POTAMOLOGY INVESTIGATIONS

Report 21-3

INVESTIGATION OF EXISTING DIKE SYSTEMS

POTAMOLOGY RESEARCH PROJECT 9

by

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FOREWORD

This report is submitted in connection with Potamology Research Project No. 9, being conducted by the U. S. Army Engineer District, Memphis, by direction of the Lower Mississippi Valley Division Potamology Board. The project consists of a study of selected reaches where pile dikes have been constructed, to relate dike effectiveness with various characteristics of the channel. The study was approved by the Mississippi River Commission in first indorsement, LMVGP, dated 16 September 1963, to Memphis District letter, subject: Proposals for Potamology Study.

The study was conducted under the direction of Mr. Robert T. Easley, Chief, Potamology and Maintenance Section, and under the general direction of Mr. J. L. Hyde, Chief, Design Branch, and Mr. A. C. Michaels, Acting Chief, Engineering Division, Memphis District. Mr. Bobby J. Littlejohn was responsible for the conduct of the investigation, analysis of data, and preparation of this report. The report has been reviewed and approved for publication by the Potamology Board.

Colonel James A. Vivian, CE, was District Engineer during the preparation of this report.

CONTENTS

SUMMARY

This report presents an analysis of three problem reaches, in which four pile dike systems have been constructed, to establish trends or relationships between dike effectiveness and various channel factors. The study is part of a continuing program of general investigations for improving the design of channel regulation works on the Mississippi River.

The reaches were analyzed by comparing conditions in each reach before and after the dikes were constructed to indicate how effectively each dike system has performed. Several variables were selected as a basis for comparison which include entrance conditions, channel alignment, width, depth, scour and fill, and water surface profile. The dike systems were built from 1959 to 1962 and surveys were made at frequent intervals after construction to show progressive changes.

The data obtained in the study indicated that the four dike systems studied have been effective, to a limited extent. The dike systems have resulted in an improvement in channel alignment, widths, and depths in the immediate vicinity of the dikes but this improvement extended for only a short distance downstream. This would indicate the need for more extensive initial dike systems, both as closure structures and contraction works. The failure to follow through with supplementary contraction works has resulted in the partial loss of the initial improvement in some instances. The analysis also indicates some usages of dikes and dredging that could possibly be employed to improve unstable reaches similar to those studied.

POTAMOLOGY INVESTIGATIONS

INVESTIGATION OF EXISTING DIKE SYSTEMS

POTAMOLOGY RESEARCH PROJECT 9

PART I: INTRODUCTION

Background

1. The design, method of construction, and type of structures used in regulation works on the Lower Mississippi River have varied widely over the years since the first project began in 1878. The proven types of structures include revetments and dikes, with dredging essential as a third tool. Revetments were the first means of stabilization, used primarily to prevent lateral movement of the channel. With major migration thus controlled, the stabilization program has advanced to the point of regulating the channel along planned lines through the wide uncontrolled reaches of river between the stabilized bends. Dikes and dredging offer the most practical approach to this problem, and they are being used to contract the channel and direct the flow into planned alignments through unstable reaches. Although the criteria for the planning and design of dikes has been refined considerably since the first flood control and navigation project was initiated in 1878, studies are continuing in an effort to make even further improvements. The ultimate goal of these studies is to build more effective structures at lower costs.

Purpose and Scope

2. This investigation was made as a part of a comprehensive study, Field and Office Study of Dike Systems, which was approved and initiated in 1963. The study is designated as Potamology Research Project 9 and consists of three parts: (1) a review of past experience with contraction works; (2) investigation of existing dike systems; and (3) planning

and testing of new structures. Studies have been made and reports published in connection with parts (1) and (3). This report is concerned with part (2) and presents a study of three problem reaches in the Memphis District to establish any relationships between effectiveness of the dike systems and certain channel factors. These factors include entrance conditions, channel alignment, width, depth, scour and fill, and water surface slopes at high and low stages. Reaches selected for study include Wrights Point, Ashport-Golddust and Kate Aubrey, and Lookout Bar. Although these reaches vary widely in character, they are common in two respects: The channel through each reach is unstable due to excessive riverbed width, and each is divided by one or more bar formations, causing a secondary channel. In this study, each reach was analyzed to determine what improvements in the channel had occurred since installation of the various dike systems. Most of the data were obtained from hydrographic surveys made before and after the dikes were placed. Current directions and velocities were not included in the study since there were no data available to represent conditions before construction; thus, there was no basis for comparison of these two factors. The final objective of the study is to establish any relations or trends that would provide additional information in the planning and design of future dike structures.

PART II: WRIGHTS POINT REACH

Description

3. Wrights Point is a peninsula located in a deep meander of the river about 80 miles upstream of Memphis (see Plates 1 and 2). The reach selected for study extends from the lower part of Huffman-Hickman Revetment to the downstream end of Obion-Tamm Revetment. The reach is 10 miles long with limits at Miles 824.0 and 814.0. The upper portion of the reach is a relatively straight section of river, with the lower seven miles passing through Tamm Bend. The bend is characterized by a relatively narrow channel in a riverbed of excessive widths, up to 10,000 feet, allowing uncontrolled meandering of the channel within its banks. A secondary channel has developed along the right bank around the tip of Wrights Point with a large point bar extending most of the length of the bend, causing divided flow. These conditions have contributed to shallow crossings and consequently an inefficient navigation channel at low stages. Low water channel widths vary from 1,300 to 4,000 feet and average 2,300 feet. Low and high water slopes through the reach average 0.53 and 0.45 feet per mile, respectively.

History of Construction

4. The bend upstream of the reach was stabilized with the construction of Huffman-Hickman Revetment in 1932 which prevented active caving from endangering the main line levee. This revetment was extended downstream in 1953. During the period from 1955 to 1963 Tamm Bend Revetment was built to maintain the alignment of the concave bank in the middle and lower portions of Tamm Bend. In 1962 Obion Bar Revetment was constructed in the upper portion of the bend to arrest continued active caving along Obion Bar. This structure was extended downstream in 1963 and again in 1964. The latter extension joined Obion Bar and Tamm Bend Revetments, completing stabilization of the bend. In 1961-62, the Wrights

Point Dikes were built for the purpose of training the river into a single channel crossing of better alignment with more desirable depths and widths. Another purpose was to eliminate the danger of a natural cut-off across the tip of Wrights Point by reducing the flow through the chute channel. There were five dikes constructed along the right bank immediately upstream of the chute entrance (see Plate 2). All five dikes were constructed of timber piling with lumber foundation mattress and consist principally of three-row clump structures except in the deep secondary channel near the right bank in Dikes Nos. 4 and 5 where the clumps were increased to 4 and 5 rows. Design features of the Wrights Point Dikes are shown in the following tabulation:

Dike No.	Length	ALWP Elev.	Crest	Angle with Current
1	900	+15.3	Level	Normal
2	1,400	+15.5	Level	Normal
3	1,900	+15.6	Level	Normal
4	2,200	+15.9	Level	Normal
5	2,670	+16.0	Level	Normal

Hydrographic Developments

5. Entrance conditions into the Wrights Point Reach are very poor. Island 21, located at Mile 824 in the bend about 2 miles above the Wrights Point Dikes, causes a divided channel flow which converges just upstream of the dike field. Since construction of the Wrights Point Dikes, the flow through the Island 21 Chute channel, east of the Island, has more than doubled at stages up to mid-bank. This condition has continued to force the channel toward the right bank farther downstream in the vicinity of the Wrights Point Dikes causing more flow through the chute channel at Wrights Point. However, the dike system has reduced the possibility of a natural cut-off across Wrights Point by directing the flow back to the left bank in an alignment considered to be fair. A comparison of the 1961 and 1965 sailing lines indicates the

change in channel alignment since construction of the dikes (see Plate 3). The crossing opposite the dike field has moved downstream into a smoother alignment, eliminating impingement of the current along the left bank near the upstream end of Obion-Tamm Revetment. This has caused the sailing line to shift as much as 1,000 feet riverward where it now follows a line parallel to the riverward ends of the dikes. In this improved alignment, the channel comes in along the revetment directly opposite Dike No. 5 and follows the concave left bank through the entire length of the bend. There has been virtually no change in alignment through this portion of the reach. Despite the very poor entrance conditions into the reach, the Wrights Point Dikes have played a major role in improving the alignment of the channel crossing from poor to fair.

6. The configuration of the channel in the Wrights Point Reach has changed considerably since the dikes were built, with most of the change occurring in the crossing opposite the dike field. Plate 4 reflects this change by comparing surveys made before and after the dikes were built. A hydrographic survey made in 1961 was selected as a base survey with 10-foot contours shown. Superimposed on the base survey is a 1965 survey with the 0 and -10 contours shown to delineate the limits of the navigation channel. The heavy 10-foot contour line indicates the approximate controlling depth of the channel after the dikes had been in place about three years and the 0 contour outlines the bar formations. The dike system has brought about much better widths as well as a much improved alignment, especially through the crossing. It is interesting to note that the maximum increase in width of the navigation channel occurred directly opposite the lower part of the dike field, where contraction of the channel is normally expected. At this location the width has increased from 600 to 2,600 feet. This improved channel width extends down through approximate Mile 817.7. However, from this point through the remainder of the reach, widths have decreased to a critical point, particularly at Mile 817 where the navigation channel has narrowed

from 2,200 to 600 feet. This points out the tendency for a point bar to grow channelward near the lower end, thus restricting the flow and causing insufficient widths for navigation.

7. A fill and scour pattern was developed through the reach which is also shown on Plate 4. This comparison shows numerically the amount of fill or scour occurring between the 1961 and 1965 surveys. Considerable scour is indicated through the channel adjacent to the dike field with the greatest depths of scour along the riverward ends of the dikes ranging to 43 feet. This scour action extends downstream to approximate Mile 819.5 in the bendway channel. However, this trend has reversed in the lower portion of the bend, with large fill deposits accumulating to depths of 36 feet. In the deepest part of the bend, fill has deposited over the entire riverward side of the bar. This results from heavy scour in the upstream end of the reach with the sediment from such areas being transported farther downstream in the reach and deposited along the existing bar formation. This is, in effect, downstream migration of a point bar. The entire area of the dike field has accumulated fill with some depths ranging to 25 feet. But even with this filling tendency near the entrance to the chute along Wrights Point, the amount of flow through the chute continues to increase and is accelerated by heavy scour along the left side of the chute channel. This is particularly true in the lower portion of the chute where scour depths have reached 35 feet along the bar. This development of the chute channel is allowing the divided flow condition to become worse and is causing deterioration of the main channel below the dikes.

8. Further indications of scour and fill conditions are reflected by comparative cross sections through the Wrights Point Reach. Study ranges were selected at three critical locations in this reach (see Plate 2), and are designated as Study Ranges 820.39, 819.01, and 816.98 (AHP Miles). A comparison of various surveys at each of these ranges indicates the progressive changes in cross section and reemphasizes the instability of the channel in this reach (see Plates 5-7). Cross sections are plotted looking downstream. Range 820.39 shows extensive

enlargement of the channel with an increase in depth as well as width. A sizeable fill deposit had covered the upper part of the middle bar by 1964, but the latest survey shows that part of this fill has since been removed. This deposit extended across the chute entrance except for a 600-foot width along the right bank where the chute channel has deepened by about 15 feet. Range 819.01 illustrates the effect of the dikes on a channel which had filled to 6-foot depths at low water. This condition existed at the time of the 1963 survey, about 4 months after completion of the dikes. The 1964 and 1965 surveys show that the dikes have reversed this filling tendency and enlarged the channel to efficient widths and depths. The low water channel has almost doubled in area at this location. The middle bar has increased considerably in size but the chute channel has deepened over its entire width. Range 816.98 shows the channel becoming restricted by the growing bar formation. The chute channel, however, has developed to a large degree with active caving of the bar. This increase in width and depth can probably be attributed to the decrease in capacity of the main channel, resulting in a greater amount of flow through the chute. Stage hydrographs are shown on Plate 8 to indicate flow conditions at the time of each survey. The rate of rise or fall was well within the normal range for each survey.

9. Changes in channel depth through the Wrights Point Reach were studied by making a thalweg comparison. The base survey of 1961 shows conditions before installation of the dike system while the 1965 survey shows the changes that have occurred in bed profile since that time (see Plate 9). These profiles clearly indicate the much improved depths through the crossing opposite the dike field, as already evidenced by the fill and scour pattern on Plate 4. Channel depths have increased as much as 19 feet. Farther downstream at Mile 817.7, up to 22 feet of fill has deposited in the channel. This point coincides with the point at which the channel abruptly becomes much narrower as a result of accretion along the point bar (see Plate 4). This comparison illustrates, too, the downstream migration of the point bar where material from a scour area is transported farther downstream and deposited along the

river side of the bar to create a restriction. This is the only location in the reach where the controlling channel depth approaches the minimum project depth of 9 feet. Maintenance dredging has been required only one time within the reach since the dikes were completed. About 144,000 cubic yards of material were removed from the channel at Mile 819 in 1963. This was necessary because of extensive fill deposits between 1961 and 1963, resulting in a controlling depth of only 6 feet as mentioned in paragraph 8 above.

10. Water surface profiles were included in the study to determine the effects of the Wrights Point Dikes on the flow line of the channel through this reach. A comparison of various surveys was made to indicate the change in profile since construction of the dikes. Study gages were located at 11 points through the channel and chute to obtain this data (see Plate 2). The only significant change is shown by the 1960 and 1965 low water profiles on Plate 10. At Gage 4A (Mile 818.2 L), the upstream slope has flattened while the downstream slope has steepened, creating a slight hump in the flow line. This irregularity was apparently caused by the restricted channel section at Mile 817.7 and indicates that flow through this section was less uniform in 1965 than in 1960. Smooth slopes usually represent more favorable flow conditions since the head loss is uniform. Little change has occurred in the profiles taken at stages above mid-bank. Chute slopes at both high and low stages show some change, as might be expected, which reflects the development of the middle and lower portions of the secondary channel (see Plate 11). Low water slopes through the bendway channel average 0.53 foot per mile, compared to an average slope of 0.50 in the New Madrid-Memphis Reach.

Discussion

11. The Wrights Point Reach has shown considerable improvement since construction of the dike system. Channel alignment, widths, and depths have improved through the crossing in the vicinity of the dike field. In addition to these benefits, the dikes have lessened the

probability of a natural cut-off across the tip of Wrights Point. However, these improvements have occurred in the upstream 6 miles of the reach while the characteristics of the channel in the downstream 4 miles have become less favorable. The channel alignment is still satisfactory but insufficient widths and depths have developed in this portion of the reach. The influence of the dike system has extended downstream to about Mile 817.7, a distance of about 3 miles below the dike field. The evidence presented in the above analysis and on Plate 4 indicates that extending the dike system farther downstream would probably extend the channel improvements to the lower end of the reach. The division of flow must be eliminated before full development of the bendway channel in Tamm Bend can be expected, even if additional dikes are required farther downstream or in the chute. A system of three vane dikes downstream from the riverward end of Dike No. 5 across the entrance to the chute is planned for construction in FY 1969. It is also planned to fill the existing Dikes Nos. 3 and 5 with stone to close off low flow at the entrance to the chute. It is thought that stone dikes will prove to be much more effective for this purpose than the pile dike closures attempted in the past. These additional works should aid considerably in improving the Wrights Point Reach; however, the flow through the chute at Island 21 may have to be reduced before ultimate stabilization of the Wrights Point Reach can be realized. To accomplish this, a stone closure dike is planned across the chute channel in FY 1969.

PART III: ASHPORT-GOLDDUST AND KATE AUBREY REACH

Description

12. Ashport-Golddust and Kate Aubrey is a long and relatively straight section of river located about 55 miles above Memphis (see Plates 1 and 12). The study reach extends from the lower end of Island 26 Revetment to the upstream end of Island 30 Revetment, a length of about 11.0 miles, with limits from Miles 797.0 to 786.0. The excessive riverbed width has caused meandering of the low water navigation channel, resulting in its present unstable condition. Wide shoal crossings have caused insufficient navigation depths at low stages. The main channel follows the left bank through most of the reach, but an undesirable secondary channel has developed down the right bank extending most of the length of the reach and causing deterioration of the main channel. The flow is divided at Fletcher Towhead in the upper portion of the reach and Kate Aubrey Towhead in the lower portion, with a smaller bar opposite Kate Aubrey Towhead which further divides the flow into a main channel and two secondary channels, one along each bank. This division of flow is responsible for many of the adverse conditions existing in this reach. Low water channel widths vary from 2,400 to 4,500 feet and average 3,600 feet. Low and high water slopes through the reach average 0.68 and 0.41 feet per mile, respectively.

History of Construction

13. The original project for improvement of this reach was adopted in 1881. Before improvement, channel depths of 4.5 to 6 feet were frequently reported at extreme low stages, with a width of over 10,000 feet between high banks throughout much of this reach. The purpose of the project was to protect caving banks with revetment and contract the

mid-bank channel width to 3,000 feet by means of dikes and at the same time eliminate chute flow. Revetments were constructed at Daniel Point (797 R) and Ashport (794 L), both of which have since been masked by bar formations and dropped from the records. A detailed account of these and other earlier works is given in Potamology Report 21-2, dated March 1967. Dikes were constructed at two locations within the reach, Ashport-Golddust and Keyes Point. These were partially successful in influencing the natural tendencies of the river but complete contraction was not accomplished because of failure to follow through with the plan. Consequently, the fate of these two systems was the same as most of the dike systems built during the 1929-37 contraction era and only remnants of these still remain. Under this same project the Keyes Point Revetment was constructed in 1931 to prevent caving and to maintain a desirable alignment along the left bank. With several extensions, the latest of which was in 1964, this revetment now protects nearly 6 miles of the left bank. Kate Aubrey Revetment was also built in 1931 to arrest caving along a 0.5-mile section of Kate Aubrey Towhead, but this structure, too, was later covered by a bar formation. In 1957, Island 26 Revetment was constructed to prevent active caving along the right bank, which was causing an undesirable alignment in the upper end of the reach. Then in 1959, Island 30 Revetment was constructed for the same purpose in a bend at the lower end of the reach. Of the six revetments constructed in this reach, only Island 26, Keyes Point, and Island 30 still remain operative. The dike systems constructed at Ashport-Golddust and Keyes Point as a part of the original project have since been replaced with the new Ashport-Golddust Dikes and the Kate Aubrey Dikes, respectively. (See Plate 12.) The Ashport-Golddust system was built in 1960 to regulate and control the upper channel crossing and to reduce the chute flow which had increased with the deterioration of the old dikes. The new system consisted of three timber pile dikes which were located along the right bank just downstream from and utilizing the lumber mattress of the old structures. These were of 2-row and 3-row clump construction, and the design features are shown in the following tabulation:

Dike No.	Length	ALWP Elev.	Crest	Angle with Current
2AR	2,350	+16.4	Level	Normal
3AR	2,630	+16.7	Level	Normal
4AR	2,980	+16.9	Level	Normal

The Kate Aubrey Dikes, located along the right bank in the lower part of the reach, were constructed during 1962 and consist of three pile dikes varying in structure from single pile with stone foundation to 3- and 4-row clumps with lumber mattress foundations. The following tabulation shows the pertinent design data:

Dike No.	Length	ALWP Elev.	Crest	Angle with Current
1	2,680	+16.1	Level	Normal
2	2,790	+15.9	Level	Normal
3	2,790	+16.1	Level	Normal

Hydrographic Developments

14. The entrance conditions to the Ashport-Golddust Reach are similar to those above the Wrights Point Reach in that the channel flow is divided by a large middle bar. A secondary channel follows the left bank just above the mouth of the Forked Deer River and joins the channel just above the Ashport-Golddust Dikes. The concave configuration of the left bank through this chute directs the flow at higher stages toward the right bank at the downstream end of Island 26 Revetment, thus causing more flow to enter the right bank channel at Ashport-Golddust. The depths of the pool and crossing are comparatively shallow at 20 and 10 feet, respectively. These adverse entrance conditions have probably served as a deterrent to an efficient, stable channel through this reach. Plate 13, showing a comparison of the 1960 and 1965 sailing lines, indicates the effect of the two dike systems on the alignment of the channel. The crossing between Island 26 and Keyes Point Revetments remains unchanged in a very good alignment. However, the alignment through the remainder of the reach has become somewhat less favorable. Beginning at approximate Mile 792 and extending downstream to about

Mile 790, the channel has shifted toward the left bank as much as 700 feet. From this point downstream, the channel has developed a very irregular alignment, alternately shifting from left to right of the 1960 alignment in amounts up to 800 feet. At the lower end of the reach, the channel comes in along the right bank at the upper end of Island 30 Revetment in much the same alignment as before. This extreme variation illustrates the instability of the channel in this reach. The hydraulic characteristics of the river here have been altered not only by the two dike systems but by dredging as well. Extensive maintenance dredging has been required in the crossings of this reach at frequent intervals during low stages. The combined effect of the two dike systems and dredging have undoubtedly changed the entire regimen of the river at this location but separating these effects would be difficult if not impossible, so no attempt is made here to do so. Regardless of the cause of this poor alignment, it is evident that even more contraction will be required to stabilize the shifting channel and correct the problem of inadequate navigation depths. The lack of sinuosity in this reach of river disrupts the normal pattern of pools and crossings, making it unusually difficult to maintain a satisfactory channel. Even with additional works to further contract the channel, it is expected that dredging will still be required at frequent intervals until the channel is fully developed along a favorable alignment.

15. The change in channel bed configuration through this reach of river is shown on Plates 14 and 15. A 1960 hydrographic survey shows the base conditions with a 1965 survey superimposed to indicate the changes occurring since the dikes were built. Ten-foot contours are shown on the 1960 survey with the 0 and -10 contours of the 1965 survey to show the approximate limits of the navigation channel and outline the bar formations. The channel has lost some width in the upper crossing but has narrowed to less than 900 feet directly across from the Ashport-Golddust Dikes. Farther downstream in the vicinity of Keyes Point, the channel has become almost totally inadequate with insufficient depths as well as a poor alignment, but channel conditions have become excellent

below the Kate Aubrey crossing with more than sufficient depths and a smooth alignment coming into the pool along Island 30 Revetment. The channel opposite the Kate Aubrey Dikes has always been a problem to navigation and will continue to be until the excessive width is contracted even more. The riverbed width is about 7,500 feet at this location and is contracted by the Kate Aubrey Dikes to about 5,000 feet at low water which is still excessive, as evidenced by the shallow and unstable channel. The bank-to-bank width in the vicinity of the Ashport-Golddust Dikes is about 8,000 feet and is contracted to about 5,000 feet, which is still excessive. The width throughout the entire reach must be contracted before an efficient and stable channel can be achieved.

16. A fill and scour pattern within this reach is also shown on Plates 14 and 15. Within the Ashport-Golddust dike field, little or no fill has accumulated except around Dike No. 4AR. Upstream from the dikes, a bar build-up has held the crossing in practically the same favorable alignment but has reduced the channel width slightly. Fill has deposited along the outer ends of the dikes to 13-foot depths and extends along the riverward edge of the bar throughout most of the length of the reach. Upstream from Dike No. 4AR, fill has been predominant within the channel ranging in depths to 23 feet in the pool along the left bank. Downstream from this point, scour action has increased channel depths by 25 feet at some locations. Accumulations of fill have covered most of the Kate Aubrey dike field in amounts up to 13 feet. This fill extends out into the channel in even greater depths of up to 30 feet, causing the change in alignment shown on Plate 13. This condition, coupled with the scour action along the left bank opposite the dikes, has forced the channel against the concave left bank, changing the alignment from fair to poor. However, this temporary deterioration in channel conditions as a result of partially completed contraction works may have to be accepted as an interim condition until the completed works are in place.

17. Six study ranges were established in the Ashport-Golddust and Kate Aubrey Reaches to ascertain any change in channel cross section at critical points (see Plate 12). These study ranges are 796.72, 795.01, 793.81, 792.24, 791.05, and 789.92. The original conditions are shown by a 1960 survey and for comparison a 1965 survey is used to show conditions after the two dike systems had been in place 3-5 years (see Plates 16 through 21). Various surveys made between these dates were included to show the progressive changes. Cross sections are plotted looking downstream. The channel has enlarged and deepened at Range 796.72 while the opposite has occurred farther downstream at Range 795.01. The chute has enlarged at the latter range. At Ranges 793.81 and 792.24, the channel has become narrower and deeper, while the chute has filled slightly at the upper range and enlarged at the lower. The channel has decreased slightly in area but more important is the shifting of the channel from the approximate midpoint of the riverbed to the left bank, as was pointed out in paragraph 16. The channel depth has not changed materially with this realignment, but the chute has enlarged to some degree. Farther downstream at Range 789.92 there is a secondary channel along each bank in addition to the main channel. The chute along the left bank has widened considerably with the rapid caving of the towhead. This caving has caused a fill in the main channel which has practically eliminated divided flow at this point. The right bank channel has shown a sizeable decrease in area since the dikes were built. The main channel has widened but has become much shallower during this time. This section points out the highly unstable nature of the channel within this reach. Stage hydrographs for each survey are shown on Plate 22 to indicate flow conditions. Stage fluctuations during these survey dates were normal except for the July 1965 survey. During this time the stage was rising at a rate of 2.5 feet per day.

18. A thalweg comparison was made to indicate the relative changes in channel depths through this reach. Profiles taken from surveys made in 1960 and 1965 are used to show changes that have occurred (see Plate 23).

The profile from the upper end of the reach down to the Ashport-Golddust Dikes remains practically unchanged. Over the next 1.7 miles below the dikes, the channel has deepened as much as 21 feet, probably resulting from decreased widths. This indicates that the dikes have been effective to some degree, although this deepening effect did not extend very far downstream. The next 2.5-mile stretch extending below the Kate Aubrey Dikes has accumulated fill to 23-foot depths. This has resulted in a controlling depth of about 7 feet directly across from Kate Aubrey Dike No. 1. Some effect of this dike system is reflected in the next 0.7 mile where scour action has increased the controlling depth in the crossing at Mile 789.5 from 11 to 15 feet. The very deep crossing in the next mile has filled as much as 19 feet, but channel depths are still sufficient for navigation. Little change in bed profile has occurred in the downstream one mile. This thalweg comparison shows some degree of improvement in channel depths in the vicinity of both dike systems, but the improvement at neither location has extended very far downstream. The channel in this reach still requires frequent maintenance dredging, particularly in the middle portion. The channel has been dredged on 25 occasions since 1960 to maintain project depths within this reach.

19. Water surface profiles were studied by comparing surveys made at various stages before and after the dikes were built. Profiles were plotted for both the main and right bank channels, as shown on Plates 24 and 25. Study gages were located at 15 points through the channel and chute to obtain data for these profiles (see Plate 12). The flowline of the main channel has changed but little at stages above mid-bank; however, the slopes at lower stages have gradually become steeper in the downstream crossing between Gages 4 and 9. Similarly, chute slopes have changed at lower stages only. The 1965 profile shows a sharp increase in slope over the 1960 profile between Gages 3 and 6. This is in the Kate Aubrey dike field, and the change in slope probably results from fill accumulated in the chute at this point. The change in profile of the main channel is caused by a combination of the two dike systems, maintenance dredging,

and a major change in channel cross section in the lower crossing. The towhead near the left bank opposite the Kate Aubrey Dikes has been rapidly disappearing, as shown on Plate 21. The removal of this obstruction accounts for the lowering of the water surface profile in the downstream end of the reach. The average slope of the low water profile through this reach is 0.68 foot per mile, which is considerably steeper than the low water slope of 0.50 in the New Madrid-Memphis Reach.

Discussion

20. The Ashport-Golddust and Kate Aubrey Reach has shown little improvement since construction of the two dike systems. Even with these dikes in place, the channel width is still excessive. More contraction will be required to maintain a navigation channel of good alignment and adequate depth. The most evident need for additional dikes is in the gap between the two systems, where channel width, controlling depth, and alignment have become critical since construction of the two systems. Additional dikes at this location would reduce the flow entering the right bank channel between the two systems and would give direction to the flow in the main channel. At the same time, additional dikes would probably produce the scouring action necessary to maintain project depths in the channel. One new dike will be built in FY 1969, which will practically close the gap between the Ashport-Golddust Dikes and the Kate Aubrey Dikes, thus giving the effect of one continuous dike system through the entire straight portion of the reach. As another improvement, the existing dikes in the Ashport-Golddust system are to be extended riverward to provide more contraction in the upper part of the reach. But there still remains the problem of poor channel alignment in the vicinity of the Kate Aubrey Dikes. This has become more serious with the disappearance of Keyes Point Towhead, allowing more flow along the concave left bank opposite Kate Aubrey. To correct this irregular alignment, some means must be employed to develop the channel

away from the left bank and back toward midstream, which would cause a smoother alignment through the lower crossing, similar to the alignment before construction of the dikes. A system of three short dikes is planned in FY 1971 farther downstream in the pocket of the left bank opposite the Kate Aubrey Dikes. All proposed work will be of stone construction, which will provide a greater degree of contraction than the existing timber pile dikes. The system of dikes proposed for the left bank, aided by dredging as necessary, should produce a much better channel alignment by developing the flow along a straighter line into the lower crossing. If, after these additional structures are in place, the channel through this reach does not stabilize, even more new structures and extensions may be necessary to achieve an efficient channel. With the dredging that is required in this reach each year, placing the dredged material within the dike field whenever possible could aid considerably in closing the right bank flow by accelerating accretion. This would improve the section of the reach where divided flow exists and extend the effects of the dikes farther downstream.

PART IV: LOOKOUT BAR REACH

Description

21. Lookout Bar is located in a right angle bend of the river about 40 miles above Memphis (see Plates 1 and 26). This bendway reach is characterized by a very wide channel changing to a very narrow and deep channel below the bend. The channel flow is divided by a large bar along the right bank and two smaller bars along the left bank, actually causing three channels at certain stages. The riverbed is more than 8,000 feet wide in the bend with no barriers to prevent lateral movement of the channel. The channel has a history of meandering between Lookout Bar along the right bank and the concave left bank formed by Chickasaw Bluff with no fixed alignment. Low water channel widths vary from 1,300 to 6,000 feet and average 3,500 feet. Low and high water slopes through the reach average 0.55 and 0.43 feet per mile, respectively. This study reach extends from the lower part of Sunrise Towhead Revetment to the downstream end of Chickasaw Bluff. Upper and lower limits are Miles 775.0 and 769.0, a distance of six miles.

History of Construction

22. The upper section of the Lookout Bar reach was stabilized with the construction of Sunrise Towhead and Lookout Revetments (see Plate 26). Both were built in 1958 to prevent active caving along the right bank from producing an undesirable alignment. Sunrise has been extended as recently as 1964 but no additions have been made at Lookout. The point of Lookout Bar was revetted in 1961 because the general plan for alignment in this reach depended upon the stabilization of this bar. The divided channel down the right bank was becoming a detriment to the navigation channel, and in 1959 and 1960 the Lookout Dikes were built across the chute to prevent its development. This dike system was designed as a closure structure and is located well down in the chute.

The dikes are of timber pile construction with lumber foundation mattress and consist principally of standard three-and four-row clump construction. Design features of the Lookout Bar Dike system are shown in the following tabulation:

Dike No.	Length	ALWP Elev.	Crest	Angle with Current
1	2,100	+17.8	Level	Normal
1-1/2	1,230	+17.9	Level	Normal
2	780	+18.1	Level	Normal
3	1,400	+18.3	Level	Normal

Hydrographic Developments

23. The channel is relatively straight in the area upstream of the study reach. The channel is joined at Mile 774 by the chute that flows behind Sunrise Towhead and farther downstream at Mile 773, the Hatchie River empties into the channel (see Plate 26). The pool along Lookout Revetment is about 30 feet deep with a 10-foot deep crossing to the left bank at the upper end of Hatchie Towhead. A comparison was made to determine what changes in channel alignment, if any, had occurred since the dikes were built. Two sailing lines were plotted on Plate 27 to illustrate the original conditions and those existing at the time of the latest survey in 1965. At the upper end of the reach, the channel has moved from an alignment adjacent to the left bank along Hatchie Towhead to a new alignment along the right bank adjacent to Sunrise and Lookout Revetments. From the lower end of Lookout Revetment downstream through the bend, a major change in alignment has occurred. The 1960 channel made a straight crossing from Lookout Revetment to the left bank in the vicinity of Randolph and followed the concave left bank along Chickasaw Bluff through the lower end of the reach. The 1965 channel, rather than crossing to Randolph, follows a straight alignment along the riverward side of Lookout Bar and comes into the left bank at Mile 770 in a very sharp turn. No significant change was noted in the remainder of the reach.

This new channel provides a straighter alignment except for the fishhook turn near the bluff which is very difficult for towboats to negotiate. For that reason, this is considered to be a poor alignment. The most favorable alignment would follow the 1965 line down to Lookout Revetment, but would follow the 1960 line or some path between the 1960 and 1965 lines from this point through the remainder of the reach.

24. The bed configuration within the Lookout Bar Reach has changed considerably since construction of the dikes. Plate 28 reflects this change by comparing surveys made before and after the dikes were built. The survey selected to show original or base conditions was made in 1958 and is compared with the latest survey, made in 1965. The former shows all contours at 10-foot intervals while only the 0 and -10 contours are superimposed from the latter survey. The most drastic change has occurred in the crossing from Lookout Revetment to above Randolph. The wide crossing has changed to a narrow channel flowing along Lookout Bar and crossing in a straight alignment to Chickasaw Bluff. The channel has completely realigned itself from the bendway to the pointway. Below the pointway crossing at Mile 770, the channel along the very deep pool has decreased in width from 1,600 to 900 feet. The lower part of the bendway channel has changed little, but the mouth of the chute has shown some development since the earlier survey.

25. Fill and scour through the reach was studied and amounts are shown on Plate 28 by (+) and (-) figures along certain ranges. In the upper crossing, fill has accumulated in depths up to 12 feet, which has practically closed off this crossing, forcing the flow down the right bank where scour depths have exceeded 30 feet. This filling tendency extends down into the pool along the left bank to about Mile 770.3. These deposits have caused a sizeable bar formation between the bendway and pointway channels. Depths of fill have exceeded 35 feet at some locations. Considerable scour is shown at the entrance to the chute because of an enlargement of the chute immediately before construction of the dikes. The construction of Lookout Bar Revetment in 1961 has increased the development of the right bank chute channel, but the Lookout Bar Dikes appear to have counteracted this tendency and forced the development

of the middle channel. This reach of river has undergone considerable change in channel and bed configuration and may require one or more extensive contraction systems to direct the channel back to the left bank in a smooth crossing with adequate depths. Timely extension of the existing dike system could possibly have accomplished these results, but this would not provide a practical solution to the problem now since the pointway channel has developed to such a degree.

26. Three study ranges were established in the Lookout Bar Reach to study the change in cross section after construction of the dike system (see Plate 26). Study ranges selected were 771.85, 771.16, and 770.35; and various surveys are shown on Plates 29, 30, and 31 for comparative purposes. The survey dates range from 1958 to 1965. The cross sections are plotted looking downstream. Range 771.85 shows what was indicated by the channel development comparison above, that the left bank channel has almost completely filled while the pointway channel has developed along the river side of Lookout Bar. The bulk of Lookout Bar had disappeared by 1962. However, the chute channel has filled since that time and carries little or no low water flow. Below the crossing at range 771.16, the trend is generally the same. The upper portion of the pool along the left bank still shows a sizeable fill deposit. The pointway channel has deepened to accommodate the flow, but no significant changes have occurred in the chute channel. At range 770.35, the main channel comes in along the concave left bank where the channel has become narrower. At this point the low water channel is 60 feet deep along the foot of Chickasaw Bluff. On this range, most of Lookout Bar had caved away before Lookout Bar Dikes and Revetment were placed, but only minor changes have occurred since that time. From these comparative cross sections, it is clearly seen that excessive width is the primary problem and any solution must include some means of further contracting the channel. Flow conditions at the time of each survey are shown by stage hydrographs of the Memphis Gage (see Plate 32). The stage was on a stand for all surveys except the April 1964 survey, at which time the stage was rising at a moderate rate.

27. A thalweg comparison was made by using a 1960 survey to show original conditions and the latest survey, made in 1965, to show the after conditions (see Plate 33). In the area immediately upstream of the Lookout Bar Dikes, the channel has filled as much as 20 feet. Some scour action has occurred directly opposite the dike field, but in the area below the dikes considerable depths of fill exceeding 40 feet have accumulated in the deep channel along Chickasaw Bluff. This fill accumulation upstream of the dike system has caused the navigation channel to seek another route, resulting in development of the pointway channel along the left side of Lookout Bar. This major realignment of the channel within the reach is not considered to be the result of the Lookout Bar Dikes, but rather the excessive riverbed width which has permitted the channel to meander. And even though the dike system has been effective to some degree in reducing chute flow, the channel will continue to be unstable until the remaining low water channel width of 5,000 feet is further reduced.

28. Nine study gages were established within the Lookout Bar Reach to study changes in water surface profiles. The gages were spaced along the main channel and through the chute (see Plate 26). In the upper part of the reach, the high water profile of the channel has changed very little; but down in the bend between Gages 4 and 5, a reverse slope has occurred (see Plate 34). The realignment of the channel probably accounts for this. Because of the large fill accumulation in the upper portion of the left bank channel near Randolph, the flow down the pointway channel creates a backwater effect. The mid-bank profile shows almost no change. The low water profile shows little change in the upper part but shows a steepening in the bend between Gages 3 and 5. Profiles of the pointway and chute channels are shown on Plate 35. The only significant change is in the high water profile of the pointway channel. Between 1958 and 1965, the slope has changed from a uniform one to an irregular one. The slope has become much flatter above and steeper below Gage 5. This again reflects the change in channel regimen in this reach. Through the chute, the profiles at high and mid-bank stages are practically unchanged; however, considerable change has occurred in the low water flow line. Over the three-year period between 1962 and 1965, the slope

has changed from fairly uniform to very irregular. The slope between Gages 2 and 5A has more than doubled. This lowering of the profile can be attributed to the development of the mouth of the chute. Low water slopes through the channel average 0.55 foot per mile which is somewhat higher than the average slope of 0.50 for the New Madrid-Memphis Reach.

Discussion

29. The Lookout Bar dike system has been effective in accomplishing its intended purpose by practically eliminating flow through the chute at low stages. However, due to a major change in regimen in this reach of river, this closure has not resulted in a more efficient navigation channel. Following the chute closure, slopes increased in the bendway, and a filling tendency in the bendway channel along the left bank caused the channel to realign itself by developing a pointway channel between the bendway and Lookout Bar, which is less favorable than the bendway channel. A more comprehensive plan in the beginning, which would have included a system of contraction dikes placed on the channel side of Lookout Bar simultaneously with the closure dike system, would probably have maintained the bendway alignment. To accomplish this now, at least one dike system will be required on the right bank in the vicinity of Lookout Revetment to direct the flow back to the left bank in a smooth crossing, and if the channel does not respond to this treatment, a more extensive or additional system may be required, as well as considerable dredging. The attainment of this new alignment will be a big task considering the state of development of the pointway channel, but once achieved, holding this alignment should not present a big problem.

PART V: DISCUSSION AND CONCLUSIONS

Discussion

30. In studying an alluvial stream like the Mississippi River, the many variables are so interrelated that the problem of isolating these variables becomes extremely complex. A practical, rather than a theoretical, approach was used in the conduct of this investigation, which consisted of comparing conditions before and after installation of the dike systems in each reach. A number of variable channel factors were selected as parameters for analyzing the effectiveness of the dike systems within the three study reaches, with a view to finding possible solutions to improving problem reaches such as these. The factors included entrance conditions, channel alignment, width, depth, fill and scour, cross section area, thalweg profile, and water surface slope. These were used as a basis for comparing original conditions with conditions at frequent intervals after the dikes had been constructed. The after conditions used in the comparison extend from the time of construction to the time of the latest survey to show progressive changes. This indicates how the channel has responded to the contraction or closure dike systems constructed in a given reach. Since construction of the dike systems in these study reaches in the early 1960's, stone has come into extensive use in the Memphis District. The more permanent stone structures, being less permeable than pile dikes, restrict the flow more and therefore provide a greater degree of contraction. Although practically all dikes since 1964 have been built of stone, pile dikes with stone fill still have some use, particularly in deep water where the cost of stone dikes would be prohibitive. However, the use of contraction works alone to correct an unstable reach is often a lengthy process and has sometimes been futile. Dredging at opportune times, in conjunction with dikes, can be used to considerable advantage in developing a satisfactory navigation channel in a problem reach. In addition to assisting the dikes directly in developing a channel, dredge spoil can be used to encourage accretion

in the dike field. This could expedite the procedure of achieving and maintaining an adequate channel. Consideration should be given to more extensive use of dredging to assist in contraction by means of dikes. Close surveillance would be required during the development of the channel in these reaches to determine the most opportune time for dredging. It is hoped that the data presented in this report will provide additional insight into the problem of dike effectiveness by pinpointing some of the deficiencies and inadequacies of our present dike systems and will lead to improving our dike design criteria.

Conclusions

31. The investigation has indicated certain trends or relationships concerning the effectiveness of dike systems as contraction works or closure structures, which are as follows:

a. The effect of the dike systems extended for only a limited distance downstream of the dikes - less than one mile in most cases. Farther downstream channel conditions did not improve and sometimes became worse. This indicates the need for placing more extensive initial dike systems at most locations in order to achieve and hold a desired alignment through a crossing.

b. Although each of the dike systems has been fairly successful in effecting a low-water closure at the chute entrance, the lower portion of the chute below the dike field has shown considerable development. The dikes in each system studied were constructed with their crests level with respect to each other. Laboratory tests conducted by WES have indicated that the stepped-down design is more effective than the level-crest design in contraction dikes on the main channel. This would also appear to be true in the case of chute closure structures since the stepped-down design would create less turbulence at high stages in the lower portion of the dike field and would therefore result in smoother flow. This would reduce scour action below the dikes and still cause a filling tendency at the entrance to the chute.

c. The failure to follow through with supplementary contraction works soon enough in these problem reaches has resulted in a slowdown in the rate of improvement or even a partial loss of the initial improvement in some instances. Timely extension of present dikes or construction of additional dikes could make a dike system operate much more efficiently and more nearly accomplish its intended purpose.

d. In closing secondary channels, the placing of dikes in the main channel simultaneously with the closure structures would in many cases be beneficial in directing the channel flow through a difficult crossing. Since the closure of a secondary channel will usually result in increased slopes in the main channel, a second system of dikes, placed simultaneously with the closure dikes, may be necessary. This would serve to control the development of the main channel and possibly prevent further pointway tendencies as occurred at Lookout Bar.

e. Dredging could be used more extensively, in conjunction with contraction works, to develop a satisfactory navigation channel in unstable reaches similar to those studied. Where dredging is planned in the proximity of dike fields, particularly closure structures, consideration should be given to placing the spoil in the dike field when feasible. This would increase the effectiveness of the dike system considerably by assisting the natural tendencies of the river in depositing fill over the dike field to expedite a bar formation or chute closure.

f. The most feasible solution to the problem of a restricted channel in a point bar reach with divided flow is considered to be a closure of the chute channel to divert more flow through the main channel. This increased flow would usually maintain project dimensions in the channel. But in some cases where a closure may not be feasible, a concept mentioned by the Vicksburg District in previous potamology reports offers a possible alternate solution to this problem. It suggests the use of submerged stone dikes or groins designed to force concentrated flow away from concave banks and create additional turbulence against the point bar to widen the channel by scour action.

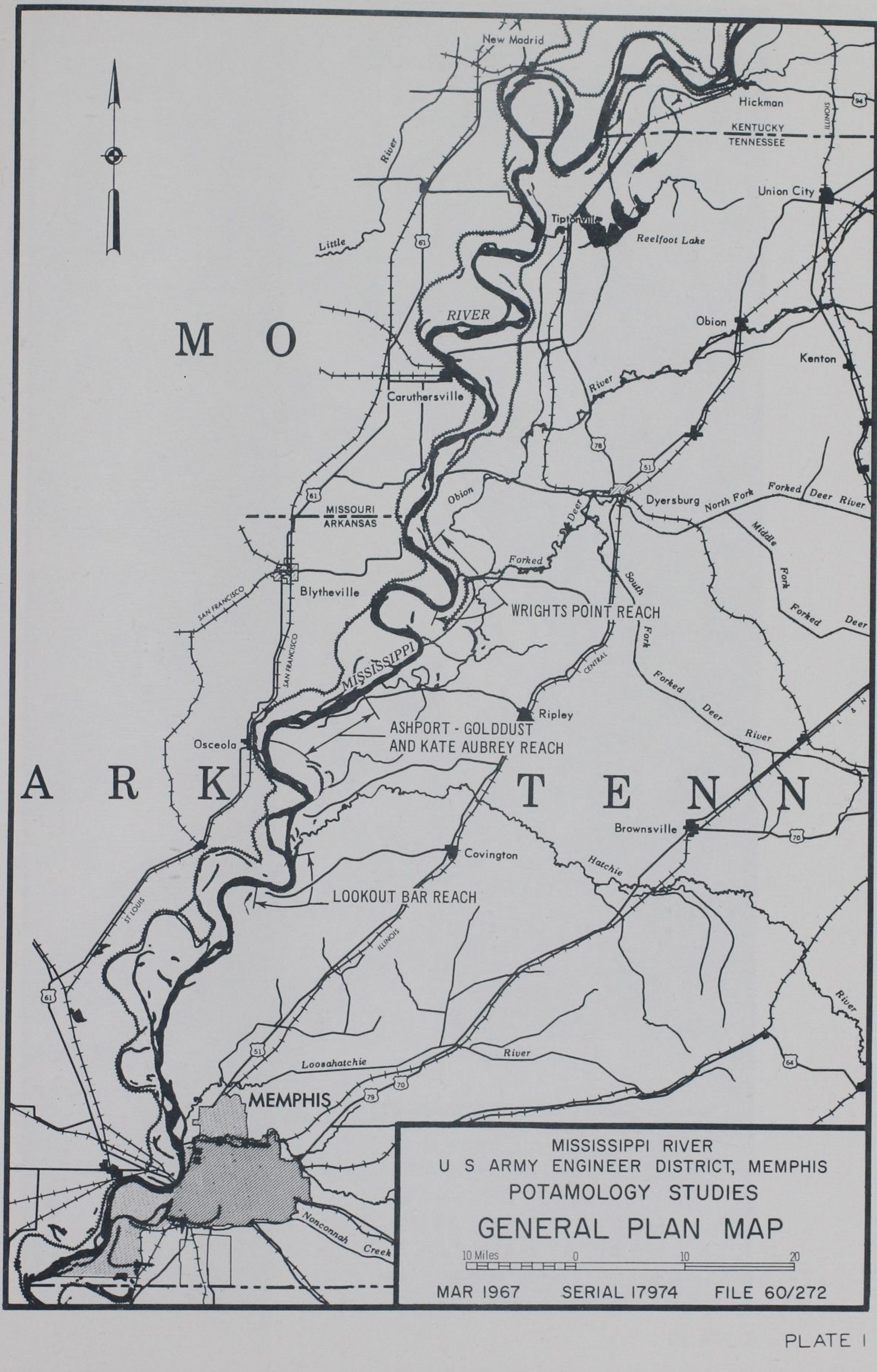

New Madrid
Hickman
KENTUCKY
TENNESSEE
Union City
Tiptonville
Reelfoot Lake
Little River
RIVER
M O
Obion
Kenton
Caruthersville
River
Dyersburg
North Fork Forked Deer River
MISSOURI
ARKANSAS
Obion
Forked Deer
Blytheville
WRIGHTS POINT REACH
Middle Fork Forked Deer
South Fork Forked Deer River
MISSISSIPPI
Ripley
Osceola
ASHPORT - GOLDDUST
AND KATE AUBREY REACH
A R K
T E N N
Brownsville
Covington
Hatchie
LOOKOUT BAR REACH
River
Loosahatchie River
MEMPHIS
Nonconnah Creek
MISSISSIPPI RIVER
U S ARMY ENGINEER DISTRICT, MEMPHIS
POTAMOLOGY STUDIES
GENERAL PLAN MAP
10 Miles 0 10 20
MAR 1967 SERIAL 17974 FILE 60/272

PLATE I


TENNESSEE
OBION RIVER
OBION
OBION BAR
SG2
SR 820.37
820
SG4
TAMM
TAMM
SG4a
SR 819.01
BEND
REVETMENT
SG3
SG3b
WRIGHTS POINT DIKES
(1961 – 1962)
SG3a
Dike No. 1
Dike No. 2
Dike No. 3
Dike No. 4
Dike No. 5
SR 816.98
ISLAND 21
SG1
REVET
HICKMAN
825
WRIGHTS POINT
815
SG5
SG6
TENN.
ARKANSAS
HUFFMAN
SCALE OF MILES
.5 0 .5 1
LEGEND
SR ------------ STUDY RANGE
SG ------------ STUDY GAGE
MISSISSIPPI RIVER
U. S. ARMY ENGINEER DISTRICT, MEMPHIS
POTAMOLOGY STUDIES
WRIGHTS POINT REACH
AHP MILE 814.0 TO 824.0
MARCH 1967 SERIAL 17974 FILE 60/272


TENNESSEE
OBION RIVER
OBION
OBION BAR
TAMM
TAMM BEND REVETMENT
820
WRIGHTS POINT DIKES
(1961 – 1962)
SAILING LINE 1961
SAILING LINE 1965
ISLAND 21
REVET
HICKMAN
825
WRIGHTS POINT
HUFFMAN
ARKANSAS
815
TENN.
SCALE OF MILES
.5 0 .5 1
MISSISSIPPI RIVER
U. S. ARMY ENGINEER DISTRICT, MEMPHIS
POTAMOLOGY STUDIES
CHANNEL ALIGNMENT COMPARISON
WRIGHTS POINT REACH
MARCH 1967 SERIAL 17974 FILE 60/272

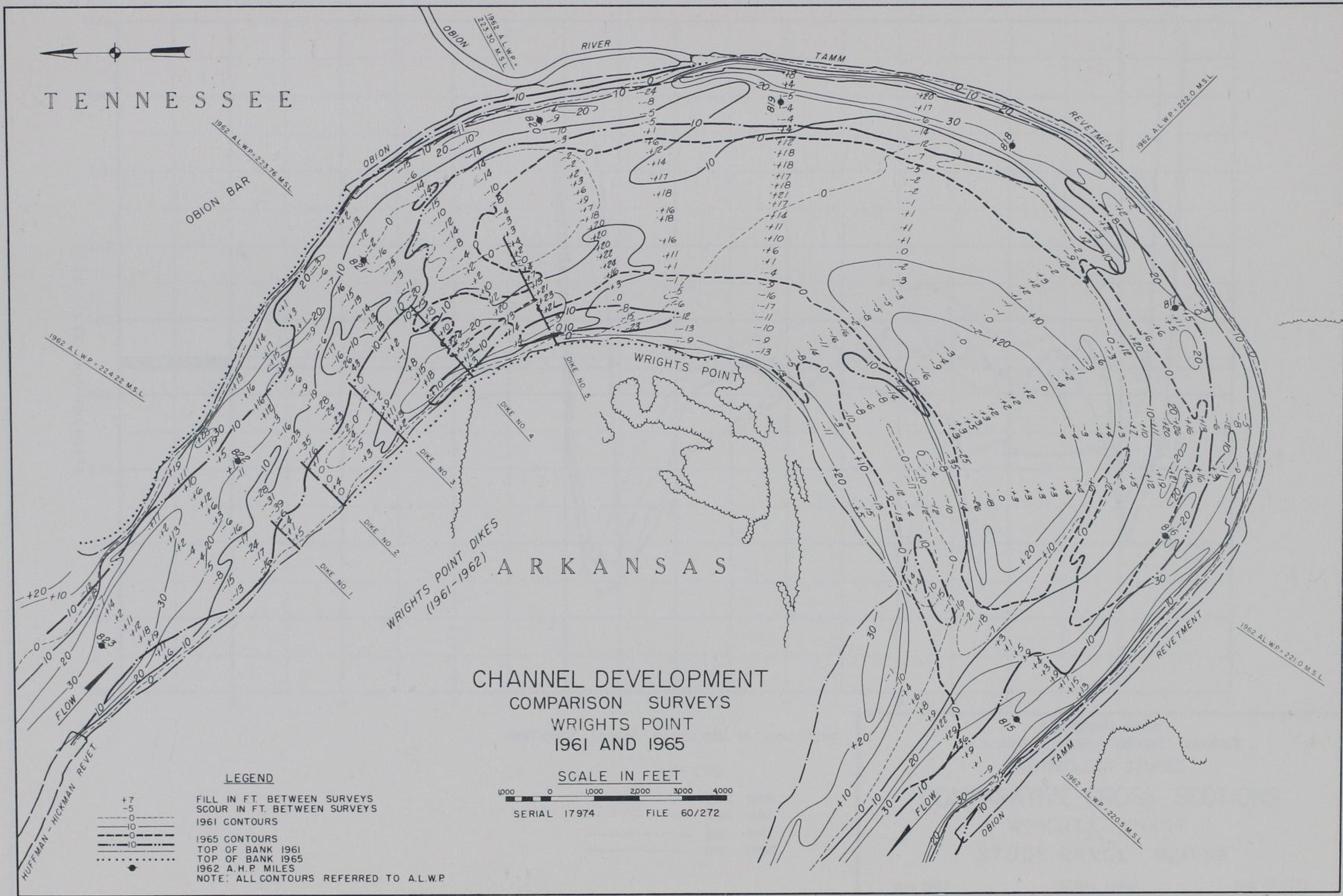
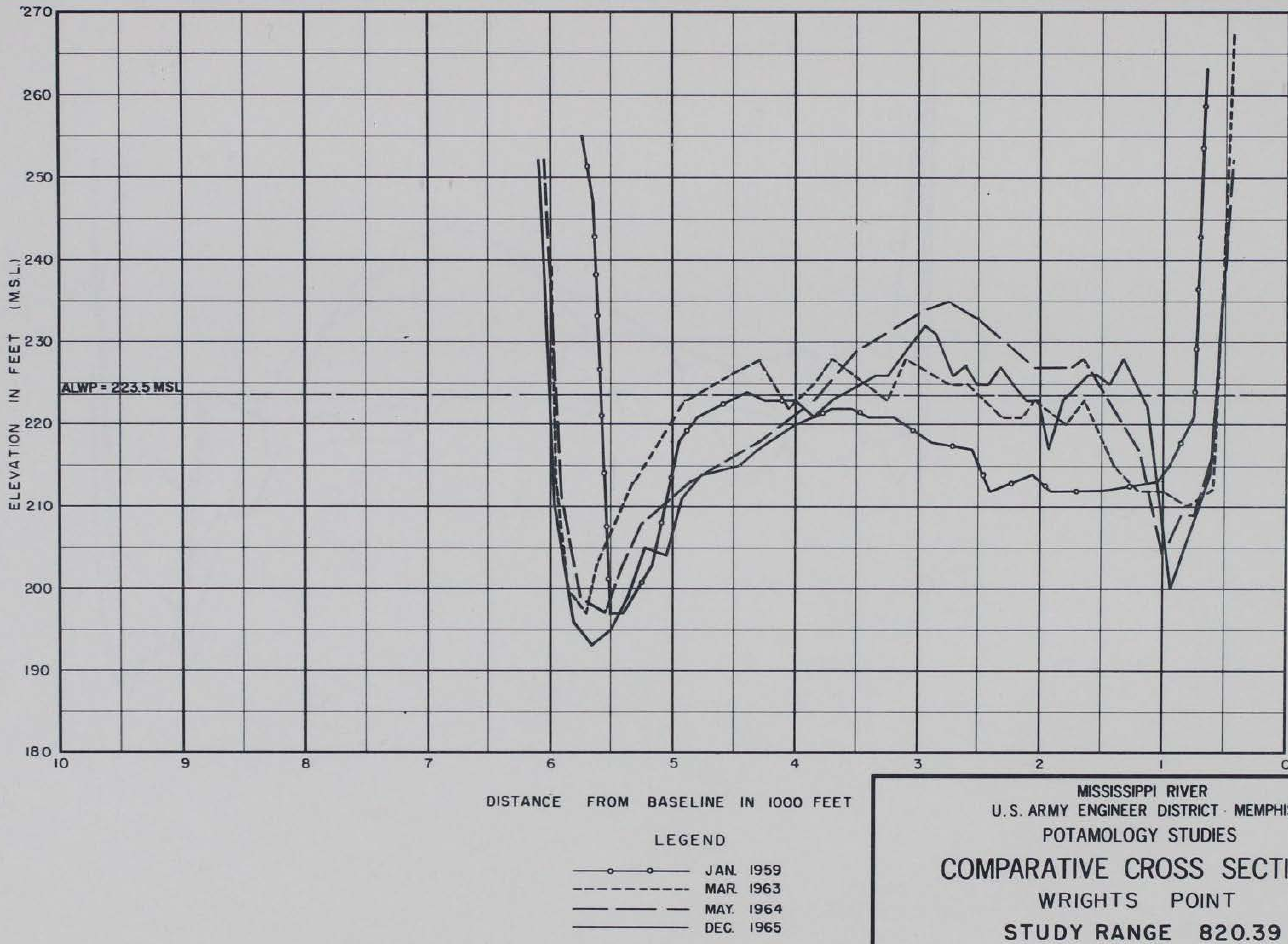

TENNESSEE
ARKANSAS
OBION RIVER
OBION BAR
OBION
TAMM
REVETMENT
WRIGHTS POINT
WRIGHTS POINT DIKES (1961-1962)
DIKE NO. 1
DIKE NO. 2
DIKE NO. 3
DIKE NO. 4
DIKE NO. 5
HUFFMAN - HICKMAN REVET
FLOW
1962 A.L.W.P.= 223.30 M.S.L.
1962 A.L.W.P.= 223.76 M.S.L.
1962 A.L.W.P.= 224.22 M.S.L.
1962 A.L.W.P.= 222.0 M.S.L.
1962 A.L.W.P.= 221.0 M.S.L.
1962 A.L.W.P.= 220.5 M.S.L.
815
817
818
819
820
821
822
823
CHANNEL DEVELOPMENT
COMPARISON SURVEYS
WRIGHTS POINT
1961 AND 1965
SCALE IN FEET
1,000 0 1,000 2,000 3,000 4,000
SERIAL 17974
FILE 60/272
LEGEND
+7 FILL IN FT. BETWEEN SURVEYS
-5 SCOUR IN FT. BETWEEN SURVEYS
1961 CONTOURS
1965 CONTOURS
TOP OF BANK 1961
TOP OF BANK 1965
1962 A.H.P. MILES
NOTE: ALL CONTOURS REFERRED TO A.L.W.P.

PLATE 4



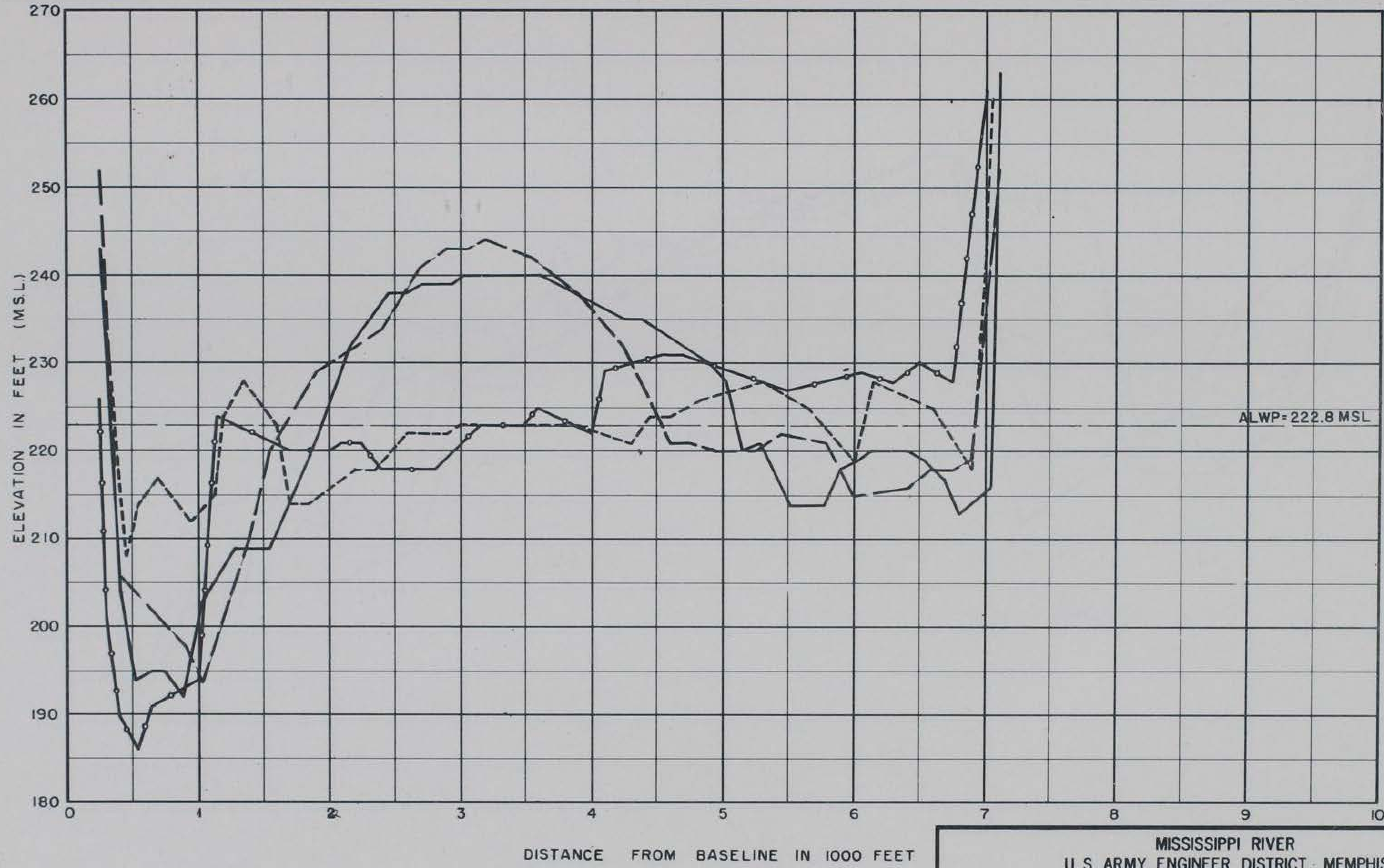
MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT · MEMPHIS
POTAMOLOGY STUDIES

COMPARATIVE CROSS SECTIONS

WRIGHTS POINT

STUDY RANGE 820.39

MAR 1967 SERIAL 17974 FILE 60/272



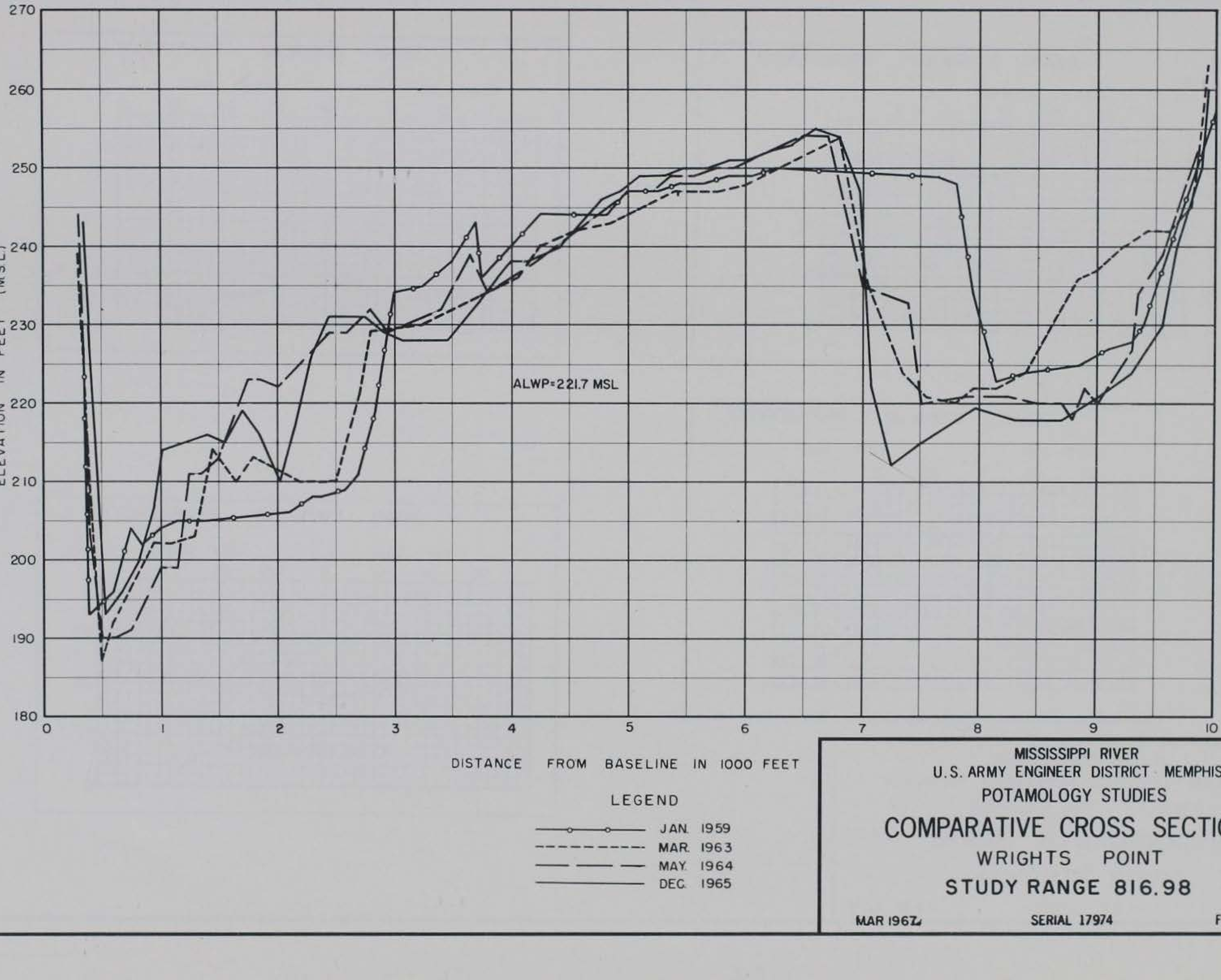
LEGEND

JAN. 1959
MAR. 1963
MAY 1964
DEC. 1965

MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT MEMPHIS
POTAMOLOGY STUDIES

COMPARATIVE CROSS SECTIONS
WRIGHTS POINT
STUDY RANGE 819.01

MAR 1967 SERIAL 17974 FILE 60/272



MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT MEMPHIS
POTAMOLOGY STUDIES

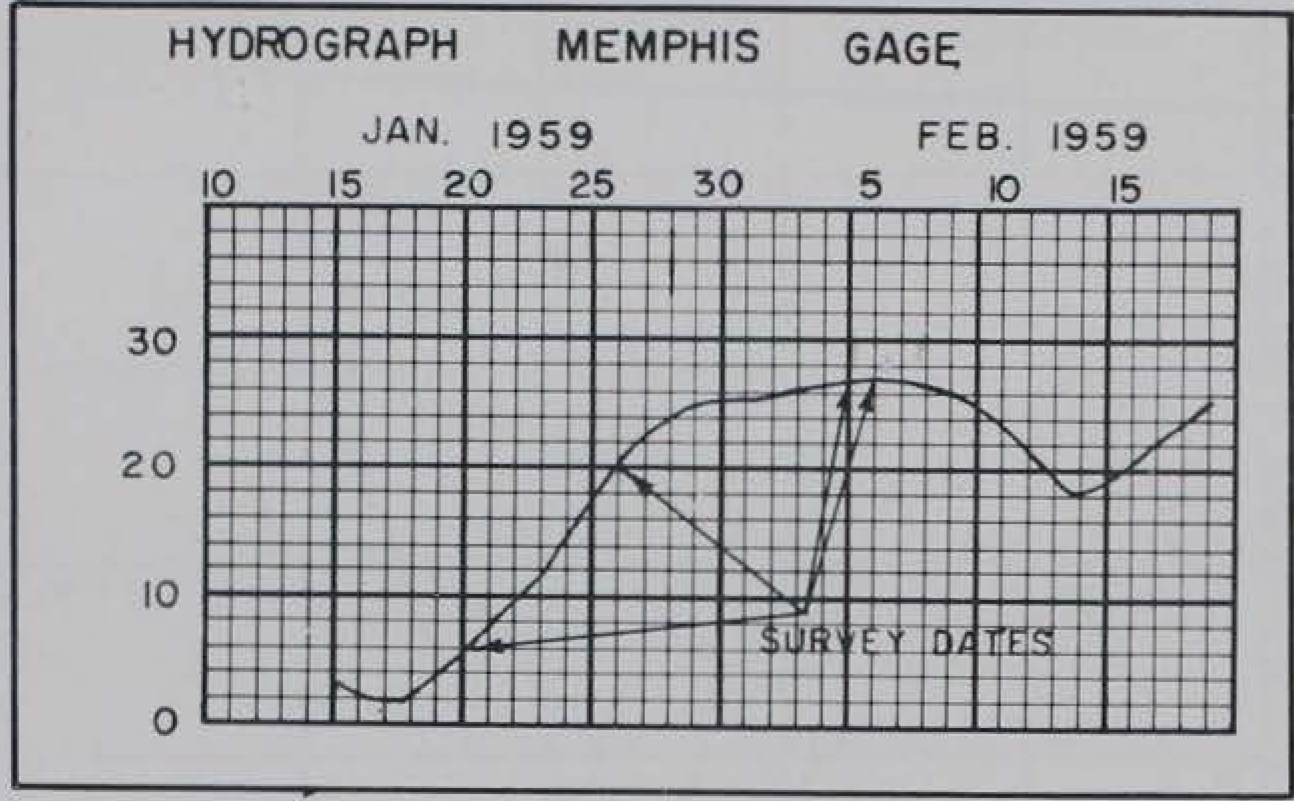
COMPARATIVE CROSS SECTIONS

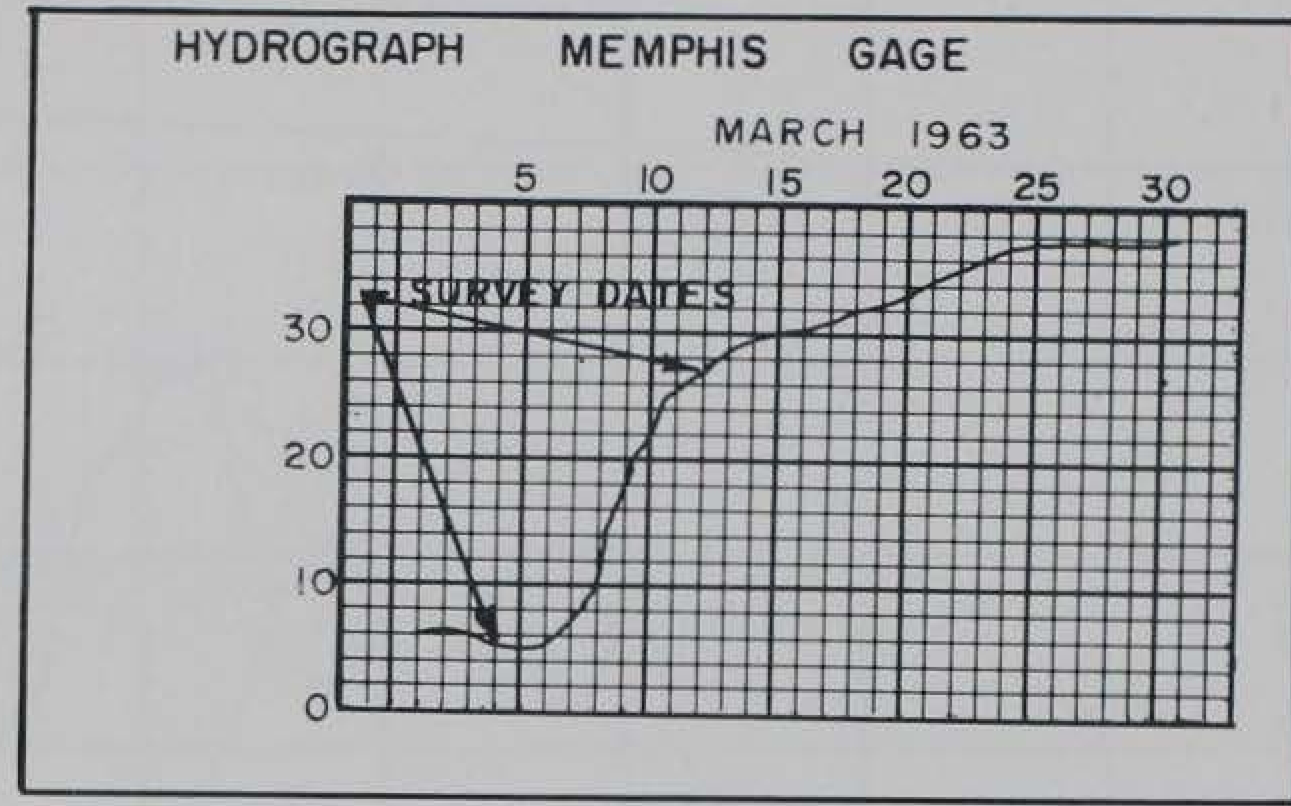
WRIGHTS POINT

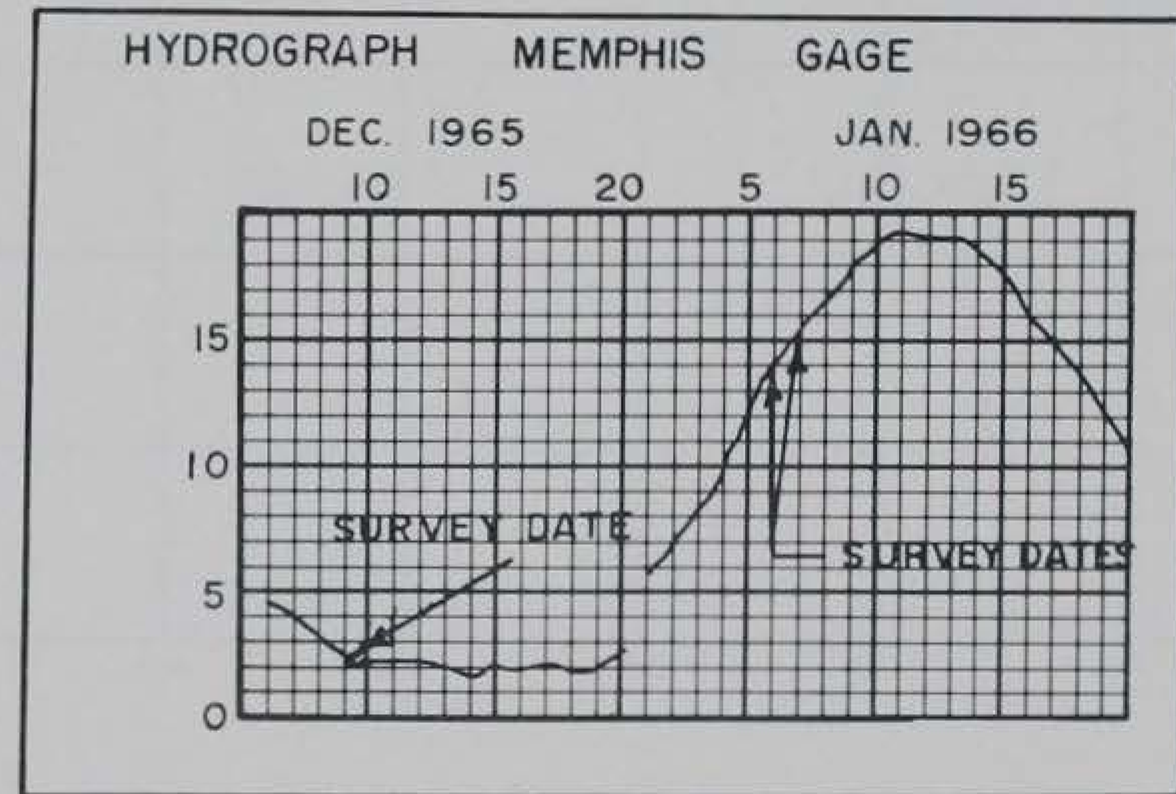
STUDY RANGE 816.98

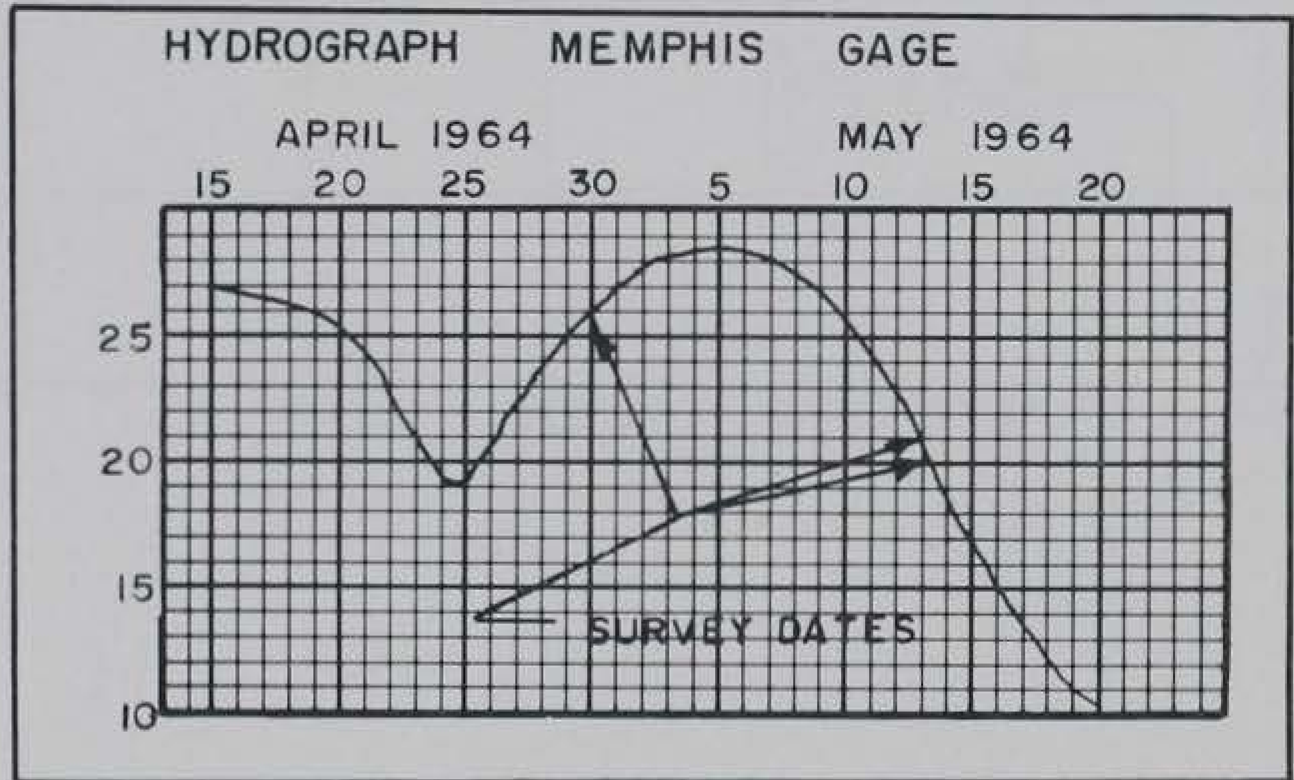
MAR 1967 SERIAL 17974 FILE 60/272

PLATE 7









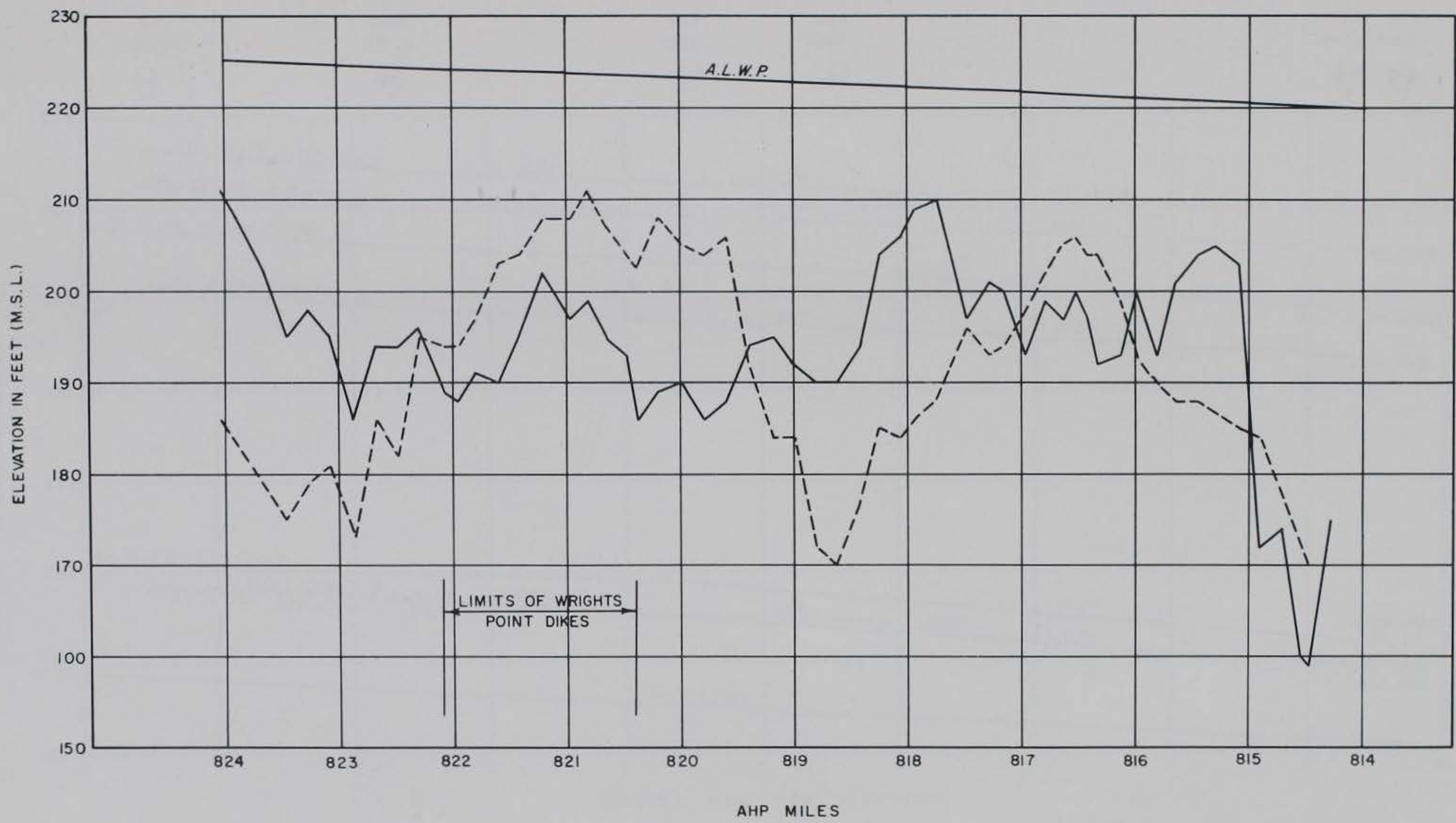
MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT - MEMPHIS
POTAMOLOGY STUDIES

STAGE HYDROGRAPHS

WRIGHTS POINT

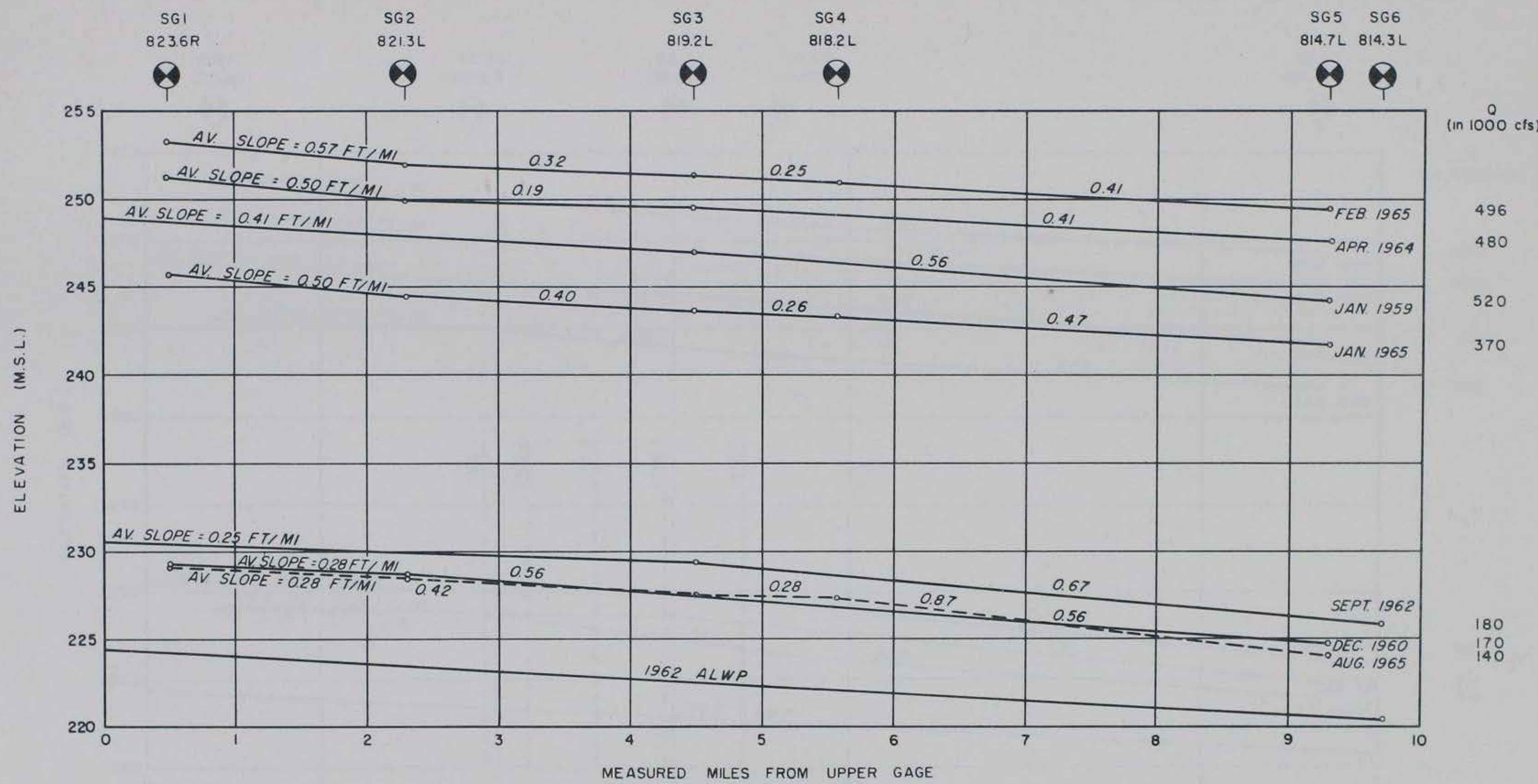
MAY 1965 SERIAL 17974 FILE 60/272

PLATE 8



MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT – MEMPHIS
POTAMOLOGY STUDIES
THALWEG PROFILES
WRIGHTS POINT

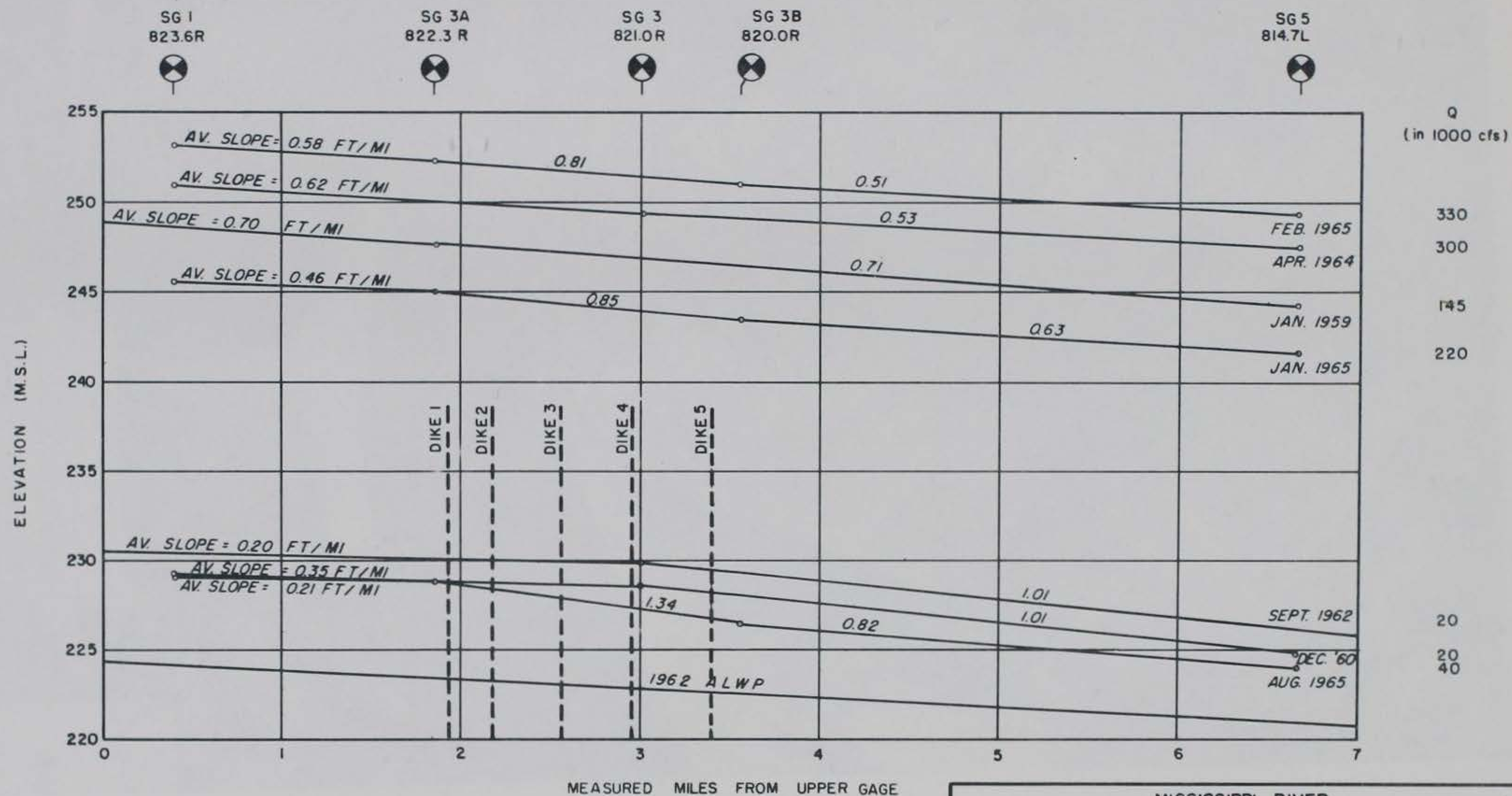
FEB. 1967 SERIAL 17974 FILE 60/272



LEFT BANK (CHANNEL)

MISSISSIPPI RIVER
U. S. ARMY ENGINEER DISTRICT – MEMPHIS
POTAMOLOGY STUDIES
WATER SURFACE PROFILES
WRIGHTS POINT

JAN. 1966 SERIAL 17974 FILE 60/272



RIGHT BANK (CHUTE)

MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT - MEMPHIS
POTAMOLOGY STUDIES

WATER SURFACE PROFILES

WRIGHTS POINT

JAN. 1966 SERIAL 17974 FILE 60/272

FORKED DEER RIVER
TENNESSEE
ASHPORT TOWHEAD
SG1b
SG2a
SG1
SG2
SG4
SG5
SG6
SG7
SG7a
SG7b
SG7c
SG8
ISLAND 26 REVET
KEYES POINT
REVET
KEYES POINT
SR 796.72
SR 793.61
SR 792.24
SR 791.05
TENN.
FORKED DEER ISLAND
DANIEL POINT
ASHPORT - GOLDDUST DIKES
(1960)
Dike No. 2AR
Dike No. 3AR
Dike No. 4AR
CANADIAN REACH
FLETCHER TOWHEAD
KATE AUBREY DIKES
(1962)
Dike No. 1
Dike No. 2
Dike No. 3
KATE AUBREY TOWHEAD
ARKANSAS
TENN.
ISLAND NO 30
SCALE OF MILES
.5 0 .5
LEGEND
SR STUDY RANGE
SG STUDY GAGE
MISSISSIPPI RIVER
U. S. ARMY ENGINEER DISTRICT
POTAMOLOGY STUD
ASHPORT - GOLDD
AND KATE AUBREY
APH MILE 786.0 -
MARCH 1967 SERIAL 17974

DEER RIVER
TENNESSEE
ASHPORT TOWHEAD
KEYES
POINT
KEYES POINT
REVET
TENN.
ISLAND
DANIEL POINT
ASHPORT – GOLDDUST DIKES (1960)
CANADIAN REACH
FLETCHER TOWHEAD
KATE AUBREY DIKES (1962)
KATE AUBREY TOWHEAD
ARKANSAS
TENN.
ISLAND NO 30
Osceola
SCALE OF MILES
.5 0 .5 1
LEGEND
SR STUDY RANGE
SG STUDY GAGE
MISSISSIPPI RIVER
U. S. ARMY ENGINEER DISTRICT - MEMPHIS
POTAMOLOGY STUDIES
ASHPORT – GOLDDUST
AND KATE AUBREY REACH
APH MILE 786.0 – 797.0
MARCH 1967 SERIAL 17974 FILE 50/272

PLATE 12

FORKED DEER RIVER
TENNESSEE
ASHPORT TOWHEAD
SAILING LINE 1965
795
ISLAND 26 REVET
KEYES
POINT
REVET
TENN.
FORKED DEER ISLAND
ASHPORT - GOLDDUST DIKES
(1960)
DANIEL
POINT
CANADIAN REACH
FLETCHER TOWHEAD
KATE AUBREY DIKES
(1962)
KEYES POINT
SAILING LINE 1960
KATE AUBREY TOWHEAD
ARKANSAS
TENN.
ISLAND
.5 0
U. S. ARMY
CHANNEL
AND KATE
MARCH 1967


TENNESSEE
ASHPORT TOWHEAD
SAILING LINE 1965
REVET
KEYES
POINT
REVET
KEYES POINT
SAILING LINE 1960
785
TENN.
DEER ISLAND
DANIEL POINT
ASHPORT - GOLDDUST
(1960)
DIKES
CANADIAN REACH
FLETCHER TOWHEAD
KATE AUBREY
(1962)
DIKES
KATE AUBREY TOWHEAD
ARKANSAS
TENN.
ISLAND NO 30
Osceola
SCALE OF MILES
.5 0 .5 1
MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT - MEMPHIS
POTAMOLOGY STUDIES
CHANNEL ALIGNMENT COMPARISON
ASHPORT GOLDDUST
AND KATE AUBREY REACH
MARCH 1967 SERIAL 17974 FILE 60/272

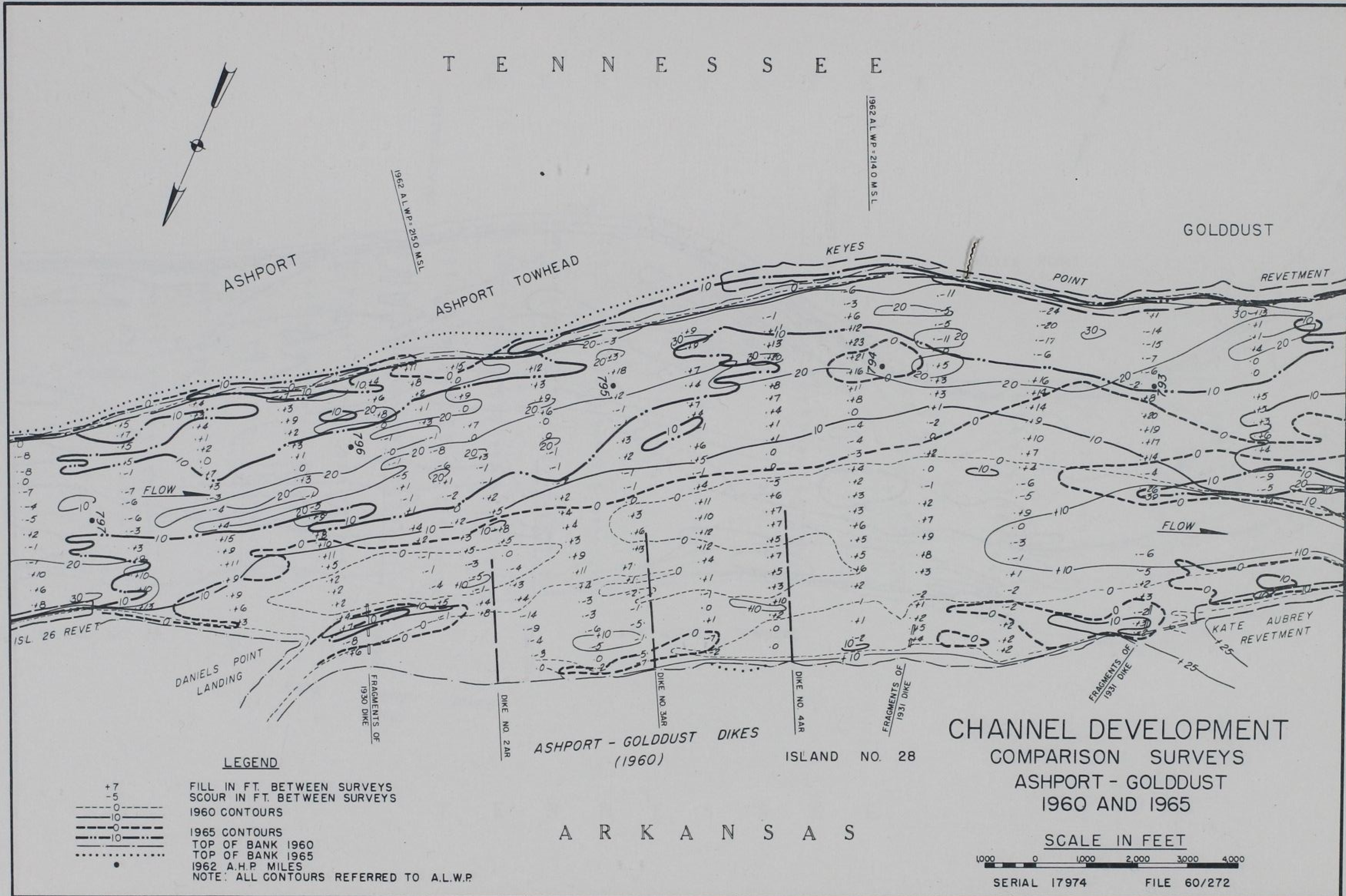

TENNESSEE
ARKANSAS
ASHPORT
ASHPORT TOWHEAD
KEYES
POINT
GOLDDUST
REVETMENT
1962 A.L.W.P.=215.0 M.S.L.
1962 A.L.W.P.=214.0 M.S.L.
FLOW
ISL. 26 REVET
DANIELS POINT LANDING
FRAGMENTS OF 1930 DIKE
DIKE NO. 2AR
DIKE NO. 3AR
DIKE NO. 4AR
FRAGMENTS OF 1931 DIKE
KATE AUBREY REVETMENT
ASHPORT - GOLDDUST DIKES (1960)
ISLAND NO. 28
796
797
795
794
793
LEGEND
FILL IN FT. BETWEEN SURVEYS
SCOUR IN FT. BETWEEN SURVEYS
1960 CONTOURS
1965 CONTOURS
TOP OF BANK 1960
TOP OF BANK 1965
1962 A.H.P. MILES
NOTE: ALL CONTOURS REFERRED TO A.L.W.P.
CHANNEL DEVELOPMENT
COMPARISON SURVEYS
ASHPORT - GOLDDUST
1960 AND 1965
SCALE IN FEET
1,000 0 1,000 2,000 3,000 4,000
SERIAL 17974
FILE 60/272

PLATE 14

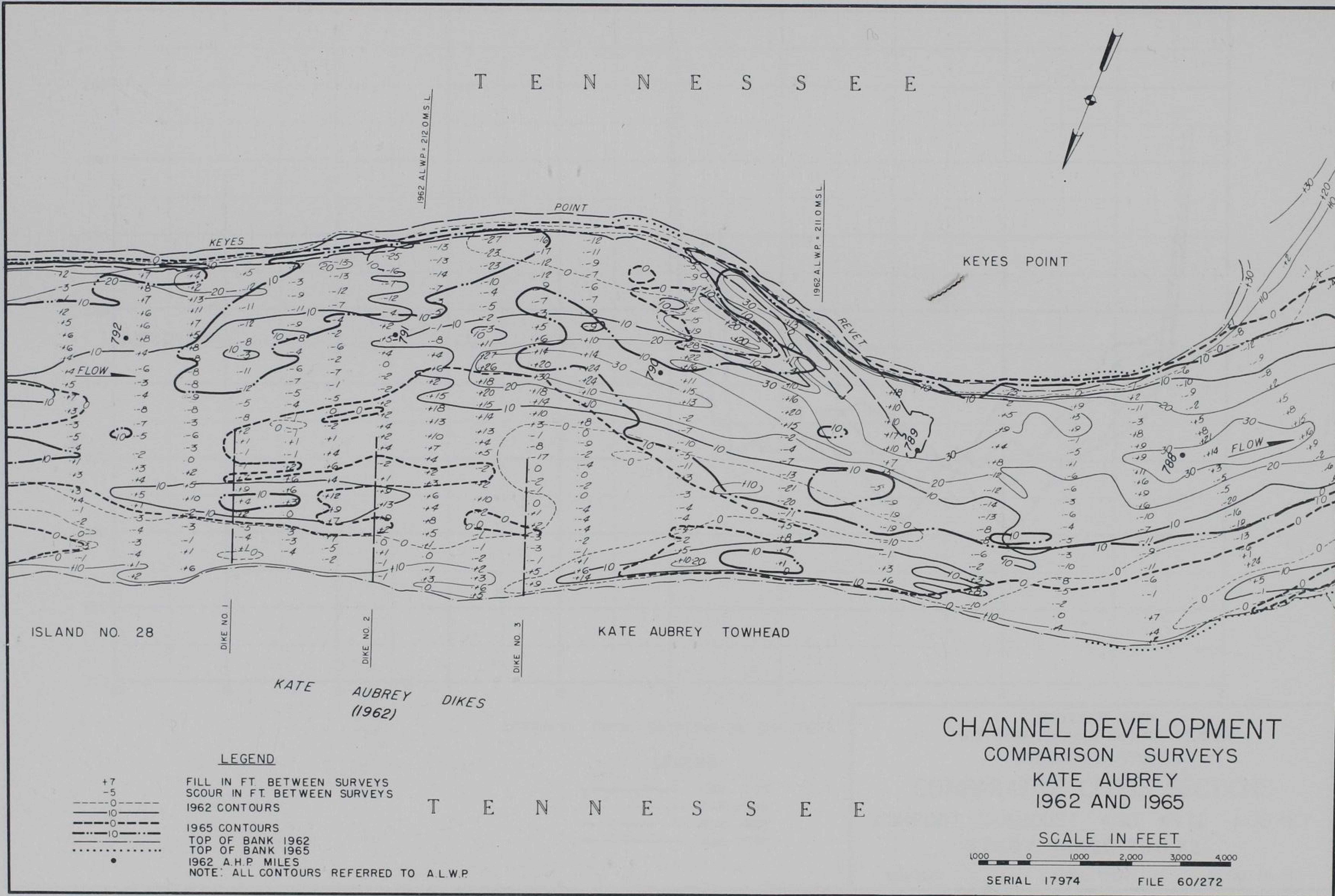
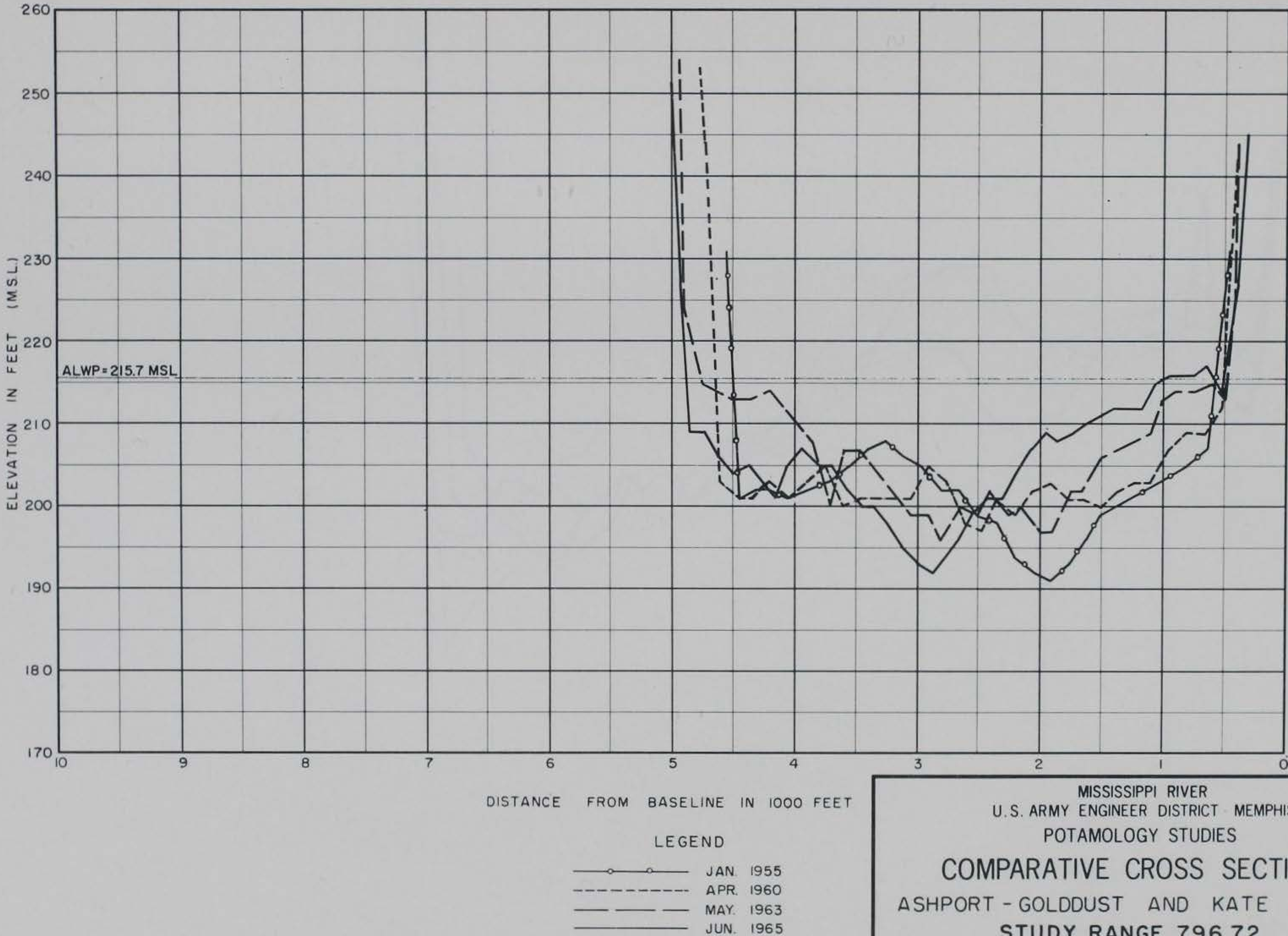

TENNESSEE
KEYES POINT
KEYES POINT
REVET
FLOW
FLOW
1962 AL.W.P. = 212.0 M.S.L.
1962 A.L.W.P. = 211.0 M.S.L.
792
791
790
789
788
ISLAND NO. 28
DIKE NO. 1
DIKE NO. 2
DIKE NO. 3
KATE AUBREY TOWHEAD
KATE AUBREY DIKES (1962)
TENNESSEE
LEGEND
+7 FILL IN FT. BETWEEN SURVEYS
-5 SCOUR IN FT. BETWEEN SURVEYS
1962 CONTOURS
1965 CONTOURS
TOP OF BANK 1962
TOP OF BANK 1965
1962 A.H.P. MILES
NOTE: ALL CONTOURS REFERRED TO A.L.W.P.
CHANNEL DEVELOPMENT
COMPARISON SURVEYS
KATE AUBREY
1962 AND 1965
SCALE IN FEET
1,000 0 1,000 2,000 3,000 4,000
SERIAL 17974
FILE 60/272

PLATE 15



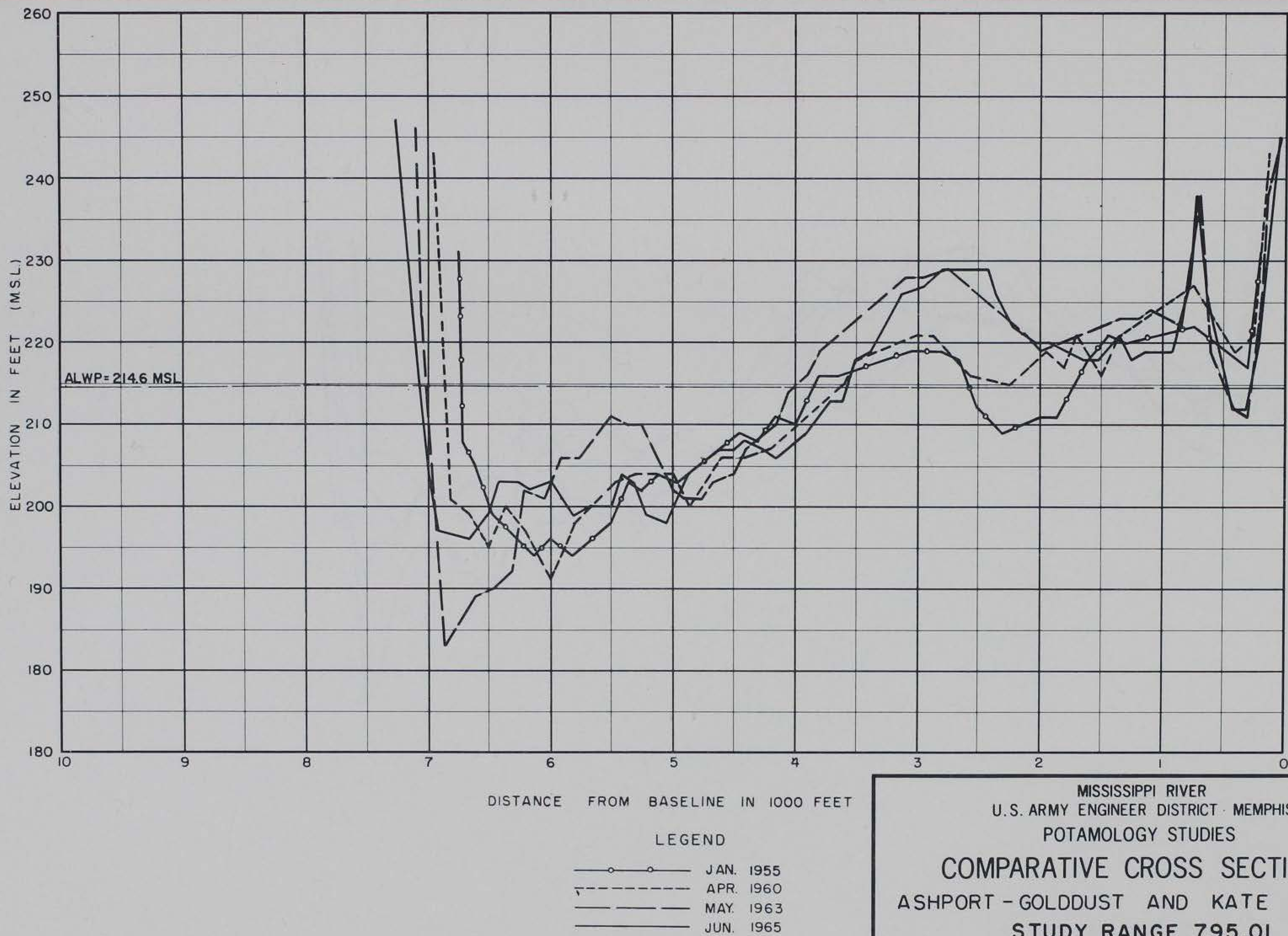
MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT MEMPHIS
POTAMOLOGY STUDIES

COMPARATIVE CROSS SECTIONS

ASHPORT - GOLDDUST AND KATE AUBREY

STUDY RANGE 796.72

MAR 1967 SERIAL 17974 FILE 60/272



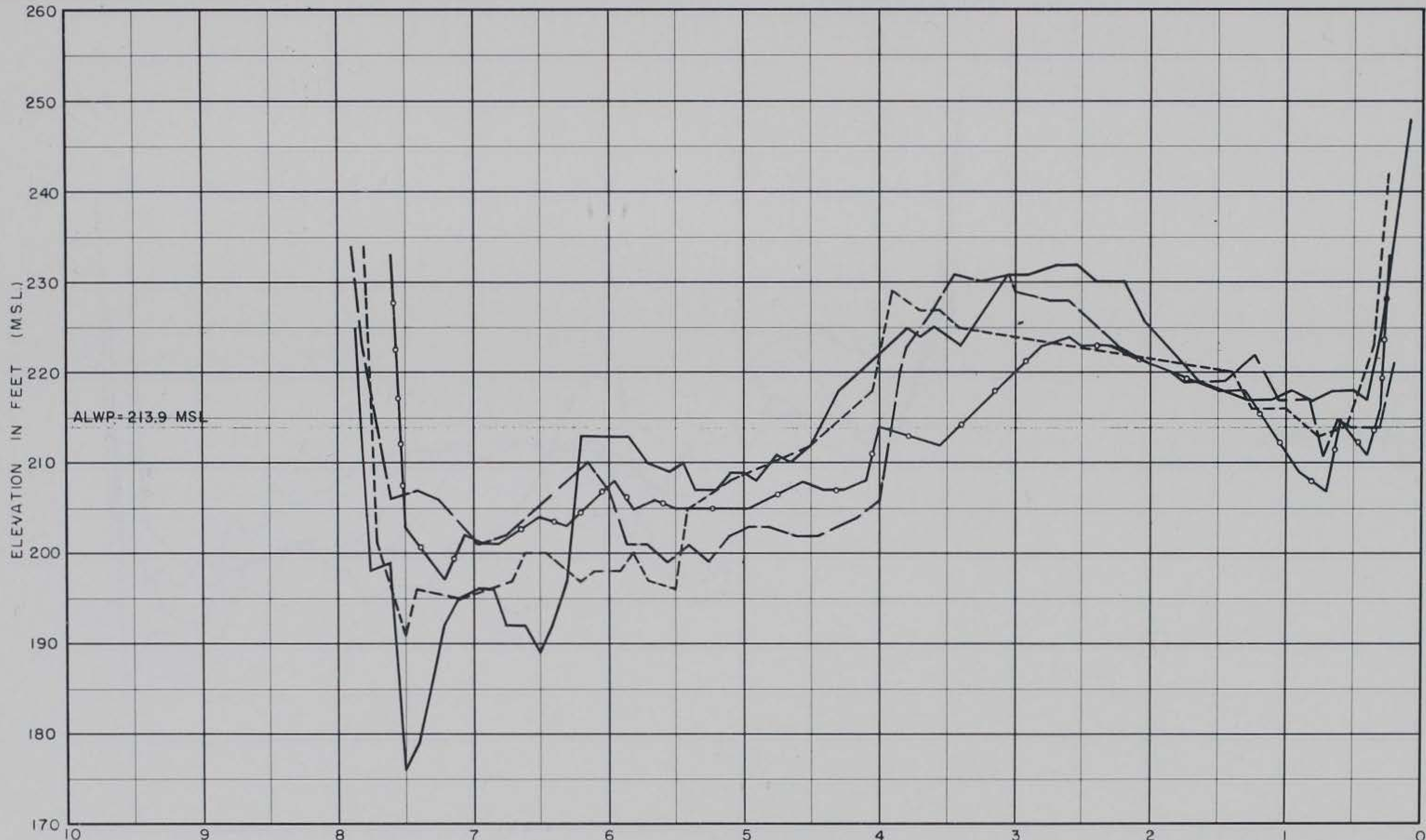
MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT · MEMPHIS
POTAMOLOGY STUDIES

COMPARATIVE CROSS SECTIONS

ASHPORT - GOLDDUST AND KATE AUBREY

STUDY RANGE 795.01

MAR 1967 SERIAL 17974 FILE 60/272



DISTANCE FROM BASELINE IN 1000 FEET

LEGEND

JAN. 1955
APR. 1960
MAY 1963
JUN. 1965

MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT MEMPHIS
POTAMOLOGY STUDIES

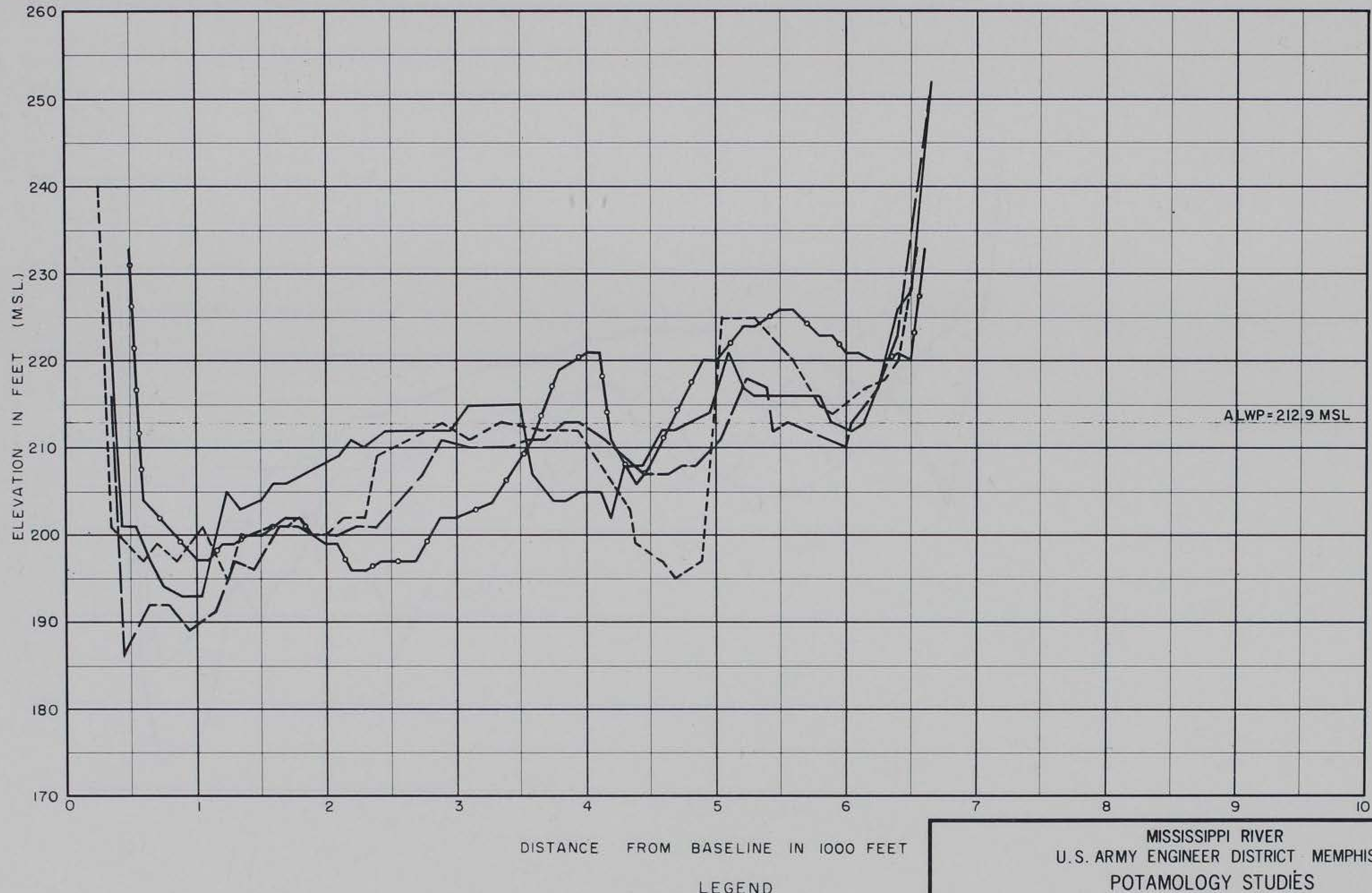
COMPARATIVE CROSS SECTIONS

ASHPORT - GOLDDUST AND KATE AUBREY

STUDY RANGE 793.81

MAR 1967 SERIAL 17974 FILE 60/272

PLATE 18



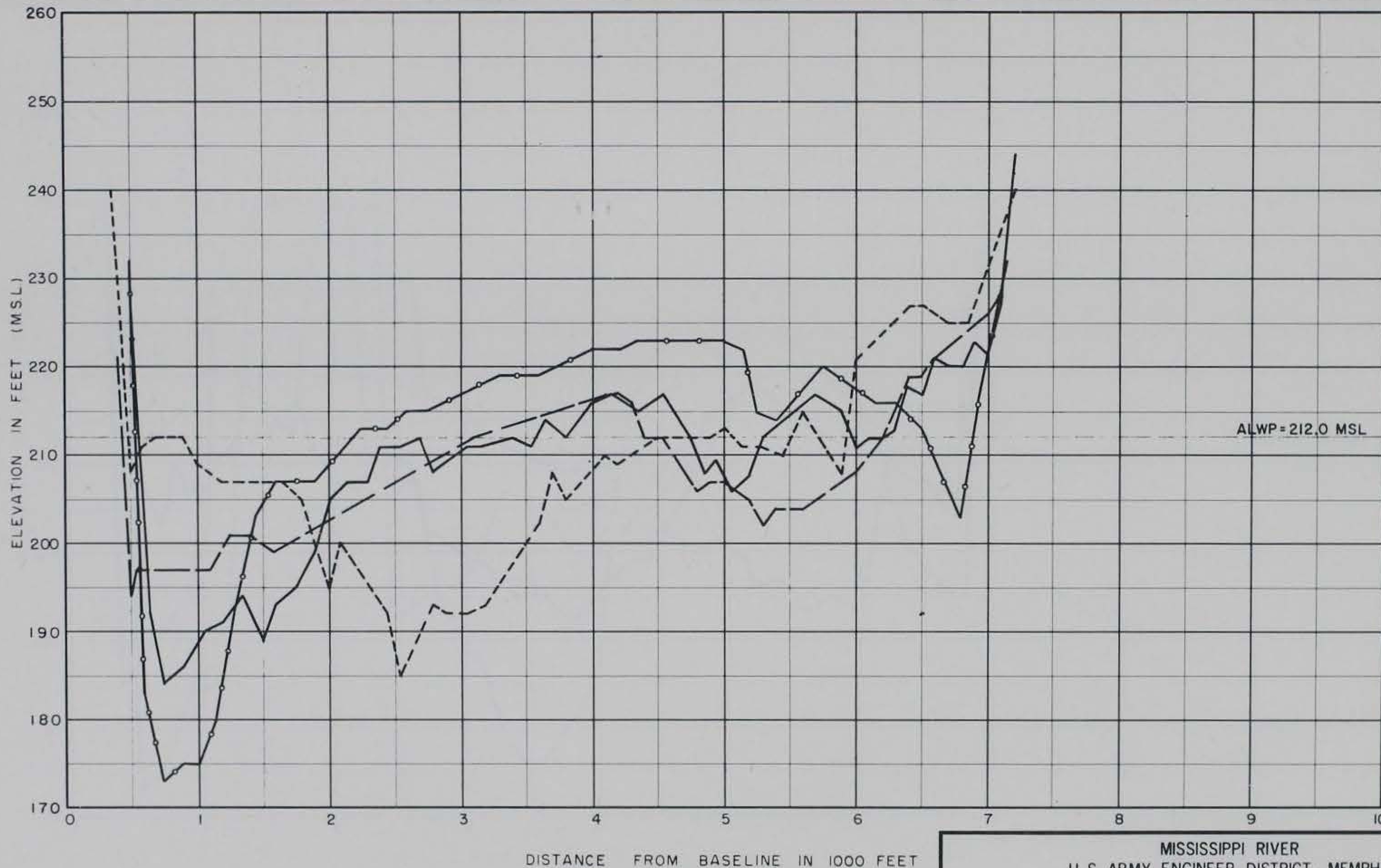
MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT MEMPHIS
POTAMOLOGY STUDIES

COMPARATIVE CROSS SECTIONS

ASHPORT - GOLDDUST AND KATE AUBREY

STUDY RANGE 792.24

MAR 1967 SERIAL 17974 FILE 60/272



LEGEND

JAN. 1955
APR. 1960
JUN. 1963
JUN. 1965

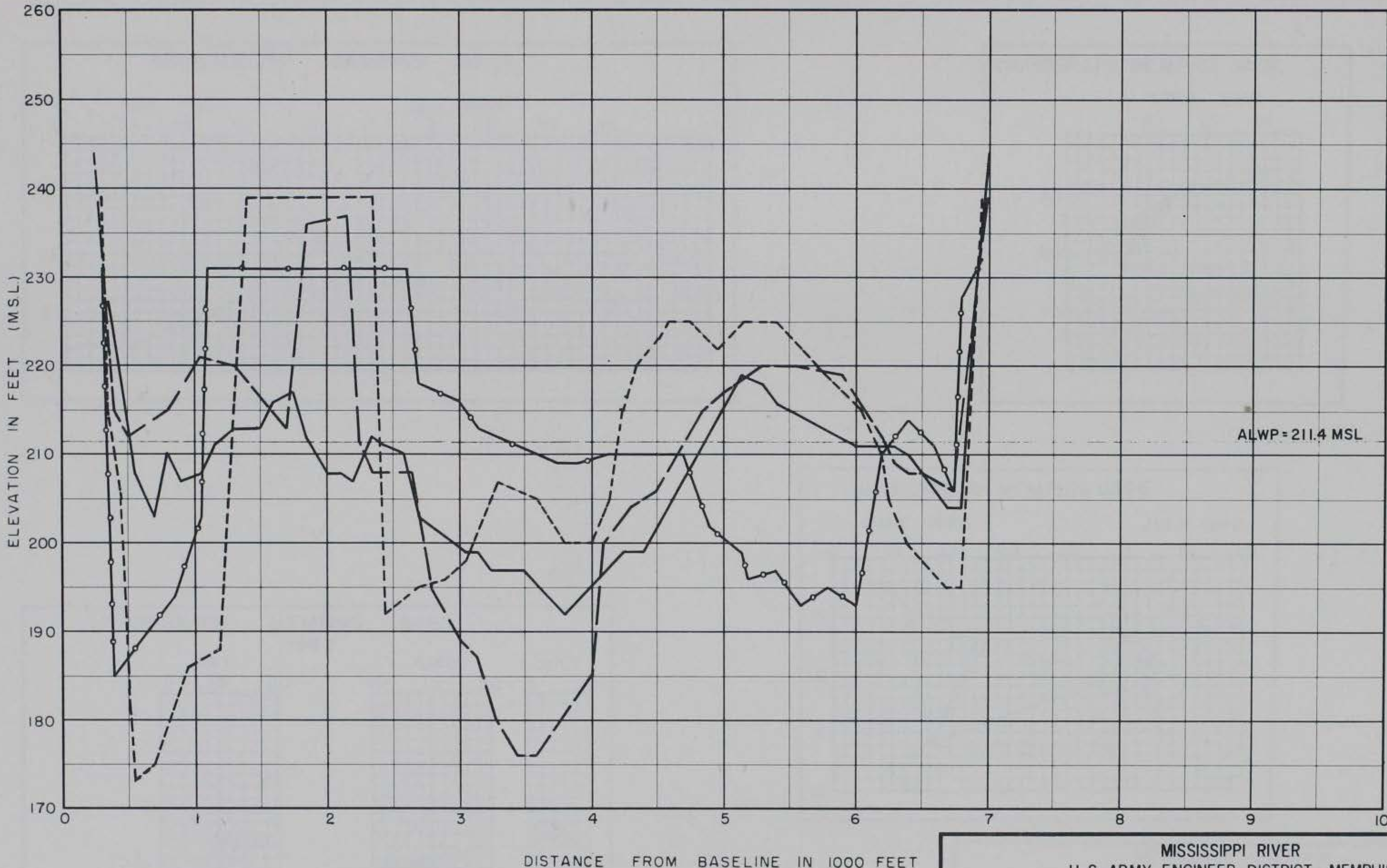
MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT MEMPHIS
POTAMOLOGY STUDIES

COMPARATIVE CROSS SECTIONS

ASHPORT - GOLDDUST AND KATE AUBREY

STUDY RANGE 791.05

MAR 1967 SERIAL 17974 FILE 60/272



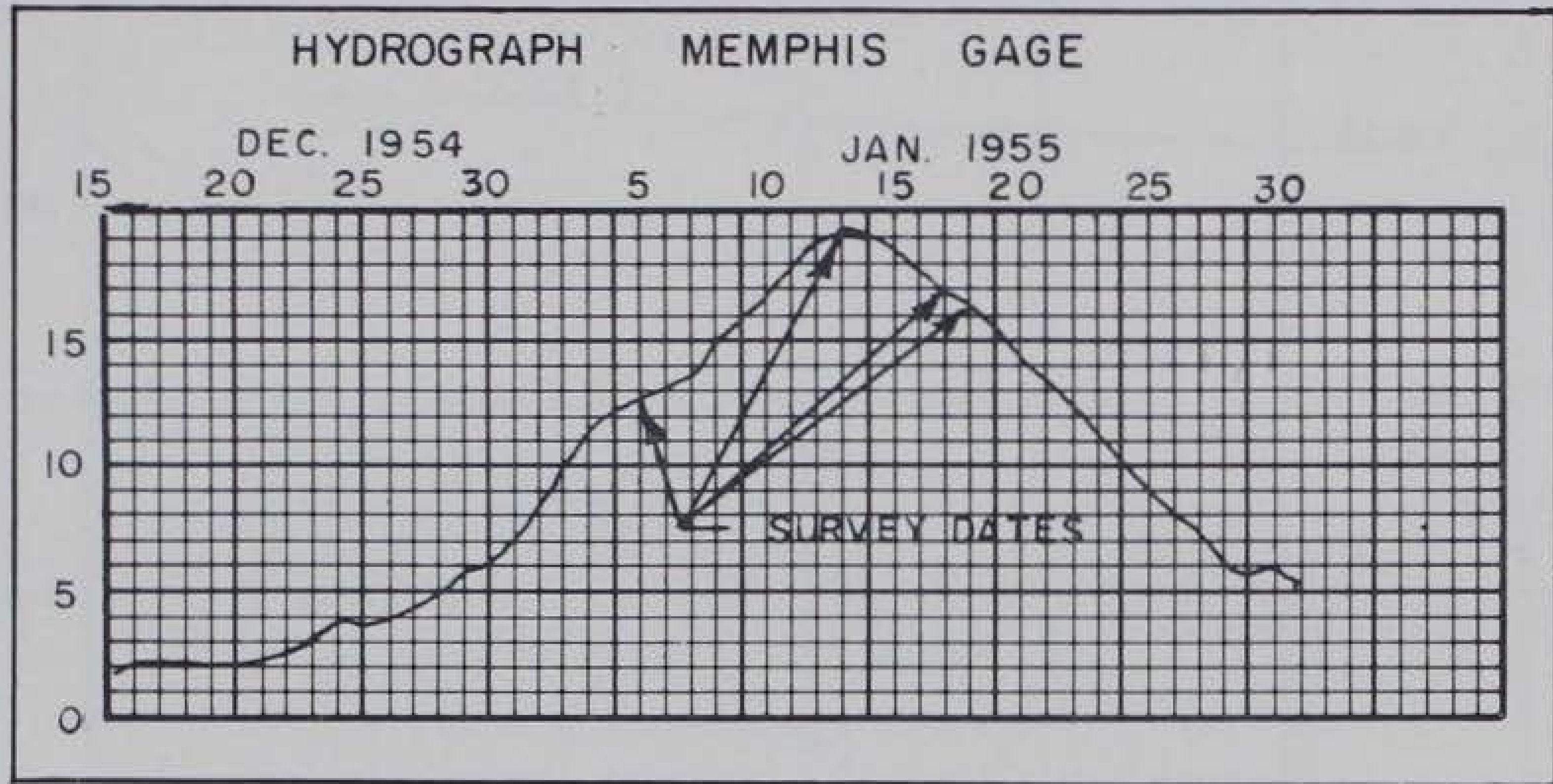
MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT MEMPHIS
POTAMOLOGY STUDIES

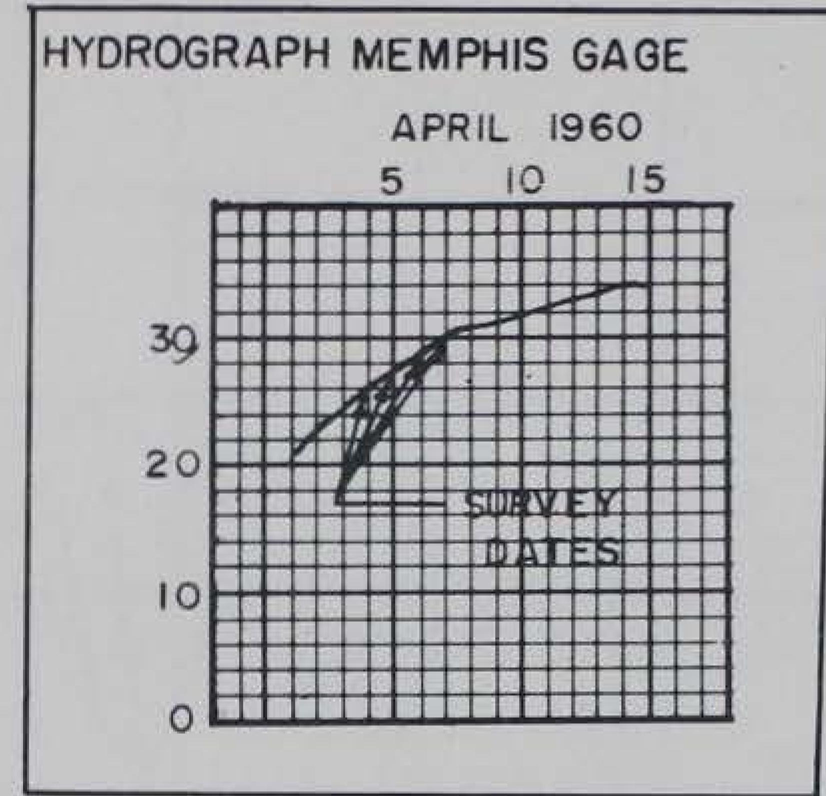
COMPARATIVE CROSS SECTIONS

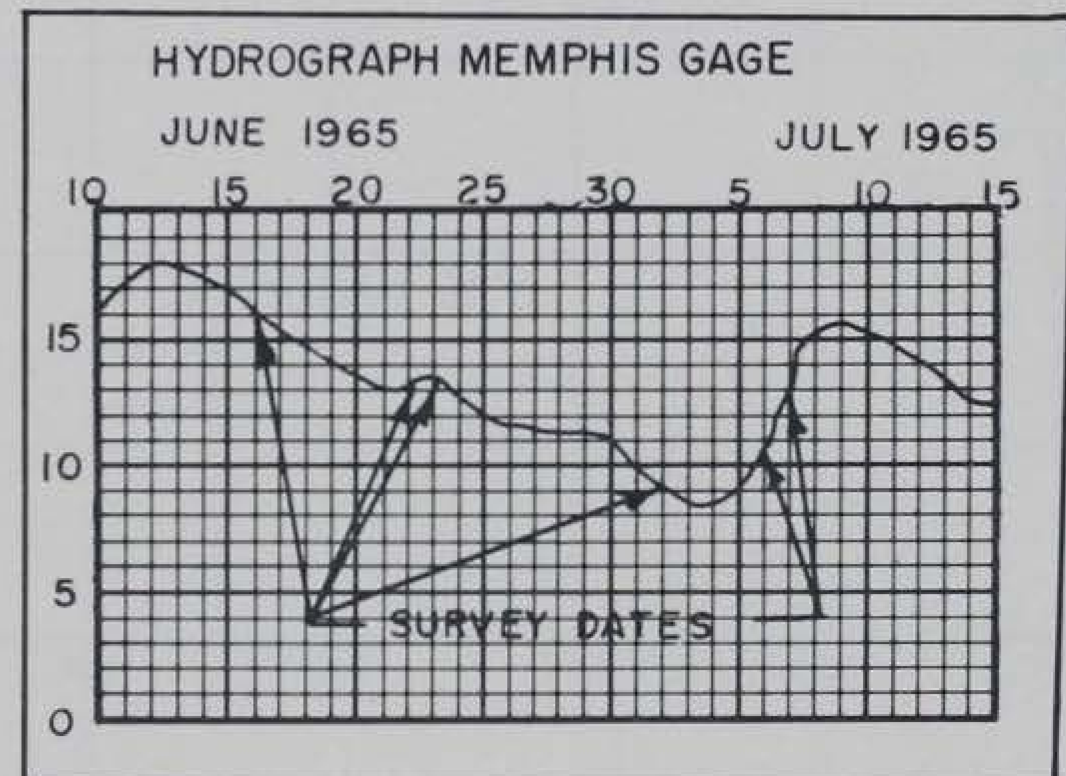
ASHPORT - GOLDDUST AND KATE AUBREY

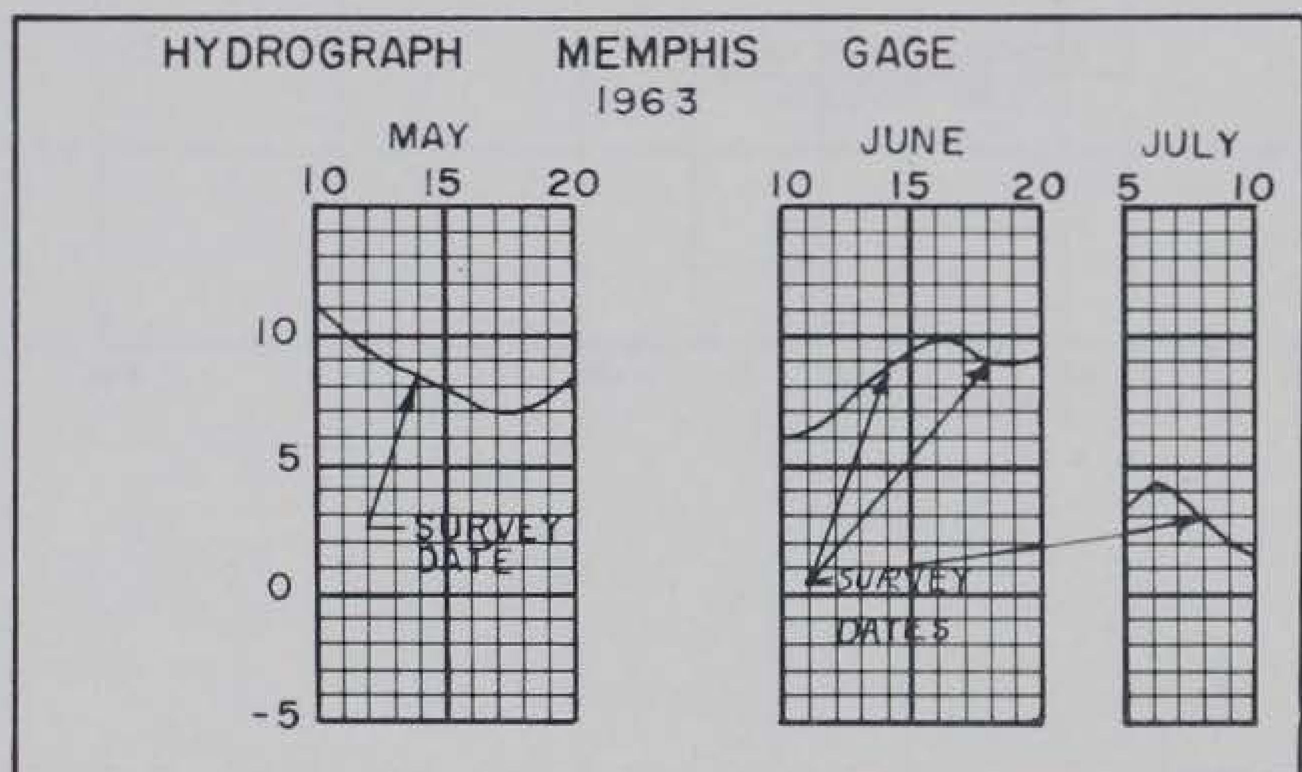
STUDY RANGE 789.92

MAR 1967 | SERIAL 17974 | FILE 60/272









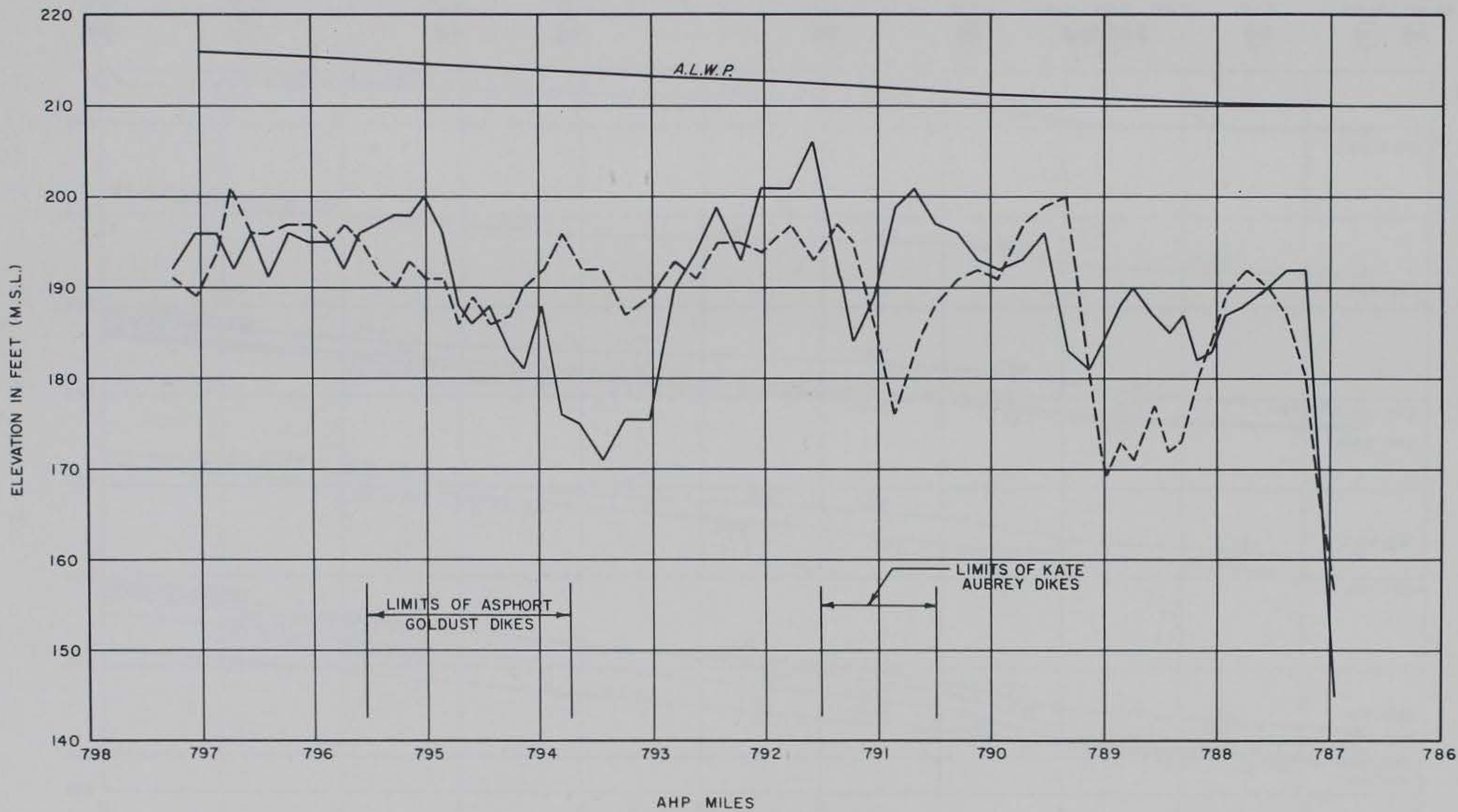
MISSISSIPPI RIVER
U.S.ARMY ENGINEER DISTRICT-MEMPHIS
POTAMOLOGY STUDIES

STAGE HYDROGRAPHS

ASHPORT-GOLDDUST AND KATE AUBREY

MAY 1965 SERIAL 17974 FILE 60/272

PLATE 22

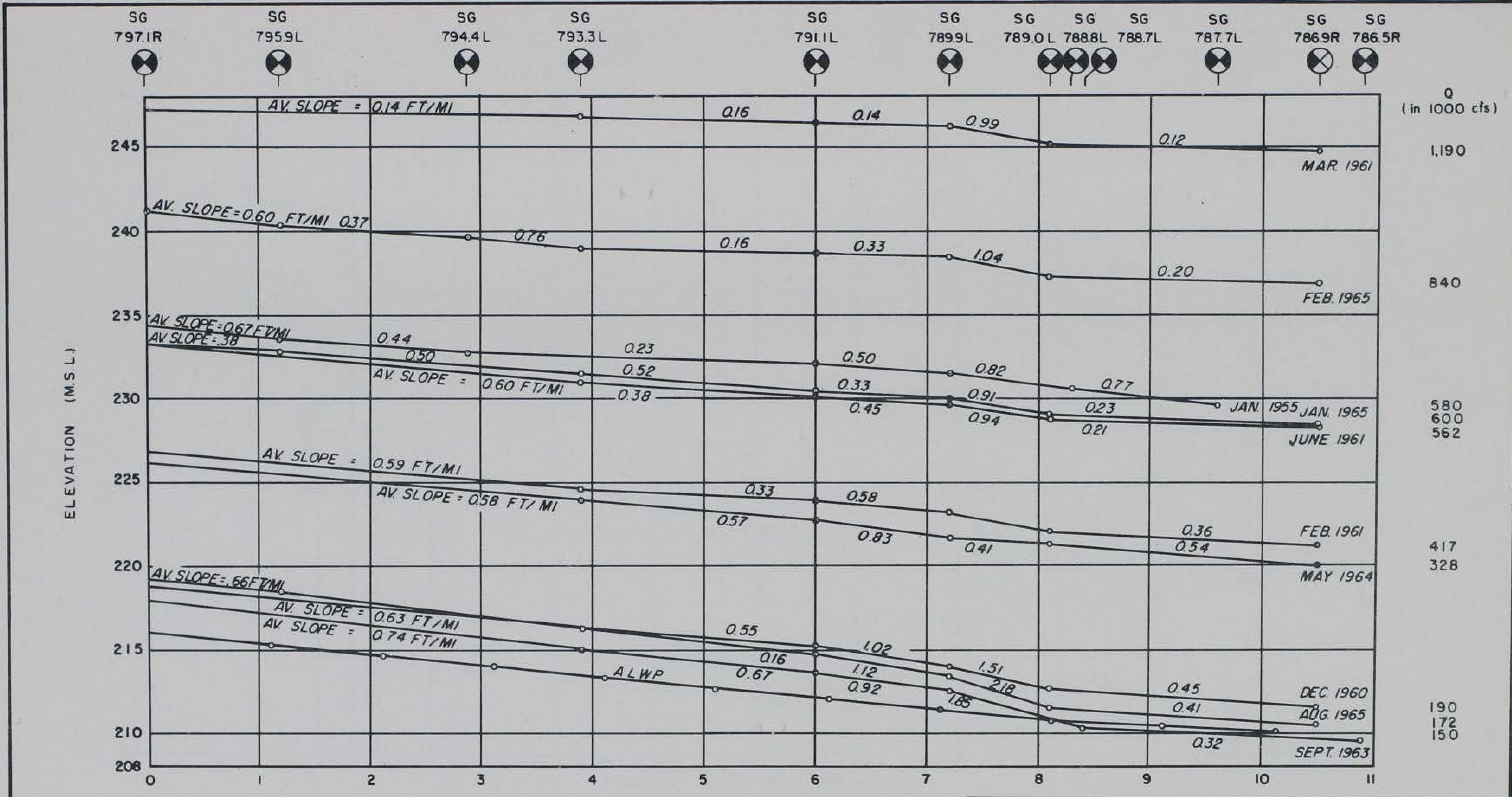


MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT – MEMPHIS
POTAMOLOGY STUDIES

THALWEG PROFILES

ASHPORT GOLDUST AND KATE AUBREY

FEB. 1967 SERIAL 17974 FILE 60/272



MAIN CHANNEL

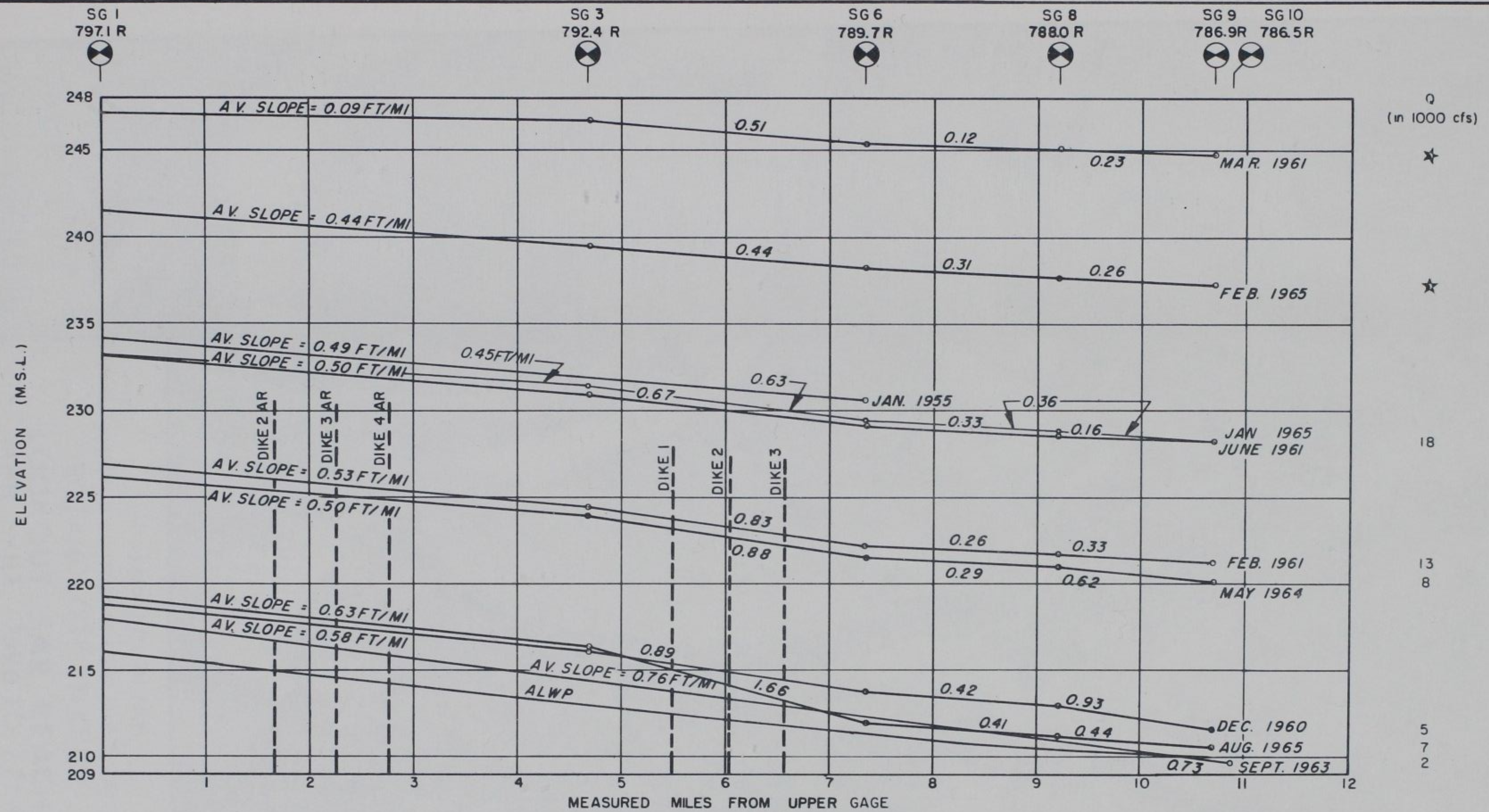
MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT - MEMPHIS
POTAMOLOGY STUDIES

WATER SURFACE PROFILES

ASHPORT - GOLDDUST AND KATE AUBREY

JAN. 1966 SERIAL 17974 FILE 60/272

PLATE 24



RIGHT BANK CHANNEL

☆ FLOW NOT DIVIDED

MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT - MEMPHIS
POTAMOLOGY STUDIES

WATER SURFACE PROFILES

ASHPORT - GOLDDUST AND KATE AUBREY

JAN. 1966 SERIAL 17974 FILE 60/272

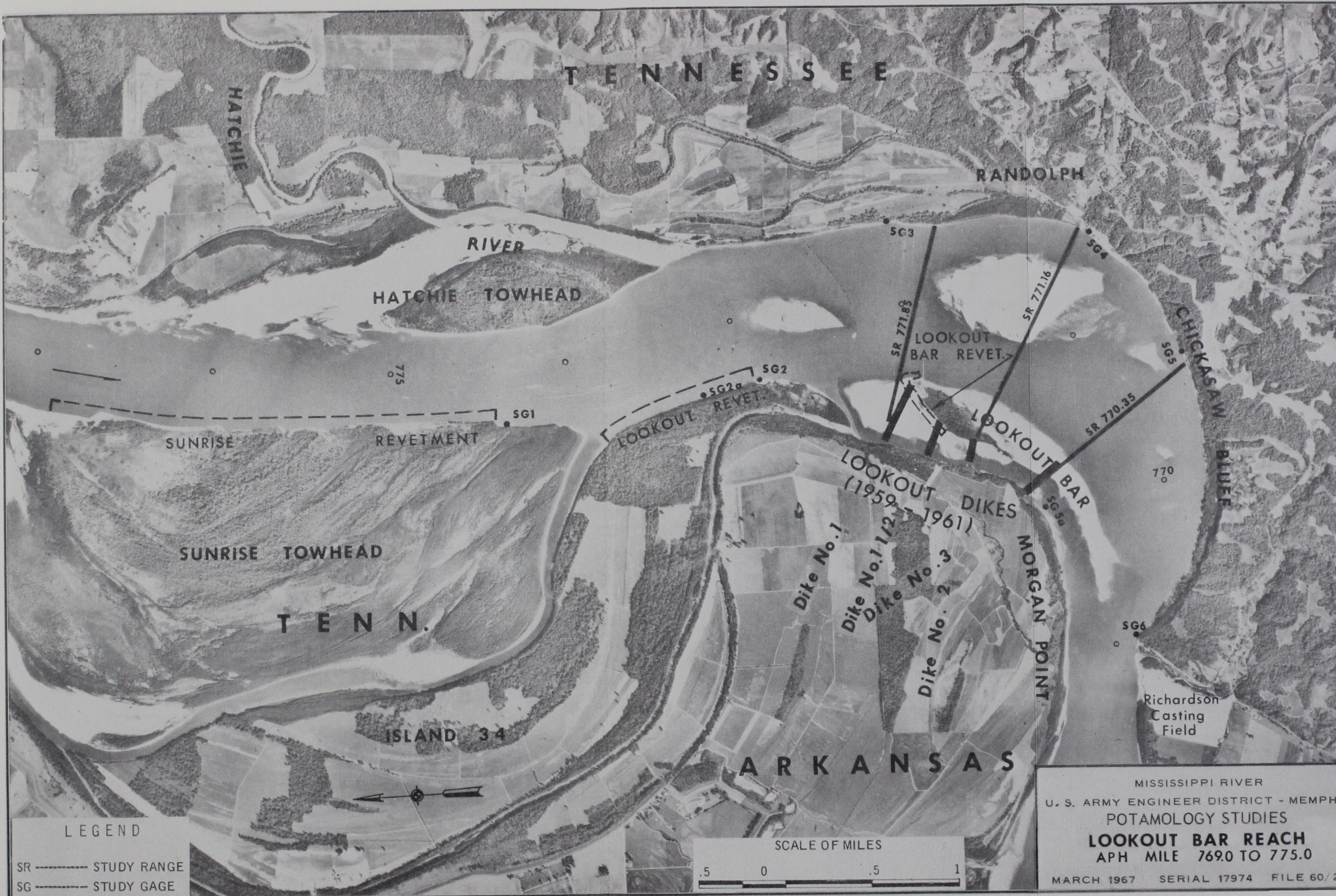

TENNESSEE
HATCHIE
RANDOLPH
RIVER
HATCHIE TOWHEAD
SG3
SG4
SR 771.85
SR 771.16
LOOKOUT BAR REVET.
CHICKASAW BLUFF
SG5
SR 770.35
775
SG2
SG2a
SG1
LOOKOUT REVET.
SUNRISE REVETMENT
LOOKOUT BAR
LOOKOUT DIKES (1959 - 1961)
SG5a
770
SUNRISE TOWHEAD
Dike No.1
Dike No.1 1/2
Dike No. 3
Dike No. 2
MORGAN POINT
TENN.
SG6
Richardson Casting Field
ISLAND 34
ARKANSAS
LEGEND
SR ---------- STUDY RANGE
SG ---------- STUDY GAGE
SCALE OF MILES
.5 0 .5 1
MISSISSIPPI RIVER
U. S. ARMY ENGINEER DISTRICT - MEMPHIS
POTAMOLOGY STUDIES
LOOKOUT BAR REACH
APH MILE 769.0 TO 775.0
MARCH 1967 SERIAL 17974 FILE 60/272

PLATE 26

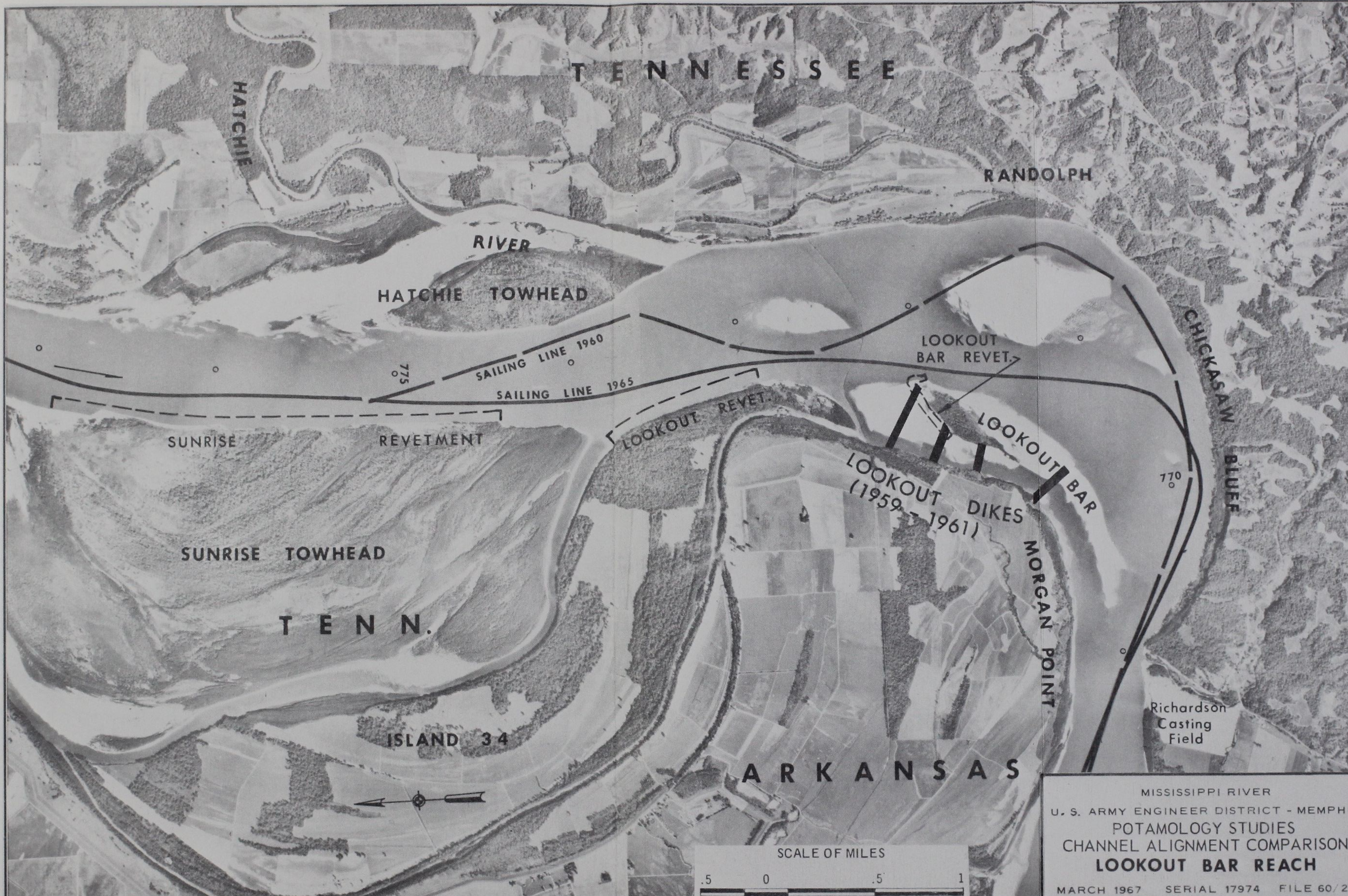
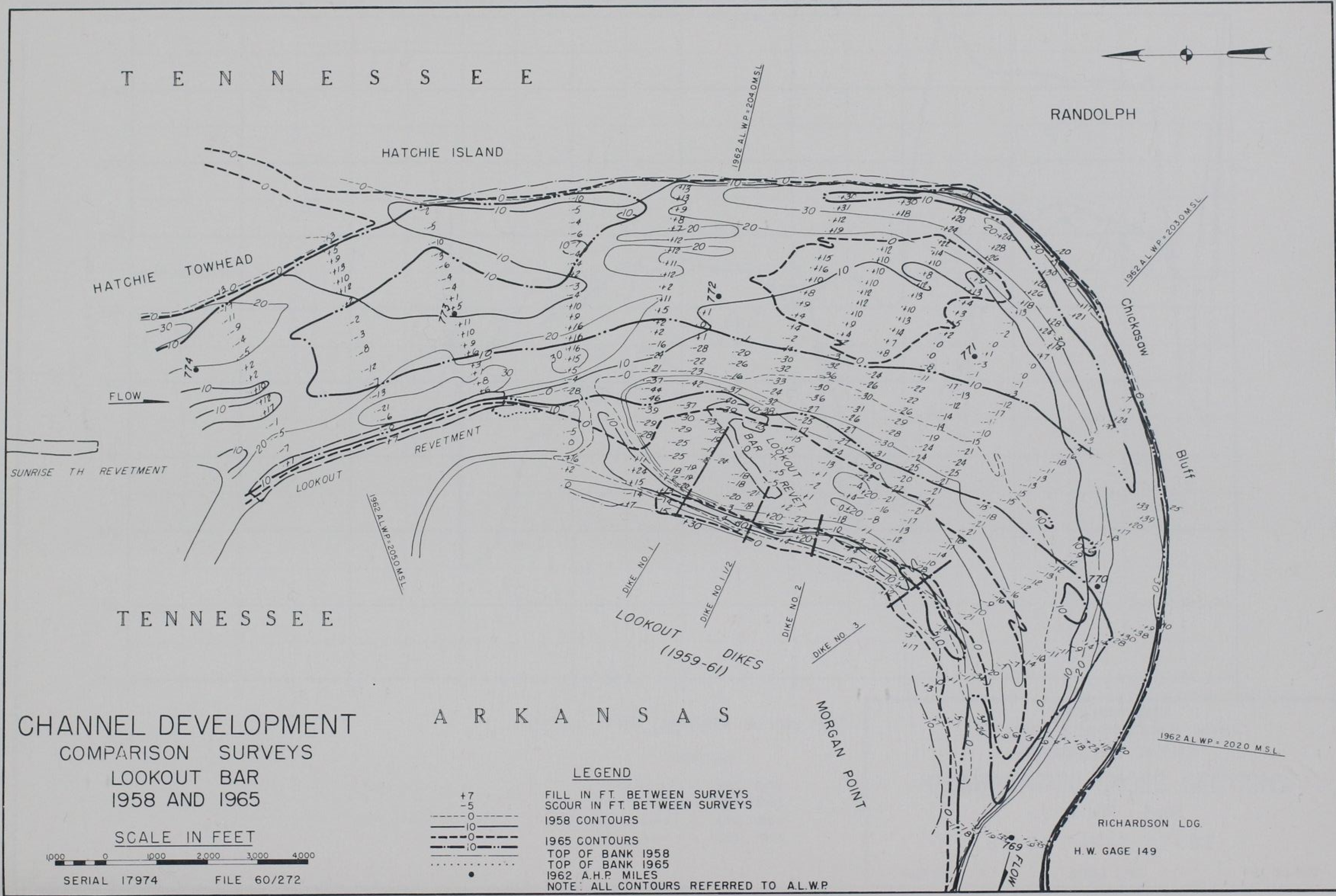
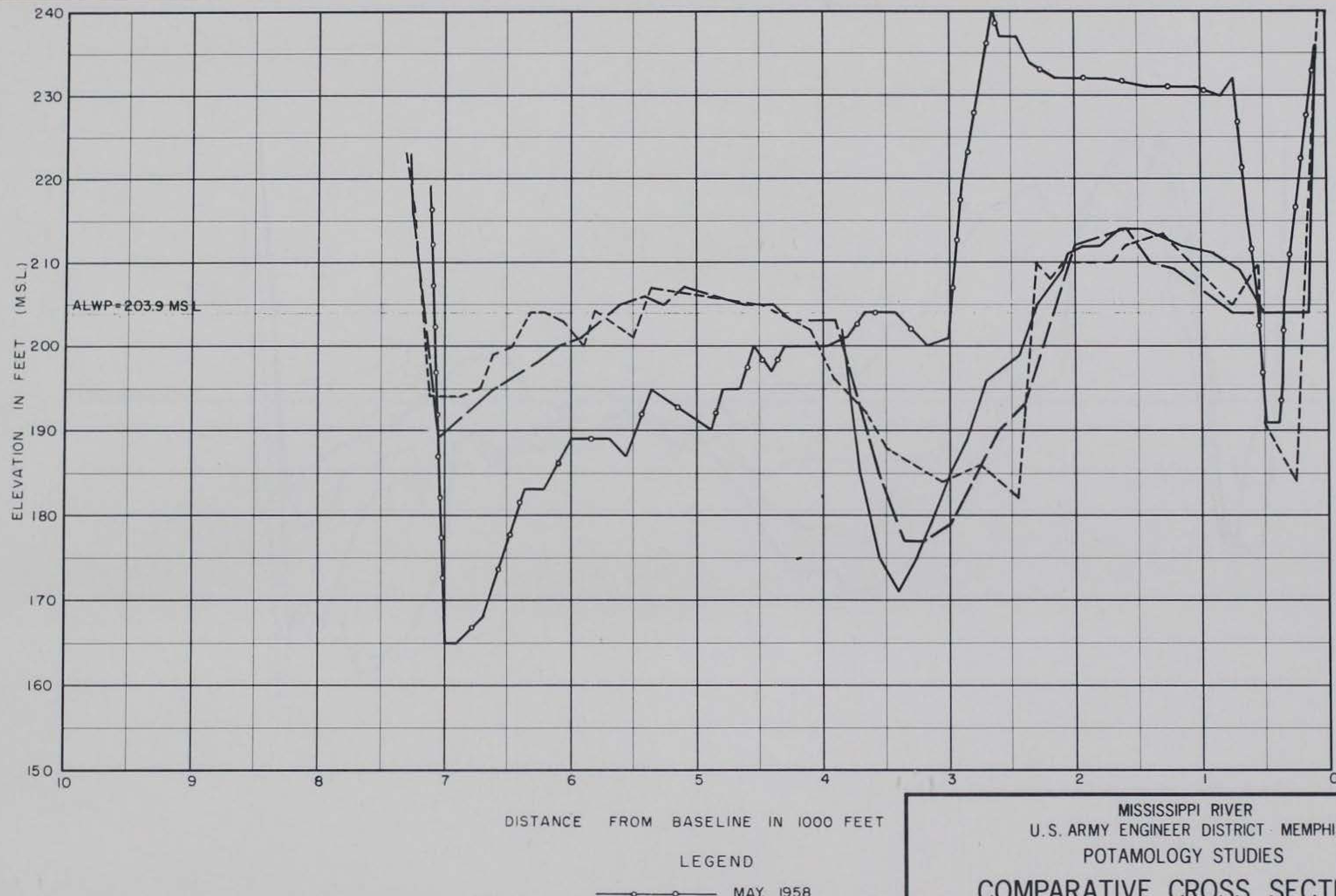

TENNESSEE
HATCHIE
RANDOLPH
RIVER
HATCHIE TOWHEAD
CHICKASAW
BLUFF
LOOKOUT
BAR REVET.
SAILING LINE 1960
SAILING LINE 1965
775
770
LOOKOUT REVET.
SUNRISE
REVETMENT
LOOKOUT
BAR
LOOKOUT
DIKES
(1959 - 1961)
MORGAN
POINT
SUNRISE TOWHEAD
TENN.
ISLAND 34
ARKANSAS
Richardson
Casting
Field
SCALE OF MILES
.5
0
.5
1
MISSISSIPPI RIVER
U. S. ARMY ENGINEER DISTRICT - MEMPHIS
POTAMOLOGY STUDIES
CHANNEL ALIGNMENT COMPARISON
LOOKOUT BAR REACH
MARCH 1967 SERIAL 17974 FILE 60/272

PLATE 27


CHANNEL DEVELOPMENT
COMPARISON SURVEYS
LOOKOUT BAR
1958 AND 1965
SCALE IN FEET
1,000 0 1,000 2,000 3,000 4,000
SERIAL 17974
FILE 60/272
LEGEND
+7 FILL IN FT. BETWEEN SURVEYS
-5 SCOUR IN FT. BETWEEN SURVEYS
1958 CONTOURS
1965 CONTOURS
TOP OF BANK 1958
TOP OF BANK 1965
1962 A.H.P. MILES
NOTE: ALL CONTOURS REFERRED TO A.L.W.P.
TENNESSEE
HATCHIE ISLAND
RANDOLPH
HATCHIE TOWHEAD
1962 A.L.W.P. = 204.0 M.S.L.
1962 A.L.W.P. = 203.0 M.S.L.
1962 A.L.W.P. = 205.0 M.S.L.
1962 A.L.W.P. = 202.0 M.S.L.
Chickasaw Bluff
FLOW
SUNRISE TH REVETMENT
LOOKOUT REVETMENT
LOOKOUT BAR
LOOKOUT REVET
DIKE NO. 1
DIKE NO. 1 1/2
DIKE NO. 2
DIKE NO. 3
LOOKOUT DIKES (1959-61)
TENNESSEE
ARKANSAS
MORGAN POINT
RICHARDSON LDG.
H. W. GAGE 149
FLOW
774
773
772
771
770
769



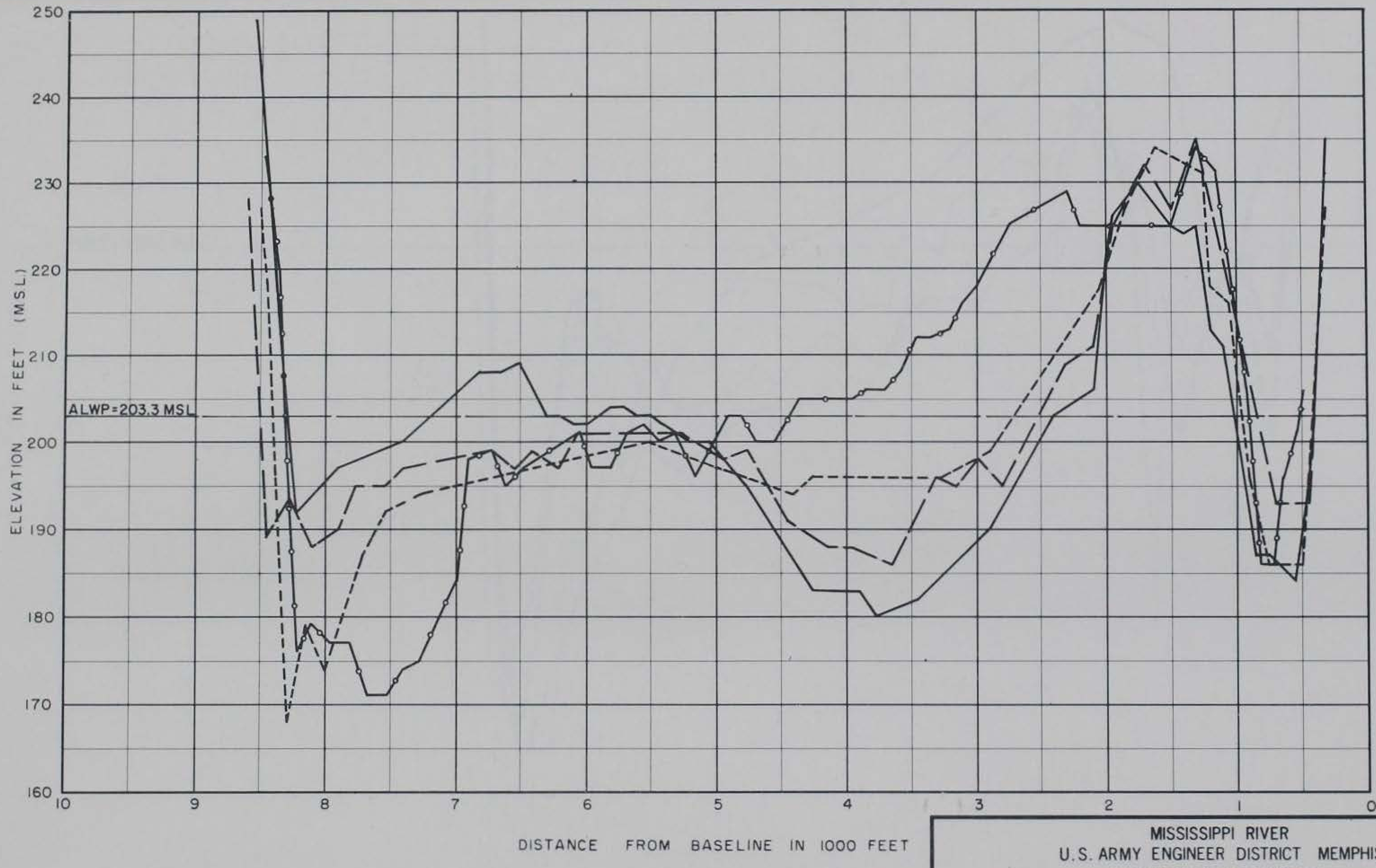
MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT MEMPHIS
POTAMOLOGY STUDIES

COMPARATIVE CROSS SECTIONS

LOOKOUT BAR

STUDY RANGE 771.85

MAR 1967 SERIAL 17974 FILE 60/272



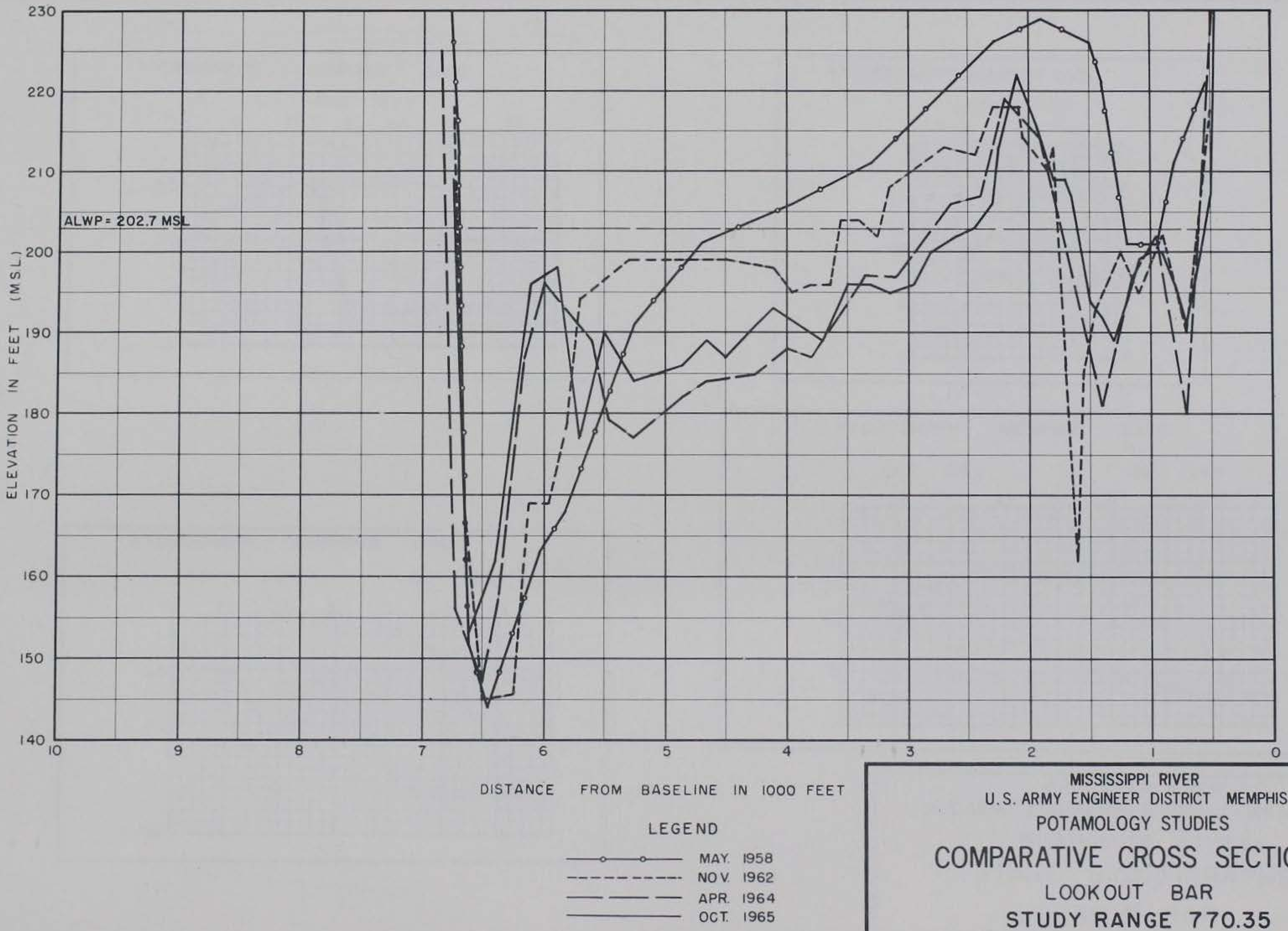
MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT MEMPHIS
POTAMOLOGY STUDIES

COMPARATIVE CROSS SECTIONS

LOOKOUT BAR

STUDY RANGE 771.16

MAR 1967 SERIAL 17974 FILE 60/272



MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT MEMPHIS
POTAMOLOGY STUDIES

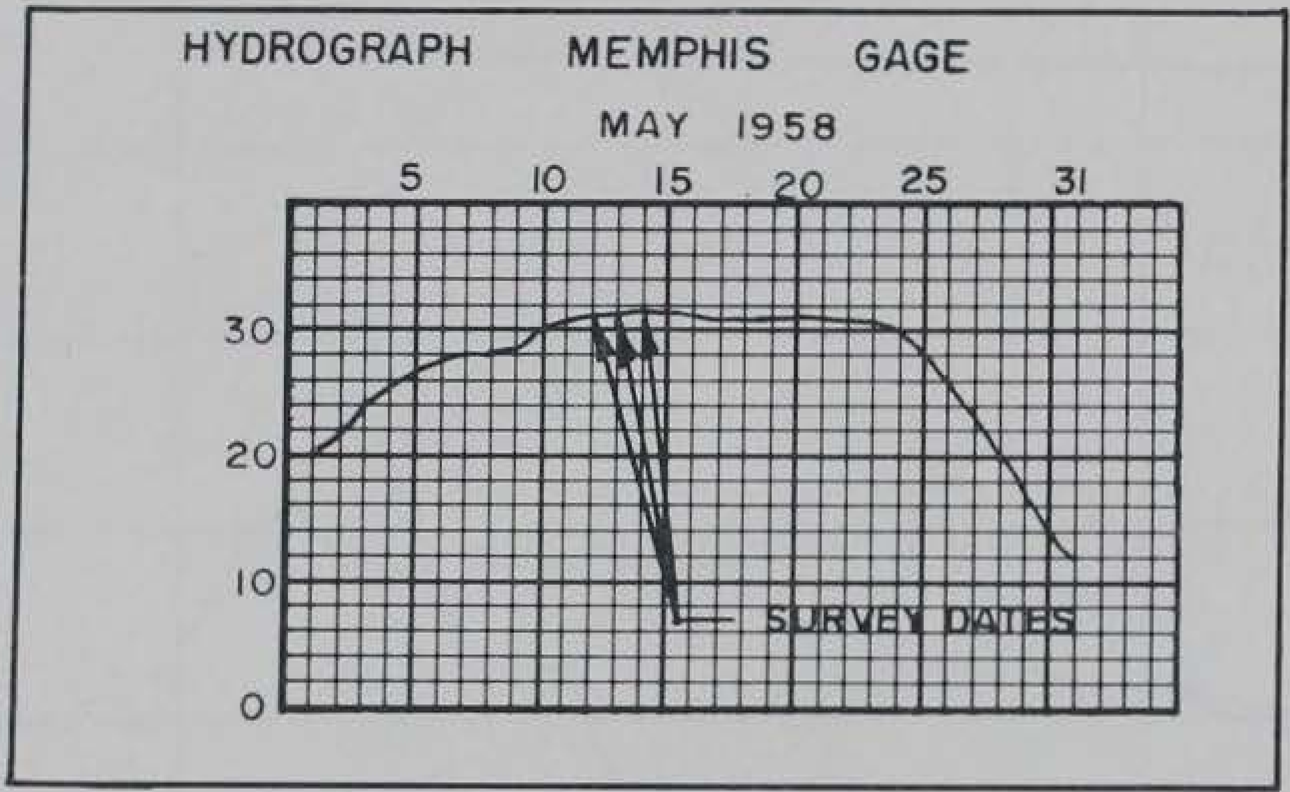
COMPARATIVE CROSS SECTIONS

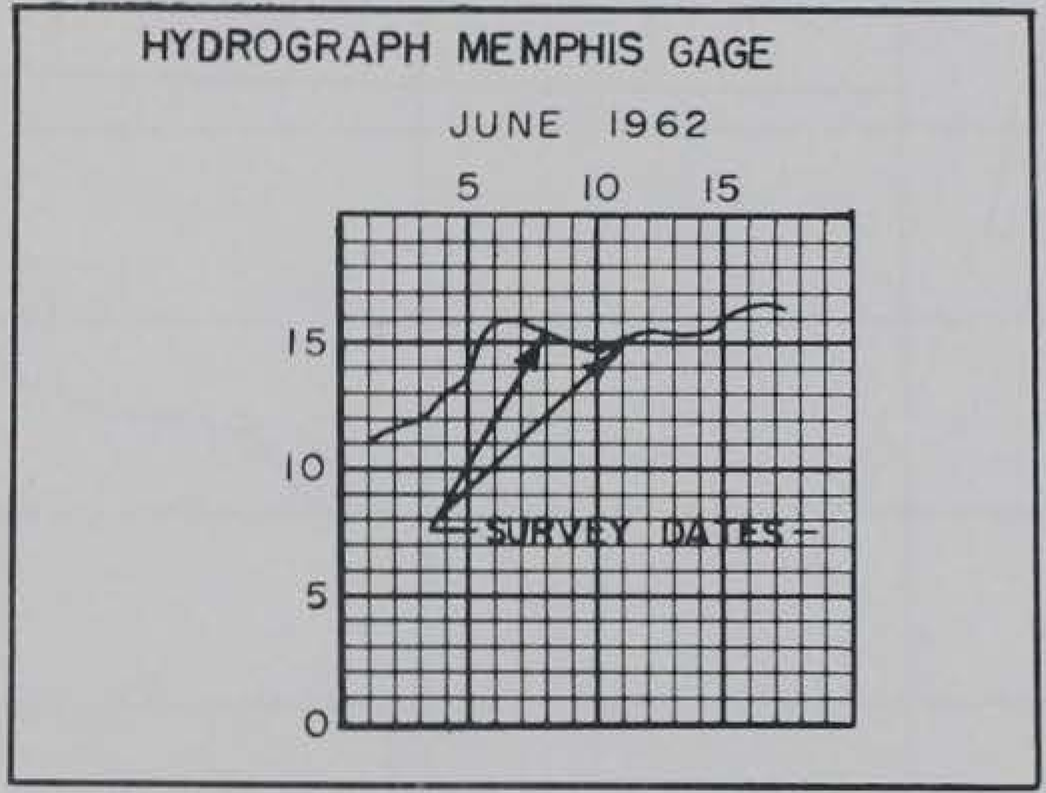
LOOKOUT BAR

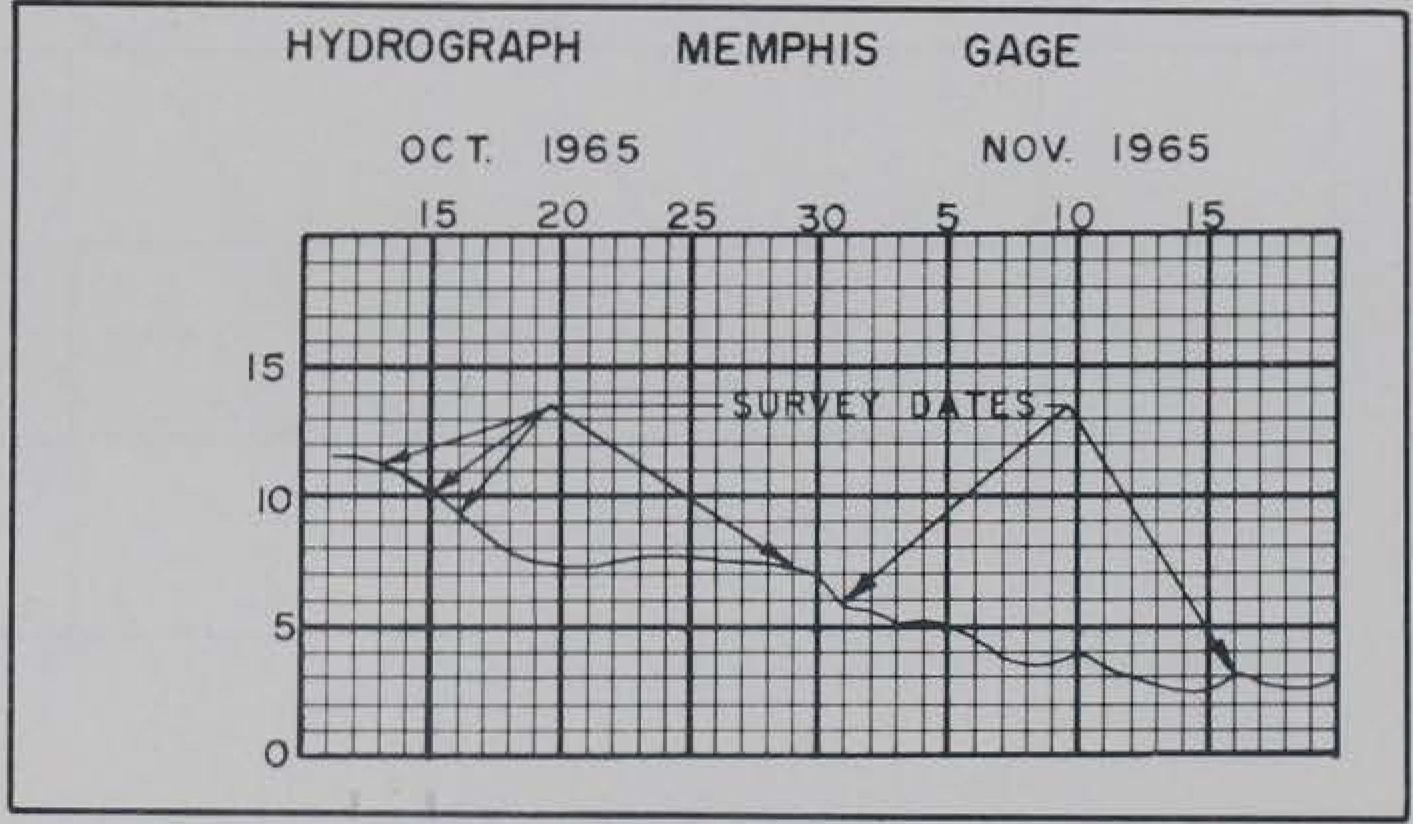
STUDY RANGE 770.35

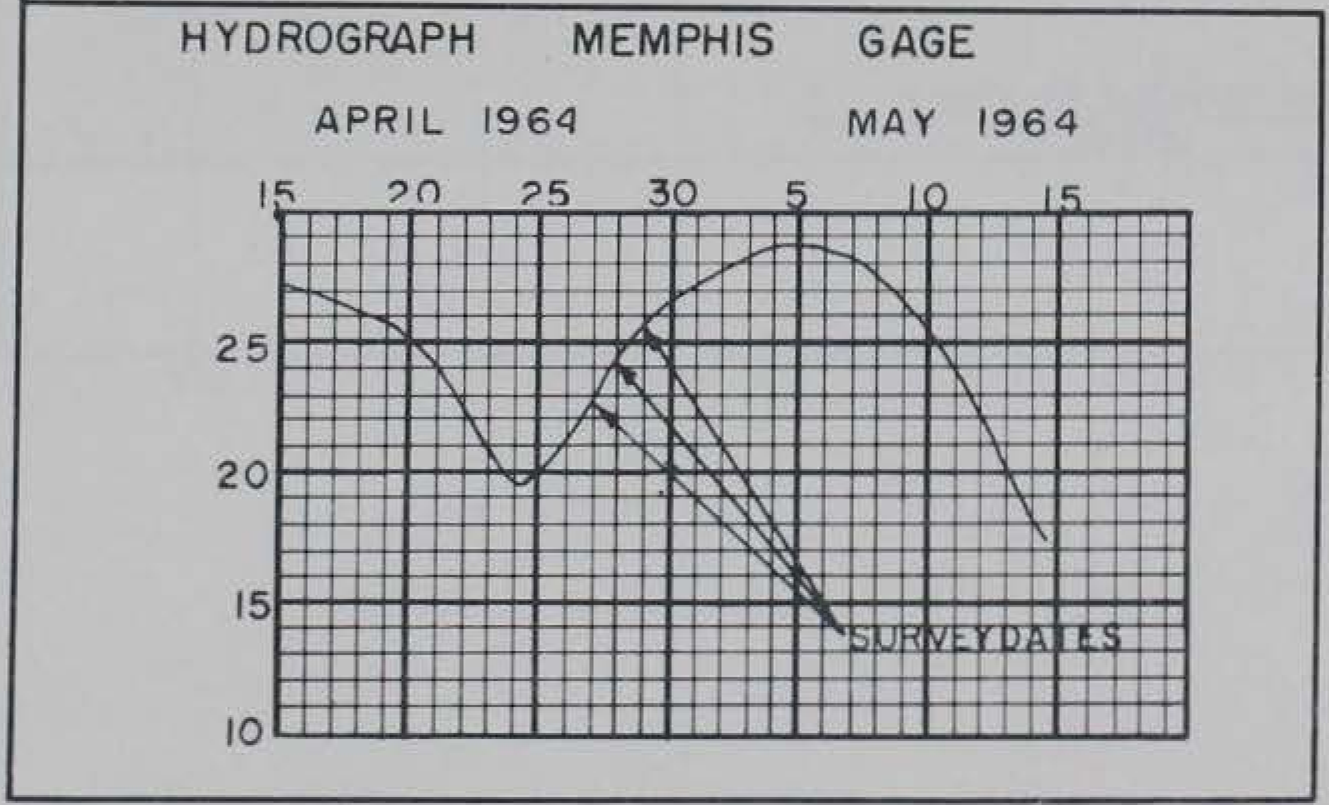
MAR 1967 SERIAL 17974 FILE 60/272

PLATE 31







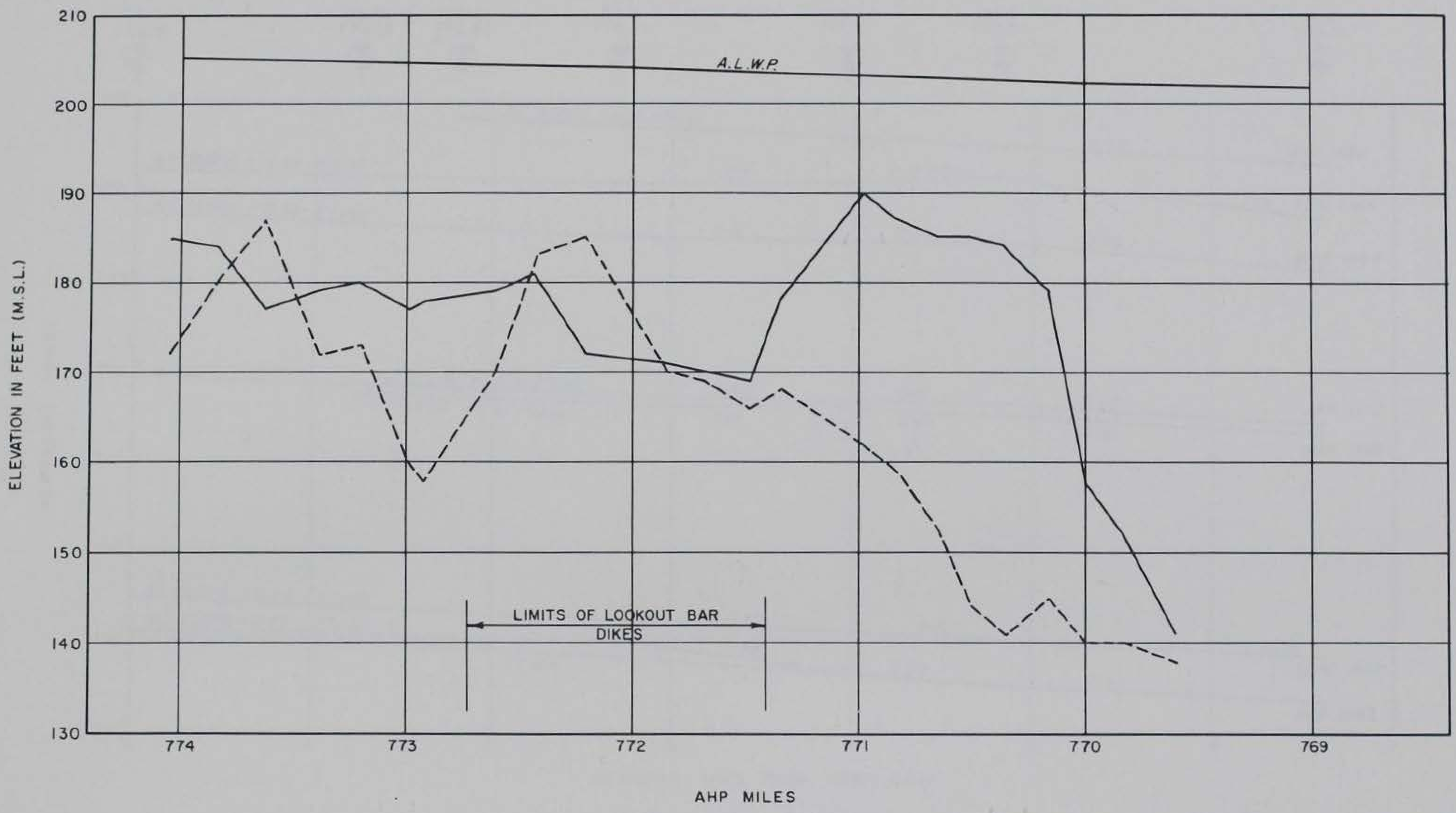


MISSISSIPPI RIVER
U.S.ARMY ENGINEER DISTRICT - MEMPHIS
POTAMOLOGY STUDIES

STAGE HYDROGRAPHS

LOOKOUT BAR

MAY 1965 SERIAL 17974 FILE 60/272

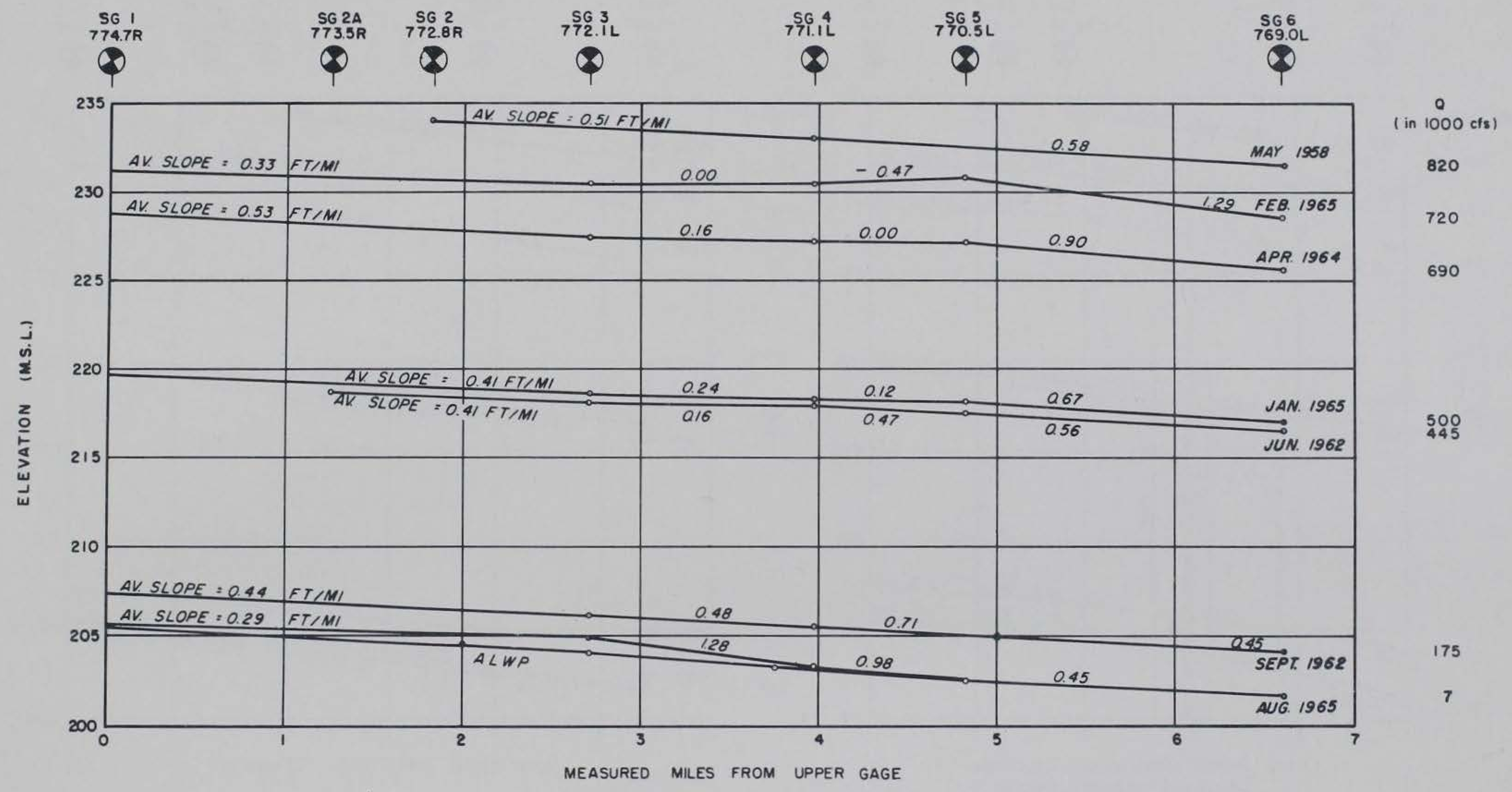


MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT - MEMPHIS
POTAMOLOGY STUDIES

THALWEG PROFILES

LOOKOUT BAR

FEB. 1967 SERIAL 17974 FILE 60/272

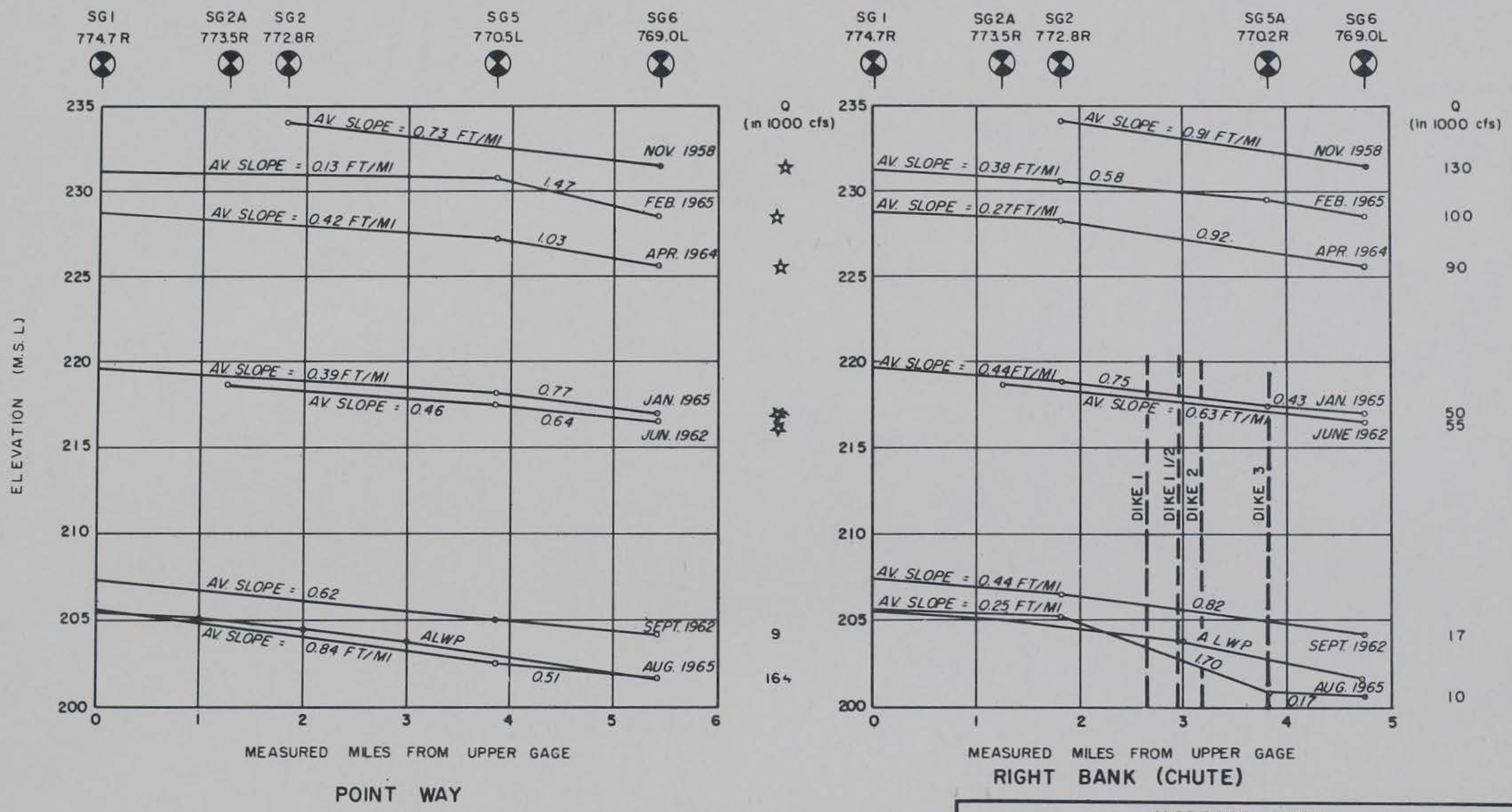


MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT – MEMPHIS
POTAMOLOGY STUDIES

WATER SURFACE PROFILES

LOOKOUT BAR

JAN. 1966 SERIAL 17974 FILE 60/272



☆ FLOW NOT DIVIDED

MISSISSIPPI RIVER
U.S. ARMY ENGINEER DISTRICT - MEMPHIS
POTAMOLOGY STUDIES

WATER SURFACE PROFILES

LOOKOUT BAR

JAN. 1966 SERIAL 17974 FILE 60/272

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Study of Materials in Suspension, Mississippi River; T. M. No. 122-1	February 1939
Study of Materials in Transport, Passes of the Mississippi River; T. M. No. 158-1	September 1939
Geological Investigation of the Alluvial Valley of the Lower Mississippi River; Mississippi River Commission	December 1944
A Laboratory Study of the Meandering of Alluvial Rivers	May 1945
Fine-grained Alluvial Deposits and Their Effects on Mississippi River Activity	July 1947
Report of Conference on Sand-asphalt Revetment, 12 August 1948	August 1948
Geological Investigation of Mississippi River Activity, Memphis, Tenn., to Mouth of Arkansas River; T. M. No. 3-288	June 1949
Bank Caving Investigations, Morville Revetment, Mississippi River; T. M. No. 3-318	September 1950
Investigation of Free Nigger Point Crevasse, Mississippi River; Mississippi River Commission	December 1950
Mississippi River Revetment Studies; St. Anthony Falls Hydraulic Laboratory Project Report No. 21	June 1951
Investigation of Mass Placement of Sand Asphalt for Underwater Protection of River Banks; T. M. No. 3-329	August 1951
Mississippi River Revetment Studies - Tests on a Double Layer Articulated Concrete Mattress; St. Anthony Falls Hydraulic Laboratory Project Report No. 28	May 1952
Potamology Barrel Samples; Miscellaneous Paper No. 3-9	August 1952
Torsion Shear Study; Miscellaneous Paper No. 3-10	August 1952
Study of Variability of Sand Deposits; Miscellaneous Paper No. 3-12	August 1952
Flume Investigation of Prototype Revetment; Miscellaneous Paper No. 2-35	September 1952
Investigation of Bituminous Cold Mixes for the Protection of Upper River Banks; T. M. No. 3-362	April 1953
Feasibility Study of Improved Methods for Riverbank Stabilization; Contract Report No. 3-81 by Harza Engineering Co.	November 1964

* Unless otherwise noted, all reports listed are publications of the Waterways Experiment Station.