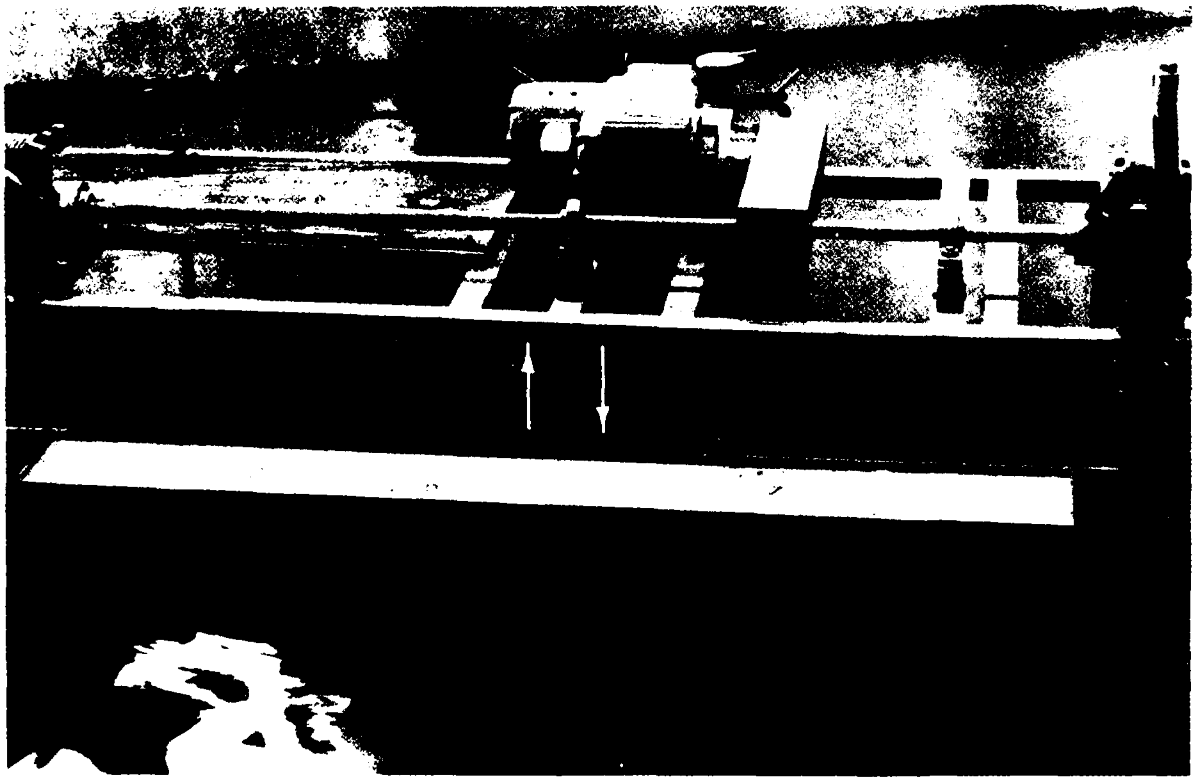


Figure 7. Wave generator

Dye injection and measuring equipment

25. Model tests were made to determine the flushing rate and dispersion characteristics of the model. A given weight of powdered fluorescent dye was thoroughly mixed with a known volume of water and then stored in a glass-sided

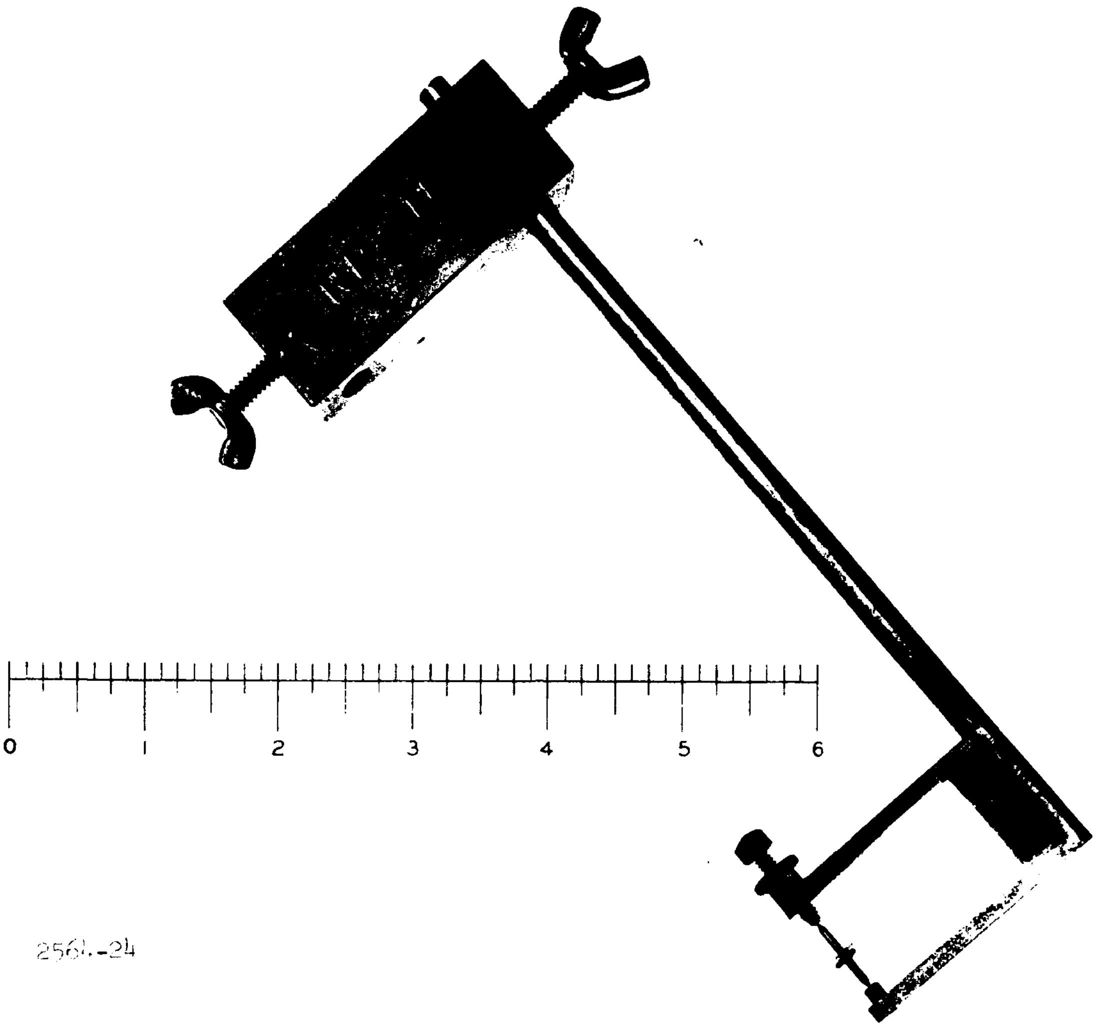


Figure 6. Miniature Price-type current meter

constructed of a light plastic or metal material, were approximately 0.04 ft (4 ft prototype) in diameter and were mounted on a horizontal wheel 0.11 ft in diameter. The center of the cups was 0.05 ft (5 ft prototype) from the bottom of the frame. The meters were calibrated frequently to ensure accurate operation and were capable of measuring actual velocities as low as 0.03 fps (0.3 fps prototype).

Freshwater inflow measuring device

22. Only the Merrimack River was equipped with a constant head tank and Van Leer weir for precise measurements of freshwater inflows.

Skimming weir

23. The mixed salt water and fresh water that accummulated in the model

Chemical titration equipment

19. This method of determining salinity concentration was used primarily to determine the salinity concentration at the saltwater source (sump). The equipment consisted of a graduated burette for measuring the volume of silver nitrate, pipettes for measuring the volume of samples used, sample jars in which to perform the titration, a supply of silver nitrate, and a quantity of potassium chromate for use as an end-point indicator in the titration process. The method consisted of adding a known concentration of silver nitrate solution to a known volume of the model salinity sample; the amount of silver nitrate required to precipitate the salt contained in the sample was then converted to salinity in parts per thousand of NaCl.

Salinity meters

20. All salinity concentrations for samples taken from the model were determined by use of conductivity cells specially built and calibrated for this purpose. The salinity meter assembly is shown in Figure 5.

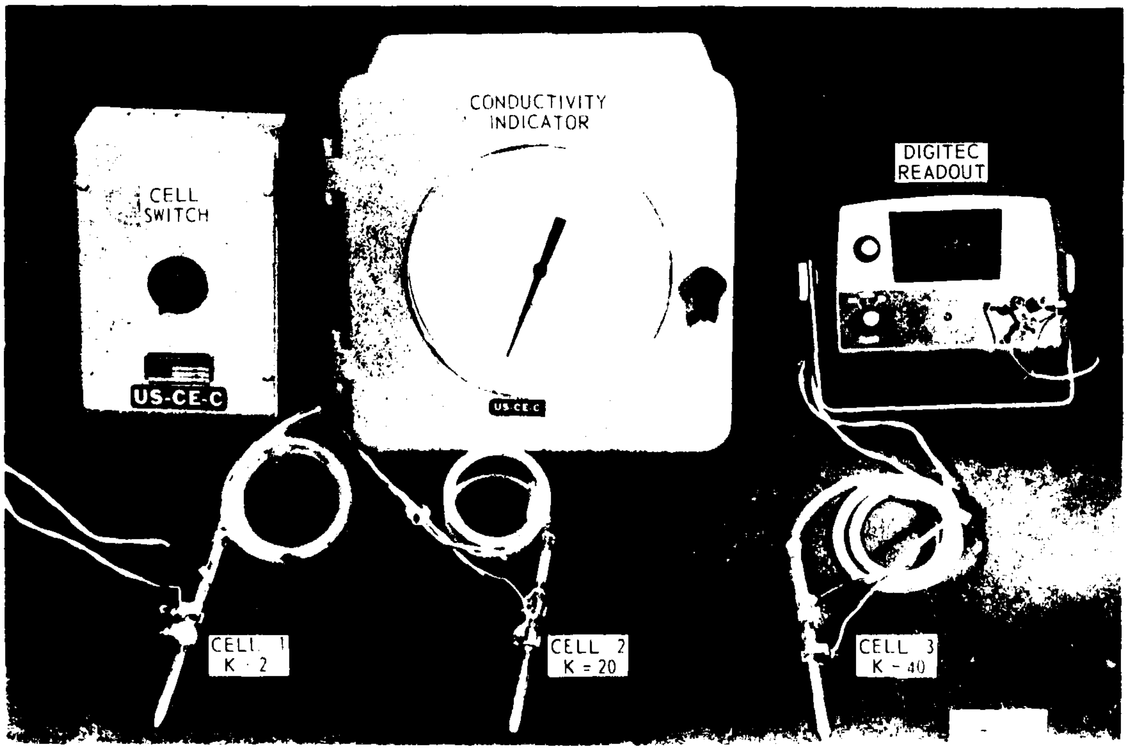


Figure 5. Salinity meter assembly

Current velocity meters

21. Current velocity measurements were obtained with miniature Price-type current meters, one of which is shown in Figure 6. The five meter cups,

collection vials by negative pressure from a vacuum pump connected to a central manifold, which in turn was connected to tubes running to each sampling location. This device enabled simultaneous sampling at all desired depths at all sampling stations throughout the model. Details of the multidepth sampler are shown in Figure 4.

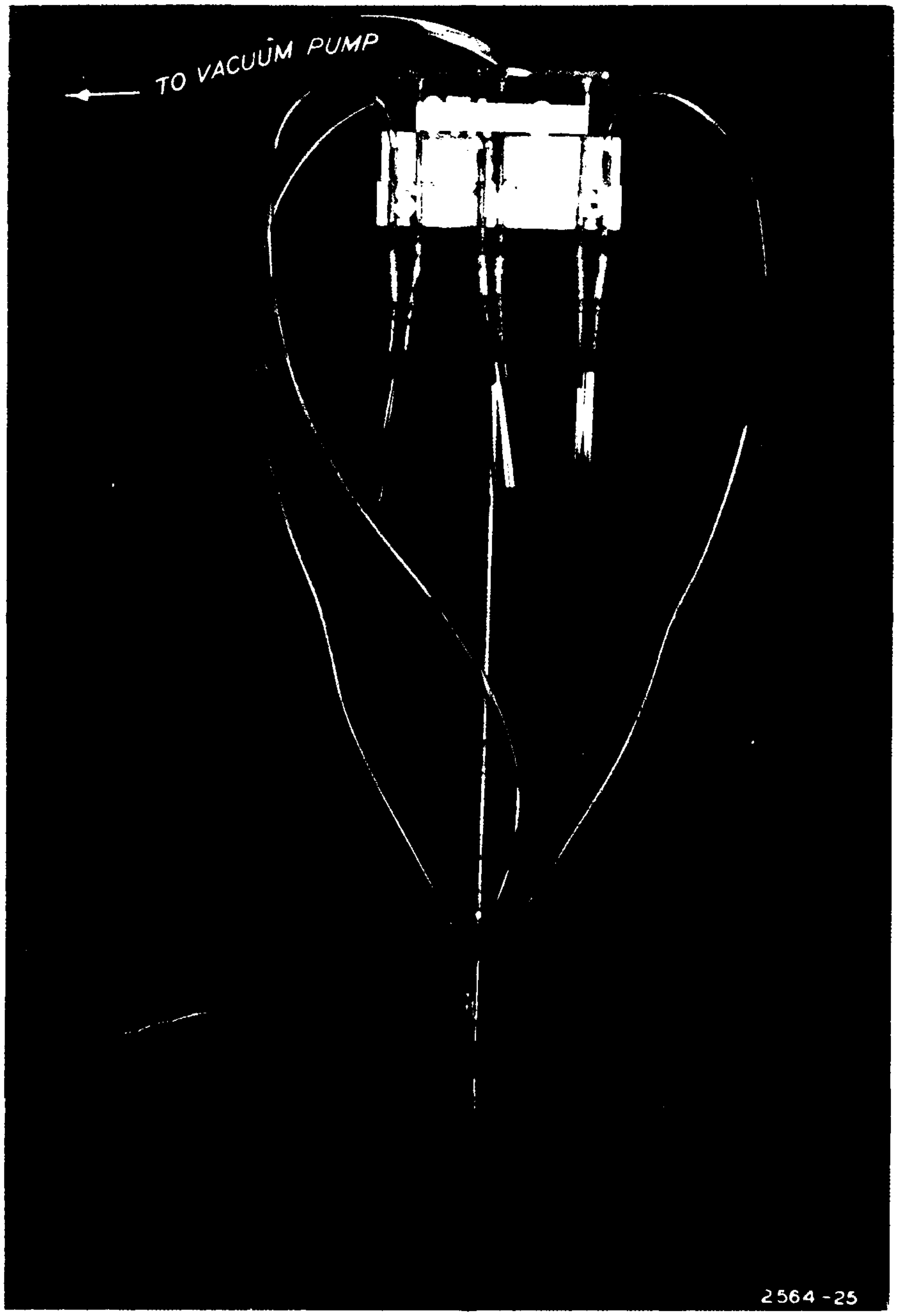


Figure 4. Multidepth sampler

Tide generator and recorder

16. The reproduction of tidal action in the model was accomplished by means of a tide generator (Figure 3) located in the model ocean. The tide generator maintained a differential between a pumped inflow of salt water to the mode' and a gravity return flow to the supply sump as required to reproduce all characteristics of the prototype tides at the control station (Coast Guard Station, sta 2). The tide generator was equipped with a continuous tide recorder so that the accuracy of the model tide reproduction could be checked visually at any time.

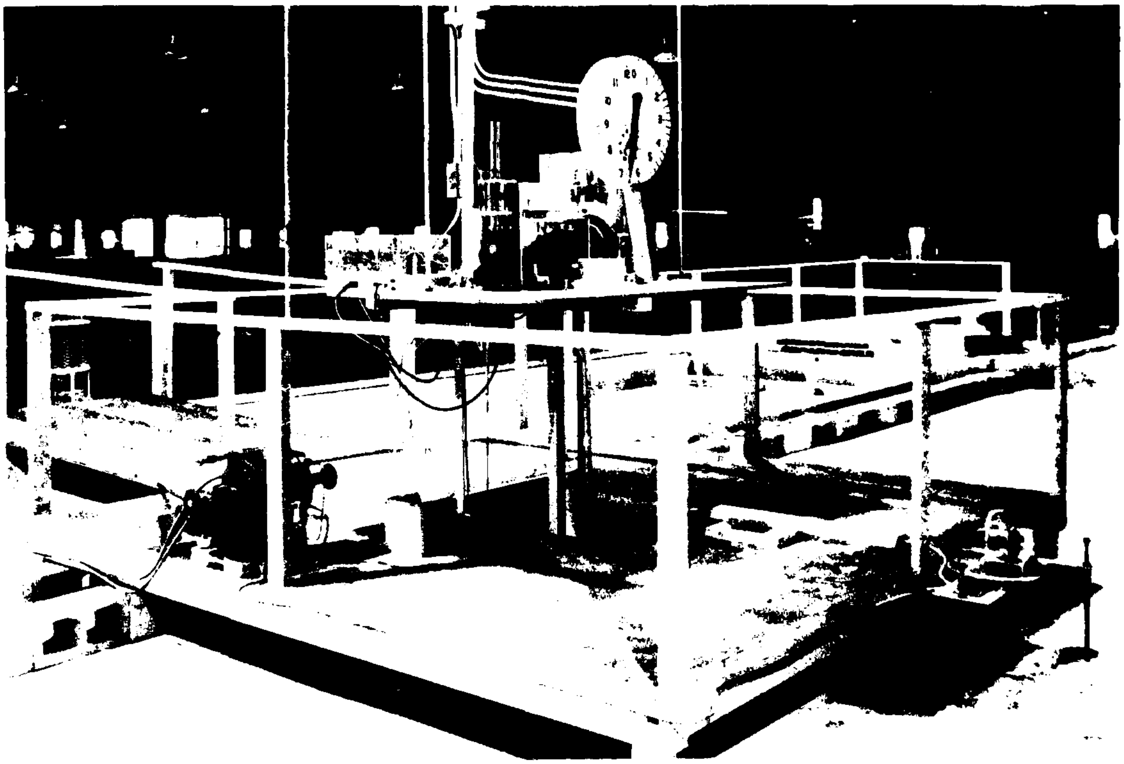


Figure 3. Tide generator

Tide gages

17. Permanently mounted point gages were installed in the model at the locations of the seven recording tide stations used for collection of field tide data (Plate 1). Portable point gages were used to measure tidal elevation at other points as required. The model gages were graduated in 0.001 ft (0.1 ft prototype).

Salinity and dye samplers

18. Water samples for salinity and dye analysis were drawn into

(cross section) 1:30,000, and area (horizontal) 1:90,000. The salinity and dye concentrations ratios for the study were 1:1. One prototype cycle (semidiurnal) of 12 hr and 25 min was reproduced in the model in 24 min and 50.4 sec. Horizontal grid coordinates are based on the Massachusetts coordinate system, and vertical control was based on USC and GS NGVD mean sea level (msl) datum. The model was approximately 180 ft long and 100 ft wide at its widest point, covered an area of about 17,000 sq ft, and was completely enclosed to protect it and its appurtenances from the weather and to permit uninterrupted operation.

13. The model was initially constructed as a fixed-bed model; however, provisions were made to convert the entrance area to a movable-bed model at a later date when such studies were deemed necessary. Limits of the movable-bed section are shown in Plate 1. The model was molded to conform to the prototype hydrographic conditions that existed in the fall of 1973.

14. The permanent model roughness employed consisted of 3/4-in.-wide metal strips placed in depths greater than 6 ft below NGVD and cut off below the low-water elevation. The use of these metal strips as roughness was necessary because proper adjustment of velocity and distribution of currents, both horizontally and vertically, in any given cross section could not be obtained by the use of ordinary boundary roughness alone in the deep areas of the model. The areas above -6 ft NGVD (shoal areas and tidal flats) were roughened by raking the model surface during construction to provide the desired degree of roughness.

Appurtenances

15. The model was equipped with the necessary appurtenances to reproduce and measure all pertinent phenomena such as tidal elevations, saltwater intrusion, current velocities, freshwater inflow, dispersion characteristics, and shoaling distribution. Apparatus used in connection with the reproduction and measurement of these phenomena included a tide generator and recorder, tide gages, salinity meters, salinity samplers, chemical titration equipment, current velocity meters, freshwater measuring weirs, wave generators, dye injection and measuring equipment, and shoaling injection and recovery apparatus. This equipment is described in detail in subsequent paragraphs.

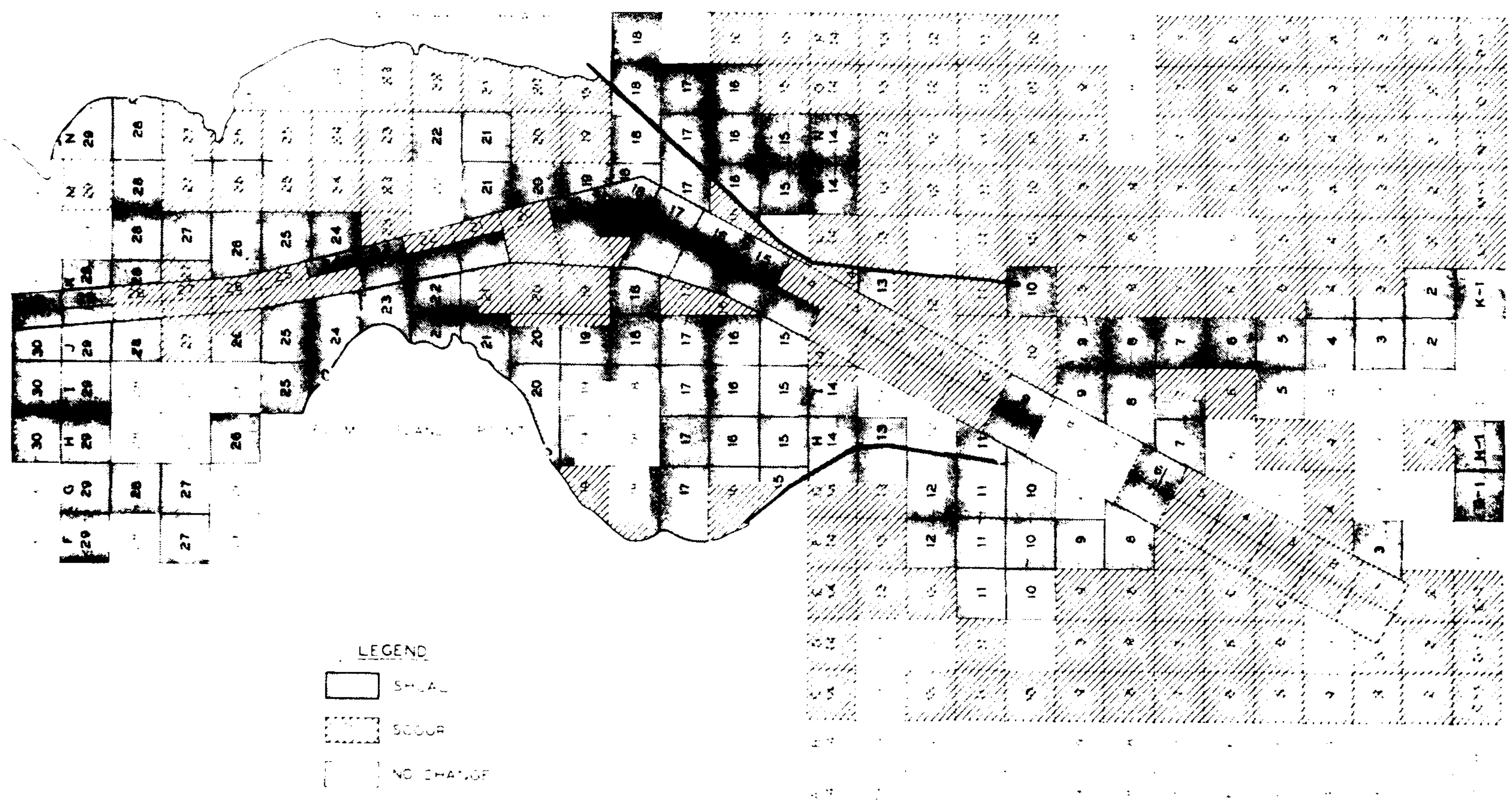


Figure 11. Weighted average shoaling and scour pattern, fall 1973 to spring 1974

Figure 12. Weighted average shoaling and scour patterns, fall 1973 to fall 1974

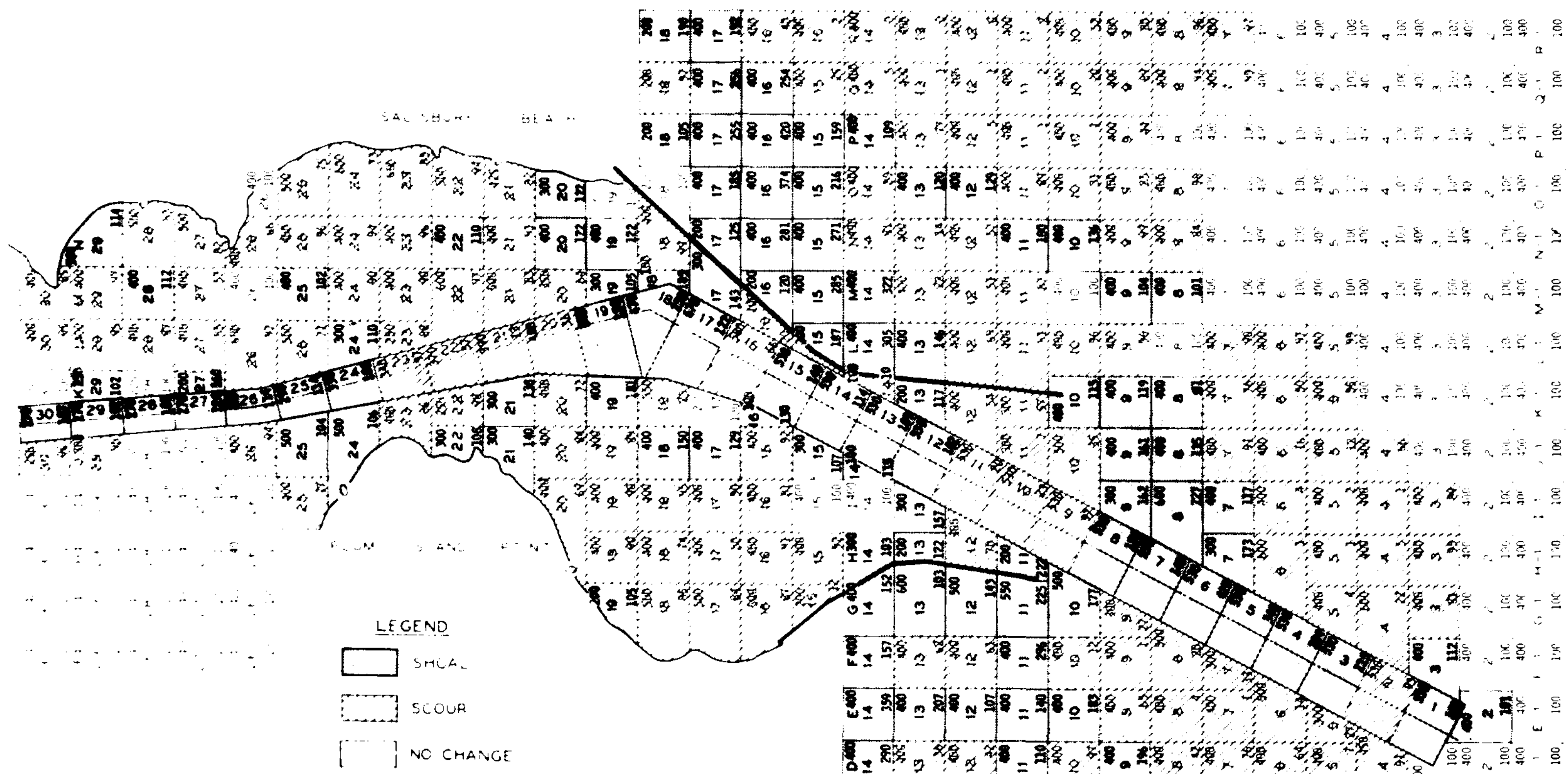
400 cc/sq ft, while the model tide was held at el +4.2 or high water for this series of tests. Two wave generators, each 30 ft in length, were used in the model to simulate the effects of wave energy on the resuspension and movement of the model sediment. The waves generated did not represent any particular prototype wave condition.

40. Trial tests involved the selection of material, the position and operation schedule of the wave generators, tidal conditions, roughness adjustments, injection procedure, and test duration. The procedure that gave the most satisfactory results is described below. The model was flooded to el +4.2 and held at that level until the nylon material (specific gravity 1.14) could be placed uniformly (400 cc/sq ft) over the test area. The initial amount of material in each section was determined by the area of the section. Each section's initial volume is shown in Figure 13. The final test was conducted with the model reproducing a tide range of 8.6 ft at the pit gage. The elevation of high water and low water during each test was +4.2 and -4.4, respectively. The freshwater inflow was 5,000 cfs and the entire model was fresh water (ocean water was fresh water). Since the estuary is a well-mixed system (very little difference in density from surface to bottom), it was concluded that operation without salt water in the ocean would have minimum effect on model shoaling test accuracy, and would further reduce model test cost. Following the placement of the material, the model was started and allowed to run the first tidal cycle without any waves being generated. One wave generator was oriented to generate waves from the southeast (145 deg), while the second generator was placed to generate waves from the northeast (48 deg). Each of the wave generator's plunger and plunger speed was set to generate a model deepwater wave amplitude of 0.8 in. (9.6 ft prototype) having a period of one wave every 1.5 sec. At no time during the test did the two wave generators run simultaneously.

41. The wave generator operation schedule is shown in the tabulation below:

Cycle	Direction of Tidal Flow	Period of Wave Generator Operation: Northeast	Southeast
1	Ebb	No waves	
1	Flood	No waves	

(Continued)



NOTE SECTION IDENTIFICATION IS SHOWN BY LARGE NUMBERS LOCATED IN THE CENTER OF EACH SECTION. THE VOLUME (CC'S) PLACED IN EACH SECTION PRIOR TO TESTING IS SHOWN BY SMALL NUMBERS IN UPPER PORTION OF EACH SECTION. THE SMALL NUMBERS IN LOWER PORTION OF EACH SECTION REPRESENT THE VOLUME OF MATERIAL RECOVERED IN THAT SECTION FOLLOWING THE FINAL VERIFICATION AND/OR BASE TESTS. THE VALUES ARE SHOWN IN PERCENT OF ORIGINAL VOLUME. A VALUE OF 100 INDICATES NO CHANGE, WHILE VALUES GREATER THAN 100 INDICATE SHOALING, AND VALUES LESS THAN 100 INDICATE SCOUR.

Figure 13. Original volumes and final verification and/or base test results

Cycle	Direction of Tidal Flow	Period of Wave Generator Operation	
		Northeast	Southeast
2	Ebb		Hours 4-5
2	Flood		Hours 8-9
3	Ebb	Hours 5-	
3	Flood	-7	
4	Ebb		Hours 4-5
4	Flood		Hours 8-9
5	Ebb	Hours 5-	
5	Flood	-7	
6	Ebb	Hours 5-	Hours 8-9
6	Flood	-7	

42. Material was added along the northern and southern perimeter of the test area as it was depleted from those areas. The model was stopped at the end of six complete tidal cycles (hour 0, cycle 7). Prior to retrieving the material, a sketch of the shoaling and scour patterns was made and an example is shown in Figure 14. The shaded areas in this sketch, and in similar sketches of individual plans shown in plates, indicate areas that appeared from visual observations to be heavier than the original distribution (400 cc/sq ft). The cross-hatched areas indicate complete scour; no material was present within the boundaries of the cross-hatched area. The blank or white areas indicate that no visible change took place. Figure 13 is an example showing shoaling and scour at individual sections for the entrance shoaling and scour verification. The values shown in Figure 13 were obtained by averaging the results from two identical runs. Two runs of this test and all future plan tests were made to ensure an accurate reproduction and to discover any possible error that might have occurred during any particular test. In the event the two runs did not check, a third run was made. After each test, the material in each section was recovered and measured. The percentage change from the original amount for each section was then determined. This percentage is shown in small numbers in the lower portion of each section, while the original volume is shown in the upper portion of each section as in Figure 13. Sections are identified by the large numbers in the center of each section.

43. From an examination of Figures 9, 10, and 14, and 12 and 13, referred to in the above paragraphs, it can be concluded that a successful

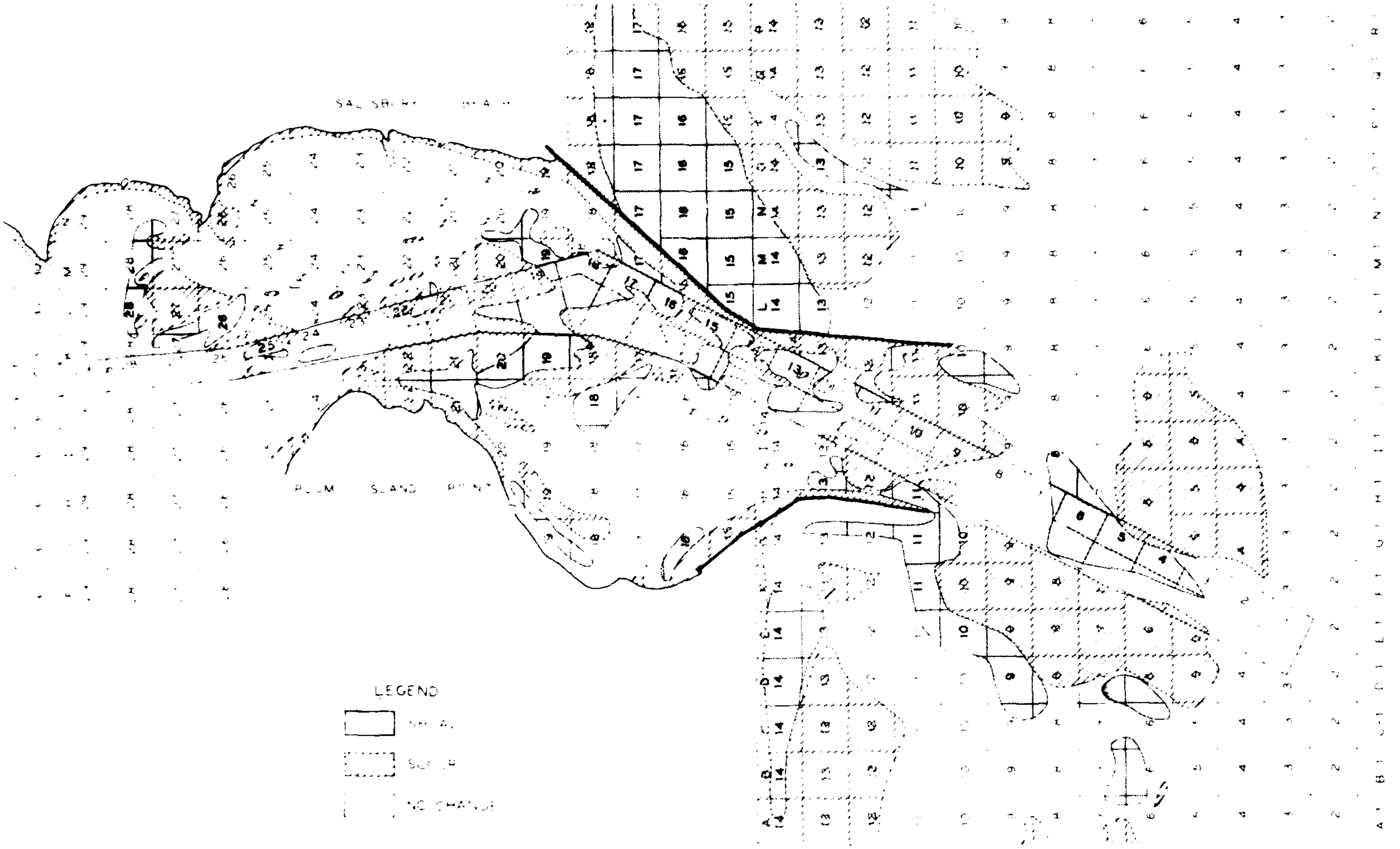


Figure 14. Verification and/or base test entrance shoaling and scour patterns

shoaling and scour verification was made for the prototype conditions; therefore the verification is considered sufficient to ensure a valid indication of effects from proposed plans on shoaling and scour in the entrance area. The final entrance shoaling and scour verification described in this part of this report served as the basis for determining the effects of proposed plans.

Limitations of the
accuracy of model measurements

44. Measurements of tidal elevations in the model were made with point gages graduated to 0.001 ft (0.1 ft prototype). Limitations of the current velocity meters used in the model should be considered in making close comparisons between model and prototype velocity data. The center line of the meter cup was about 0.05 ft above the bottom of the frame; therefore bottom velocity measurements in the model were actually obtained at a point 5.0 ft (prototype) above the bottom instead of about 2.0 ft as in the prototype metering program. The model velocities were determined by counting the number of revolutions in a 10-sec interval (which represented a period of about 5 min in the prototype), as compared with about a 1-min observation in the prototype. The horizontal spread of the entire meter cup wheel was about 0.11 ft in the model, representing about 33 ft in the prototype, as compared with less than 1.0 ft for the prototype meter. Thus the distortion of area (model to prototype) results in comparison of prototype point velocities with model mean velocities for a much larger area. The same is true for the vertical area, since the height of the meter cup was about 0.04 ft (4.0 ft prototype) as compared with only a few inches for the prototype meter. Middepth measurements in the model were made at a point midway between the bottom and an average of low tide and high tide elevations.

45. All model salinity measurements presented in this report were made with a calibrated salinity meter (conductivity type) and are considered to be accurate within 0.5 ppt in the higher range and 0.2 ppt in the lower ranges. The model samples were collected at the bottom, middepth, and surface elevations. The elevations of the bottom and middepth samplers were fixed in the model and were not allowed to vary with the tide as was the surface sampler. Simultaneous water samples were drawn into vials from the three elevations by means of a vacuum system. Similar to the model velocity data, the model salinity data also represent an average over a much larger prototype area, since the vacuum sampling system used in the model drew the sample from a

radius of about 0.05 to 0.10 ft (15 to 30 ft in the prototype). The accuracy with which the model could be expected to duplicate salinities from cycle to cycle for identical conditions appears to be about ± 3 percent.

PART IV: BASE AND PLAN TEST PROCEDURES

Test Conditions

46. In order to evaluate the effects of the proposed improvement plans, it was first necessary to establish hydraulic, salinity, surface current patterns, dye dispersion, and entrance shoaling "base tests" that depicted, respectively, the characteristics of these conditions throughout the model for existing conditions. Thus a test in which no improvement plan was installed in the model is referred to as a base test, since its results constitute a basis of comparison for determining the effects of improvement plans. Base conditions consisted of fall 1973 prototype hydrographic conditions throughout the model, with the exception that the entrance bar channel was dredged to the authorized depth of 16 ft (-12 ft mlw). Each plan subjected to hydraulic, salinity, and dye dispersion tests included the proposed new channel realignment across the inner bar as shown in Plate 59. The proposed realignment channel was dredged to el -16 (-12 ft mlw) for a distance of 200 ft on either side of its center line (400 ft wide). Therefore all plan test data (hydraulic, salinity, and dye dispersion) will reflect the combined effects of both plan (groins, dikes, jetties, etc.) and channel realignment. Entrance shoaling and scour plan tests were conducted with the existing authorized channel installed rather than the proposed realignment. This is discussed in more detail in paragraph 60.

47. All hydraulic and salinity tests were conducted with model conditions of a spring tide (9.6-ft range at pit sta 1) and a source salinity concentration of 29.0 ppt. With tide and salinity conditions as stated above, base test data were obtained for three Merrimack River freshwater inflow conditions. The three freshwater inflow conditions furnished by NED for testing were: 2,200 cfs (low), 5,000 cfs (mean), and 11,000 cfs (high). Dye dispersion and surface current pattern base test data were obtained for only the mean (5,000 cfs) freshwater inflow condition. All the test data (base and plan) shown in this report are for mean (5,000 cfs) freshwater inflow conditions. The base test data resulting from conditions of low and high freshwater inflows are not included in this report, but are on file in the NED office and at WES. Prior to data collection of any type, the model was operated for a sufficient period of time to achieve a condition of dynamic salinity

stability. The procedure for starting operation of a tidal model utilizing salt water is developed during the verification phase of the study and thereafter is followed exactly. The initial salinity concentrations are artificial; and the model must be operated for a period of time to allow salinities to reach stable values with respect to time, depth, and location. It was found in the Newburyport Harbor model that the best procedure was to flood the area upstream from Deer Island (Plate 1) with fresh water and the ocean and downstream area with ocean (salt water) water to the high-water elevation. A barrier installed across the model at Deer Island to separate the fresh and salt water during the flooding stage was removed and the tide generator and proper freshwater inflow were initiated to begin the test. The model was operated until salinity stability was achieved prior to initiation of data collection. For mean freshwater inflow conditions it was necessary to operate the model for about six tidal cycles (about 3 hr) before relatively stable conditions existed, after which data collection could be initiated. To ensure a higher degree of salinity stability when obtaining salinity or dye measurements, salinity and dye samples were not taken until the model had operated for at least 16 tidal cycles (about 7 hr).

48. Locations of stations monitored during base and plan test conditions are shown in Plate 60. Tide station locations are identical with those in the verification, except that three stations were added (1, 1B, and 9) to more accurately define tidal changes resulting from any plan investigated. Sta 1 and 1B reflect tidal conditions in the pit and ocean, respectively, while sta 9 is located in the vicinity of Deer Island. Pit sta 1 was the control station throughout all base and plan tests and was held constant throughout all plan testing.

49. Verification of current velocities and salinities was based on the results of data obtained at 12 locations throughout the estuary (Plate 1). This coverage was not sufficient, particularly in the entrance area, to give a complete composite picture of the effects of any possible future improvement plan to be tested; therefore the station location and numbering scheme used during the verification phase of the model study was abandoned during the testing phase for a sampling scheme that would better define the effects of proposed plans. During the base test data collection phase of most model studies, the policy is to obtain enough data to define almost any possible change that might arise following the installation of any possible type of

improvement plan. In many instances, however, a particular plan does not need the full or complete coverage to accurately define or analyze the changes brought about by its installation, as is the case in this model study.

50. Sta 0+00 (Massachusetts Grid - N661-601.55; E 789-001.36), located on the center line of the authorized navigation channel approximately 3,000 ft east of the jetties, was the point of origin for the new numbering scheme and is designated range 0. Ranges located upstream from this point are designated by a number representing the distance in 1,000 ft from sta 0+00. Individual stations located on each range are designated with a letter, beginning with "A" at the southernmost station.

Hydraulics

Tides

51. Tidal height data were obtained at 10 locations throughout the model. The data, collected at half-hour intervals, were plotted and smooth curves were drawn through the points. Locations of tide stations are shown in Plate 60.

Current velocities

52. Base condition current velocity data were obtained at 28 locations throughout the model (Plate 60). Data were obtained at the surface, middepth, and bottom elevations at half-hour intervals at all locations where bottom elevations exceeded -12. Only surface and bottom data were obtained at locations where bottom elevations were between -5 and -12, while only one sample (bottom) was obtained at locations where the bottom elevation was -5 or less. Only 21 of the above 28 locations were monitored during tests conducted with the plans installed. The reduction in coverage was necessary to conserve operation time and cost; however, the coverage is considered to be more than sufficient to define any changes effected by the installation of any of the plans tested. The half-hour measurements were plotted and smooth curves were drawn through the points. Locations of current velocity stations for plan conditions are shown in Plate 61.

Flow predominance

53. Current velocity data for base and all plan tests were analyzed to determine flow predominance. This method of presenting current velocity data reduces magnitude, direction, and duration of the currents to a single

expression that defines the predominant direction and percentage of total flow at any given point. This expression was derived from a conventional plot of velocity versus time at any given point. The area subtended by both ebb and flood portions of the curve was measured and summarized. The area subtended by the flood portion of the curve was then divided by the total area to determine what percentage of the total flow was in the flood direction. A negative (-) sign and a positive (+) sign were designated to indicate ebb direction and flood direction, respectively. For simplification, only the percent of flow in the flood direction was calculated, then a value of 50 percent was subtracted from each calculation to determine predominant direction and magnitude. Using this method of analysis, a value of 0 percent indicates that flow in both the ebb and flood directions is equally balanced; the ebb area and flood area of the curve are equal. A value of +50 percent indicates that flow at that point is in the flood direction at all times during a tidal cycle, while a -50 percent value indicates flow in the ebb direction throughout a tidal cycle. The table and plates in this report use the above method to show flow predominance.

Salinities

54. Base test salinity data were obtained at 44 locations throughout the model (Plate 60). The procedure for determining the number of depths sampled per location was identical with that used for current velocity measurements. The salinity concentrations were determined with a salinity meter and were later plotted and smooth curves drawn through the points. The number of sampling locations monitored during base tests was reduced from 44 to 29 when plan test conditions were investigated. This coverage is considered to be more than adequate to define changes resulting from the plans. Locations of salinity stations for plan conditions are shown in Plate 62.

Dye Dispersion

55. Model tests were made to determine the flushing rate and dispersion characteristics of the estuary for a single generalized source of material entering the estuary. The test procedure consisted of introducing a conservative fluorescent dye (Pontacyl Brilliant Pink) at the middepth elevation at

the channel center line at Route 1 Bridge in Newburyport, Mass. The dye, with an initial concentration of 500,000 ppb and the density of fresh water (1.0), was injected into the model at a prototype rate of 10.0 mgd. The injection was initiated at hour 0.0, cycle 1, and continued throughout the sampling period (16 tidal cycles). The dye mixture was contained in a glass standpipe and was introduced at a constant rate throughout the sampling period, through a 1/4-in. tube oriented at the proper elevation. A small laboratory pump, calibrated to ensure a constant rate of discharge, was installed in the line between the injection point and the standpipe. Prior to initiating dye injection, the model was operated for 16 tidal cycles to establish salinity stability throughout the model. Dye dispersion tests were conducted with only mean ([illegible] cfs) freshwater inflows.

[illegible]. Locations of the dye release point and stations sampled are shown in Plate 60. During the dye dispersion tests, water samples were withdrawn from the model for subsequent analysis for dye concentrations. Base condition samples were taken at 42 locations using the multidepth sampler described in paragraph 17, whereas only 30 locations were monitored for plan conditions (Plate 63). This coverage is more than adequate to define changes resulting from plan tests. Only surface and bottom samples were obtained at each location; however, at a few locations where the bottom elevation was -5 ft or less, only one sample (bottom) was obtained. Samples were obtained as near as possible to time of occurrence of high-water slack (hws) and low-water slack (lws) at each individual location over a period of 16 tidal cycles. Since the time of occurrence of hws and lws varied at individual stations throughout the model, it was necessary to stagger the sampling times in order that samples be obtained as near as possible to the correct slack time. The procedure adopted is described as follows: hws samples on sta 0A-6C were obtained at hour 0:30, sta 8A-20C at hour 1:00, and sta 26A-66A at hour 1:30. Lws samples on sta 0A-14A were obtained at hour 7:30, sta 16A-20C at hour 8:00, and sta 26A-66A at hour 8:30. Two stations (16A and 16B) were not monitored during the lws period because they were exposed during that phase of the tidal cycle. Concentrations of the samples were measured by means of a Turner Model 111 fluorometer. The fluorescent dye used in the model tests was conservative, that is, it did not decay with time. Model dispersion and flushing rates thus cannot be directly related to the prototype without application of the appropriate decay rate.

57. All measurements were plotted on semilogarithmic graph paper to make a detailed analysis possible at each sampling point. At stations located near the release point there is a definite increase in point scatter. This is attributed to the fact that considerable effluent collects near the outfall during the injection cycle. The heavy, visible concentrations of dye clouds move away with the ebbing or flooding tide and form detached areas of comparatively high dye concentrations for several tidal cycles thereafter. For this reason, dye concentrations measured at points 1.0 ft apart in the model (300 ft prototype) can and do differ greatly. This same phenomenon undoubtedly occurs in nature and is probably responsible to a great degree for the reported difficulty in the analysis of results of similar full-scale studies in the prototype.

Surface Current Pattern Mosaics

58. Surface current pattern mosaics made for base conditions include a portion of the Atlantic Ocean, the entrance area, and portions of the estuary on either side of the navigation channel up to and including the Route 1 Bridge. Photo coverage for plan conditions did not extend as far upstream as did base condition coverage; however, the coverage is sufficient to define any changes in surface current patterns affected by the plans. These mosaics were used in evaluating proposed channel realignments and effectiveness plans. The mosaics also provide a means for current velocity measurements in areas too shallow for measurements with the velocity meter. Surface current pattern photographs were made for mean (5,000 cfs) freshwater inflow conditions only.

59. The mosaics were prepared from time-exposure photographs of confetti floating on the water surface. A bright light was flashed immediately before the camera lens was closed, resulting in a bright spot at approximately the end of each confetti streak that indicates the direction of flow. Current velocities can be determined from the photographs by measuring the lengths of the confetti streaks and comparing the lengths with the velocity scale presented in each mosaic. Photographs were taken at hourly (prototype) intervals throughout a complete tidal cycle. Surface current pattern mosaics for base test conditions are presented in Photos 1-7.

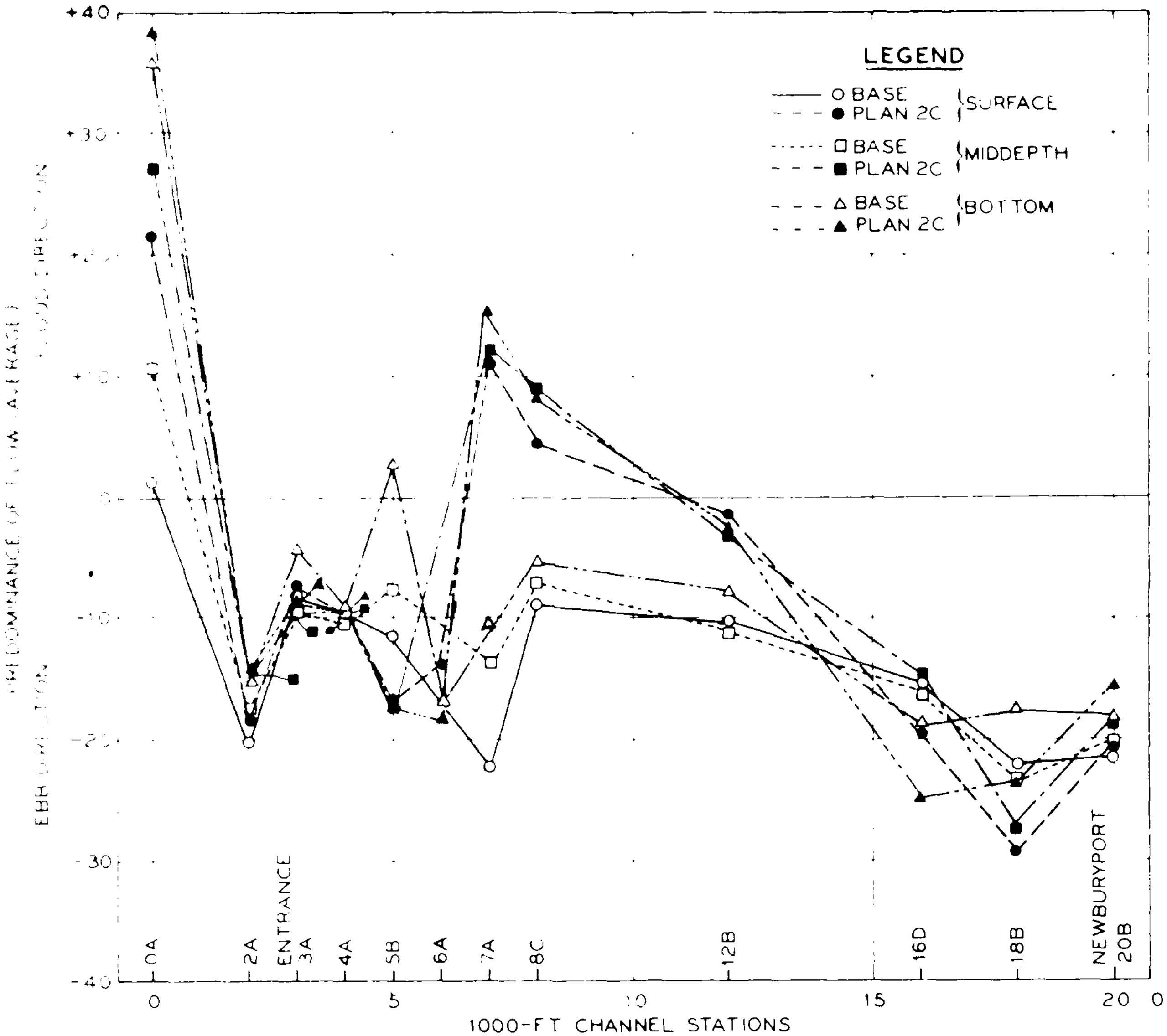


Figure 21. Flow predominance profile, Plan 2C

each of which was located in the entrance near the plan. Low-water levels at these three stations were 0.3, 0.5, and 0.6 ft higher than base conditions, while high-water levels at these same stations remained essentially unchanged. This trend was observed at all locations except sta 7 but not to the extent observed at stations located near the plan. The decrease in tide range was primarily due to the increase in the low-water levels created by Plan 2C.

Currents

75. Current velocity measurements obtained at 21 locations throughout the estuary with Plan 2C installed are presented in Plates 69-89. Table 1 shows flow predominance calculations. Surface current patterns are shown in Photos 38-42. This plan resulted in rather significant and large changes in base condition currents at seven stations (5A, 5C, 6A, 6B, 6C, 7A, and 8C), all of which were located in the immediate vicinity of the plan. Flow predominance at sta 5A was changed from a strong ebb predominance during base conditions to almost total flood predominance with Plan 2C installed. Sta 6C was changed from an almost balanced flow to an almost total flood predominance condition. Extremely high ebb currents in excess of 8.0 fps were observed at sta 6A and 6B, located just downstream from the plan. Maximum ebb currents (bottom depth) at these two locations were increased from 2.9 to 8.3 fps and from 4.6 to 8.7 fps, respectively. Just upstream from the plan, sta 7A and 8C showed rather large increases in flood currents with no apparent change in ebb currents. This effect resulted in a drastic change in flow predominance as shown by the profiles in Figure 21. Flow predominance (ebb direction) at sta 12B was decreased to the point of almost balanced flow. Changes at other locations were observed, but none appeared to be significant.

Salinities

76. Salinity data obtained at 29 locations with Plan 2C installed are shown in Plates 90-118. Average salinity concentrations are shown in Table 2. Average salinity concentration profiles for stations located on the channel center line are shown in Figure 22. Plan 2C had very little effect on salinities except at locations in the immediate vicinity of the plan. Like Plan 2B, maximum effects were observed during the period of minimum salinity concentration (lws). Maximum salinity concentrations (hws) were not affected to any significant degree. The greatest effects occurred at sta 5B, 6C, and 8A. Minimum salinity concentrations at sta 5B were lower than base concentration by 3.8, 4.2, and 3.6 ppt at surface, middepth, and bottom elevations,

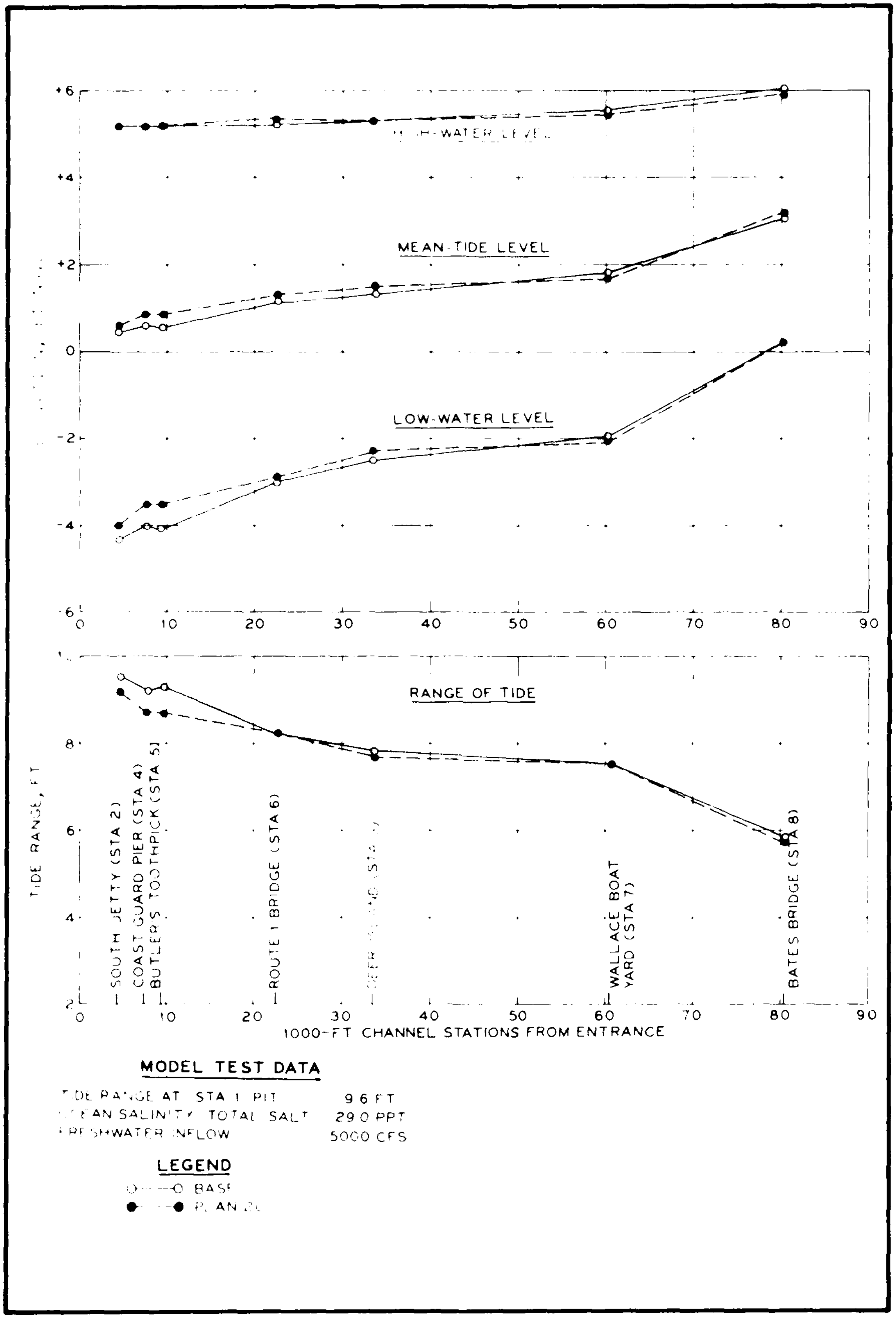


Figure 20. Tidal observations, Plan 2C

also shown in Table 4. Shaded sections are areas where the volume recovered was greater than that recovered following base test; and crosshatched sections are areas where the volume recovered was less than base conditions.

72. Shoaling index calculations were made for the navigation channel only and are shown in Table 4 and in Plate 152. Data in Table 4 show that the shoaling index for the navigation channel was 98.5, or a reduction in overall shoaling of 1.5 percent, well within the limits of accuracy of repeating identical tests. However, the patterns were changed significantly (Plate 152). The large peak shoal located in section 6 (12.3 percent) following base tests was relocated seaward to section 2 as a result of Plan 3B and was reduced to a value of 9.5 percent. Sections 8 and 9 scoured completely, in comparison to shoaling of 4.5 percent and 2.9 percent, respectively, from base conditions. During base tests, two peak shoals developed on the inner bar in sections 12 (5.5 percent) and 18 (6.7 percent). These shoals were much heavier as a result of Plan 3B, and were relocated upstream to sections 15 (10.0 percent) and 19 (9.9 percent), respectively.

73. Changes at the above two areas in the navigation channel were the most significant. However, considerable scouring occurred in sections located between the jetties, both in the navigation channel and adjacent sections. Scouring in adjacent sections was primarily north of the channel. A rather heavy shoal or bar also developed immediately south of the channel in sections I13-I14, J14-J16, and K16. Sections located along the north beach of Plum Island (sections G16-G18 and I20) were slightly higher than these observed from base test results, indicating that this area would have a tendency to shoal as a result of Plan 3B. Very little change was observed on the beaches and offshore sections north and south of the respective jetties. The heavy bar formed just offshore on the beach north of the north jetty was slightly less than that observed for base conditions. Also, no significant change was observed upstream of Plum Island Point.

Plan 2C

Tidal heights

74. The effects of Plan 2C on hourly tidal heights at 10 locations throughout the estuary are shown in Plates 65-68. The water-level profiles shown in Figure 20 show that maximum effects occurred at sta 2, 4, and 5,

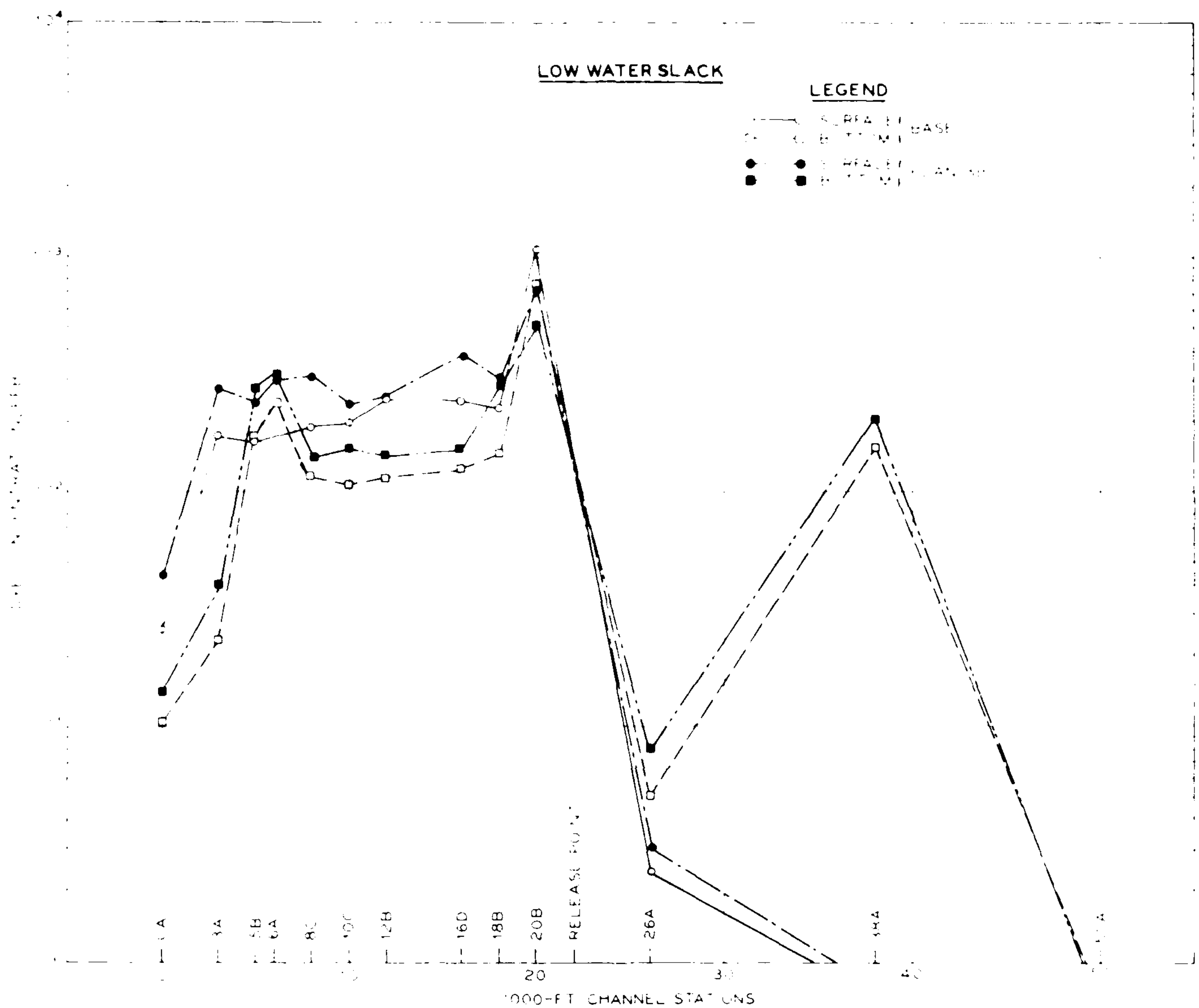


Figure 19. Low-water slack average dye concentration profile, Plan 3B

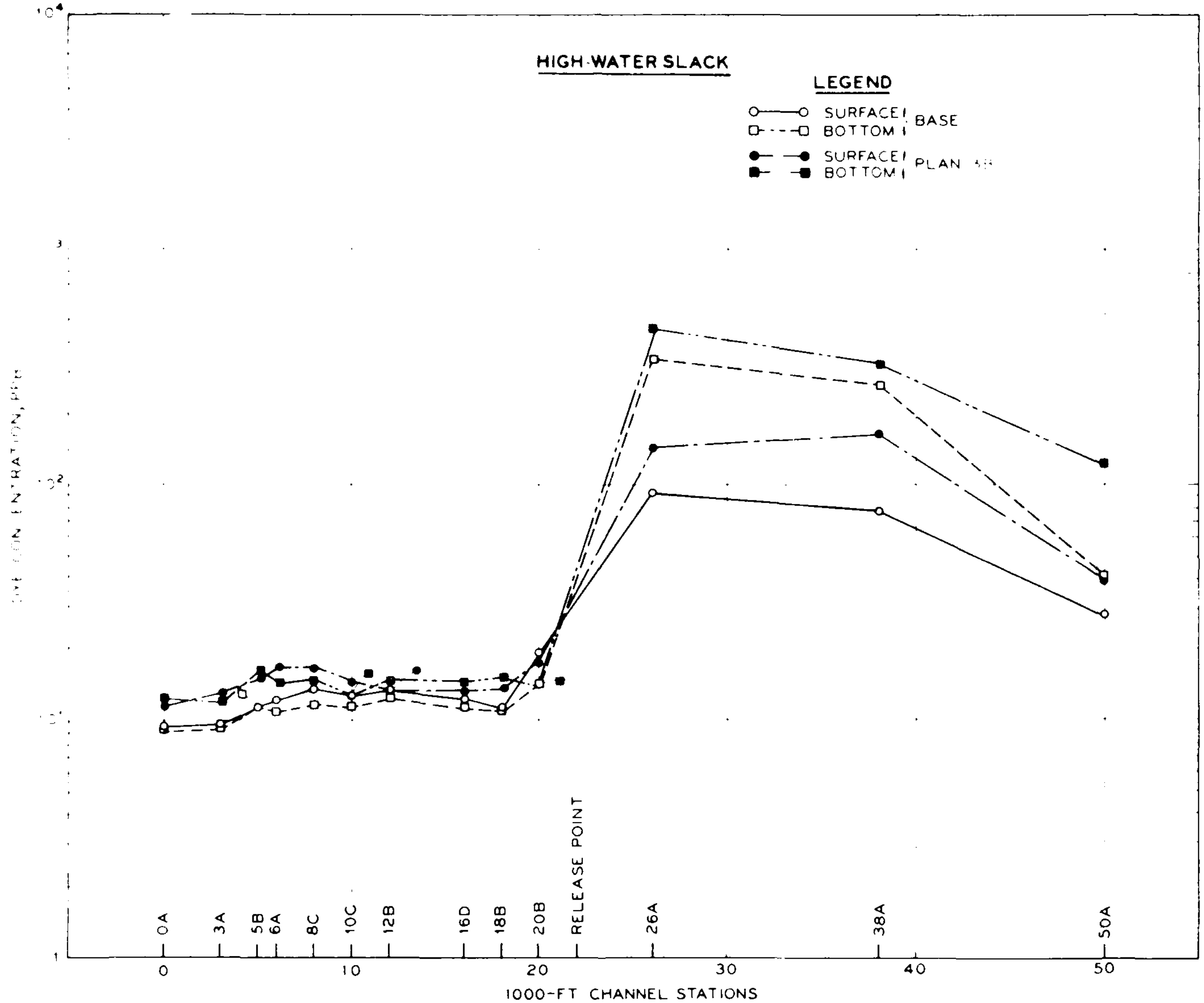


Figure 18. High-water slack average dye concentration profile, Plan 3B

Maximum and average dye concentrations are shown in Table 3. The hws and lws average dye concentration profiles for channel center-line stations are shown in Figures 18 and 19, respectively. Data shown in Table 3 and Figures 18 and 19 reflect the average concentrations of all dye samples obtained throughout the 16 cycle test period at that particular point.

70. Both the hws and lws average dye concentration profiles show a small increase. The extreme high concentration observed at the bottom depth at sta 38A during the lws sampling period reflects the effects of the deep hole where the station is located. Other than this location, there appeared to be no areas in the estuary where an unusual buildup of dye occurred. The maximum concentration was observed at this station during cycle 2, hws sampling period (Plate 146), after which time the dye concentration began to decrease slightly as the test progressed. The hws dye concentrations at almost all locations increased throughout the test period for both base and plan conditions; however, very little difference was noted between base and Plan 3B conditions. The lws dye concentrations at the majority of stations peaked about cycles 2 to 4, and thereafter remained fairly stable throughout the remainder of the test for both base and plan conditions.

Entrance fixed-bed shoaling and scour

71. Plate 149 shows the results on shoaling and scour by individual sections with the model operating for base conditions. The volume of material recovered in cc's following the completion of base tests is shown in small numbers in the lower portion of each section, together with initial volumes (cc's) in upper portion of each section. Plate 150 is a sketch showing the shoaling and scour patterns that developed as a result of Plan 3B. Plate 150, when compared with Figure 14 (similar sketch of final verification and/or base test), shows the effects of Plan 3B on the shoaling and scour patterns. The data in Plate 151 show the effects of Plan 3B at individual test sections. The values shown in the lower portion of each section represent the effects of the plan at that particular section and are shown as a percent of the volume remaining after base test. Values of 95 to 105 represent areas of no change from base conditions. Those areas within ±5 percent were considered not changed or within the limits of accuracy of repeating identical test of this type. Values greater than 105 percent indicate areas of shoaling, while values less than 95 percent indicate areas of scour. These same data are

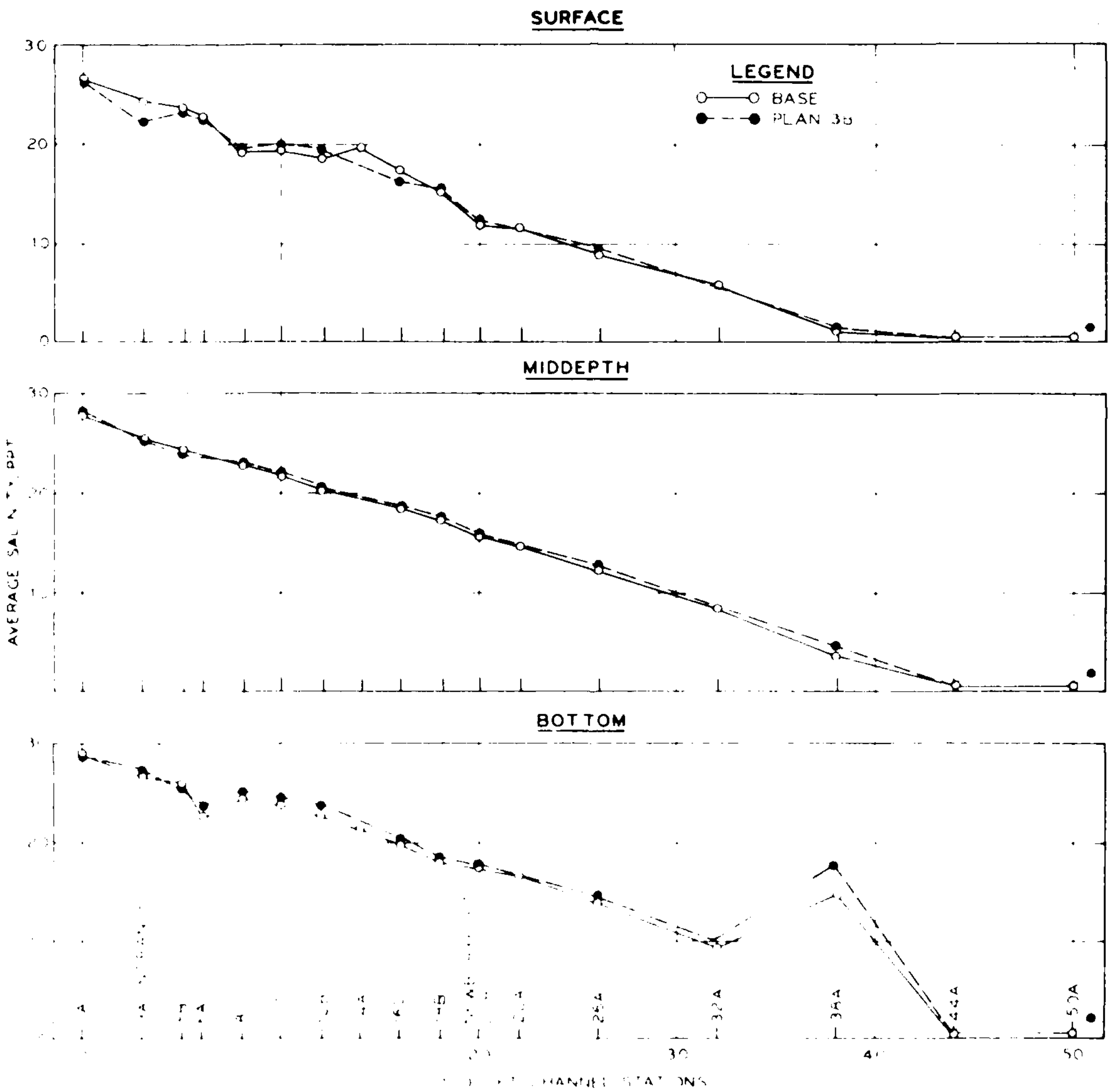


Figure 17. Salinity profile, Plan 3B

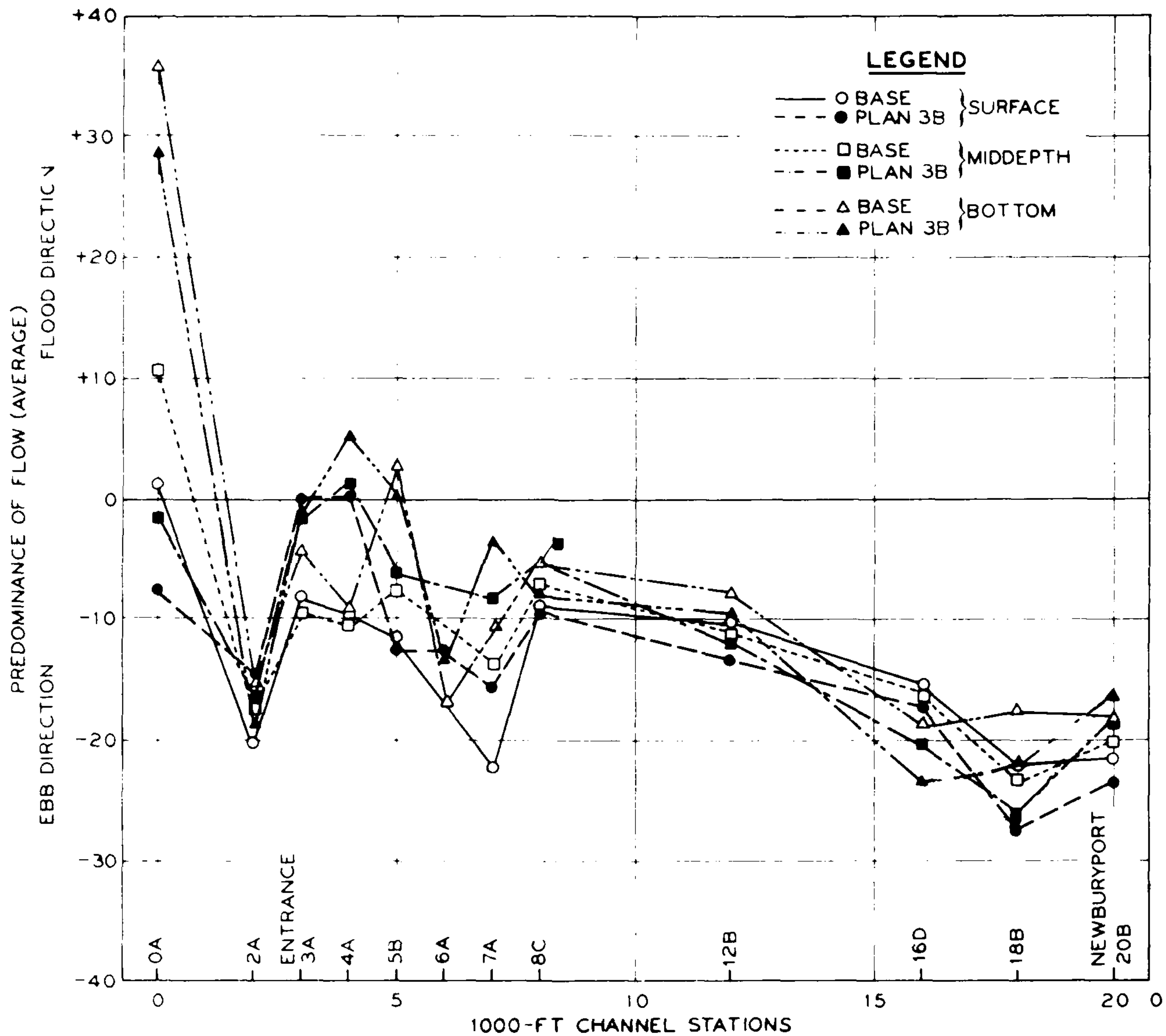


Figure 16. Flow predominance profile, Plan 3B

66. Plan 3B changed the predominant flow direction at several points (Figure 16). Sta 0A surface and 0A middepth were changed from a predominant flood direction to a predominant ebb direction. Sta 3A surface depth was changed from about 8 percent ebb predominance to a balanced flow condition. Flow predominance directions at sta 4A were changed at all three depths, with the bottom depth reflecting the greatest change. Flow predominance at this point went from a 9.3 percent ebb direction to a 5.3 percent flood direction. Each of the above stations is located in the immediate vicinity of the plan. Predominant flow directions were also changed at sta 3B bottom depth, 5B bottom depth, and 5C middepth and bottom depth. Although changes were present throughout the estuary, none were as severe as those in the immediate vicinity of the plan. The general trend upstream from range 7 was toward a stronger ebb flow.

Salinities

67. The effects of Plan 3B on hourly salinity concentrations over a complete tidal cycle at 29 locations throughout the estuary are shown in Plates 90-118. Average salinity concentrations are shown in Table 2. Average salinity concentrations (averaged over a complete tidal cycle) were slightly higher than base conditions, particularly at the bottom depth. Increases ranged from about 0.3 to 0.5 ppt as shown in Figure 17. The weighted averages for plan salinity concentrations were higher than base concentrations primarily because of the effects of Plan 3B on salinity concentrations during the lws period (minimum salinity period). Minimum (lws) salinity concentrations during this period of the tidal cycle were generally 1 to 3 ppt higher than those observed during the same period with base conditions installed in the model, while maximum (hws) salinity concentrations remained relatively unchanged.

68. The notably high salinity concentrations at the bottom depth at sta 38A for both base and plan conditions were due to the location of this station. Sta 38A was located in a deep hole in a bend of the river and would never completely flush clear of salt water during the ebb tide as did other stations located upstream and downstream from this point. Salinity concentrations at this location remained exceptionally high for all the plans investigated.

Dye dispersion

69. Plan 3B dye dispersion data were obtained at 30 locations throughout the estuary over a period of 16 tidal cycles and are shown in Plates 119-148.

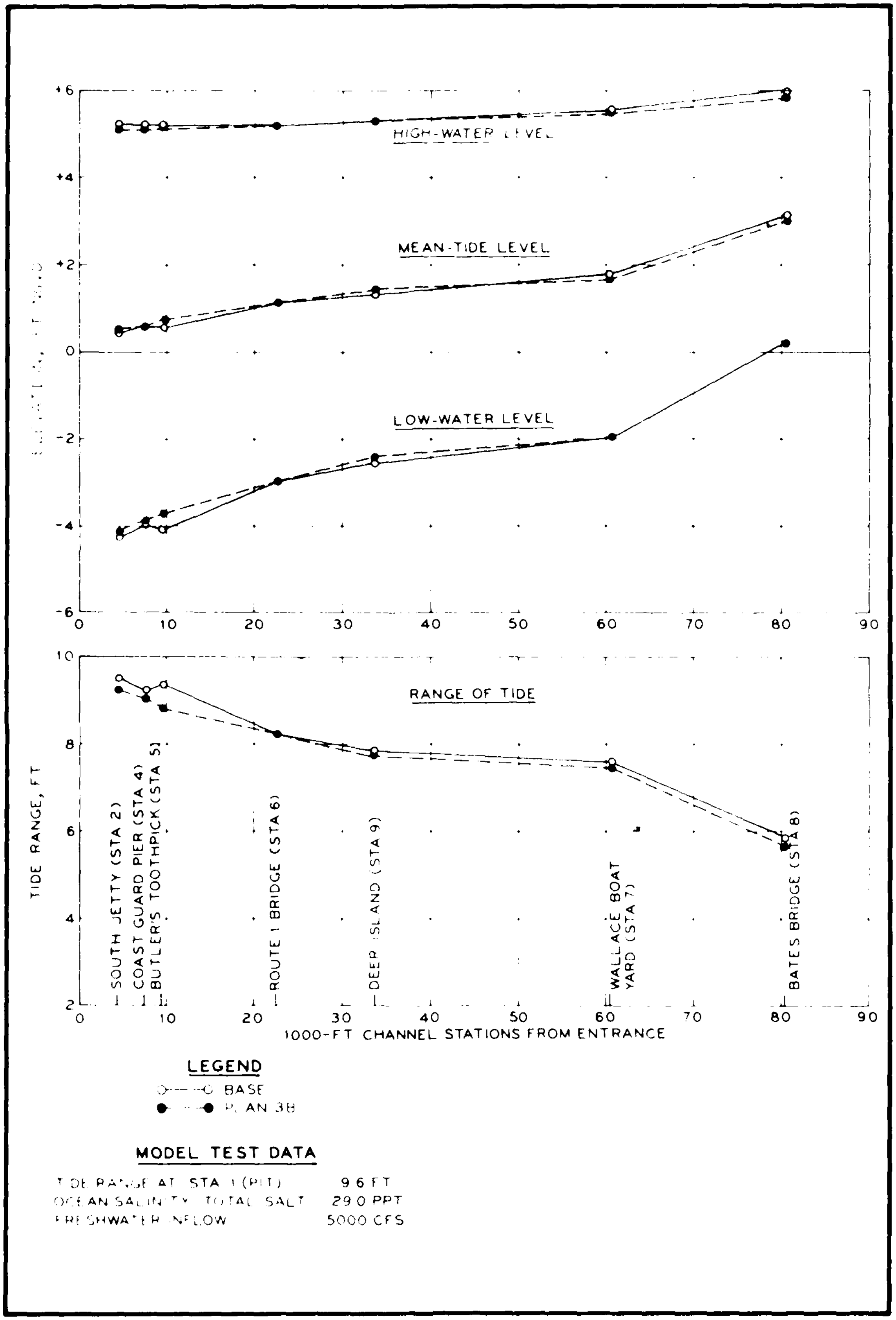


Figure 15. Tidal observations, Plan 3B

PART V: TESTS RESULTS

Plan 3B

Tidal heights

64. The effects of Plan 3B (Plate 59) on hourly tidal heights at 10 locations throughout the estuary are shown in Plates 65-68. Plan 3B had very small effects on time of occurrence of either hws or lws. Figure 15 shows the effects of Plan 3B on high-water level, mean-tide level, low-water level, and tide range. Plan 3B caused a small rise in low-water levels throughout the estuary and an even smaller lowering of high-water levels, thus resulting in a decreased tide range. The maximum change in tidal range and tide levels occurred at Butler's Toothpick (sta 5), where the tide range was reduced from 9.3 to 8.4 ft, and low-water level was 0.4 ft higher than base conditions. Effects at other station locations were either less than those at sta 5 or within the limits of accuracy of repeating identical model runs.

Currents

65. Plan 3B effects on hourly current velocities at 21 locations throughout the estuary are shown in Plates 69-89. Table 1 shows the effects of the plan on flow predominance. Surface current patterns are shown in Photos 33-37. Significant changes occurred at locations in the immediate vicinity of the plan. Maximum ebb velocity increases were observed at sta 2A and 3A and were as follows: 2A surface, 3.1 fps; 2A middepth, 2.7 fps; 2A bottom, 3.1 fps; 3A surface, 2.4 fps; 3A middepth, 2.0 fps; and 3A bottom, 2.8 fps. Plan 3B maximum ebb velocities at each of these two locations were in excess of 6.0 fps, and reached a maximum of 7.0 fps on the surface at sta 2A. The greatest increases in maximum flood currents occurred at the surface and middepth elevations at sta 3A and 4A. Maximum flood currents at sta 3A surface were increased from 4.0 to 7.5 fps, middepth from [illegible] to 7.2 fps, and bottom from 3.7 to 6.6 fps. Maximum flood currents at sta 4A were increased as follows: surface from 4.7 to [illegible] fps, middepth [illegible] 7.5 fps, and bottom from 3.6 to 5.8 fps. Significant change [illegible] stations in the immediat[illegible] [illegible]rance area; however, they were [illegible] changes at sta 3A and 4A. Stations located upstream from [illegible] relatively minor changes, primarily in predominance of [illegible] changes were noted in the maximum currents.

Each of the plans was molded in the model as an impervious structure and had crown elevations above the high-water level.

Entrance Fixed-Bed Shoaling and Scour Tests

60. The procedure used during the entrance fixed-bed shoaling and scour plan tests was identical with the procedure described for the final verification (paragraphs 38-43), the only difference being the plan that was being investigated at that time. Prior to completing the entrance fixed-bed shoaling and scour verification, NED office decided to conduct all shoaling and scour plan tests with the existing authorized channel installed in the model instead of the proposed new alignment used during the hydraulic, salinity, and dye dispersion plan tests. Therefore all the entrance shoaling and scour plan tests were conducted with the authorized channel installed. The shoal extending into the authorized channel over the inner bar was removed to project depth of 16 ft (-12 mlw).

61. A minimum of two identical runs were made with each plan installed in the model. Following the tests, the results were averaged and compared with the base tests results (final verification) to determine effects resulting from the construction of the plan. Sketches of the resulting shoal and scour patterns were made following each test. Time-lapse movies were made for base and the six major plan conditions. Copies of these films are on file at the NED and WES.

Elements of Plans

62. Eleven plans were investigated in the model, six of which were tested extensively. Plans B, C, E, B-B, and E-E (Plate 64) were observed visually in the model and later photographed to record surface current patterns. No further tests were conducted with these particular plans. Following the visual observations and analysis of surface current pattern photographs of the above plans, the plans were either eliminated, changed, or combined. Photos 8-32 show surface current patterns for the above plans. No further analysis of the above plans was undertaken by this office and is not within the scope of this report.

63. To avoid confusion, the above plans that had some changes or were combined with other plans were assigned new designation symbols. Plans designated 3B, 2C, D, 3E, BE, and BX (Plate 59) were designed following the above analysis and visual observations were subjected to extensive model testing.

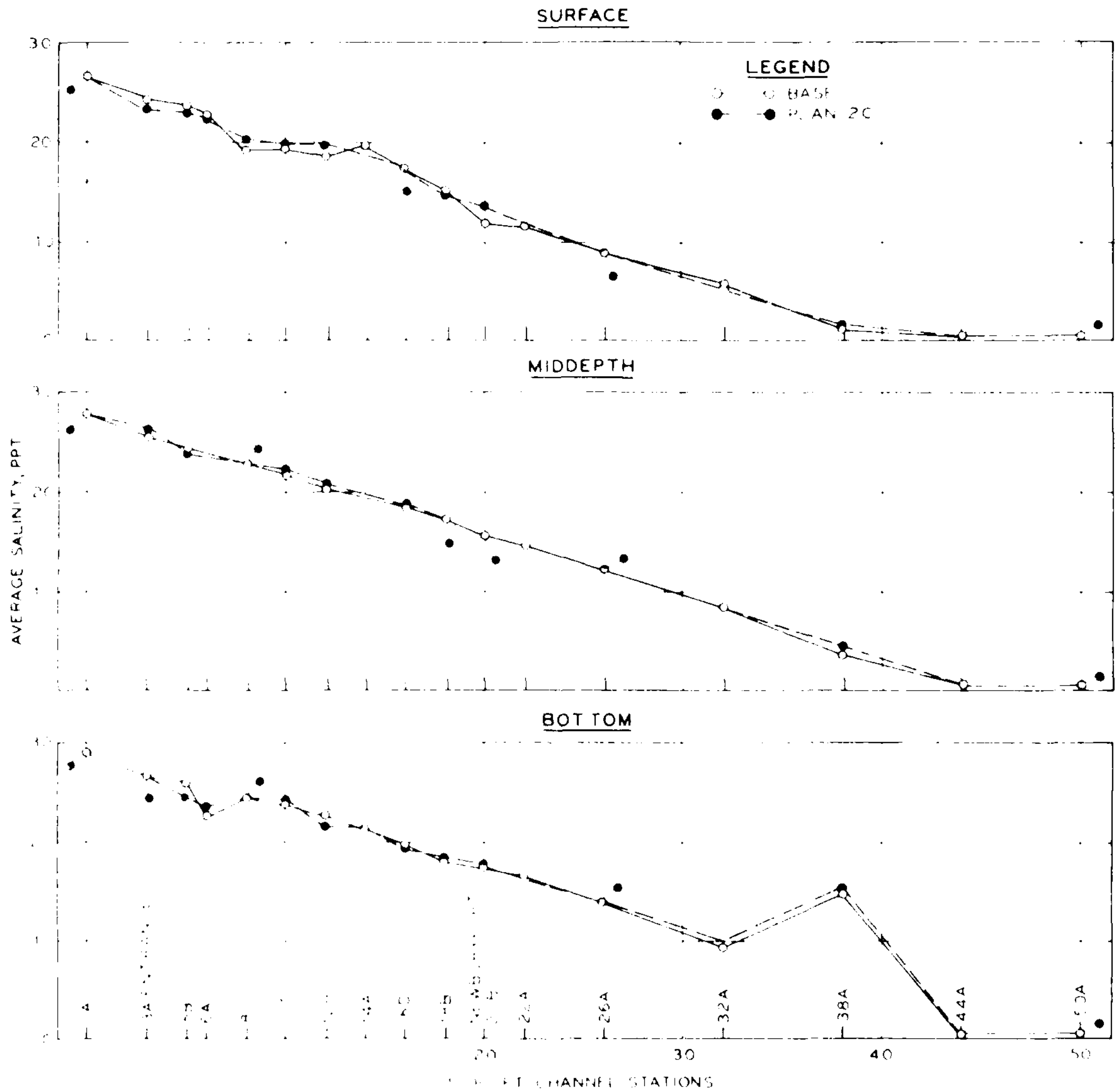


Figure 22. Average salinity profile, Plan 2C

respectively, while minimum salinity concentrations at sta 6C surface, middepth, and bottom elevations were 6.2, 4.0, and 3.8 ppt respectively, higher than those observed during base conditions. Minimum surface and middepth concentrations at sta 8A were 5.0 and 11.8 ppt, respectively, higher than those observed during base tests. Thus a substantial increase in mixing occurred at sta 8A during the time of minimum salinities. Although these very large changes occurred at stations in the vicinity of the plan, there were generally very little effects throughout the remainder of the estuary, and especially at stations located on the channel center line, as shown by the average salinity profiles in Figure 22. The overall trend was toward an increase in average salinity concentrations.

Dye dispersion

77. The effects of Plan 2C on dye dispersion are shown in Plates 153-182. Maximum and average dye concentrations are shown in Table 3. Figures 23 and 24 show average dye concentration profiles along the channel center line for hws and lws, respectively. As shown in these figures, average dye concentrations along the channel center line were slightly higher than those observed for base conditions during both hws and lws sampling periods. This trend was typical for the majority of stations throughout the estuary. There were no noticeable changes in the arrival time of peak concentrations nor were there any unusual areas of buildup.

Entrance fixed-bed shoaling and scour

78. Plate 183 shows a sketch of shoaling and scour patterns that resulted from tests conducted with Plan 2C installed in the model. The base test shoaling and scour patterns are shown in Figure 14. Plate 184 shows the effects of Plan 2C in percent of base tests results for individual test sections. Table 4 contains the above data in tabular form together with shoaling indices for the navigation channel. Shoaling index values for the navigation channel are also presented in Plate 152. The shoaling index data in Table 4 show that overall shoaling in the navigation channel was reduced by 10.5 percent in comparison with base test results. However, the peak shoal (12.3 percent) occurring on the outer bar during base tests in section 6 was increased to 14.4 percent and relocated to section 5 as a result of Plan 2C. The major reduction to channel shoaling occurred over the inner bar in the immediate vicinity of the plan. With the exception of section 16, all the channel

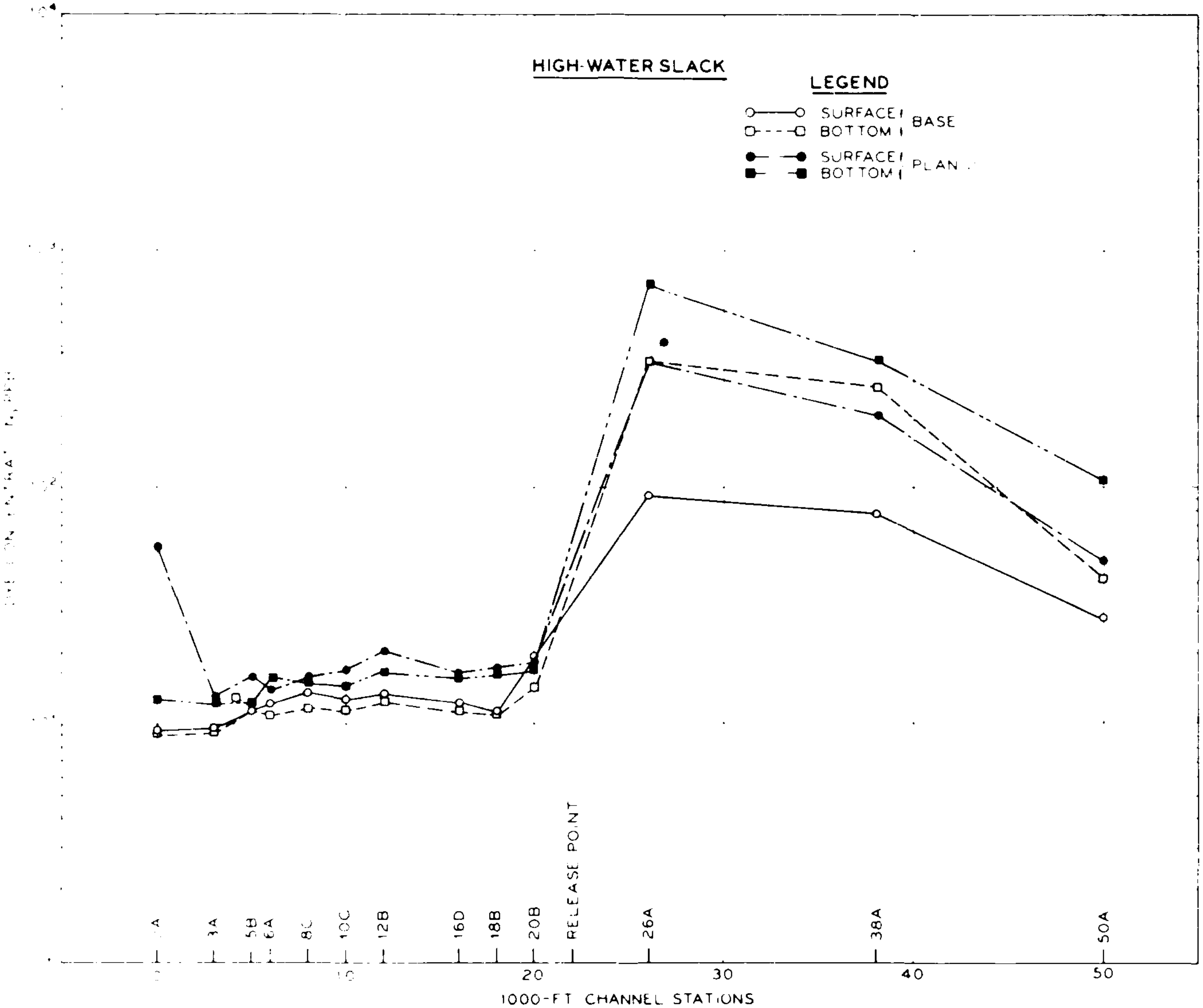


Figure 23. High-water slack average dye concentrations, Plan 2C

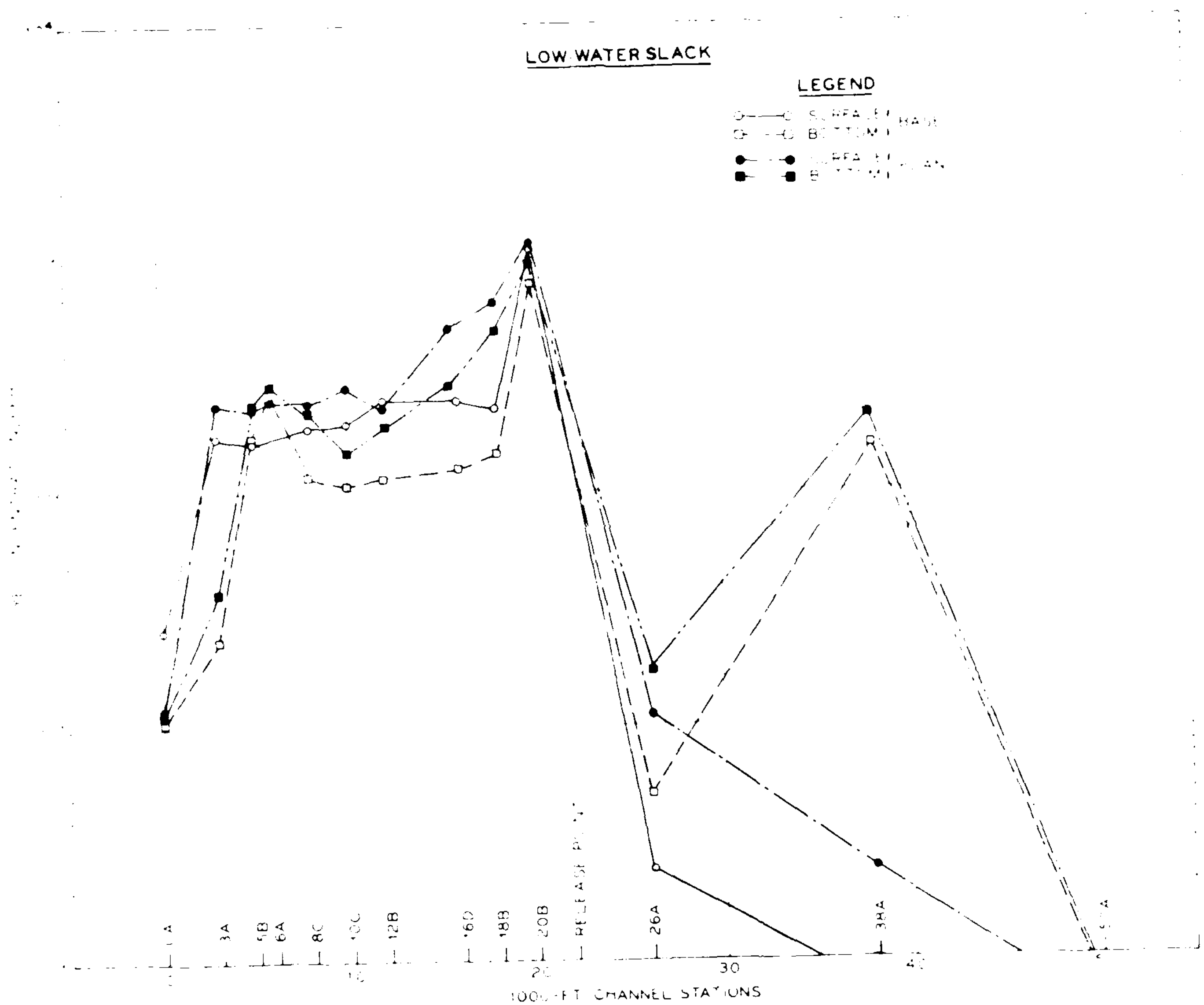


Figure 24. Low-water slack average dye concentrations, Plan 2C

sections between 12 and 26 were lower than base test conditions. The peak shoals occurring during base test conditions at sections 13 (5.5 percent) and 18 (6.7 percent) were relocated to become a single peak shoal in section 16 and were reduced to 5.3 percent of base.

79. Plan 2C had very little effect on shoaling and scour rates or patterns either north of the north jetty or south of the south jetty. With respect to the base condition, sections located along the north beach of Plum Island shoaled with Plan 2C installed, with the exception of sections G15 and G19 (Plate 184). Sections immediately south of the navigation channel in the vicinity of the inner bar (sections K18 to K23) were either unchanged or scoured as a result of Plan 2C.

Plan D

Tidal heights

80. The effects of Plan D on hourly tidal heights are shown in Plates 65-68. Figure 25 shows high-water levels, mean-tide levels, low-water levels, and range of tide profiles constructed from Plan D data. Water levels in the entrance area and upstream to Route 1 Bridge (sta 6) were slightly higher than water levels observed for base conditions. Low-water levels upstream from Route 1 Bridge were lower than base while high-water levels remained unchanged or slightly higher. The changes in high- and low-water levels resulted in a small increase in tide range throughout the estuary.

Currents

81. The effects of Plan D on hourly current velocities are shown in Plates 69-89. Flow predominance calculations are presented in Table 1. Surface current patterns are shown in Photos 43-47. Predominance of flow profiles for channel center-line stations are shown in Figure 26. Generally, flow predominance along the channel center line was increased slightly in the ebb direction. As observed with the two previous plans, maximum changes occurred in the immediate vicinity of the plan. The greatest change occurred at the bottom depth at sta 5B, where flow predominance was changed from a [illegible] percent flood predominance to a 10.6 percent ebb predominance. This point was the only location where predominant flow direction was changed. Sta [illegible]A was the only location along the channel center line where the predominance of flow was not increased in the ebb direction. Flow at this

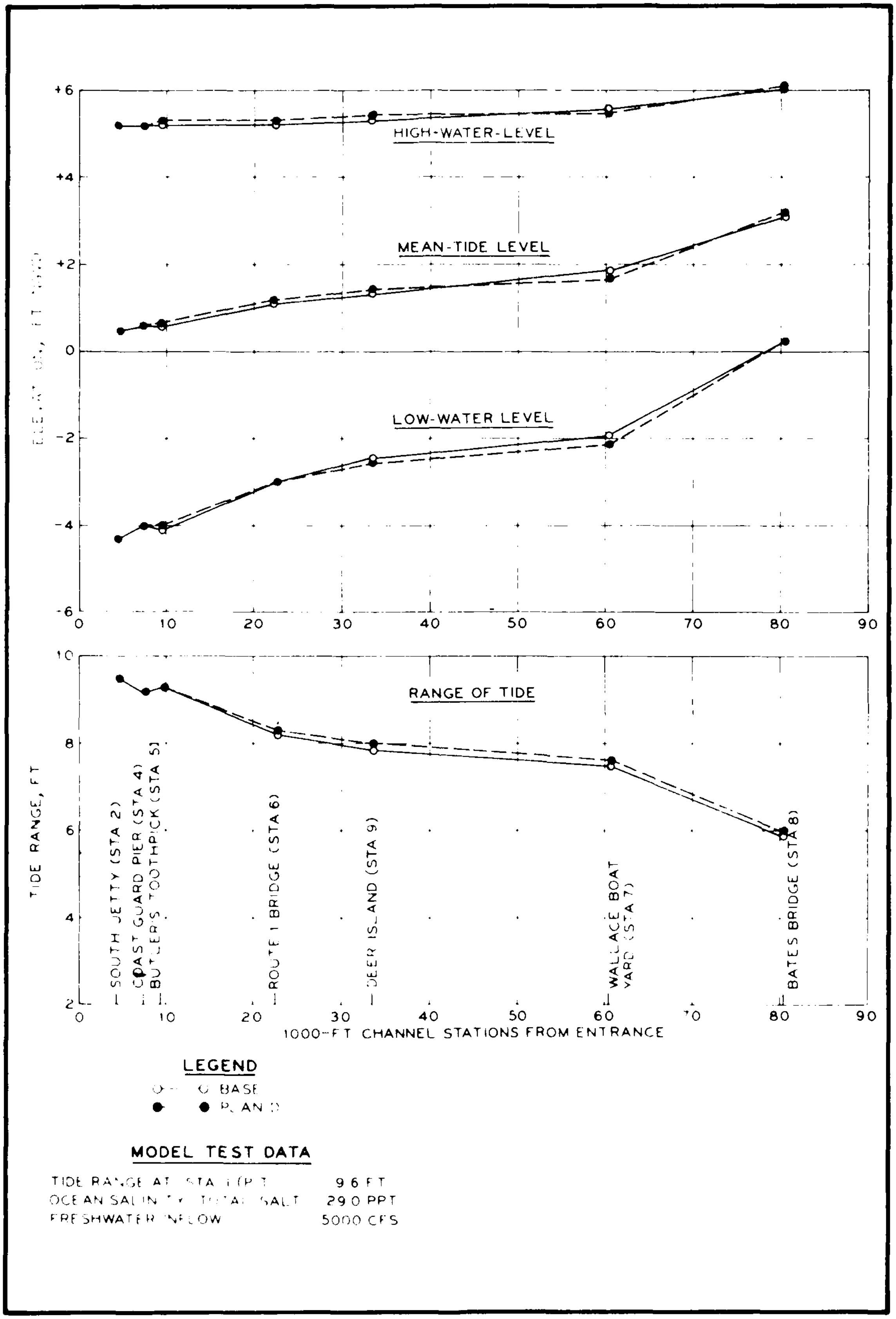


Figure 25. Tidal observations, Plan D

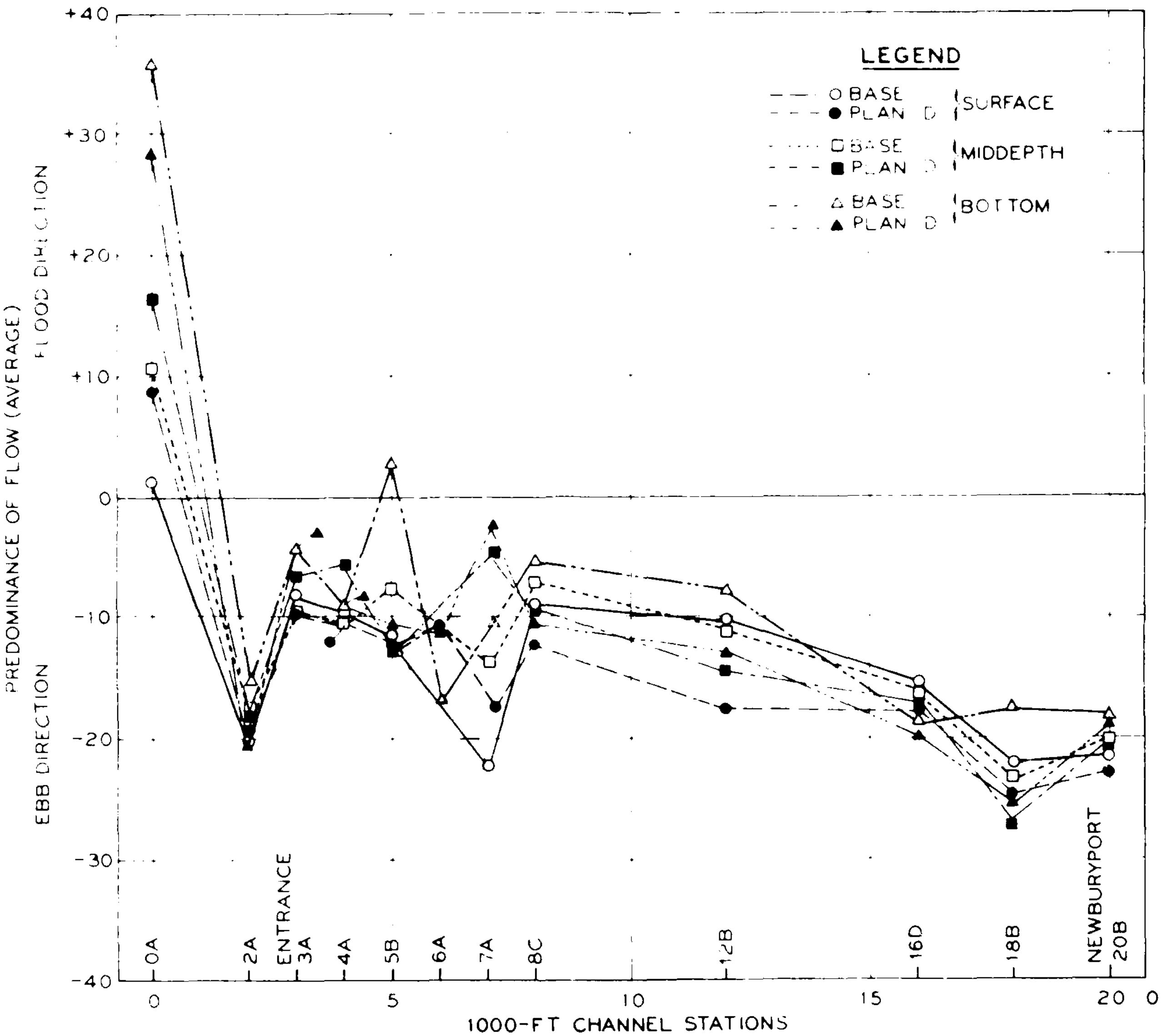


Figure 26. Flow predominance profile, Plan D

location continued to be predominant in the ebb direction but was considerably less than that observed for base conditions.

82. Both ebb and flood maximum currents were generally increased a small amount in the entrance area. The greatest increases were at sta 3A, 5B, and 6A, and were generally about 0.8 to 1.8 fps higher than those observed during base tests. Increases at other locations in the entrance area were generally less than 0.5 fps.

Salinities

83. The effects of Plan D on hourly salinities over a tidal cycle at 29 locations throughout the estuary are shown in Plates 90-118. Table 2 shows the effects of the plan on average salinities. These average salinity values were used to plot average salinity profiles for stations located on the channel center line. The profiles shown in Figure 27 are representative of effects throughout the estuary, as Plan D average salinity concentrations were lower than base throughout the estuary. Generally, the decrease in average salinity concentrations was fairly consistent from surface to bottom, with no particular depth having any significant difference from the other.

84. The decreases in average salinity concentrations were influenced primarily by the decrease in minimum salinity concentrations (low water) since maximum salinity concentrations were changed very little. Minimum salinity concentrations in the entrance area (sta 0A-8D) average about 2.0 ppt lower than base averages. The greatest decrease occurred at sta 5B, where Plan D minimum salinity concentrations were 7.3, 7.6, and 6.6 ppt (surface, middepth, and bottom, respectively) lower than those observed for base conditions. Minimum salinity concentrations upstream from range 8 (sta 10A-56A) averaged about 0.7 ppt lower than base conditions.

Dye dispersion

85. The effects of Plan D on dye dispersion are shown in Plates 185-214. The effects of the plan on maximum and average dye concentrations are also shown in Table 3. Figures 28 and 29 show average dye concentration profile plots at channel center-line stations for the hws and lws sampling periods, respectively. The hws profiles (Figure 28) indicate a very weak trend toward an increase in average dye concentrations, although small decreases were evident at several points. Figure 29 (lws profiles) indicates a weak trend toward a decrease in average dye concentrations; however, as with the high-water profile, there were small changes in the other direction at several points. These

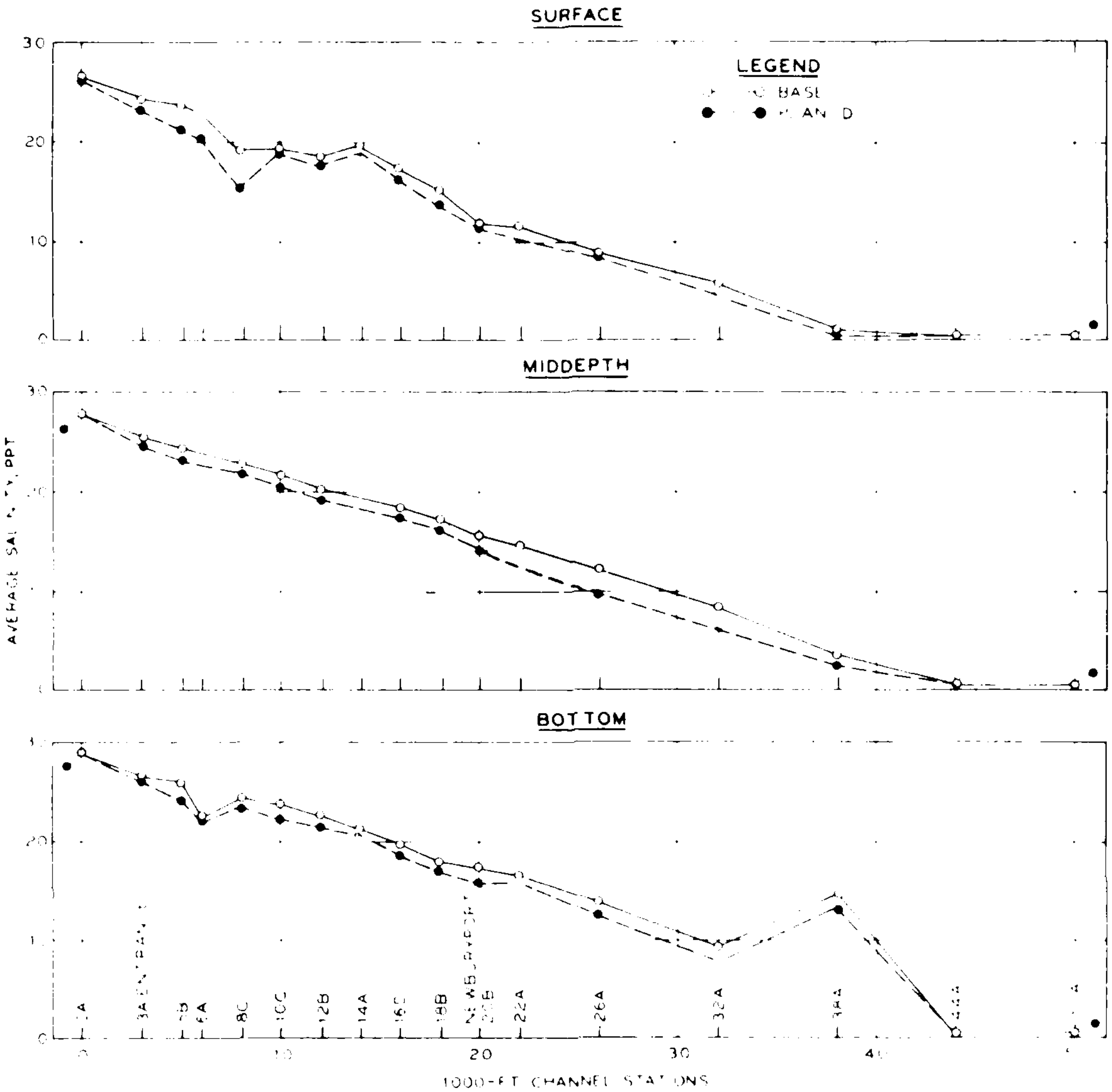


Figure 27. Average salinity profile, Plan D

profile plots are typical of the results throughout the estuary with Plan D installed in the model. There were no noticeable effects on arrival times of peak concentrations or areas of unusual buildup.

86. The effects of Plan D on flow predominance (Figure 26) and average salinities (Figure 27) support the above general effects observed during the dye dispersion tests. However, the dye dispersion data for base and Plan D conditions repeat extremely close; it is very difficult to conclude that a change has taken place. The data are extremely close and are considered well within the accuracy of repeating identical model runs.

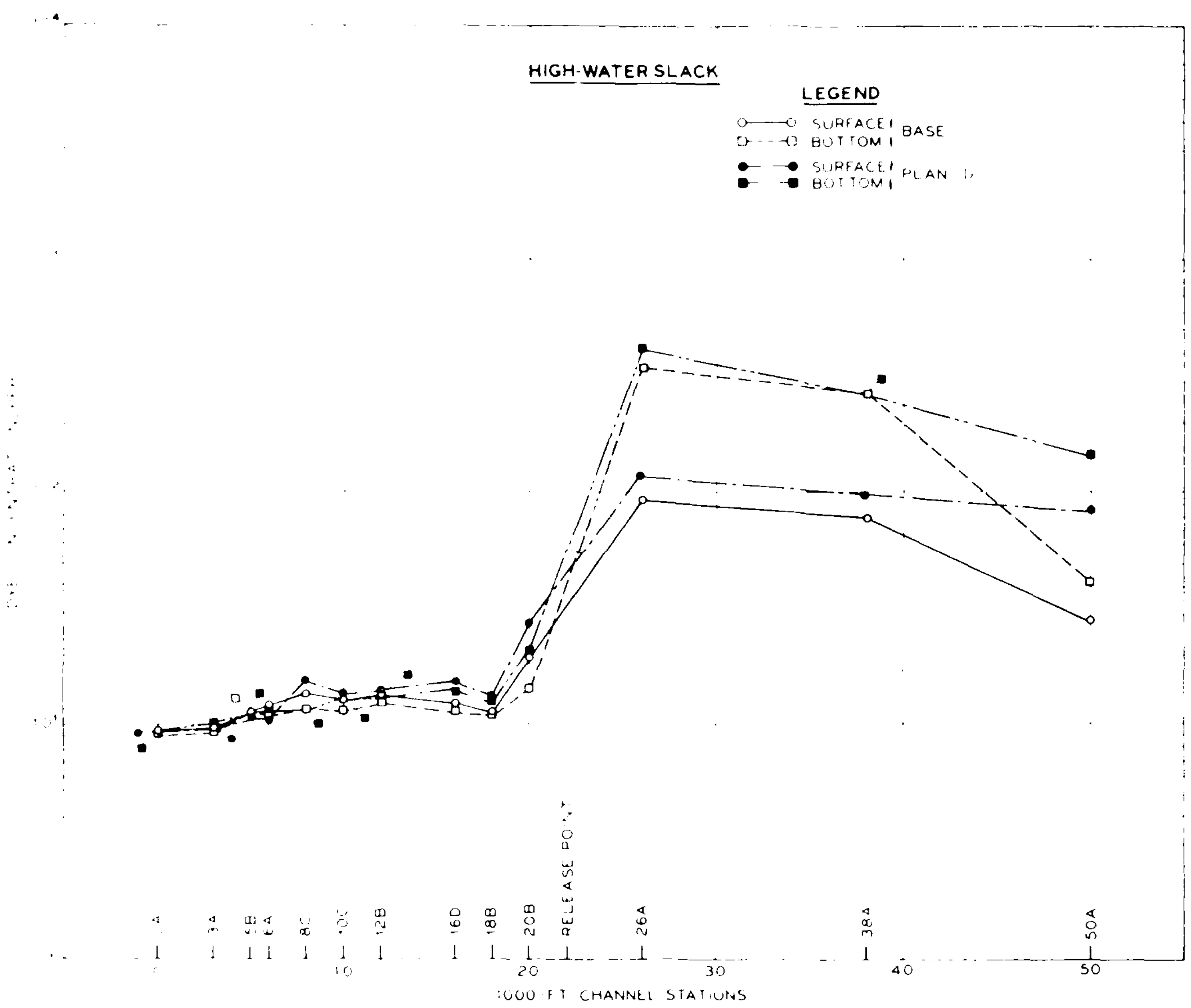


Figure 28. High-water slack average dye concentrations, Plan D

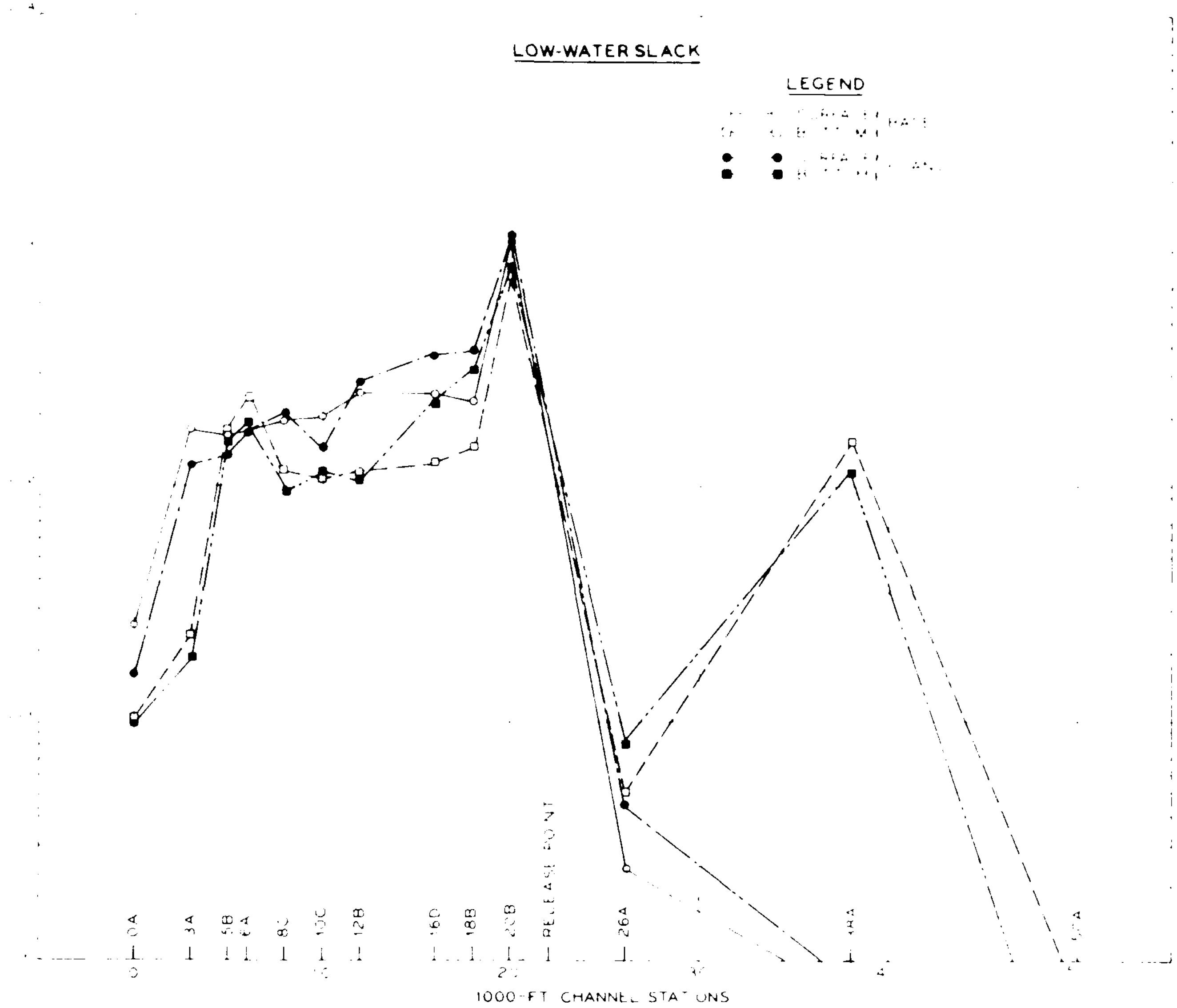


Figure 29. Low-water slack average dye concentrations, Plan D

Entrance fixed-bed shoaling and scour

87. The effects of Plan D on entrance shoaling and scour are shown in Plates 152, 215, 216, and in Table 4. Plate 152 shows the navigation channel shoaling index plotted in profile form. Channel shoaling as shown by this plot and in Table 4 was slightly higher (4.4 percent) than base conditions. Peak shoal sections over the outer bar (section 6) and inner bar (section 18) were increased as a result of Plan D and relocated slightly. The peak shoal on the outer bar was relocated one section (300 ft) seaward and increased from 12.3 to 14.0 percent. The peak shoal on the inner bar was relocated one section (300 ft) landward and was increased from 6.7 to 7.6 percent. Very little difference was noted in other sections located along the navigation channel, as both rates and patterns were relatively unchanged.

88. In general, Plan D shoaling patterns and rates were unchanged throughout the entrance area and offshore area, as shown by comparing the sketch in Plate 215 with the sketch in Figure 14. The north shore of Plum Island was completely protected by the plan; therefore no erosion or filling in this area was observed. Sections located adjacent to the plan (sections 113-120) were relatively unchanged by the plan, as both small increases and decreases were observed in this area.

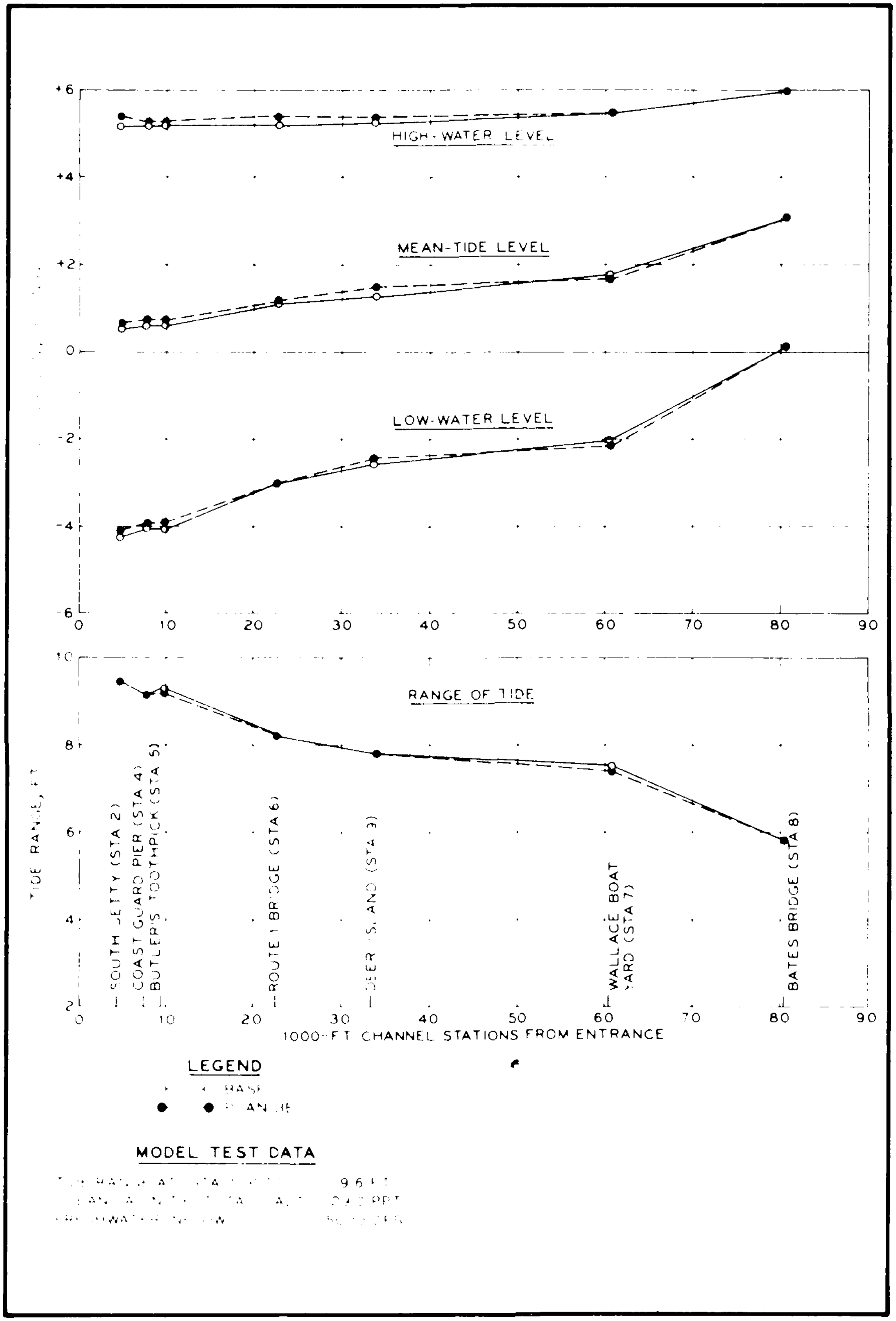
89. Plate 216 shows the effects of Plan D on shoaling and scour at individual sections in percent of material recovered from base tests. These data indicate that very small changes occurred as a result of installation of Plan D.

Plan 3E

Tidal heights

90. The effects of Plan 3E on hourly tidal heights are shown in Plates 217-2[illegible]. Figure 30 shows the effects of the plan on high-, mean-tide, and low-water levels and range of tide throughout the model. Plan 3E had very little effect on tidal heights; however, water levels were increased slightly in the entrance and lower portion of the estuary, while in the upper reaches of the estuary, water levels were decreased a small amount. These changes are [illegible] the limits of accuracy in repeating identical model tests [illegible].

91. The effects of Plan 3E on hourly current velocities throughout a



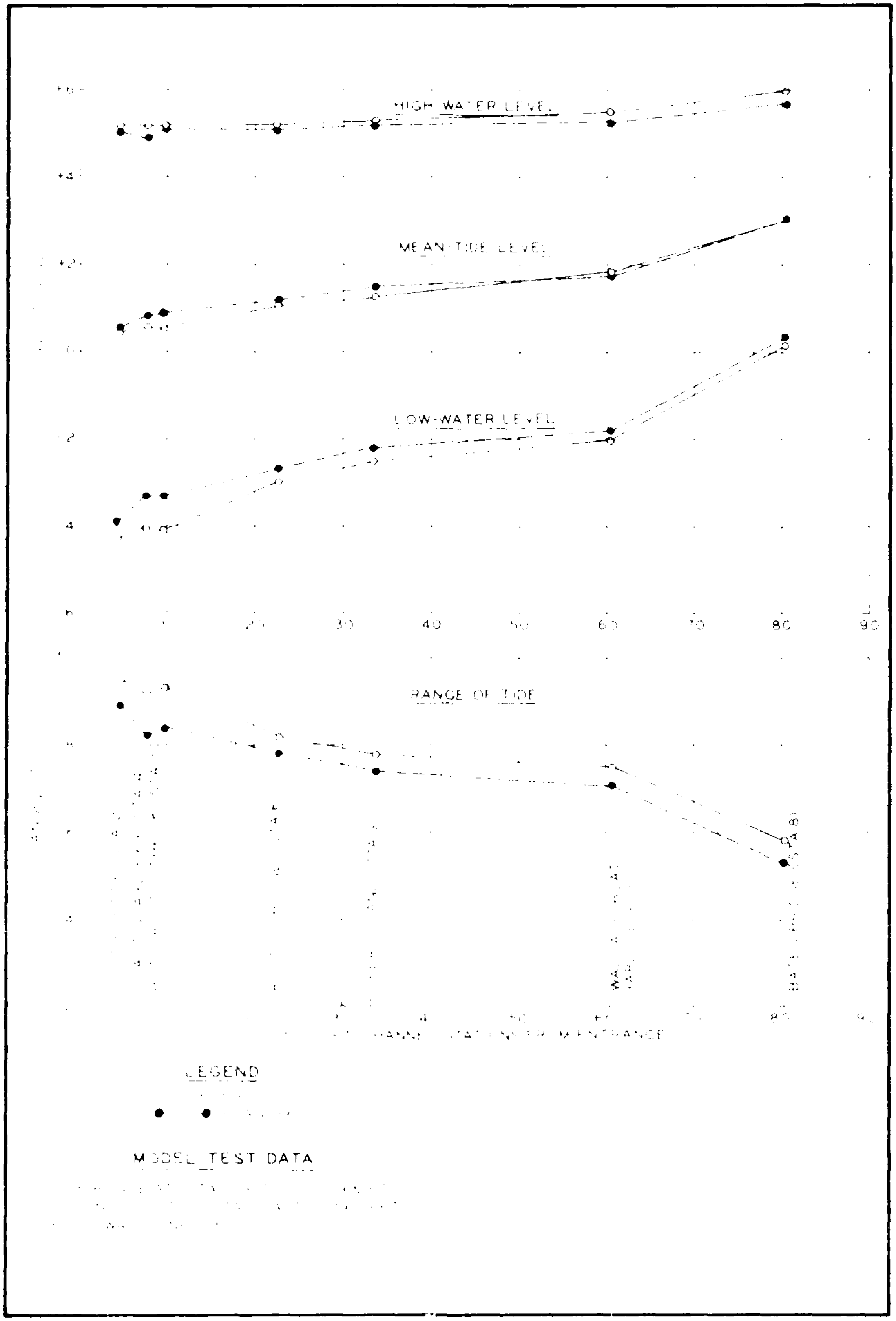
HIGH-WATER LEVEL
MEAN-TIDE LEVEL
LOW-WATER LEVEL
RANGE OF TIDE
TIDE RANGE, FT
SOUTH JETTY (STA 2)
COAST GUARD PIER (STA 4)
BUTLER'S TOOTHPICK (STA 5)
ROUTE 1 BRIDGE (STA 6)
(STA 3)
WALLACE BOAT YARD (STA 7)
BATES BRIDGE (STA 8)
1000-FT CHANNEL STATIONS FROM ENTRANCE
LEGEND
MODEL TEST DATA

tidal cycle at 21 locations are shown in Plates 221-241. Flow predominance calculations are shown in Table 1 and in Figure 31. Figure 31 shows a profile plot of flow predominance values for stations located on the channel center line. Surface current patterns are shown in Photos 48-52. Maximum ebb and flood were increased slightly in the entrance area and were generally unchanged in other areas. Increases in maximum flood currents were slightly greater than increases in maximum ebb currents in the entrance area, and would account for the small decrease in ebb predominance in this area. The predominant direction of flow along the channel center line was changed at only two points, sta 3A middepth and 5B bottom. Middepth at sta 3A changed from an ebb predominance value of 4.2 percent to a flood predominance value of 2.3 percent. Sta 5B, bottom depth, changed from a flood predominance value of 2.7 percent to an ebb predominance value of 2.6 percent. Other than these two points, flow predominance was not significantly affected. With the exception of only a few points, Plan 3E current velocity measurements were extremely close to the limits of accuracy in repeating identical model tests.

Salinities

92. The effects of Plan 3E on hourly salinities over a tidal cycle at 29 locations throughout the estuary are shown in Plates 242-270. Average salinity concentrations are shown in Table 2. Figure 32 shows profiles of average salinity concentrations at stations located on the navigation channel center line. These data show that Plan 3E resulted in small increases in minimum (lws) salinity concentrations, but did not affect maximum (hws) salinity concentrations to any significant degree. However, maximum salinity concentrations at the [illegible] 20A to 50A also showed a small increase as a result of [illegible] that Plan 3E would result in increased [illegible]

[illegible] throughout the estuary are [illegible] concentrations are shown in [illegible] channel center- [illegible] effect on dye [illegible] dye concentra- [illegible] from the release [illegible], Figure 34 [illegible] general trend in



HIGH WATER LEVEL
MEAN TIDE LEVEL
LOW-WATER LEVEL
RANGE OF TIDE
LEGEND
MODEL TEST DATA

The base condition peak shoal located in section 18 was not affected as much, however, there was a small increase and a shift upstream.

104. Comparison of shoal and scour pattern sketches shown in Figure 14 (base) and in Plate 334 (Plan BE) shows that considerable scouring occurred between the outer 1,000 ft of the jetties. This sketch (Plate 334) also shows that the plan had very little effect in the areas north and south of the respective jetties. However, deposition in the outer bar, as indicated by navigation channel shoaling indices, shifted oceanward. This sketch also indicates that very little change occurred upstream from about channel section 20.

105. Plate 335 shows the results of Plan BE in percent of base volumes for each individual section. These data show that minimum scouring would occur on the north shoreline of Plum Island.

Plan BX

Tidal heights

106. The effects of Plan BX on tidal heights over a tidal cycle are shown in Plates 217-220. The effects of the plan were to slightly decrease high-water levels and to increase low-water levels. Figure 40 shows tidal height profiles for high-, mean-tide, and low-water levels and tide range for conditions with Plan BX. As shown in this figure, the greatest effects occurred during the low-water period in the immediate entrance area at sta 2, 4, and 5. Low-water levels at sta 2, 4, and 5 were 0.4, 0.7, and 0.8 ft higher than base conditions, respectively. Low-water levels upstream averaged about 0.25 ft higher than base, while high-water levels averaged about 0.2 ft lower than base conditions throughout the estuary. The lowering of high-water levels and the raising of low-water levels resulted in a significant decrease in tide range throughout the estuary. The time of occurrence of both high- and low-water levels was about 30 min to 1 hr later than that observed during base conditions.

Currents

107. The effects of Plan BX on hourly current velocity measurements at [illegible] stations are shown in Plates [illegible]. Flow predominance calculations are shown in Table 3. Flow predominance calculations for stations located along the channel center line are shown in Figure 41. Surface current patterns are shown in Photos [illegible]. Plan BX caused considerable change to currents in the

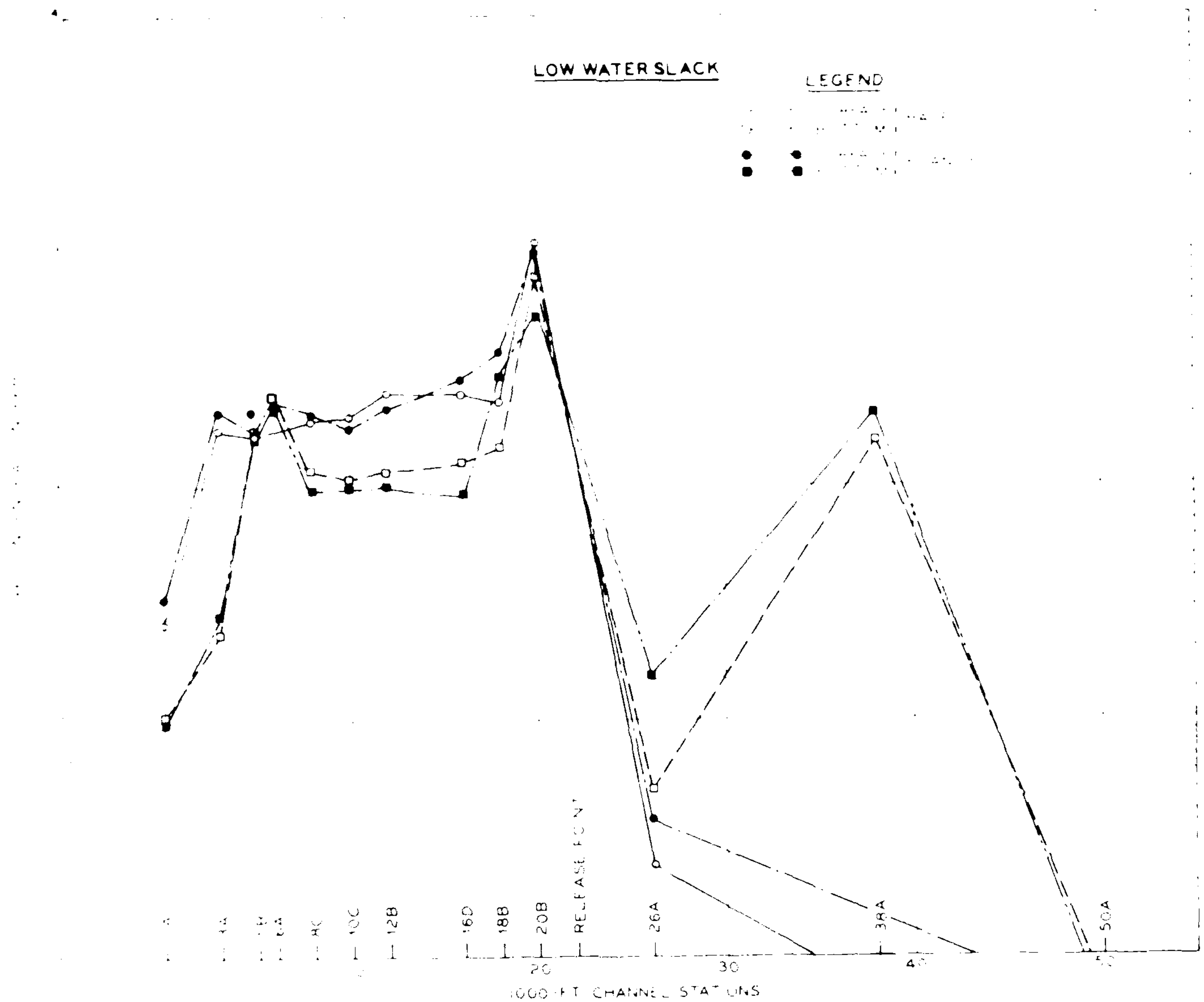


Figure 39. Low-water slack average dye concentrations, Plan BE

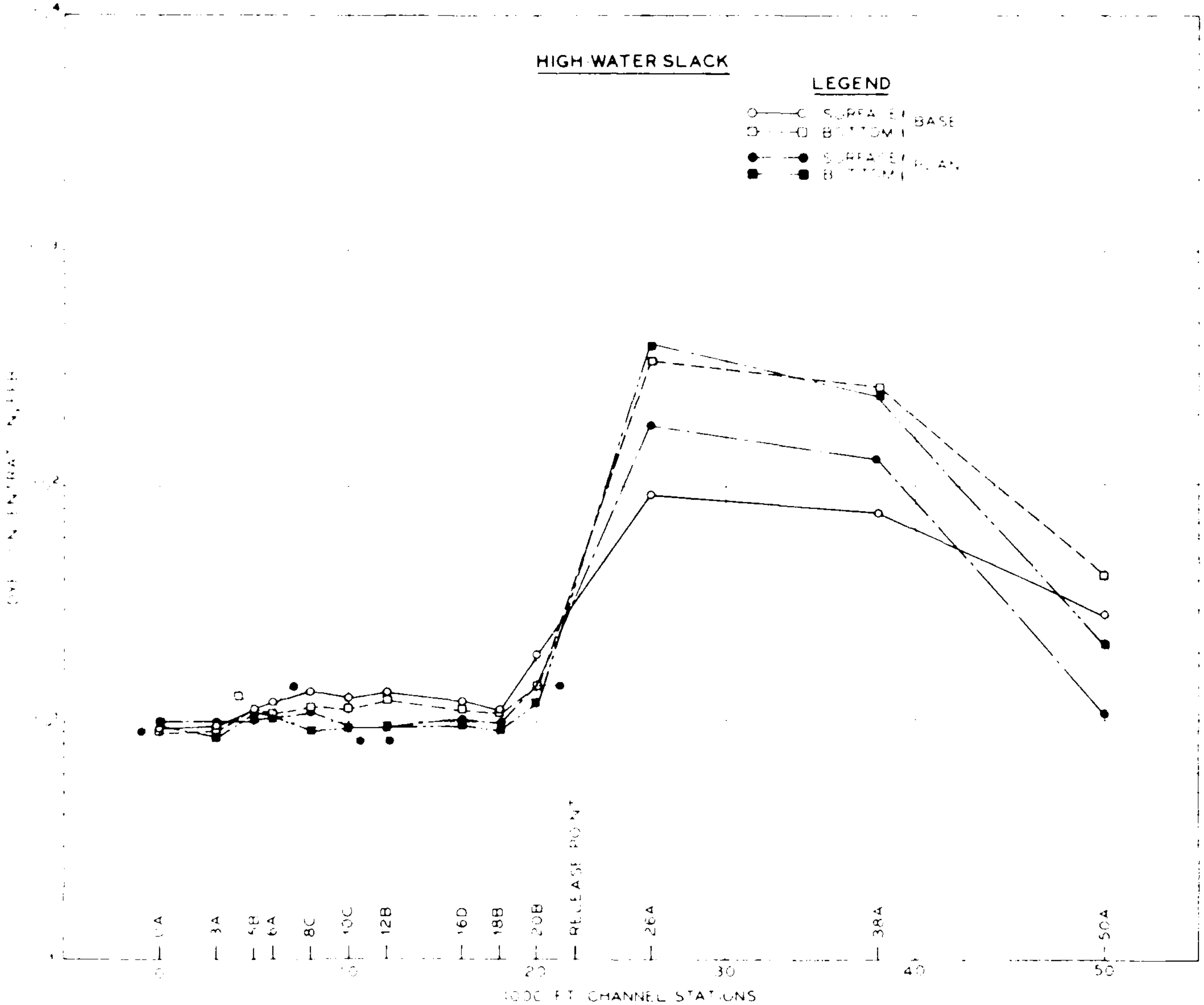


Figure 38. High-water slack average dye concentrations, Plan BE

indicated by the profiles in Figure 37. Rather surprisingly, the only changes in mixing characteristics during the period of minimum salinities in the entrance area and lower estuary occurred at stations well away from the plan (sta 8A, 8C, 10C, and 12B).

101. Maximum salinity concentrations were generally about 1 to 2 hr longer in duration than those observed during base tests. The overall effect of Plan BE was to cause a small increase in salinity concentrations throughout the estuary.

Dye dispersion

102. The effects of Plan BE on dye dispersion during a period of 16 tidal cycles at 30 locations throughout the estuary are shown in Plates 304-333. Maximum and average dye concentrations are shown in Table 3. Average dye concentration profiles for stations located on the center line of the navigation channel are shown in Figures 38 and 39, hws and lws, respectively. Overall, there were no significant changes in dye dispersion as a result of tests conducted with Plan BE installed in the model. Both the high-water and low-water average dye concentration profiles for stations located on the channel center line did indicate a weak trend toward a slight reduction in dye concentrations in the estuary downstream from Newburyport and an increase upstream from that point. Peak dye concentrations and arrival time of same were essentially unchanged by Plan BE. The differences noted between base and Plan BE dye concentrations were so small in magnitude that the results are considered to be within the limits of accuracy of repeating two identical tests.

Entrance fixed-bed shoaling and scour

103. The effects of Plan BE on shoaling and scour in the entrance are shown in Table 4 and in Plates 303, 334, and 335. Shoaling index values for the navigation channel are shown in Table 4 and as a profile plot in Plate 303. These data show that Plan BE resulted in a shoaling index of 97.0 or a 3.0 percent reduction as compared with base tests. The outer bar peak shoal was reduced from 12.3 percent to 9.5 percent and was relocated oceanward four sections (1,200 ft). Sections 8 and 9, as in Plan 3E, were scoured completely. However, the two inner bar peak shoals located in sections 13 and 18 during base conditions were shifted upstream and increased as a result of the plan. The base condition peak shoal located in section 15 was increased from an index value of [illegible] percent to a value of 10.8 percent, almost twice the volume recovered for base conditions. This shoal was relocated upstream about 600 ft

Salinities

100. The effects of Plan BE on hourly salinity concentrations at 29 locations throughout the estuary are shown in Plates 242-270. Average salinity concentrations are shown in Table 2. Profiles showing average salinity concentrations at stations located on the center line of the navigation channel are shown in Figure 37. Generally, Plan BE had very little effect on maximum salinities (hws) but did result in increasing the minimum salinity concentrations (lws). However, maximum salinity concentrations at stations located in the extreme upper portion of the estuary were slightly higher than base. The greatest effects occurred during the lws sampling period at bottom depths, as

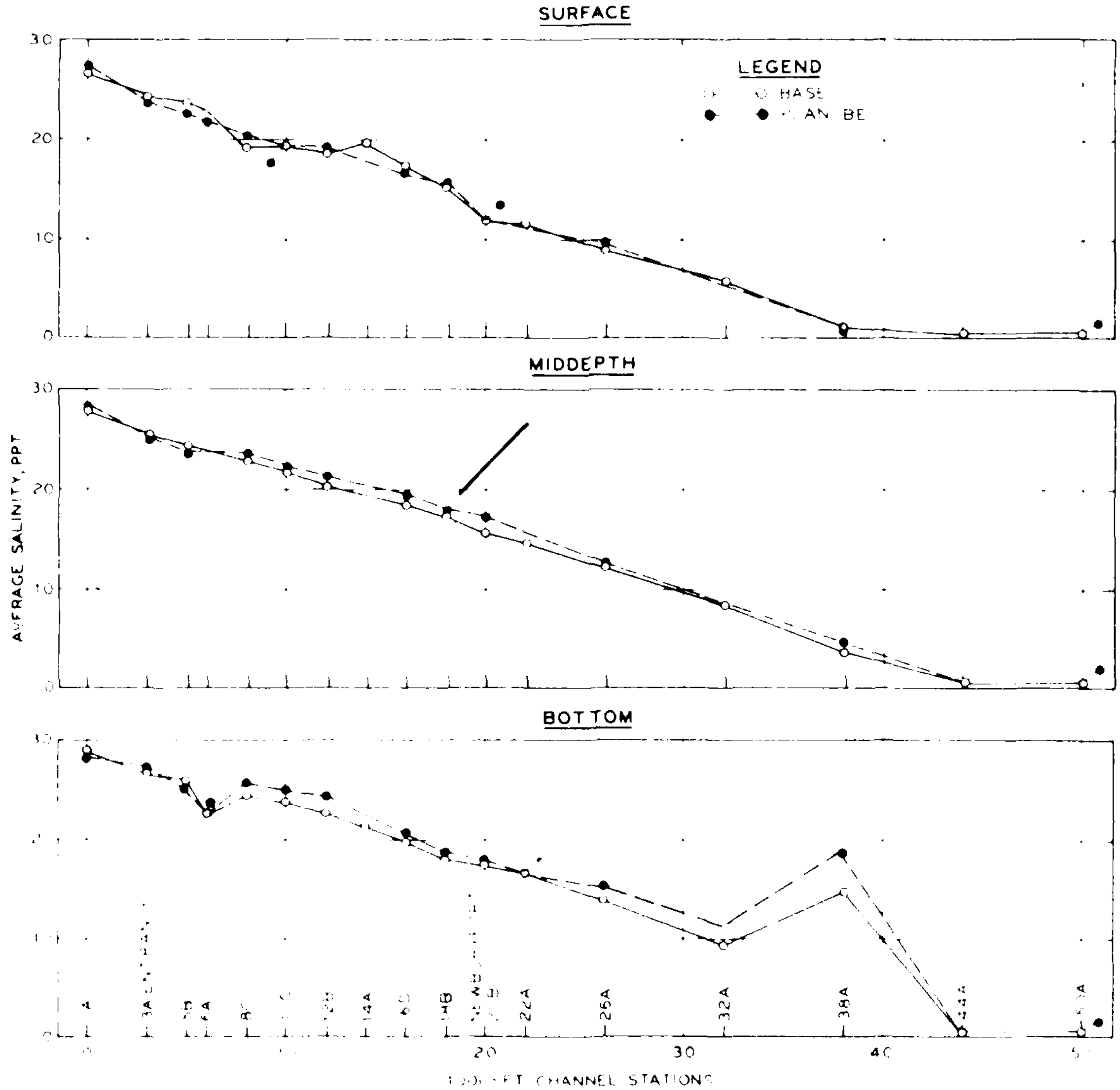


Figure 37. Average salinity profiles, Plan BE

are shown in Photos 53-57. Maximum currents throughout the entrance area were changed significantly as a result of Plan BE. Current velocity measurements at 17 stations (sta 0A-8C), located in the entrance area and immediately seaward of the jetties, were changed as follows: maximum ebb currents measured at the surface depth were increased at 4 stations, reduced at 3 stations, and remained relatively unchanged at 10 stations. The maximum increase at the surface depth was 1.9 fps at sta 3B, and the maximum decrease was 3.0 fps at sta 2B. Maximum middepth ebb currents were increased at seven locations, decreased at three locations, and unchanged at seven locations. The greatest increase at the middepth was 3.0 fps and occurred at sta 2A, while the greatest decrease, measuring 3.0 fps, occurred at sta 2B. Maximum ebb currents measured on the bottom were higher than base at six locations, lower than base at five locations, and unchanged at six locations. The greatest increase was 3.0 fps at sta 2A. The greatest decrease was 2.5 fps and occurred at sta 2B. Sta 2B, located seaward of the north jetty extension portion of the plan, was almost completely shielded from ebb currents by the structure throughout the tidal cycle; therefore maximum reductions in ebb currents were observed at this location.

98. Maximum flood currents measured in the entrance increased with Plan BE installed; however, one station (sta 6C, surface and bottom depth) showed a small decrease. Maximum currents at the other stations (surface, middepth, and bottom depths) averaged about 1.5 fps higher than those observed during base tests. The greatest increase was 2.9 fps and was observed at sta 3A. Both maximum ebb and flood currents measured at stations located other than the entrance showed small, insignificant changes.

99. Flow predominance was likewise affected to the greatest degree in the entrance, as shown by the profiles in Figure 30. Predominant flow direction was completely reversed at several locations as a result of Plan BE. With the exception of only a few points, ebb flow was weakened in the entrance and strengthened upstream from the entrance as a result of Plan BE. The most significant changes along the channel center line occurred at sta 3A and 4A, where flow predominance values were changed from a rather strong ebb flow predominance (about 10 percent) to a weak ebb or a weak flood flow predominance at all depths. Maximum current velocities measured at the surface and middepth at these two locations for Plan BE were generally in excess of 6.0 fps.

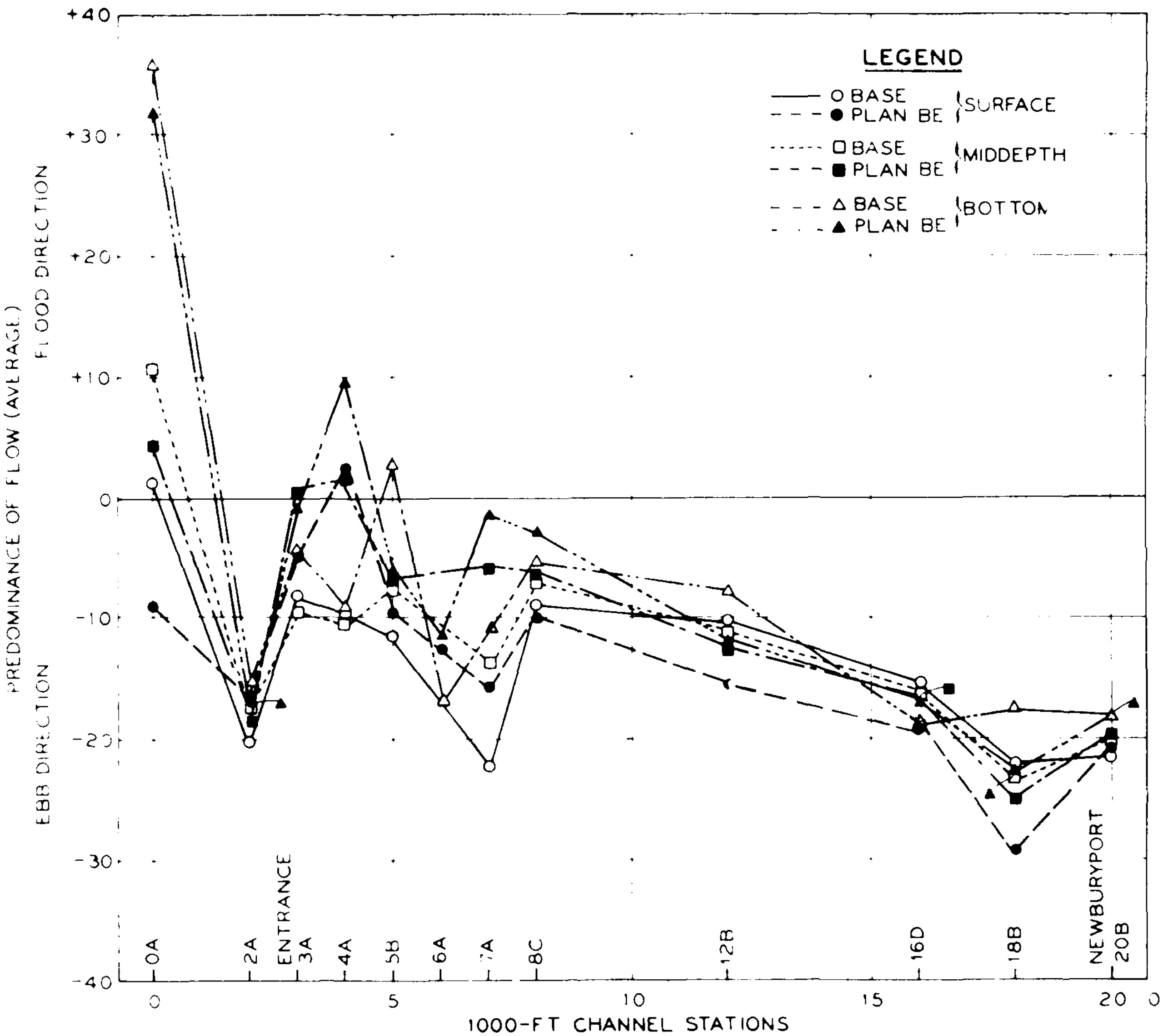
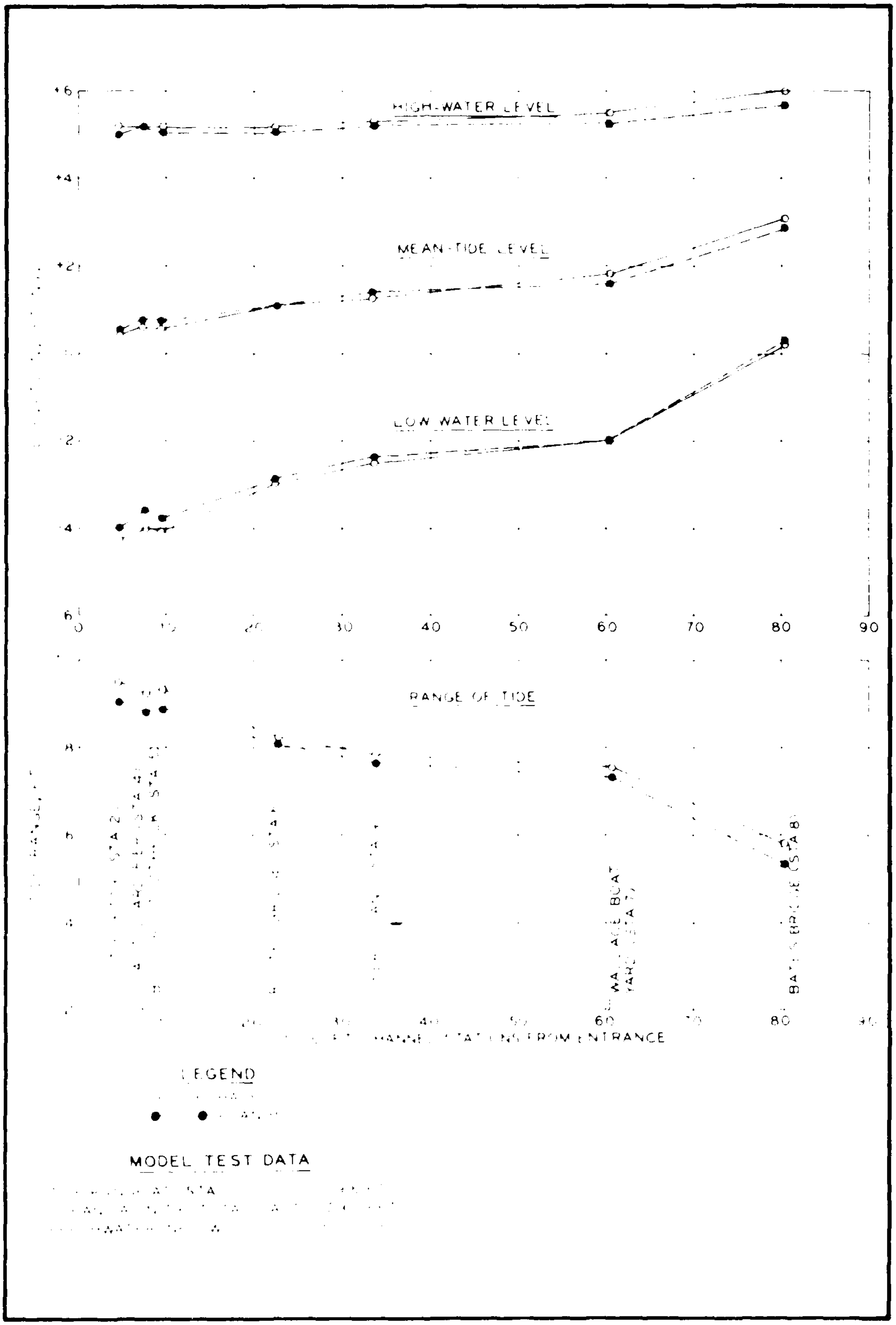


Figure 36. Flow predominance profile, Plan BE


HIGH-WATER LEVEL
MEAN-TIDE LEVEL
LOW WATER LEVEL
RANGE OF TIDE
WALLACE BOAT YARD (STA 7)
STATIONS FROM ENTRANCE
LEGEND
MODEL TEST DATA

patterns in the entrance or on the beaches and offshore areas. The shoals existing during base tests in sections J17 to J18 were reduced by the plan. Other than this area, in the immediate vicinity of the plan, there were no significant changes to the base condition shoaling and scour patterns.

95. Plate 302 shows the effects of Plan 3E with respect to the base at each individual test section. The data in this plate and in Table 4 show that Plan 3E resulted in an overall slight increase in shoaling in sections located along the north beach of Plum Island (sections G15 to G19). The shoaling index for the navigation channel was 104.9 or 4.9 percent higher than that observed for base tests. The data in Table 4 and the profile plot in Plate 303 show that the plan caused an increase in the shoaling rate on the outer bar at the peak shoal section. The peak shoal located on the inner bar was reduced slightly and relocated one section (300 ft) farther upstream. Other than these two areas, there was very little difference in the plan and base condition shoaling index profile.

Plan BE

Tidal heights

96. The effects of Plan BE on hourly tidal heights are shown in Plates 217-220. Plan BE lowered high-water levels and raised low-water levels as shown by the tide level profiles in Figure 35. Maximum effects on high-water levels occurred at sta 7 and 8, located in the upper portion of the estuary, while maximum effects on low-water levels occurred at stations located in the entrance (sta 2, 3, and 5). High-water levels at sta 7 and 8 were lowered by 0.2 and 0.3 ft, respectively, while low-water levels at sta 2, 3, and 5 were raised 0.3, 0.4, and 0.3 ft, respectively. There was a delay of about 15 to 20 min in the time of occurrence of both high- and low-water levels throughout the estuary. The tide range was decreased about 0.4 ft in the entrance, 0.2 ft in the central portion of the estuary, and about 0.4 ft in the upper estuary.

Currents

97. The effects of Plan BE on hourly current velocities at 21 locations throughout the estuary are shown in Plates 221-241. Flow predominance calculations are shown in Table 1. Flow predominance profiles for stations located along the channel center line are shown in Figure 36. Surface current patterns

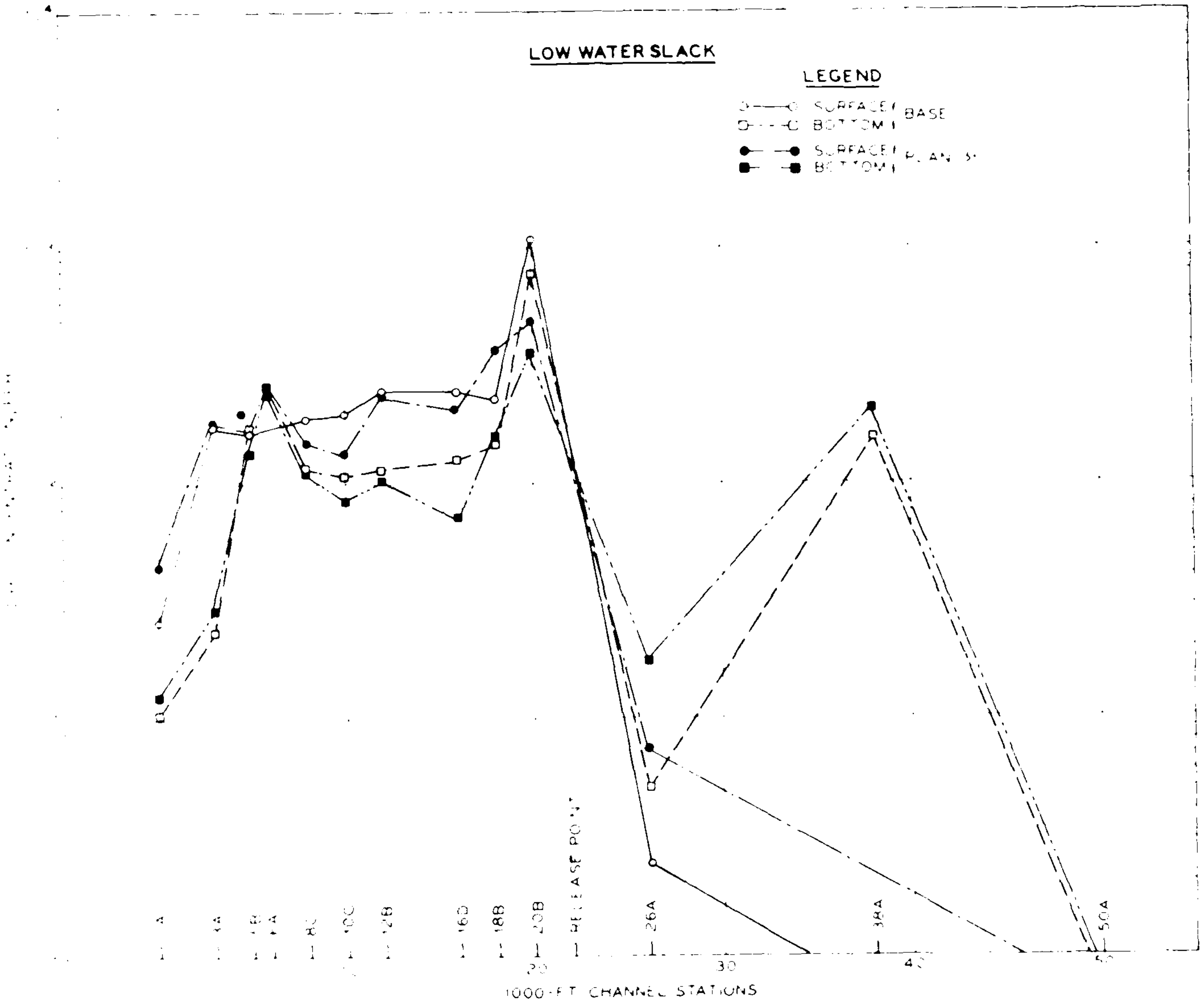


Figure 34. Low-water slack average dye concentrations, Plan 3E

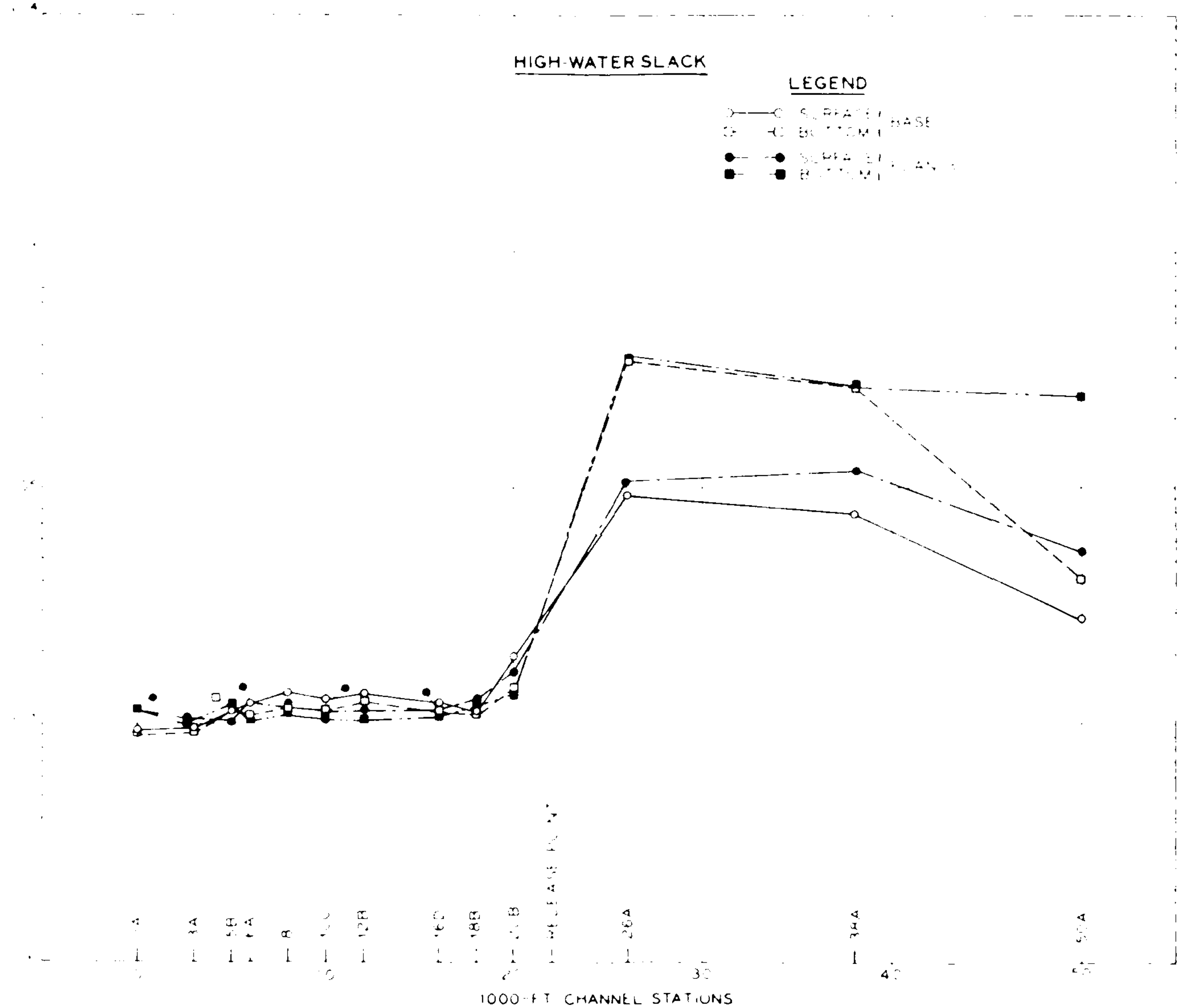


Figure 33. High-water slack average dye concentrations, Plan 3E

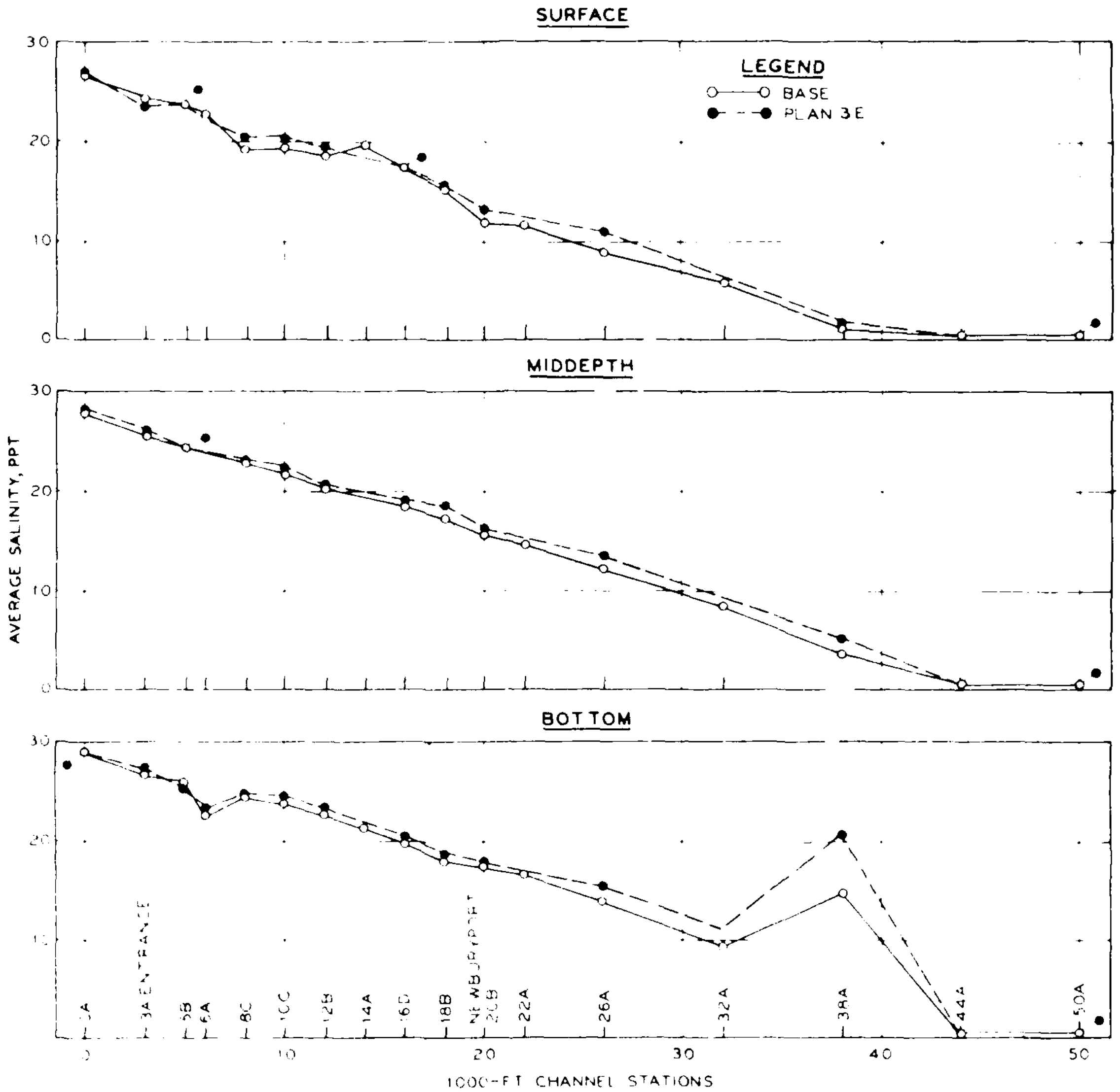


Figure 32. Average salinity profile, Plan 3E

observed during the high-water sampling period. There were no areas of dye buildup nor were the arrival times of peak dye concentrations changed. These data are extremely close to the limits of accuracy in repeating two identical model tests of this type.

Entrance fixed-bed shoaling and scour

94. The effects of Plan 3E on shoaling and scour in the entrance are shown in Table 4 and in Plates 301, 302, and 303. Plate 301 is a sketch showing shoal and scour patterns resulting from tests conducted with Plan 3E installed in the model. This sketch, when compared with the sketch in Figure 14, shows that Plan 3E had very little overall effect on shoaling and scour

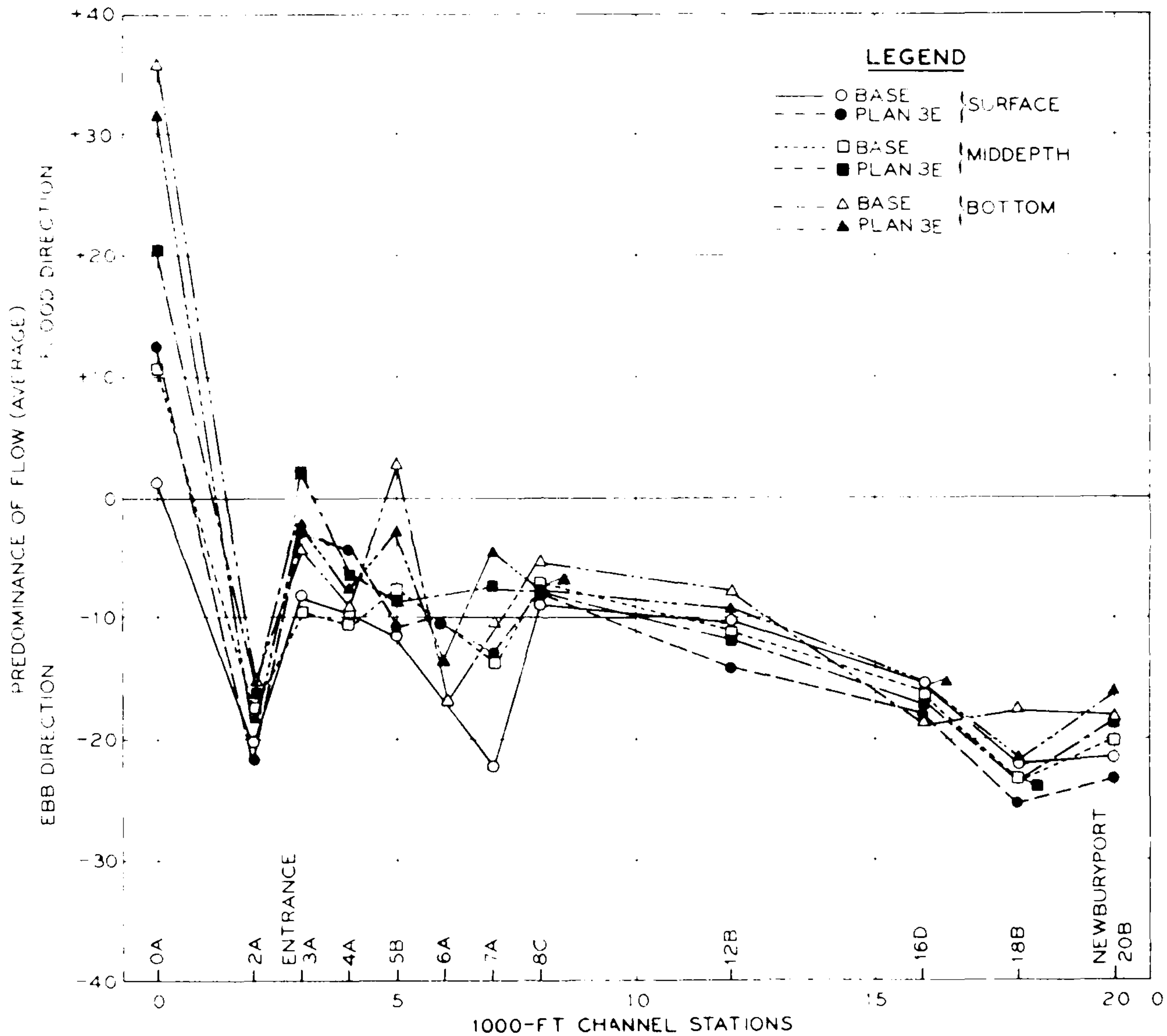


Figure 31. Flow predominance profile, Plan 3E

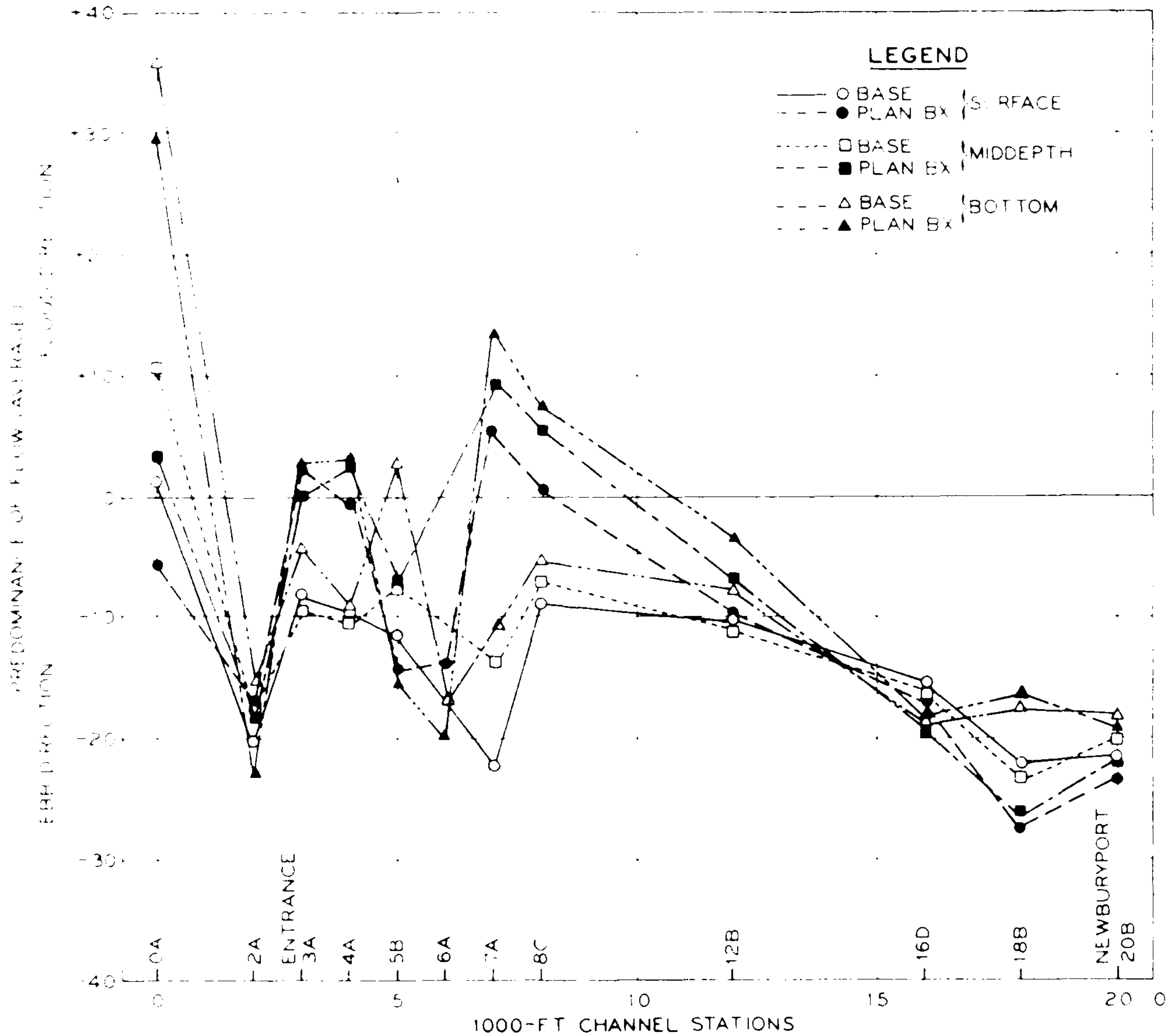


Figure 41. Flow predominance profile, Plan BX

entrance and small insignificant changes upstream from range 12. Sta 0B and 2B, located seaward of the north jetty extension portion of the plan, and sta 0C, located just seaward of the groin "2C" portion of the plan, were changed most with respect to flow predominance. Each of these stations during base conditions had fairly well-balanced flow, with a slight predominance in the ebb direction. Plan BX changed this small ebb predominance into a rather strong flood predominance or flood flow entirely.

108. Maximum current velocities in the entrance were increased considerably, with maximum flood currents being increased more than maximum ebb currents. The average increase was about 2 to 3 fps. Maximum flood currents along the channel center line occurred at sta 3A, 4A, 5C, and 7A and had values of 6.6 fps (surface), 6.7 fps (middepth), 5.9 fps (middepth), and 6.0 fps (surface), respectively. The greatest maximum ebb currents occurring along the center line of the navigation channel were at sta 2A, 3A, 4A, 5C, and 6B, and had magnitudes of 5.6 fps (middepth), 5.0 fps (surface), 5.5 fps (surface), 7.2 fps (middepth), and 7.9 fps (bottom). Maximum ebb currents generally occurred at the surface; however, the greatest ebb current observed during tests conducted with Plan BX was measured at sta 6B (bottom).

109. Flow predominance profiles (Figure 41) show that predominant direction of flow was changed at several points along the channel center line. At sta 0A surface depth, the predominant direction was changed from flood to ebb, and the flood predominance at middepth was weakened. No significant change occurred at sta 2A. All depths at sta 3A and 4A were changed from an ebb predominance to either a weak ebb predominance or a flood predominance. The bottom depth at sta [illegible] was changed from a weak flood predominance to a rather strong ebb predominance. Surface and middepth flow predominance values at this station along with predominance values at sta [illegible]A were relatively unchanged by the plan. However, all depths at sta [illegible]A and [illegible] went from a strong ebb predominance to either a weak flood or strong flood. Sta [illegible] followed a similar trend; however, the predominant direction was not changed. Stations upstream from range 12 were not significantly changed.

Salinities

110. The effect of Plan BX on hourly salinity concentrations over a tidal cycle are shown in Plates [illegible]. Average salinity concentrations are shown in Table [illegible]. Average salinity concentrations at stations along the center line of the navigation channel are shown in Figure [illegible]. Maximum and

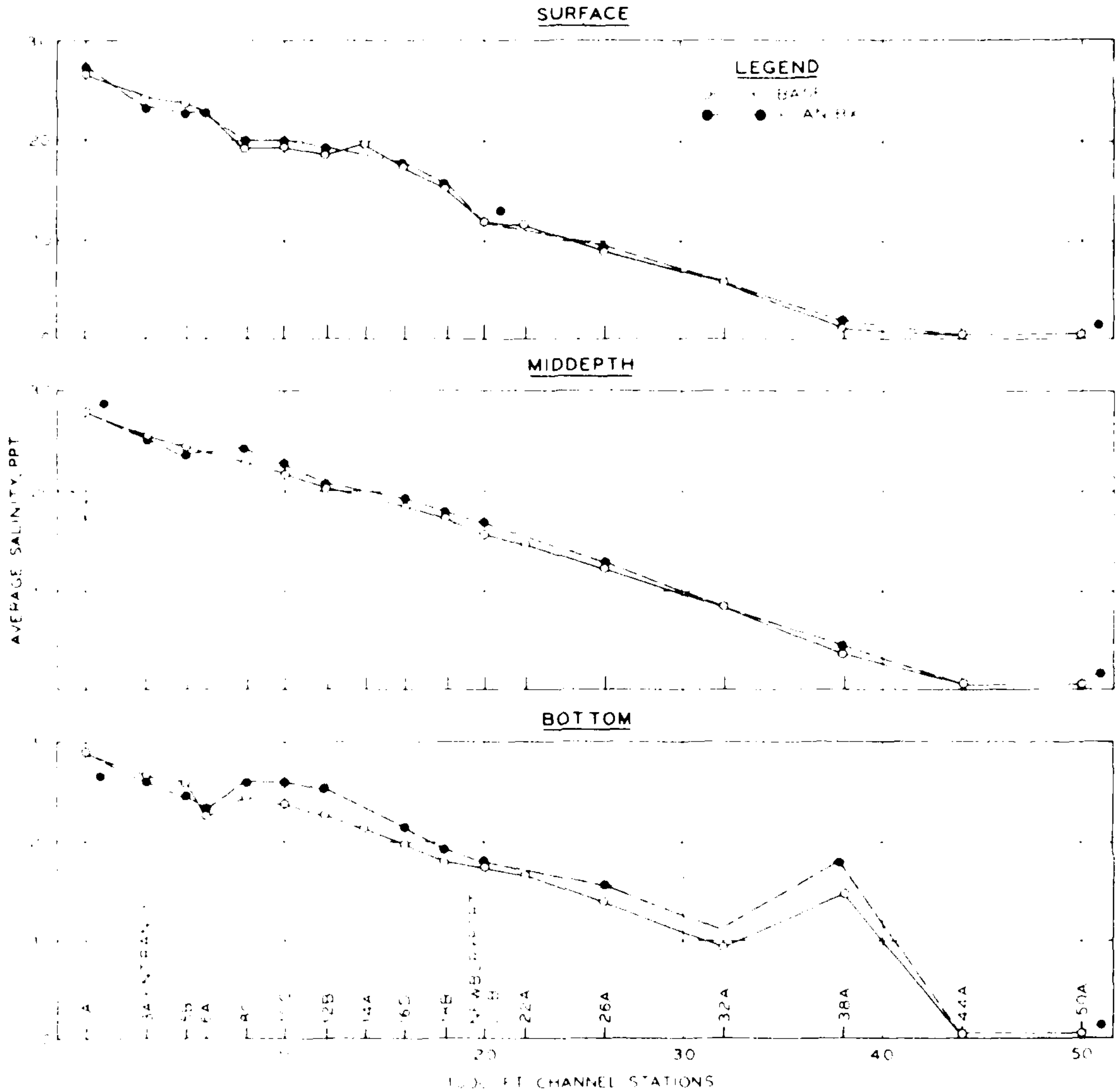


Figure 42. Average salinity profile, Plan BX

minimum salinity concentrations at stations beginning in the ocean and through range 5 were relatively unchanged; however, salinity concentrations averaged over the tidal cycle for stations located in this area were generally 0.1 to 0.3 ppt lower than base conditions. Upstream from range 5, maximum salinity concentrations were generally unchanged, while minimum salinity concentrations were about 1.0 ppt to 5.0 ppt higher than base. This trend was observed at all depths; however, maximum changes occurred at the bottom depth, as illustrated by the salinity profiles (Figure 42). Minimum salinity concentrations generally occurred about 30 min to 1 hr later than those observed during base tests. The only substantial changes to mixing characteristics occurred during the minimum salinity period at sta 10C and 12B. The duration of maximum salinity concentrations was slightly longer than base conditions.

Dye dispersion

111. The effects of Plan BX on dye dispersion throughout the test period (16 cycles) at 30 locations throughout the estuary are shown in Plates 336-365. Maximum dye concentrations and average dye concentrations for the above stations are shown in Table 3. Average dye concentration profiles for hws and lws sampling periods at locations along the channel center line are shown in Figures 43 and 44, respectively. Plan BX generally caused only small changes in dye concentrations throughout the estuary. Figure 43 and Table 3 show that hws average dye concentrations at locations downstream from the injection location were relatively unchanged, as average changes were generally plus or minus 1 to 4 ppb. Likewise, changes upstream from the injection location are considered insignificant, as they also showed plus and minus effects. Maximum change occurred at sta 26A, a station located very near the injection point.

112. Lws average dye concentrations were not changed to any significant degree; however, a weak trend did develop as average dye concentrations at most locations were slightly higher than those observed during base conditions.

Entrance fixed-bed shoaling and scour

113. The effects of Plan BX on shoaling and scour in the entrance area are shown in Table 4 and in Plates 303, 366, and 367. Shoaling index values for the navigation channel are shown in Table 4 and in Plate 303. These data show that the Plan BX channel shoaling index was 87.3 or 12.7 percent less than base conditions. The rates and pattern of the peak shoal on the outer bar were very similar to those of Plan 3B and BE, as in each case the peak shoal was relocated oceanward by 1,200 ft. The peak shoal was reduced from 12.3 percent for base conditions to 10.3 percent with Plan BX installed in the model. Sections 8 and 9 scoured completely in comparison with 4.5 percent and 2.9 percent of the total channel shoaling, respectively, for base tests. Two separate peak shoals were again present on the inner bar; however, the seawardmost peak shoal was considerably higher than base conditions, 13.8 percent in comparison with [illegible] percent. This peak shoal was relocated seaward a distance of [illegible] ft. The second or landwardmost peak shoal on the inner bar was likewise relocated seaward, but unlike the seawardmost peak, it was slightly reduced. This reduction was from a value of [illegible] percent for base conditions

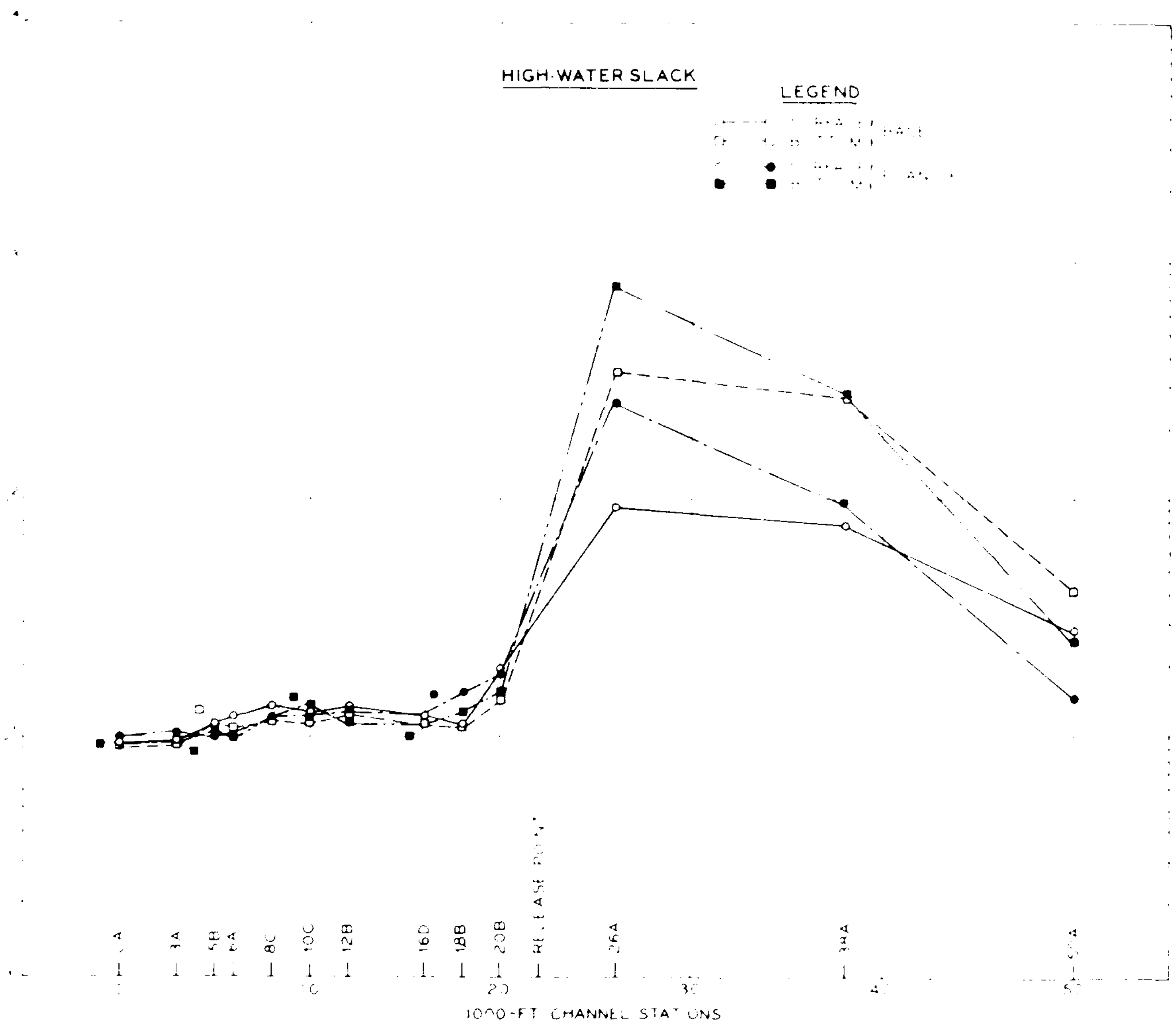


Figure 43. High-water slack average dye concentrations, Plan BX

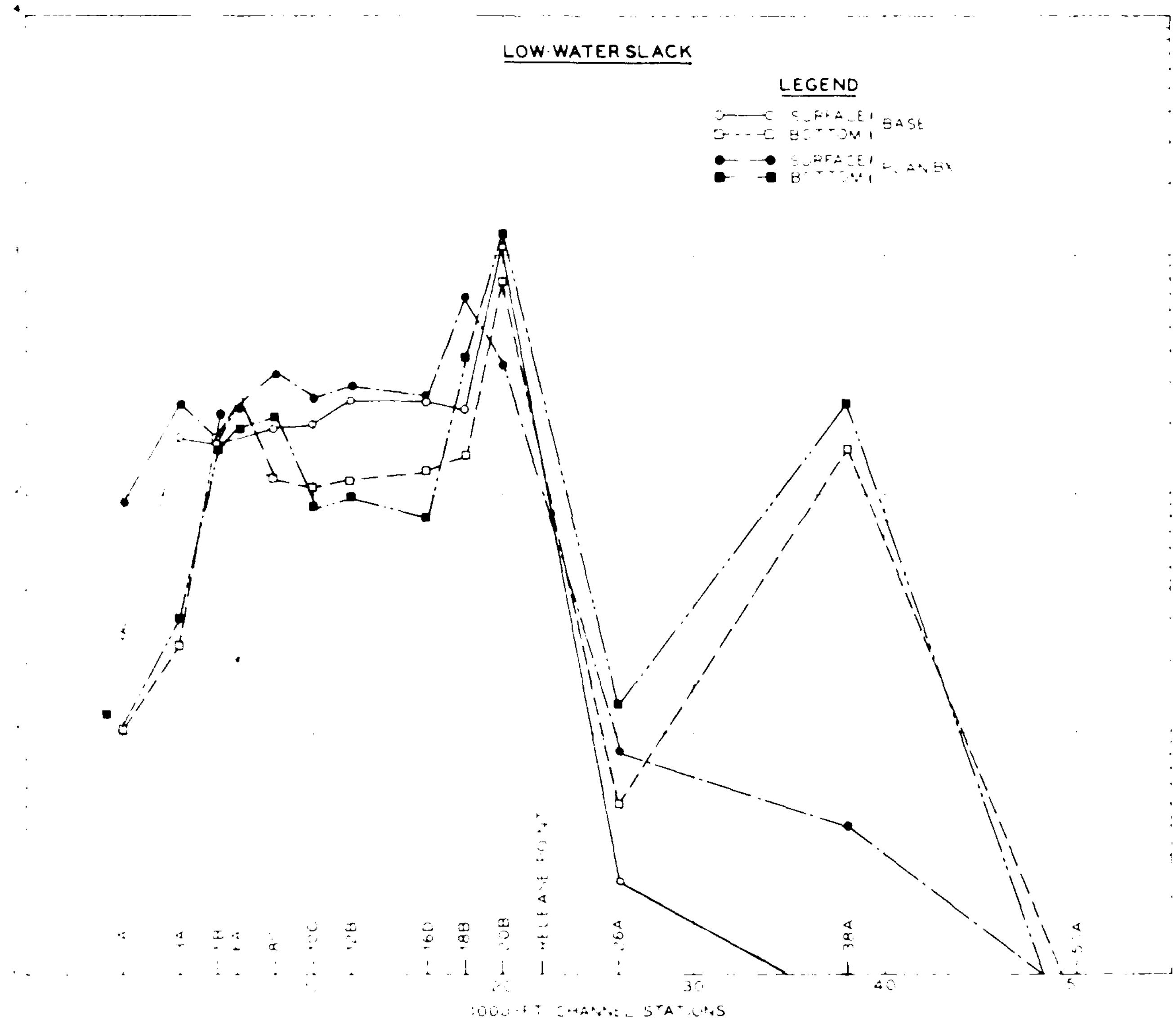


Figure 44. Low-water slack average dye concentrations, Plan BX

to a value of 4.4 percent for the plan. Sections 19-23 in the channel were completely scoured out as a result of Plan BX.

114. Shoaling and scour patterns in Plate 366, when compared with base condition patterns in Figure 14, show that Plan BX had very little effect on patterns north and south of the respective jetties or in the adjacent offshore areas. The outer bar shoal, as previously discussed in the above paragraph, was relocated seaward. As seen in Plate 366, considerable scour occurred along the entire length of the navigation channel.

115. Although the sketch in Plate 366 shows some scouring along the immediate north shore of Plum Island, the overall change in this area (sections G15-G19) as shown by the values in Plate 367 were toward increasing shoaling. Sections H14-H19 also showed either no change or a small increase over that observed for base conditions. The values in Plate 367 show the effects of Plan BX for individual sections and are presented as a percent of base test volumes recovered from each section.

PART VI: DISCUSSION OF RESULTS

Tidal Observations

116. Maximum effects on tide levels occurred during the low-water periods of the tidal cycle with each of the six plans investigated, and with the exception of Plan D, resulted in slightly higher low-water levels. This effect resulted in a reduction in tide range since the high-water levels were not affected to the same degree. The greatest effects were observed at gages located in the entrance as, in most instances, effects upstream from Newburyport were minor. Plan BX, a combination of Plans 3B, 2C, and 6E, had the greatest effect of the six plans as rather significant changes were observed throughout the model. Plans D and 3E had the least effects of the six plans, as they were generally within the limits of accuracy of repeating two identical model tests. Plan BX resulted in a general delay in tide phase of about 30 min throughout the model. Other plans had very little effect on tide phase.

Current Velocities

117. In general, the six plans tested had very little effect on current velocities except in the immediate vicinity of the plan being tested. In most cases, however, these local changes were rather significant. Plans 3B, BE, and BX resulted in the most severe changes and in general were very similar in nature. Each of the above plans weakened ebb flow predominance observed for [illegible] from sta 7A. Flow predominance calculations for stations [illegible] along the navigation channel center line between sta 3A and 8C [illegible], in most cases, changed from a significant ebb predominance to either a weak ebb, balanced flow or a strong flood predominance. These changes could result in a potential shoal problem in the immediate entrance. Changes to current velocities and flow predominance by Plans 3B, BE, and BX indicate that material would be more readily transported into the entrance by flood currents and would have a better chance of remaining. This is shown very clearly by the rather large increase in the peak shoals (Plates 152 and 303) on the inner bar resulting from the entrance fixed-bed shoaling and scour tests.

118. Plan 2C resulted in large increases in maximum ebb current velocities immediately downstream from the plan (sta 6A and 6E) and large increases

in flood current velocities immediately upstream (sta 7A and 8C). These maximum current velocities were in excess of 8.0 fps and might be hazardous to small craft navigating the area during either of the above periods. The increases in flood current velocities at sta 7A, 8C, and 12B resulted in significantly changing the base condition flow predominance at these stations. Flow predominance at sta 7A was changed from an ebb predominance value of 15.5 percent to a flood predominance value of 12.9 percent. Sta 8C flow predominance was changed from 7.1 percent ebb to 7.3 percent flood. The direction at sta 12B was not changed by Plan 2C, but the base condition ebb predominance value of 9.8 percent was reduced to only 2.4 percent. Flow predominance values at these three locations would indicate that shoal material would be more easily transported upstream and would very likely result in creating a shoal near sta 12B. The high ebb current velocities immediately downstream from the plan was the primary force in relocating the inner bar shoal about 600 ft farther seaward.

119. Plans D and 3E had very little effect on current velocities throughout the estuary. Overall, Plans D and 3E resulted in a very small increase in discharge in the ebb direction. However, this trend was not consistent, especially at stations located near the plans, as in this area there were a few stations where the opposite was observed. Changes to the predominant direction of flow at channel center-line stations were observed at only three points. At sta 3A middepth with Plan 3E installed, the base ebb predominance was changed to a weak flood predominance; and at sta 5B bottom depth, the weak flood predominance was changed to a weak ebb predominance for each of the plans. Current velocity measurements obtained with Plans D and 3E are considered to be very close to or within the limits of accuracy in repeating identical model tests.

Salinities

120. With the exception of Plan D, each of the plans tested resulted in slightly higher average salinity concentrations throughout the estuary. Bottom and middepth elevations were generally affected to a greater degree than the surface depth, and like other model measurements, the greatest changes were observed in the vicinity of the plan under investigation. The greatest changes to hourly salinity concentrations during the tidal cycle occurred

during the lws period (minimum salinity), while salinity concentrations occurring during the hws period (*maximum salinity*) *were influenced very little* by the plans.

121. Plan D resulted in lower average salinity concentrations; and like the other five plans, maximum changes occurred near the plan at the middepth and bottom elevations during the lws sampling period. Plan D would reduce the extent of salinity intrusion if installed in the prototype but not to any significant degree. The other five plans would result in an increase in salinity intrusion but like Plan D, would not be significant.

122. Very little change was noted in vertical mixing or stratification characteristics of the system, except in the immediate vicinity of the groin in Plan 2C and extending somewhat farther upstream from the groins in Plans BE and BX. The base condition estuary was such a well-mixed system that the addition of the plans, which generated additional turbulence and mixing, generally was of little effect. Plan 2C had the least overall effect of the six plans tested, while Plan BX exhibited the greatest effect on salinity conditions.

Dye Dispersion

123. Each of the six plans investigated had very little effect on the flushing or dispersion characteristics of the estuary. Again, as observed with tidal heights, currents, and salinity measurements, the maximum effects occurred in the immediate vicinity of the plan being investigated. The base test data and resulting plan test data for individual sampling points and periods were generally so closely *matched* that concentrations for the entire test [illegible] were averaged in an effort to develop a trend or direction of effects. [illegible] type of analysis indicated that the plans had very little effect on flushing and dispersion.

124. [illegible] the above type of analysis, several very weak trends were [illegible] average dye concentrations for both the hws and lws sampling periods were slightly higher than base condition average data. This indicates that Plan [illegible] would cause a slight decrease in the flushing ability of the [illegible] for an upland source of pollutant. A similar trend was observed for Plan [illegible]. Plan D average dye concentrations showed a small increase at hws and a small decrease at lws, indicating a slight improvement in flushing ability for an [illegible] source of pollutant.

125. Plan 3E average dye concentrations for both hws and lws periods showed that average concentrations were generally lower than base downstream from the release point and slightly higher upstream from the release point. This trend indicates a reduction in flushing ability. Plans BE and BX average dye concentrations reflected the same general trend as was observed with Plan 3E average concentration data. Therefore these two plans would also cause a slight decrease in the flushing ability of the estuary.

126. Exceptions to the above trends were noted with each plan's test results, thereby emphasizing the close similarity between base and plan conditions. Therefore it is concluded that the overall flushing ability of the estuary was not significantly helped or hurt by the installation of any particular plan. A very large percentage of the test results was within the limits of accuracy of repeating identical model tests of this type. There were no areas in the model where unusual buildup or depletion of dye occurred as a result of any of the six plans tested.

Entrance Area Fixed-Bed Shoaling and Scour

127. Each of the three plans (3E, BE, and BX), involving the north jetty extension, reduced and relocated seaward the outer bar shoal. However, each of these three plans also caused an even greater increase in shoaling over the inner bar. The reduction over the outer bar would mean less frequent dredging; but at the same time, the plans would require dredging a greater volume and at more frequent intervals on the inner bar to maintain the authorized channel depth. None of the above plans caused any significant change in shoaling and scour rates or patterns along the beaches or along the eastern half of the north shoreline of the Plum Island.

128. From a study of the surface current pattern photographs of these three plans together with the shoaling and scour pattern sketches, it is evident that the strong ebb currents caused by the north jetty extension are tending to develop a new outer bar channel in a more southerly orientation from the presently authorized alignment. This situation could eventually result in an increase in shoaling in the present channel even though model tests indicate otherwise.

129. Plans [illegible], [illegible], and [illegible], like the three plans discussed above, had very little effect on shoaling and scour rates or patterns along the beaches

and offshore areas, or along the eastern half of the north [illegible] Island. Plans D and 3E had the least effect of any of the other plans [illegible] as very small changes from base conditions were noted. Plan D and [illegible] were very similar. Each plan caused a small increase to the peak [illegible] outer bar. This shoal was relocated about 300 ft seaward with [illegible] and was relatively unchanged with Plan 3E. Shoaling rates over the [illegible] were relatively unchanged, but the landwardmost peak shoal was shifted upstream about 300 ft by each plan. Plan D caused a small increase in this shoal while Plan 3E decreased this shoal a small amount. Each plan caused a small increase in shoaling over the outer bar on each side of the navigation channel.

130. Plan 2C had the greatest effect of any plan on inner bar shoaling rates and patterns, resulting in almost complete scour in the navigation channel for a distance of about 15,000 ft downstream and 900 ft upstream from the plan. This scouring was due to the extremely high bottom current velocities (in excess of 8.0 fps) created by the plan in the navigation channel in the vicinity of the structure. Sta 6B, immediately downstream, had bottom ebb current velocities in excess of 8.5 fps, while sta 7A and 8C, immediately upstream, had flood current velocities in excess of 6.0 fps. These extremely high current velocities in this area eventually would be reduced as the channel scoured a larger cross-sectional area. However, in the early life of Plan 2C, erosion to Plum Island Point would occur.

131. No effort was made to recover material from the channel in the vicinity of sta 12B as this was beyond the problem area. However, flow predominance calculations indicate this section of the navigation channel to be a potential shoal area with Plan 2C. As the channel scoured, existing flow conditions in this area would be restored, thereby reducing the possibility of this shoal developing into a serious problem.

PART VII: CONCLUSIONS AND RECOMMENDATIONS

[illegible]. Based on the results of model testing, the following conclusions [illegible] be made:

a. None of the six plans investigated had any significant effects on existing tidal heights, salinities, or dye dispersion characteristics of the estuary.

b. Plans 3B, 2C, BE, and BX would affect currents in such a manner as to create potentially hazardous navigation problems through the entrance, especially during the early life of each plan. Each of the above plans would result in increased flood flow predominance in the entrance area, which would increase the movement of sediment from the outer bar area to the inner bar area. Plans D and 3E had the least effect of the six plans on existing current patterns or velocities. Plans D and 3E each showed a slight increase in ebb flow predominance in the entrance area which would result in less transportation of material from the outer bar area to the inner bar.

c. Plans which include the curved extension to the north jetty and an interior groin (Plans 3B, BE, and BX) would reduce outer bar shoaling, immediately seaward of the jetties, but would increase channel shoaling at the seaward end of the channel (sections 1-4) and on the inner bar. The reduction in shoaling realized at the outer bar would be offset by the greater increase in shoaling over the inner bar and seaward end of channel. Plan BX, with a navigation shoaling index of 87.3, was the most effective of the six plans tested in respect to overall channel shoaling. Plan 2C was next with a navigation channel shoaling index of 89.5. Plan 2C was an integral part of Plan BX and is primarily responsible for the large decrease in channel shoaling shown by Plan BX. Therefore it can be concluded that Plan 2C was the most efficient plan tested in respect to channel shoaling. Plan D and 3E had the least effect of the six plans on shoaling and scour in the entrance and on the outer bar. Each of these two plans showed a small increase in the channel shoaling index; however, each plan was within [illegible] percent of base test values, which is considered within the limits of accuracy of repeating identical model tests of this type. None of the six plans tested resulted in any significant or detrimental effects to shoaling or scour [illegible] patterns along either beach or offshore areas. Each plan resulted in a slight increase in shoaling along the [illegible] of the north shoreline of Plum Island.

d. None of the above plans are recommended for construction since each showed either no beneficial effects or resulted in in[illegible] shoaling [illegible]. It is recommended that additional model tests be conducted with a north jetty extension plan that [illegible] the present outer bar alignment. Several lengths of such an extension should be investigated. Consideration should be given to [illegible] landward extension to the south jetty which would parallel the north jetty for a distance of about 2,500 ft then tie back into Plum Island Point. The spacing of jetties (1,000 ft) would remain the same as at outer end. This plan would provide a shorter, more direct route to deep water and would provide complete protection to Plum Island Point.

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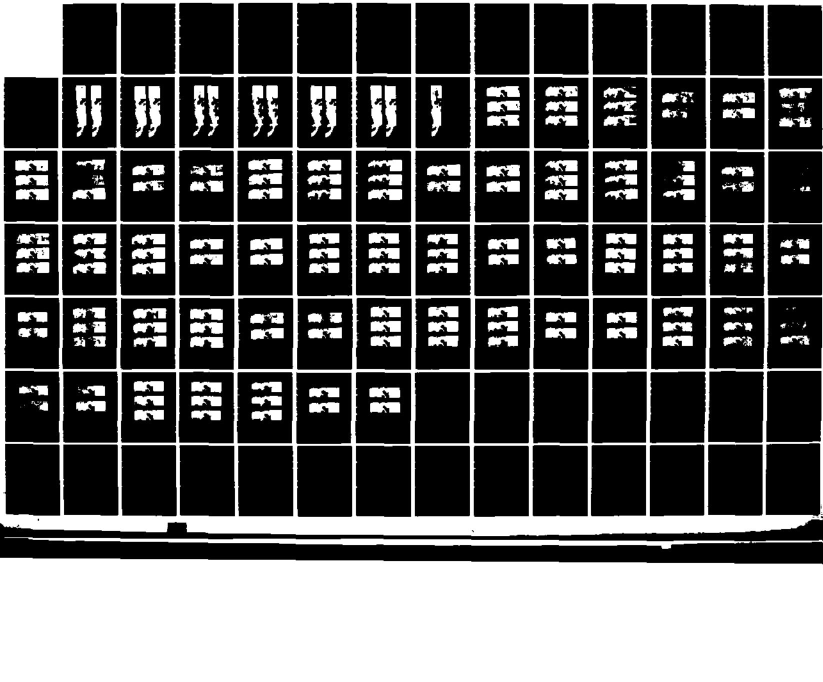
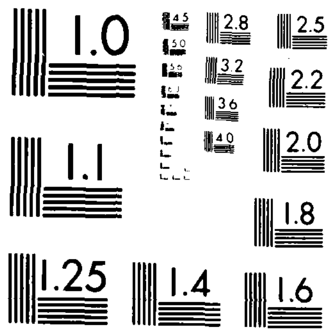
HYDRODYNAMICS SALIN..(U) ARMY ENGINEER WATERWAYS
EXPERIMENT STATION VICKSBURG MS HYDRA..
UNCLASSIFIED N J BROGDON ET AL. MAR 85 WES/TR/HL-79-1-2 F/G 8/10 NL





MICROCOPY RESOLUTION TEST CHART

Table [illegible]

[illegible]

Station No.	[illegible]	[illegible]	[illegible]					
			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
A	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
A	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	--	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	-8.6	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	-13.7	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

Table [illegible]

[illegible] on Average Salinities

Station No.	Depth	[illegible]	Salinity, ppt					
			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
A	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]
	Middepth	--	--	--	--	--	--	--
	Bottom	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	--	[illegible]	[illegible]	[illegible]
F	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	--	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	--	--	--	--	--	--	--
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 2 (Concluded)

Station No.	Depth	Base	Salinity, ppt Plan [illegible]	Plan [illegible]	Plan 1	Plan [illegible]	Plan [illegible]	Plan [illegible]
[illegible]	Surface	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Bottom	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Surface	[illegible]	[illegible]	19.9	[illegible]	19.3	19.0	[illegible]
	Middepth	[illegible]	[illegible]	20.6	[illegible]	20.6	21.1	[illegible]
	Bottom	[illegible]	[illegible]	21.6	[illegible]	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	21.5	[illegible]
[illegible]	Bottom	[illegible]	[illegible]	[illegible]	19.1	19.8	19.6	[illegible]
	Average	[illegible]	[illegible]	[illegible]	19.1	19.8	19.6	[illegible]
[illegible]	Bottom	[illegible]	16.6	16.7	16.0	16.9	16.8	[illegible]
	Average	[illegible]	16.6	16.7	16.0	16.9	16.8	[illegible]
[illegible]	Surface	17.0	16.3	[illegible]	16.2	17.4	16.6	17.7
	Middepth	[illegible]	18.6	18.7	17.6	19.2	19.5	19.5
	Bottom	[illegible]	20.5	19.6	18.4	20.5	20.5	[illegible]
	Average	[illegible]	[illegible]	18.5	17.4	19.0	18.9	19.5
[illegible]	Surface	[illegible]	14.3	14.3	12.7	14.3	[illegible]	13.8
	Middepth	16.4	[illegible]	16.7	15.4	17.3	17.0	17.0
	Bottom	17.7	[illegible]	17.6	16.7	18.5	18.4	18.8
	Average	[illegible]	16.5	[illegible]	14.9	16.7	16.3	16.5
[illegible]	Surface	15.0	[illegible]	15.0	[illegible]	15.8	15.4	15.6
	Middepth	17.1	[illegible]	17.1	[illegible]	18.1	17.8	17.3
	Bottom	17.9	18.4	18.2	17.0	19.0	18.7	19.1
	Average	16.7	[illegible]	16.8	15.7	17.6	17.3	17.3
[illegible]	Surface	11.9	[illegible]	13.9	11.3	13.1	11.9	11.7
	Middepth	15.5	15.7	15.4	14.3	16.1	17.1	16.7
	Bottom	17.1	[illegible]	17.3	15.7	17.8	17.6	17.6
	Average	14.8	[illegible]	15.5	13.8	15.7	15.5	[illegible]
[illegible]	Surface	[illegible]	9.5	8.9	8.3	11.0	9.7	[illegible]
	Middepth	[illegible]	[illegible]	[illegible]	10.4	13.7	12.7	12.6
	Bottom	13.9	[illegible]	13.9	12.6	[illegible]	15.1	15.4
	Average	[illegible]	[illegible]	11.7	10.4	[illegible]	[illegible]	11.4
[illegible]	Surface	1.0	[illegible]	[illegible]	[illegible]	[illegible]	1.4	1.4
	Middepth	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.6
	Bottom	[illegible]	[illegible]	15.4	[illegible]	20.7	[illegible]	17.4
	Average	[illegible]	[illegible]	[illegible]	[illegible]	9.6	[illegible]	7.8
[illegible]	Surface	[illegible]	[illegible]	[illegible]	0.1	[illegible]	0.1	0.1
	Middepth	[illegible]	[illegible]	[illegible]	0.1	[illegible]	0.1	[illegible]
	Bottom	[illegible]	[illegible]	0.1	0.1	[illegible]	[illegible]	[illegible]
	Average	[illegible]	[illegible]	0.1	0.1	[illegible]	0.1	[illegible]

Section E

(Continued)

Line A Volume Recovered (in. ml)	Line A Percent of Base Volume	Line B Volume Recovered (in. ml)	Line B Percent of Base Volume	Line C Volume Recovered (in. ml)	Line C Percent of Base Volume
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
--	--	--	--	--	--
[illegible]	95	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	167	[illegible]	[illegible]	[illegible]	[illegible]
300	85	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	94	[illegible]	[illegible]	[illegible]	[illegible]
389	104	[illegible]	[illegible]	[illegible]	[illegible]
435	119	[illegible]	[illegible]	[illegible]	[illegible]
350	109	[illegible]	[illegible]	[illegible]	[illegible]
300	102	[illegible]	[illegible]	[illegible]	[illegible]
436	114	[illegible]	117	[illegible]	[illegible]
--	--	--	--	--	--
[illegible]	100	[illegible]	[illegible]	[illegible]	[illegible]
400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
400	100	[illegible]	[illegible]	[illegible]	68
400	100	400	100	[illegible]	[illegible]
400	100	410	102	400	100
(6,956)		(6,110)		[illegible]	

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

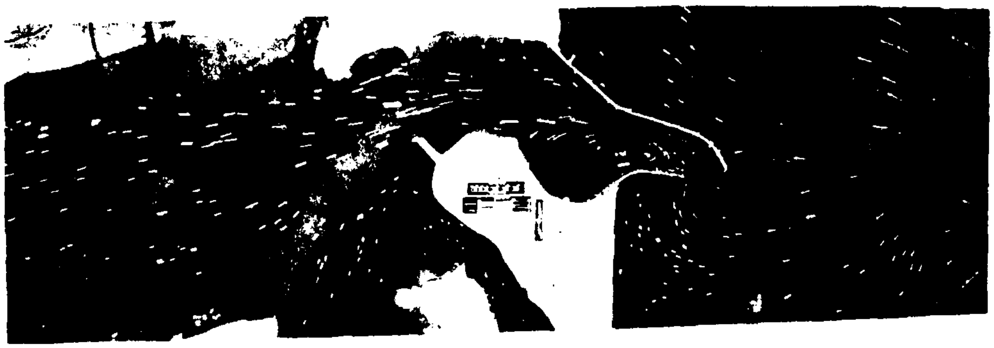
[illegible]

HOUR 2

VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN C
HOURS 0, 1, AND 2

HOUR 11



HOUR 12

SURFACE CURRENT PATTERNS
PLAN B
HOURS 11 AND 12

PHOTO 12

HOUR 10

SURFACE CURRENT PATTERNS
PLAN B
HOURS 9 AND 10

PHOTO 11

HOUR 6

HOUR 7

HOUR 8

VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN B
HOURS 6 7 AND 8

PHOTO 10

HOUR 3

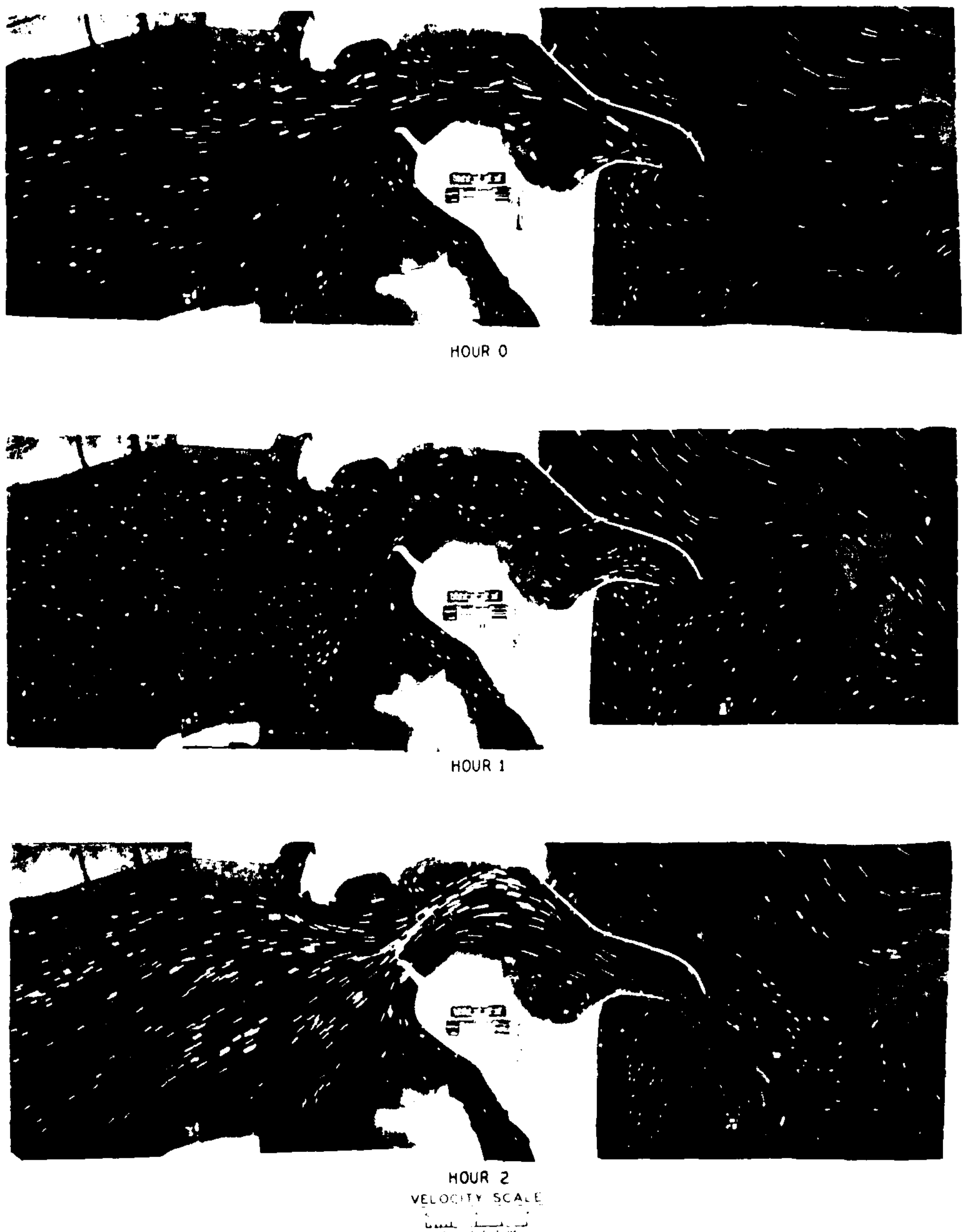
HOUR 4

HOUR 5

VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN B
HOURS 3, 4, AND 5

PHOTO 9



SURFACE CURRENT PATTERNS
PLAN B
HOURS 0, 1, AND 2

PHOTO 8

PHOTO 7

SURFACE CURRENT PATTERNS
BASE CONDITIONS
HOURS 10 AND 11

PHOTO 6

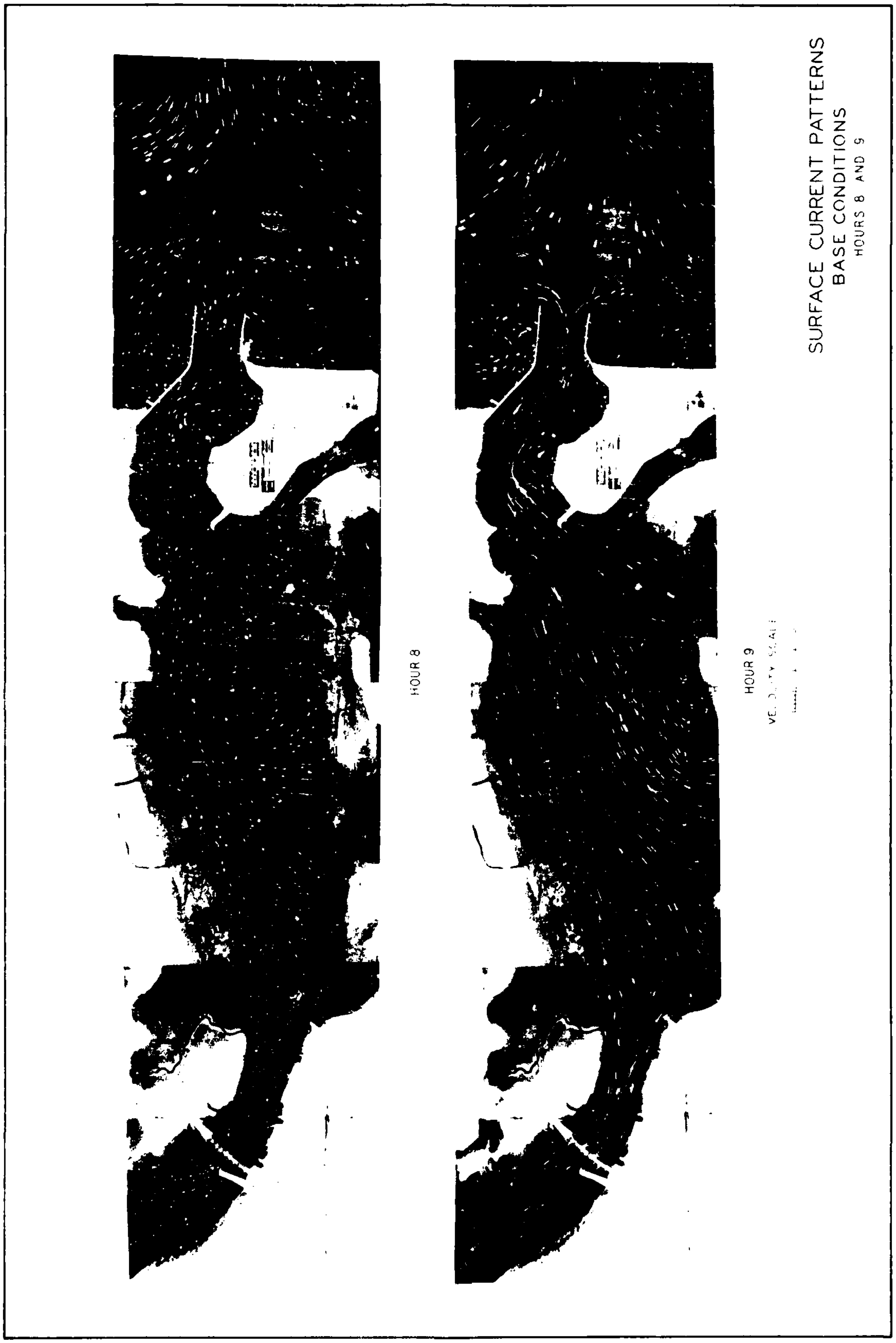
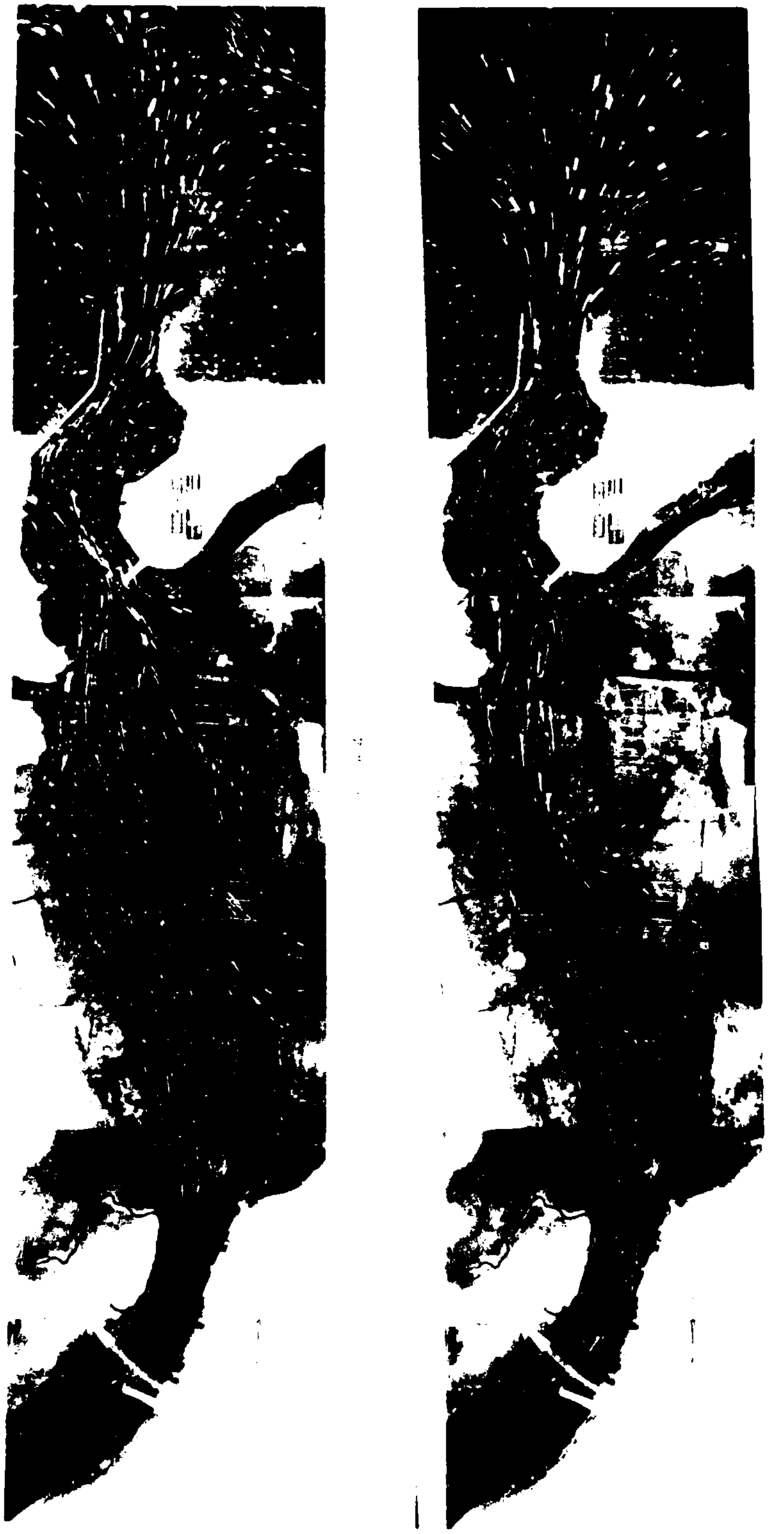

SURFACE CURRENT PATTERNS
BASE CONDITIONS
HOURS 8 AND 9
HOUR 8
HOUR 9

PHOTO 5


SURFACE CURRENT PATTERNS
BASE CONDITIONS
HOURS 6 AND 7
HOUR 6
HOUR 7

PHOTO 4



SURFACE CURRENT PATTERNS
BASE CONDITIONS

PHOTO 3


SURFACE CURRENT PATTERNS
BASE CONDITIONS
HOURS 2 AND 3
HOUR 2
HOUR 3
VELOCITY SCALE

PHOTO 2

PHOTO 1

HOUR 3

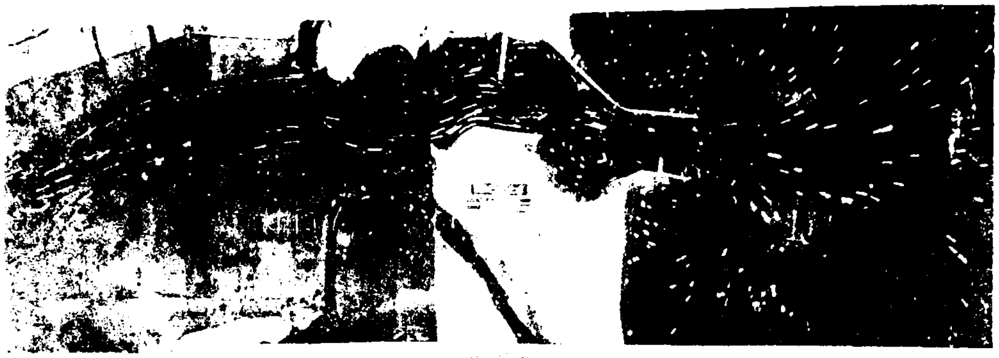
HOUR 4

HOUR 5

VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN C
HOURS 3, 4, AND 5

PHOTO 14



HOUR 8

SURFACE CURRENT PATTERNS
PLAN C
HOURS 6, 7 AND 8

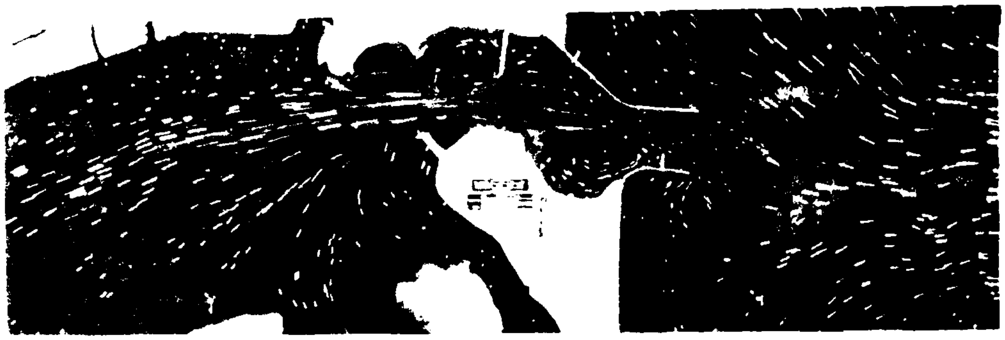
PHOTO 15

HOUR 9

HOUR 10

SURFACE CURRENT PATTERNS
PLAN C
HOURS 9 AND 10

PHOTO 16



SURFACE CURRENT PATTERNS
PLAN C
HOURS 11 AND 12

PHOTO 17

HOUR 0

HOUR 1

HOUR 2

VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN E
HOURS 0 1 AND 2

PHOTO 18

HOUR 4

HOUR 5

VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN E
HOURS 3, 4 AND 5

PHOTO 19

HOUR 6

HOUR 7

HOUR 8

VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN E
HOURS 6, 7 AND 8

PHOTO 20

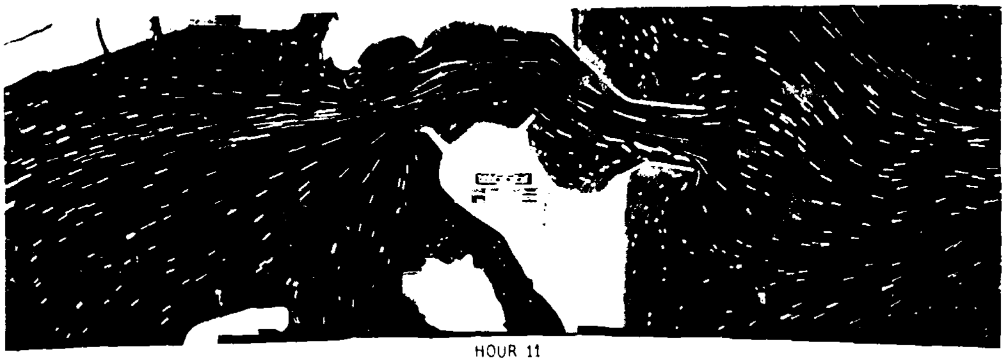
HOUR 9

HOUR 10

VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN E
HOURS 9 AND 10

PHOTO 21



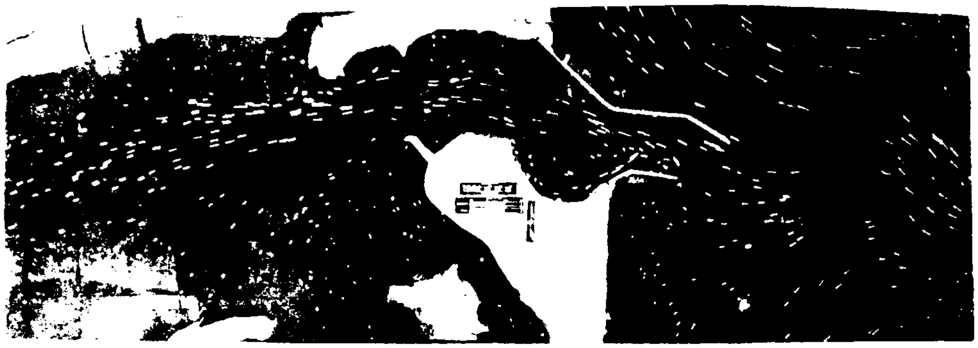
HOUR 11

HOUR 12

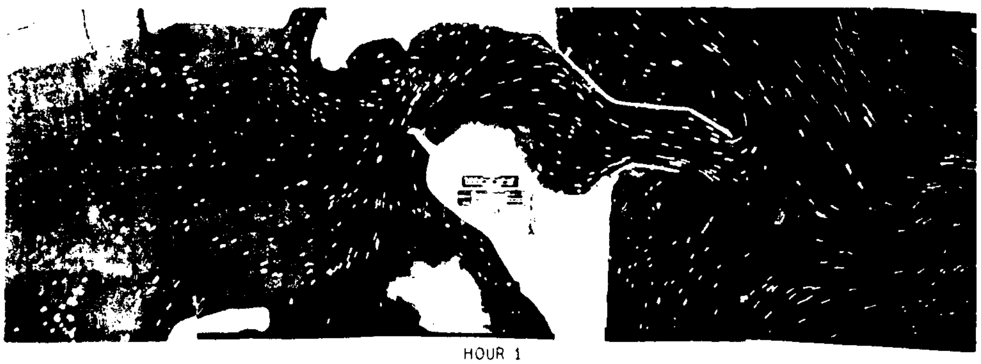
VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN E
HOURS 11 AND 12

PHOTO 22



HOUR 0



HOUR 1

HOUR 2

VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN B-B
HOURS 0, 1 AND 2

PHOTO 23

HOUR 3

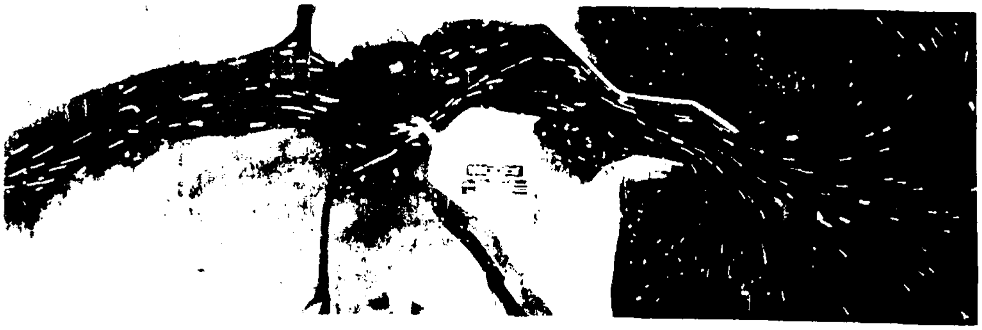
HOUR 4

HOUR 5

VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN B-B
HOURS 3, 4, AND 5

PHOTO 24



HOUR 6

HOUR 7

HOUR 8

VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN B-B
HOURS 6 7 AND 8

HOUR 9

HOUR 10

SURFACE CURRENT PATTERNS
PLAN B-B
HOURS 9 AND 10

PHOTO 26

HOUR 11

HOUR 12

SURFACE CURRENT PATTERNS
PLAN B-B
HOURS 11 AND 12

PHOTO 27

SURFACE CURRENT PATTERNS
PLAN 2C
[illegible]

PHOTO 41

SURFACE CURRENT PATTERNS
PLAN 2C
[illegible] AND [illegible]

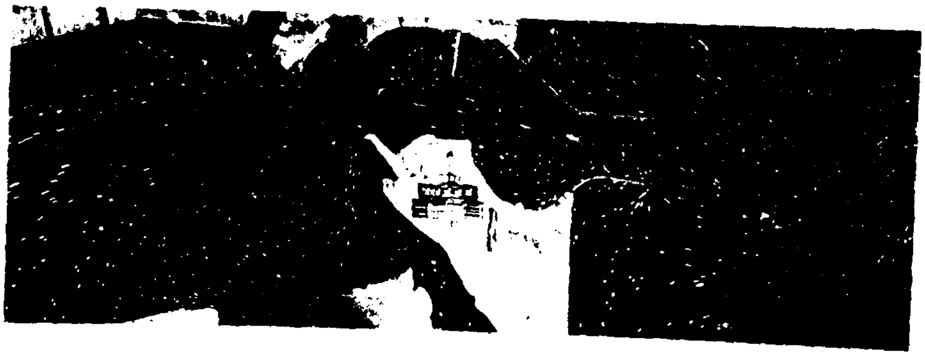
PHOTO 42

HOUR 4

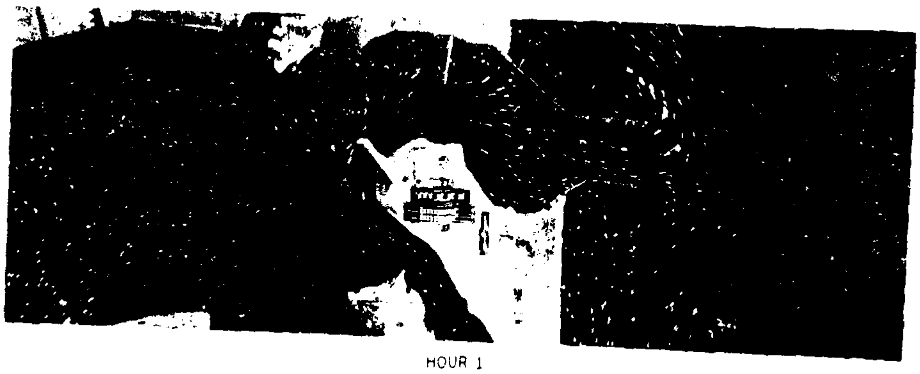
HOUR 5

SURFACE CURRENT PATTERNS
PLAN 2C
HOURS 3, 4, AND 5

PHOTO 39



HOUR 0



HOUR 1

HOUR 2

VELOCITY SCALE

SURFACE CURRENT PATTERNS

PLAN 2C

HOURS 0, 1 AND 2

PHOTO 38

HOUR 11

HOUR 12

SURFACE CURRENT PATTERNS
PLAN 3B
HOURS 11 AND 12

PHOTO 37

HOUR 9

HOUR 10

SURFACE CURRENT PATTERNS
PLAN 3B
HOURS 9 AND 10

PHOTO 36

HOUR 6

HOUR 7

HOUR 8

VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN 3B
HOURS 6 7 AND 8

PHOTO 35

HOUR 3

HOUR 4

HOUR 5

VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN 3B
HOURS 3, 4, AND 5

PHOTO 34

HOUR 0

HOUR 1

HOUR 2

SURFACE CURRENT PATTERNS
PLAN 3B
HOURS 0, 1, AND 2

HOUR 11

HOUR 12

VELOCITY SCALE

SURFACE CURRENT PATTERNS

PLAN E-E

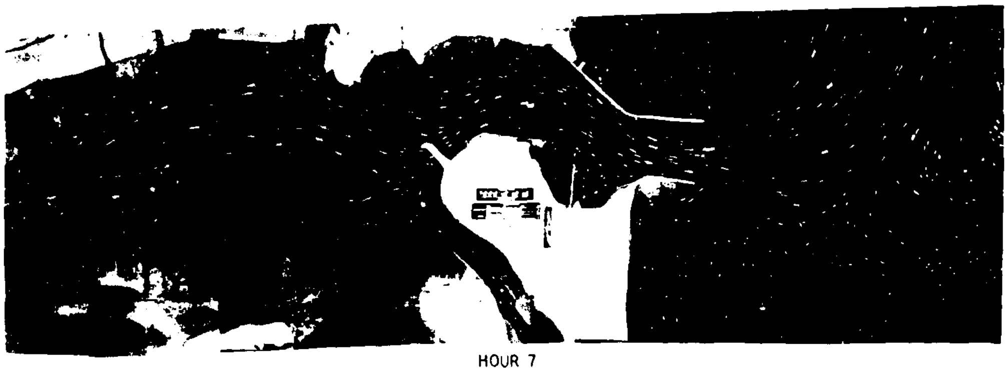
HOURS 11 AND 12

PHOTO 32

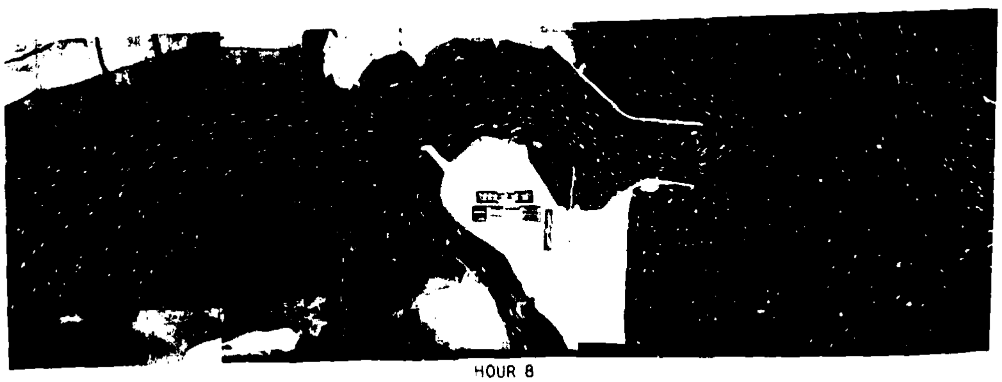
SURFACE CURRENT PATTERNS
PLAN E-E
HOURS 9 AND 10

PHOTO 31

HOUR 6



HOUR 7



HOUR 8

VELOCITY SCALE

SURFACE CURRENT PATTERNS
PLAN E-E
HOURS 6, 7 AND 8

PHOTO 30

HOUR 5

SURFACE CURRENT PATTERNS
PLAN E-E
HOURS 3 4 AND 5

HOUR 0

HOUR 1

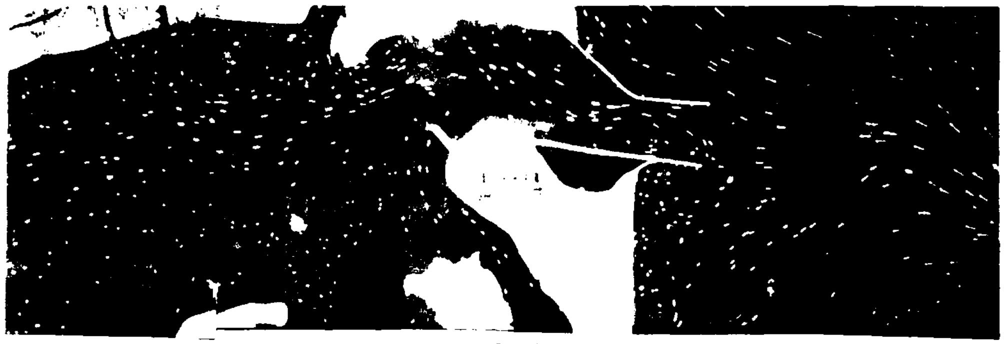
HOUR 2

SURFACE CURRENT PATTERNS
PLAN E-E
HOURS 0, 1 AND 2

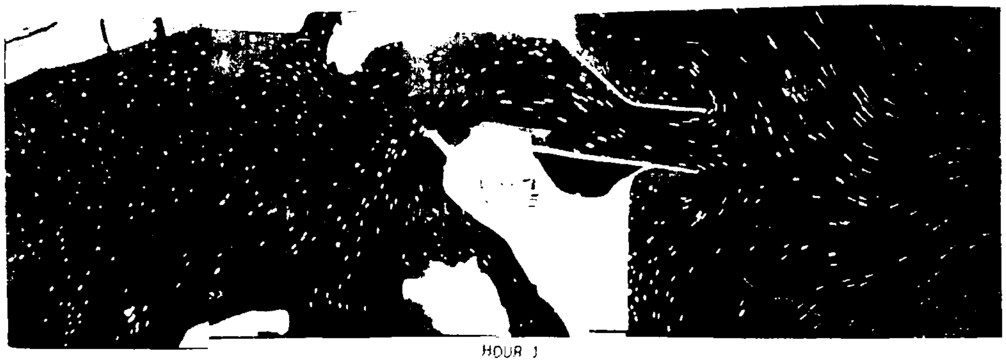
PHOTO 28

SURFACE CURRENT PATTERNS
PLAN 2C

PHOTO 42



HOUR 0



HOUR 1

HOUR 2

SURFACE CURRENT PATTERNS
PLAN D
HOURS 0, 1 AND 2

PHOTO 43

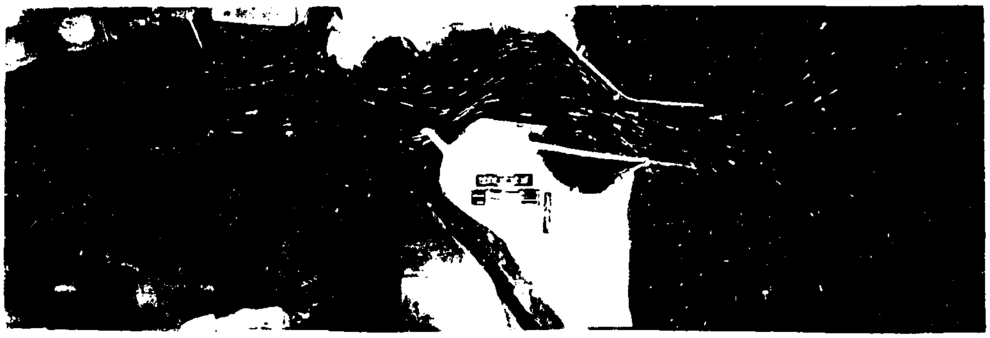
HOUR 3

HOUR 4

HOUR 5

SURFACE CURRENT PATTERNS
PLAN D
HOURS 3, 4 AND 5

PHOTO 44



HOUR 6

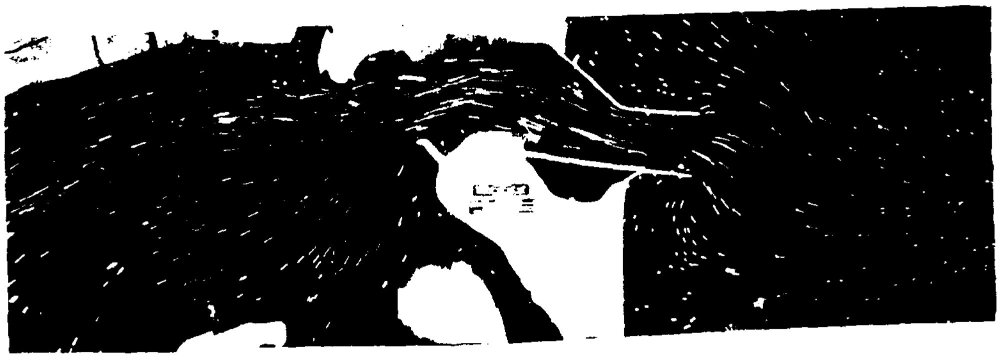
HOUR 7

HOUR 8

SURFACE CURRENT PATTERNS
PLAN D

PHOTO 45

HOUR 9



HOUR 10

SURFACE CURRENT PATTERNS
PLAN D

PHOTO 46

HOUR 11

HOUR 12

SURFACE CURRENT PATTERNS
PLAN D
HOURS 11 AND 12

PHOTO 47

HOUR 0

HOUR 1

HOUR 2

SURFACE CURRENT PATTERNS
PLAN 3E
HOURS 0, 1, AND 2

PHOTO 48

HOUR 3

HOUR 4

HOUR 5

SURFACE CURRENT PATTERNS
PLAN-3E
HOURS 3, 4 AND 5

PHOTO 49

HOUR 6

HOUR 7

HOUR 8

SURFACE CURRENT PATTERNS
PLAN 3E

PHOTO 50

HOUR

SURFACE CURRENT PATTERNS
PLAN 3E

PHOTO 51

SURFACE CURRENT PATTERNS

PLAN 3E

PHOTO 52

HOUR 1

HOUR 2

SURFACE CURRENT PATTERNS
PLAN BE

PHOTO 53

HOUR 5

PLAN BE

PHOTO 54

PHOTO 55

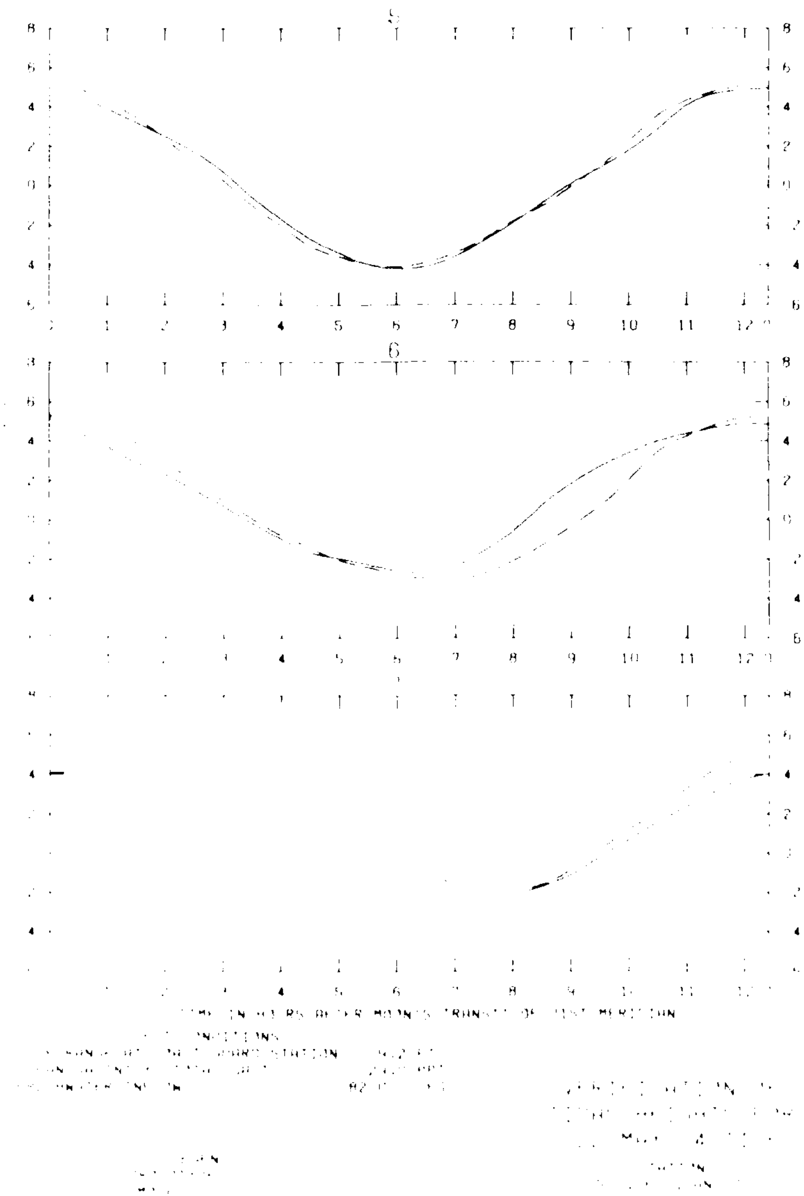
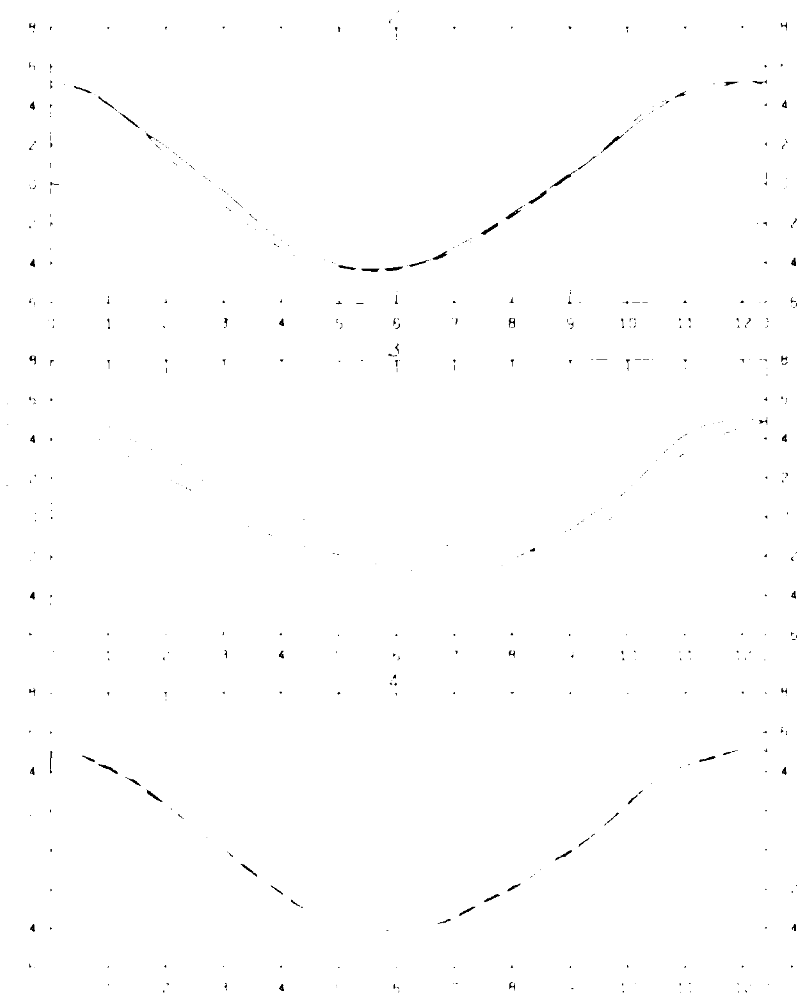
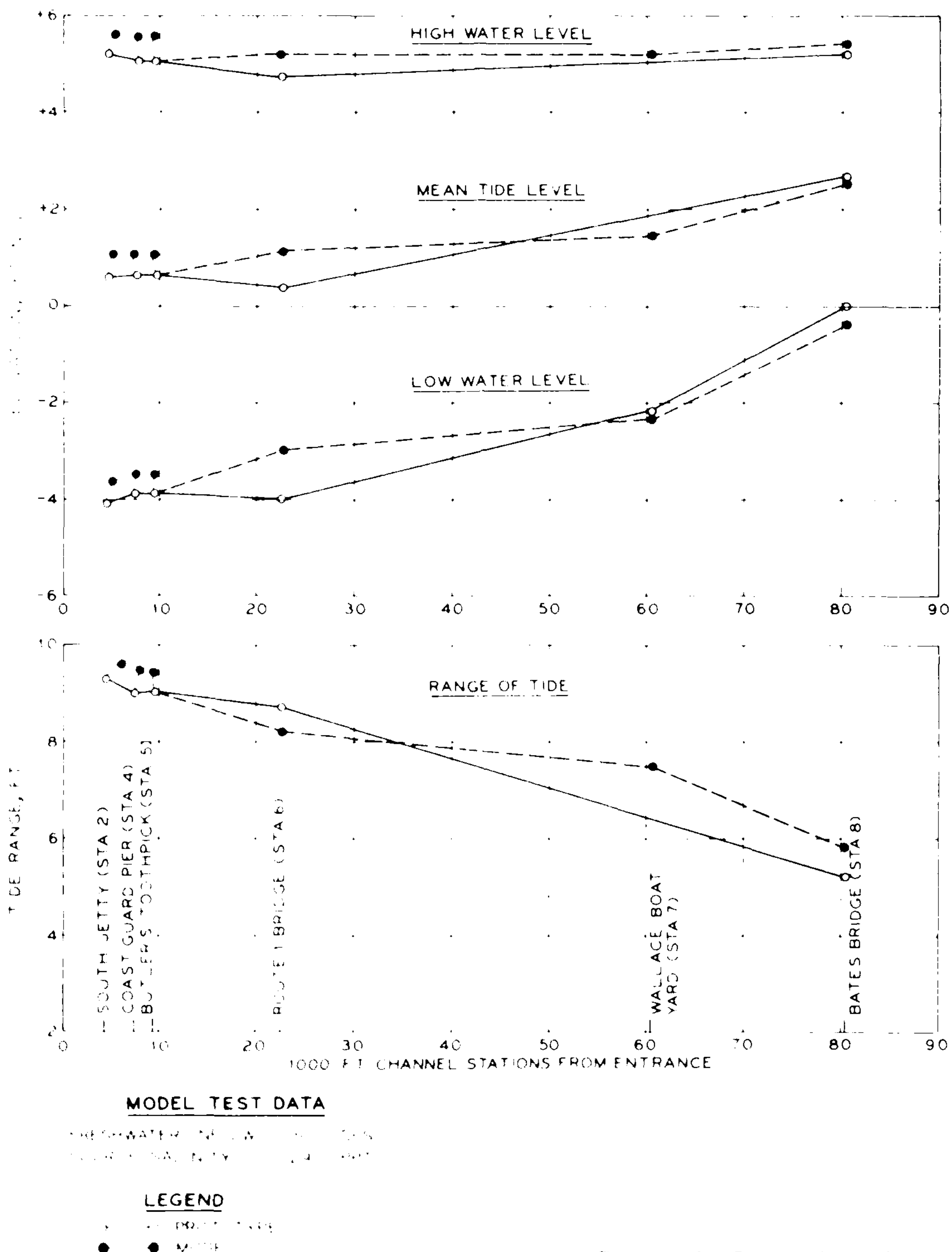


PLATE 7

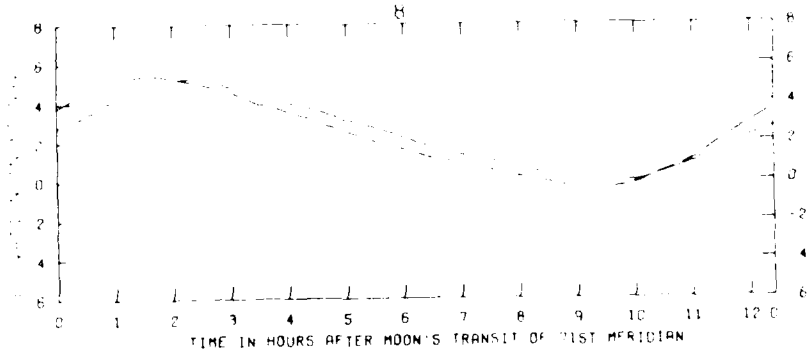




TIDAL OBSERVATIONS

13 SEPTEMBER 1973

LOW FRESHWATER INFLOW



TEST CONDITIONS

PLATE 4

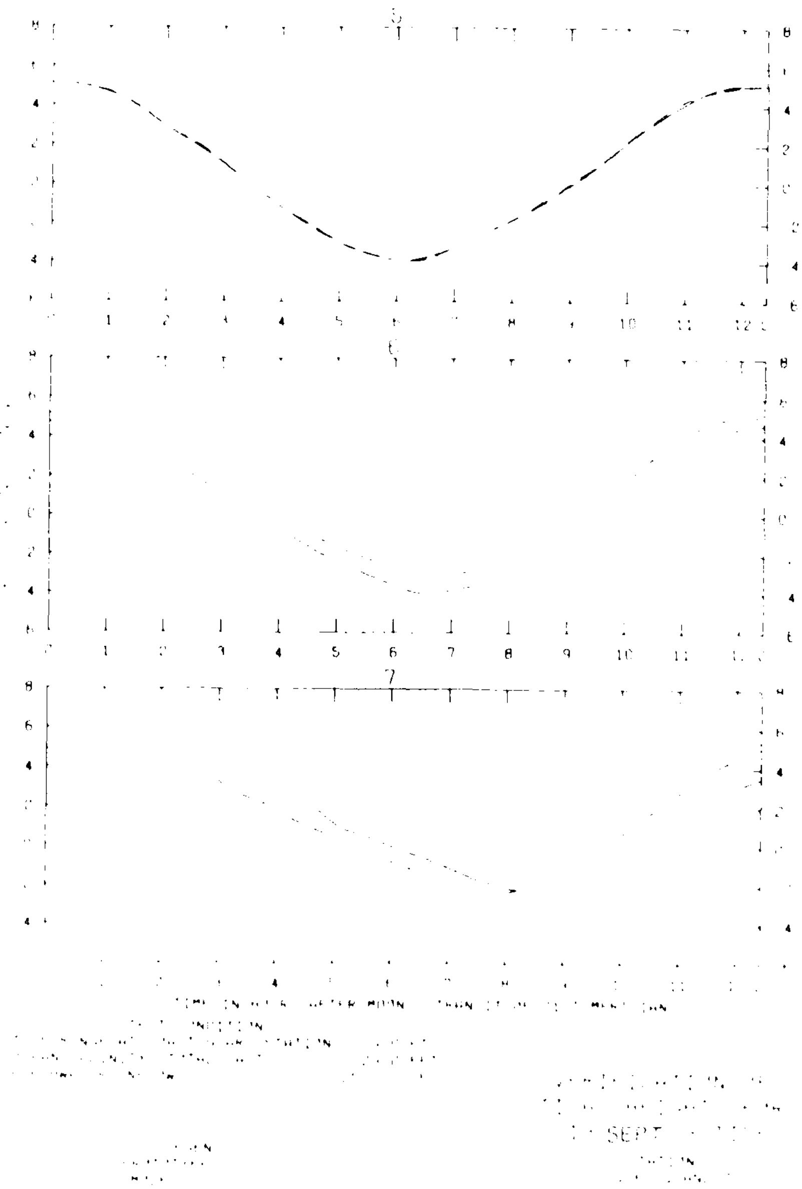


PLATE 3

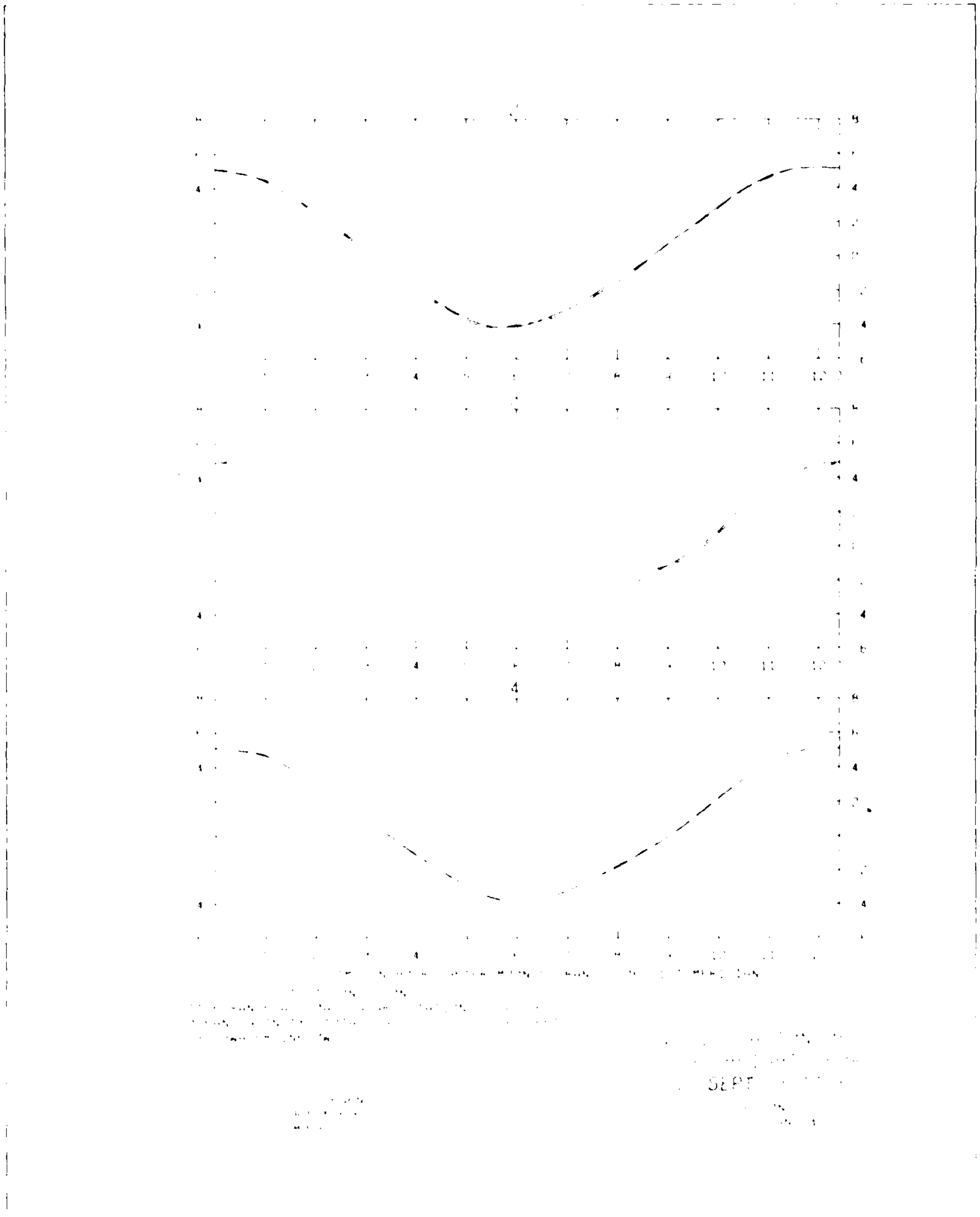


PLATE 2

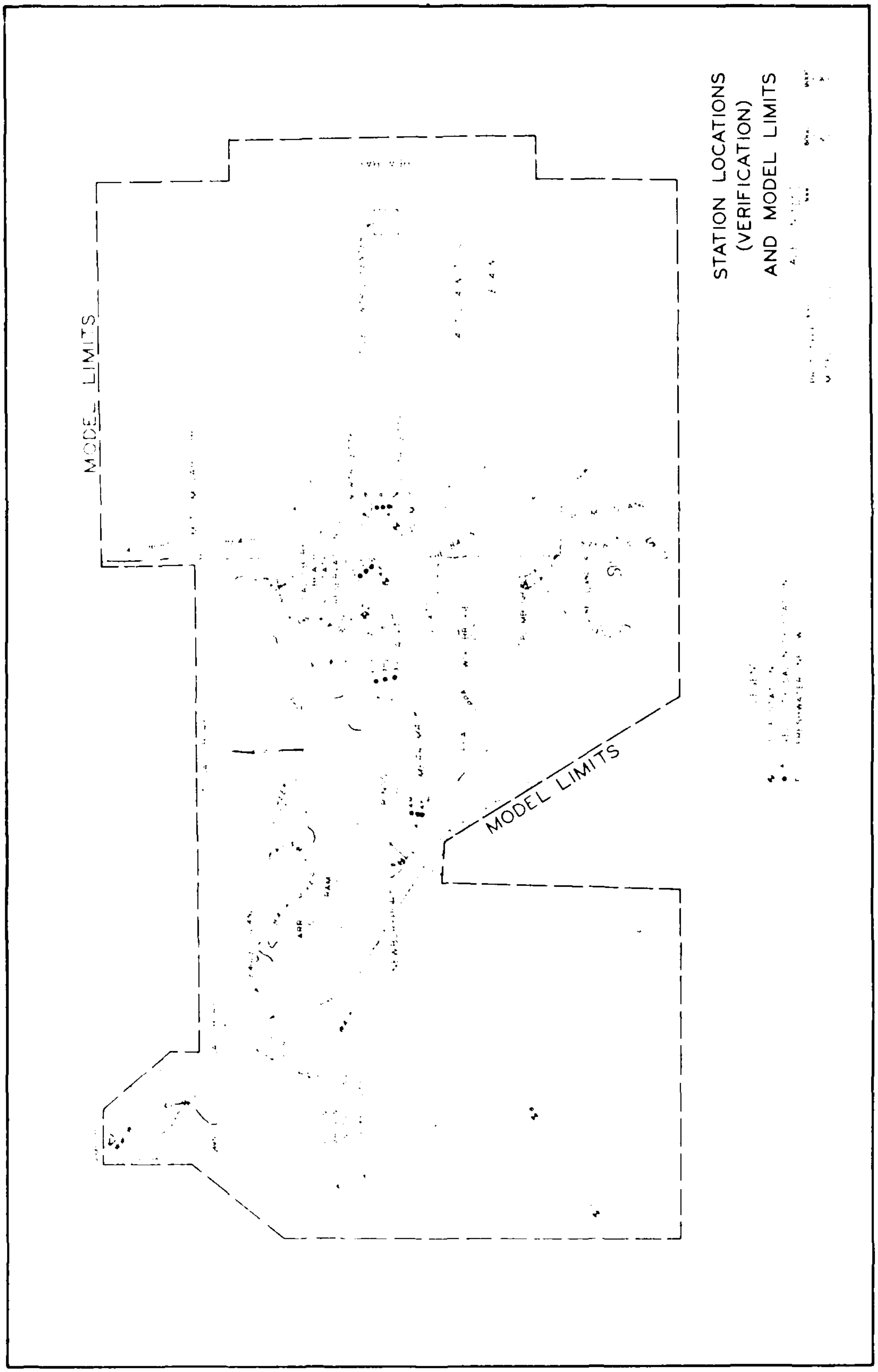
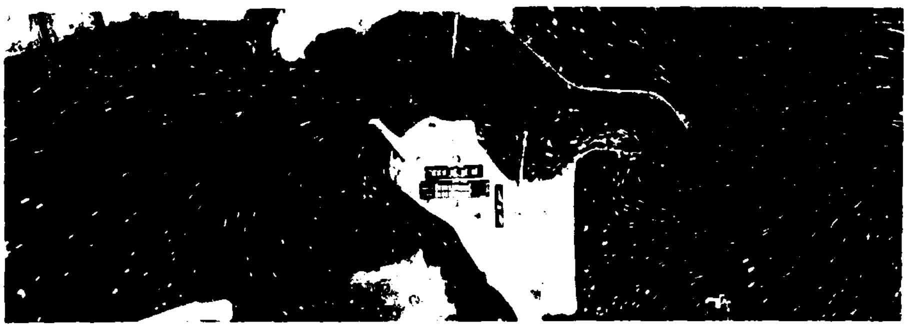

STATION LOCATIONS
(VERIFICATION)
AND MODEL LIMITS
MODEL LIMITS
MODEL LIMITS

PLATE 1

HOUR 11



HOUR 12

SURFACE CURRENT PATTERNS

PLAN BX

HOURS 11 AND 12

PHOTO 62

HOUR 9

SURFACE CURRENT PATTERNS

PLAN BX

HOURS 9 AND [illegible]

PHOTO 61

HOUR 6

HOUR 7

SURFACE CURRENT PATTERNS
PLAN BX

PHOTO 6

HOUR 4

SURFACE CURRENT PATTERNS
PLAN BX

PHOTO 59

SURFACE CURRENT PATTERNS

PLAN BX

PHOTO 58

HOUR 11

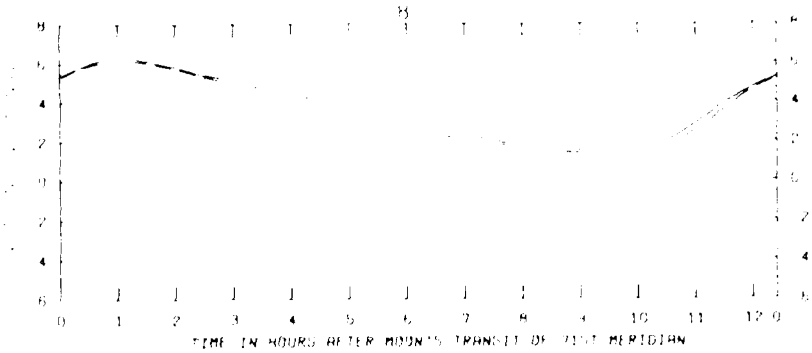
HOUR 12

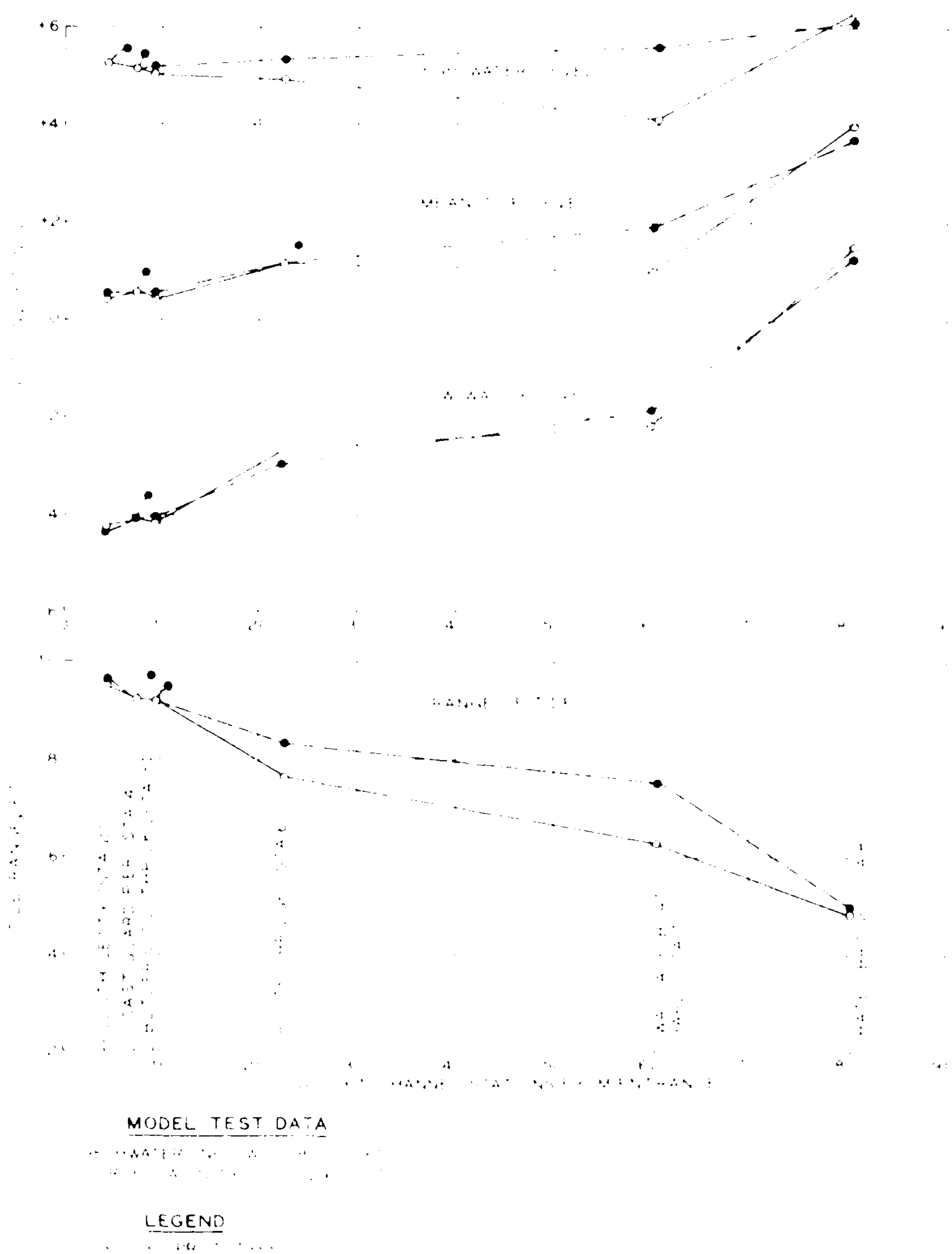
SURFACE CURRENT PATTERNS
PLAN 8E
HOURS 11 AND 12

PHOTO 57

SURFACE CURRENT PATTERNS
PLAN BE

PHOTO 56

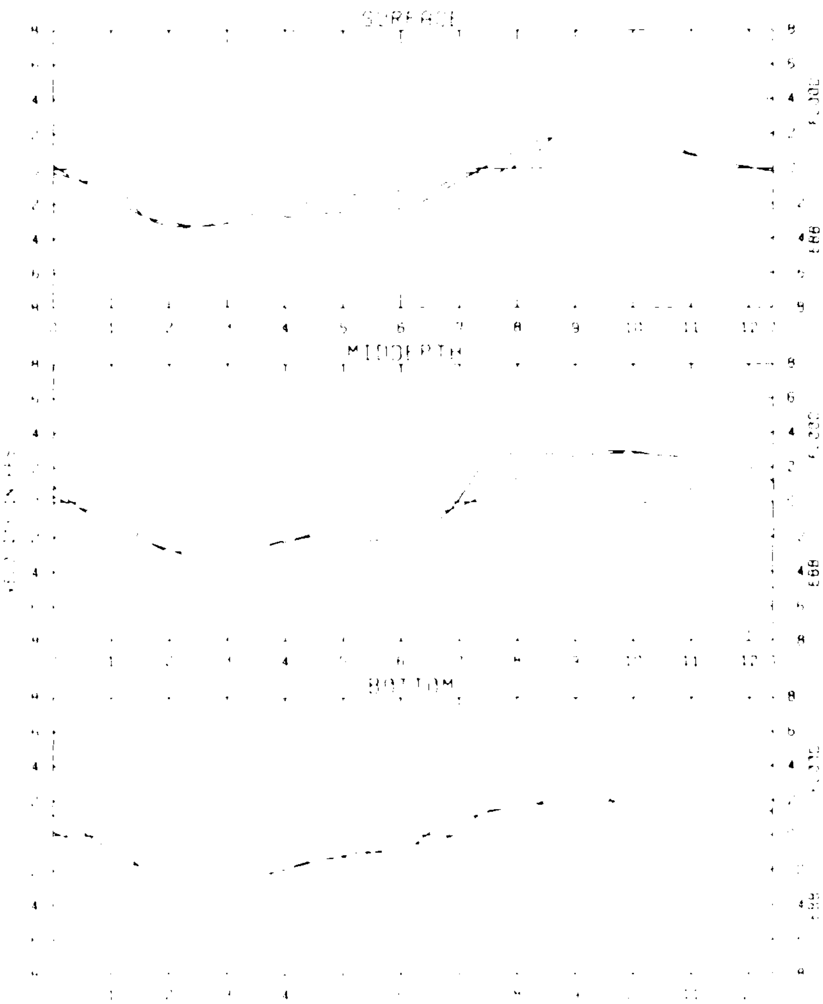

TIME IN HOURS AFTER MOON'S TRANSIT OF



TIDAL OBSERVATIONS

22 MAY 1974

PLATE 9



SURFACE
MIDDEPTH
BOTTOM

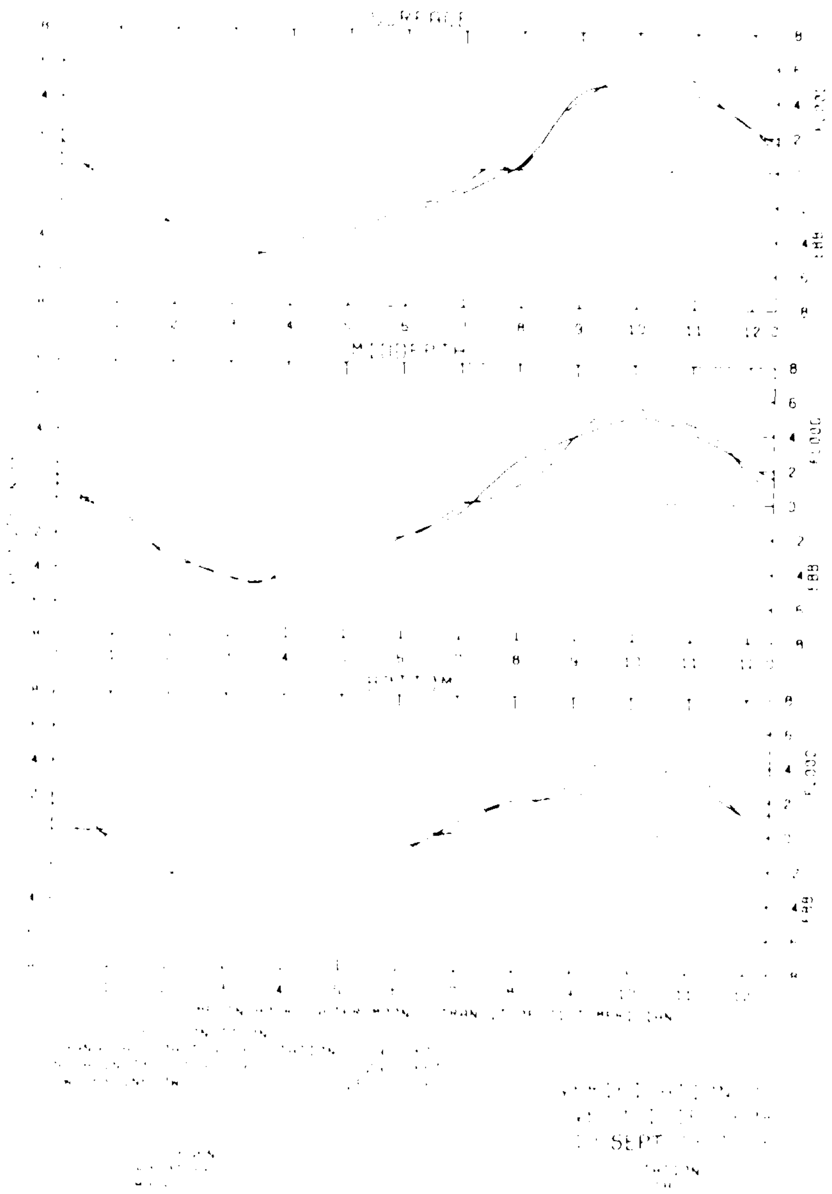
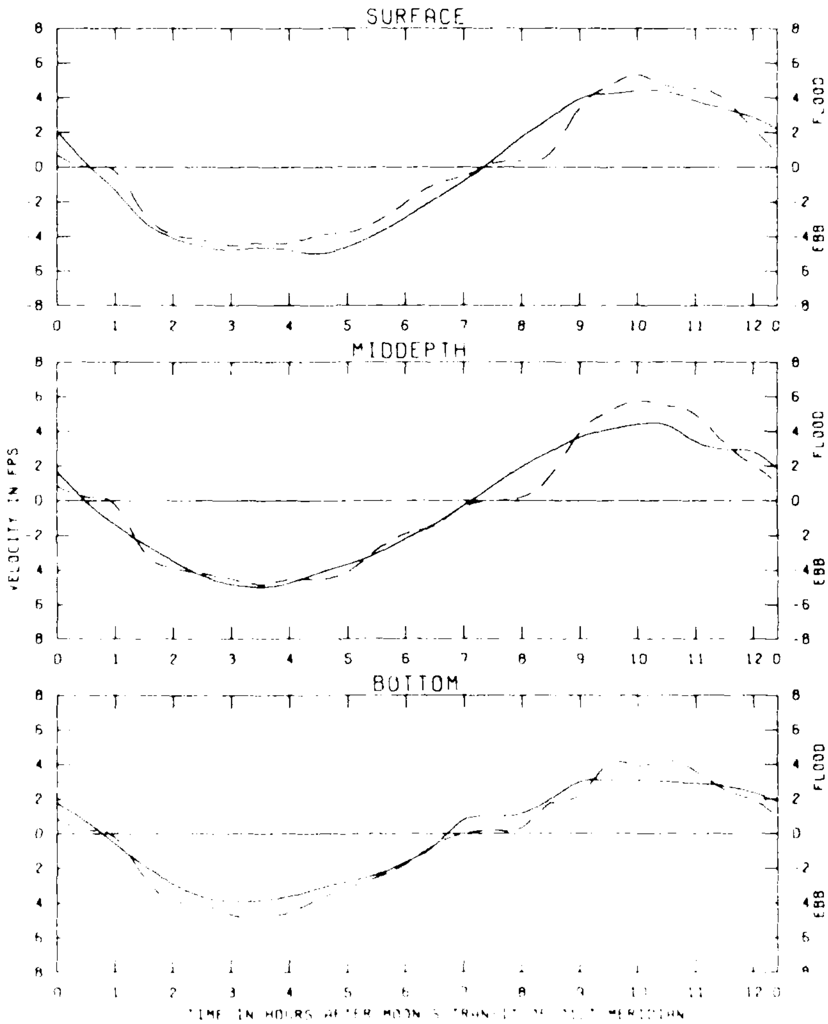


PLATE 11

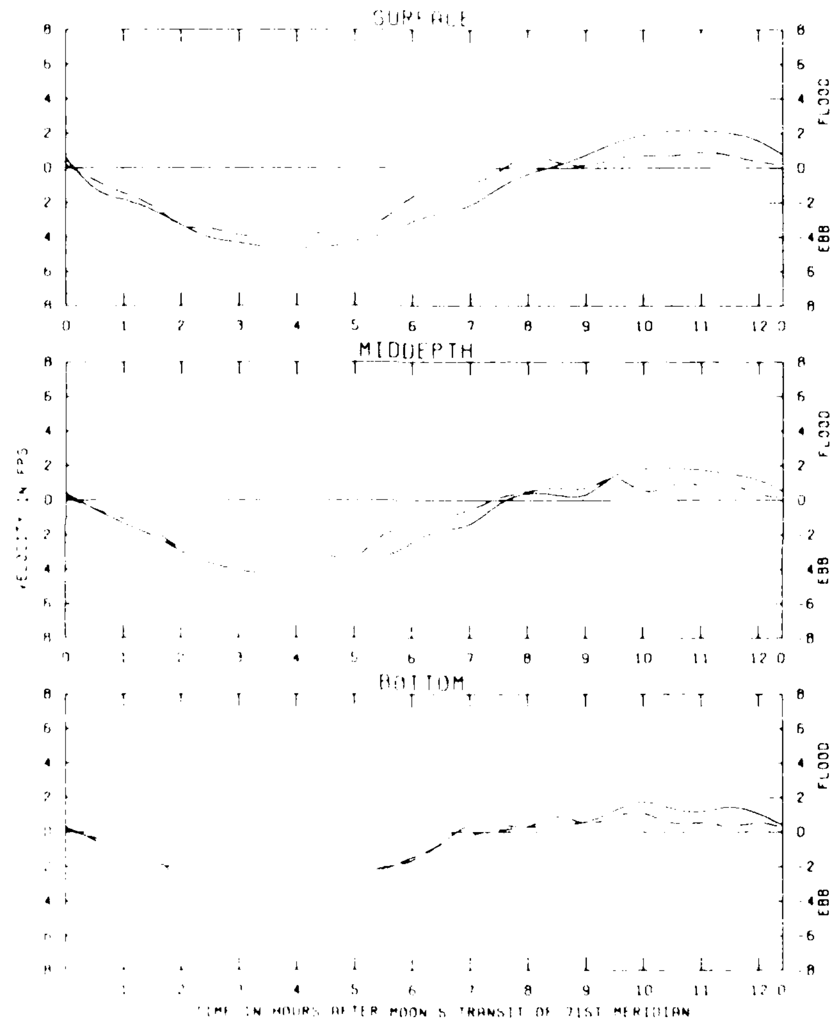


TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION
MEAN SALINITY TOTAL SALT 23 PPT
FRESHWATER INFLOW

LEGEND
PROTOTYPE
MODEL

SEPT

PLATE 12



TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION 9.0 FT
MEAN SALINITY, TOTAL SALT 29.0 PPT
FRESHWATER INFLOW 2500 CFS

LEGEND
PROTOTYPE
MODEL

VERIFICATION OF
VELOCITIES FOR
13 SEPT 73 TIDE

STATION
20

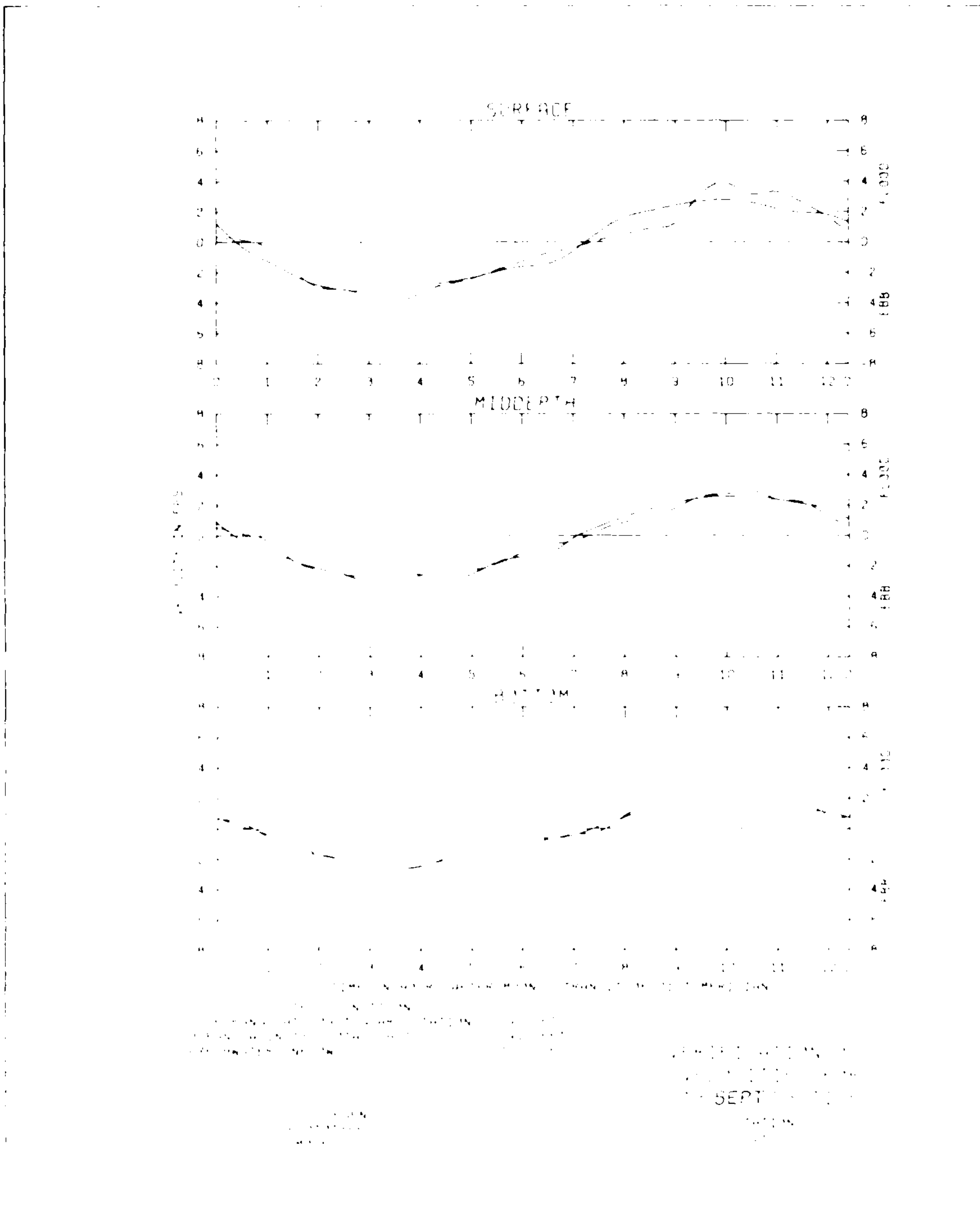
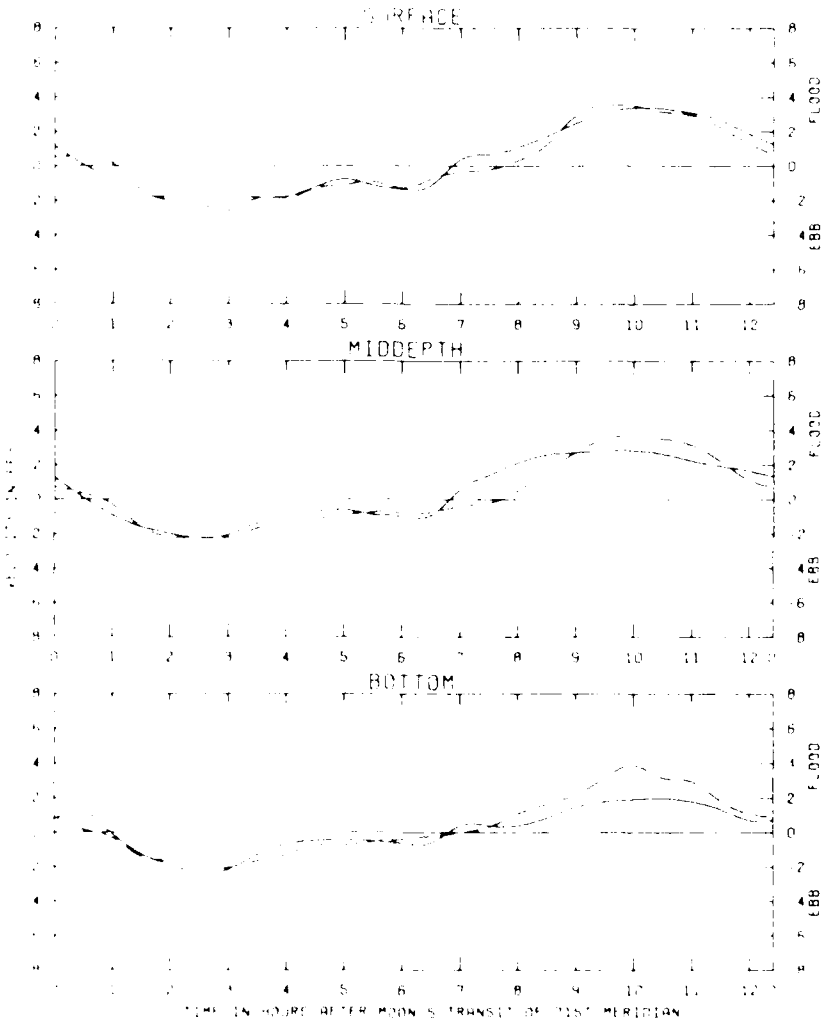


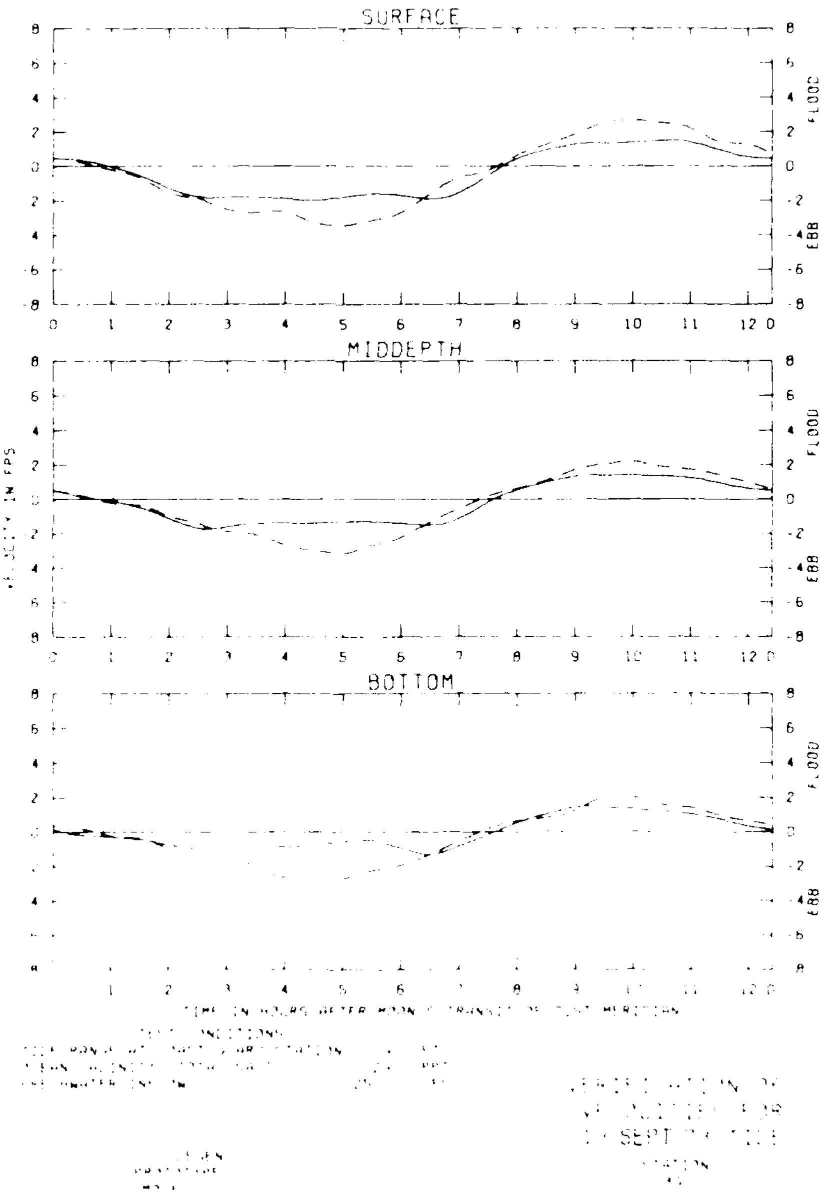
PLATE 14



VERIFICATION OF
VELOCITIES FOR
13 SEPT 73 TIDE

STATION
2F

PLATE 15



SURFACE
MIDDEPTH
BOTTOM
FLOOD
EBB
VELOCITY IN FPS
TIME IN HOURS AFTER MOON'S TRANSIT OF ... MERIDIAN
SEPT

PLATE 16

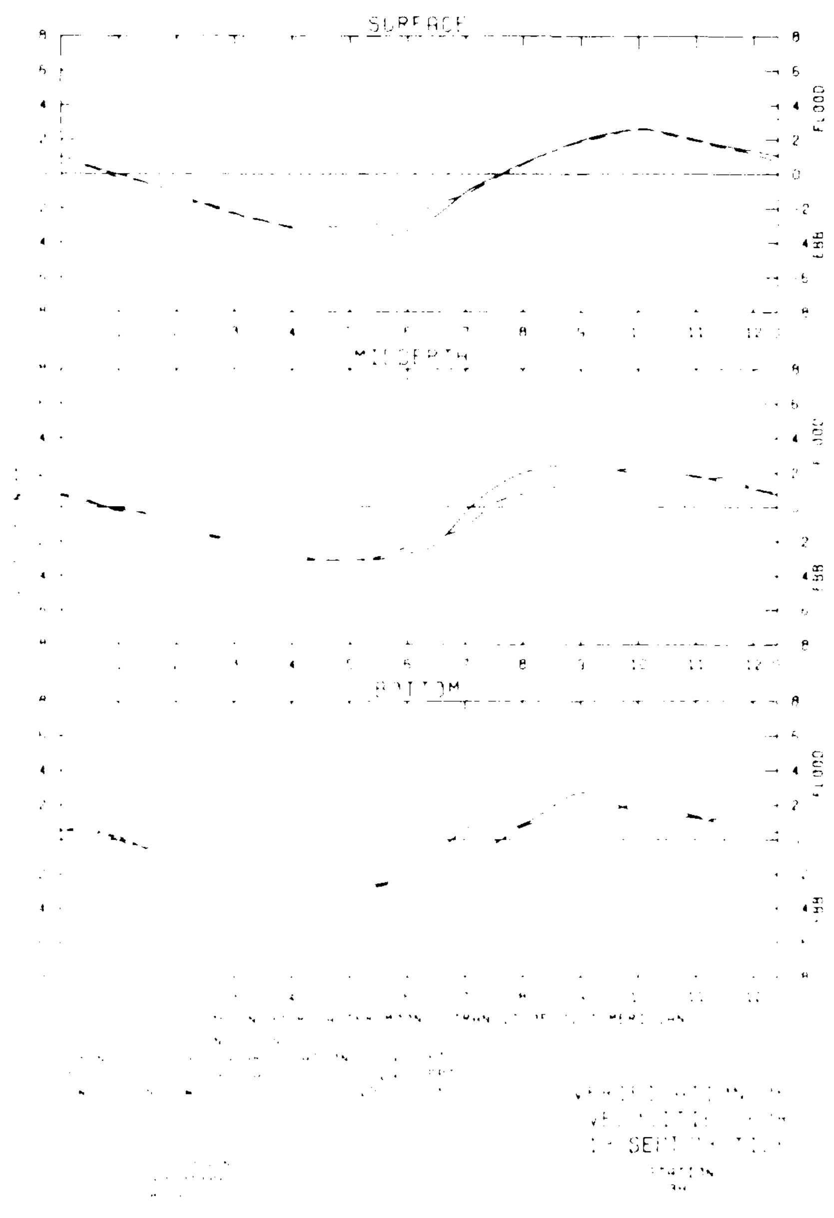
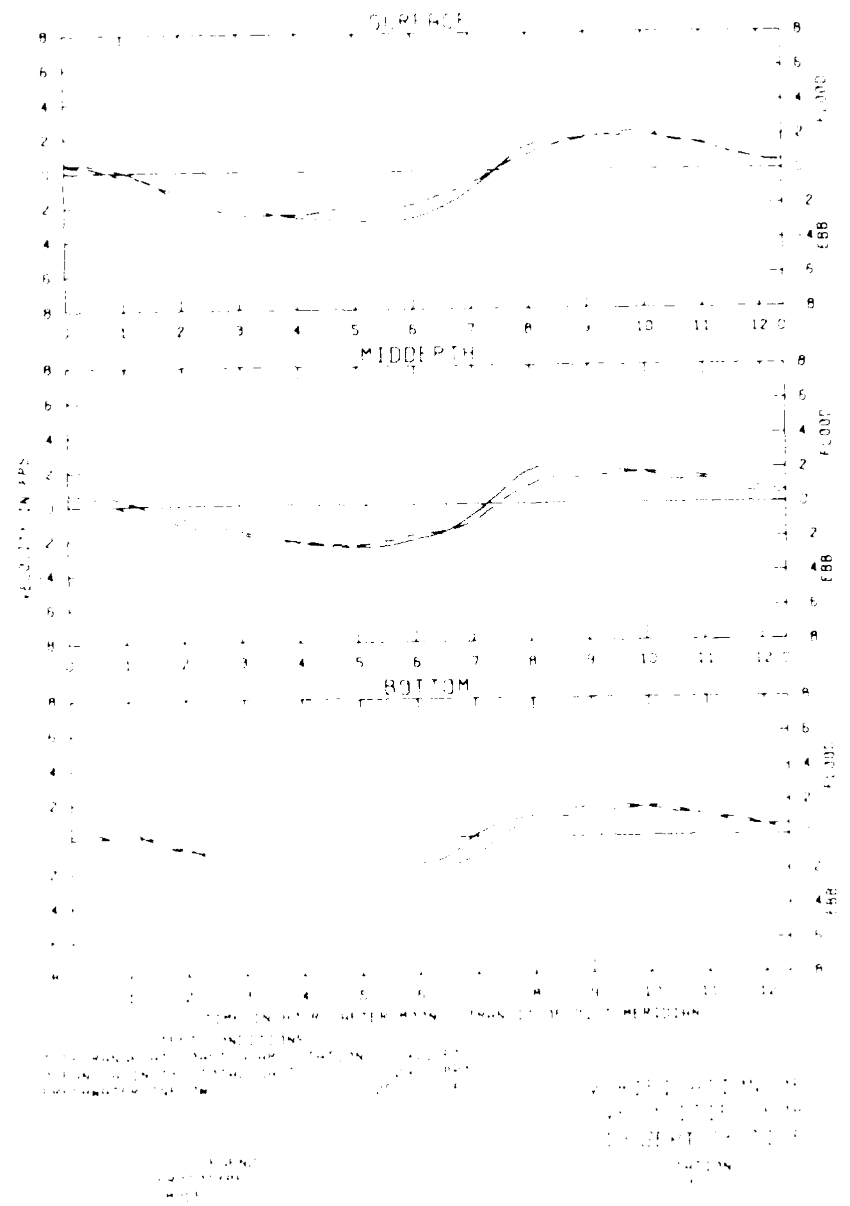


PLATE 17



SURFACE
MIDDEPTH
BOTTOM
EBB

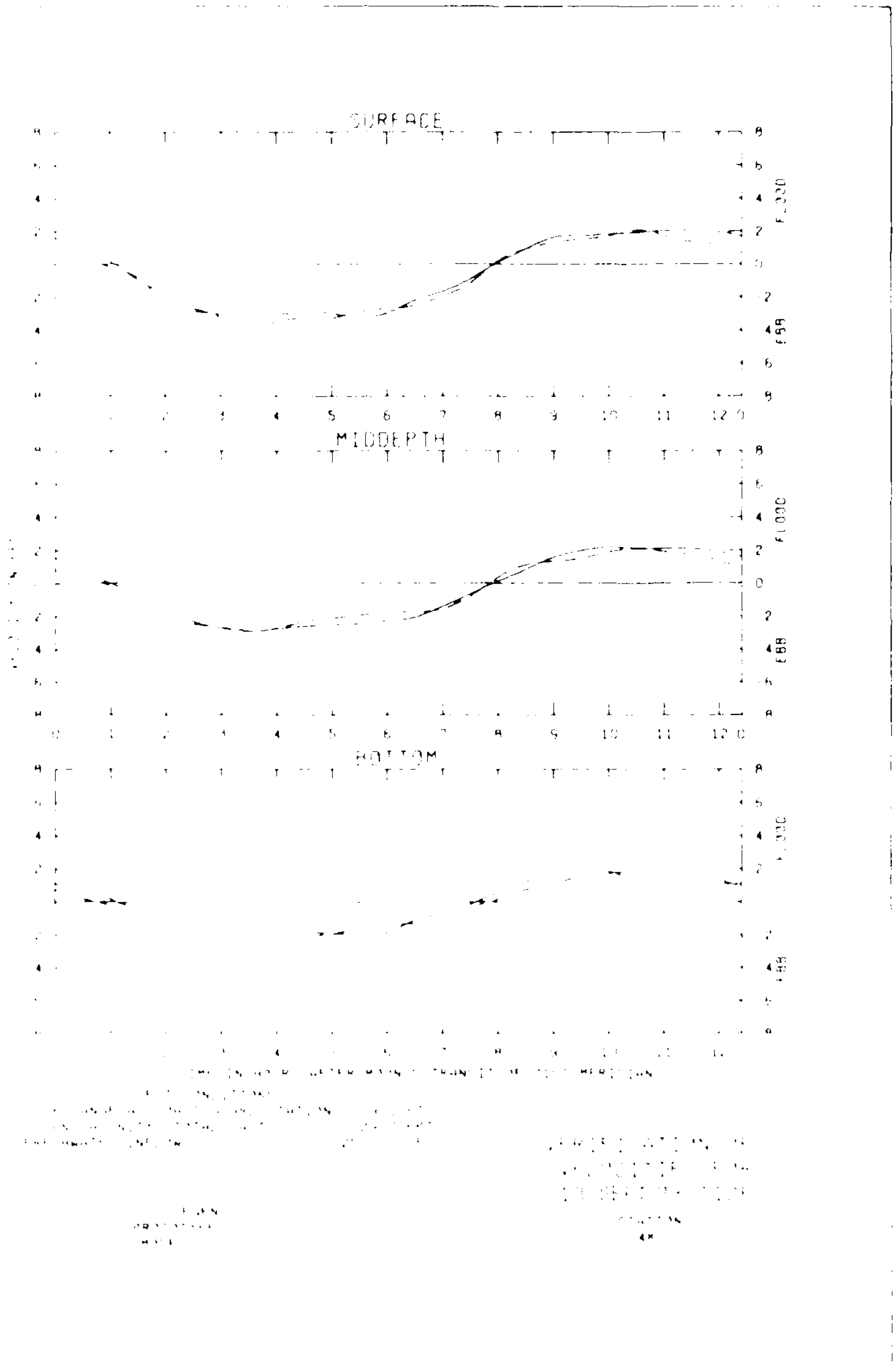
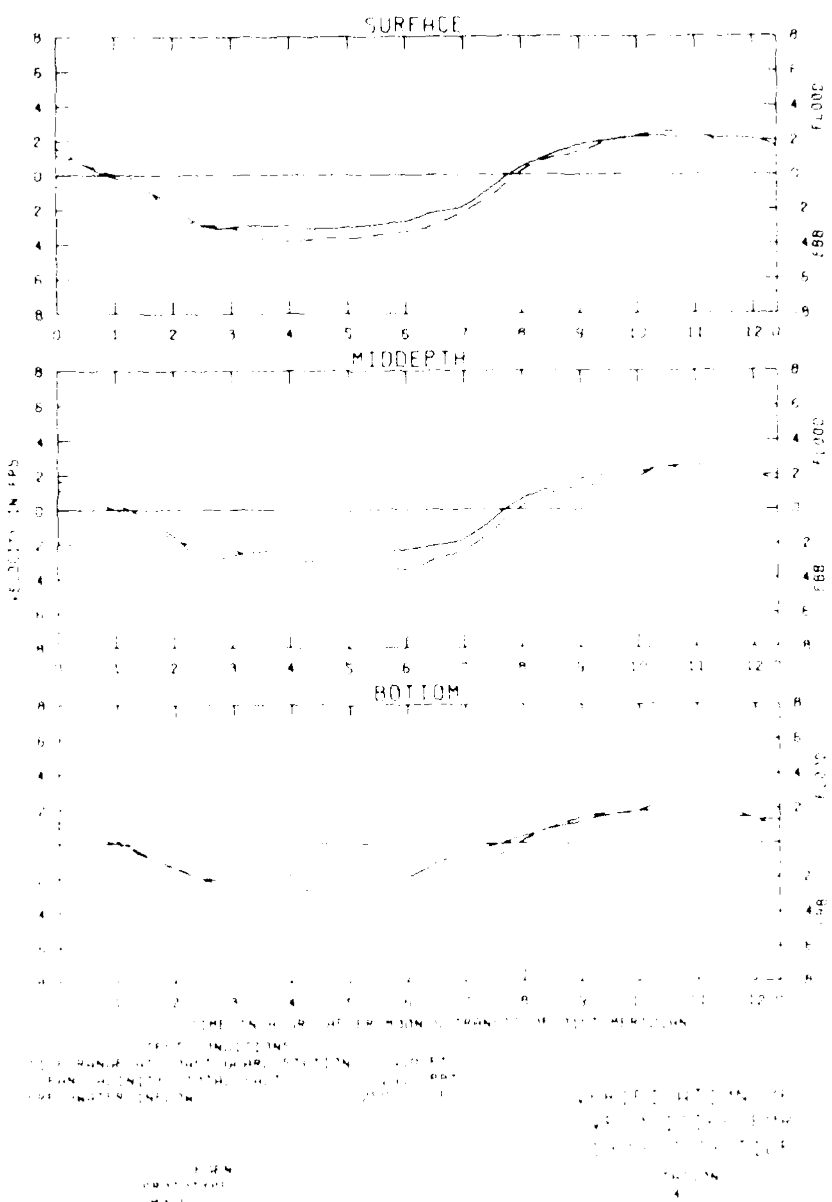
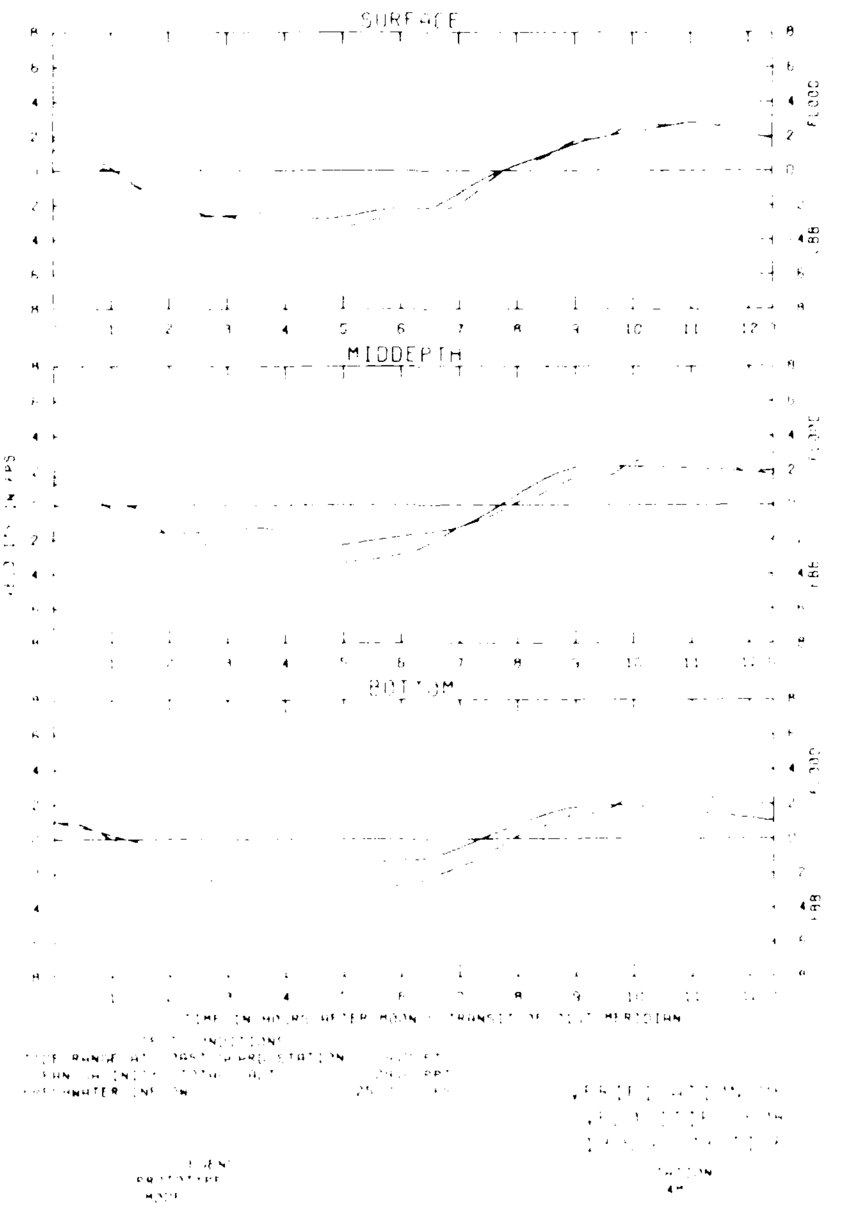


PLATE 19



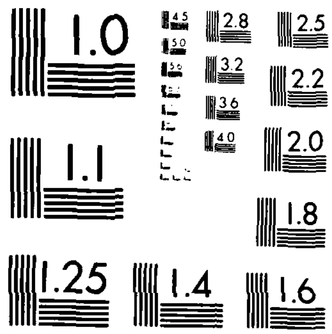
SURFACE
MIDDEPTH
BOTTOM
FLOOD
EBB



SURFACE
MIDDEPTH
BOTTOM
FLOOD
EBB
TIME IN HOURS AFTER MOON'S TRANSIT OF 75TH MERIDIAN

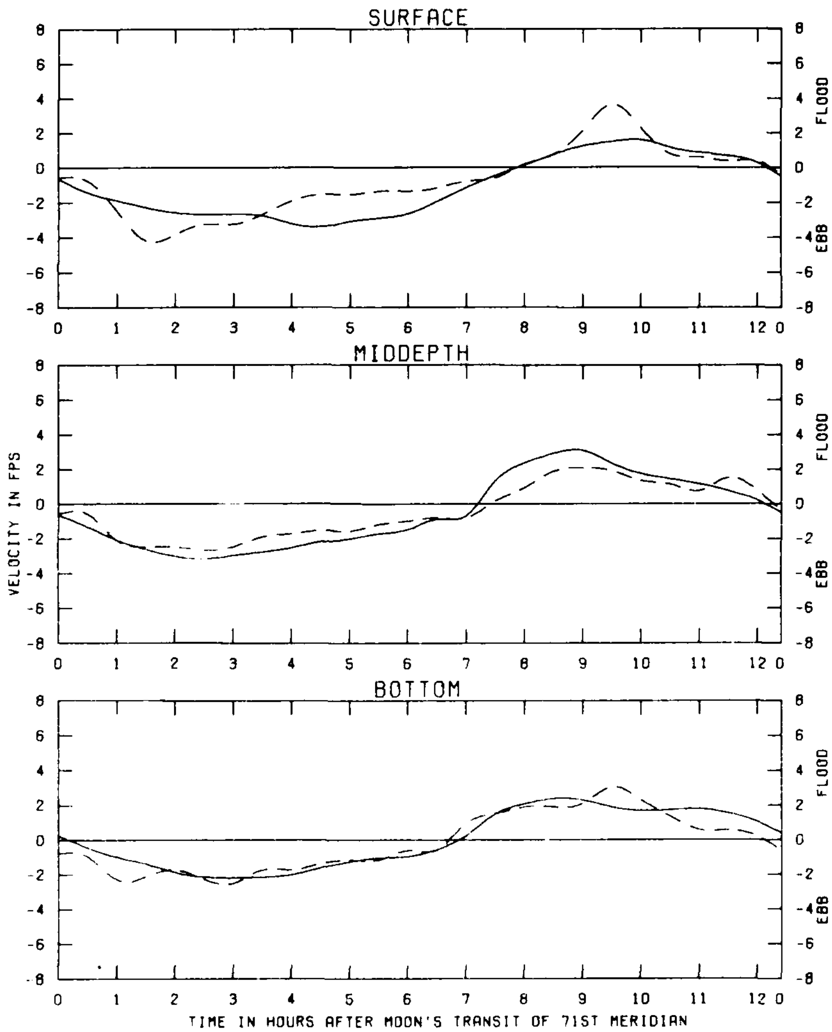
PLATE 31

AD-A157 046 NEWBURYPORT HARBOR MASSACHUSETTS; REPORT 2 DESIGN FOR 3/6
HYDRODYNAMICS SALIN..(U) ARMY ENGINEER WATERWAYS
EXPERIMENT STATION VICKSBURG MS HYDRA..
UNCLASSIFIED N J BROGDON ET AL. MAR 85 WES/TR/HL-79-1-2 F/G 8/10 NL



MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS



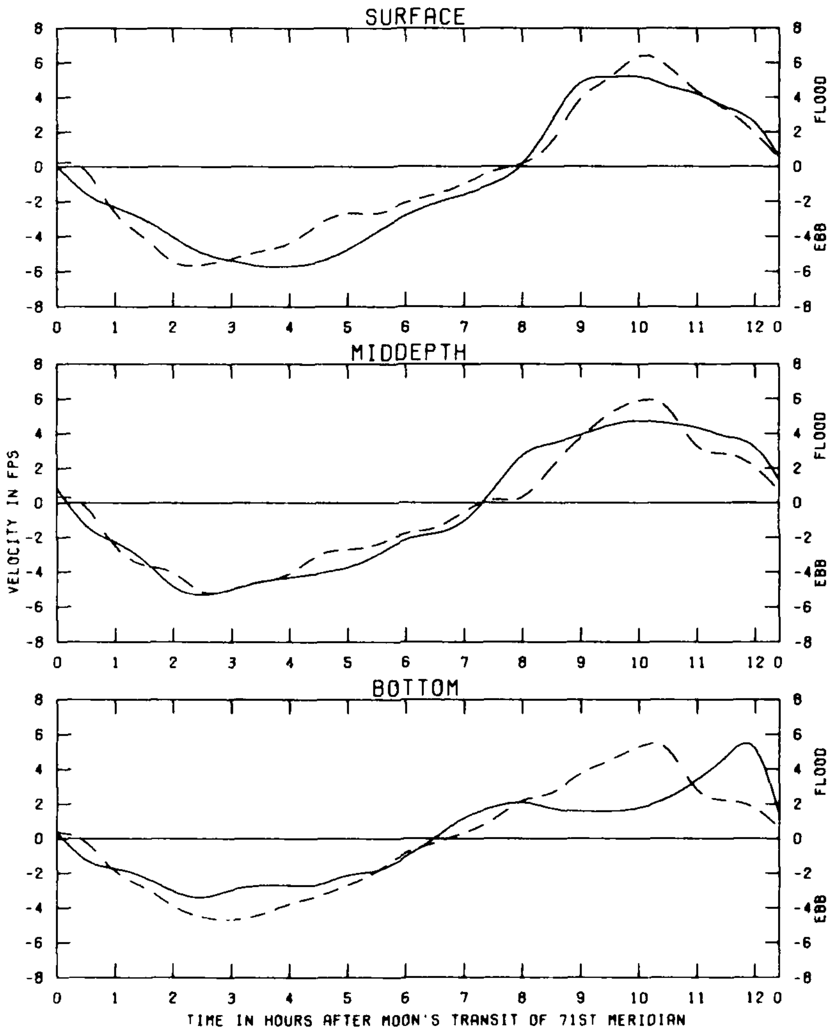
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION	9.2 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	8200 CFS

VERIFICATION OF VELOCITIES FOR 22 MAY 74 TIDE

STATION 1A

LEGEND
PROTOTYPE ———
MODEL — — —



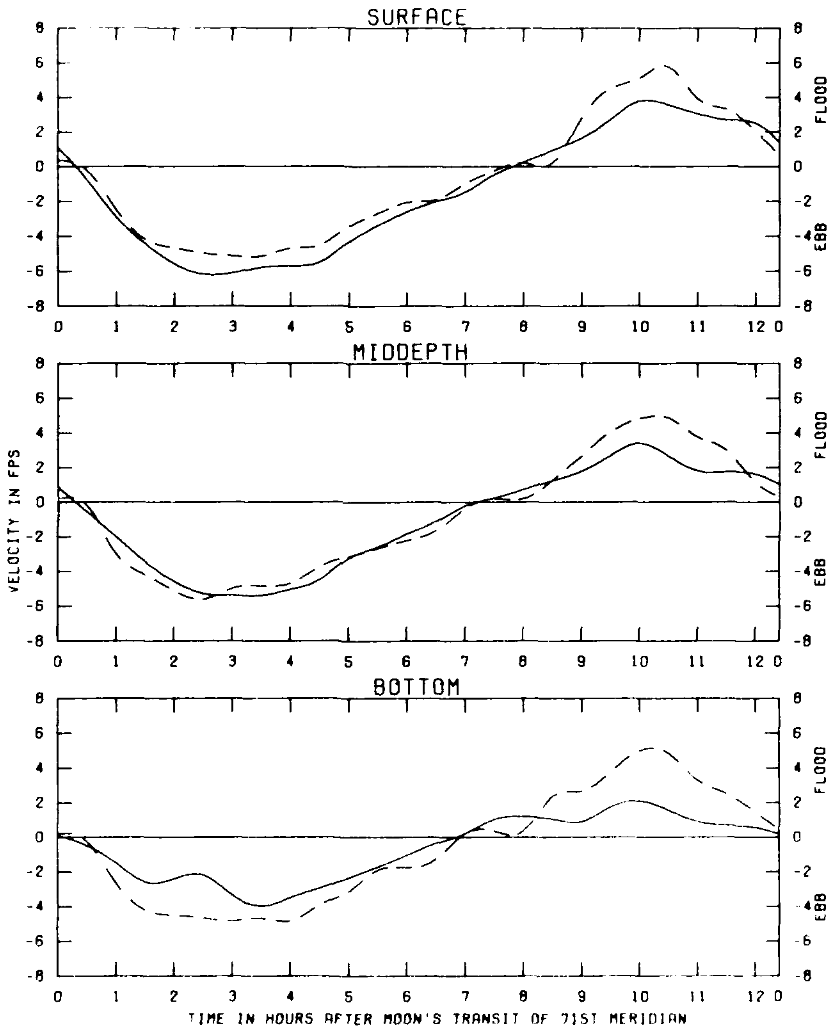
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION 9.2 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 8200 CFS

LEGEND
PROTOTYPE ———
MODEL — — —

VERIFICATION OF VELOCITIES FOR 22 MAY 74 TIDE

STATION 1B



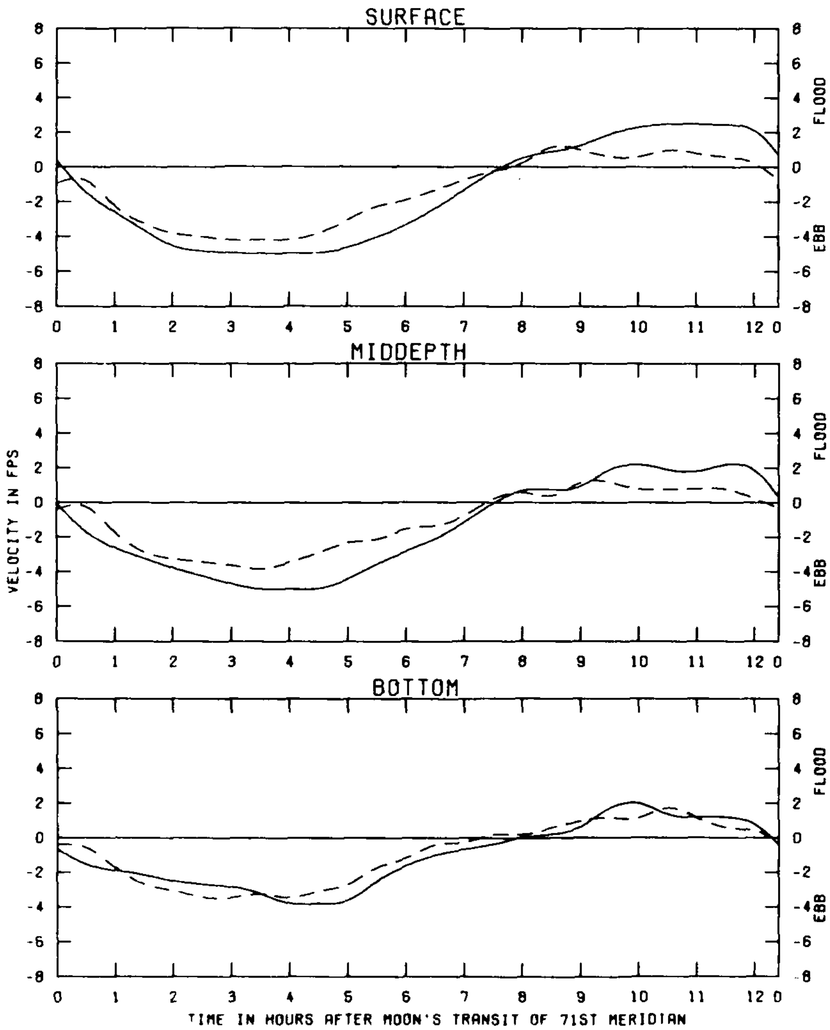
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION 9.2 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 8200 CFS

VERIFICATION OF VELOCITIES FOR 22 MAY 74 TIDE

STATION 10

LEGEND
PROTOTYPE ———
MODEL — — —

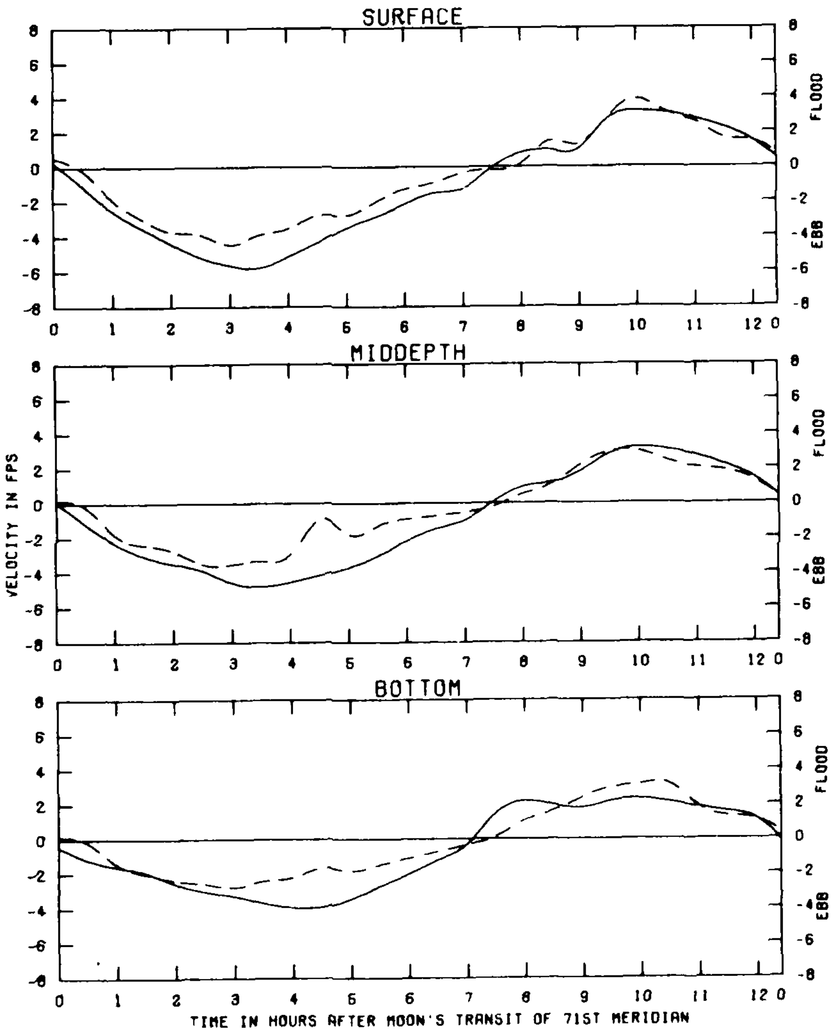


TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION 9.2 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 8200 CFS

LEGEND
PROTOTYPE ———
MODEL — — —

VERIFICATION OF
VELOCITIES FOR
22 MAY 74 TIDE

STATION
20

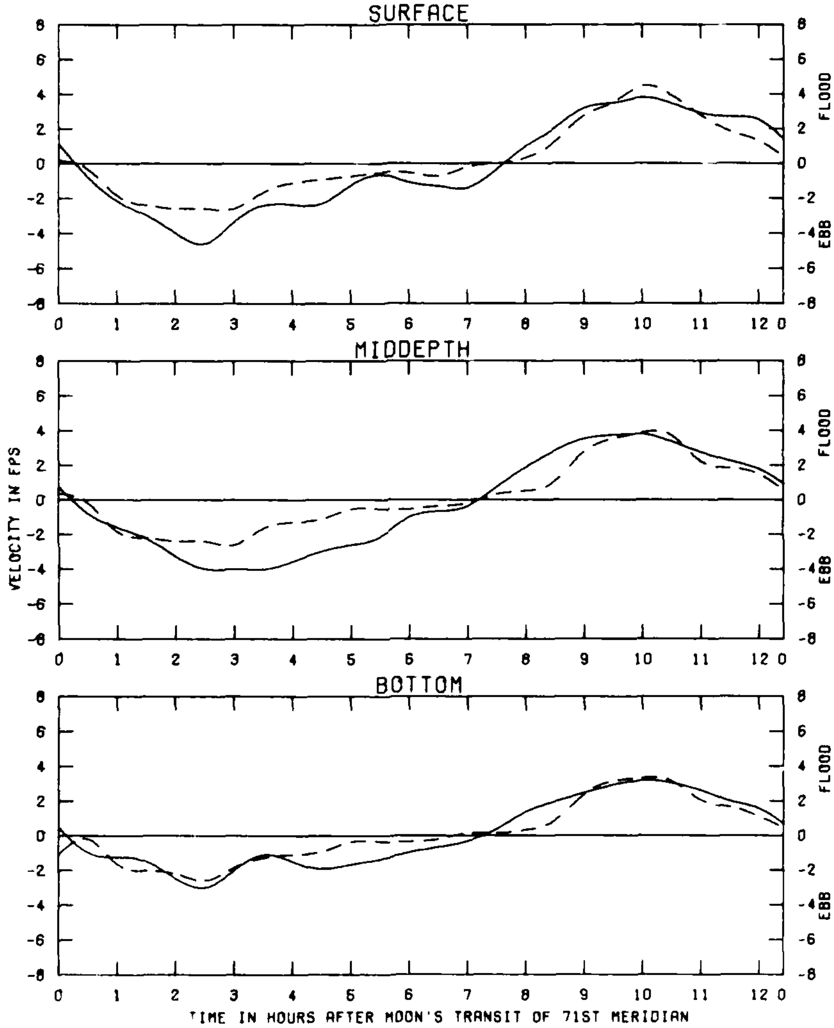


TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION 9.2 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 8200 CFS

LEGEND
PROTOTYPE ———
MODEL – – –

VERIFICATION OF
VELOCITIES FOR
22 MAY 74 TIDE

STATION
2E



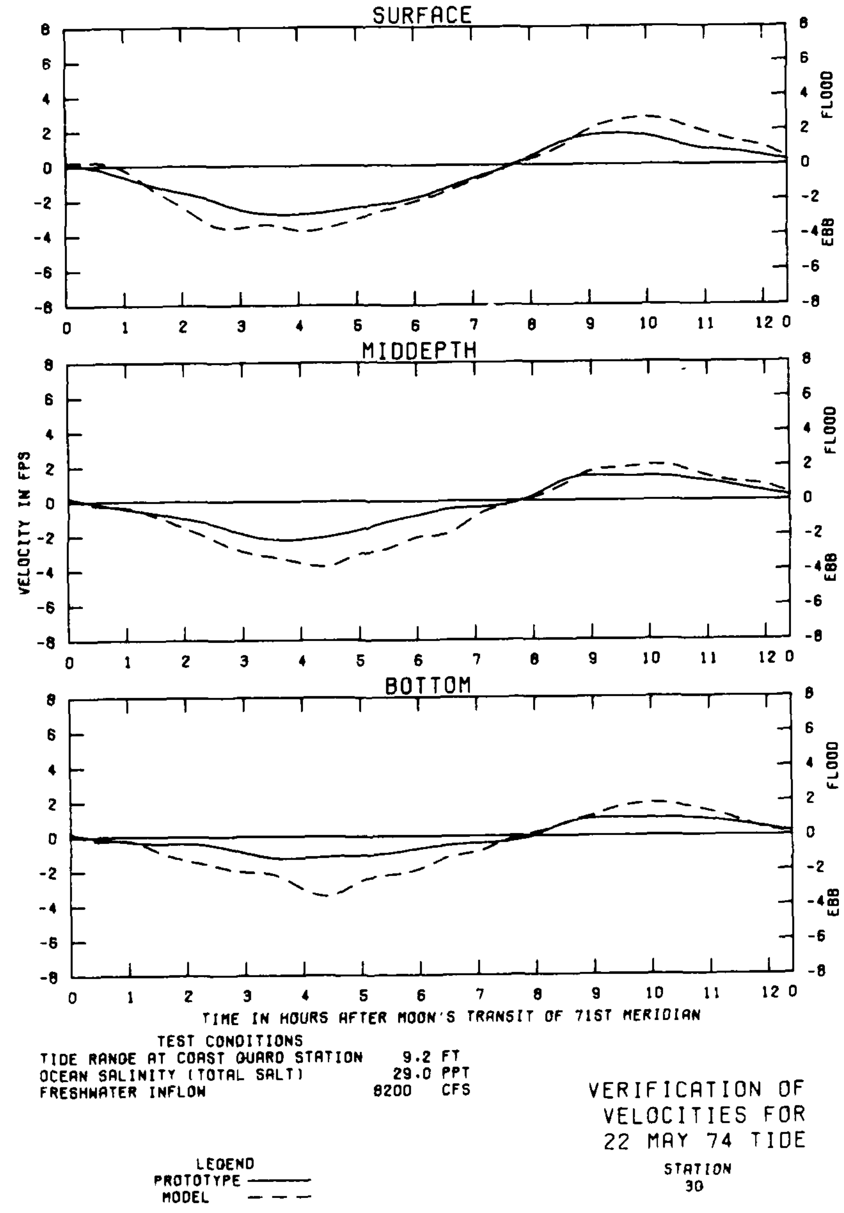
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION	9.2	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	8200	CFS

LEGEND
PROTOTYPE ———
MODEL — — —

VERIFICATION OF
VELOCITIES FOR
22 MAY 74 TIDE

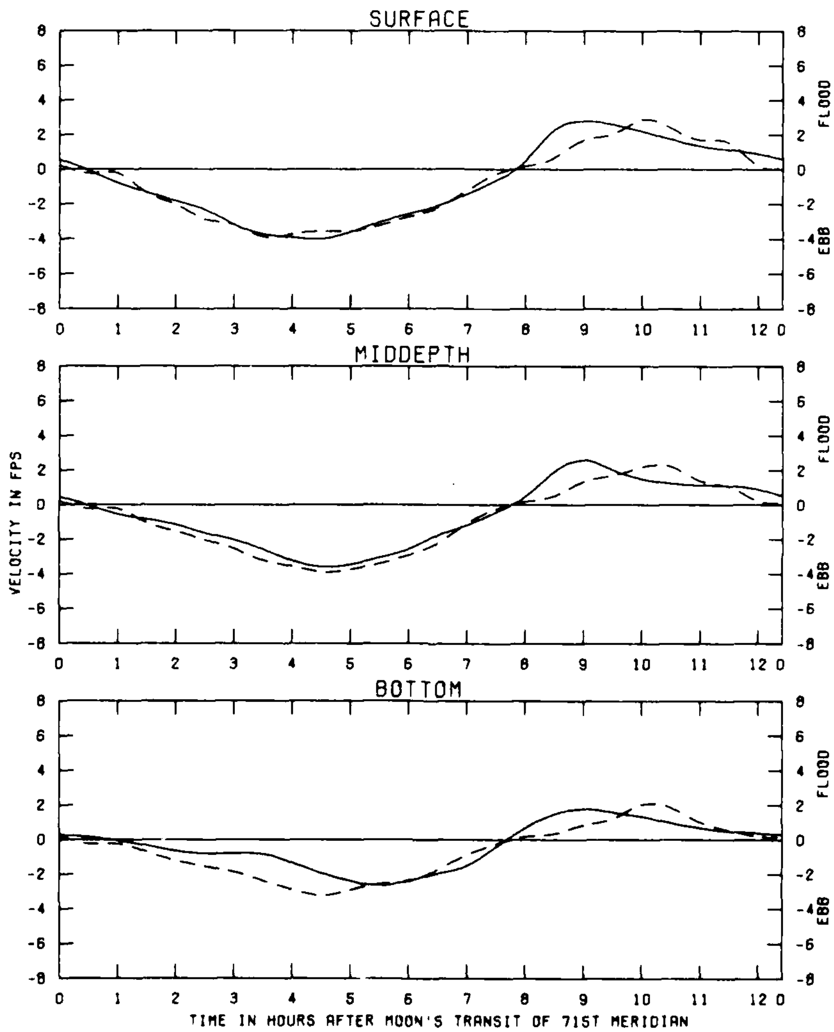
STATION
2F



VERIFICATION OF
VELOCITIES FOR
22 MAY 74 TIDE

STATION
30

PLATE 28



TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION	9.2	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	8200	CFS

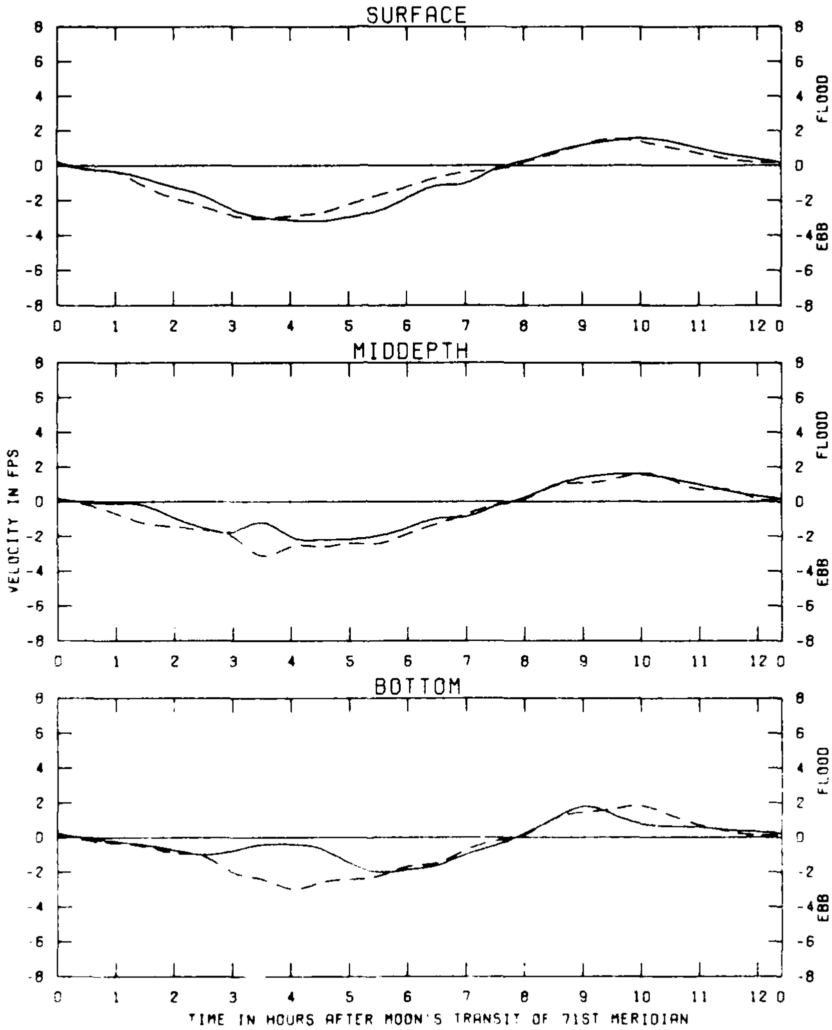
LEGEND

PROTOTYPE ———

MODEL – – –

VERIFICATION OF
VELOCITIES FOR
22 MAY 74 TIDE

STATION
3H

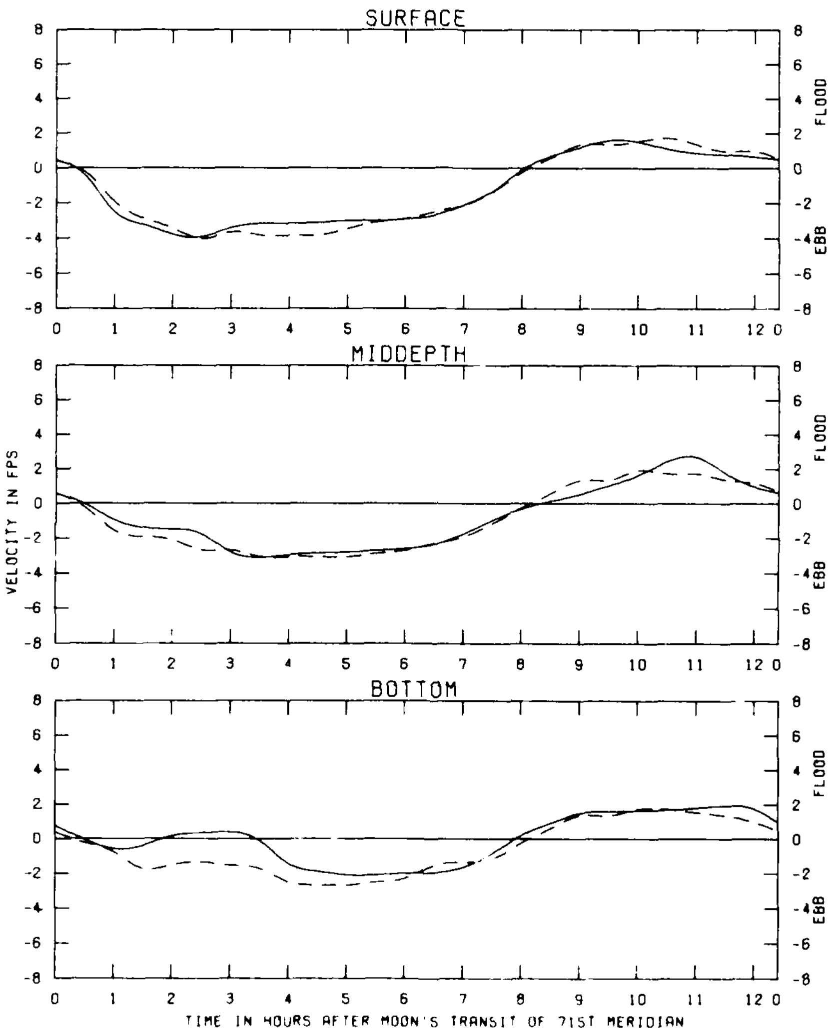


TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION 9.2 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 8200 CFS

LEGEND
PROTOTYPE ————
MODEL — — — —

VERIFICATION OF
VELOCITIES FOR
22 MAY 74 TIDE

STATION
3J

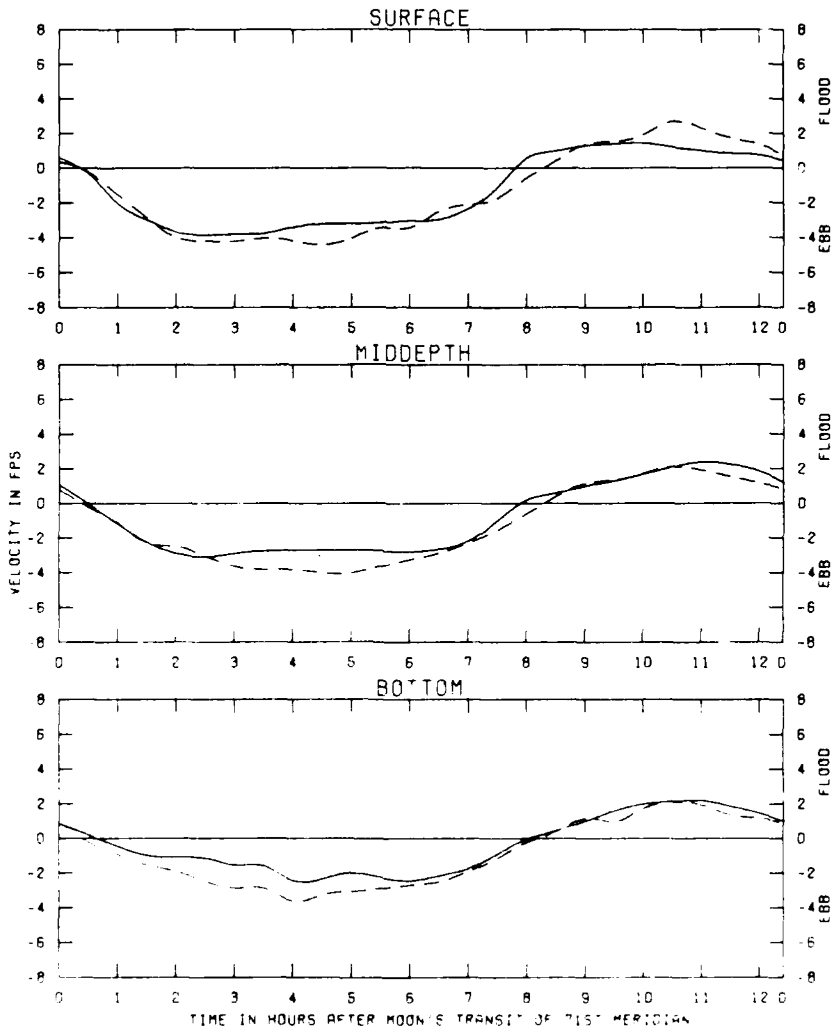


TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION 9.2 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 8200 CFS

LEGEND
PROTOTYPE
MODEL

VERIFICATION OF VELOCITIES FOR 22 MAY 74 TIDE

STATION 4K



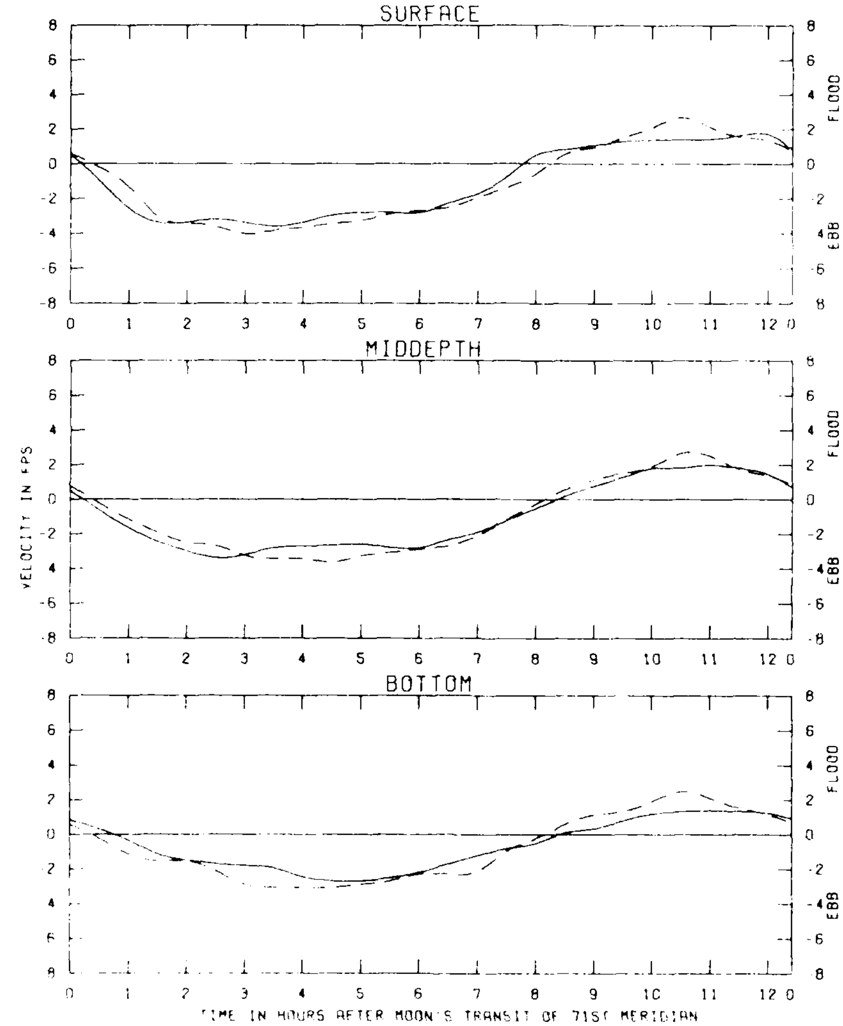
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION	9.2 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	8200 CFS

LEGEND
PROTOTYPE ———
MODEL — — —

VERIFICATION OF VELOCITIES FOR 22 MAY 74 TIDE

STATION 4

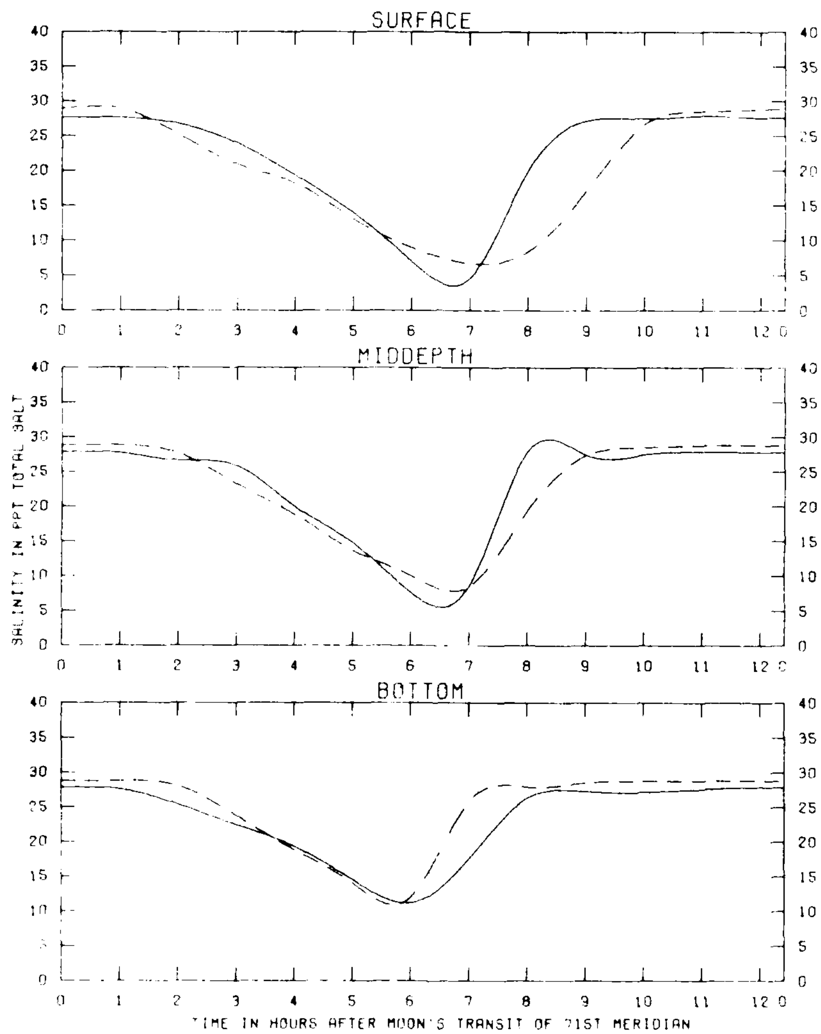


TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION 9.2 FT
MEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 8200 CFS

LEGEND
PROTOTYPE
MODEL

VERIFICATION OF
VELOCITIES FOR
22 MAY 74 TIDE

STATION
4M



TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION	9.2	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	8200	CFS

LEGEND
PROTOTYPE —
MODEL — —

VERIFICATION OF
SALINITIES FOR
22 MAY 74 TIDE

STATION
18

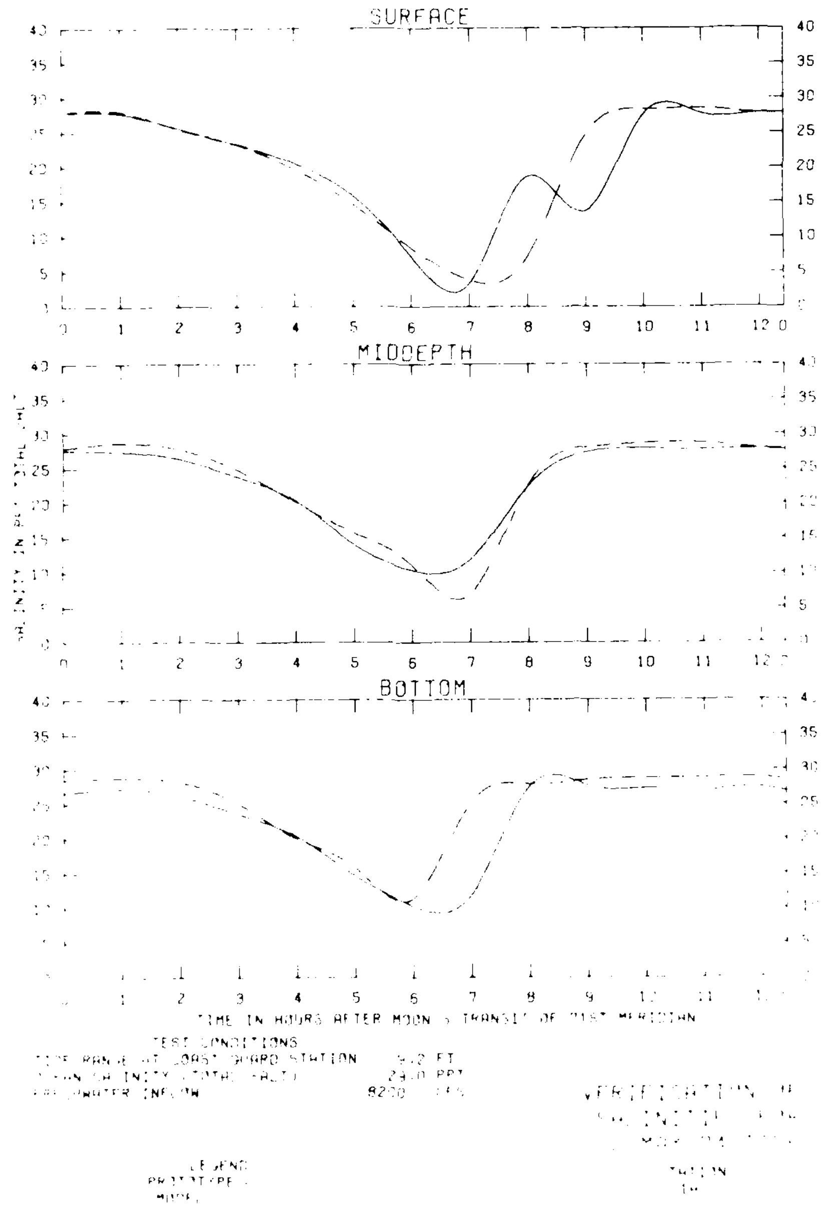
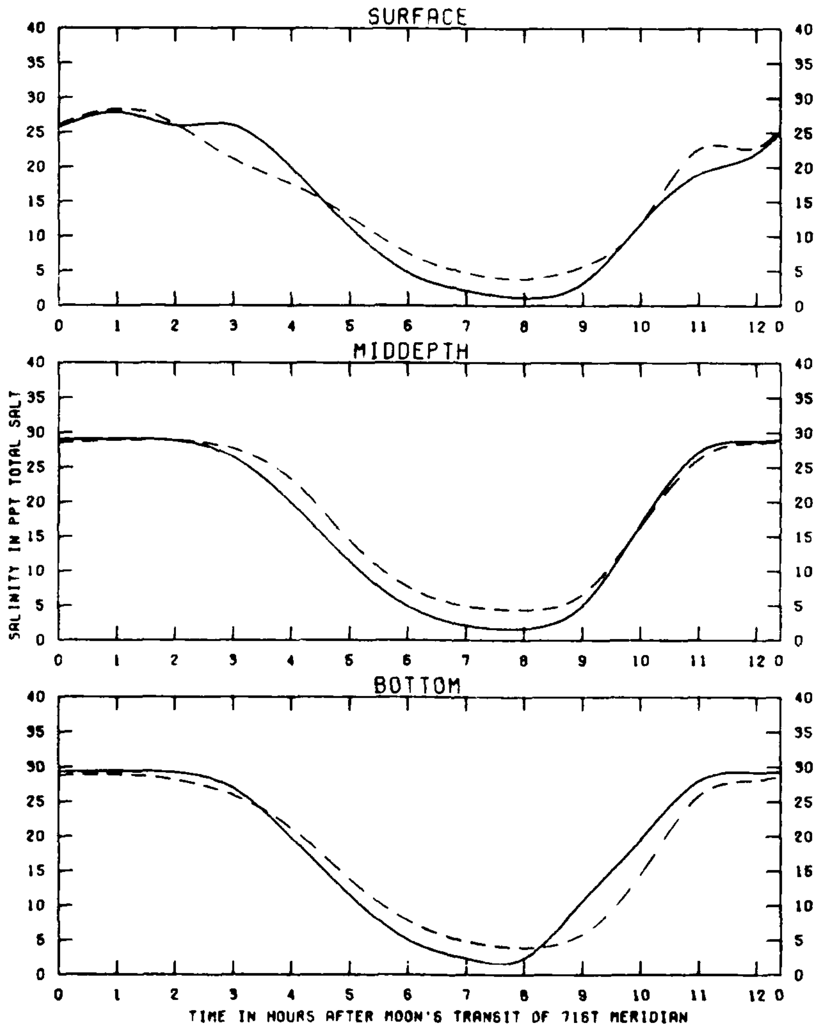


PLATE 46

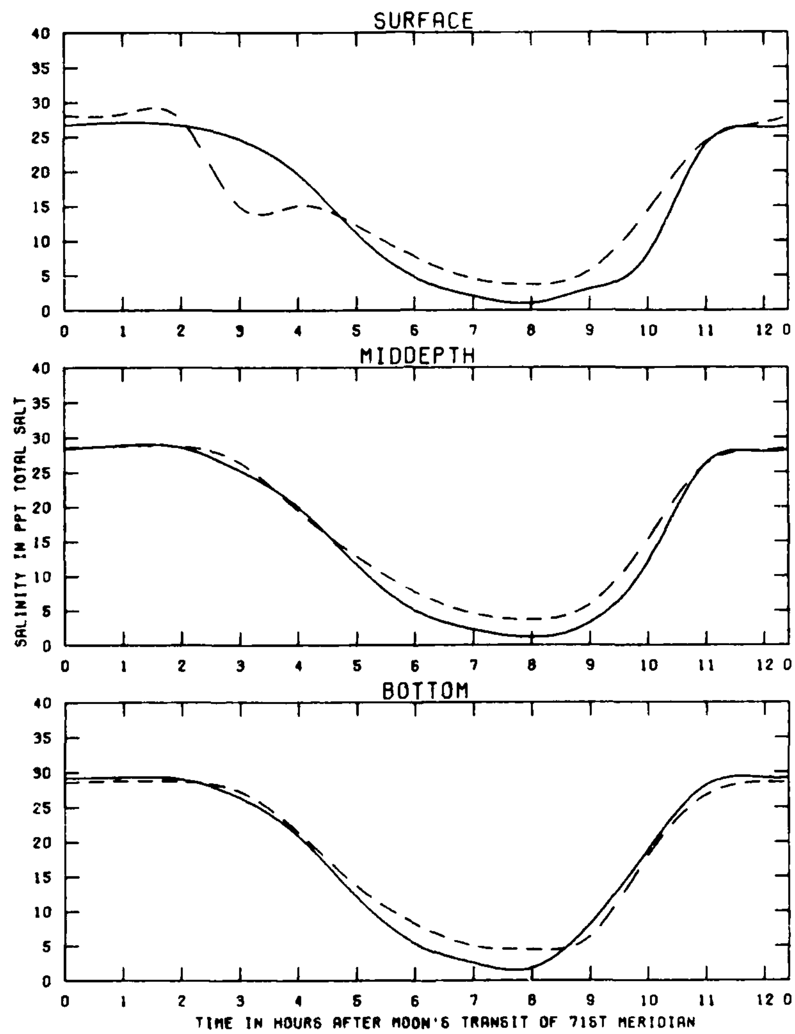


TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION 9.0 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 2500 CFS

LEGEND
PROTOTYPE ———
MODEL - - -

VERIFICATION OF
SALINITIES FOR
13 SEPT 73 TIDE

STATION
4M



TEST CONDITIONS

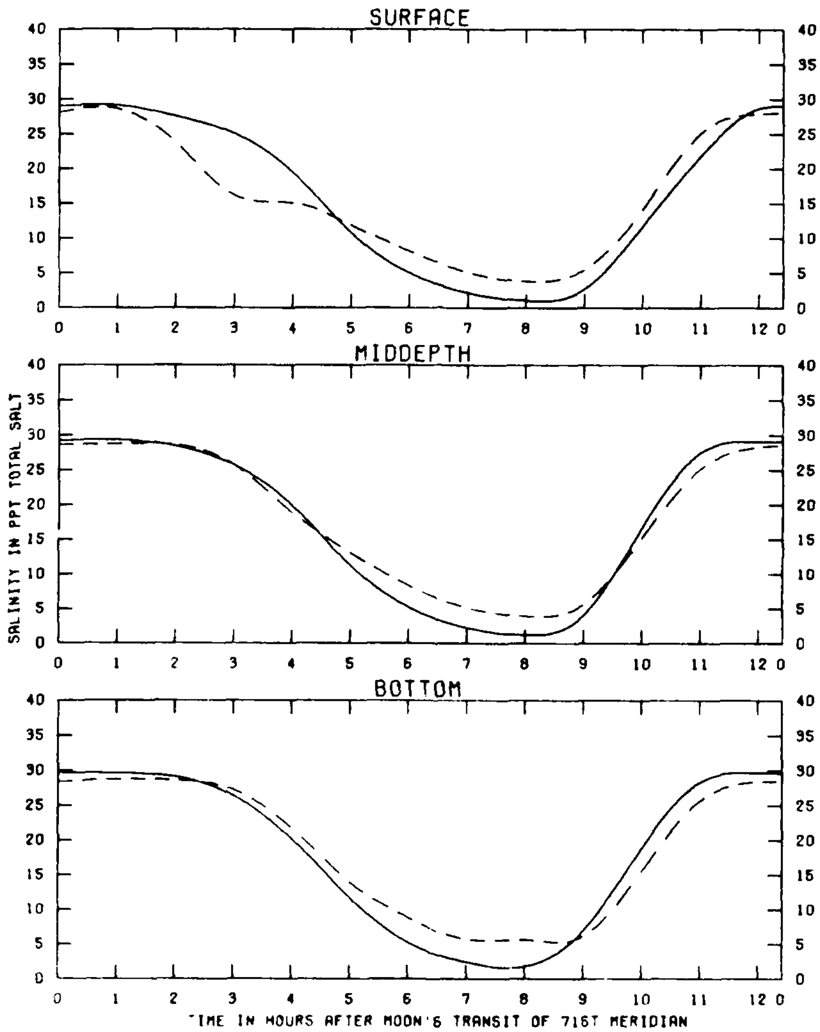
TIDE RANGE AT COAST GUARD STATION 9.0 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 2500 CFS

LEGEND
PROTOTYPE ———
MODEL – – –

VERIFICATION OF SALINITIES FOR 13 SEPT 73 TIDE

STATION 4L

PLATE 44



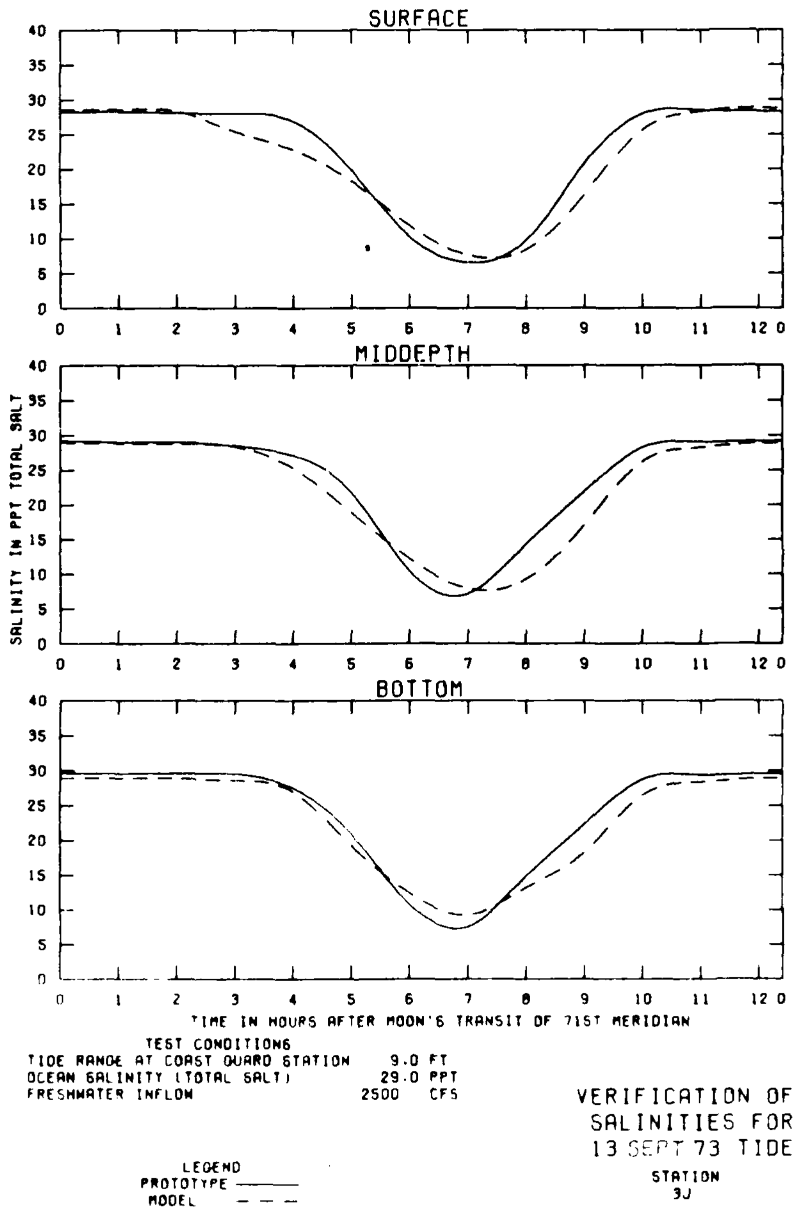
TEST CONDITIONS

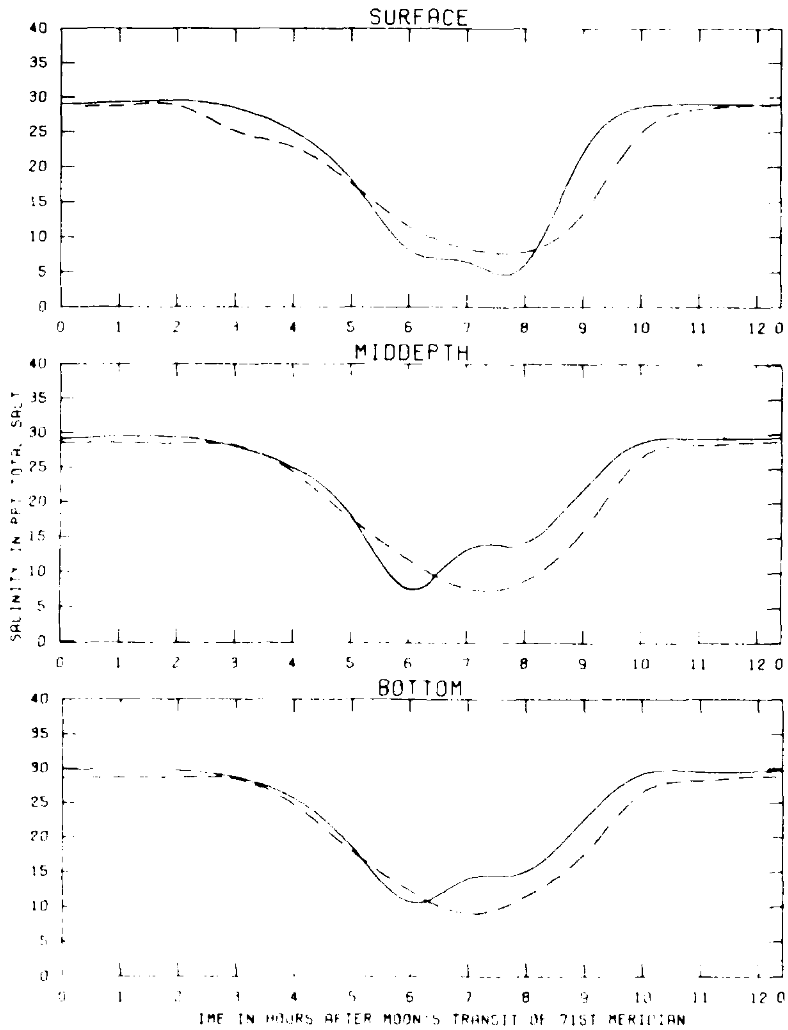
TIDE RANGE AT COAST GUARD STATION	9.0	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	2500	CFS

LEGEND
PROTOTYPE ————
MODEL — — —

VERIFICATION OF
SALINITIES FOR
13 SEPT 73 TIDE

STATION
4K


SURFACE
MIDDEPTH
BOTTOM
SALINITY IN PPT TOTAL SALT
TIME IN HOURS AFTER MOON'S TRANSIT OF 71ST MERIDIAN
TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION 9.0 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 2500 CFS
LEGEND
PROTOTYPE
MODEL
VERIFICATION OF
SALINITIES FOR
13 SEPT 73 TIDE
STATION
3J

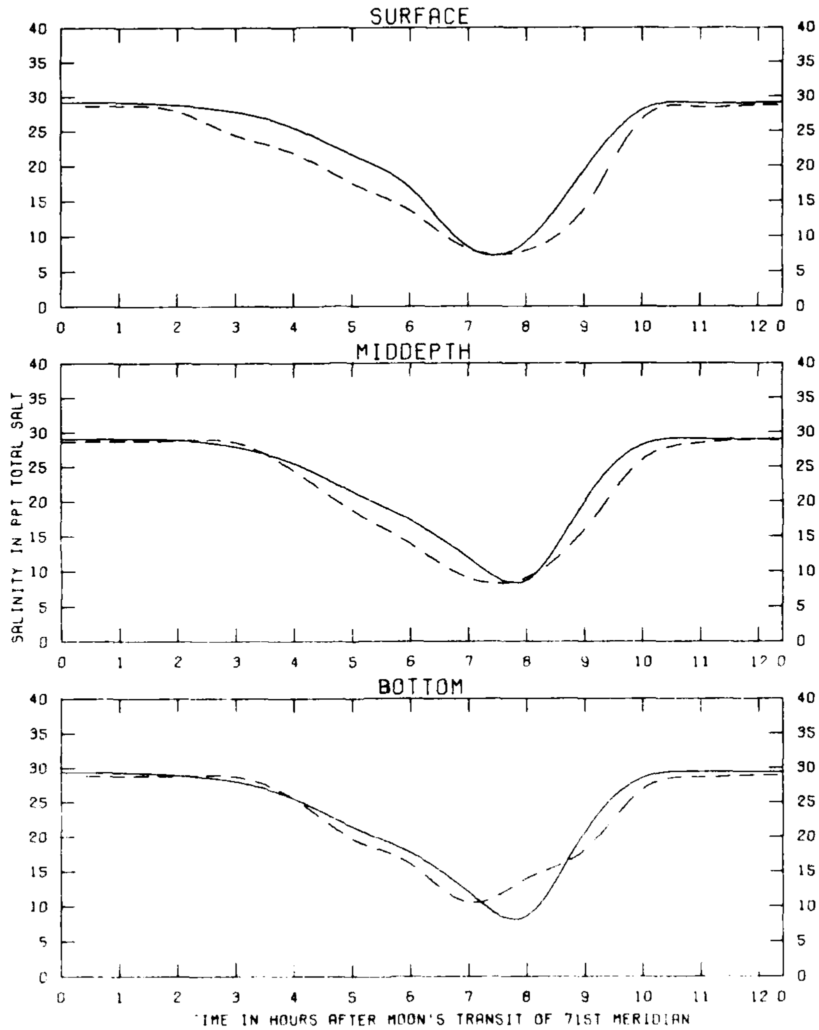


TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION 9.0 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW [illegible]500 CFS

VERIFICATION OF
SALINITIES FOR
13 SEPT 73 TIDE

LEGEND
PROTOTYPE
MODEL

STATION
3H



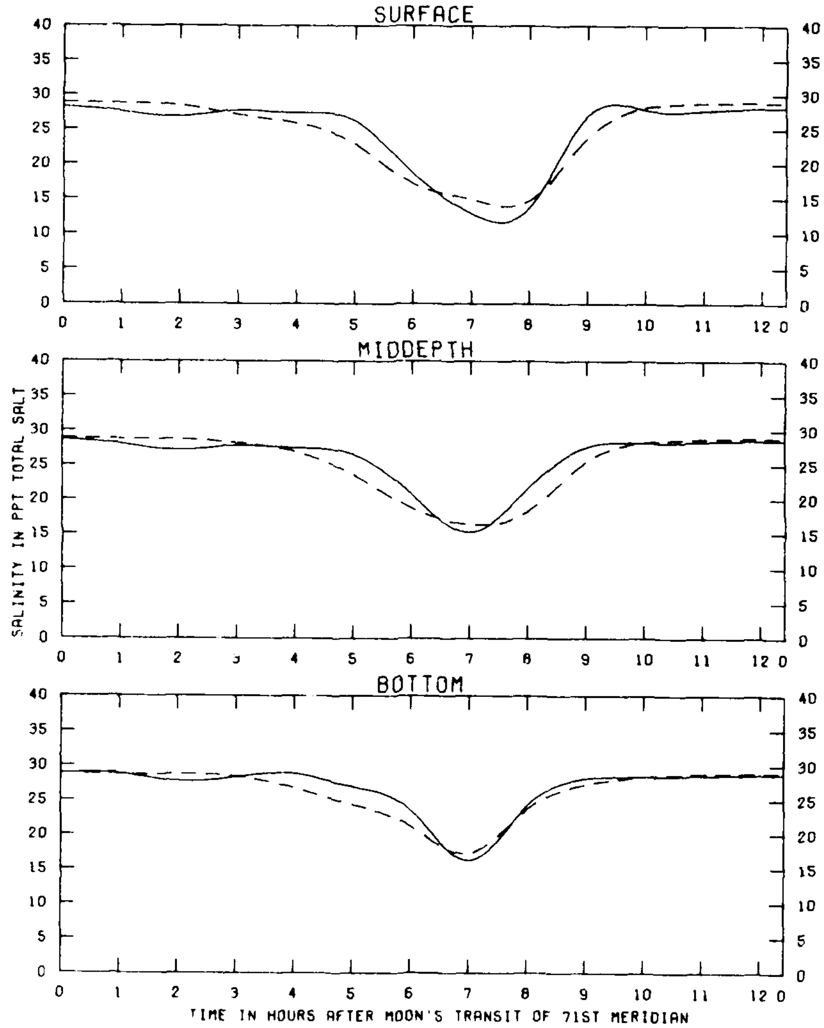
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION	9.0	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	2500	CFS

LEGEND
PROTOTYPE ———
MODEL — — —

VERIFICATION OF SALINITIES FOR 13 SEPT 73 TIDE

STATION 3G



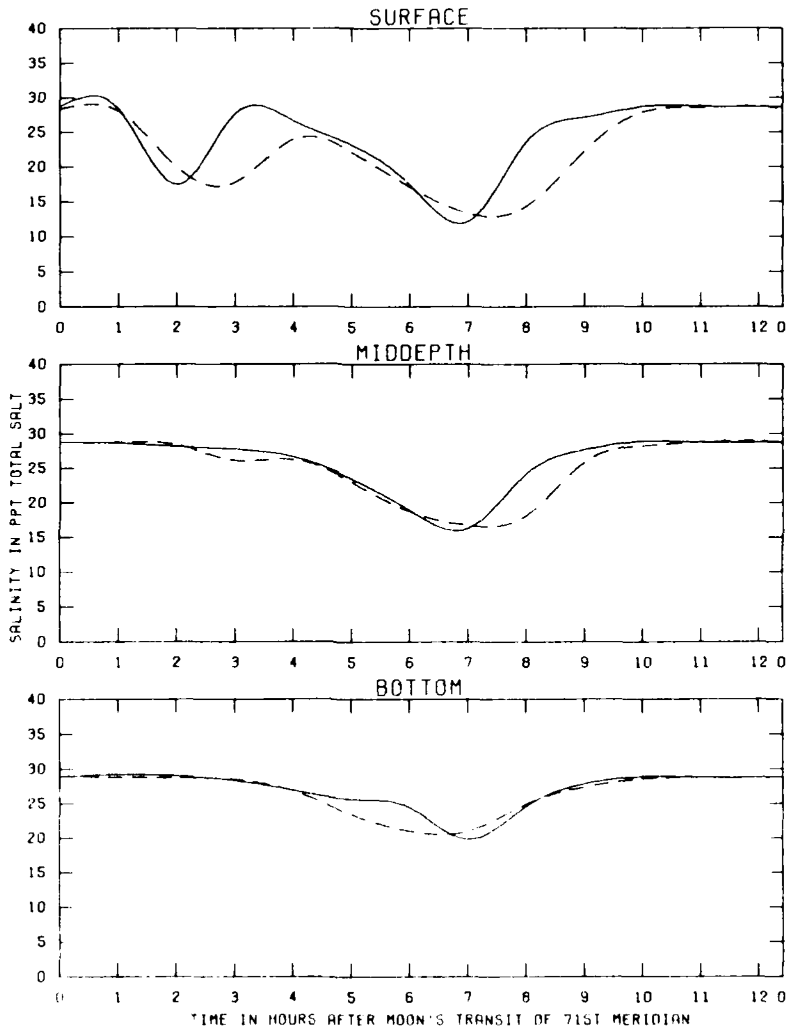
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION	9.0 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	2500 CFS

LEGEND
PROTOTYPE ———
MODEL — — —

VERIFICATION OF SALINITIES FOR 13 SEPT 73 TIDE

STATION 2F



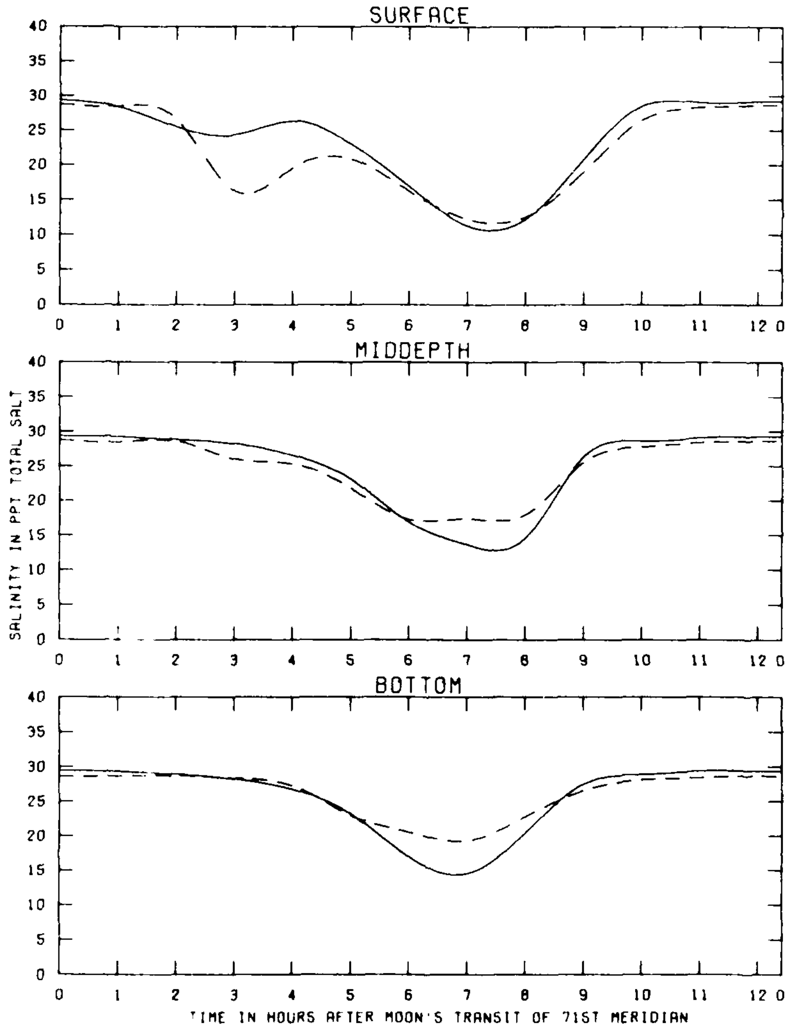
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION 9.0 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 2500 CFS

LEGEND
PROTOTYPE
MODEL

VERIFICATION OF SALINITIES FOR 13 SEPT 73 TIDE

STATION 2E



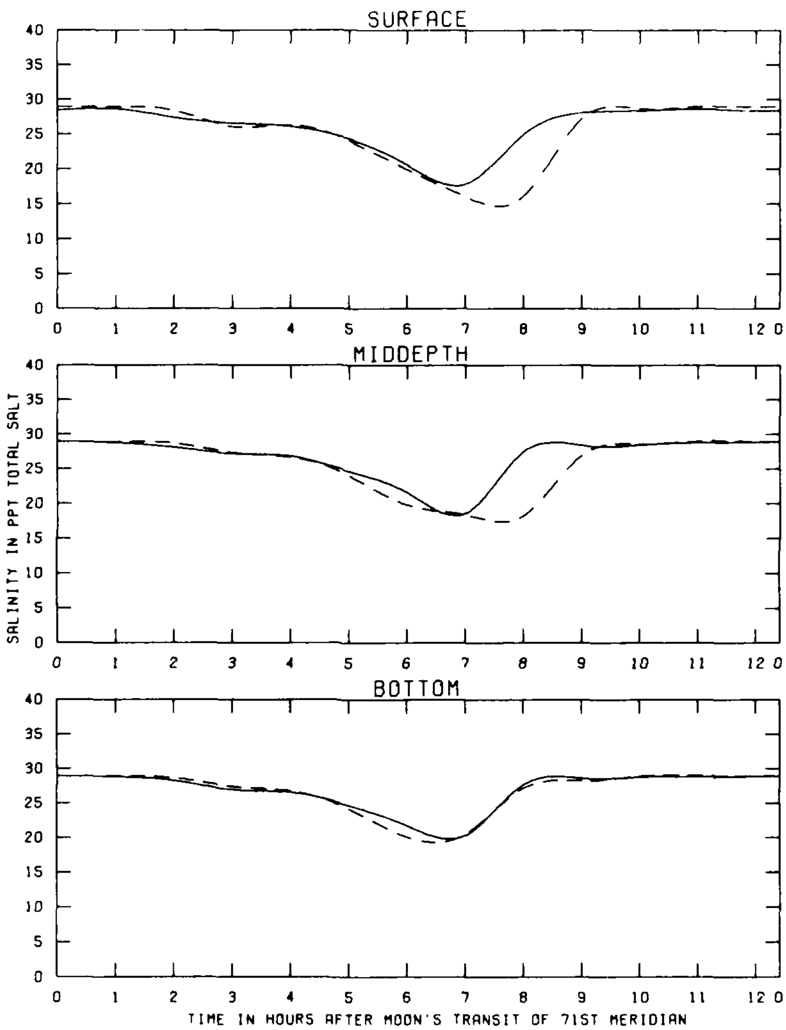
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION	9.0 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	2500 CFS

LEGEND
PROTOTYPE ———
MODEL — — —

VERIFICATION OF
SALINITIES FOR
13 SEPT 73 TIDE

STATION
20



TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION 9.0 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 2500 CFS

LEGEND
PROTOTYPE ———
MODEL — — —

VERIFICATION OF SALINITIES FOR 13 SEPT 73 TIDE

STATION 1C

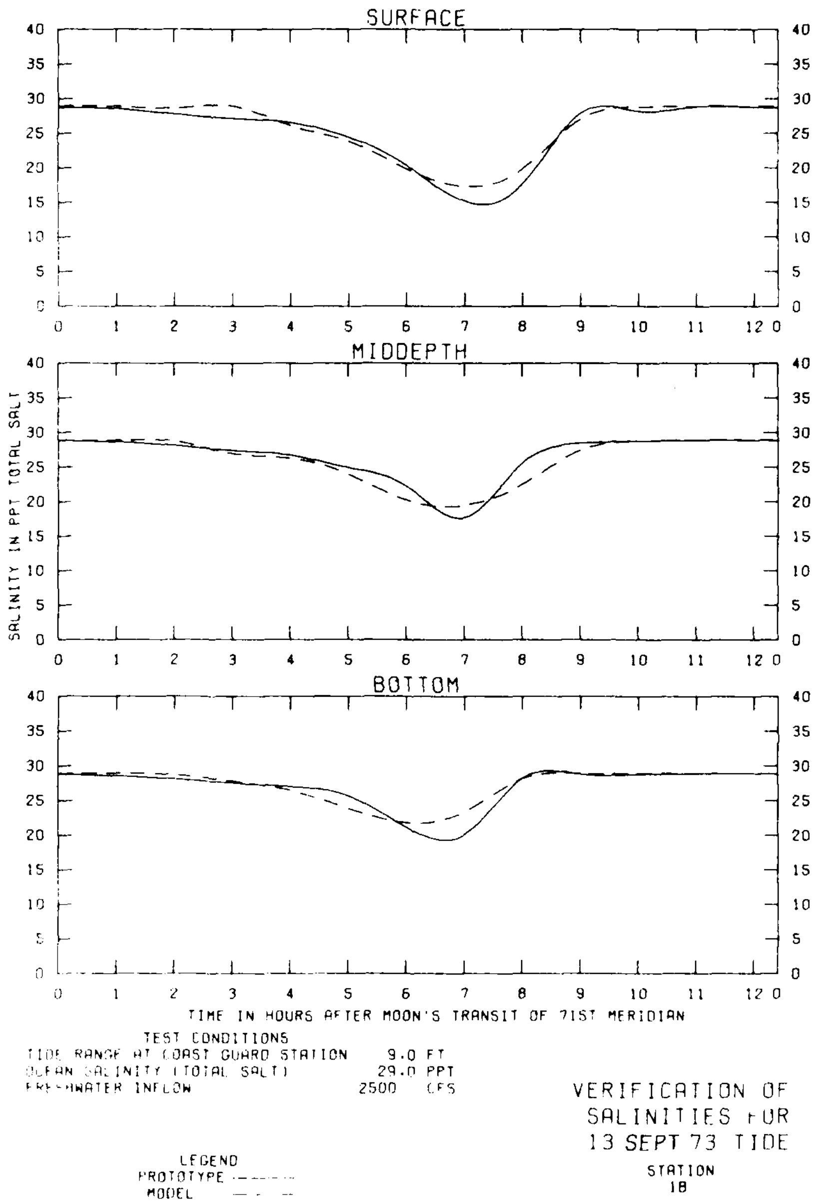
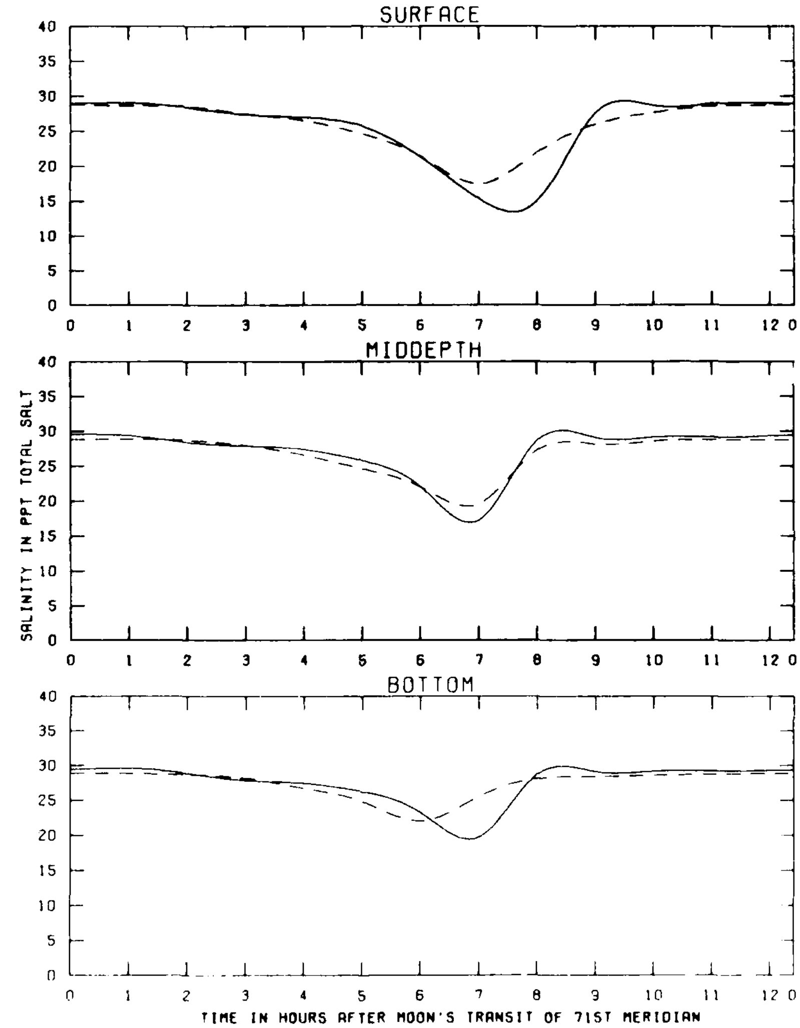

SURFACE
MIDDEPTH
BOTTOM
SALINITY IN PPT TOTAL SALT
TIME IN HOURS AFTER MOON'S TRANSIT OF 71ST MERIDIAN
TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION 9.0 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 2500 CFS
LEGEND
PROTOTYPE
MODEL
VERIFICATION OF
SALINITIES FOR
13 SEPT 73 TIDE
STATION
18

PLATE 35



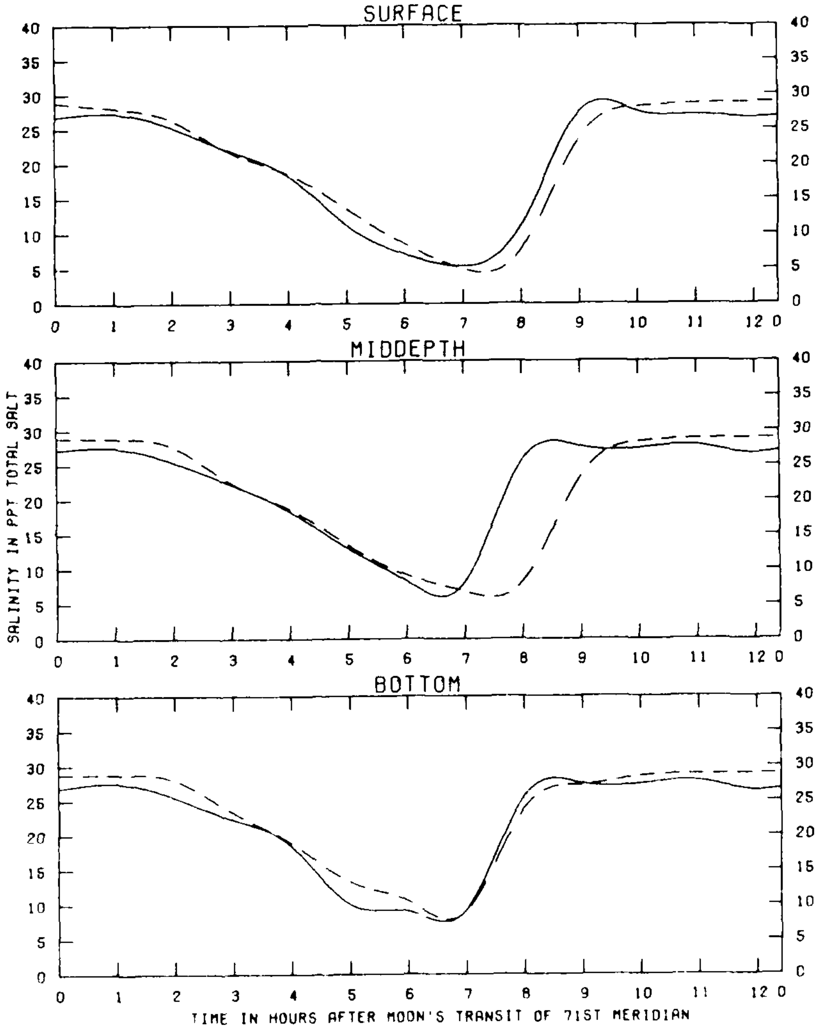
TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION 9.0 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 2500 CFS

LEGEND
PROTOTYPE ———
MODEL — — —

VERIFICATION OF
SALINITIES FOR
13 SEPT 73 TIDE

STATION
1A

PLATE 34



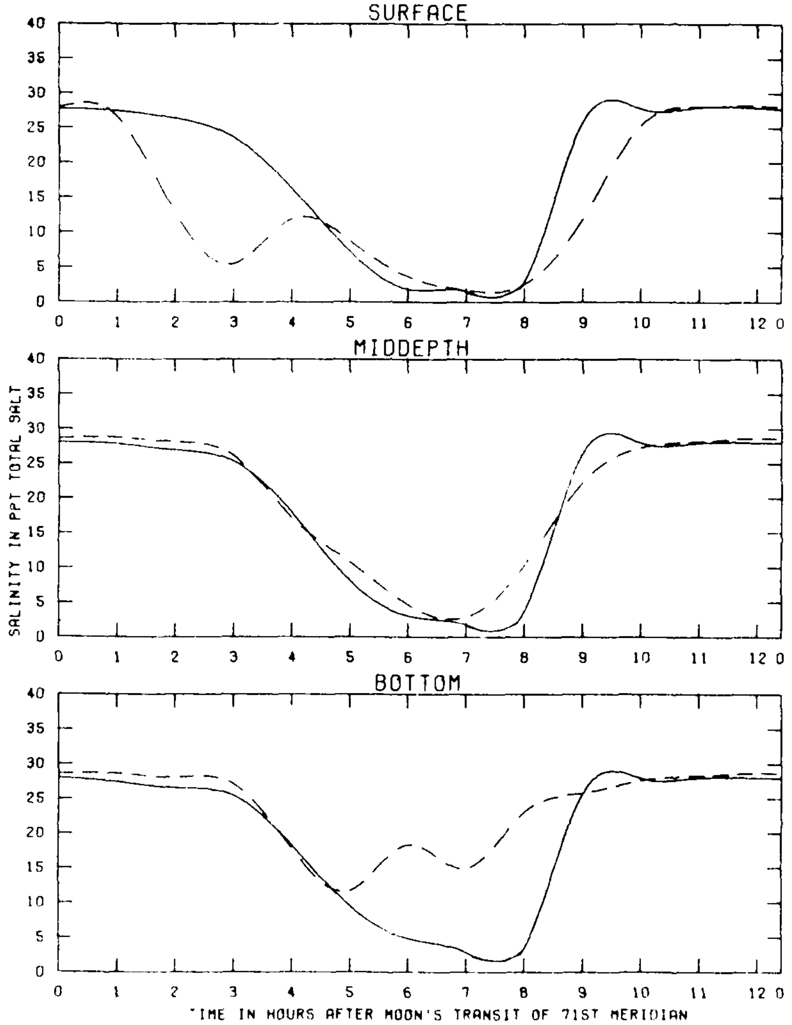
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION 9.2 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 8200 CFS

LEGEND
PROTOTYPE ———
MODEL — — —

VERIFICATION OF SALINITIES FOR 22 MAY 74 TIDE

STATION 1C

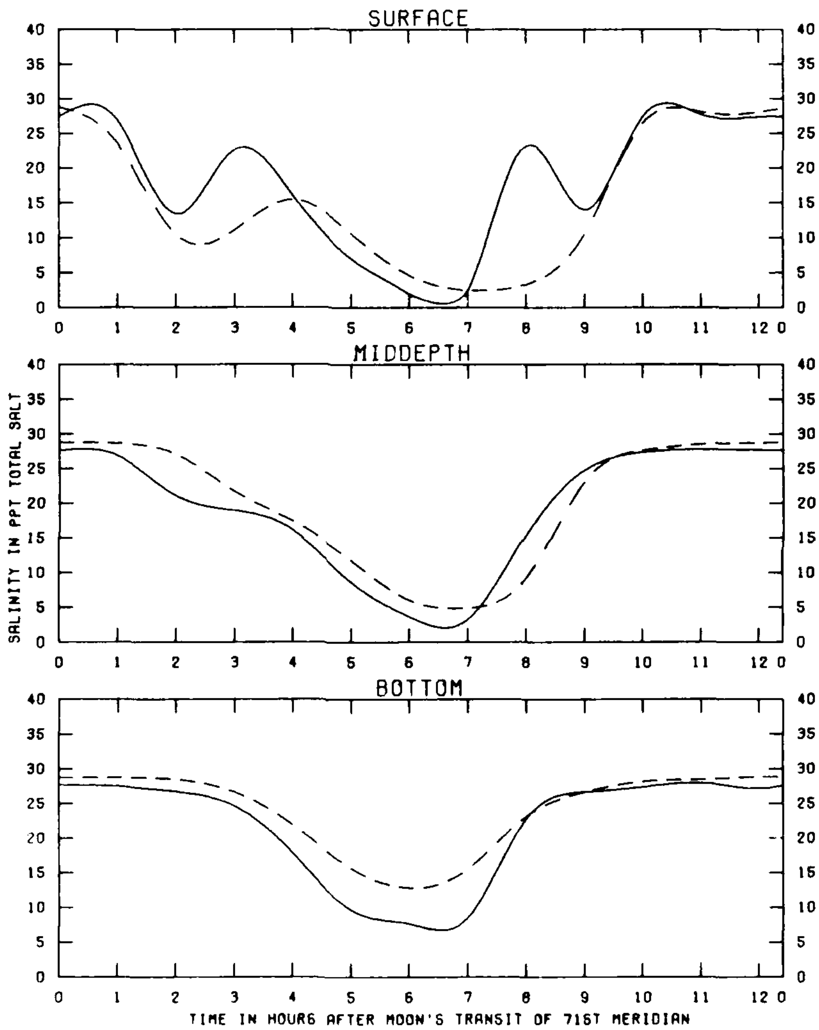


TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION 9.2 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 8200 CFS

VERIFICATION OF
SALINITIES FOR
22 MAY 74 TIDE

LEGEND
PROTOTYPE ———
MODEL — — —

STATION
2D



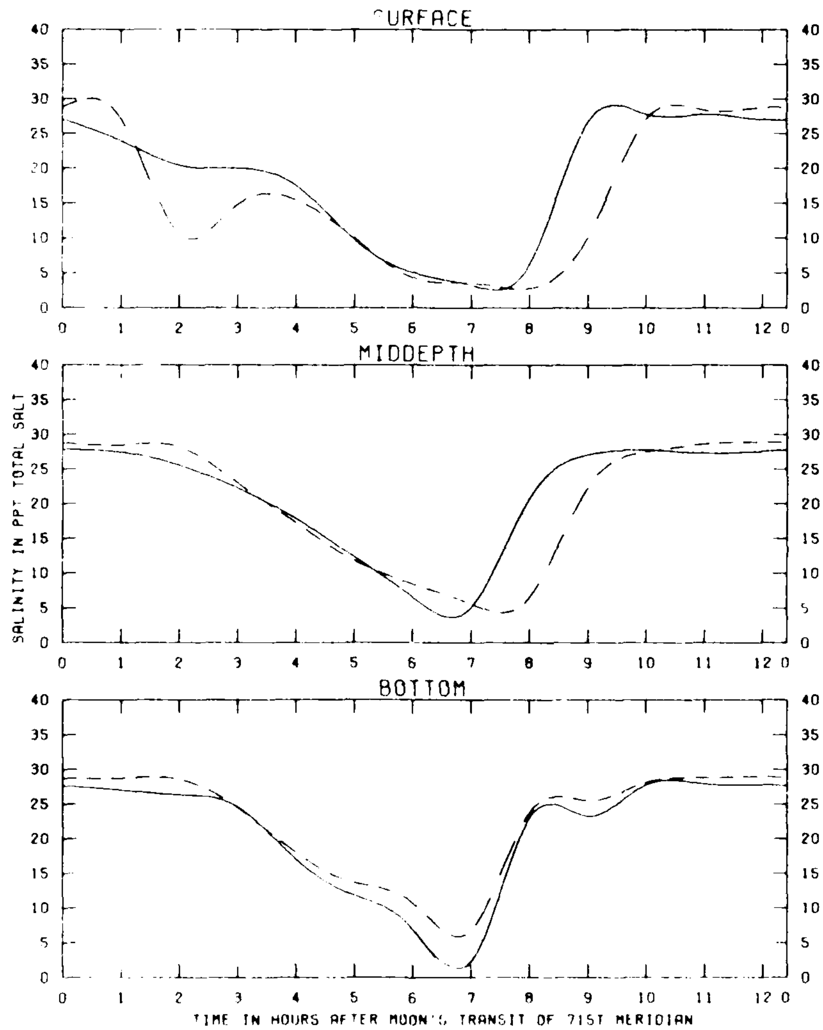
TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION 9.2 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 8200 CFS

LEGEND
PROTOTYPE ———
MODEL — — —

VERIFICATION OF
SALINITIES FOR
22 MAY 74 TIDE

STATION
2E

PLATE 50



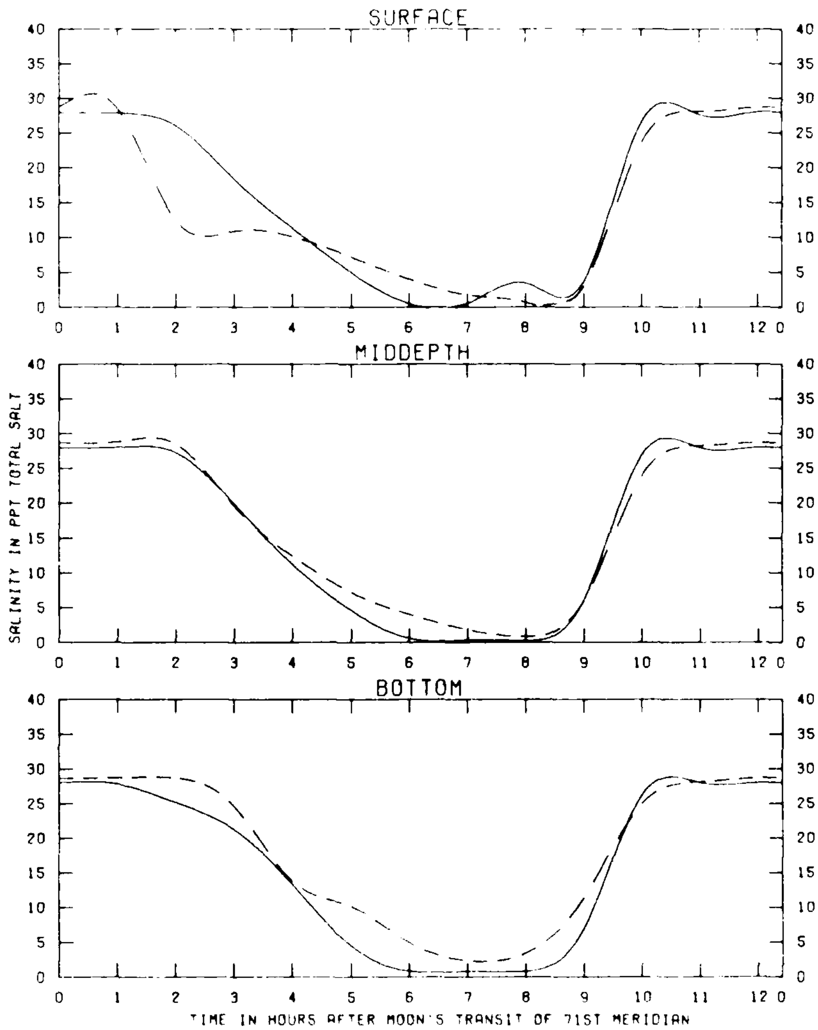
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION	9.2 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	8200 CFS

VERIFICATION OF
SALINITIES FOR
22 MAY 74 TIDE

LEGEND
PROTOTYPE
MODEL

STATION
2F



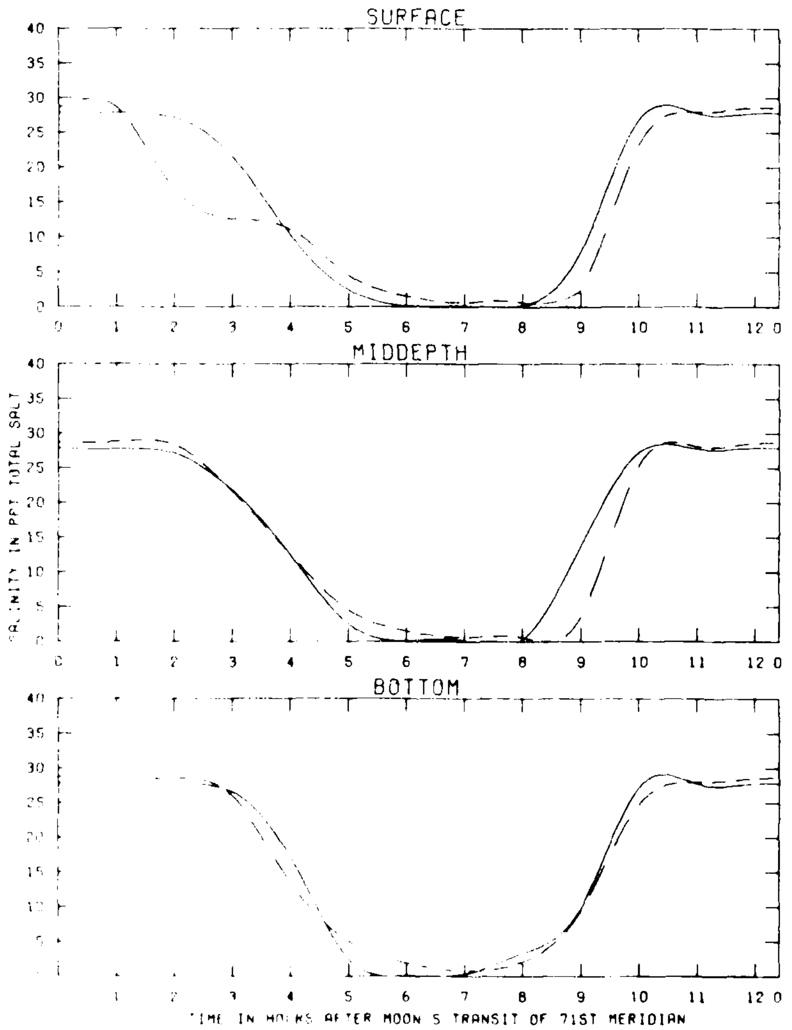
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION 9.2 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 8200 CFS

LEGEND
PROTOTYPE - - -
MODEL — — —

VERIFICATION OF
SALINITIES FOR
22 MAY 74 TIDE

STATION
39



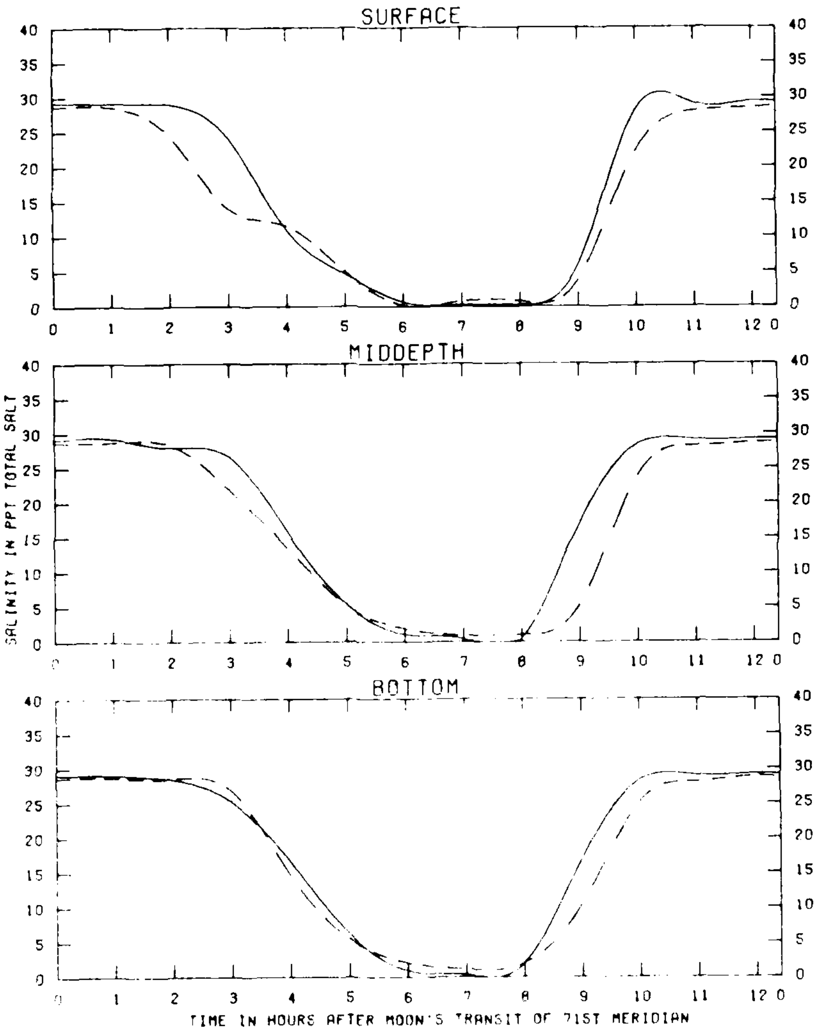
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION	9.2 FT
MEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	8200 CFS

LEGEND
PROTOTYPE
MODEL

VERIFICATION OF
SALINITIES FOR
22 MAY 74 TIDE

STATION
3H



TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION	9.2	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	8200	CFS

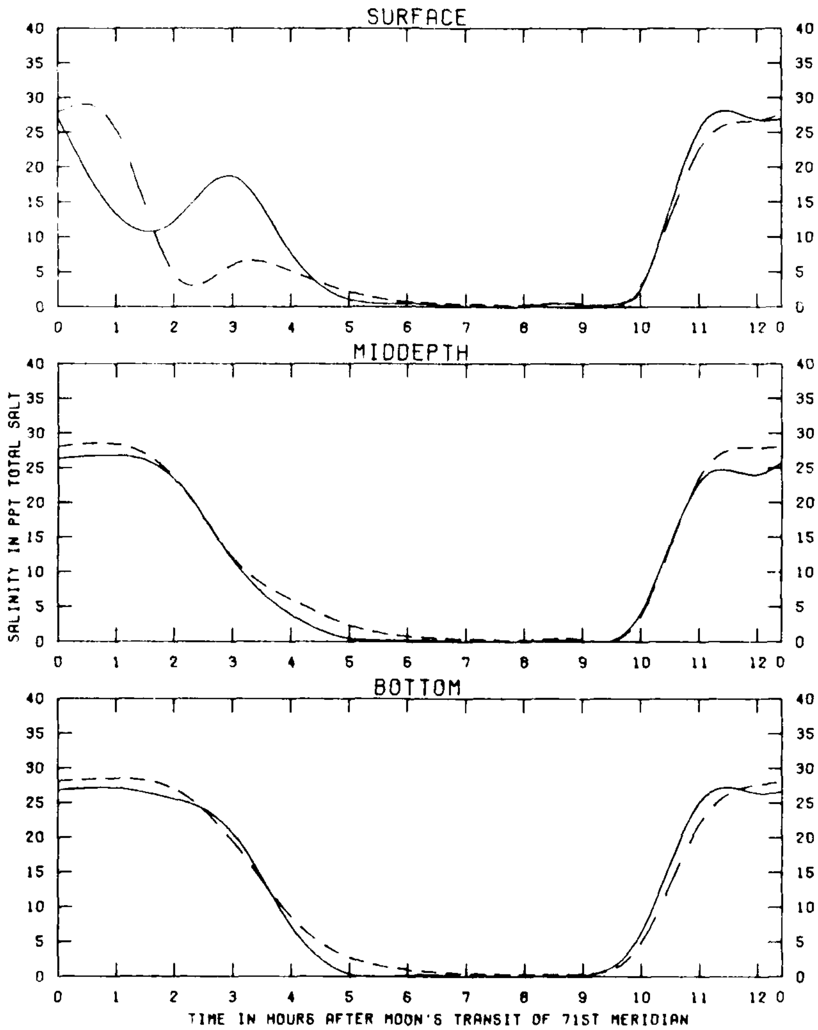
LEGEND

PROTOTYPE ———

MODEL – – –

VERIFICATION OF SALINITIES FOR 22 MAY 74 TIDE

STATION 3J



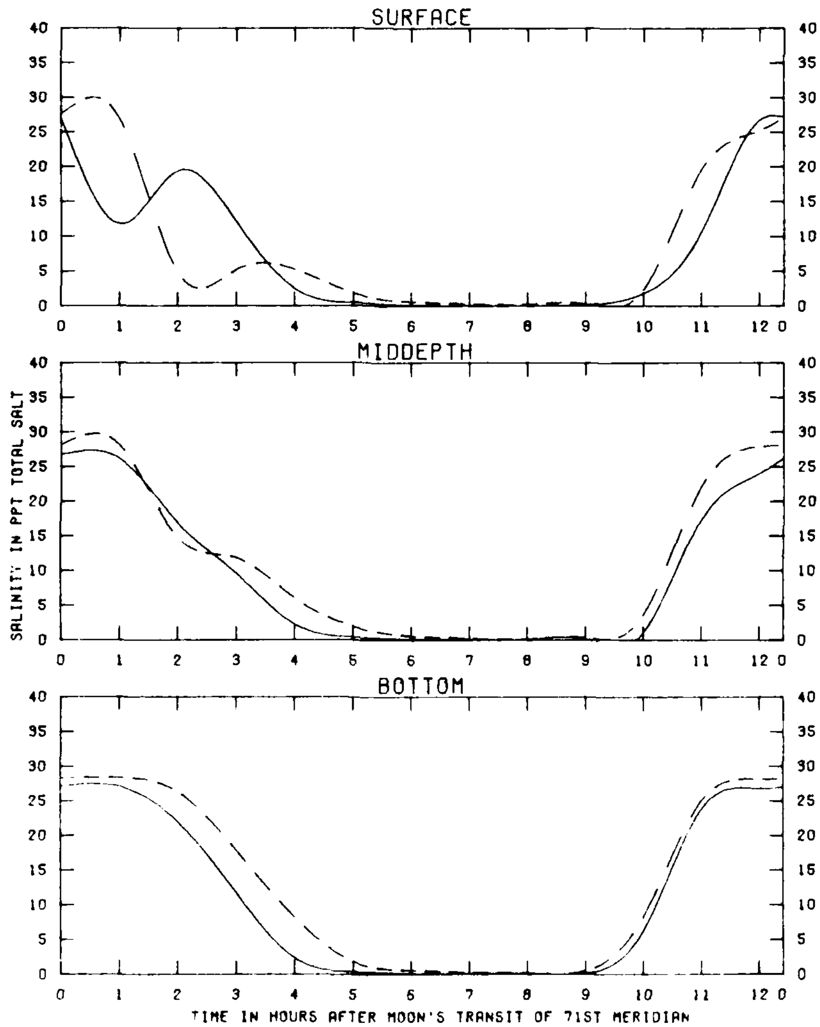
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION	9.2	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	8200	CFS

LEGEND
PROTOTYPE ———
MODEL — — —

VERIFICATION OF
SALINITIES FOR
22 MAY 74 TIDE

STATION
4K



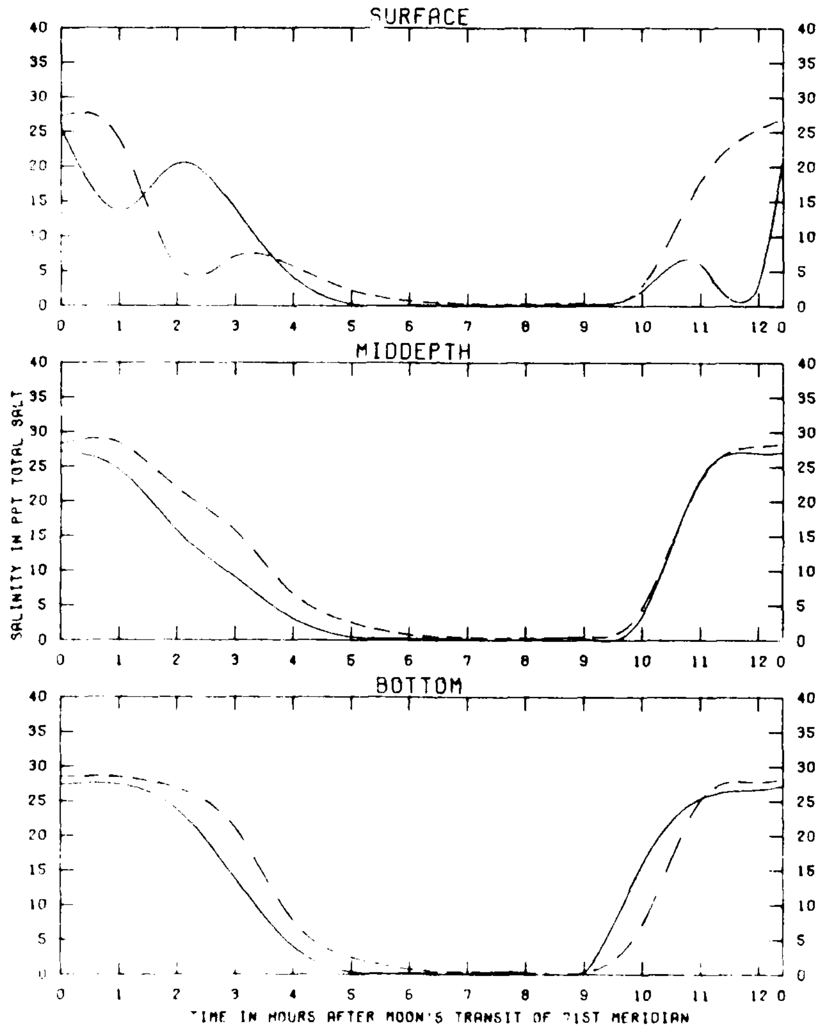
TEST CONDITIONS

TIDE RANGE AT COAST GUARD STATION	9.2 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	8200 CFS

LEGEND
PROTOTYPE ———
MODEL — — —

VERIFICATION OF SALINITIES FOR 22 MAY 74 TIDE

STATION 4L

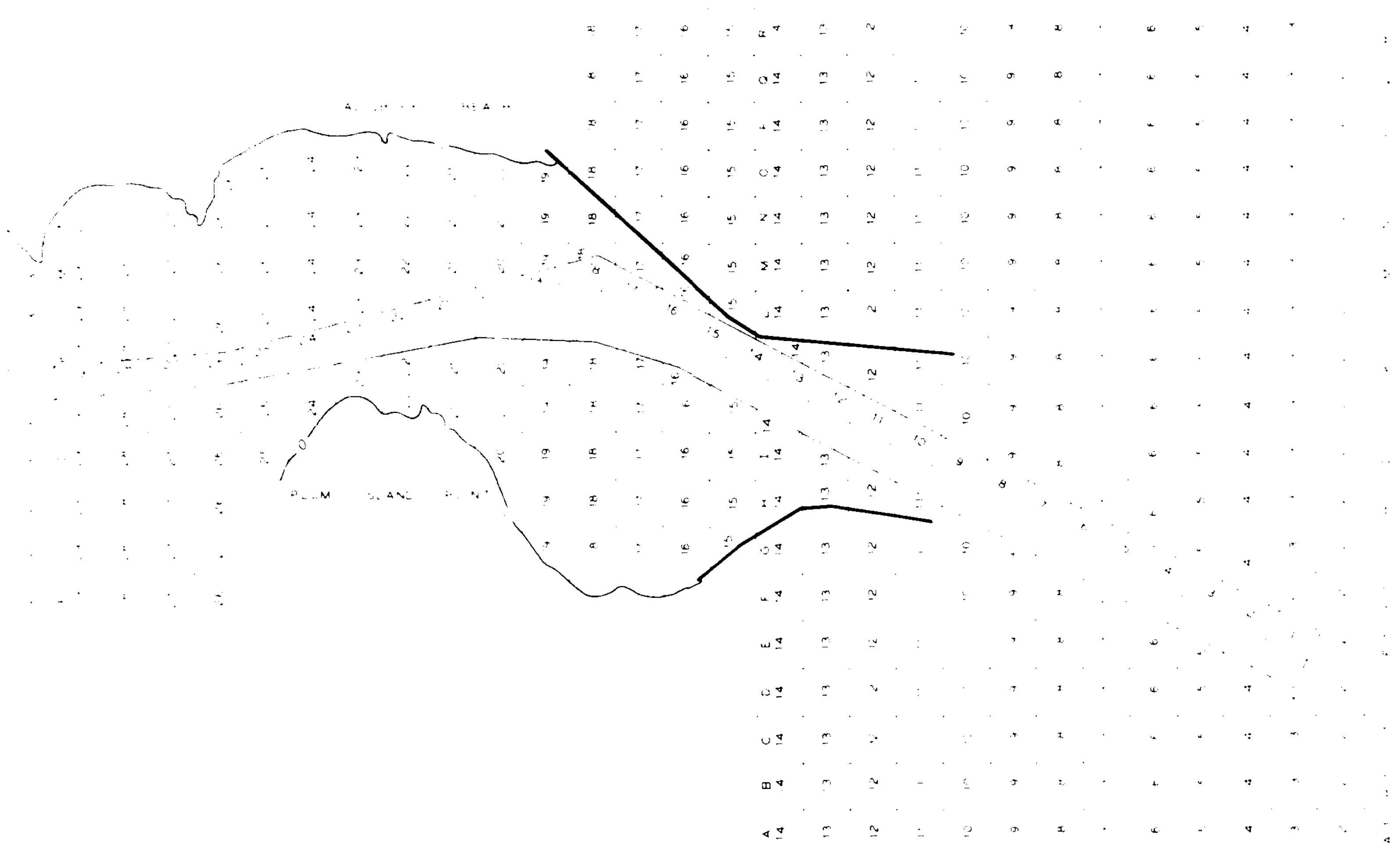


TEST CONDITIONS
TIDE RANGE AT COAST GUARD STATION 8.2 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 8200 CFS

LEGEND
PROTOTYPE
MODEL

VERIFICATION OF
SALINITIES FOR
22 MAY 74 TIDE

STATION
4M



ENTRANCE FIXED-BED SHOALING AND SCOUR TEST SECTIONS

LOCATION MAP

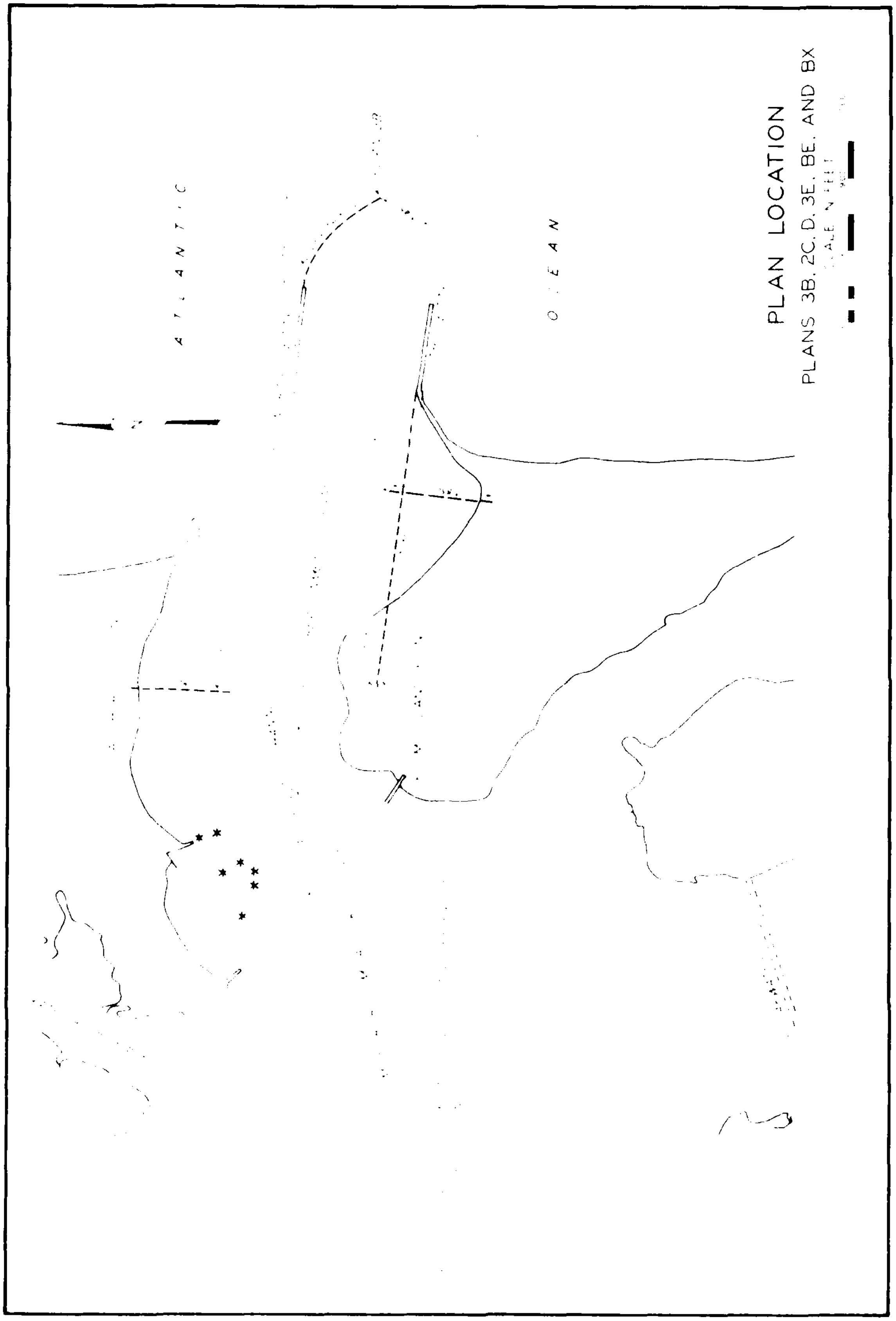
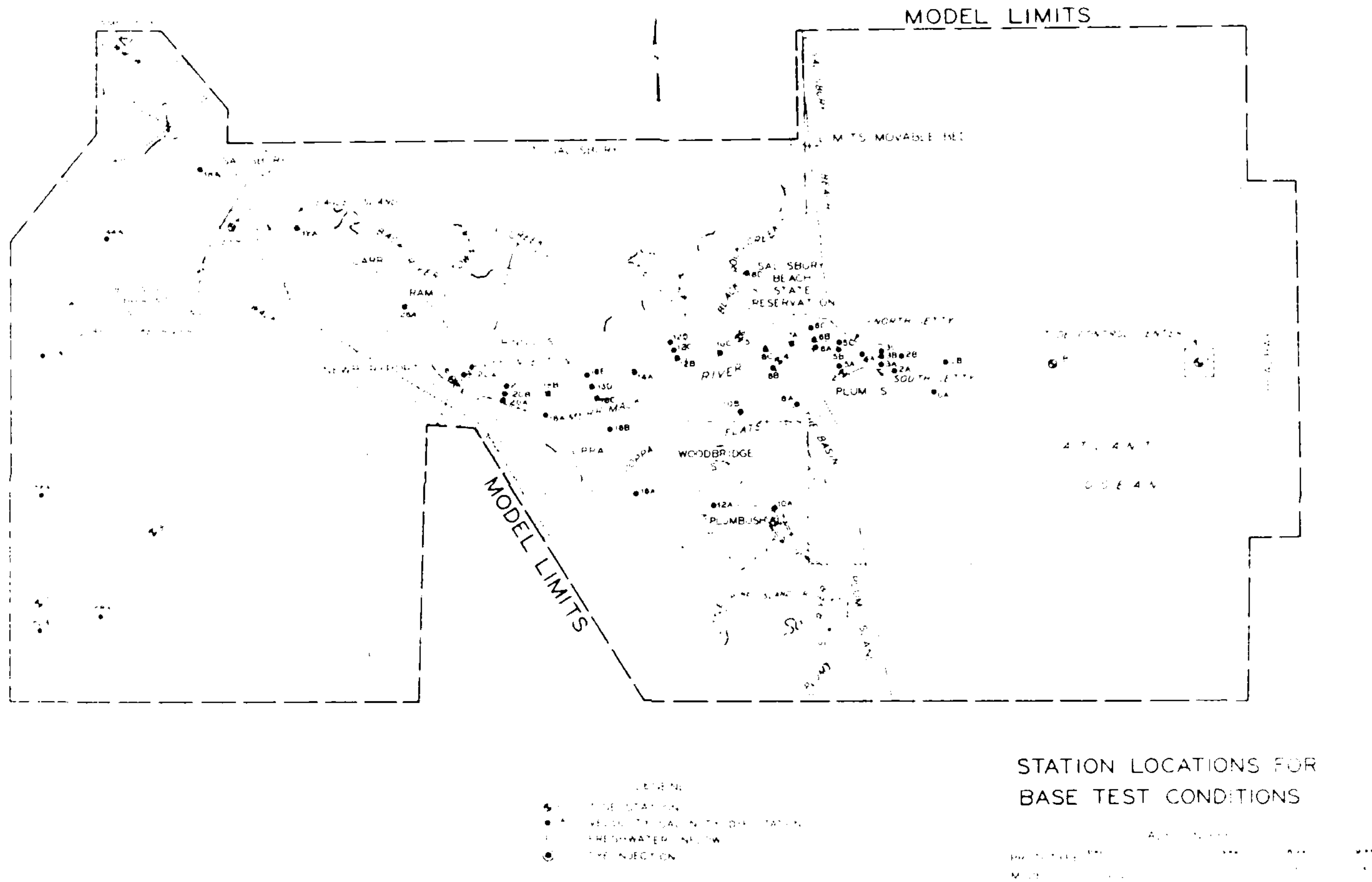
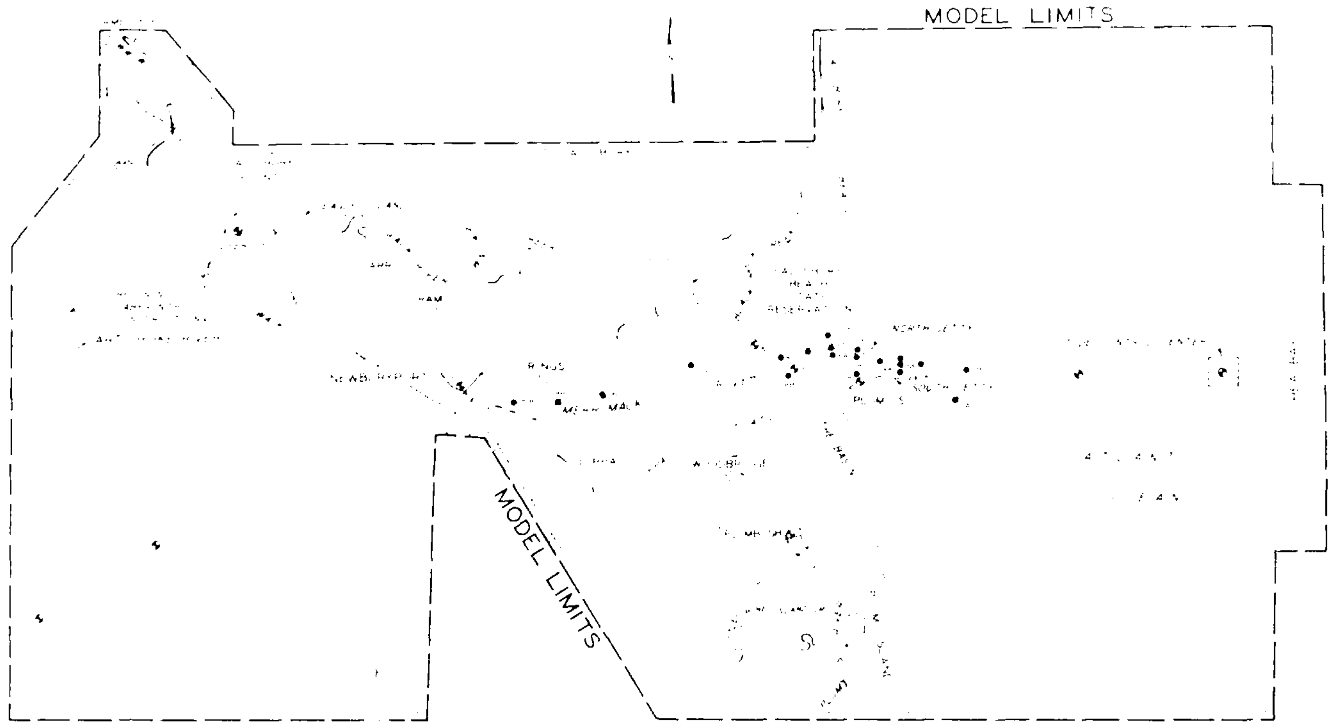


PLATE 59



STATION LOCATIONS FOR
BASE TEST CONDITIONS

PLATE 60



VELOCITY STATION LOCATIONS
FOR PLAN CONDITIONS

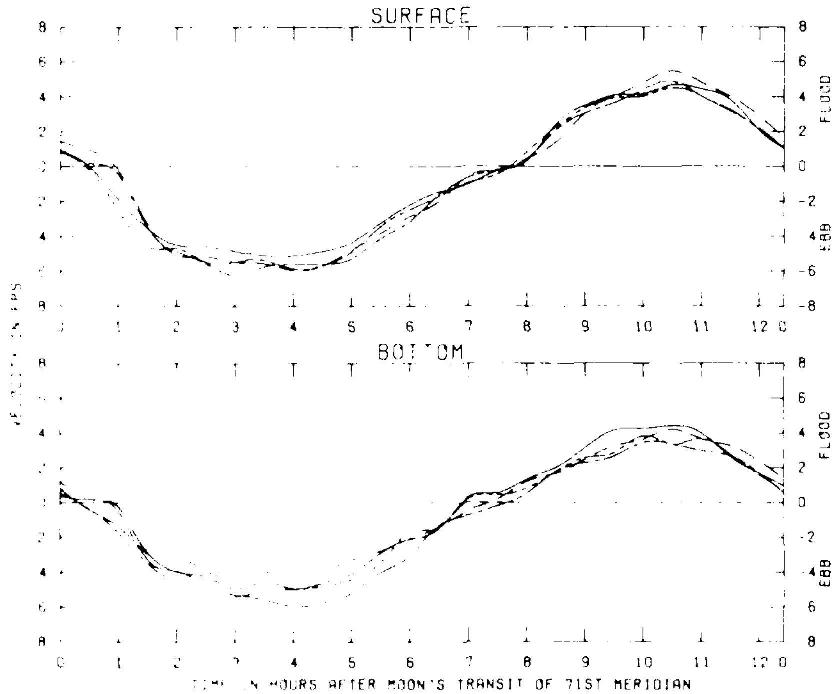
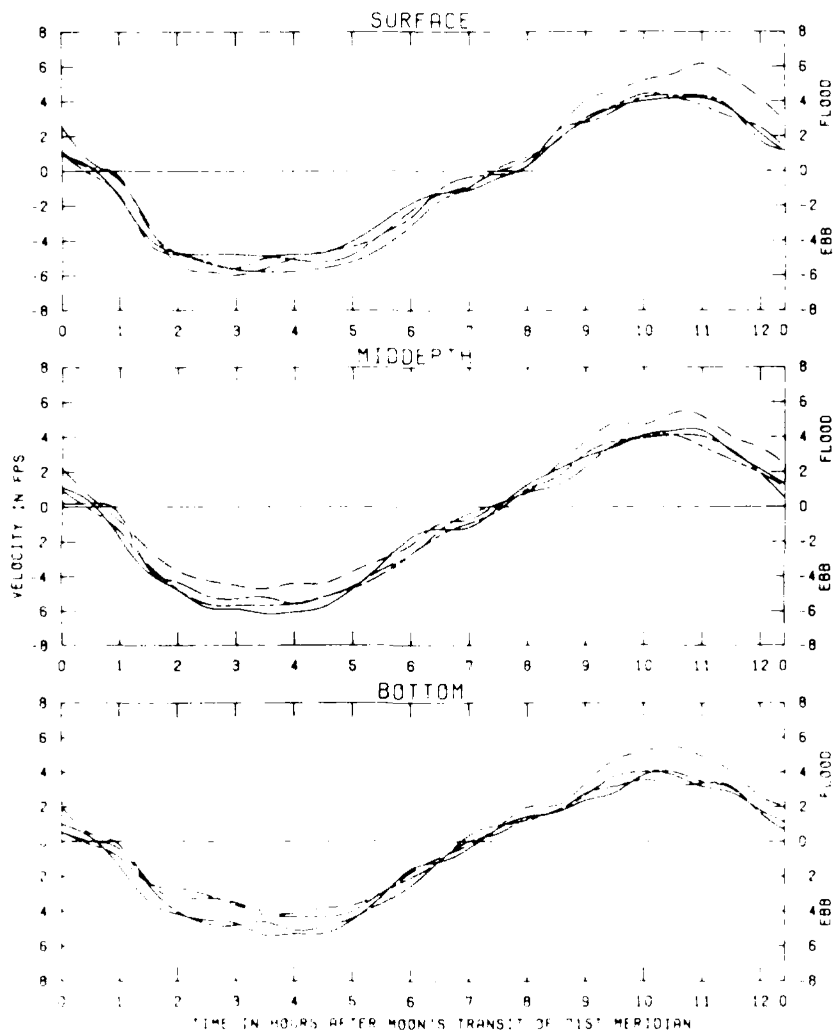

SURFACE
BOTTOM
FLOOD
EBB
8
6
4
2
0
-2
-4
-6
-8
0 1 2 3 4 5 6 7 8 9 10 11 12 0
HOURS AFTER MOON'S TRANSIT OF 71ST MERIDIAN

PLATE 75



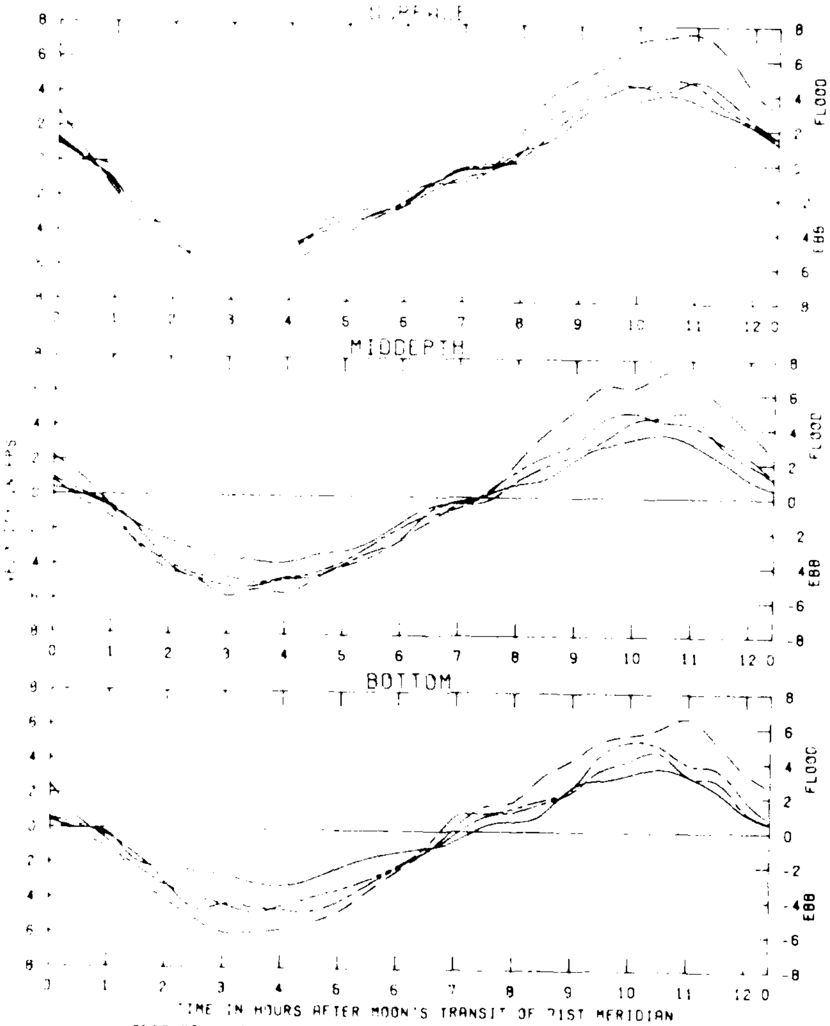
TEST CONDITIONS

TIDE RANGE AT BASE (LIMITS)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
PLANS 3B,2C AND D
ON VELOCITIES

STATION
3B



TEST CONDITIONS

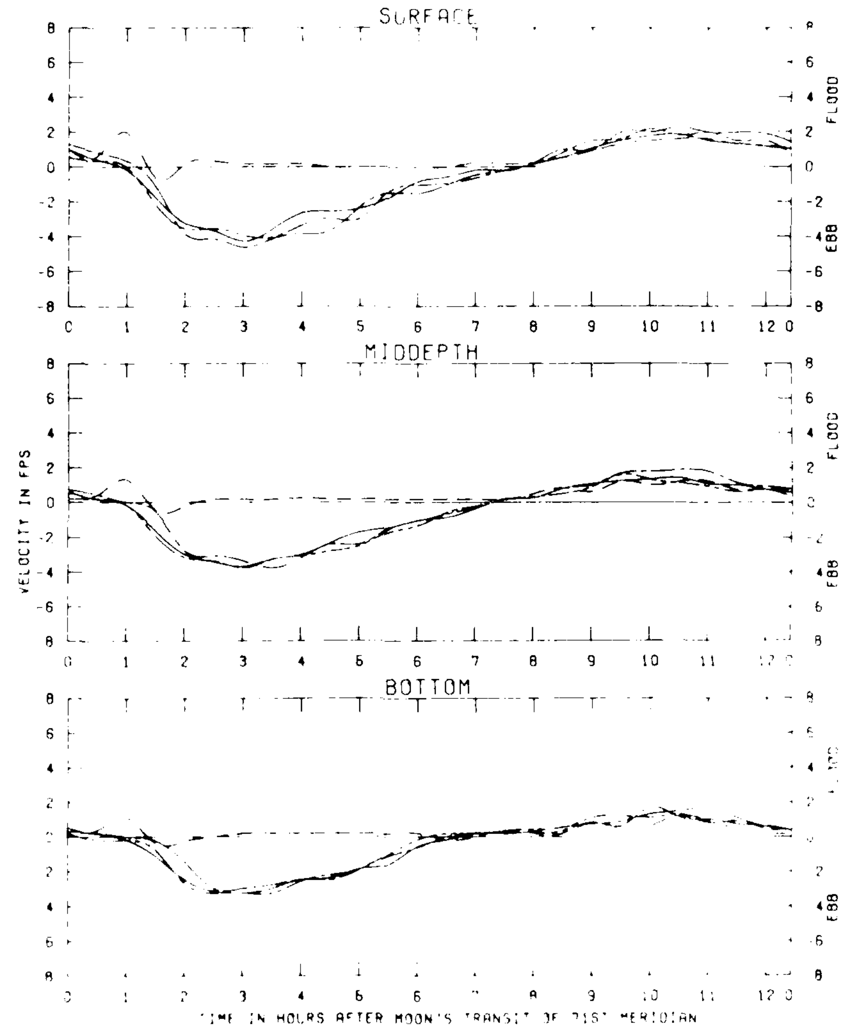
TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND

BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
PLANS 3B, 2C AND D
ON VELOCITIES

STATION
3A



TEST CONDITIONS

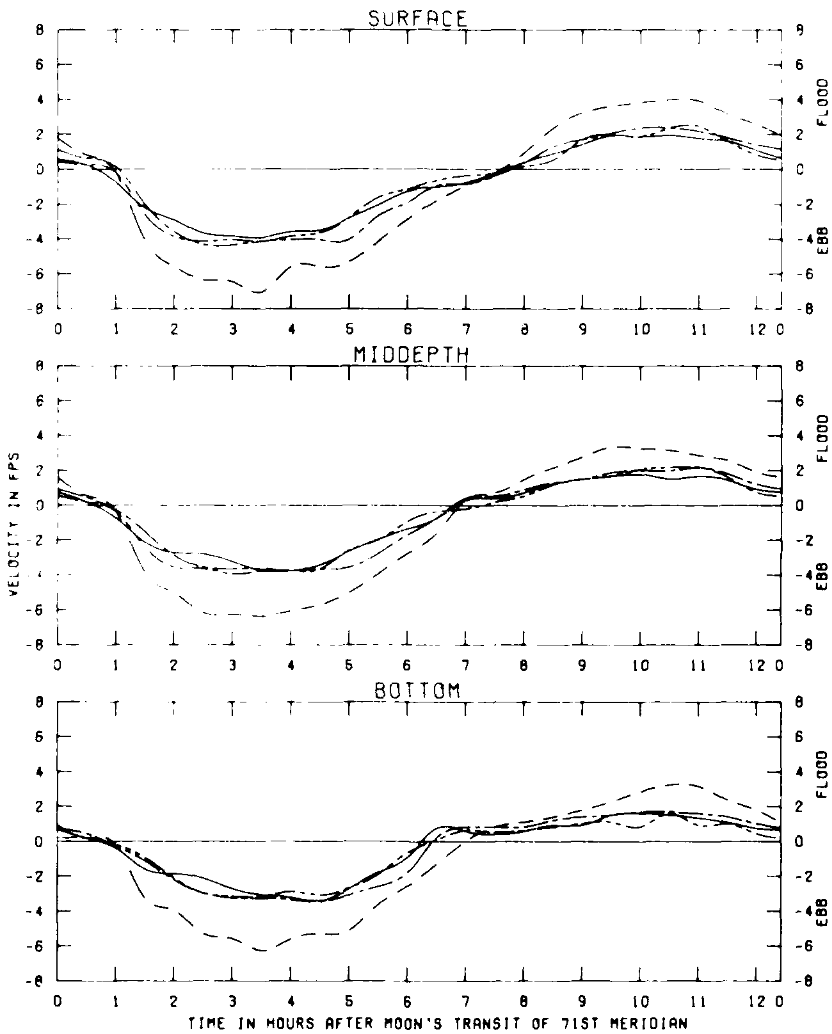
TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND

BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
PLANS 3B, 2C AND D
ON VELOCITIES

STATION
28



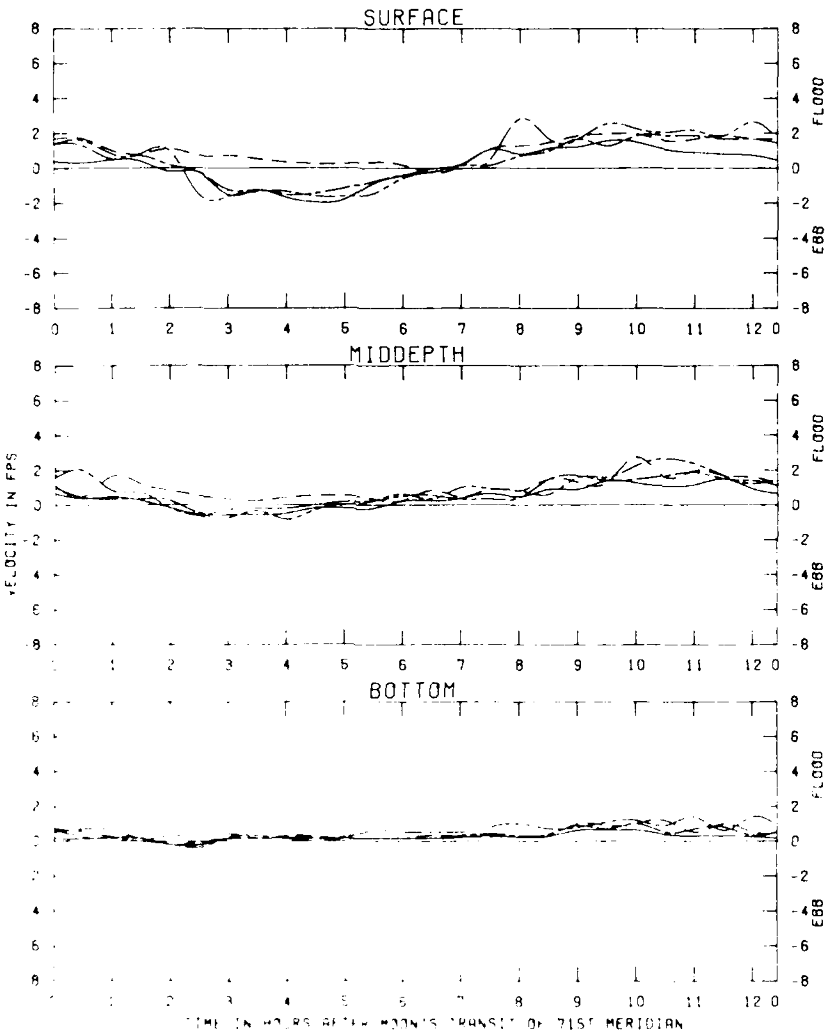
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
PLANS 3B,2C AND D
ON VELOCITIES

STATION
2A



TEST CONDITIONS

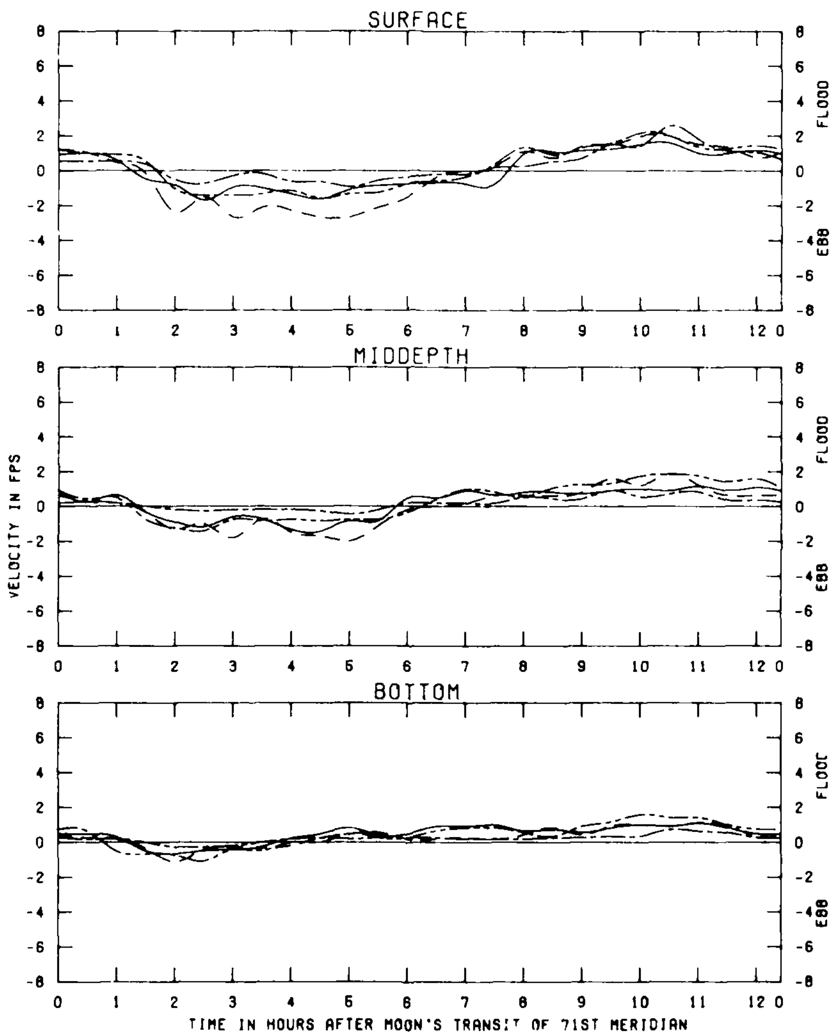
FRESHWATER INFLOW

EFFECTS OF
PLANS 3B, 2C AND D
ON VELOCITIES

STATION

PLAN
BASE
PLAN 3B

PLATE 70



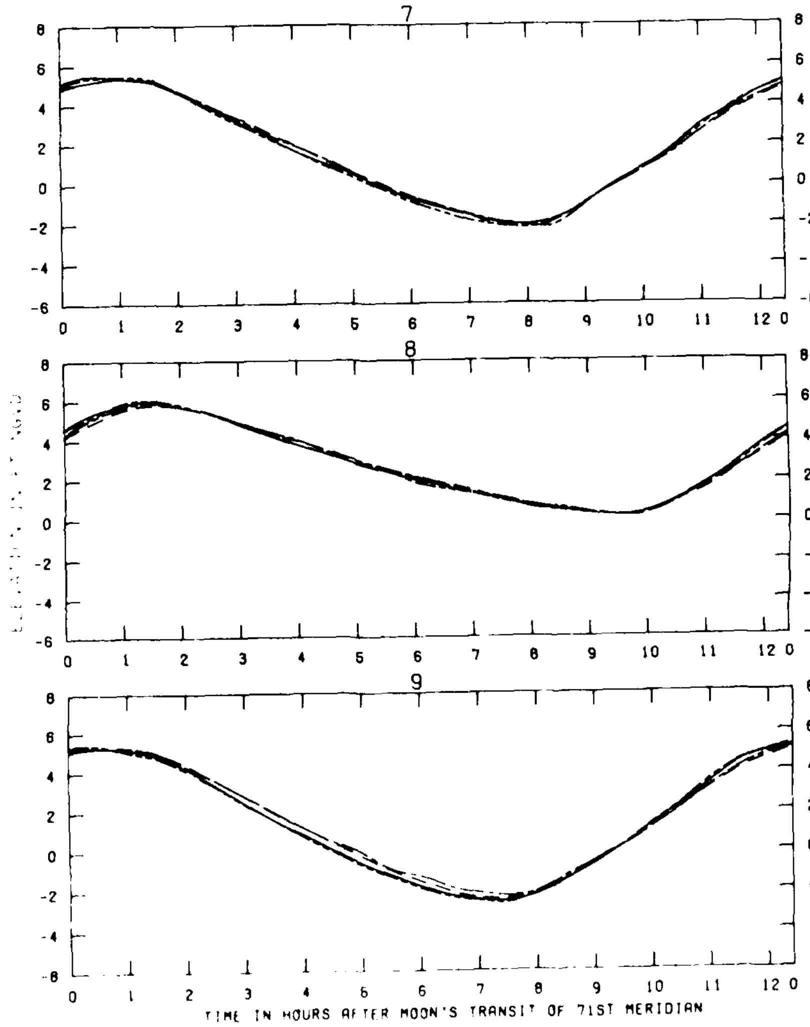
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	5000	CFS

EFFECTS OF
PLANS 3B, 2C AND D
ON VELOCITIES

STATION
OA

LEGEND
BASE ———
PLAN 3B — — —
PLAN 2C —·—·—
PLAN D —··—··—



TEST CONDITIONS

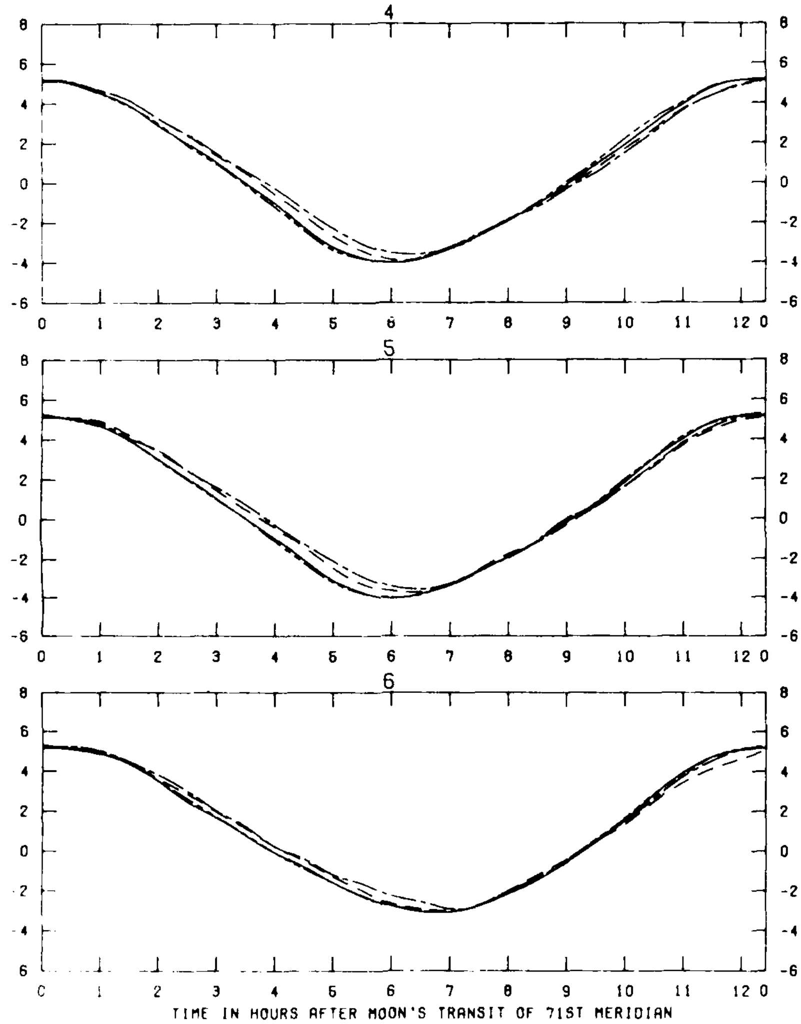
TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN
PLAN

EFFECTS OF
PLANS 3B,2C AND D
ON TIDAL HEIGHTS

STATIONS
7 , 8 , AND 9

PLATE



TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT) 9.6 FT

OCEAN SALINITY (TOTAL SALT) 29.0 PPT

FRESHWATER INFLOW 6000 CFS

LEGEND

BASE

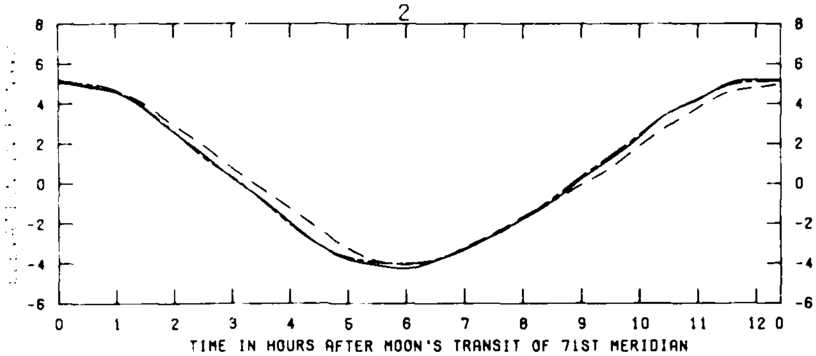
PLAN 3B

PLAN 2C

PLAN D

EFFECTS OF
PLANS 3B, 2C AND D
ON TIDAL HEIGHTS

STATIONS
4, 5, AND 6



TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIER)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

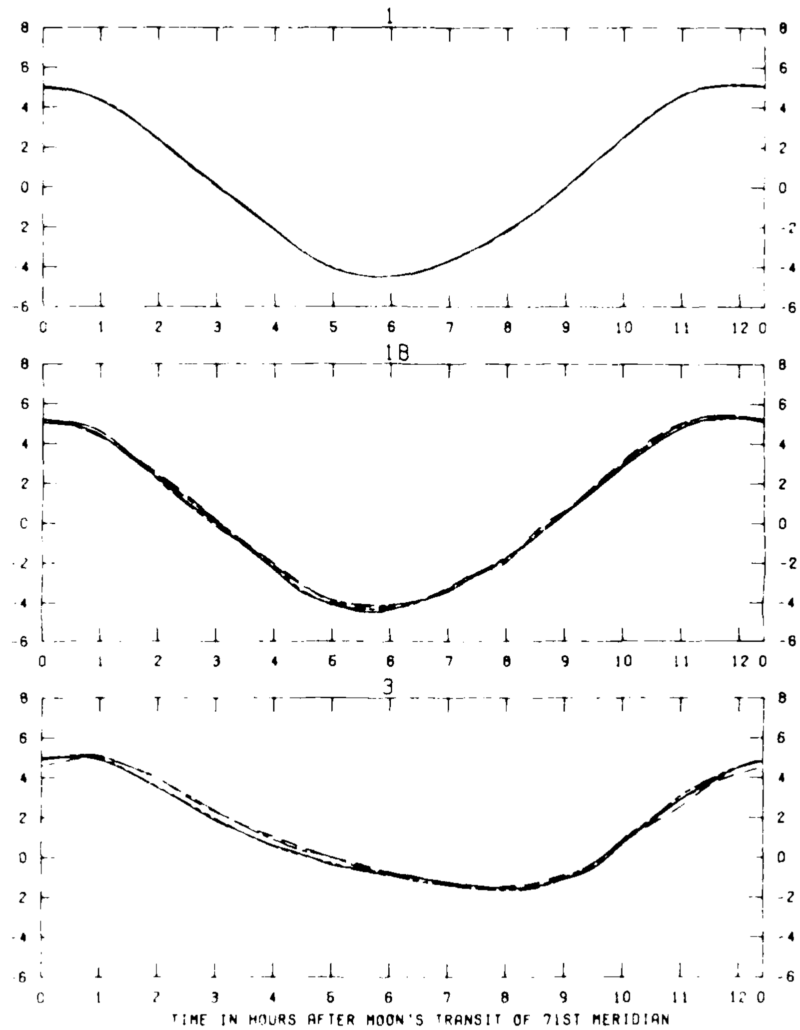
LEGEND

BASE
PLAN 3B
PLAN 2C

EFFECTS OF
PLANS 3B,2C AND D
ON TIDAL HEIGHTS

STATION
2

PLATE 66



TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.8 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

EFFECTS OF
PLANS 3B, 2C AND D
ON TIDAL HEIGHTS

STATIONS
1, 1B, AND 3

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

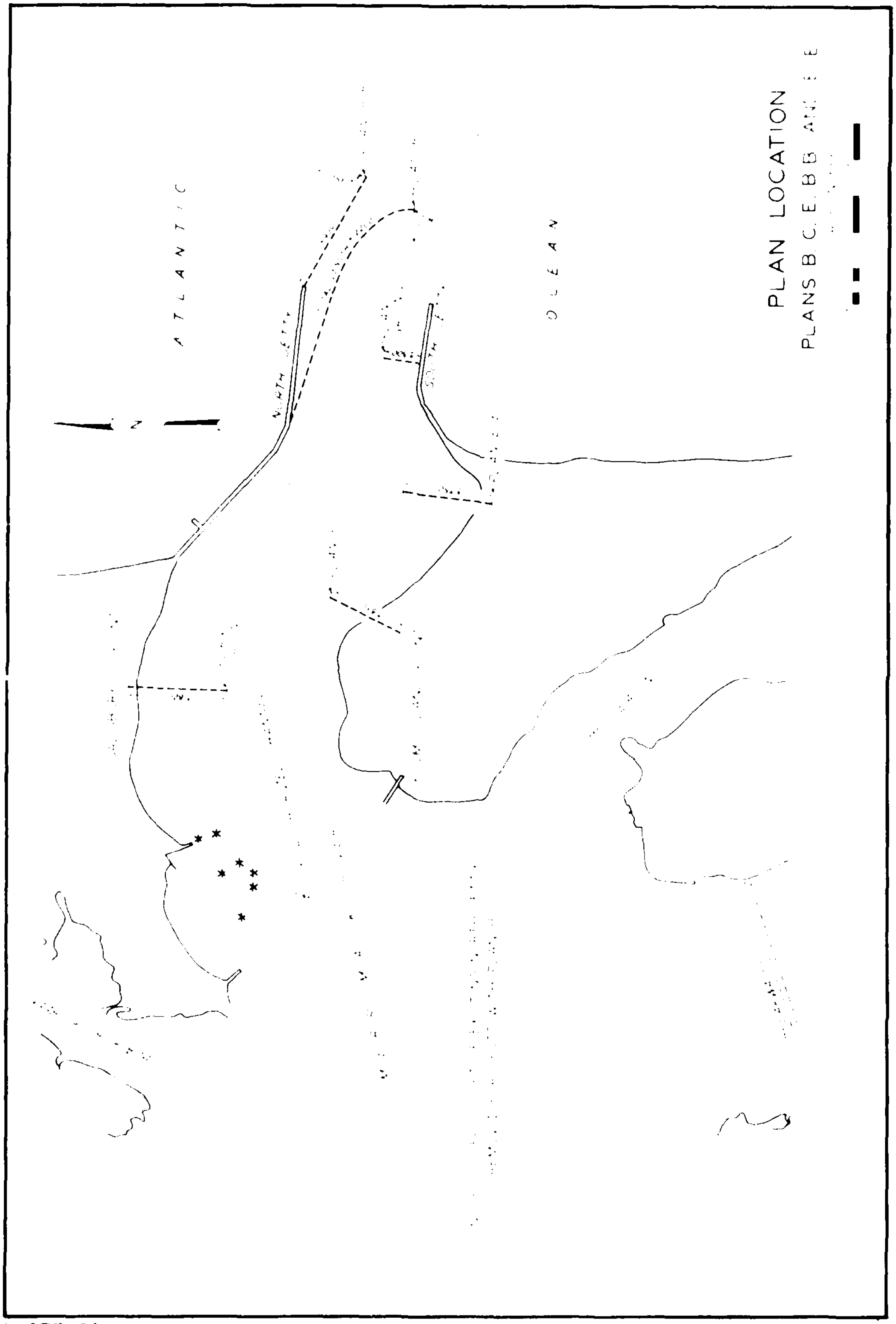
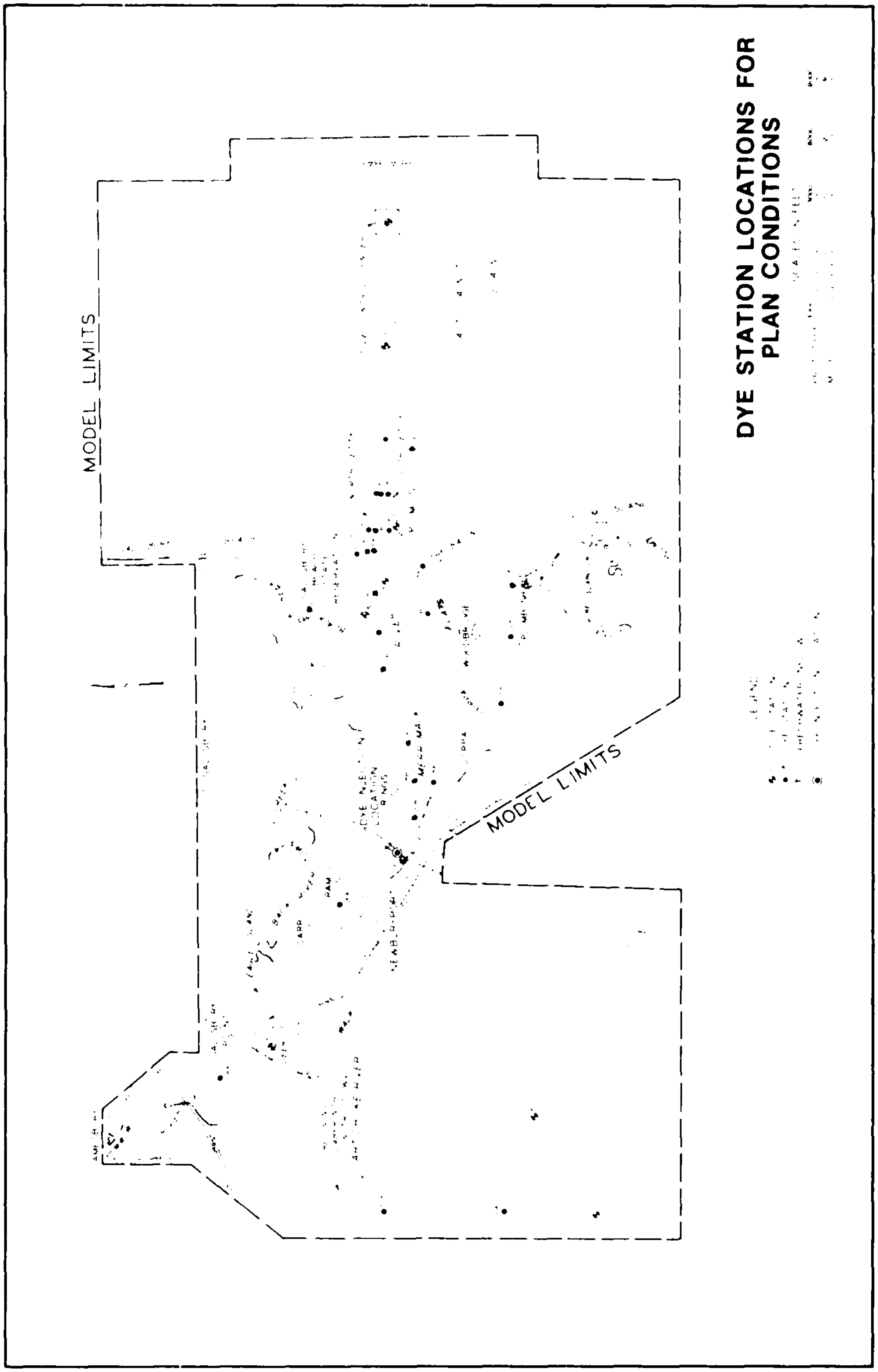
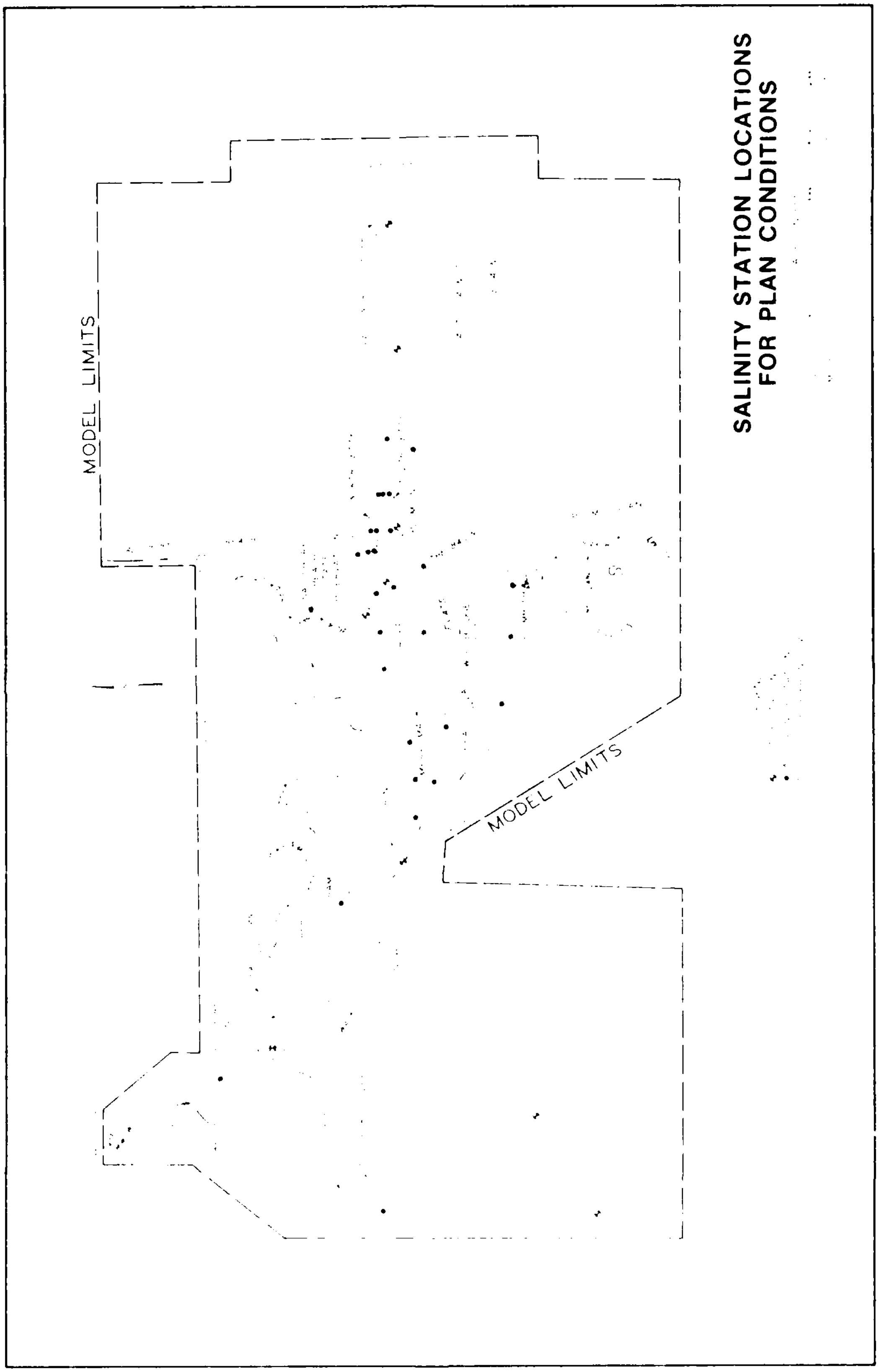
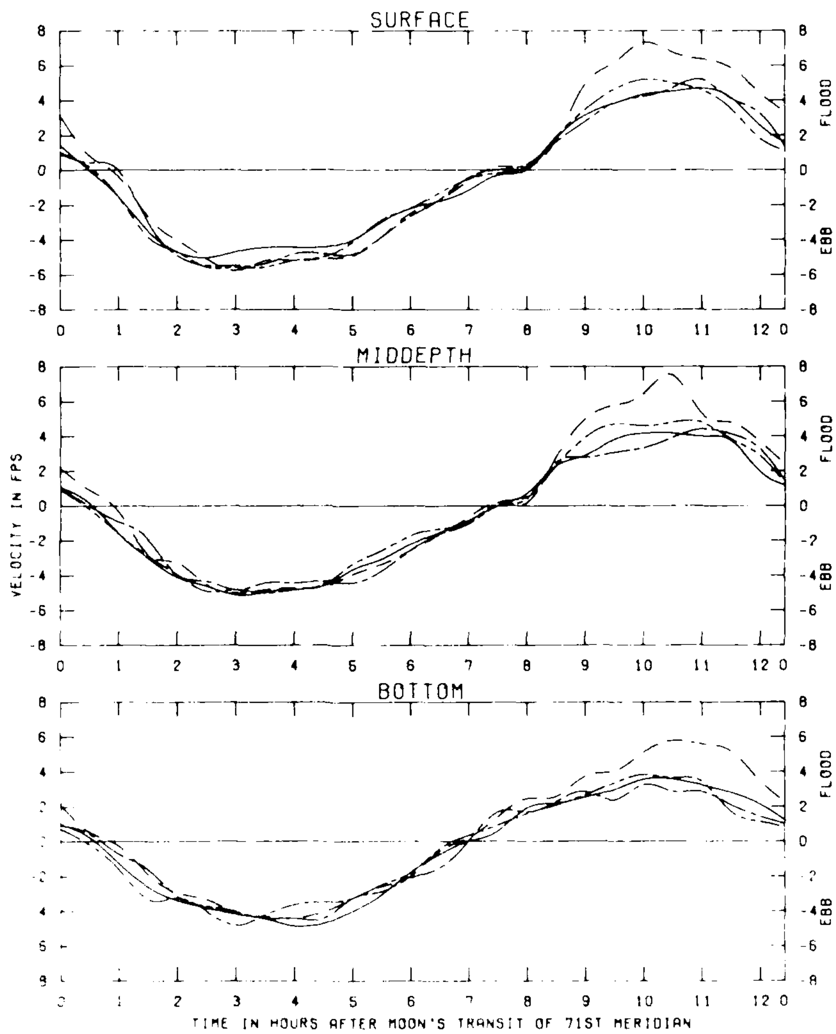


PLATE 64


DYE STATION LOCATIONS FOR
PLAN CONDITIONS
MODEL LIMITS
MODEL LIMITS


SALINITY STATION LOCATIONS
FOR PLAN CONDITIONS
MODEL LIMITS
MODEL LIMITS



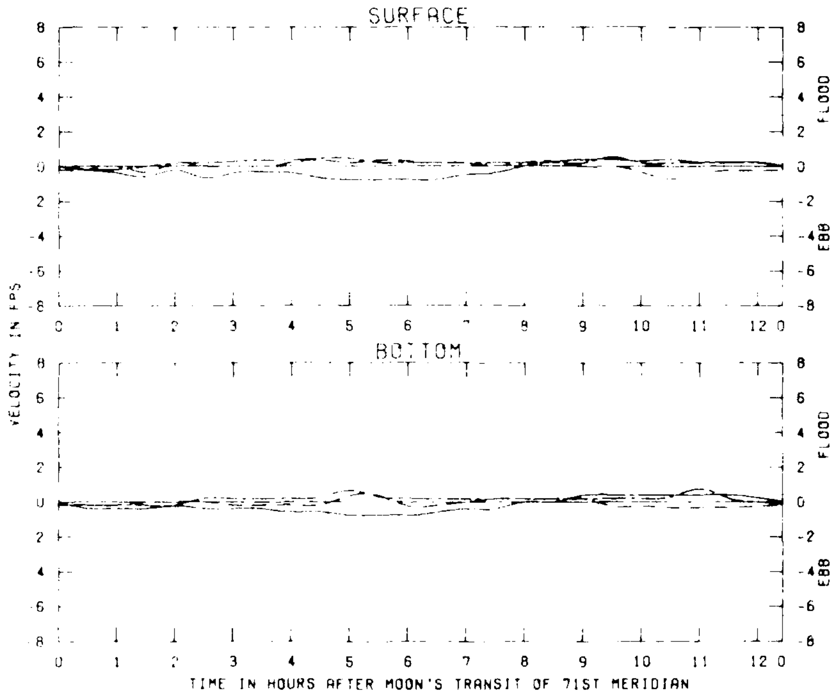
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
PLANS 3B, 2C AND D
ON VELOCITIES

STATION
4A



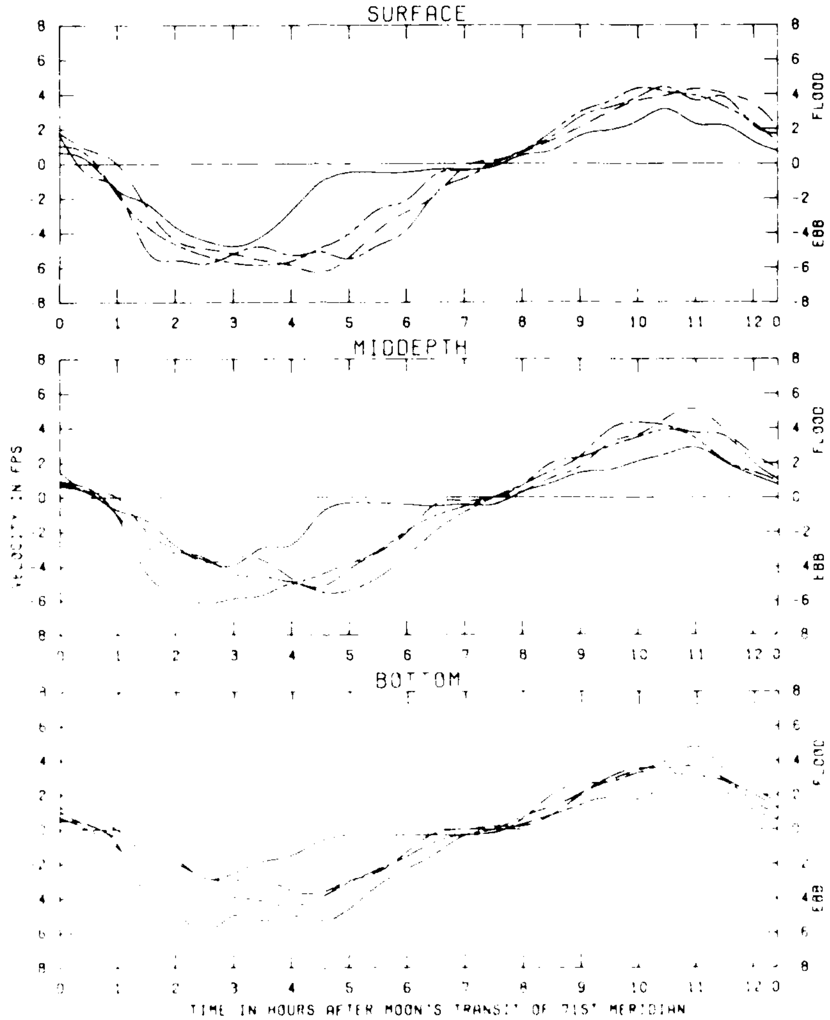
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C

EFFECTS OF
PLANS 3B, 2C AND D
ON VELOCITIES

STATION
5A



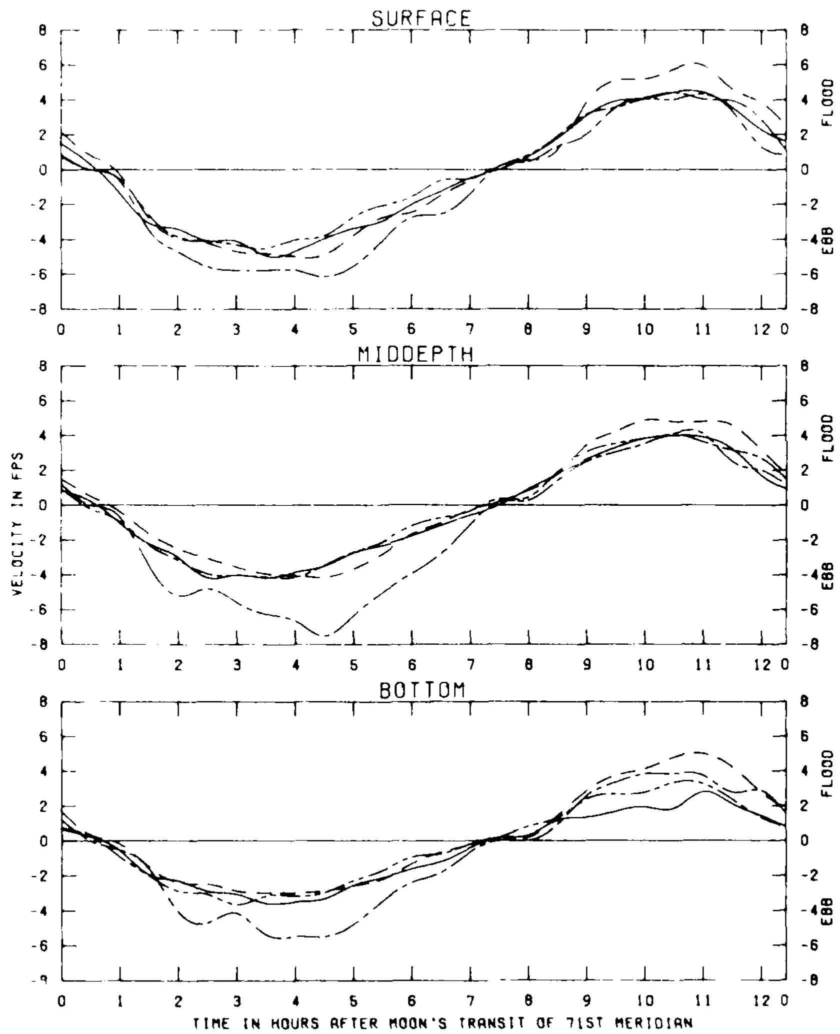
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN

EFFECTS OF
PLANS 3B, 2C AND
ON VELOCITIES

STATION
EB

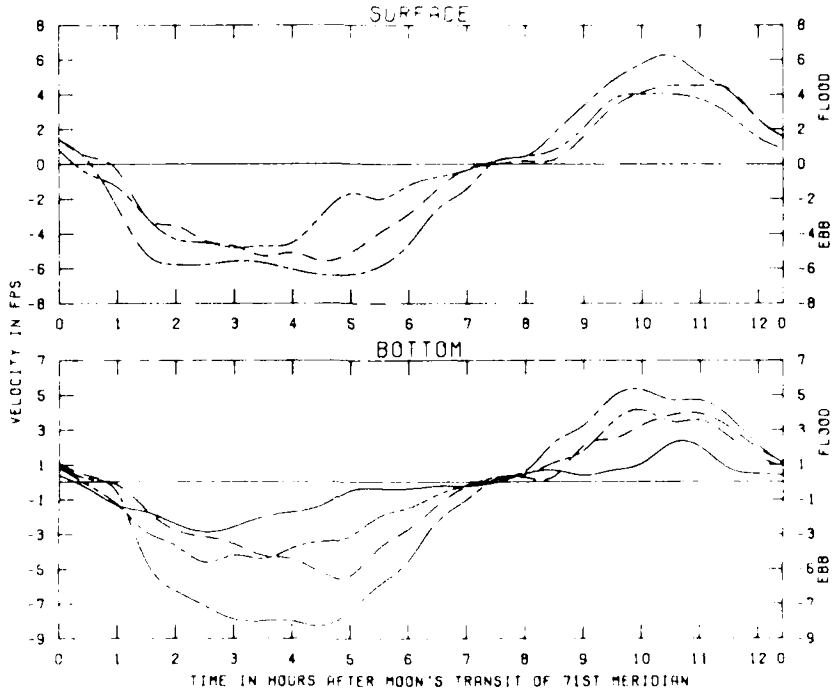


TE^ CONDITIONS
TIDE RANGE AT ..UE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 6000 CFS

EFFECTS OF
PLANS 3B,2C AND D
ON VELOCITIES

STATION
6C

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

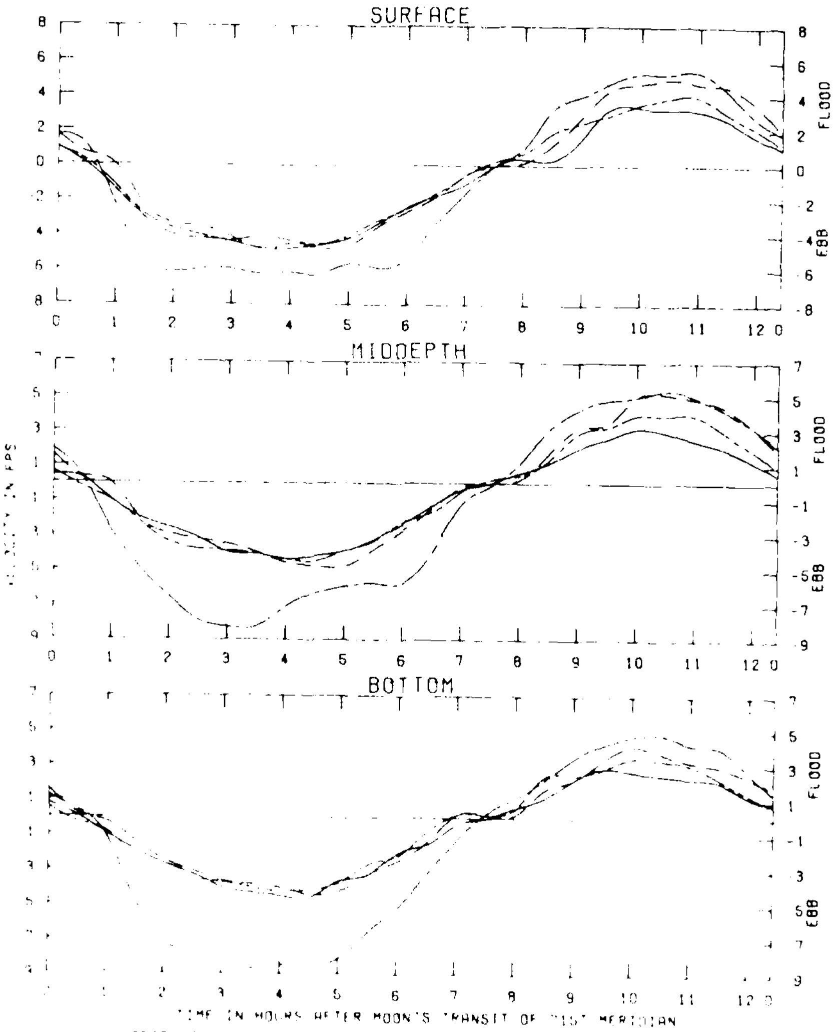


TEST CONDITIONS	
TIDE RANGE AT DADE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	23.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
PLANS 3B, 2C AND D
ON VELOCITIES

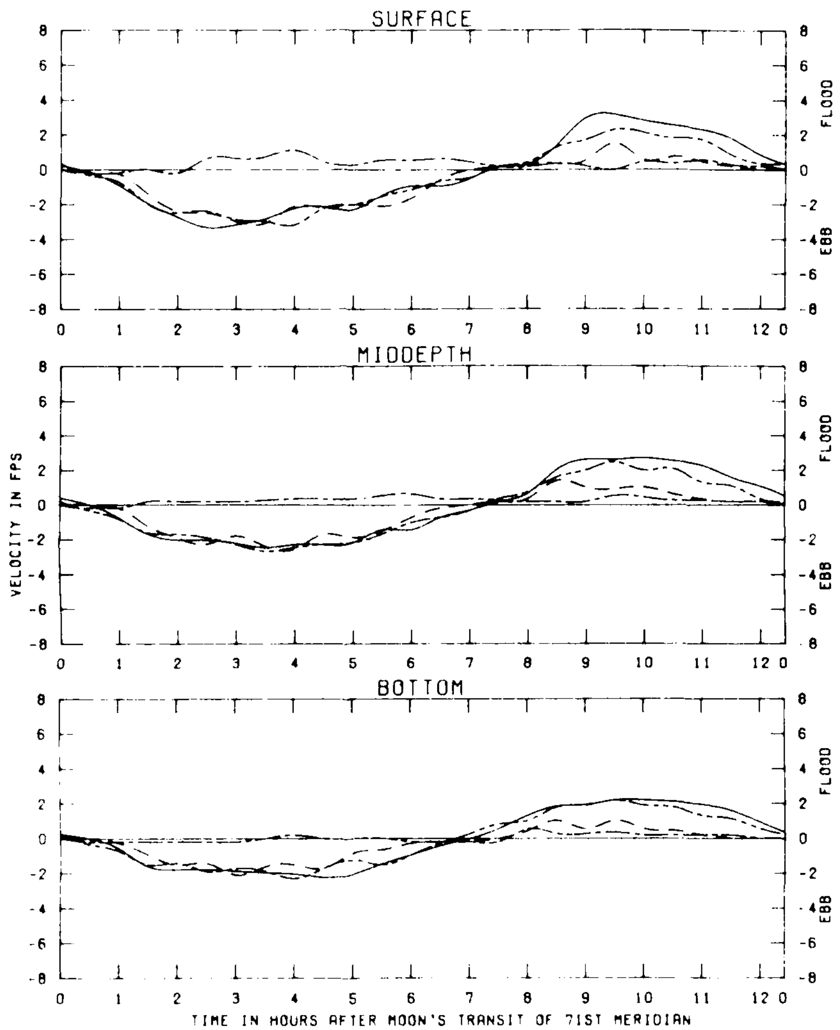
STATION
6A



TEST CONDITIONS
[illegible] RANGE [illegible] 9.6 FT
[illegible] 29.[illegible] PPT
FRESHWATER INFLOW 5000 [illegible]

[illegible]

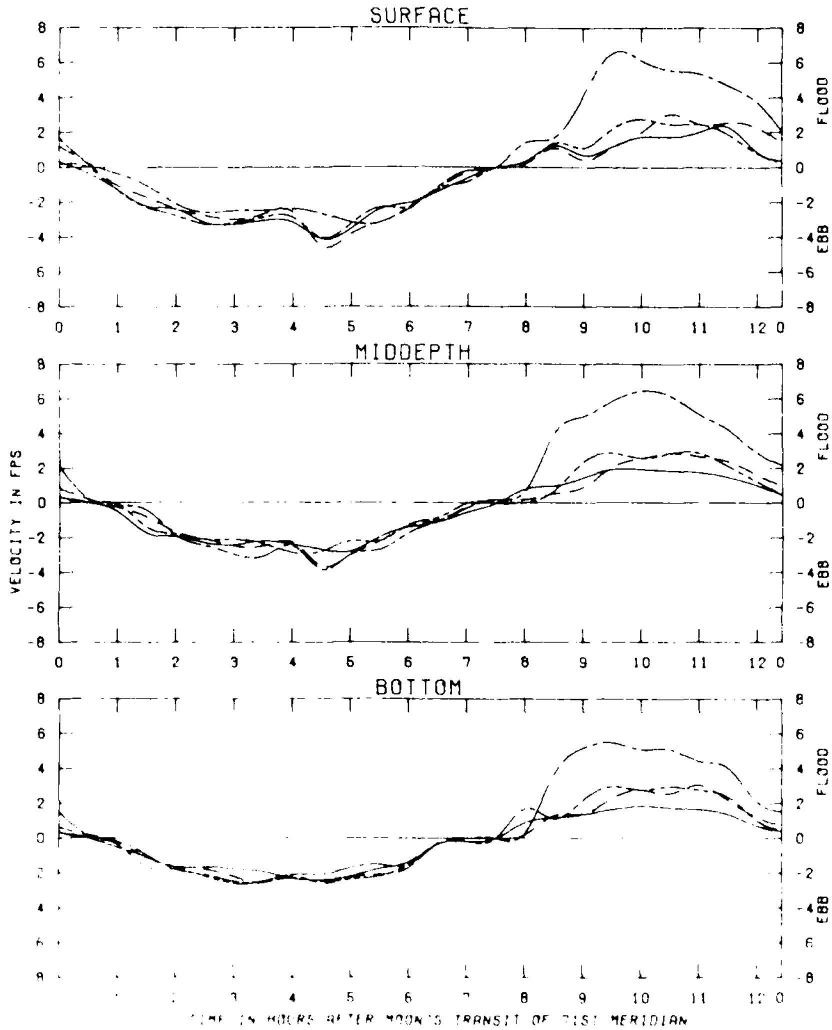
EFFECTS OF
[illegible]
ON VELOCITIES
STATION
68



TEST CONDITIONS
TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
PLANS 3B,2C AND D
ON VELOCITIES
STATION
6C



TEST CONDITIONS [illegible]

[illegible] 9.6 [illegible]

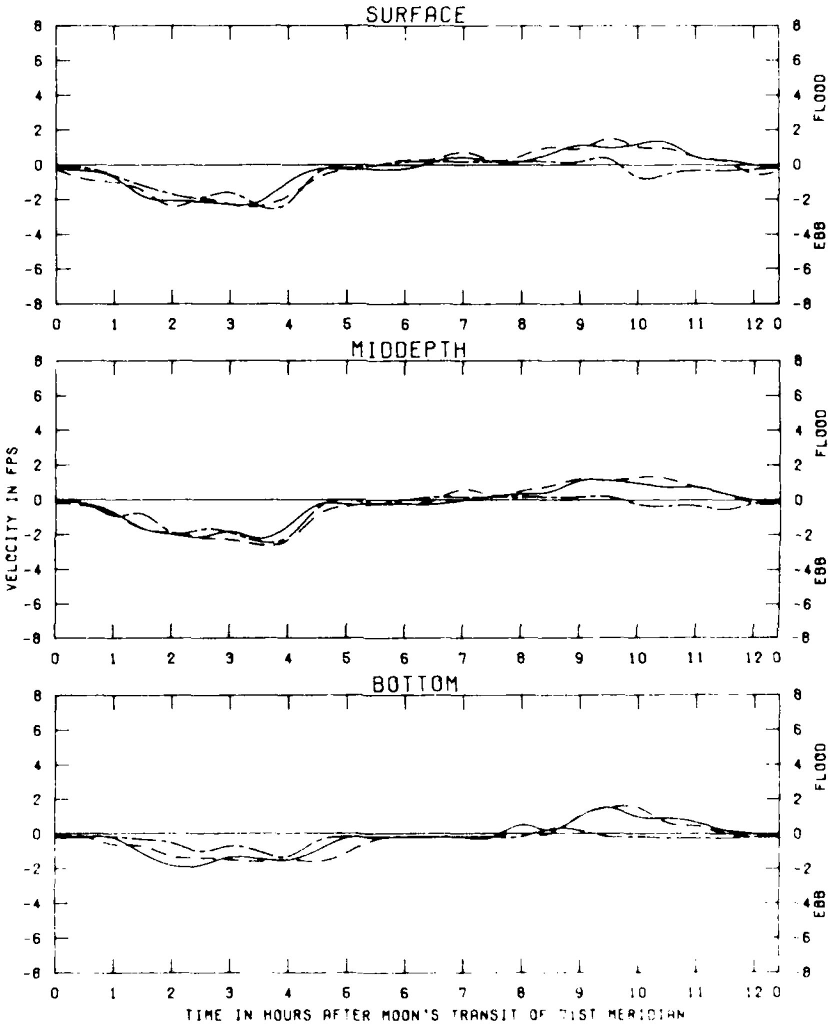
[illegible] 29.0 [illegible]

[illegible] 5000 [illegible]

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
[illegible] 3B, [illegible] AND D
ON VELOCITIES

STATION
[illegible]



TEST CONDITIONS

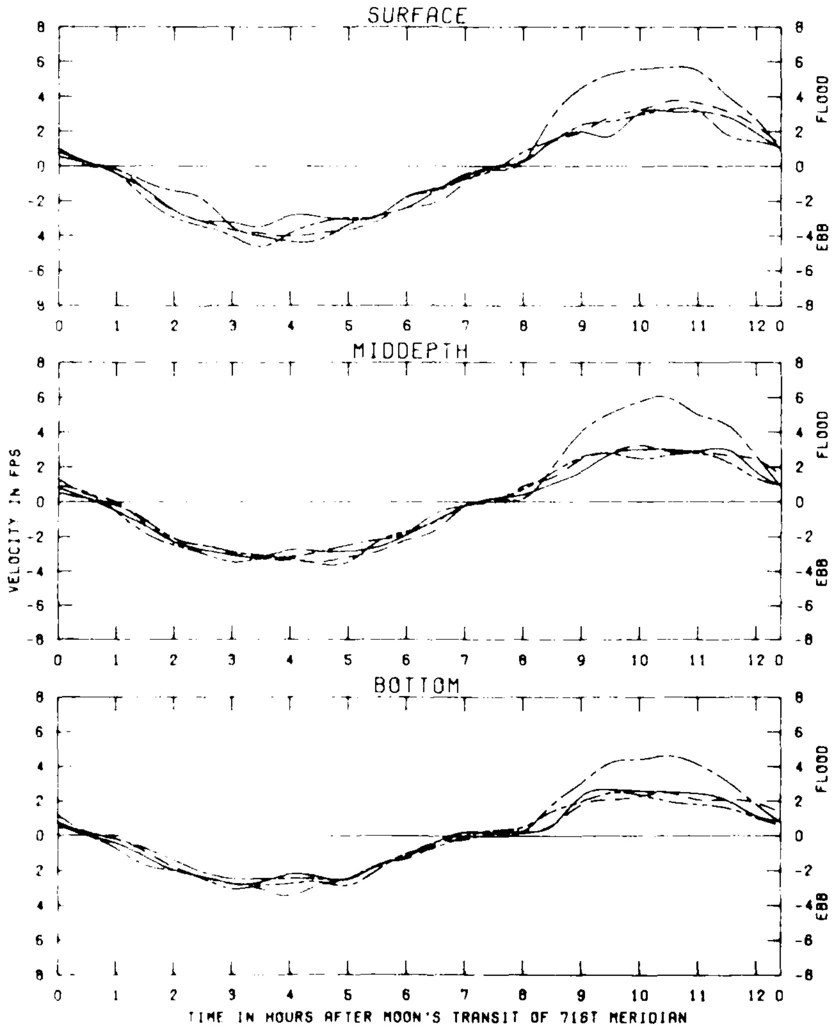
TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C

EFFECTS OF
PLANS 3B, 2C AND C
ON VELOCITIES

STATION
AB

PLATE 34

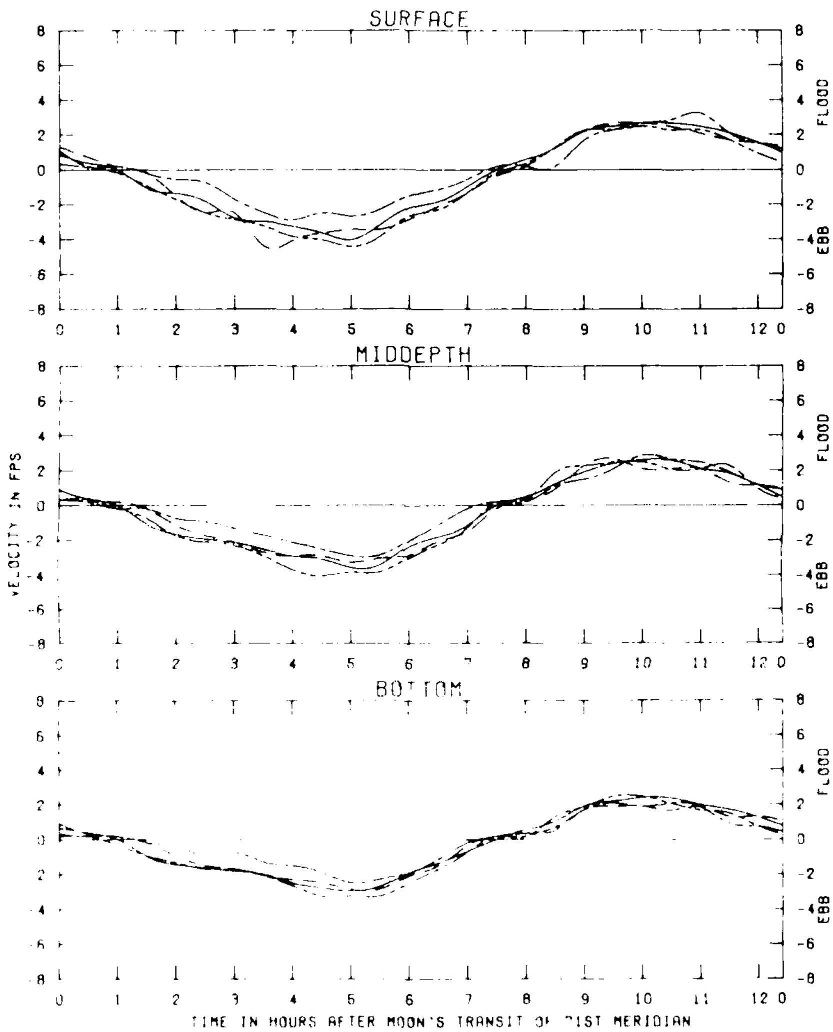


TEST CONDITIONS
TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 6000 CFS

EFFECTS OF
PLANS 3B,2C AND D
ON VELOCITIES

STATION
8C

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D



TEST CONDITIONS

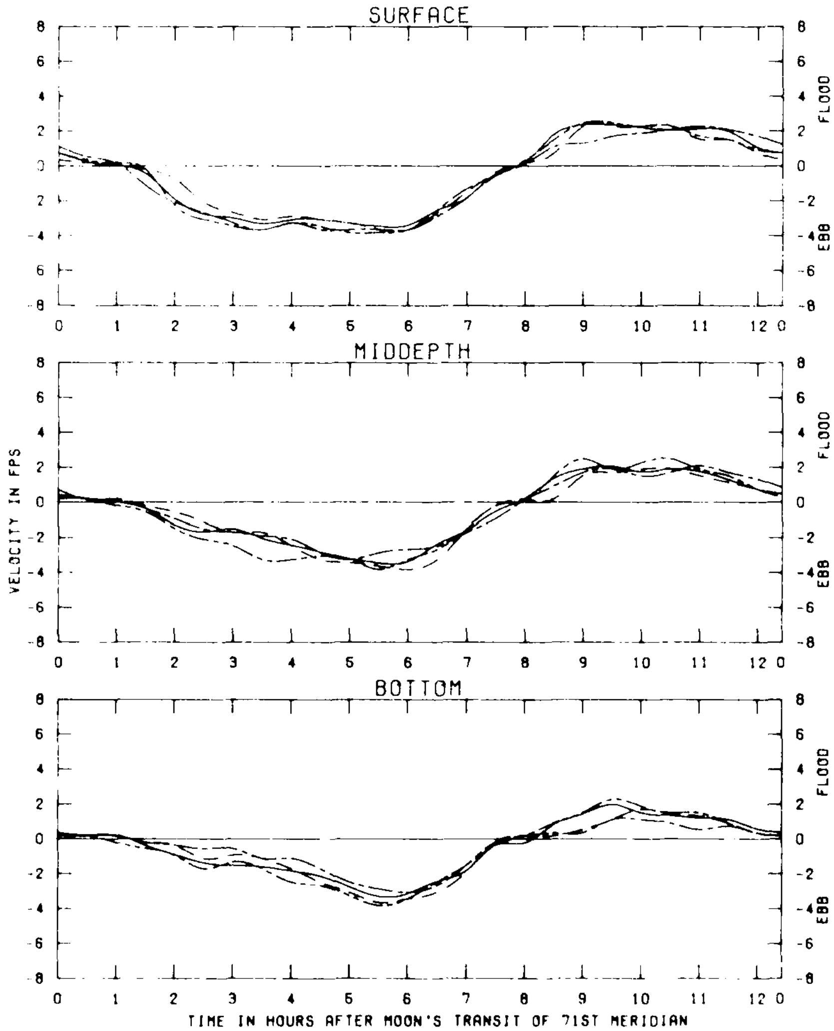
TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

EFFECTS OF PLANS 3B, 2C AND D ON VELOCITIES

STATION 12B

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

PLATE 36



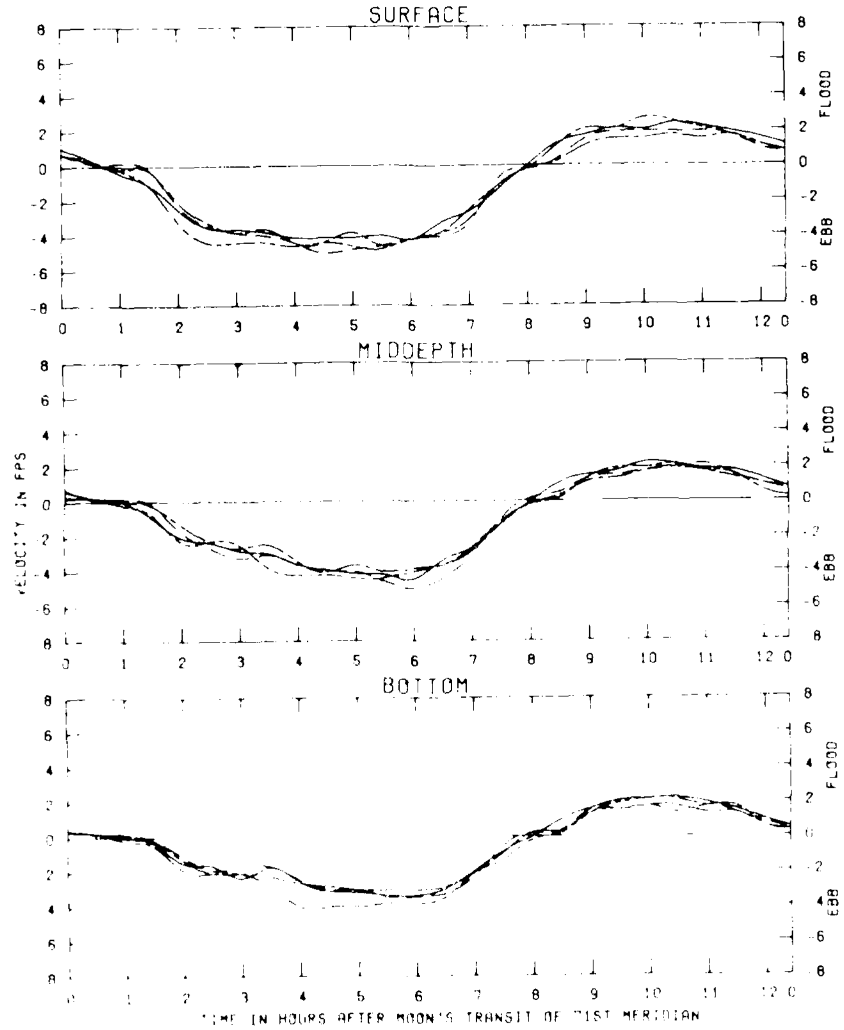
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
PLANS 3B,2C AND D
ON VELOCITIES

STATION
160



TEST CONDITIONS

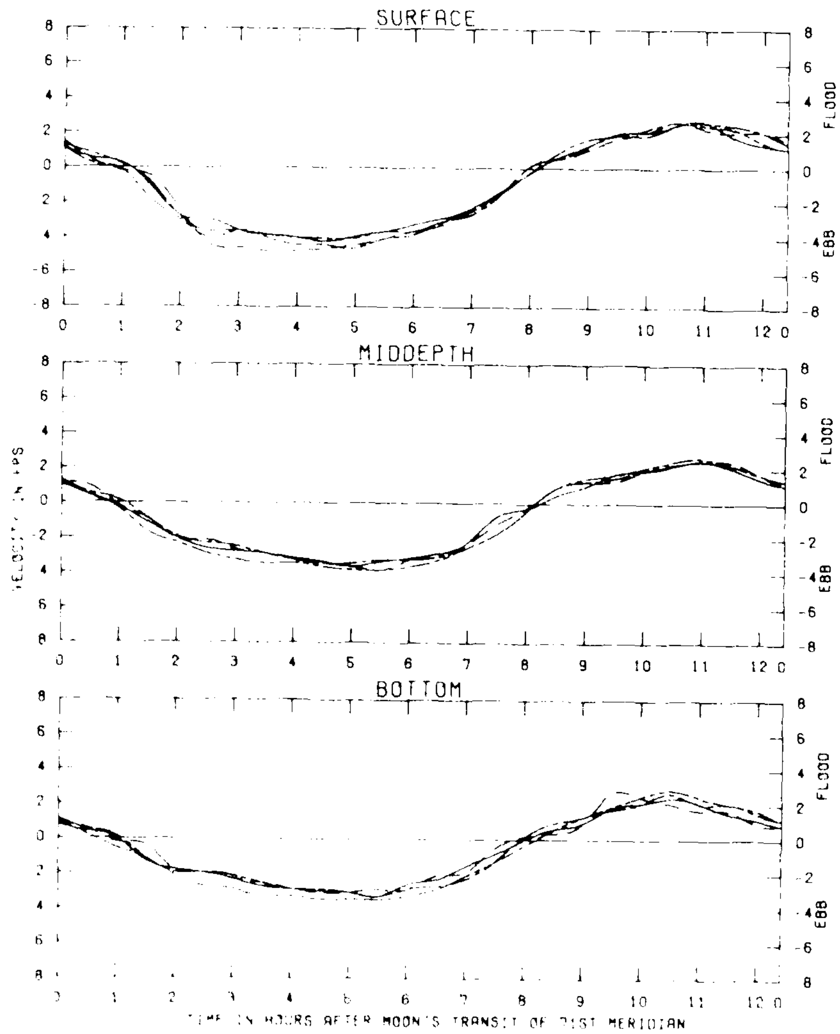
TIDE RANGE AT	9.6 FT
OCEAN SALINITY	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN

EFFECTS OF
PLANS 3B, AND
ON

STATION

PLATE

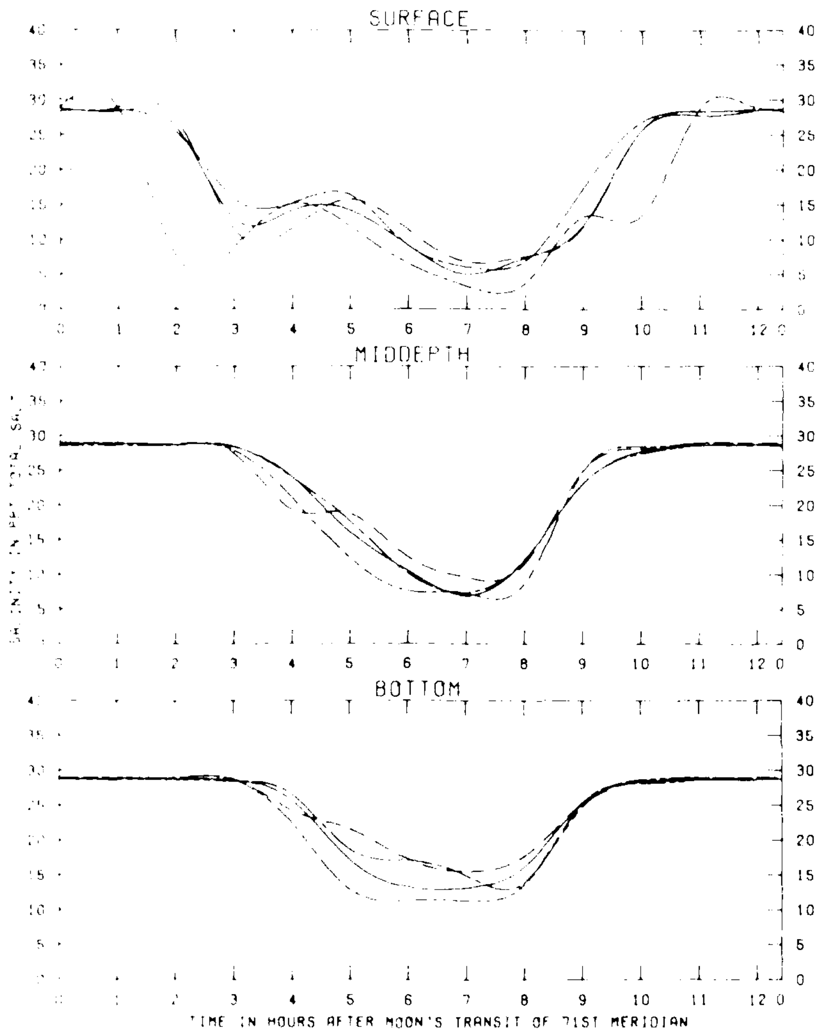


TEST CONDITIONS

TIDE RANGE AT [illegible]	9.6 FT
OCEAN SALINITY [illegible]	29.0 PPT
FRESHWATER INFLOW	5000 [illegible]FS

LEGEND
BASE
PLAN 3B
PLAN [illegible]
PLAN [illegible]

EFFECTS OF
PLANS 3B, [illegible] AND [illegible]
ON VELOCITIES
STATION
[illegible]



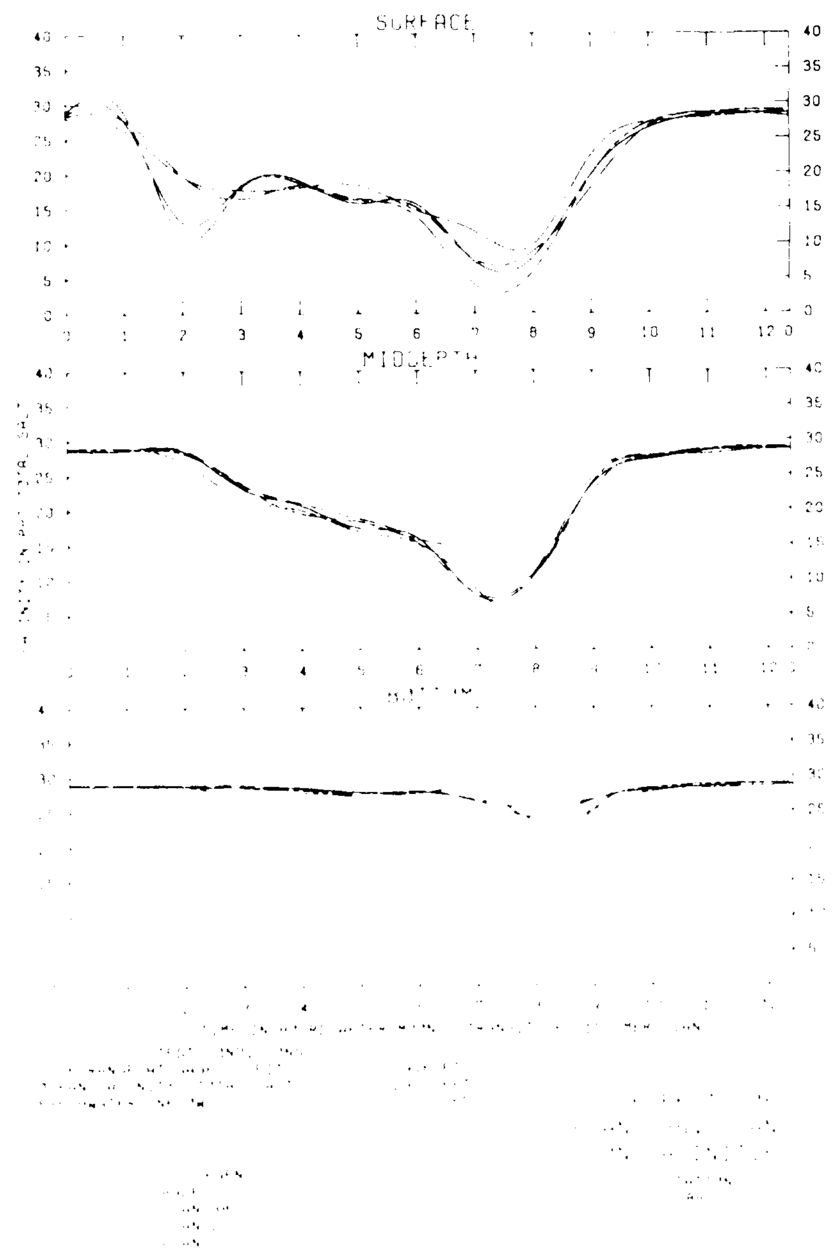
TEST CONDITIONS

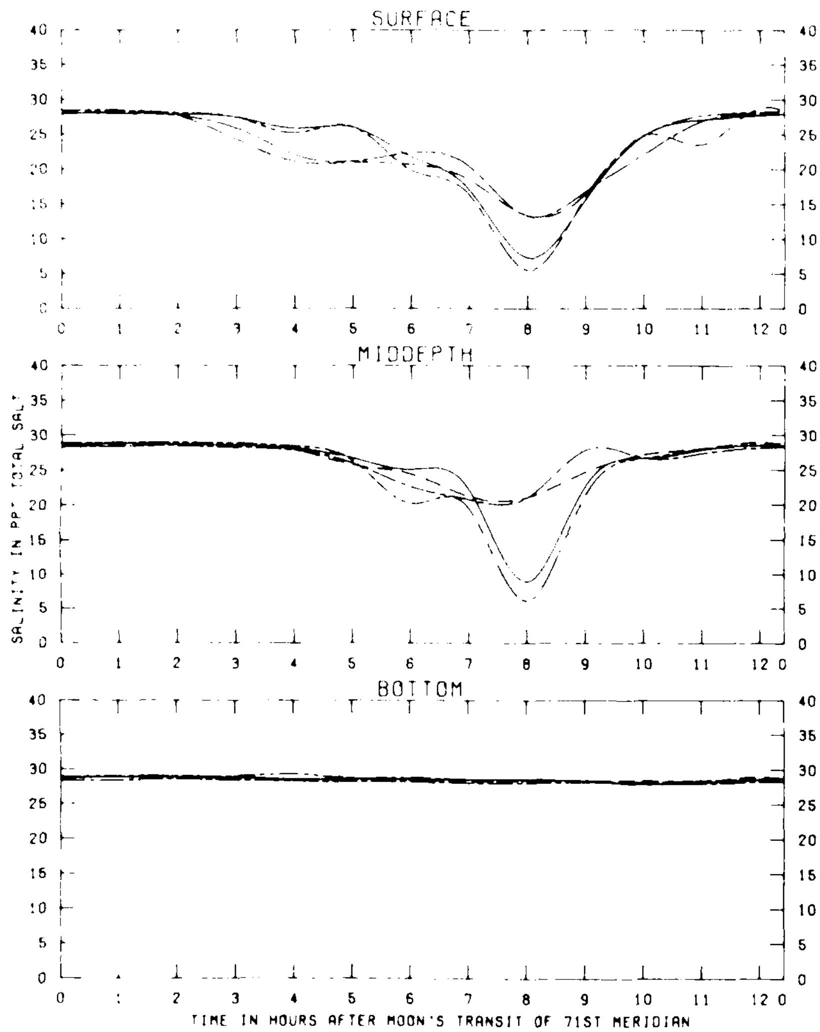
TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
MEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN

EFFECTS OF
PLANS 3B, 2C AND
ON SALINITIES

STATION
8C





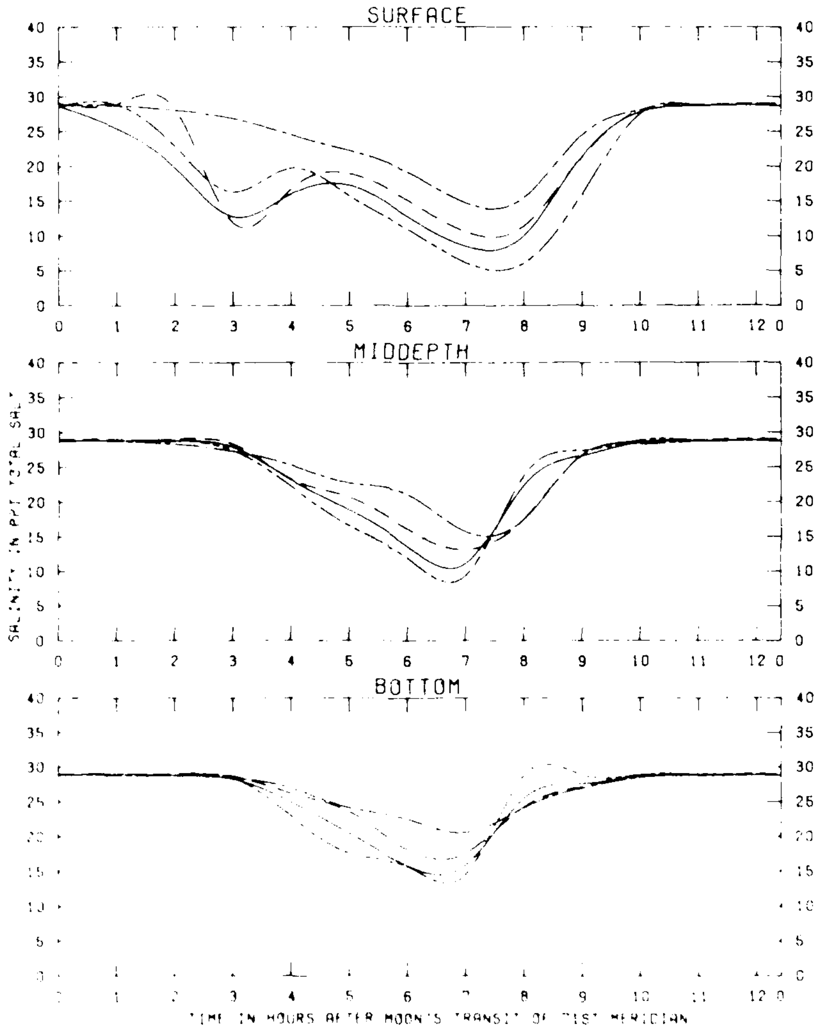
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

EFFECTS OF
PLANS 3B, 2C AND D
ON SALINITIES

STATION
8A

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

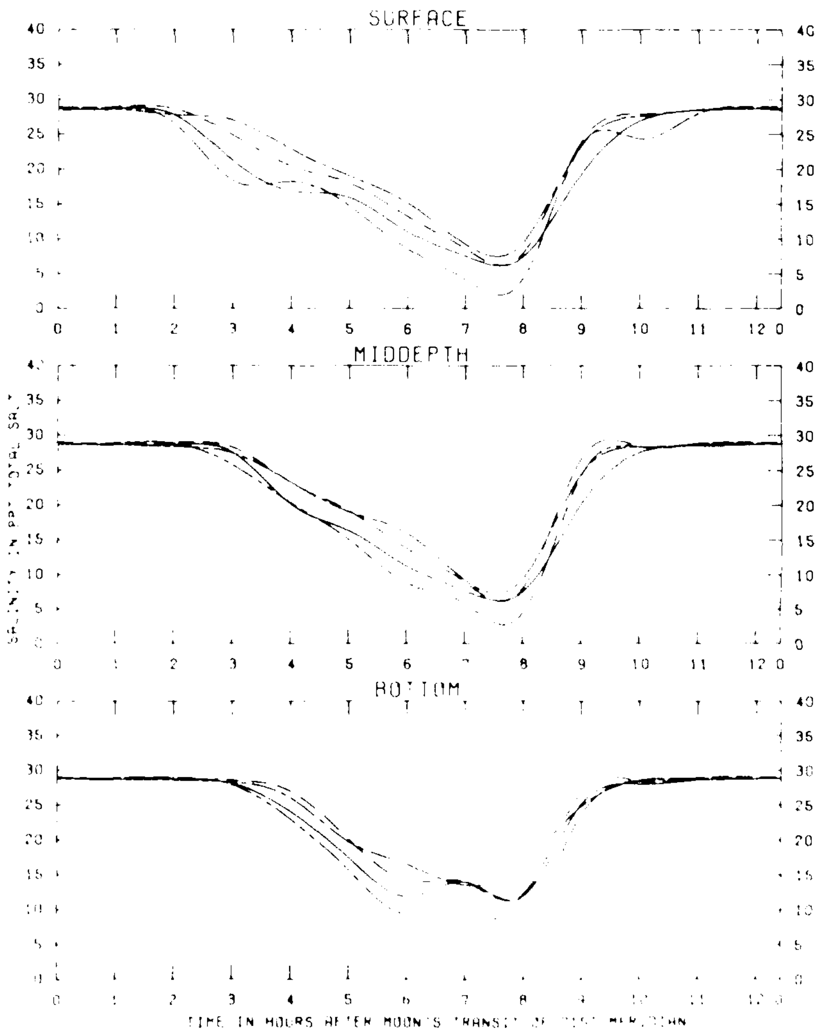


TEST CONDITIONS
TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN 2D

EFFECTS OF PLANS 3B, 2C, AND 2D ON SALINITIES
STATION

PLATE 108

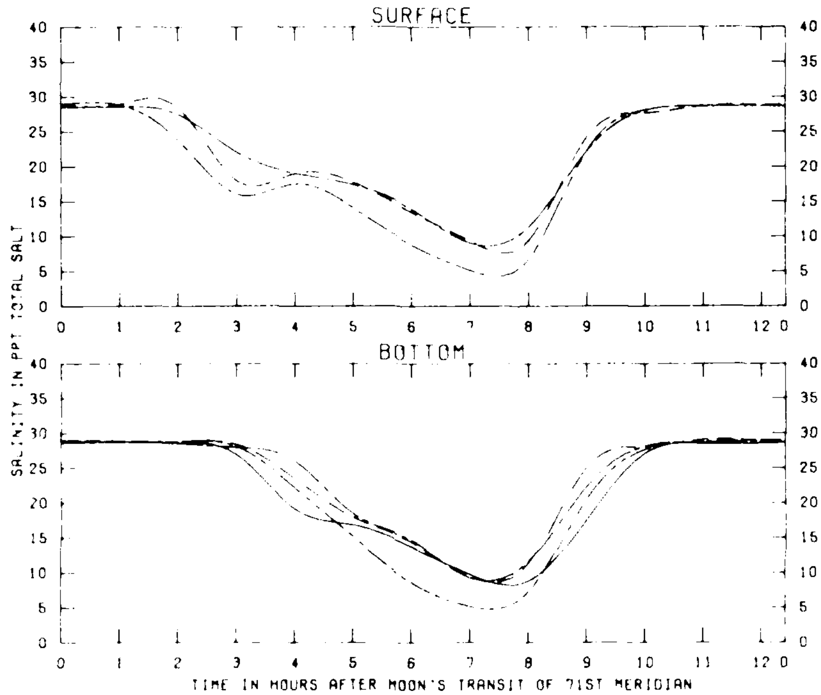


TEST CONDITIONS

TIDE RANGE AT [illegible] 9.6 FT
[illegible] SALINITY [illegible] 29 [illegible] PPT
FRESHWATER INFLOW 5,[illegible]

LEGEND
BASE
PLAN [illegible]
[illegible]
[illegible]

STATION
[illegible]

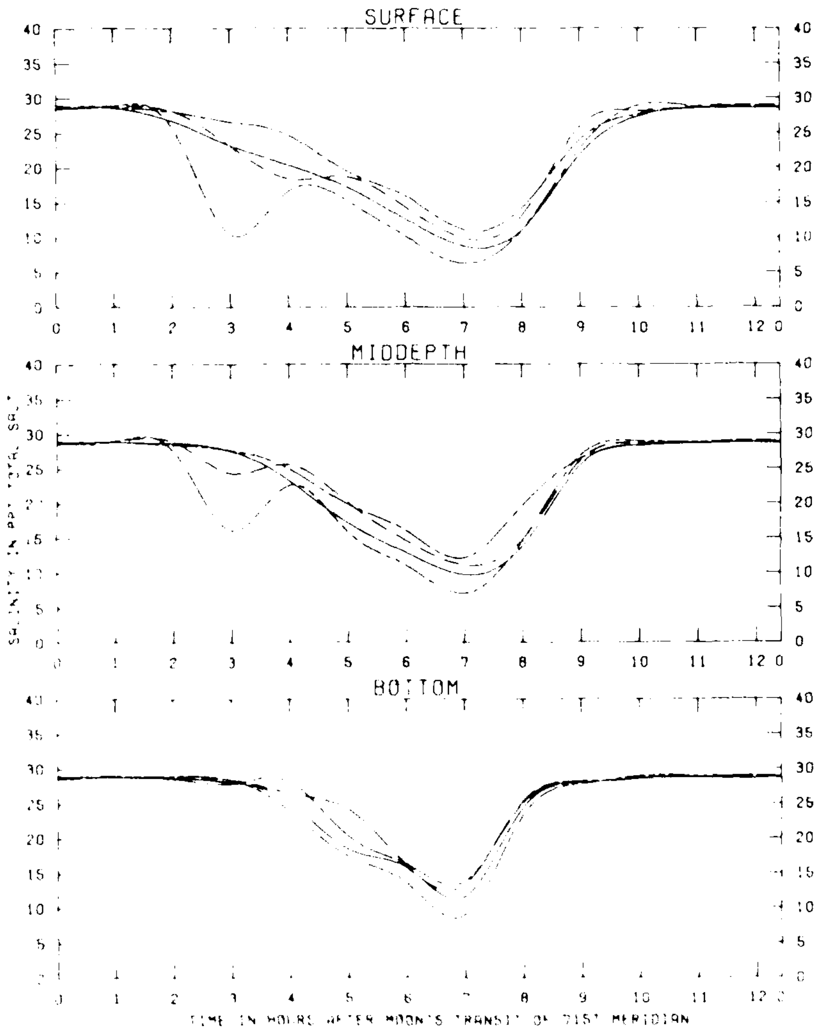


TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
MEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN 3D

EFFECTS OF
PLANS 3B, 2C AND 3D
ON SALINITIES
STATION
6A



TEST CONDITIONS

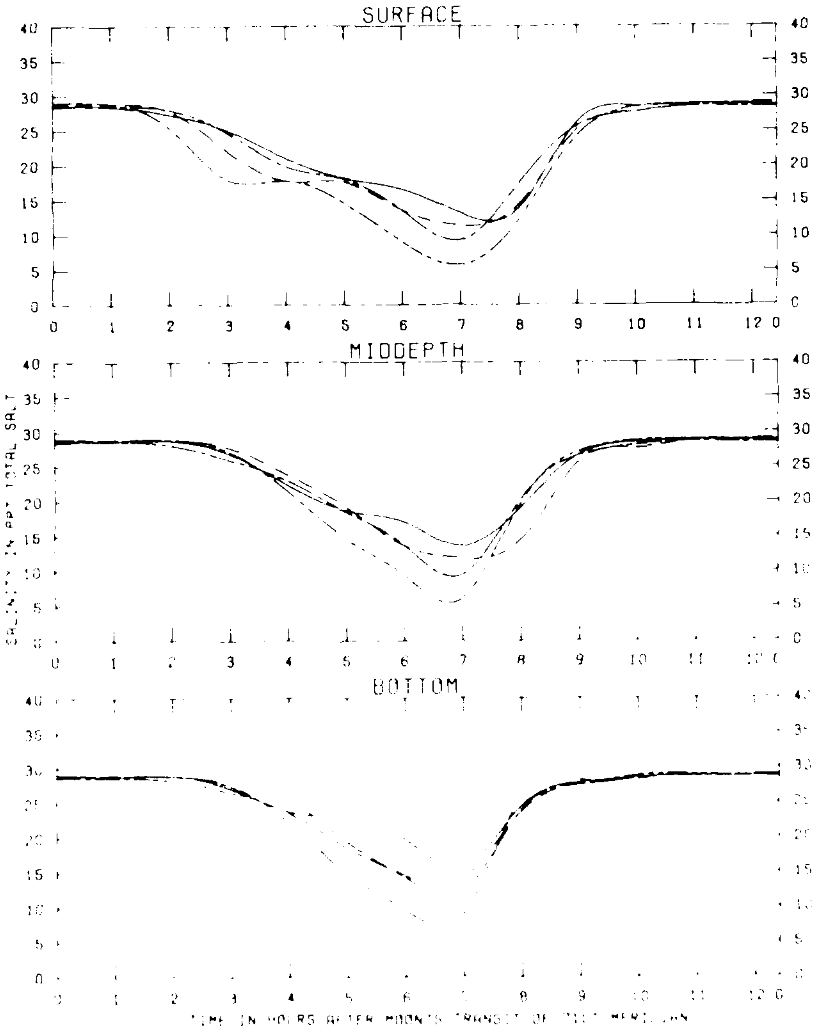
TIDE RANGE AT ... 9.6 FT
MEAN SALINITY (TOTAL SALT) 29.0
FRESHWATER INFLOW ... CFS

LEGEND

BASE
PLAN 3B
PLAN 2C
PLAN

EFFECTS OF
PLANS 3B, 2C AND
ON SALINITIES

STATION

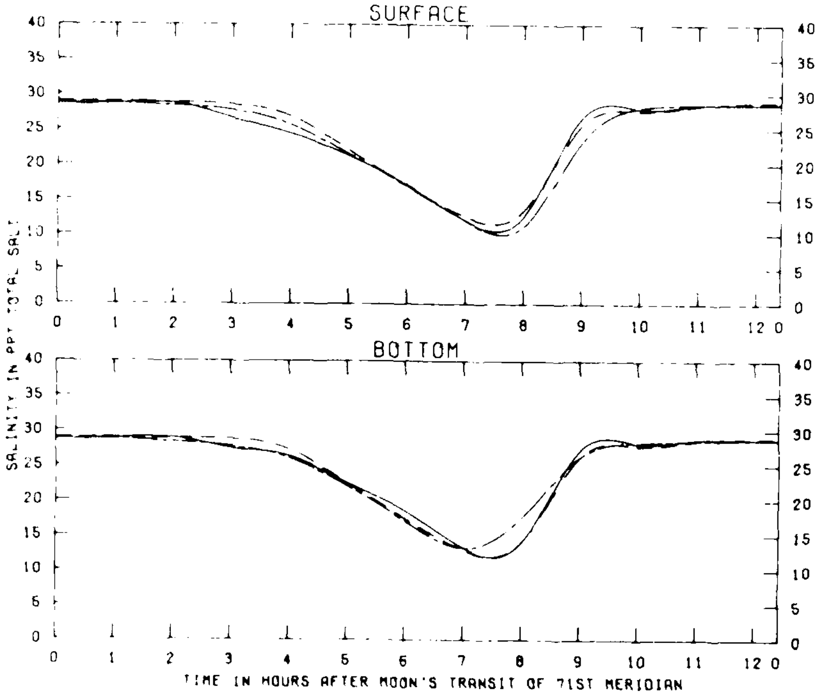


TEST CONDITIONS

TIDE RANGE AT GAGE — 9.6 FT
OCEAN SALINITY (TOTAL SALT) — 29.0 PPT
FRESHWATER INFLOW — 5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN

EFFECT OF



TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
PLANS 3B,2C AND D
ON SALINITIES

STATION
6A

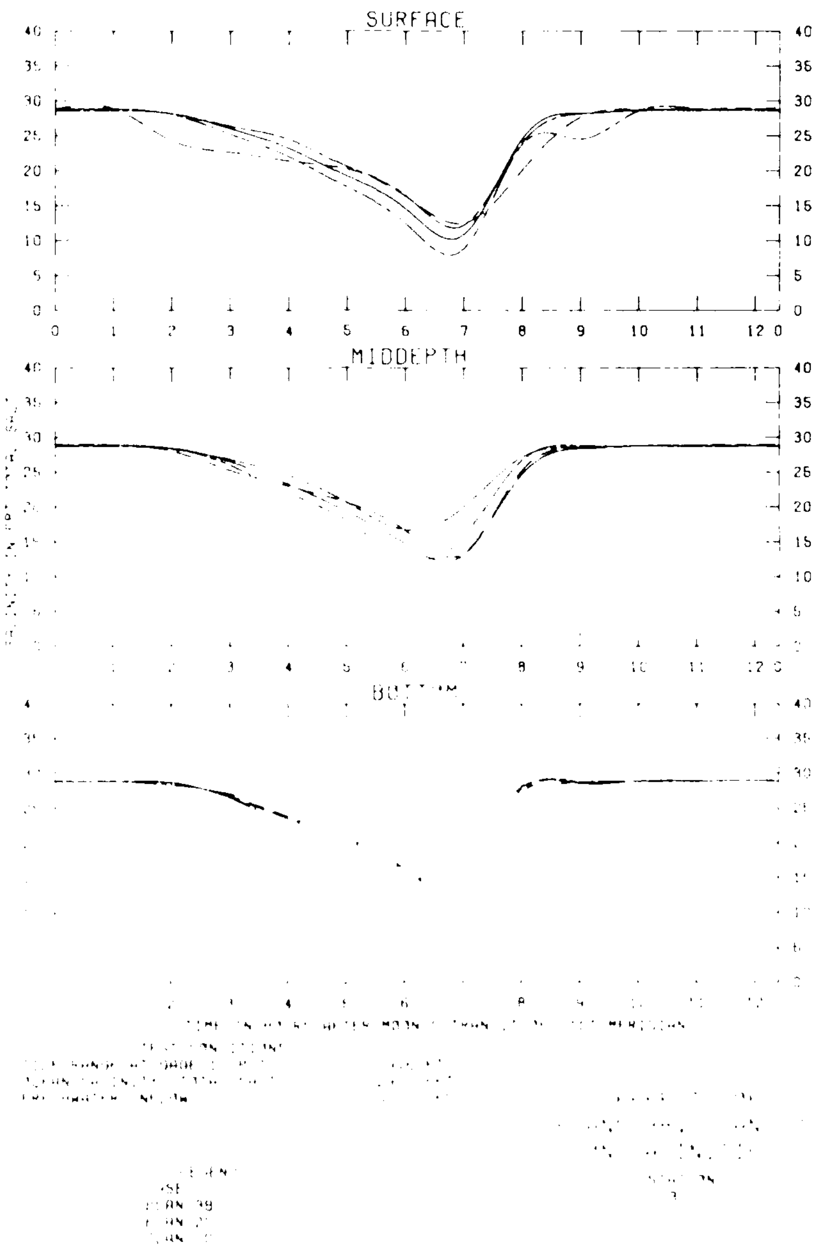
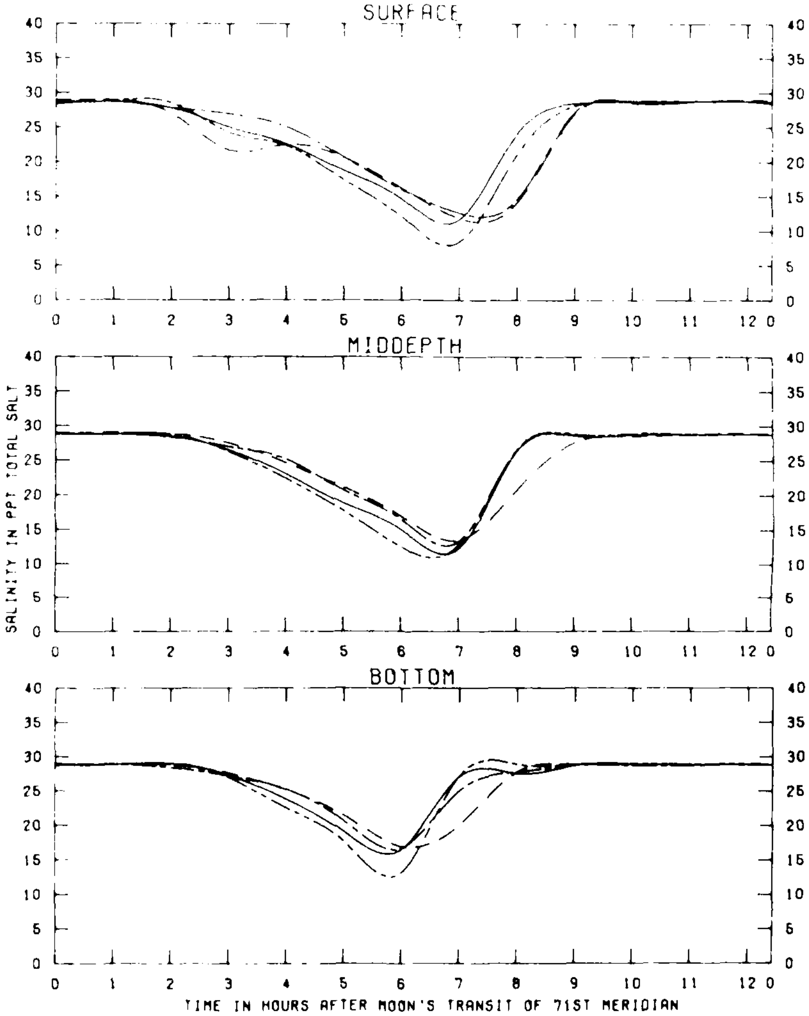


Plate 4



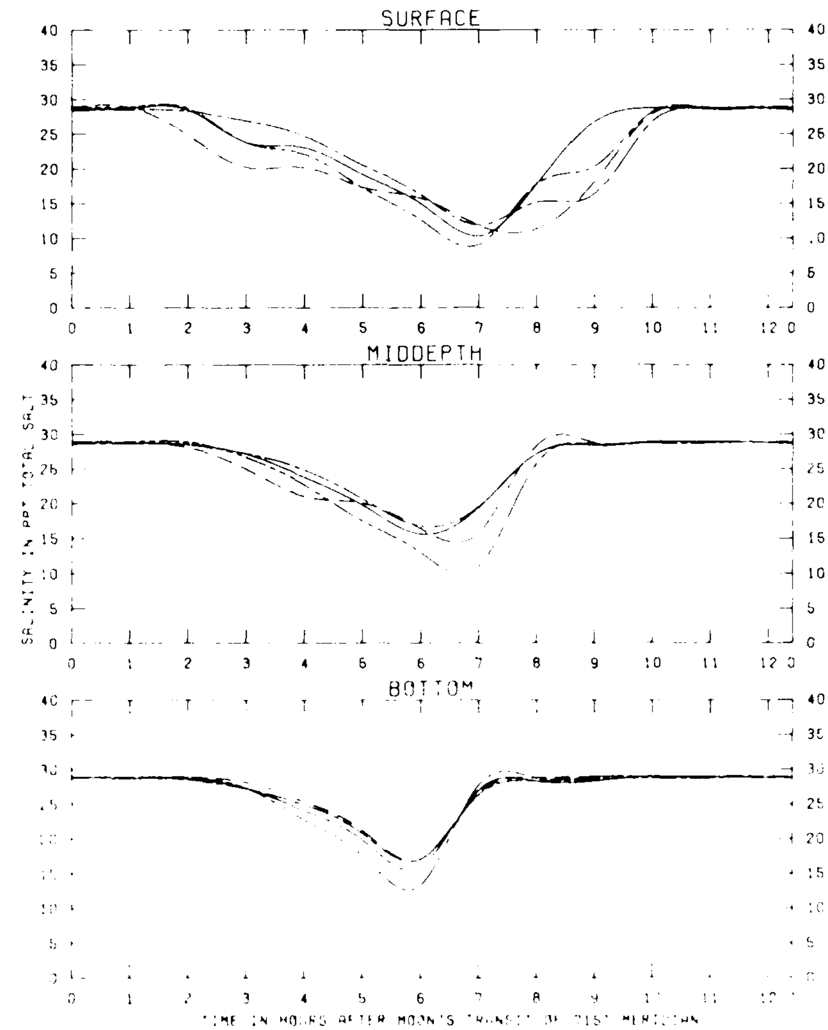
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
PLANS 3B,2C AND D
ON SALINITIES

STATION
3B

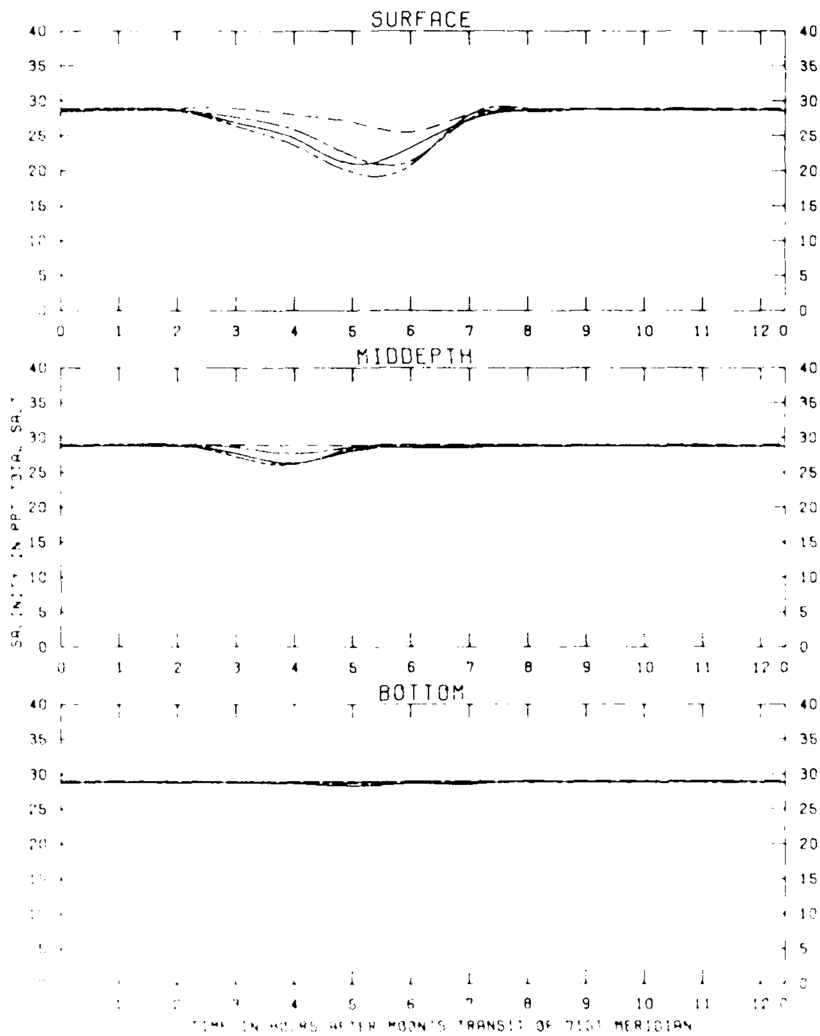


TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

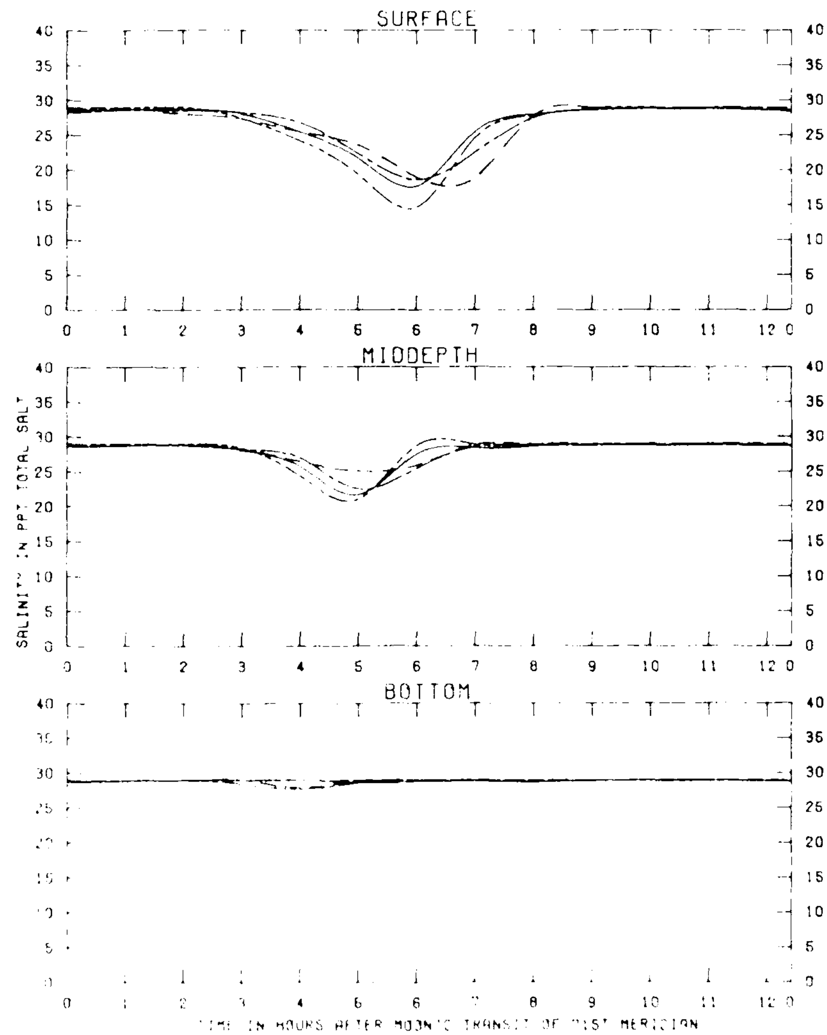
LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN 2

PLATE 92



9.6
29.
EFFECTS OF
ON SALINITY
STATION

PLATE 91

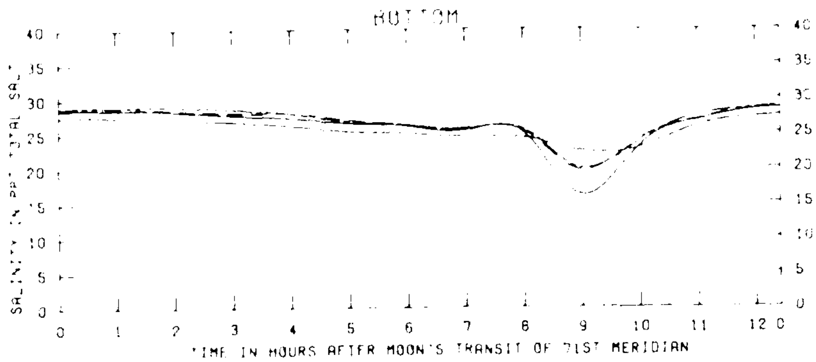


TEST CONDITIONS

TIDE RANGE AT DADE 1 (FT)	9.5 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

LEGEND
BASE
PLAN 3B
PLAN 3C
PLAN 3D

EFFECTS OF
PLANS 3B, 3C AND 3D
ON SALINITIES
STATION
9A


BOTTOM
SALINITY IN PPT TOTAL SALT
0
5
10
15
20
25
30
35
40
0 1 2 3 4 5 6 7 8 9 10 11 12 0
TIME IN HOURS AFTER MOON'S TRANSIT OF 71ST MERIDIAN

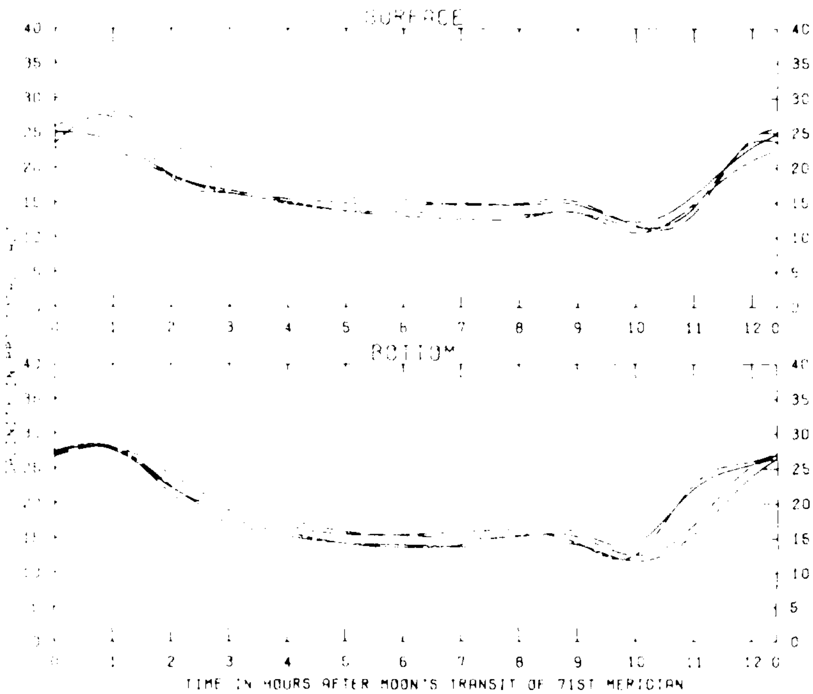
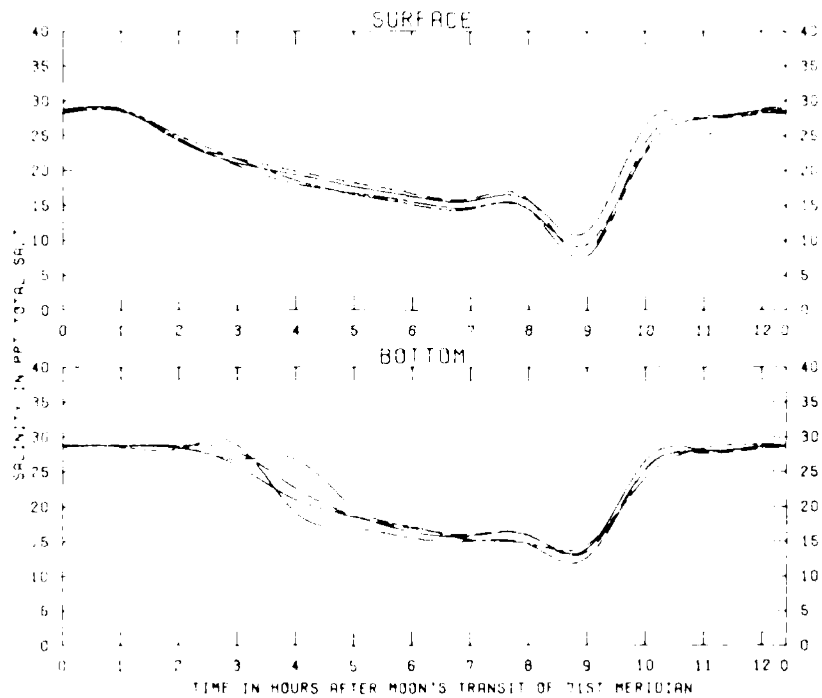

SURFACE
BOTTOM
TIME IN HOURS AFTER MOON'S TRANSIT OF 71ST MERIDIAN

PLATE 105



SURFACE
BOTTOM
SALINITY IN PPT TOTAL SALT
TIME IN HOURS AFTER MOON'S TRANSIT OF 75TH MERIDIAN

PLATE 106

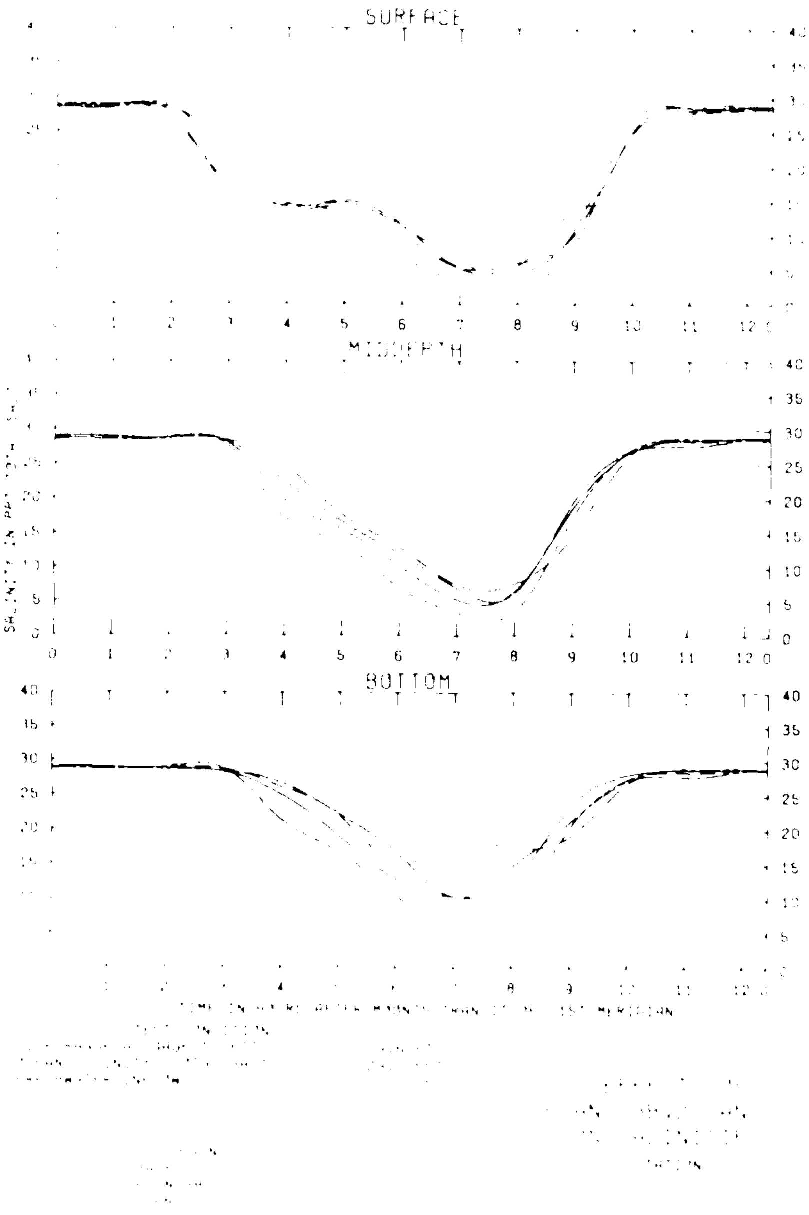
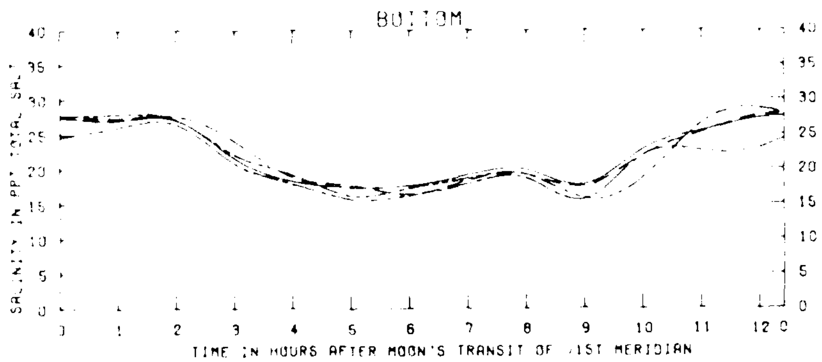


PLATE 107



TEST CONDITIONS

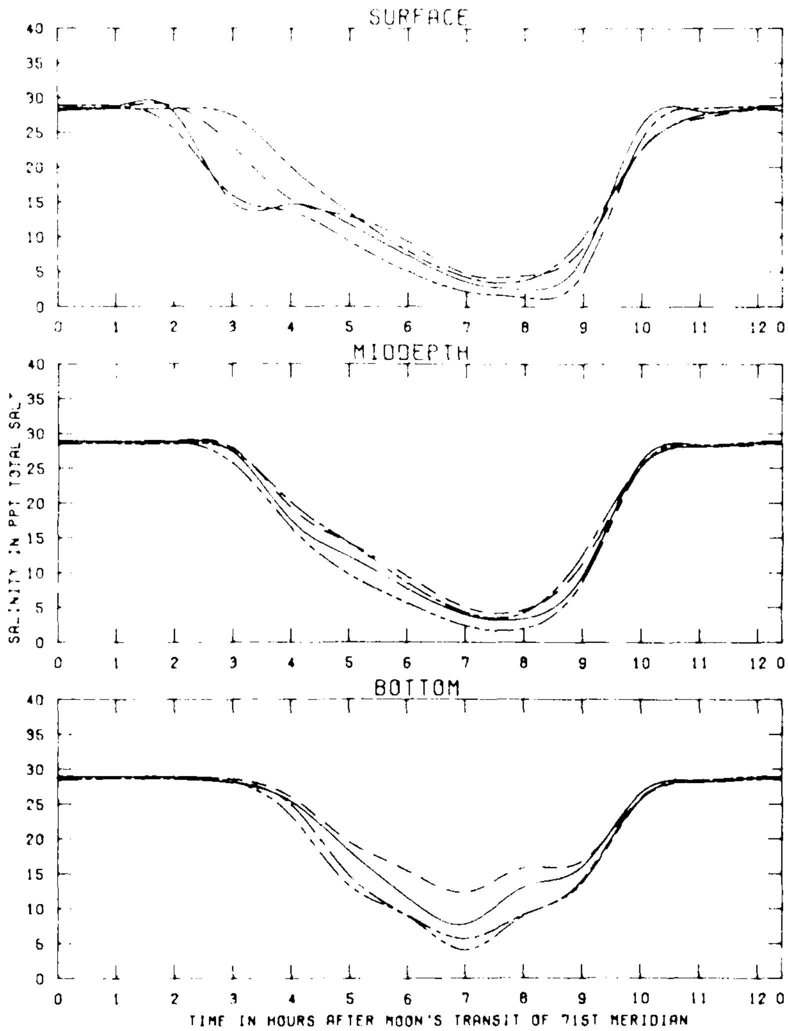
TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
PLANS 3B, 2C AND D
ON SALINITIES

STATION
12A

PLATE 108



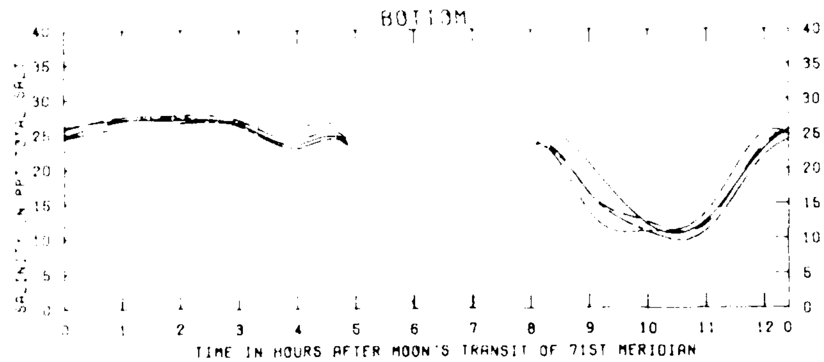
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
PLANS 3B, 2C AND D
ON SALINITIES

STATION
12B



TEST CONDITIONS

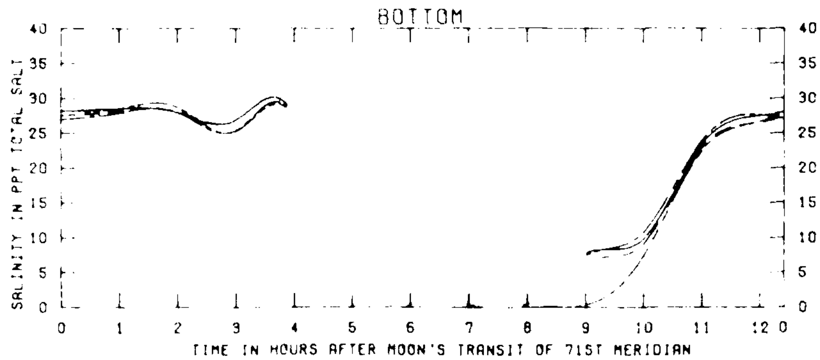
TIDE RANGE AT GAGE 1 (PIT)	3.6 FT
MEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
PLANS 3B, 2C AND D
ON SALINITIES

STATION
16A

PLATE 116



TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND

BASE

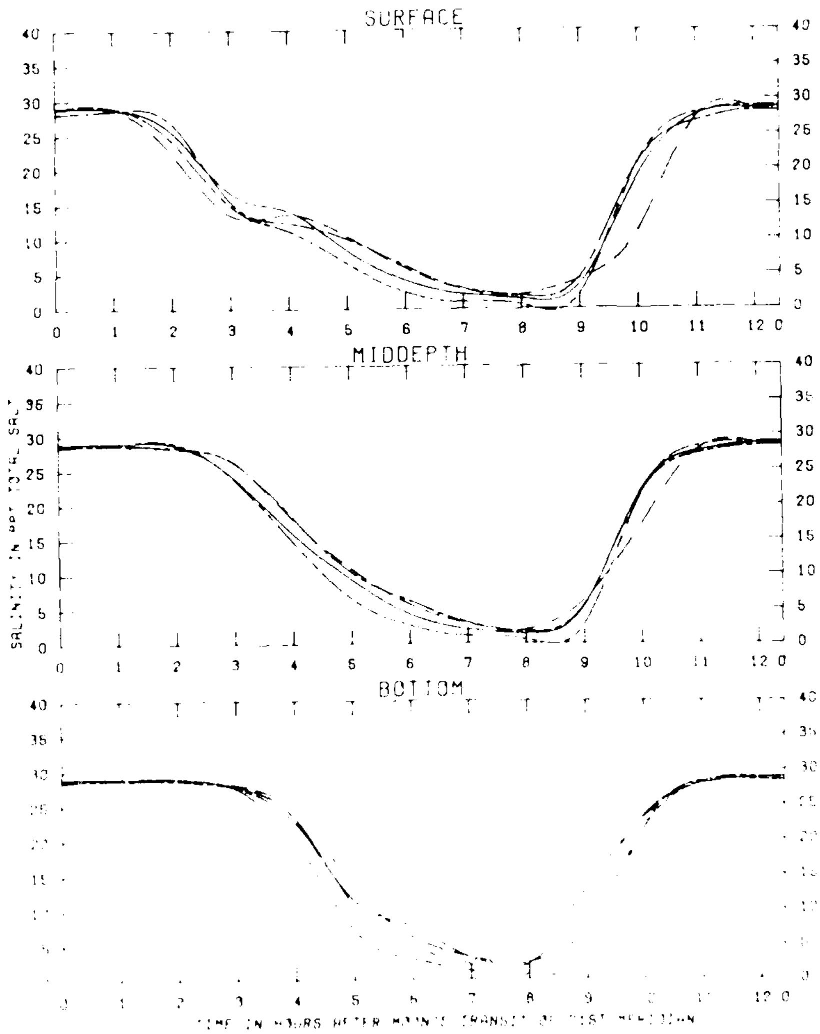
PLAN 3B

PLAN 2C

PLAN D

EFFECTS OF
PLANS 3B, 2C AND D
ON SALINITIES

STATION
168



BASE

PLATE 112

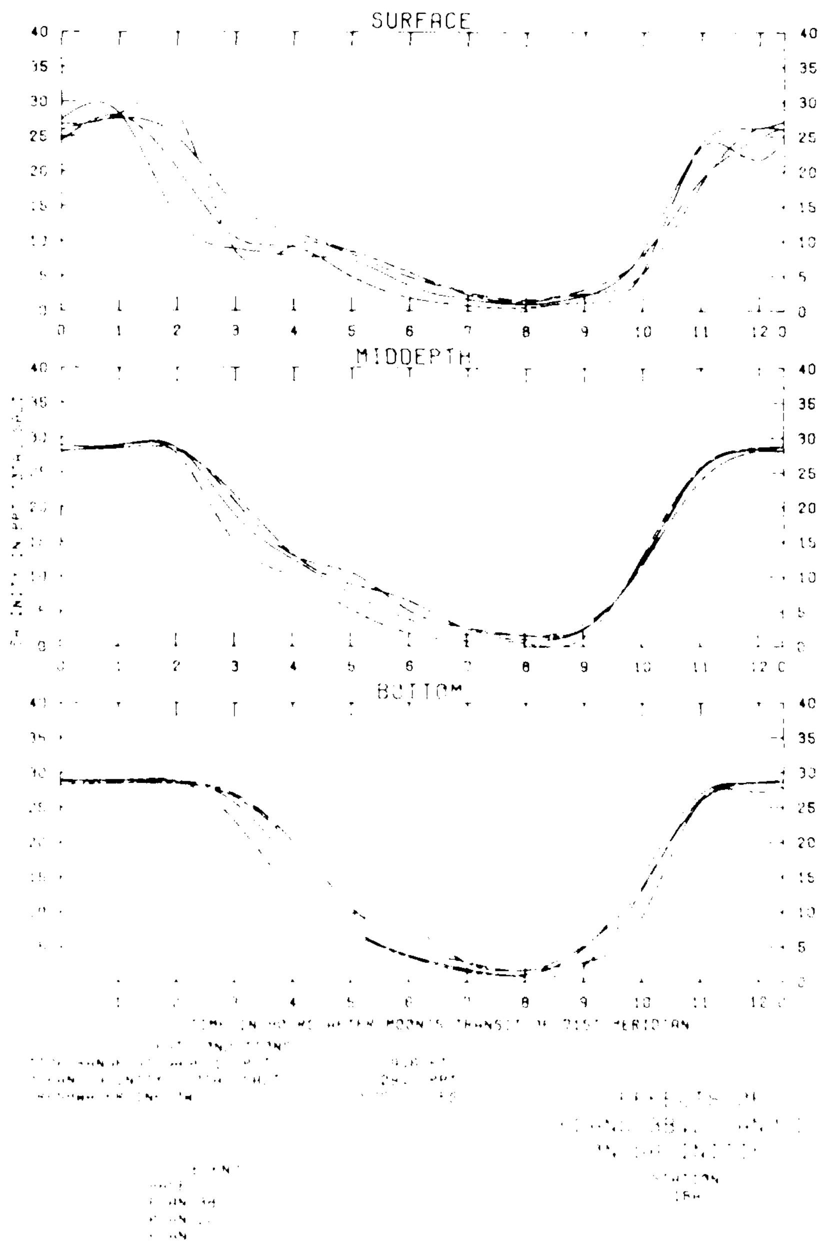
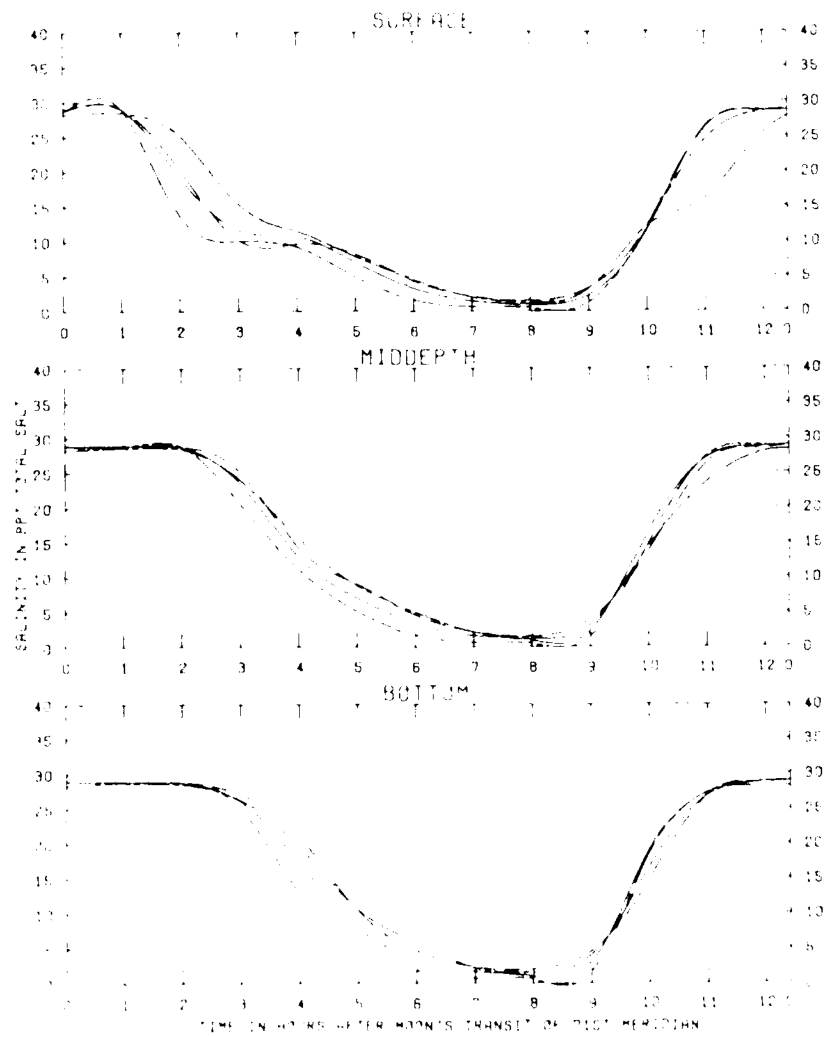


PLATE 113



TEST CONDITIONS
TIDE RANGE AT DAOR ... 9.6 FT
MEAN SALINITY ... 29.0 PPT
FRESHWATER INFLOW ...

LEGEND
BASE
PLAN 3B

STATION

PLATE 113

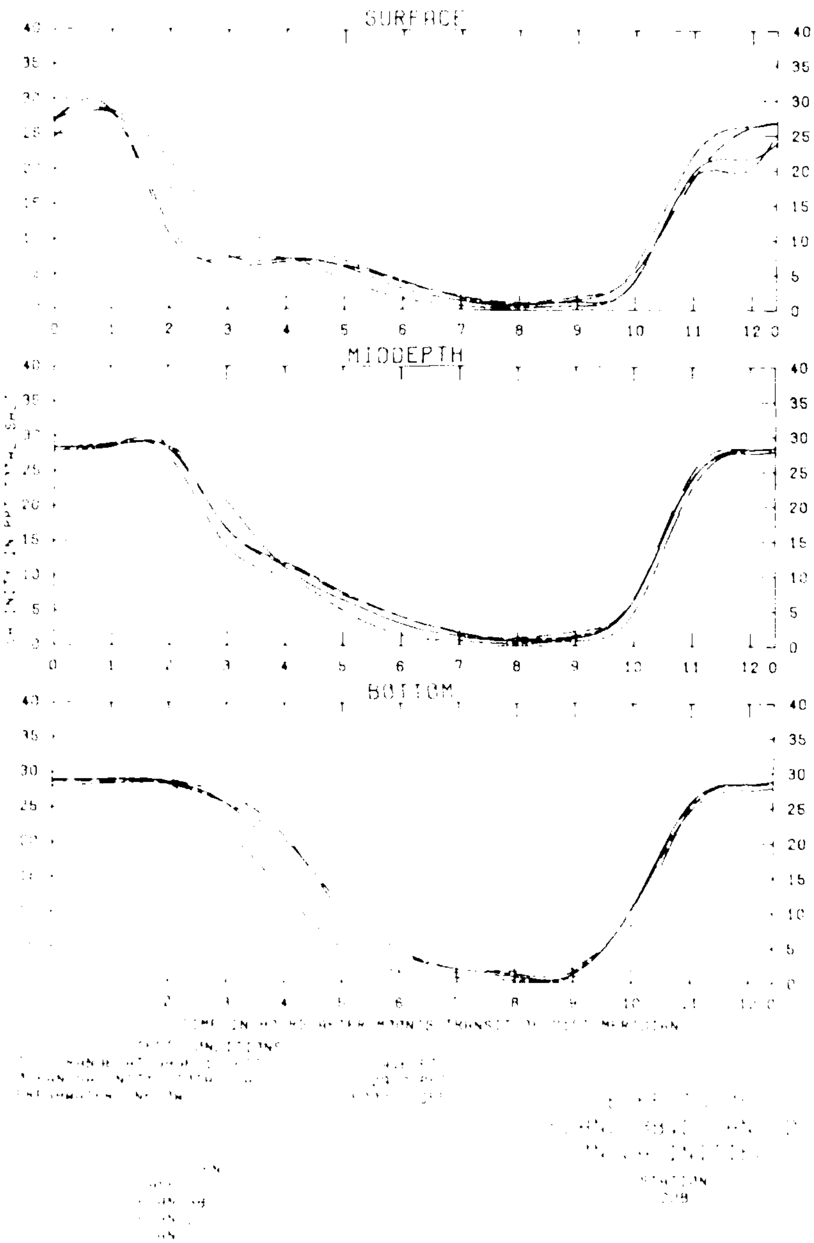


PLATE 115

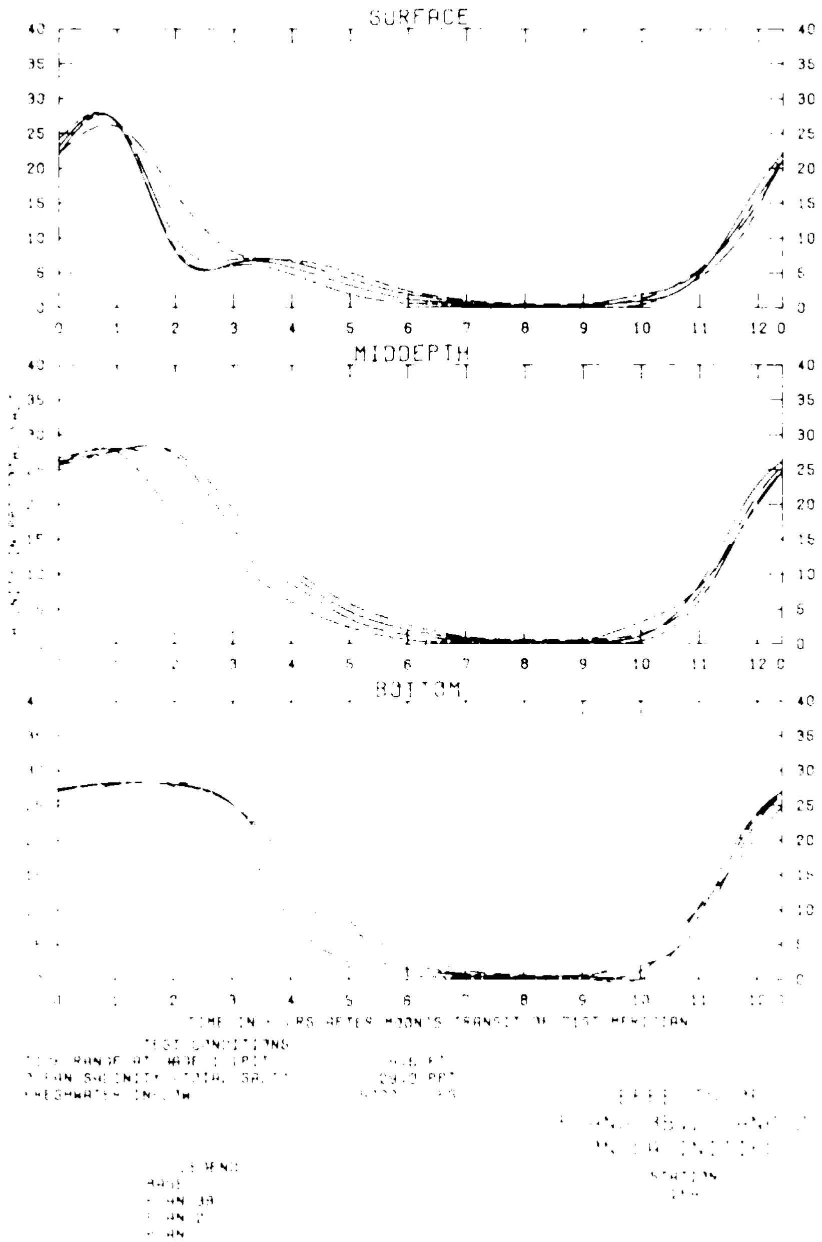
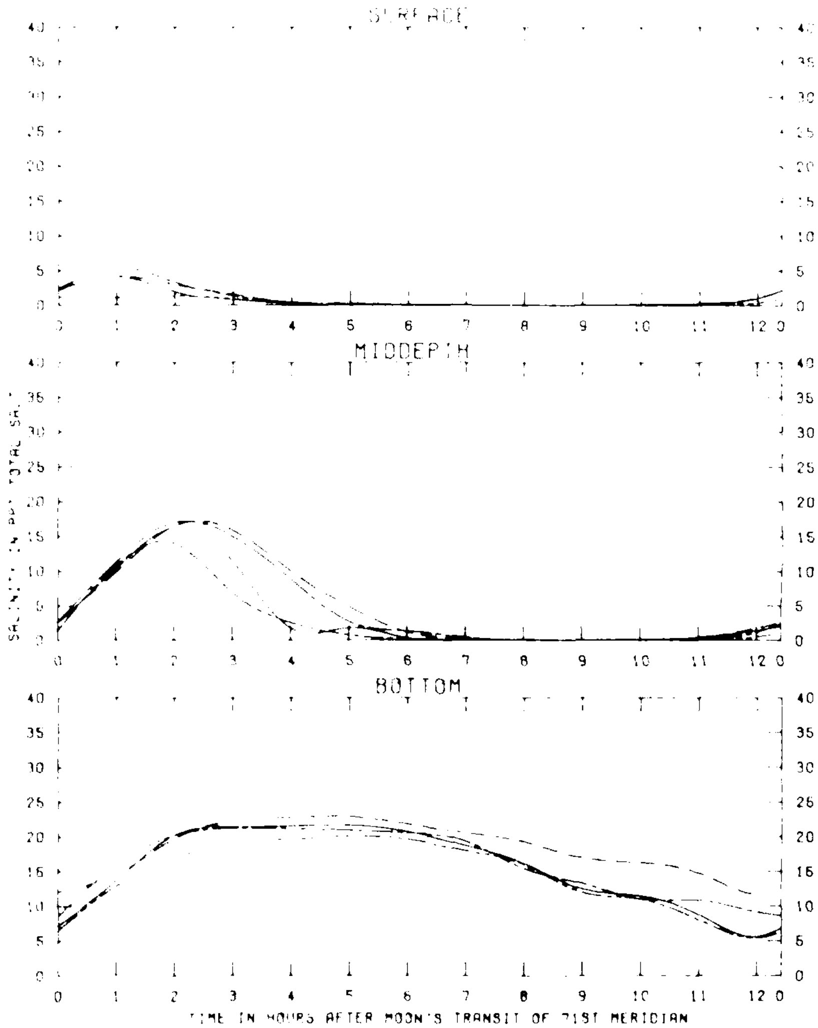

SURFACE
MIDDEPTH
BOTTOM
TEST CONDITIONS
29.0 PPT
LEGEND
BASE

PLATE 11



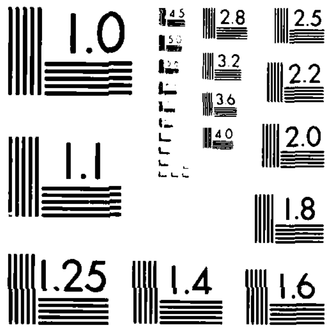
TEST CONDITIONS
TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

EFFECTS OF
PLANS 3B,2C AND D
ON SALINITIES

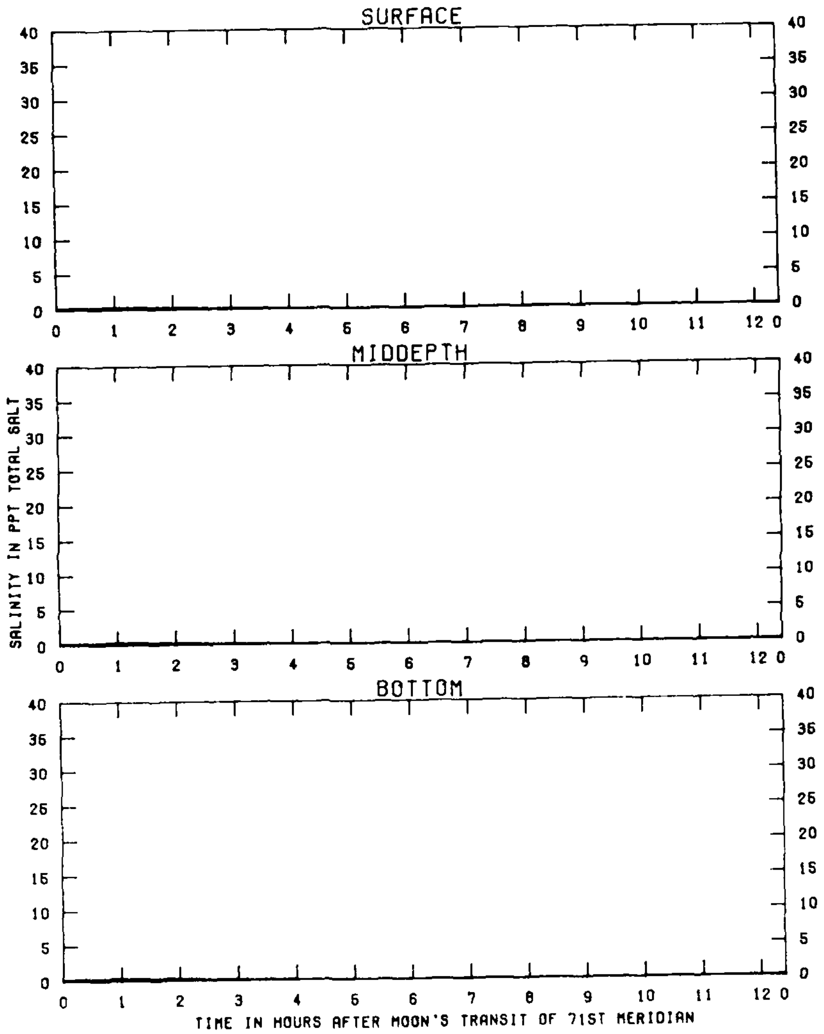
STATION
38A

AD-A157 046 NEWBURYPORT HARBOR MASSACHUSETTS; REPORT 2 DESIGN FOR HYDRODYNAMICS SALIN..(U) ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS HYDRA..

UNCLASSIFIED N J BROGDON ET AL. MAR 85 WES/TR/HL-79-1-2 F/G 8/10 NL



MICROCOPY RESOLUTION TEST CHART



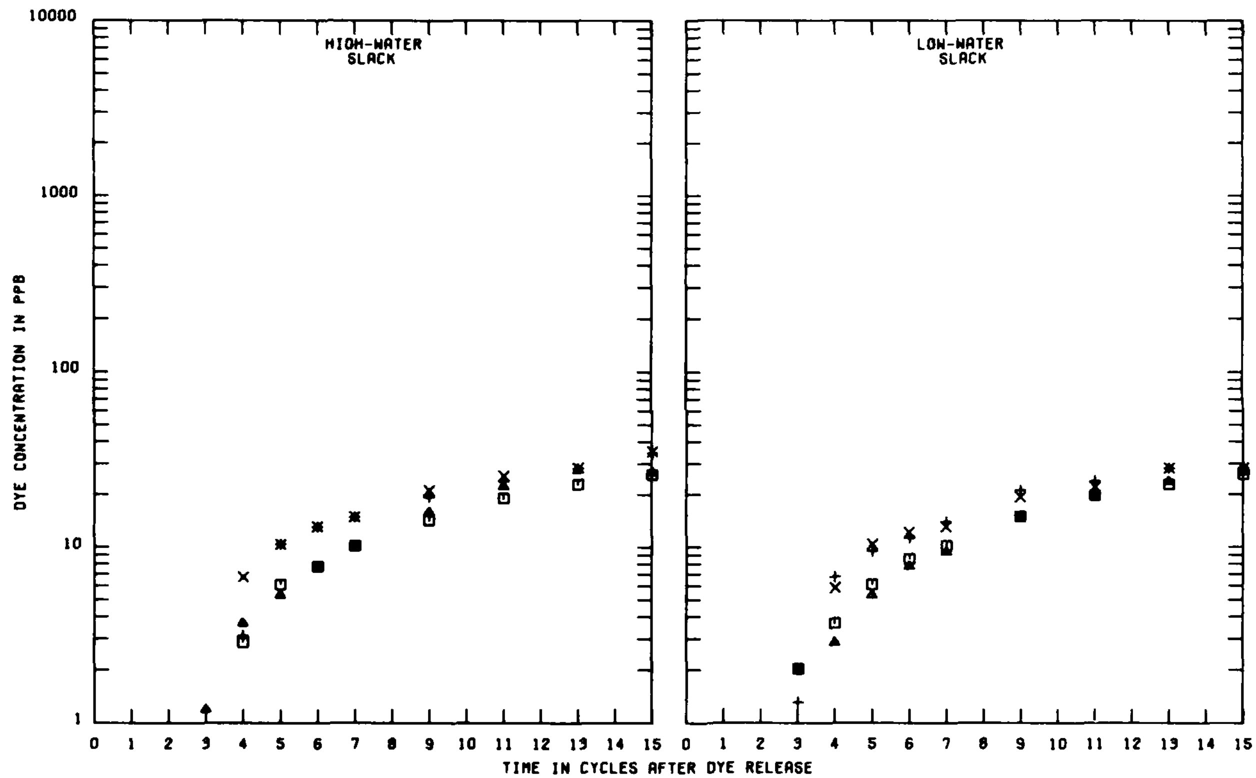
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3B
PLAN 2C
PLAN D

EFFECTS OF
PLANS 3B, 2C AND D
ON SALINITIES

STATION
50A



TEST CONDITIONS

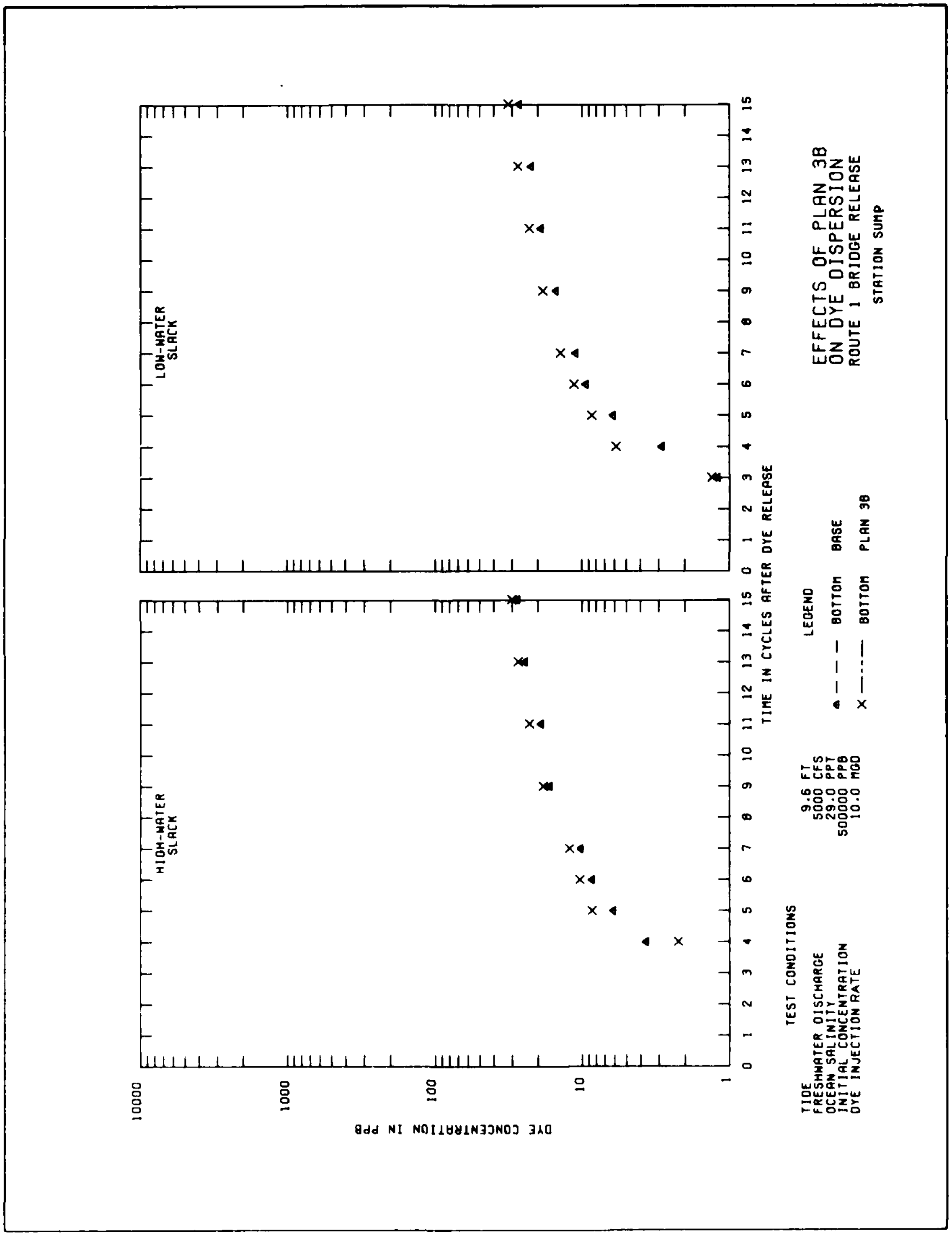
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

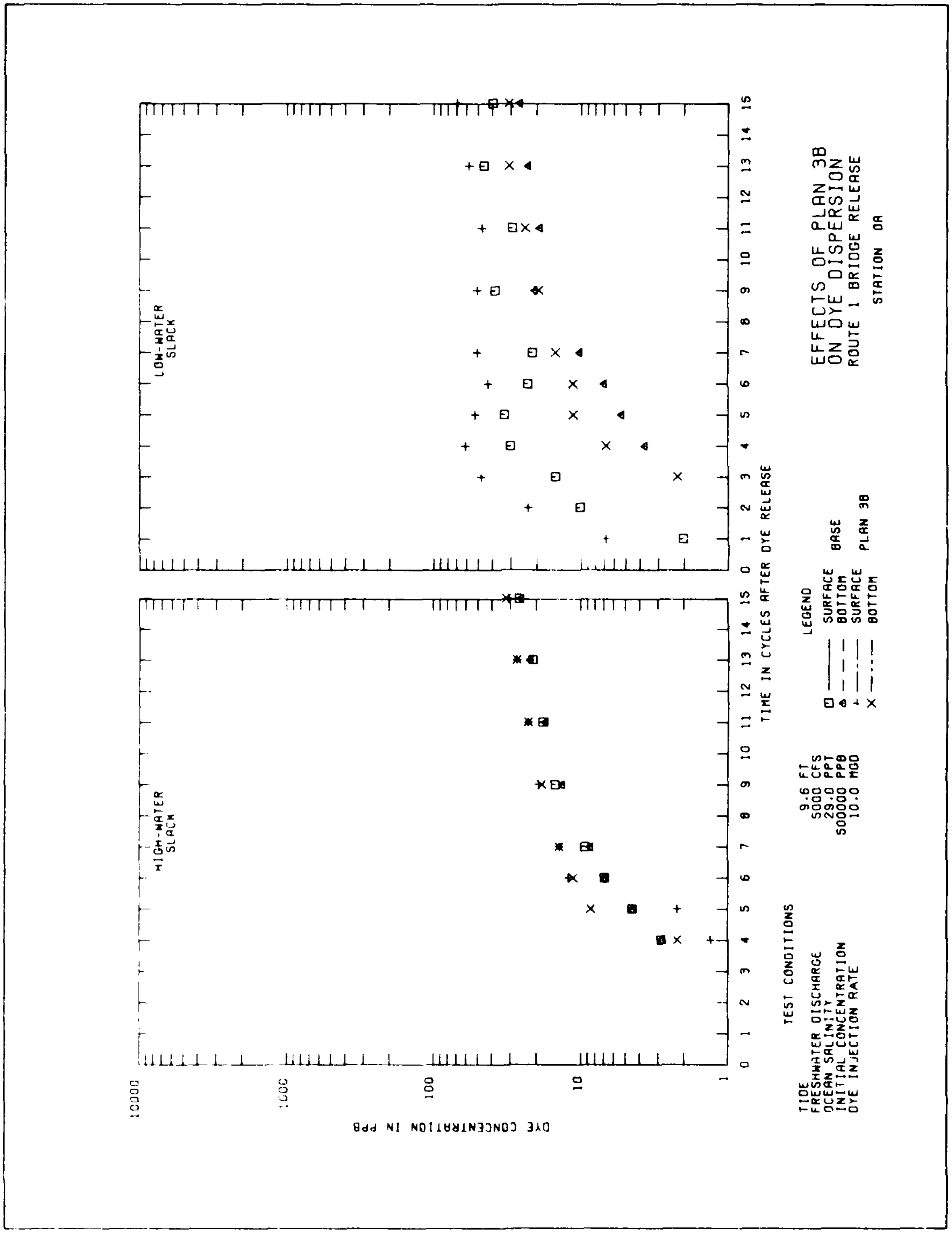
LEGEND

□ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—	SURFACE	PLAN 3B
X —··—	BOTTOM	

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION OCEAN


EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION SUMP
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
BOTTOM BASE
BOTTOM PLAN 3B


EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 0A
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B

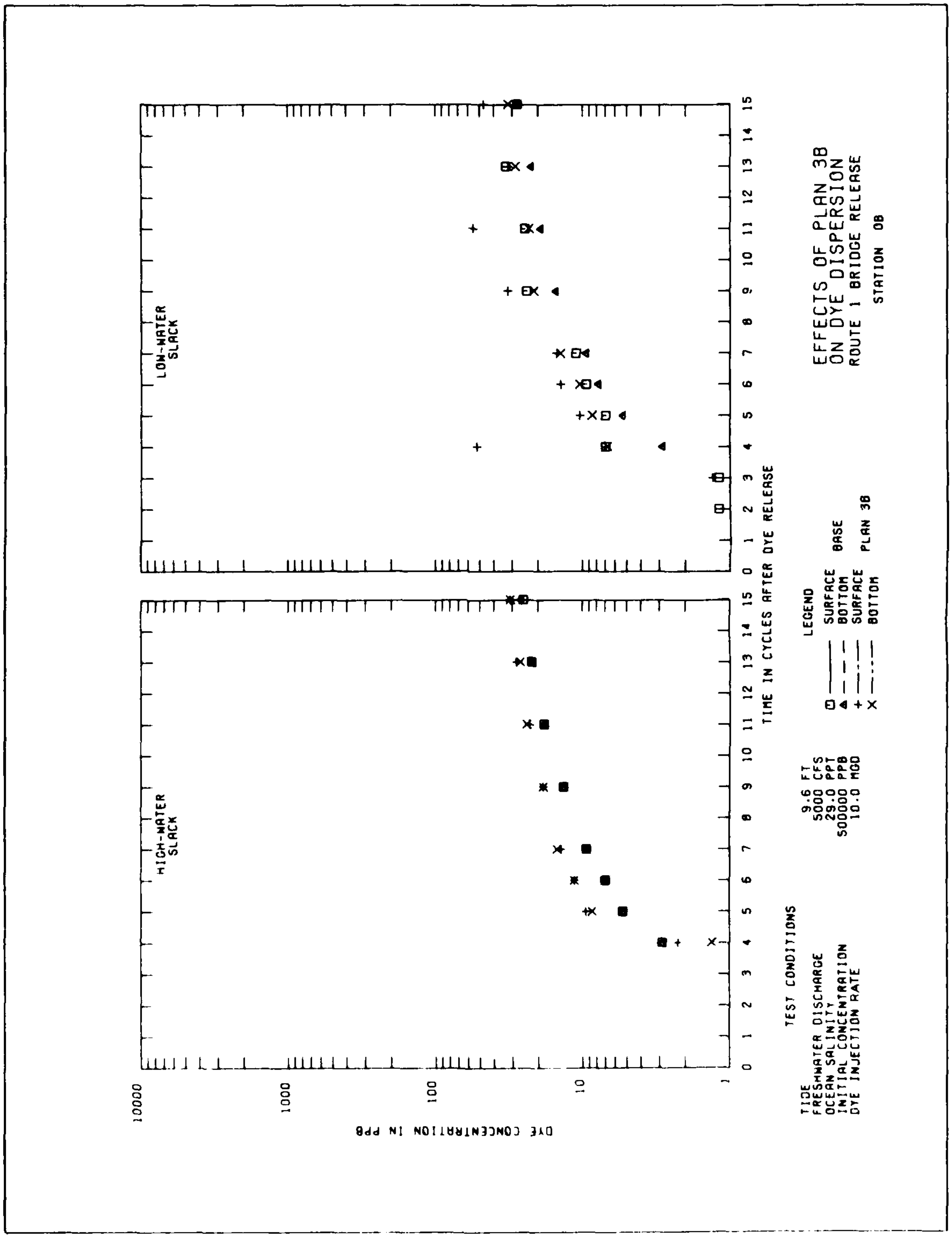
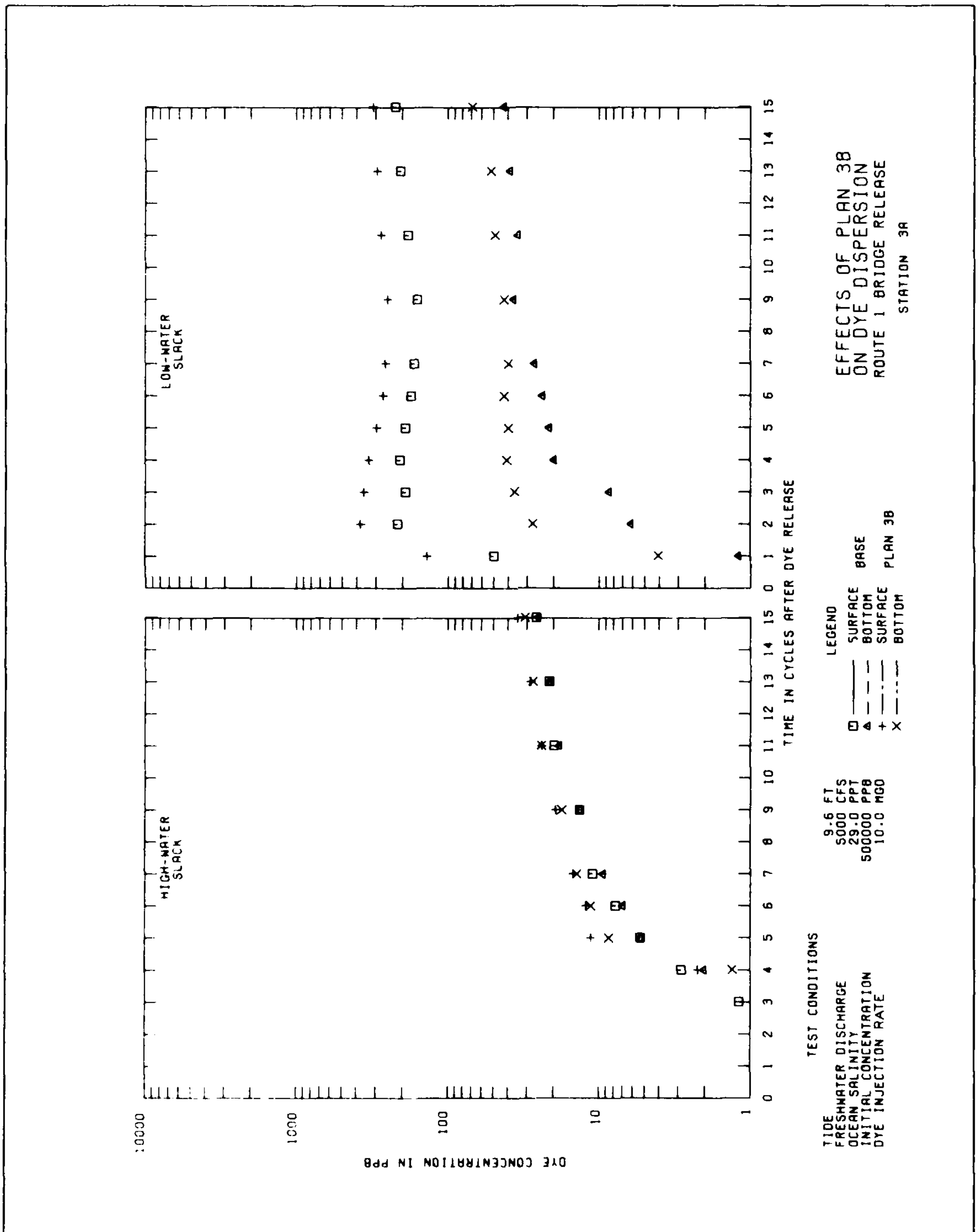
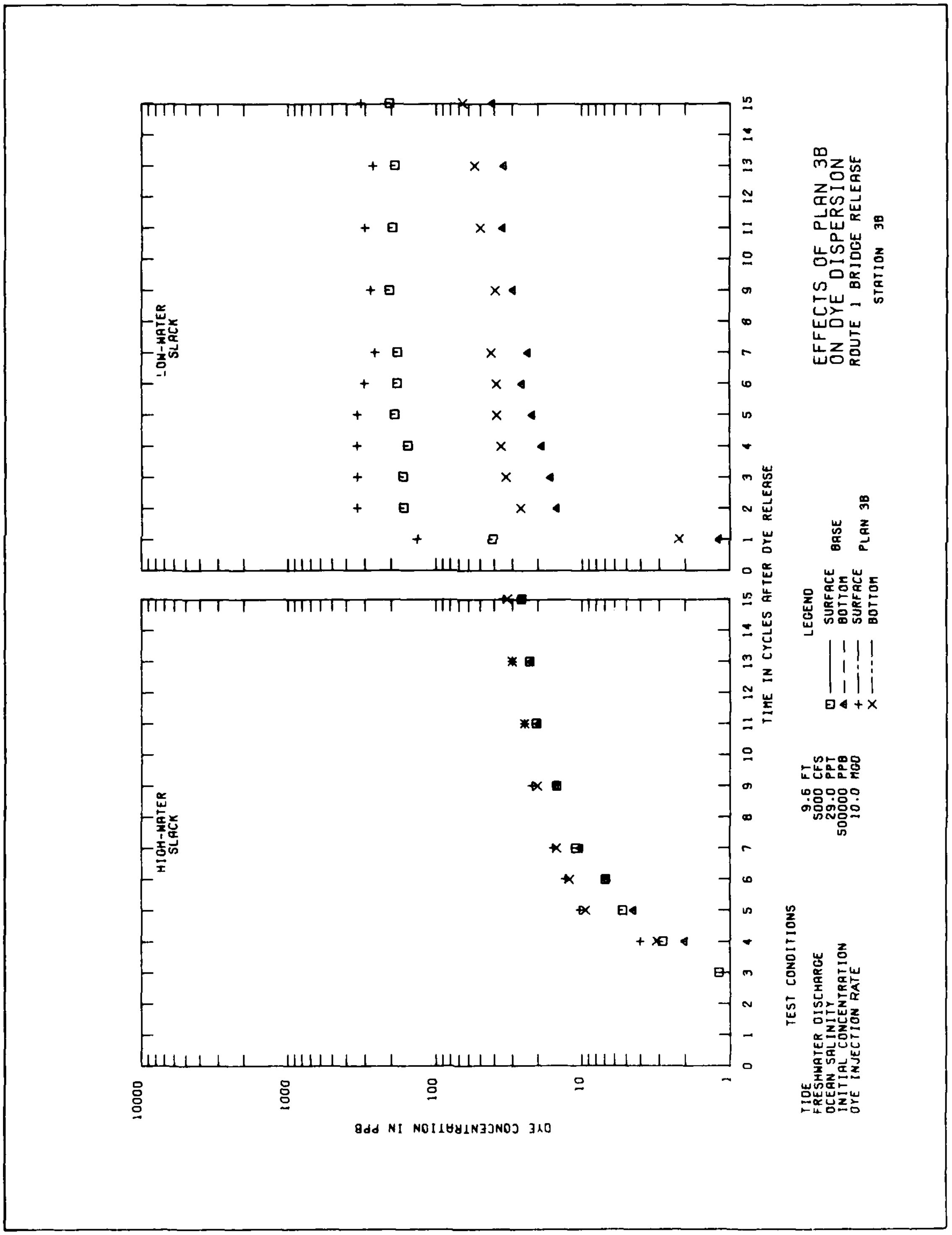

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 0B
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B

PLATE 122

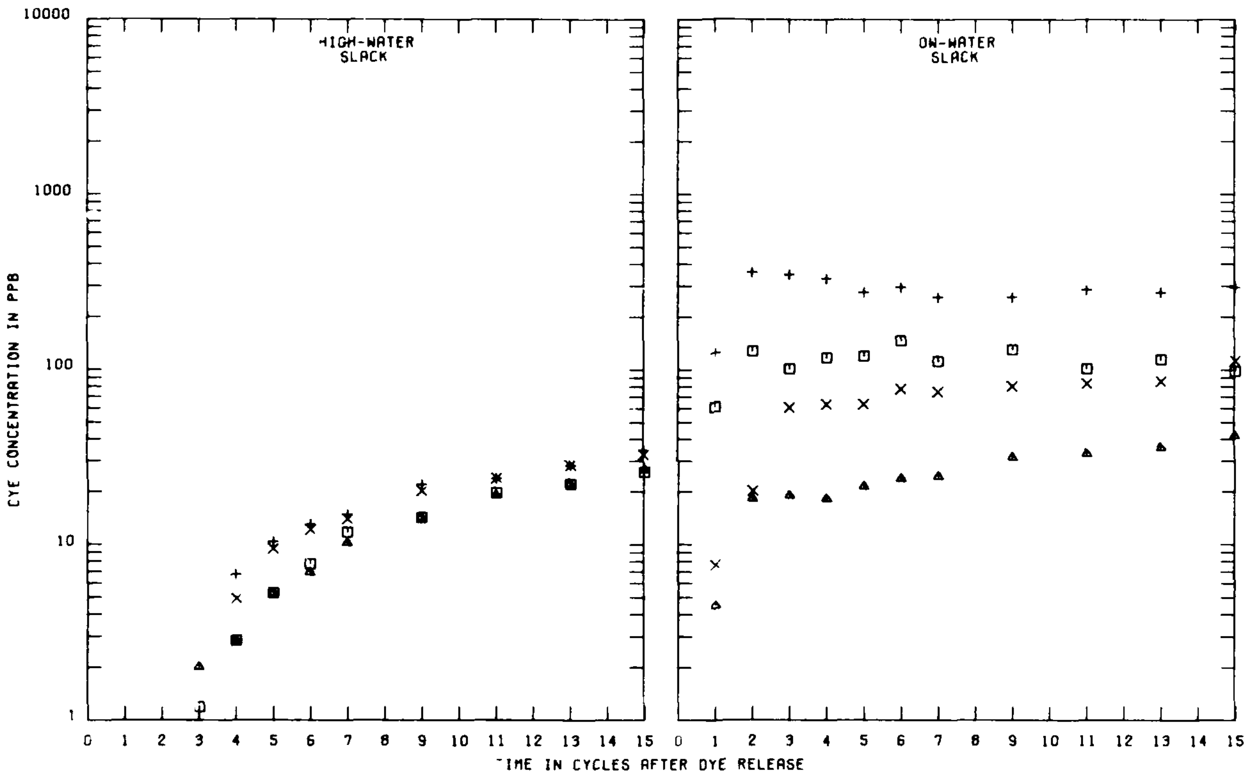


EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 3A
HIGH-WATER
SLACK
LOW-WATER
SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B



EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 3B
HIGH-WATER
SLACK
LOW-WATER
SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B

PLATE 124



TEST CONDITIONS

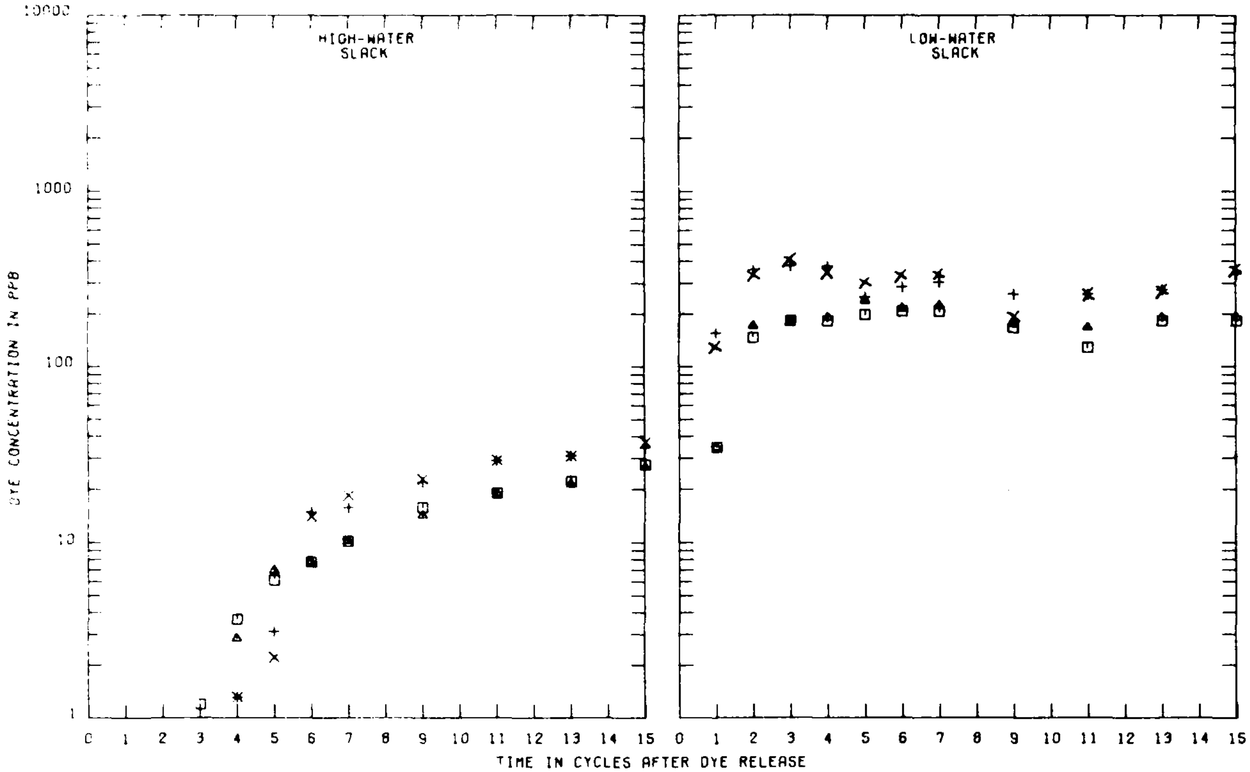
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

□ ———	SURFACE	BASE
△ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN 3B
× —··—··	BOTTOM	

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 3C



TEST CONDITIONS

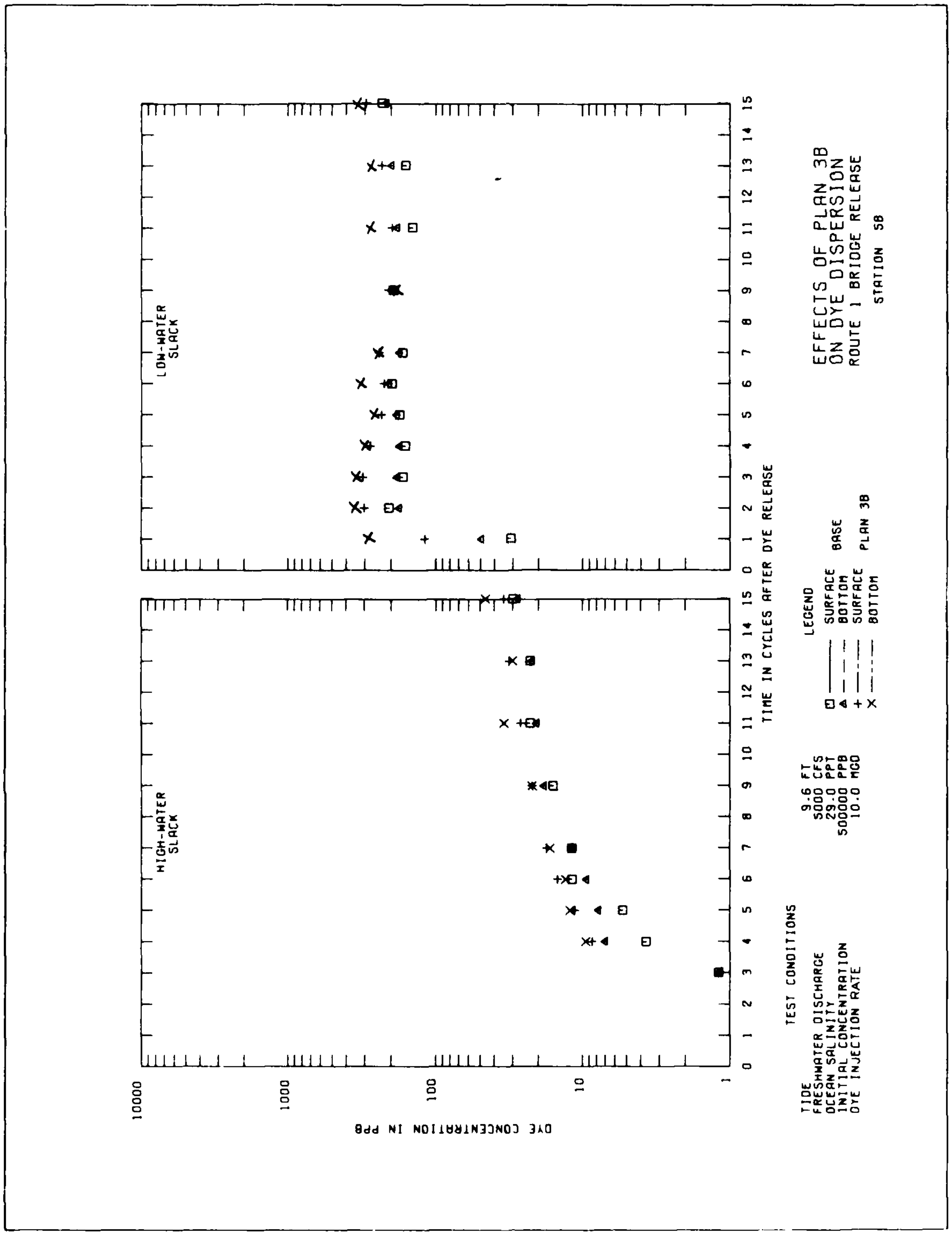
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

□ ———	SURFACE	BASE
△ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN 3B
× —··—··	BOTTOM	

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 5A



EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 5B
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B

PLATE 127

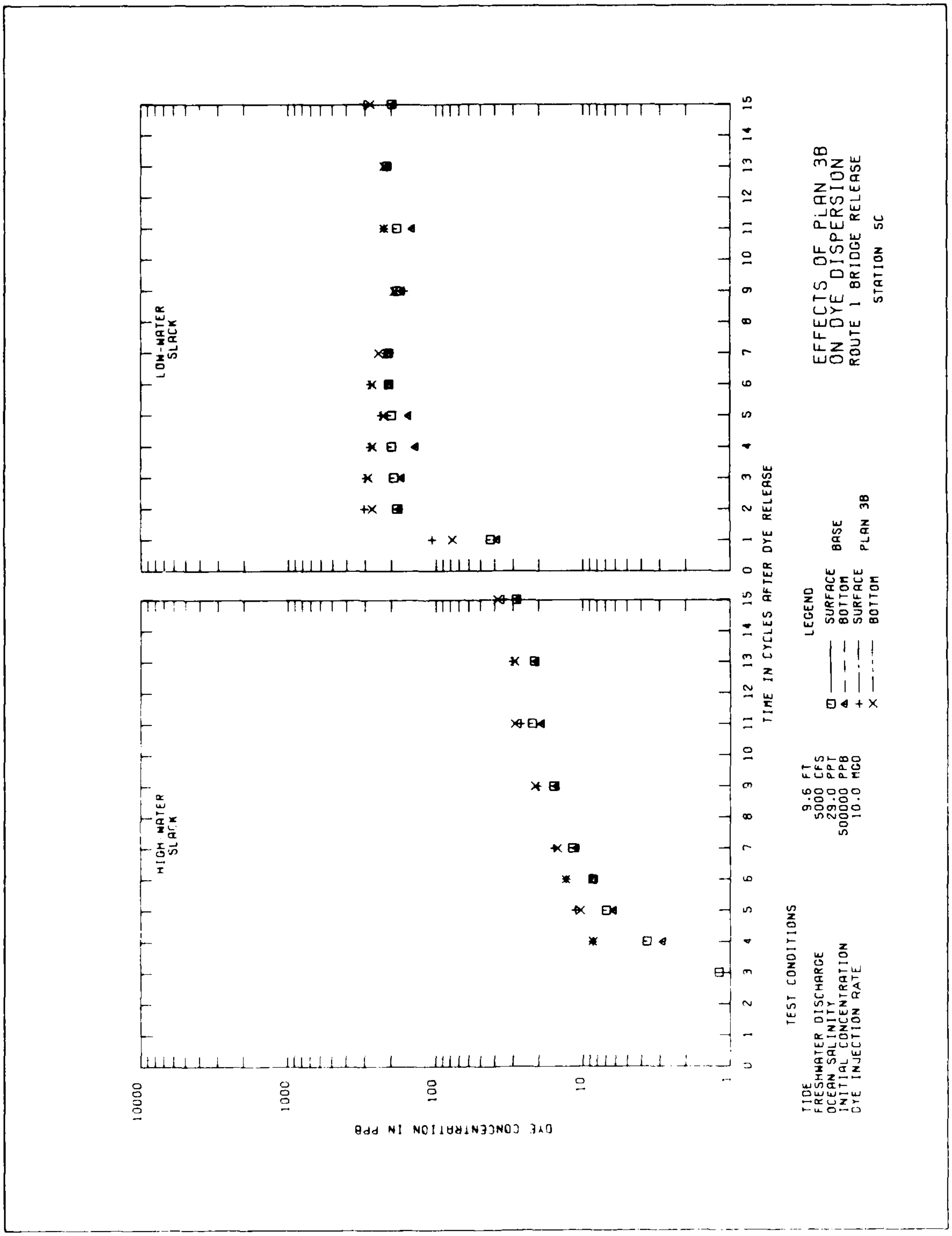

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 5C
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B

PLATE 128

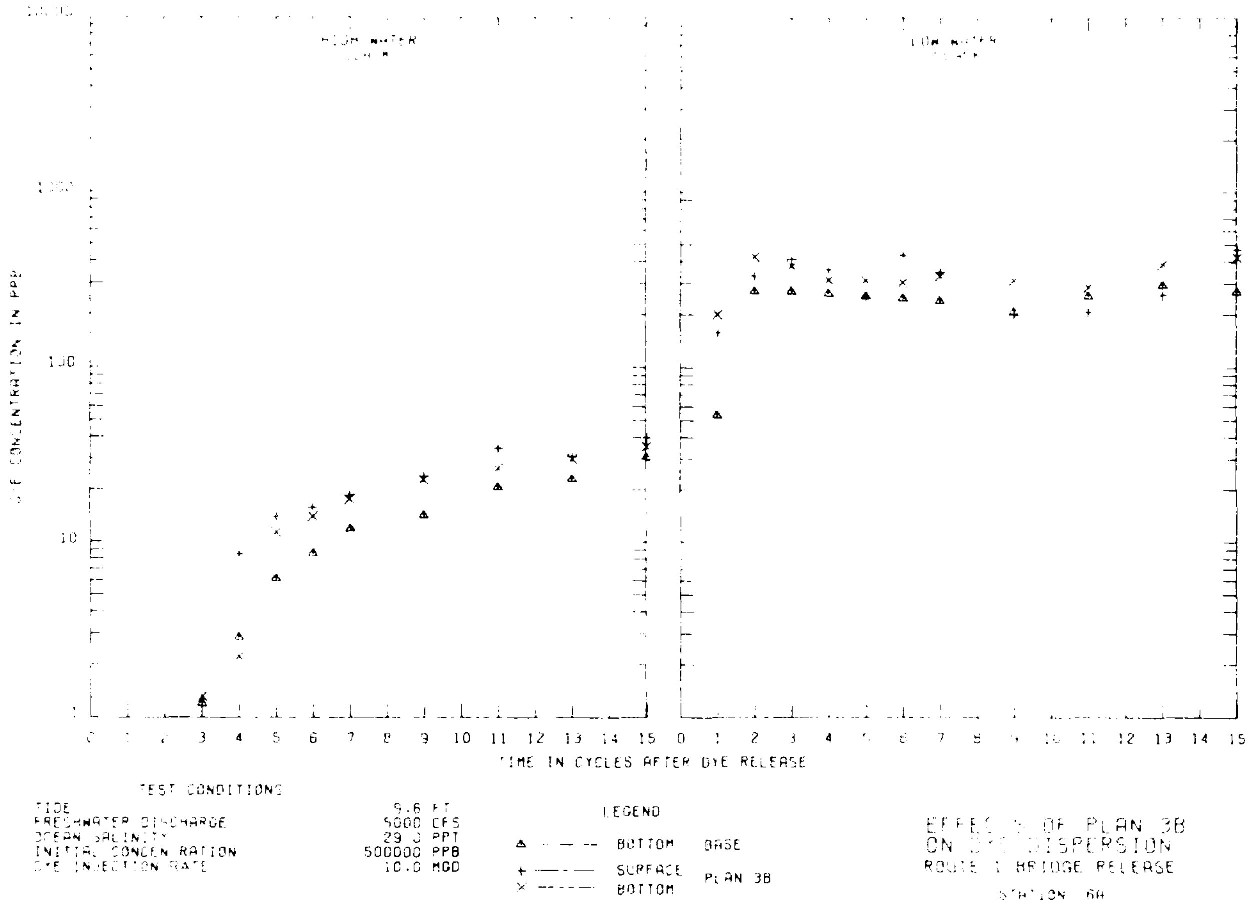
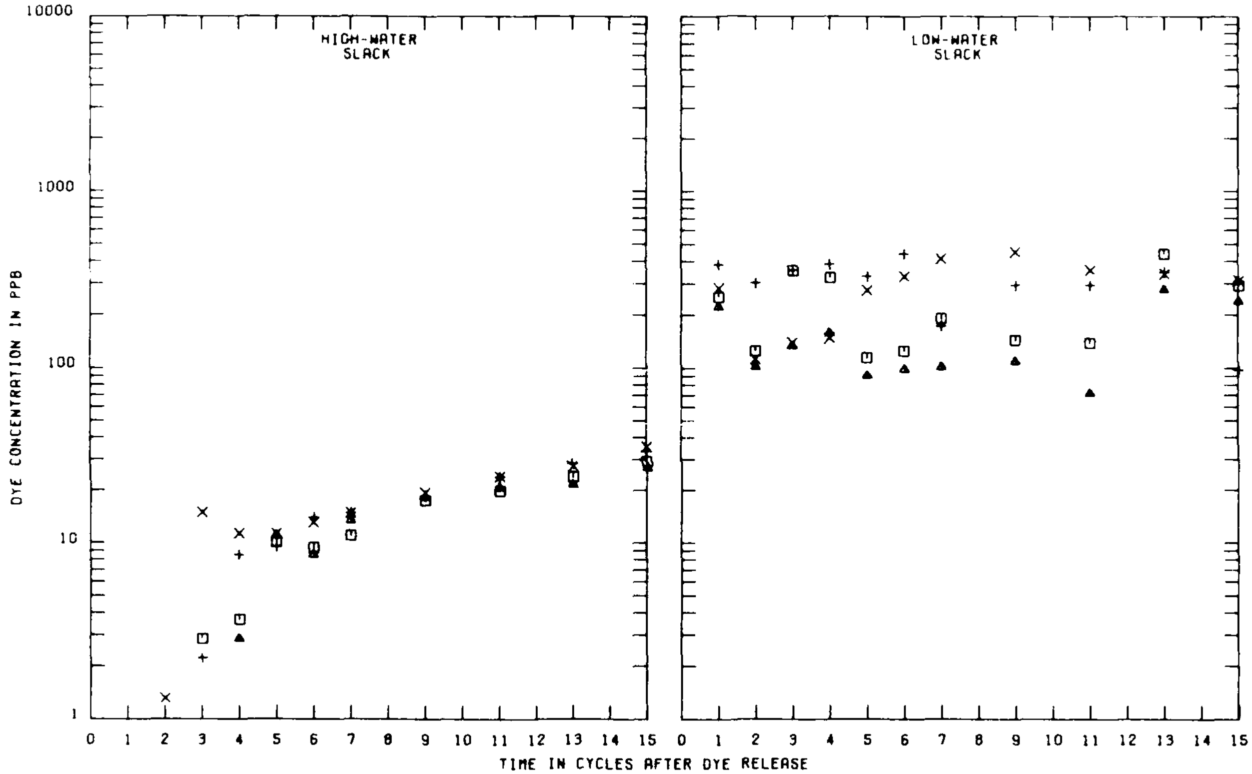

HIGH WATER
LOW WATER
DYE CONCENTRATION IN PPB
1000
100
10
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
BOTTOM BASE
SURFACE PLAN 3B
BOTTOM
EFFECT OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 6A

PLATE 129



TEST CONDITIONS

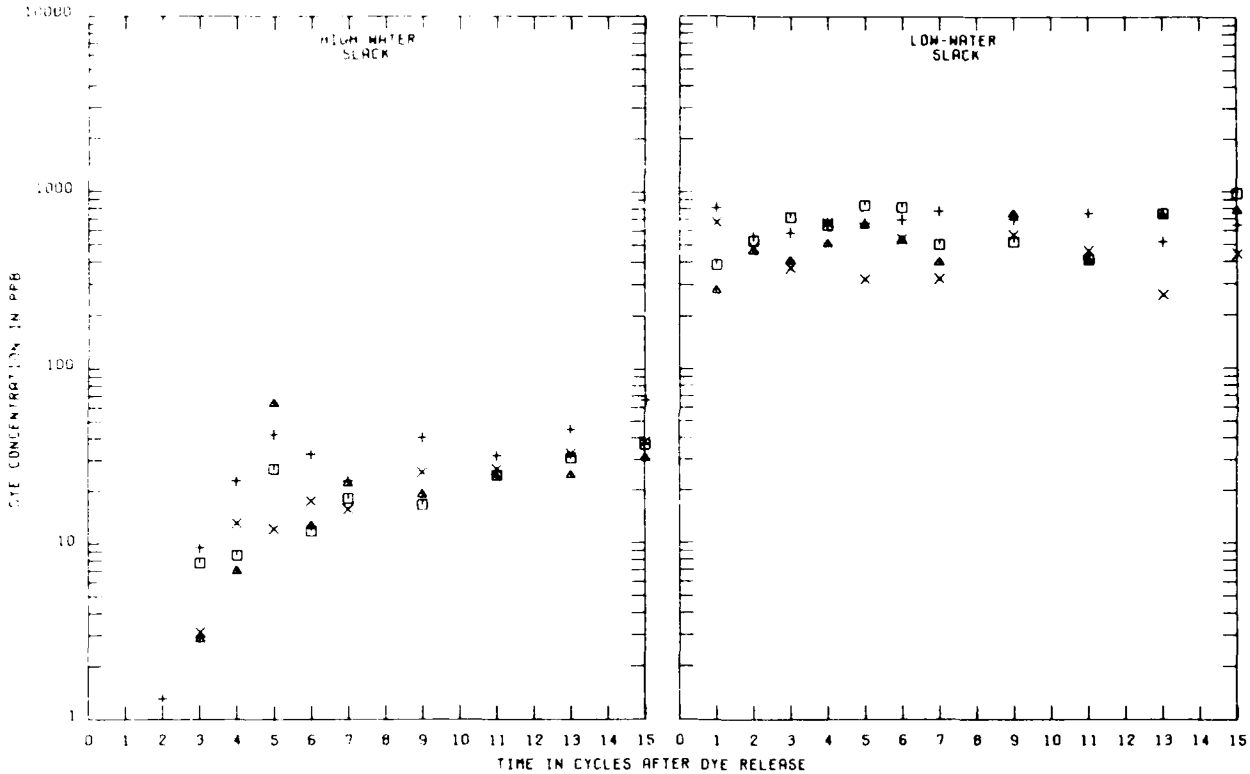
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN 3B
× —··—··	BOTTOM	

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 18B



TEST CONDITIONS

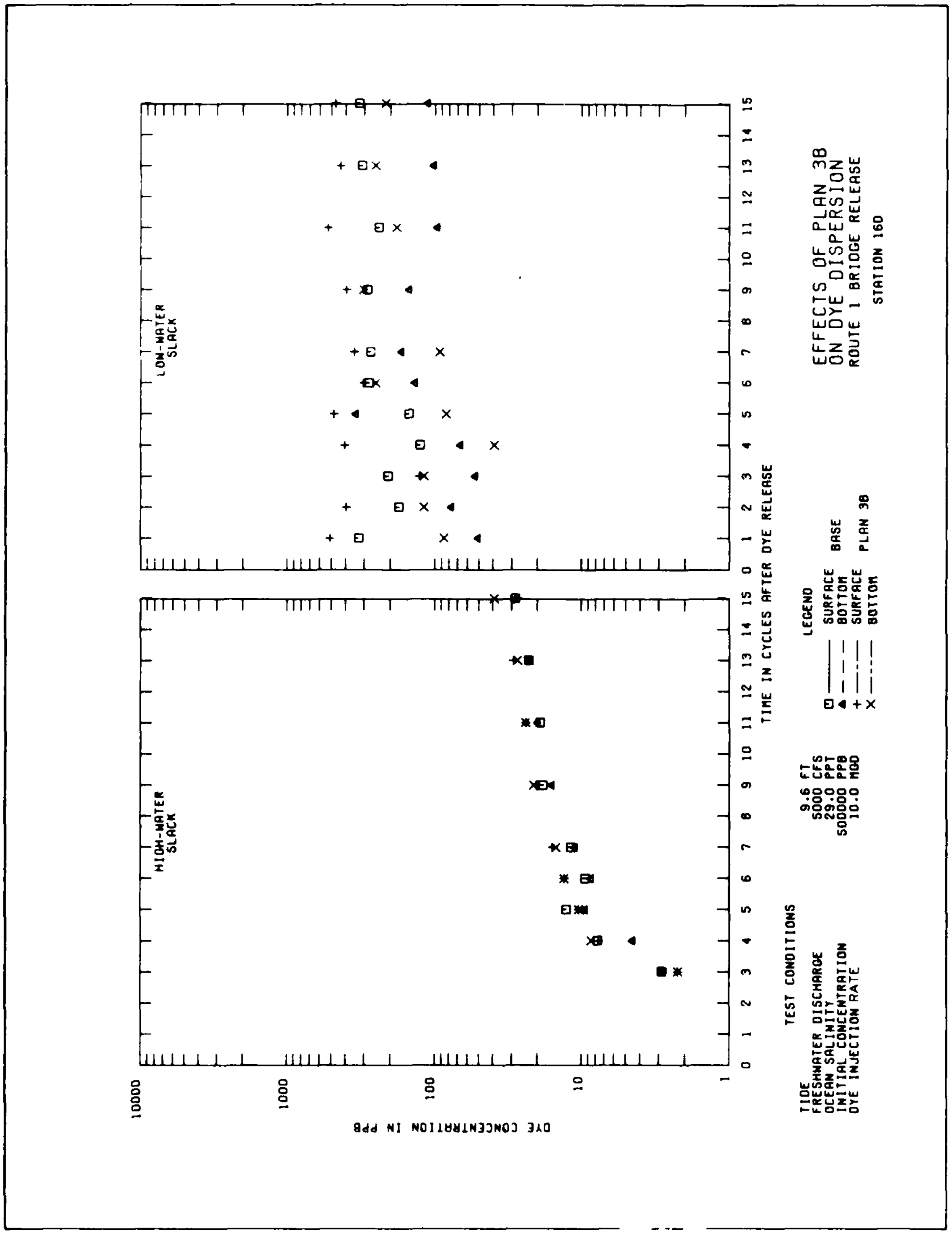
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

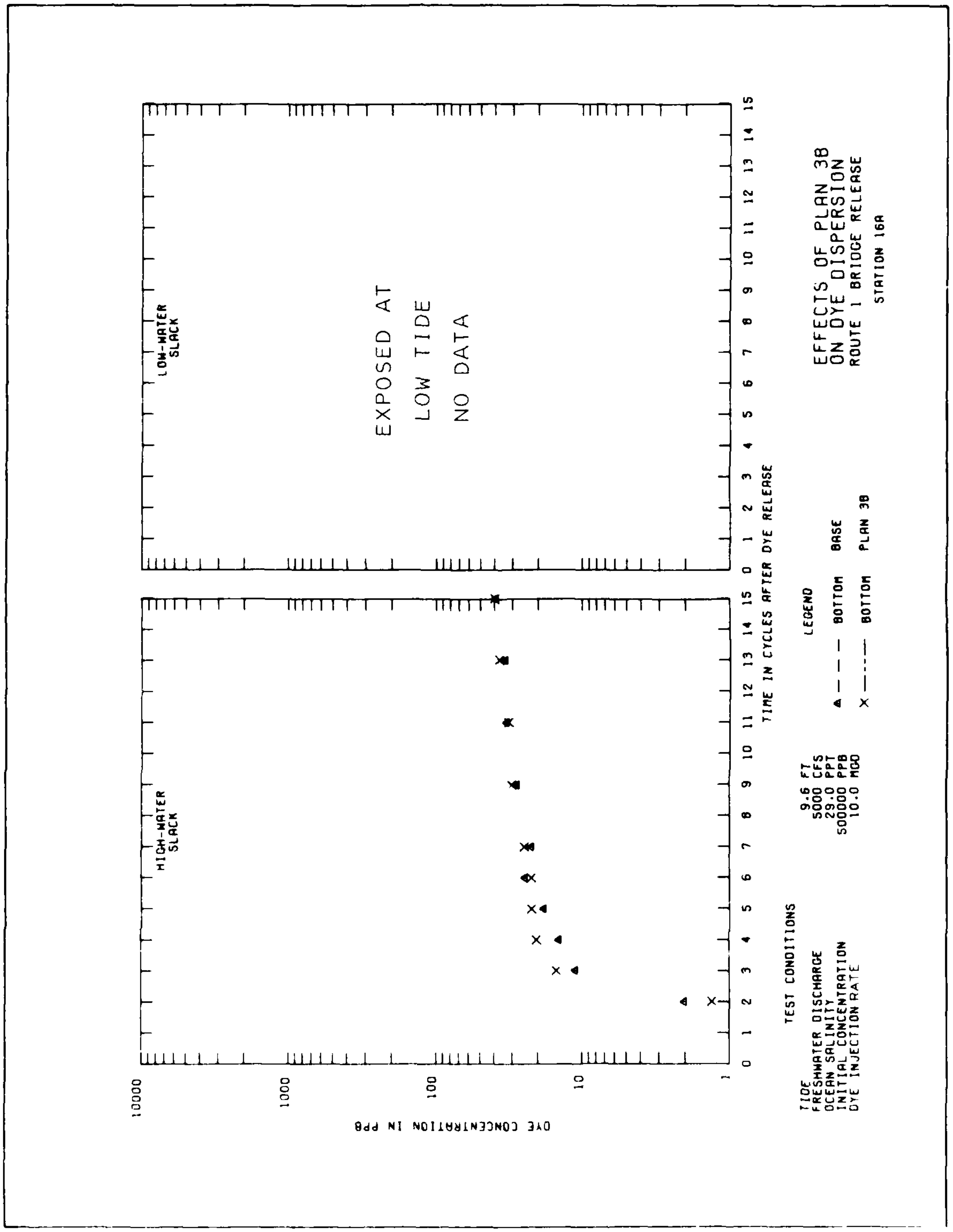
⊡ ————	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN 3B
× —··—··	BOTTOM	

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 18A



EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 16D
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B



EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 16A
HIGH-WATER SLACK
LOW-WATER SLACK
EXPOSED AT
LOW TIDE
NO DATA
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
BOTTOM BASE
BOTTOM PLAN 3B

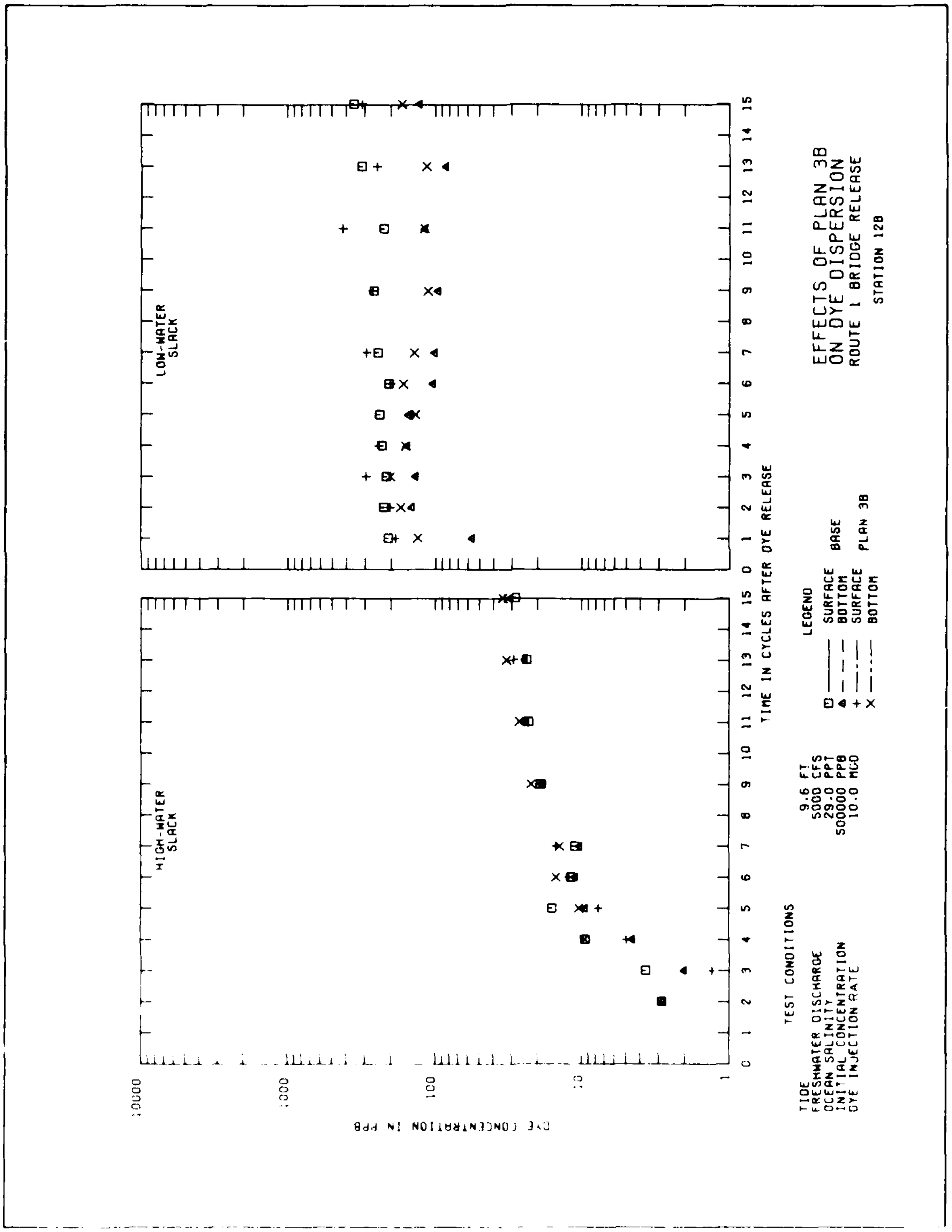
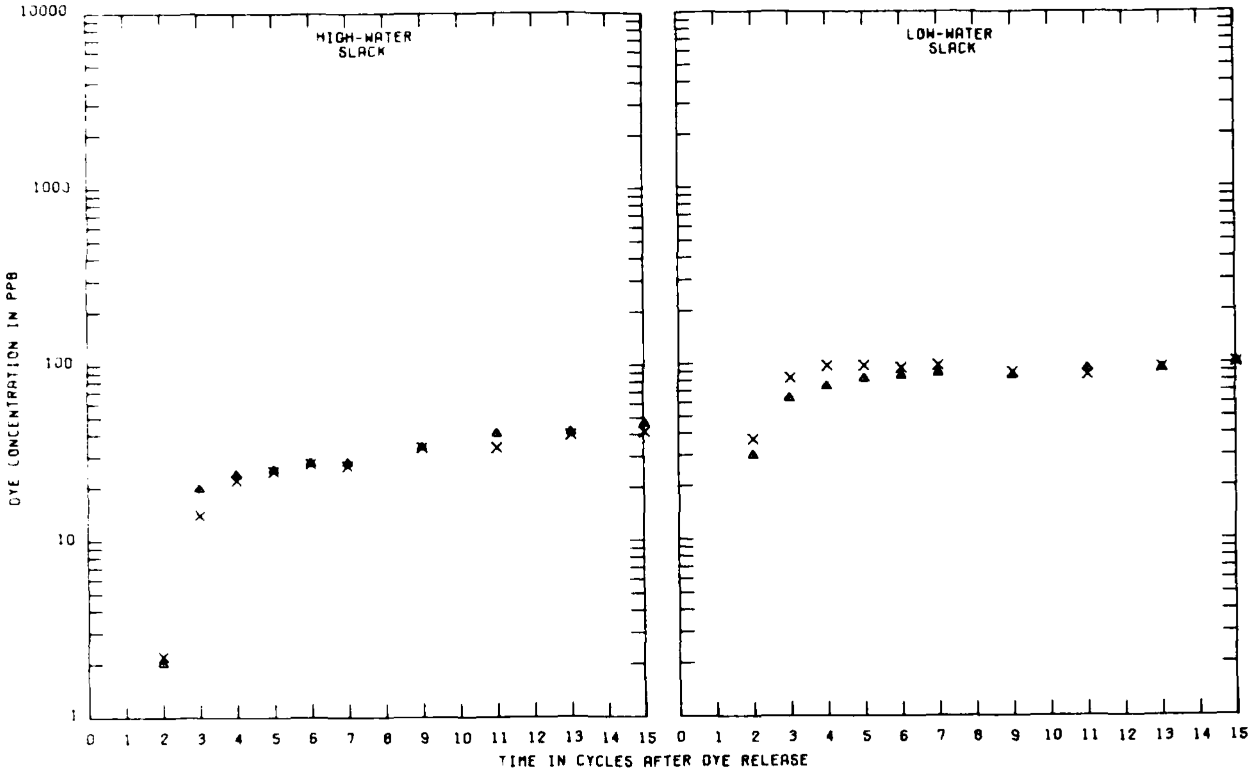

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 12B
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B

PLATE 139



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

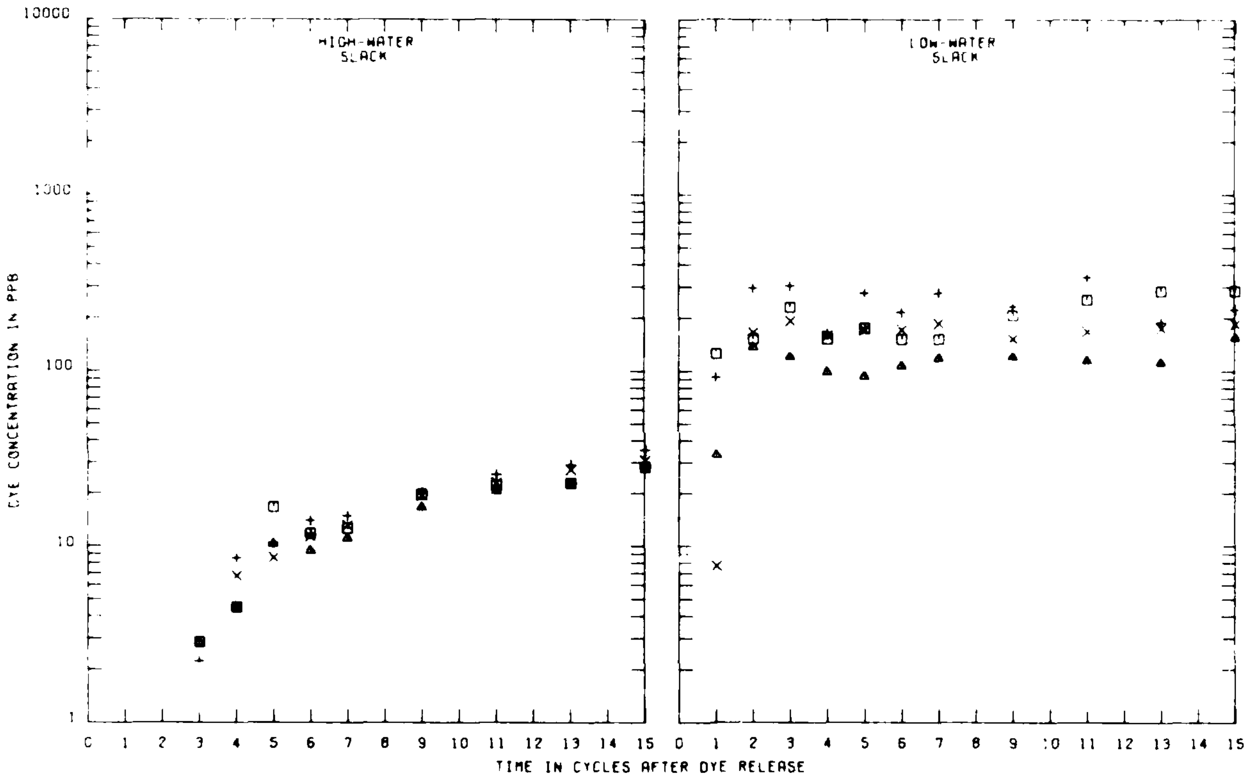
LEGEND

▲ — — — BOTTOM BASE

× —·—·— BOTTOM PLAN 3B

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 12A



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

□ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—	SURFACE	PLAN 3B
× —··—	BOTTOM	

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 10C

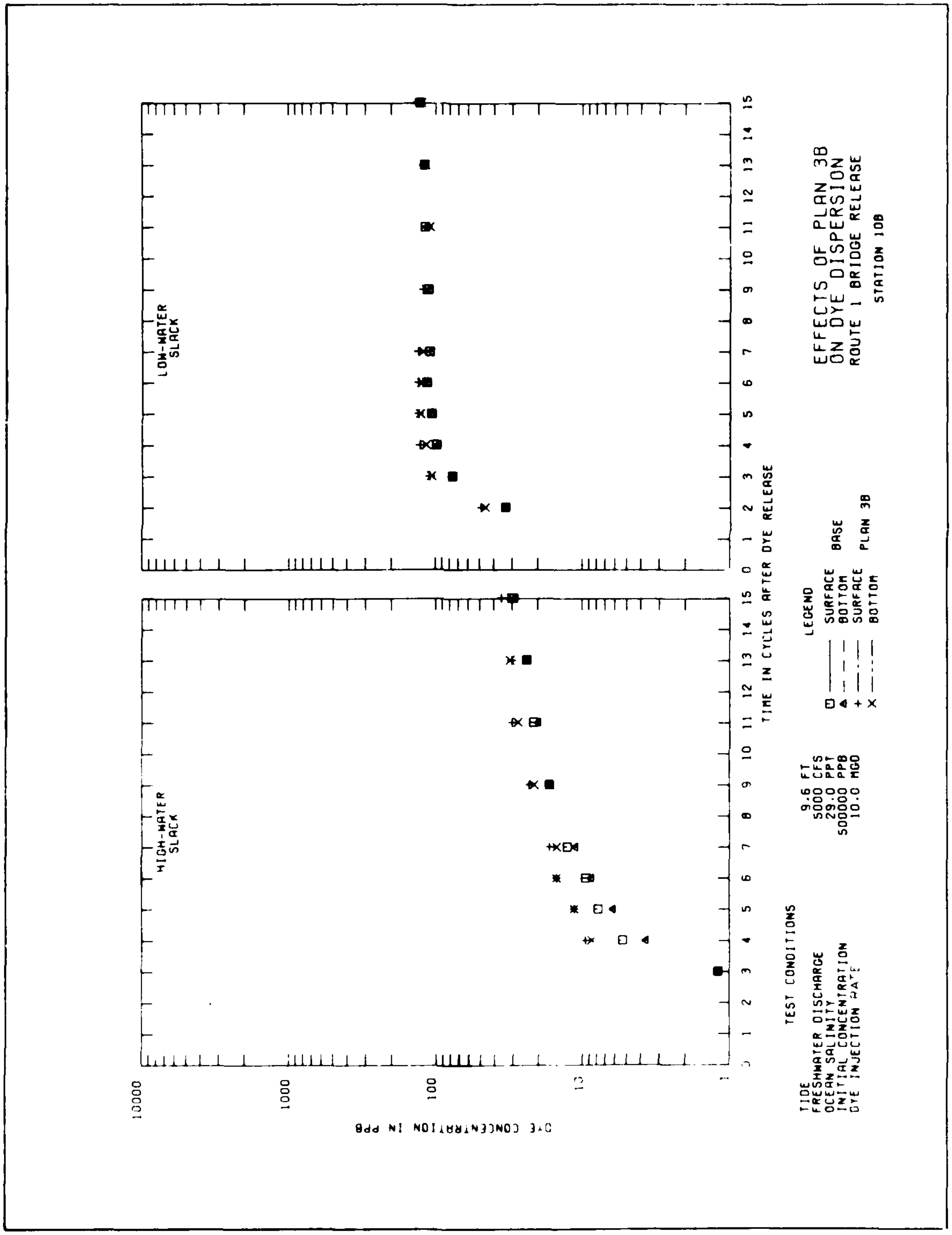
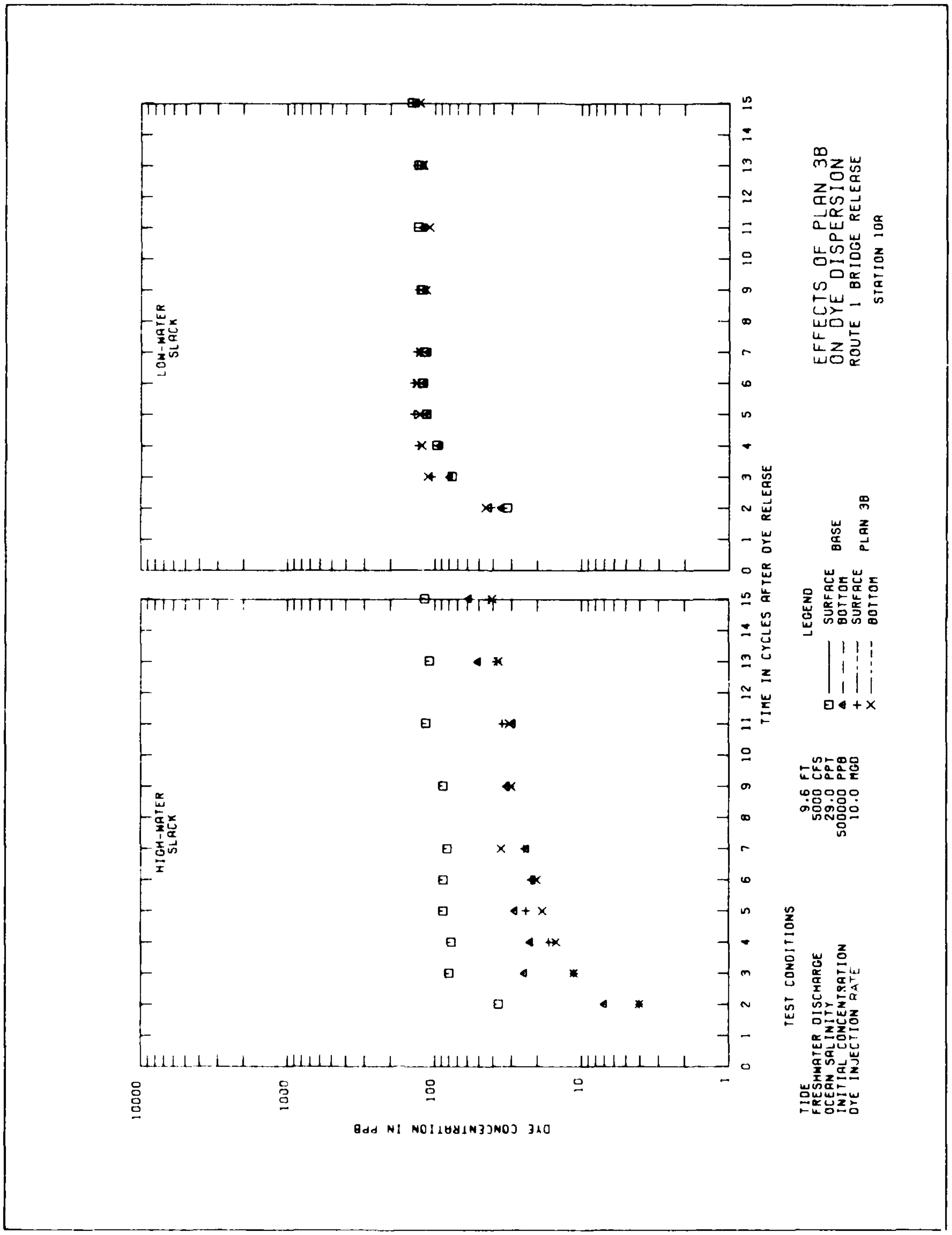

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 10B
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B

PLATE 136


EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 10R
HIGH-WATER
SLACK
LOW-WATER
SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B

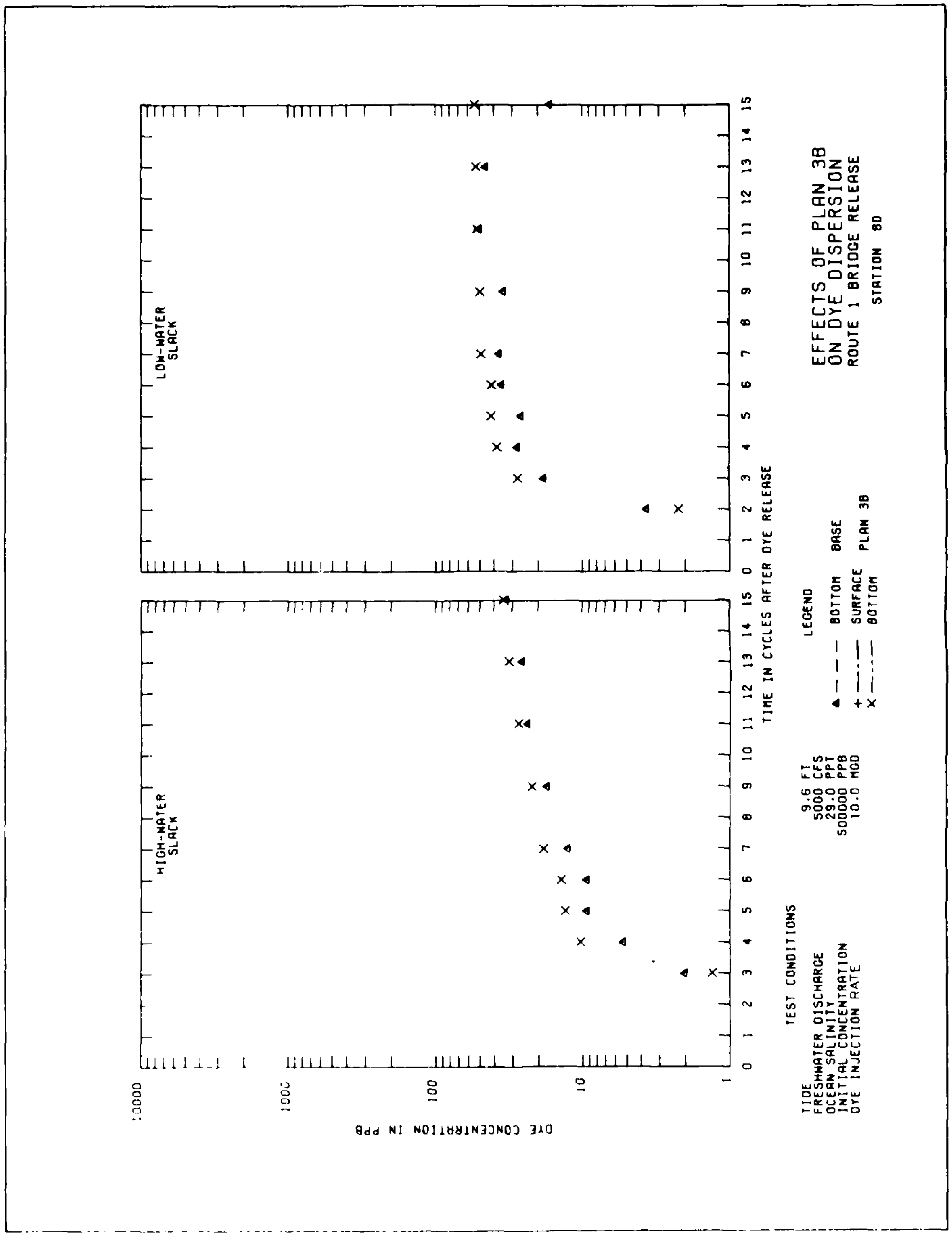

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 8D
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
10000
1000
100
10
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
BASE
BOTTOM
PLAN 3B
SURFACE
BOTTOM

PLATE 134

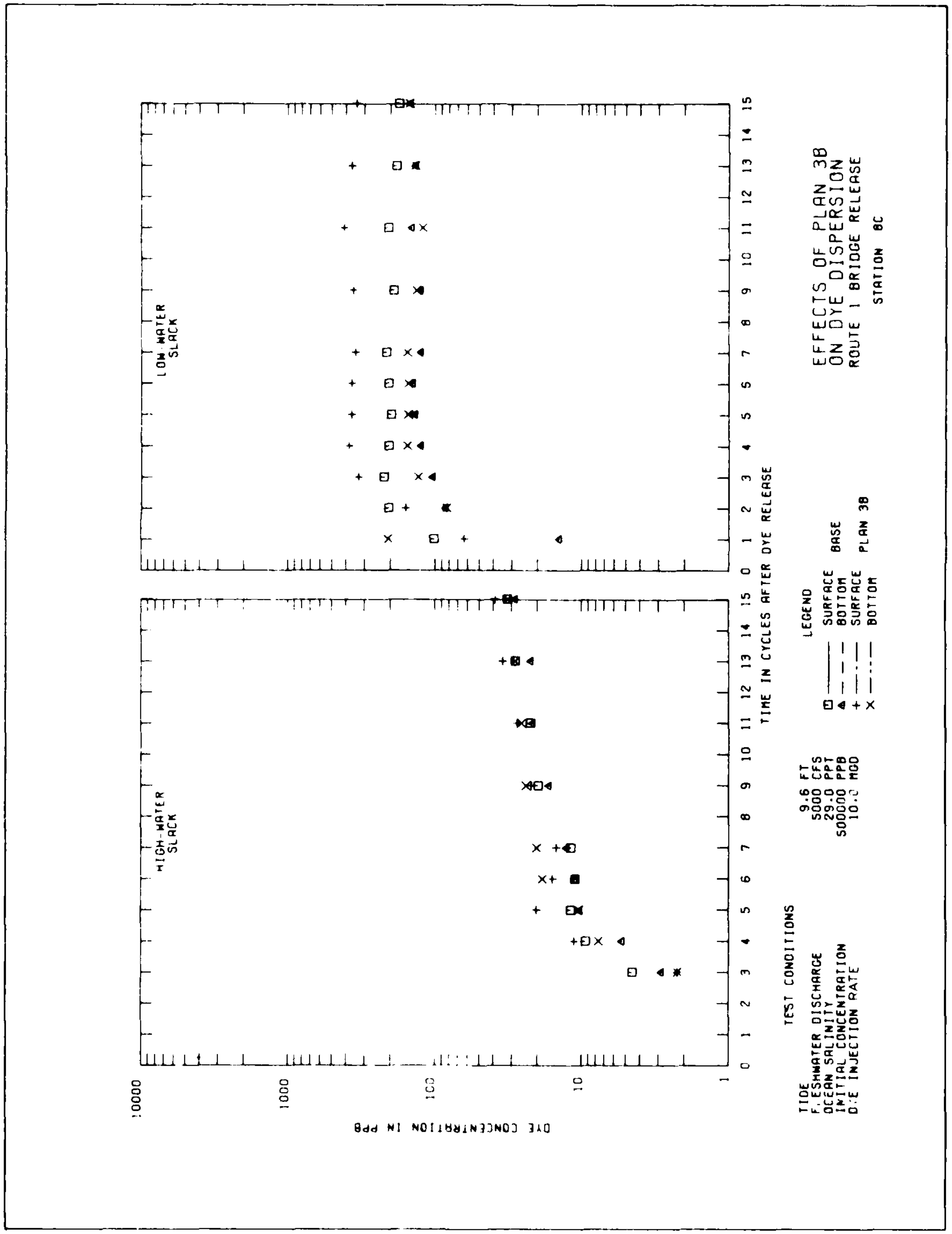
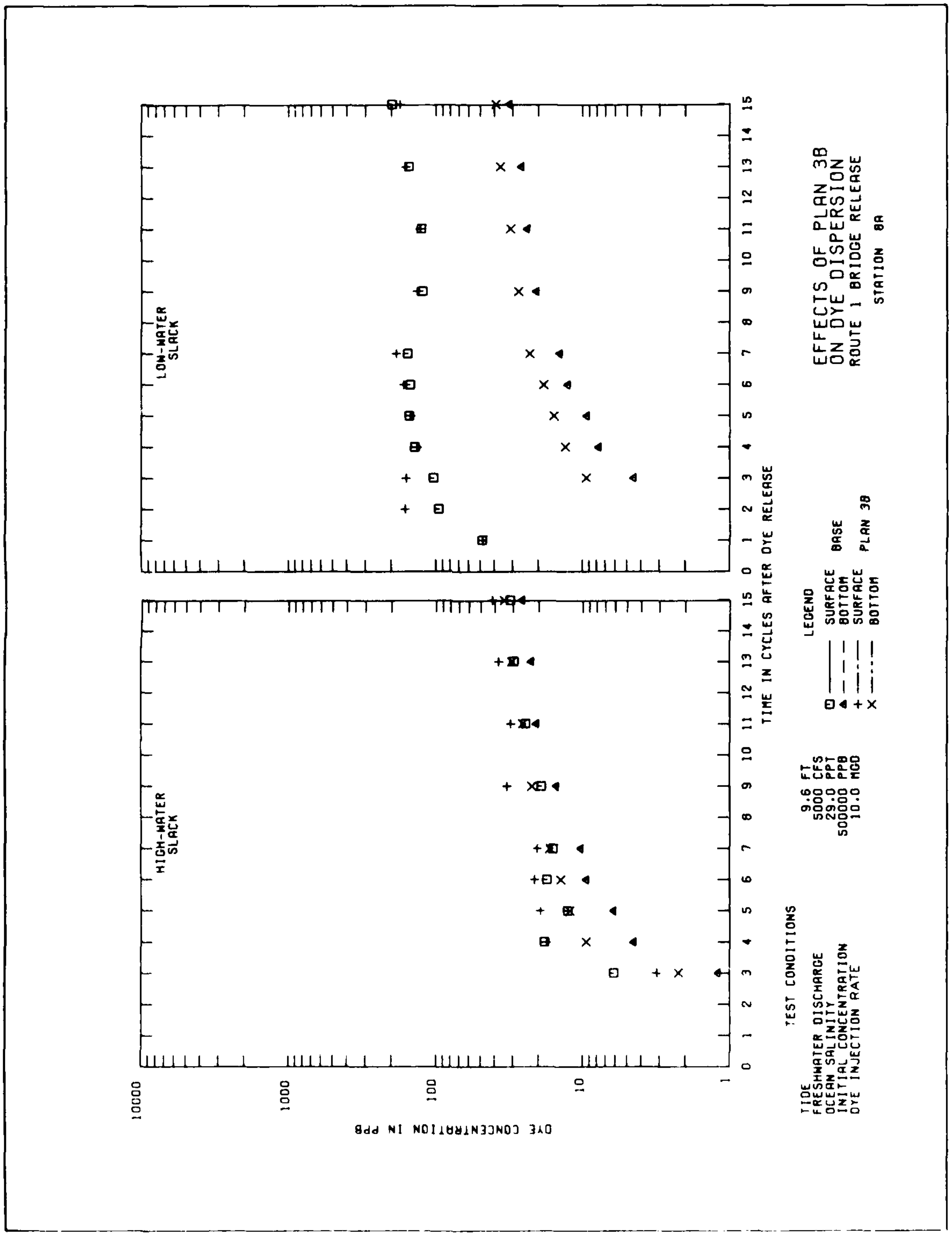
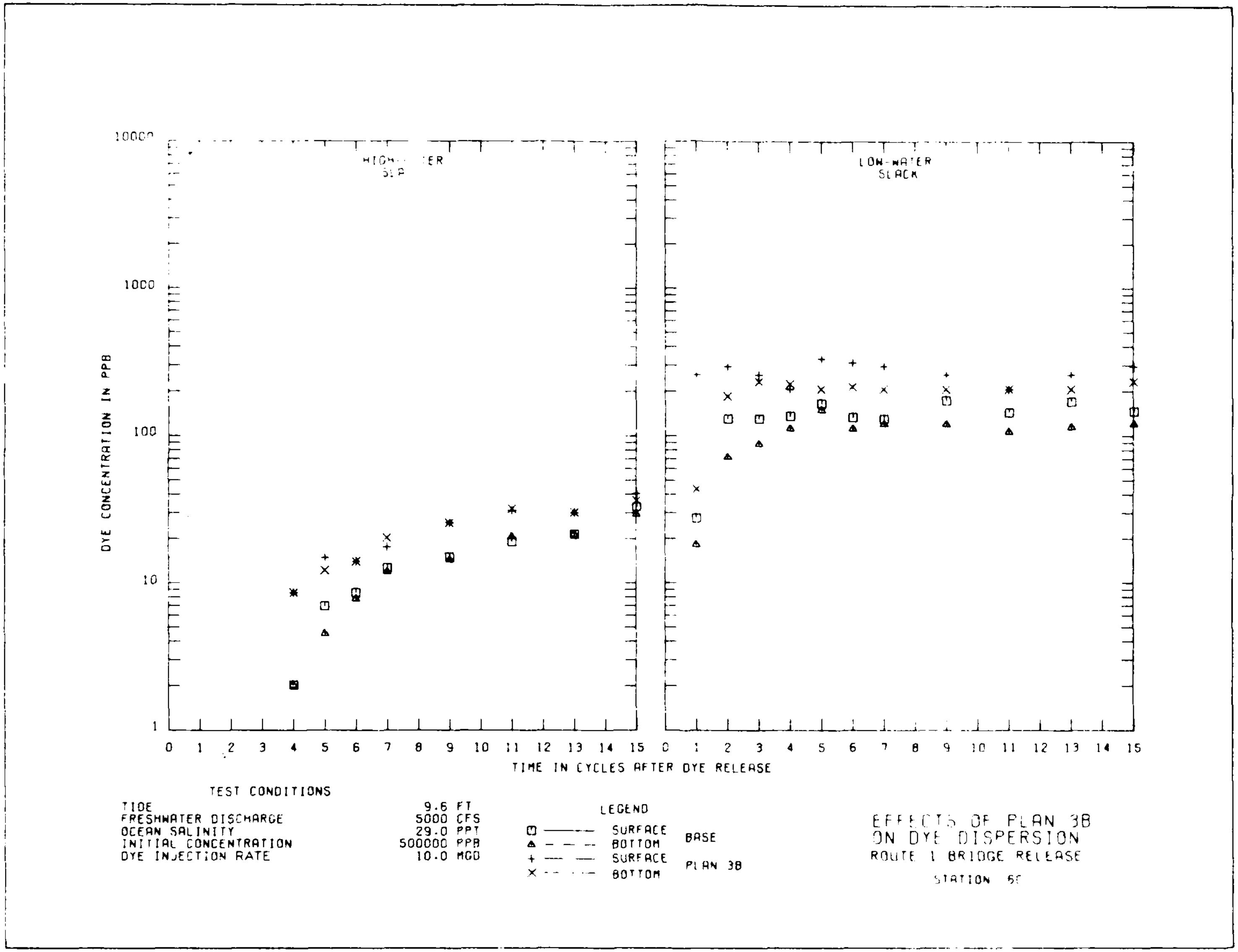

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 8C
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B

PLATE 133



EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 8A
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B

PLATE 132



HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B
EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

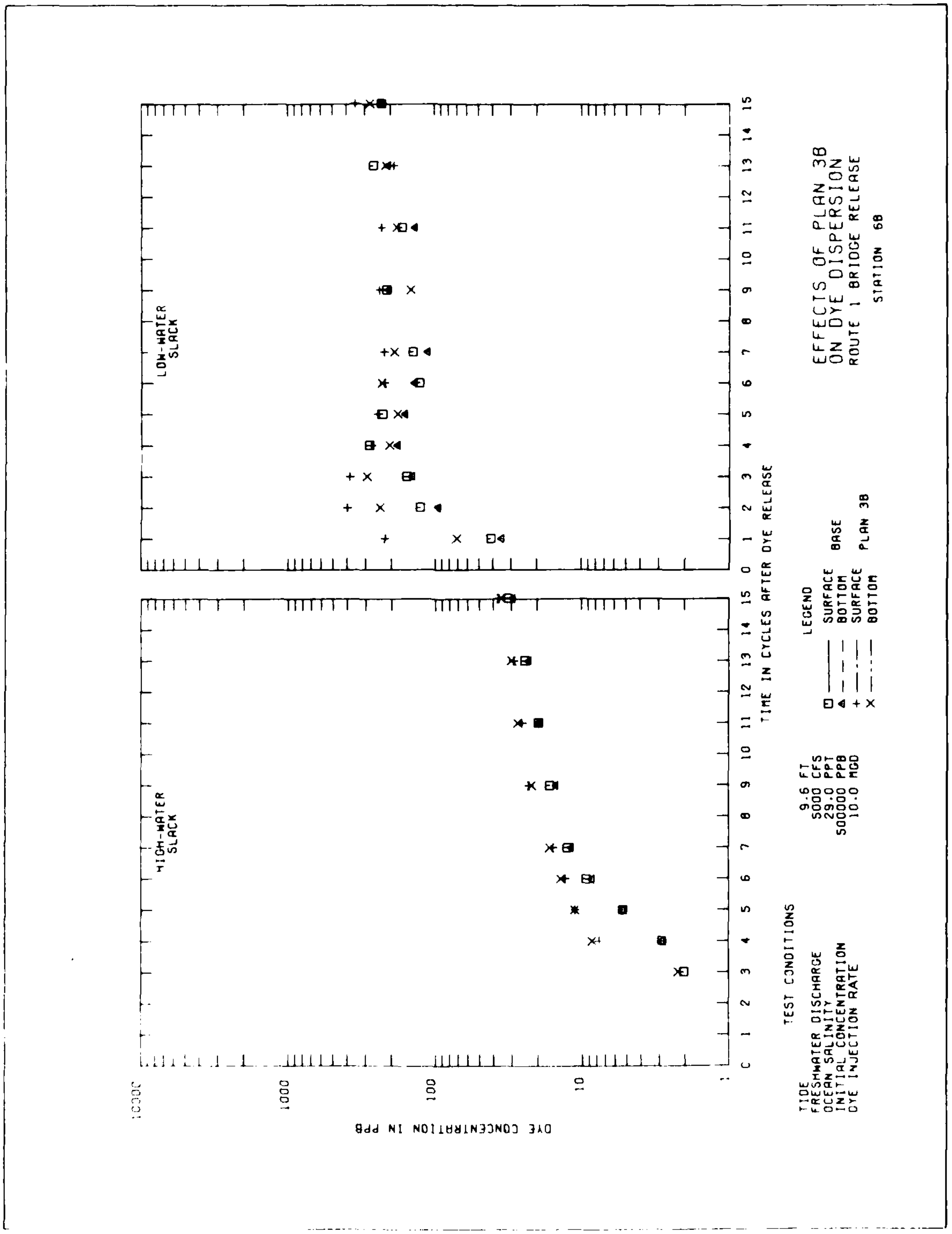

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 6B
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B

PLATE 130

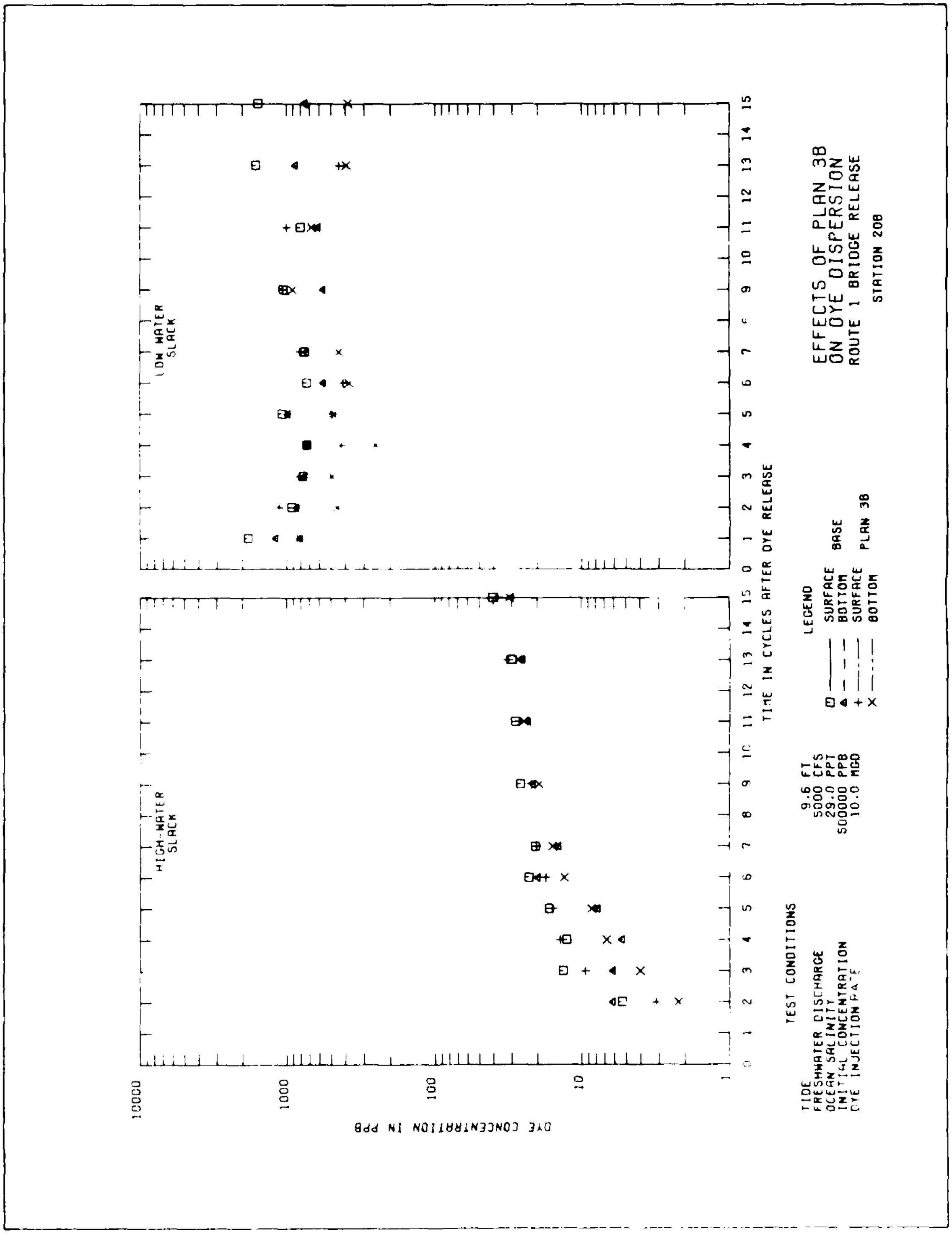
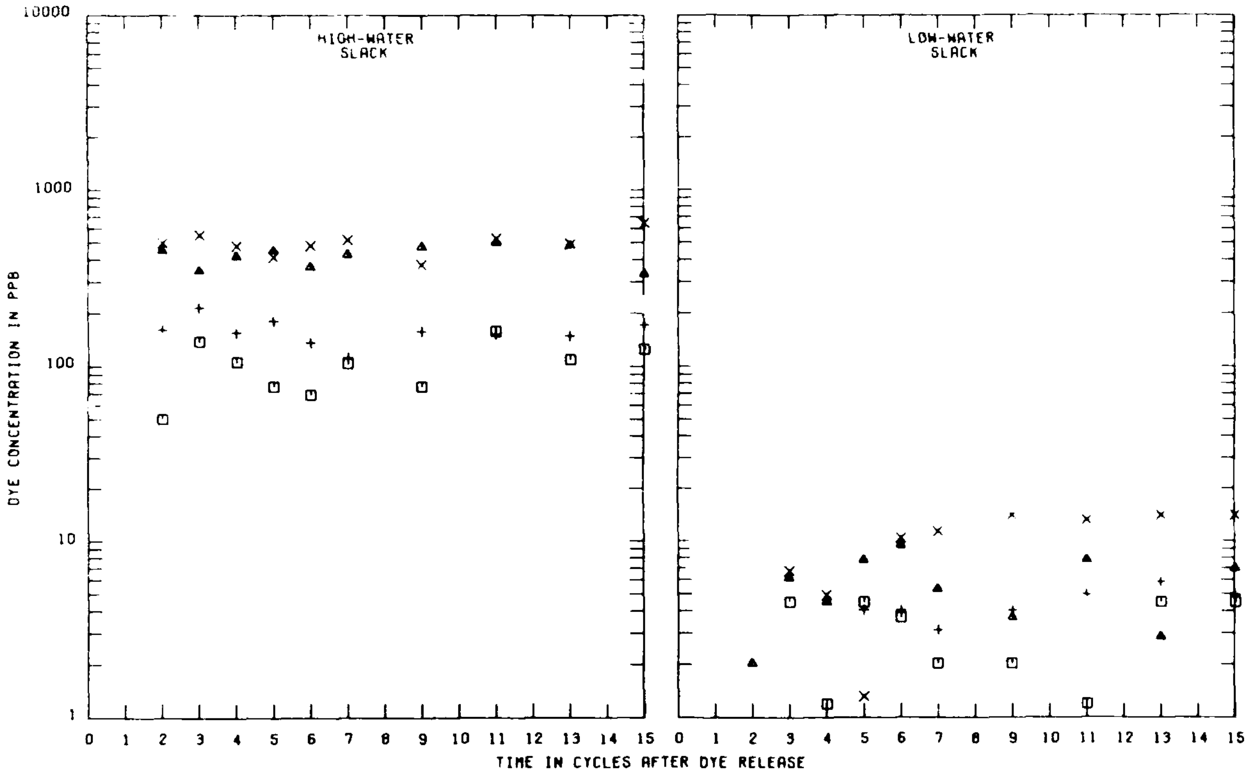

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 20B
LOW WATER
SLACK
HIGH-WATER
SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B

PLATE 144



TEST CONDITIONS

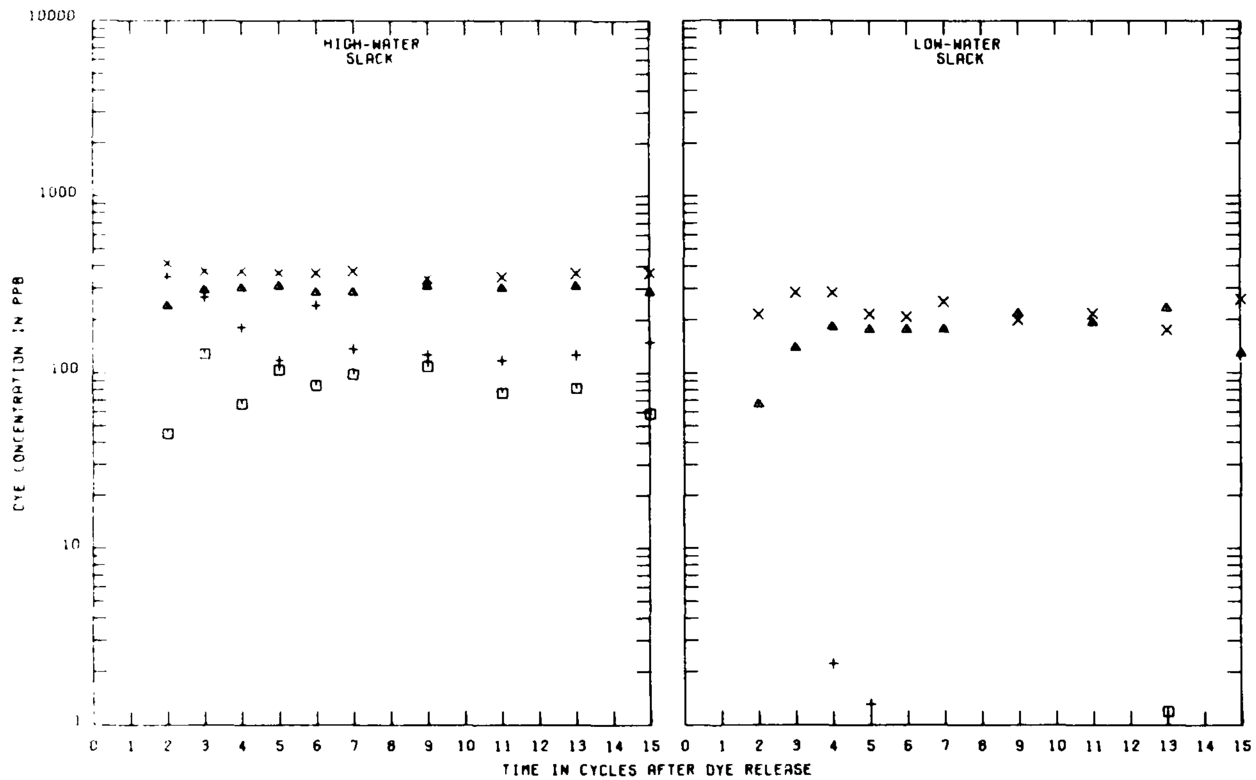
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

□ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—	SURFACE	PLAN 3B
× —··—	BOTTOM	

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 26A



TEST CONDITIONS

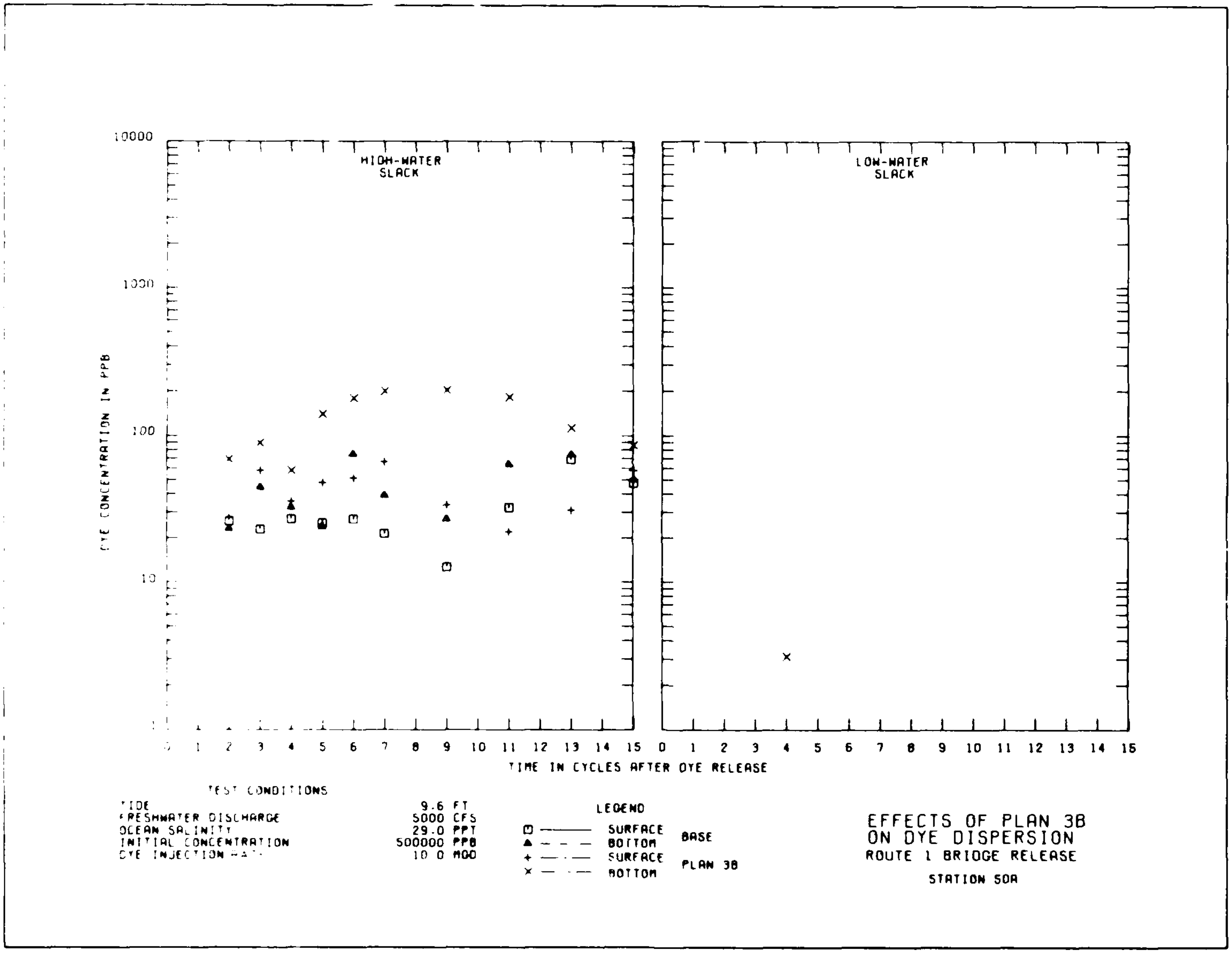
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

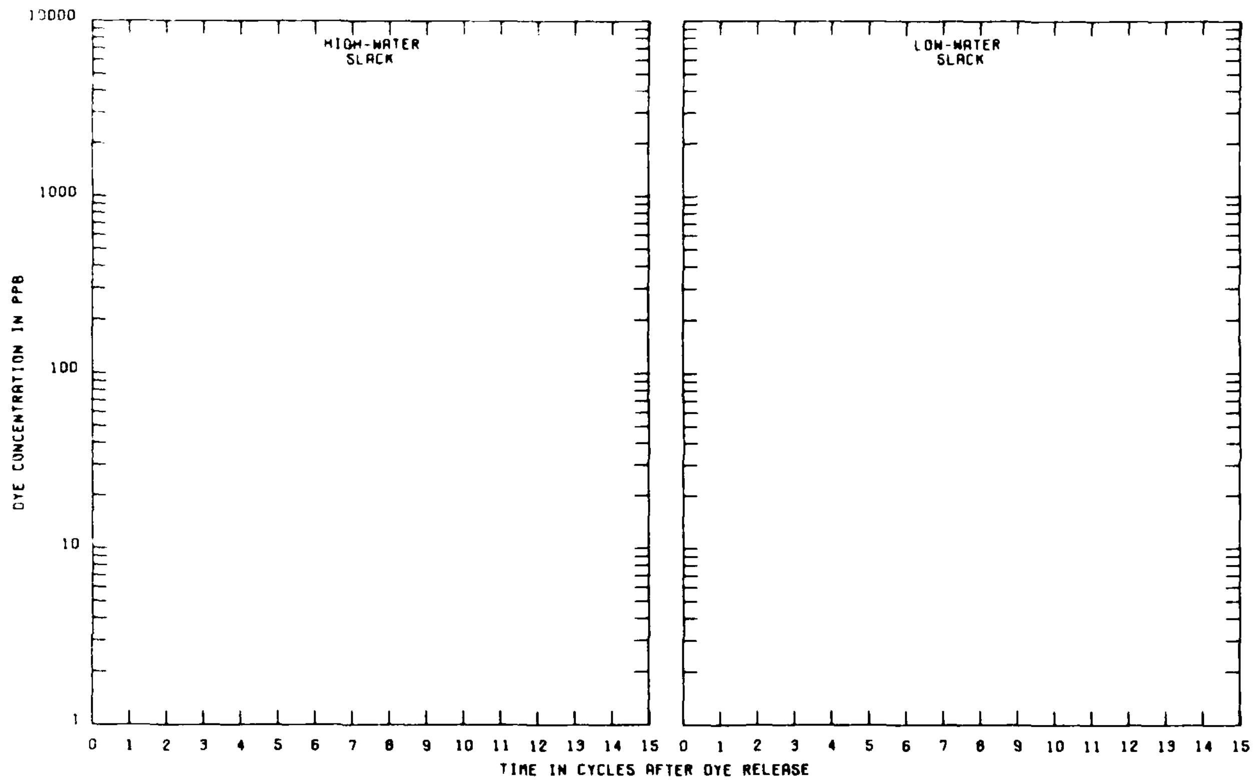
LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—	SURFACE	PLAN 3B
× —··—	BOTTOM	

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 38A


HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MOD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3B
EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 50A



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

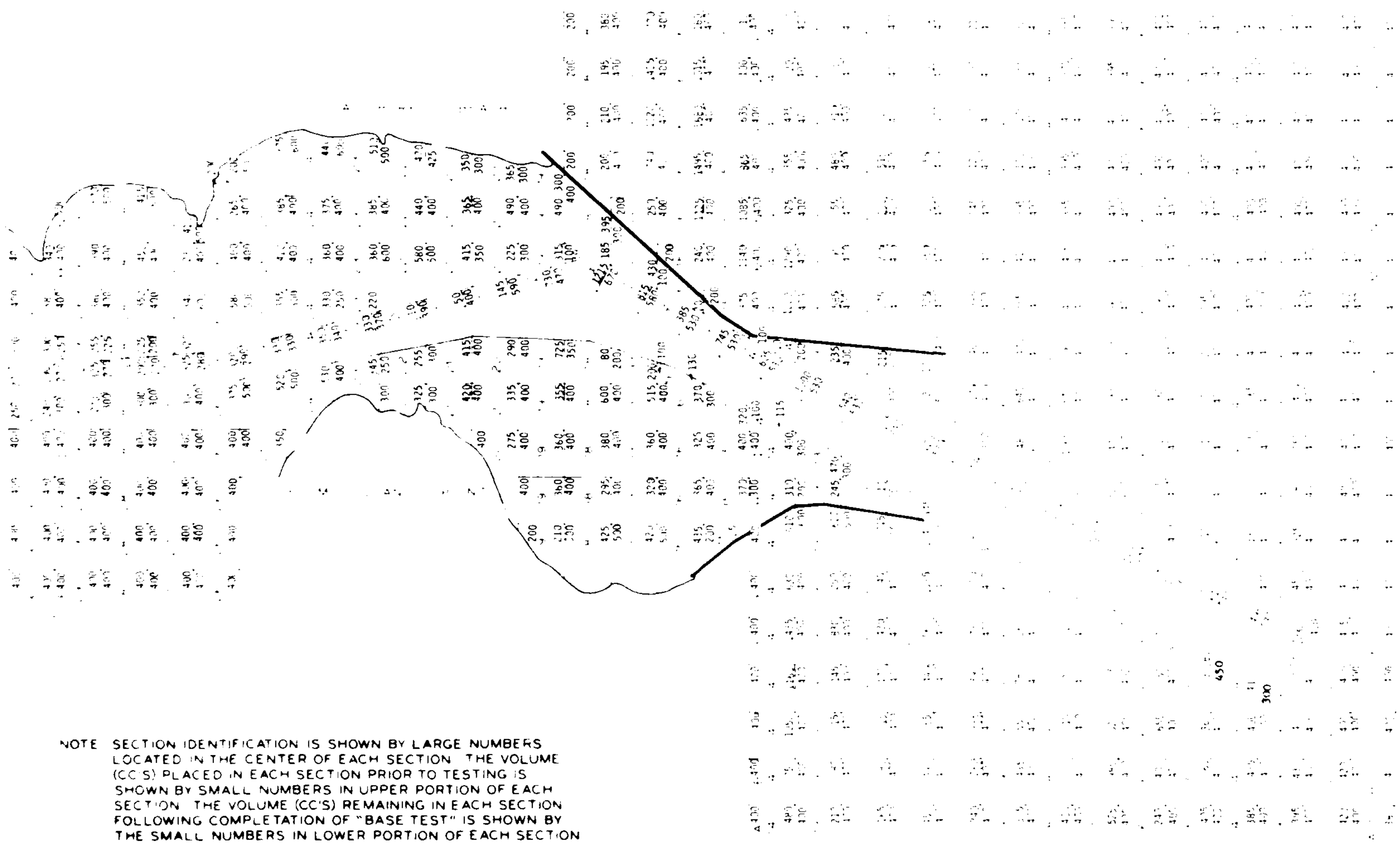
LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN 3B
× —··—··—	BOTTOM	

EFFECTS OF PLAN 3B
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 56A

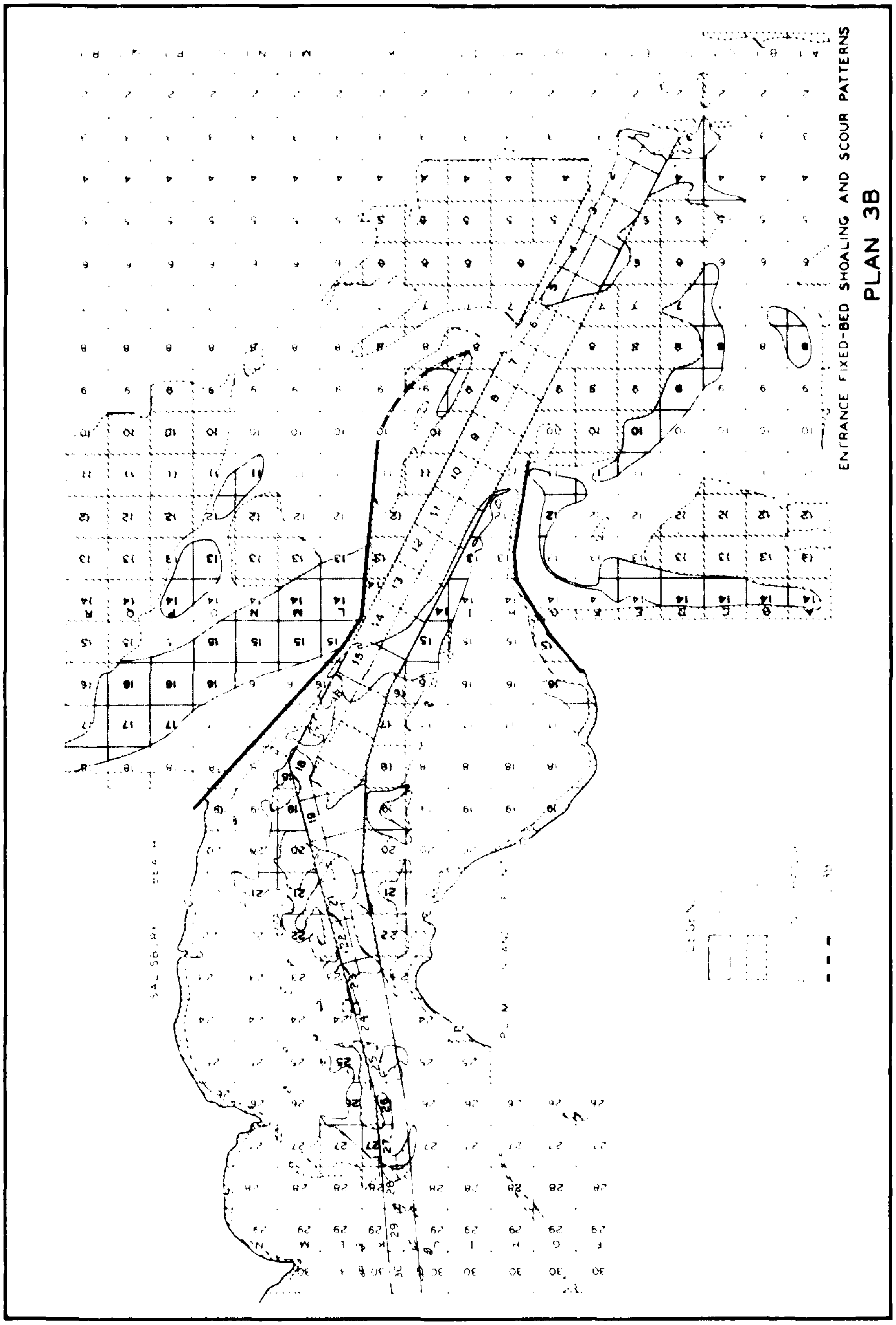
PLATE 148



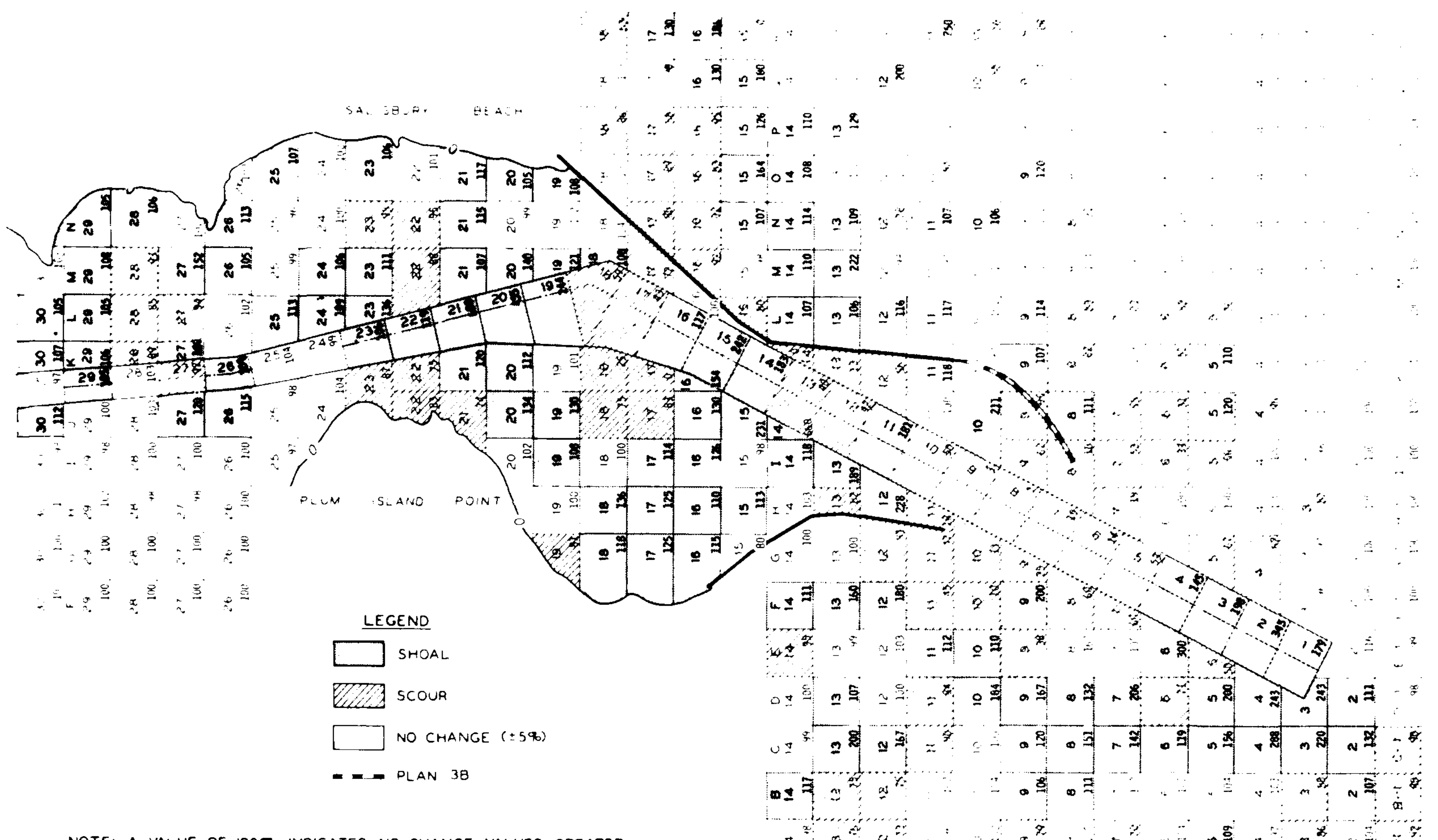
NOTE SECTION IDENTIFICATION IS SHOWN BY LARGE NUMBERS LOCATED IN THE CENTER OF EACH SECTION. THE VOLUME (CC'S) PLACED IN EACH SECTION PRIOR TO TESTING IS SHOWN BY SMALL NUMBERS IN UPPER PORTION OF EACH SECTION. THE VOLUME (CC'S) REMAINING IN EACH SECTION FOLLOWING COMPLETATION OF "BASE TEST" IS SHOWN BY THE SMALL NUMBERS IN LOWER PORTION OF EACH SECTION

ENTRANCE FIXED-BED SHOALING AND SCOUR

BEST TEST RESULTS IN CC'S



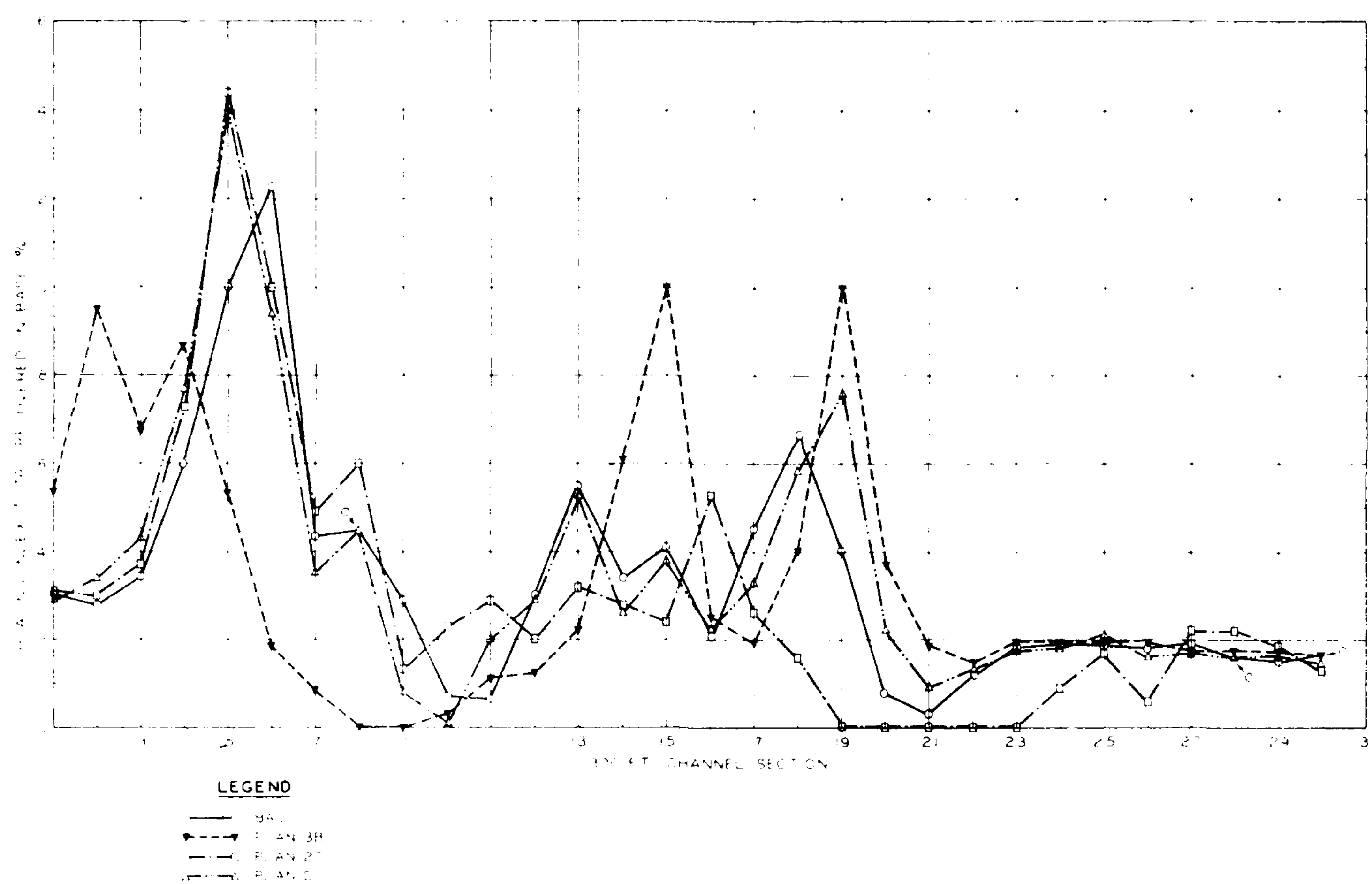
ENTRANCE FIXED-BED SHOALING AND SCOUR PATTERNS
PLAN 3B



NOTE: A VALUE OF 100% INDICATES NO CHANGE; VALUES GREATER THAN 100% INDICATE AREAS OF SHOALING, WHILE VALUES LESS THAN 100% INDICATE AREAS OF SCOUR. AREAS WHERE EFFECTS WERE WITHIN PLUS OR MINUS 5% ARE CONSIDERED NOT CHANGED.

ENTRANCE FIXED-BED SHOALING AND SCOUR IN PERCENT OF BASE

PLAN 3B



EFFECTS OF PLANS 3B, 2C, AND D
ON CHANNEL SHOALING

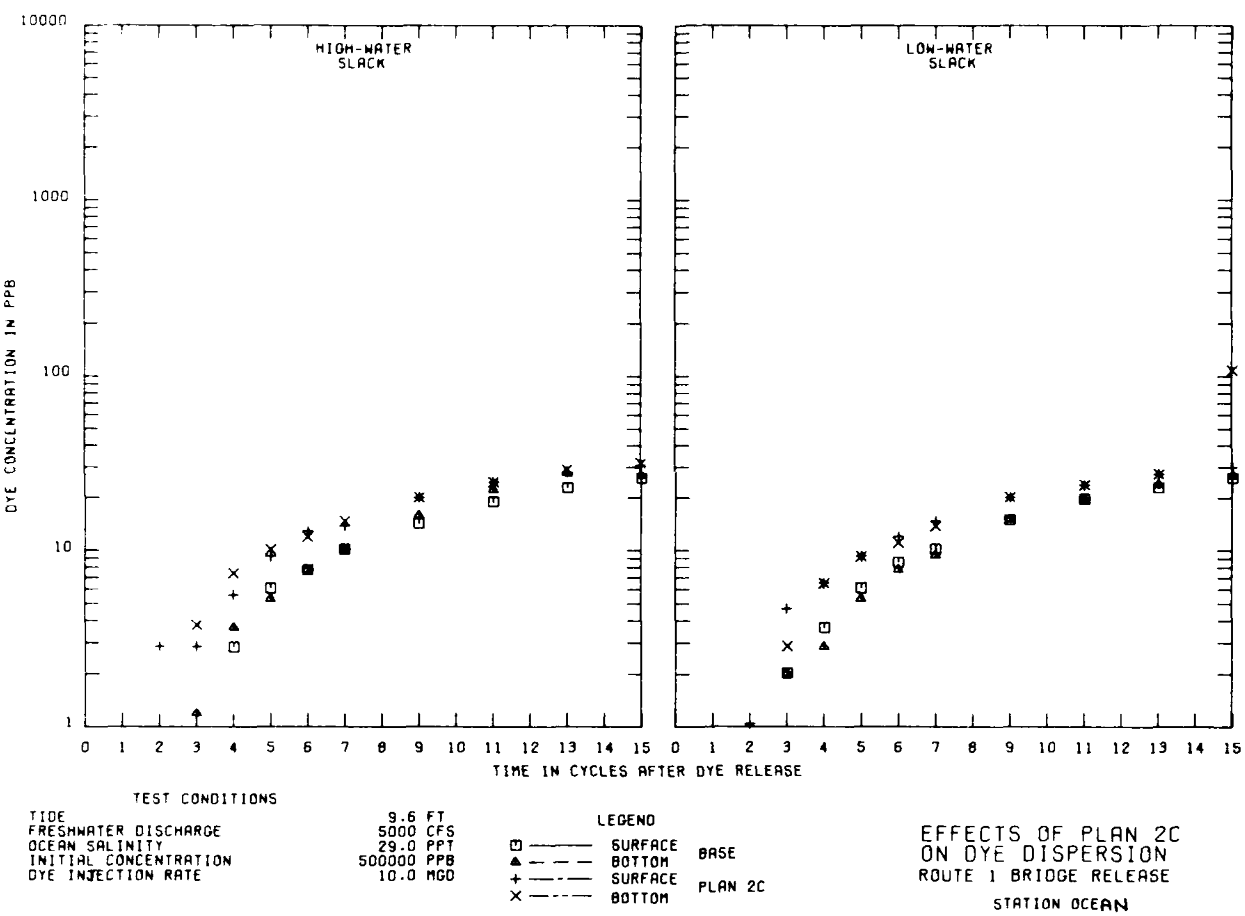
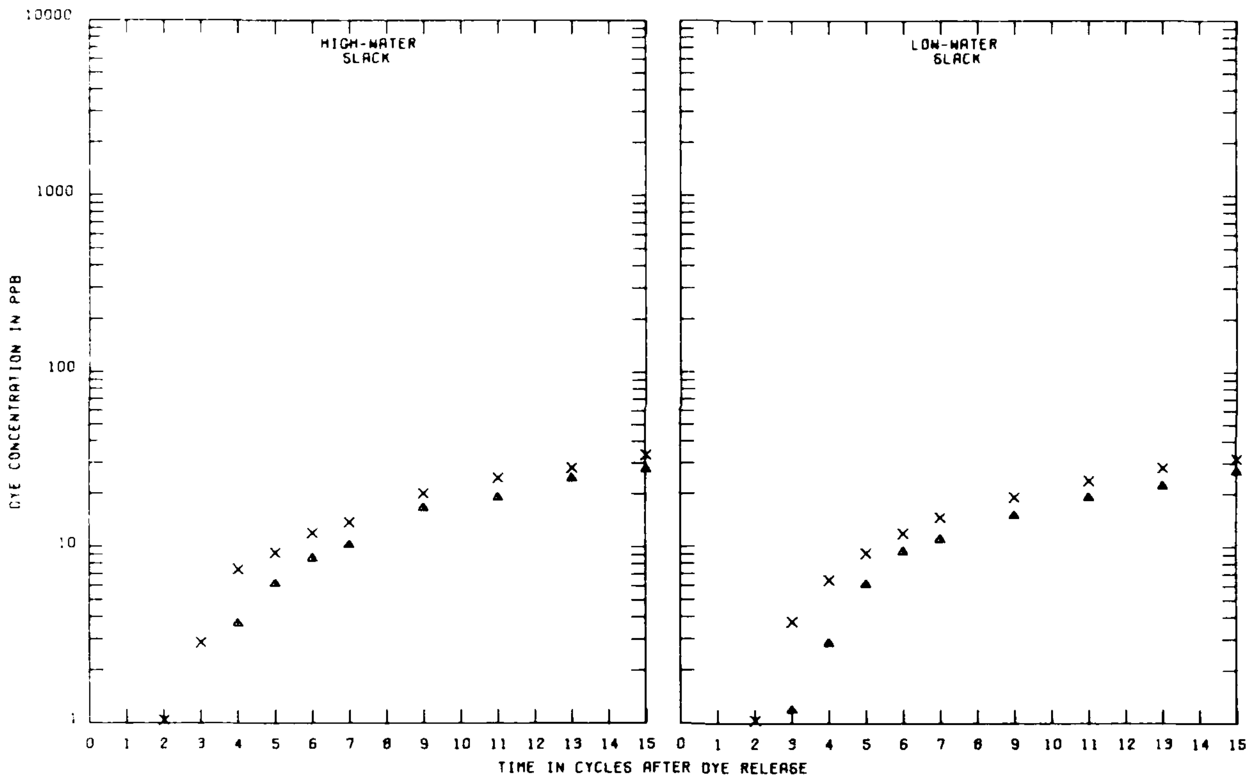

HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 2C
EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION OCEAN

PLATE 153



TEST CONDITIONS

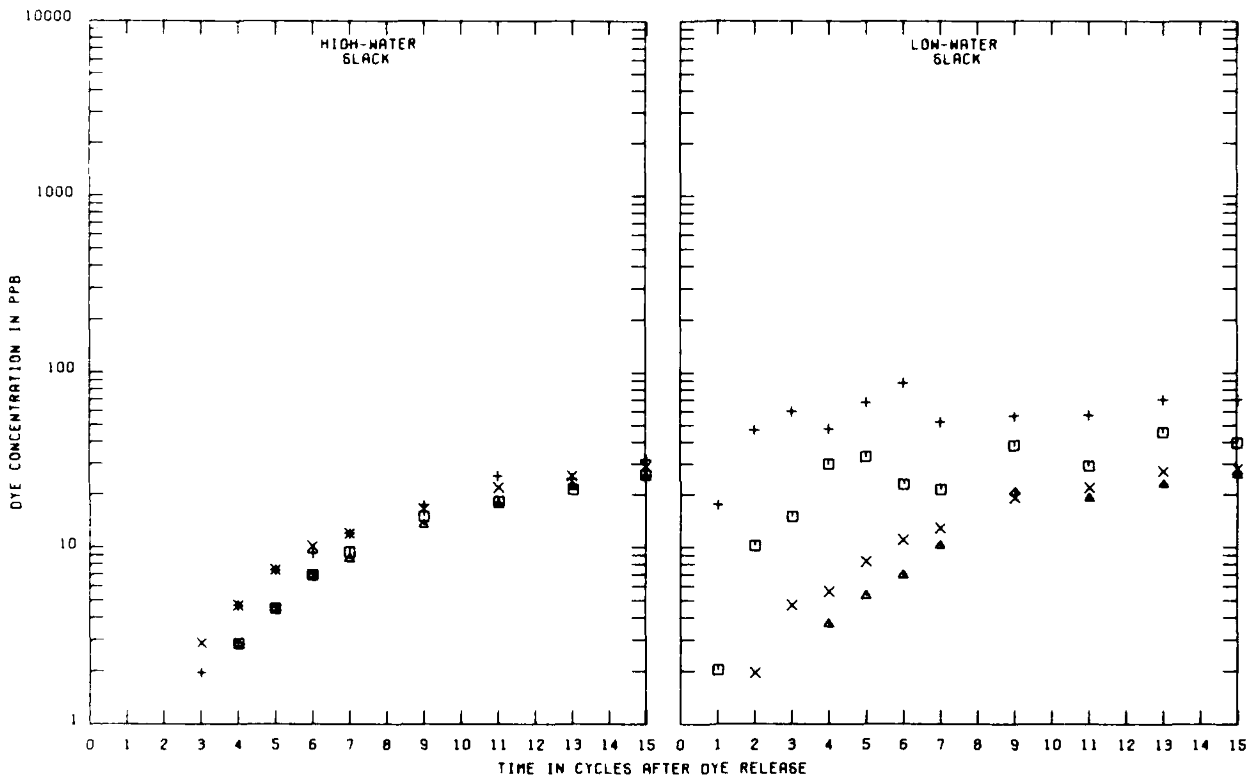
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

▲ — — — BOTTOM BASE

× —·—·— BOTTOM PLAN 2C

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION SUMP



TEST CONDITIONS

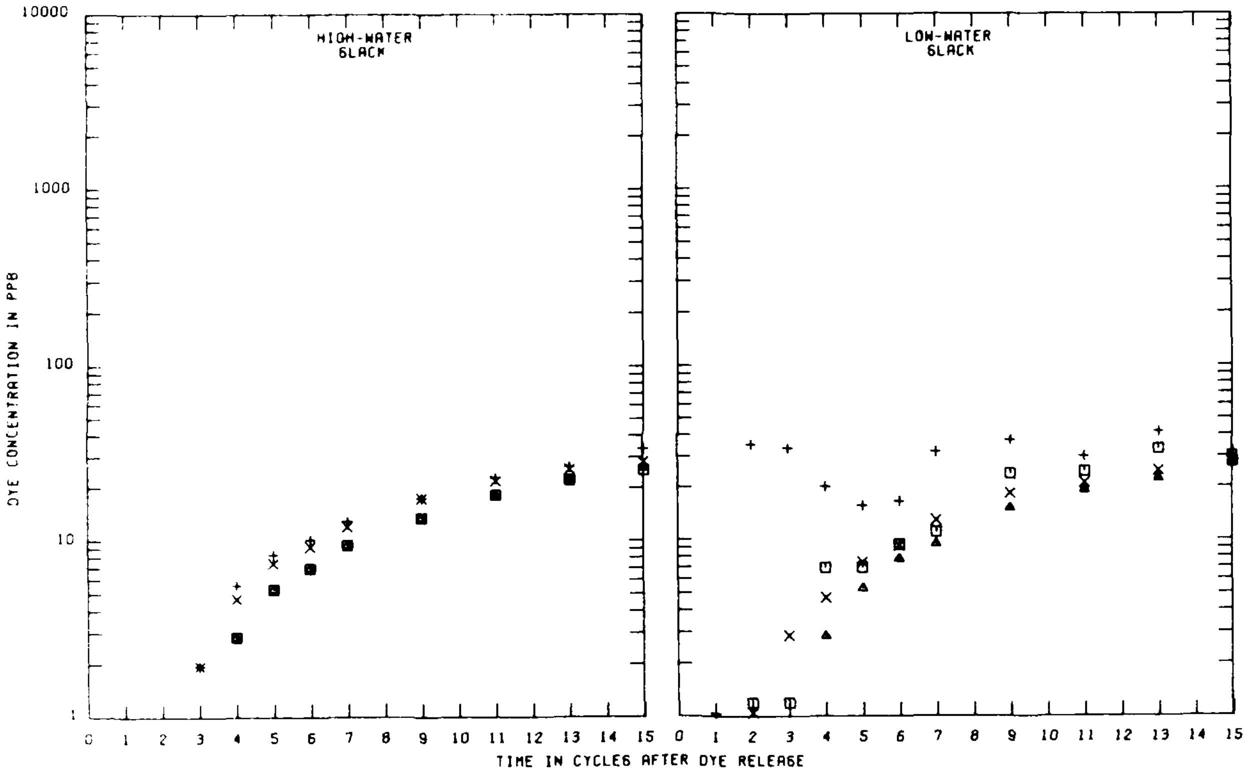
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—	SURFACE	PLAN 2C
× —··—	BOTTOM	

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 0A



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

□ ———	SURFACE	BASE
▲ — — —	BOTTOM	BASE
+ —·—·—	SURFACE	PLAN 2C
× —··—··	BOTTOM	PLAN 2C

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 08

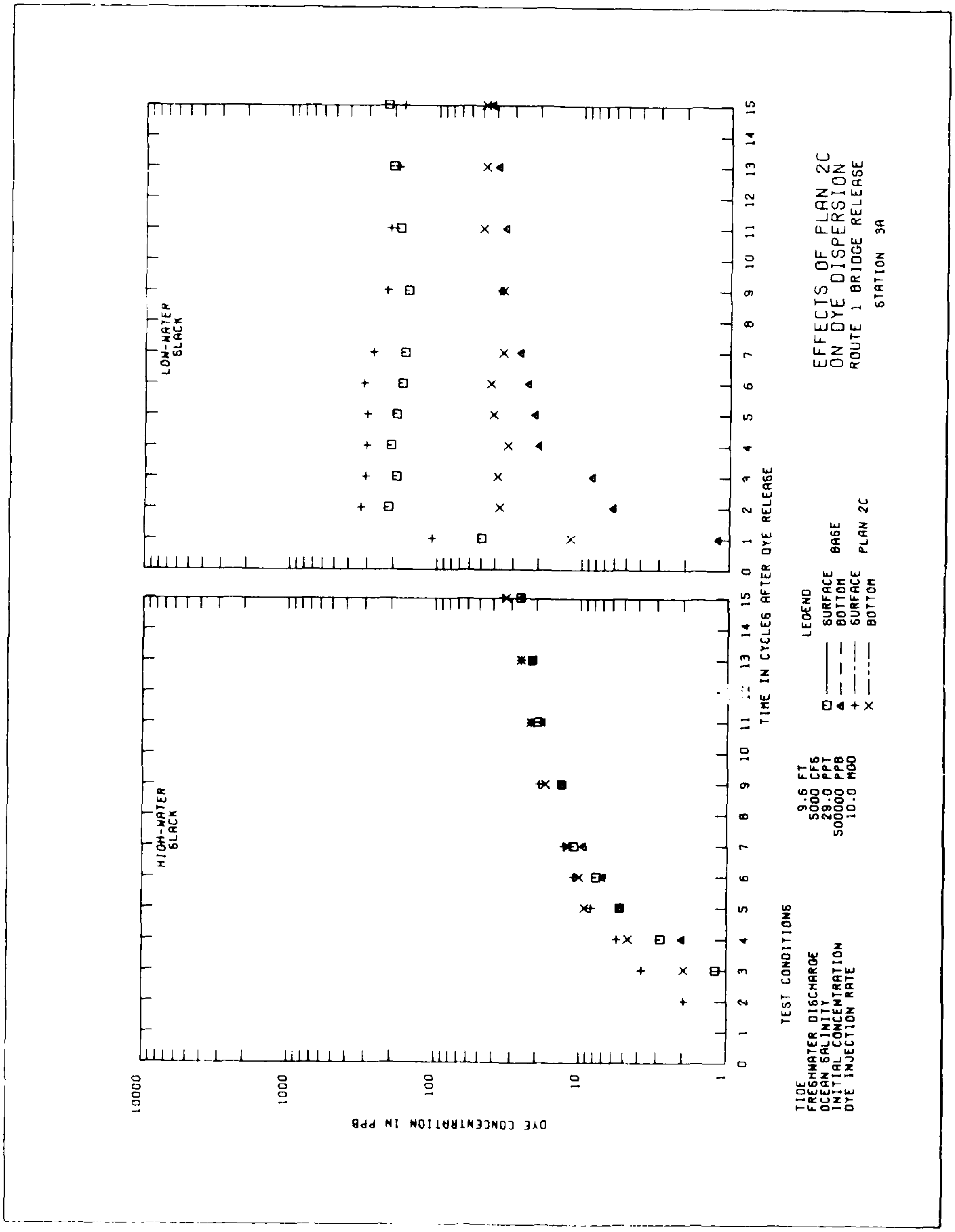
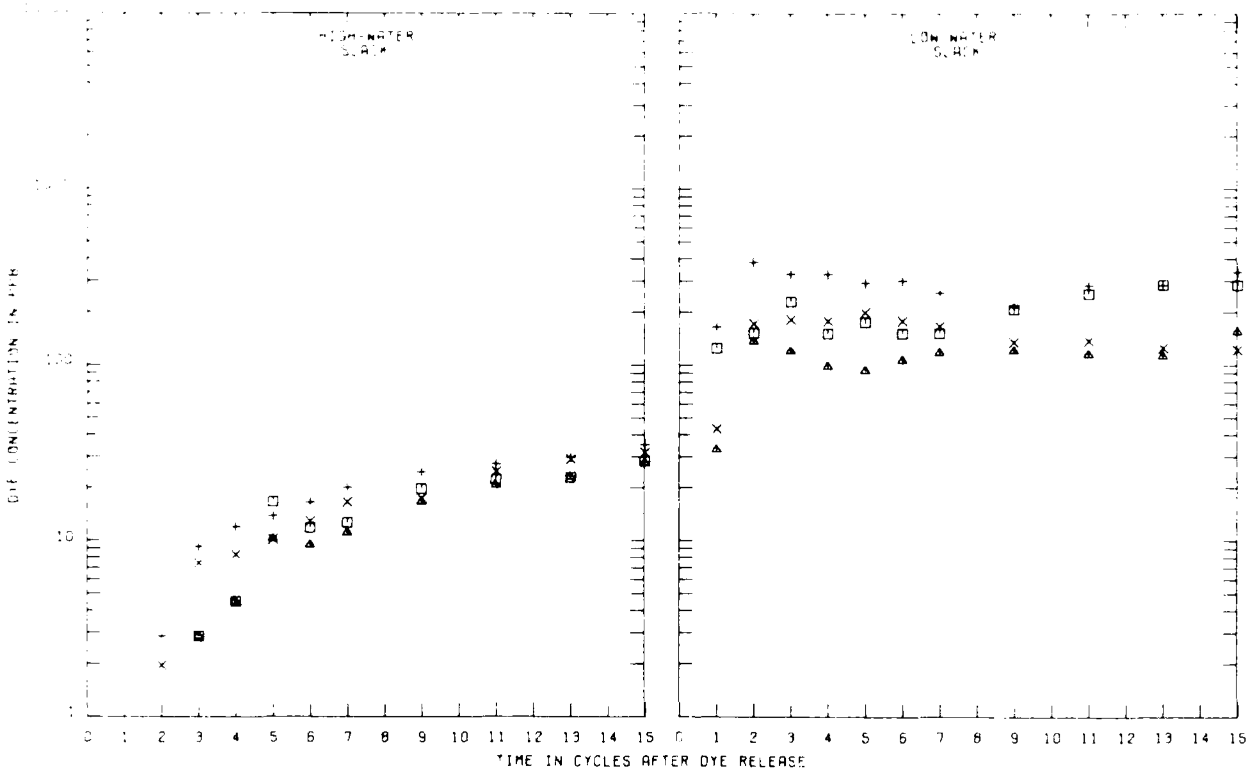

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 3A
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 2C

PLATE 157



TEST CONDITIONS

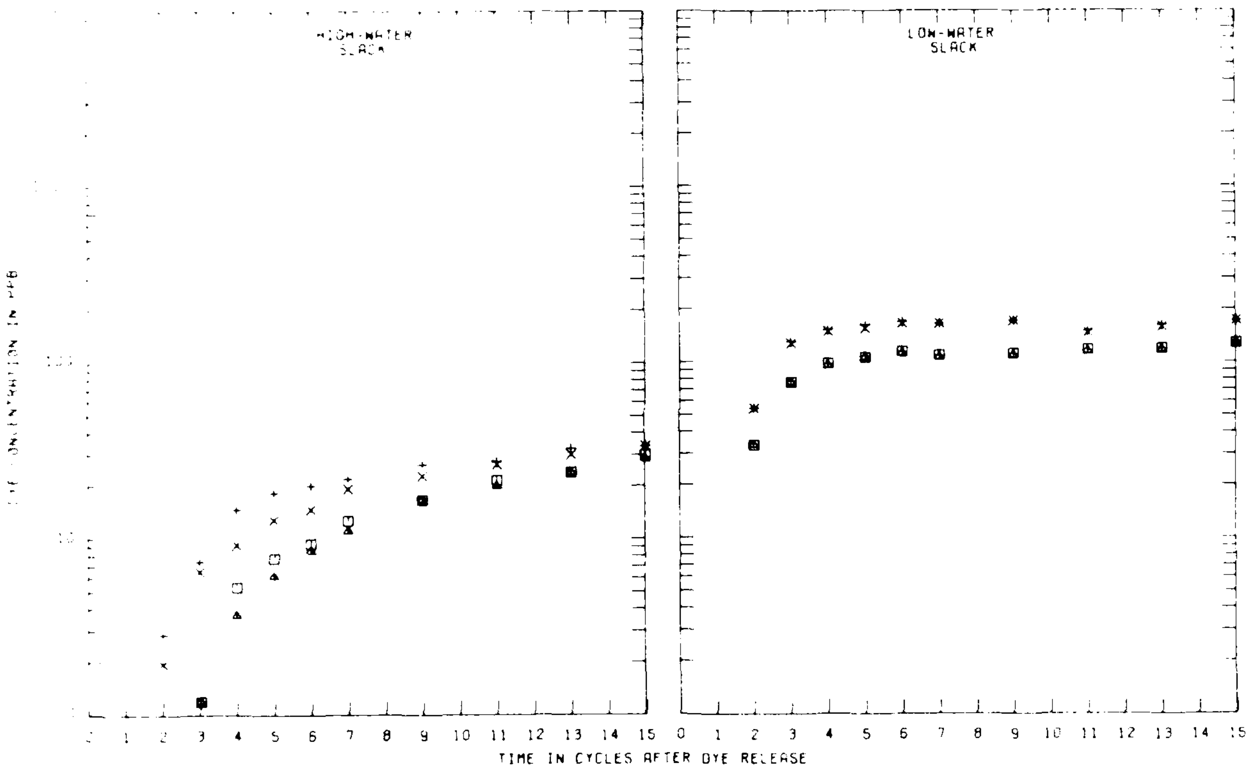
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

□ ———	SURFACE	BASE
△ — — —	BOTTOM	
+ —·—	SURFACE	PLAN 2C
× —··—	BOTTOM	

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 10C



TEST CONDITIONS

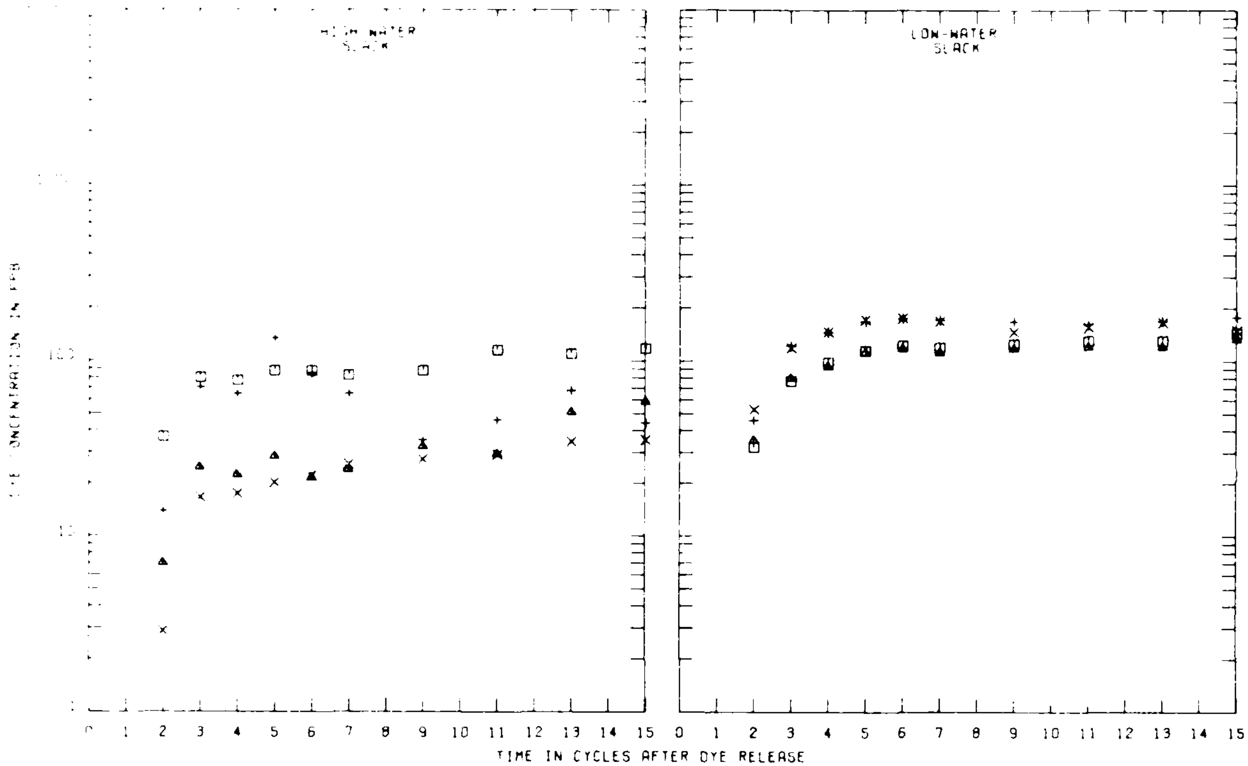
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN 2C
× —··—··—	BOTTOM	

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 10B



TEST CONDITIONS

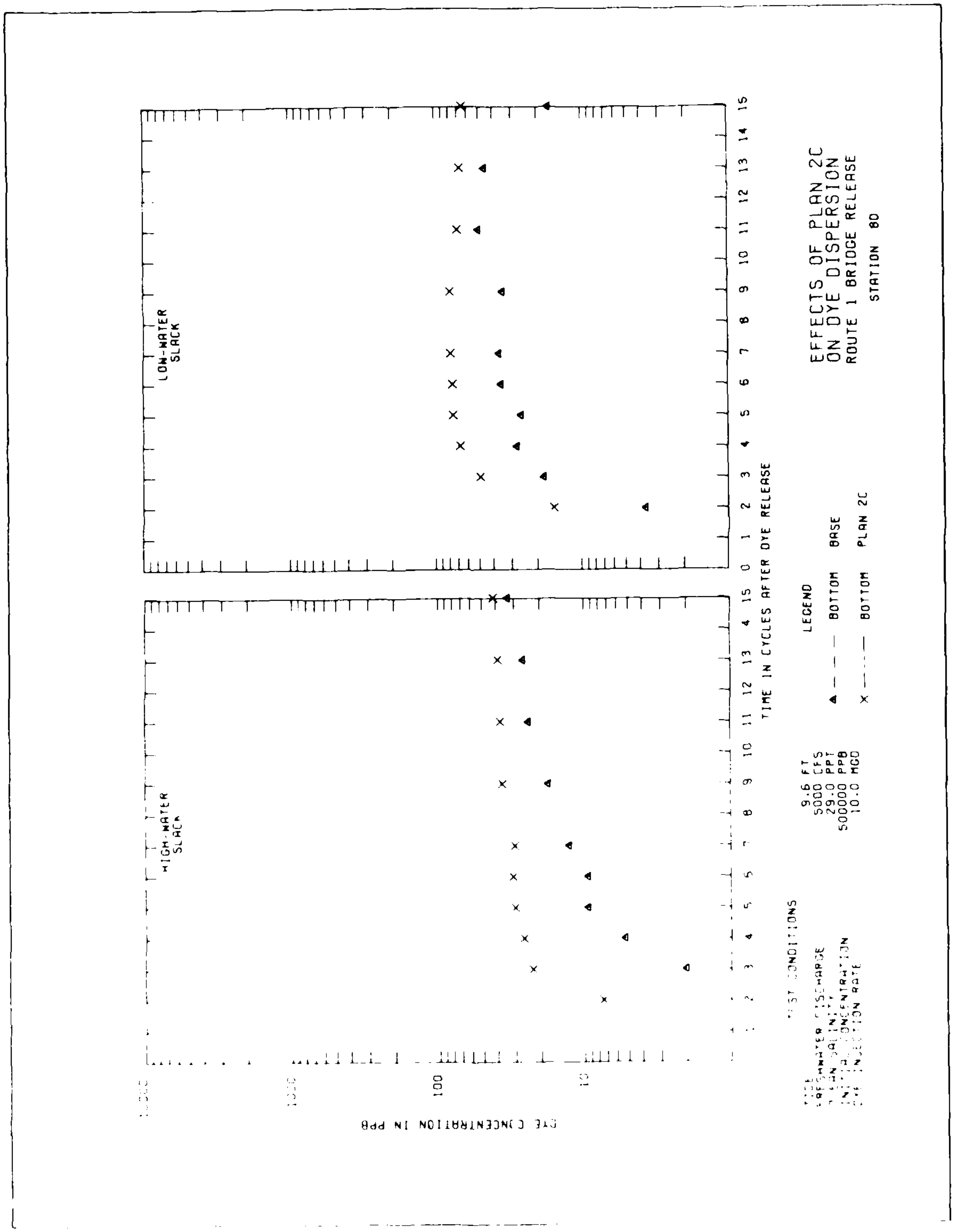
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	BASE
+ —·—·—	SURFACE	PLAN 2C
× —··—··—	BOTTOM	PLAN 2C

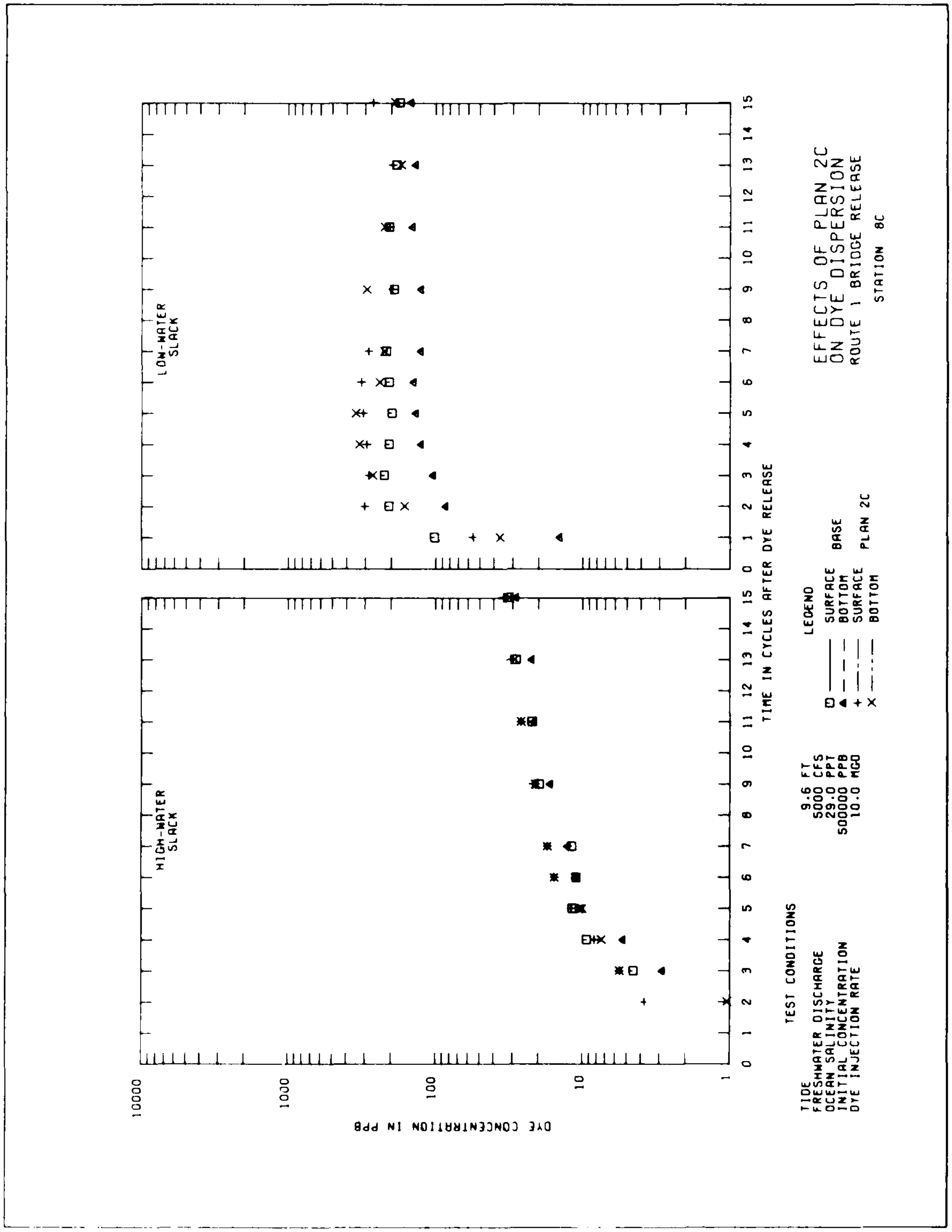
EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 10A



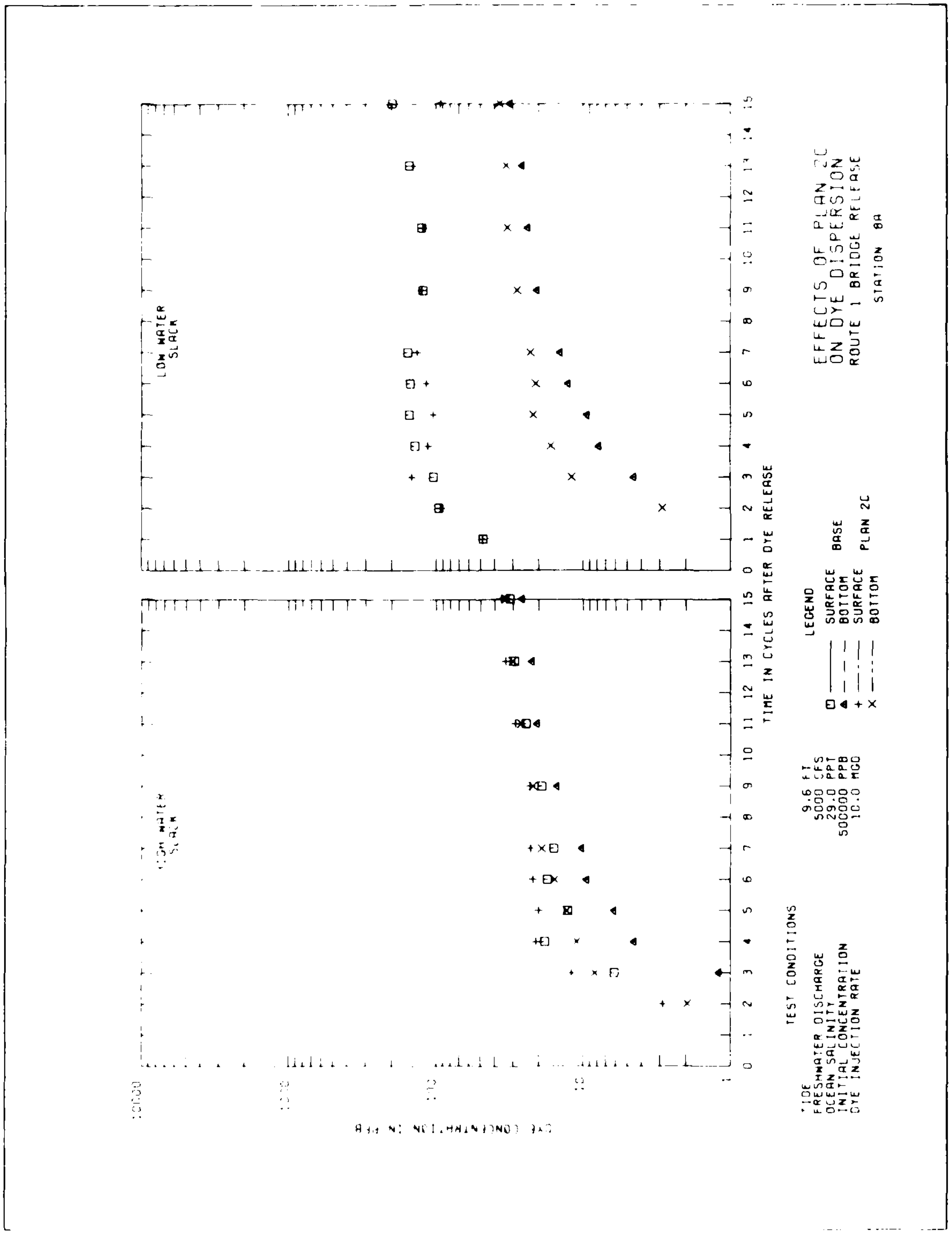
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
9.6 FT
5000 CFS
29.0 PPT
500000 PPB
10.0 MGD
LEGEND
BOTTOM BASE
BOTTOM PLAN 2C
EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 80

PLATE 168



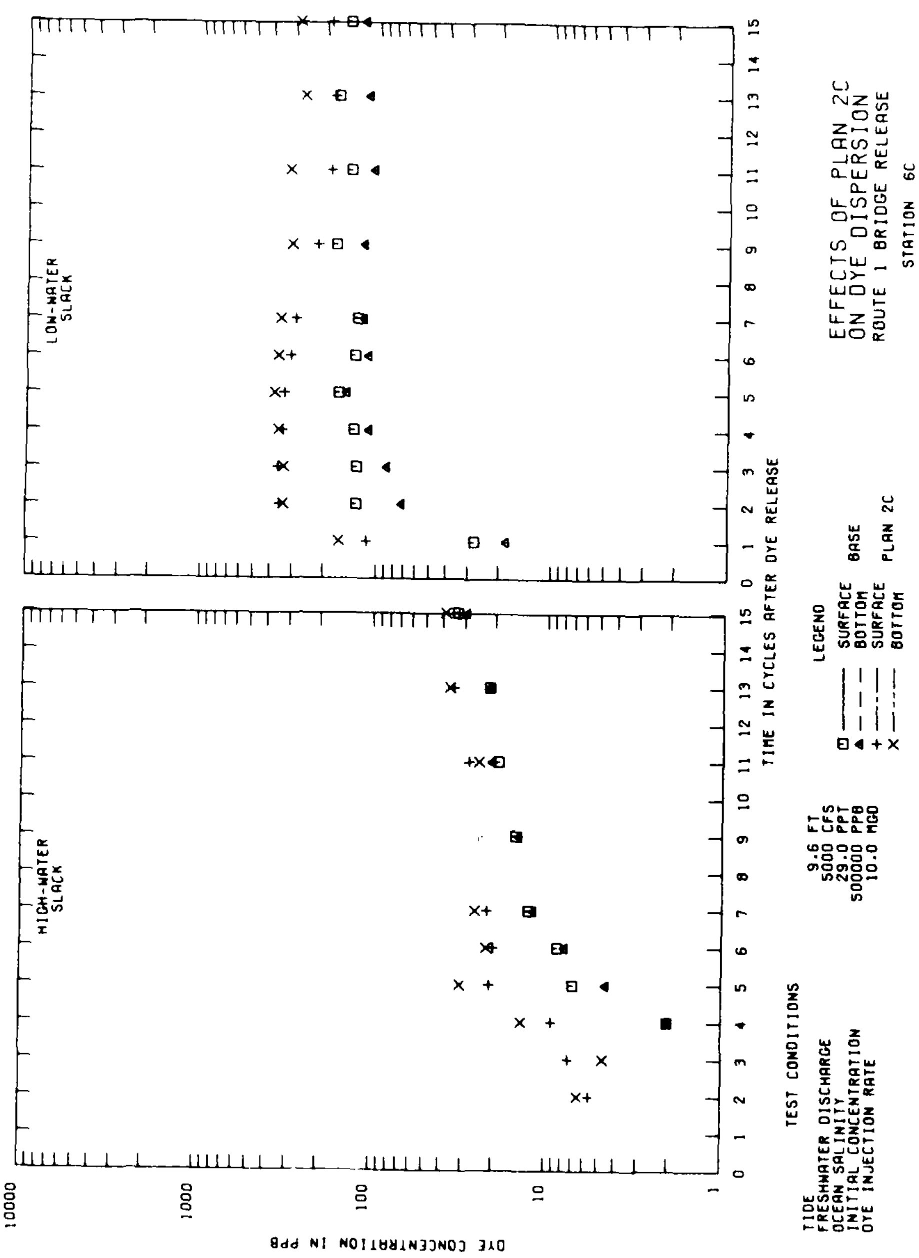
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 2C
EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 8C

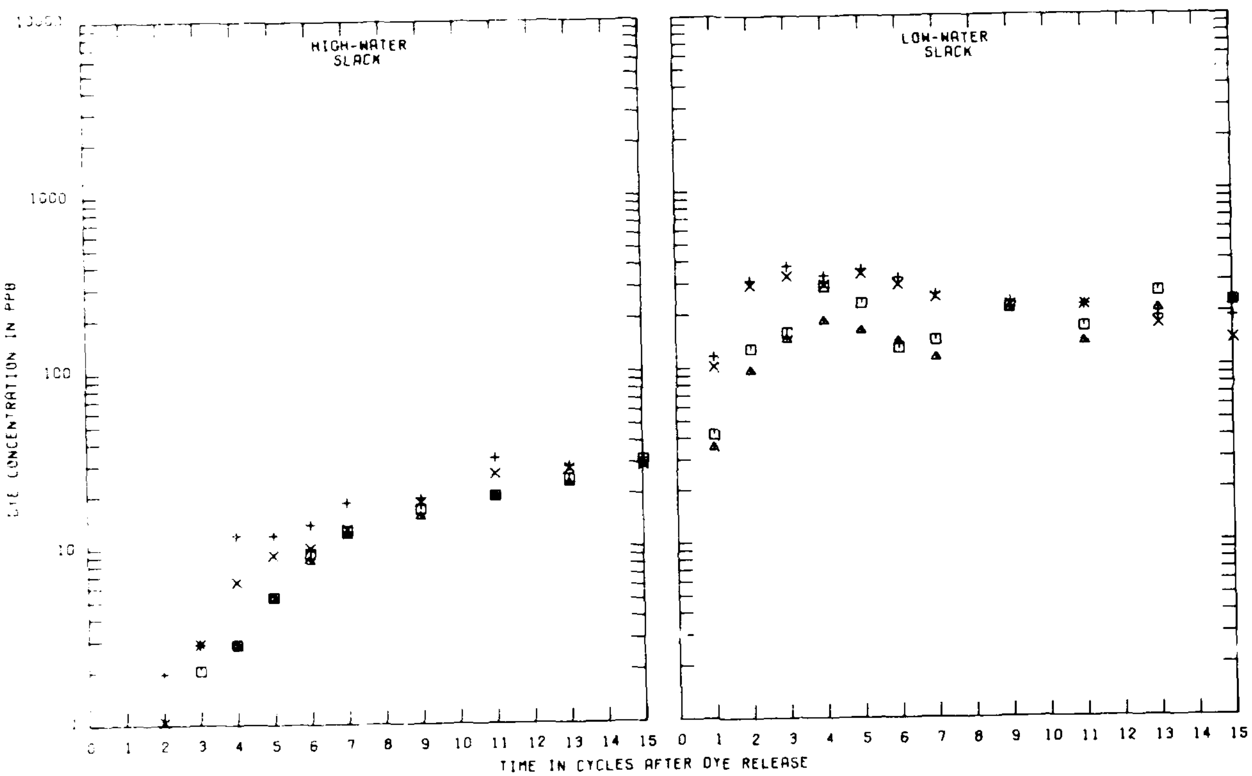
PLATE 167



HIGH WATER SLACK
LOW WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE BASE
BOTTOM BASE
SURFACE PLAN 2C
BOTTOM PLAN 2C
EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 8A

PLATE 166


EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 6C
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
LEGEND
SURFACE BASE
BOTTOM BASE
SURFACE PLAN 2C
BOTTOM PLAN 2C
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD



TEST CONDITIONS

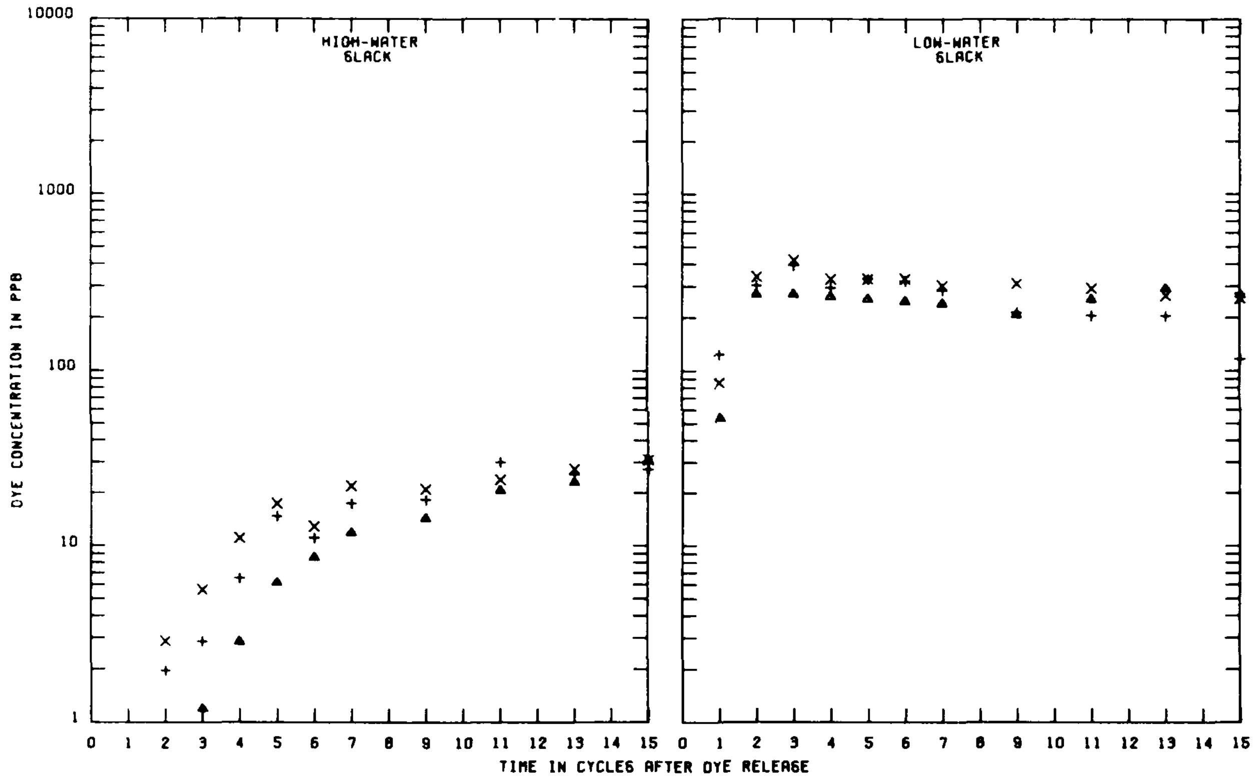
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN 2C
× —··—··—	BOTTOM	

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 68



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

▲ — — — BOTTOM BASE
+ —·—·— SURFACE PLAN 2C
× —·—·— BOTTOM

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 6A

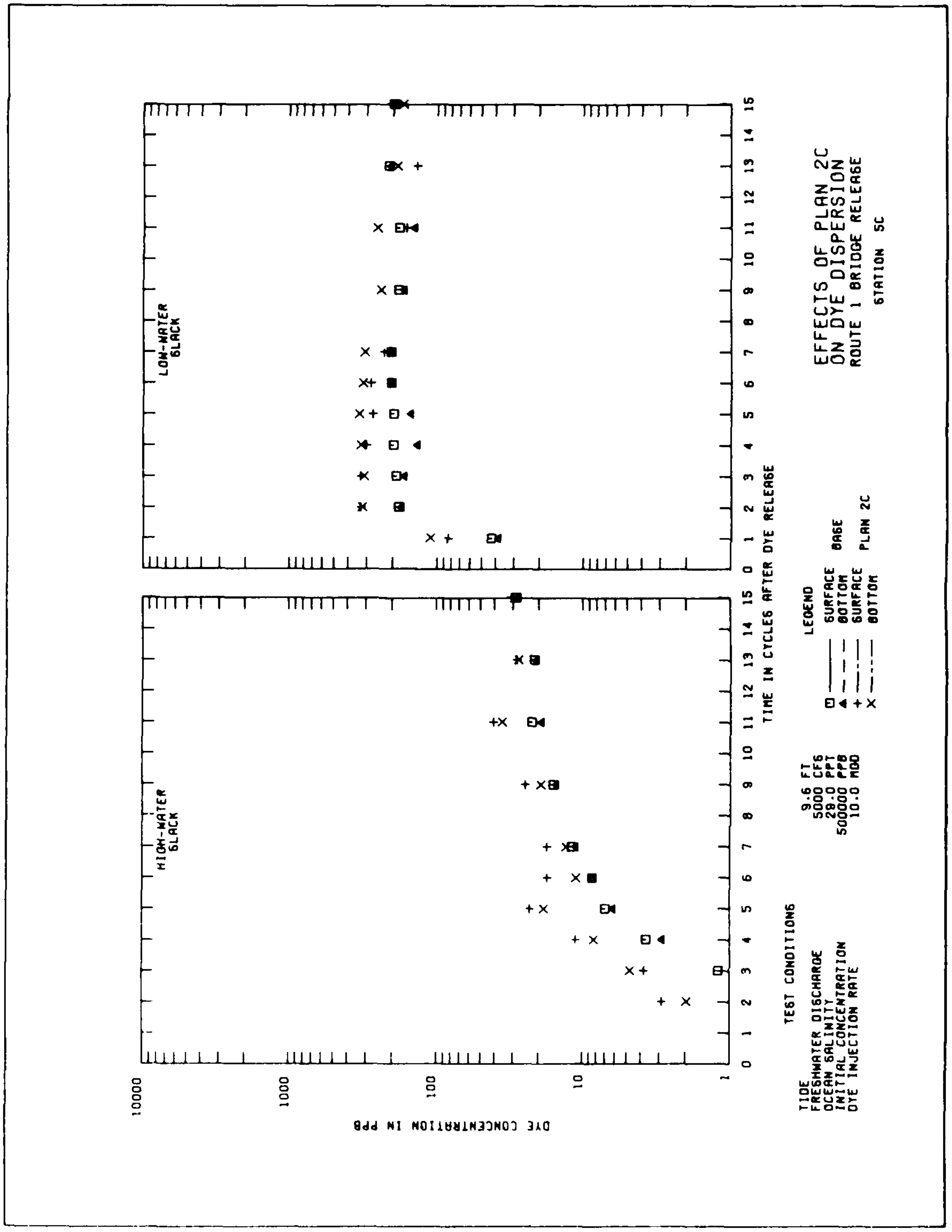
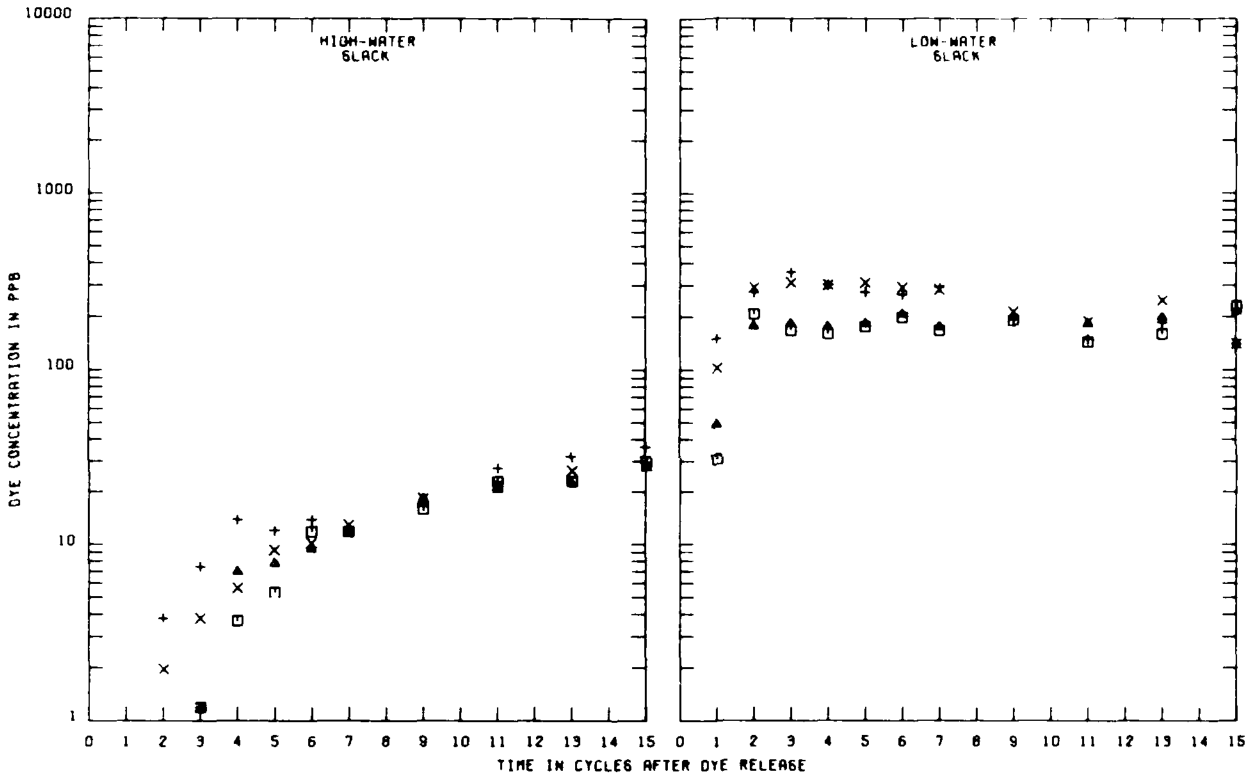

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 5C
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MOD
9.6 FT
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 2C

PLATE 162



TEST CONDITIONS

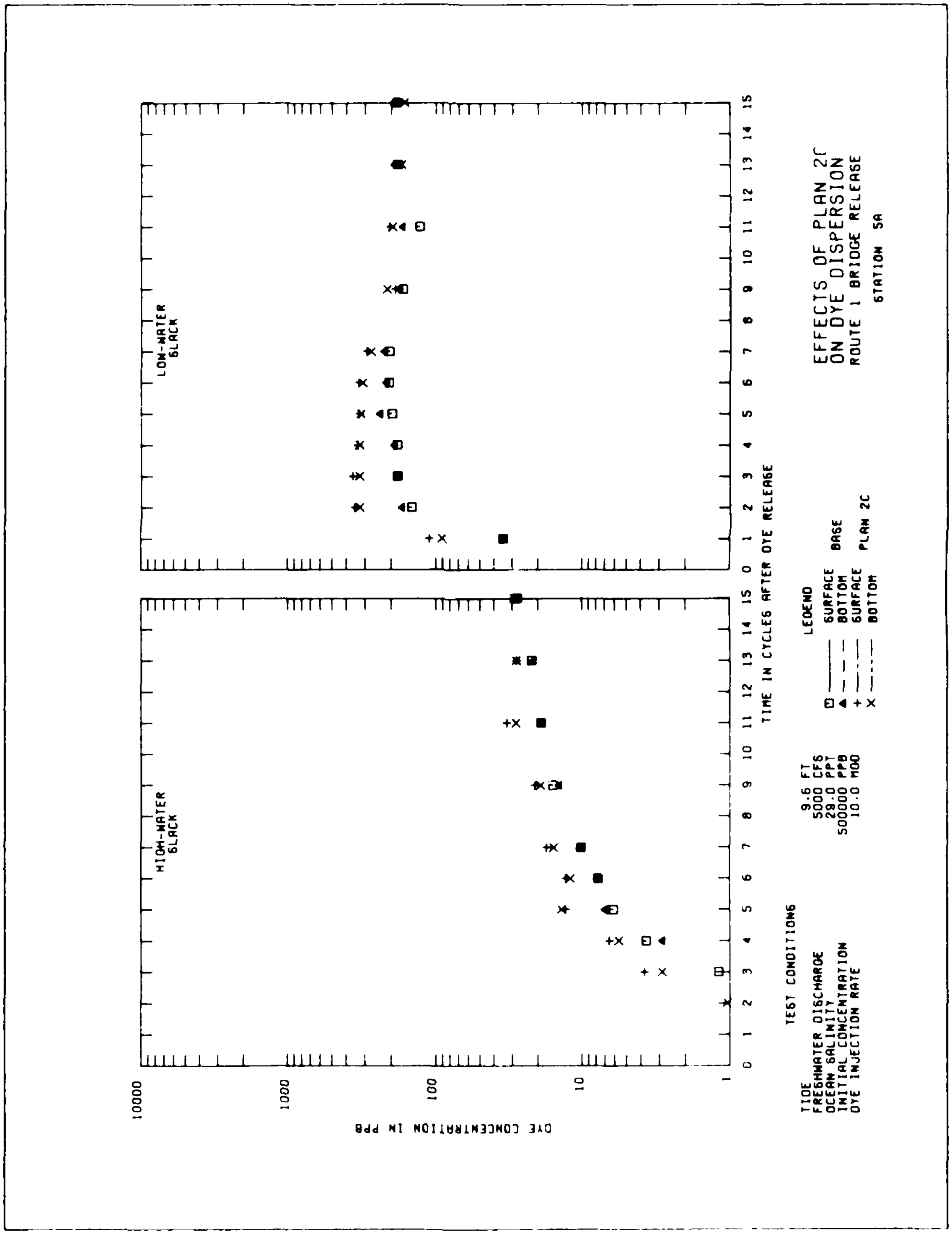
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

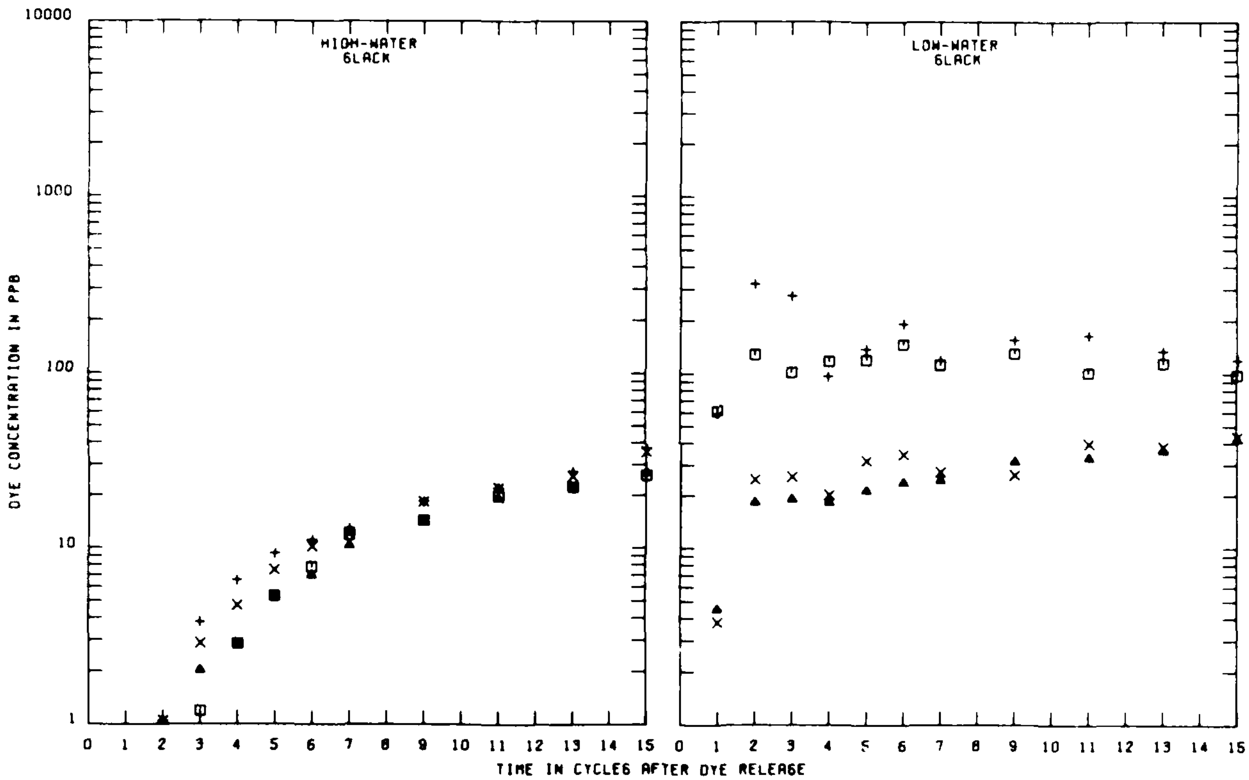
□ ——— SURFACE, ▲ — — — BOTTOM: BASE
\+ —·— SURFACE, X —··— BOTTOM: PLAN 2C

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 58



EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 5A
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 2C



TEST CONDITIONS

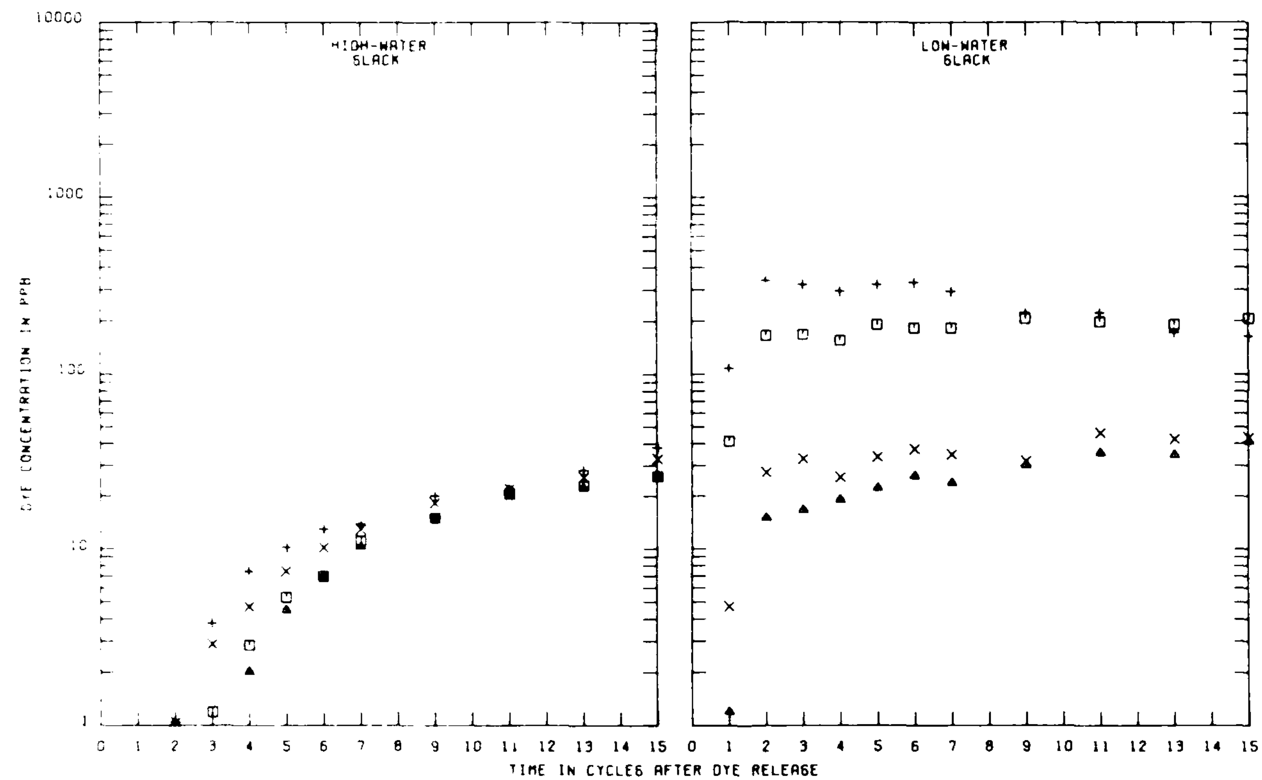
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

□ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN 2C
× —··—··	BOTTOM	

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 3C



TEST CONDITIONS

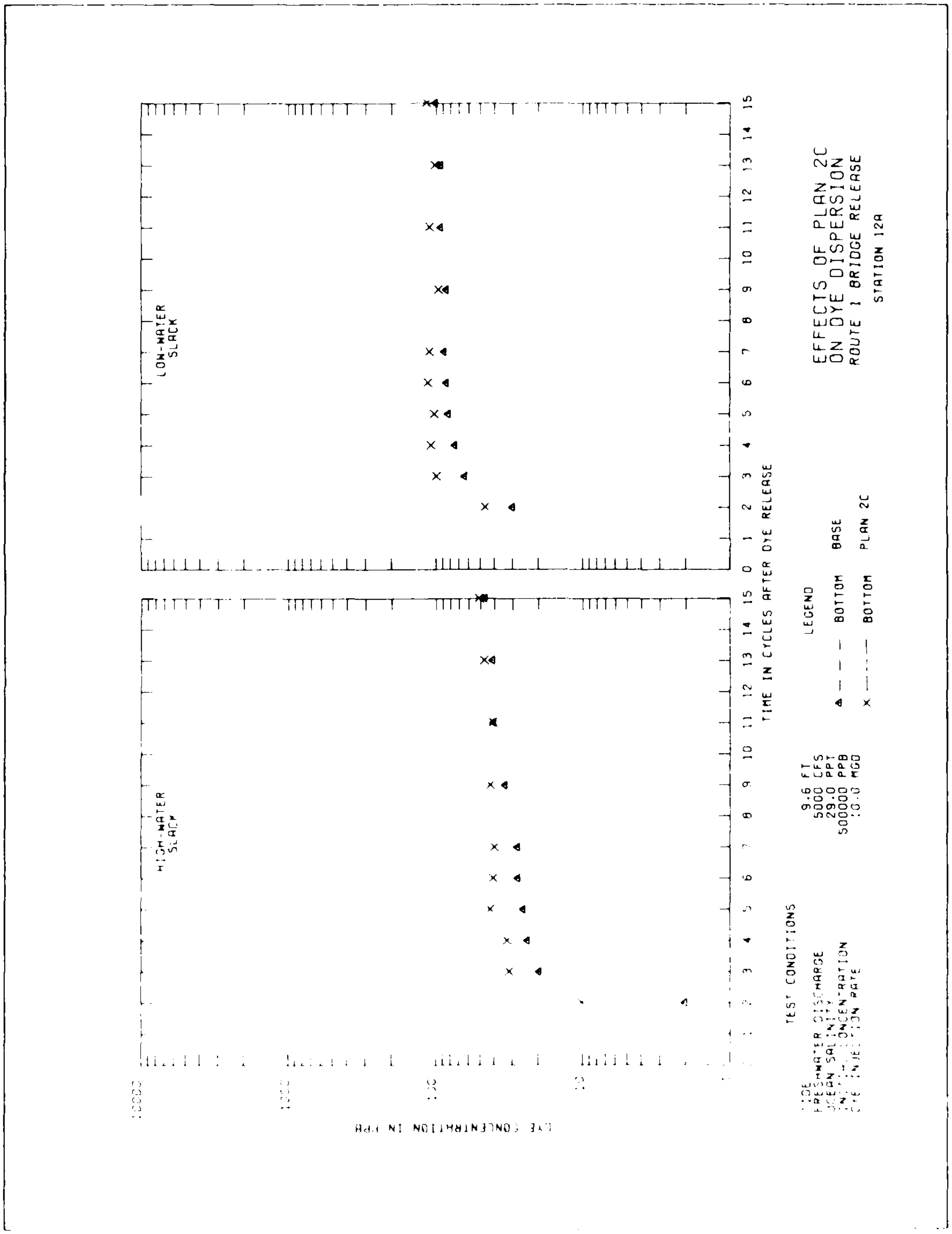
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

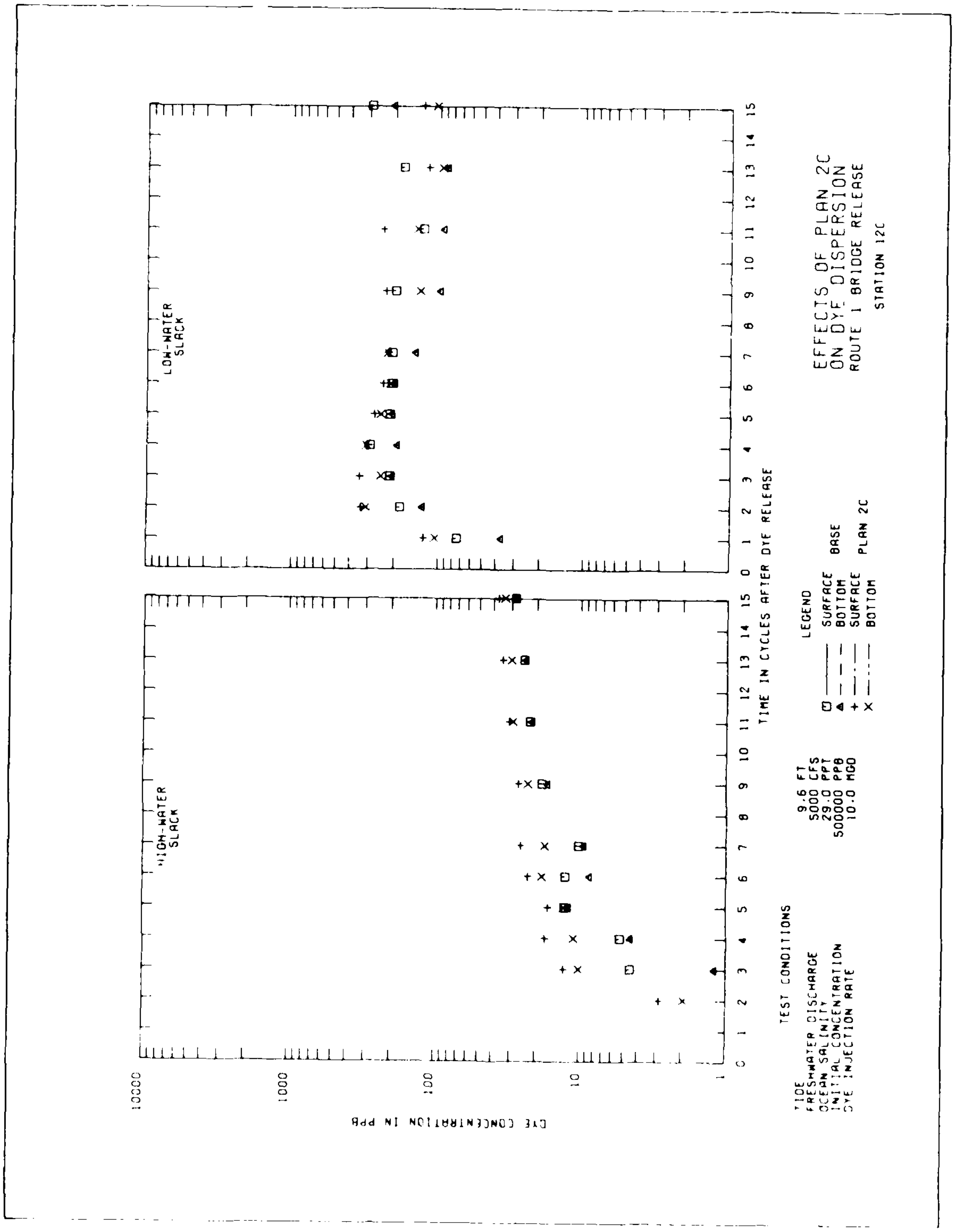
LEGEND

□ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —-—-—	SURFACE	PLAN 2C
× —·—·—	BOTTOM	

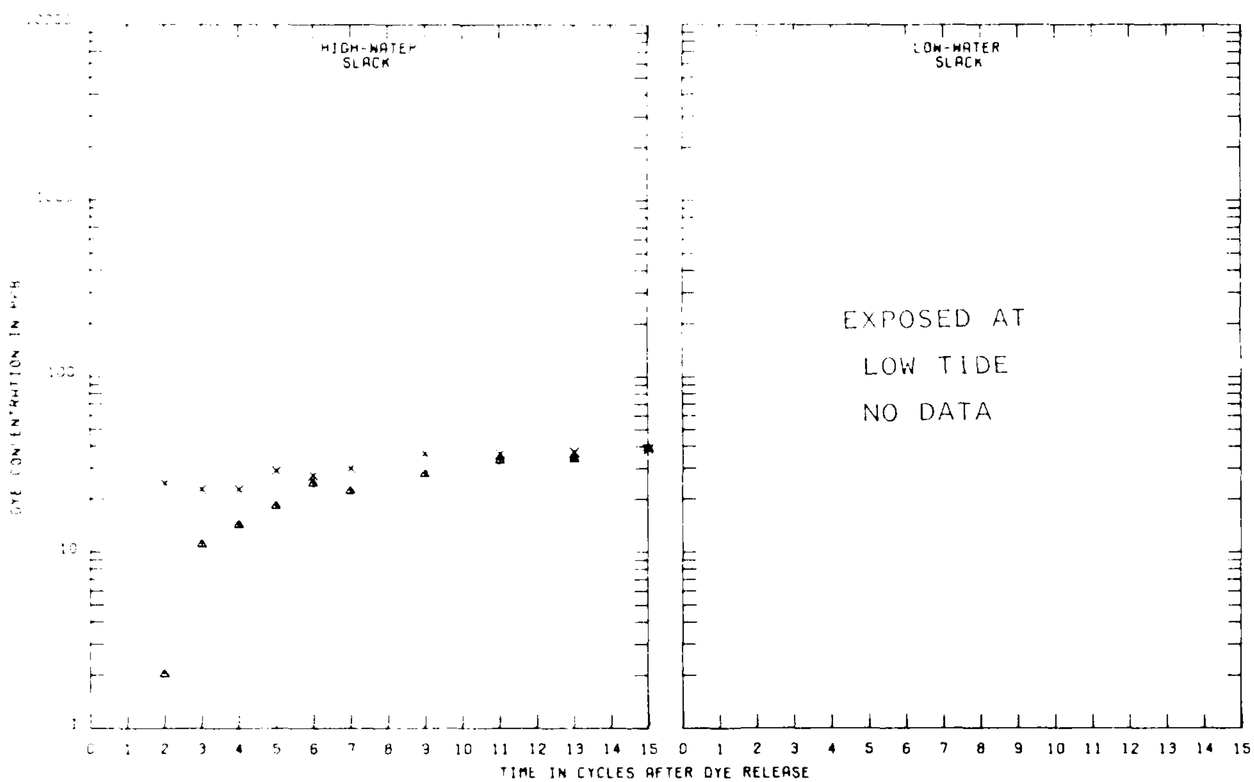
EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 38


EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 12A
LOW-WATER SLACK
HIGH-WATER SLACK
TIME IN CYCLES AFTER DYE RELEASE
DYE CONCENTRATION IN PPB
TEST CONDITIONS
9.6 FT
5000 CFS
29.0 PPT
500000 PPB
10.0 MGD
LEGEND
BOTTOM BASE
BOTTOM PLAN 2C



LOW-WATER SLACK
HIGH-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 2C
EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 12C



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

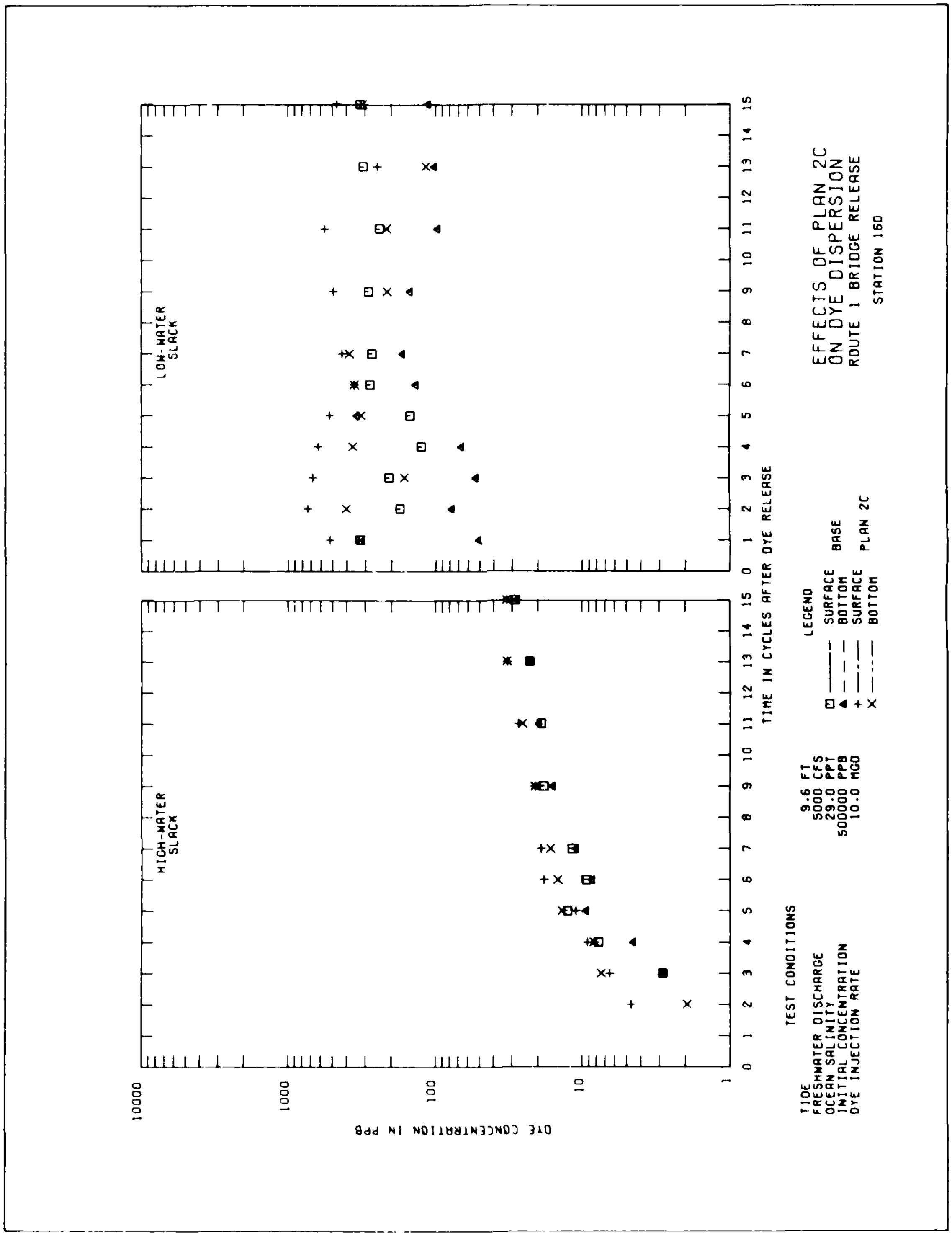
LEGEND

▲ — — — BOTTOM BASE
+ —·— SURFACE PLAN 2C
× —··— BOTTOM PLAN 2C

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 16A

PLATE 174



EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 160

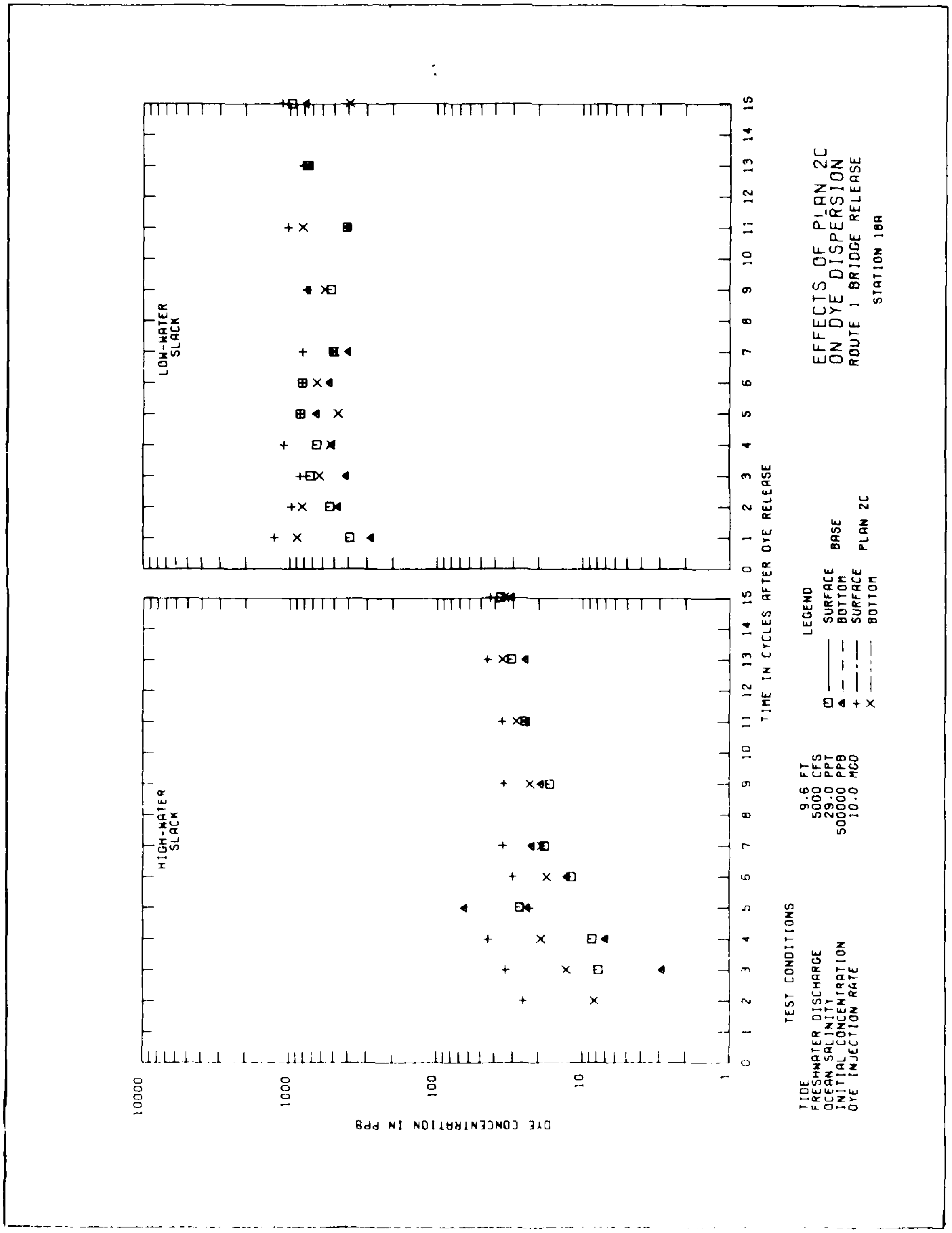
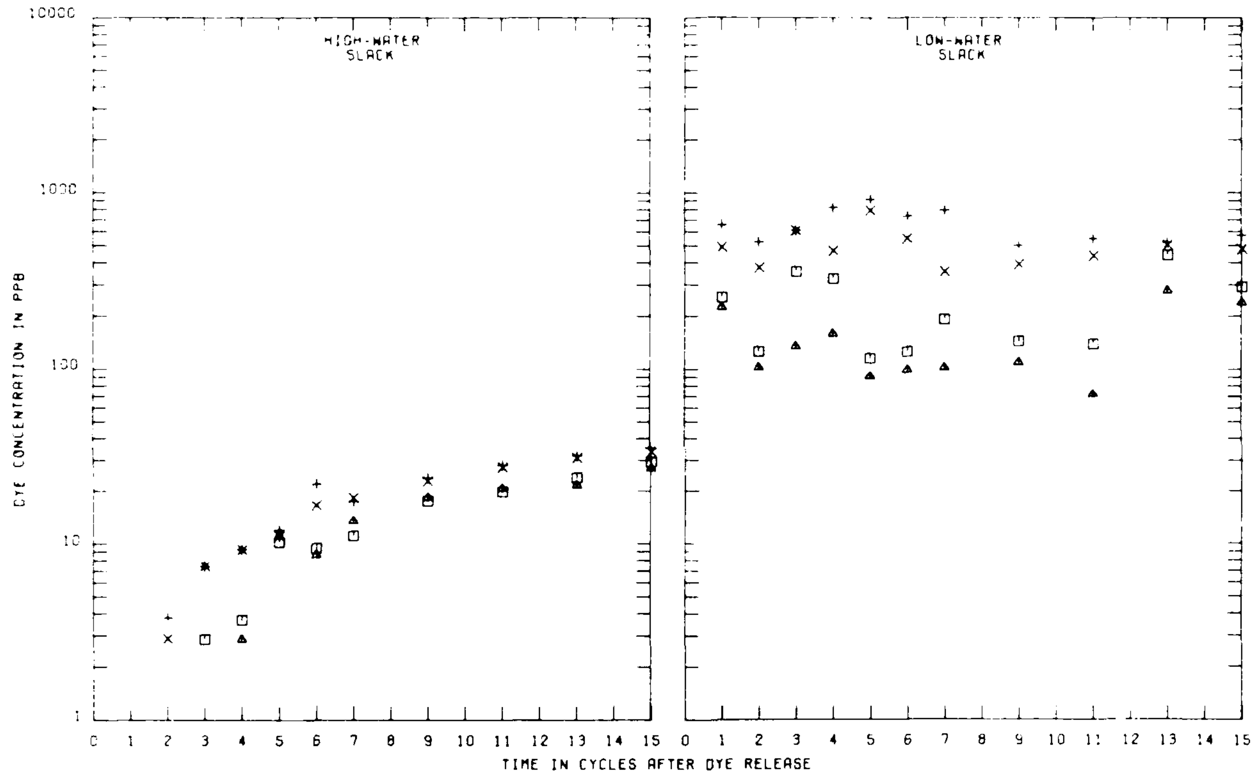

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 18A
LOW-WATER SLACK
HIGH-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 2C
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD

PLATE 176



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

□ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—	SURFACE	PLAN 2C
× —··—	BOTTOM	

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 188

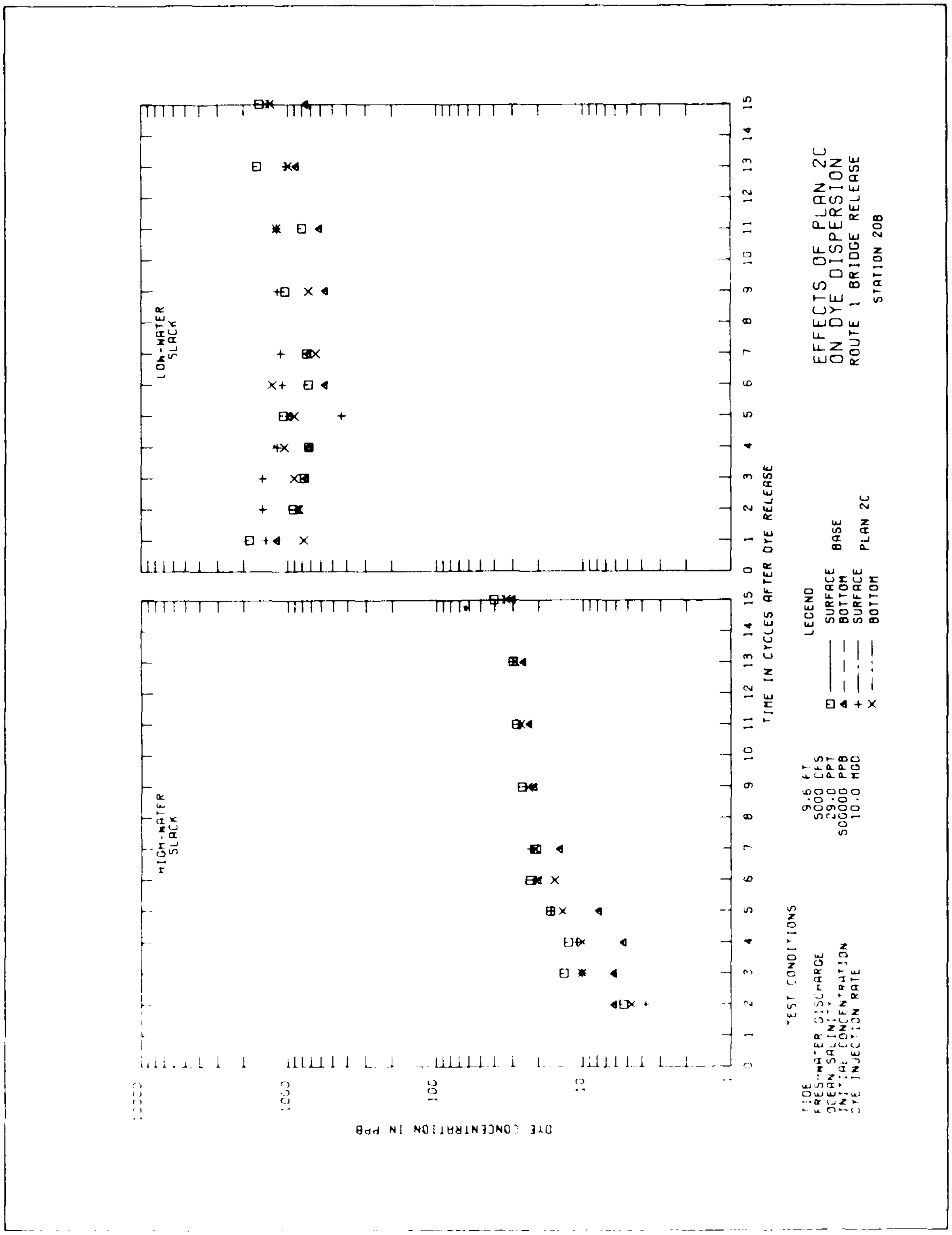
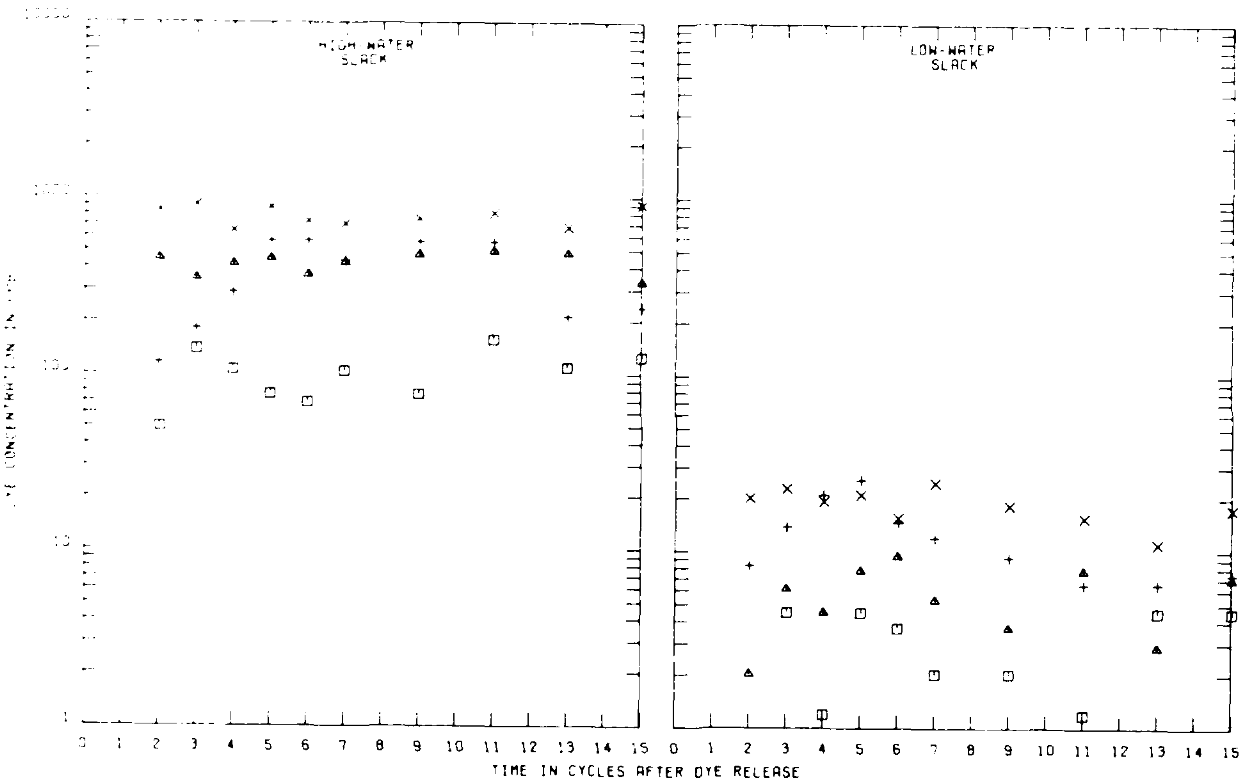

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 20B
HIGH-WATER SLACK
LOW-WATER SLACK
TIME IN CYCLES AFTER DYE RELEASE
DYE CONCENTRATION IN PPB
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 2C

PLATE 178



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

□ ———	SURFACE	BASE
△ — — —	BOTTOM	BASE
+ —·—	SURFACE	PLAN 2C
× —··—	BOTTOM	PLAN 2C

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 26A

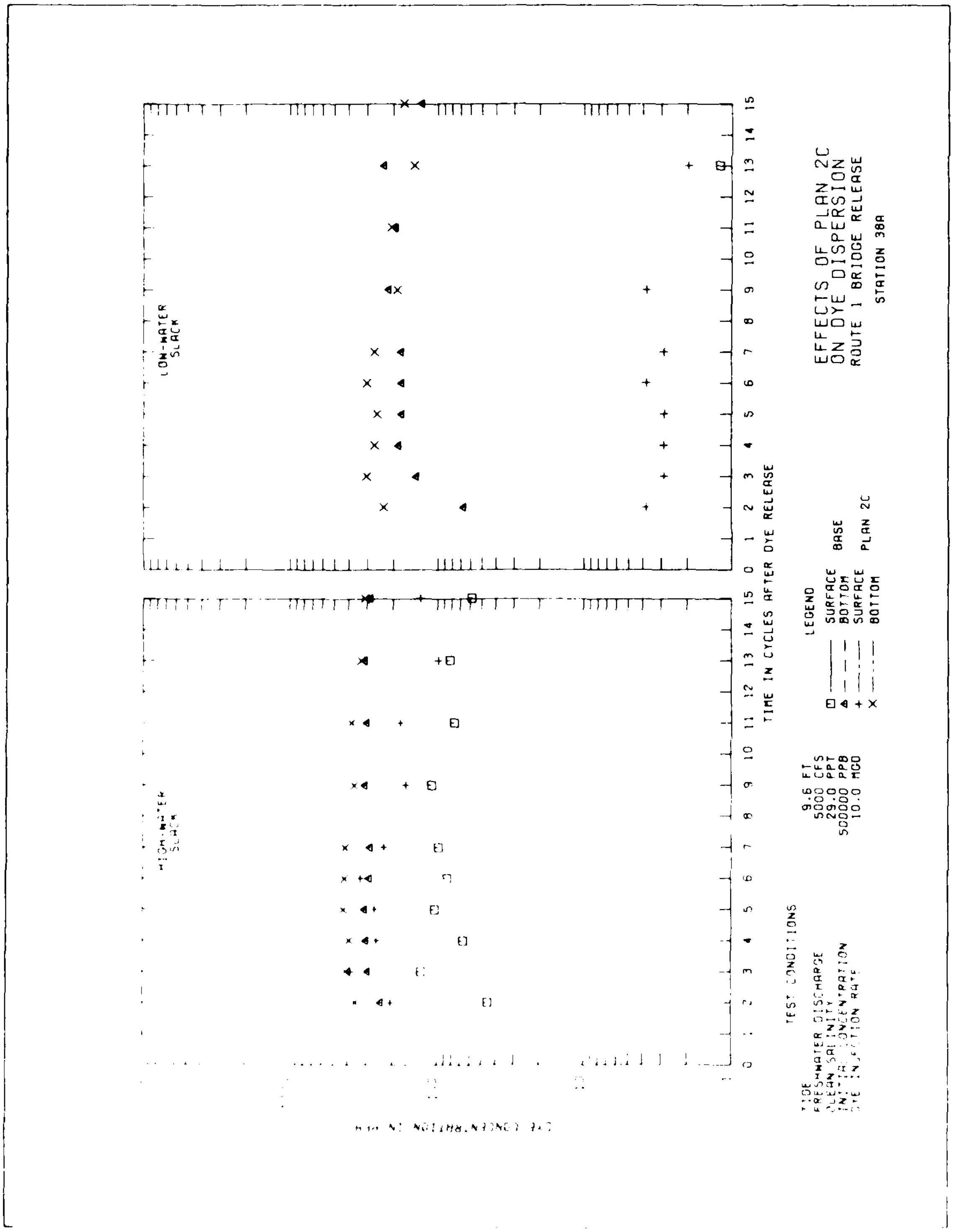
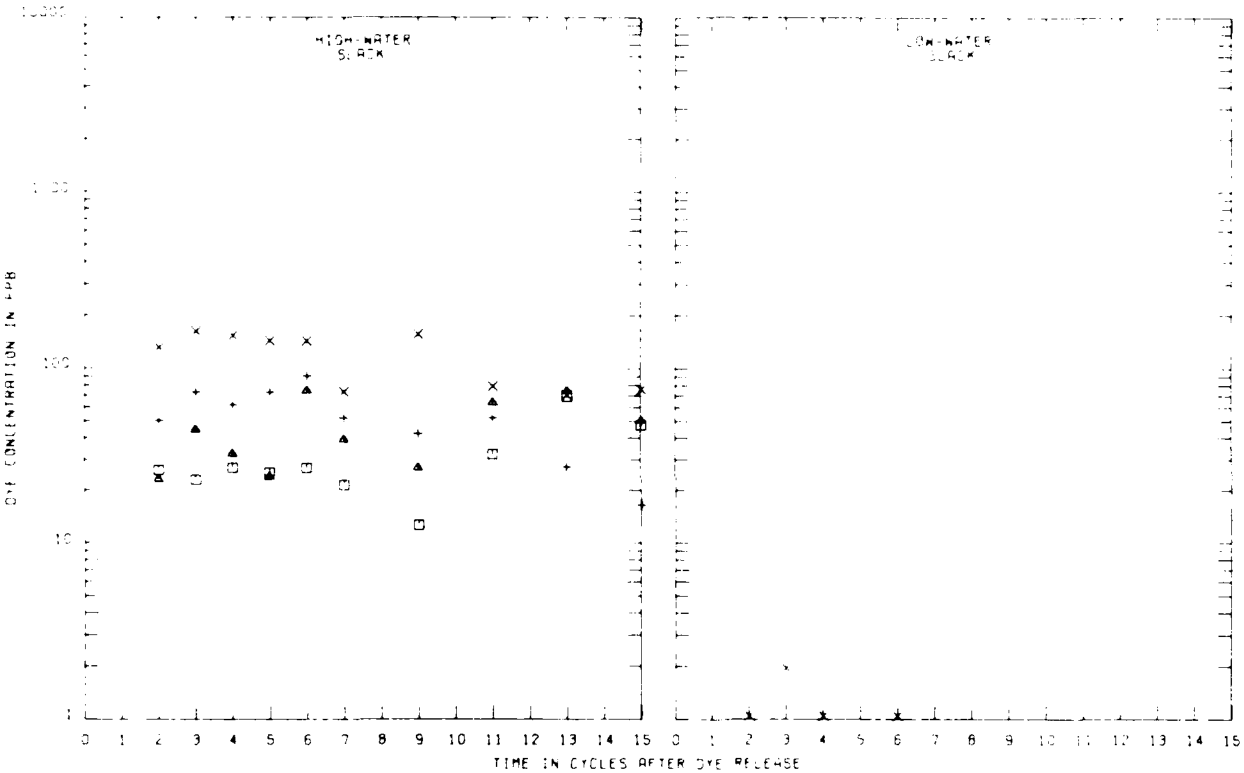

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 38A
LOW-WATER SLACK
HIGH-WATER SLACK
TIME IN CYCLES AFTER DYE RELEASE
DYE CONCENTRATION IN PPB
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 2C
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD

PLATE 180



TEST CONDITIONS

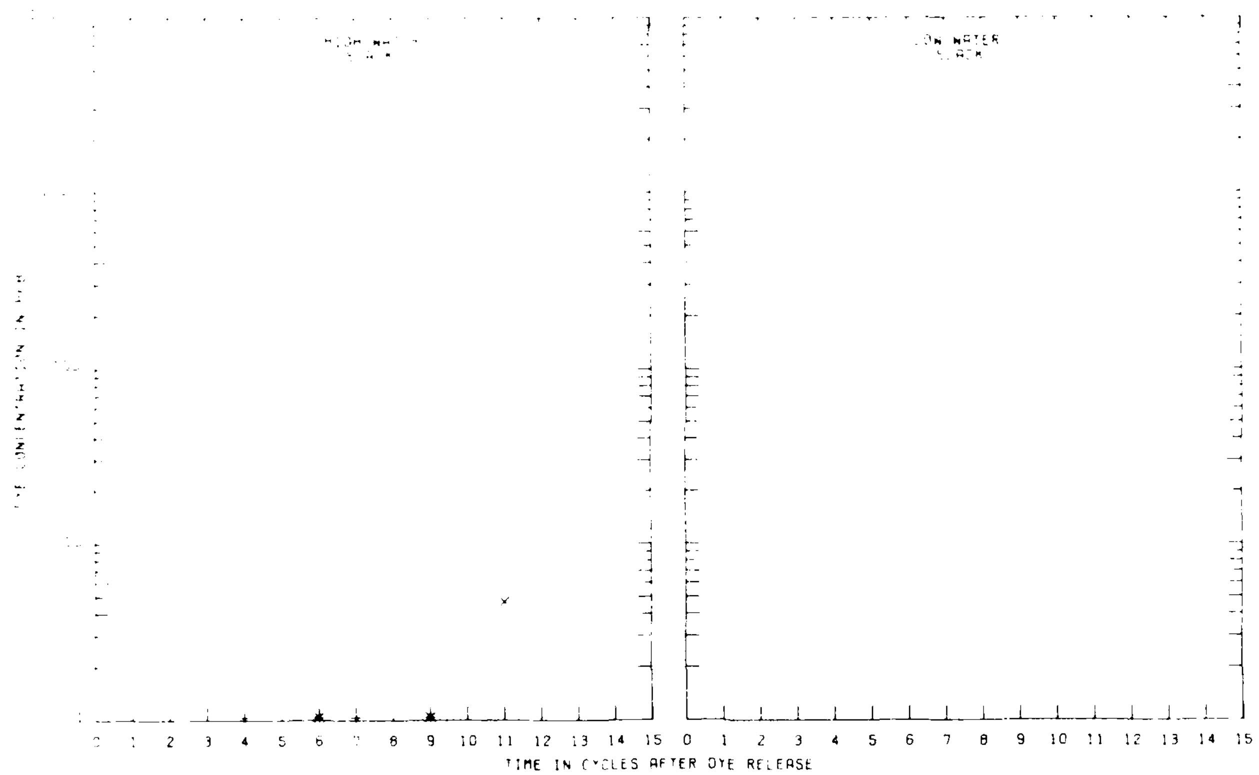
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN 2C
× —··—··	BOTTOM	

EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 50A



TEST CONDITIONS

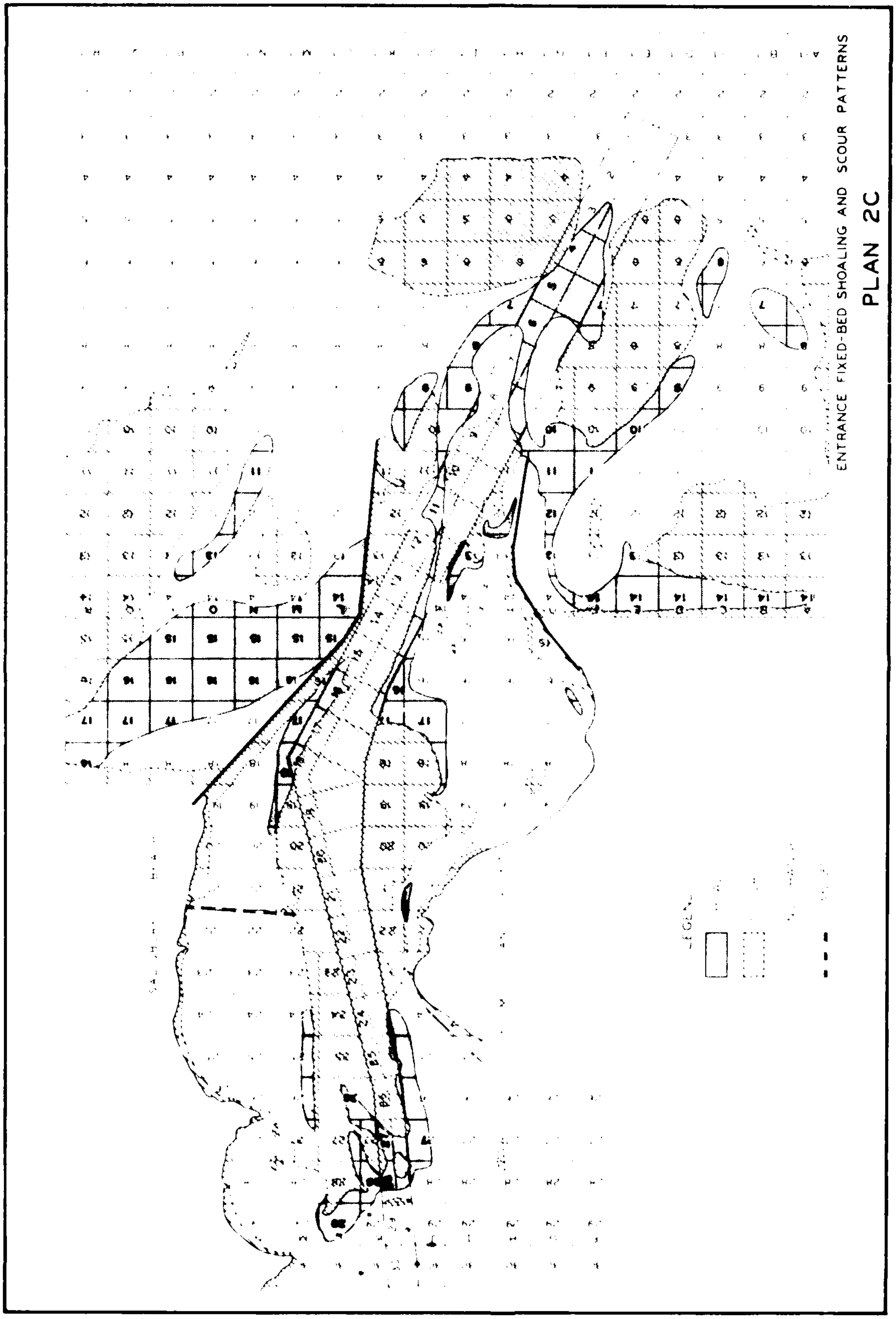
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
MEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

□ ———	SURFACE	BASE
△ — — —	BOTTOM	BASE
+ —·—·—	SURFACE	PLAN 2C
× —··—··—	BOTTOM	PLAN 2C

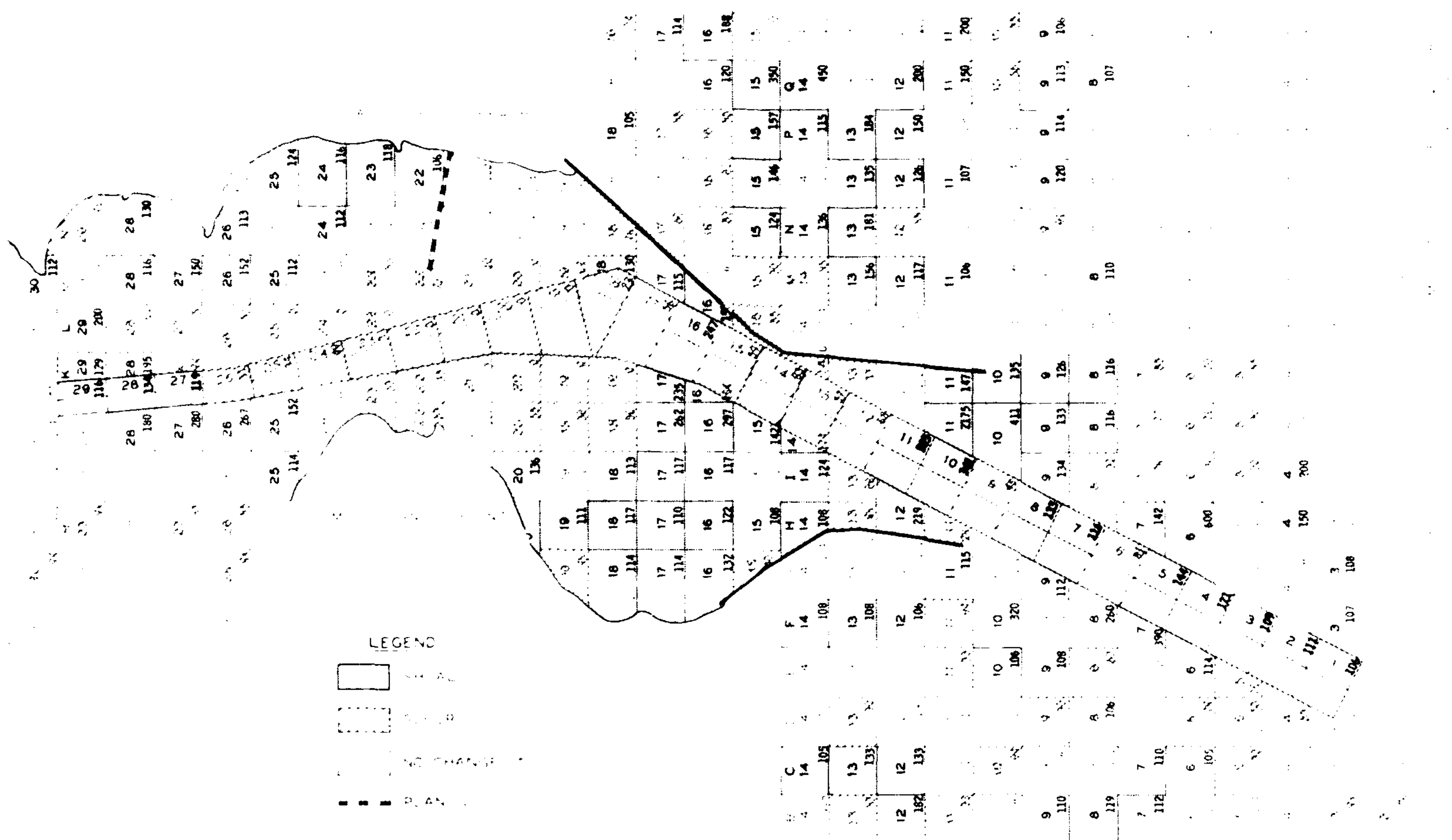
EFFECTS OF PLAN 2C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 56A



ENTRANCE FIXED-BED SHOALING AND SCOUR PATTERNS

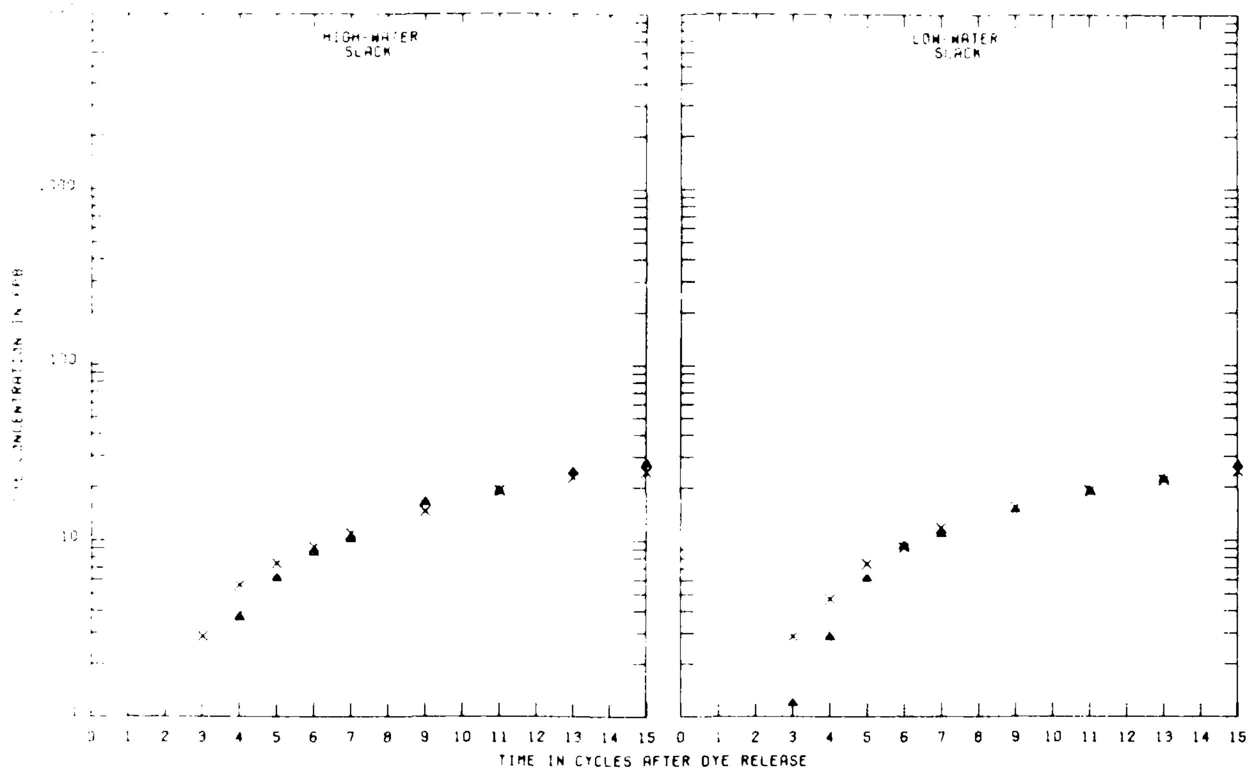
PLAN 2C



NOTE: A VALUE OF 100% INDICATES NO CHANGE. VALUES GREATER THAN 100% INDICATE AREAS OF SHOALING, WHILE VALUES LESS THAN 100% INDICATE AREAS OF SCOUR. AREAS WHERE EFFECTS WERE WITHIN PLUS OR MINUS 5% ARE CONSIDERED NOT CHANGED.

ENTRANCE FIXED-BED SHOALING AND SCOUR
IN PERCENT OF BASE

PLAN 2C



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

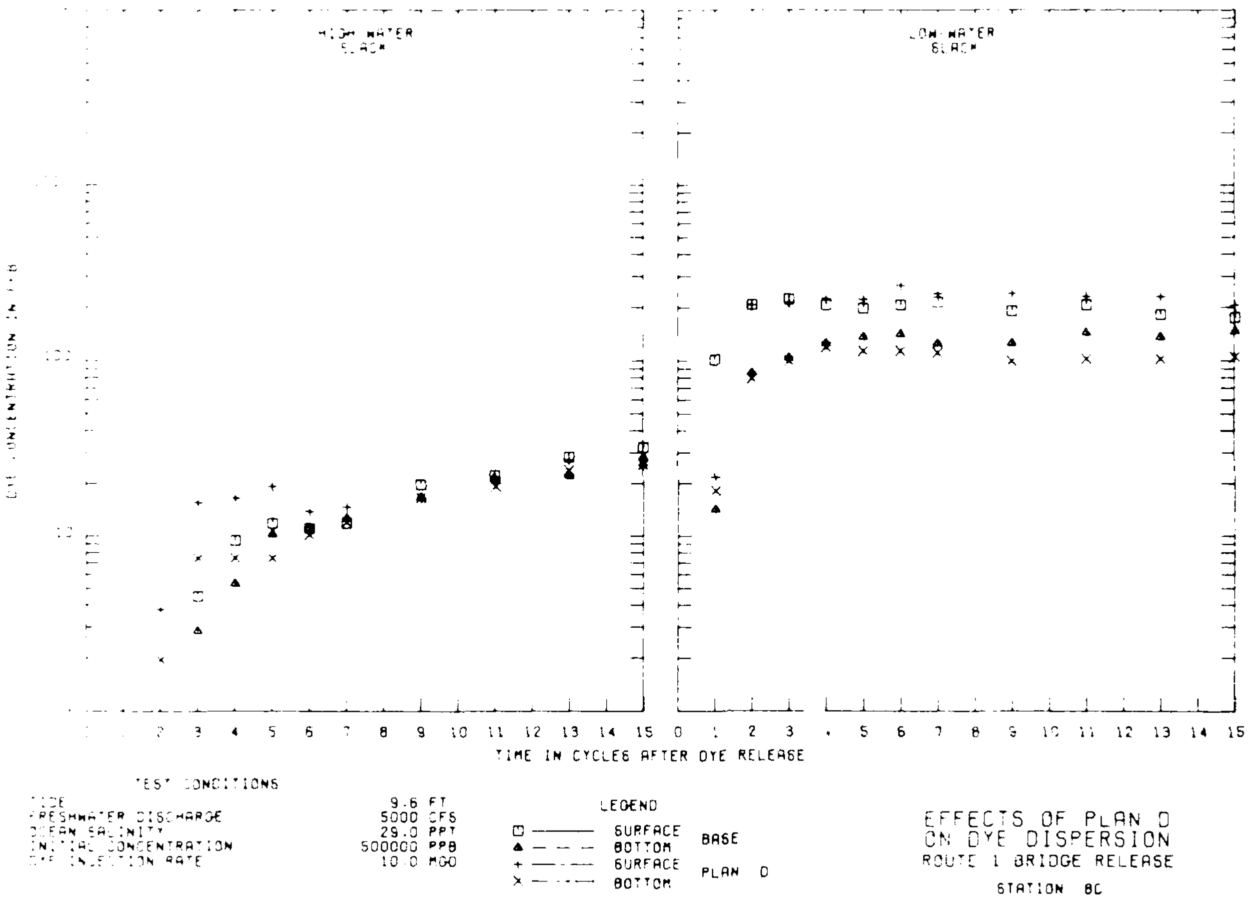
LEGEND

▲ — — — BOTTOM BASE

× —·—·— BOTTOM PLAN D

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION SUMP

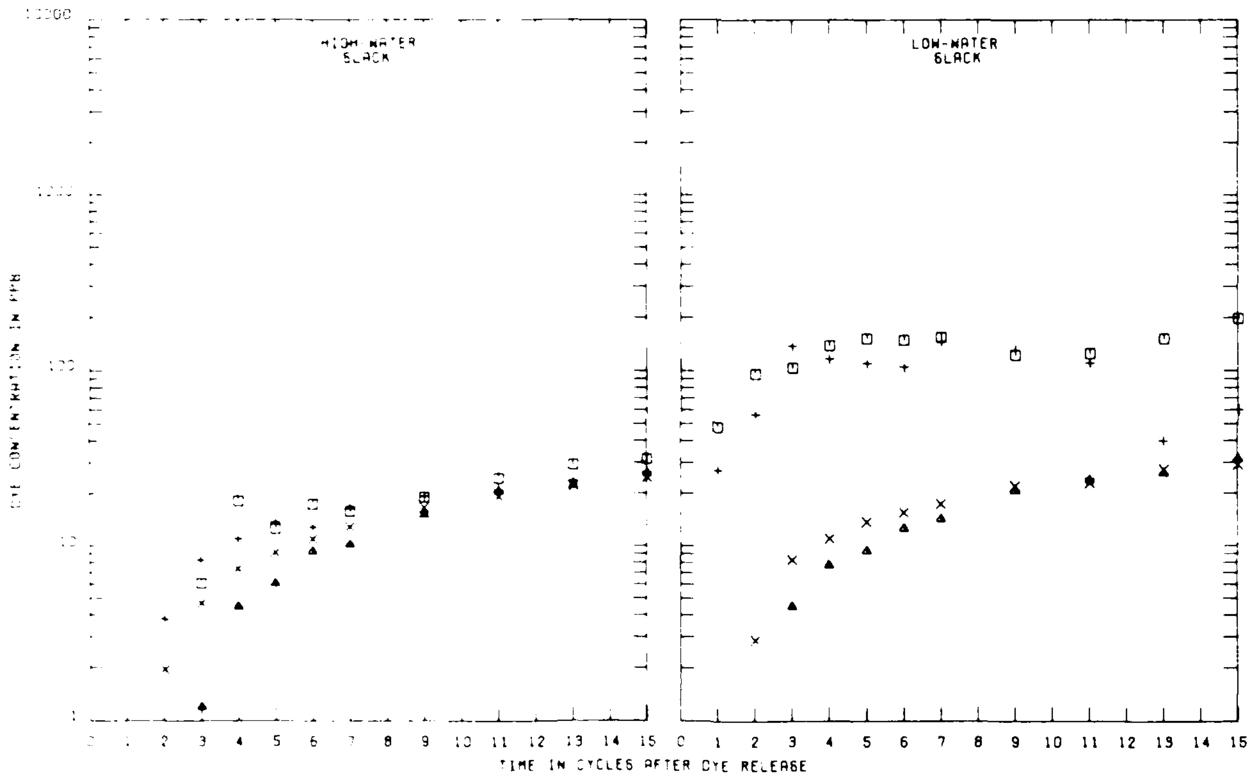


TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 8C



TEST CONDITIONS

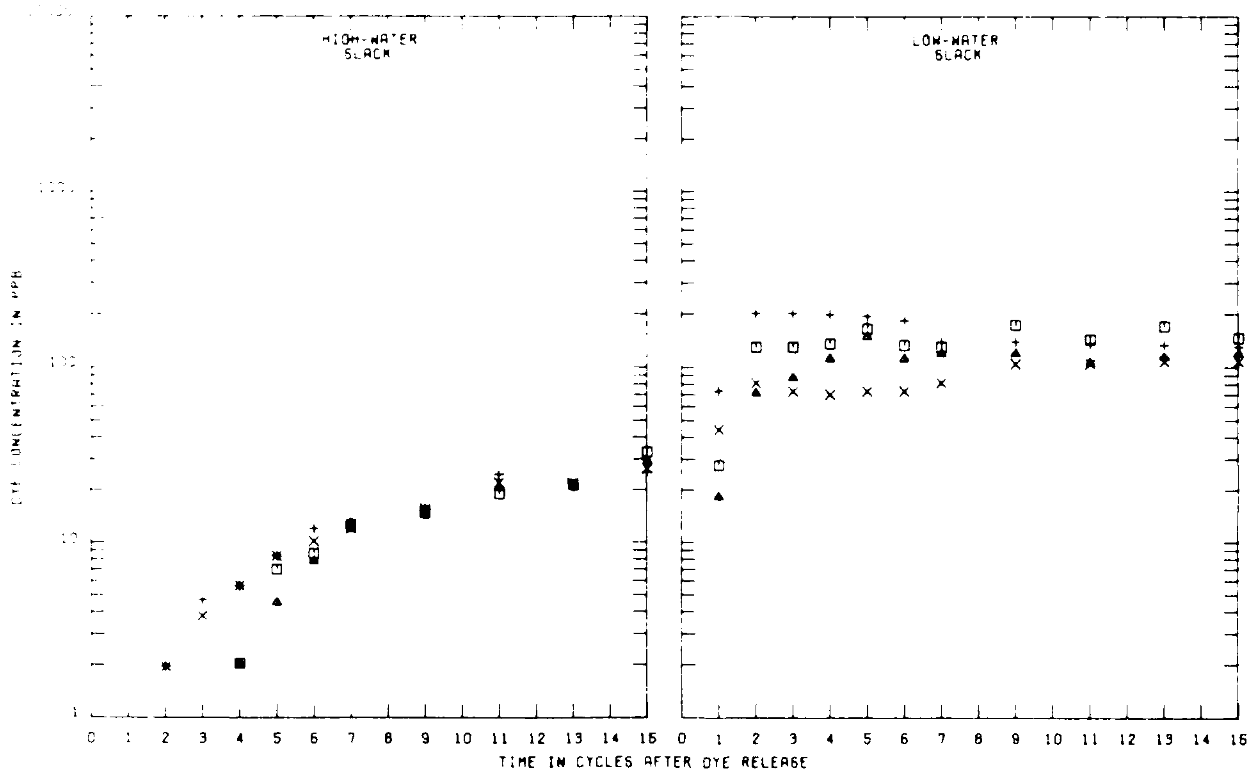
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

□ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN D
× — ··· —	BOTTOM	

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 8A



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN D
× —··—··—	BOTTOM	

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 6C

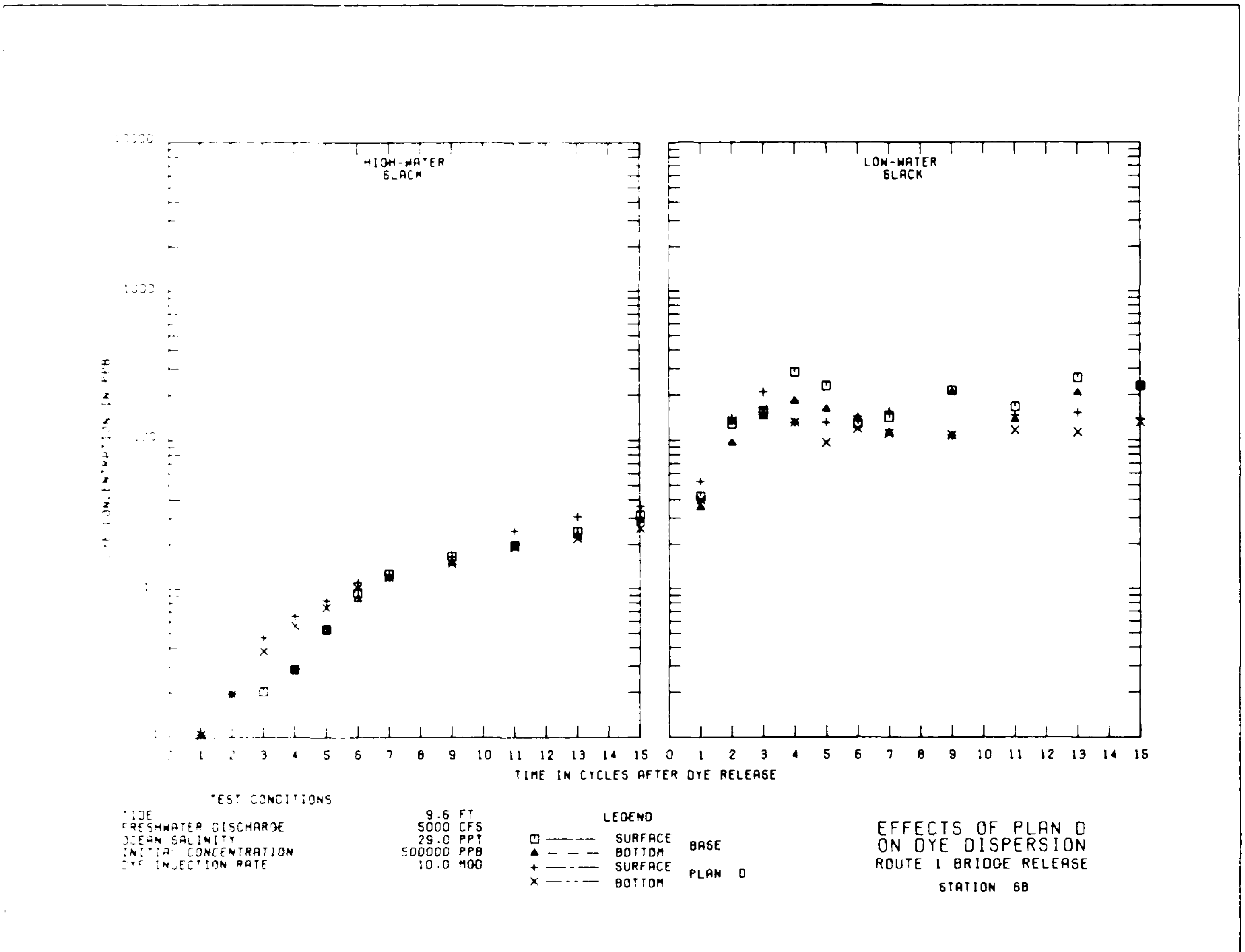
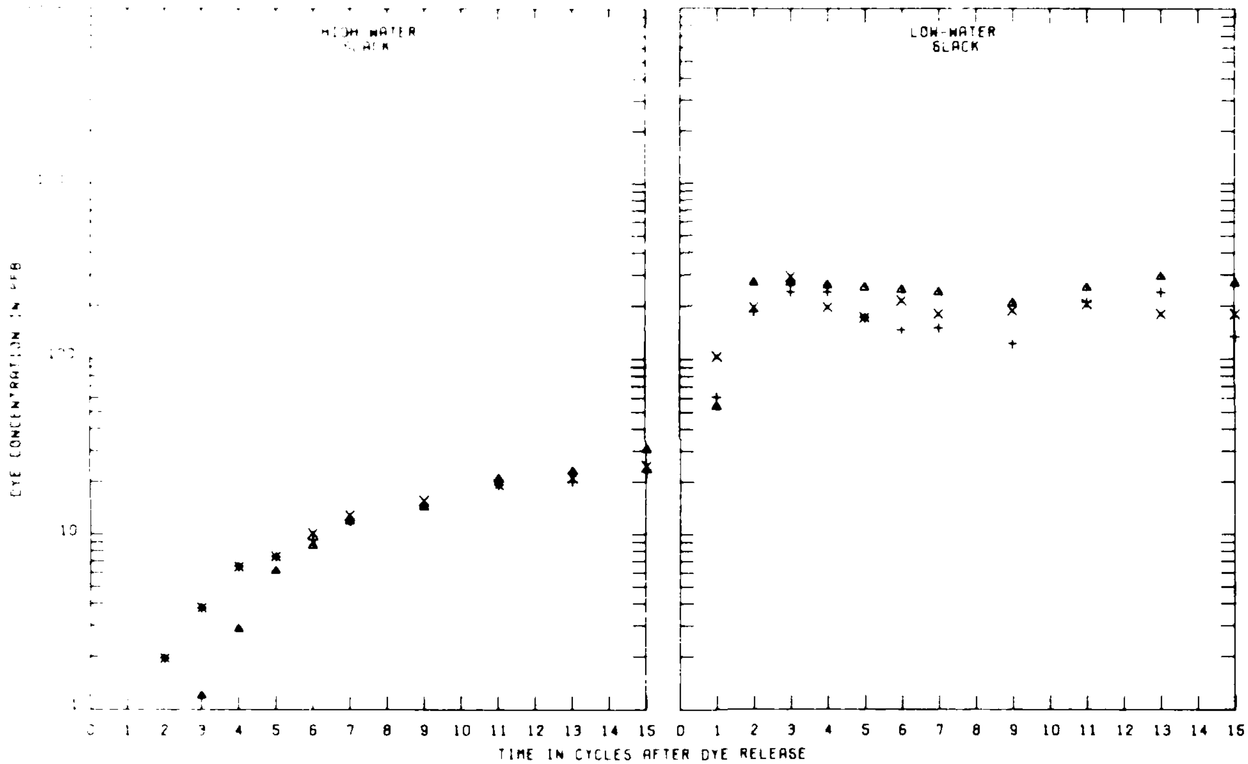

HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN D
EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 6B

PLATE 196



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

▲ — — — BOTTOM BASE

+ —·— SURFACE PLAN D

× —··— BOTTOM

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 6A

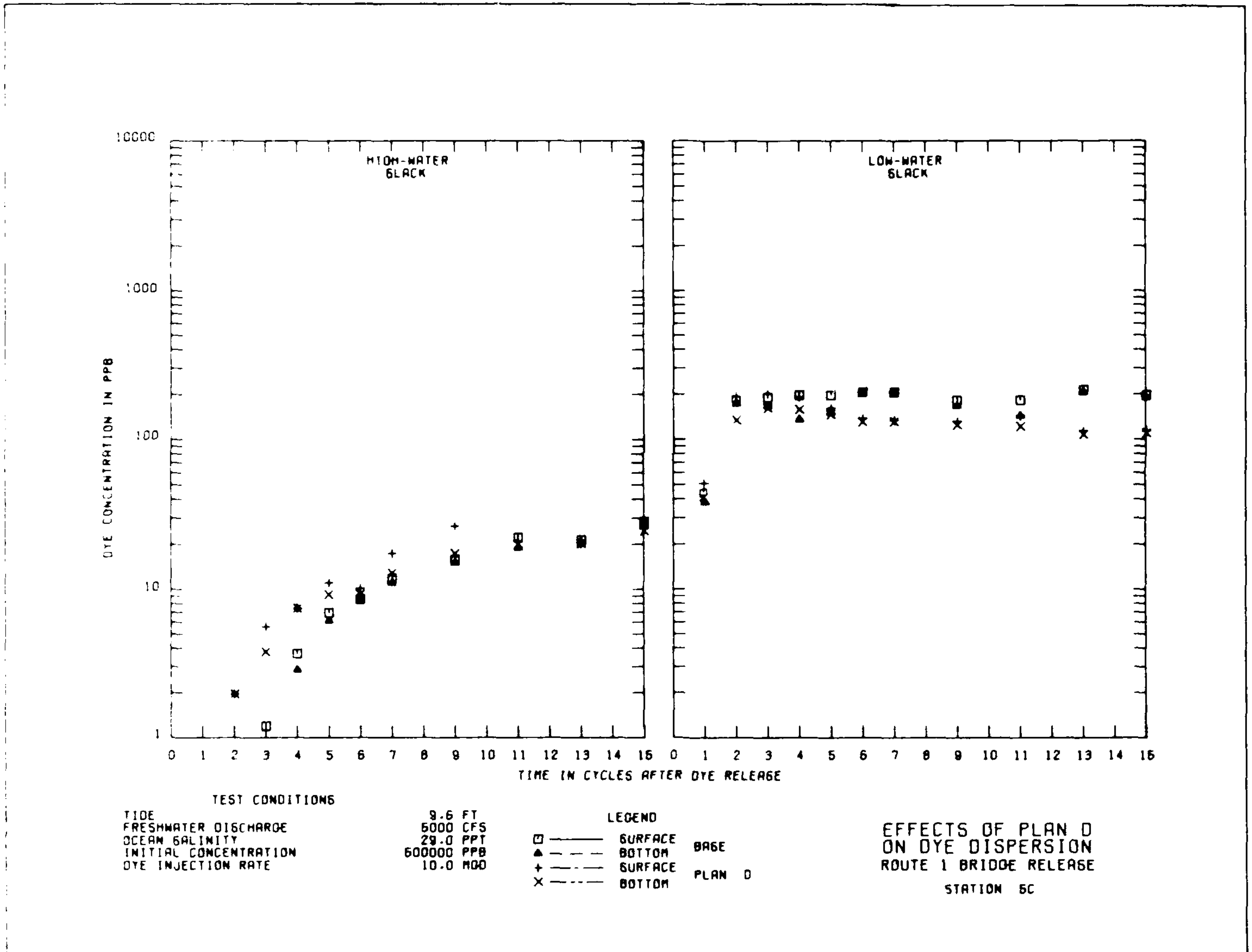

HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 600000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE BASE
BOTTOM BASE
SURFACE PLAN D
BOTTOM PLAN D
EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 5C

PLATE 194

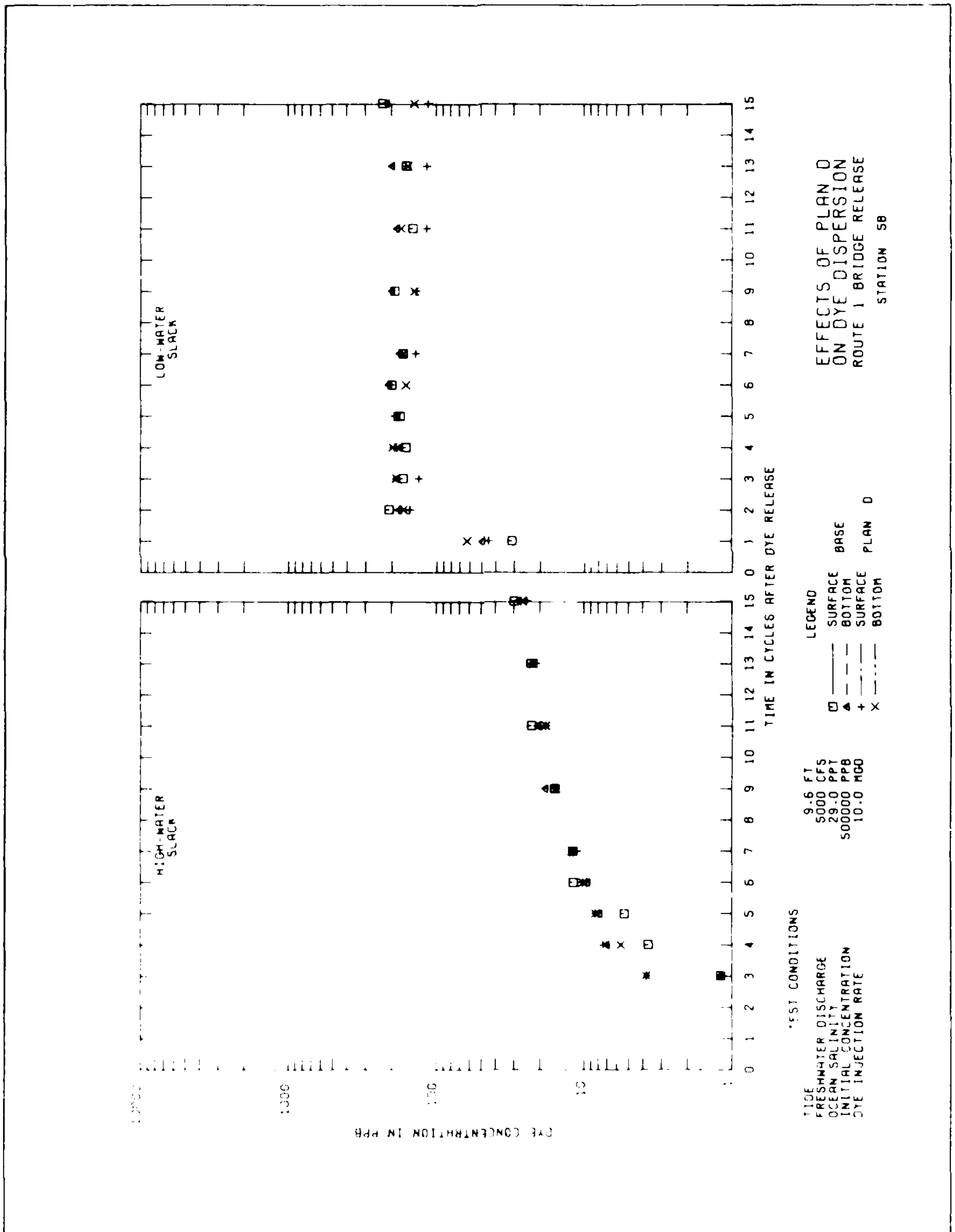
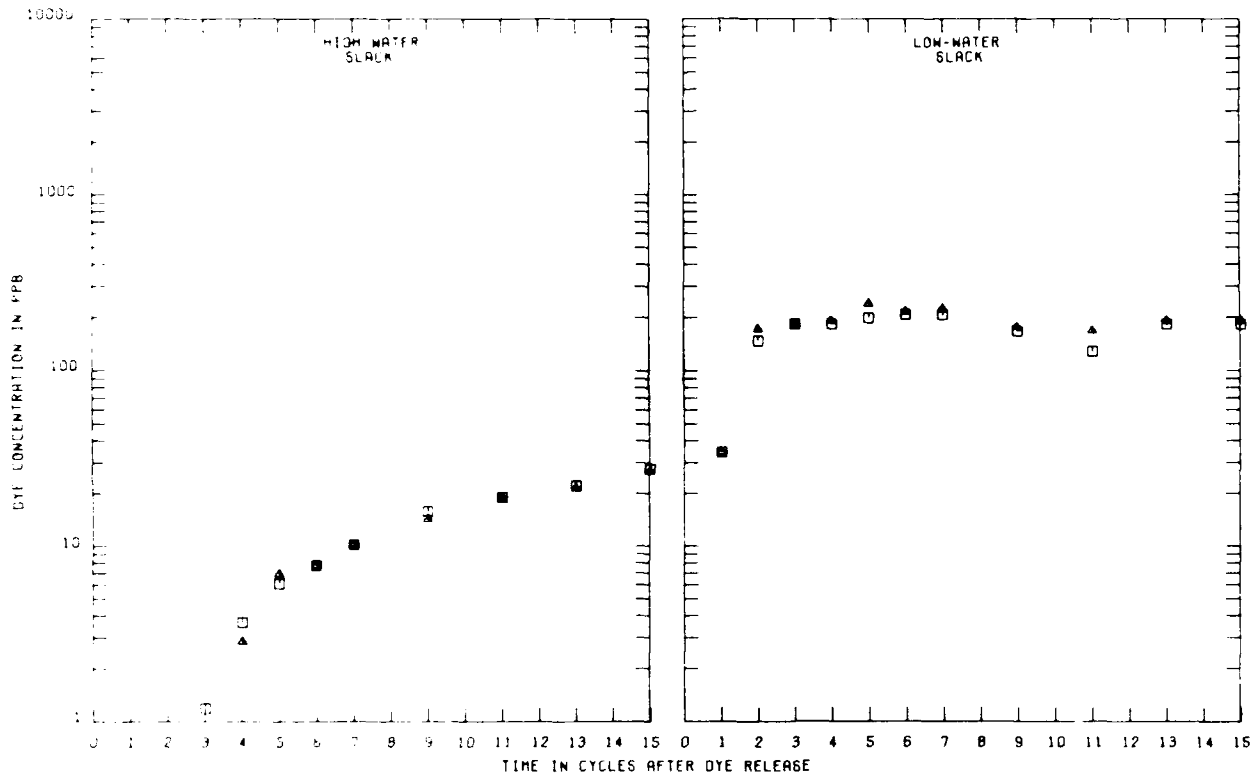

HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN D
EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 58

PLATE 193



TEST CONDITIONS

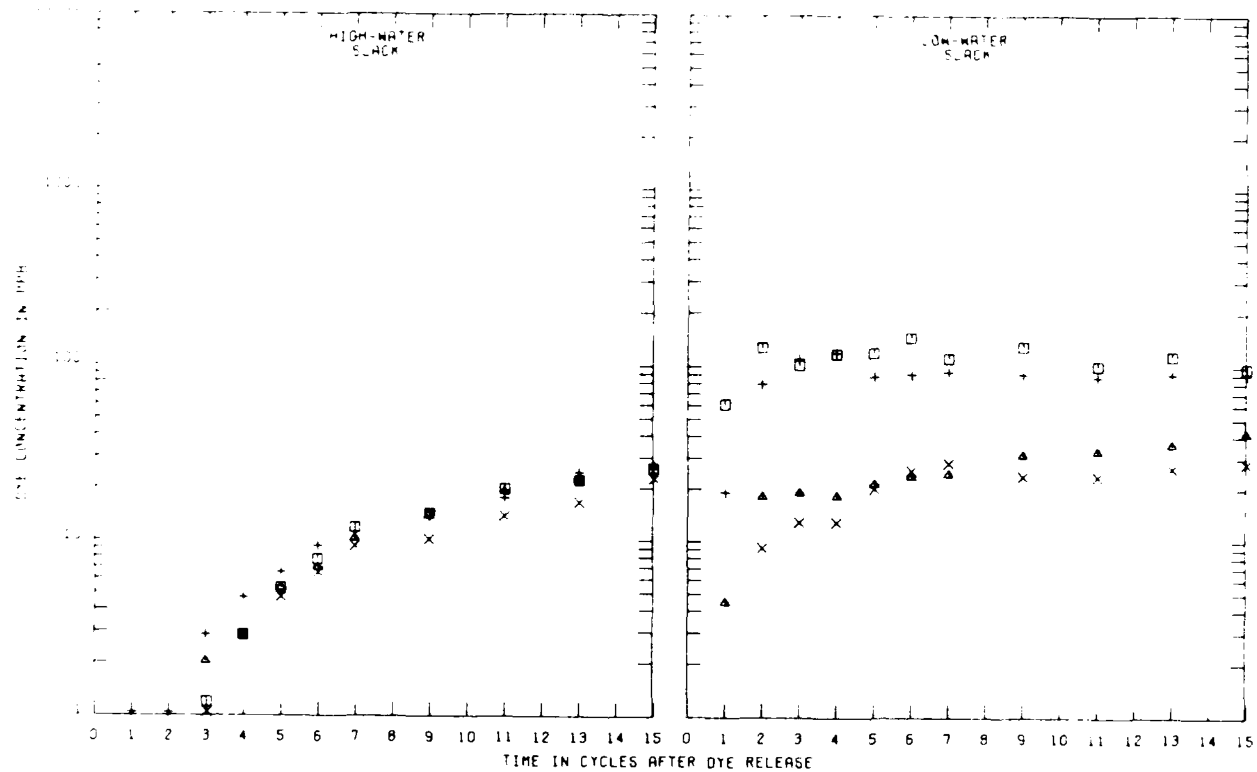
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

▲ — — — BOTTOM BASE

× —·—·— BOTTOM PLAN D

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 5A



TEST CONDITIONS

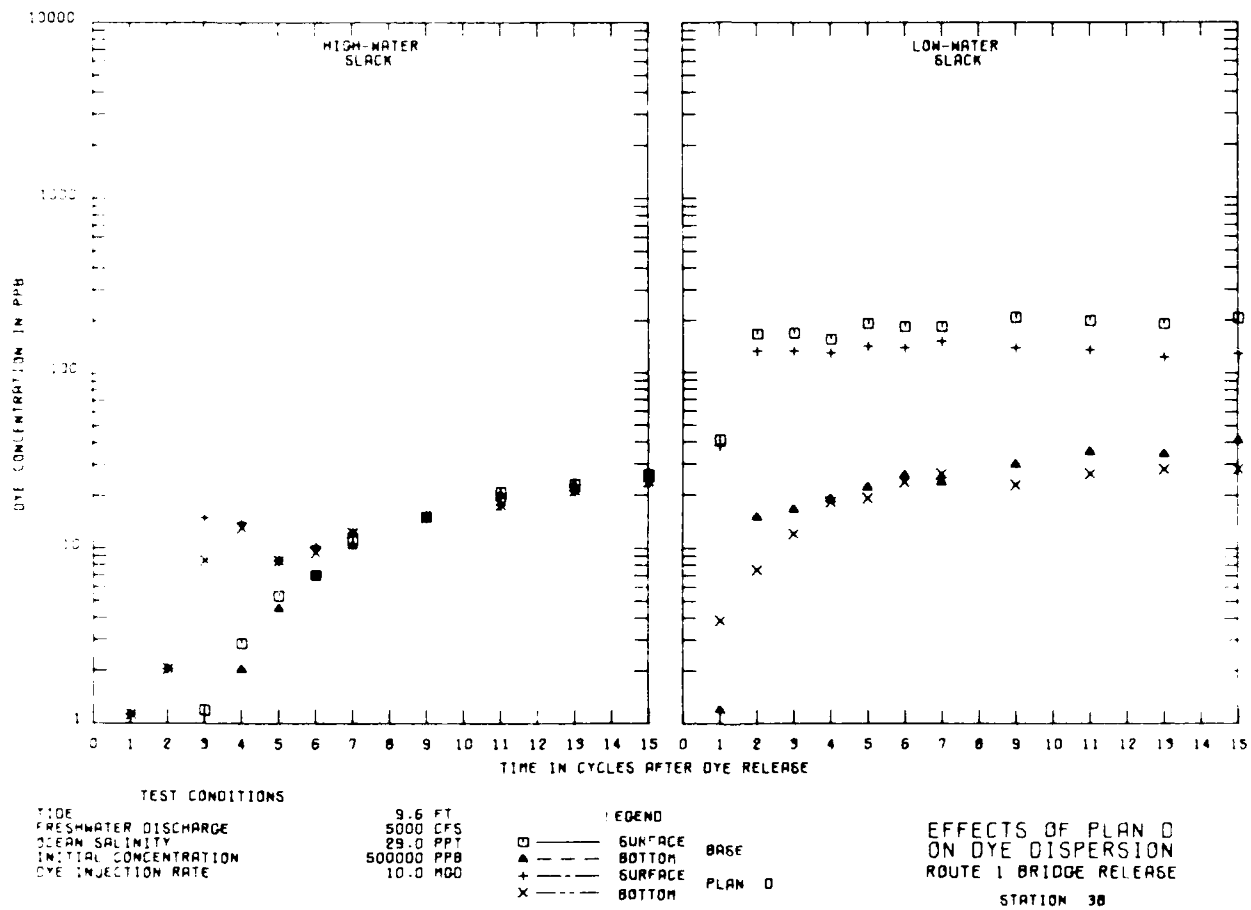
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

⊡ ———	SURFACE	BASE
△ — — —	BOTTOM	
+ —·—·	SURFACE	PLAN D
× —··—	BOTTOM	

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

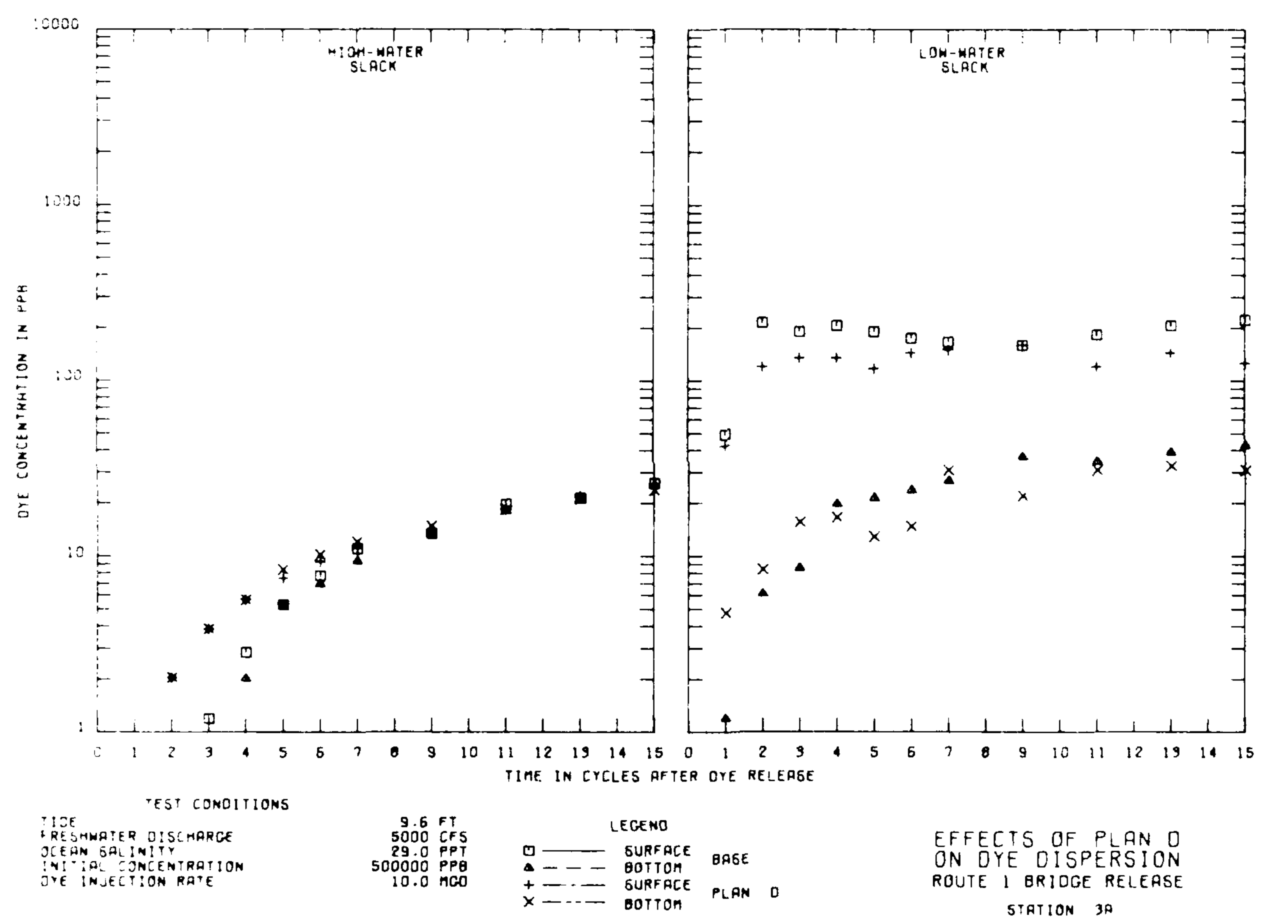
STATION 3C



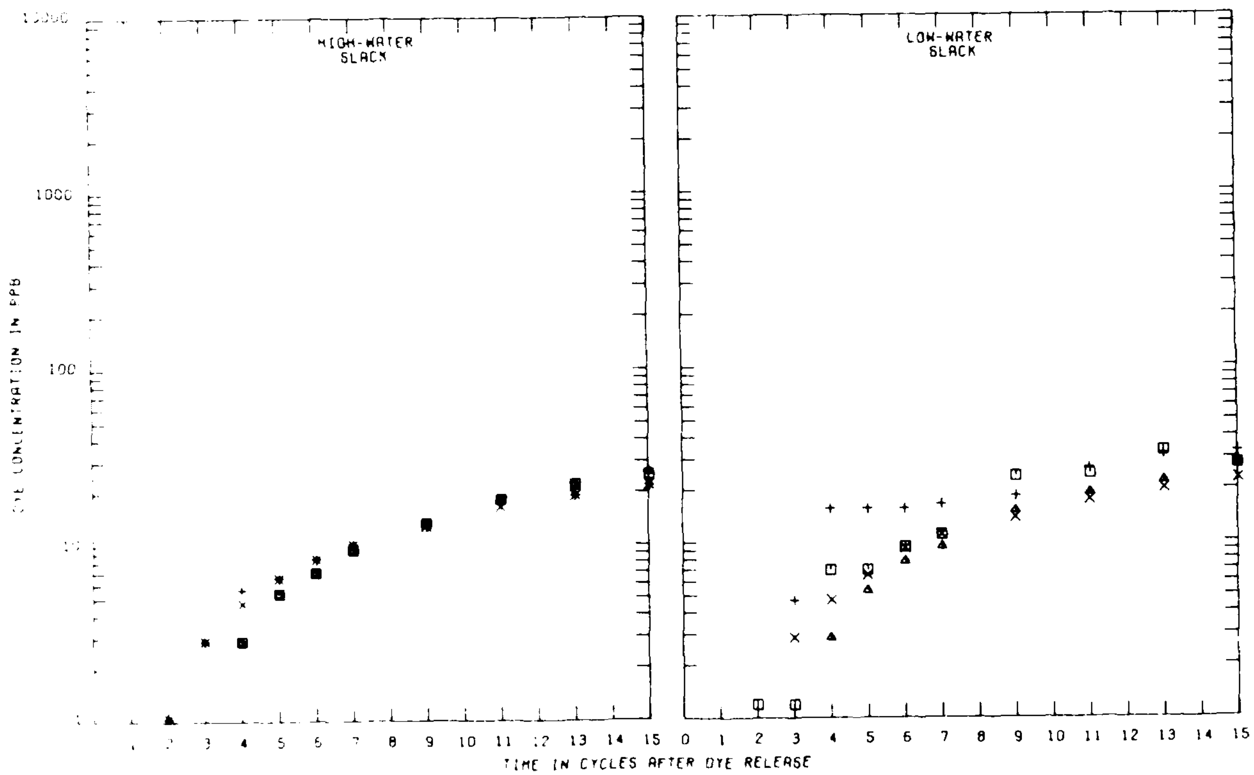
EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 38

PLATE 190



10000
1000
100
10
1
DYE CONCENTRATION IN PPB
HIGH-WATER SLACK
LOW-WATER SLACK
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN D
EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 3A



TEST CONDITIONS

TIDE	5.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

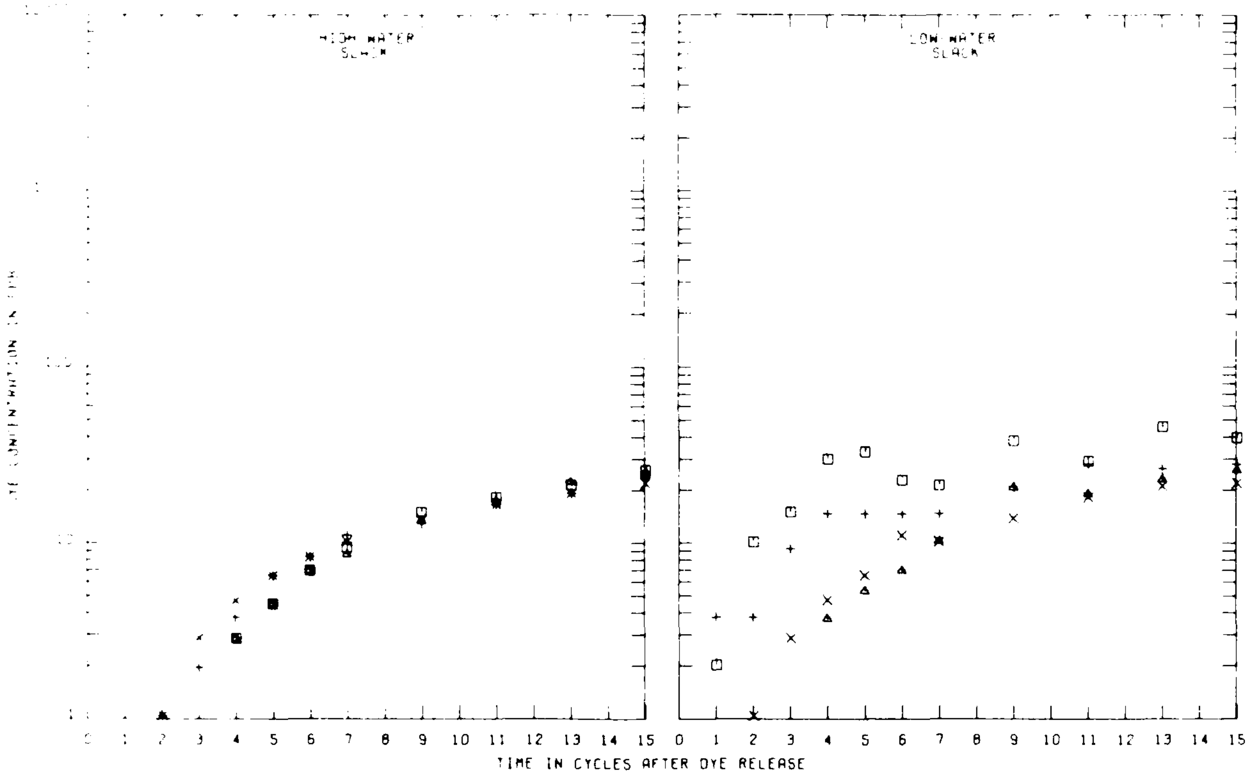
LEGEND

□	SURFACE	BASE
△	BOTTOM	BASE
+	SURFACE	PLAN D
×	BOTTOM	PLAN D

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 08

PLATE 188



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
△ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN D
× —··—··—	BOTTOM	

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE [illegible] DYE RELEASE
STATION OA

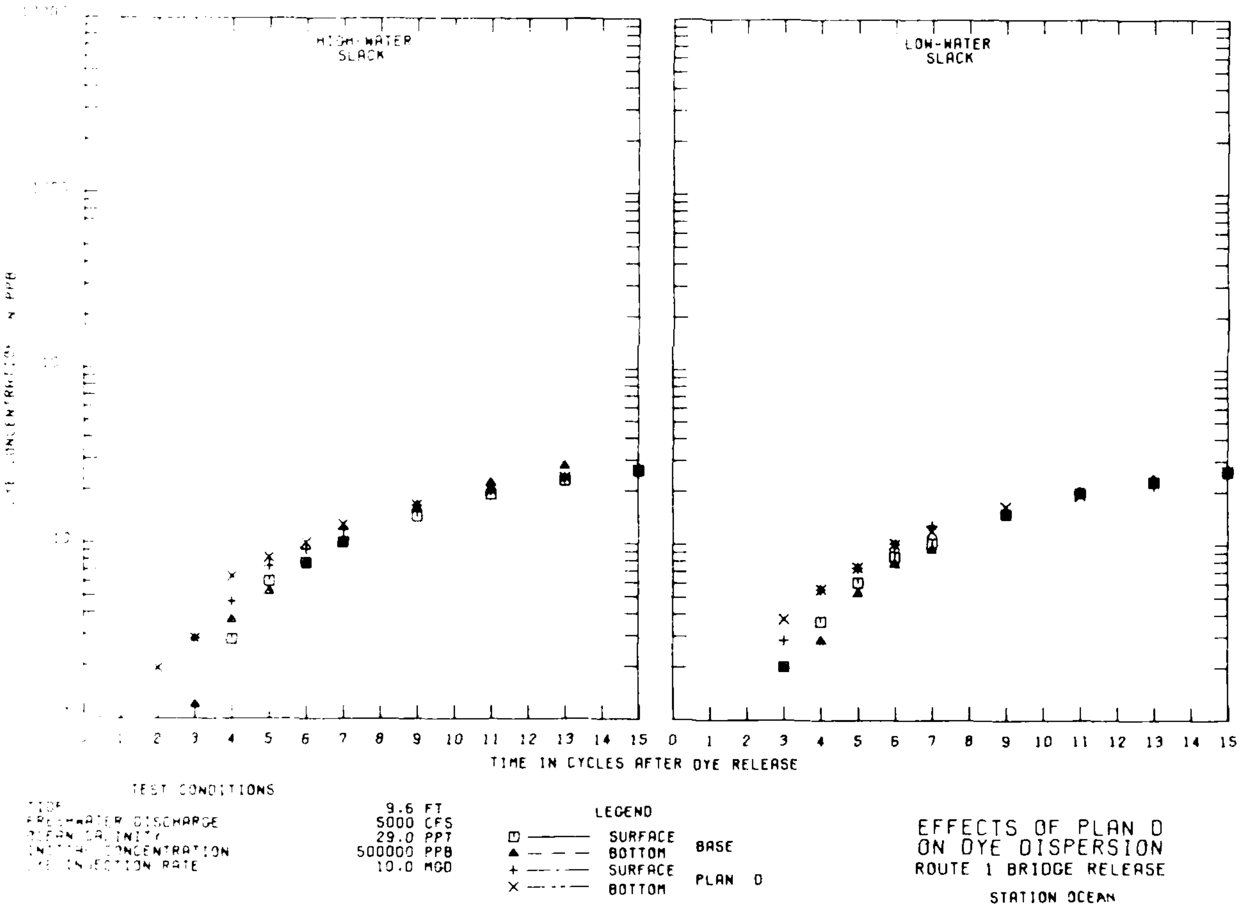
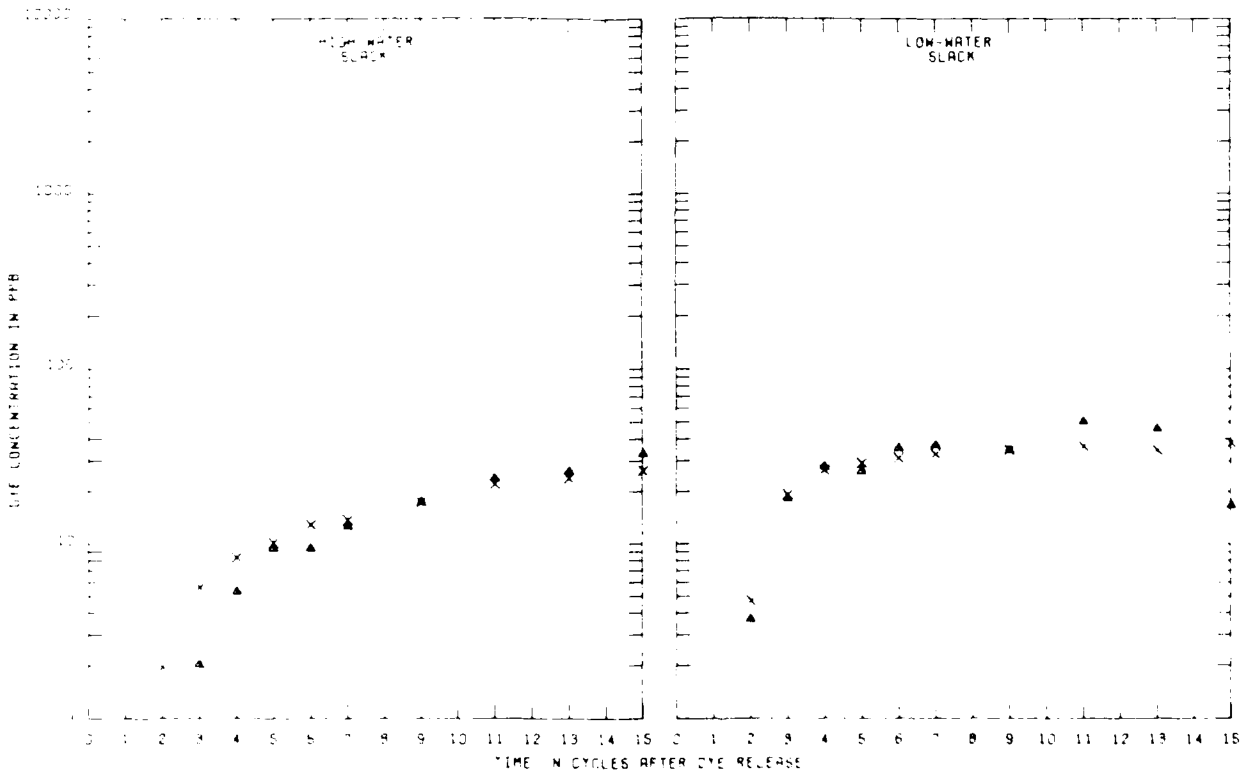

HIGH-WATER SLACK
LOW-WATER SLACK
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
9.6 FT
5000 CFS
29.0 PPT
500000 PPB
10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN D
EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION OCEAN

PLATE 1...



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	[illegible] MOD

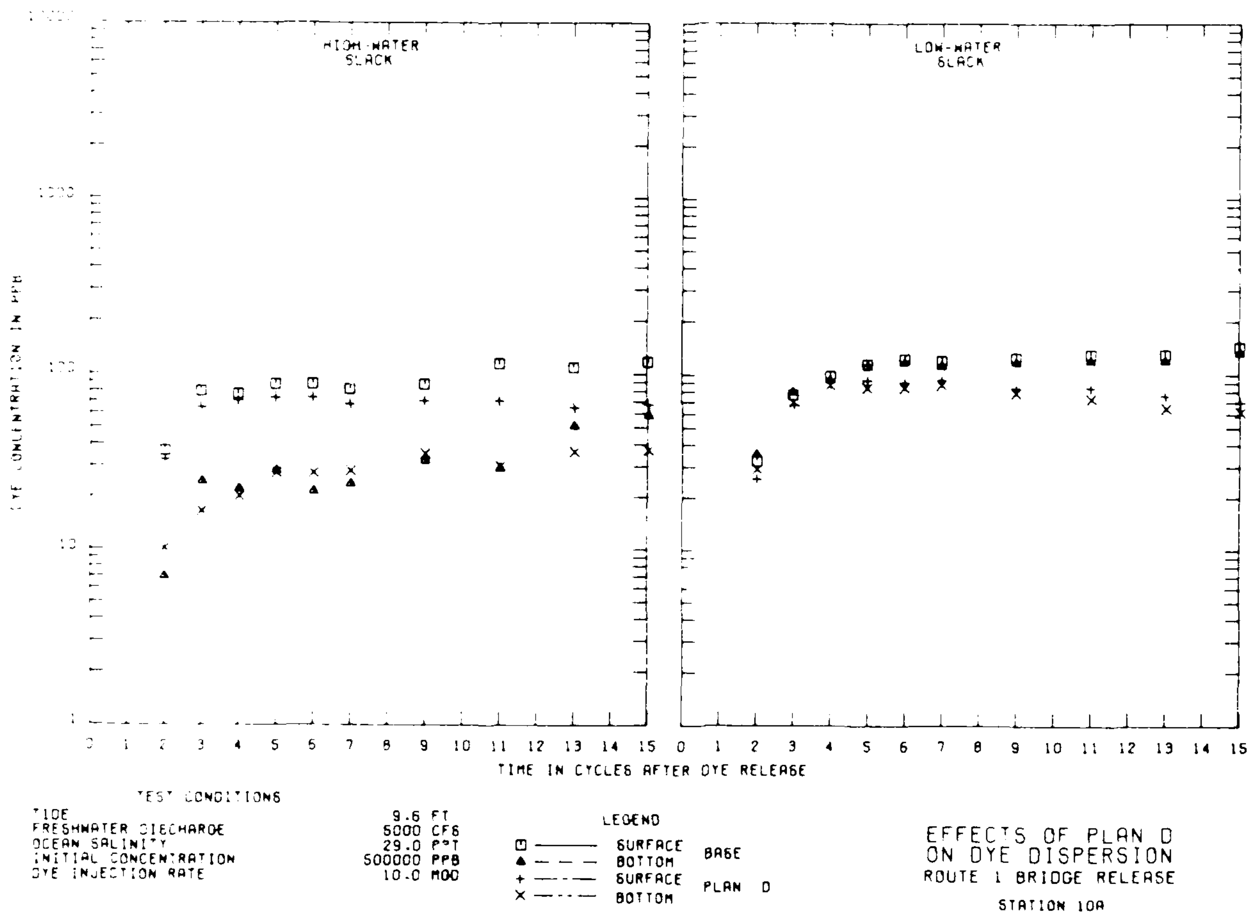
LEGEND

▲ — — — BOTTOM BASE

× —·—·— BOTTOM PLAN C

EFFECTS OF PLAN C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

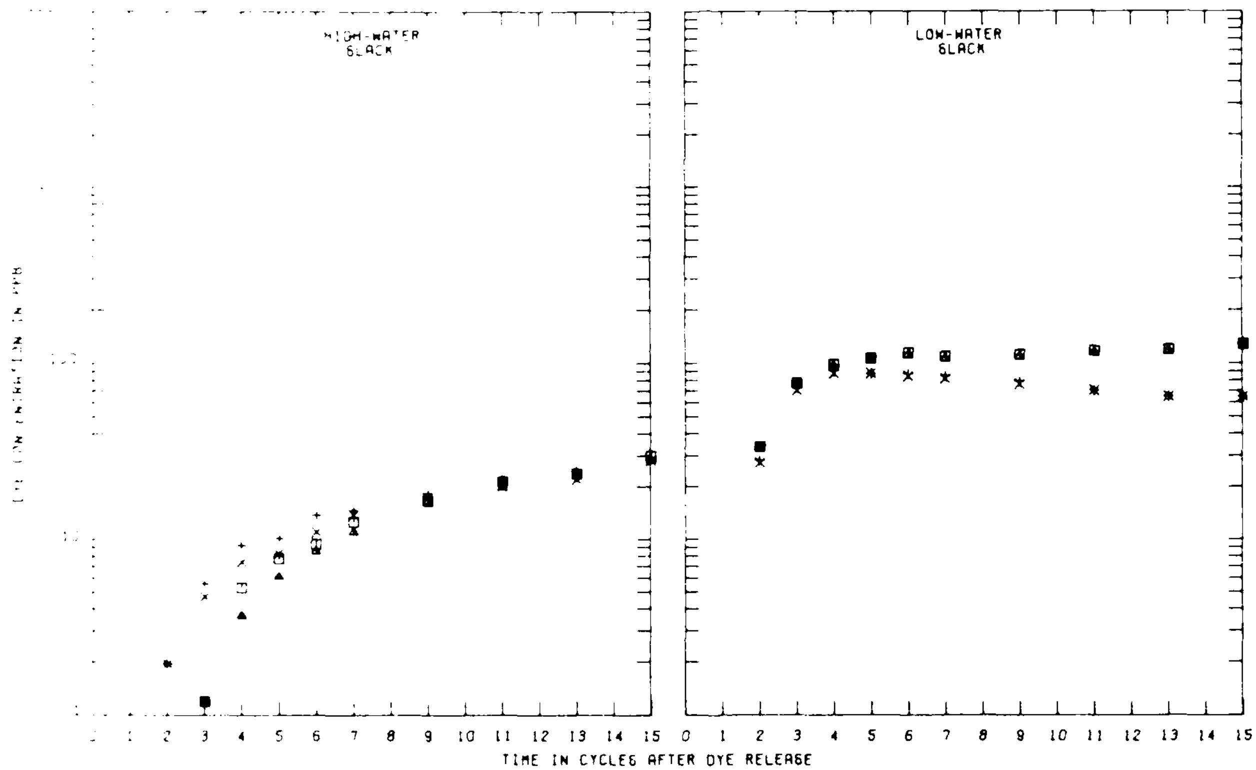
STATION 80



EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 10A

PLATE 2.1



TEST CONDITIONS

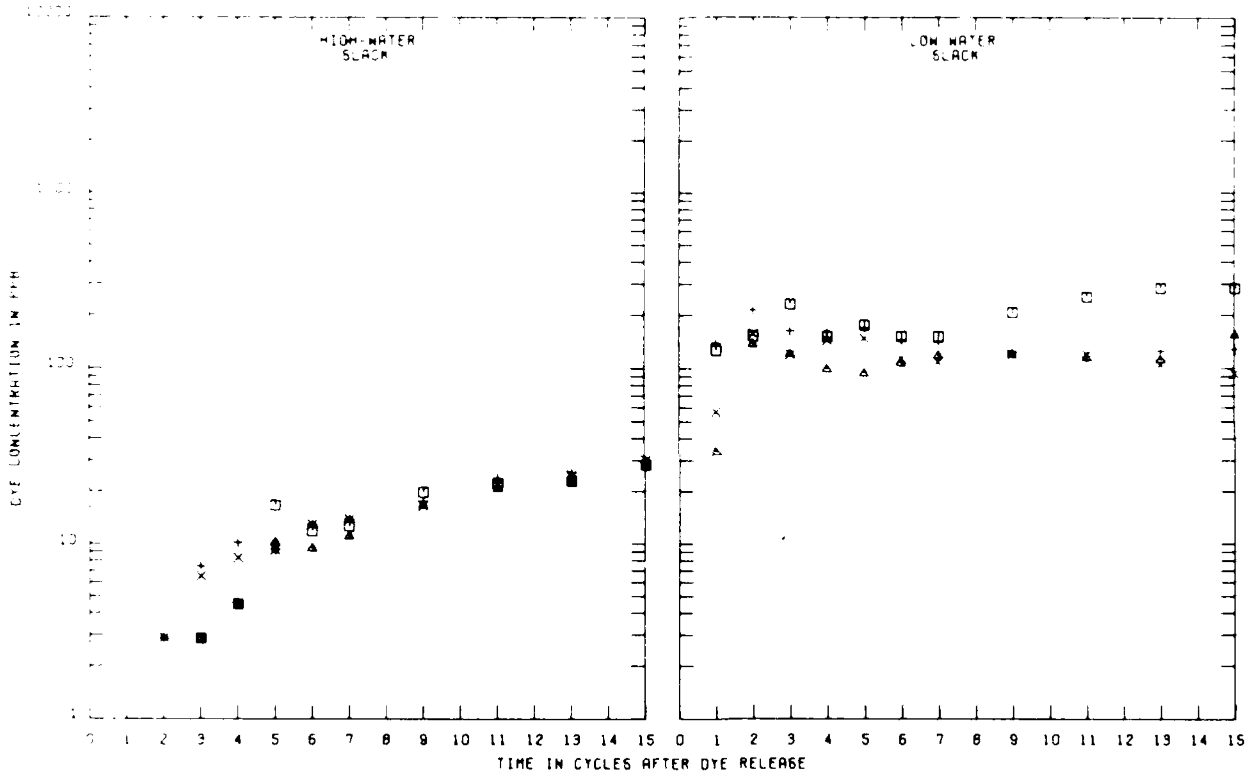
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

□ ———	SURFACE	BASE
▲ — — —	BOTTOM	BASE
+ —·—	SURFACE	PLAN D
× —··—	BOTTOM	PLAN D

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 10B



TEST CONDITIONS

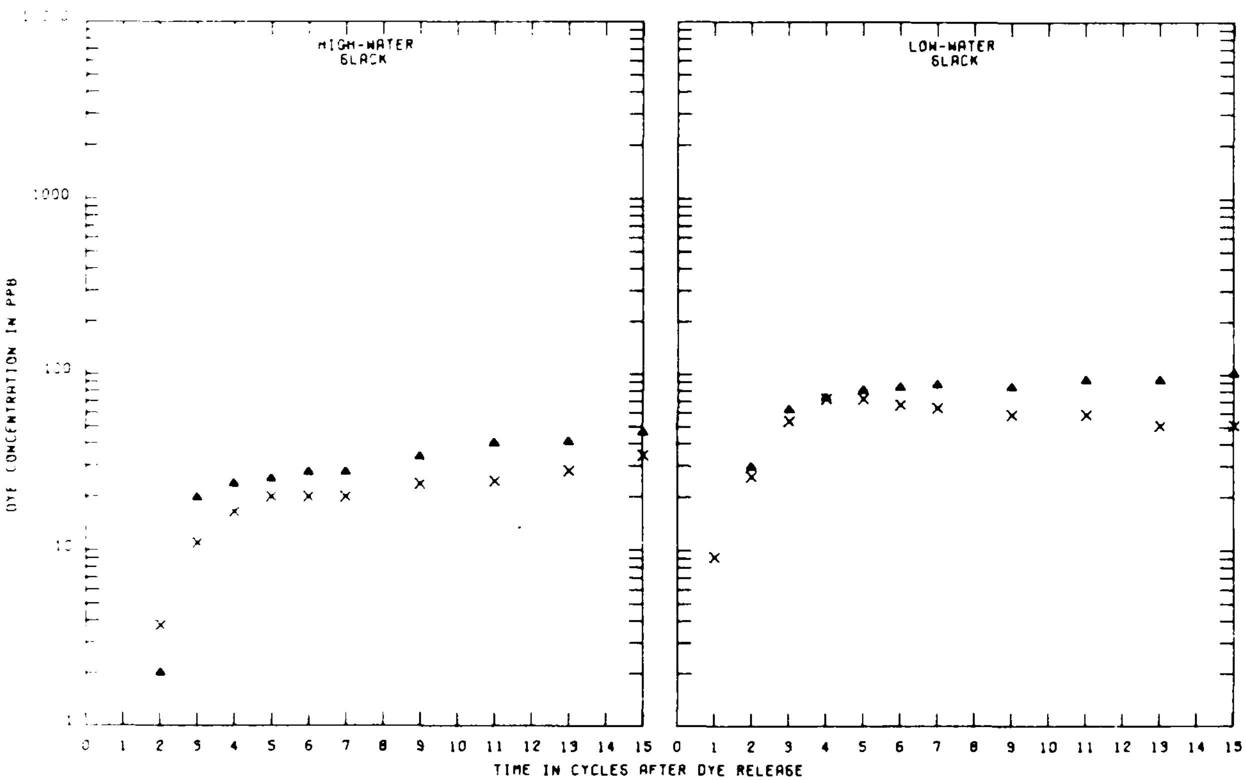
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOO

LEGEND

□ ——— SURFACE	BASE	
△ — — — BOTTOM		
+ —·—·— SURFACE	PLAN D	
× —··—··— BOTTOM		

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 10C



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

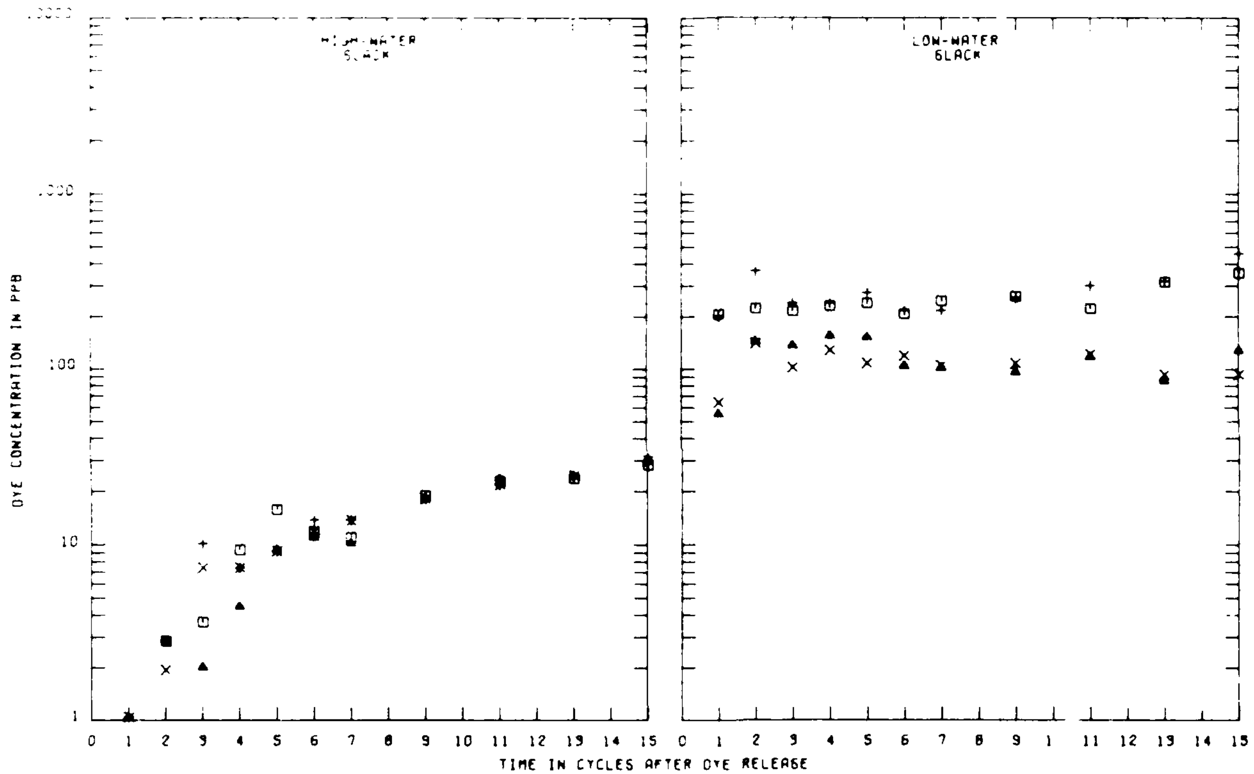
LEGEND

▲ — — — BOTTOM BASE

× —·—·— BOTTOM PLAN D

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 12A



TEST CONDITIONS

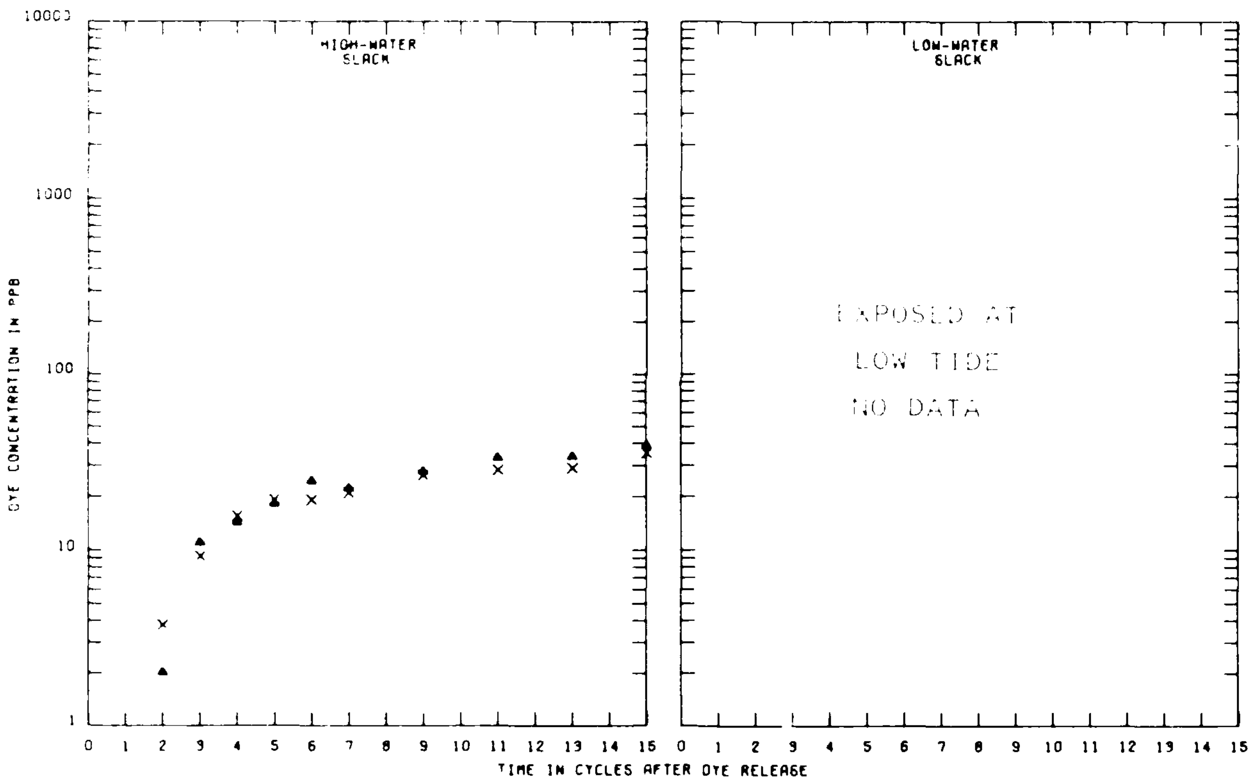
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡	———	SURFACE	BASE
▲	— — —	BOTTOM	BASE
+	—·—	SURFACE	PLAN D
×	—··—	BOTTOM	PLAN D

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 128



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

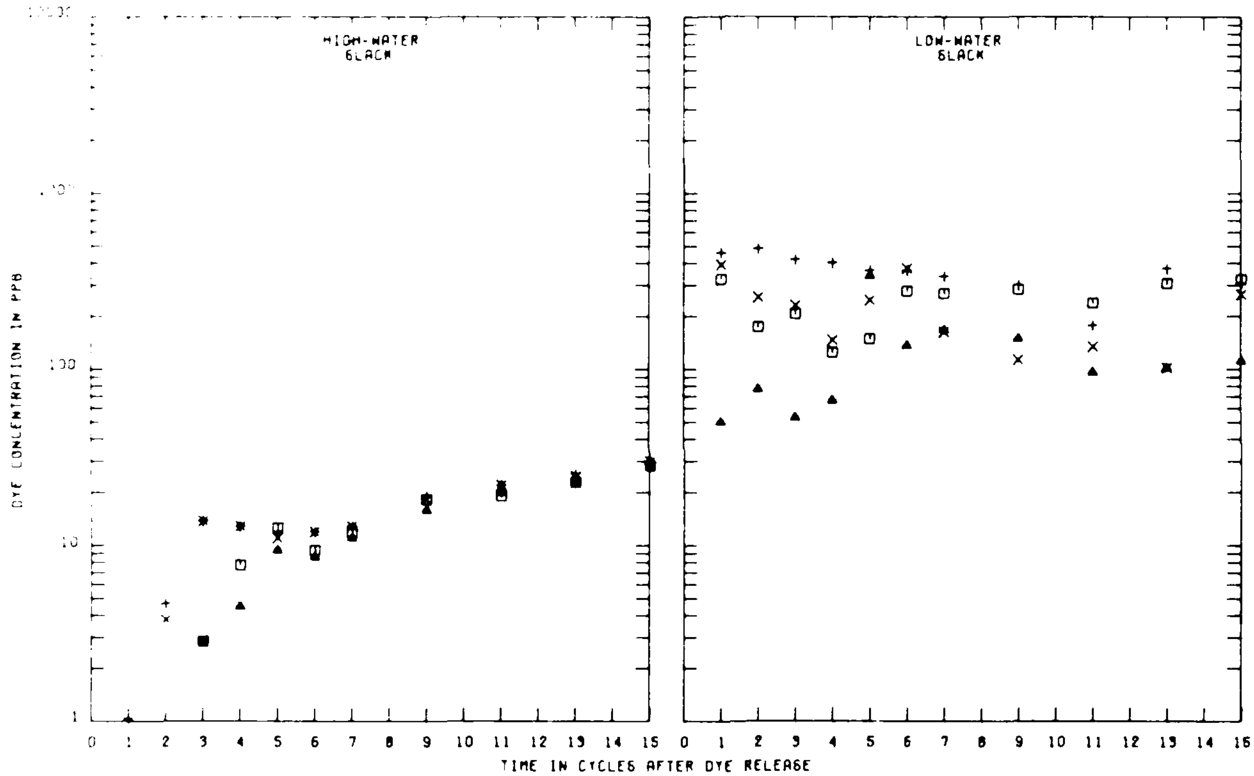
▲ — — — BOTTOM BASE

× —·—·— BOTTOM PLAN D

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 16A

PLATE 206



TEST CONDITIONS

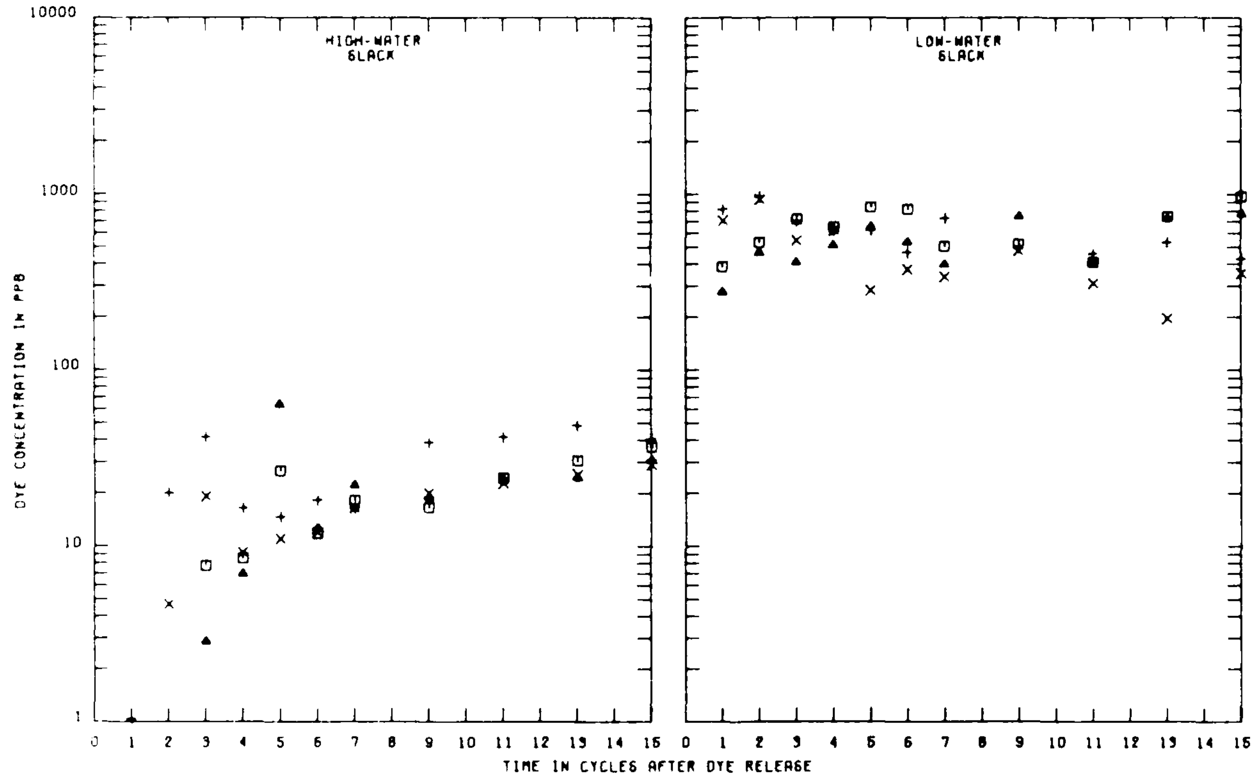
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN D
× —··—··	BOTTOM	

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 160



TEST CONDITIONS

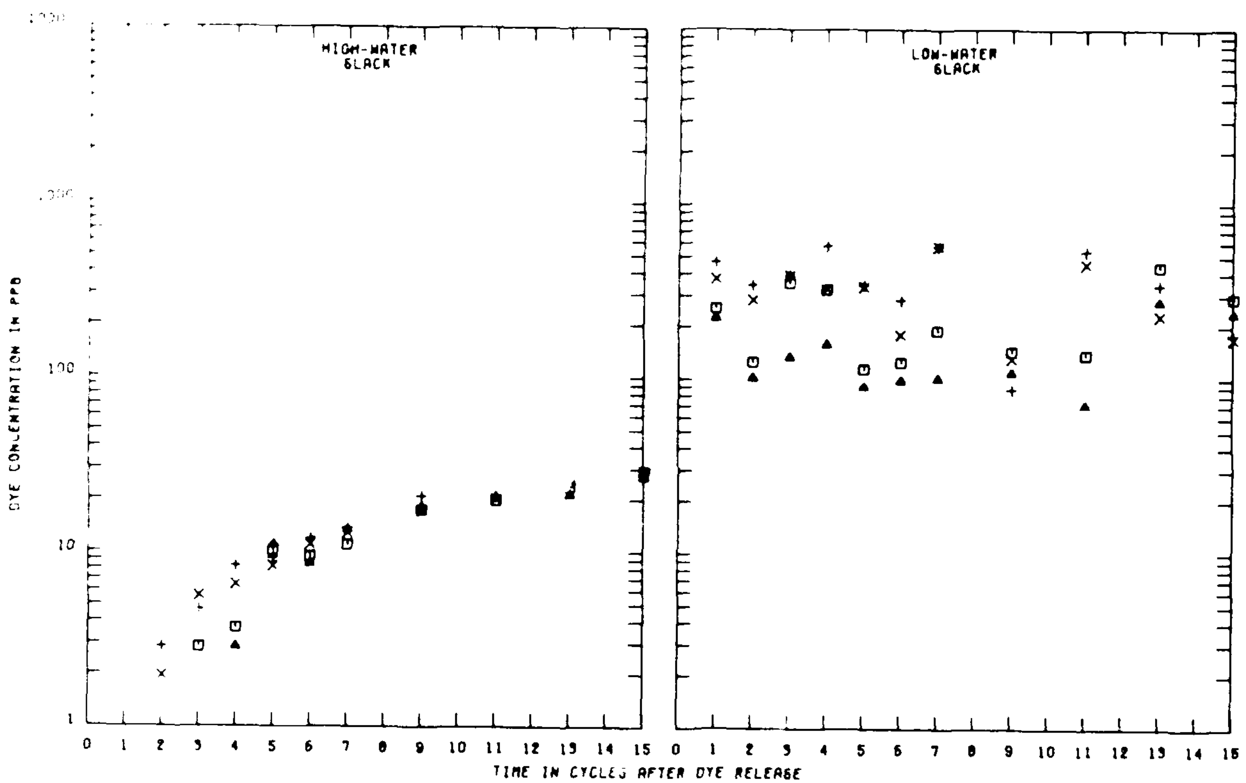
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—	SURFACE	PLAN D
× —··—	BOTTOM	

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 18A



TEST CONDITIONS

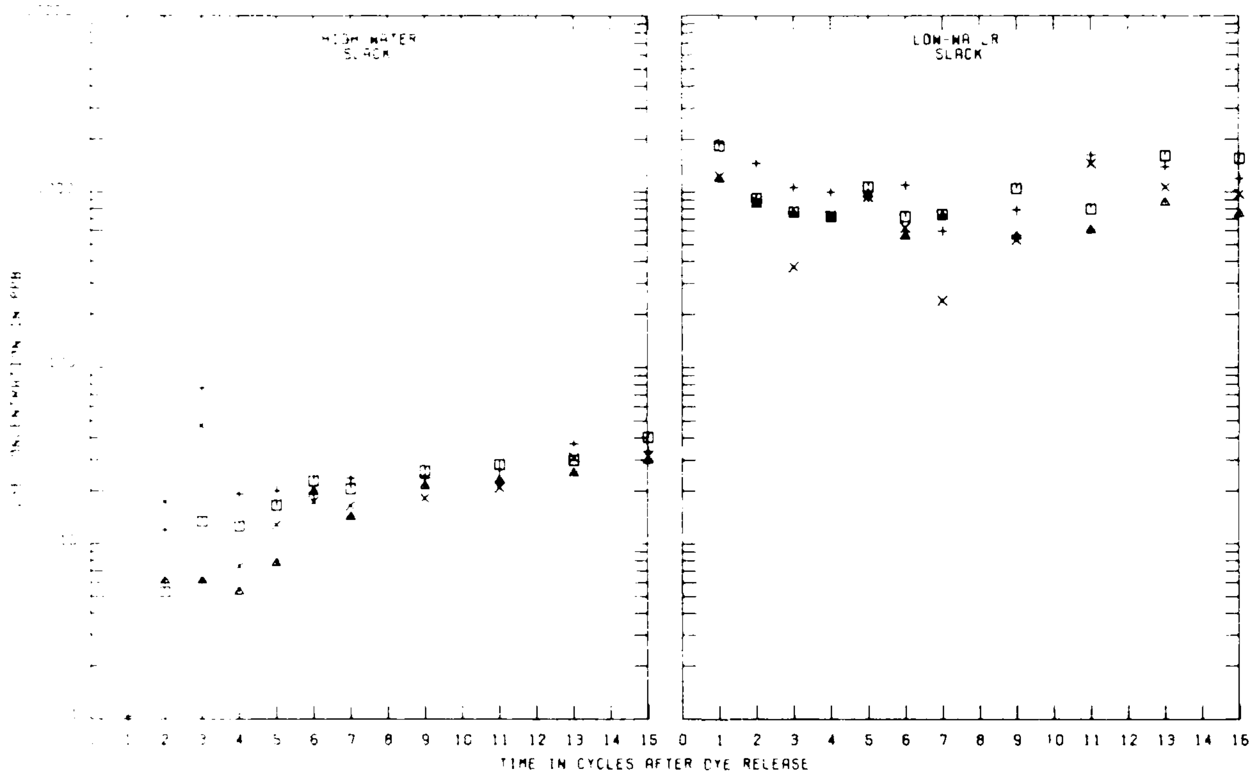
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

⊡ ——— SURFACE BASE
▲ — — — BOTTOM
\+ —·—· SURFACE PLAN D
× —··— BOTTOM

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 188



TEST CONDITIONS

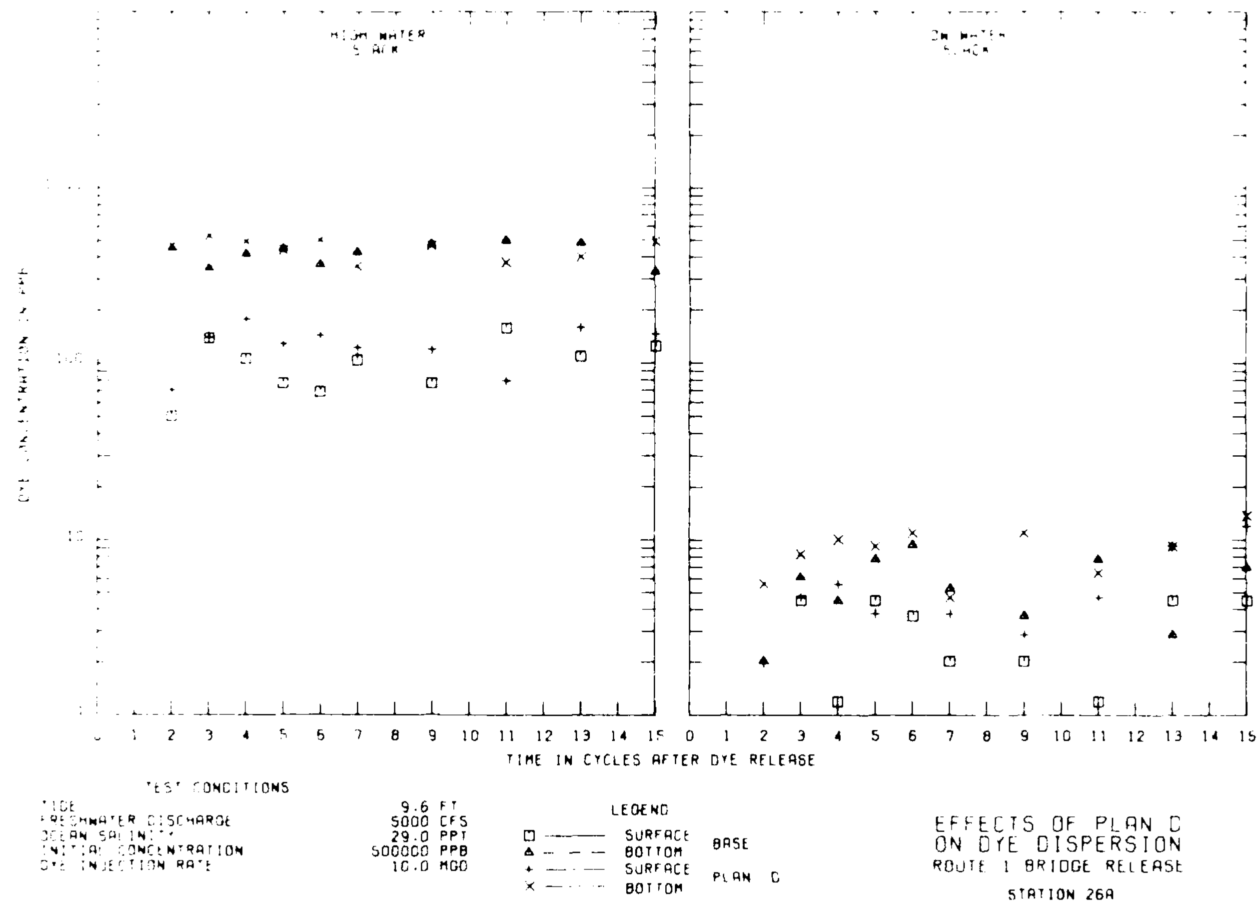
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	25.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

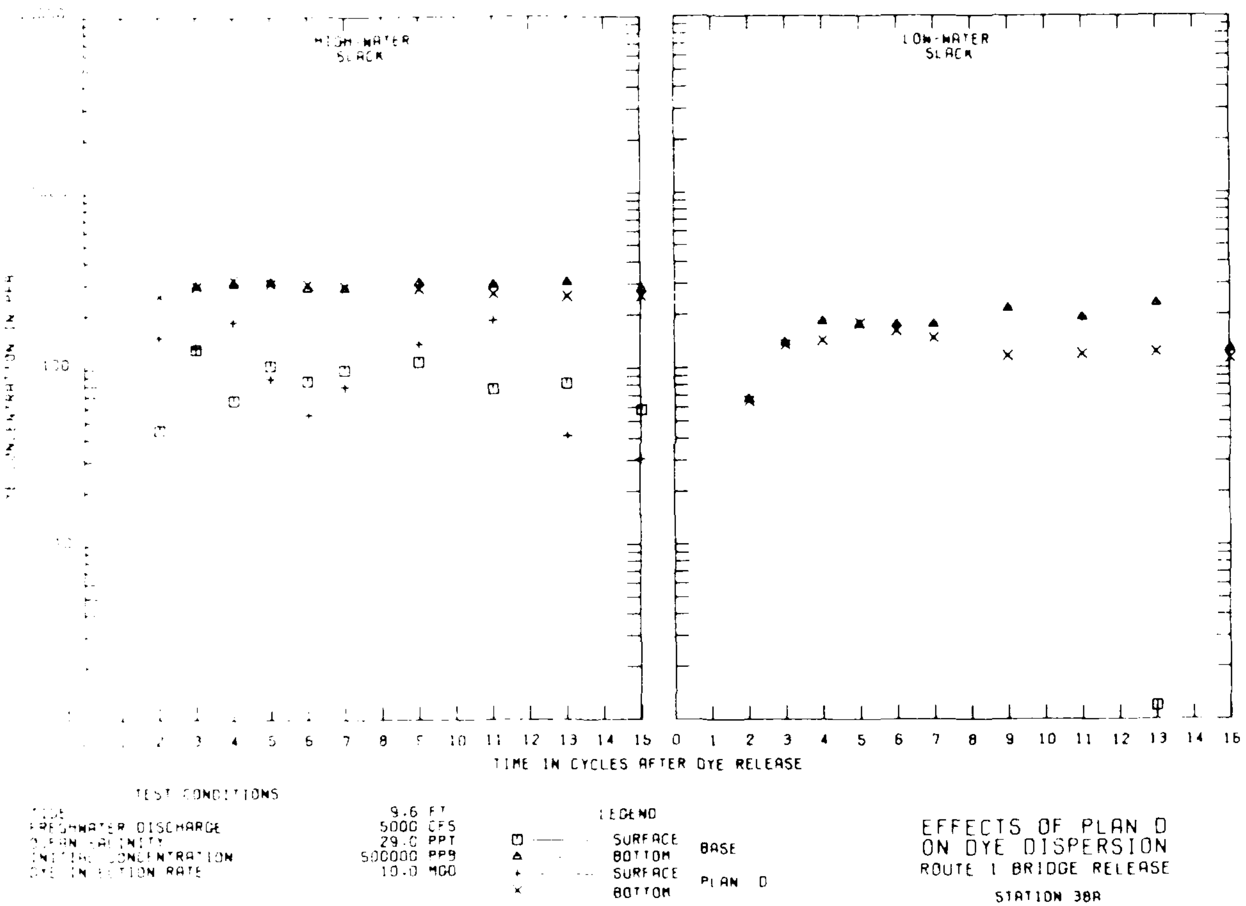
LEGEND

□ ———	SURFACE	BASE
△ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN D
× —··—··—	BOTTOM	

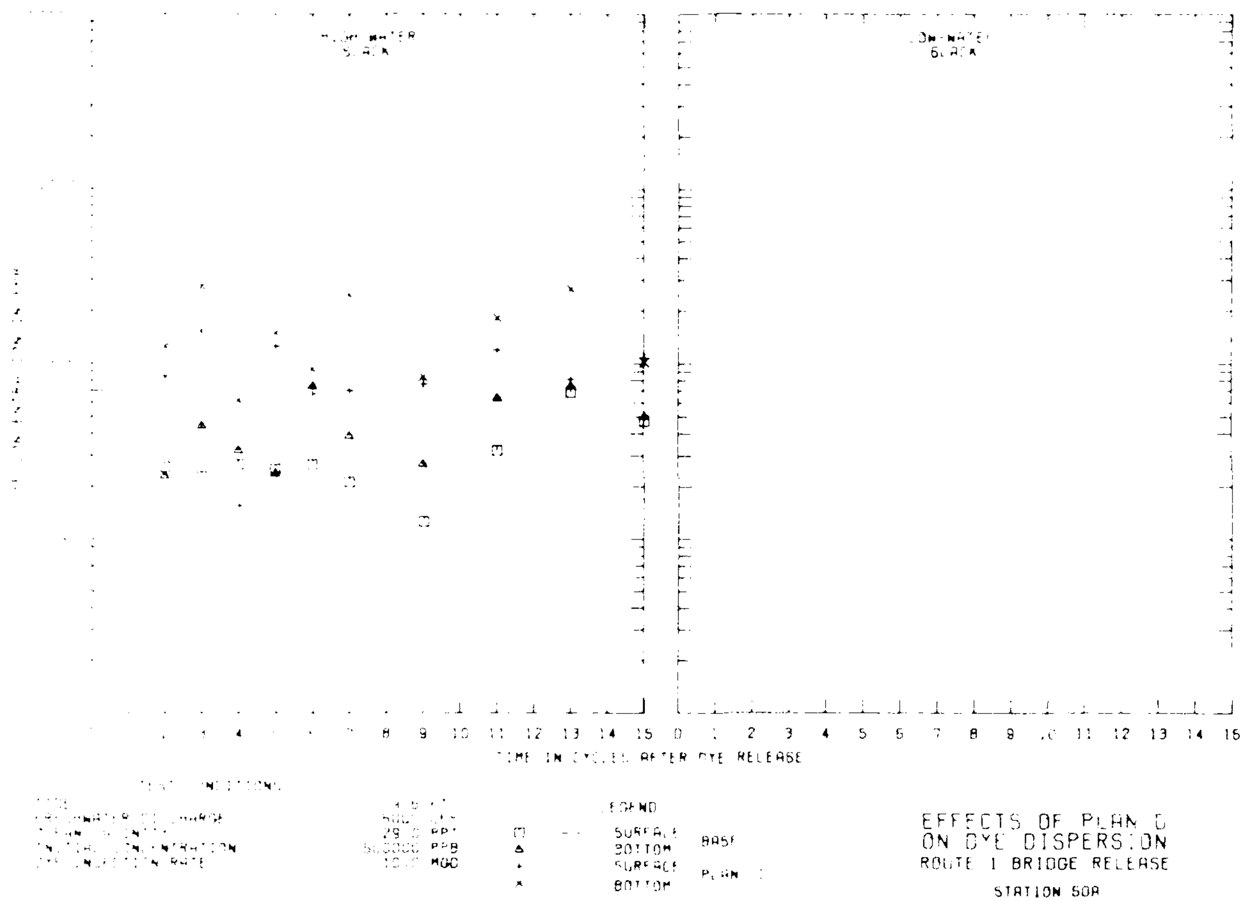
EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 20B


HIGH WATER SLACK
LOW WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE BASE
BOTTOM BASE
SURFACE PLAN C
BOTTOM PLAN C
EFFECTS OF PLAN C
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 26A



EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 38A



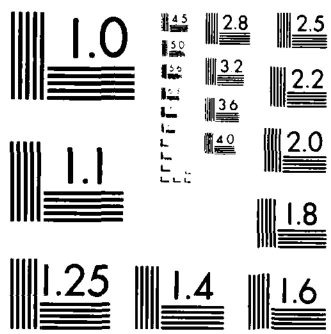
EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 50A

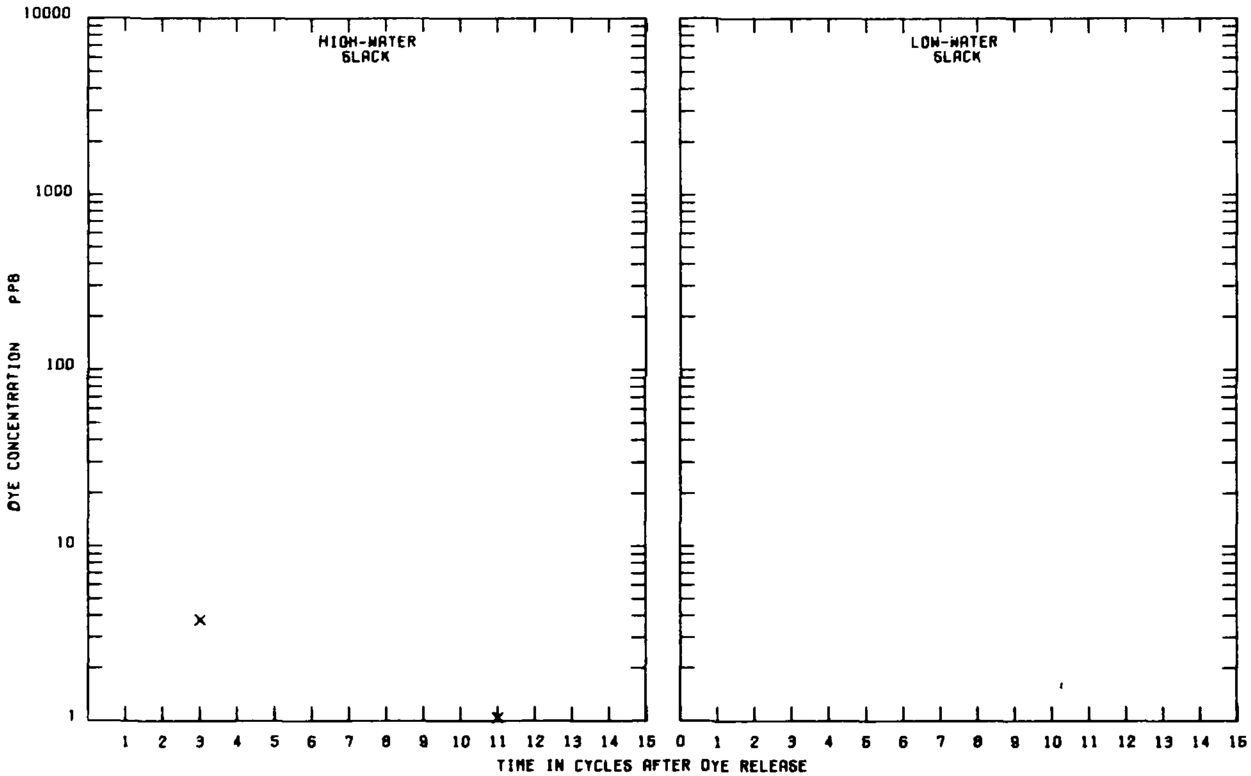
AD-A157 046 NEWBURYPORT HARBOR MASSACHUSETTS; REPORT 2 DESIGN FOR HYDRODYNAMICS SALIN..(U) ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS HYDRA..

UNCLASSIFIED N J BROGDON ET AL. MAR 85 WES/TR/HL-79-1-2 F/G 8/10 NL

5/6



MICROCOPY RESOLUTION TEST CHART



TEST CONDITION

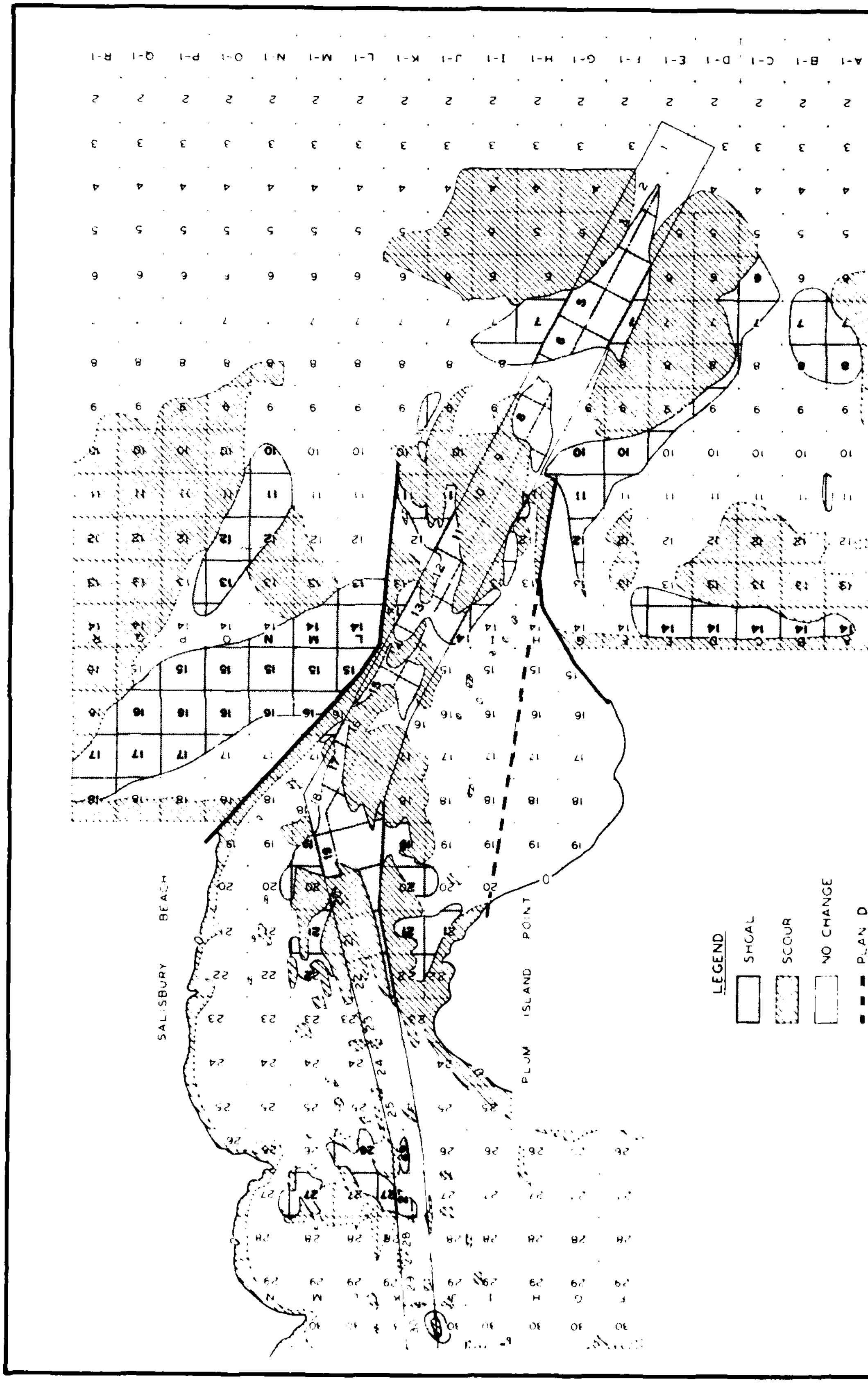
TIDE	9.6 FT
FRESHWATER DISCHARGE	6000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN D
X —··—··	BOTTOM	

EFFECTS OF PLAN D
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 56A



ENTRANCE FIXED-BED SHOALING AND SCOUR PATTERNS

PLAN D

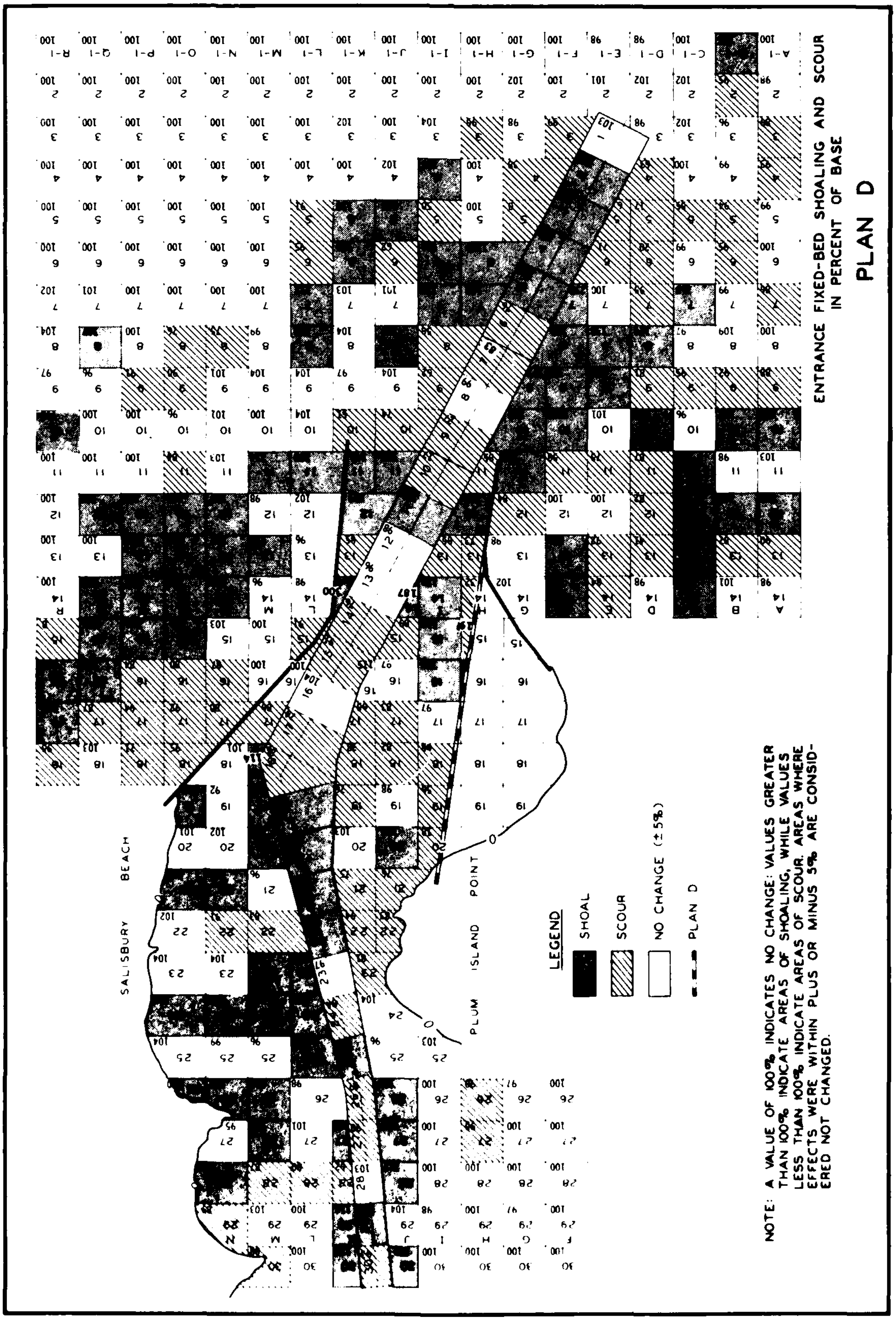
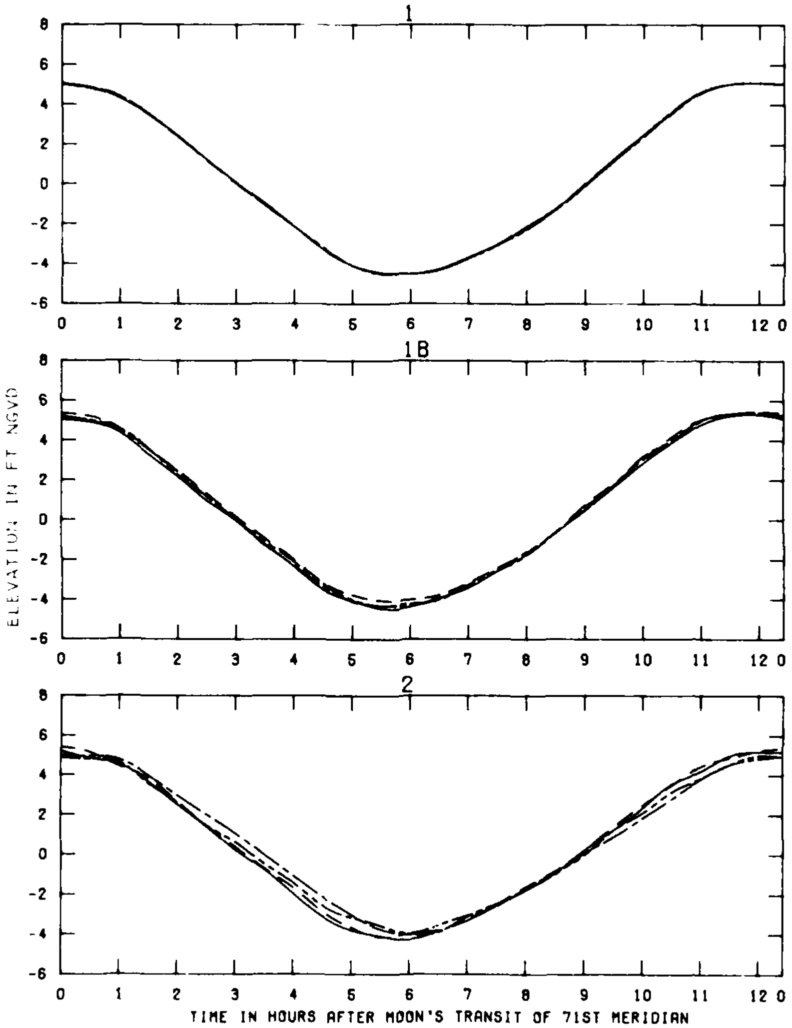

ENTRANCE FIXED-BED SHOALING AND SCOUR
IN PERCENT OF BASE
PLAN D
SALISBURY BEACH
PLUM ISLAND POINT
LEGEND
SHOAL
SCOUR
NO CHANGE (±5%)
PLAN D
NOTE: A VALUE OF 100% INDICATES NO CHANGE; VALUES GREATER THAN 100% INDICATE AREAS OF SHOALING, WHILE VALUES LESS THAN 100% INDICATE AREAS OF SCOUR. AREAS WHERE EFFECTS WERE WITHIN PLUS OR MINUS 5% ARE CONSIDERED NOT CHANGED.

PLATE 216

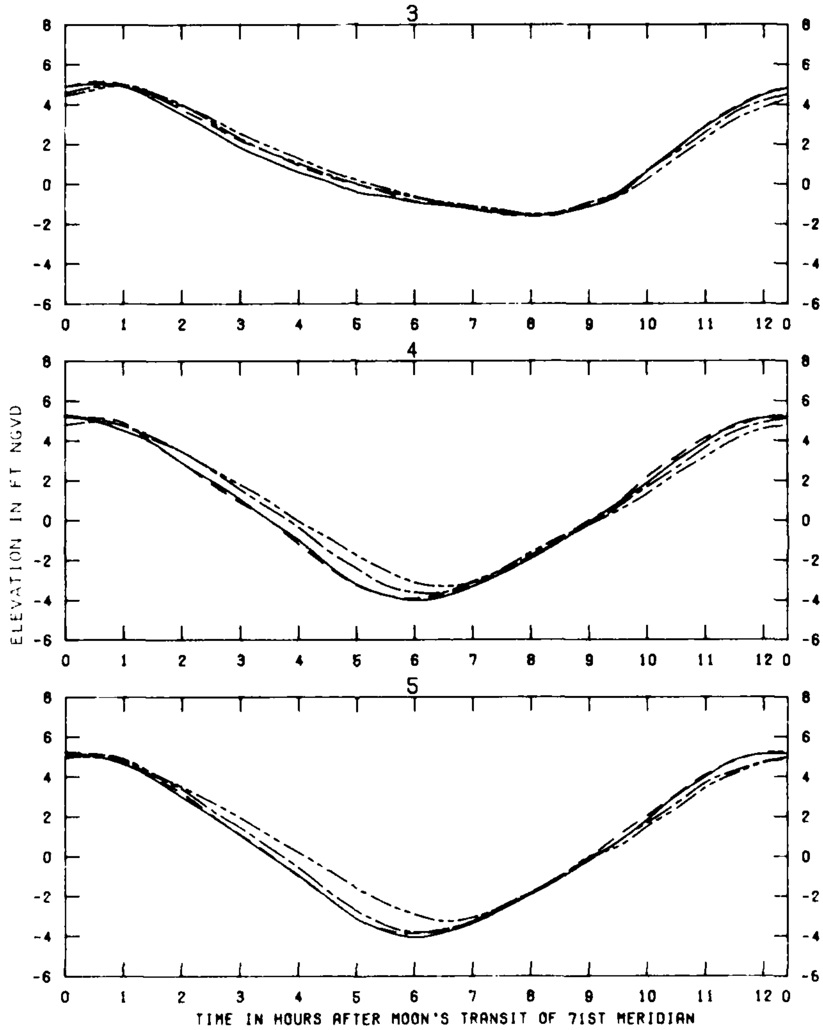


TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	5000	CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON TIDAL HEIGHTS
STATIONS
1 , 1B , AND 2



TEST CONDITIONS

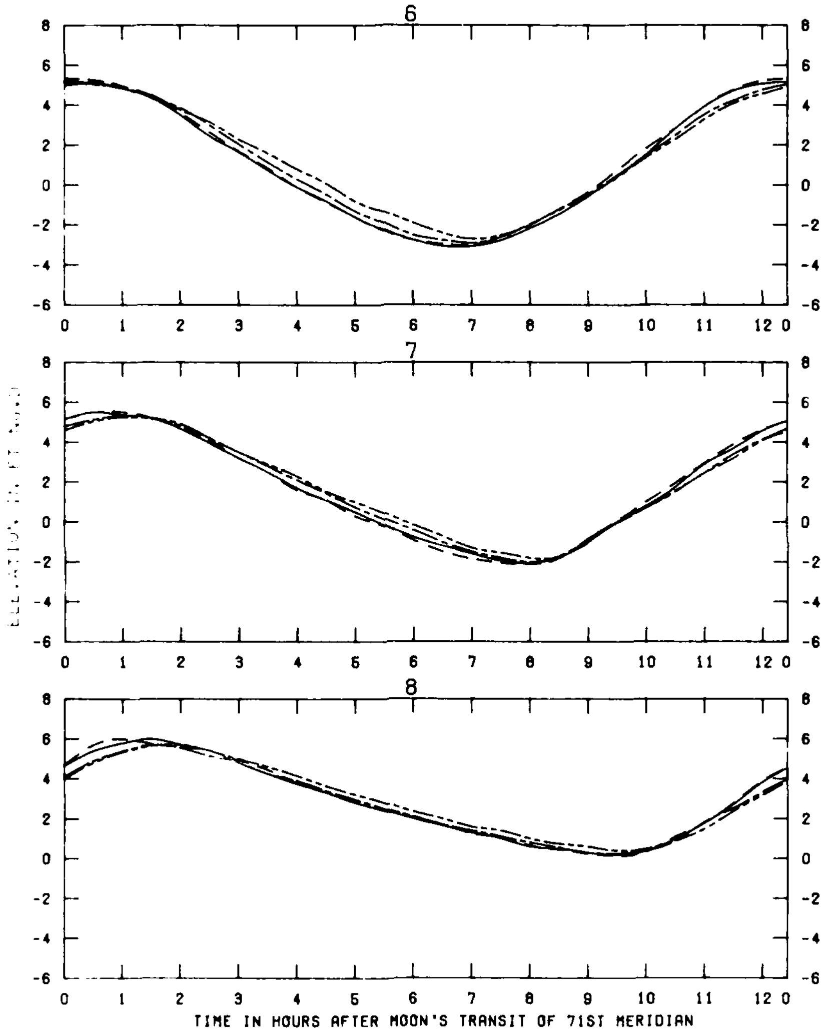
TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND

BASE ———
PLAN 3E — — —
PLAN BE —-—-—
PLAN BX —--—

EFFECTS OF
PLANS 3E, BE AND BX
ON TIDAL HEIGHTS

STATIONS
3 , 4 , AND 5

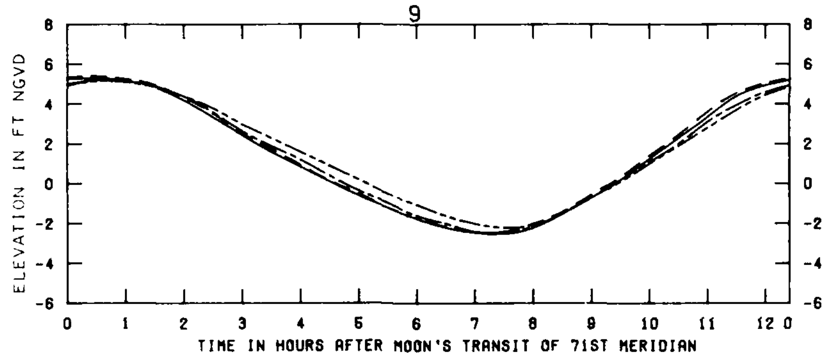


TEST CONDITIONS
TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX

EFFECTS OF
PLANS 3E, BE AND BX
ON TIDAL HEIGHTS

STATIONS
6 , 7 , AND 8



TEST CONDITIONS

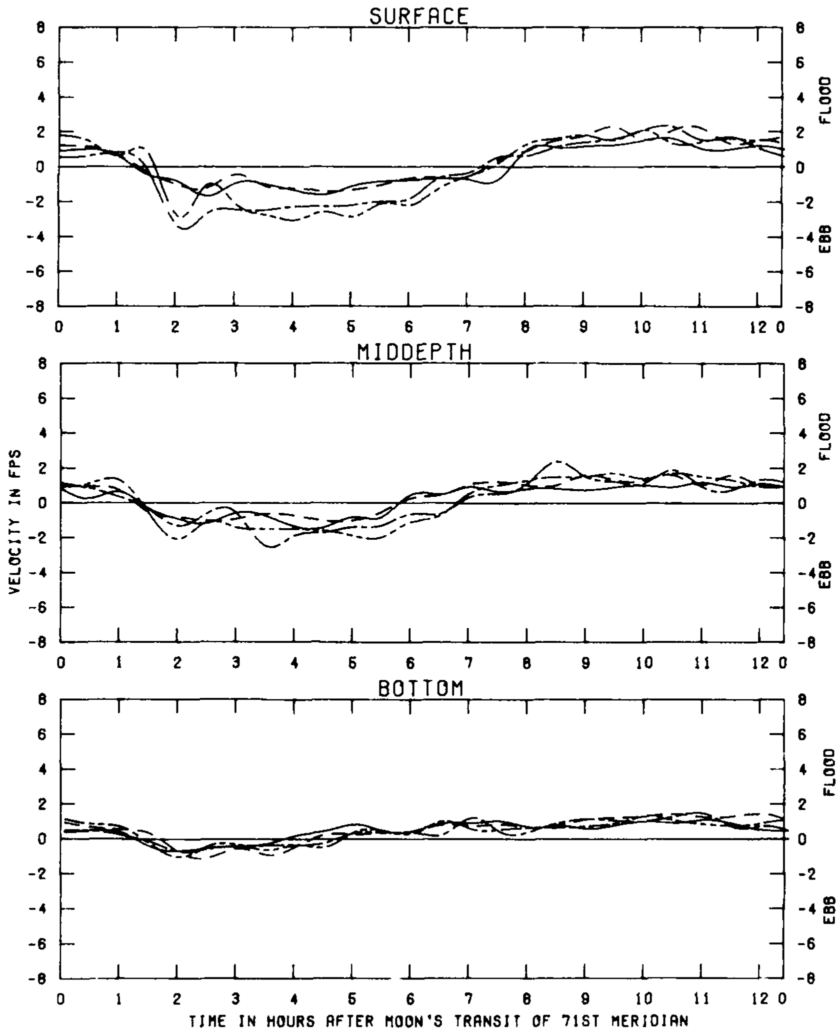
TIDE RANGE AT GAGE 1 (PIT)	9.6	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	5000	CFS

LEGEND

BASE ————
PLAN 3E — — —
PLAN BE —·—
PLAN BX —·-·—

EFFECTS OF
PLANS 3E, BE AND BX
ON TIDAL HEIGHTS

STATION
9



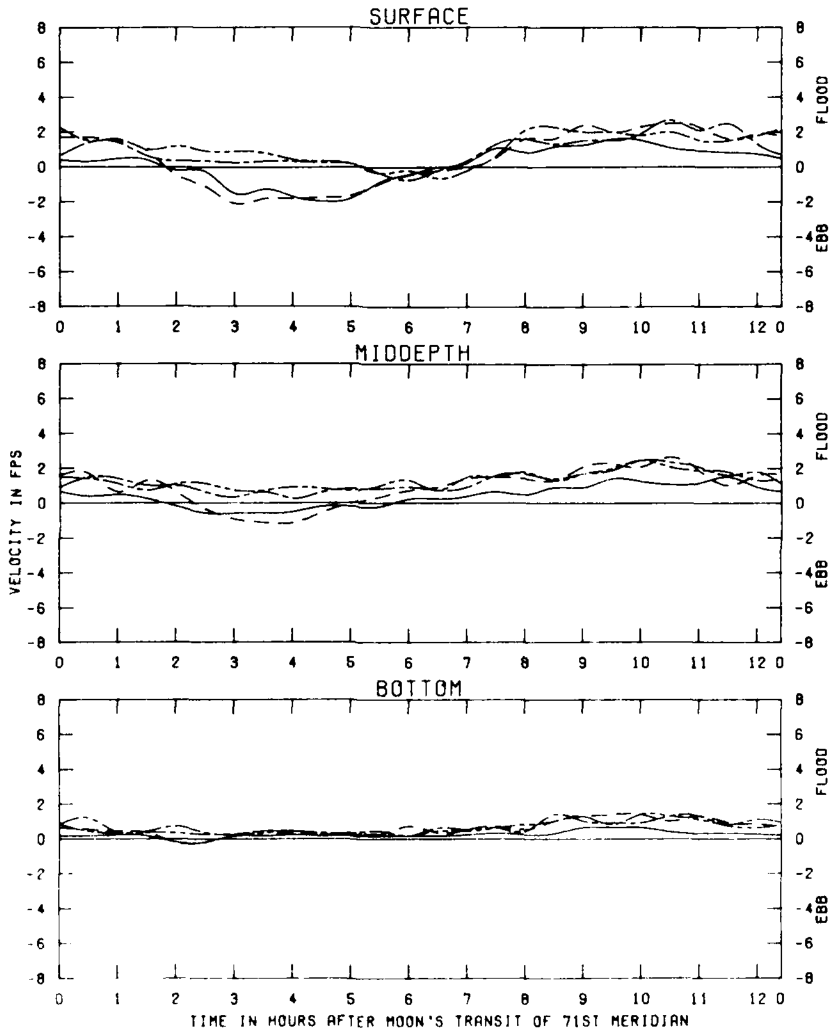
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 6000 CFS

EFFECTS OF
PLANS 3E, BE AND BX
ON VELOCITIES

STATION
OA

LEGEND
BASE ———
PLAN 3E — — —
PLAN BE —-—-—
PLAN BX —-·-·—



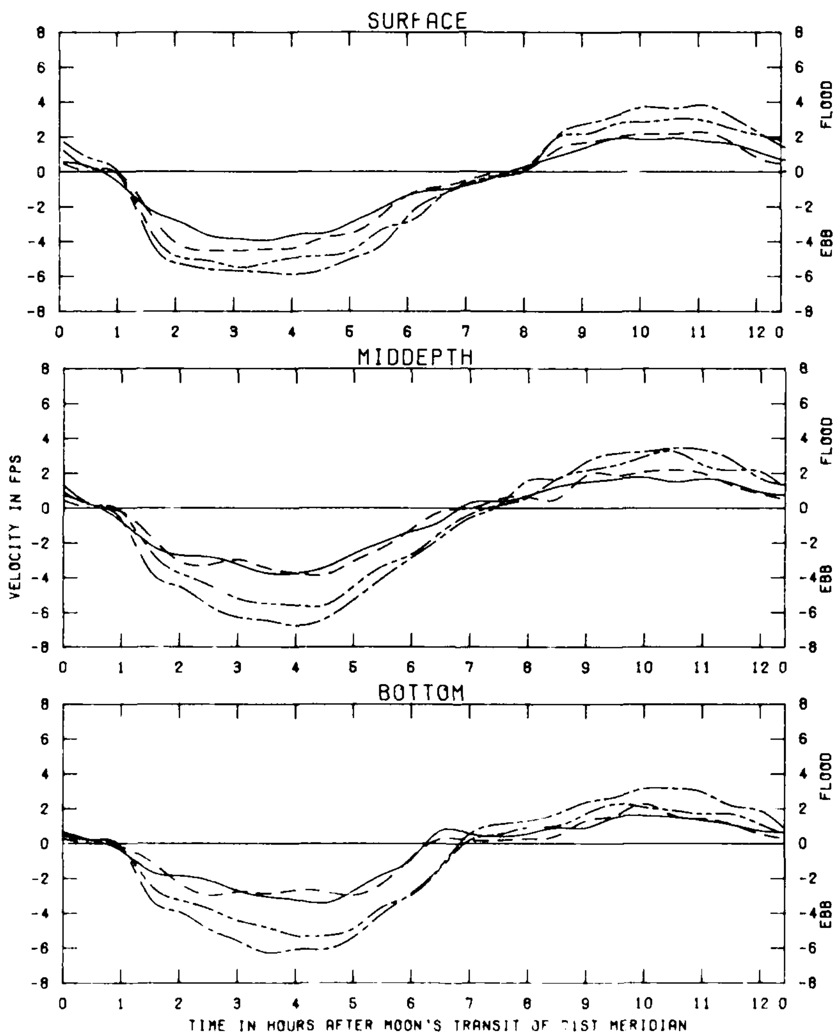
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

EFFECTS OF
PLANS 3E, BE AND BX
ON VELOCITIES

STATION
08

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX



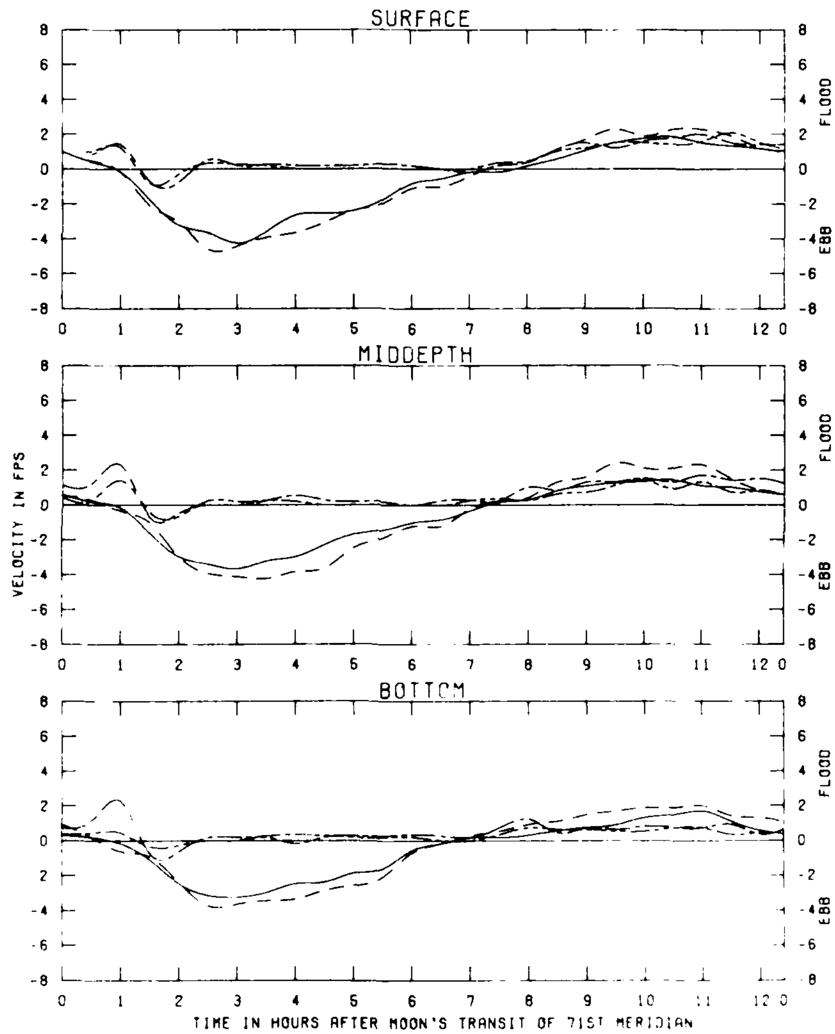
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON VELOCITIES

STATION
2A



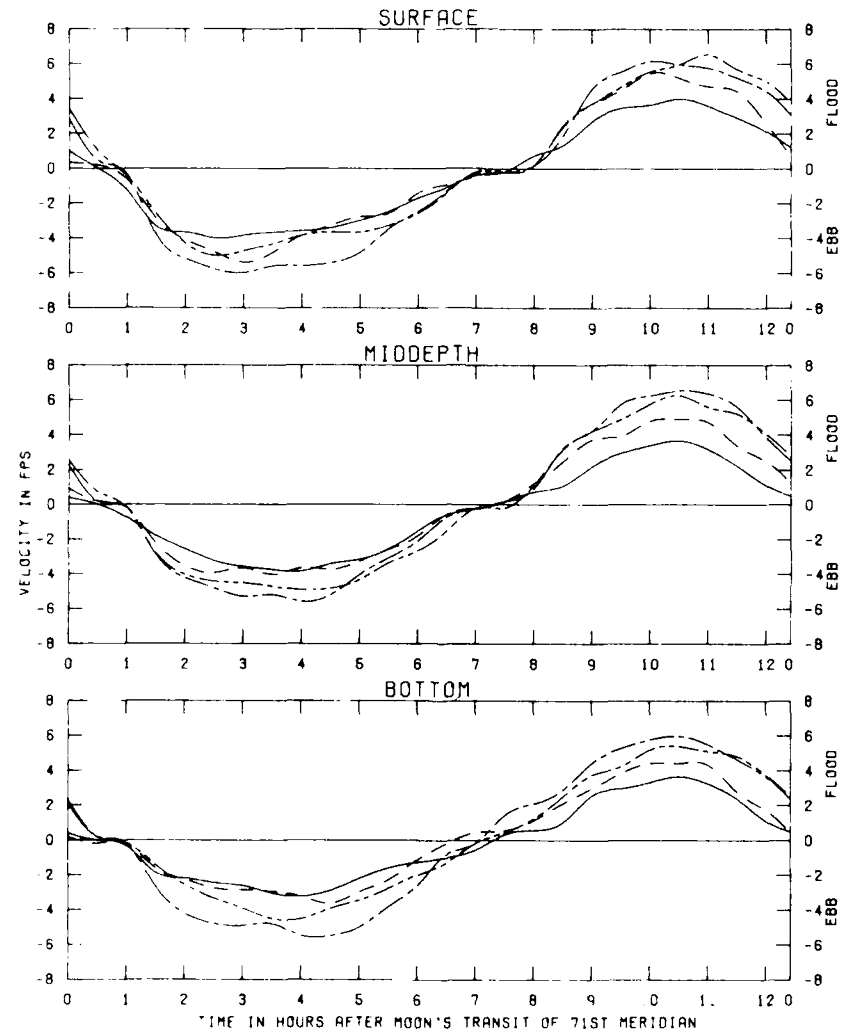
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3F
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3F, 8F AND 8X
ON VELOCITIES

STATION
28

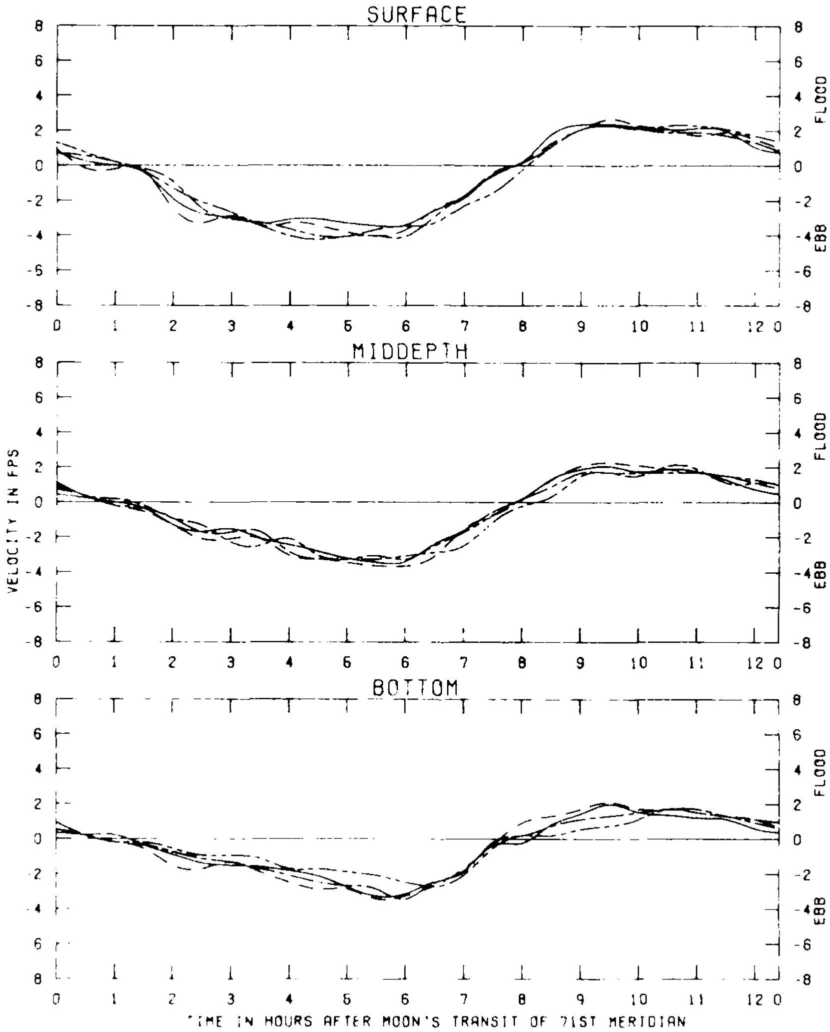


TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON VELOCITIES
STATION
3A



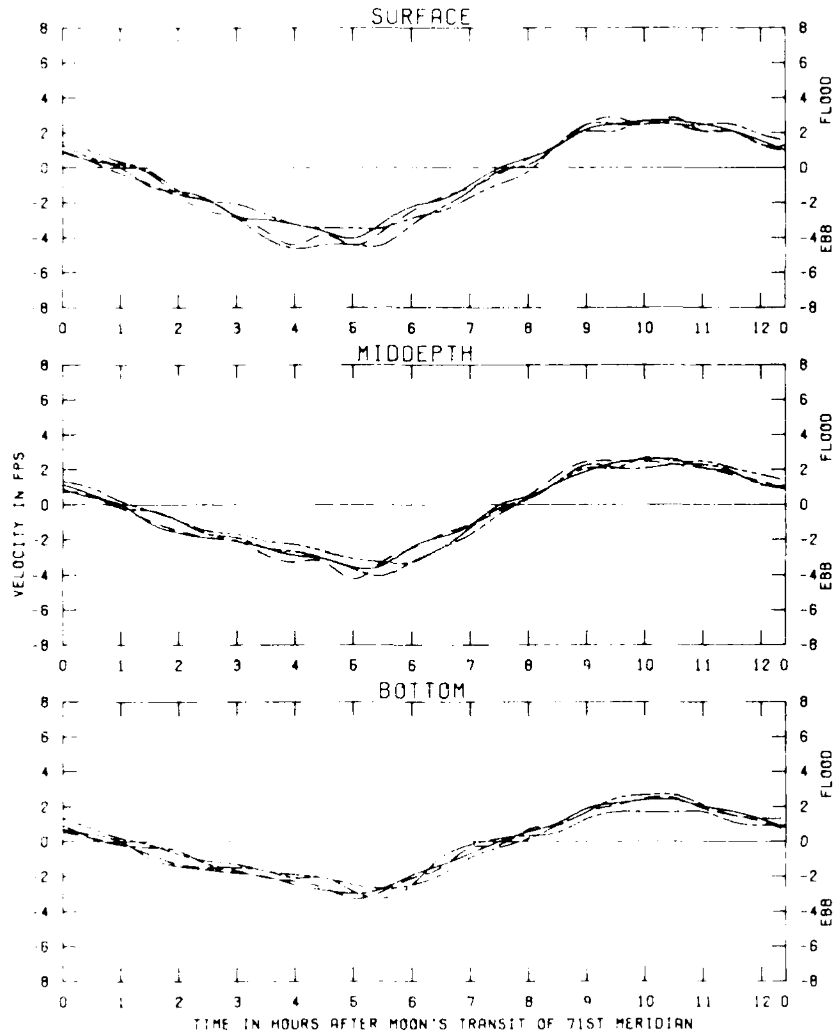
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX

EFFECTS OF
PLANS 3E, BE AND BX
ON VELOCITIES

STATION
160



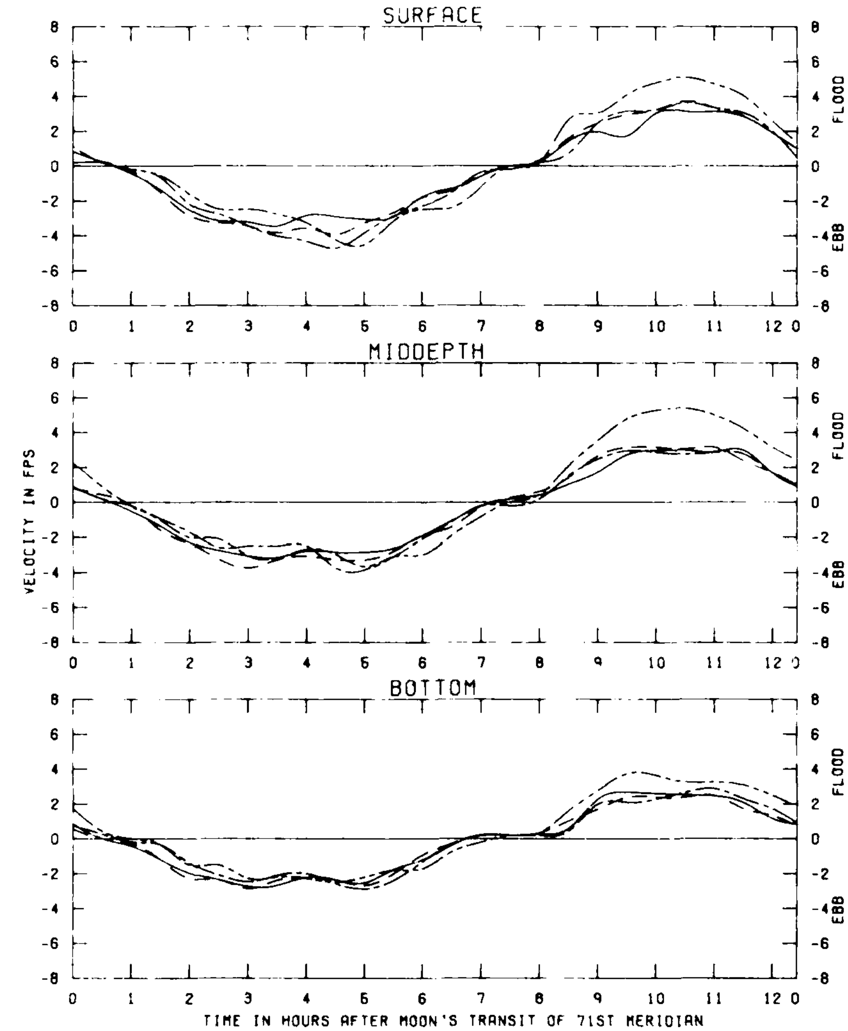
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

EFFECTS OF
PLANS 3E, BE AND BX
ON VELOCITIES

STATION
128

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX

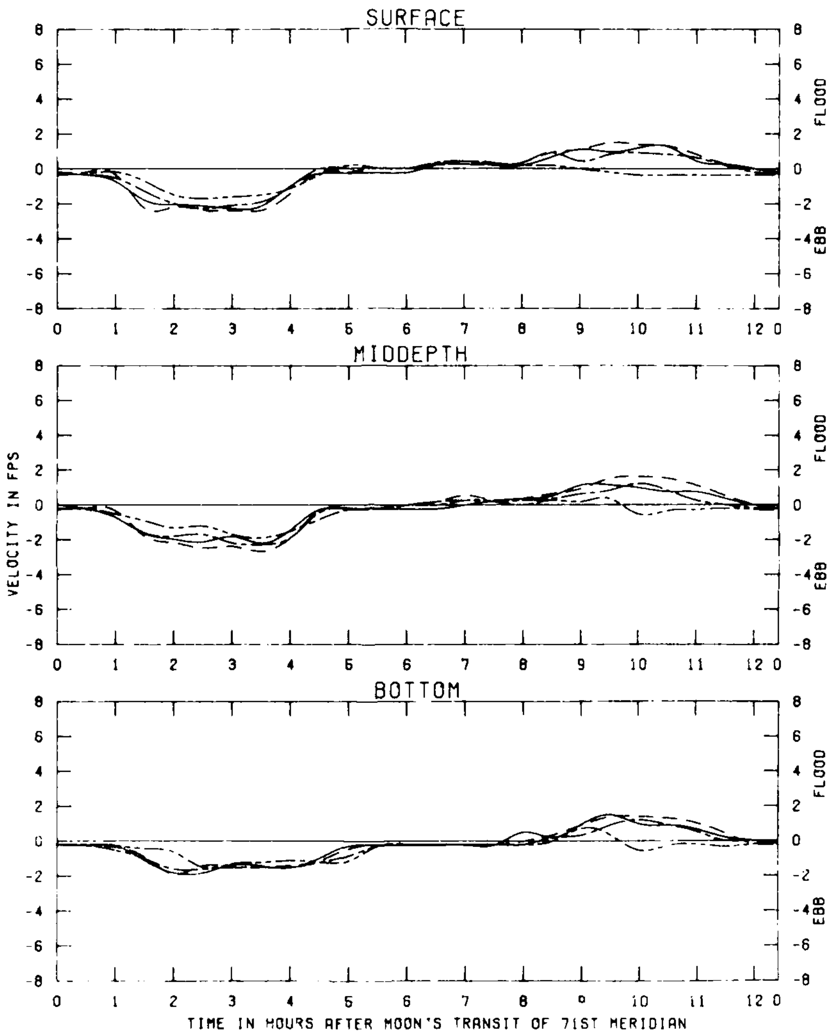


TEST CONDITIONS
TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 6000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON VELOCITIES

STATION
8C



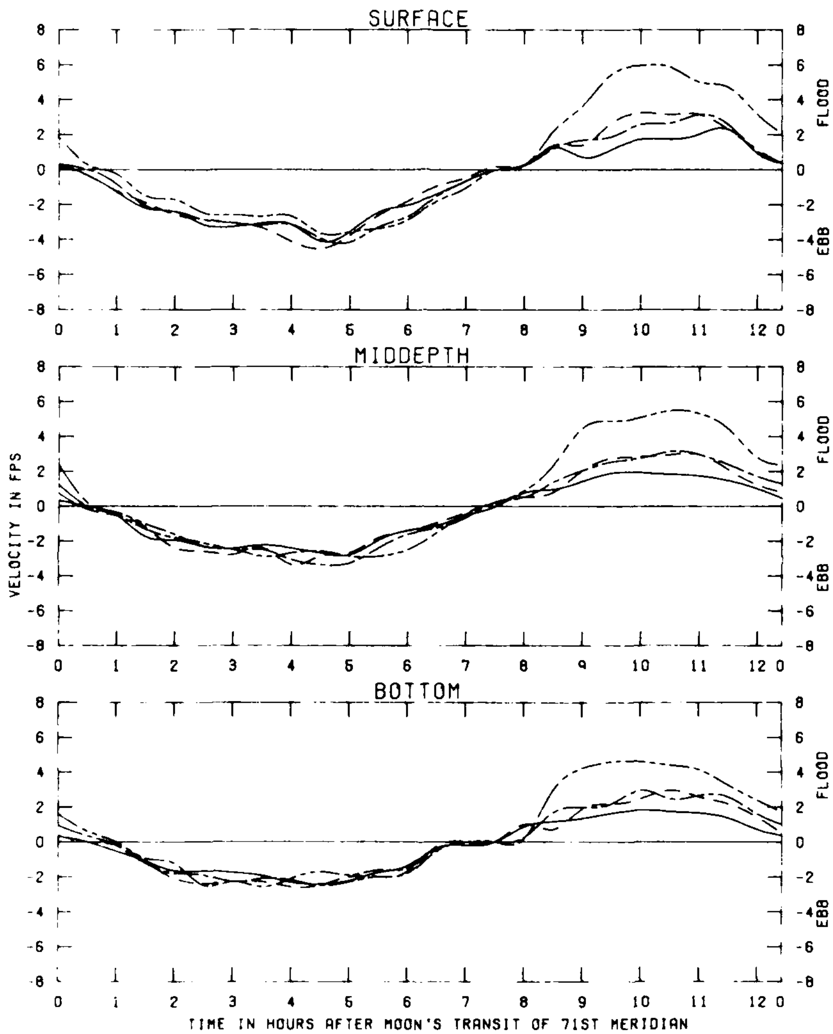
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX

EFFECTS OF
PLANS 3E.BE AND BX
ON VELOCITIES

STATION
88



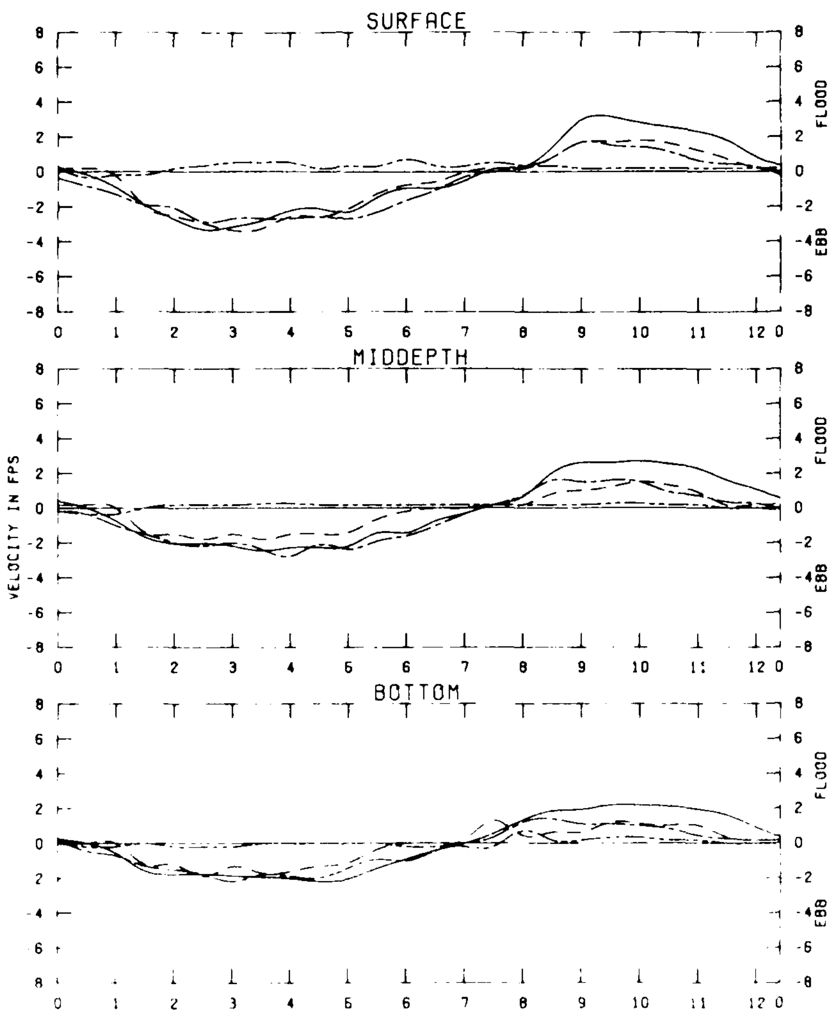
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX

EFFECTS OF
PLANS 3E, BE AND BX
ON VELOCITIES

STATION
7A



TEST CONDITIONS

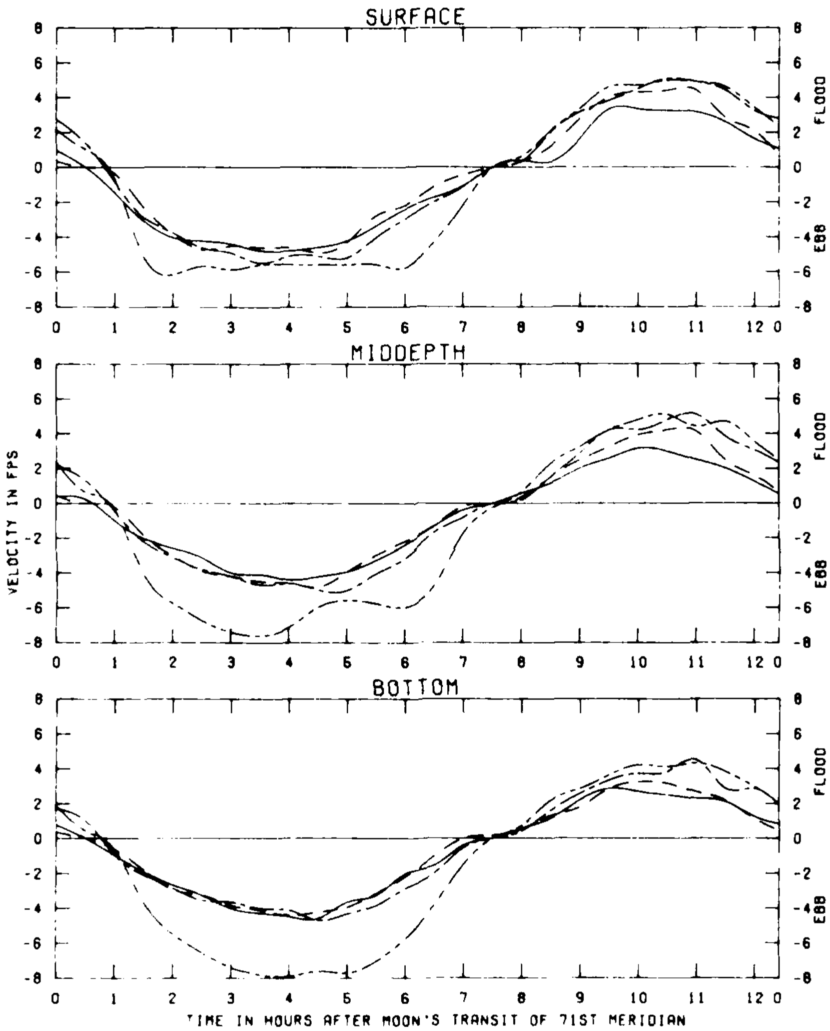
TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

LEGEND

BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON VELOCITIES

STATION
6C



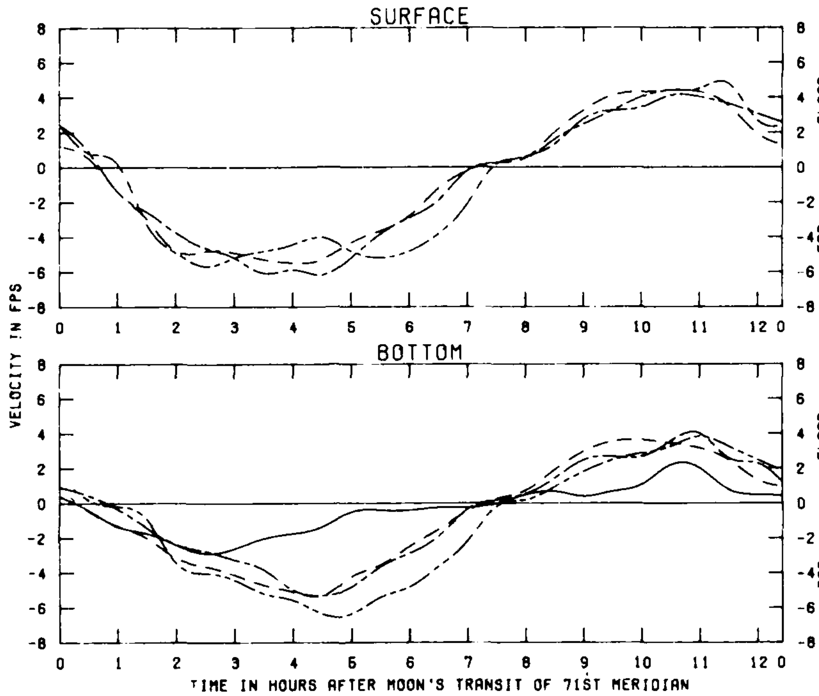
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX

EFFECTS OF
PLANS 3E, BE AND BX
ON VELOCITIES

STATION
6B



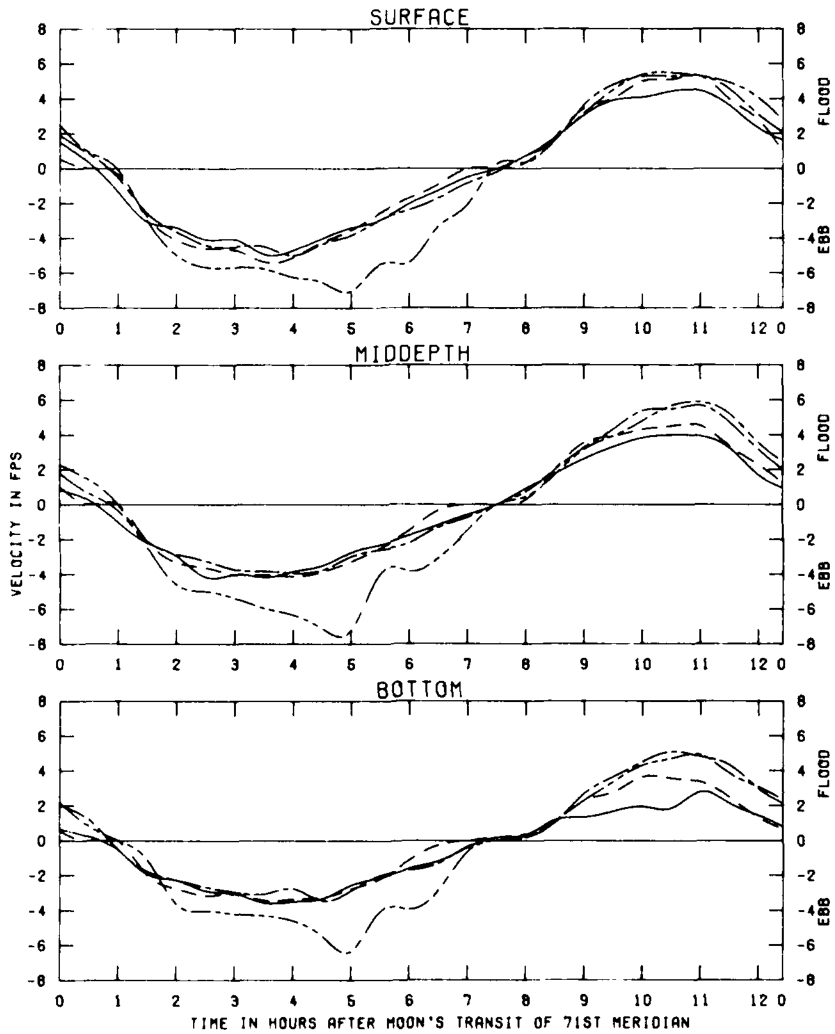
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	5000	CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E,8E AND 8X
ON VELOCITIES

STATION
6A



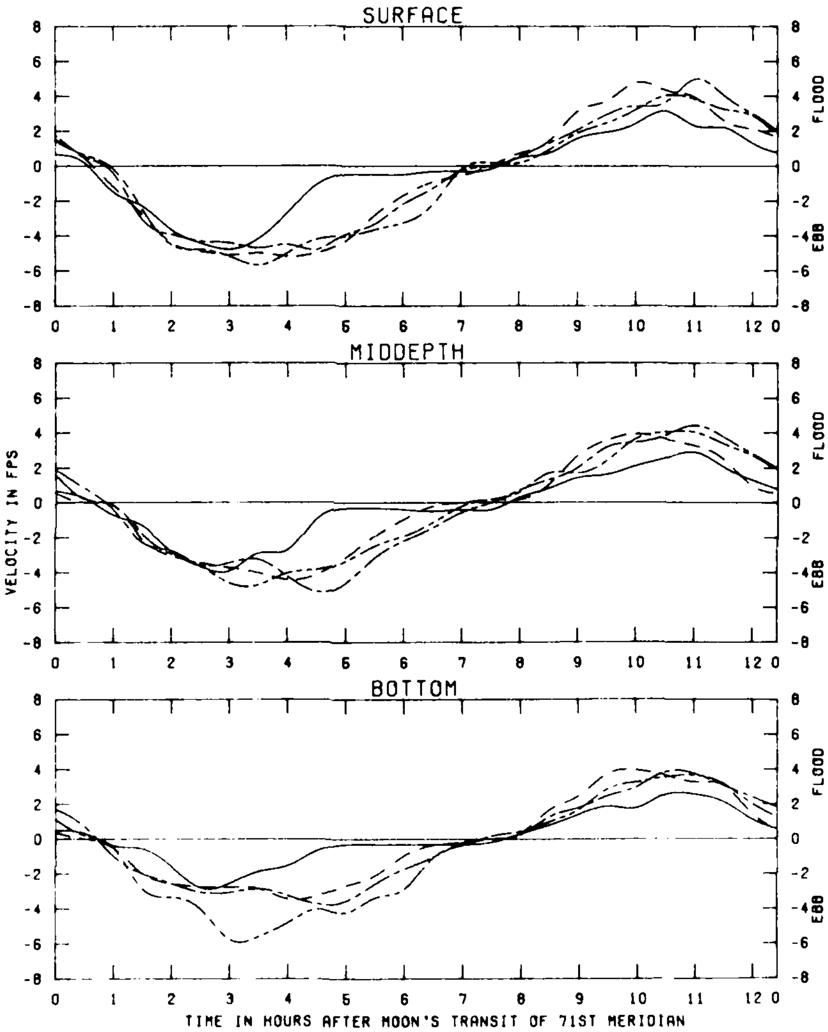
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON VELOCITIES

STATION
6C



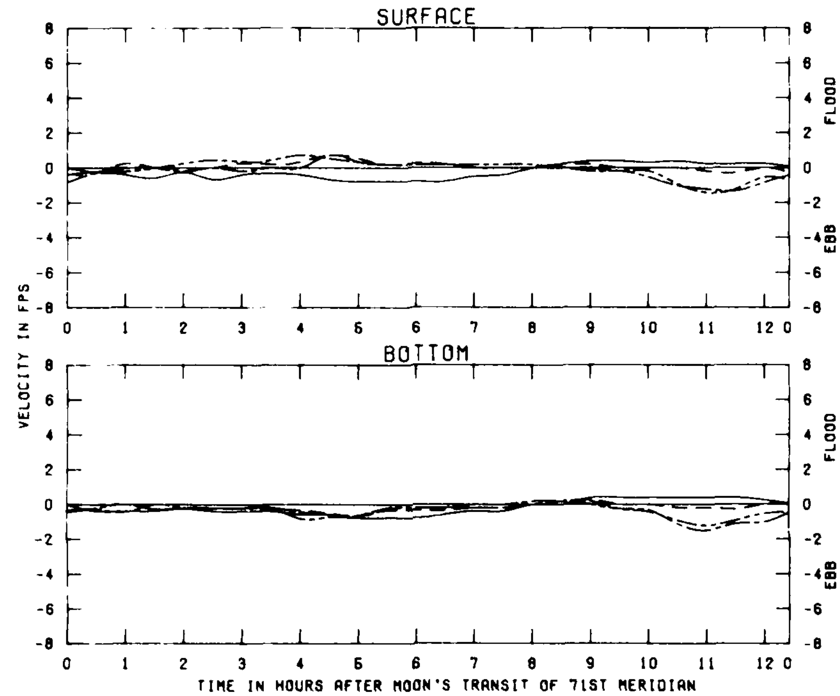
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	5000	CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E,8E AND 8X
ON VELOCITIES

STATION
5B



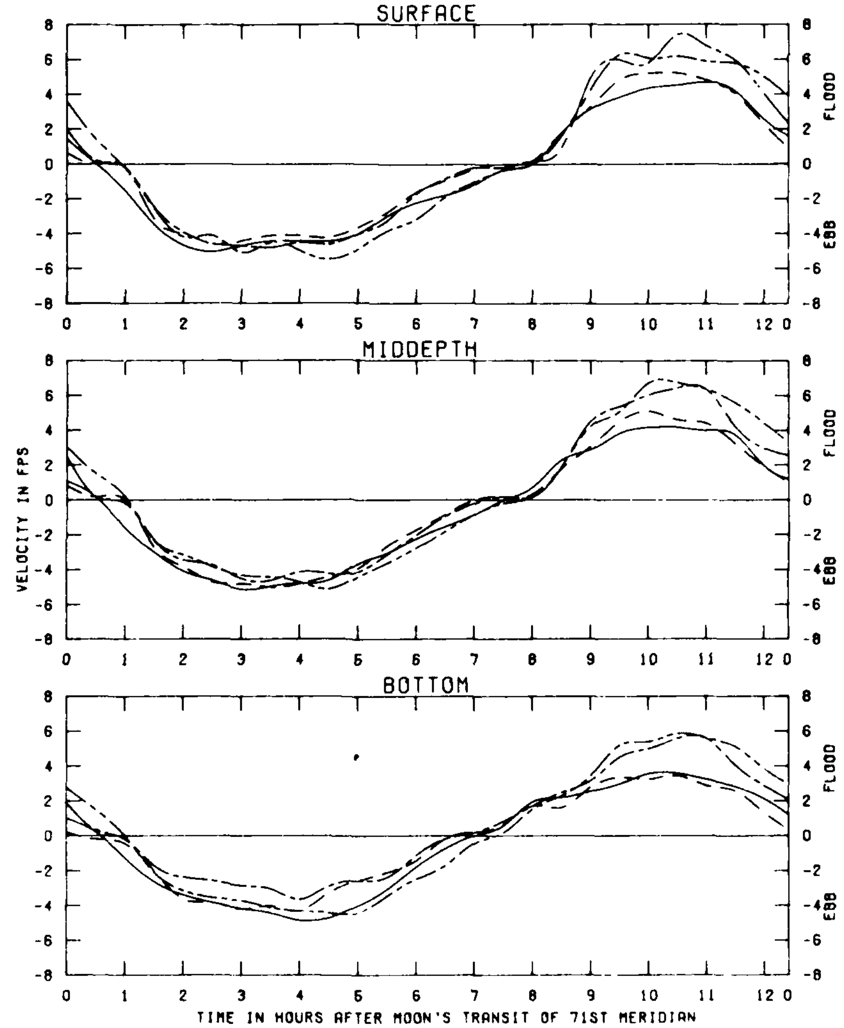
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON VELOCITIES

STATION
5A



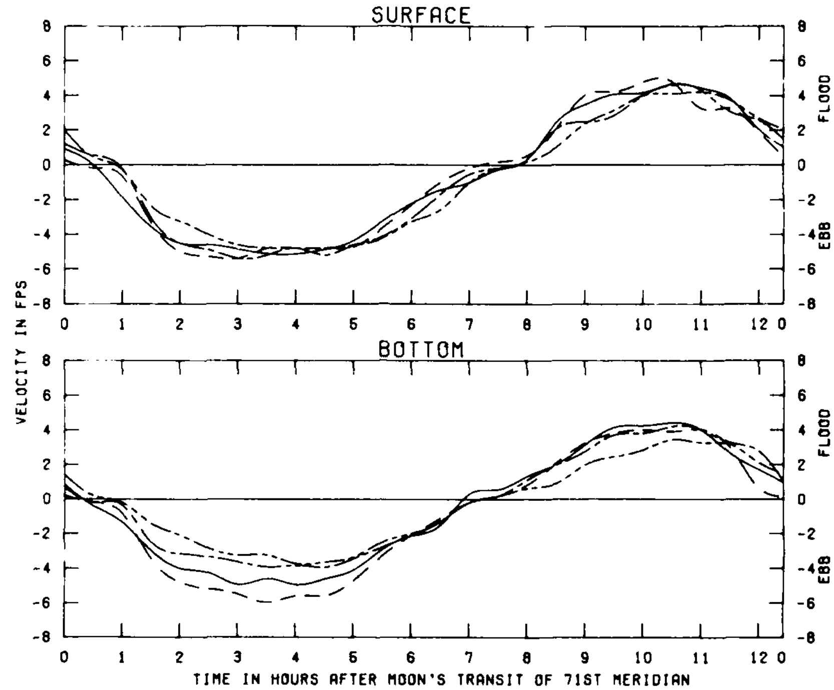
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

LEGEND
BASE ————
PLAN 3E — — —
PLAN BE —·—·—
PLAN BX -------

EFFECTS OF
PLANS 3E,BE AND BX
ON VELOCITIES

STATION
4A



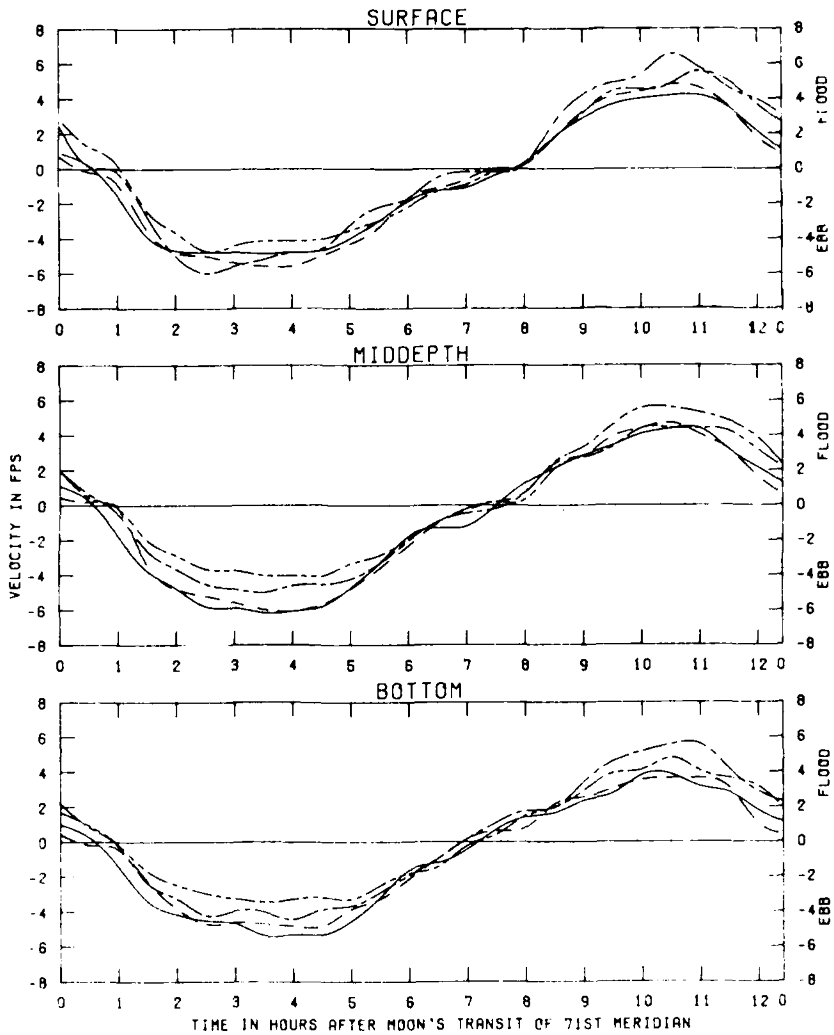
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE ————
PLAN 3E — — —
PLAN 8E —·—·—
PLAN 8X ——·——

EFFECTS OF
PLANS 3E, 8E AND 8X
ON VELOCITIES

STATION
3C



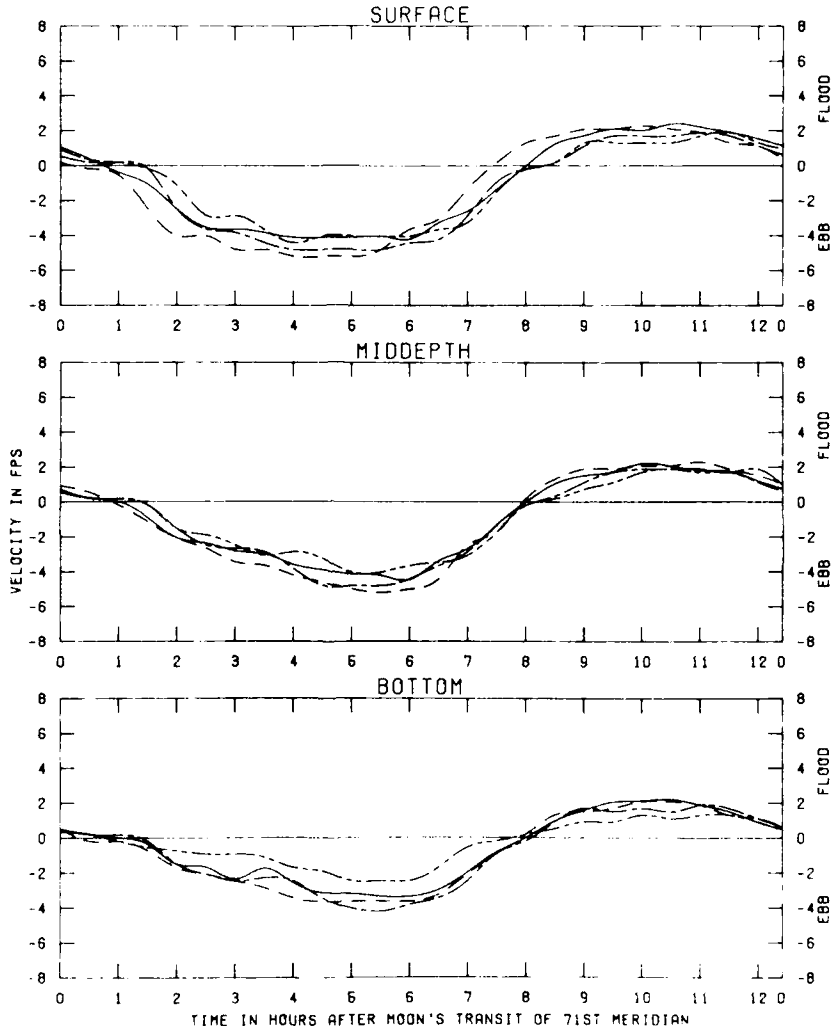
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON VELOCITIES

STATION
38



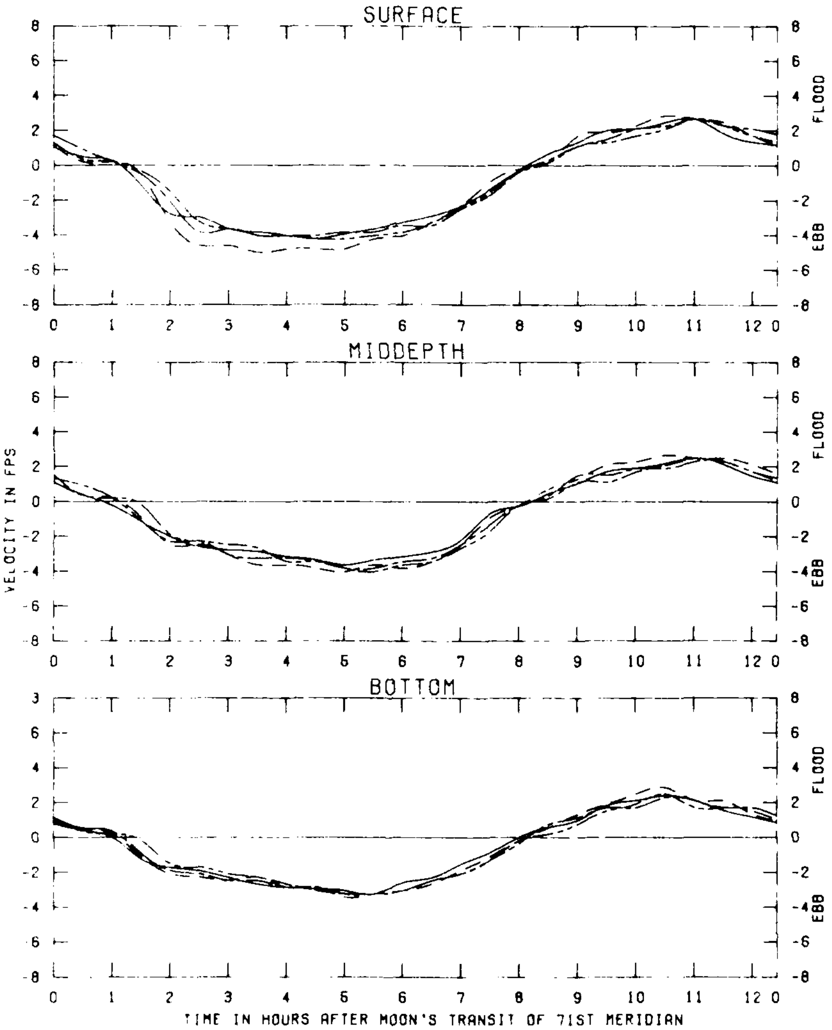
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	5000	CFS

EFFECTS OF
PLANS 3E, BE AND BX
ON VELOCITIES

STATION
18B

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX



TEST CONDITIONS

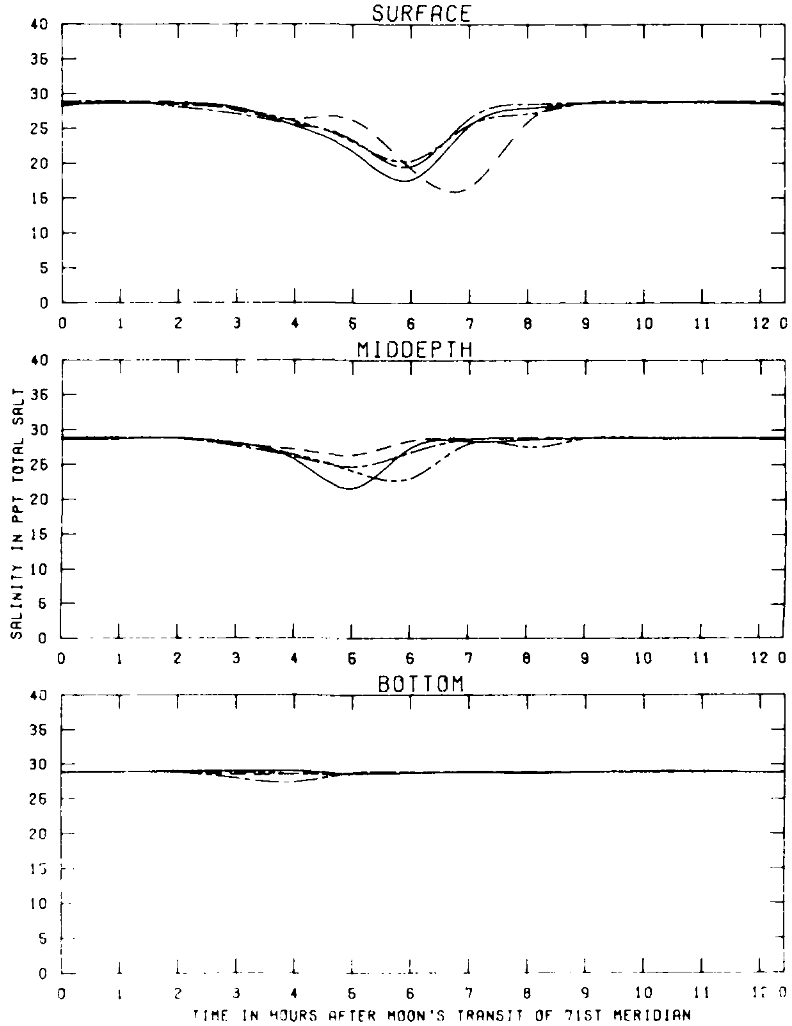
TIDE RANGE AT GAGE 1 (PIT)	9.6	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	6000	CFS

LEGEND

BASE ——
PLAN 3E -- — --
PLAN BE ------
PLAN BX -·-·-·-

EFFECTS OF PLANS 3E, BE AND BX ON VELOCITIES

STATION 20B



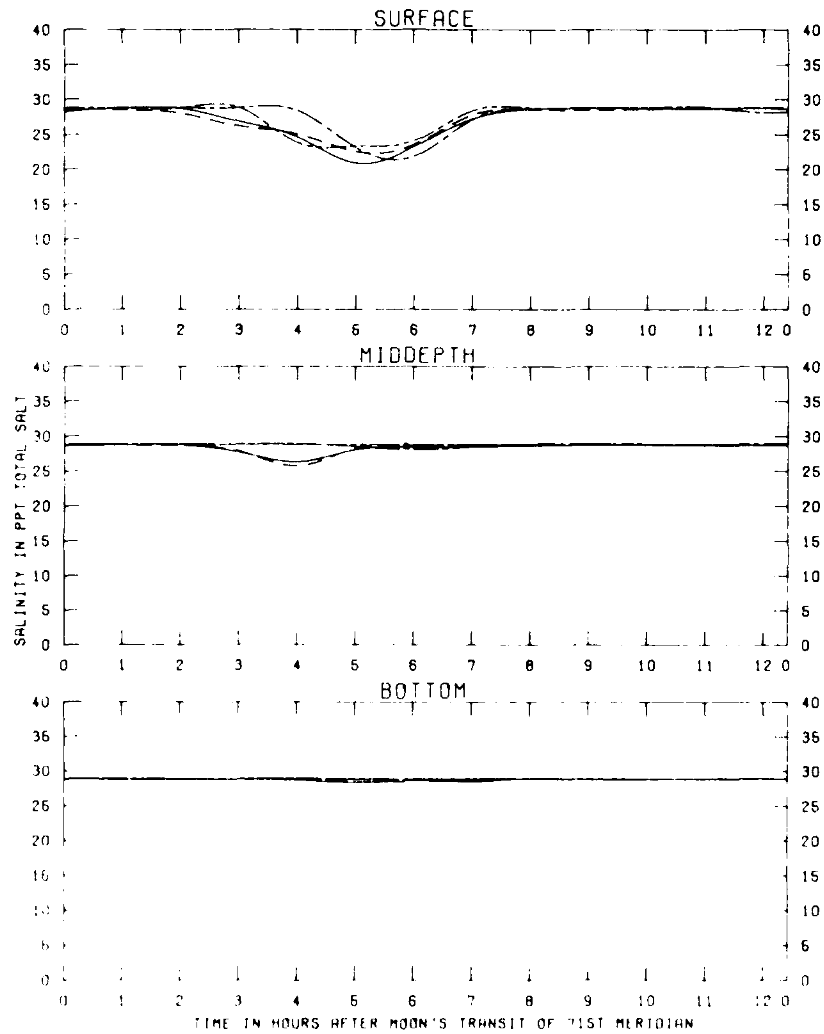
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON SALINITIES

STATION
OA



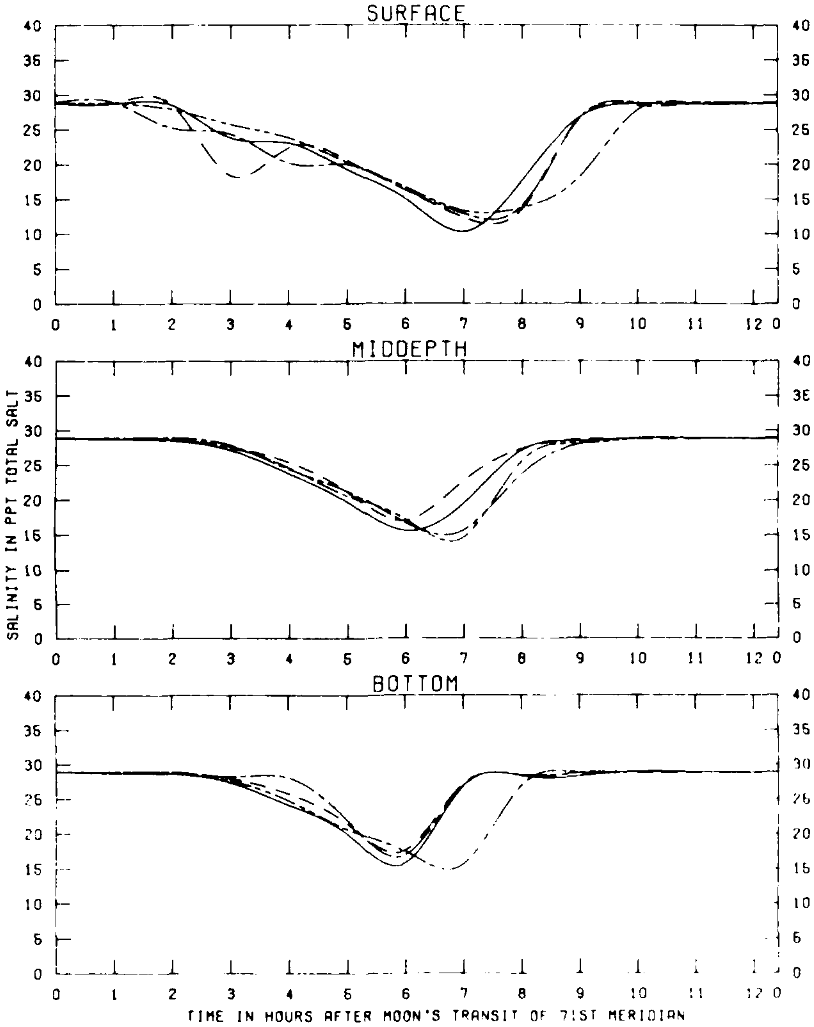
TEST CONDITIONS

TIDE RANGE AT DAUE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX

EFFECTS OF
PLANS 3E, BE AND BX
ON SALINITIES

STATION
08

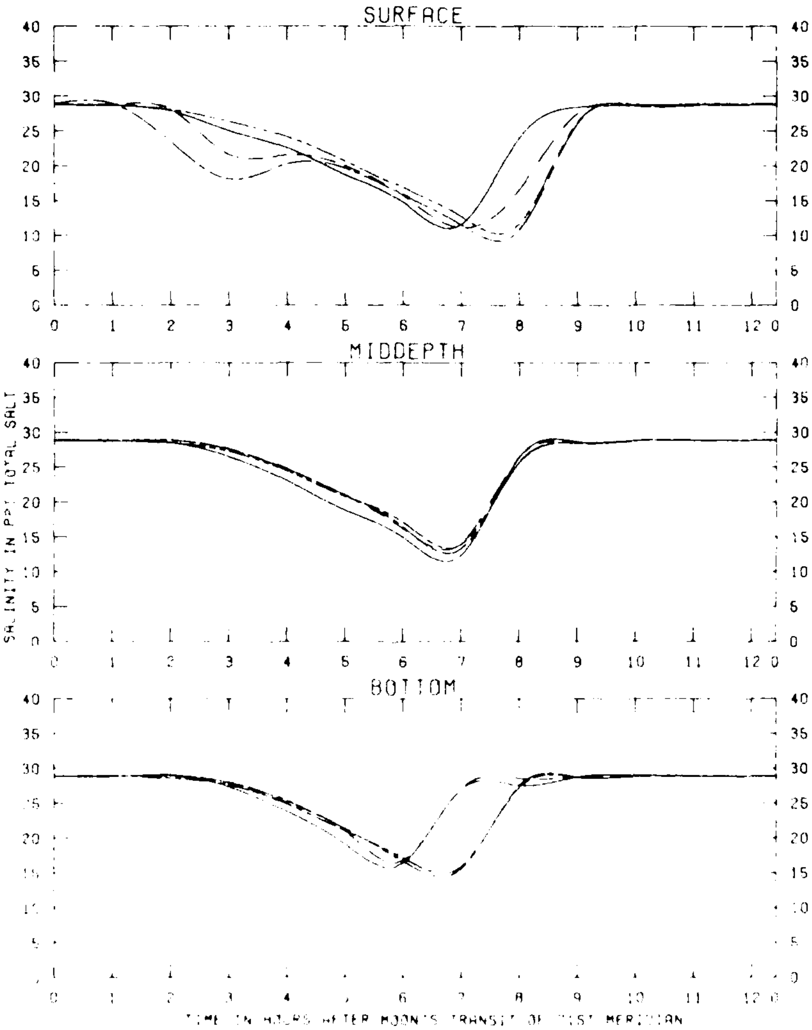


TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON SALINITIES
STATION
3A



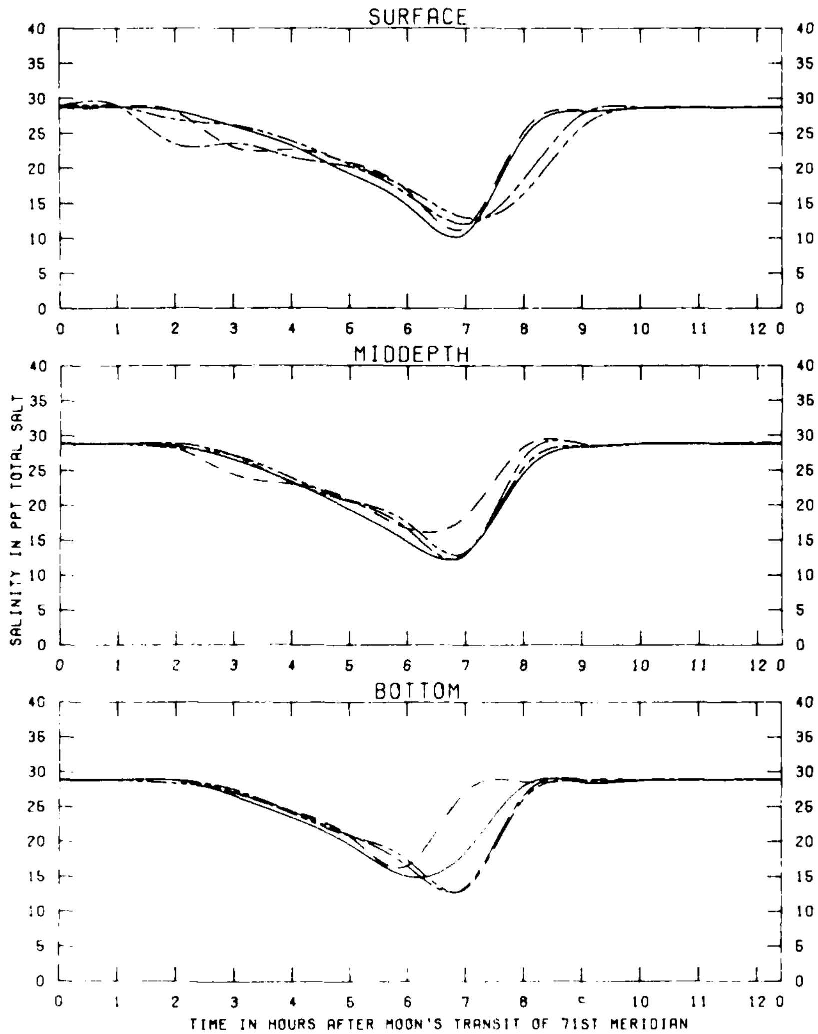
TEST CONDITIONS

TIDE RANGE AT GAGE 1 ... 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX

EFFECTS OF
PLANS 3E, BE AND BX
ON SALINITIES

STATION
3A



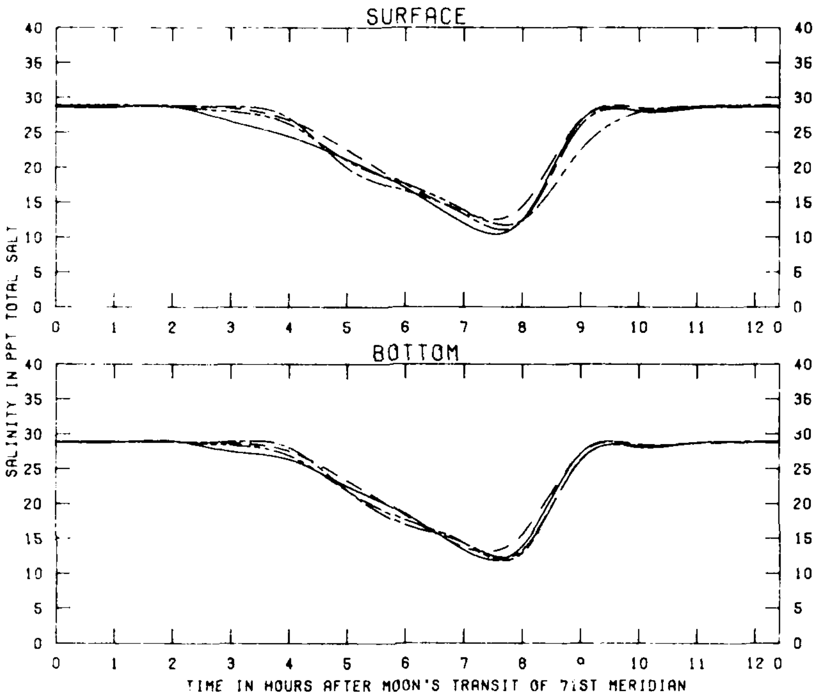
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX

EFFECTS OF
PLANS 3E, BE AND BX
ON SALINITIES

STATION
3C



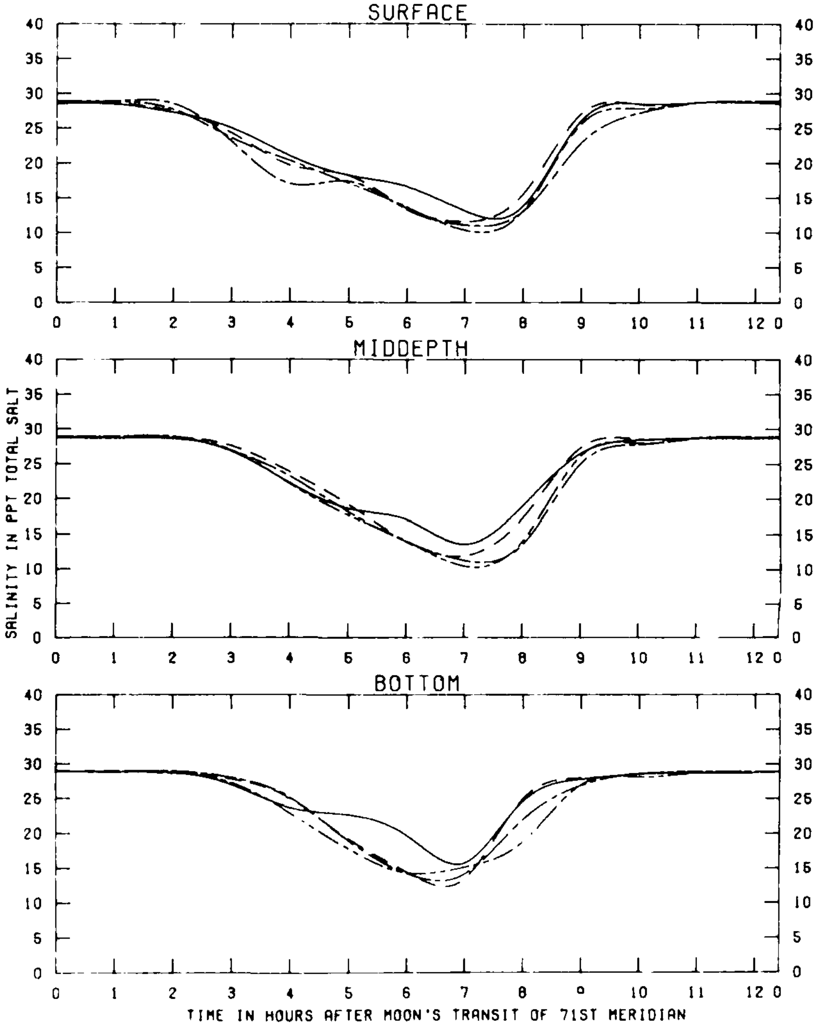
TEST CONDITIONS

TIDE RANGE AT DADE 1 (PIT)	9.6	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	6000	CFS

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX

EFFECTS OF
PLANS 3E, BE AND BX
ON SALINITIES

STATION
6A



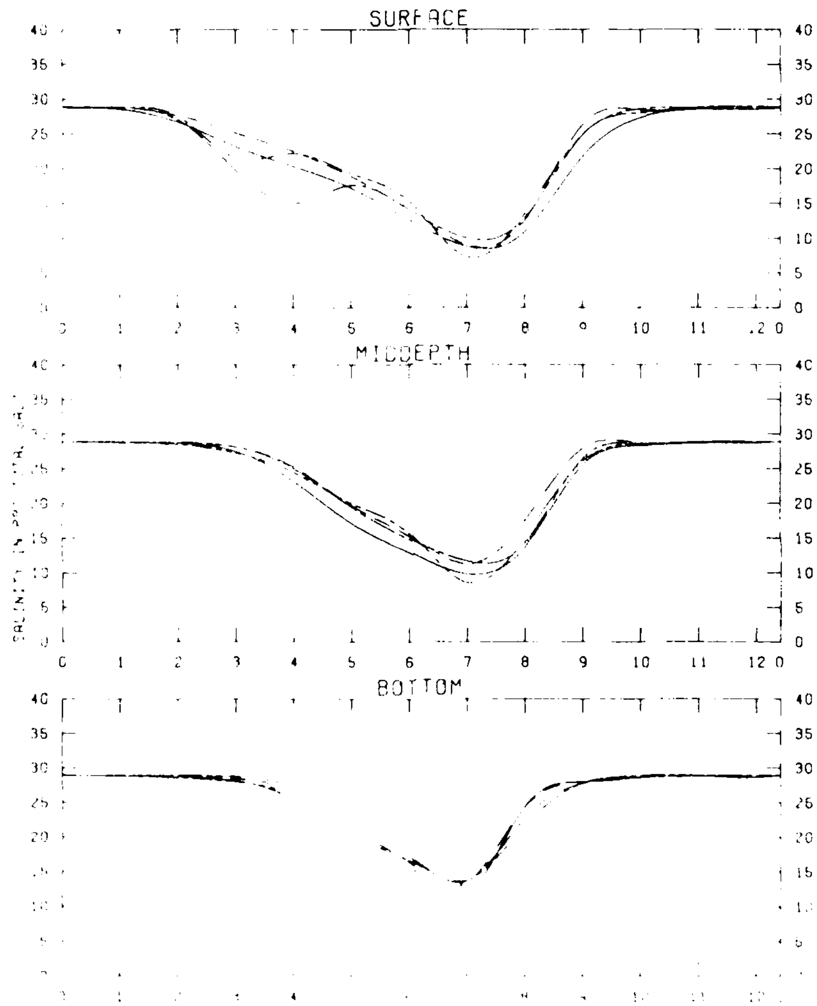
TEST CONDITIONS

TIDE RANGE AT DADE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF PLANS 3E, 8E AND 8X ON SALINITIES

STATION 58

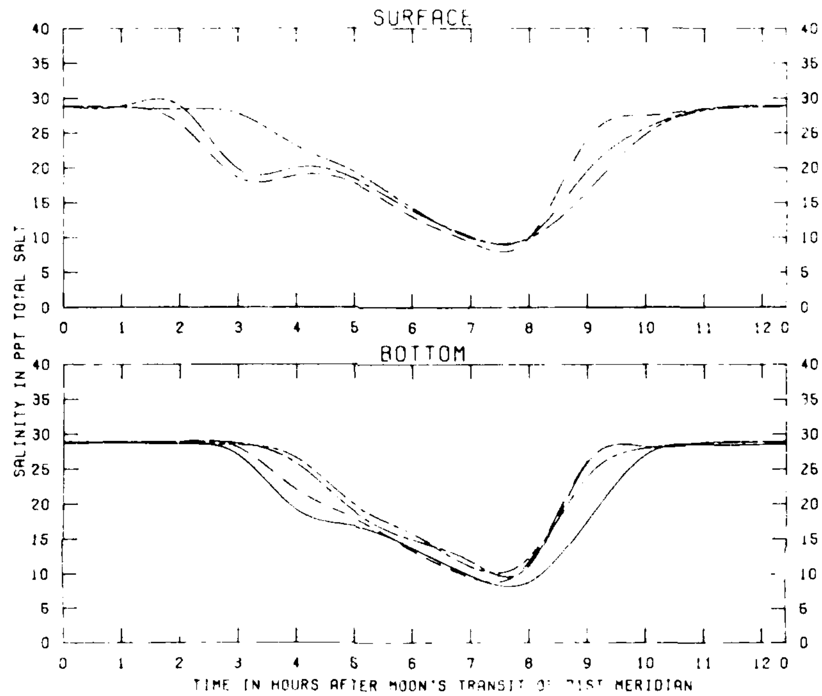


TIDE RANGE
MEAN SALINITY
FRESHWATER INFLOW

STATION

BASE
PLAN
PLAN
PLAN

PLATE 249



TEST CONDITIONS

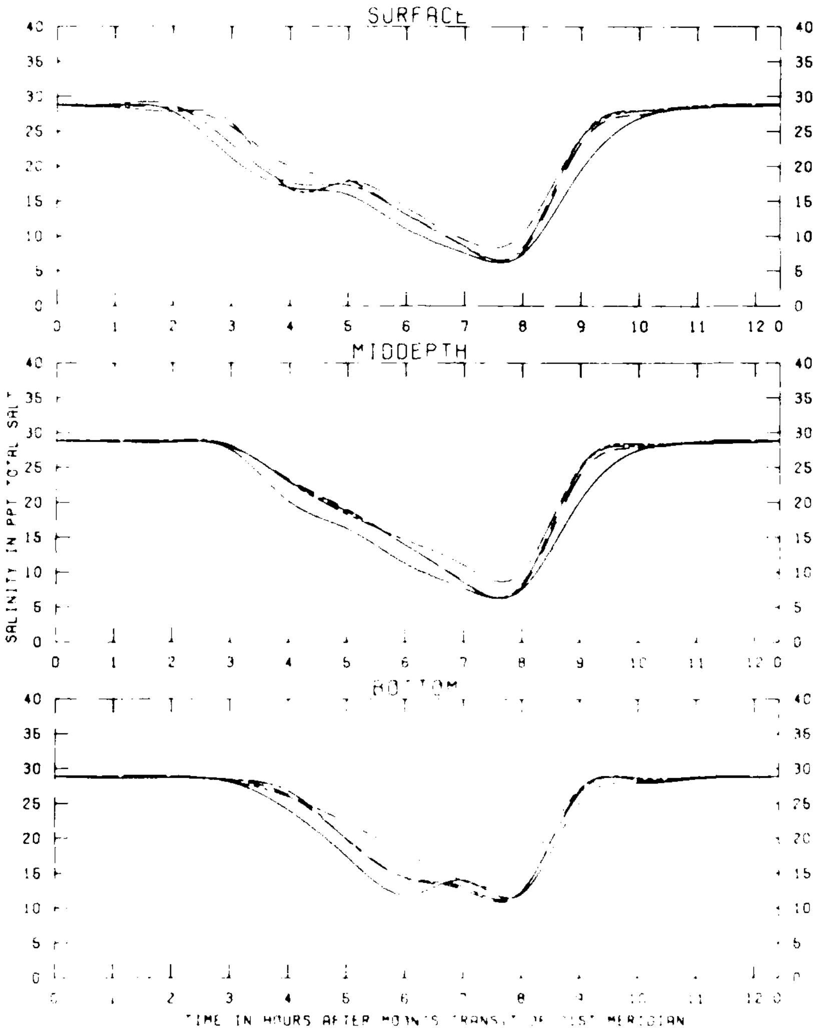
TIDE RANGE AT GAGE 1 (PIT)	9.6	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	5000	CFS

LEGEND

BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON SALINITIES

STATION
6A



TEST CONDITIONS

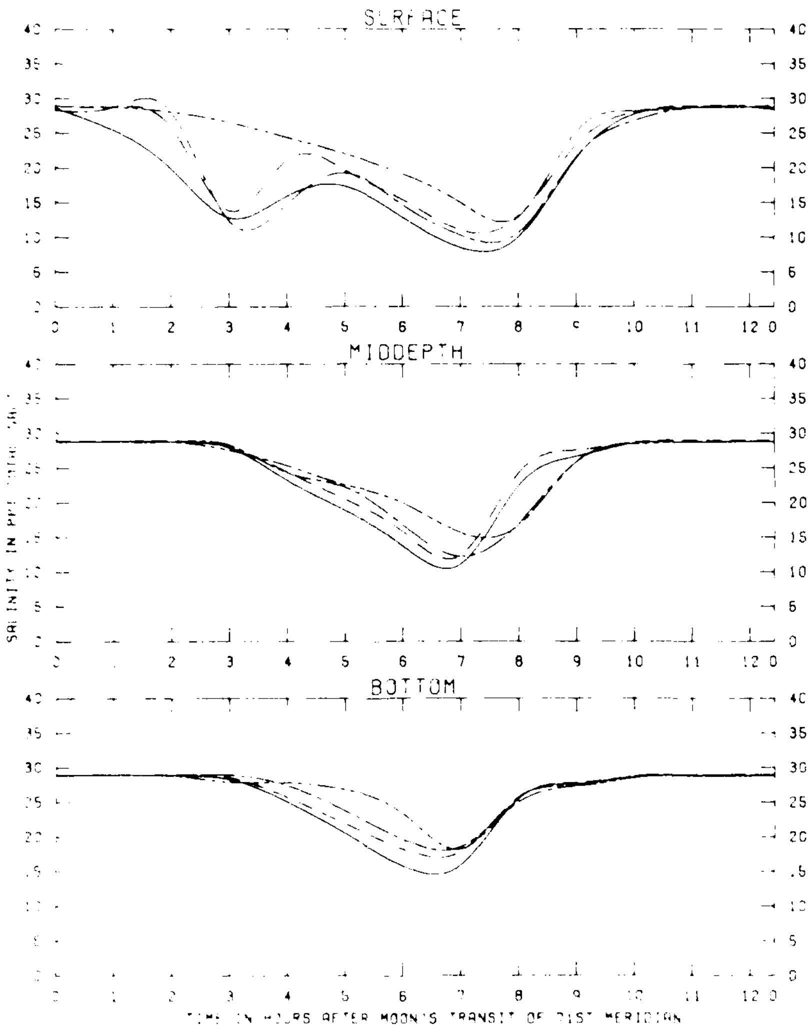
TIDE RANGE AT GAGE 1 (PT)	9.0 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

EFFECTS OF
PLANS 3E, 8E, AND 8X
ON SALINITIES

STATION
68

LEGEND

BASE
PLAN 3E
PLAN 8E
PLAN 8X



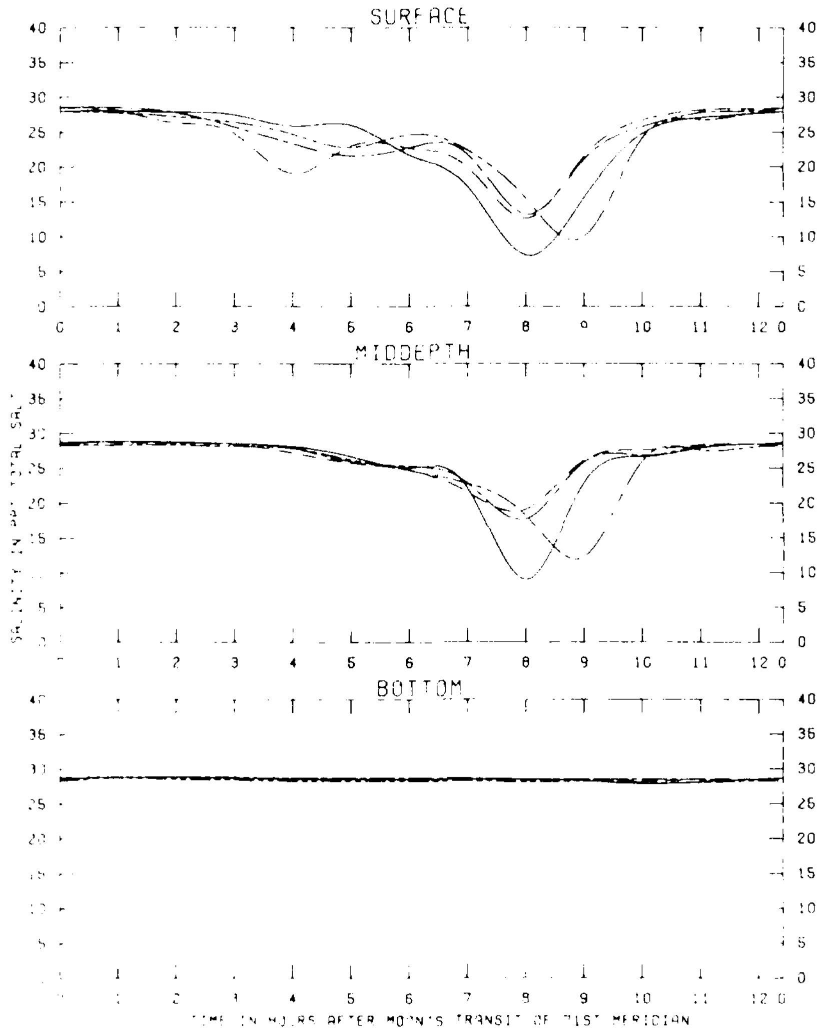
TEST CONDITIONS

TIDE RANGE AT GAGE [illegible]	9.6 FT
MEAN SALINITY, TOTAL SALT	29.0 PPT
FRESHWATER INFLOW	5000 CFS

EFFECTS OF
PLANS [illegible], BE AND B[illegible]
ON SALINITIES

STATION
6[illegible]

LEGEND
BASE
PLAN [illegible]
PLAN BE
PLAN B[illegible]



TEST CONDITIONS

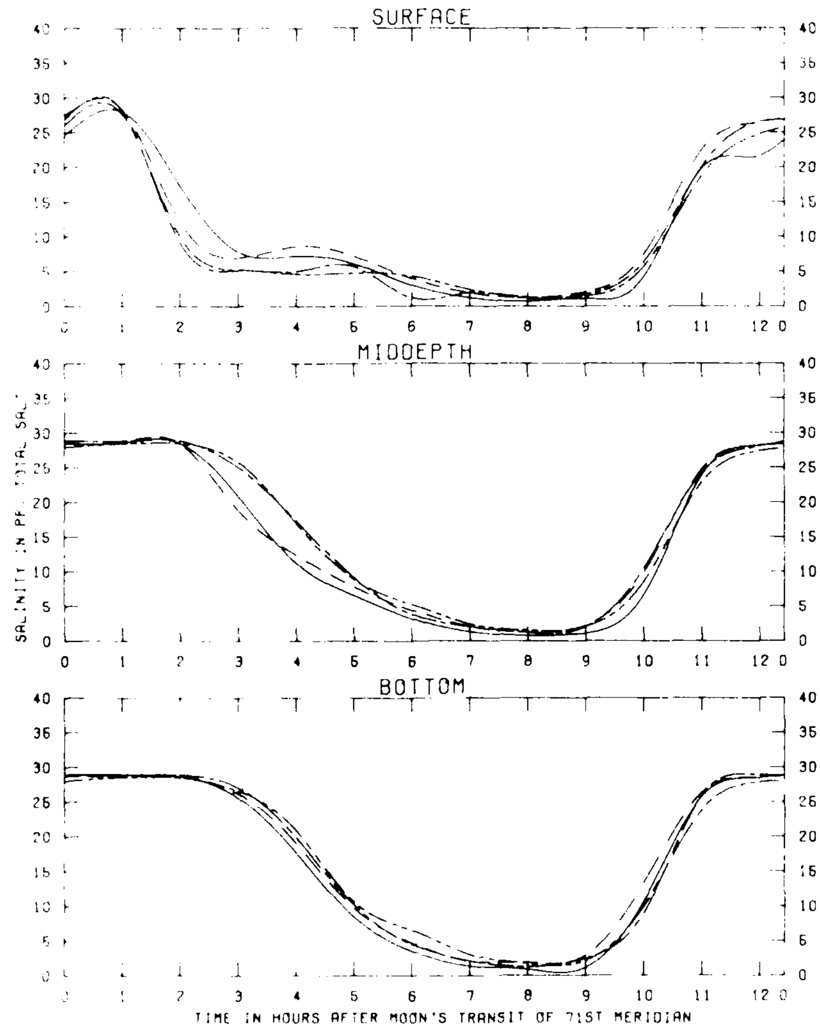
TIDE RANGE AT BASE (...)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3F
PLAN 8F
PLAN 8X

EFFECTS OF
PLANS 3F, 8F AND 8X
ON SALINITIES

STATION
AA

PLATE 253



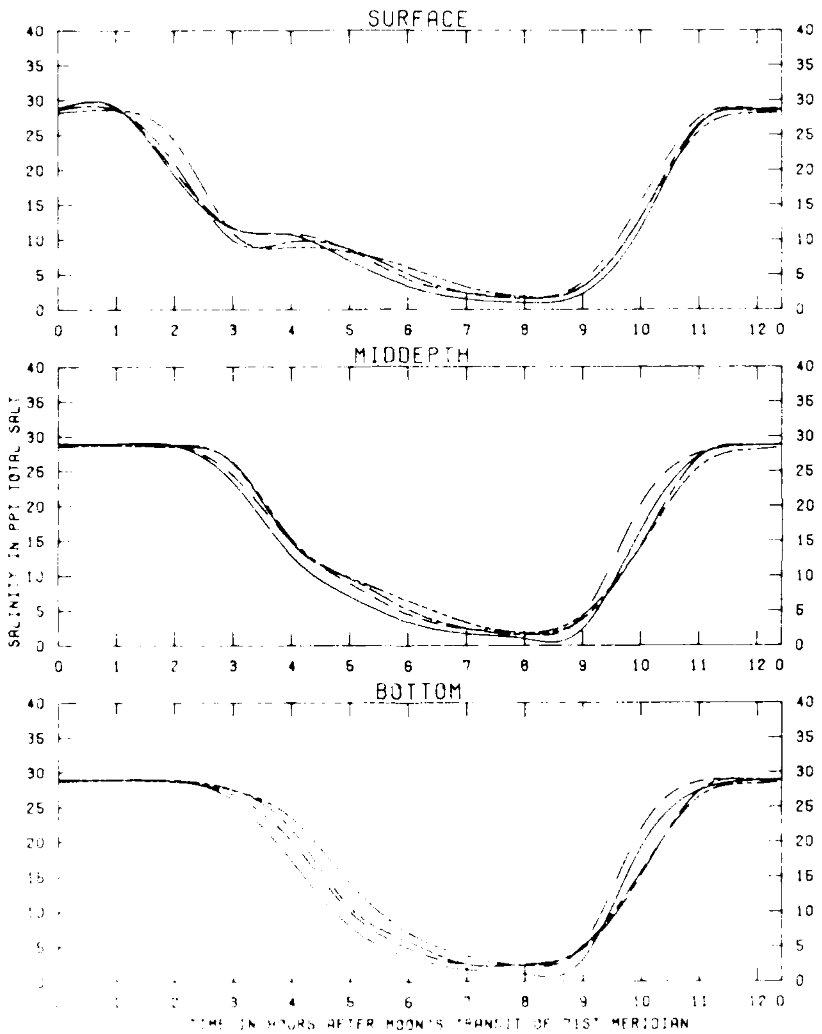
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8Y

EFFECTS OF
PLANS 3E,8E AND 8Y
ON SALINITIES

STATION
208

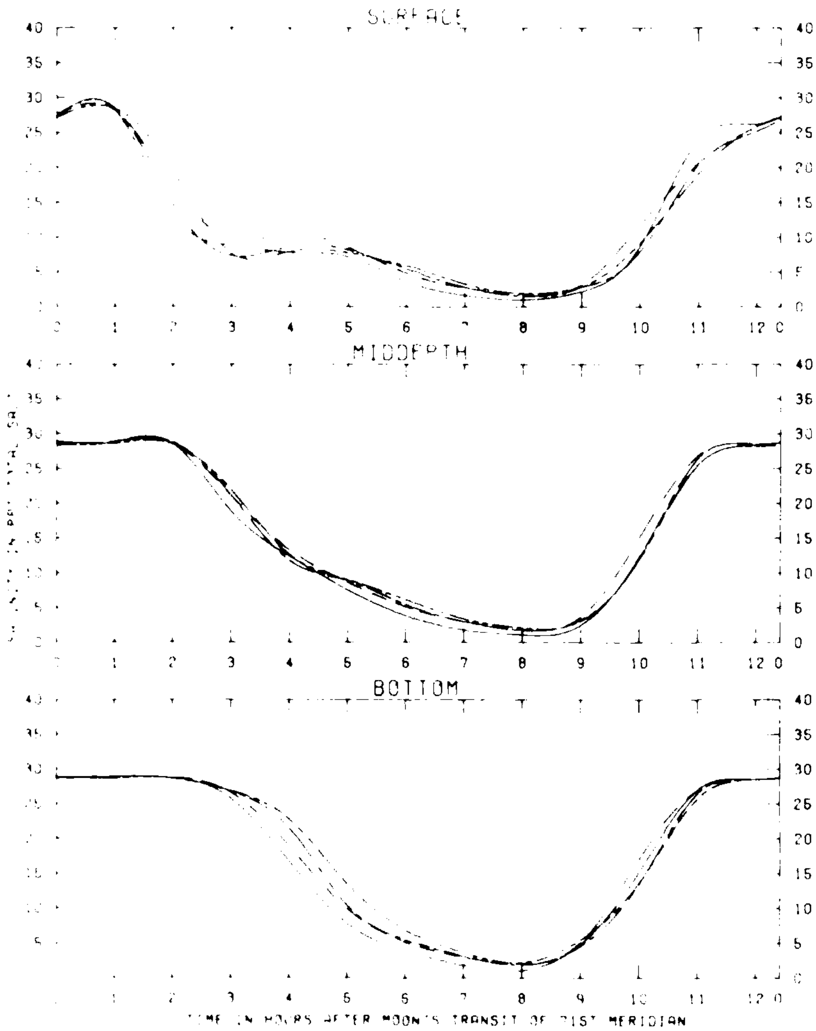


TEST CONDITIONS
TIDE RANGE AT GAGE 1 (PT1) 3.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

EFFECTS OF
PLANS 3F, 8F AND 8X
ON SALINITIES

STATION
88

LEGEND
BASE
PLAN 3F
PLAN 8F
PLAN 8X



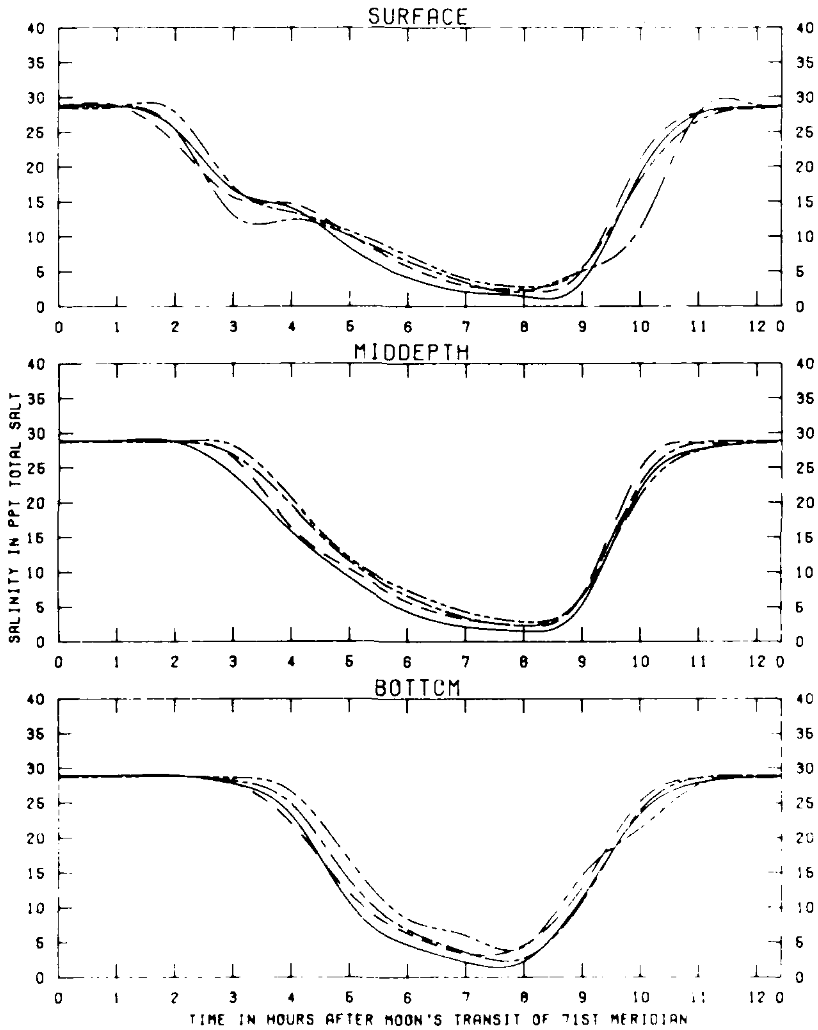
TEST CONDITIONS
[illegible] 9.6 FT
[illegible] 29.[illegible] PPT
FRESHWATER INFLOW 5000 CFS

EFFECTS OF
[illegible]
ON SALINITIES

STATION
[illegible]

LEGEND
BASE
PLAN [illegible]
PLAN [illegible]
PLAN [illegible]

PLATE 265

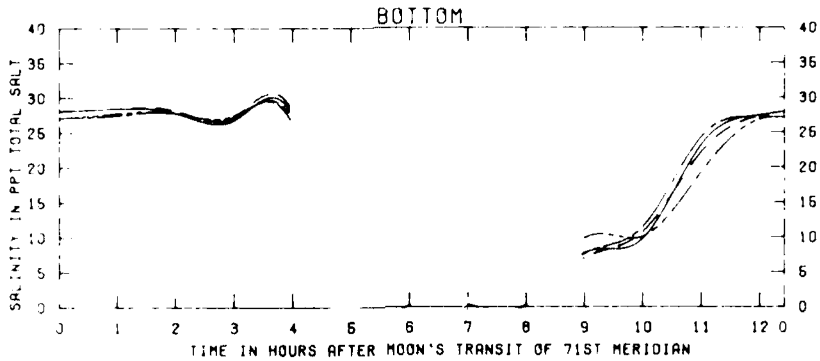


TEST CONDITIONS
TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON SALINITIES

STATION
160



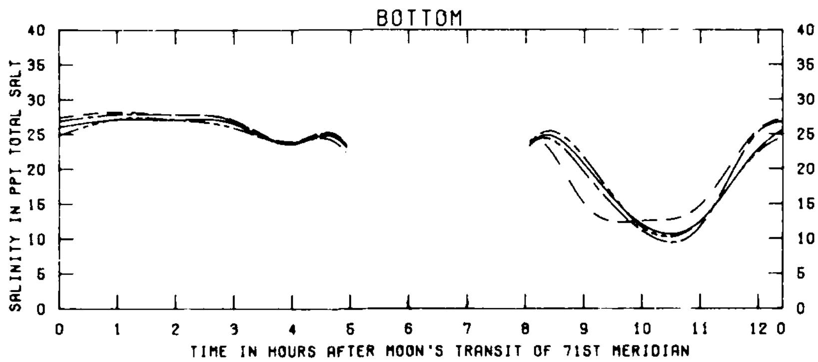
TEST CONDITIONS

TIDE RANGE AT OADE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON SALINITIES

STATION
168



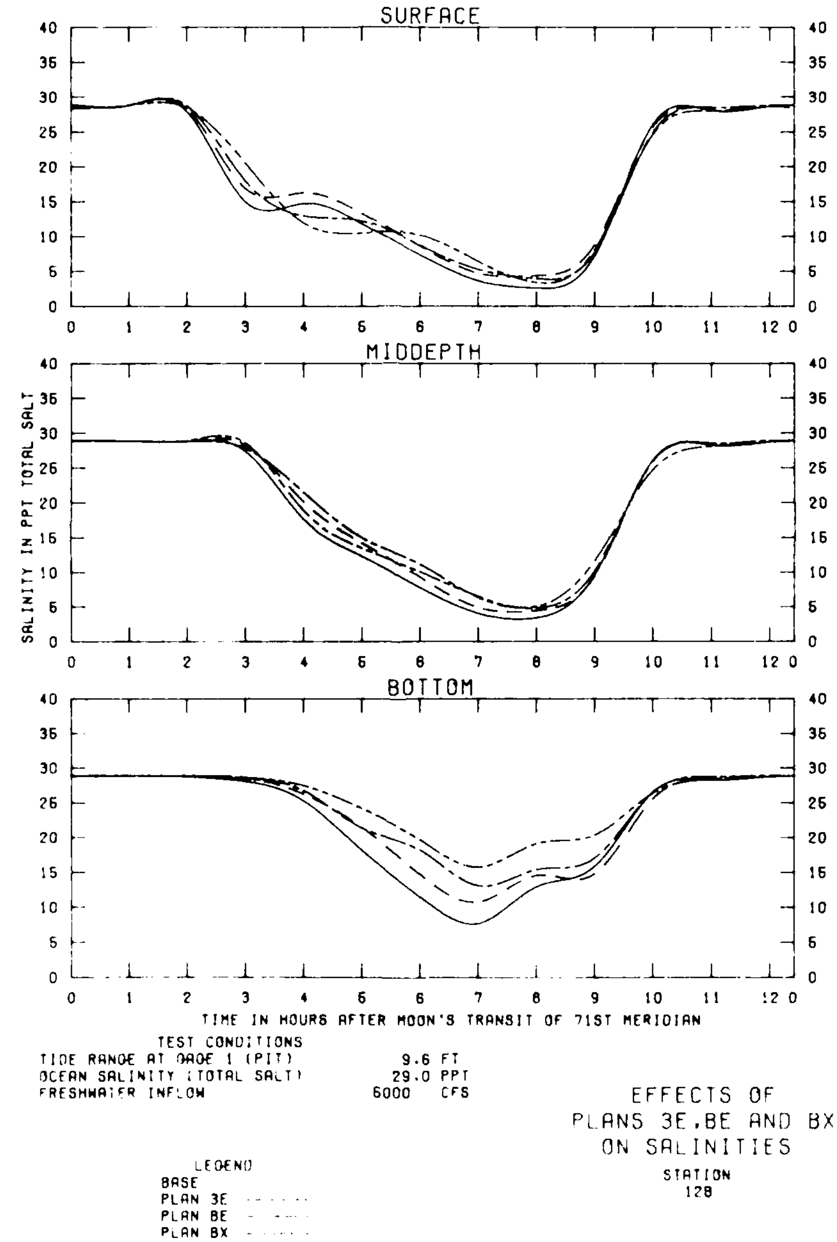
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

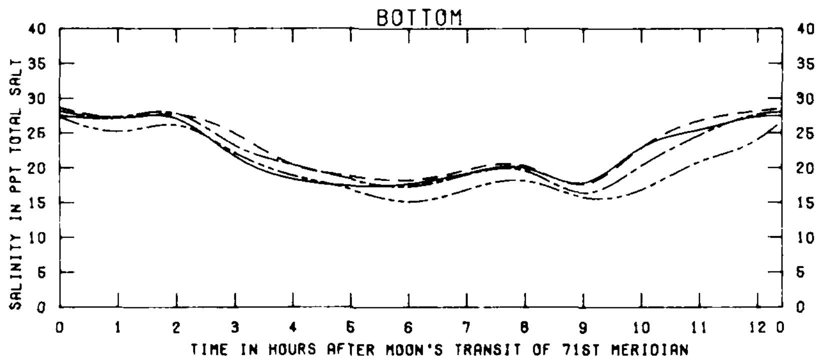
EFFECTS OF
PLANS 3E,8E AND 8X
ON SALINITIES

STATION
16A



EFFECTS OF
PLANS 3E, BE AND BX
ON SALINITIES

STATION
128



TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	28.0 PPT
FRESHWATER INFLOW	6000 CFS

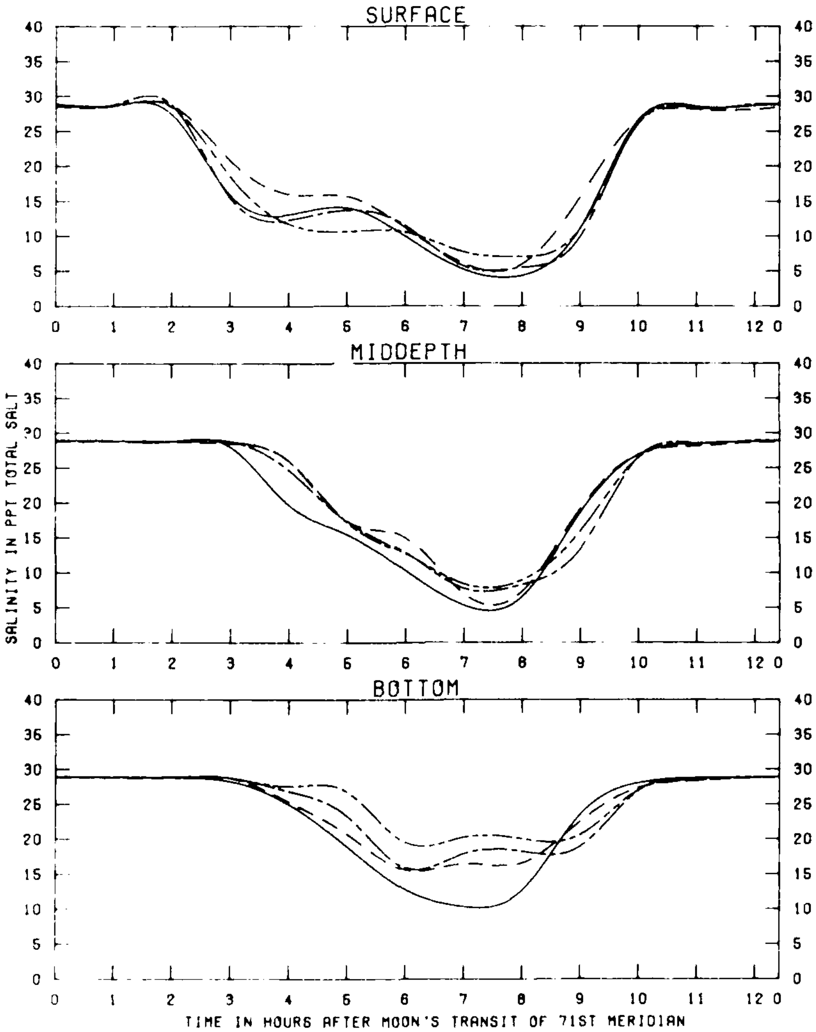
LEGEND

BASE
PLAN 3F
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3F, 8F AND 8X
ON SALINITIES

STATION
12A

PLATE



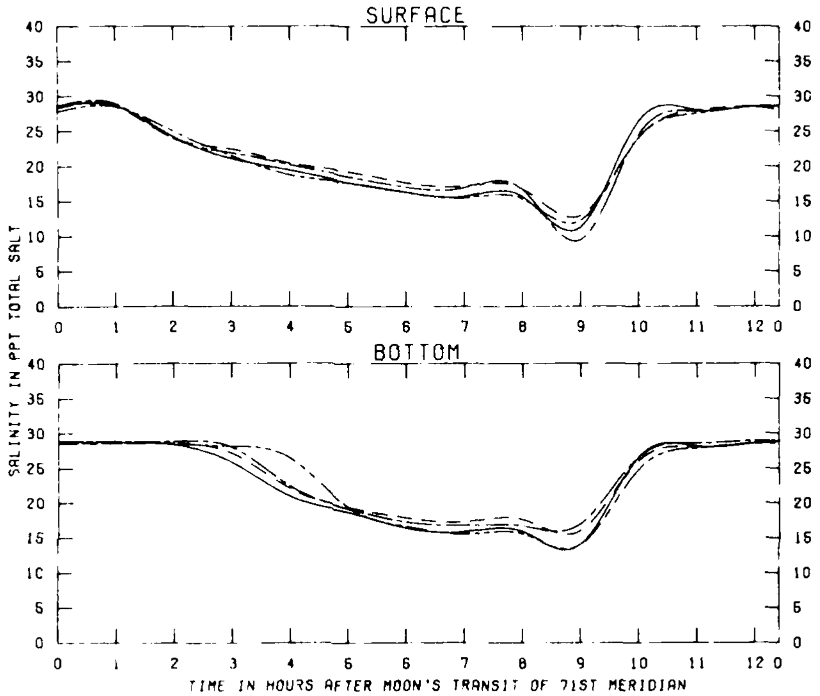
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT) 9.6 FT
OCEAN SALINITY (TOTAL SALT) 29.0 PPT
FRESHWATER INFLOW 5000 CFS

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX

EFFECTS OF
PLANS 3E, BE AND BX
ON SALINITIES

STATION
10C



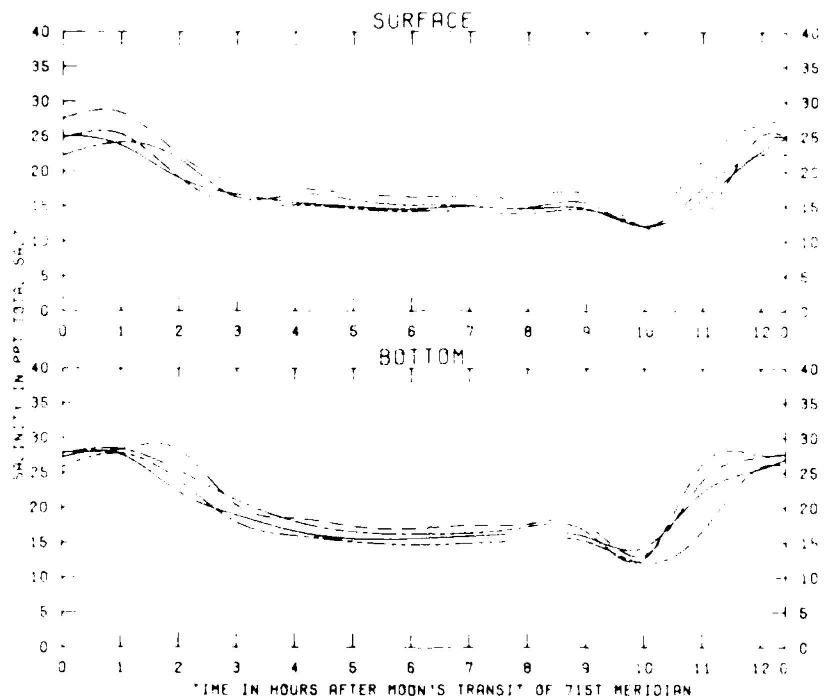
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON SALINITIES

STATION
10B



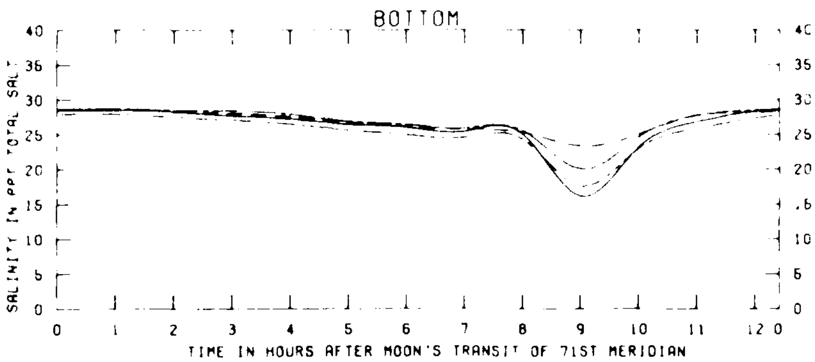
TEST CONDITIONS

TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON SALINITIES

STATION
[illegible]A



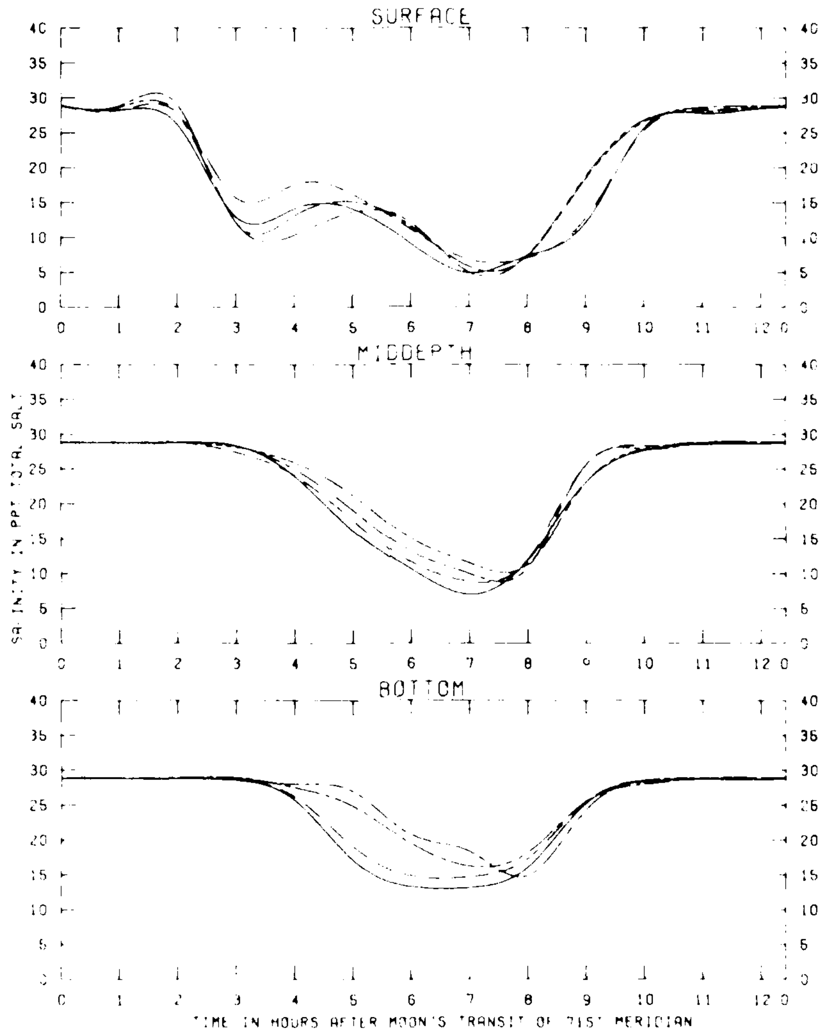
TEST CONDITIONS

TIDE RANGE AT DADE L (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	6000 CFS

LEGEND
BASE
PLAN 3E
PLAN 8E
PLAN 8X

EFFECTS OF
PLANS 3E, 8E AND 8X
ON SALINITIES

STATION
8C

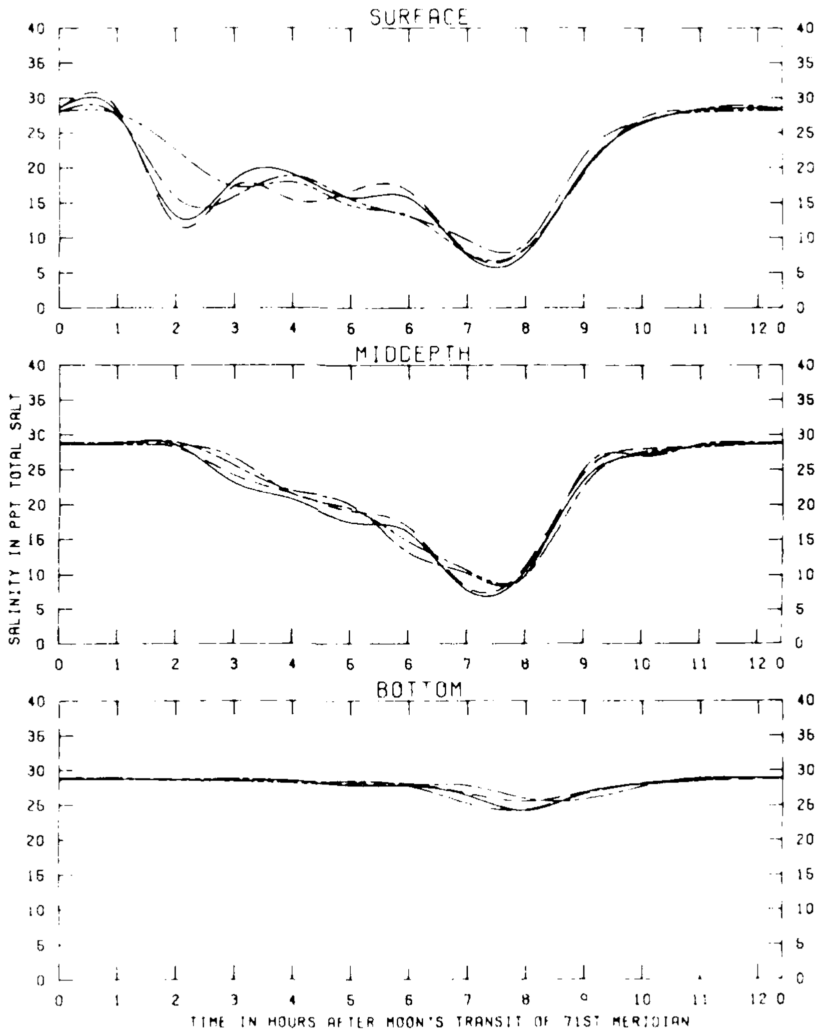


TEST CONDITIONS

TIDE RANGE AT DADE I (PT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX

EFFECTS OF
PLANS 3E, BE AND BX
ON SALINITIES
STATION
BC



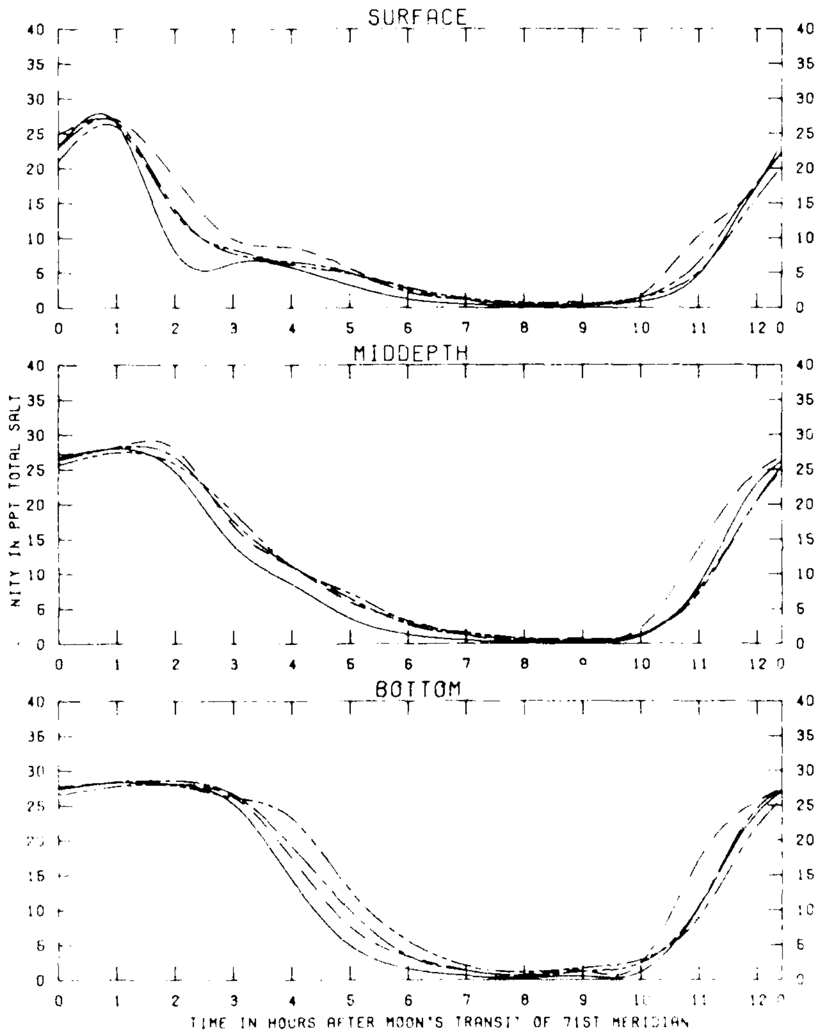
TEST CONDITIONS

TIDE RANGE AT DAGE I (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX

EFFECTS OF
PLANS 3E, BE AND BX
ON SALINITIES

STATION
8B



TEST CONDITIONS

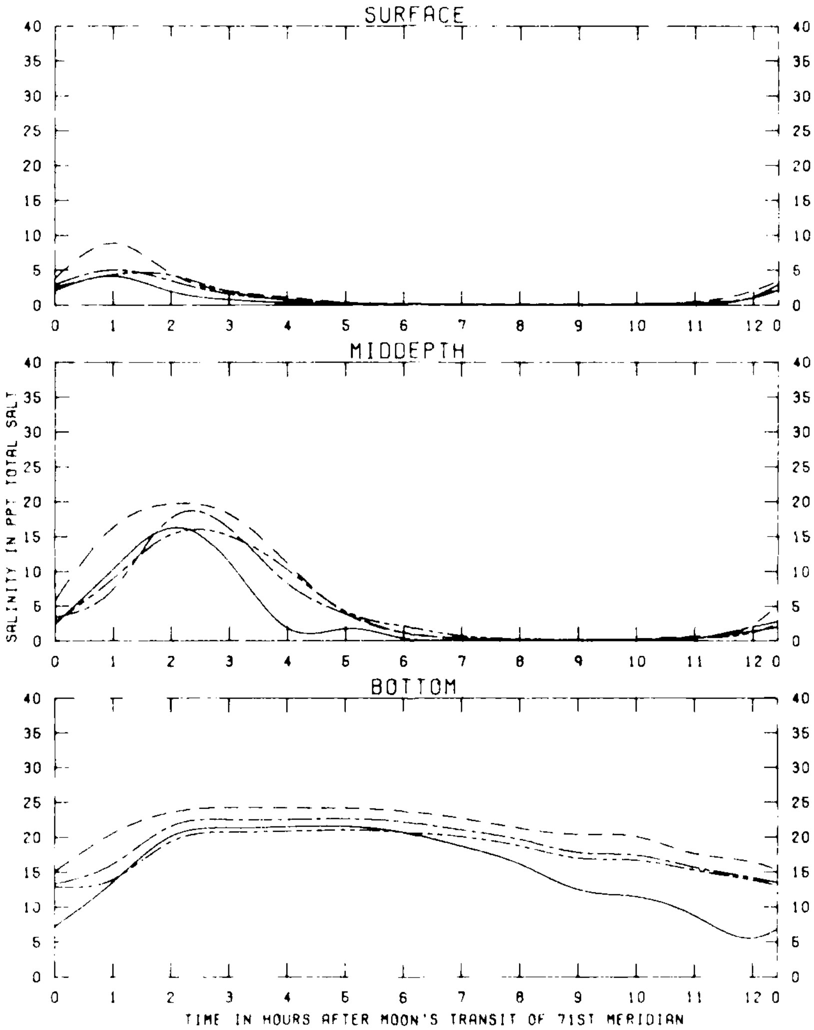
TIDE RANGE AT GAGE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND
BASE
PLAN 3E
PLAN BF
PLAN 8X

EFFECTS OF
PLANS 3F, BE AND BX
ON SALINITIES

STATION
26A

PLATE 268



TEST CONDITIONS

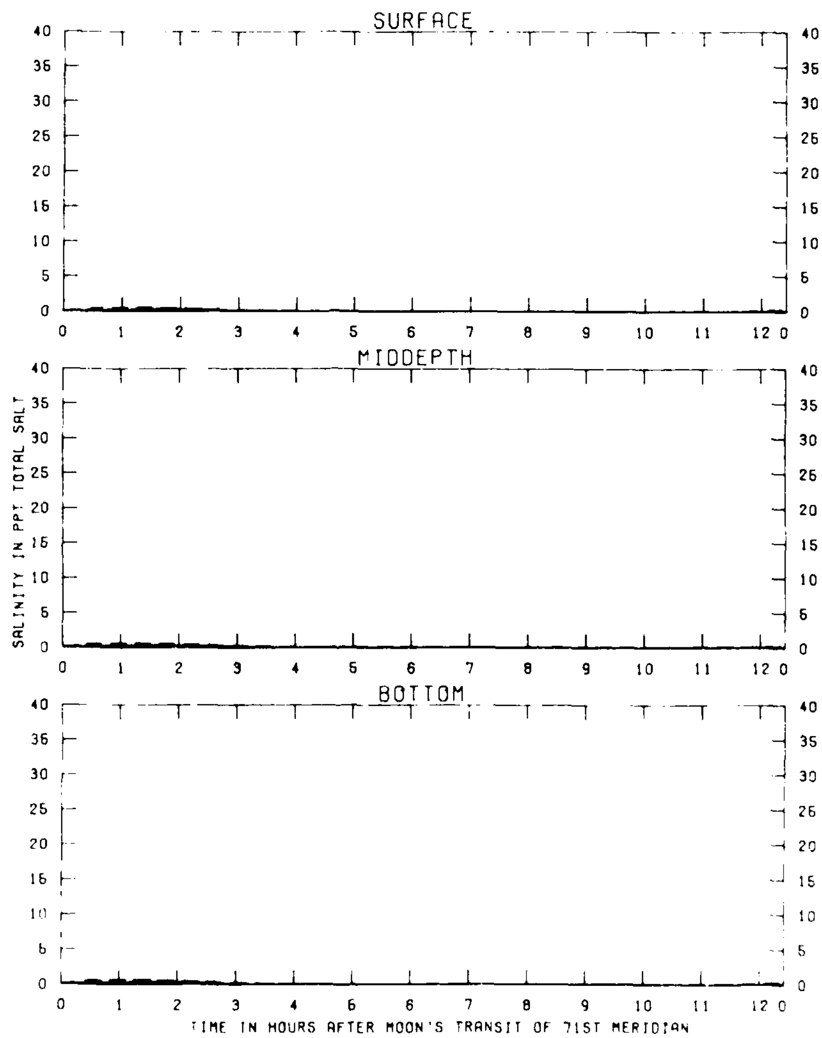
TIDE RANGE AT DADE 1 (PIT)	9.6 FT
OCEAN SALINITY (TOTAL SALT)	29.0 PPT
FRESHWATER INFLOW	5000 CFS

LEGEND

BASE
PLAN 3E
PLAN BE
PLAN BX

EFFECTS OF
PLANS 3E, BE AND BX
ON SALINITIES

STATION
38A



TEST CONDITIONS

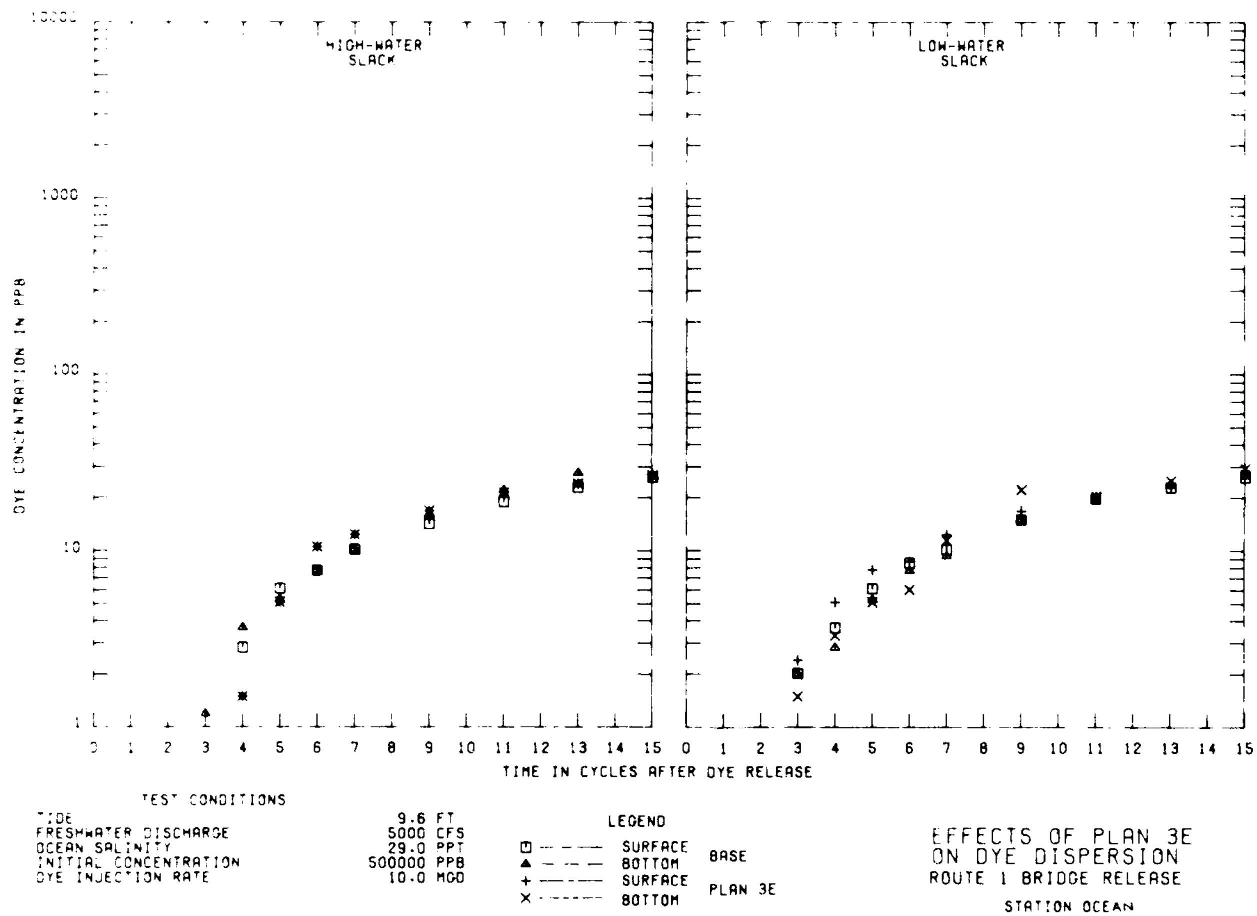
TIDE RANGE AT GAGE 1 (PIT)	9.6	FT
OCEAN SALINITY (TOTAL SALT)	29.0	PPT
FRESHWATER INFLOW	5000	CFS

LEGEND
BASE
PLAN 3E
PLAN BE
PLAN BX

EFFECTS OF
PLANS 3E,BE AND BX
ON SALINITIES

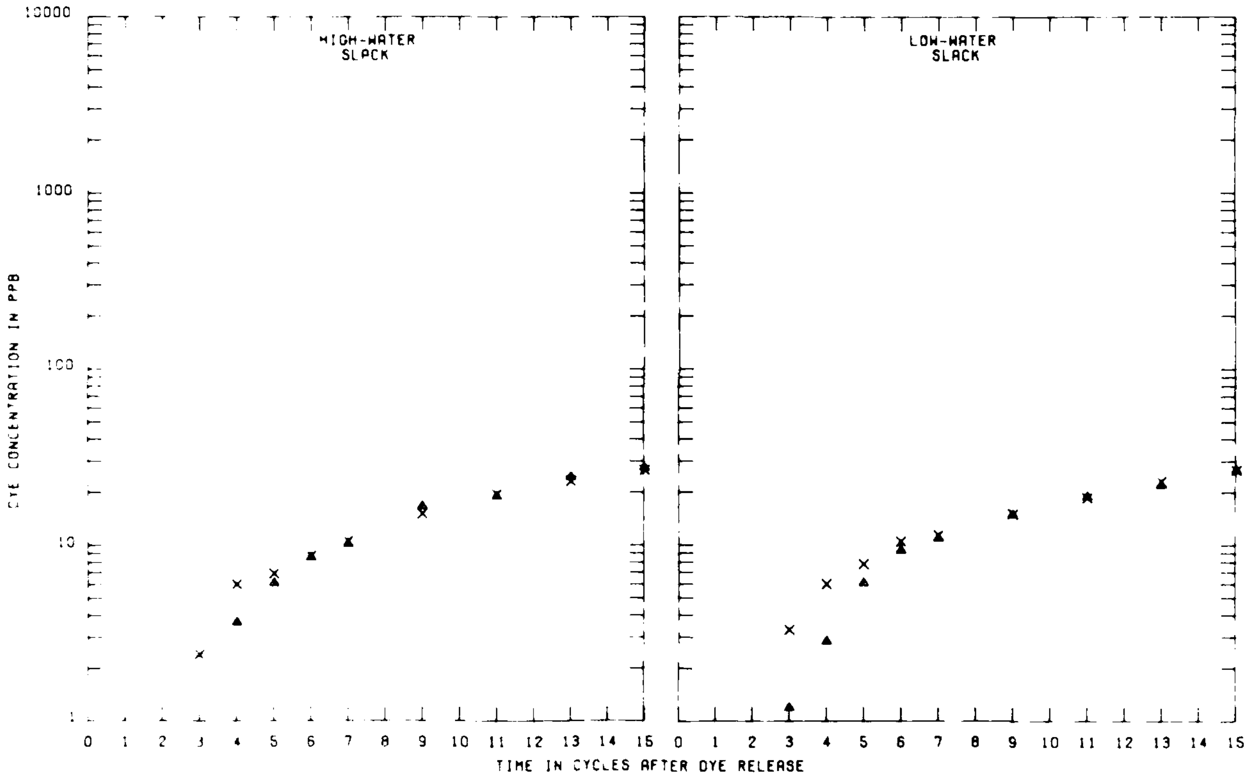
STATION
50A

PLATE 270



EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION OCEAN



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOO

LEGEND

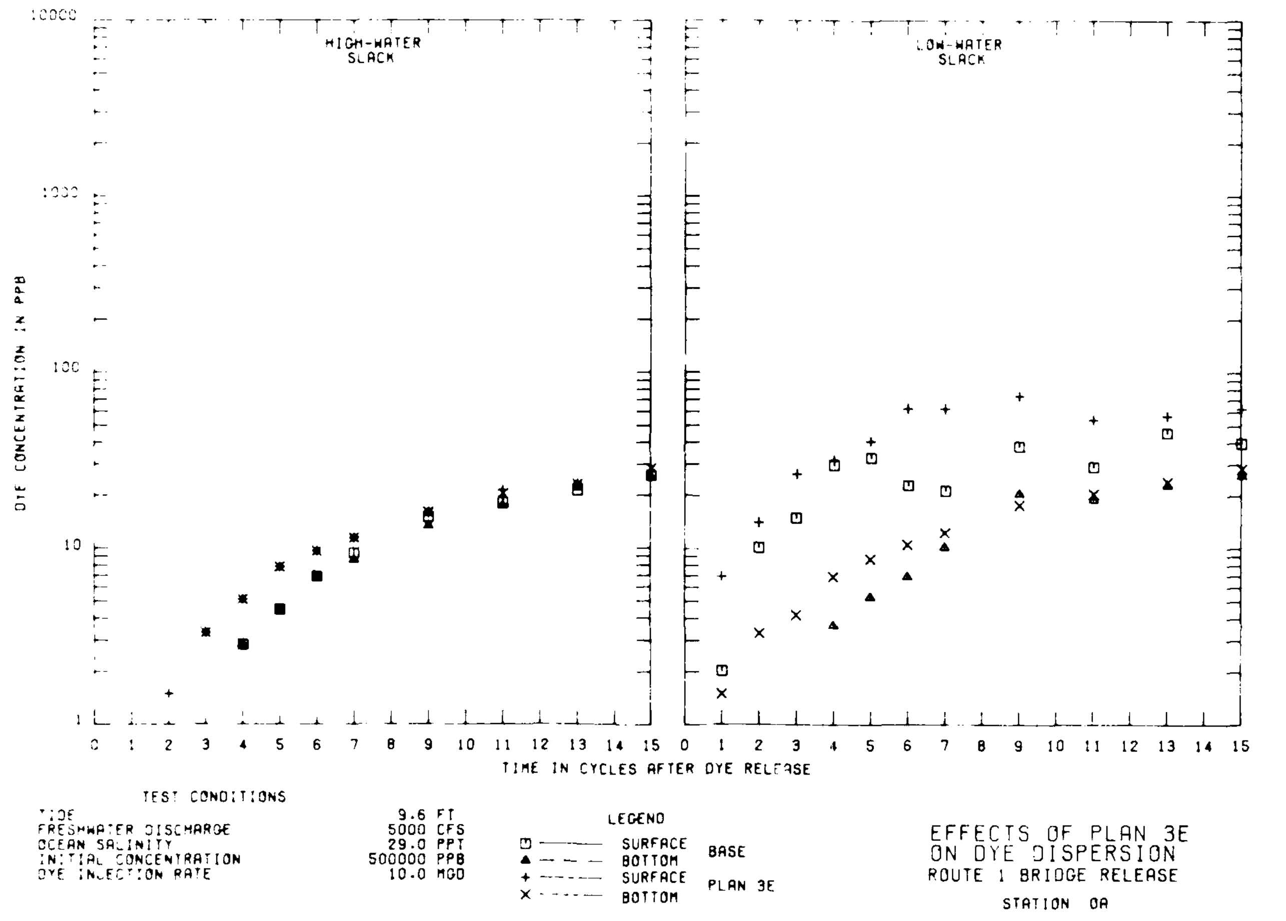
▲ — — — BOTTOM BASE

× —·—·— BOTTOM PLAN 3E

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION SUMP

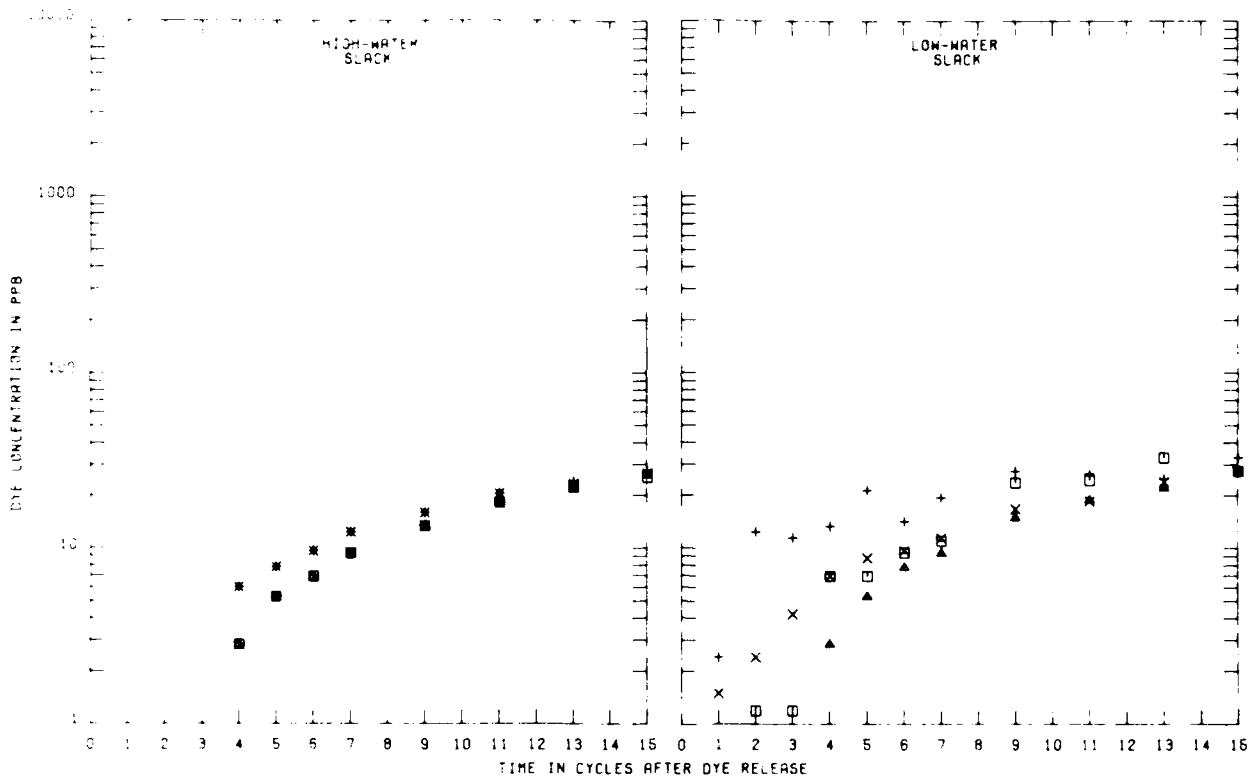
PLATE 272



EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION OA

PLATE 273



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

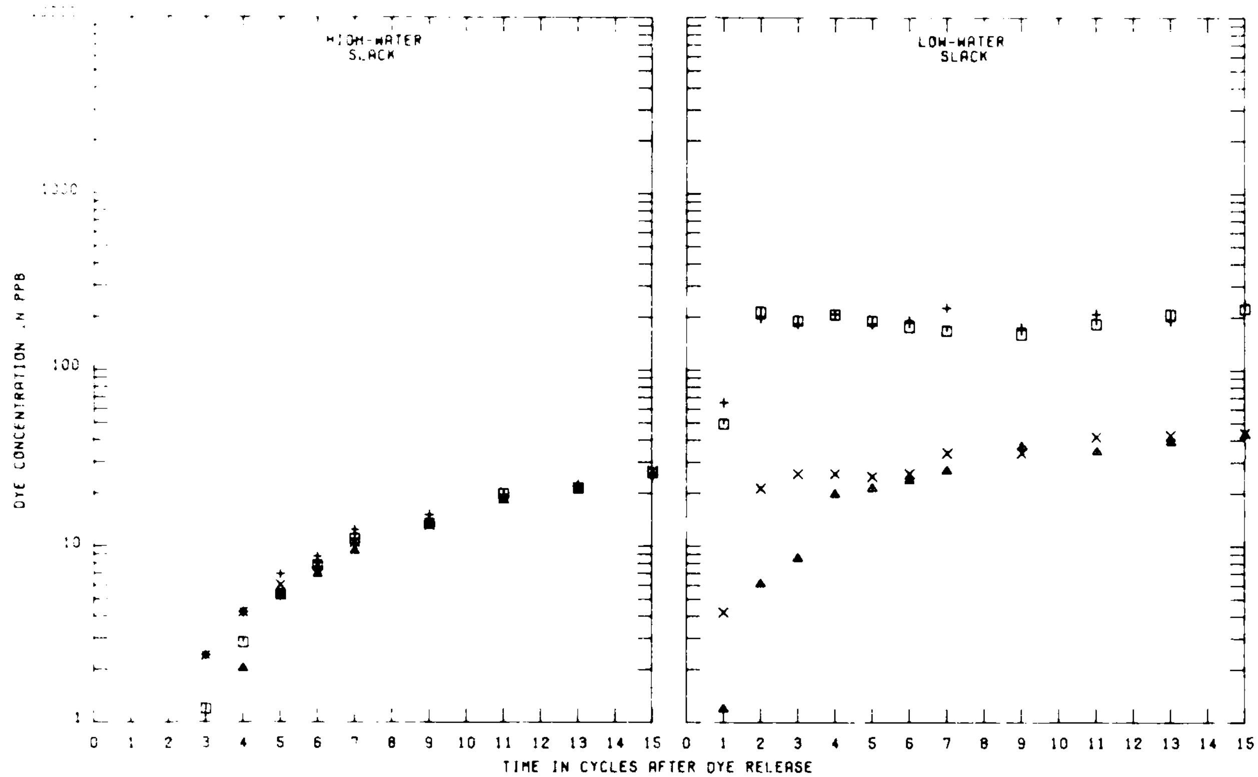
LEGEND

□ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN 3E
× —·····—	BOTTOM	

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 08

PLATE [illegible]74



TEST CONDITIONS

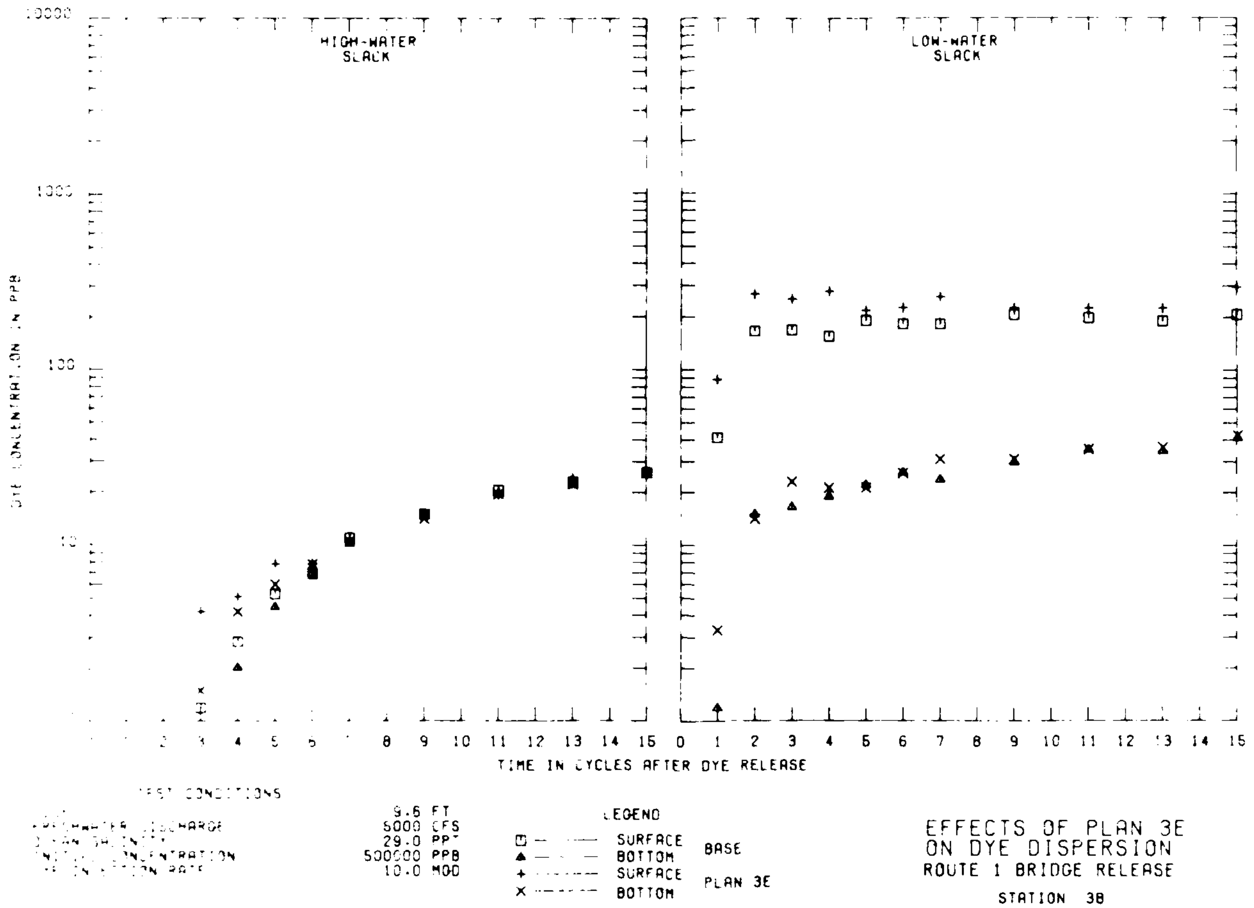
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

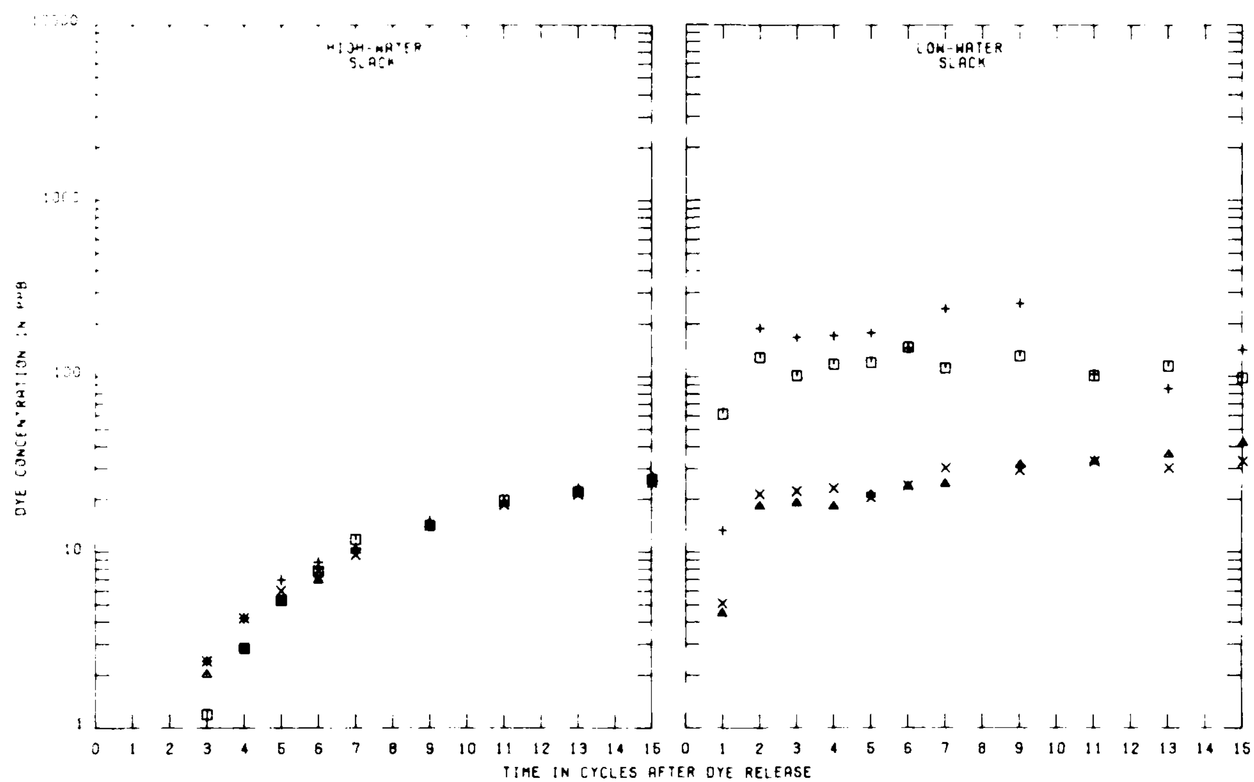
LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN 3E
× —··—··	BOTTOM	

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 3A


HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
9.6 FT
5000 CFS
29.0 PPT
500000 PPB
10.0 MOD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3E
EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 3B



TEST CONDITIONS

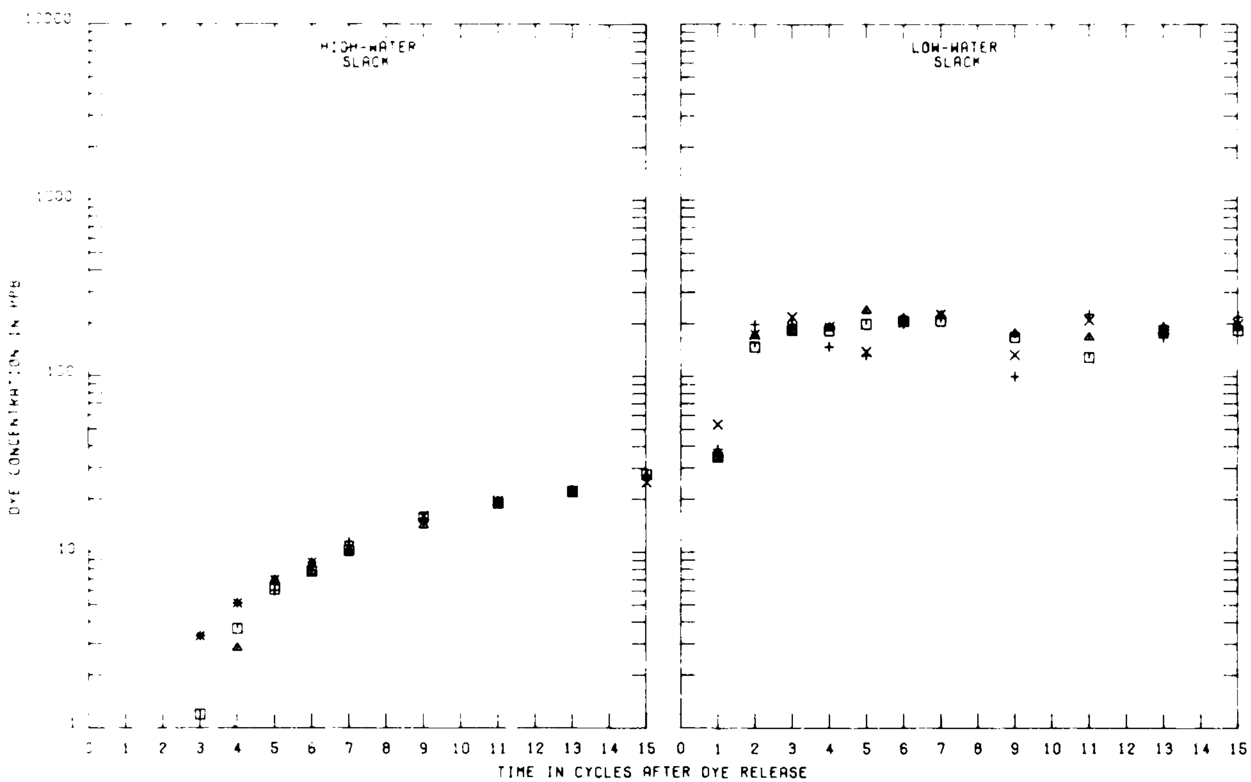
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	600000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ - — - —	SURFACE	PLAN 3E
× — · · —	BOTTOM	

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 3C



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

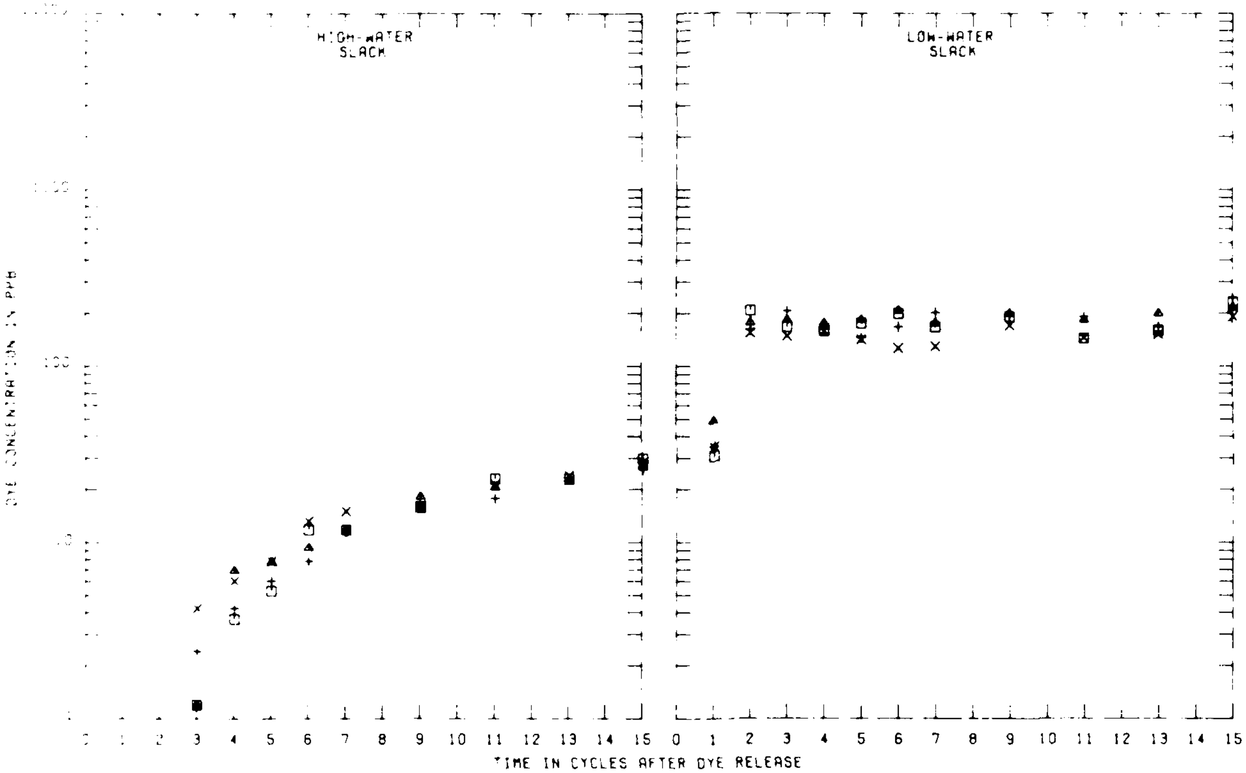
LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN 3E
× —··—··—	BOTTOM	

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 5A

PLATE 276



TEST CONDITIONS

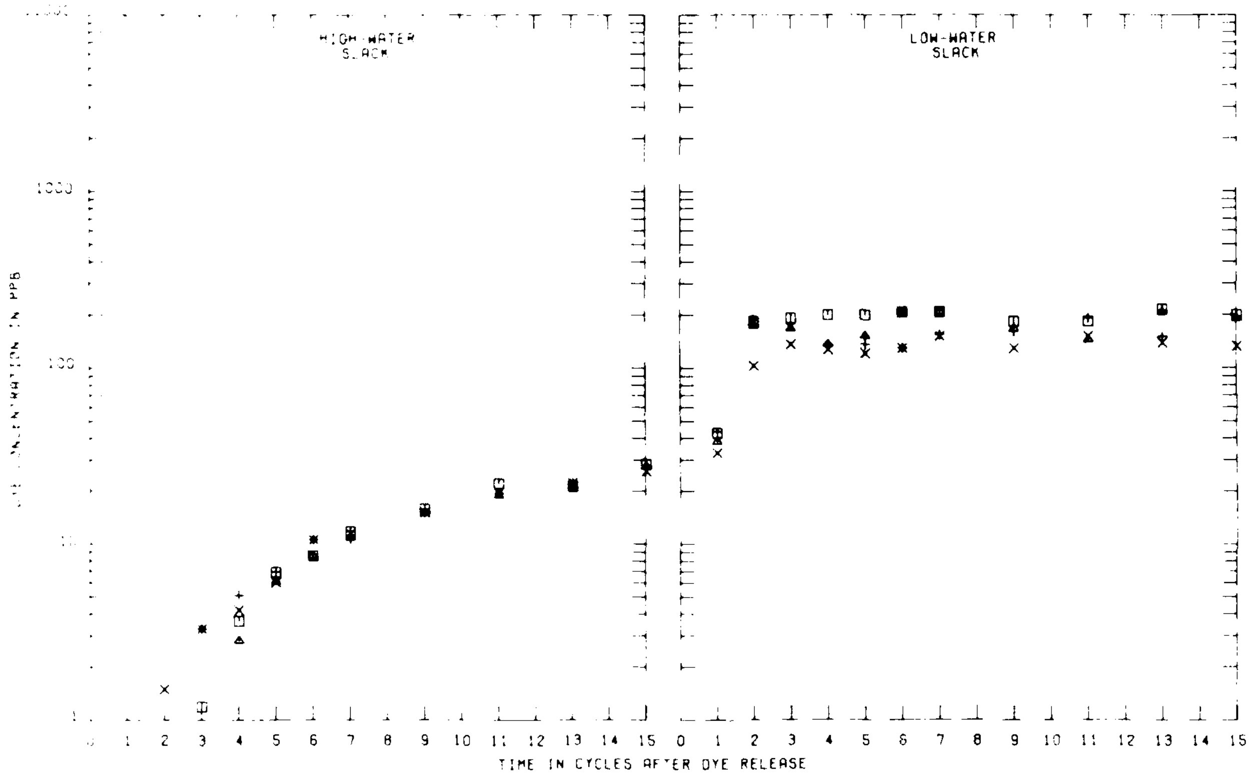
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡	SURFACE	BASE
▲	BOTTOM	
+	SURFACE	PLAN 3E
×	BOTTOM	

EFFECTS OF PLAN 3E ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 58



TEST CONDITIONS

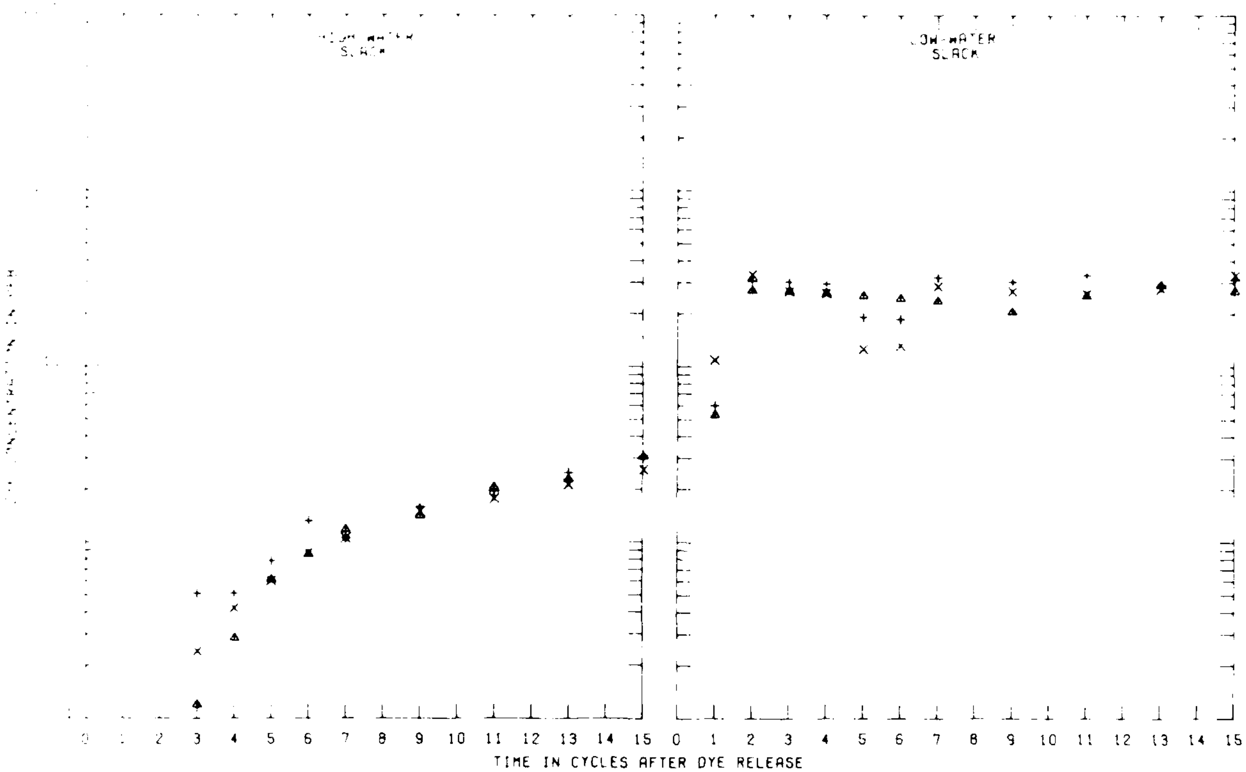
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊞	SURFACE	BASE
△	BOTTOM	BASE
+	SURFACE	PLAN 3E
×	BOTTOM	PLAN 3E

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 6C



TEST CONDITIONS

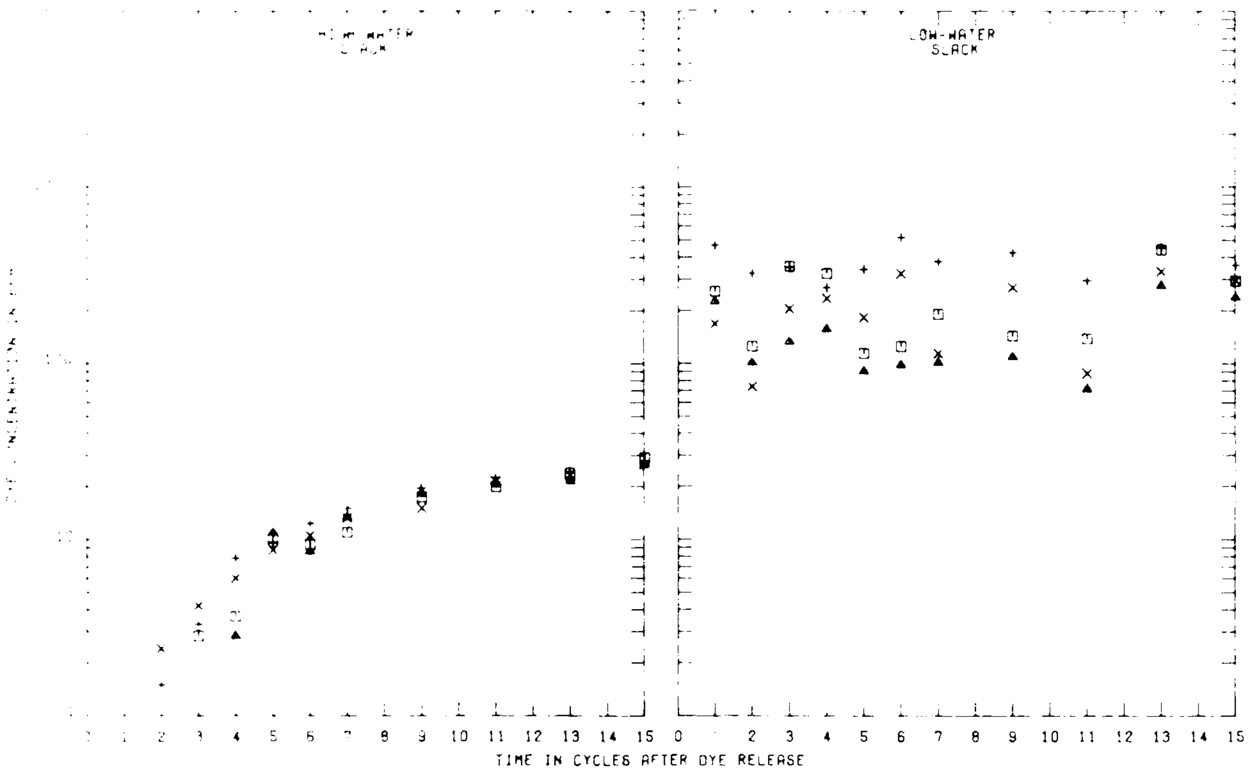
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

▲ — — — BOTTOM — BASE
+ — - - — SURFACE — PLAN 3E
× — · - — BOTTOM — PLAN 3E

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 6A



TEST CONDITIONS

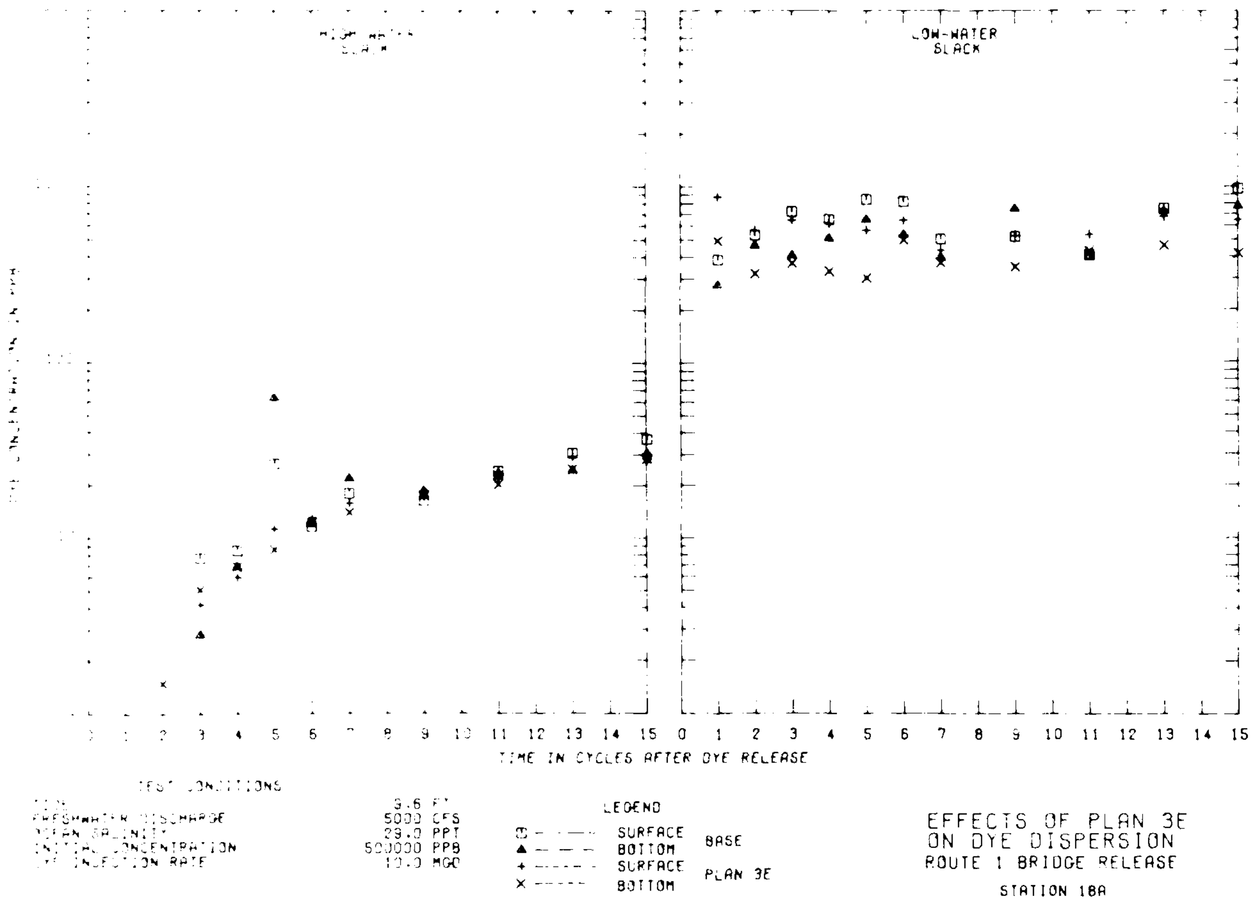
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡	— - - -	SURFACE	BASE
▲	— — —	BOTTOM	BASE
+	——·——	SURFACE	PLAN 3E
×	—·-·-·—	BOTTOM	PLAN 3E

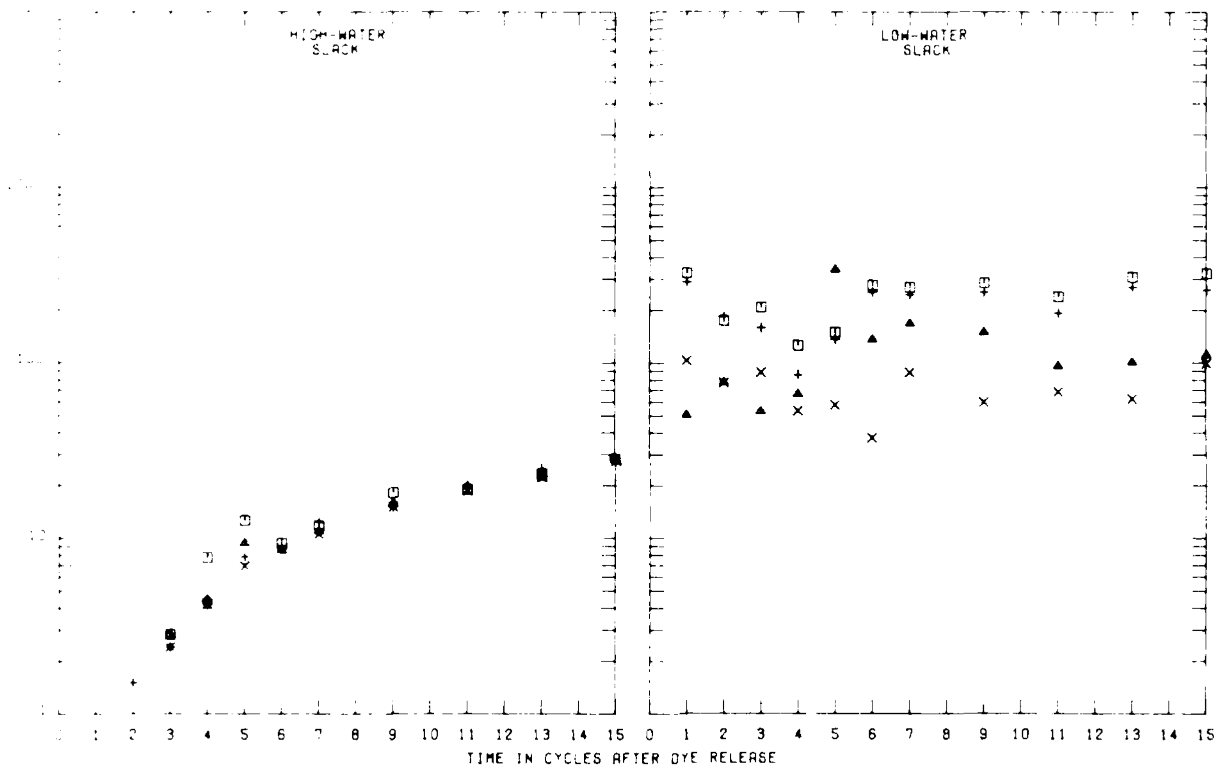
EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 188



EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 18A



TEST CONDITIONS

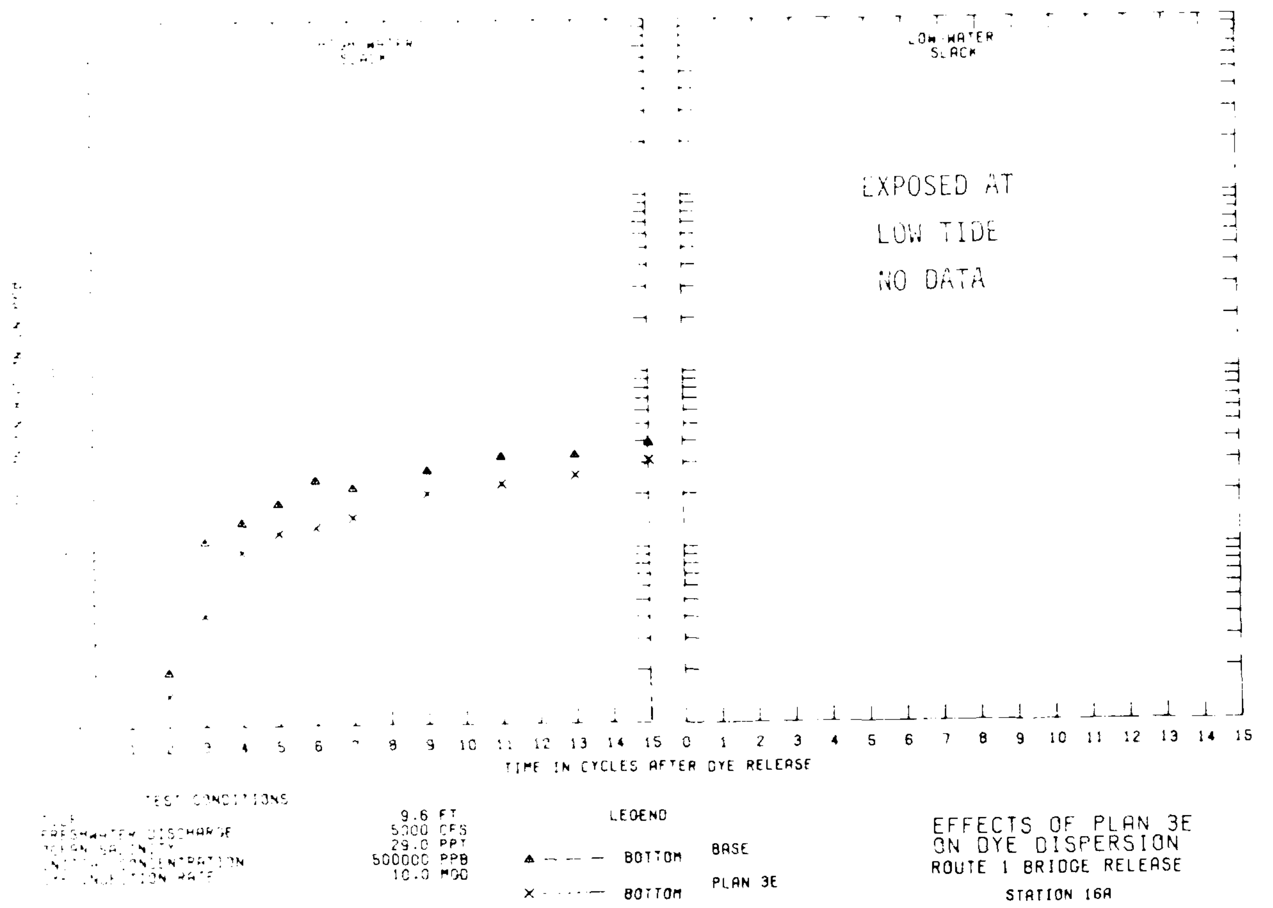
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

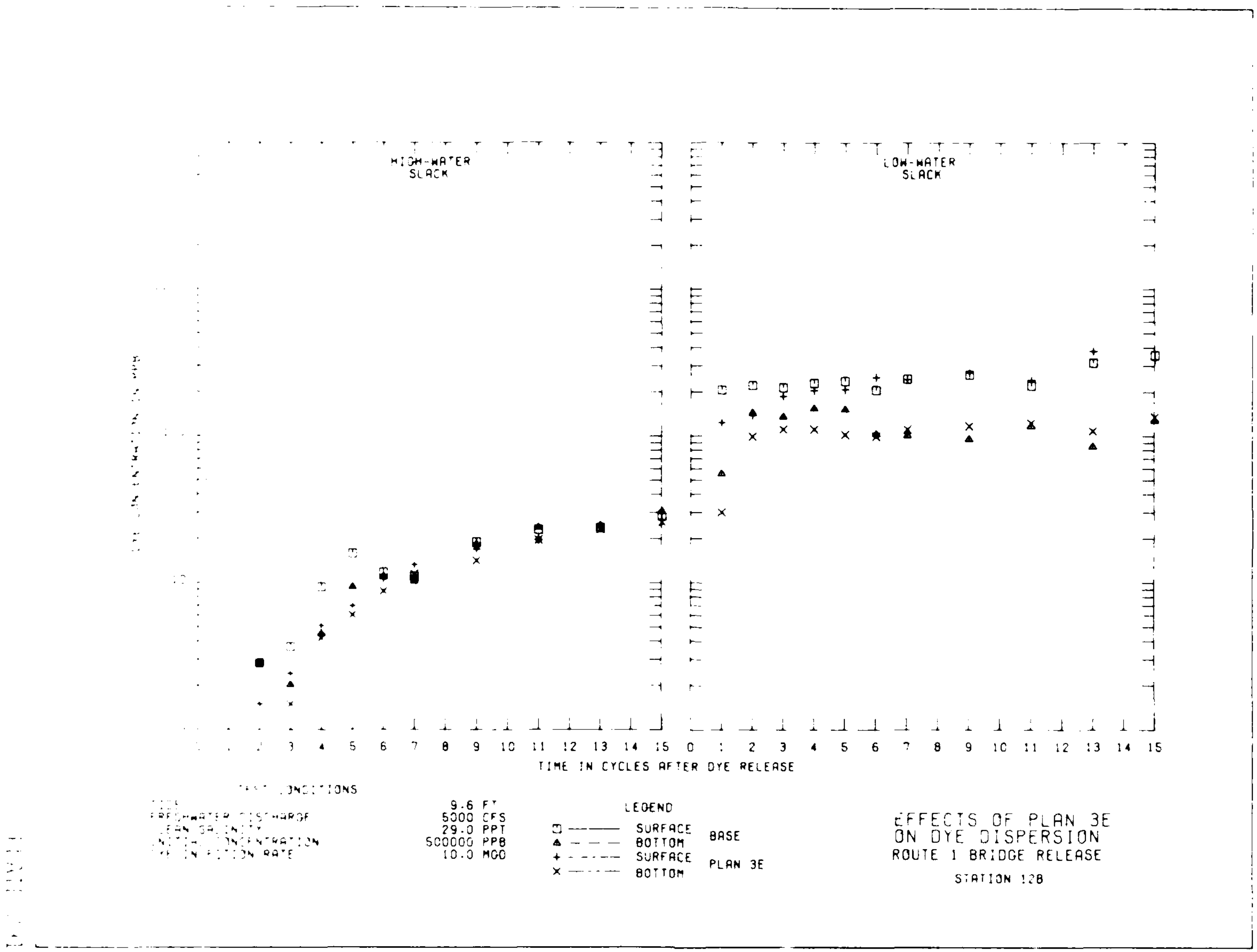
LEGEND

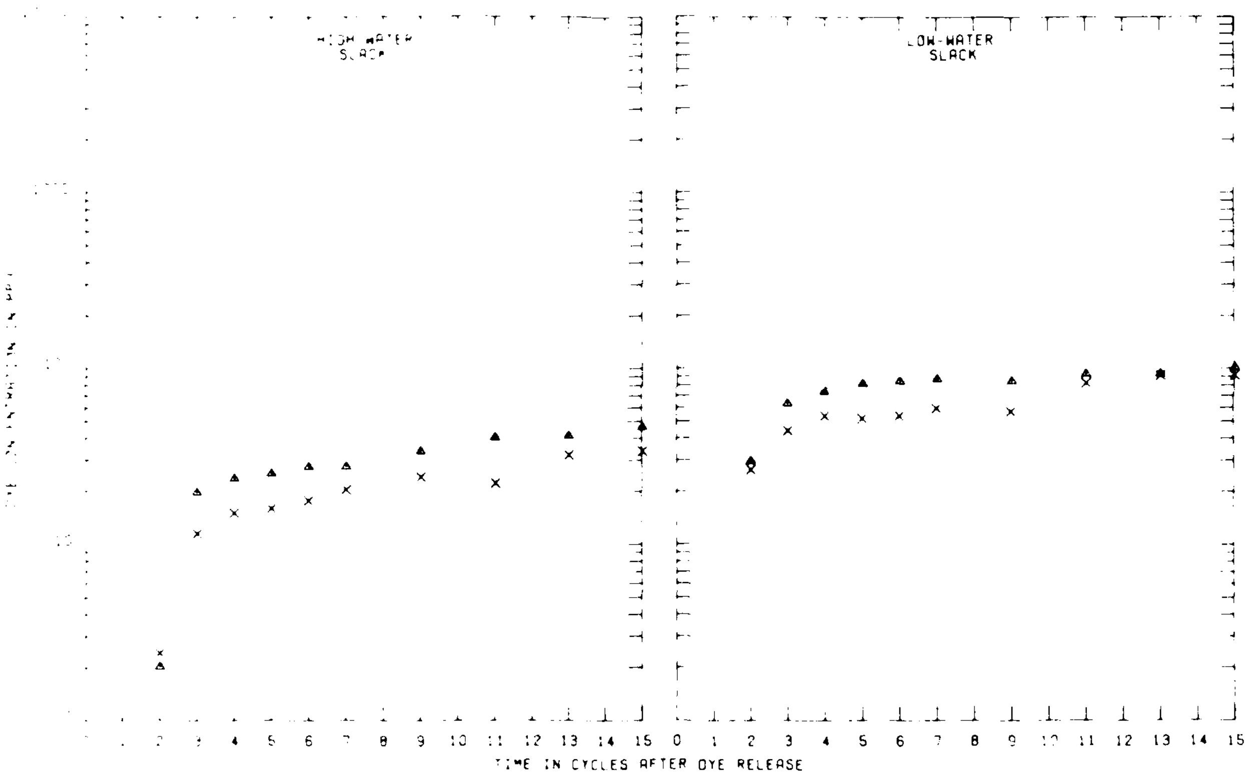
⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	BASE
+ —·—·—	SURFACE	PLAN 3E
× —··—··	BOTTOM	PLAN 3E

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 16D


LOW WATER SLACK
EXPOSED AT
LOW TIDE
NO DATA
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
9.6 FT
5000 CFS
29.0 PPT
500000 PPB
10.0 MGD
LEGEND
BOTTOM BASE
BOTTOM PLAN 3E
EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 16A


HIGH-WATER SLACK
LOW-WATER SLACK
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
9.6 FT
5000 CFS
29.0 PPT
500000 PPB
10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3E
EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 128



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

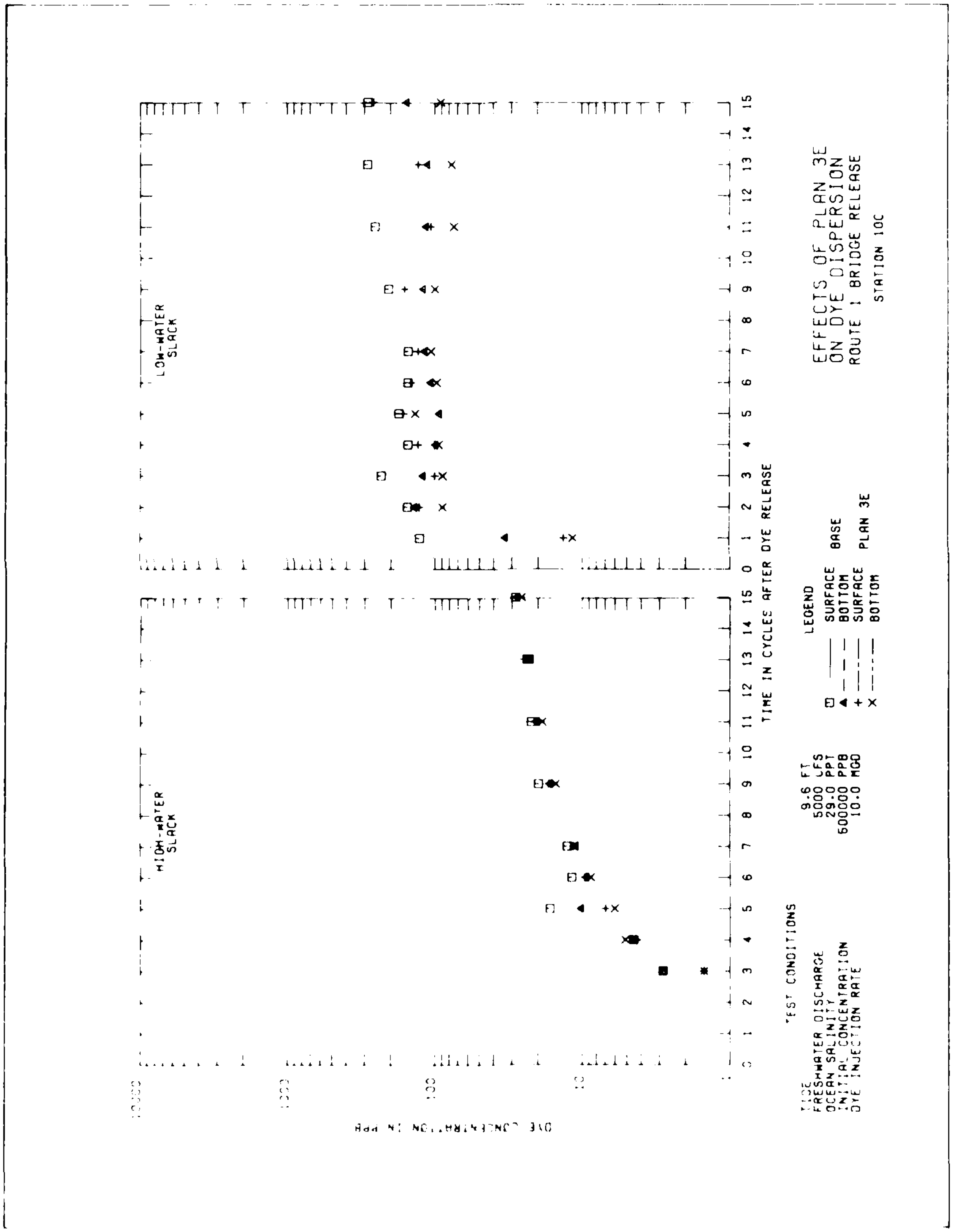
LEGEND

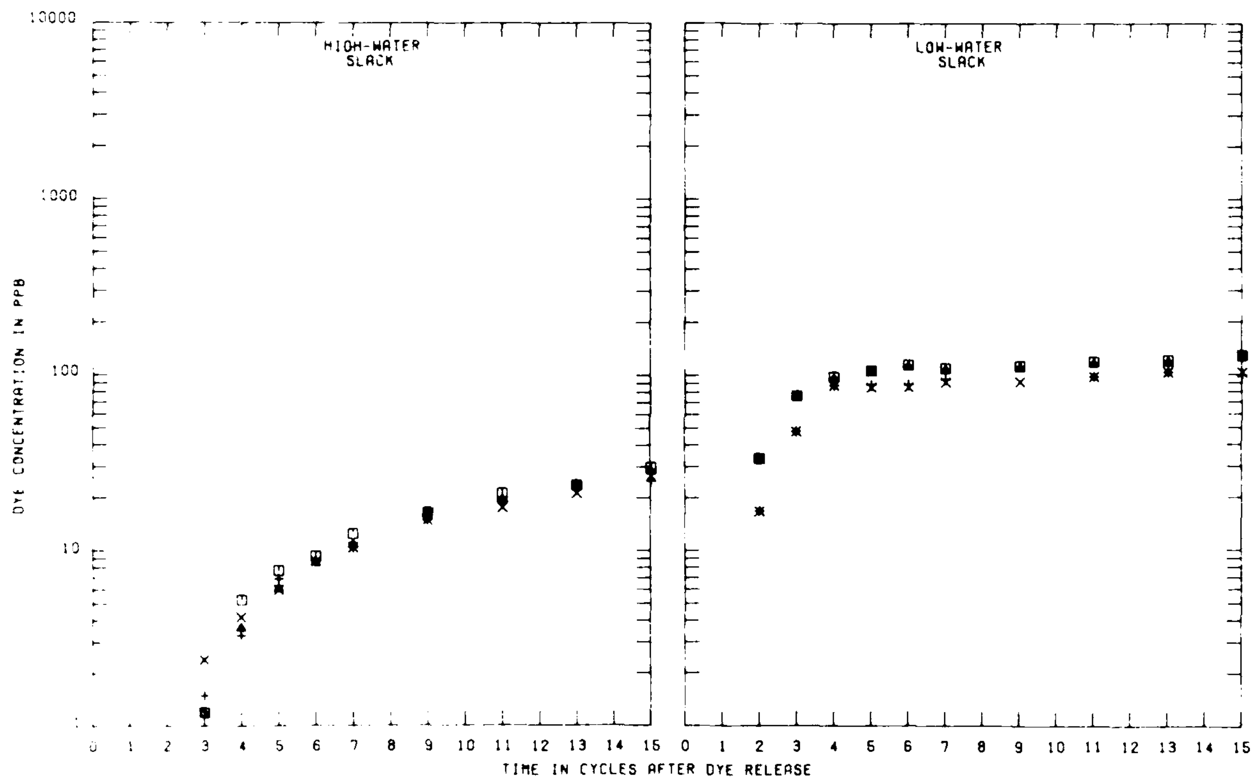
▲ — — — BOTTOM BASE

× ----- BOTTOM PLAN 3E

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 12A


EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 10C
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 600000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3E



TEST CONDITIONS

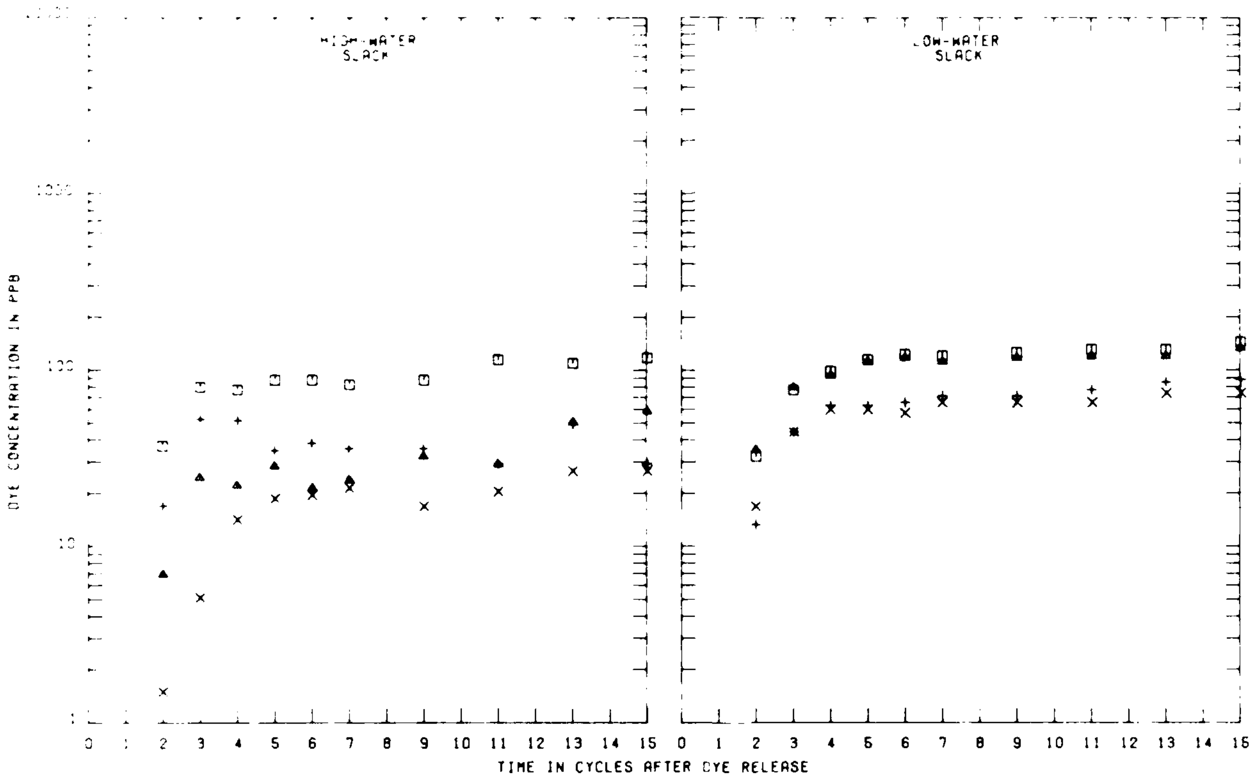
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOO

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN 3E
× —··—··—	BOTTOM	

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 108



TEST CONDITIONS

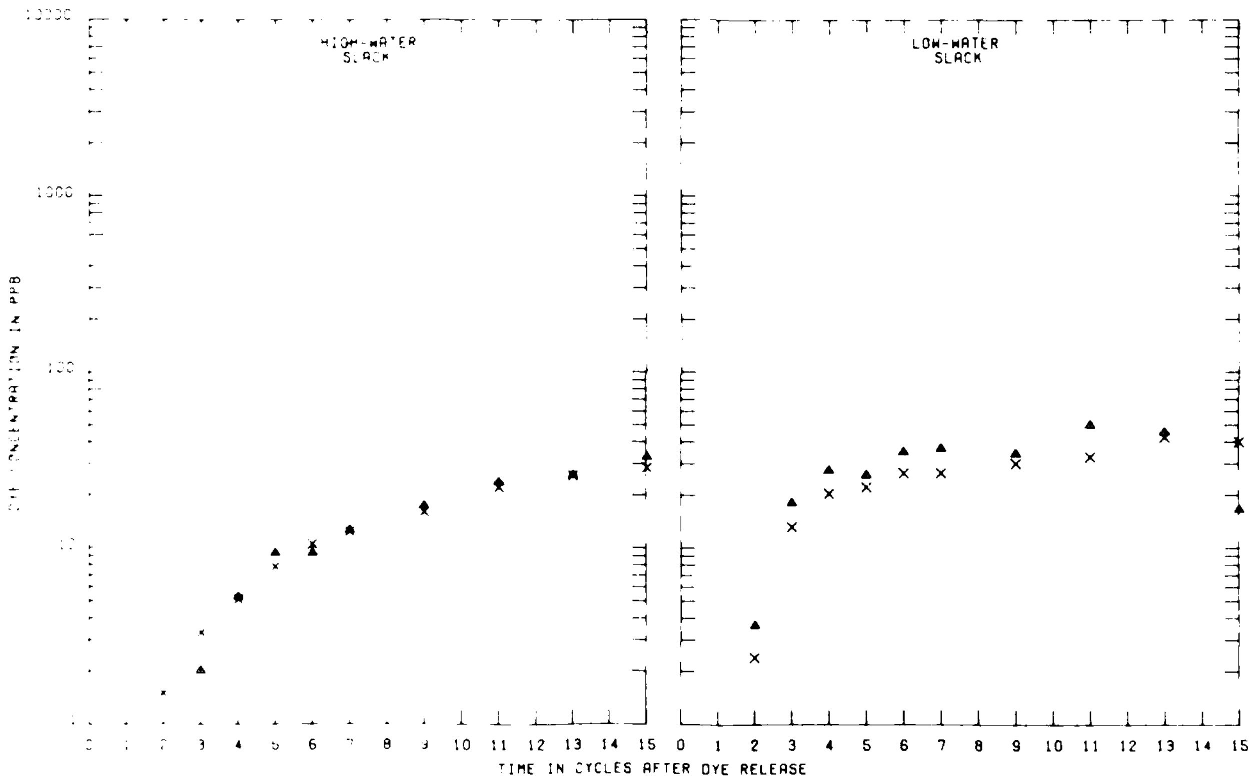
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	600000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—	SURFACE	PLAN 3E
× —··—	BOTTOM	

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 10A



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

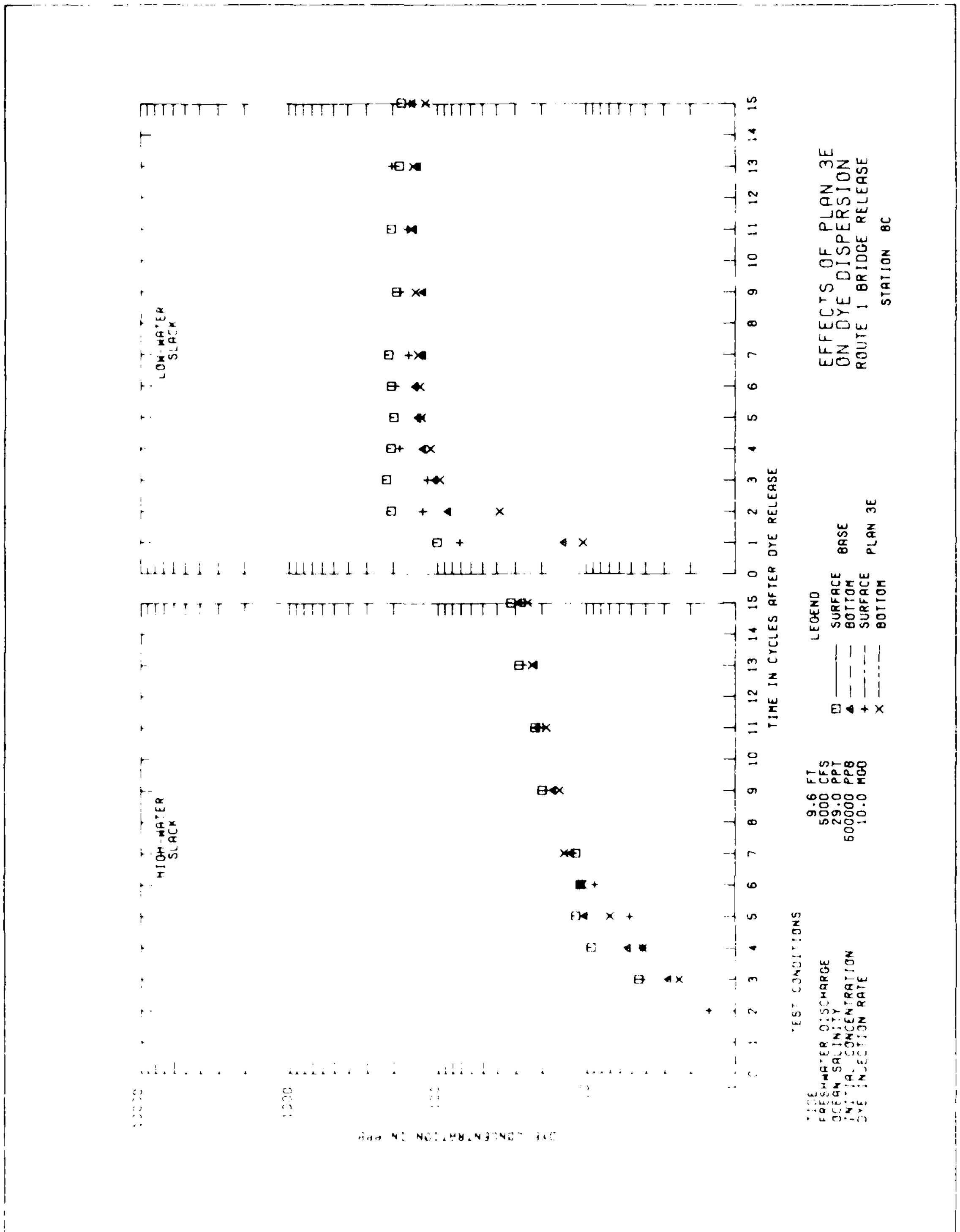
▲ — — — BOTTOM BASE

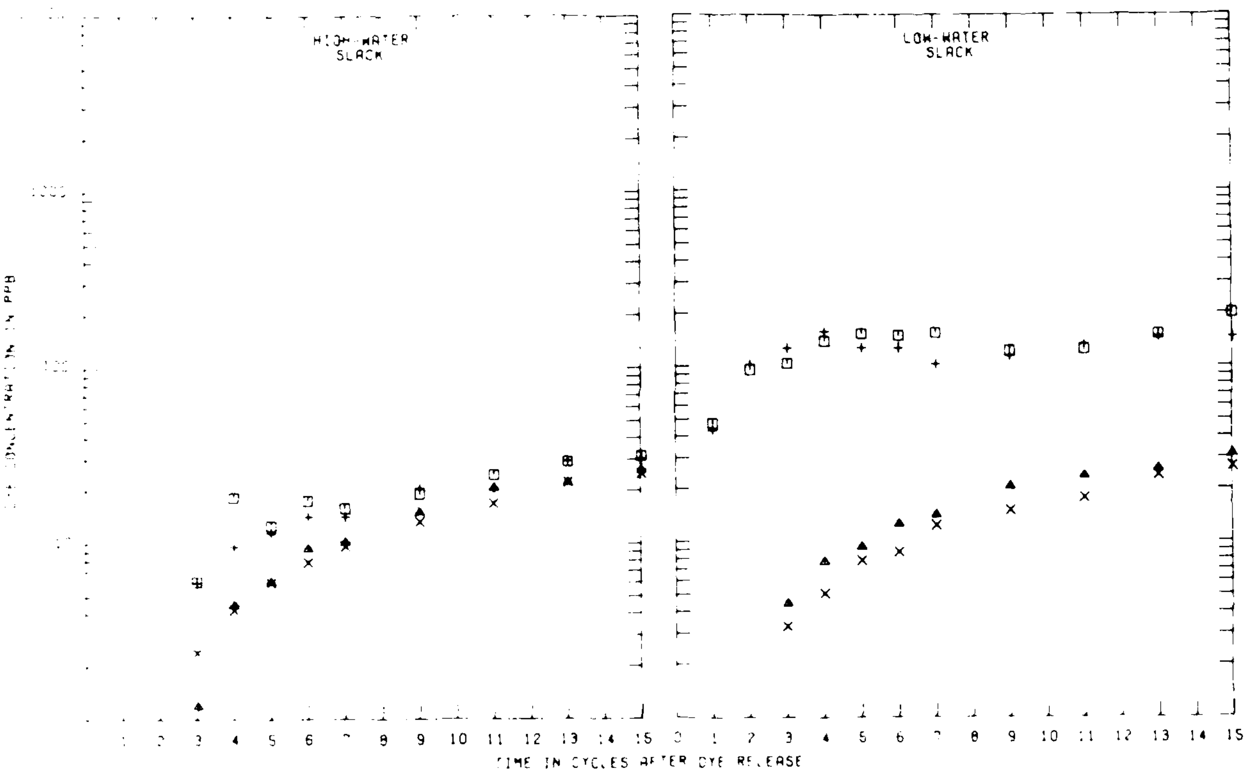
× —·—·— BOTTOM PLAN 3E

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 8D

PLATE


EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 8C
LOW-WATER SLACK
HIGH-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 600000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 3E



TEST CONDITIONS

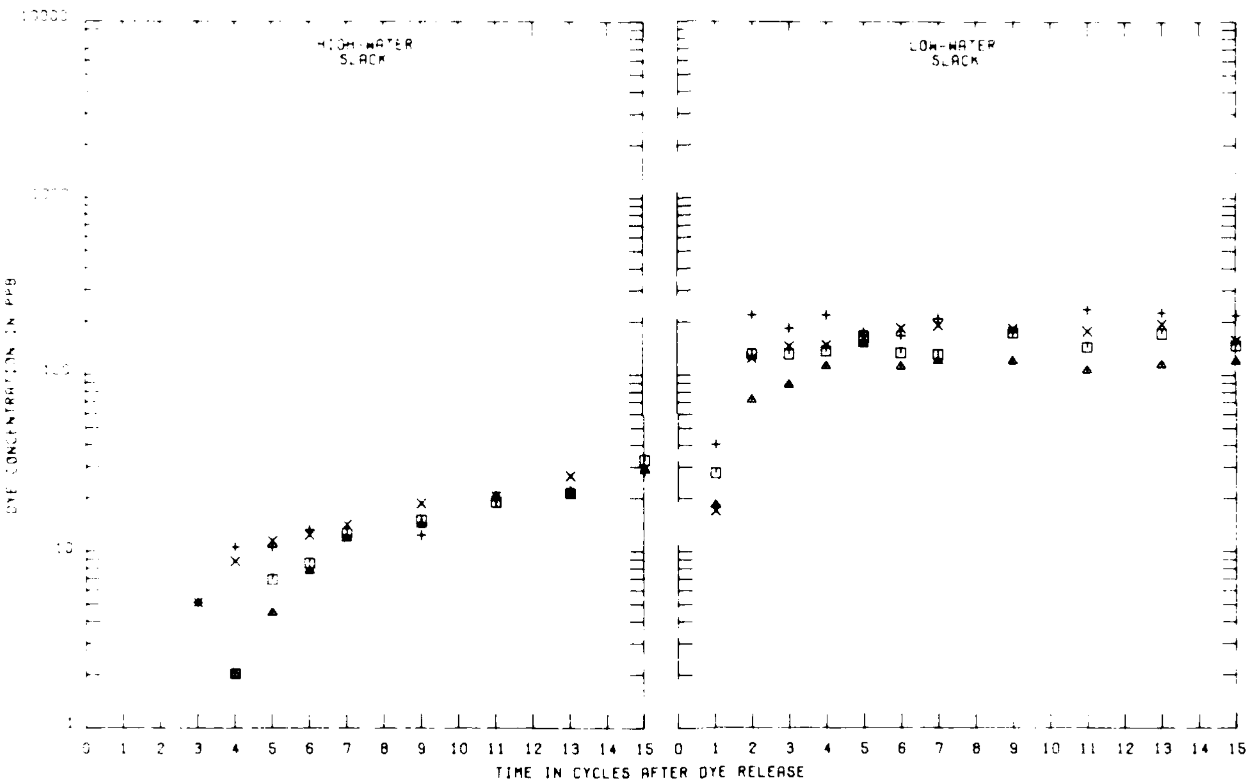
TIDE	9.6 FT
FRESHWATER DISCHARGE	6000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡	SURFACE	BASE
▲	BOTTOM	
+	SURFACE	PLAN 3E
×	BOTTOM	

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 8A



TEST CONDITIONS

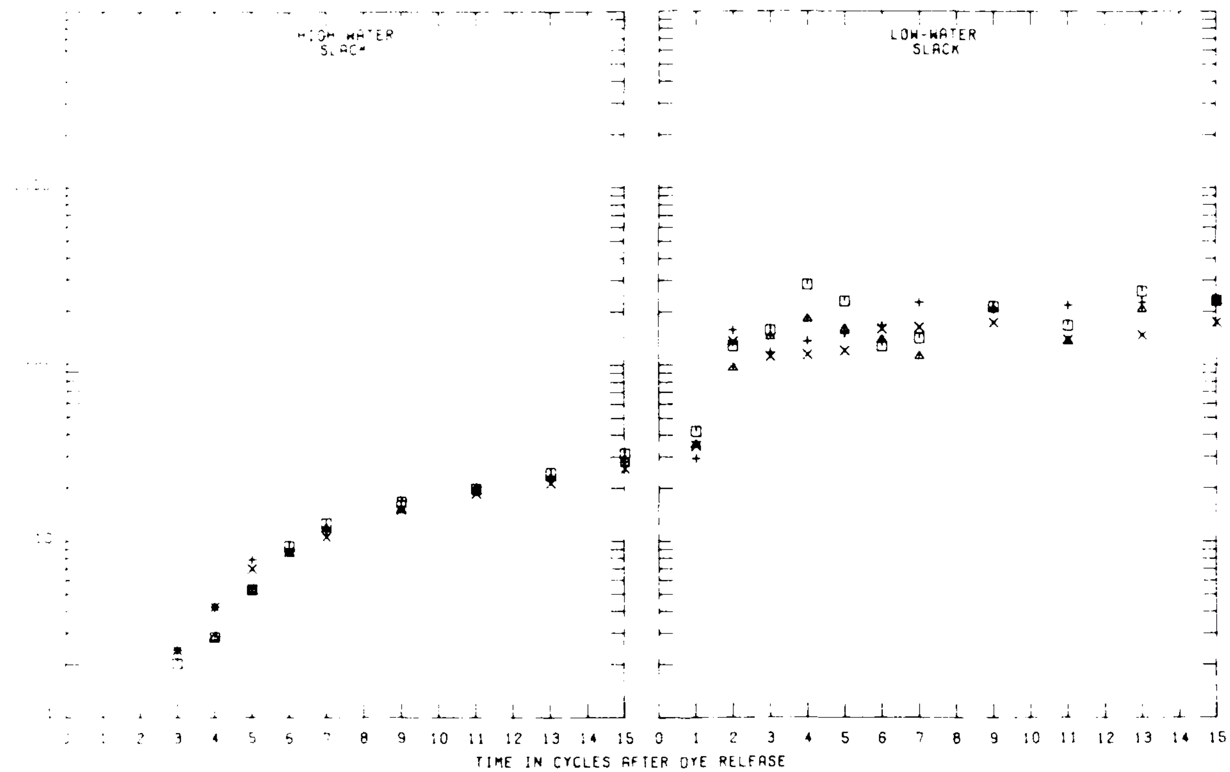
TIDE	9.6 FT
FRESHWATER DISCHARGE	6000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡	SURFACE	BASE
▲	BOTTOM	
+	SURFACE	PLAN 3E
×	BOTTOM	

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 6C



TEST CONDITIONS

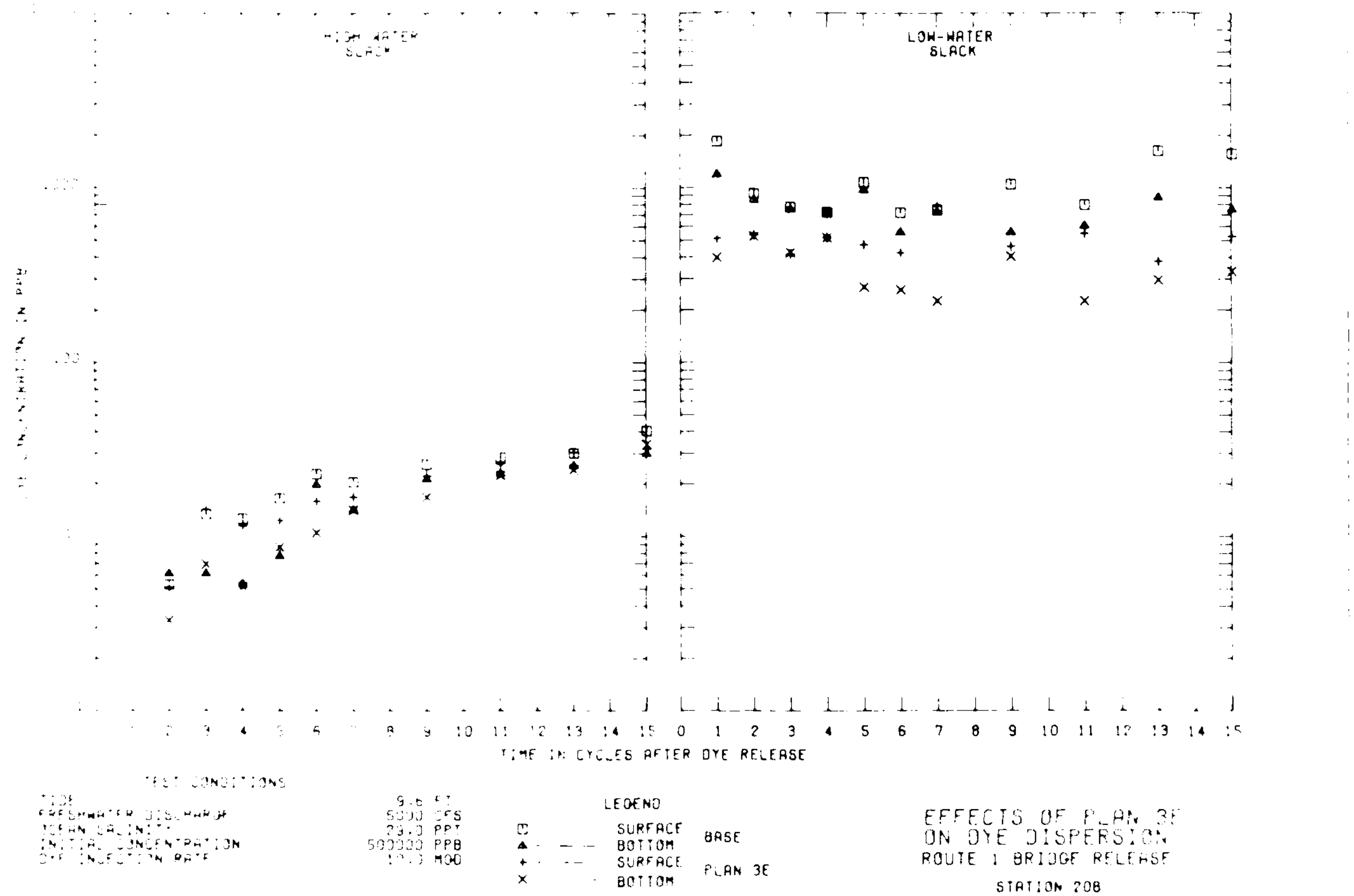
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
MEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

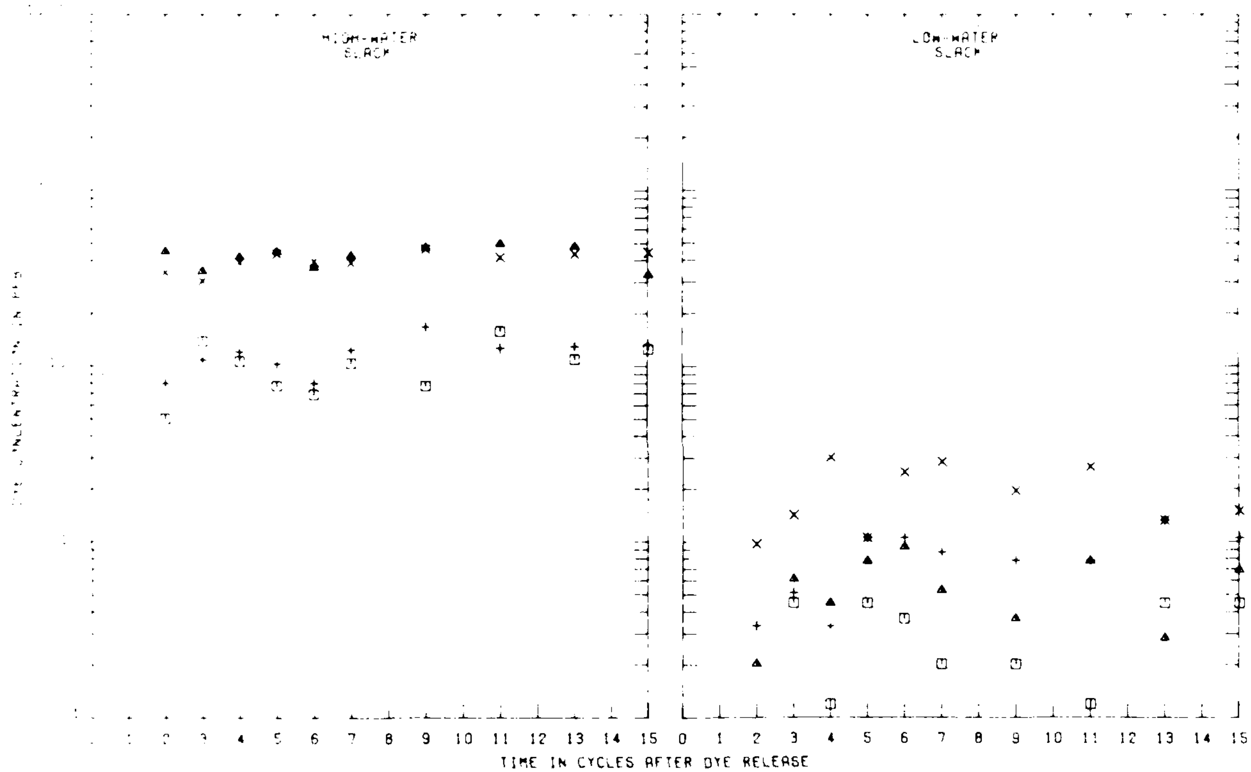
⊡	SURFACE	BASE
▲	BOTTOM	
+	SURFACE	PLAN 3E
×	BOTTOM	

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 68



EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 208



TEST CONDITIONS

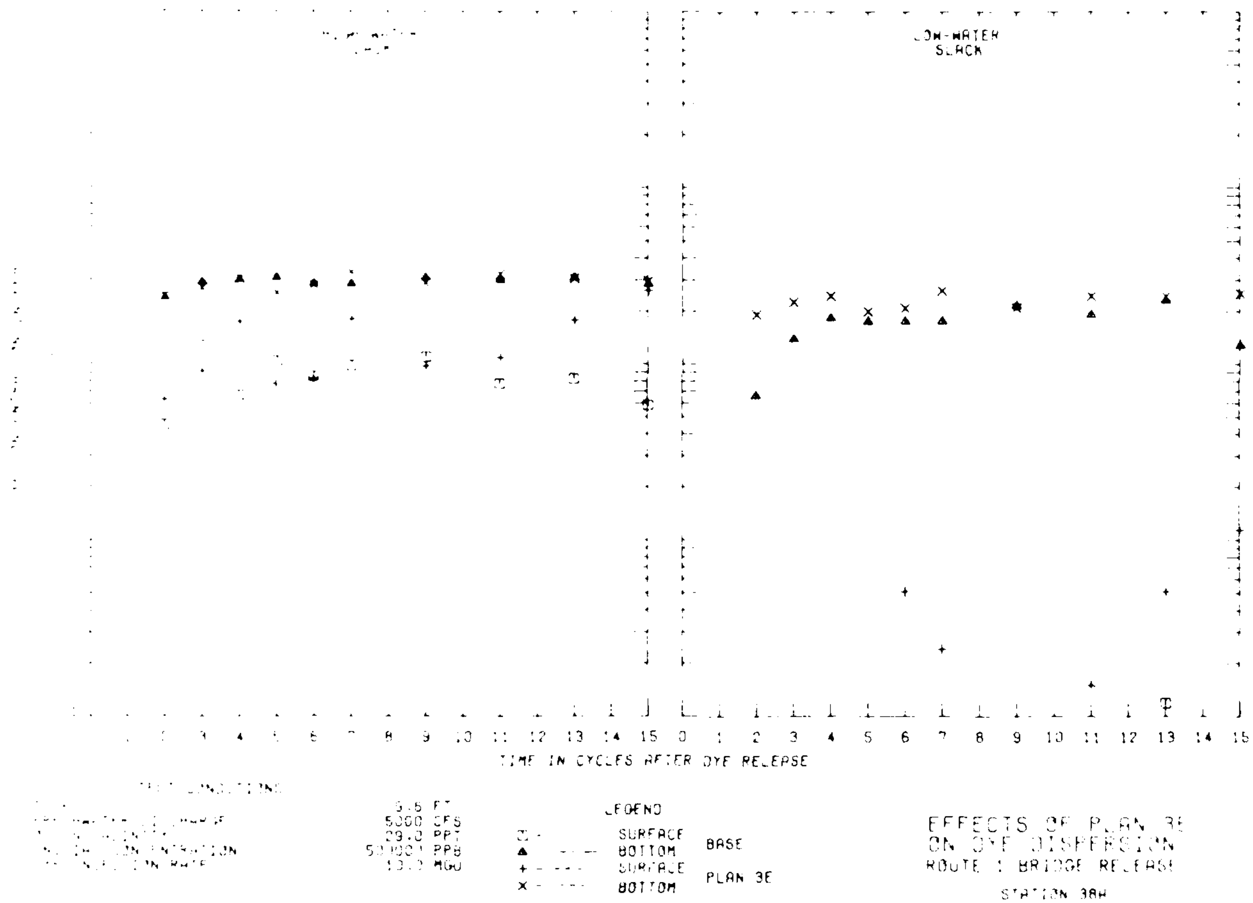
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
MEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

⊡	SURFACE	BASE
▲	BOTTOM	BASE
+	SURFACE	PLAN 3E
×	BOTTOM	PLAN 3E

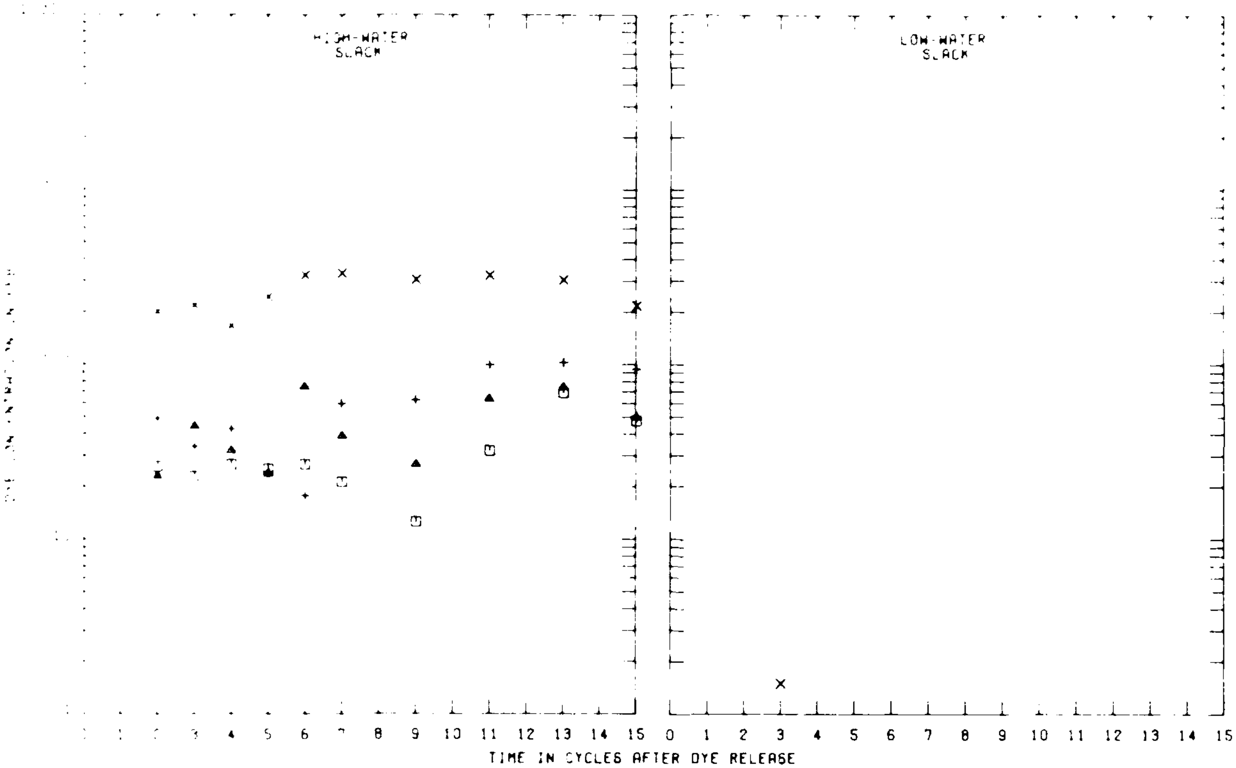
EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 26A



EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 38H



TEST CONDITIONS

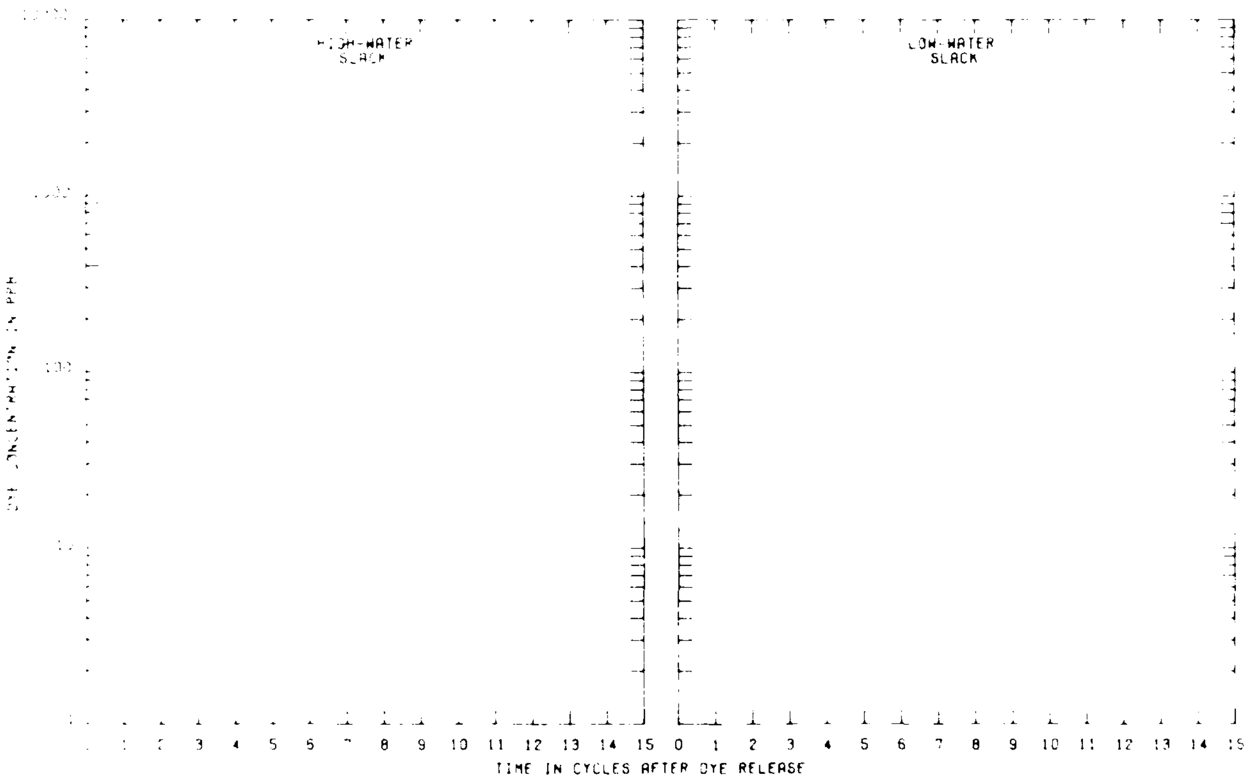
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOO

LEGEND

⊡ — - - —	SURFACE	BASE
▲ — — —	BOTTOM	
+ ——·——	SURFACE	PLAN 3E
× · ·-··	BOTTOM	

EFFECTS OF PLAN 3E
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 50A



TEST CONDITIONS

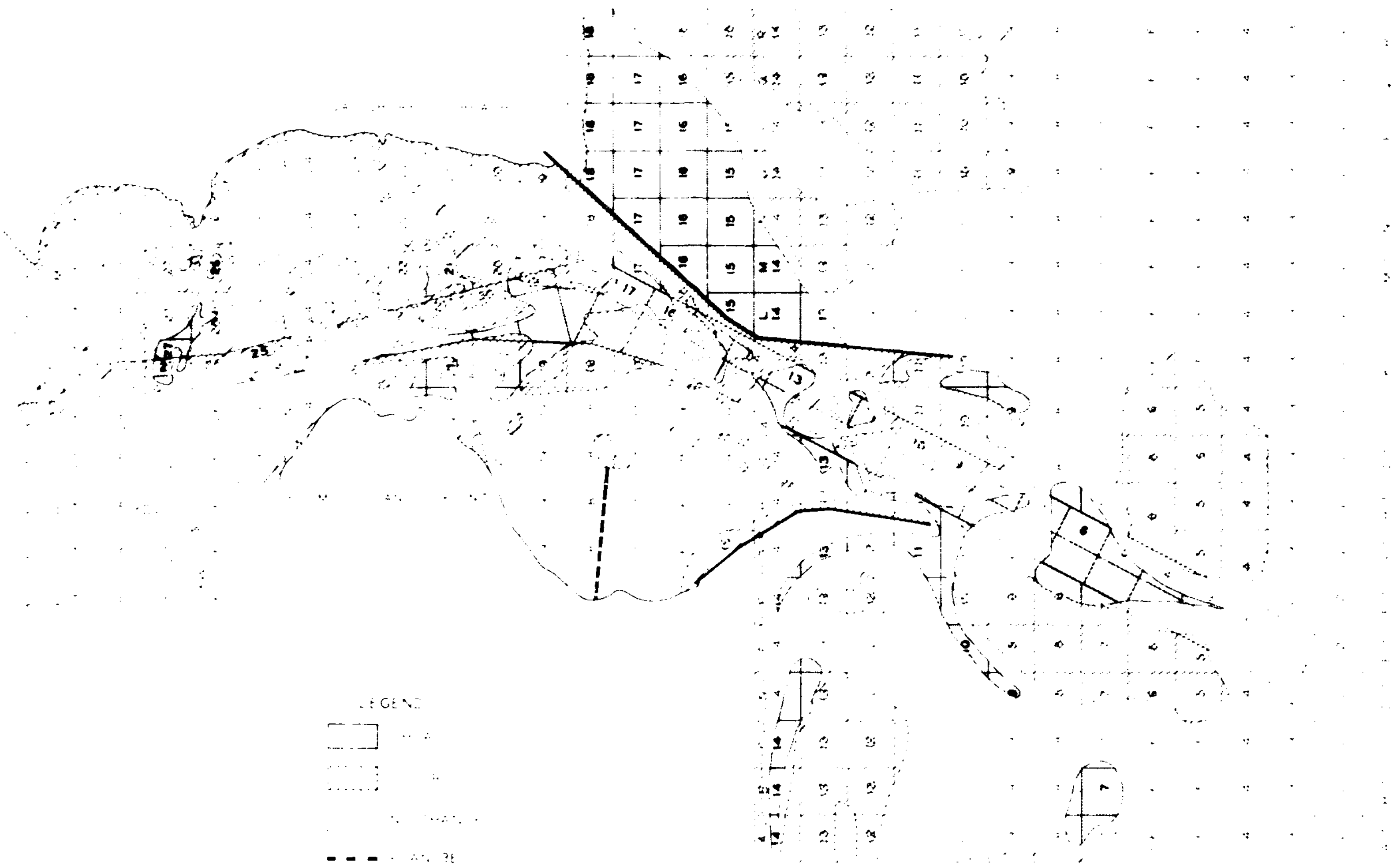
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

☐	SURFACE	BASE
▲	BOTTOM	BASE
+	SURFACE	PLAN 3E
×	BOTTOM	PLAN 3E

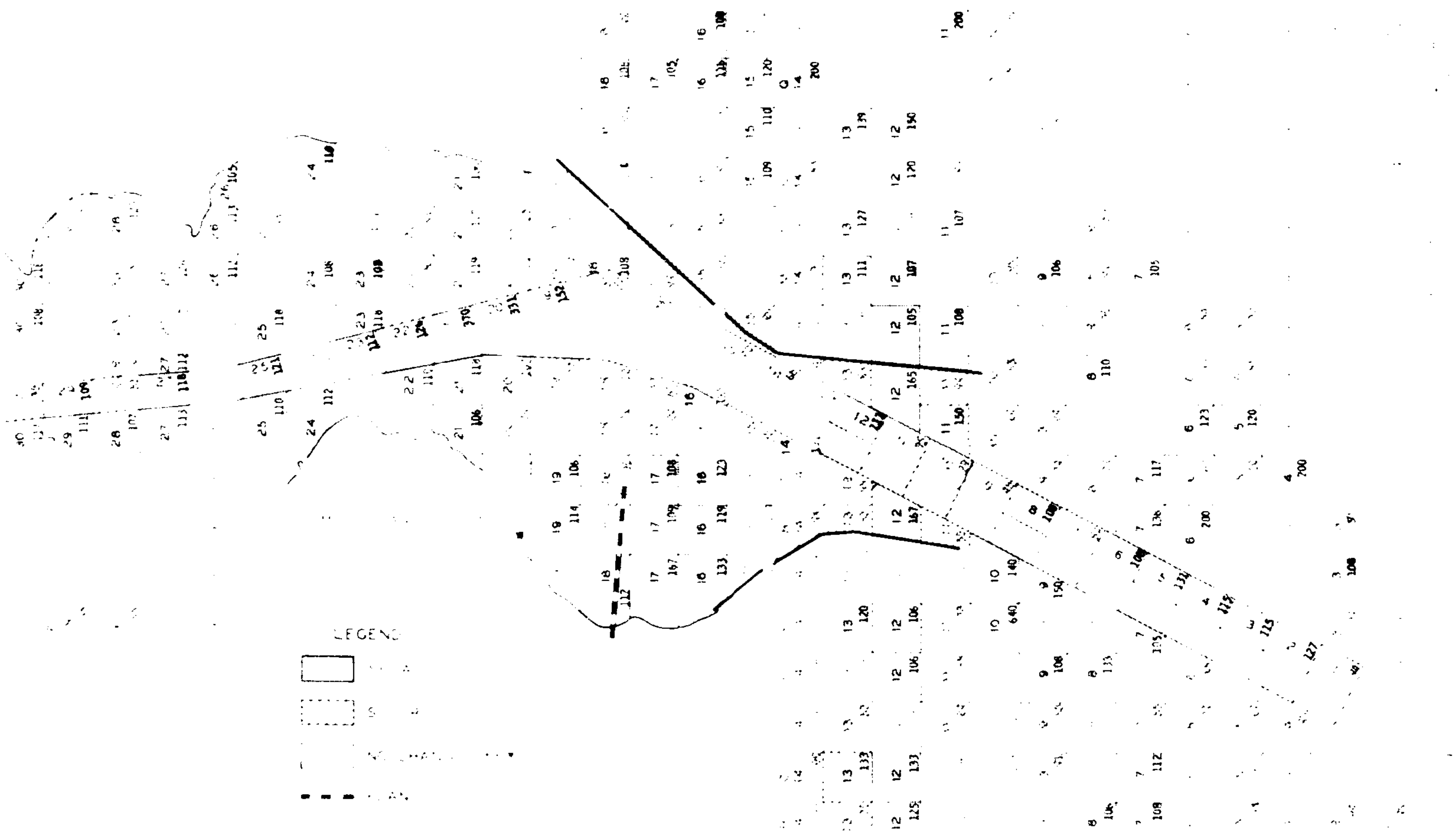
EFFECTS OF PLAN 3E ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 56A



ENTRANCE FIXED-BED SHOALING AND SCOUR PATTERNS

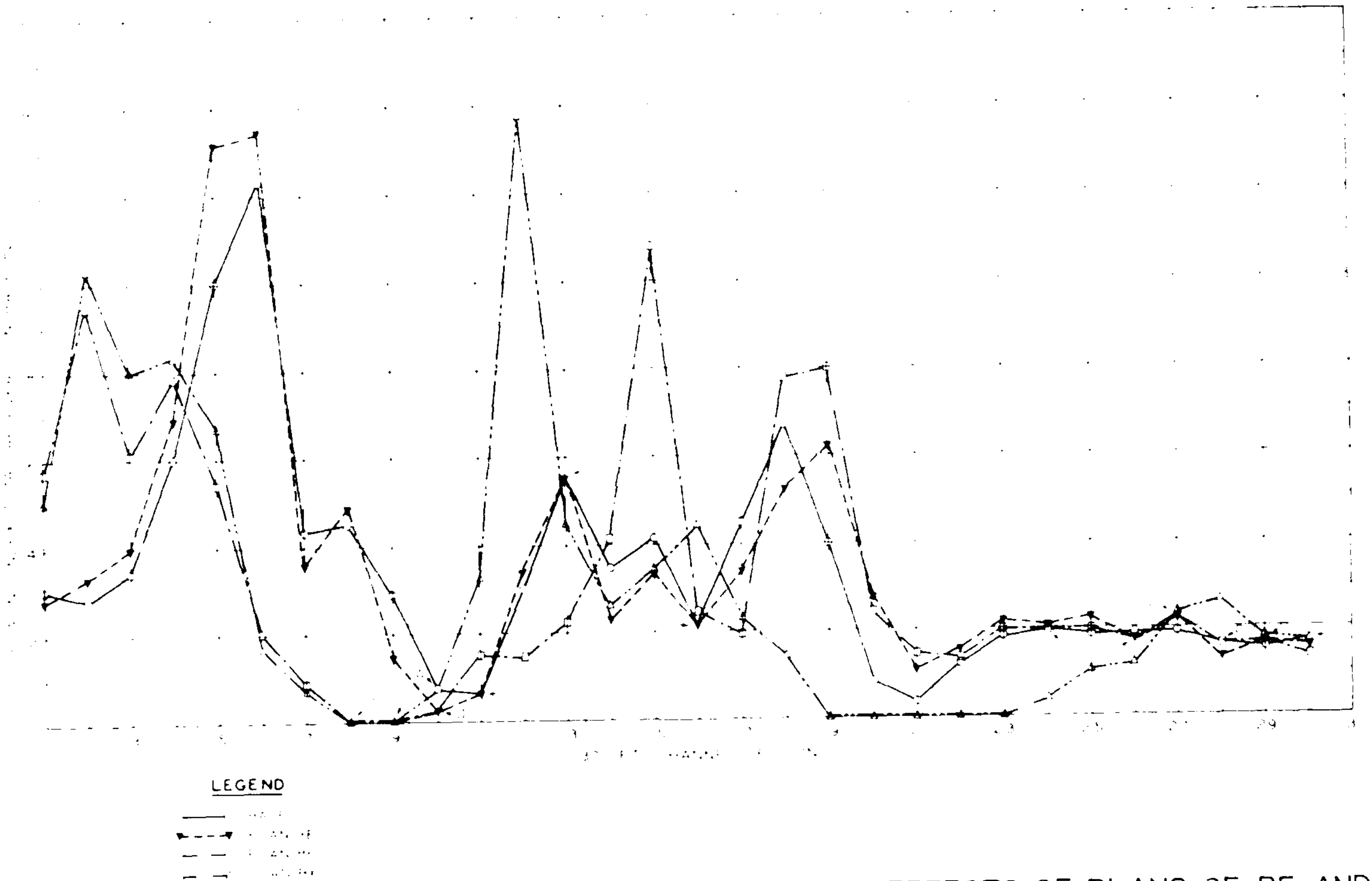
PLAN 3E



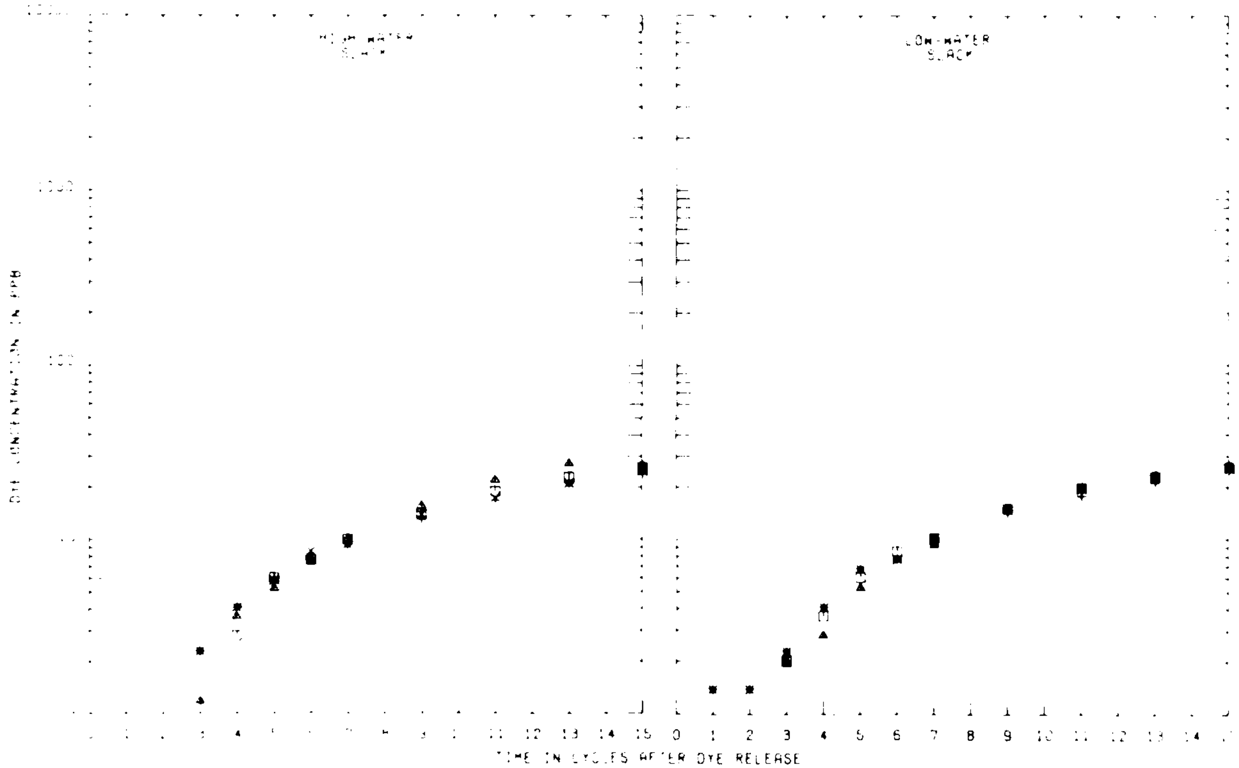
NOTE: A VALUE OF 100% INDICATES NO CHANGE. VALUES GREATER THAN 100% INDICATE AREAS OF SHOALING, WHILE VALUES LESS THAN 100% INDICATE AREAS OF SCOUR. AREAS WHERE EFFECTS WERE WITHIN PLUS OR MINUS 5% ARE CONSIDERED NOT CHANGED.

ENTRANCE FIXED-BED SHOALING AND SCOUR
IN PERCENT OF BASE

PLAN 3E



EFFECTS OF PLANS 3E, BE, AND BX
ON CHANNEL SHOALING



TEST CONDITIONS

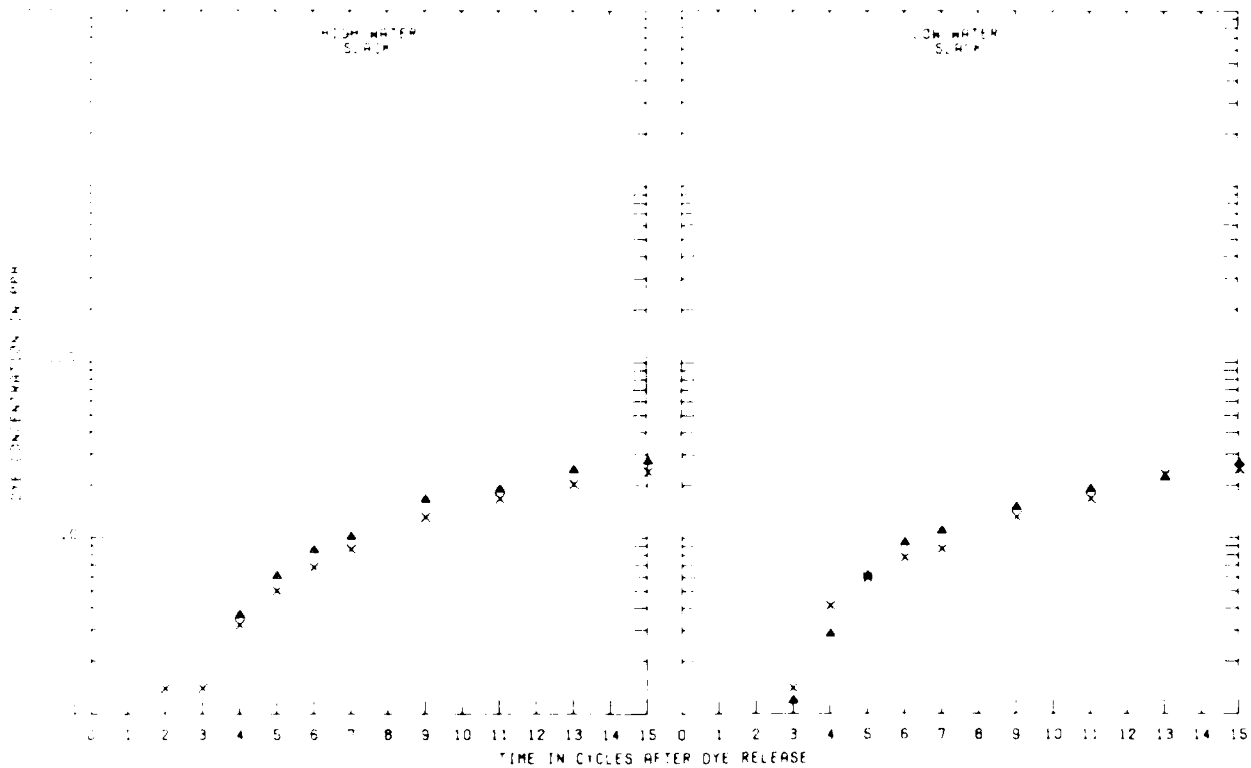
FRESHWATER DISCHARGE
OCEAN SALINITY
INITIAL CONCENTRATION
DYE INJECTION RATE

LEGEND

⊡	SURFACE	BASE
▲	BOTTOM	
+	SURFACE	PLAN BE
×	BOTTOM	

EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION OCEAN



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

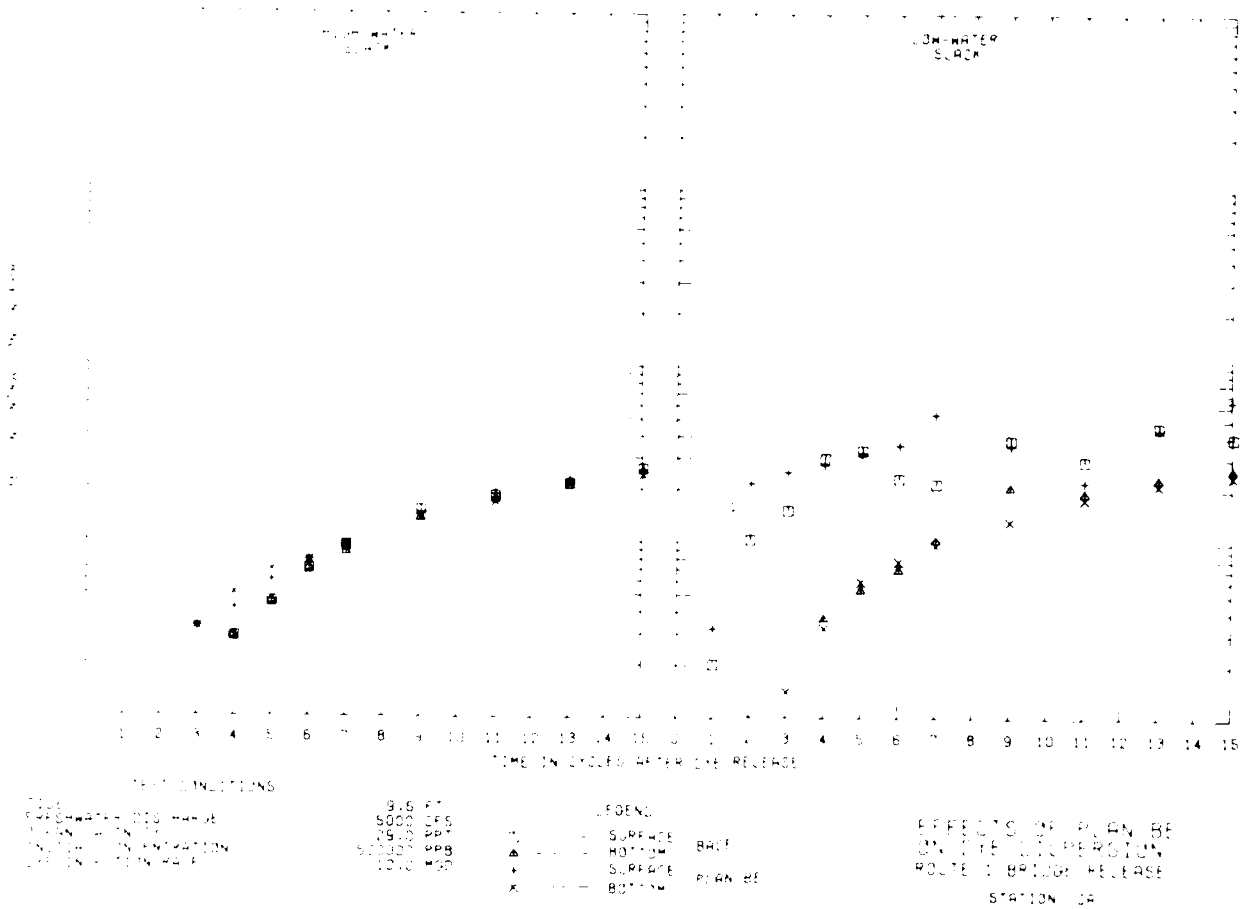
LEGEND

▲ ---- BOTTOM BASE

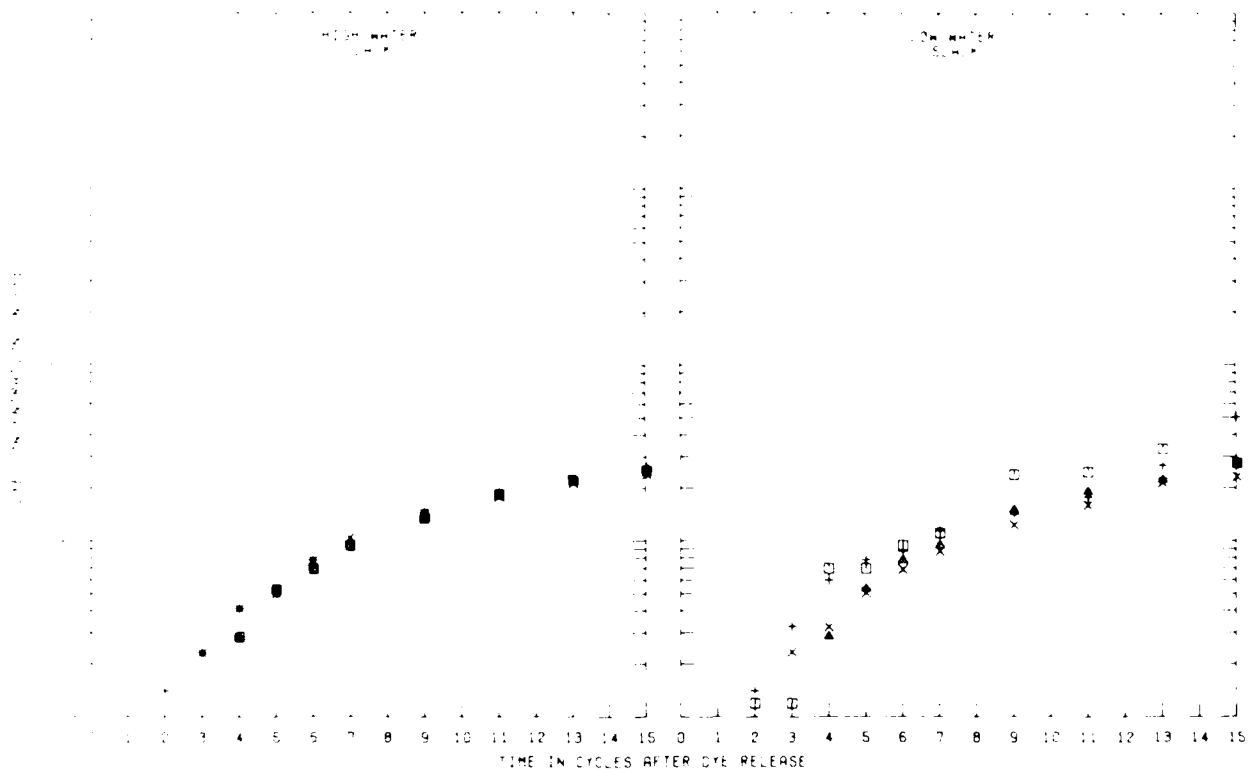
× ---- BOTTOM PLAN BE

EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION SUMP



LOW-WATER SLACK
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
9.5 FT
5000 CFS
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BE
EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 2A



TEST CONDITIONS

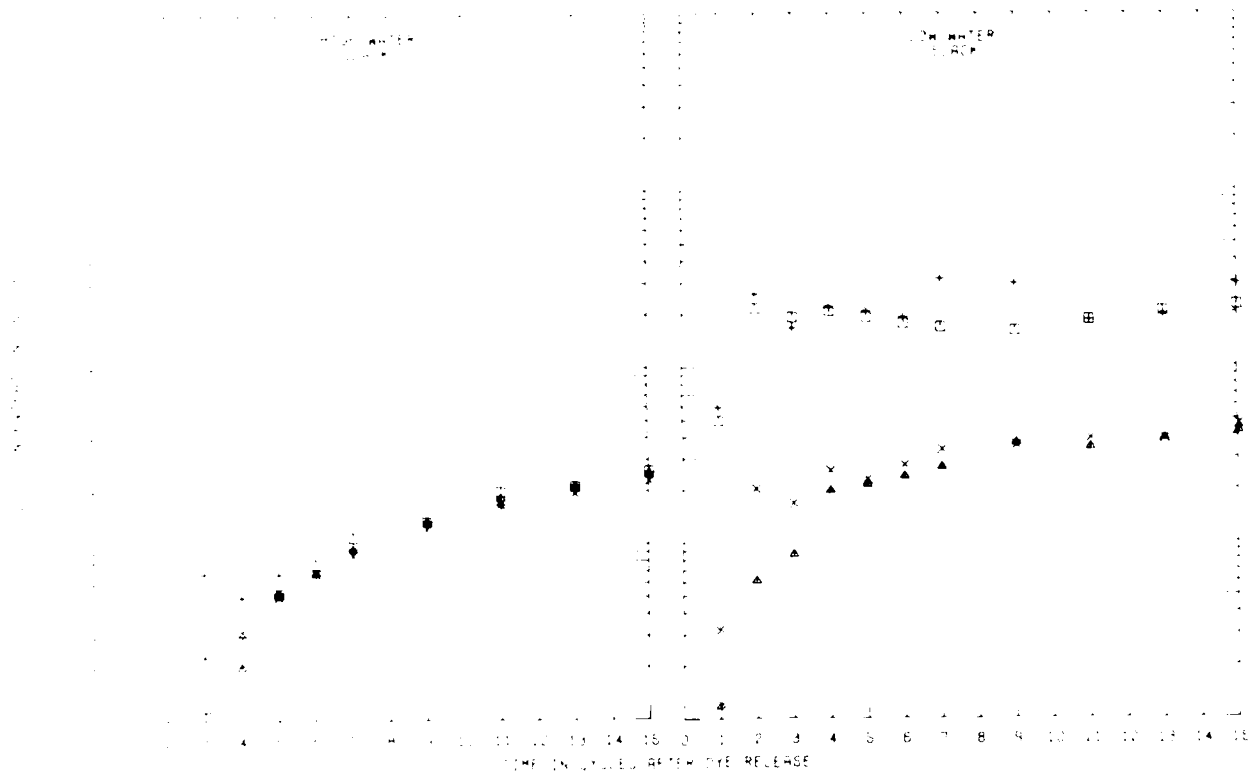
	9.6 FT
	5000 CFS
	29.0 PPT
	500000 PPB
	10.0 MGD

LEGEND

⊞	SURFACE	BASE
▲	BOTTOM	BASE
+	SURFACE	PLAN BE
×	BOTTOM	PLAN BE

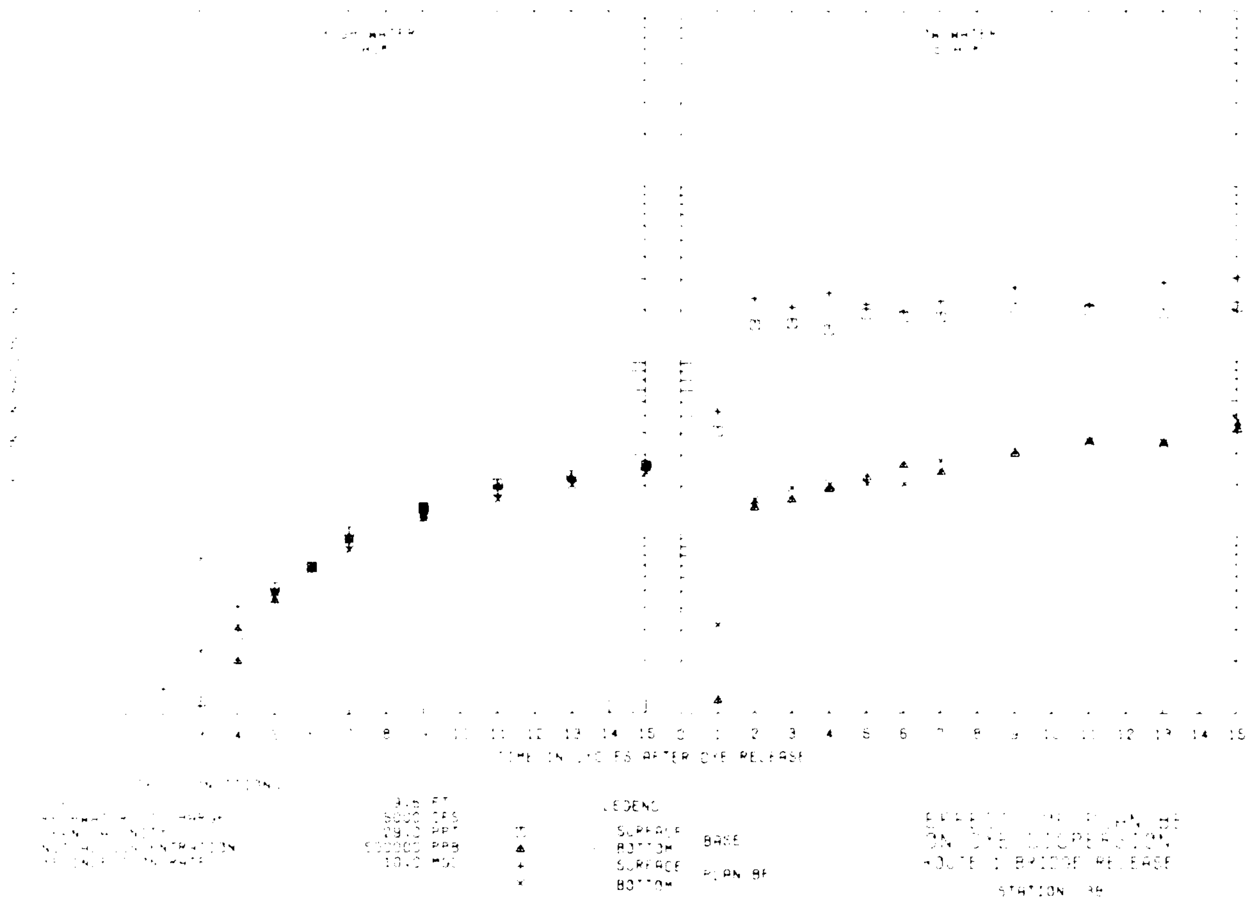
EFFECTS OF PLAN BE ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 08



LEGEND
SURFACE BASE
BOTTOM
SURFACE PLAN BE
BOTTOM

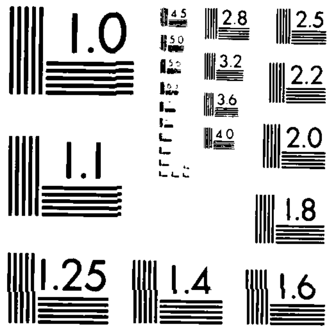
EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 3A


TIME IN CYCLES AFTER DYE RELEASE
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN 8F
5000 CFS
29.0 PPT
500000 PPB
ROUTE 1 BRIDGE RELEASE
STATION 3B

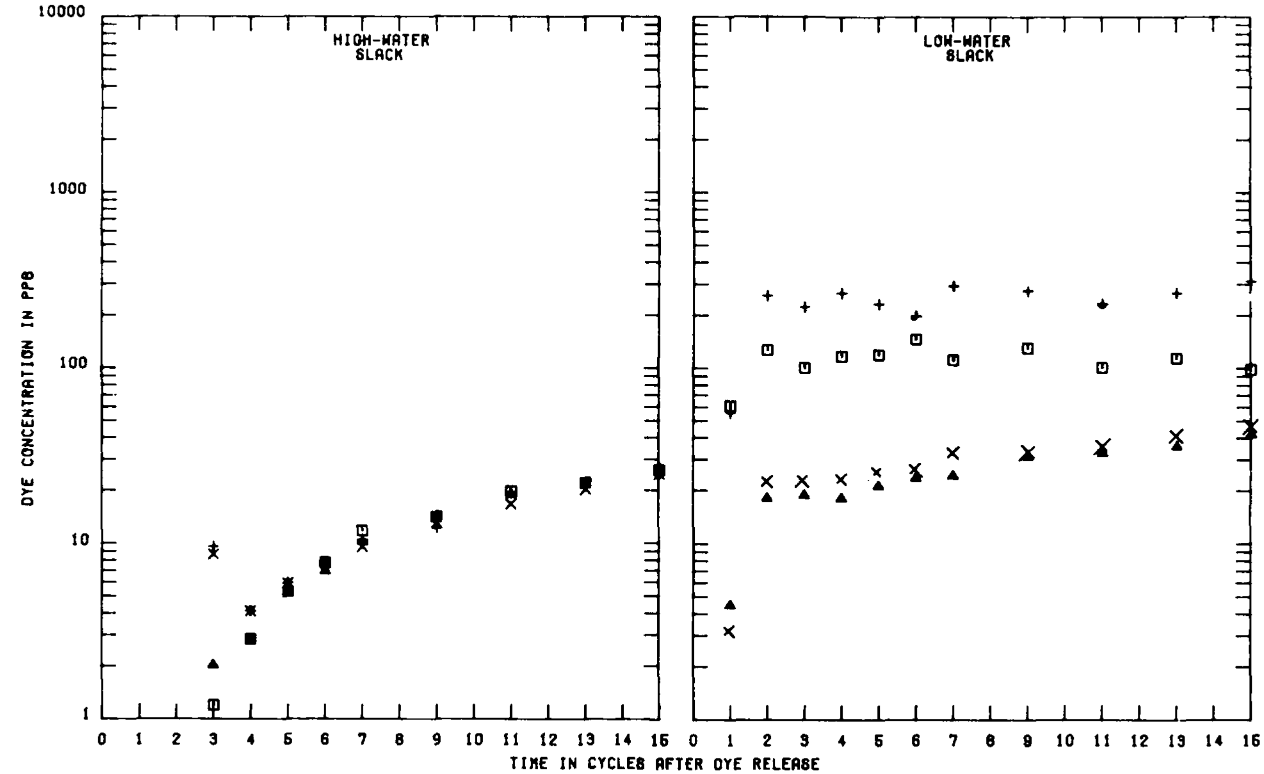
AD-A157 046   NEWBURYPORT HARBOR MASSACHUSETTS; REPORT 2 DESIGN FOR HYDRODYNAMICS SALIN..(U) ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS HYDRA..   6/6

UNCLASSIFIED   N J BROGDON ET AL. MAR 85 WES/TR/HL-79-1-2   F/G 8/10   NL

END



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A



TEST CONDITIONS

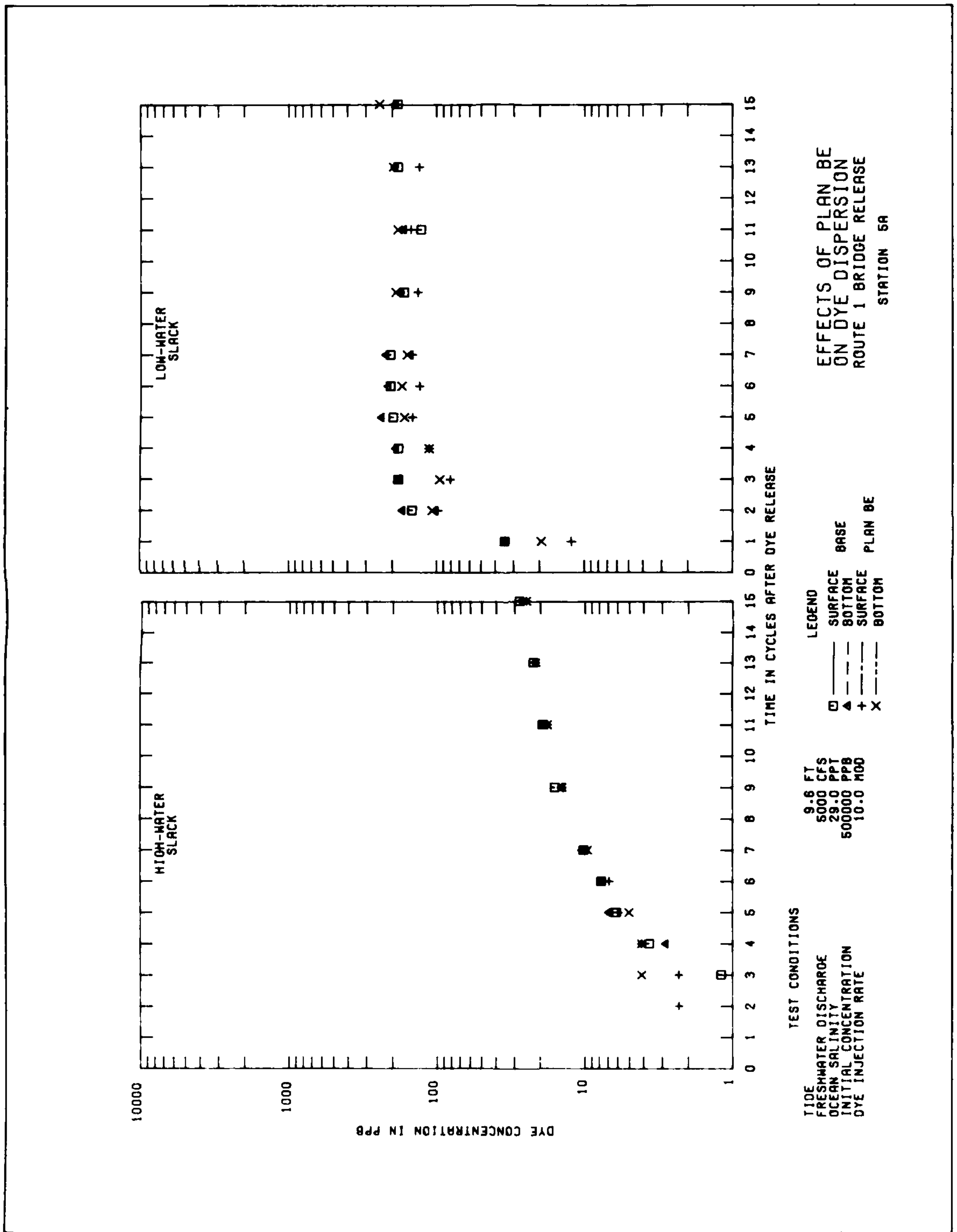
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—	SURFACE	PLAN BE
× —·—·—	BOTTOM	

EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 3C

PLATE 310



EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 5A
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BE
TEST CONDITIONS
TIDE 9.8 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD

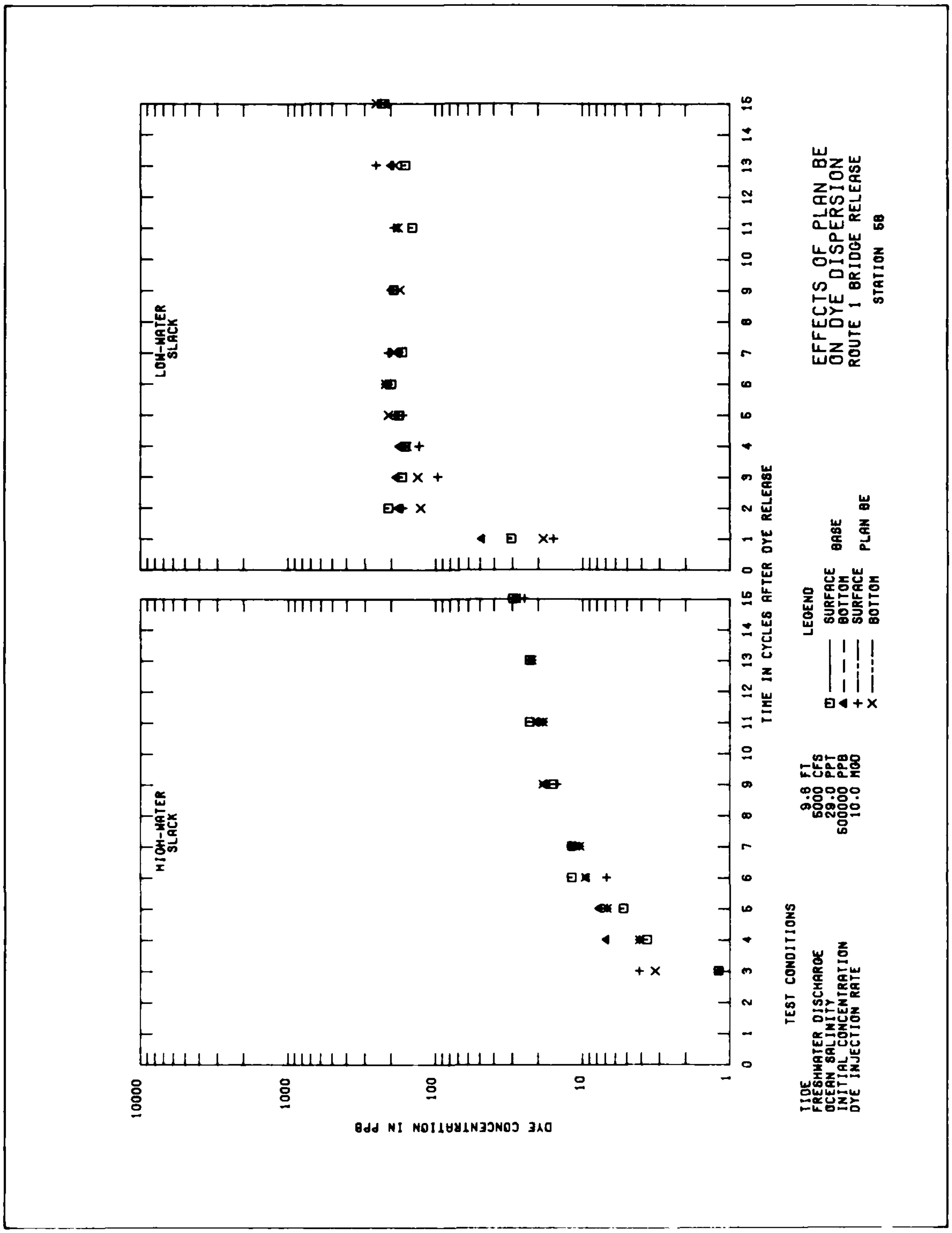
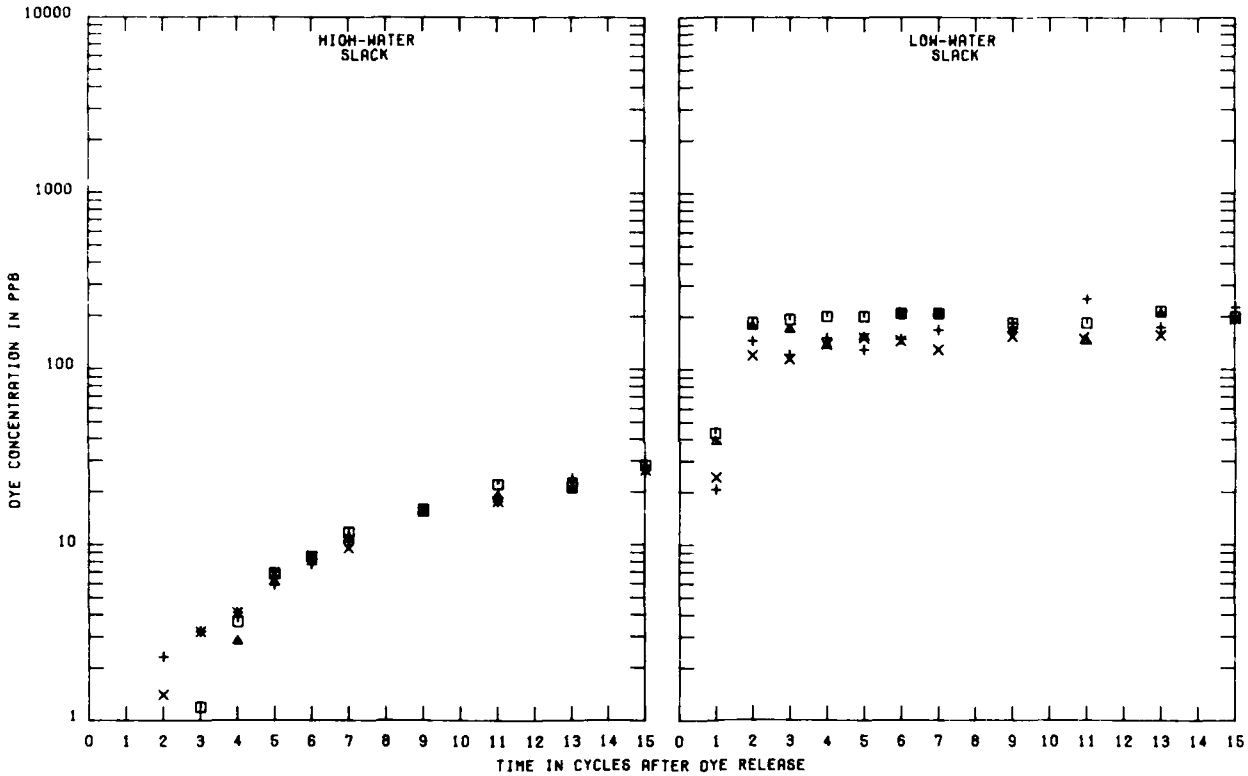

LOW-WATER SLACK
HIGH-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
TEST CONDITIONS
TIDE 9.8 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BE
EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 58

PLATE 312



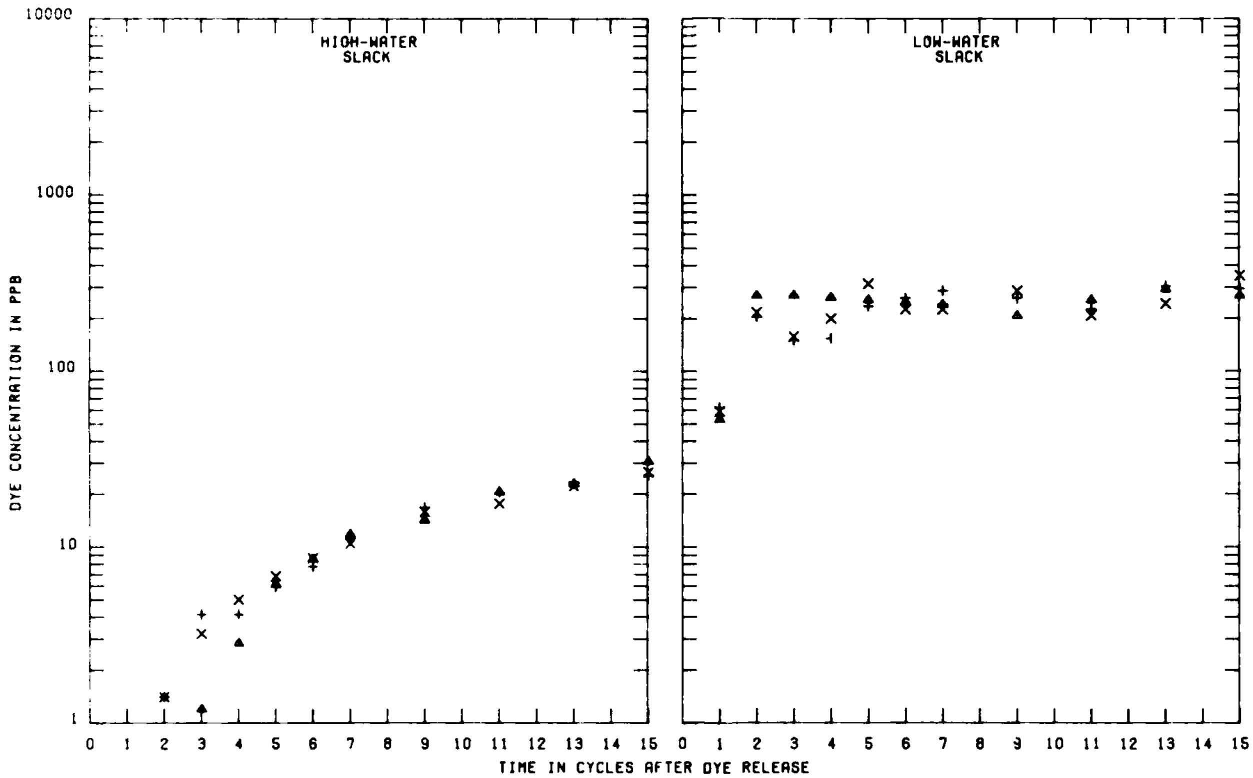
TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN BE
× —·—·—	BOTTOM	

EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 5C



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	600000 PPB
DYE INJECTION RATE	10.0 MOD

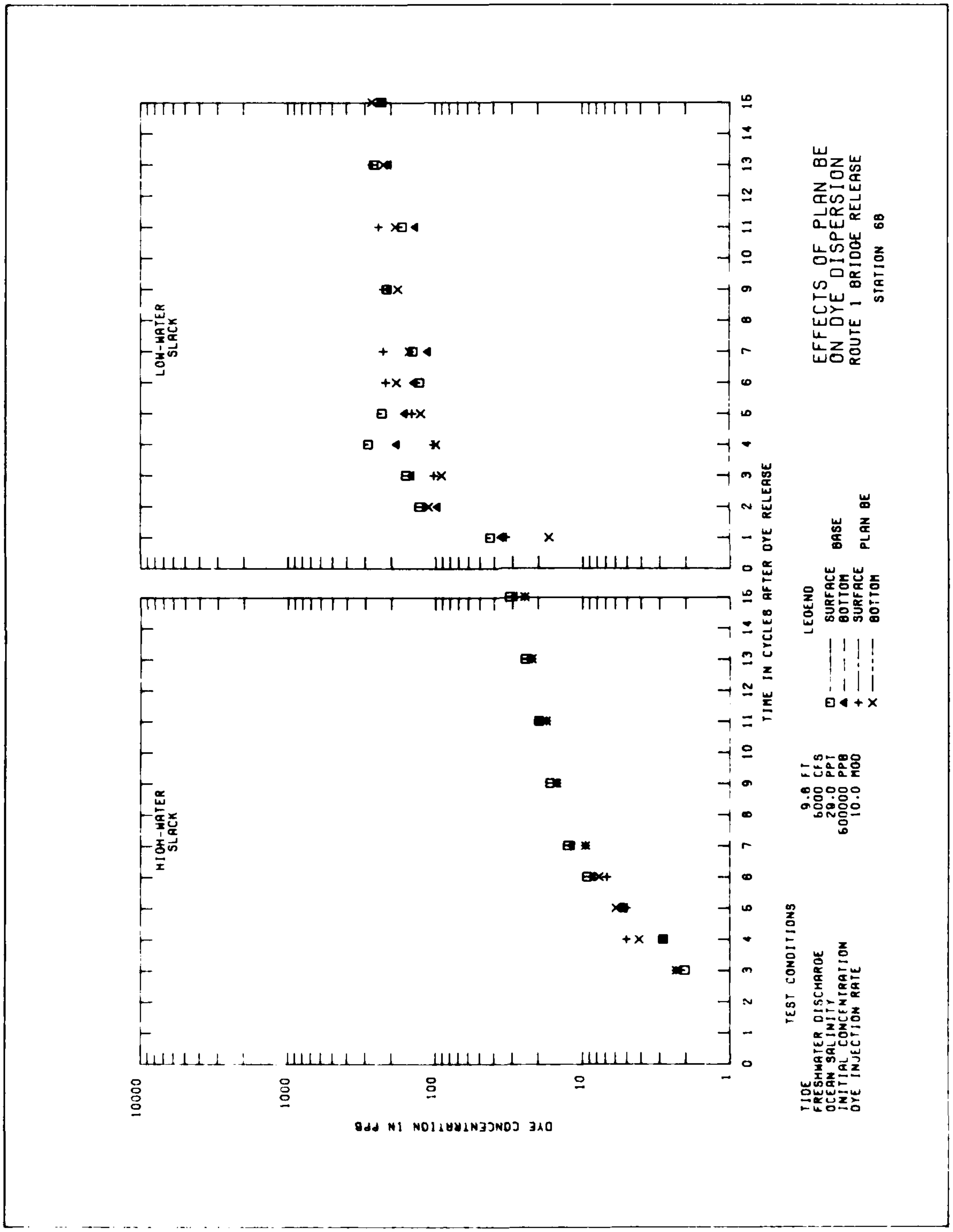
LEGEND

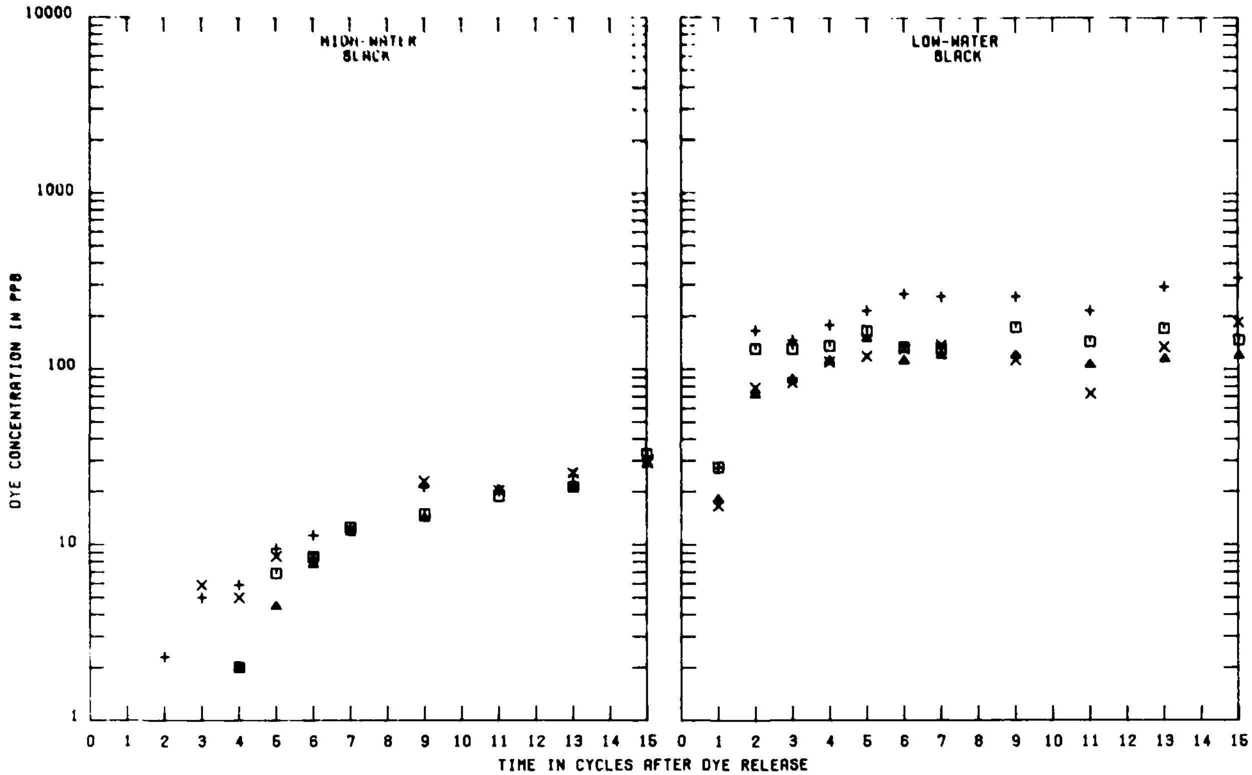
▲ — — — BOTTOM BASE
\+ —·—·— SURFACE PLAN BE
× —·—·— BOTTOM PLAN BE

EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 6A

PLATE 314


EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 6B
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.8 FT
FRESHWATER DISCHARGE 6000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 600000 PPB
DYE INJECTION RATE 10.0 MOD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BE



TEST CONDITIONS

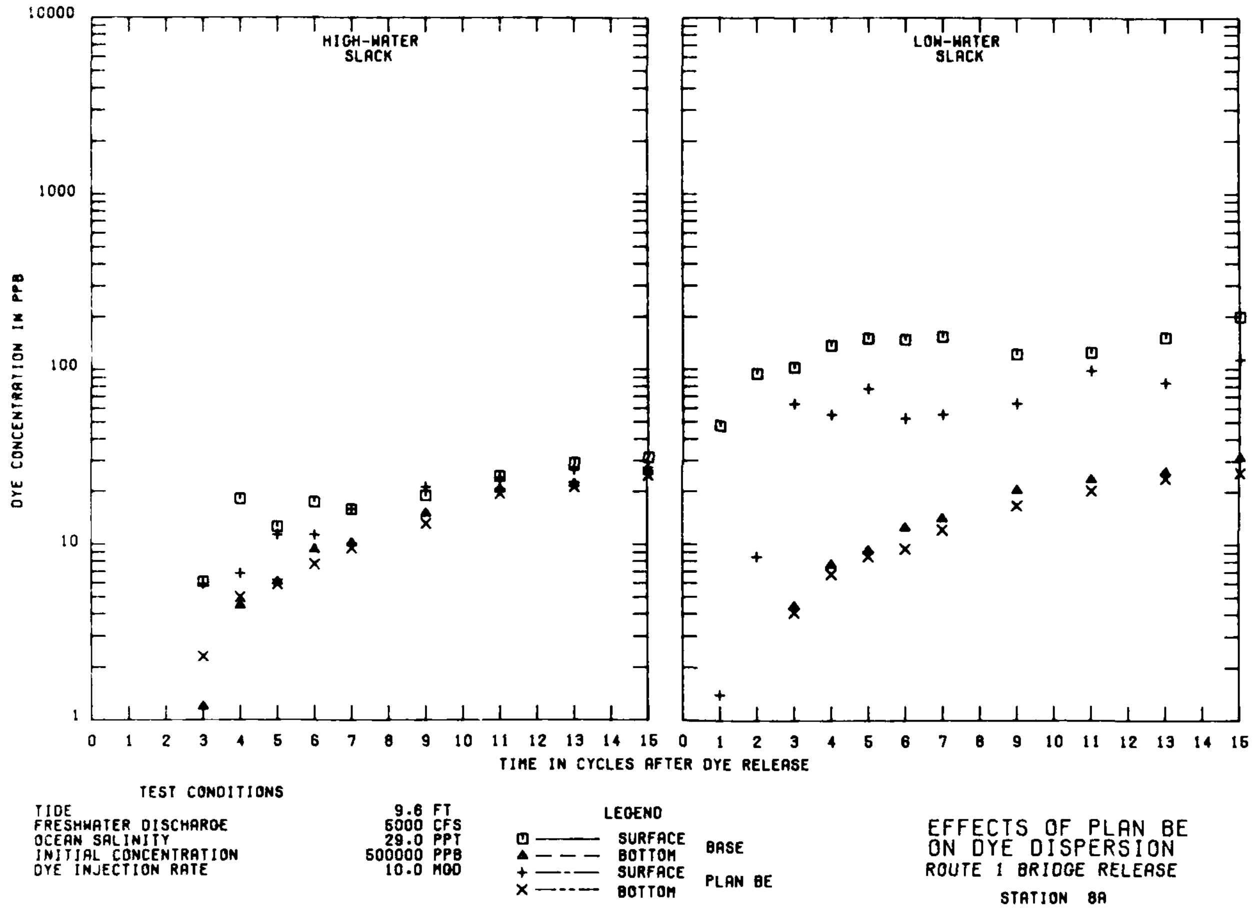
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN BE
× —··—··	BOTTOM	

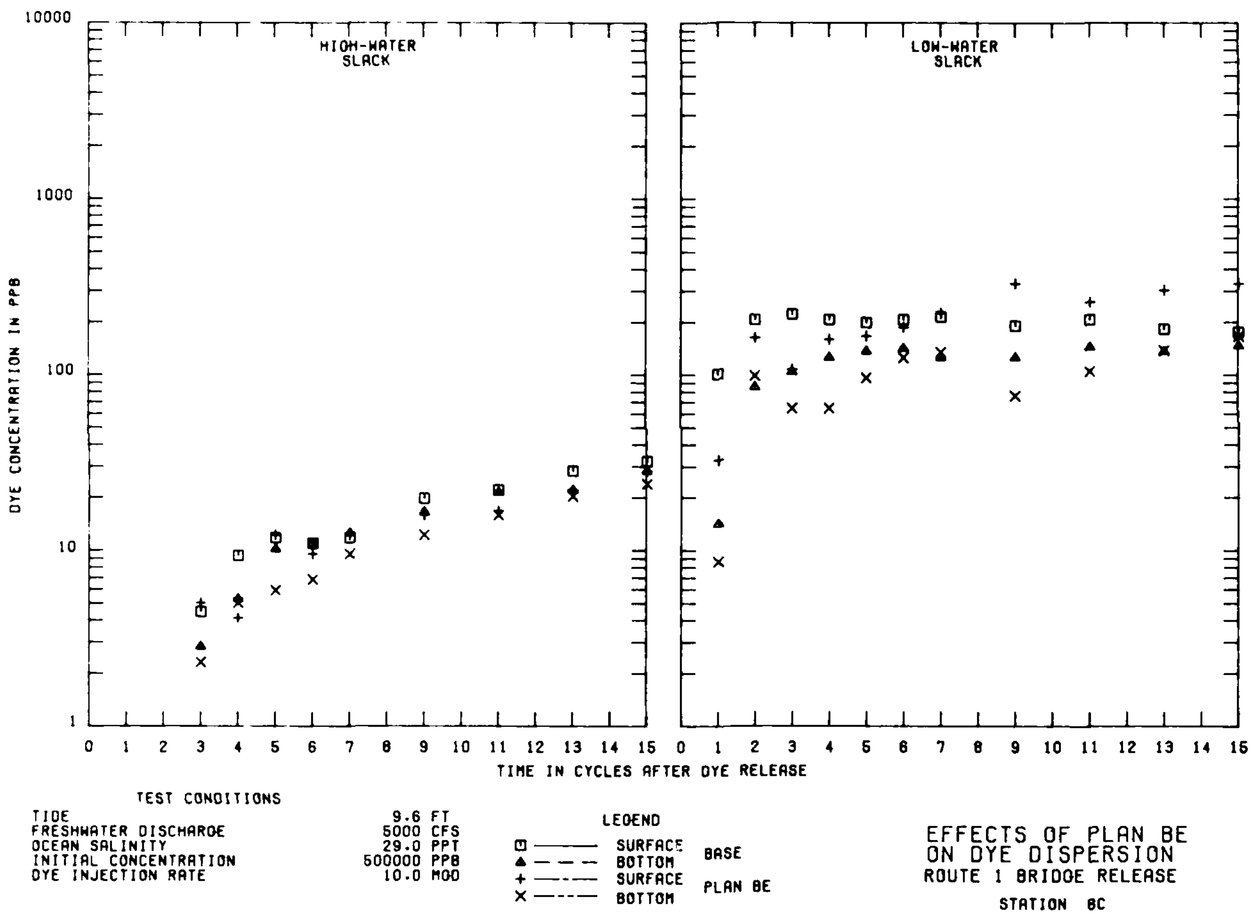
EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

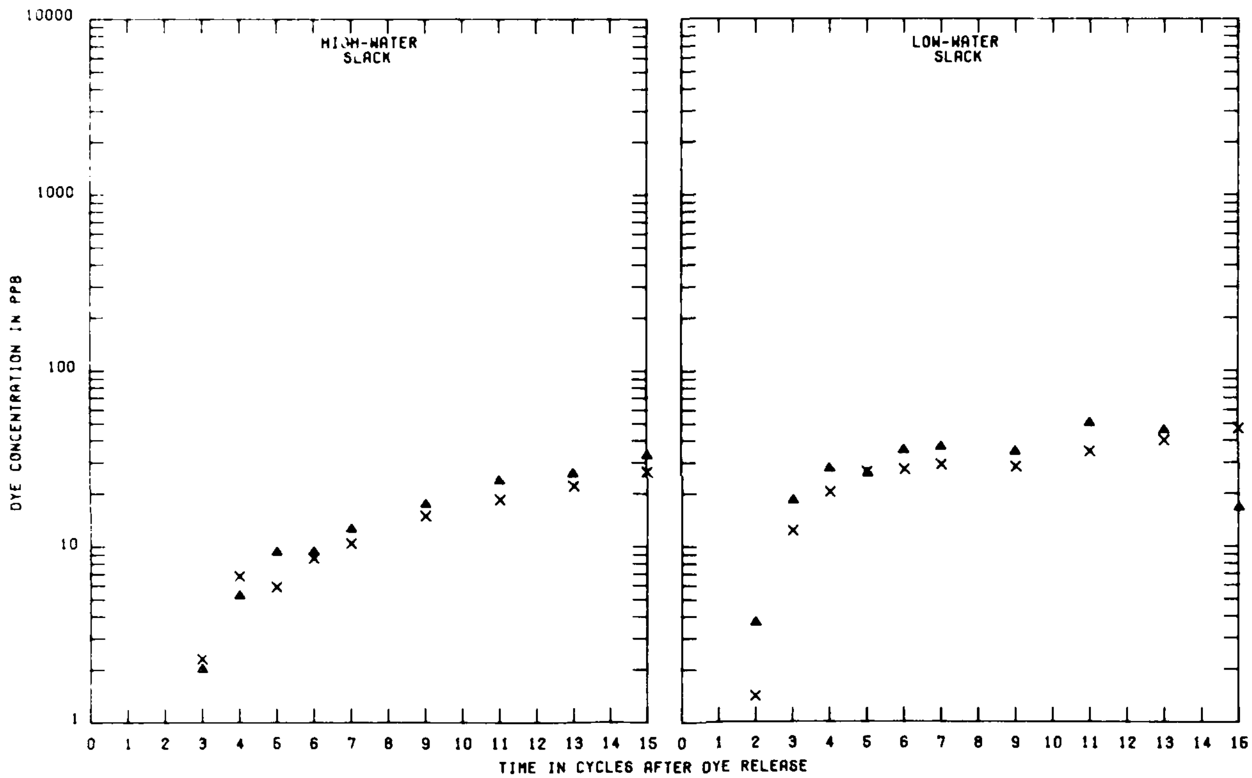
STATION 6C



EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 8A


HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BE
EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 8C



TEST CONDITIONS

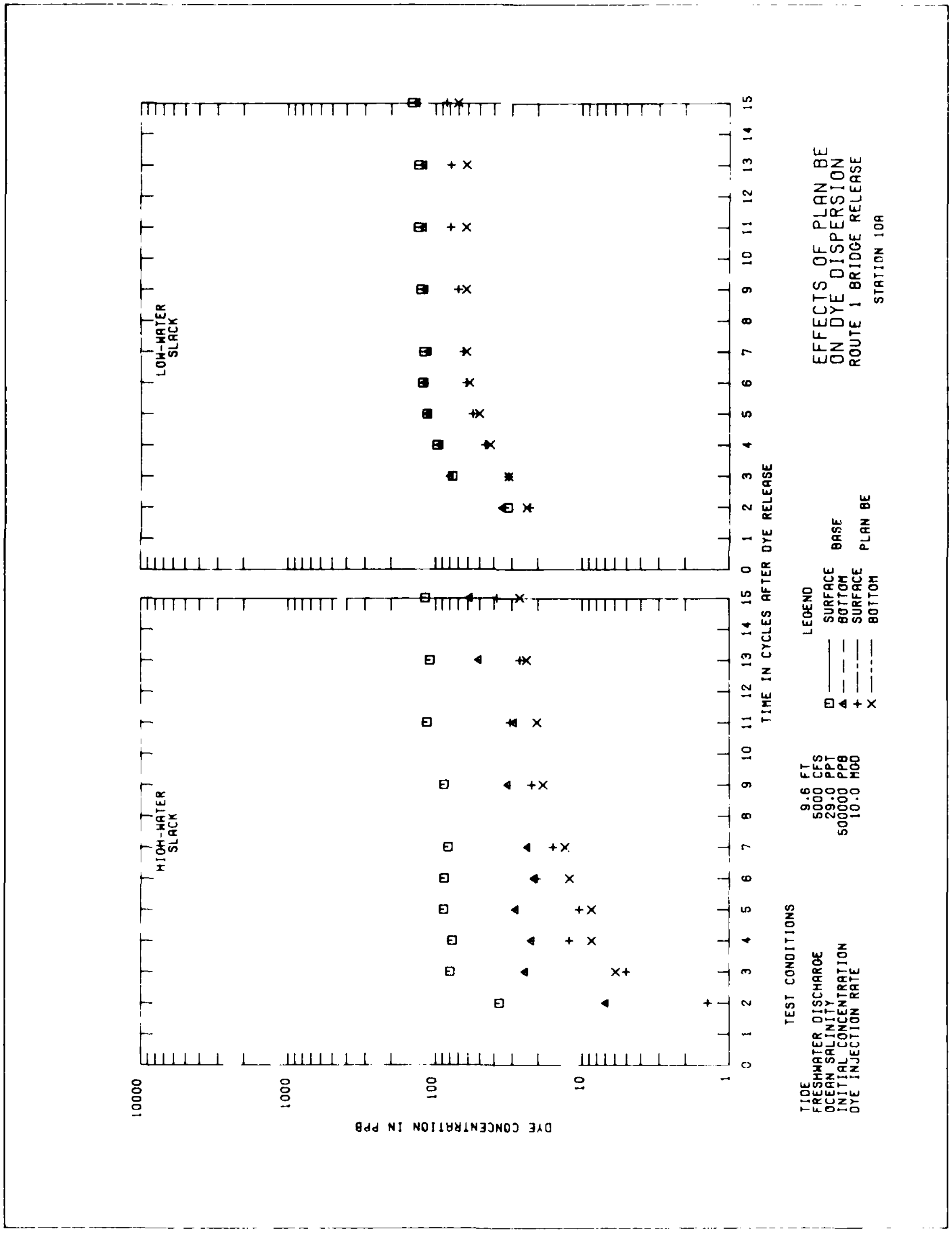
TIDE	9.6 FT
FRESHWATER DISCHARGE	6000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

▲ — - - — BOTTOM BASE

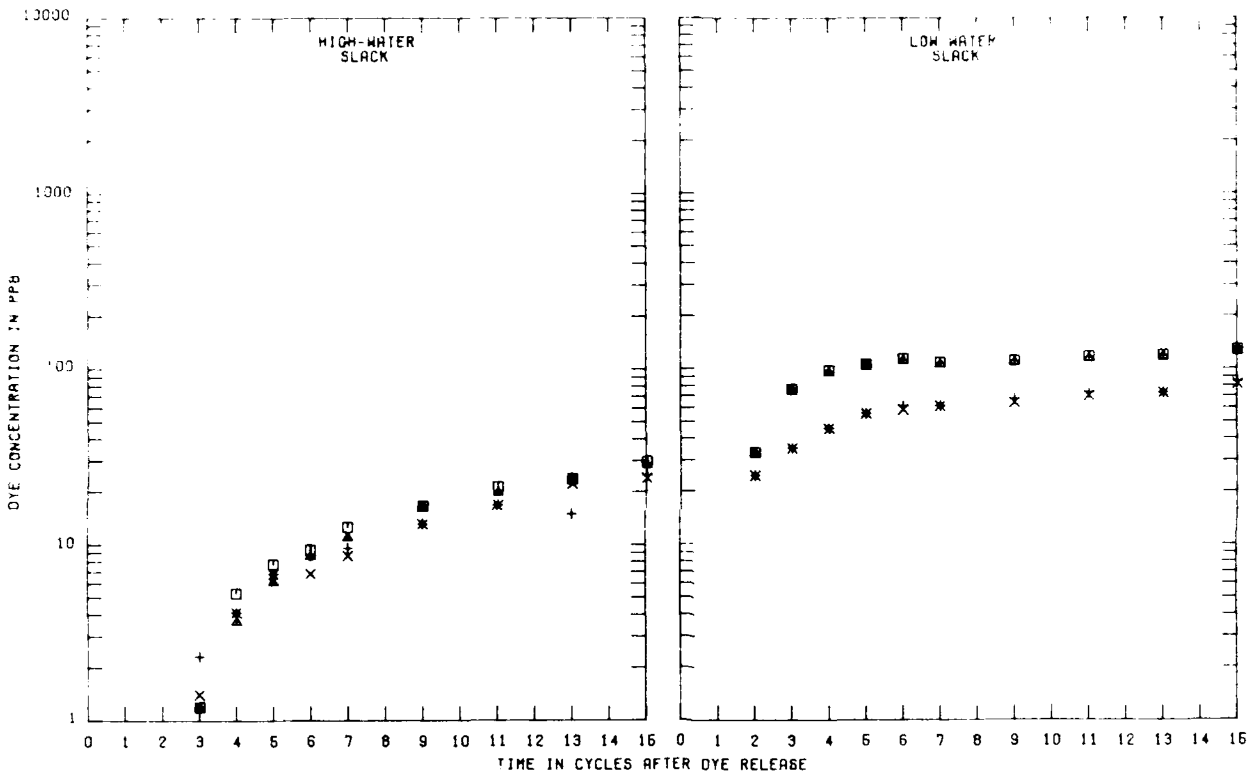
× —-·-— BOTTOM PLAN BE

EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 8D



EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 10A
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MOD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BE

PLATE 320



TEST CONDITIONS

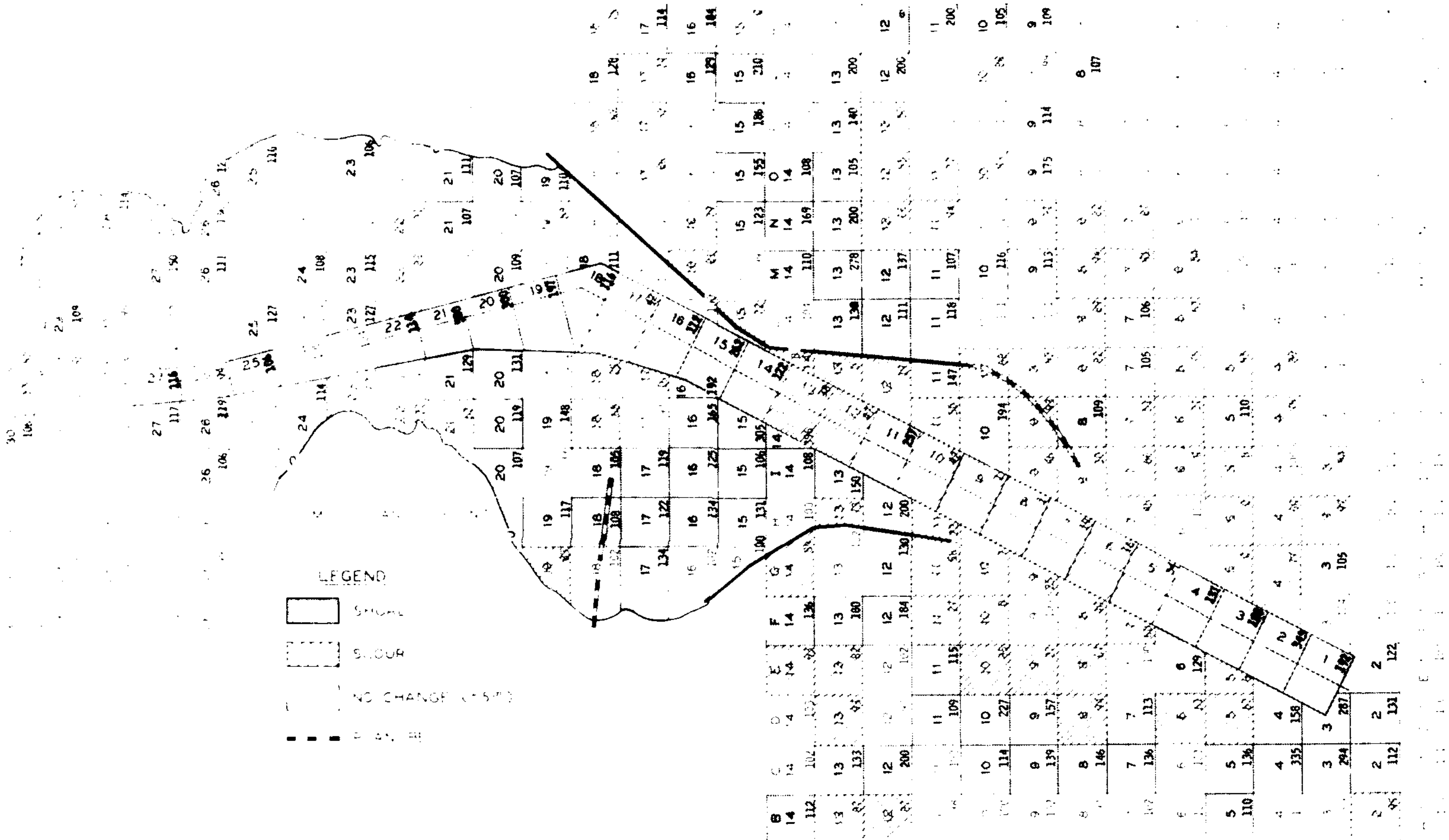
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

□ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN BE
× ------	BOTTOM	

EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

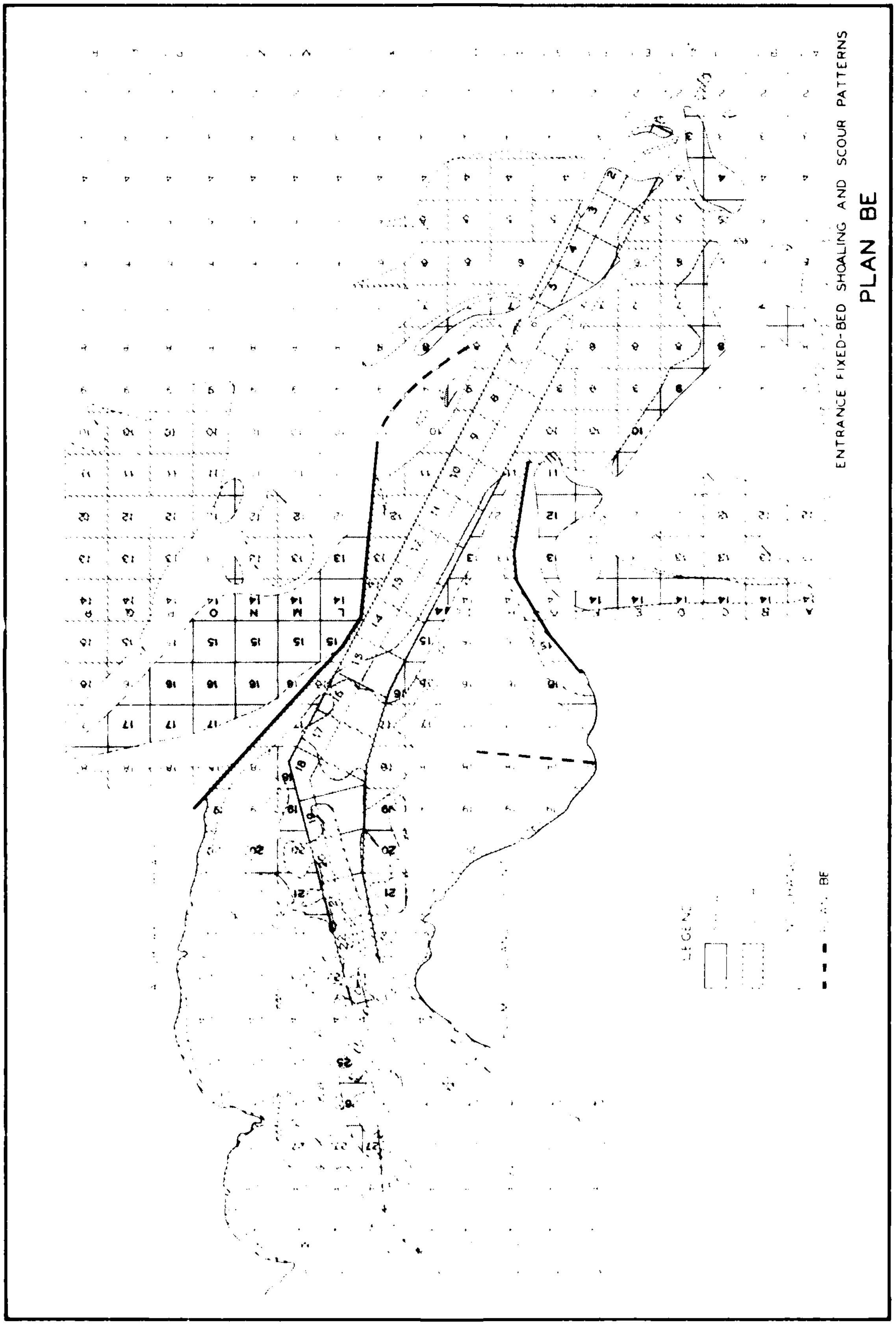
STATION 108



NOTE: A VALUE OF 100% INDICATES NO CHANGE; VALUES GREATER THAN 100% INDICATE AREAS OF SHOALING, WHILE VALUES LESS THAN 100% INDICATE AREAS OF SCOUR. AREAS WHERE EFFECTS WERE WITHIN PLUS OR MINUS 5% ARE CONSIDERED NOT CHANGED

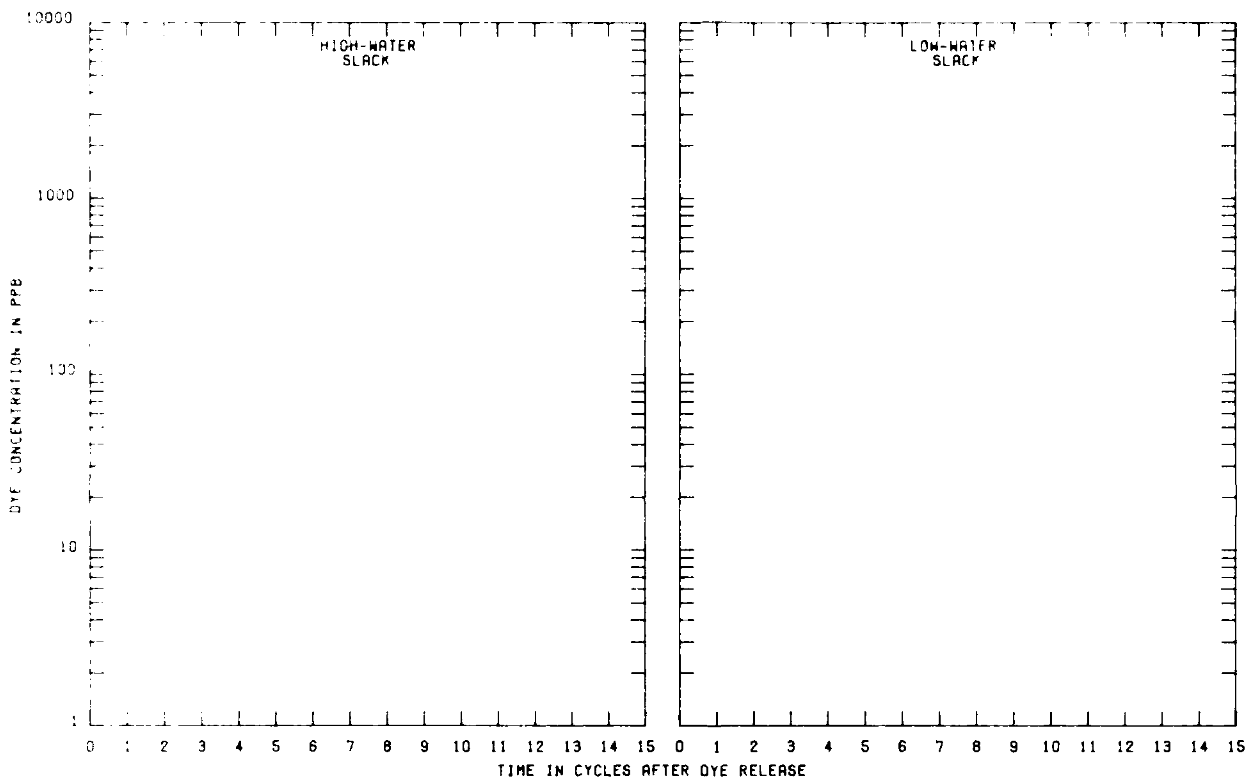
ENTRANCE FIXED-BED SHOALING AND SCOUR
IN PERCENT OF BASE

PLAN BE



ENTRANCE FIXED-BED SHOALING AND SCOUR PATTERNS

PLAN BE



TEST CONDITIONS

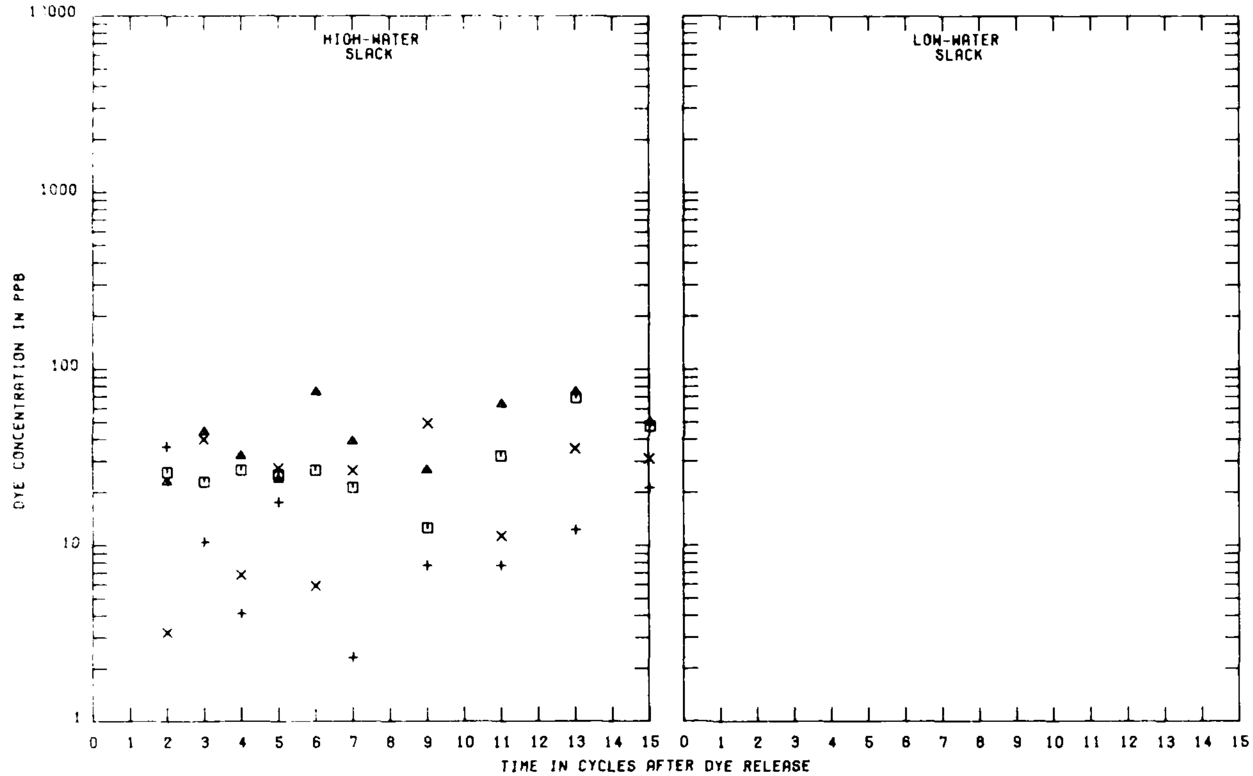
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN BE
× —··—··	BOTTOM	

EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 56A



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	600000 PPB
DYE INJECTION RATE	10.0 MOO

LEGEND

□ SURFACE, ▲ BOTTOM — BASE
+ SURFACE, × BOTTOM — PLAN BE

EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 50A

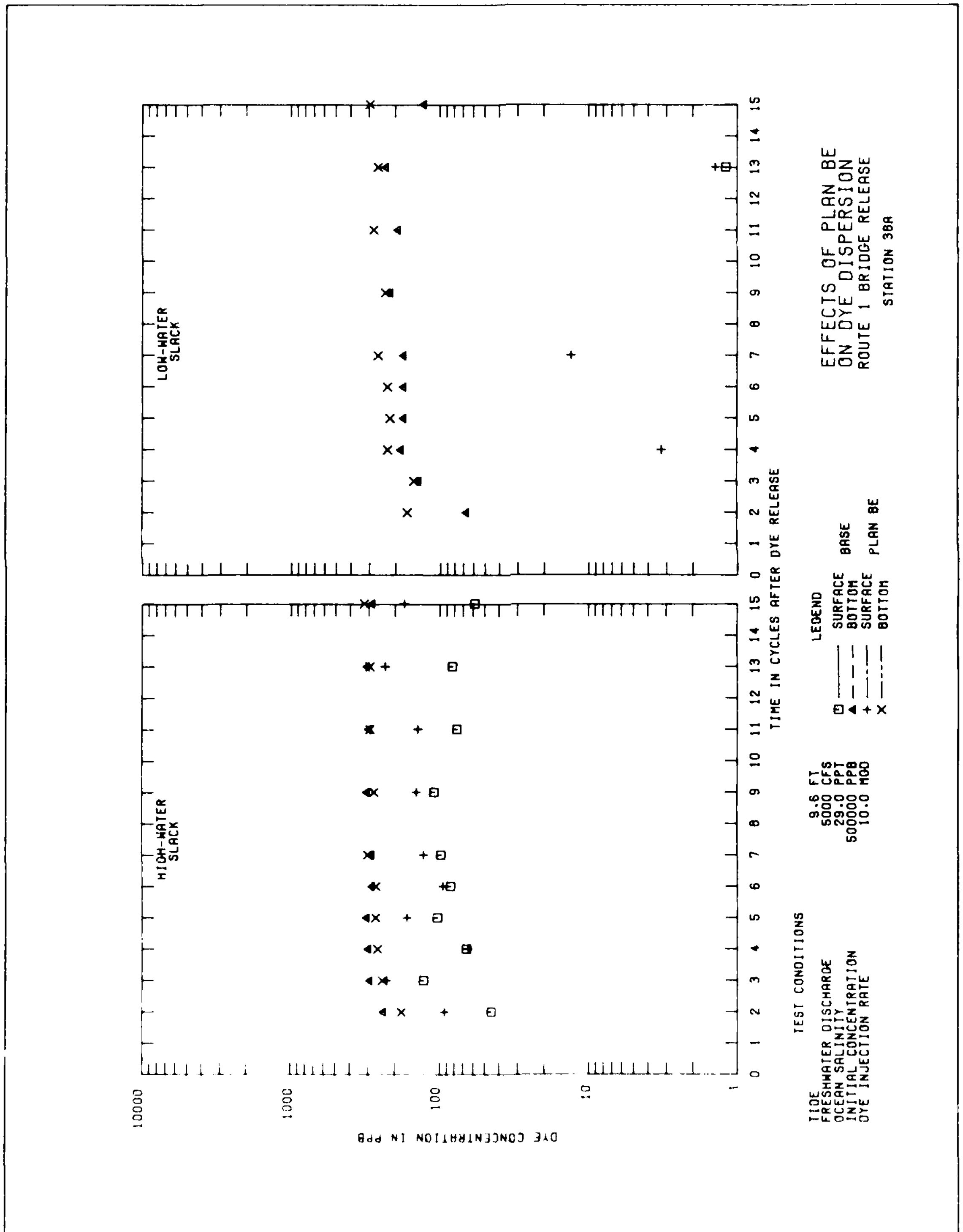
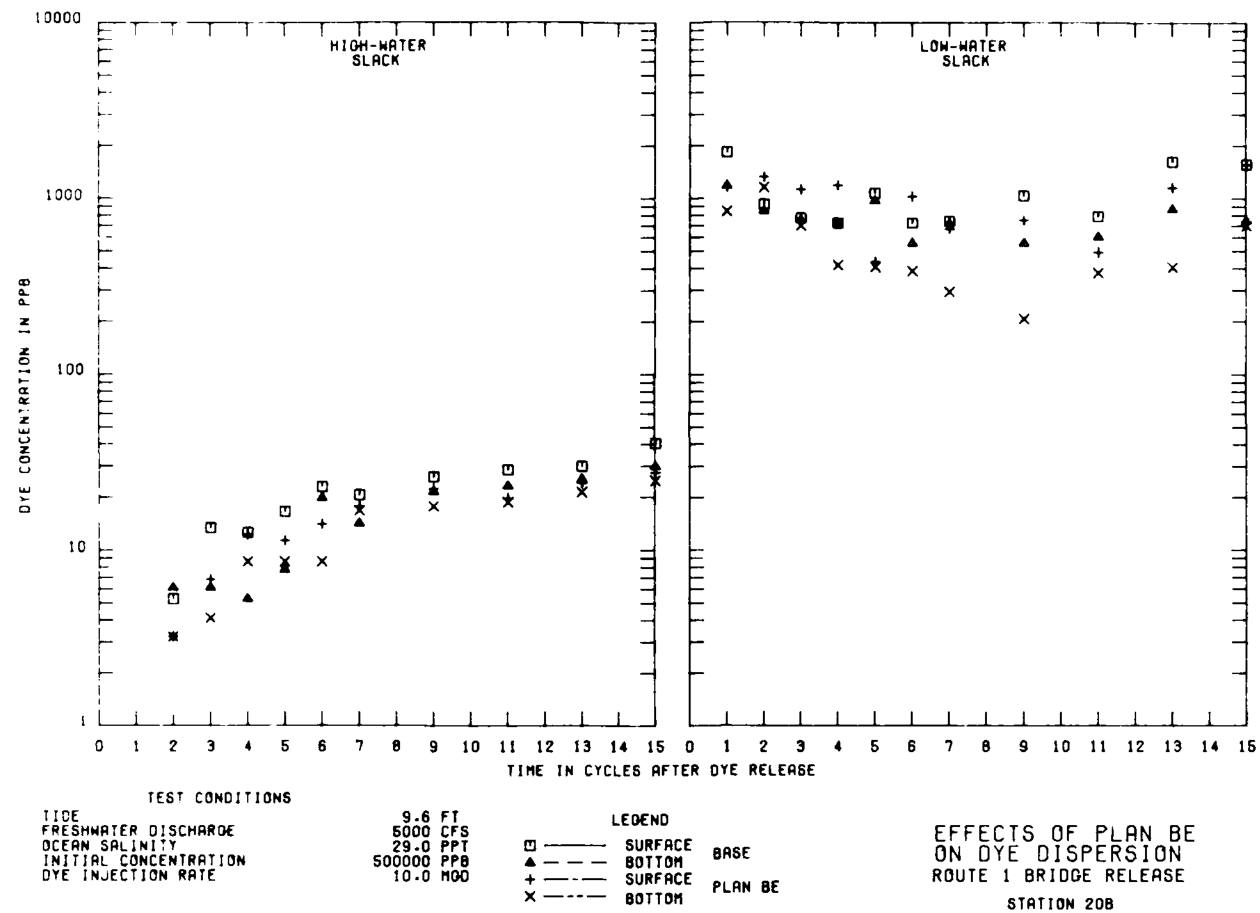
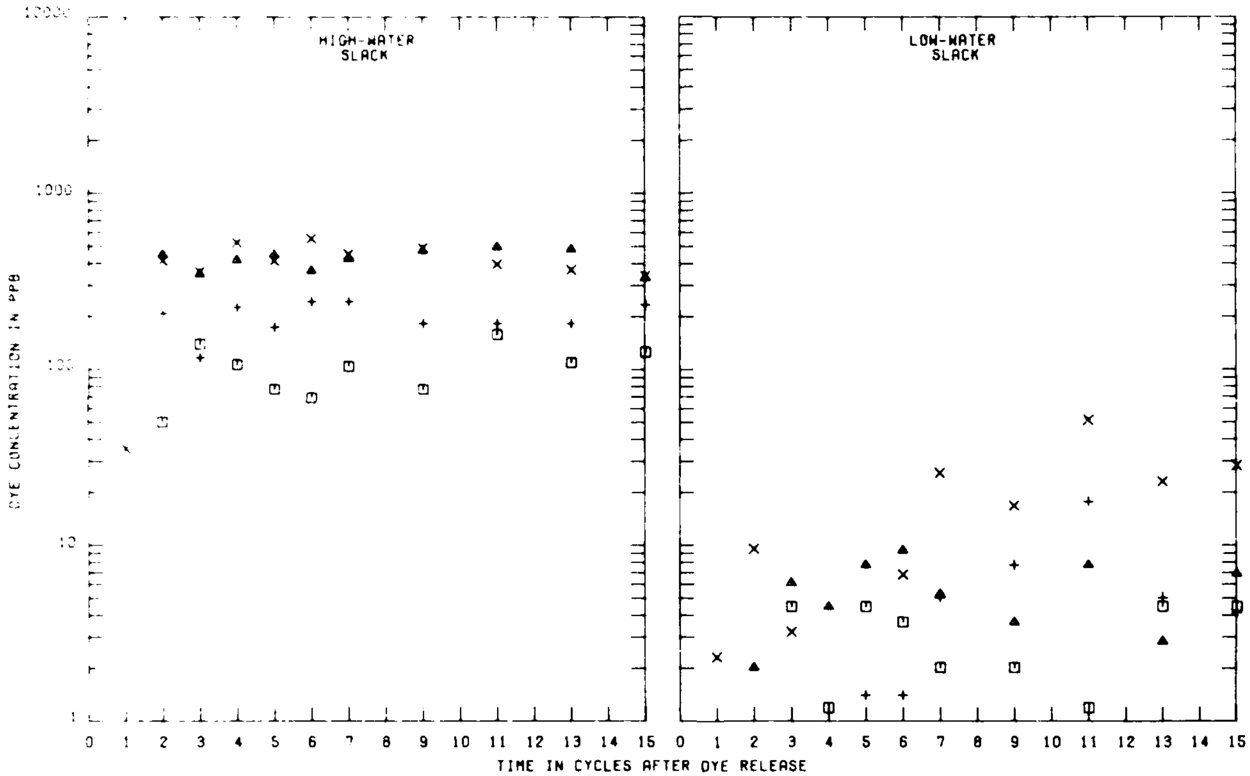

EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 38A
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BE

PLATE 331



EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 20B



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	600000 PPB
DYE INJECTION RATE	10.0 MGD

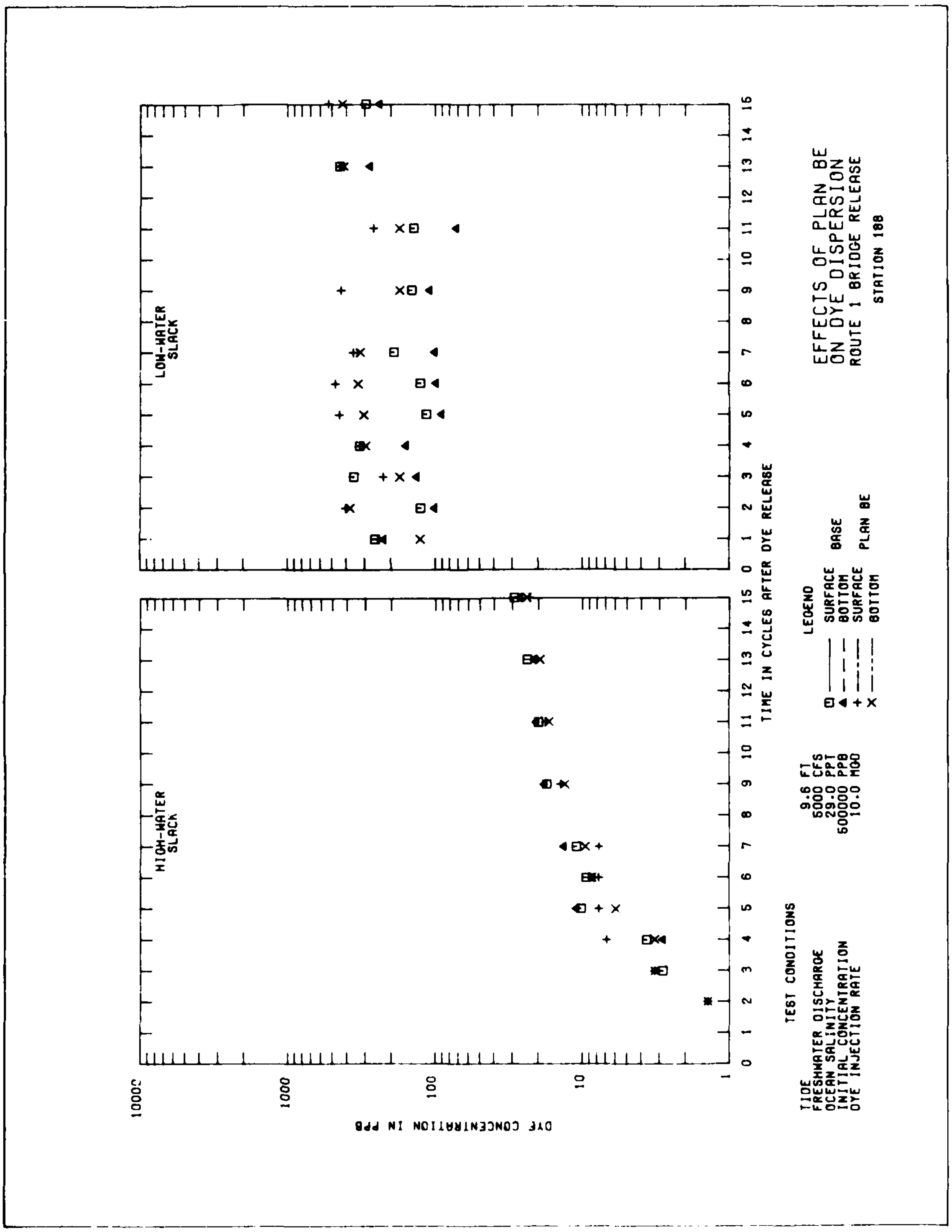
LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN BE
× —··—··	BOTTOM	

EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

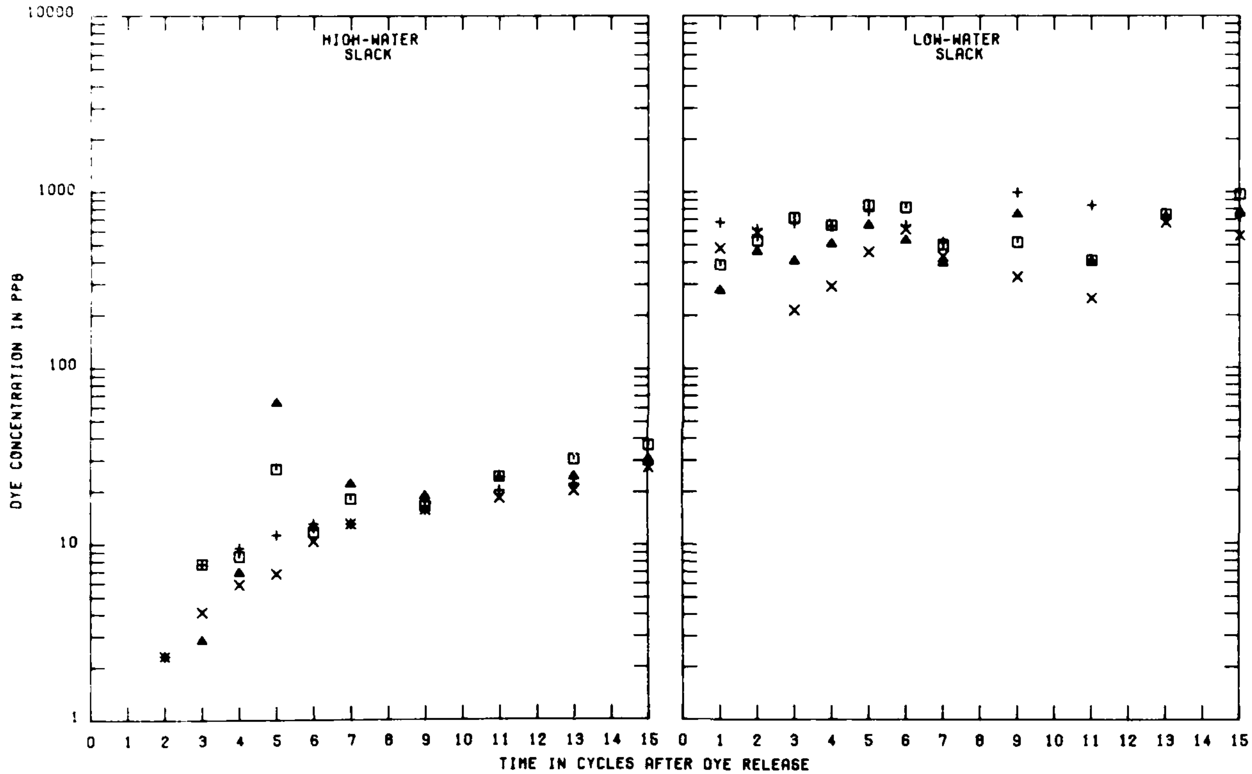
STATION 26A

PLATE 53



EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 188
LOW-WATER SLACK
HIGH-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MOD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BE

PLATE 328



TEST CONDITIONS

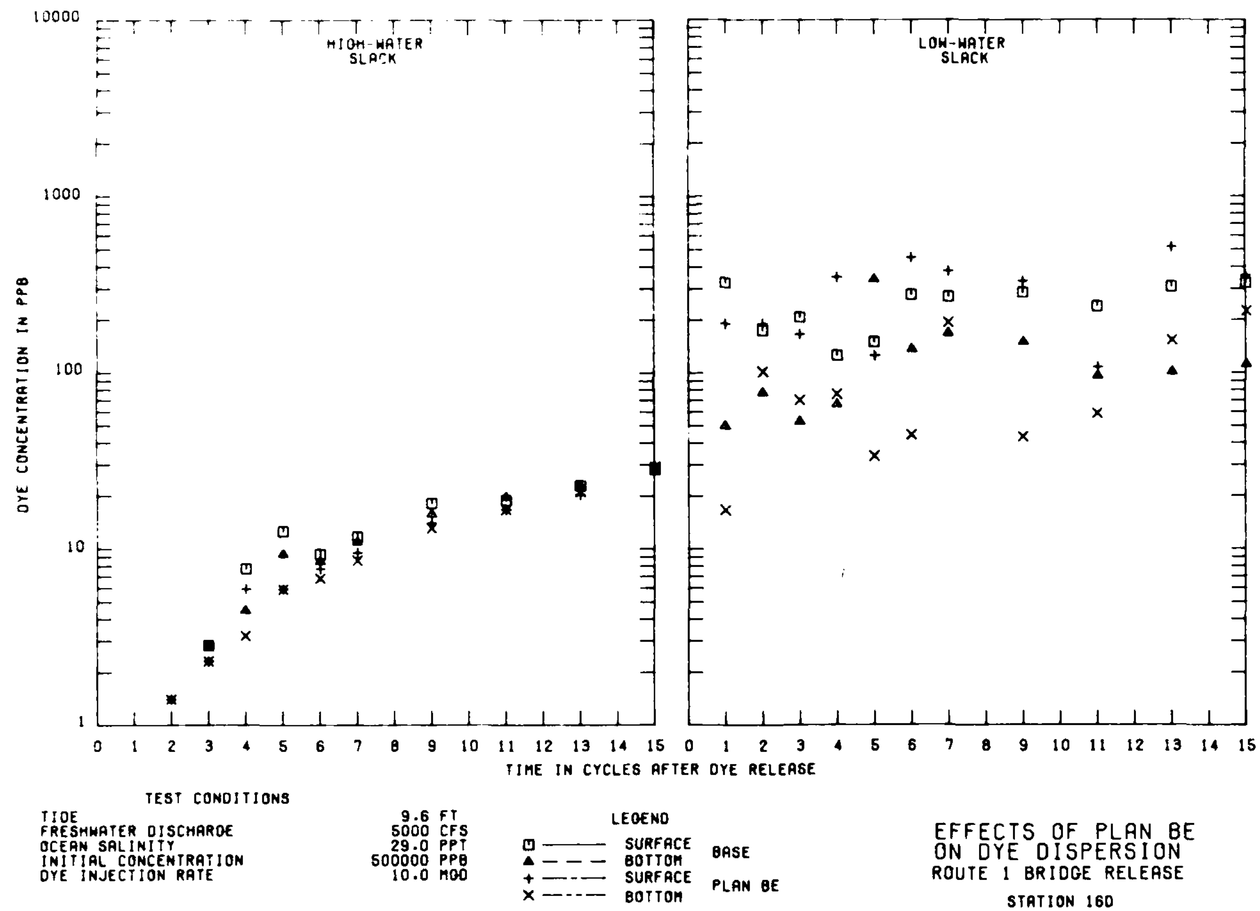
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN BE
× —··—··	BOTTOM	

EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 10A



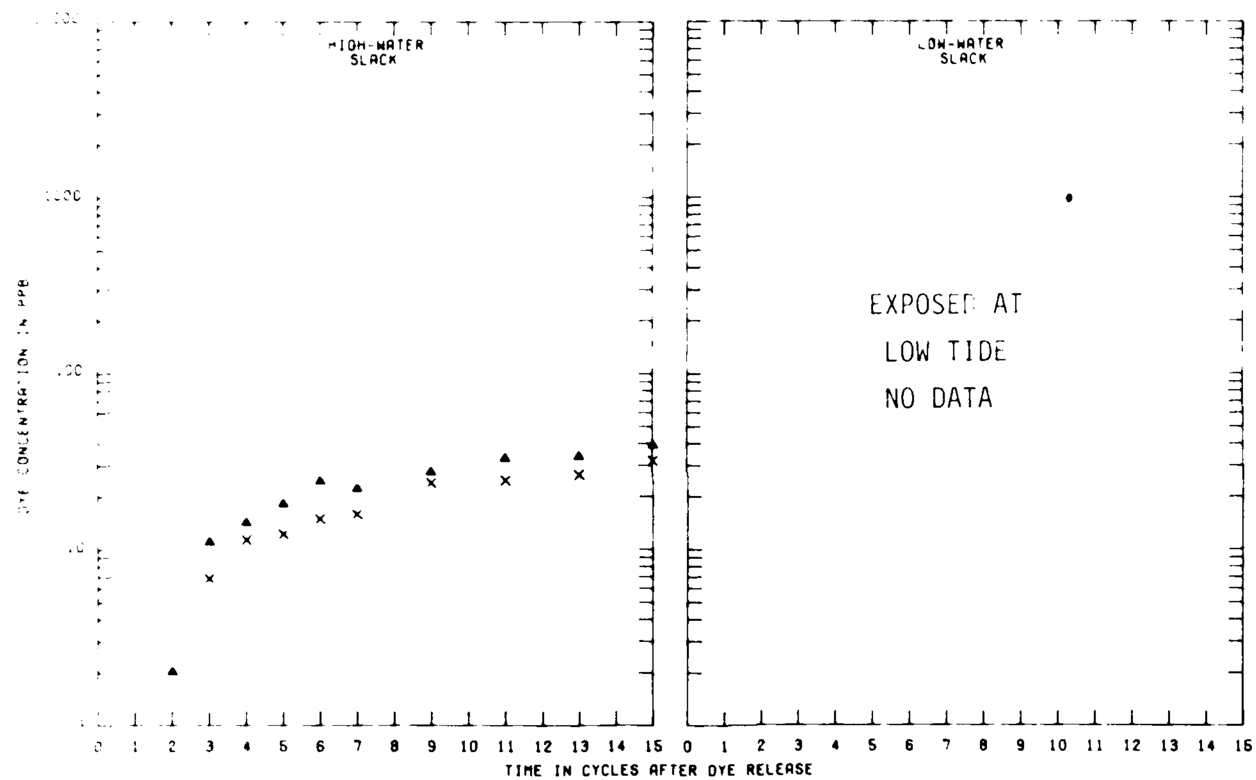
TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 160

PLATE 326



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

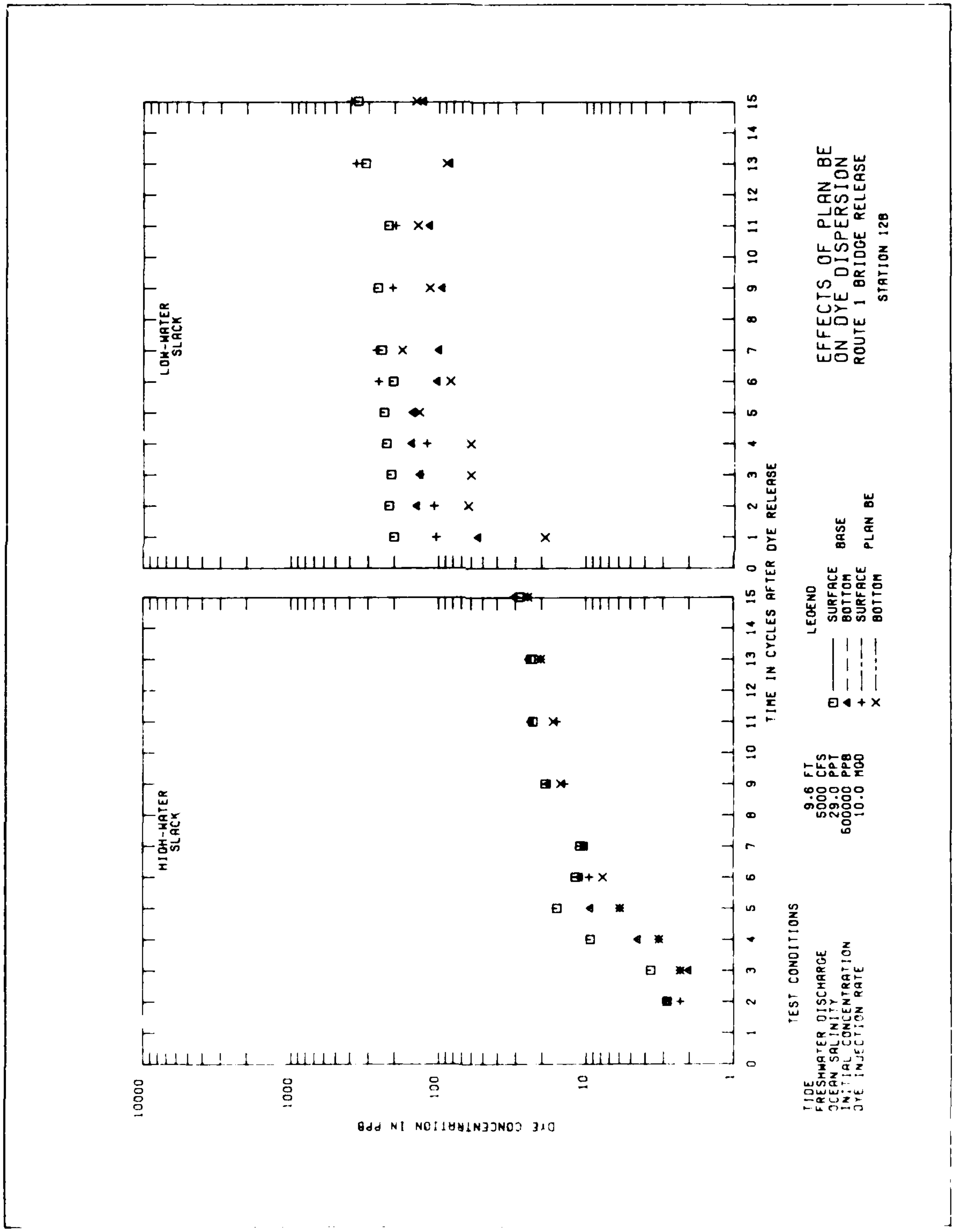
LEGEND

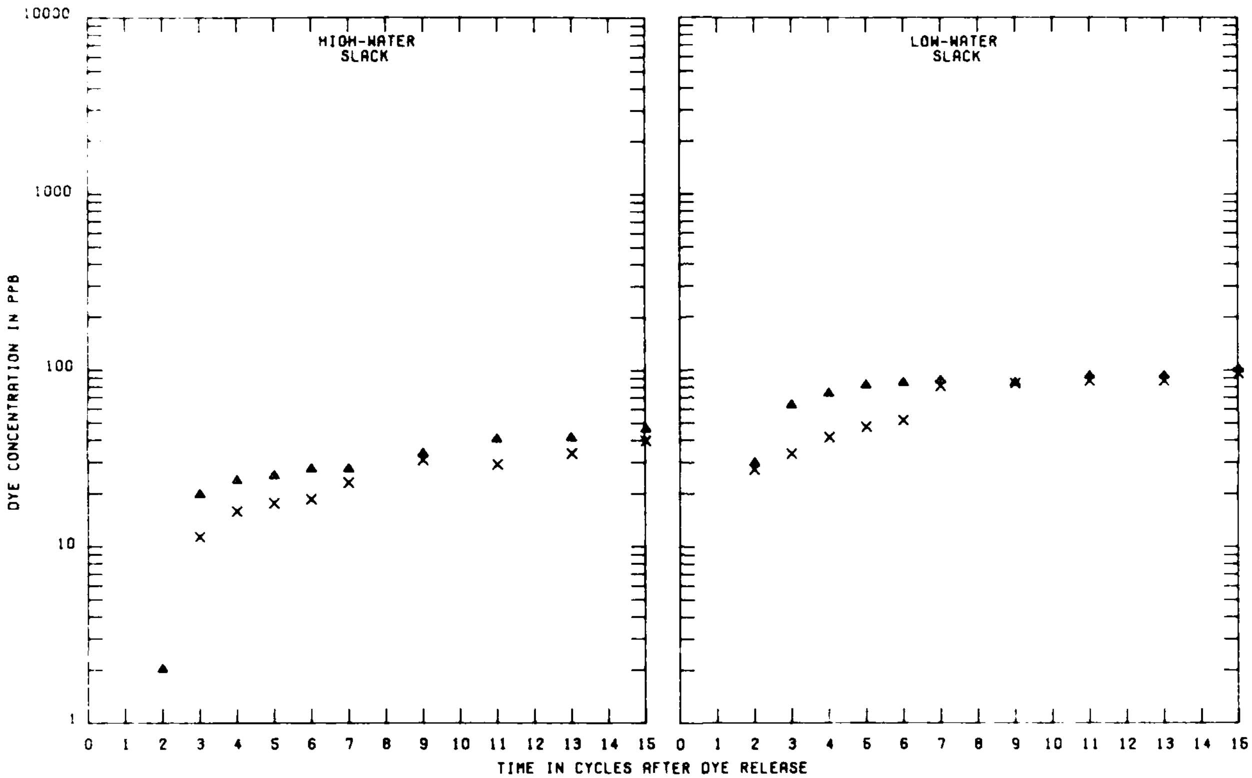
▲ — — — BOTTOM BASE

× —·—·— BOTTOM PLAN BE

EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 18A


EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 12B
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 600000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BE



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	600000 PPB
DYE INJECTION RATE	10.0 MGD

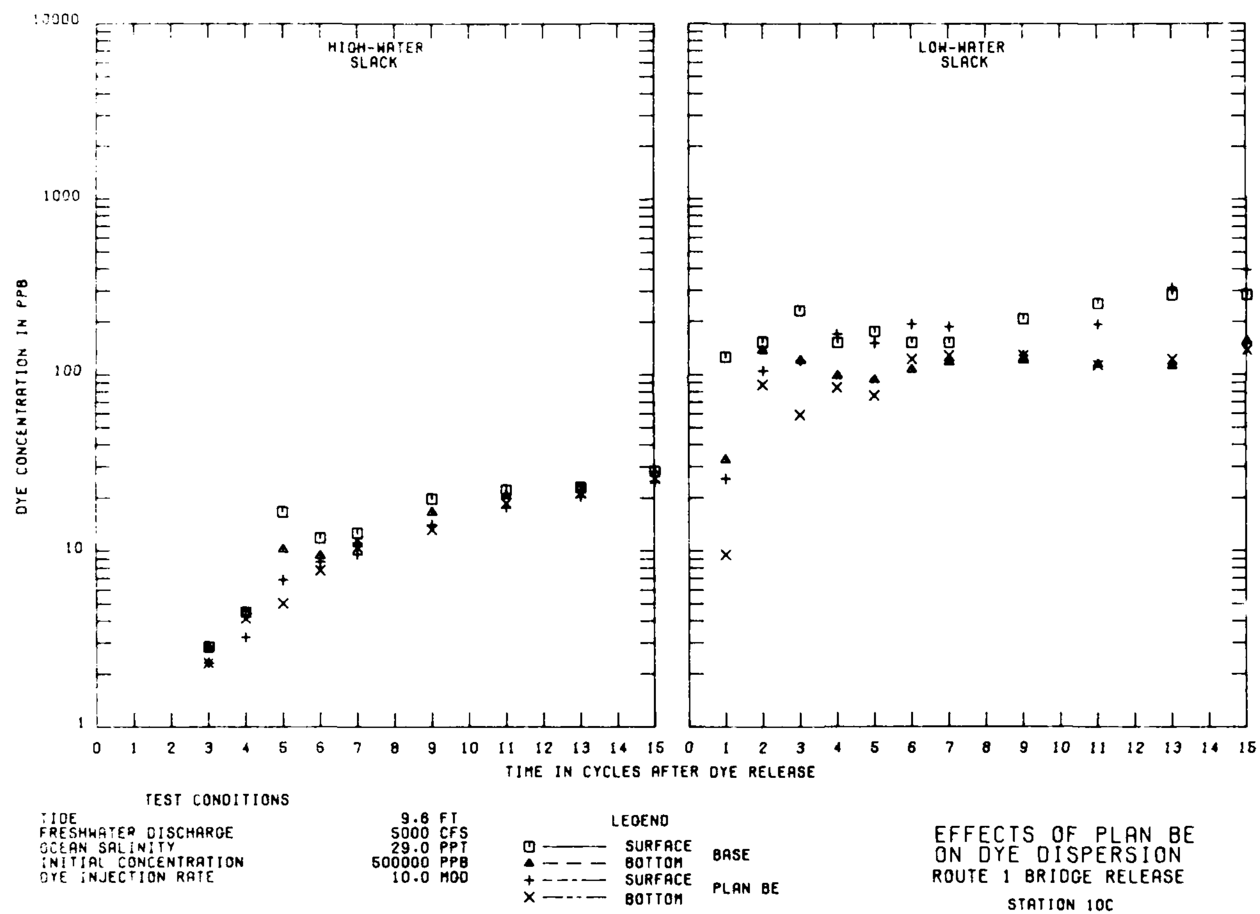
LEGEND

▲ — — — BOTTOM BASE

× ——— BOTTOM PLAN BE

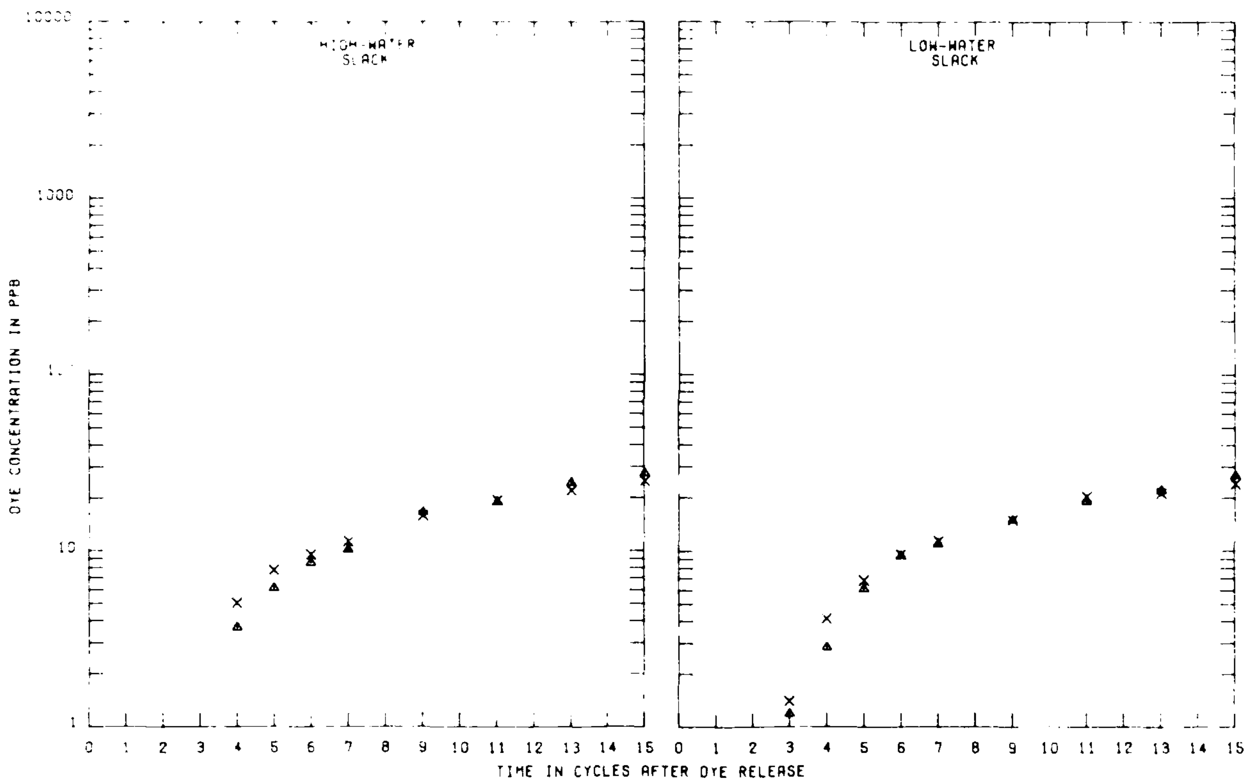
EFFECTS OF PLAN BE
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 12A



EFFECTS OF PLAN BE ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 10C

PLATE 322



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

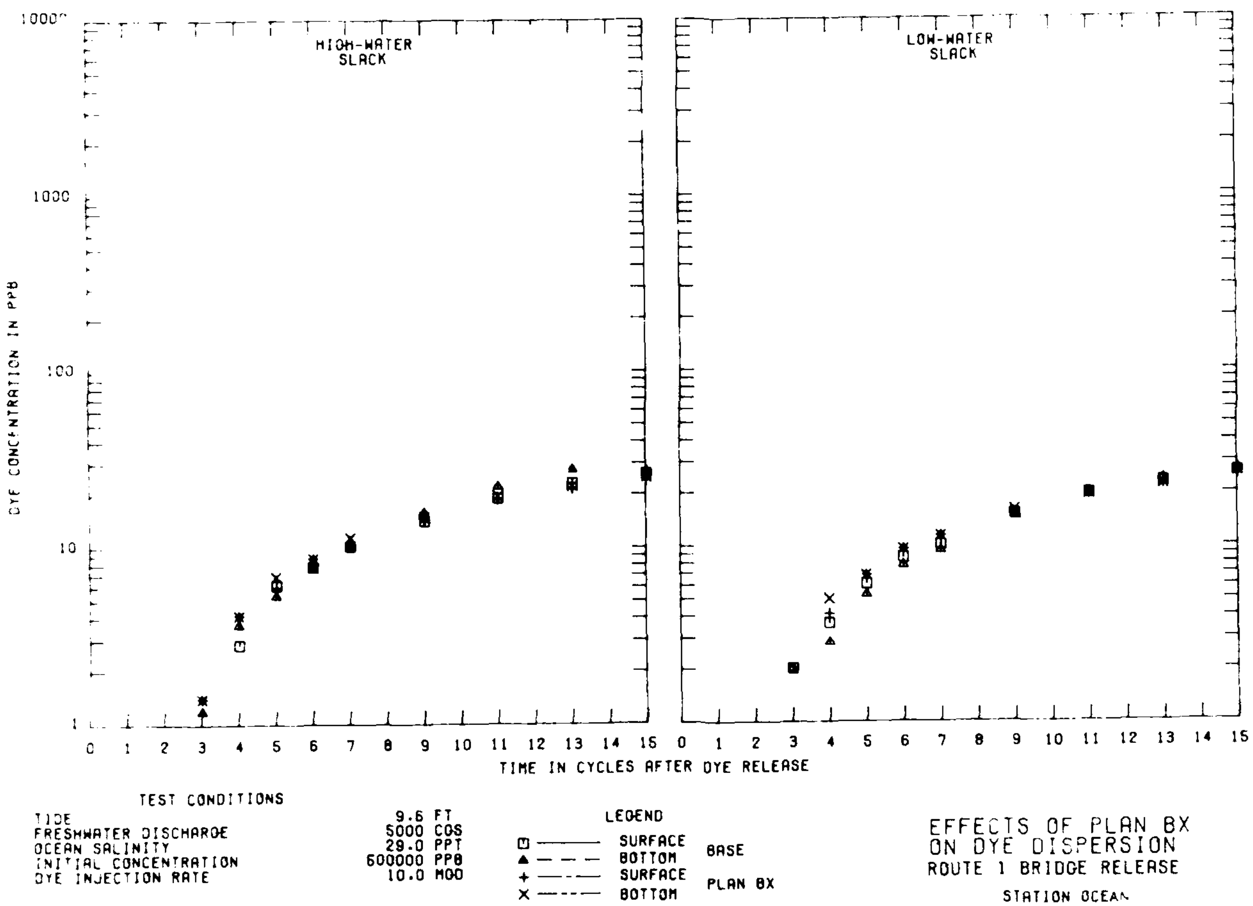
▲ — — — BOTTOM BASE

× ------- BOTTOM PLAN BX

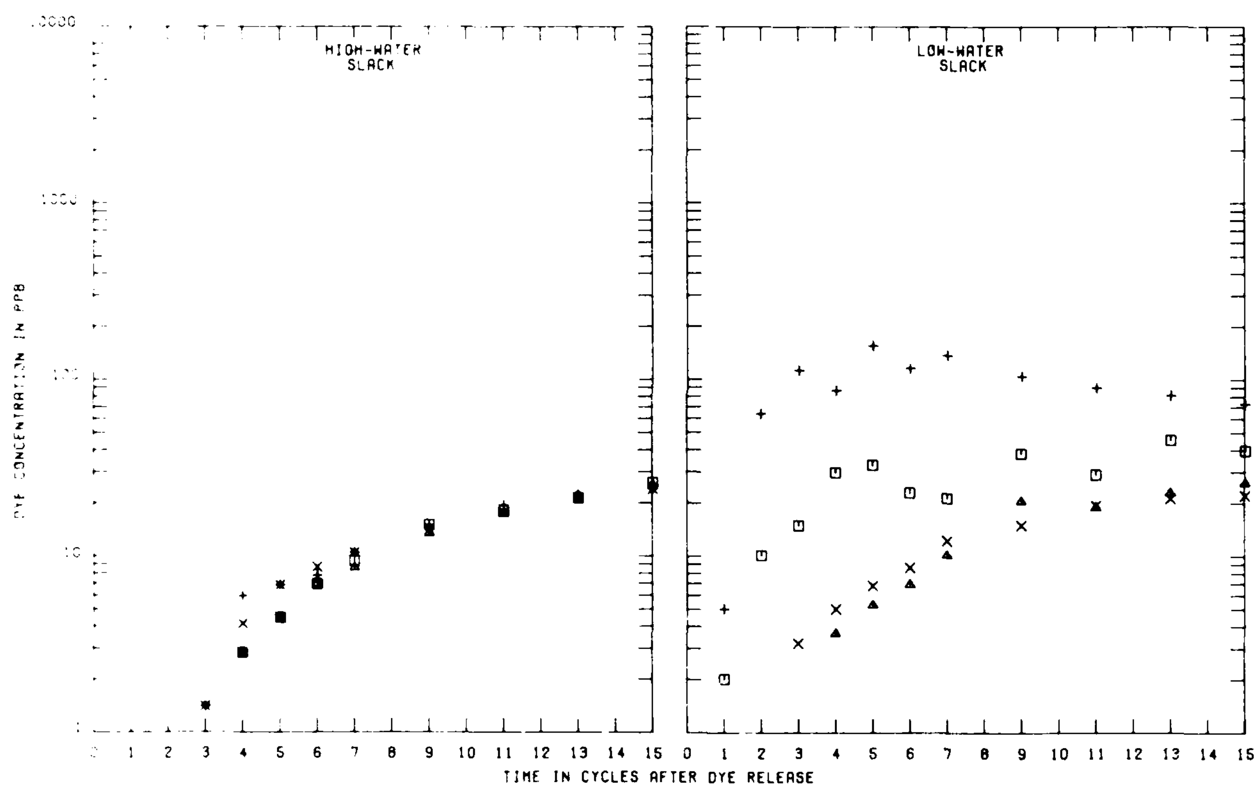
EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION SUMP

PLATE 336



HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 600000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BX
EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION OCEAN



TEST CONDITIONS

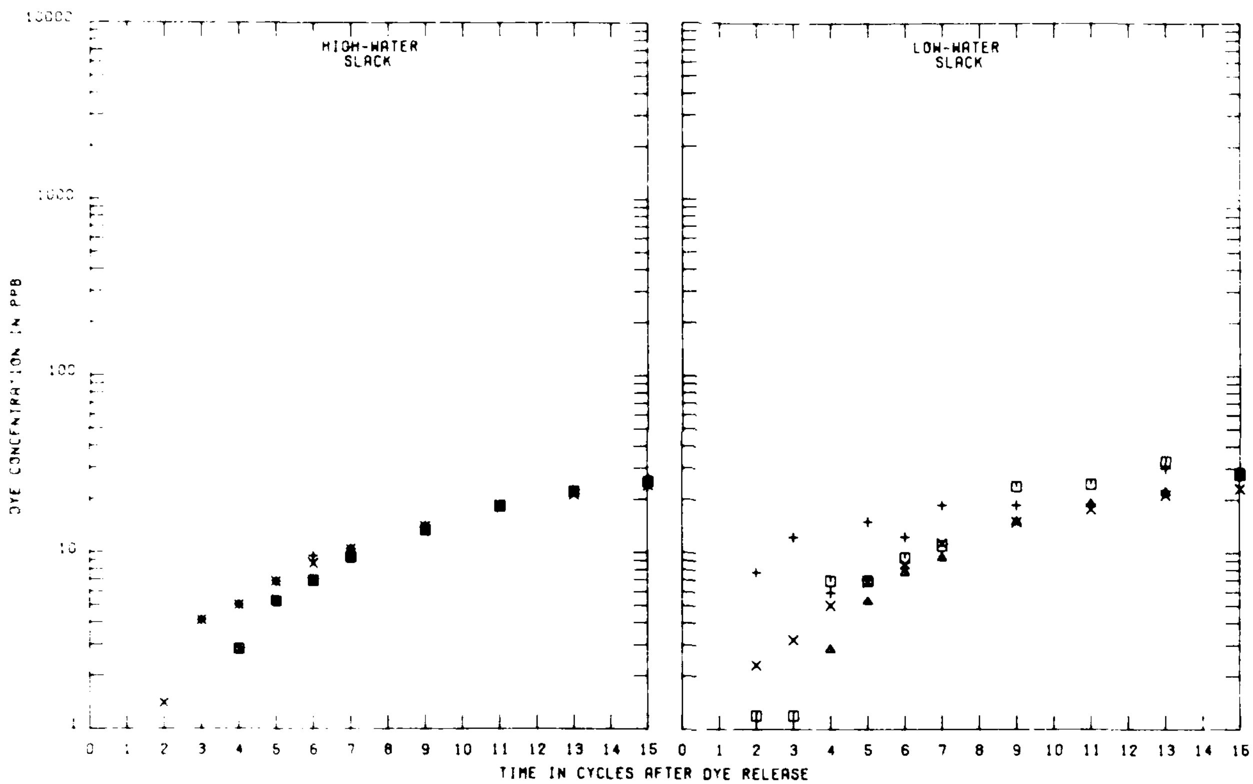
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MOD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	BASE
+ —·—·—	SURFACE	PLAN BX
× —··—··	BOTTOM	PLAN BX

EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 0A



TEST CONDITIONS

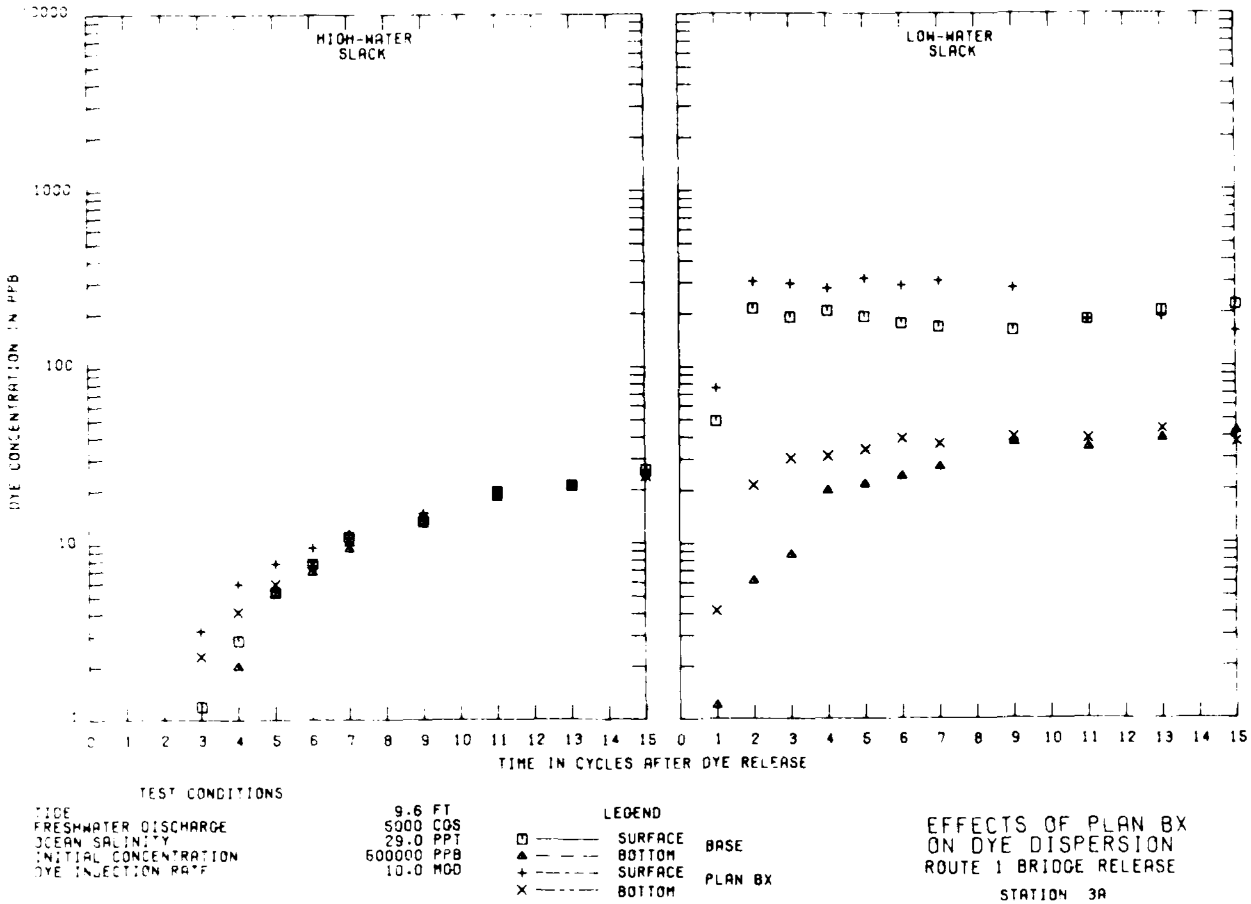
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—	SURFACE	PLAN BX
× -----	BOTTOM	

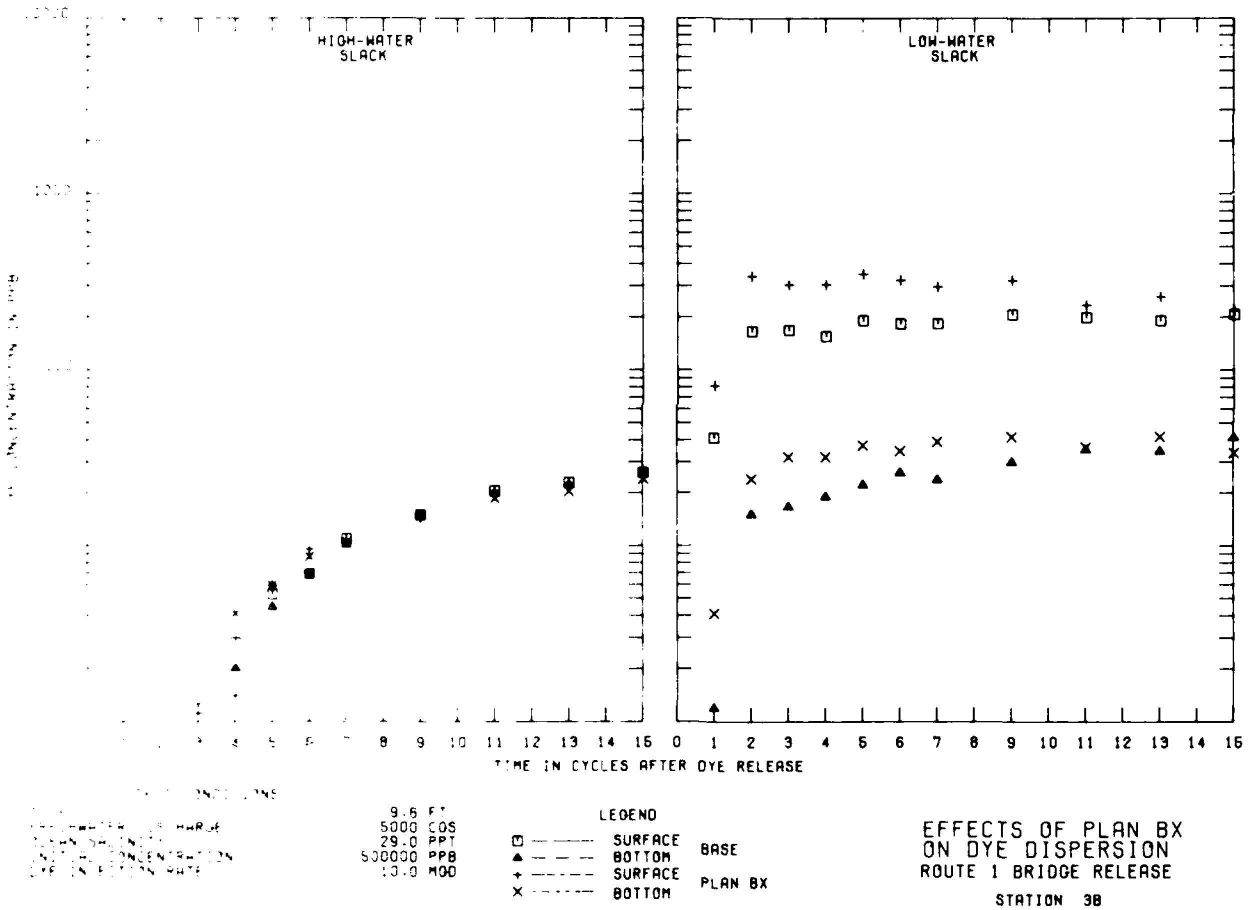
EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 08



EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 3A



EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 3B

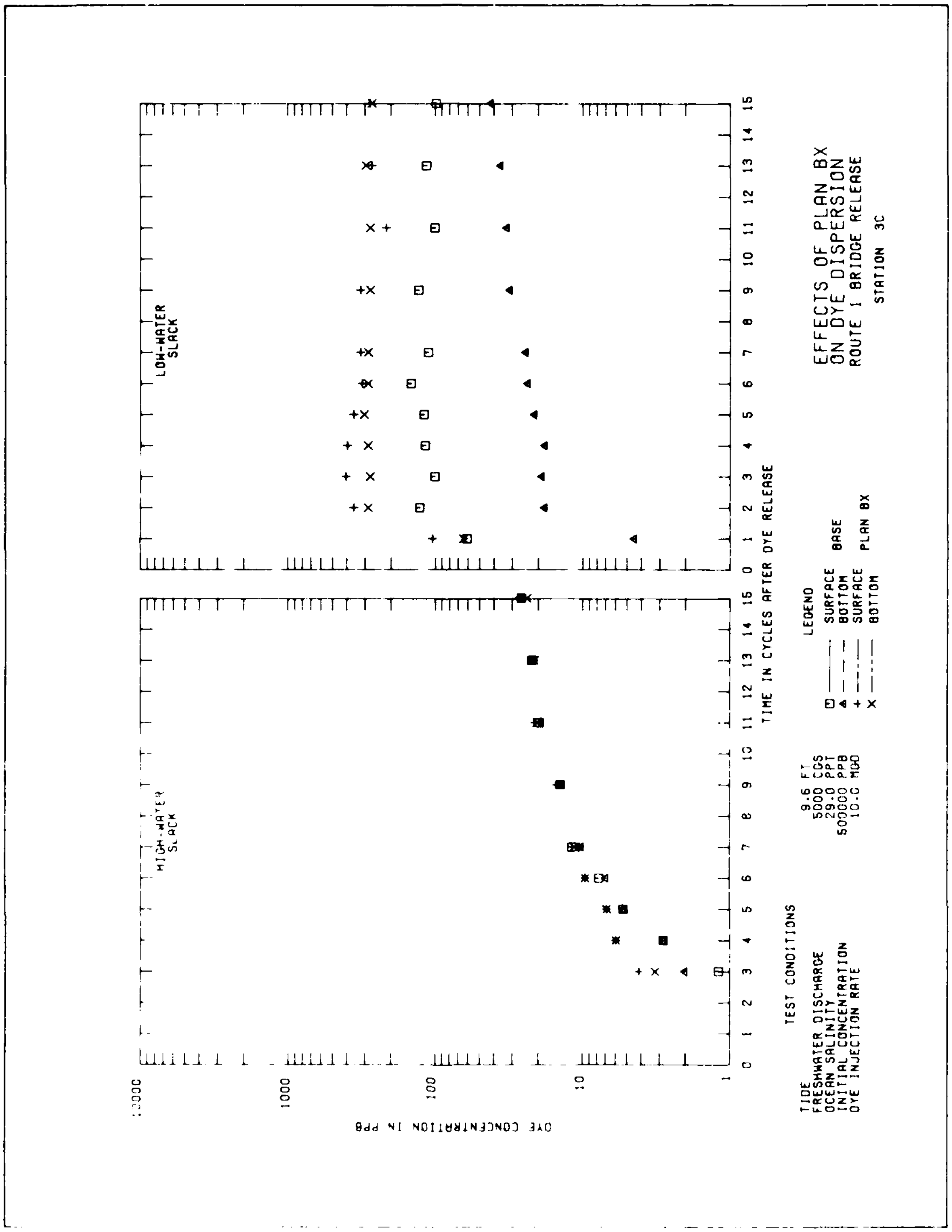
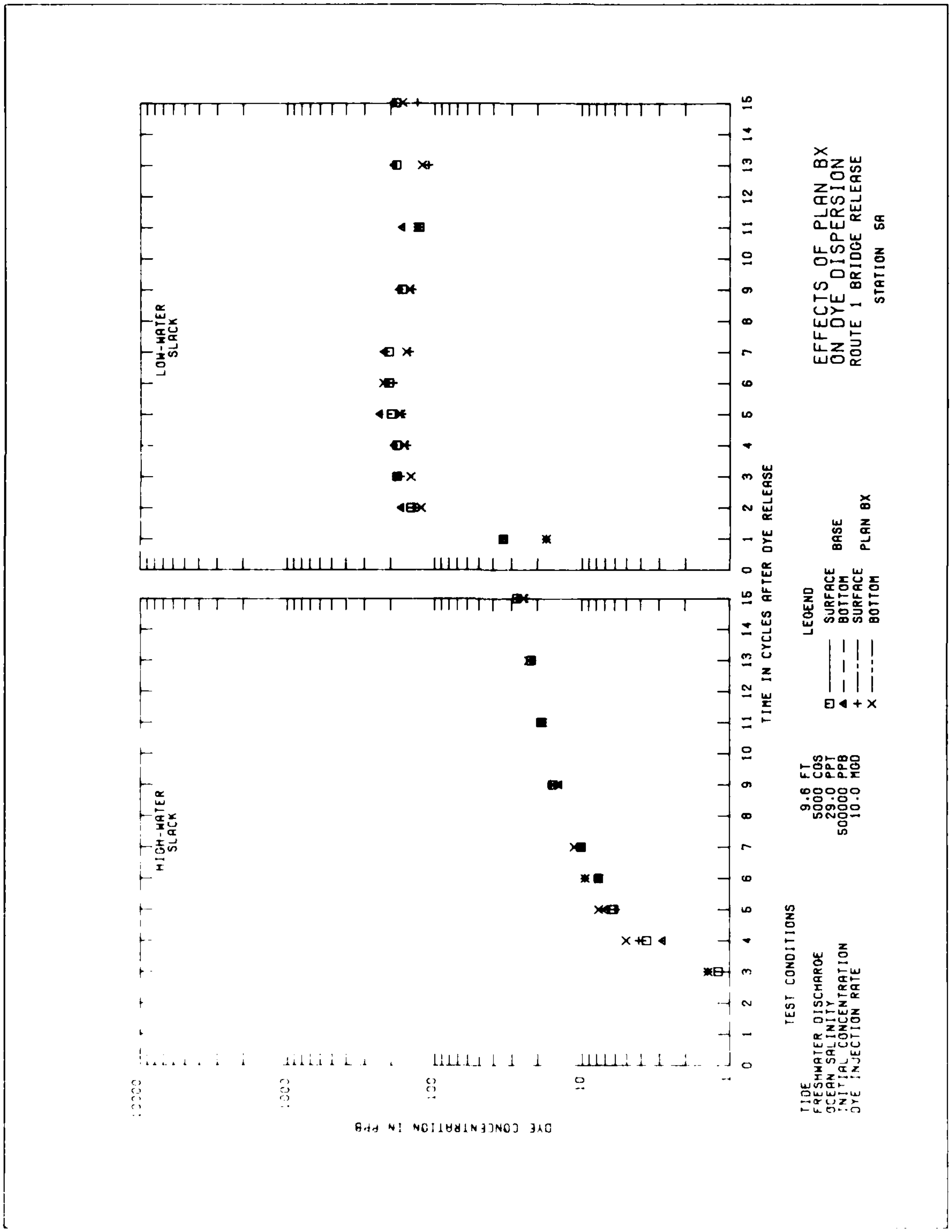
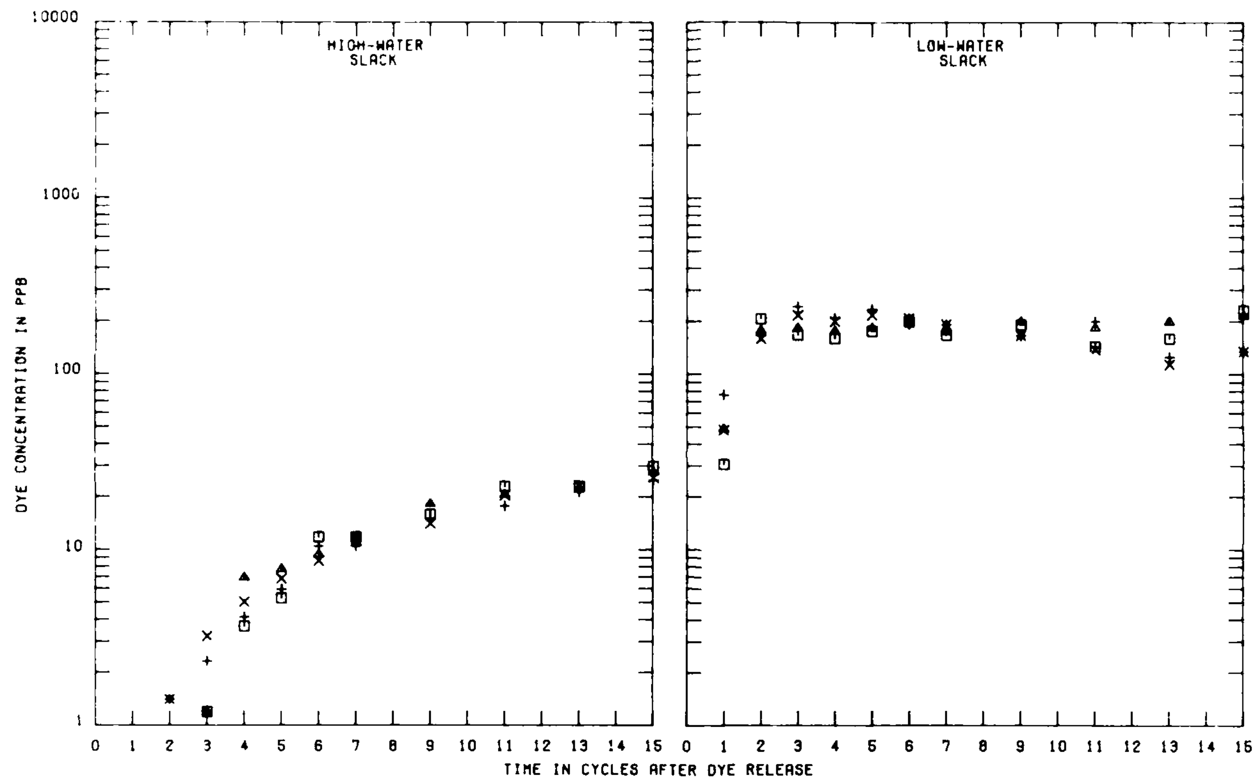

EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 3C
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BX

PLATE 342


EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 5A
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BX



TEST CONDITIONS

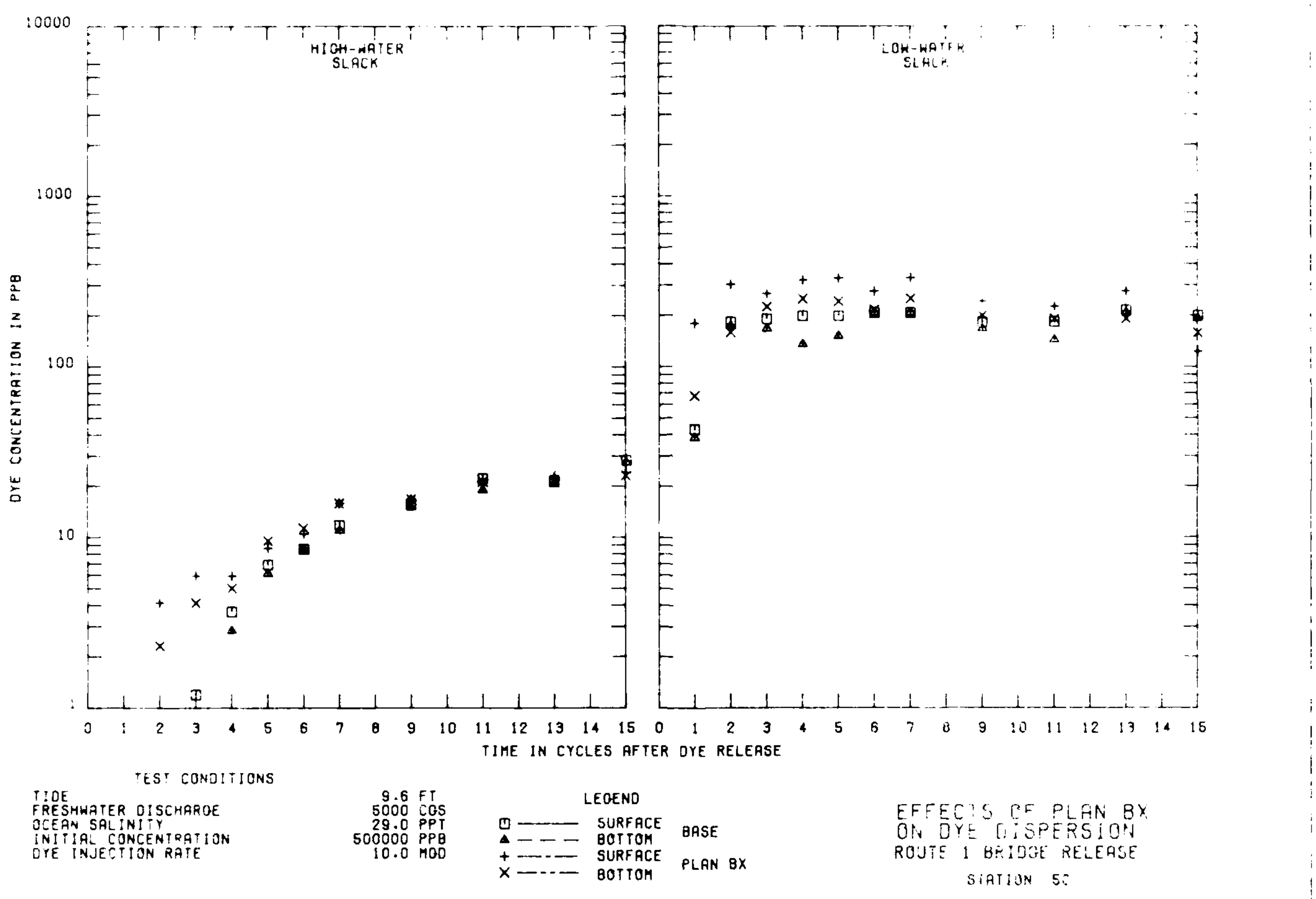
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

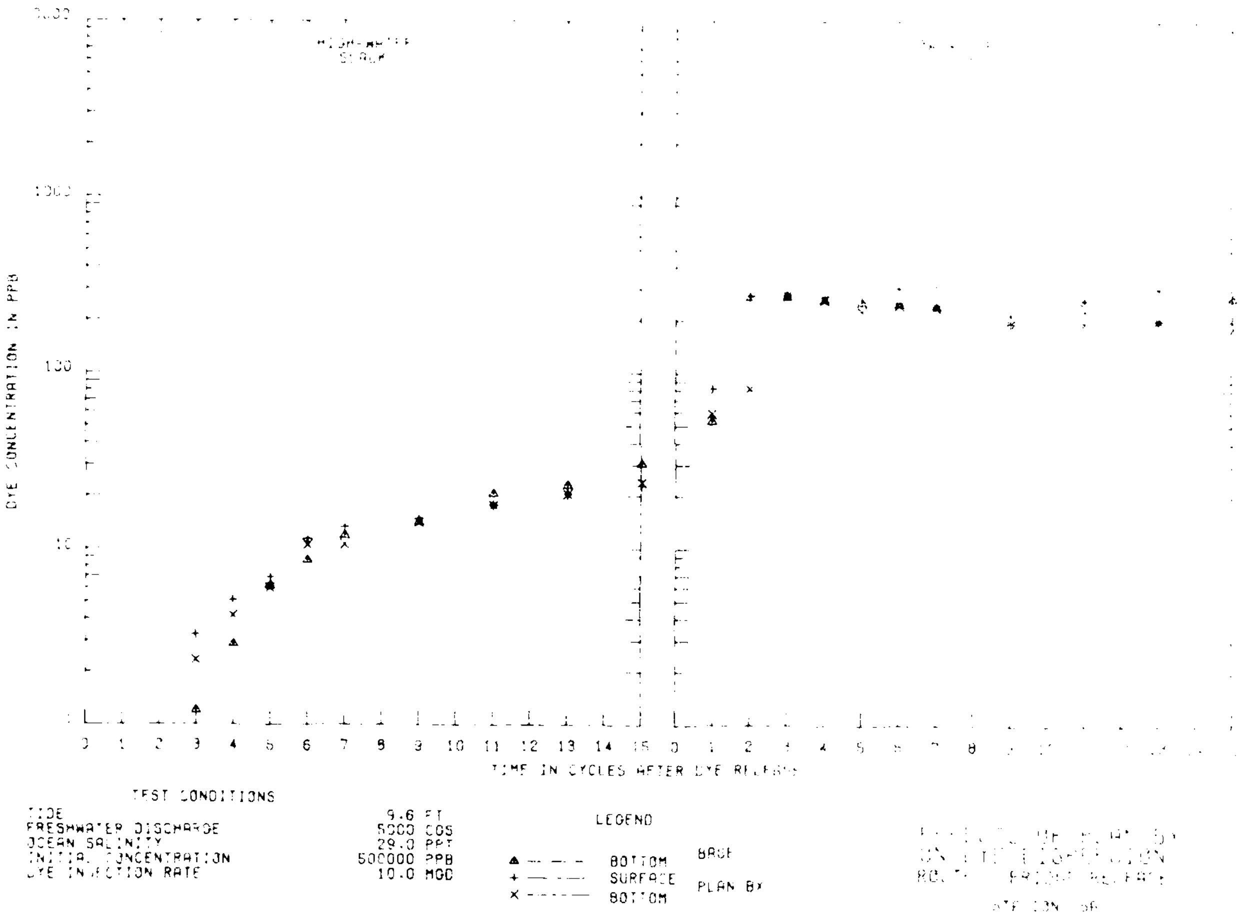
LEGEND

□ ———	SURFACE	BASE
▲ — — —	BOTTOM	BASE
+ —·—	SURFACE	PLAN BX
× —··—	BOTTOM	PLAN BX

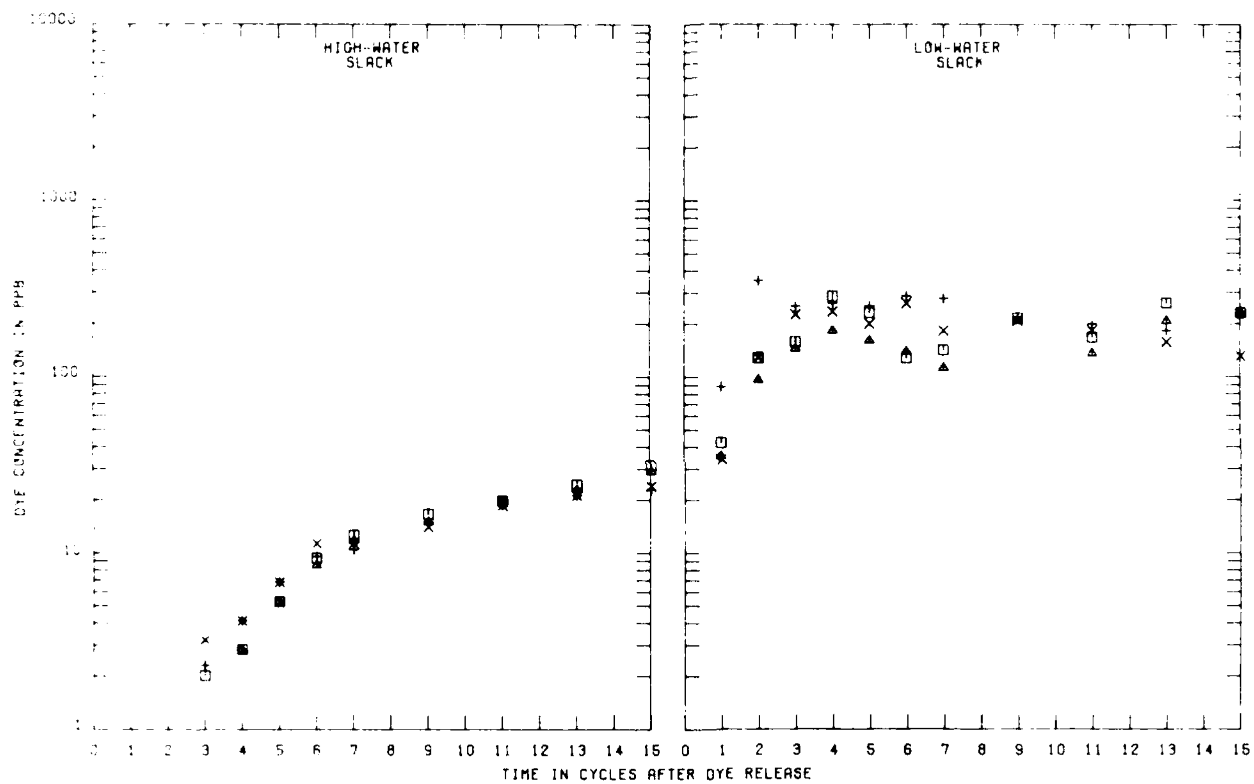
EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 5B

PLATE 344


HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CGS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MOD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BX
EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 5C



DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
BOTTOM
SURFACE
BOTTOM
BRUF
PLAN BX



TEST CONDITIONS

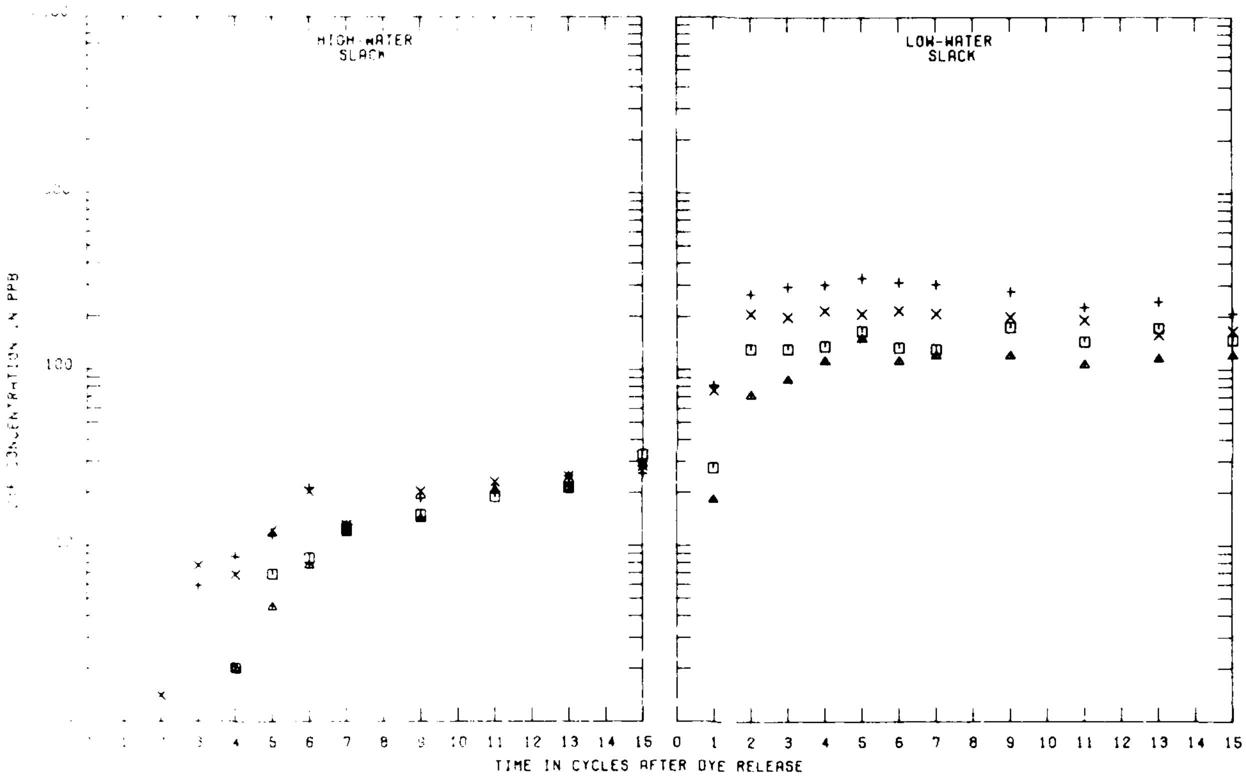
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CGS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ – – –	BOTTOM	
+ —·—	SURFACE	PLAN BX
× —··—	BOTTOM	

EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 6B



TEST CONDITIONS

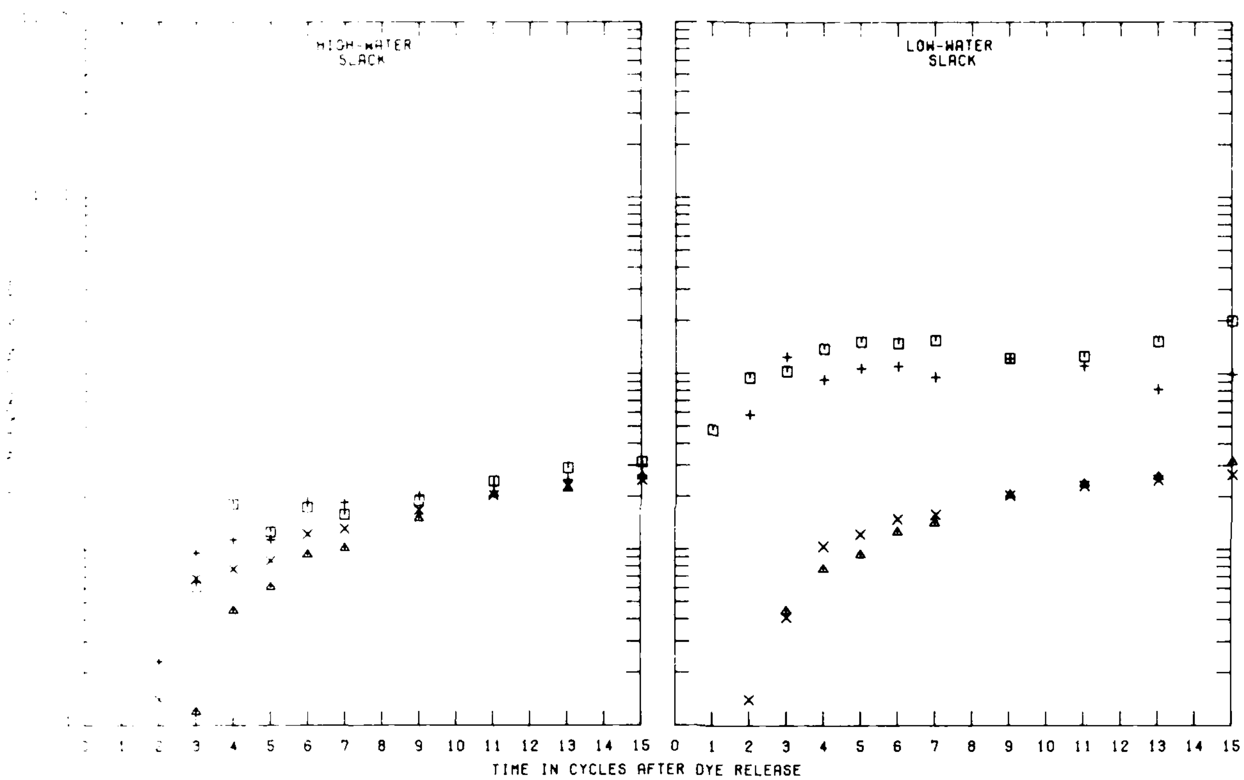
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡	SURFACE	BASE
▲	BOTTOM	
+	SURFACE	PLAN BX
×	BOTTOM	

EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 6C



TEST CONDITIONS

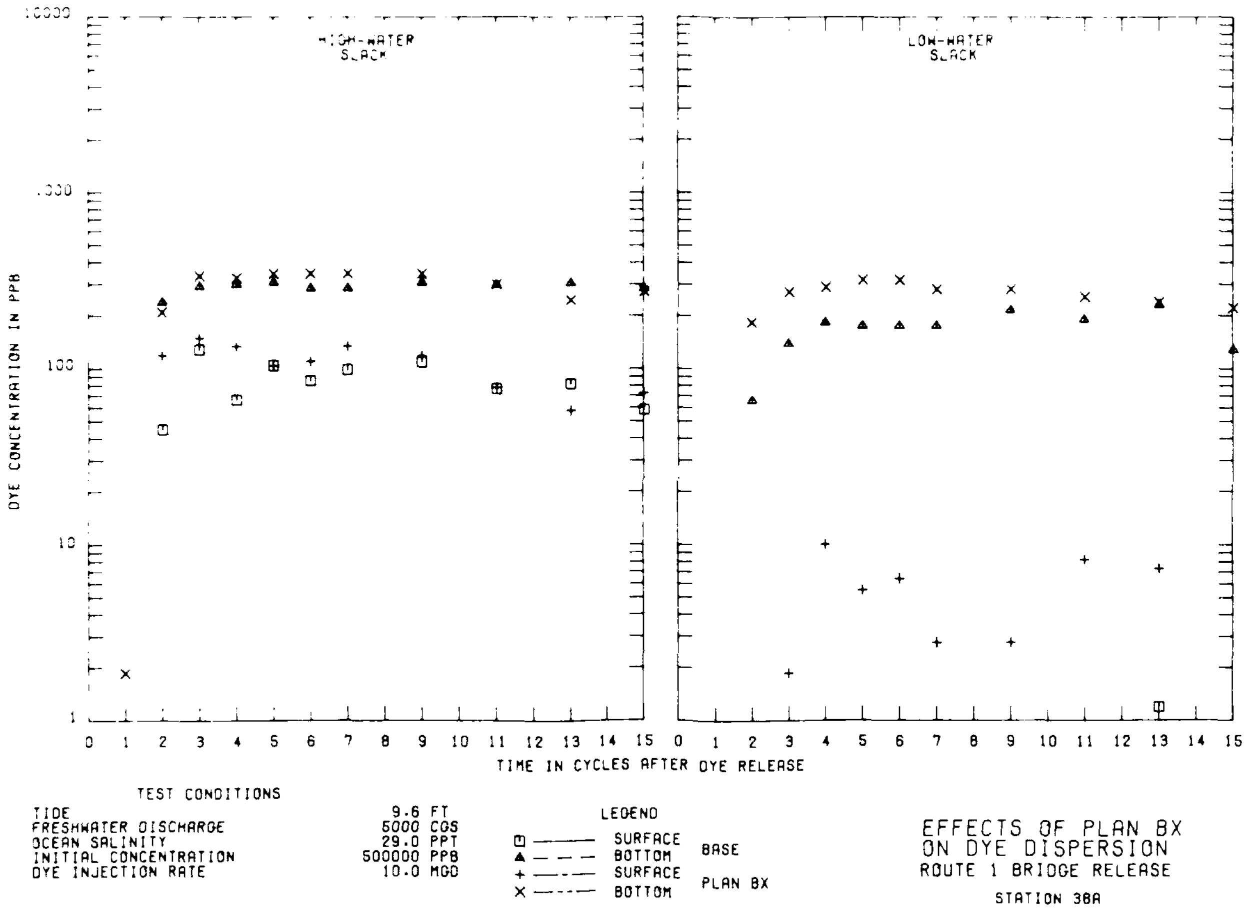
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

□ ——— SURFACE BASE
▲ — — — BOTTOM BASE
+ —·—·— SURFACE PLAN BX
× —··—··— BOTTOM PLAN BX

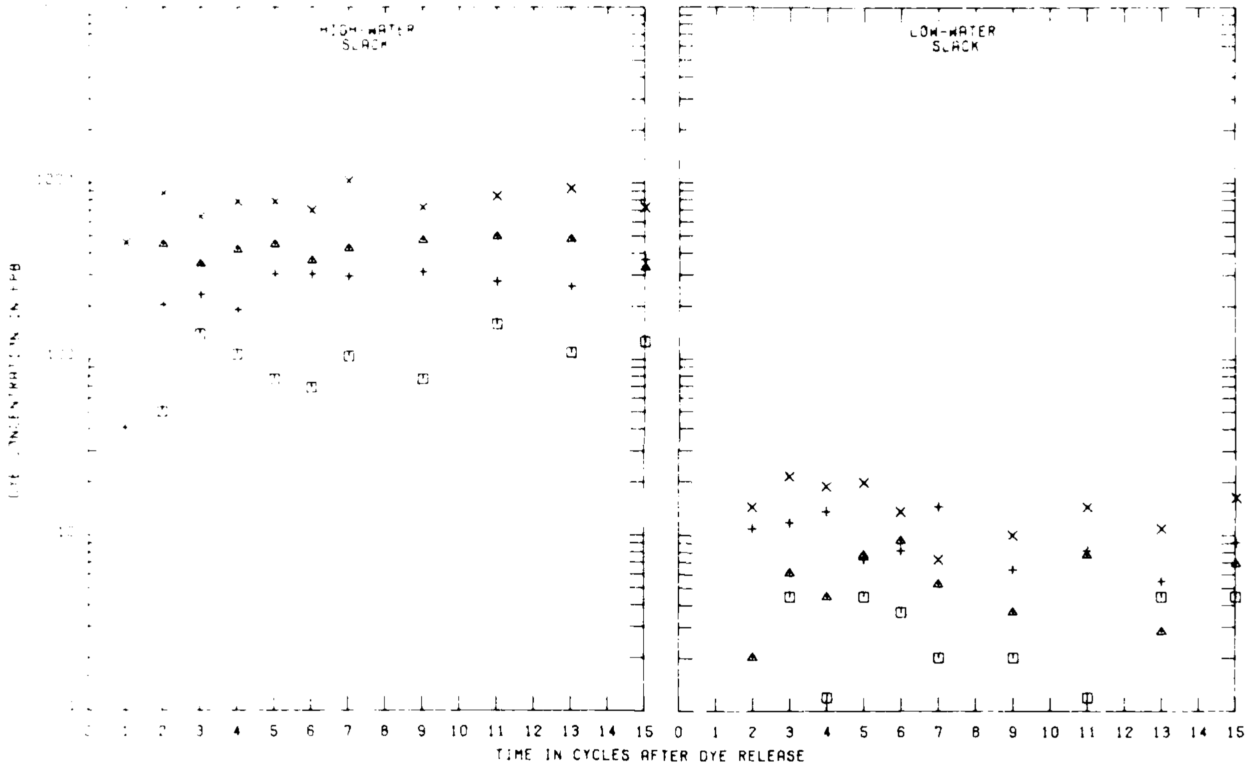
EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 8A



EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 38A



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN BX
× —··—··	BOTTOM	

EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 26A

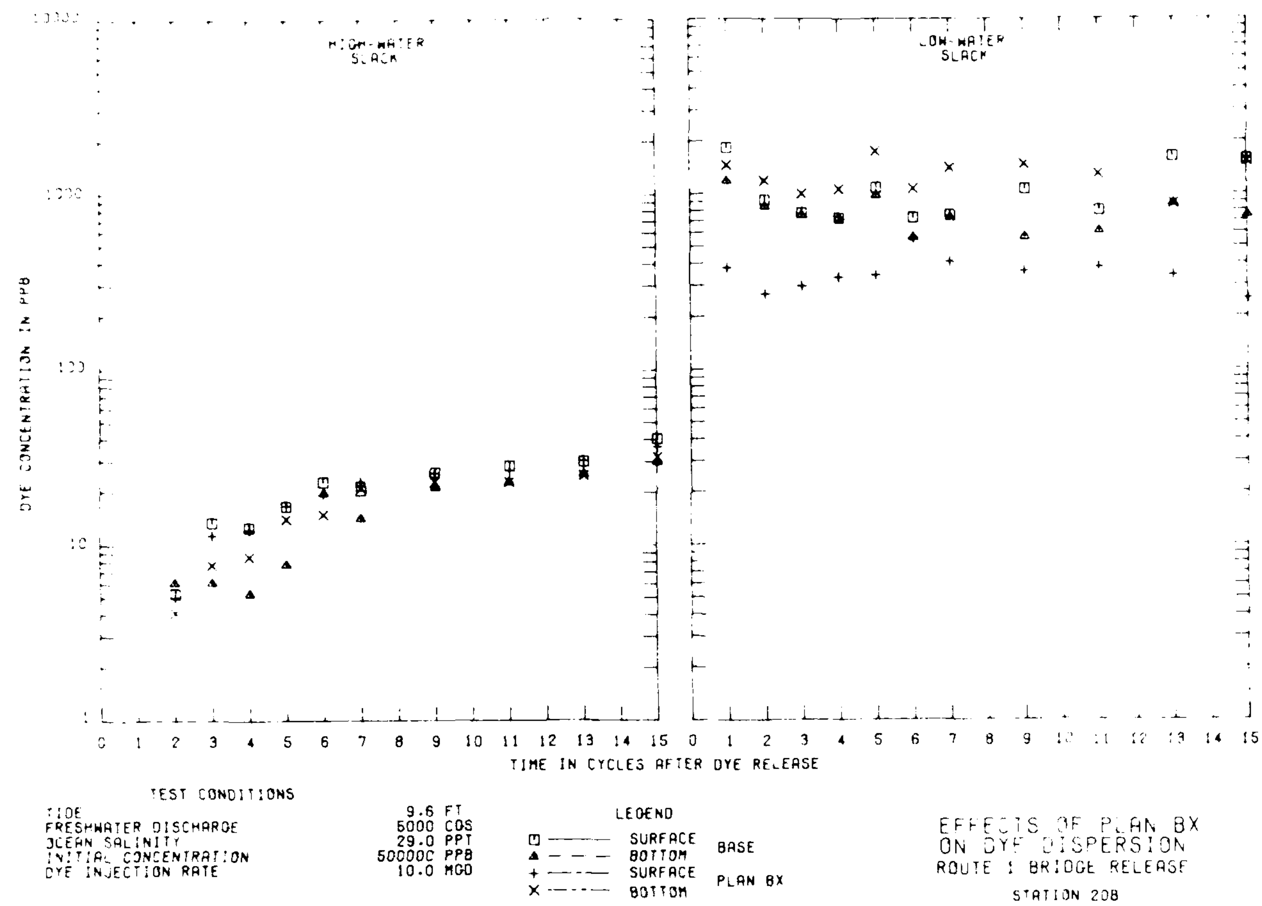
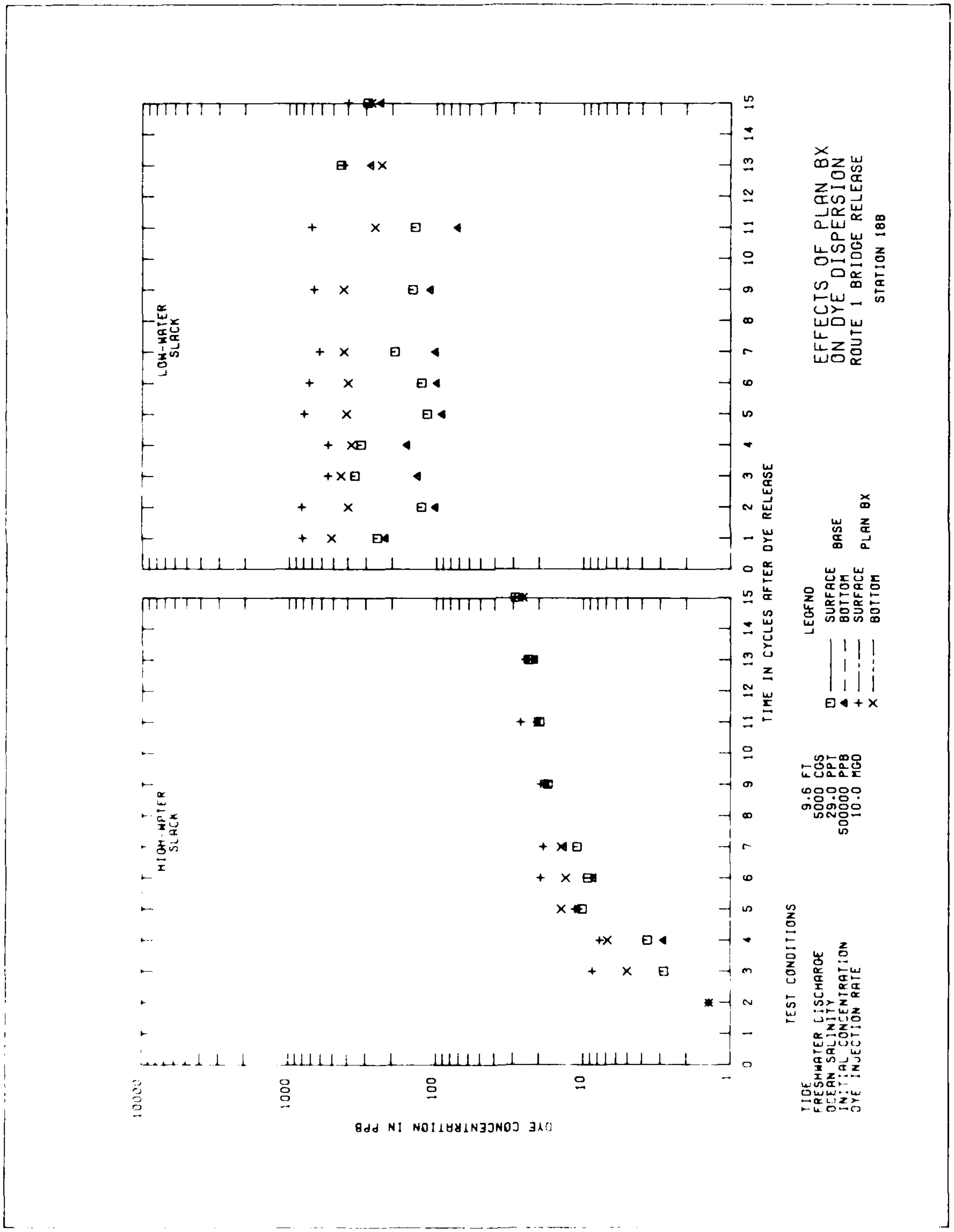
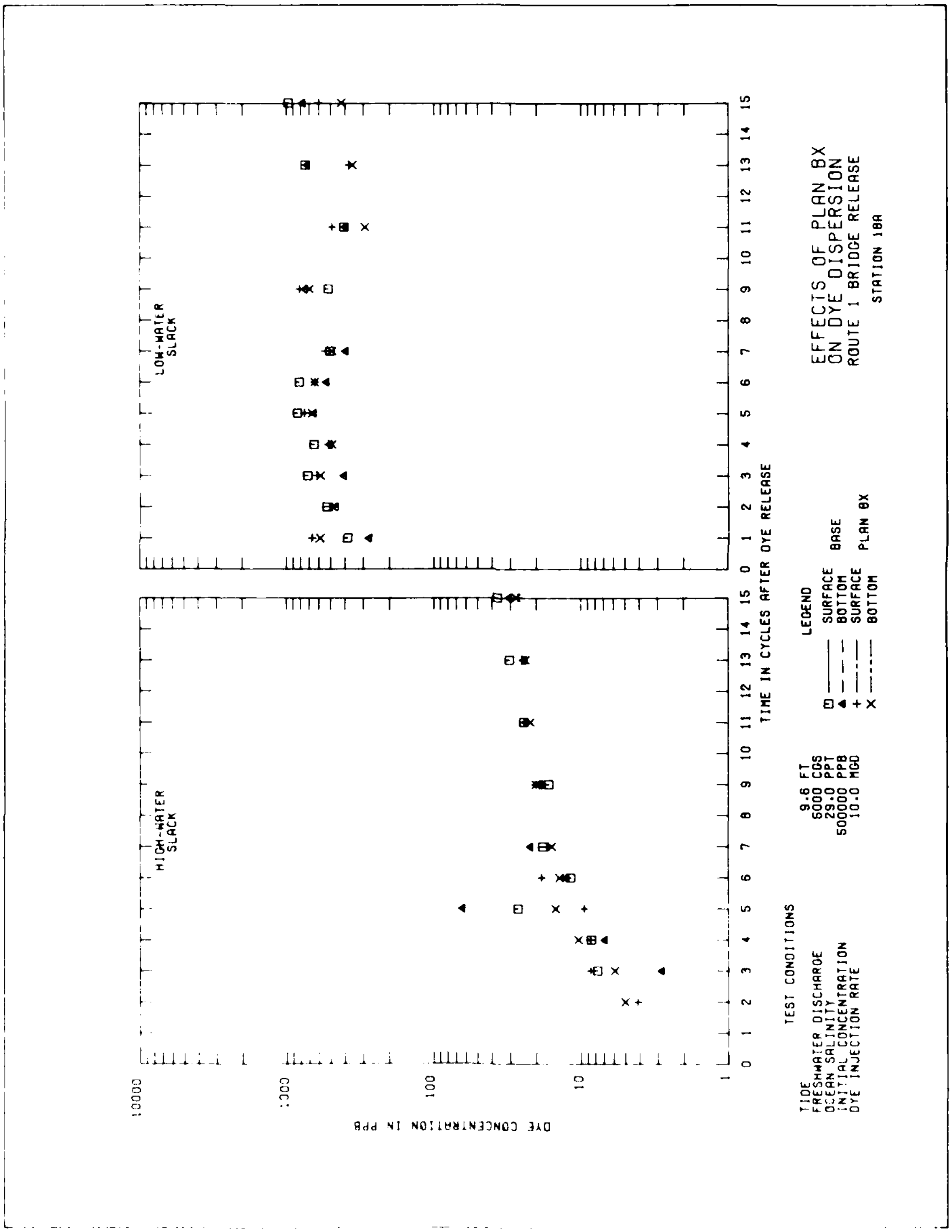

HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10
100
1000
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BX
EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 208

PLATE 361



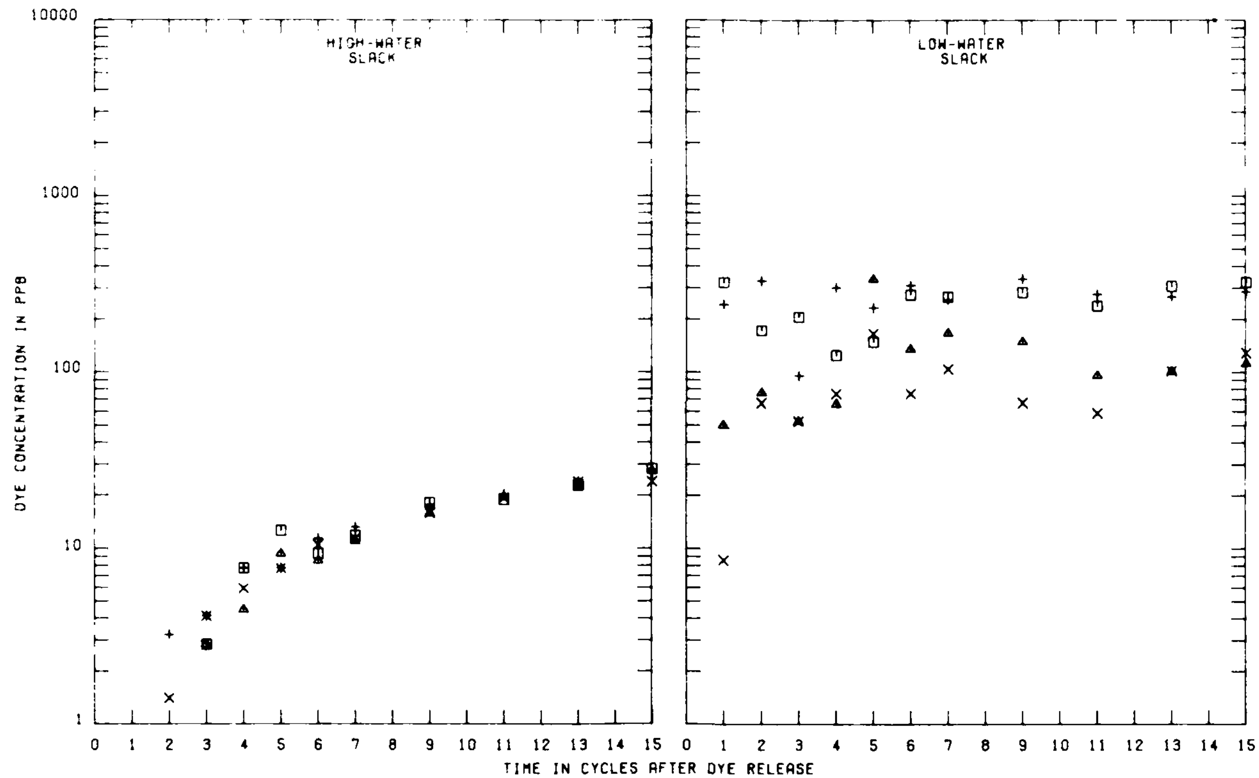
EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 18B
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BX

PLATE 360



EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 18A
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 6000 CGS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BX

PLATE 359



TEST CONDITIONS

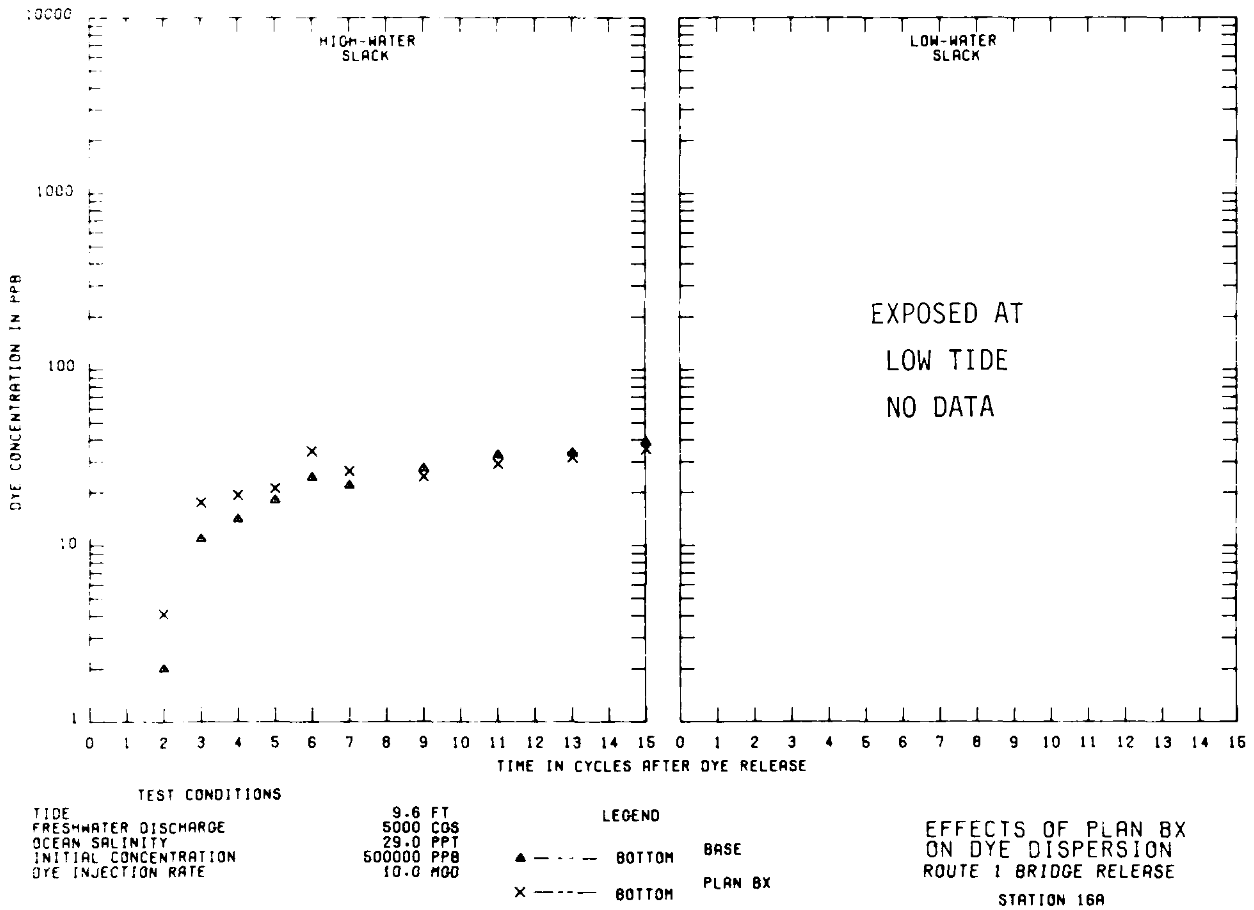
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CGS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

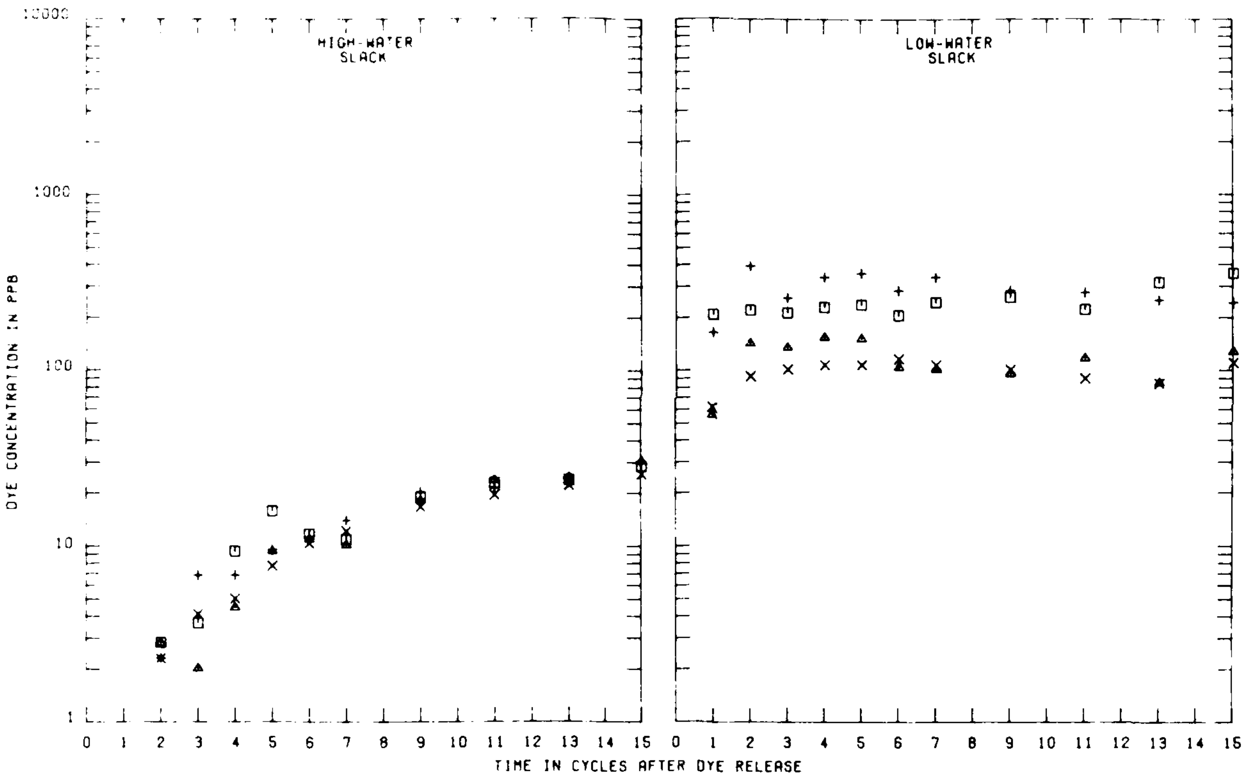
□ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN BX
× —··—··—	BOTTOM	

EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 160



EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 16A



TEST CONDITIONS

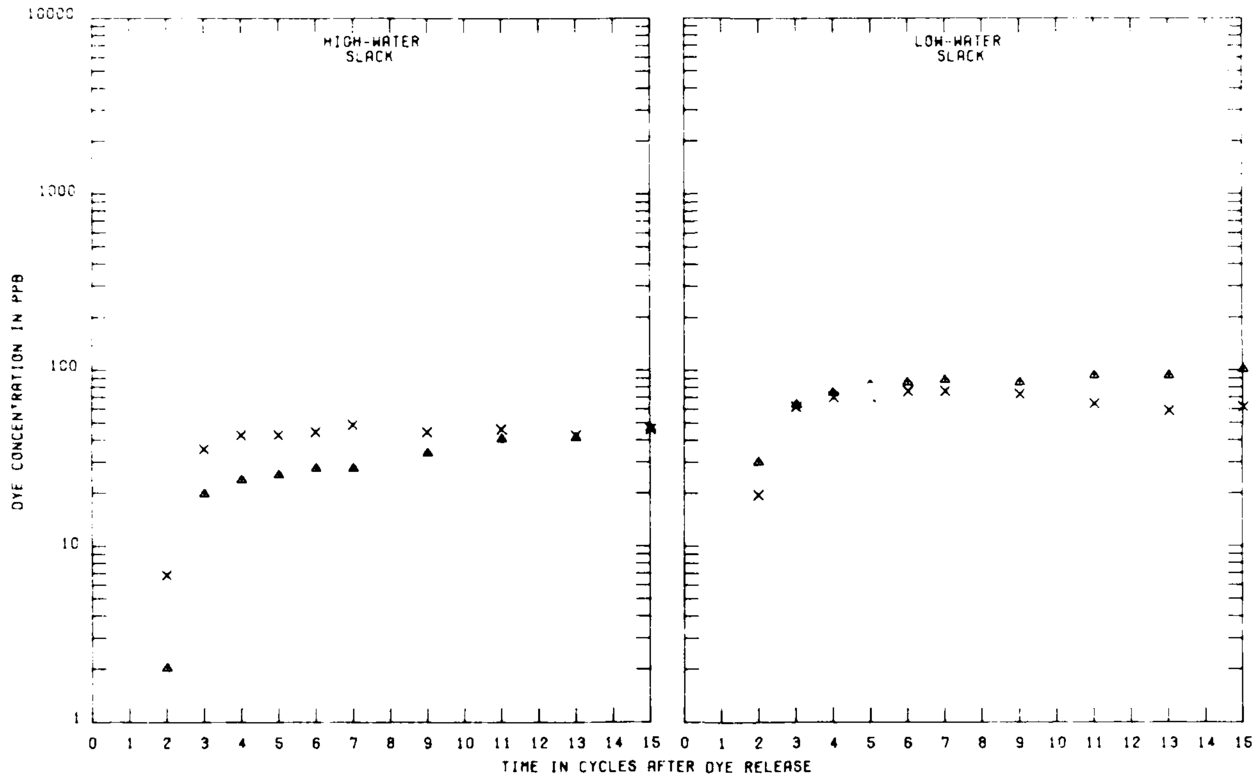
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CGS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

□ ——— SURFACE BASE
▲ — — — BOTTOM BASE
+ —·—·— SURFACE PLAN BX
× —··—··— BOTTOM PLAN BX

EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 128



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CDS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

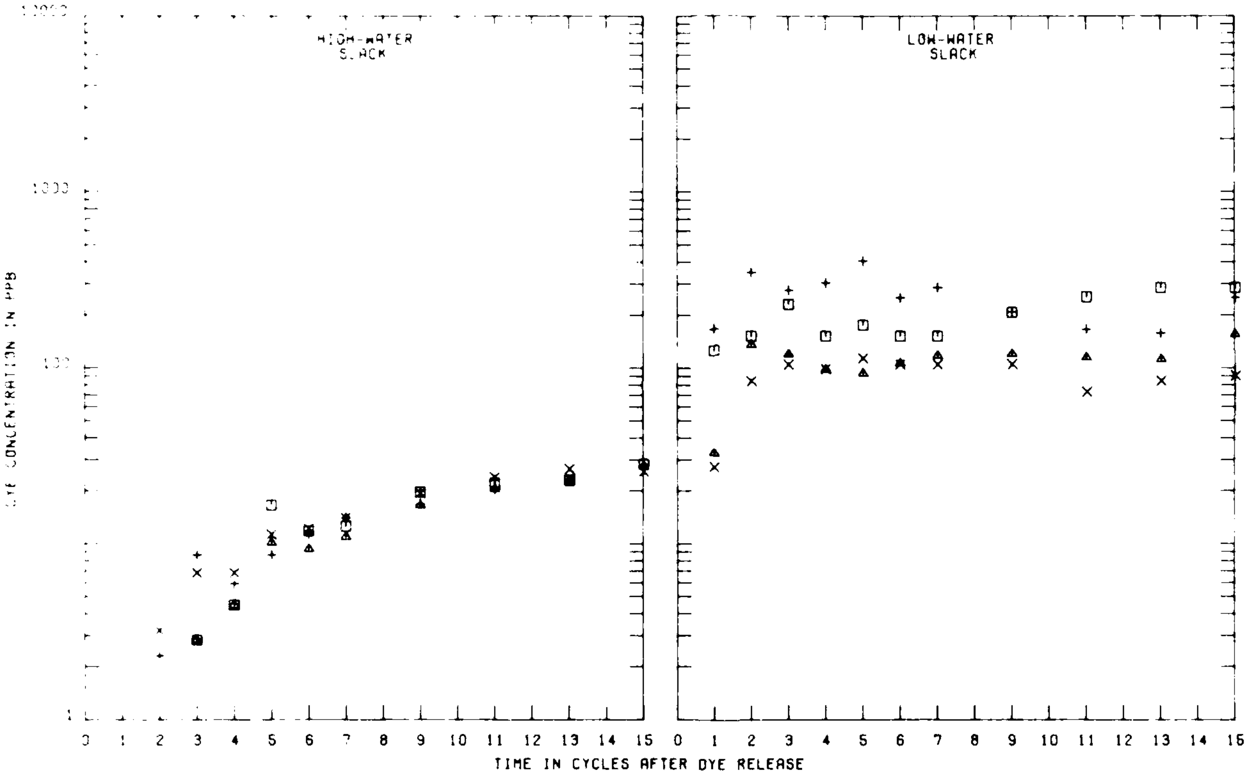
LEGEND

▲ — — — BOTTOM BASE

× —·—·— BOTTOM PLAN BX

EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 12A



TEST CONDITIONS

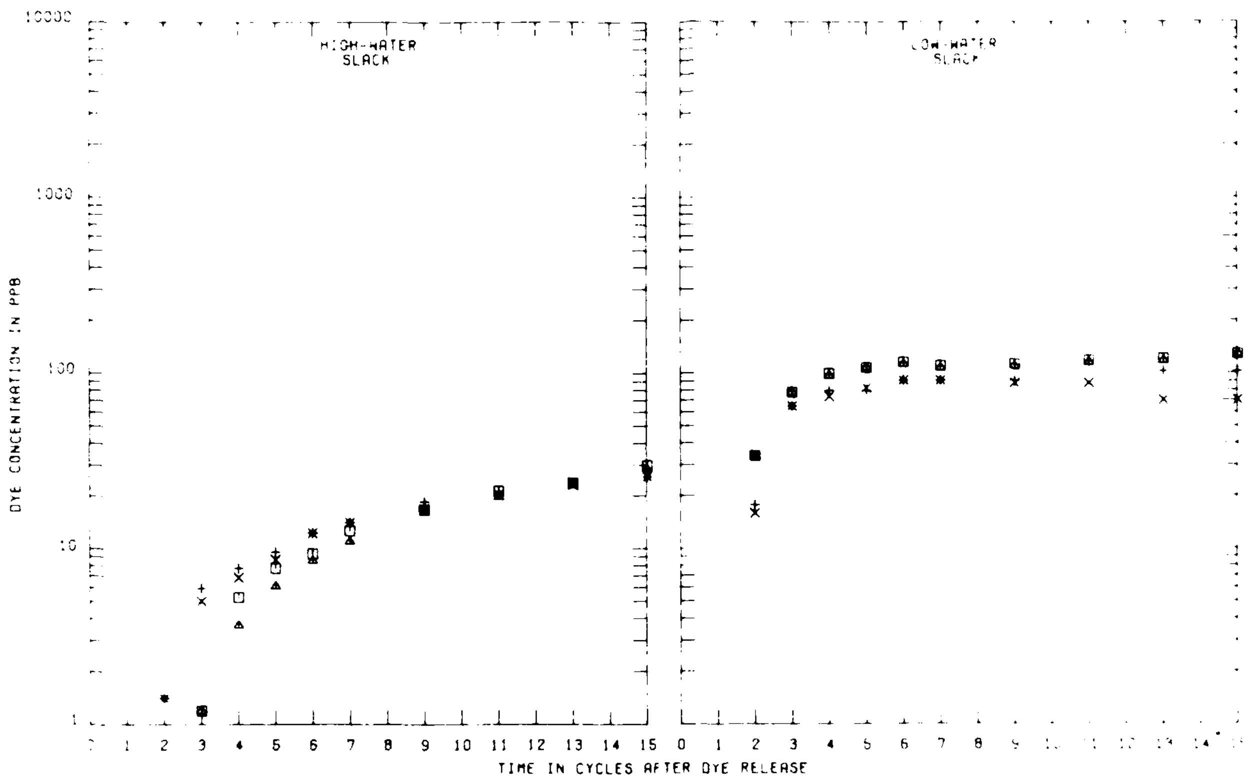
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN BX
× —··—··	BOTTOM	

EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 10C



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CGS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

□	SURFACE	BASE
▲	BOTTOM	
+	SURFACE	PLAN BX
×	BOTTOM	

EFFECT OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION [illegible]

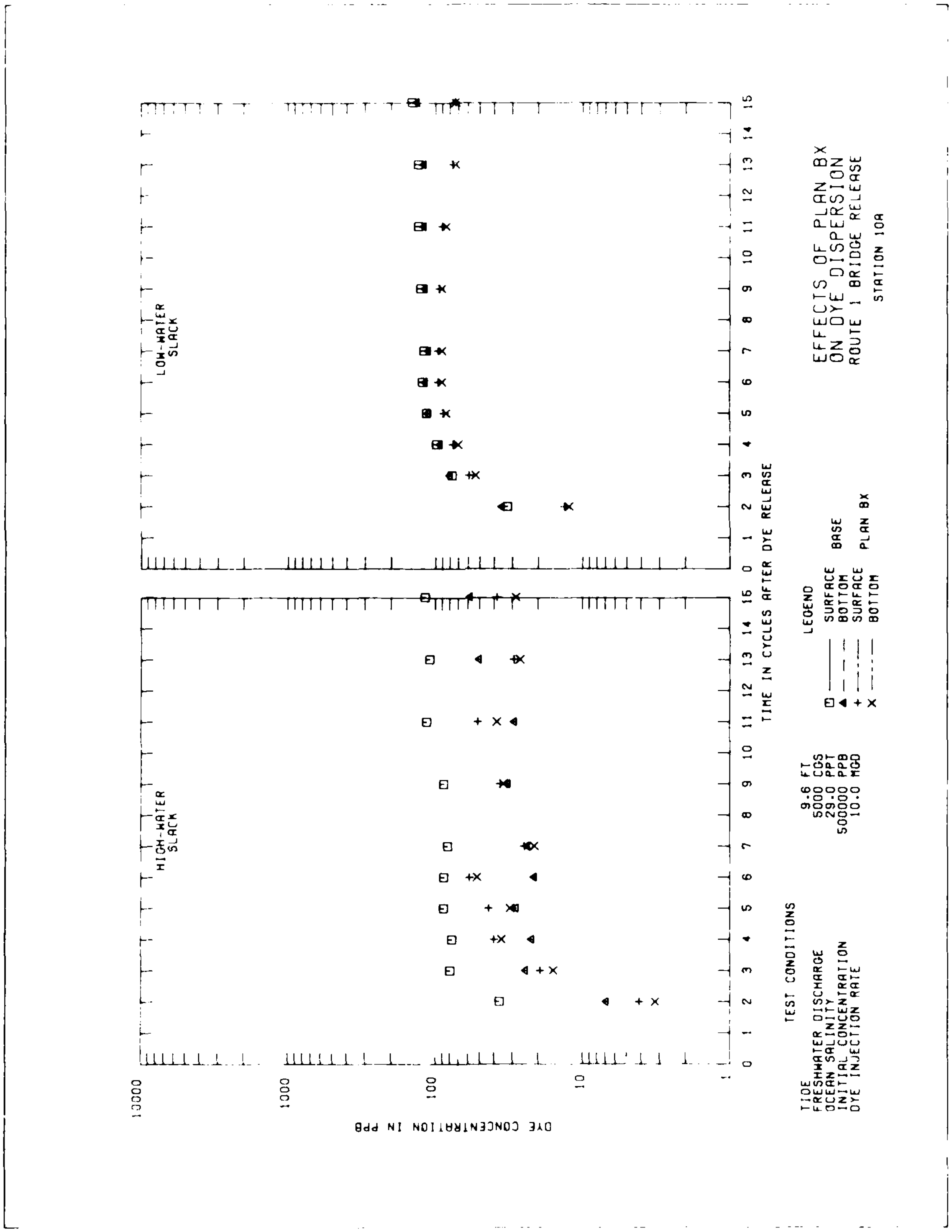
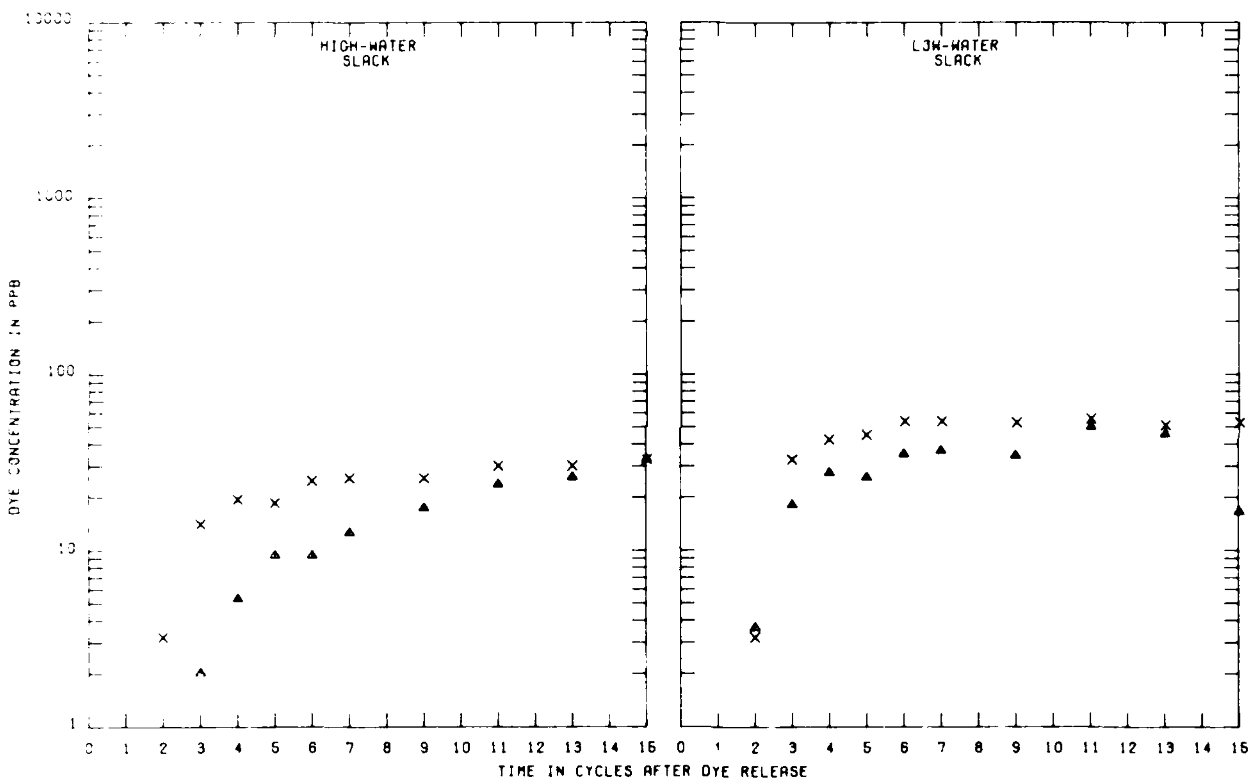

EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 10A
HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
TIME IN CYCLES AFTER DYE RELEASE
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 500000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BX

PLATE 352



TEST CONDITIONS

TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

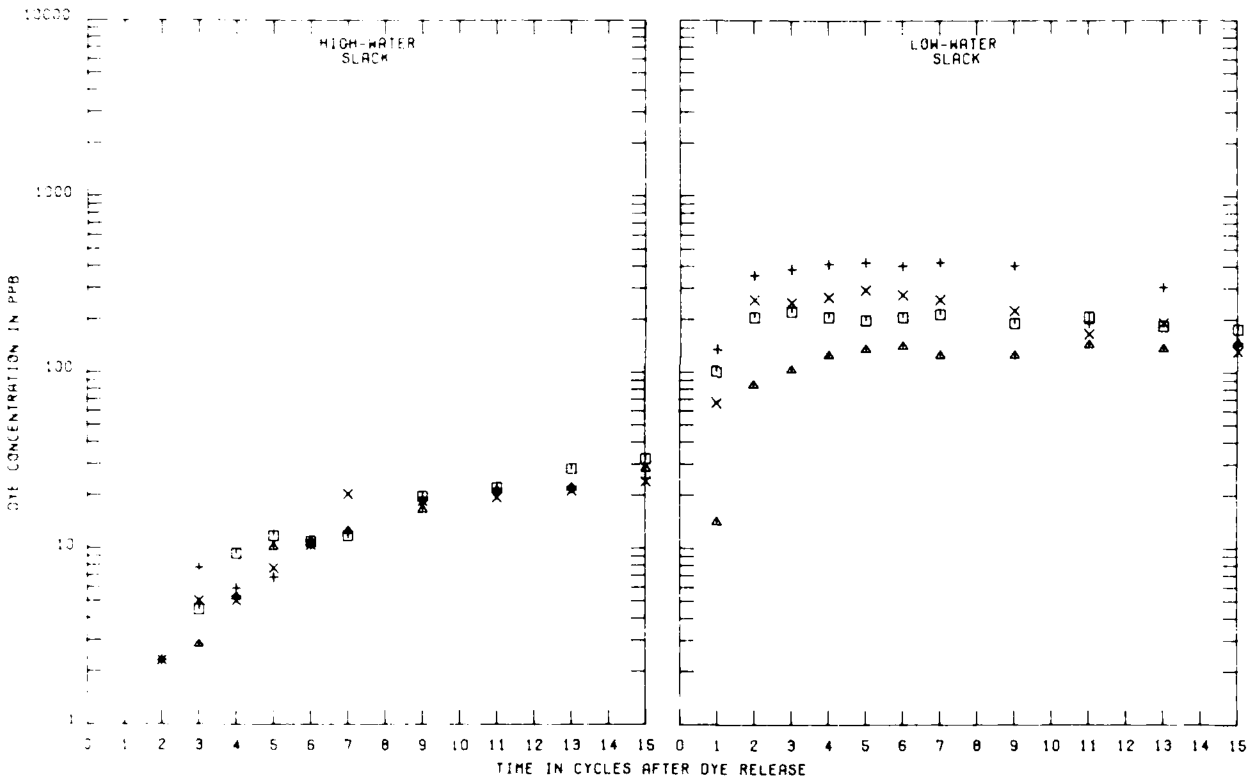
LEGEND

▲ — — — BOTTOM BASE

× —·—·— BOTTOM PLAN BX

EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 8D



TEST CONDITIONS

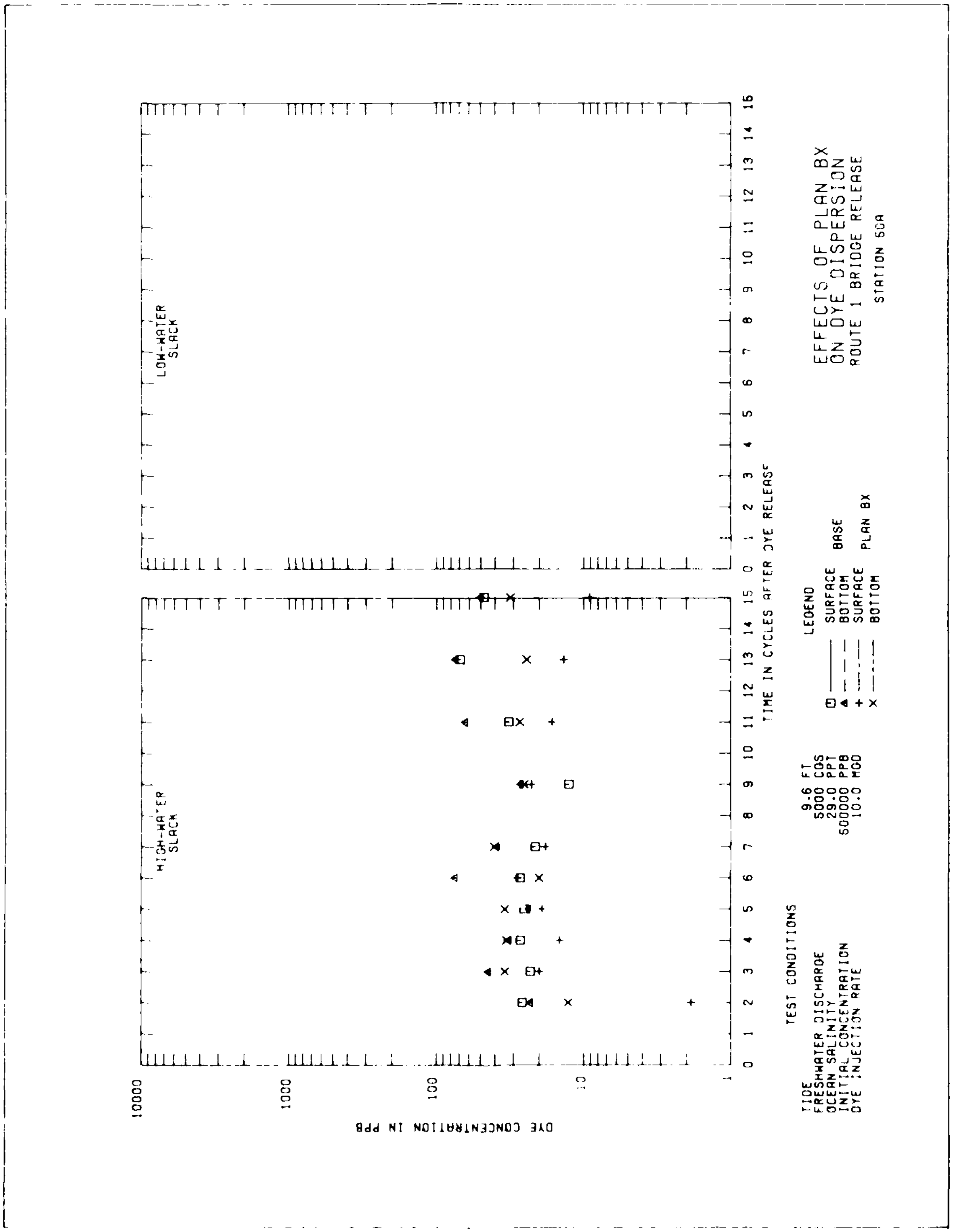
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CFS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

LEGEND

⊡ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—	SURFACE	PLAN BX
× ------	BOTTOM	

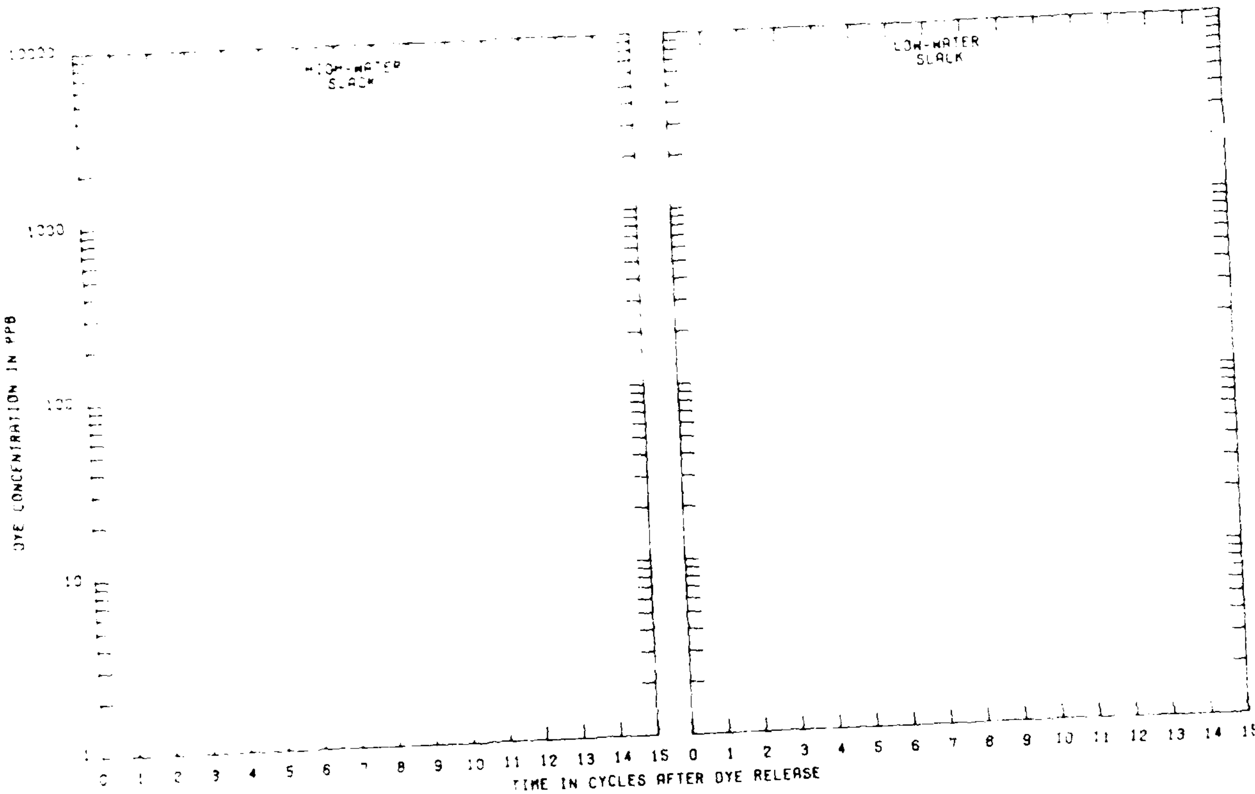
EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 8C



HIGH-WATER SLACK
LOW-WATER SLACK
DYE CONCENTRATION IN PPB
10000
1000
100
10
1
TIME IN CYCLES AFTER DYE RELEASE
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
TEST CONDITIONS
TIDE 9.6 FT
FRESHWATER DISCHARGE 5000 CFS
OCEAN SALINITY 29.0 PPT
INITIAL CONCENTRATION 600000 PPB
DYE INJECTION RATE 10.0 MGD
LEGEND
SURFACE
BOTTOM
BASE
SURFACE
BOTTOM
PLAN BX
EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE
STATION 50A

PLATE 364



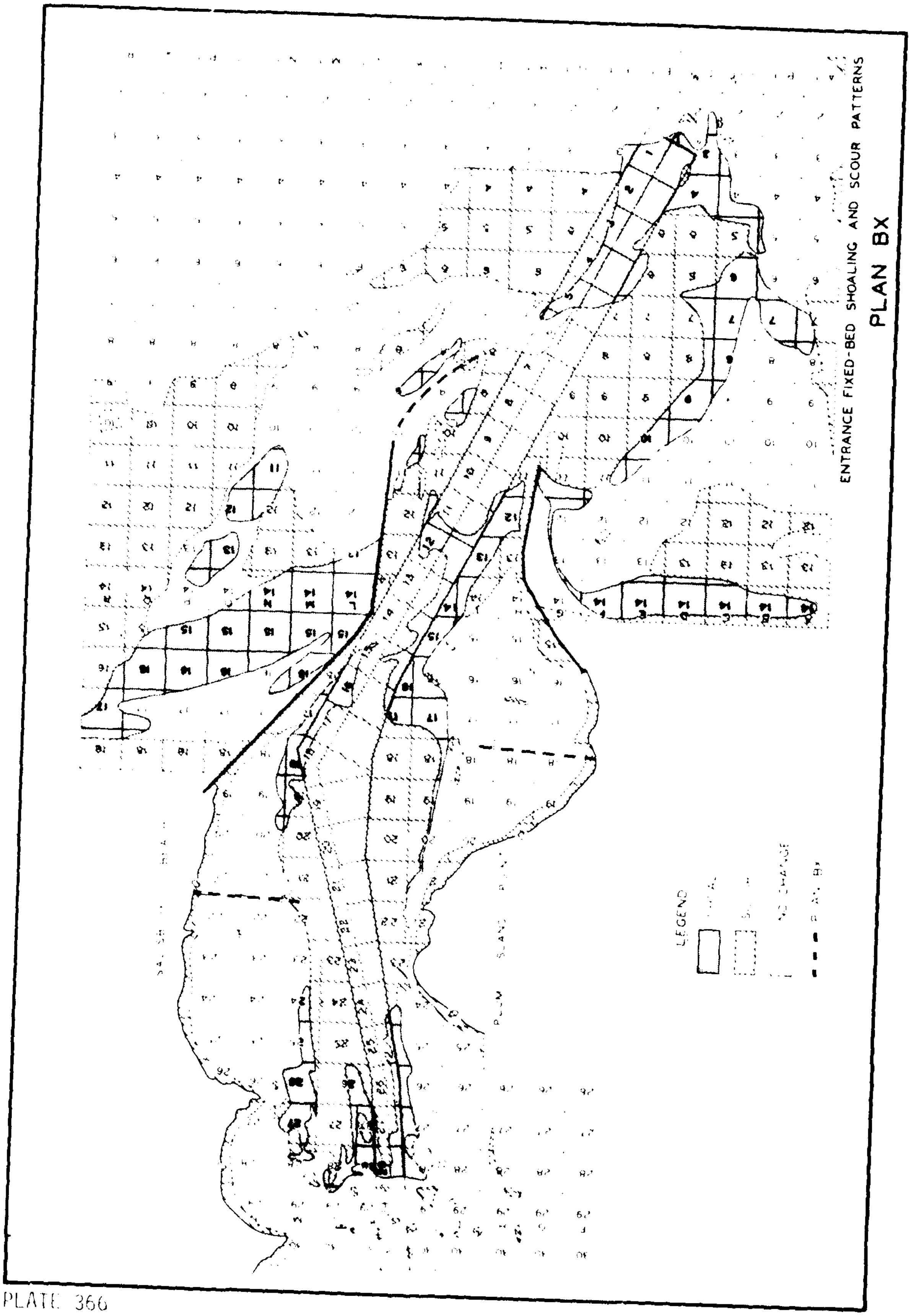
TEST CONDITIONS	
TIDE	9.6 FT
FRESHWATER DISCHARGE	5000 CGS
OCEAN SALINITY	29.0 PPT
INITIAL CONCENTRATION	500000 PPB
DYE INJECTION RATE	10.0 MGD

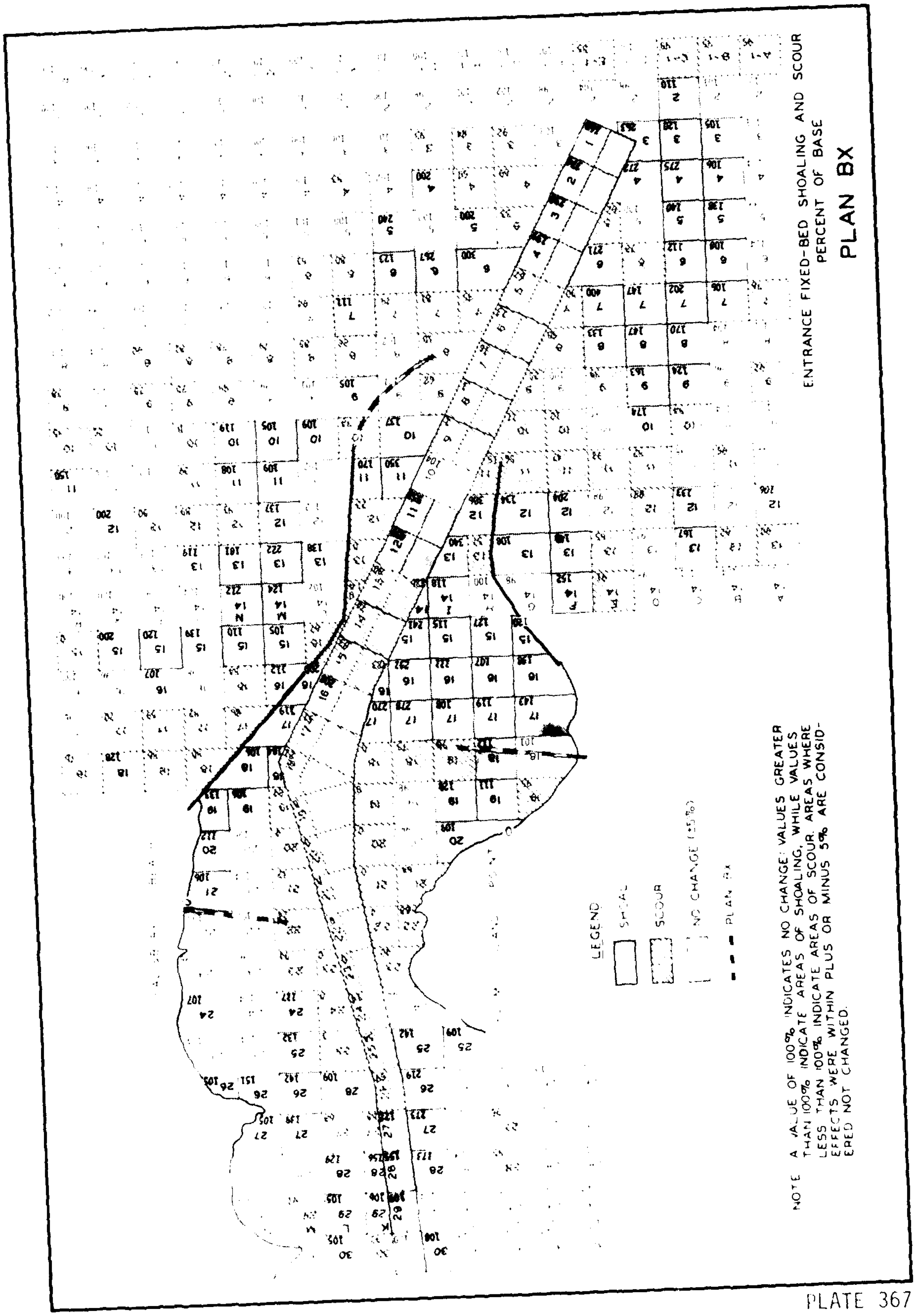
LEGEND

□ ———	SURFACE	BASE
▲ — — —	BOTTOM	
+ —·—·—	SURFACE	PLAN BX
× —··—··—	BOTTOM	

EFFECTS OF PLAN BX
ON DYE DISPERSION
ROUTE 1 BRIDGE RELEASE

STATION 56A


ENTRANCE FIXED-BED SHOALING AND SCOUR PATTERNS
PLAN BX
LEGEND



ENTRANCE FIXED-BED SHOALING AND SCOUR
PERCENT OF BASE
PLAN BX
LEGEND
SHOAL
SCOUR
NO CHANGE (±5%)
PLAN BX
NOTE: A VALUE OF 100% INDICATES NO CHANGE; VALUES GREATER THAN 100% INDICATE AREAS OF SHOALING, WHILE VALUES LESS THAN 100% INDICATE AREAS OF SCOUR. AREAS WHERE EFFECTS WERE WITHIN PLUS OR MINUS 5% ARE CONSIDERED NOT CHANGED.

PLATE 367

END

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