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TECHNICAL REPORT M-74-5

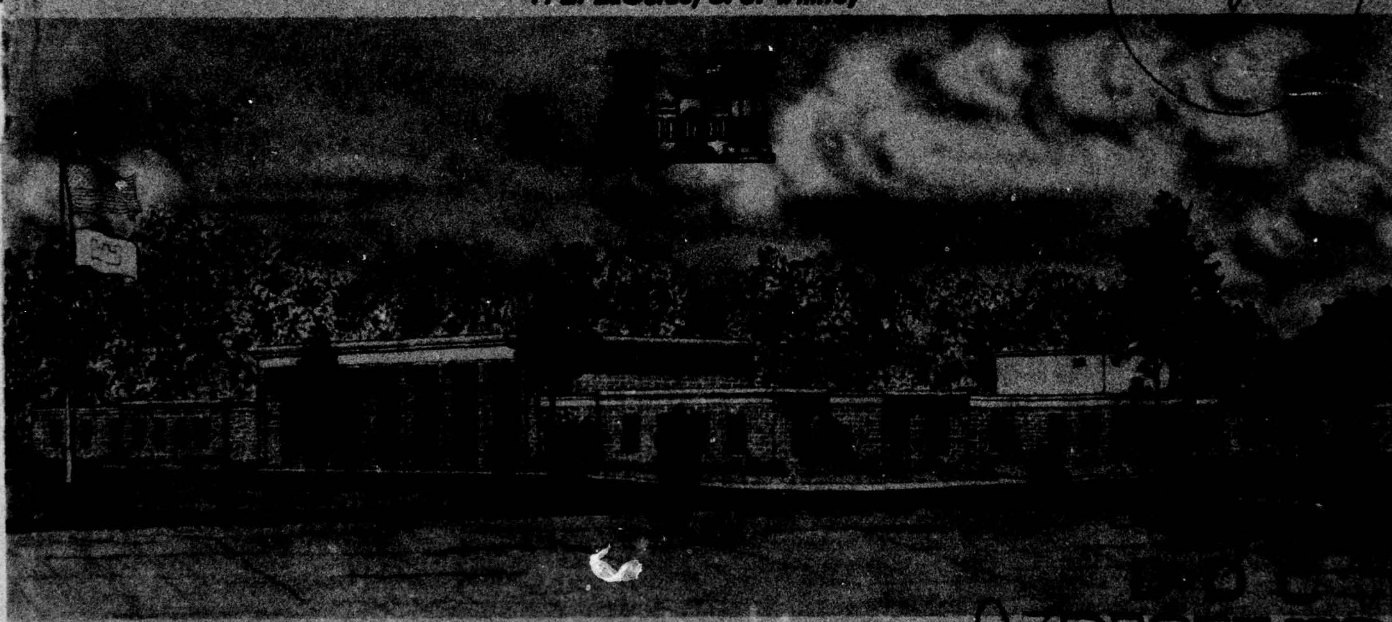
COMPUTER-CALCULATED GEOMETRIC CHARACTERISTICS OF MIDDLE-MISSISSIPPI RIVER SIDE CHANNELS

VOLUME I: PROCEDURES AND RESULTS

by

V. E. LaGarde, S. J. Winfrey

See 1473 in back



June 1974

Sponsored by U. S. Army Engineer District, St. Louis
Office of Environmental Resources, St. Louis, Missouri

Conducted by U. S. Army Engineer Waterways Experiment Station
Mobility and Environmental Systems Laboratory
Vicksburg, Mississippi

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FOREWORD

This study was conducted for the U. S. Army Engineer District, St. Louis (SLD), from January to August 1973. It was performed under the general supervision of Messrs. W. G. Shockley, Chief, Mobility and Environmental Systems Laboratory, W. E. Grabau, Chief, Environmental Systems Division, and J. K. Stoll, Chief, Environmental Simulation Branch (ESB), and MAJ W. P. Emge, Office for Environmental Studies. Dr. V. E. LaGarde, Project Manager, ESB, was responsible for design of the project, development of calculational procedures, and development of a portion of the computer software. Mr. S. J. Winfrey, ESB, was responsible for the development of the remaining computer software and the operation of all stages of the calculational procedures. This report was prepared by Dr. LaGarde and Mr. Winfrey.

Directors of WES during the study and preparation of the report were BG E. D. Piexotto, CE, and COL G. H. Hilt, CE. Technical Director was Mr. F. R. Brown.

CONTENTS

PLATES

CONVERSION FACTORS, BRITISH TO METRIC AND METRIC TO BRITISH UNITS OF MEASUREMENT

Units of measurement used in this report can be converted as follows:

Multiply	By	To Obtain
	British to Metric	
feet	0.3048	meters
miles (U. S. statute)	1.6093	kilometers
acres	0.4047	hectares
acre-feet	1232.75	cubic meters
	Metric to British	
meters	3.2808	feet

SUMMARY

Several geometric characteristics of water-basin regimes, including basin size and shape, area underwater at specific water depth, and cross-sectional area, are commonly associated with benthic, plankton, and fish community population structures, although little quantitative data are available to support the association. This two-volume report describes a general procedure that was developed to calculate values of selected parameters used to define the above-mentioned geometric characteristics of any water-basin regime. The procedure was successfully applied to yield quantitative information for those parameters for 18 side channels of the Middle Mississippi River. Which of the parameters selected as quantitative descriptors of the characteristics are best indicators of animal community population structures is expected to be determined as a result of other projects currently under way at the U. S. Army Engineer Waterways Experiment Station.

Volume I contains a description of the procedure and the results of implementing it. Volume II contains a set of computer-plotted contour maps for the 18 side channels.

COMPUTER-CALCULATED GEOMETRIC CHARACTERISTICS OF
MIDDLE MISSISSIPPI RIVER SIDE CHANNELS

VOLUME I: PROCEDURES AND RESULTS

PART I: INTRODUCTION

Background

1. The continued implementation of engineering structures, such as wing dams, is under study as an aid in maintaining the 9-ft*-deep by 300-ft-wide channel between St. Louis, Missouri, and Cairo, Illinois. Dams constrict the river flow to midchannel, so that the scouring action of the swifter midstream flow helps maintain the desired channel depth. The materials scoured from the main river channel and other solids already in suspension are transported downstream, and portions are deposited in slack-water areas. The deposit of those materials along the riverbanks has an effect upon the aquatic regimes along the river, particularly side channels that are open to the river and have flow through them at normal river stages. Since the side channels are important as fish and wildlife habitats, particularly as sport and commercial fish spawning areas, there is a need to examine the scouring action and transport within the main channel and the probable effects on geometric, chemical, and biological characteristics of the side channels. An analysis of the relation between those characteristics and animal populations can be used as a basis for predicting possible changes in animal populations caused by changes in side-channel characteristics and, indirectly, the changes in animal populations caused by maintaining the 9-ft-deep channel.

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* A table of factors for converting British units of measurement to metric units, and metric units to British units, is presented on page ix.

Purpose

2. The purpose of the research program under which this study was performed was to provide reference material to the U. S. Army Engineer District, St. Louis (SLD), for preparation of an Environmental Impact Statement relative to the development and maintenance of a 9-ft-deep navigation channel in the Middle Mississippi River.* The primary purpose of the study reported herein, which is one of several conducted by the U. S. Army Engineer Waterways Experiment Station (WES) in support of the program, was to provide a portion of the environmental inventory information needed to analyze relations between animal populations and the geometric, chemical, and biological elements of the project side-channel areas. A secondary purpose was to establish a comprehensive computer-accessible data base containing Middle Mississippi River side-channel data for use by analysts to calculate parameter values for additional side-channel geometric characteristics.

Scope

3. This study encompassed the definition, development, and use of a general procedure to quantify geometric characteristics of 18 Middle Mississippi River side channels from St. Louis, Missouri, to Cairo, Illinois.

Approach

4. Several geometric characteristics of water-basin regimes, including basin size and shape, area underwater at specific water depth, and cross-sectional area, have been associated with benthic, plankton,

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* The results of the program will be published by the Waterways Experiment Station in a report entitled "Environmental Analysis and Assessment of the Mississippi River 9-ft Channel Project Between St. Louis, Mo., and Cairo, Ill.," by W. P. Emge, and others.

and fish community population structures,* typically through the food chain. For example, penetration of sunlight to the basin bottom has a major influence on the type and mass of aquatic vegetation, which, in turn, provides hiding places for some fish species and a major link in the food chain of all fishes.

5. The following parameters were selected to describe quantitatively the geometric characteristics of side channels.

- a. Center-line length.
- b. Average width between high banks.
- c. Water volume as a function of water elevation.
- d. Shoreline length as a function of water elevation.
- e. Water surface area as a function of water elevation.
- f. Shoreline development as a function of water elevation.
- g. Rate of change of water surface area with respect to water elevation (derivative of water surface area with respect to water elevation) as a function of water elevation.
- h. Ratio of water surface area to volume as a function of water elevation.
- i. Ratio of shoreline length to water surface area as a function of water elevation.
- j. Bottom surface area underwater as a function of water elevation and water depth.
- k. Water cross-sectional area as a function of water elevation at selected sampling locations (stations).

Since values of side-channel characteristics change as a function of water elevation within the side channel (and therefore as a function of season), the appropriate parameters were calculated as a function of water elevation as indicated above. The calculation of parameters as a function of water elevation makes possible the analysis of the data during the major phases of animal life cycles; for example, fish

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* C. E. Warren and P. Doudoroff, Biology and Water Pollution Control, Saunders, Philadelphia, Pa., 1971.
G. E. Hall, ed., "Reservoir Fisheries and Limnology," Special Publication No. 8, 1971, American Fisheries Society, Washington, D. C.
C. D. Sculthorpe, The Biology of Aquatic Vascular Plants, Edward Arnold, London, 1967.

spawning, juvenile, and mature phases, which occur during different seasons of the year and, thus, usually at different water levels.

6. The Middle Mississippi River side channels identified during the research program are indicated in fig. 1 and listed in table 1 in decreasing order of river mile location. (Side channels are identified and numbered identically with those described in the report to be published containing the research program results.) River mile locations of the extremities of each side channel and sampling locations (stations) within each also are noted in table 1. The parameters listed in paragraph 5 were calculated in this study for all side channels except side channels 5, 7, 13, 14, 15, 24, and 25.

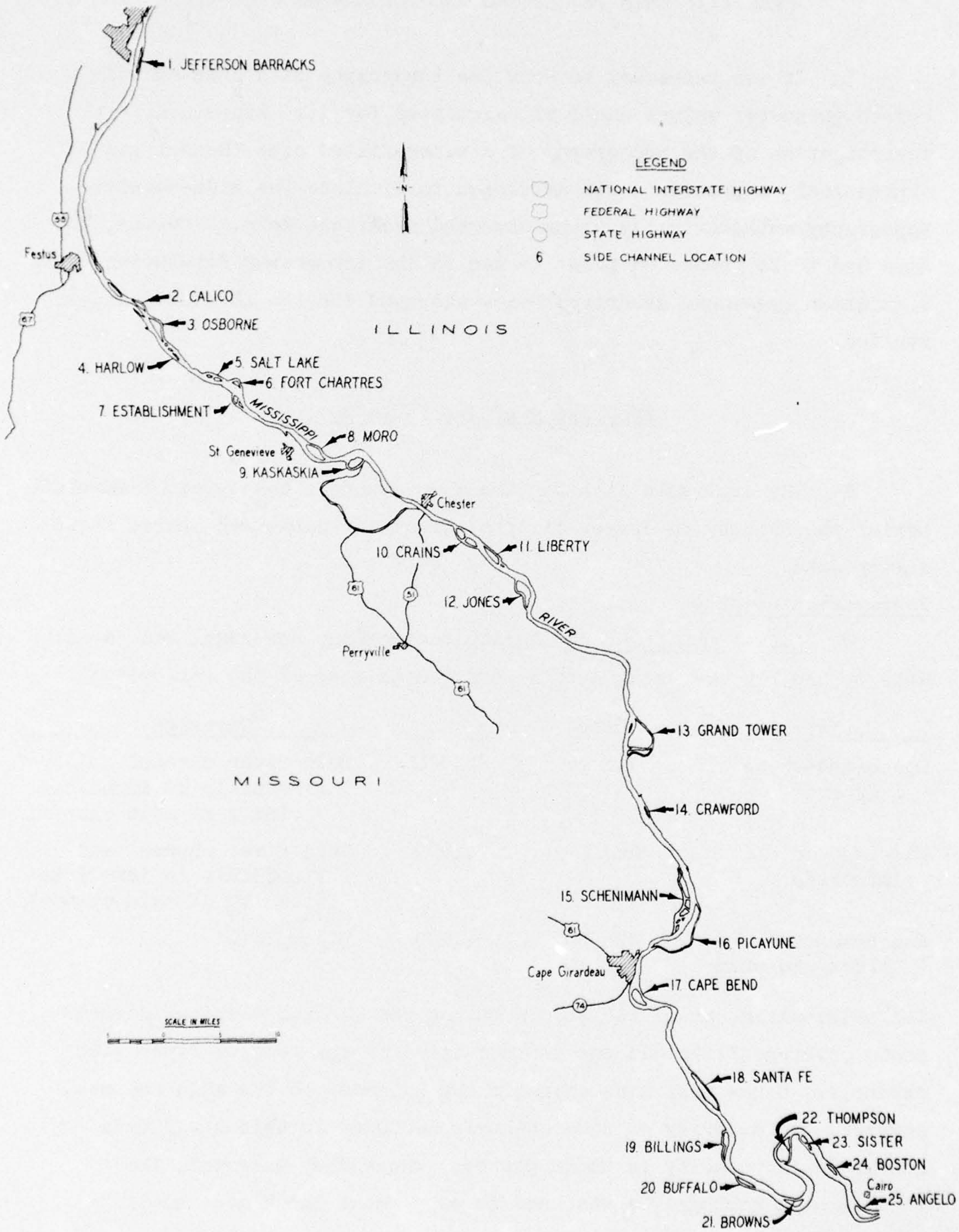


Fig. 1. Index map of Middle Mississippi River side channels

PART II: DATA PROCESSING AND TOPOGRAPHY SIMULATION

7. It was necessary to know the topography of a side channel before parameter values could be calculated for it. Since a direct investigation of the topography of a water-filled side channel was impractical, a procedure was developed to simulate the side-channel topography mathematically using assorted available data. However, the data had to be processed prior to use in the topography simulation. The simulation procedure described below was used for the 18 side channels studied.

Processing of Available Data

8. The available data for the side channels consisted of complete aerial photography coverage, limited fathometer data, and sparse field survey data.

Preparation of data

9. Aerial photographs. Aerial photography coverage, made available by the SLD and used in this study, consisted of the following:

Type	Date	Scale	Coverage
Black-and-white infrared	Jan 70	1:12,000	Main river channel and floodplain in immediate vicinity of main channel
False-color infrared	Aug 71	1:12,000	Main river channel and floodplain in immediate vicinity of main channel
Panchromatic (black and white)	Jun 69	1:24,000	Floodplain

The original intent of the SLD in having the black-and-white infrared photo coverage flown did not include specific coverage of river side channels. Since most side channels are adjacent to the main channel, however, the majority of side channels included in this study were contained in totality in those photos. Where they were not, the panchromatic photography was used to supplement the black-and-white infrared coverage. The supplementary panchromatic coverage was enlarged by a camera process to the scale of the black-and-white infrared coverage.

10. Only one of the 18 side channels was totally contained on a single black-and-white infrared aerial photo. A complete picture of the remaining side channels was produced by constructing photomosaics with the black-and-white infrared photos, supplemented by the panchromatic photos where necessary. According to SLD, the photos were rectified and were at a scale of 1:12,000, and these statements were taken as the basis for assuming nondistortion of the side channels' spatial configurations on the photos and for calculating the side channels' horizontal dimensions from the photos, respectively. No control points were available on the photos to validate these statements. Fig. 2 is a reproduction of that portion of the photomosaic containing side channel Osborne and a portion of the main channel. The photomosaic was made up of two black-and-white infrared photos, and is approximately nine-tenths the scale of the original. In fig. 2 the notations in the area of the side channel include locations where fathometer and survey data were taken (paragraphs 16-19) and water levels at the times of the aerial photo coverage and the fathometer runs.

11. The black-and-white infrared coverage was used as the basis for side-channel horizontal dimensions data for several reasons. It contained the most complete coverage, with a late flyover date, at the largest scale available. In addition, the coverage was flown during the time when deciduous tree foliage was at a minimum and the water stage was low. Also, the black-and-white infrared film energy response functions are such that the water-land interface is most easily interpreted on that type of film.

12. The false-color photography was examined in a limited number of situations to resolve ambiguities on the black-and-white photography. It was not found useful for supplementing the data to any extent because the foliage was in full bloom in that photography, making interpretation of high bank difficult, and the water level was higher than in the black-and-white coverage. In addition, false-color photography does not always show the land-water interface distinctly; it is frequently

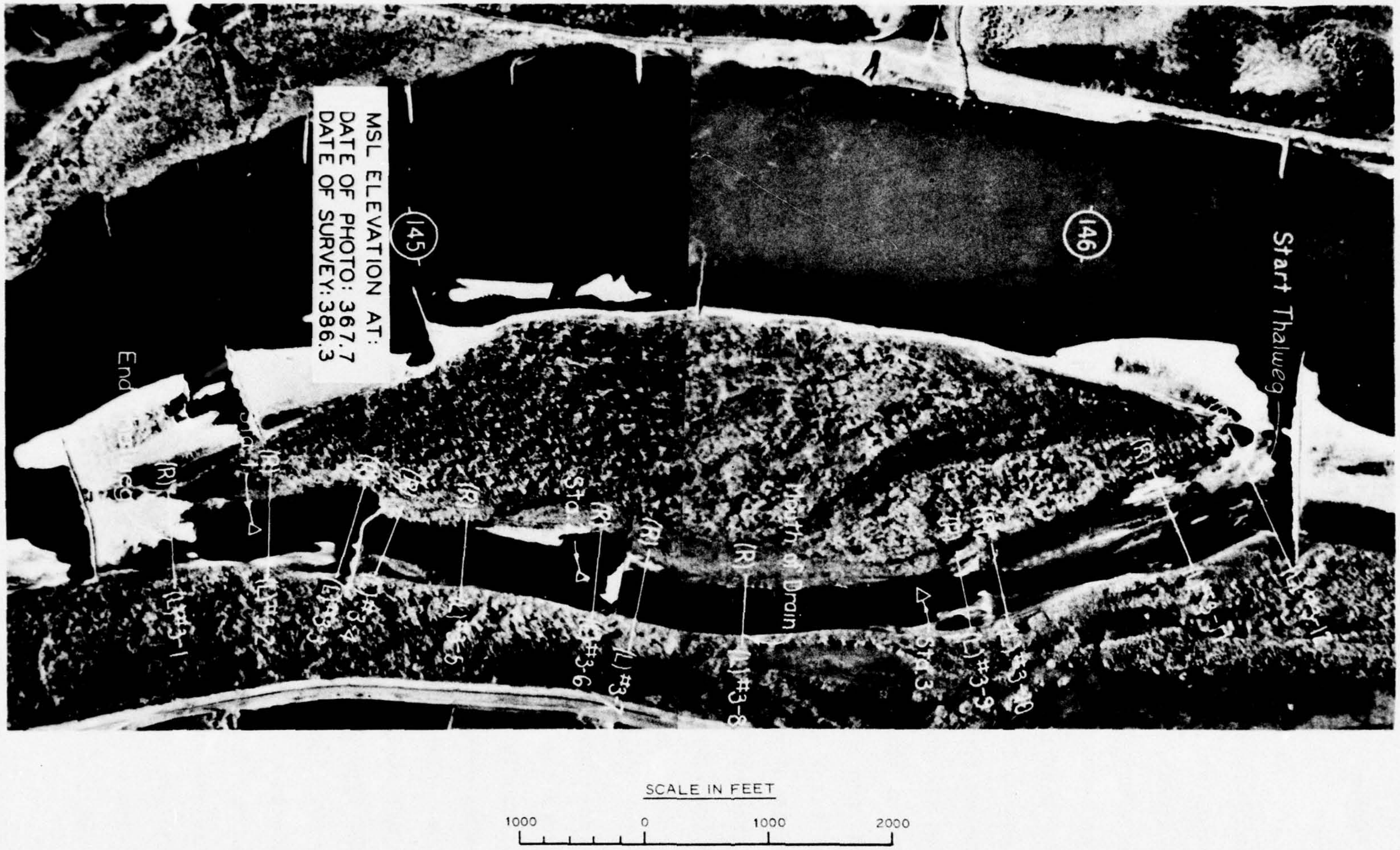


Fig. 2. Aerial photomosaic of side channel Osborne

difficult to determine whether a flat sand structure is above or immediately below the water surface.

13. The river stage in the immediate locale of each side channel was calculated jointly by SLD and WES for the time of photo coverage. Most side channels contained water at the same level as the main river channel, providing a ready source of elevation data within the side channels at the land-water interface locations. Procedures described in paragraph 28 were used to deduce the elevation of pools not connected to the main river channel.

14. The spatial extent of each side channel was delineated on transparent overlays from the aerial photos by photo interpreters. The high-bank position, as indicated by mature willow growth, was used to define the side-channel edges. The water entrance and egress locations (ends of the side channel) were defined at their junctures with the main river channel, or preferably at the location of water-flow control structures within the side channel close to that juncture. An example of such a transparent overlay is shown in fig. 3, which is a reproduction of the overlay for side-channel Osborne at the same scale as fig. 2. It shows the total outline of that side channel, the locations where fathometer data were obtained, the locations of dikes, the waterline within the side channel, and stations where the cross-sectional area of the side channel was to be calculated.

15. Since the data on the transparent overlays were at an inconveniently small scale for subsequent operations, the overlays were digitized and input to the WES computer, and expanded overlays were computer-plotted at a much larger scale to yield working base maps. Digitizing was performed through the use of a manually operated device, which recorded the two-dimensional Cartesian coordinates of points and lines at positions dictated by the equipment user. Information other than Cartesian coordinates, e.g. the elevation of a specific point, was recorded through a keyboard. All recorded data were automatically placed on magnetic tape during the digitizing process, and were immediately available for input to computer software at completion of the digitizing process. A computer graphics rather than camera expansion procedure was

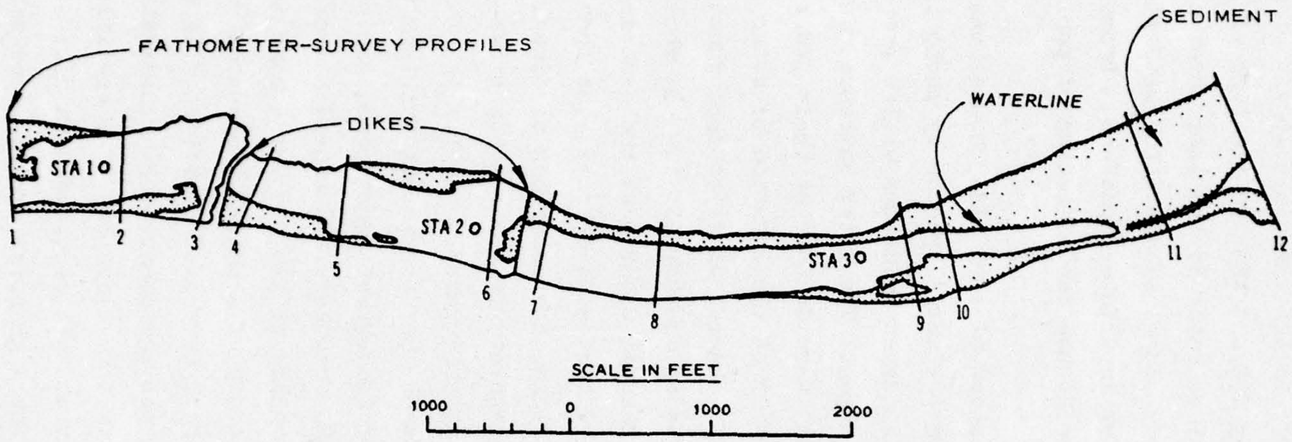


Fig. 3. Reproduction of transparent overlay for side channel Osborne

used because of the overall time and funds savings and the fact that perfect linearity and scale control were assured in the computerized expansion process.

16. Fathometer and survey data. During May 1972, personnel of the SLD operated the SLD's fathometer equipment to obtain bottom profiles within the side channels. Bottom profiles for any side channel consisted of both selected profiles across (cross profiles numbered 1-12 in fig. 3) and a single profile down the estimated position of the thalweg. Attempts were made to locate the cross profiles at the side channel ends (often at or near control structures), on both sides of any known underwater control structures, and at one position between control structures. Since the operation occurred during high water, the fathometer was carried over the maximum possible extent of the side-channel width on cross profiles and over all dikes along the thalweg profile. Because of the high water, the boat carrying the fathometer was able to reach the high-bank positions and, in a few cases, to actually pass over the high banks on cross profiles. The distances of the starting and ending points for a cross profile from local reference points (e.g. willow line) were noted on the fathometer strip charts. The inability to measure cross profiles over the entire distance from high bank to high bank for most of the profiles was primarily due to trees protruding from the water over the high banks and, in a few cases, to bluffs forming the high banks.

17. A survey team, operating in August 1972 during a period of relatively low water, supplemented the data. The team located the fathometer-profile positions and took profile data over the ends of the profiles up to the high-bank position, and measured the horizontal distance from high bank to high bank along the profiles, the distances along the side channel between cross profiles, and dike elevations. All measurements were performed with rod and transit.

18. Figs. 4 and 5 are examples of the profile data available for this study after the fathometer and survey data were spliced. The figures consist of one of the cross profiles and the thalweg profile, respectively, for side channel Osborne. The location of the cross

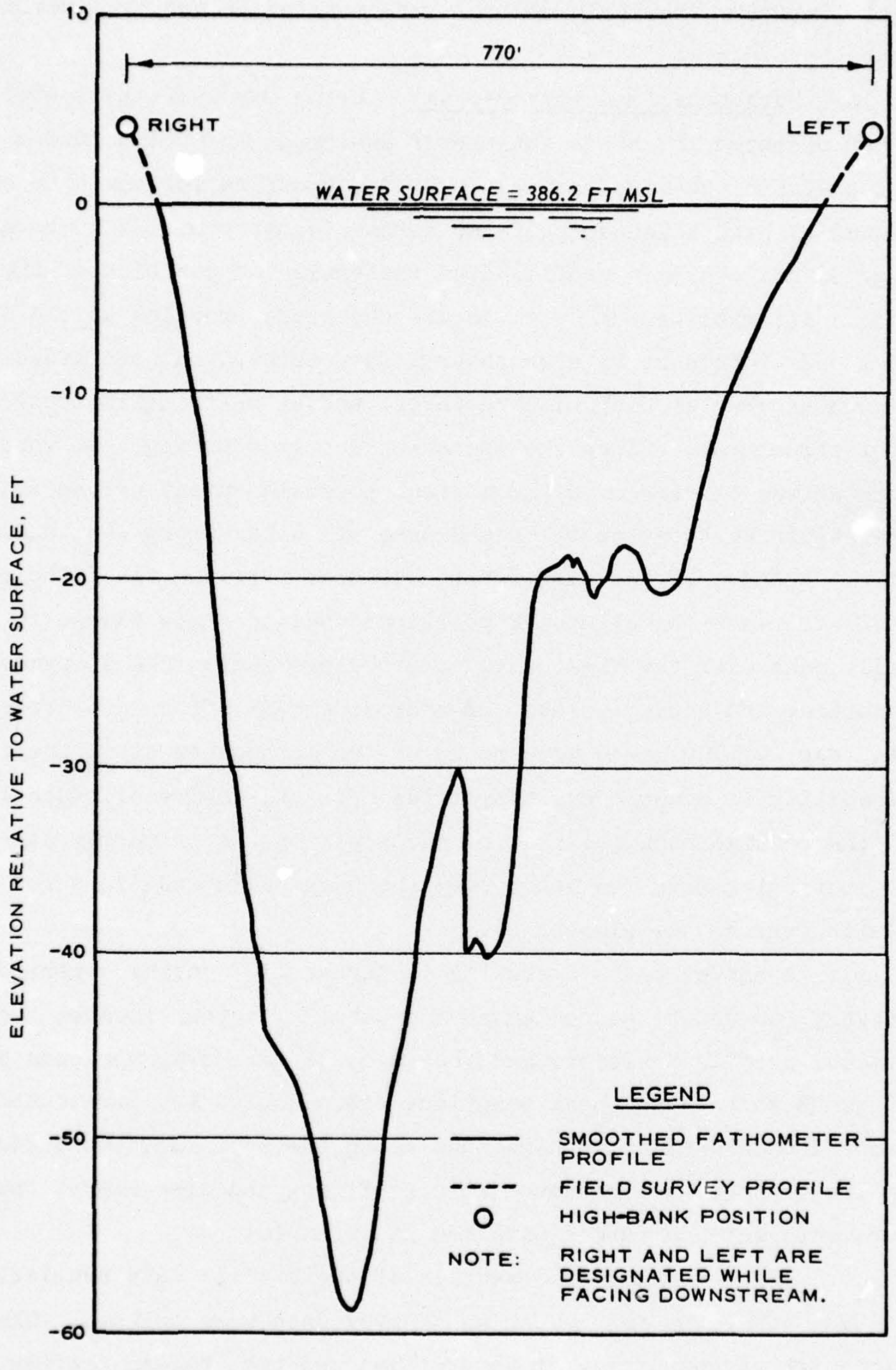


Fig. 4. Profile 3 of side channel Osborne

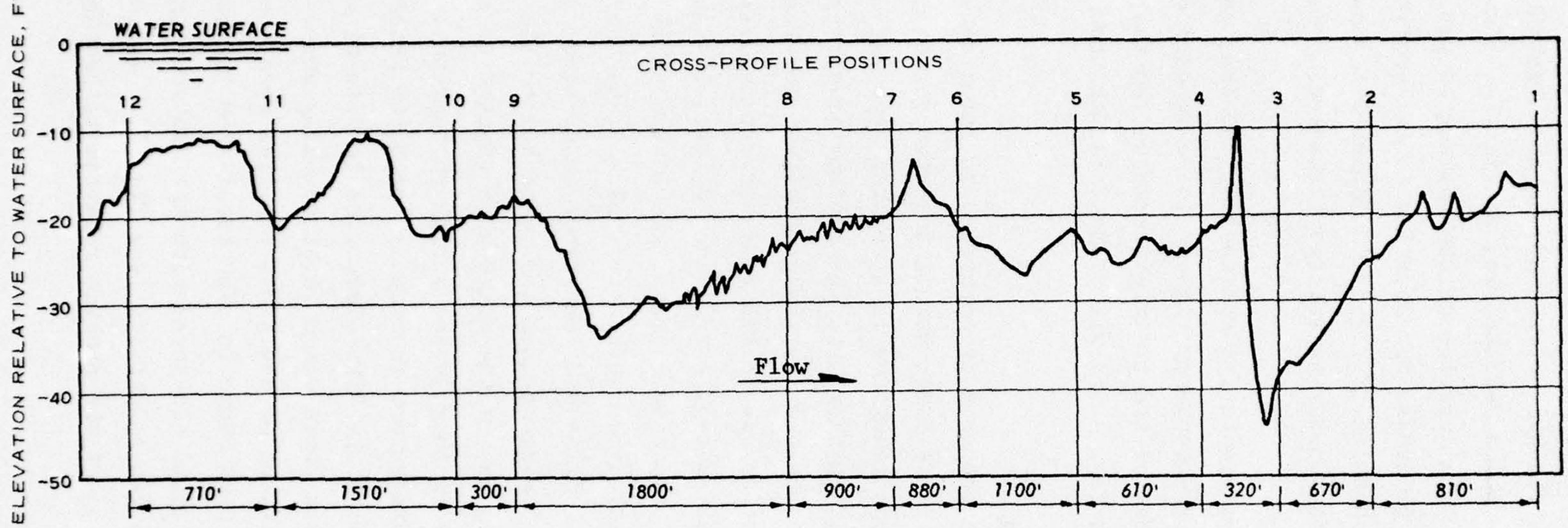


Fig. 5. Profile of side channel Osborne along thalweg

profile in the side channel corresponds to the location of the line in fig. 2 where the notation 3-3 appears, and in fig. 3 where the line labeled 3 appears. The location of the thalweg is not shown in figs. 2 and 3; the procedure for locating it is described in paragraph 24. The orientation of fig. 5 is opposite to that of figs. 2 and 3 because the fathometer-survey team traveled downstream to obtain the thalweg profile.

19. Submerged vegetation and debris, bubbles, and equipment noise frequently cause high-frequency signals to be imposed on the true bottom signal. The portions of the profiles derived from the fathometer data (e.g. solid line in fig. 4 and all of fig. 5) were smoothed to remove these effects.

Integration of data

20. The data prepared as described in paragraphs 9-19, except fathometer-profile elevations, were integrated for each side channel in an identical fashion, resulting in a working base map of the side channel. This map, together with the fathometer-survey profile elevations was used to calculate the topography data for the side channel.

21. The base map was formed by superimposing all available data, except the fathometer-survey profile elevations, on the computer-plotted expanded overlay of the side channel (see paragraph 15). The locations and elevations of all dikes were noted, as well as the locations of all fathometer-survey profiles and land-water interfaces, particularly where the water within the side channel was connected to the main channel.

22. The positions of the dikes were checked by comparison with the dike structures visible in the aerial photography. The survey elevation data for the dikes were checked by comparing water elevations in the side channels with the dike elevations to determine whether dikes that should have been above water level actually were.

23. The positions of the cross profiles were checked by measuring the distances from high banks to high banks from the expanded computer plot and comparing those distances with the distances measured by the survey team for the cross profiles (see fig. 4). In addition, the height of one portion of the profile relative to another (the profile

shape) could be deduced by examining the positions of land and water along the profile on the aerial photo. Deduced features included the general position of the thalweg relative to the center of the side channel and the locations where the profile should be high (e.g. above water) or low (e.g. below water). The deduced shape of a profile from the base map was checked against the *fathometer-survey profiles* as a second check to ensure that the fathometer-survey profile was properly located and oriented. Various data errors were encountered in this data editing procedure. In several instances, the orientations of profiles were opposite to what they should have been; the confusion in alignment was easily detected and corrected. In a few instances, the survey-measured bank-to-bank distance on a fathometer-survey profile did not agree with the scaled-off aerial photo distance. Since the boat crew performing the fathometer measurements attempted to keep the boat speed constant during a profile measurement and at the same speed from one profile to the next, the length of the profile in question was estimated roughly from the horizontal length of the fathometer chart of the profile relative to that of neighboring profiles for which the horizontal ground distance was known. In a few cases where errors were detected, the survey-measured distance was found to be in obvious error (e.g. factor of two incorrect). In all situations where data corrections were performed, the photo-interpreted distance was given preference, since the chance of gross error was less than for the field measurement.

24. The thalweg profile data (see fig. 5) contained notation as to where it passed over cross profiles. Locations in the profile where the fathometer had passed over dikes were obvious. The dike elevation survey data were checked against the profile depth data converted to elevation as one consistency check, and no problems were encountered. The water depth on the thalweg profile was checked against the water depth on the cross profile for each cross profile where they intersected. The position of the intersection of the two was chosen so that the thalweg profile was toward the center of the side channel, since the boat crew had attempted to keep to the center, and the water depth at the point of intersection of cross and thalweg profiles was the same. Where

possible, the structure of the side-channel bottom, as seen on the aerial photo, was correlated with the shape of the thalweg profile as a counter-check of the data (in particular, a check on the correct horizontal positioning of the thalweg profile). No extensive checking of this type could be performed, however, as the thalweg profile was typically measured along the deepest region of the side channel, and, therefore, the majority of the profile position was underwater even in the aerial photos taken during low water. No particular problems were encountered where correlations could be made.

25. There was a time lapse of 28 months between the aerial photography and the fathometer measurements. As a result of the data editing process, it was discovered that, insofar as it could be determined, the two data sources were in close agreement as to the side-channel bottom structure. Any differences in shoaling patterns between the two measurements were not extensive. Channels did not move from one side to the other in the side channels, nor did the shoaling patterns appear to change extensively.

26. In addition to including on the base map the locations and elevations of all land-water interfaces where the water within the side channel was connected to the main channel, so that the water elevation was known, various elevation data were interpolated onto the map using a combination of the measured and interpreted data as a basis. This step was necessary to make the full informational content of the measured and interpreted data available to the computerized topography calculation. The interpolated data consisted of high-bank elevations and elevations of the land-water interface for pools within the side channel not connected to the main channel.

27. Measured data on the high banks consisted of field survey measurements on the cross profiles at the high-bank positions. Photo interpreters interpolated elevations along the high banks between those data points with the aerial photos as an aid. An attempt to use available contour maps was unsuccessful, since their data, when available, were much coarser than those which the photo interpreters could reasonably interpret. Most side channels exhibited a smooth change in

elevation along the high banks, typically changing a few feet per mile, thus making interpolation simple. Since the parameter values were calculated as a function of water elevation up to a maximum elevation equal to that at which 50 percent of the high banks were overtopped (see Part III), the results of this study are independent of elevations along a high-bank bluff.

28. The water elevations of standing pools were interpolated by studying the shapes of the pools and attempting to locate the intersection of the water surface with cross profiles. The distances of the land-water interfaces from the high banks, as well as the pool width, were measured from the aerial photography and scaled onto the cross profiles to provide the approximate intersection points. Locating a pool's elevation was not difficult in most cases, since the side-channel shapes did not change radically in the time between aerial photo coverage and measurement of profiles.

Topography Simulation

29. The production of topographic data that describe the geometry of each side channel required five operations and resulted in three products. The five operations were the manual digitizing of the data on the base maps and profile plots in a format suitable for computer operations, production of a set of (XYZ) data from the base map and profile data, computer calculation of an elevation grid array over the side channel, computer calculation of a contour map of the side channel, and the manual digitizing of that contour map to produce a file containing the (XYZ) coordinates of the contour lines.

30. The three products resulting from this sequence of operations were the elevation grid array, the contour map, and the computer file of (XYZ) coordinates of the contours. The elevation grid array and the computer file of (XYZ) coordinates were produced to provide topographic data in a form necessary for calculation of the parameter values. The contour map was an intermediate product in producing the contour (XYZ) coordinates.

Data retrieval

31. The data on the base map and fathometer-survey plots were digitized using the same equipment described in paragraph 15. The information retrieved from the base map included the (XY) coordinates for the boundary of the side channel, the base map scale, the identification numbers and (XY) coordinates for the end points of each cross profile, the identification numbers and (XY) coordinates for each section of the thalweg profile where it intersected the cross profiles, and the (XYZ) coordinates of all elevation data, such as waterlines, high banks, and dikes. The information retrieved from each of the cross-profile plots included the elevation scale, the mean sea level elevation of the water surface, the identification number, the high-bank positions, the orientation of the profile relative to direction of water flow, and the (XY) coordinates of the profile in sufficient detail to describe the profile with straight lines between data points. The information retrieved from each thalweg profile included the elevation scale, the mean sea level elevation of the water surface, the (XY) coordinates of the profile in sufficient detail to describe the profile with straight lines between data points, and the location of each position on the profile where it intersected a cross profile.

32. Because of the differences in side-channel sizes and complexity of data, digitizing time varied from 2 to 6 hr/per side channel. Typically, a relatively unskilled equipment operator could digitize all the necessary data for one side channel in an average of about 4 hr. At the conclusion of the digitizing process, the digitized data were on magnetic tape and ready for use in the next operation.

(XYZ) data preparation

33. The data for a side channel contained on a magnetic tape from the digitizer were used as input to a computer program that produced a second data file containing (XY) coordinates of the boundary (high banks and ends) of the side channel and (XYZ) coordinates of the elevations within the side channel.

34. The coordinates of the boundary and the (XYZ) coordinates of the elevation data derived from the base map were simply repeated in the

output data file by that program. The program then "recognized" each profile by its identification number and superimposed it on the other base map data in the form of (XYZ) coordinates between the positions of the high-bank coordinates for that profile. Each profile was positioned properly across the side channel relative to the direction of water flow and scaled linearly so that the high-bank positions on the profile were made to coincide with the high-bank end positions for that profile on the base map. Finally, each digitized point along the profile was transformed into an (XYZ) coordinate on the base map.

35. The same operation was performed with the sections of the thalweg profile, except the sections were scaled linearly so that the end points of each section were made to coincide with the points of intersection between the thalweg and the cross profiles.

Grid process

36. The set of (XY) points defining a side-channel boundary and the set of (XYZ) coordinates within that boundary were input to a computer program that calculated elevations on a grid across that side channel. "Calculated elevations on a grid" means that an elevation was calculated at each intersection of equally spaced horizontal and vertical lines (20-m spacing) superimposed over the side channel. The (XY) coordinates defining the side-channel boundary were used by the program to restrict its calculations to the region within the side-channel high banks and ends.

37. The elevation grid was calculated because data in that format make many analysis procedures straightforward, including calculations of values of some of the parameters of this study and the calculation of the contour maps. (The calculations of parameter values and the contour maps are discussed in Part III.) Also, the maximum amount of informational content can be compressed into the computer data file compared with the space required by other (than grid) formats, since only the uniform grid spacing and the elevations of the grid points are required to describe the geometry rather than a set of (XYZ) coordinates. The elevation at any (XY) position can be found by retrieving the elevation from the proper row and column position.

38. The procedure used for calculating the elevation at each grid position is one that has been sucessfully applied at the WES in many prior studies involving reconstruction of topographic surfaces from sparse data. The calculational procedure is as follows: A local coordinate system is first centered at the grid position for which an elevation is to be calculated, and the space about the grid position is divided into quadrants. The data point in each quadrant closest to the grid position (nearest neighbor) is selected out of the total available data set. The elevations and positions of those four data points are used to calculate the elevation at the grid position, using the inverse-distance-square weighted elevations of the four data points. The algortihm used is

$$Z = \frac{\sum_{i=1}^{4} \frac{Z_i}{R_i^2}}{\sum_{i=1}^{4} \frac{1}{R_i^2}}$$

where

Z = the elevation at the grid position

i = the index over the four nearest neighbors

Z_i = the elevation of the i^{th} nearest neighbor

R_i = the distance of the i^{th} nearest neighbor from the grid position

If a nearest neighbor cannot be found in all quadrants, as frequently occurs when a grid position is close to the boundary of the site, as many nearest neighbors as are found are used. If a data point is located within the immediate vicinity of the grid position (within a radius less then one-tenth the space between grid positions), the elevation of that data point is used for the grid position elevation.

39. A topographic surface produced with the algorithm above has the qualities of being smoothly varying with no discontinuties and of providing an exact fit in the locale of all data points. Other

advantages of the grid representation are that the interpolative procedures bring out surface details not immediately apparent and frequently overlooked when the data are handled by other procedures.

40. The informational content of a grid array representation of a topographic surface is a function of the grid spacing. Since the grid array representation is achieved by an interpolative procedure, it can contain no more information about the surface than the set of (XYZ) coordinates used as input. Based on past experience, a grid spacing of 20 m was chosen for the grid arrays of all side channels based on the estimated accuracy and distribution of the data, the resolution required for the calculation of parameter values, the desire to make any errors in the final results due to the grid spacing both systematic and in the same direction for results for all side channels, and computer time and memory space limitations.

Contour maps

41. Computer-calculated and -plotted contour maps were produced for each of the 18 side channels. Reproductions of these maps are contained in Volume II. The contour maps were produced to yield a simple and rapid means of checking the contents of the grid array file for errors in the data input to the grid array calculation, and to provide the topographic data in a form needed for a subsequent operation. Some input data errors were discovered using this process and subsequently corrected.

42. The computer procedure used for calculating the profiles was as follows: The topographic surface of a side channel was broken into a series of grid squares, where each grid square was defined by the elevations of the grid positions at its four corners. Each grid square was further subdivided by cutting it diagonally into two triangles, and then planes were uniquely fit to the two sets of triangularly arranged points in each grid square. A series of equally separated horizontal planes was constructed starting at mean sea level with a separation equal to the contour interval (5 ft). Whenever a "triangular" topographic surface plane intersected a horizontal plane, the coordinates of the line of intersection were calculated and computer plotted. Since

the surface representation as a grid array was smoothly varying with no discontinuities, the total series of lines of intersection calculated and computer plotted formed closed contour lines on completion of the process over the entire grid array.

43. Since the contour lines were calculated as intersections of planes with planes, each contour line was a series of short, straight-line segments as seen in the maps in Volume II. The contour maps were plotted with straight-line segments between calculated positions on the contour lines rather than with smoothed lines, because smoothing techniques ordinarily introduce errors into the contour map in the form of contour line dislocation.

44. A series of contour maps was plotted for selected side channels at several contour intervals to determine the smallest interval that was consistent with the data content of the grid array. It was originally intended to produce maps with 2-ft contour intervals; however, such maps showed distinctive effects of interpolating between larger intervals, i.e. there was a high occurrence of parallel contour lines over most substructures of a bottom surface. Therefore, 5-ft intervals were chosen, since maps plotted at that and larger intervals did not show the above-mentioned effect to any appreciable degree.

Contour (XYZ) coordinates

45. Contour data calculated from the grid array were used to plot contour maps automatically. The maps (shown in Volume II) were then digitized manually with the same equipment previously described to provide the topographic data in a form suitable for calculating parameters d and e, paragraph 5. While manual digitizing was laborious and time-consuming, the total project time and funds did not permit the development of a more versatile automated procedure.* The manual procedure for all maps was the same and consisted of digitizing each contour line as a closed loop, thereby providing the elevation and coordinates of each line in a computer file for use in calculating some of the parameters.

* A new procedure for performing this step with increased accuracy and a drastic reduction in time and cost per side channel was developed shortly after project completion.

PART III: CALCULATIONS AND RESULTS

46. The parameters for which values were calculated are listed in paragraph 5, but are repeated below for convenience.

- a. Center-line length.
- b. Average width between high banks.
- c. Water volume as a function of water elevation.
- d. Shoreline length as a function of water elevation.
- e. Water surface area as a function of water elevation.
- f. Shoreline development as a function of water elevation.
- g. Rate of change of water surface area with respect to water elevation (derivative of water surface area with respect to water elevation) as a function of water elevation.
- h. Ratio of water surface area to volume as a function of water elevation.
- i. Ratio of shoreline length to water surface area as a function of water elevation.
- j. Bottom surface area underwater as a function of water elevation and water depth.
- k. Water cross-sectional area as a function of water elevation at selected sampling locations (stations).

Water Elevation

47. "Water elevation" is defined as the elevation of the water within the side channel. It is important to recognize certain problems associated with specifying water elevation, the errors that can arise in the calculational results because of those problems, and the error correction procedures built into the procedures for evaluating the parameters.

48. Three conditions associated with water surface slope and impoundment affect the meaning and assignment of water elevation:

- a. There is a difference between the water elevation in the side channel and that in the main channel.
- b. There is a change in water elevation in the side channel relative to mean sea level due to the surface slope of moving water in the side channel.

c. Any impounded water within a side channel is typically not at the same elevation as that in the main channel or other parts of the side channel.

Each of these conditions is discussed below.

49. Since only the main channel water elevation was available at the time the fathometer profiles were measured and at the time of aerial photo coverage, and no data were available to specify the difference between main- and side-channel water elevations, the elevation of the latter was accepted as equal to the former when they were connected. In addition, the difference in water levels is not constant, but varies uniquely in each side channel with river stage, so that the difference at the time of photo coverage was not the same as that at the time of fathometer measurements, nor the same from one side channel to the next. This problem does not affect the shape of the parameters (how the values of the parameters, which are a function of water elevation, change with changes in water elevation), but rather introduces errors into the absolute values of those parameters. Since the difference in water elevation referred to is considered small (typically less than 1 ft for any side channel at any time), the introduced error is considered negligible compared with errors due to sparseness of data.

50. Because of the slope of the water surface in a side channel, the water elevation relative to a fixed datum varies along the side channel when water is flowing through it, but is almost constant when flow is stopped. The fathometer profiles were measured at a time of maximum flow--when the water surface slope within the side channel most closely approximated that within the main channel. The fathometer profiles contain the elevations affected by water surface slope at that time, since all elevations in those data are relative to the water surface. The values of the parameters are, therefore, already partially adjusted for that effect for the water elevations when water is flowing through the side channels. The end-to-end difference in water elevation is typically no more than 1.5 ft for any side channel, which is small compared with errors introduced in interpretation of the fathometer and aerial photo data.

51. All parameters in paragraph 46, except _a_ and _b_, were calculated as a function of water elevation at a single location, recognizing the effects of water surface slope as noted above. That location was the approximate lengthwise center of the side channel. The water elevation in the main channel opposite that location was found (rounded off to the nearest foot) from interpolating between the mean sea level elevations available on the aerial photography and the elevation assigned to water in the side channel connected with the main channel. The results presented in this report as a function of water elevation are relative to that center point. The single exception is parameter _k_, for which values were referenced to the water elevation at the location of the cross-sectional calculation (see paragraphs 76 and 77).

52. As the water level drops in a side channel, various structures, particularly sandbars at the ends of the side channels and dikes within or at the side-channel ends, restrict water flow. As the water level continues to drop, pools are formed with different water elevations. The water level within a pool does not normally remain constant, however. The local climatic conditions, the hydraulic head, the composition of the dike or other control structures, and the composition of the base material affect the percolation, evaporation, and seepage rates in lowering the pool level. Local rainfall, runoff, and fluctuations of the main channel above the elevations of control structures work to raise the pool level. Finally, a time comes when the elevation of the main river rises above the elevation of one of the control structures, and the pool is again connected to the main channel. The locations and elevations of the major control structures are known, but there is no general theoretical relation developed that takes all environmental controlling conditions into account, nor are empirical data generally available to describe the elevations of the impounded water relative to the elevation of the main river channel.

53. If that information were available, each of the parameters evaluated in this study would be double-valued over the water elevation range, from that elevation at which water was impounded anywhere in the side channel down to the minimum water elevation in that side channel.

Lacking those data, the parameters were calculated for the entire side channel, ignoring the impoundment effects. The values of the parameters calculated in this study for water elevations lower than an "impoundment elevation" for a side channel are between the double values. There is no assurance that a single-valued function is at the mean of the double-valued function for any of the parameters.

54. The state-of-the-art incapability to provide a means of calculating the double- rather than single-valued functions over the range of impoundment is not particularly distressing, considering the purpose of this study. The purpose is to provide geometric characteristics (as one part of the physical characteristics) for correlation with wildlife population structures. The accuracy of such a correlation depends on the appropriateness of the parameters chosen to quantitatively describe the characteristics and the accuracy with which the values of those parameters are calculated. It is well known mathematically that the accuracy of the results of a correlation is a function of the accuracy of the parameters used in the correlation, and that the correlation accuracy cannot be greater than the worst accuracy of any of the set of parameters used in the correlation. The accuracy of the parameters calculated in this study is much greater than that of other than geometric parameters or of the biological data and is, therefore, more than sufficient for the intended purpose. The reason for the difference in accuracy is primarily one of sample size. Expressed simply, the geometric parameter values are typically based on several thousand "samples" per side channel, while such sample sizes are not normally obtainable, for example, for animal populations.

Pool Parameters

55. In addition to calculation of the parameters over the entire range of water elevations of all side channels, side channels Osborne, Fort Chartres, and Liberty were selected for more detailed calculations. The levels and locations of the water-control structures were identified, and all parameters were evaluated for each separate "pool" formed by the

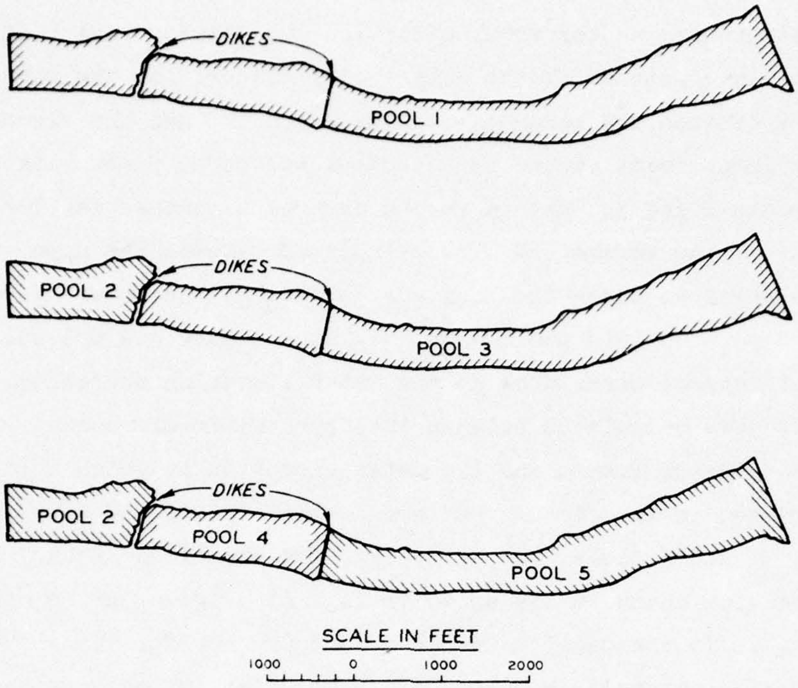
control structures as the water elevation decreased. Pool 1 of all three side channels consisted of the entire side channel for the range of water elevations between the maximum (see paragraph 56) and the elevation at which any impoundment caused by a control structure first took place, forming pools 2 and 3. When a second control structure was located in pools 1 or 2, the parameters were calculated between the upper water elevation level at which the pool was formed and the lower elevation at which it separated into pools 4 and 5. When a pool did not contain any additional control structures as the water elevation decreased, the parameters were calculated between the upper water elevation level at which the pool was formed and the water elevation at which negligible water remained in the pool. The three selected side channels contained 5, 3, and 5 pools, respectively. The locations of the pools within the side channels are shown in fig. 6. Fig. 6 can be understood by viewing it in conjunction with the contour maps for the abovementioned side channels in Volume II. The dikes, which were the control structures for those side channels, are also shown on the contour maps in Volume II. A review of fig. 2 would also be helpful, since it shows Osborne at low water, revealing the dikes that formed the pools.

Range of calculations

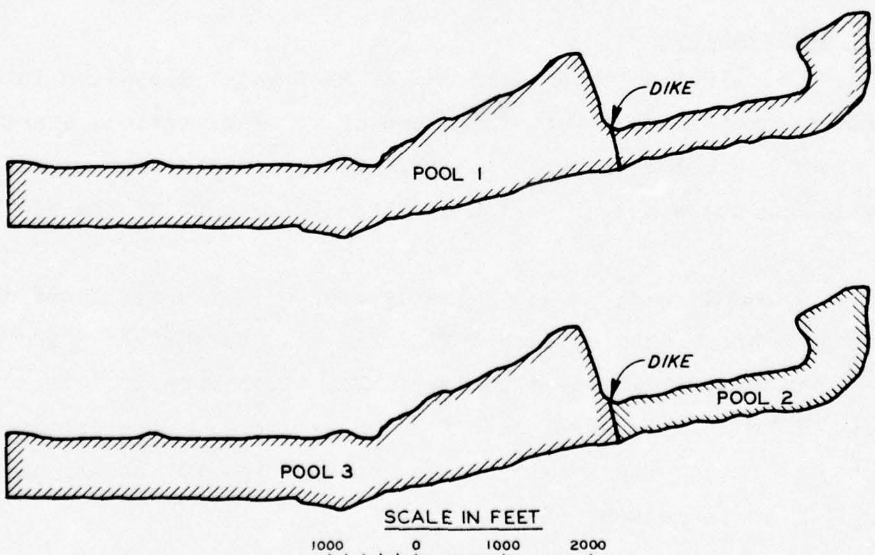
56. Calculations were performed at 2-ft water elevation intervals for those parameters that were functions of water elevation, starting at the water elevation at which the side channel was dry or nearly dry and continuing up to the elevation at which 50 percent of the high banks was overtopped.

57. Parameters c, j, and k (paragraph 46) were calculated directly from the grid array data at each 2-ft interval. Parameters d and e were calculated using the digitized contour data, which were at 5-ft intervals. The 2-ft-interval data for the parameters were interpolated from the 5-ft data. The total calculational procedure for all parameters is described in paragraphs 61-77.

58. The upper and lower water-level extremes used in the calculations for a specific side channel were chosen by inspection of the base map and the contour map, respectively. Since the side-channel high banks

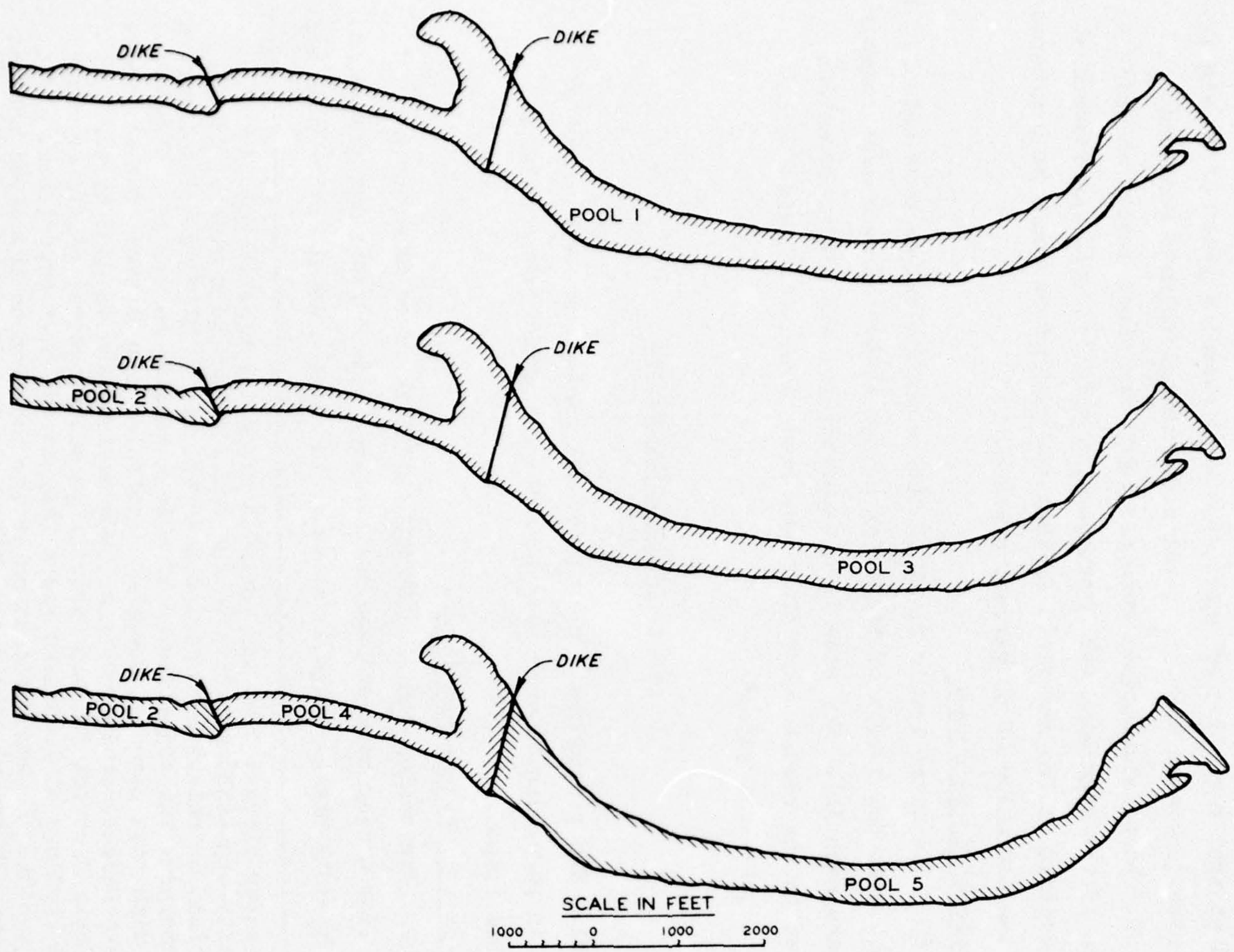


a. Five pools of side channel Osborne



b. Three pools of side channel Fort Chartres

Fig. 6. Locations of pools in selected side channels (sheet 1 of 2)



c. Five pools of side channel Liberty

Fig. 6. (sheet 2 of 2)

were typically smoothly varying, it was possible to choose the upper water-level extreme easily and unambiguously. Selection of the lower extreme was more subjective. The general rule was that the extreme be picked at that elevation at which separated standing pools of no significant size (compared with the total side-channel extent) remained.

59. When calculations were performed for those levels at which a portion of the high bank was overtopped, a vertical wall was assumed at the locations of the overflow, so that the parameters could be evaluated up to the elevation of 50 percent overtop.

Water-elevation reference

60. The water levels at which the parameter values were calculated were the mean sea levels of the water at the center of each side channel (see paragraph 51). For ease in interpretation, all water elevations reported in the results were also converted to the St. Louis (Market Street) equivalent gage.*

Calculational Procedures

61. The procedures for computer calculation of each parameter listed in paragraph 46 were identical for all side channels and are described below.

Parameter a: Center-line length

62. The center-line length was calculated from the base map. A center line midway between high banks of the side channel was placed on the photo-interpreted representation of the side channel on the base map.

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* The water elevation at any position along the Mississippi River is normally expressed relative to the scale of the gage closest to that position, or relative to mean sea level. It is difficult for a person to interpret the significance of a gage reading unless he has experience with that gage. A somewhat artificial gage system, the St. Louis (Market Street) equivalent gage, was devised and is used by the St. Louis District to help District personnel better relate to river stage readings at locations where they do not have experience. Using that system, the water elevation at any location on the river between St. Louis, Missouri, and Cairo, Illinois, is converted to the equivalent elevation that would be read on the St. Louis Market Street gage if the river was in a steady-state condition.

Length was measured by digitizing the center line as a series of very short, straight segments, and calculating the total center-line length as the sum of the segment lengths with the following equation:

$$L = \sum_{i=1}^{N} \sqrt{(X_{i+1} - X_i)^2 + (Y_{i+1} - Y_i)^2}$$

where

- L = the center-line length
- N = the total number of segments
- X_i, Y_i = the Cartesian coordinates of the i^{th} digitizer point on the center line
- $(N+1)$ = the number of digitized points defining the center line

The straight-line segments were made small enough so that the total digitized center line was essentially continuous.

63. When a side channel had branches (see contour map II-5 in Volume II) so that more than one center line could be defined, the length of the longest center line was calculated.

64. The "ends" of a side channel on the base map were not necessarily at the juncture of that side channel with the main channel, but were generally fixed at the first structure that controlled water flow within the side channel from that juncture.

Parameter b: Average
width between high banks

65. The average width between high banks was calculated from the base map. On the average, 10 lines were constructed perpendicular to the center line, and the distances between high banks on those lines were calculated and averaged with the following equation:

$$\bar{W} = \frac{\sum_{i=1}^{N} \sqrt{(X_{2i} - X_{1i})^2 + (Y_{2i} - Y_{1i})^2}}{N}$$

where

$\bar{W}$ = the average side-channel width

N = the total number of lines

(X_{2i}, Y_{2i}) = the coordinates of one high-bank position on the i^{th} line

(X_{1i}, Y_{1i}) = the coordinates of the other high-bank position on the i^{th} line

Parameter c: Water volume
as a function of water elevation

66. The water volume as a function of water elevation was calculated using the elevation grid array as a data source. The volume for a specific water elevation was calculated by summing the volumes of water over all grid squares, where a grid square was that section of the side-channel bottom surface determined by four adjacent grid elevations. The volume of water over any grid square was calculated in the following manner: The grid square was first cut into two triangles with a vertical plane passing through a grid square diagonally. The vertical plane also cut the rectangular column of water above that grid square into two triangular columns. The volumes of both triangular columns bounded by the plane of the water surface, the plane formed by the triangle on the bottom, and vertical planes passing through the three sets of vertices of the triangle were calculated and summed to yield the volume of water over that grid square. A mathematical expression for the entire operation is as follows:

$$V_k = \frac{1}{2} \sum_{R=1}^{2} \sum_{j=1}^{M} \sum_{i=1}^{N} D^2 \left(E_k - \bar{Z}_{ij}^{R} \right), \text{ for } E_k > \bar{Z}_{ij}^{R}$$

where

V_k = the volume of water in the side channel when water elevation is at the k^{th} level

M = the number of grid squares in the Y direction

N = the number of grid squares in the X direction

D = the horizontal distance between elevation grid points

E_k = the elevation of water at the k^{th} level

$\bar{Z}^R_{ij}$ = the average of the three grid elevations in the R^{th} triangle of the $(i,j)^{th}$ grid square = $\sum_{p=1}^{3} Z^R_{ijp}/3$

Z^R_{ijp} = elevation of the p^{th} grid point in the R^{th} triangle of the $(i,j)^{th}$ grid square

and where the summation is completed only for those triangles of bottom surface within the grid squares where the water elevation is above the bottom surface $(E_k > \bar{Z}^R_{ij})$.

Parameter d: Shoreline length as a function of water elevation

67. The shoreline length as a function of water elevation was calculated from the digitized contour-line data. The shoreline length at a specific water elevation was calculated by summing the lengths of all contour lines (as closed loops) at that elevation. Since the contour lines were at 5-ft intervals, a table was formed of shoreline length at 5-ft water-elevation intervals. The mathematical procedure used was as follows:

$$L_k = \sum_{j=1}^{M} \sum_{i=1}^{N} \sqrt{\left(X^k_{i+1,j} - X^k_{ij}\right)^2 + \left(Y^k_{i+1,j} - Y^k_{ij}\right)} \; , \quad \begin{cases} X^k_{N+1,j} = X^k_{1j} \\ Y^k_{N+1,j} = X^k_{1j} \end{cases}$$

where

L_k = the shoreline length when water is at the k^{th} level

M = the number of contour lines with water at the k^{th} level

N = the number of digitized data points on the j^{th} contour line with an elevation at the k^{th} level

$\left(X^k_{ij}, Y^k_{ij}\right)$ = the coordinates of the i^{th} point on the j^{th} contour line that has an elevation at the k^{th} level

and where the contour lines were "closed" in the calculation by connecting the coordinates of the first point in the string of numbers with the coordinates of the last point by specifying the condition

$$\left(X^k_{N+1,j}, Y^k_{N+1,j}\right) = \left(X^k_{1j}, Y^k_{1j}\right)$$

Parameter e: Water surface area
as a function of water elevation

68. The water surface area as a function of water elevation was calculated from the digitized contour-line data. The surface area at any water elevation was calculated by summing the areas inclosed by all contour lines with that elevation which were covered with water. The area inclosed by a contour line was calculated using the trapezoidal rule on the set of coordinates defining that contour line as a closed loop. The mathematical procedure was as follows:

$$A_k = \frac{1}{2} \sum_{j=1}^{M} \sum_{i=1}^{N} \left(X^k_{i+1,j} - X^k_{ij}\right)\left(Y^k_{i+1,j} + Y^k_{ij}\right) , \begin{cases} X^k_{N+1,j} = X^k_{1j} \\ Y^k_{N+1,j} = Y^k_{1j} \end{cases}$$

where

A_k = the water surface area when water is at the k^{th} level

M = the number of contour lines at the k^{th} level

N = the number of digitized data points on the j^{th} contour line with an elevation at the k^{th} level

$\left(X^k_{ij}, Y^k_{ij}\right)$ = the coordinates of the i^{th} point on the j^{th} contour line that has an elevation at the k^{th} level

and where the condition $\left(X^k_{N+1,j}, Y^k_{N+1,j}\right) = \left(X^k_{1j}, Y^k_{1j}\right)$ satisfies the condition of contour-line closure.

Parameter f: Shoreline development as a function of water elevation

69. Shoreline development is a parameter commonly used as a measure of a water body's circularity. It can be easily shown that the minimum extremum circumference of a two-dimensional geometric figure inclosing a region must have a circular shape. The value of shoreline development of a circular water body is unity, whereas that of all water

bodies with other geometric configurations is greater than unity. Thus, the departure of a water body's shoreline development value from unity is a measure of its "differentness" from a circle. The parameter values were calculated using the following equation:

$$D_k = \frac{L_k}{2(\pi A_k)^{1/2}}$$

where

D_k = the shoreline development when water is at the k^{th} level
L_k = the shoreline length when water is at the k^{th} level
A_k = the water surface area when water is at the k^{th} level

Parameter g: Rate of change of water surface area with respect to water elevation

70. The rate of change (derivative) of water surface area with respect to water elevation was calculated using the previously calculated surface area data. A smooth curve, a third-order polynomial,* was analytically fit to the surface area as a function of water elevation data in the immediate locale of each water elevation for which a derivative would be calculated. First derivatives were then calculated at the 2-ft-interval water elevations from the analytic expressions for the data (one analytic expression per data point).

Parameter h: Ratio of water surface area to volume as a function of water elevation

71. The ratio of water surface area to volume as a function of water elevation was calculated using the previously calculated shoreline-length and water-surface-area data. Ratios were taken at each water elevation as expressed by the following relation:

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* A second-order polynomial was used for data points close to the low-water and high-water ends of the data.

$$R^k_{AV} = \frac{A^k}{V^k}$$

where

R^k_{AV} = the ratio of water surface area to water volume when water is at the k^{th} level

A^k = the water surface area when the water is at the k^{th} level

V^k = the water volume when water is at the k^{th} level

Parameter i: Ratio of shoreline length to water surface area as a function of water elevation

72. The ratio of shoreline length to water surface area as a function of water elevation was calculated using the previously calculated shoreline-length and water-surface-area data. Ratios were taken at each water elevation as expressed by the following equation:

$$R^k_{LA} = \frac{L^k}{A^k}$$

where

R^k_{LA} = the ratio of water surface area to water volume when the water is at the k^{th} level

L^k = the shoreline length when the water is at the k^{th} level

A^k = the water surface area when the water is at the k^{th} level

Parameter j: Bottom surface area underwater as a function of water elevation and water depth

73. The relation between water depth and wildlife populations is not completely understood. There is information (mostly qualitative), however, regarding the "typical" water depths acceptable to different waterfowl and fish species, and acceptable to fish species during the major phases of their life cycles. Using that information, seven depth class ranges were defined as follows.

a. Surface to 2 ft.

b. From 2 to 4 ft.

c. From 4 to 6 ft.

d. From 6 to 10 ft.

e. From 10 to 15 ft.

f. From 15 to 20 ft.

g. In excess of 20 ft.

An attempt was made to class the depths such that conditions that influence wildlife population densities (for this parameter) are uniform in each depth class range, but differ from one class to another.

74. The data for the bottom surface area under water as a function of water elevation and water depth were calculated from the grid array data. The parameter results were calculated for a specific water elevation by calculating the area of the bottom surface within each range class for that water elevation. The computer calculation procedure used for each water elevation was follows. A series of six horizontal planes were constructed at 2, 4, 6, 10, 15, and 20 ft below the water surface. Each grid square within the side channel was broken into two triangles by placing a diagonal on the square, thus forming two triangular planes. Each triangle was then further broken into 10 parallelograms and each parallelogram was assigned an average elevation. The average elevation of each parallelogram was then examined to determine whether it was above water level, and therefore ignored, or below water level. If it was below water level, it was examined to determine which depth-class range it belonged to, and the area of that parallelogram was added to the accumulated total area for that class range. The operation is expressed mathematically by the following equation:

$$B_j^k = \frac{1}{2} \sum_{i=1}^{N} d^2 A_{ij}$$

where

B_j^k = the bottom area in range class j when the water elevation is at the k^{th} level

N = the number of triangles in the grid array

d = the grid spacing

A_{ij} = the fraction of the i^{th} triangle in the j^{th} class range

75. The volume of information produced by performing this calculation is large, and the parameter value trends are not immediately apparent when viewing a table of values. To partially remedy that situation, the data were also expressed in a normalized form in which the data for each water elevation were normalized to the total bottom surface area underwater. The mathematical procudure followed is shown below, and both the absolute and normalized forms of the data are presented in the results.

$$P_j^k = \frac{100.0 B_j^k}{\sum_{j=1}^{7} B_j^k}$$

where

P_j^k = the percentage of the total bottom area underwater in the class range j when the water is at the k^{th} level

Parameter k: Water cross-sectional area as a function of water elevation at selected sampling locations

76. The water cross-sectional area as a function of water elevation was calculated from the elevation grid array data. Calculations were performed only at specific locations (stations). The river miles of the locations are listed in table 1 and the stations are shown in the contour maps in Volume II.

77. The calculational procedure was the same for all stations. A vertical plane was placed perpendicular to the side-channel center line at the station, and the profile formed by the intersection of that plane and the side-channel bottom was calculated. Horizontal planes were then placed at 2-ft intervals through that profile and the area bounded by each plane and the bottom of the profile was calculated. The trapezoidal

rule was used for the area calculation. The mathematical equation is as follows:

$$C_k = \frac{1}{2} \sum_{i=N}^{M} (X_{i+1} - X_i)(2E_k - Z_{i+1} - Z_i) \, , \quad \begin{cases} X_{M+1} = X_N \\ Z_{M+1} = Z_N \end{cases} \text{ and } \begin{cases} Z_i \leq E_k \\ Z_{i+1} \leq E_k \end{cases}$$

where

C_k = the cross-sectional area of the water in the side channel when the water is at the k^{th} level

M = the first point in the string of coordinates defining the profile that is above water as the profile advances upward toward the high bank from the side-channel bottom

N = the last point in the string of coordinates defining the profile that is above water as the profile advances down toward the water from the high bank

(X_i, Z_i) = the coordinates of profile in a plane that cuts the side channel perpendicular to the center line

Closure of the curve during the areal calculation was satisfied by the condition $(X_{M+1}, Z_{M+1}) = (X_N, Z_N)$. The calculation of the water cross section over only the water-covered region of the profile was satisfied by applying the conditions $Z_i \leq E_k$ or $Z_{i+1} \leq E_k$ during calculation.

Results

78. The results of all calculations are presented in tables 2-19 and plates 1-18. Each table contains the total results for a side channel. Each plate is a graphic presentation of a portion of the tabular data for a side channel. The tabular data not represented in plates 1-18 are the length along thalweg, the average width between high banks, and the side-channel bottom-surface area underwater as a function of water elevation and water depth. The former two parameters are one-dimensional and cannot be represented graphically. The lattermost parameter is three-dimensional and could have been represented

graphically, but was not, since no advantage could be gained because of the difficulty in interpreting such a graphic.

79. The tabular and graphic results are arranged by side channels as shown below:

Side Channel	Table No.	Plate No.
Jefferson Barracks	2	1
Calico	3	2
Osborne	4A	3A
Osborne, Pool 1	4B	3B
Osborne, Pool 2	4C	3C
Osborne, Pool 3	4D	3D
Osborne, Pool 4	4E	3D
Osborne, Pool 5	4F	3E
Harlow	5	4
Fort Chartres	6A	5A
Fort Chartres, Pool 1	6B	5B
Fort Chartres, Pool 2	6C	5B
Fort Chartres, Pool 3	6D	5C
Moro	7	6
Kaskaskia	8	7
Crains	9	8
Liberty	10A	9A
Liberty, Pool 1	10B	9B
Liberty, Pool 2	10C	9B
Liberty, Pool 3	10D	9C
Liberty, Pool 4	10E	9C
Liberty, Pool 5	10F	9D
Jones	11	10
Picayune	12	11
Cape Bend	13	12
Sante Fe	14	13
Billings	15	14
Buffalo	16	15
Browns	17	16
Thompson	18	17
Sister	19	18

80. Values for all parameters are given in the tables for both the

total side channel and also for the pools (except parameter k) of three selected (Osborne, Fort Chartres, and Liberty) side channels. The parameters that are functions of water elevation are tabulated both according to mean sea level and according to St. Louis gage equivalent water elevations at the side channel. Each table is formatted in an identical manner. Results for parameters a and b (center-line length and average width between high banks) appear at the top of the table, those for parameters c through i (volume, shoreline length, water surface area, shoreline development, rate of change of water surface area with respect to water elevation, ratio of water surface area to volume, and ratio of shoreline length to water surface area) appear in the upper box, those for parameter j (bottom surface area underwater as a function of water elevation and water depth) in the lower box, and those for parameter k (water cross-sectional area as a function of water elevation at selected sampling locations) in the boxes to the right in each table.

81. The graphic representations of the data, as seen in plates 1-18, were produced to provide data for those parameters in a form immediately useful in the first step required to correlate geometric characteristics with wildlife populations, and to present them in a particularly simple and readily interpretable form. The intention was to provide the data so that trends in parameters as a function of water elevation could be easily seen, and the trends for one side channel could be compared with those of any other. Since each side channel had a different size and shape, the absolute values of the parameters were different for each. To provide a uniform means of displaying the selected data that is consistent with the purpose, all selected data are displayed with a normalized format. Normalization of data for each parameter of each side channel was performed relative to the maximum value for that parameter for that side channel. The mathematical procedure was as follows:

$$M_k = 100 \frac{N_k}{N_{k(MAX)}}$$

where

M_k = any of the parameters expressed in a normalized form for the water elevation at the k^{th} level

N_k = the value of that parameter when the water level is at the k^{th} level

$N_{k(MAX)}$ = the maximum value of N_k

The vertical scales in plates 1-18 are, therefore, expressed as percent of maximum.

PART IV: CONCLUSIONS AND RECOMMENDATIONS

Conclusions

82. A procedure for quantifying geometric characteristics of water bodies was successfully developed and used in the study of 18 Middle Mississippi River side channels. Values for those parameters selected to describe the geometric characteristics quantitatively were calculated using assorted available data. Since the statistical sample size used to calculate the value of any of the parameters ranged from 3,000 to 10,000, the calculated values of the parameters can be considered more accurate than the values of parameters calculated for chemical or biological characteristics (the sample sizes available for those characteristics are simply much smaller). The primary purpose of this study was to provide data for comparing the geometric, chemical, and biological elements of a side channel. The accuracy of the data calculated in this study is sufficient for that purpose.

Recommendations

83. No further calculations, either of the same parameters in additional side channels or more parameters for the 18 side channels, should be undertaken until the results of this study are used for the intended purpose. The correlation of the calculated parameter data with wildlife populations should be performed and studied to determine which of the parameters are best indicators of, for example, total fish populations and densities. The first and most basic step in that correlation should be the grouping of side channels according to similarity of parameter function shapes using plates 1-18. Since more advanced classical correlation coefficient calculations are neither straightforward nor easily understood for two- and three-dimensional parameters, attempts should be made to show correlations on gross features (e.g. total fish population density irrespective of species against shoreline development)

to aid in understanding the data and possibly to uncover simple, strong relations, if there are any.

84. The data can also be rearranged to yield new insights. The monthly river-stage records in the immediate locale of each side channel can be used in conjunction with the elevations of controlling structures to produce estimates for the parameters as a function of month rather than water level. Parameter values at approximate fish spawning, juvenile, and mature stages, and duck migration times could be used to classify the side channels according to similarity.

85. Portions of the data could be used for other purposes. New fathometer and aerial photo data could be used to perform calculations for selected side channels to study the change in shape, particularly changes possibly due to the 1972-73 flood. Contour maps for different times could synthesize the changes for ease of interpretation. Even significant changes in a side-channel contour map would not necessarily imply significant changes in the parameter values.

Table 1

Side Channels Included in Study

Name	No.	River Mile Extremes*	River Mile Station Locations 1	2	3
Jefferson Barracks	1	168.8-166.5L	166.6	167.5	168.6
Calico	2	148.3-147.4L	147.5	147.9	148.1
Osborne	3	146.3-144.3L	144.6	145.3	145.8
Harlow	4	143.0-141.7R	142.0	142.3	142.7
Salt Lake	5	141.5-136.8L	137.8	138.8	139.9
Fort Chartres	6	134.3-132.3L	132.8	133.1	134.1
Establishment	7	132.5-130.1R	130.9	131.5	132.3
Moro	8	122.6-120.1L	120.0	121.7	122.3
Kaskaskia	9	118.0-115.8R	116.5	117.2	117.4
Crains	10	105.6-104.4R	104.5	105.1	105.4
Liberty	11	102.8-99.9L	100.4	101.3	102.0
Jones	12	98.3-95.0R	95.6	96.4	98.2
Grand Tower	13	78.5-77.8R	--	--	--
Crawford	14	73.7-71.6L	72.2	72.6	73.6
Schenimann	15	62.5-57.1R	57.7	59.1	61.7
Picayune	16	60.6-54.8L	54.9	58.0	60.1
Cape Bend	17	51.4-47.6L	48.0	48.8	50.7
Santa Fe	18	40.4-35.4L	35.6	--	37.3
Billings	19	34.0-32.7R	33.0	33.5	33.9
Buffalo	20	26.8-24.7R	25.0	25.5	26.0
Browns	21	24.7-21.7L	22.1	22.8	24.2
Thompson	22	18.7-15.3R	15.9	17.7	18.6
Sister	23	14.4-11.9R	12.5	13.0	14.0
Boston	24	10.4-7.7L	8.3	8.8	10.1
Angelo	25	5.0-1.2L	2.6	4.0	4.8

* R and L indicate that the side channel is on the right or left of the river, respectively, when facing downstream.

Table 2

Results of Calculations for

Side Channel Jefferson Barracks

SIDE CHANNEL LENGTH = 2.45 MILES = 3.95 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.08 MILES = 0.12 KILOMETERS = 396.26 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
398	23.5	1023	6.1	108.4	6.4	4.2	559	36
396	21.0	839	6.1	96.7	5.3	4.5	608	41
394	19.0	656	6.2	85.1	4.3	4.8	685	47
392	17.5	498	6.2	74.7	4.1	5.2	792	53
390	15.5	365	6.2	65.5	4.8	5.5	948	61
388	13.5	232	6.2	56.3	5.5	5.9	1281	70
386	11.5	154	6.0	43.6	6.2	6.8	1495	88
384	9.0	76	5.8	30.9	6.9	7.8	2150	120
382	7.0	30	4.6	19.8	6.6	7.1	3528	150
380	4.5	15	2.5	10.3	5.2	4.9	3551	155
378	2.5	1	0.4	0.9	3.9	2.7	4174	262

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
398	23.5	9.6	9	12.3	12	9.2	9	17.9	17	29.6	29	23.2	23	1.3	1
396	21.0	9.2	10	11.0	12	9.1	10	20.8	23	27.0	29	14.5	16	0.8	1
394	19.0	8.9	11	9.7	12	9.0	11	23.7	29	24.5	30	5.7	7	0.3	0
392	17.5	8.8	12	9.6	13	10.7	15	22.9	32	18.8	26	1.0	1	0.0	0
390	15.5	9.0	14	10.6	17	14.2	23	18.5	29	10.1	16	0.5	1	0.0	0
388	13.5	9.3	17	11.7	22	17.8	33	14.1	26	1.3	2	0.1	0	0.0	0
386	11.5	11.8	28	9.4	22	11.5	27	8.7	21	0.8	2	0.0	0	0.0	0
384	9.0	14.4	47	7.2	24	5.3	18	3.3	11	0.3	1	0.0	0	0.0	0
382	7.0	12.7	64	4.9	25	1.8	9	0.4	2	0.0	0	0.0	0	0.0	0
380	4.5	6.9	65	2.6	24	1.0	9	0.2	2	0.0	0	0.0	0	0.0	0
378	2.5	1.0	74	0.2	17	0.1	8	0.0	1	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

STATION 1		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
398	24.0	5117
396	22.0	4324
394	19.5	3533
392	17.5	2746
390	16.0	1996
388	14.0	1301
386	12.0	714
384	9.5	351
382	7.5	120
380	5.0	8

STATION 2		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
398	23.5	1939
396	21.0	1556
394	19.5	1197
392	17.5	867
390	15.5	582
388	13.5	343
386	11.5	148
384	9.0	27
382	7.0	0

STATION 3		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
398	23.0	2676
396	20.5	2152
394	18.5	1669
392	17.0	1250
390	15.0	892
388	13.0	596
386	11.0	359
384	8.5	181
382	6.5	63
380	4.0	6
378	2.[illegible]	0

CALCULATIONS OF PROFILE CROSS SECTION

Table 3

Results of Calculations for

Side Channel Calico

SIDE CHANNEL LENGTH = 0.90 MILES = 1.45 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.07 MILES = 0.11 KILOMETERS = 375.09 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
388	25.0	417	2.5	37.5	1.9	2.9	475	43
386	22.5	353	2.5	33.8	1.9	3.1	506	47
384	20.0	289	2.5	30.1	1.9	3.2	551	52
382	18.0	233	2.4	26.5	1.9	3.4	600	59
380	16.0	186	2.4	22.9	1.8	3.6	650	67
378	14.0	139	2.4	19.4	1.7	3.8	734	78
376	11.5	109	2.4	16.3	1.6	4.3	794	93
374	9.5	78	2.4	13.2	1.5	4.7	901	114
372	7.5	55	2.2	10.4	1.4	4.9	1005	136
370	5.5	40	1.9	7.9	1.2	5.1	1038	158
368	3.0	25	1.7	5.3	1.0	5.2	1111	201
366	0.5	20	1.2	3.8	0.8	4.0	1022	194
364	-1.5	14	0.7	2.4	0.6	2.9	866	179
362	-3.5	11	0.4	1.5	0.4	2.2	732	164
360	<-3.5	9	0.3	1.2	0.3	2.1	728	171
358	"	6	0.3	0.9	0.1	1.9	721	184

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
388	25.0	3.7	10	3.2	9	3.4	9	7.0	19	7.6	21	5.9	16	5.7	15
386	22.5	3.5	11	3.6	11	3.1	9	6.7	20	6.9	21	5.2	16	4.0	12
384	20.0	3.3	11	4.1	14	2.8	9	6.4	22	6.3	21	4.4	15	2.4	8
382	18.0	3.1	12	4.1	16	2.7	10	5.9	23	5.6	21	3.4	13	1.4	6
380	16.0	3.0	13	3.6	16	2.7	12	5.2	23	4.8	21	2.0	9	1.2	5
378	14.0	2.9	15	3.2	17	2.8	15	4.6	24	4.1	21	0.7	4	0.9	5
376	11.5	2.8	17	2.9	18	2.5	15	4.0	25	2.7	17	0.5	3	0.8	5
374	9.5	2.7	20	2.5	19	2.1	16	3.4	26	1.4	10	0.4	3	0.7	5
372	7.5	2.5	24	2.2	21	1.7	16	2.6	25	0.6	6	0.3	3	0.6	6
370	5.5	2.2	27	2.1	26	1.1	13	1.6	19	0.4	5	0.2	3	0.5	6
368	3.0	1.8	33	1.9	34	0.5	8	0.5	9	0.3	5	0.2	4	0.4	7
366	0.5	1.2	31	1.3	31	0.3	9	0.4	10	0.3	6	0.2	6	0.3	7
364	-1.5	0.6	27	0.6	25	0.2	9	0.3	11	0.2	10	0.2	10	0.2	8
362	-3.5	0.3	20	0.2	16	0.1	10	0.2	14	0.2	16	0.2	15	0.1	9
360	<-3.5	0.2	18	0.2	14	0.1	10	0.2	16	0.2	20	0.2	16	0.1	6
358	"	0.1	14	0.1	11	0.1	10	0.2	21	0.2	27	0.1	16	0.0	1

CALCULATED DEPTH CLASS RANGES

STATION 1		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
388	25.0	8891
386	23.0	7671
384	21.0	6696
382	18.5	5896
380	16.0	5237
378	14.0	4731
376	12.0	4250
374	10.0	3793
372	7.5	3361
370	5.5	2953
368	3.0	2570
366	0.5	2211
364	-1.5	1878
362	-3.5	1567
360	<-3.5	1279
358	"	1015
356	"	773
354	"	554
352	"	358
350	"	185
348	"	35

STATION 2		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
388	25.0	1754
386	22.5	1386
384	20.0	1040
382	18.0	717
380	16.0	439
378	14.0	213
376	11.5	49

STATION 3		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
388	25.0	858
386	22.5	690
384	20.0	530
382	18.0	377
380	16.0	233
378	13.5	113
376	11.5	36
374	9.5	2

CALCULATIONS OF PROFILE CROSS SECTION

Table 4

Results of Calculations for Side Channel Osborne

A. Side Channel Osborne

SIDE CHANNEL LENGTH = 1.72 MILES = 2.76 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.14 MILES = 0.23 KILOMETERS = 752.06 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
383	21.0	2149	4.8	140.8	3.8	2.9	346	22
381	18.5	1878	4.8	133.7	2.8	3.0	376	23
379	16.5	1606	4.8	126.6	1.8	3.0	416	24
377	14.5	1351	4.8	119.9	1.9	3.1	469	26
375	12.0	1114	4.9	113.8	3.3	3.3	539	28
373	10.0	877	5.0	107.6	4.7	3.4	648	30
371	8.0	686	5.0	94.1	6.2	3.7	725	34
369	5.5	495	5.0	80.7	7.7	4.0	860	40
367	3.5	348	4.6	65.2	8.1	4.1	990	45
365	1.0	242	3.7	47.6	7.6	3.9	1038	50
363	-1.5	137	2.9	30.1	7.0	3.7	1159	61
361	-3.0	102	2.2	21.3	5.1	3.3	1105	65
359	<-3.5	67	1.4	12.5	3.3	2.9	994	73
357	"	43	1.0	7.3	1.9	2.6	882	85
355	"	32	0.8	5.5	1.2	2.4	895	90
353	"	21	0.6	3.7	0.4	2.1	922	100
351	"	16	0.4	2.7	0.4	1.8	865	101
349	"	12	0.3	1.7	0.3	1.4	761	102
347	"	8	0.2	1.1	0.2	1.2	687	106
345	"	6	0.2	0.9	0.1	1.2	741	111
343	"	5	0.1	0.7	0.0	1.1	837	117
341	"	3	0.1	0.6	0.0	1.1	946	127
339	"	2	0.1	0.5	0.0	1.1	1165	141
337	"	1	0.1	0.4	0.0	1.1	1502	160
335	"	1	0.1	0.3	0.0	1.2	1996	187
333	"	0	0.1	0.2	0.0	1.2	5791	241

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

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A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
383	21.0	7.0	5	7.6	5	6.1	4	12.5	9	34.6	24	45.1	31	31.2	22
381	18.5	6.6	5	7.0	5	6.6	5	19.7	14	38.8	28	36.0	26	22.3	16
379	16.5	6.2	5	6.5	5	7.1	5	27.0	21	43.0	33	26.9	21	13.4	10
377	14.5	6.6	5	8.2	7	9.5	8	31.8	26	40.6	33	18.8	15	7.9	6
375	12.0	7.9	7	12.1	10	13.5	12	34.4	29	31.4	27	11.9	10	5.9	5
373	10.0	9.2	8	16.0	14	17.6	16	36.9	33	22.3	20	5.0	5	3.9	4
371	8.0	12.6	13	17.4	18	16.4	17	28.4	29	15.4	16	4.0	4	2.9	3
369	5.5	16.1	19	18.7	22	15.2	18	19.9	24	8.5	10	3.0	4	1.9	2
367	3.5	16.7	25	17.0	25	12.5	19	13.1	20	4.5	7	2.1	3	1.3	2
365	1.0	14.5	30	12.2	25	8.4	17	8.2	17	3.5	7	1.4	3	1.0	2
363	-1.5	12.4	40	7.5	24	4.2	13	3.3	11	2.5	8	0.6	2	0.8	3
361	-3.0	8.6	38	5.1	23	3.0	13	2.7	12	1.7	8	0.5	2	0.7	3
359	<-3.5	4.8	36	2.7	20	1.8	13	2.2	16	1.0	8	0.4	3	0.5	4
357	"	2.5	32	1.4	18	1.1	14	1.6	20	0.6	7	0.3	4	0.4	5
355	"	1.8	30	1.2	20	0.9	16	1.0	16	0.5	8	0.3	5	0.3	5
353	"	1.1	27	0.9	24	0.8	19	0.3	9	0.3	9	0.3	7	0.2	5
351	"	0.8	27	0.6	22	0.5	18	0.3	11	0.3	11	0.2	8	0.1	4
349	"	0.5	27	0.3	17	0.3	14	0.3	15	0.3	14	0.2	10	0.1	3
347	"	0.3	26	0.2	13	0.1	11	0.3	19	0.2	19	0.1	11	0.0	1
345	"	0.2	23	0.2	15	0.1	13	0.2	22	0.2	20	0.1	7	0.0	1
343	"	0.1	17	0.1	17	0.1	16	0.2	26	0.2	21	0.0	2	0.0	0
341	"	0.1	20	0.1	19	0.1	17	0.2	27	0.1	17	0.0	2	0.0	0
339	"	0.1	24	0.1	21	0.1	18	0.1	28	0.0	9	0.0	1	0.0	0
337	"	0.1	28	0.1	24	0.1	18	0.1	26	0.0	4	0.0	0	0.0	0
335	"	0.1	33	0.1	28	0.1	18	0.1	19	0.0	2	0.0	0	0.0	0
333	"	0.1	43	0.1	37	0.0	18	0.0	3	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

STATION 1		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
383	22.0	11602
381	19.0	10299
379	17.0	9044
377	14.5	7874
375	12.5	6756
373	10.5	5671
371	8.5	4619
369	6.0	3600
367	4.0	2613
365	1.0	1659
363	-1.0	787
361	-3.0	352
359	-3.5	83

STATION 2		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
383	21.0	14726
381	18.5	13356
379	16.5	12036
377	14.5	10767
375	12.0	9538
373	10.0	8344
371	8.0	7184
369	5.5	6060
367	3.5	5019
365	1.0	4092
363	-1.5	3348
361	-3.0	2705
359	<-3.5	2111
357	"	1571
355	"	1084
353	"	654
351	"	297
349	"	50
347	"	0

STATION 3		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
383	20.5	7910
381	18.5	6886
379	16.0	5915
377	14.0	4993
375	12.0	4196
373	9.5	3484
371	7.5	2823
369	5.5	2213
367	3.0	1654
365	0.5	1164
363	-2.0	779
361	-3.5	481
359	<-3.5	265
357	"	116
355	"	27
353	"	0

CALCULATIONS OF PROFILE CROSS SECTION

(Continued)

Table 4 (Continued)

B. Side Channel Osborne, Pool 1

SIDE CHANNEL LENGTH = 1.72 MILES = 2.76 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.14 MILES = 0.23 KILOMETERS = 752.06 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
383	21.0	2149	4.8	140.8	3.8	2.9	346	22
381	18.5	1878	4.8	133.7	3.6	3.0	376	23
379	16.5	1606	4.8	126.6	3.4	3.0	416	24
377	14.5	1351	4.8	120.0	3.2	3.1	469	26
375	12.0	1114	4.8	113.9	3.0	3.2	540	27
373	10.0	877	4.9	107.8	2.8	3.4	650	29

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT
L = SHORELINE LENGTH, MILES
A = WATER SURFACE AREA, ACRES
DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT
D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$
A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE
L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
383	21.0	7.0	5	7.6	5	6.1	4	12.5	9	34.6	24	45.1	31	31.2	22
381	18.5	6.6	5	7.0	5	6.6	5	19.7	14	38.8	28	36.0	26	22.3	16
379	16.5	6.2	5	6.5	5	7.1	5	27.0	21	43.0	33	26.9	21	13.4	10
377	14.5	6.6	5	8.2	7	9.5	8	31.8	26	40.6	33	18.8	15	7.9	6
375	12.0	7.9	7	12.1	10	13.5	12	34.4	29	31.4	27	11.9	10	5.9	5
373	10.0	9.2	8	16.0	14	17.6	16	36.9	33	22.3	20	5.0	5	3.9	4

CALCULATED DEPTH CLASS RANGES

(Continued)

Table 4 (Continued)

C. Side Channel Osborne, Pool 2

SIDE CHANNEL LENGTH = 0.31 MILES = 0.50 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.15 MILES = 0.23 KILOMETERS = 770.00 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
373	10.0	261	1.0	23.6	0.4	1.5	479	27
371	8.0	216	1.1	22.0	0.9	1.7	537	32
369	5.5	172	1.2	20.3	1.4	1.9	624	38
367	3.5	134	1.2	17.9	1.7	2.0	706	43
365	1.0	102	1.1	14.7	1.7	2.1	760	48
363	-1.5	70	1.0	11.4	1.7	2.1	865	56
361	-3.0	55	0.8	8.6	1.4	1.9	827	58
359	<-3.5	39	0.5	5.7	1.1	1.6	760	62
357	"	29	0.4	3.8	0.8	1.5	694	68
355	"	23	0.3	2.9	0.5	1.4	672	75
353	"	17	0.3	2.0	0.2	1.4	633	89
351	"	14	0.2	1.7	0.2	1.3	642	93
349	"	11	0.2	1.3	0.1	1.3	657	100
347	"	8	0.2	1.1	0.1	1.2	687	106
345	"	6	0.2	0.9	0.1	1.2	741	111
343	"	5	0.1	0.7	0.1	1.1	837	117
341	"	3	0.1	0.6	0.1	1.1	946	127
339	"	2	0.1	0.5	0.0	1.1	1165	141
337	"	1	0.1	0.4	0.0	1.1	1502	160
335	"	1	0.1	0.3	0.0	1.2	1996	187
333	"	0	0.1	0.2	0.0	1.2	5791	241

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
		ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
373	10.0	1.0	4	1.6	7	3.0	12	6.6	27	7.3	30	2.5	10	2.1	9
371	8.0	1.7	8	2.2	10	3.6	16	5.9	26	5.4	24	1.8	8	1.8	8
369	5.5	2.4	12	2.7	13	4.3	21	5.3	25	3.5	17	1.2	6	1.4	7
367	3.5	3.0	16	2.8	15	4.1	23	4.3	23	2.2	12	0.8	4	1.1	6
365	1.0	3.4	23	2.5	17	3.1	21	2.9	19	1.5	10	0.6	4	1.0	6
363	-1.5	3.9	33	2.2	19	2.1	18	1.6	13	0.9	7	0.4	4	0.8	7
361	-3.0	2.9	32	1.6	18	1.5	17	1.2	13	0.7	8	0.4	4	0.7	7
359	<-3.5	1.9	32	1.0	17	0.9	15	0.8	13	0.5	9	0.4	6	0.5	9
357	"	1.2	30	0.6	16	0.5	13	0.6	14	0.4	10	0.3	8	0.4	10
355	"	0.9	28	0.5	15	0.4	12	0.5	15	0.4	12	0.3	9	0.3	9
353	"	0.5	23	0.3	14	0.2	10	0.3	16	0.3	16	0.3	13	0.2	9
351	"	0.4	21	0.2	14	0.2	11	0.3	18	0.3	17	0.2	13	0.1	7
349	"	0.2	17	0.2	14	0.2	12	0.3	20	0.3	20	0.2	13	0.1	4
347	"	0.2	15	0.2	15	0.1	13	0.3	22	0.2	22	0.1	12	0.0	1
345	"	0.2	16	0.2	16	0.1	14	0.2	24	0.2	22	0.1	8	0.0	1
343	"	0.1	17	0.1	17	0.1	16	0.2	26	0.2	21	0.0	2	0.0	0
341	"	0.1	20	0.1	19	0.1	17	0.2	27	0.1	17	0.0	2	0.0	0
339	"	0.1	24	0.1	21	0.1	18	0.1	28	0.0	9	0.0	1	0.0	0
337	"	0.1	28	0.1	24	0.1	18	0.1	26	0.0	4	0.0	0	0.0	0
335	"	0.1	33	0.1	28	0.1	18	0.1	19	0.0	2	0.0	0	0.0	0
333	"	0.1	43	0.1	37	0.0	18	0.0	3	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

(Continued)

Table 4 (Continued)

D. Side Channel Osborne, Pool 3

SIDE CHANNEL LENGTH = 1.41 MILES = 2.26 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.13 MILES = 0.21 KILOMETERS = 704.00 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
373	10.0	612	4.0	84.0	4.0	3.1	724	30
371	8.0	467	3.8	76.0	4.0	3.1	859	32
369	5.5	322	3.7	68.0	4.0	3.2	1117	35

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
373	10.0	8.1	9	14.3	17	14.6	17	30.0	35	15.0	17	2.5	3	1.8	2
371	8.0	10.9	15	15.1	20	12.7	17	22.2	30	10.0	13	2.1	3	1.1	2
369	5.5	13.6	22	15.8	25	10.9	17	14.5	23	5.0	8	1.8	3	0.5	1

CALCULATED DEPTH CLASS RANGES

(Continued)

Table 4 (Continued)

E. Side Channel Osborne, Pool 4

SIDE CHANNEL LENGTH = 0.38 MILES = 0.61 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.13 MILES = 0.20 KILOMETERS = 671.00 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
368	4.5	117	1.1	19.4	2.2	1.8	874	36
366	2.5	87	1.0	15.6	2.1	1.9	944	41
364	-0.5	57	0.9	11.7	2.0	2.0	1087	51
362	-2.5	36	0.8	8.4	1.8	1.9	1224	59
360	<-3.5	25	0.6	5.6	1.5	1.7	1178	63
358	"	14	0.3	2.8	1.1	1.4	1060	76
356	"	10	0.3	2.2	0.8	1.3	1168	81
354	"	6	0.2	1.6	0.5	1.3	1415	88

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT
L = SHORELINE LENGTH, MILES
A = WATER SURFACE AREA, ACRES
DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT
D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$
A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE
L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
368	4.5	3.0	15	4.3	22	4.4	23	4.9	25	1.5	8	1.2	6	0.2	1
366	2.5	3.5	22	3.5	22	3.0	19	3.4	21	1.4	9	0.8	5	0.1	1
364	-0.5	4.0	33	2.7	23	1.7	14	1.9	16	1.3	11	0.4	3	0.0	0
362	-2.5	3.5	41	2.0	23	0.9	10	1.1	13	1.0	12	0.2	2	0.0	0
360	<-3.5	2.2	37	1.3	22	0.6	11	1.1	18	0.6	11	0.1	1	0.0	0
358	"	0.8	27	0.5	18	0.4	13	1.0	35	0.2	7	0.0	0	0.0	0
356	"	0.6	27	0.5	22	0.5	19	0.6	26	0.1	5	0.0	0	0.0	0
354	"	0.5	28	0.5	28	0.5	30	0.2	12	0.0	2	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

(Continued)

Table 4 (Concluded)

F. Side Channel Osborne, Pool 5

SIDE CHANNEL LENGTH = 1.03 MILES = 1.65 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.14 MILES = 0.22 KILOMETERS = 724.00 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
368	4.5	131	2.7	35.0	7.1	3.2	1407	49
366	2.5	89	2.0	24.5	5.1	2.9	1456	52
364	-0.5	47	1.3	14.1	3.2	2.5	1594	60
362	-2.5	21	0.8	7.3	2.0	2.3	1835	74
360	-3.5	12	0.6	4.2	1.4	2.2	1831	87
358	"	3	0.3	1.1	0.8	2.0	1801	173
356	"	2	0.2	0.8	0.6	1.7	2012	175
354	"	1	0.1	0.5	0.3	1.4	2713	180

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
368	4.5	11.6	32	11.8	33	5.5	15	5.8	16	1.0	3	0.3	1	0.0	0
366	2.5	8.7	34	8.3	33	3.7	15	3.7	15	0.7	3	0.2	1	0.0	0
364	-0.5	5.8	39	4.7	32	2.0	14	1.6	11	0.5	3	0.1	0	0.0	0
362	-2.5	3.6	47	2.4	31	0.9	12	0.5	7	0.3	4	0.0	0	0.0	0
360	<-3.5	2.1	47	1.3	29	0.5	12	0.4	9	0.1	3	0.0	0	0.0	0
358	"	0.6	49	0.2	19	0.2	13	0.3	20	0.0	0	0.0	0	0.0	0
356	"	0.5	49	0.2	23	0.1	11	0.2	17	0.0	0	0.0	0	0.0	0
354	"	0.3	50	0.2	34	0.0	6	0.1	10	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

Table 5

Results of Calculations for

Side Channel Harlow

SIDE CHANNEL LENGTH = 0.75 MILES = 1.21 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.11 MILES = 0.18 KILOMETERS = 579.22 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
383	22.5	535	2.2	55.2	1.4	2.1	544	25
381	20.5	432	2.3	50.4	2.9	2.3	616	29
379	18.5	330	2.4	45.6	4.3	2.5	731	33
377	16.0	247	2.3	38.9	4.9	2.7	832	39
375	14.0	184	2.2	30.2	4.4	2.9	867	46
373	11.5	121	2.0	21.5	4.0	3.1	938	60
371	9.5	97	1.5	15.7	3.1	2.6	855	61
369	7.5	73	1.0	9.9	2.1	2.2	716	64
367	5.5	55	0.7	6.4	1.4	1.8	606	66
365	3.0	45	0.5	5.2	0.8	1.6	609	63
363	0.0	35	0.4	4.1	0.2	1.3	613	59
361	-2.0	28	0.4	3.6	0.2	1.4	674	67
359	<-3.5	21	0.4	3.0	0.2	1.5	778	78
357	"	15	0.3	2.5	0.2	1.5	902	87
355	"	11	0.3	2.1	0.2	1.5	1029	91
353	"	6	0.2	1.6	0.2	1.4	1332	99
351	"	4	0.2	1.2	0.2	1.7	1605	130
349	"	2	0.3	0.9	0.2	2.0	2571	187

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

STATION 1		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
383	23.0	5809
381	21.0	4493
379	18.5	3202
377	16.0	2103
375	14.0	1284
373	12.0	594
371	10.0	156
369	7.5	0

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
383	22.5	3.6	6	3.9	7	11.4	20	15.8	28	14.2	25	3.1	5	4.1	7
381	20.5	6.2	12	5.3	10	10.6	21	13.1	26	9.7	19	2.3	5	3.6	7
379	18.5	8.8	19	6.6	14	9.9	22	10.5	23	5.3	12	1.6	3	3.1	7
377	16.0	9.9	25	6.6	17	8.2	21	7.7	20	2.7	7	1.2	3	2.7	7
375	14.0	9.4	31	5.1	17	5.6	19	4.7	16	2.0	7	1.2	4	2.2	7
373	11.5	8.9	42	3.5	17	3.0	14	1.8	8	1.2	6	1.2	6	1.7	8
371	9.5	6.1	39	2.5	16	2.1	13	1.4	9	1.2	8	1.1	7	1.3	8
369	7.5	3.2	32	1.4	14	1.2	12	1.1	11	1.2	12	1.1	11	0.9	9
367	5.5	1.6	24	0.8	12	0.7	10	0.9	14	1.2	18	1.0	15	0.5	8
365	3.0	1.1	20	0.6	11	0.6	11	0.9	18	1.1	21	0.8	15	0.3	5
363	0.0	0.6	14	0.4	11	0.5	12	1.0	23	1.0	25	0.6	16	0.0	0
361	-2.0	0.5	15	0.5	13	0.4	12	0.9	25	0.9	24	0.4	11	0.0	0
359	<-3.5	0.5	17	0.5	16	0.4	12	0.9	28	0.7	23	0.1	4	0.0	0
357	"	0.5	18	0.5	18	0.4	14	0.8	29	0.5	19	0.0	0	0.0	0
355	"	0.4	20	0.5	21	0.4	19	0.6	28	0.3	12	0.0	0	0.0	0
353	"	0.4	22	0.4	26	0.4	26	0.4	26	0.0	0	0.0	0	0.0	0
351	"	0.4	29	0.4	28	0.3	22	0.3	21	0.0	0	0.0	0	0.0	0
349	"	0.4	42	0.3	32	0.1	15	0.1	10	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

STATION 2		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
383	22.5	13595
381	20.5	12163
379	18.5	10801
377	16.0	9500
375	14.0	8259
373	11.5	7079
371	9.5	5967
369	7.5	4926
367	5.5	3954
365	3.0	3053
363	0.0	2256
361	-2.0	1608
359	-3.5	1093
357	<-3.5	695
355	"	416
353	"	224
351	"	89
349	"	15
347	"	0

CALCULATIONS OF PROFILE CROSS SECTION

Table 6

Results of Calculations for Side Channel Fort Chartres

A. Side Channel Fort Chartres

SIDE CHANNEL LENGTH = 1.91 MILES = 3.07 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.11 MILES = 0.17 KILOMETERS = 562.00 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
383	28.0	2816	5.3	165.2	3.1	3.0	310	21
381	26.0	2524	5.5	159.4	2.8	3.1	334	22
379	24.0	2231	5.7	153.7	2.6	3.3	364	24
377	21.0	1953	5.8	148.3	2.4	3.4	401	25
375	19.0	1687	5.9	143.3	2.4	3.5	448	26
373	17.0	1422	6.1	138.3	2.4	3.7	514	28
371	15.0	1189	6.0	133.1	2.4	3.7	591	29
369	13.0	957	6.0	127.8	2.3	3.8	705	30
367	10.5	747	6.0	121.4	3.9	3.9	859	32
365	8.5	559	6.1	113.9	7.2	4.1	1076	34
363	6.5	371	6.1	106.4	10.5	4.2	1514	37
361	4.0	264	4.9	75.8	10.8	4.2	1513	42
359	1.5	158	3.7	45.2	11.0	4.1	1510	53
357	-1.0	90	2.7	25.5	9.2	3.8	1501	68
355	-3.0	60	1.8	16.8	5.5	3.1	1484	70
353	<-3.5	30	0.9	8.1	1.7	2.4	1432	75
351	"	21	0.9	6.3	1.4	2.5	1560	86
349	"	13	0.8	4.5	1.0	2.6	1863	108
347	"	7	0.6	2.9	0.7	2.5	2229	130
345	"	4	0.4	1.6	0.6	2.1	2158	143
343	"	1	0.1	0.3	0.5	1.7	1654	272

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/(2(\pi A)^{1/2})$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
383	28.0	5.7	4	4.9	3	5.3	3	12.1	8	16.8	11	26.6	17	81.3	53
381	26.0	5.7	4	5.4	4	5.6	4	12.8	9	20.7	14	37.2	25	60.1	41
379	24.0	5.7	4	5.8	4	6.0	4	13.4	9	24.6	17	47.8	34	38.9	27
377	21.0	5.8	4	6.2	5	6.6	5	15.5	11	31.9	23	46.8	34	23.9	17
375	19.0	6.0	5	6.5	5	7.3	6	18.9	14	42.5	33	34.4	26	15.1	12
373	17.0	6.2	5	6.7	5	8.1	6	22.4	18	53.1	43	21.9	18	6.4	5
371	15.0	7.3	6	8.4	7	10.7	9	31.5	27	40.6	34	14.6	12	4.9	4
369	13.0	8.4	8	10.1	9	13.3	12	40.7	37	28.1	25	7.3	7	3.4	3
367	10.5	11.0	11	13.5	13	15.0	15	39.3	38	18.2	18	3.3	3	2.3	2
365	8.5	15.2	17	18.6	20	15.6	17	27.4	30	10.9	12	2.6	3	1.6	2
363	6.5	19.4	24	23.7	29	16.3	20	15.5	19	3.6	4	1.9	2	0.8	1
361	4.0	15.9	26	17.7	29	11.2	19	10.4	17	3.0	5	1.5	2	0.5	1
359	1.5	12.4	33	11.6	30	6.1	16	5.3	14	2.3	6	1.0	3	0.2	0
357	-1.0	8.8	[illegible]	7.1	30	3.1	13	2.4	10	1.7	7	0.6	3	0.0	0
355	-3.0	5.2	35	4.2	28	2.2	15	1.9	13	1.2	8	0.3	2	0.0	0
3[illegible]	<-3.5	1.6	[illegible]	1.3	21	1.3	20	1.4	21	0.8	12	0.0	0	0.0	0
351	"	1.4	28	1.0	21	1.0	20	1.0	21	0.5	9	0.0	0	0.0	0
349	"	1.2	33	0.8	22	0.7	20	0.7	20	0.2	5	0.0	0	0.0	0
347	"	0.9	[illegible]	0.5	23	0.4	19	0.4	18	0.0	0	0.0	0	0.0	0
345	"	0.7	[illegible]	0.4	26	0.2	15	0.2	13	0.0	0	0.0	0	0.0	0
343	"	0.5	[illegible]	0.3	32	0.0	3	0.0	0	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

STATION 1		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
383	28.0	12296
381	26.0	11121
379	24.0	9980
377	22.5	8873
375	19.5	7800
373	17.5	6756
371	15.5	5736
369	13.0	4757
367	11.0	3824
365	9.0	2936
363	6.5	2093
361	4.5	1297
359	2.0	615
357	-0.5	130
355	-3.0	0

STATION 2		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
383	28.0	10266
381	26.0	9169
379	24.0	8129
377	21.0	7146
375	19.5	6215
373	17.5	5329
371	15.0	4491
369	13.0	3702
367	11.0	2961
365	8.5	2270
363	6.5	1631
361	4.0	1055
359	1.5	553
357	-1.0	146
355	-3.0	0

STATION 3		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
383	27.5	6883
381	25.5	6090
379	23.0	5322
377	21.0	4649
375	19.0	4004
373	16.5	3376
371	14.5	2779
369	12.5	2217
367	10.0	1692
365	8.0	1202
363	5.5	747
361	3.5	336
359	0.5	31

CALCULATIONS OF PROFILE CROSS SECTION

(Continued)

(Sheet 1 of 4)

Table 6 (Continued)

B. Side Channel Fort Chartres, Pool 1

SIDE CHANNEL LENGTH = 1.91 MILES = 3.07 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.11 MILES = 0.17 KILOMETERS = 562.00 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
383	28.0	2816	5.3	165.2	3.0	3.0	310	21
381	26.0	2524	5.5	159.3	3.0	3.1	333	22
379	24.0	2231	5.6	153.3	3.0	3.2	363	23

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
383	28.0	5.7	4	4.9	3	5.3	3	12.1	8	16.8	11	26.6	17	81.3	53
381	26.0	5.7	4	5.4	4	5.6	4	12.8	9	20.7	14	37.2	25	60.1	41
379	24.0	5.7	4	5.8	4	6.0	4	13.4	9	24.6	17	47.8	34	38.9	27

CALCULATED DEPTH CLASS RANGES

(Continued)

Table 6 (Continued)

C. Side Channel Fort Chartres, Pool 2

SIDE CHANNEL LENGTH = 0.63 MILES = 1.00 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.06 MILES = 0.10 KILOMETERS = 327.50 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
378	23.0	433	1.8	33.2	1.0	2.3	405	36
376	21.0	373	1.9	31.1	1.0	2.4	441	39
374	18.0	312	1.9	29.0	0.9	2.5	490	42
372	16.0	256	1.9	26.8	1.0	2.6	552	46
370	14.0	204	1.8	24.5	1.1	2.7	633	48
368	11.5	152	1.8	22.2	1.3	2.7	768	52
366	9.5	112	1.8	19.0	1.5	3.0	893	60
364	7.5	72	1.8	15.7	1.7	3.3	1156	73
362	5.0	42	1.5	11.4	2.1	3.0	1443	82
360	2.5	22	0.8	6.0	2.7	2.1	1454	85
358	0.0	2	0.1	0.5	3.3	1.3	1731	158

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
378	23.0	1.8	6	1.7	5	1.7	5	3.4	10	7.0	22	14.0	43	2.8	9
376	21.0	1.8	6	1.7	6	1.7	6	4.4	14	9.8	32	9.5	31	1.7	5
374	18.0	1.7	6	1.7	6	1.8	6	5.5	19	12.6	44	5.0	17	0.6	2
372	16.0	1.7	6	1.9	7	2.3	8	7.2	26	11.8	43	2.2	8	0.0	0
370	14.0	1.9	8	2.4	9	3.3	13	9.5	37	7.3	29	1.1	4	0.0	0
368	11.5	2.1	9	2.8	12	4.3	18	11.8	49	2.8	12	0.0	0	0.0	0
366	9.5	3.0	14	4.0	19	5.1	24	7.3	35	1.7	8	0.0	0	0.0	0
364	7.5	3.9	21	5.1	28	5.8	32	2.9	16	0.6	3	0.0	0	0.0	0
362	5.0	3.9	28	4.6	33	4.9	35	0.6	4	0.0	0	0.0	0	0.0	0
360	2.5	3.2	38	2.5	30	2.5	29	0.3	3	0.0	0	0.0	0	0.0	0
358	0.0	2.4	86	0.4	13	0.0	1	0.0	0	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

(Continued)

Table 6 (Concluded)

D. Side Channel Fort Chartres, Pool 3

SIDE CHANNEL LENGTH = 1.27 MILES = 2.05 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.13 MILES = 0.20 KILOMETERS = 666.00 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
378	23.0	1644	3.9	117.6	1.4	2.6	378	21
376	21.0	1441	4.0	114.7	1.3	2.7	420	22
374	18.0	1238	4.1	111.8	1.2	2.8	477	23
372	16.0	1046	4.1	108.9	1.1	2.8	550	24
370	14.0	867	4.2	106.0	1.0	2.9	646	25
368	11.5	687	4.2	103.0	1.0	3.0	792	26
366	9.5	540	4.2	98.7	3.8	3.1	965	28
364	7.5	393	4.3	94.4	6.7	3.1	1269	29
362	5.0	276	4.0	79.7	8.4	3.4	1524	32
360	2.5	190	3.5	54.5	9.0	3.7	1518	42
358	0.0	103	3.0	29.4	9.6	4.0	1502	66
356	-2.0	74	2.2	20.9	6.5	3.4	1491	68
354	<-3.5	45	1.4	12.4	3.4	2.7	1465	71
352	"	26	0.9	7.2	1.7	2.4	1485	80
350	"	17	0.8	5.4	1.2	2.6	1673	95
348	"	8	0.7	3.6	0.8	2.7	2246	126
346	"	5	0.5	2.3	0.7	2.3	2203	134
344	"	2	0.2	1.0	0.6	1.9	2058	163

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
		ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
378	23.0	3.8	4	4.3	4	4.5	4	10.2	10	19.3	18	38.9	37	25.5	24
376	21.0	4.1	4	4.5	4	5.2	5	12.5	12	27.1	27	31.0	30	17.8	17
374	18.0	4.4	4	4.8	5	5.9	6	14.9	15	35.0	36	23.1	24	10.2	10
372	16.0	5.0	5	5.5	6	7.0	7	19.5	21	34.9	37	16.0	17	5.6	6
370	14.0	5.8	7	6.7	8	8.6	10	26.5	30	27.0	30	9.8	11	4.2	5
368	11.5	6.7	8	8.0	10	10.2	12	33.4	40	19.1	23	3.6	4	2.7	3
366	9.5	10.0	13	12.0	16	10.2	13	25.9	34	12.9	17	3.0	4	1.9	3
364	7.5	13.3	19	16.0	24	10.2	15	18.5	27	6.7	10	2.3	3	1.2	2
362	5.0	13.6	24	16.1	28	8.9	16	12.4	22	3.3	6	1.7	3	0.6	1
360	2.5	10.9	27	12.2	30	6.2	15	7.6	18	2.6	6	1.2	3	0.3	1
358	0.0	8.3	32	8.2	32	3.6	14	2.7	11	1.9	8	0.8	3	0.0	0
356	-2.0	5.6	31	5.5	31	2.6	15	2.2	12	1.5	8	0.5	3	0.0	0
354	<-3.5	3.0	29	2.7	26	1.7	17	1.6	16	1.0	10	0.2	2	0.0	0
352	"	1.5	27	1.2	21	1.1	20	1.2	21	0.6	11	0.0	0	0.0	0
350	"	1.3	30	0.9	21	0.8	20	0.8	20	0.3	7	0.0	0	0.0	0
348	"	1.0	38	0.6	23	0.6	20	0.5	19	0.0	0	0.0	0	0.0	0
346	"	0.8	42	0.5	24	0.3	18	0.3	16	0.0	0	0.0	0	0.0	0
344	"	0.6	52	0.3	28	0.1	11	0.1	9	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

Table 7

Results of Calculations for

Side Channel Moro

SIDE CHANNEL LENGTH = 2.35 MILES = 3.78 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.24 MILES = 0.38 KILOMETERS = 1242.05 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
373	25.0	5662	7.3	372.7	2.6	2.7	348	12
371	22.5	4946	7.8	362.6	5.0	2.9	387	14
369	20.0	4230	8.4	352.6	7.4	3.2	440	15
367	18.5	3556	9.0	337.7	8.8	3.5	501	17
365	16.5	2924	9.4	318.0	9.3	3.8	574	19
363	14.5	2292	9.8	298.3	9.7	4.1	687	21
361	12.0	1766	10.0	273.6	15.8	4.3	818	23
359	10.0	1239	10.1	249.0	21.9	4.6	1061	26
357	7.5	816	9.5	203.1	25.1	4.9	1314	30
355	5.5	497	8.1	135.9	25.4	5.3	1443	38
353	3.0	178	6.7	68.6	25.7	5.7	2037	62
351	1.0	136	4.3	43.9	17.3	4.2	1710	62
349	-1.0	93	1.9	19.2	8.9	2.7	1088	64
347	-3.5	67	0.7	6.4	3.6	1.8	502	66
345	<-3.5	56	0.5	5.4	1.5	1.6	503	63
343	"	46	0.4	4.4	-.6	1.3	503	58
341	"	38	0.4	3.8	-.3	1.4	529	64
339	"	31	0.4	3.3	0.0	1.5	566	72
337	"	25	0.4	2.9	0.2	1.5	613	81
335	"	19	0.4	2.5	0.2	1.6	671	92
333	"	14	0.3	2.1	0.2	1.7	771	106
331	"	11	0.3	1.8	0.2	1.8	851	118
329	"	8	0.3	1.4	0.1	1.8	1002	135
327	"	5	0.3	1.2	0.1	1.9	1175	153
325	"	4	0.2	0.9	0.1	1.9	1288	173
323	"	2	0.2	0.6	0.1	1.9	1562	209

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
373	25.0	4.9	1	9.5	3	23.3	6	35.9	10	60.1	16	163.1	45	69.0	19
371	22.5	11.6	3	12.6	4	22.0	6	41.3	12	101.3	28	122.7	34	44.2	12
369	20.0	18.3	5	15.6	5	20.8	6	46.6	13	142.5	41	82.3	24	19.3	6
367	18.5	21.9	7	18.4	6	22.6	7	68.4	21	142.9	43	50.1	15	6.4	2
365	16.5	22.3	7	20.8	7	27.4	9	106.7	34	102.5	33	26.3	8	5.4	2
363	14.5	22.8	8	23.2	8	32.2	11	145.1	50	62.1	21	2.5	1	4.4	2
361	12.0	30.2	11	49.4	18	44.8	17	99.7	37	38.2	14	2.0	1	3.9	1
359	10.0	37.5	15	75.6	31	57.4	23	54.3	22	14.4	6	1.5	1	3.4	1
357	7.5	42.9	22	73.0	37	51.4	26	25.6	13	2.3	1	1.2	1	2.9	1
355	5.5	46.3	35	41.8	31	27.0	20	13.6	10	1.8	1	1.1	1	2.6	2
353	3.0	49.8	72	10.6	15	2.6	4	1.6	2	1.3	2	1.0	1	2.2	3
351	1.0	30.4	69	6.6	15	1.8	4	1.4	3	1.2	3	0.9	2	1.8	4
349	-1.0	11.1	57	2.7	14	1.0	5	1.1	6	1.0	5	0.9	4	1.5	8
347	-3.5	1.3	19	0.7	11	0.5	8	1.0	15	1.0	15	0.8	13	1.2	18
345	>-3.5	0.9	17	0.6	11	0.5	9	0.9	16	0.9	17	0.7	14	0.9	17
343	"	0.5	12	0.5	12	0.4	10	0.8	17	0.8	19	0.7	15	0.6	14
341	"	0.5	12	0.5	12	0.4	11	0.7	19	0.8	20	0.6	14	0.5	12
339	"	0.4	13	0.4	12	0.4	11	0.7	20	0.7	21	0.4	13	0.3	10
337	"	0.4	13	0.4	13	0.4	12	0.6	22	0.6	21	0.4	12	0.2	7
335	"	0.4	15	0.4	14	0.3	13	0.6	23	0.5	20	0.3	12	0.1	4
333	"	0.4	17	0.3	15	0.3	13	0.5	25	0.4	18	0.2	11	0.0	1
331	"	0.3	18	0.3	17	0.3	14	0.4	24	0.3	18	0.1	8	0.0	1
329	"	0.3	20	0.3	19	0.2	15	0.3	23	0.3	18	0.1	4	0.0	0
327	"	0.3	22	0.3	21	0.2	16	0.3	22	0.2	16	0.0	1	0.0	0
325	"	0.2	24	0.2	22	0.2	17	0.2	24	0.1	12	0.0	1	0.0	0
323	"	0.2	28	0.1	22	0.1	19	0.2	27	0.0	3	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

STATION 1		
RIVER STAGE FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
373	26.0	16997
371	23.0	15154
369	21.0	13334
367	18.5	11551
365	16.5	9885
363	14.5	8296
361	12.5	6489
359	10.0	4885
357	8.0	3229
355	5.5	1748
353	3.5	434
351	1.0	0

STATION 2		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
373	25.0	16885
371	22.5	14167
369	20.0	12346
367	18.0	10486
365	16.0	8647
363	14.0	6851
361	12.0	5177
359	9.5	3578
357	7.5	2184
355	5.0	945
353	3.5	469
351	0.5	172
349	-1.5	2
347	-3.5	0

STATION 3		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
373	25.0	28168
371	22.5	24975
369	20.0	21928
367	17.5	18707
365	15.5	15613
363	13.5	12539
361	11.5	9494
359	9.5	6498
357	7.0	3534
355	4.5	1332
353	2.5	0

CALCULATIONS OF PROFILE CROSS SECTION

Table 8

Results of Calculations for

Side Channel Kaskaskia

SIDE CHANNEL LENGTH = 2.48 MILES = 4.00 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.08 MILES = 0.13 KILOMETERS = 428.18 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
373	27.5	1839	6.7	140.5	1.5	4.0	403	30
371	26.0	1574	6.7	134.4	3.3	4.2	451	32
369	23.0	1308	6.8	128.4	5.1	4.3	518	34
367	21.0	1063	7.0	119.2	6.0	4.6	592	38
365	19.0	838	7.2	107.1	6.1	5.0	675	43
363	17.0	612	7.4	95.0	6.1	5.4	819	50
361	15.0	461	7.1	82.4	7.2	5.6	944	55
359	13.0	309	6.7	69.8	8.3	5.8	1192	62
357	10.5	197	5.6	53.4	8.4	5.3	1432	67
355	8.5	124	3.6	33.2	7.4	4.3	1411	69
353	6.0	52	1.6	13.0	6.4	3.2	1333	79
351	3.5	36	1.2	9.4	4.3	2.9	1384	84
349	1.5	20	0.9	5.9	2.2	2.6	1512	97
347	-1.0	10	0.6	3.4	1.0	2.6	1751	120
345	-3.0	6	0.5	2.2	0.5	2.7	2002	149
343	<-3.5	1	0.4	0.9	0.0	2.8	4184	254

CALCULATED PARAMETERS

DEFINITIONS

- V = WATER VOLUME, ACRE-FT
- L = SHORELINE LENGTH, MILES
- A = WATER SURFACE AREA, ACRES
- DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT
- D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$
- A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE
- L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

STATION 1		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
373	28.0	5188
371	26.0	4338
369	23.0	3554
367	21.0	2795
365	19.5	2087
363	17.5	1500
361	15.5	1005
359	13.0	592
357	11.0	246
355	8.5	14
353	6.5	0

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
373	27.5	5.2	4	5.5	4	9.3	7	24.3	17	32.9	24	48.2	35	13.5	10
371	26.0	7.4	6	7.4	6	12.7	10	24.0	18	39.0	29	32.6	25	9.8	7
369	23.0	9.7	8	9.3	7	16.1	13	23.8	19	45.1	36	17.0	13	6.2	5
367	21.0	11.8	10	10.2	9	17.5	15	26.8	23	40.4	34	8.0	7	3.7	3
365	19.0	13.7	13	9.9	9	16.8	16	33.2	31	24.8	23	5.6	5	2.4	2
363	17.0	15.7	17	9.7	10	16.2	17	39.6	42	9.2	10	3.2	3	1.1	1
361	15.0	15.9	19	14.9	18	14.8	18	26.0	32	6.8	8	2.3	3	0.7	1
359	12.5	16.1	24	20.1	29	13.4	20	12.5	18	4.4	6	1.5	2	0.3	0
357	10.5	14.0	27	18.7	36	10.7	21	5.0	10	2.8	5	0.9	2	0.0	0
355	8.0	9.5	29	10.6	32	6.8	21	3.5	11	1.9	6	0.5	1	0.0	0
353	6.0	5.1	37	2.6	19	2.8	21	2.0	15	1.1	8	0.1	0	0.0	0
351	3.5	3.8	39	1.9	19	1.9	20	1.5	15	0.7	7	0.0	0	0.0	0
349	1.5	2.6	42	1.2	20	1.1	18	1.0	16	0.3	4	0.0	0	0.0	0
347	-1.0	1.7	45	0.8	22	0.6	15	0.6	17	0.0	1	0.0	0	0.0	0
345	-3.0	1.1	46	0.6	25	0.4	15	0.3	13	0.0	1	0.0	0	0.0	0
343	<-3.5	0.6	50	0.4	35	0.2	14	0.0	2	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

STATION 2		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
373	27.5	7774
371	26.0	6973
369	23.0	6210
367	21.0	5489
365	19.0	4[illegible]10
363	17.0	4159
361	15.0	3538
359	12.5	2927
357	10.5	2346
355	8.0	1759
353	6.0	1269
351	3.5	826
349	1.5	477
347	-1.0	283
345	-3.0	64
343	<-3.5	1
341	"	0

CALCULATIONS OF PROFILE CROSS SECTION

Table 9

Results of Calculations for

Side Channel Crains

SIDE CHANNEL LENGTH = 1.72 MILES = 2.76 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.06 MILES = 0.10 KILOMETERS = 330.48 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
358	19.5	305	3.6	52.7	6.9	3.5	913	44
356	17.0	222	3.5	41.4	5.7	4.1	982	54
354	15.0	140	3.4	30.1	4.5	4.6	1131	73
352	13.0	82	3.2	21.3	3.4	5.0	1365	95
350	10.5	49	2.7	15.1	2.6	5.2	1636	116
348	8.5	15	2.3	8.8	1.8	5.5	3132	165
346	6.0	9	1.6	5.5	1.5	5.5	3239	186
344	3.5	3	0.9	2.2	1.1	5.5	3744	267

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
358	19.5	15.5	27	10.1	18	8.0	14	13.9	25	8.2	14	0.8	1	0.0	0
356	17.0	12.4	28	8.7	20	7.3	16	10.4	23	5.2	12	0.5	1	0.0	0
354	15.0	9.3	28	7.4	23	6.6	20	7.0	21	2.3	7	0.2	0	0.0	0
352	13.0	7.2	31	5.8	25	5.3	23	4.3	18	0.6	3	0.0	0	0.0	0
350	10.5	6.2	39	4.1	25	3.2	20	2.3	14	0.3	2	0.0	0	0.0	0
348	8.5	5.1	58	2.3	26	1.2	14	0.3	3	0.0	0	0.0	0	0.0	0
346	6.0	3.4	59	1.4	25	0.7	13	0.2	3	0.0	0	0.0	0	0.0	0
344	3.5	1.6	67	0.5	21	0.2	10	0.1	2	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

STATION 1		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
358	19.5	3279
356	17.5	2422
354	15.5	1710
352	13.0	1062
350	11.0	475
348	8.5	18
346	6.5	0

STATION 2		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
358	19.5	1519
356	17.0	1051
354	15.0	695
352	12.5	410
350	10.5	196
348	8.5	58
346	6.0	2

STATION 3		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
358	19.0	591
356	17.0	320
354	15.0	107
352	12.5	0

CALCULATIONS OF PROFILE CROSS SECTION

Table 10

Results of Calculations for Side Channel Liberty

A. Side Channel: Liberty

SIDE CHANNEL LENGTH = 2.81 MILES = 4.52 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.10 MILES = 0.16 KILOMETERS = 526.69 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
363	26.0	2838	7.9	184.0	7.6	4.2	342	27
361	24.0	2497	8.0	170.6	6.6	4.4	361	30
359	22.0	2156	8.0	157.2	5.6	4.6	385	33
357	21.0	1845	8.1	145.6	4.9	4.8	417	35
355	18.0	1561	8.1	135.8	4.6	5.0	459	38
353	16.0	1278	8.1	126.0	4.3	5.1	520	41
351	14.0	1046	8.0	117.0	4.8	5.3	590	44
349	12.0	814	7.9	108.0	5.4	5.4	701	47
347	9.5	610	7.7	96.1	6.5	5.6	832	51
345	7.0	434	7.3	81.3	8.3	5.9	990	58
343	5.0	258	6.9	66.5	10.0	6.1	1362	67
341	2.5	172	5.1	45.1	10.9	5.4	1386	72
339	0.0	86	3.2	23.7	11.9	4.8	1459	87
337	-2.0	35	2.0	11.0	10.3	4.4	1650	116
335	<-3.5	20	1.5	7.1	6.1	4.1	1846	133
333	"	5	0.9	3.1	2.0	3.8	3180	192

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

STATION 1		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
363	26.0	6313
361	24.0	5624
359	22.5	4940
357	21.0	4260
355	19.0	3586
353	16.5	3048
351	14.5	2537
349	12.5	2047
347	10.5	1580
345	8.0	1155
343	5.5	779
341	3.0	451
339	1.0	173
337	-1.5	14

STATION 2		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
363	26.0	10387
361	24.0	9212
359	22.0	8062
357	20.0	6939
355	18.5	5862
353	16.0	4828
351	14.0	3839
349	12.0	2901
347	9.5	2025
345	7.5	1219
343	5.0	536
341	2.5	135
339	0.0	0

STATION 3		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
363	25.0	6964
361	23.0	6187
359	21.0	5457
357	20.0	4780
355	18.0	4153
353	16.0	3563
351	13.5	3004
349	11.5	2476
347	9.5	1980
345	7.0	1515
343	4.5	1082
341	2.0	685
339	-0.5	357
337	-2.5	142
335	<-3.5	26

CALCULATIONS OF PROFILE CROSS SECTION

RIVER STAGE, FT.		DEPTH CLASS RANGES													
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
		ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
363	26.0	8.9	5	15.6	9	11.4	6	19.4	11	22.2	12	35.4	19	70.7	39
361	24.0	9.4	5	13.3	8	10.5	6	18.7	11	27.5	16	43.1	25	48.8	28
359	22.0	9.9	6	10.9	7	9.5	6	18.1	11	32.7	21	50.9	32	26.9	17
357	21.0	9.8	7	9.5	6	9.2	6	20.3	14	39.2	27	46.3	31	13.4	9
355	18.0	9.3	7	9.1	7	9.5	7	25.3	18	47.0	34	29.4	21	8.4	6
353	16.0	8.8	7	8.7	7	9.7	8	30.3	24	54.8	43	12.5	10	3.4	3
351	14.0	9.5	8	11.0	9	13.9	12	36.2	30	37.9	32	8.8	7	2.1	2
349	12.0	10.1	9	13.3	12	18.1	16	42.1	38	21.0	19	5.0	5	0.9	1
347	9.5	12.0	12	16.5	17	19.4	20	37.6	38	10.6	11	2.5	3	0.2	0
345	7.0	15.2	18	20.6	24	18.1	21	22.6	27	6.9	8	1.4	2	0.1	0
343	5.0	18.4	26	24.6	35	16.7	24	7.6	11	3.1	4	0.3	0	0.0	0
341	2.5	14.1	29	16.2	33	11.0	22	5.4	11	2.0	4	0.2	0	0.0	0
339	0.0	9.9	37	7.7	29	5.2	19	3.2	12	0.8	3	0.1	0	0.0	0
337	-2.0	6.6	49	3.0	22	2.0	15	1.7	12	0.2	2	0.0	0	0.0	0
335	<-3.5	4.2	50	2.0	24	1.2	14	0.9	10	0.1	1	0.0	0	0.0	0
333	"	1.8	55	1.0	30	0.4	13	0.1	3	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

(Continued)

Table 10 (Continued)

B. Side Channel: Liberty, Pool 1

SIDE CHANNEL LENGTH = 3.11 MILES = 5.00 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.11 MILES = 0.18 KILOMETERS = 577.00 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
363	26.0	2838	7.9	184.0	7.6	4.2	342	27
361	24.0	2497	8.0	170.6	6.9	4.4	361	30
359	22.0	2156	8.0	157.2	6.2	4.6	385	33
357	21.0	1845	8.1	145.6	5.4	4.8	417	35
355	18.0	1561	8.1	135.8	4.7	5.0	459	38
353	16.0	1278	8.1	126.0	4.0	5.1	520	41

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT
L = SHORELINE LENGTH, MILES
A = WATER SURFACE AREA, ACRES
DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT
D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$
A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE
L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
363	26.0	8.9	5	15.6	9	11.4	6	19.4	11	22.2	12	35.4	19	70.7	39
361	24.0	9.4	5	13.3	8	10.5	6	18.7	11	27.5	16	43.1	25	48.8	28
359	22.0	9.9	6	10.9	7	9.5	6	18.1	11	32.7	21	50.9	32	26.9	17
357	21.0	9.8	7	9.5	6	9.2	6	20.3	14	39.2	27	46.3	31	13.4	9
355	18.0	9.3	7	9.1	7	9.5	7	25.3	18	47.0	34	29.4	21	8.4	6
353	16.0	8.8	7	8.7	7	9.7	8	30.3	24	54.8	43	12.5	10	3.4	3

CALCULATED DEPTH CLASS RANGES

(Continued)

Table 10 (Continued)

C. Side Channel: Liberty, Pool 2

SIDE CHANNEL LENGTH = 0.45 MILES = 0.72 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.06 MILES = 0.10 KILOMETERS = 319.00 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
353	16.0	71	1.4	11.2	0.8	3.0	833	80
351	14.0	54	1.3	9.4	1.0	3.0	930	86
349	12.0	36	1.1	7.7	1.3	3.0	1119	95
347	9.5	23	0.9	5.8	1.3	2.7	1306	103
345	7.0	15	0.6	3.8	1.2	2.2	1317	106
343	5.0	7	0.3	1.7	1.1	1.7	1356	116
341	2.5	5	0.2	1.3	0.7	1.6	1400	124
339	0.0	3	0.2	0.8	0.4	1.4	1507	141

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT
L = SHORELINE LENGTH, MILES
A = WATER SURFACE AREA, ACRES
DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT
D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$
A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE
L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
353	16.0	1.6	15	1.5	14	1.6	15	3.9	37	1.5	14	0.5	4	0.1	1
351	14.0	1.7	18	1.8	19	1.5	16	2.8	30	1.1	12	0.3	4	0.1	1
349	12.0	1.7	22	2.0	26	1.4	19	1.6	21	0.7	9	0.2	2	0.0	0
347	9.5	1.5	26	1.8	31	1.2	20	0.9	15	0.4	7	0.1	2	0.0	0
345	7.0	1.2	29	1.1	28	0.8	20	0.6	15	0.3	7	0.1	1	0.0	0
343	5.0	0.8	39	0.5	22	0.4	18	0.3	15	0.1	5	0.0	1	0.0	0
341	2.5	0.6	40	0.3	22	0.3	17	0.2	15	0.1	5	0.0	1	0.0	0
339	0.0	0.4	43	0.2	24	0.1	15	0.1	14	0.0	4	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

(Continued)

Table 10 (Continued)

D. Side Channel: Liberty, Pool 3

SIDE CHANNEL LENGTH = 2.66 MILES = 4.28 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.12 MILES = 0.19 KILOMETERS = 620.00 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
353	16.0	1205	6.6	114.7	3.6	4.4	502	37
351	14.0	991	6.7	107.5	3.6	4.6	573	40
349	12.0	776	6.7	100.3	3.6	4.8	682	43

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT
L = SHORELINE LENGTH, MILES
A = WATER SURFACE AREA, ACRES
DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT
D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$
A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE
L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
353	16.0	7.2	6	7.2	6	8.1	7	26.3	22	53.1	45	12.1	10	3.2	3
351	14.0	7.8	7	9.2	8	12.3	11	33.4	30	36.7	33	8.4	8	2.0	2
349	12.0	8.4	8	11.3	11	16.6	16	40.4	39	20.3	20	4.8	5	0.8	1

CALCULATED DEPTH CLASS RANGES

(Continued)

Table 10 (Continued)

E. Side Channel: Liberty, Pool 4

SIDE CHANNEL LENGTH = 0.92 MILES = 1.49 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.12 MILES = 0.20 KILOMETERS = 656.00 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
348	10.5	114	2.4	25.3	2.3	3.4	1170	62
346	8.5	82	2.3	20.8	2.5	3.7	1348	71
344	6.0	49	2.2	16.4	2.7	4.0	1760	87
342	4.0	27	1.9	12.2	2.6	3.8	2365	99
340	1.5	15	1.3	8.1	2.3	3.2	2773	104
338	-1.0	4	0.8	4.1	1.9	2.7	5720	118
336	-3.0	3	0.6	3.0	1.4	2.6	6261	130
334	<-3.5	1	0.5	2.0	0.8	2.5	7795	155

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
348	10.5	2.4	12	3.9	19	5.2	25	7.0	34	1.9	9	0.2	1	0.1	0
346	8.5	3.0	18	3.8	22	4.3	25	4.6	27	1.2	7	0.2	1	0.0	0
344	6.0	3.6	27	3.6	27	3.3	25	2.1	16	0.6	4	0.1	1	0.0	0
342	4.0	3.4	35	2.9	30	2.3	24	0.7	8	0.2	2	0.0	0	0.0	0
340	1.5	2.4	41	1.6	27	1.2	21	0.4	8	0.1	2	0.0	0	0.0	0
338	-1.0	1.5	68	0.3	15	0.1	7	0.2	8	0.1	3	0.0	0	0.0	0
336	-3.0	0.9	66	0.2	16	0.1	8	0.1	8	0.0	3	0.0	0	0.0	0
334	<-3.5	0.4	58	0.1	19	0.1	14	0.0	7	0.0	2	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

(Continued)

Table 10 (Concluded)

F. Side Channel: Liberty, Pool 5

SIDE CHANNEL LENGTH = 1.74 MILES = 2.79 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.12 MILES = 0.19 KILOMETERS = 621.00 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
348	10.5	536	4.3	71.5	2.1	3.7	704	39
346	8.5	404	4.4	63.1	6.0	4.0	824	45
344	6.0	272	4.4	54.7	10.0	4.3	1062	52
342	4.0	171	3.8	42.1	11.7	4.3	1298	58
340	1.5	102	2.6	25.3	11.1	3.8	1312	66
338	-1.0	32	1.4	8.4	10.5	3.4	1388	105
336	-3.0	21	1.0	5.7	6.9	3.2	1469	117
334	<-3.5	9	0.7	3.0	3.2	3.0	1755	149

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
348	10.5	6.1	8	8.0	1[illegible]	13.4	18	36.8	48	9.6	13	2.3	3	0.2	0
346	8.5	9.1	13	13.0	19	13.4	20	24.4	36	6.6	10	1.4	2	0.1	0
344	6.0	12.1	20	18.0	30	13.3	22	12.1	20	3.7	6	0.6	1	0.0	0
342	4.0	12.1	26	16.9	36	11.0	23	5.0	11	1.8	4	0.1	0	0.0	0
340	1.5	8.9	30	9.8	33	6.4	22	3.2	11	1.0	3	0.1	0	0.0	0
338	-1.0	5.8	49	2.7	23	1.8	15	1.5	12	0.2	1	0.0	0	0.0	0
336	-3.0	4.0	50	1.9	23	1.2	15	0.9	11	0.1	1	0.0	0	0.0	0
334	>-3.5	2.3	52	1.1	26	0.6	13	0.3	8	0.0	1	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

(Sheet 6 of 6)

Table 11

Results of Calculations for

Side Channel Jones

SIDE CHANNEL LENGTH = 2.97 MILES = 4.77 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.12 MILES = 0.19 KILOMETERS = 630.34 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
358	24.0	2725	7.8	210.3	4.1	3.8	408	24
356	22.0	2329	7.7	199.9	4.2	3.9	453	25
354	20.0	1933	7.6	189.5	4.3	4.0	518	26
352	17.5	1569	7.5	176.9	5.6	4.1	595	27
350	15.5	1238	7.4	162.1	8.2	4.2	692	29
348	13.5	906	7.3	147.4	10.8	4.3	858	32
346	11.5	667	7.1	120.5	11.9	4.8	953	38
344	9.5	428	7.0	93.5	12.9	5.3	1153	48
342	7.0	261	6.2	68.9	12.3	5.4	1395	58
340	5.0	165	4.8	46.5	9.9	5.1	1492	66
338	2.5	68	3.4	24.1	7.5	4.9	1858	89
336	0.0	50	2.3	16.7	5.4	3.7	1769	87
334	-2.0	31	1.2	9.4	3.2	2.5	1576	81
332	<-3.5	18	0.6	5.0	1.9	1.8	1448	74
330	"	11	0.5	3.7	1.3	1.7	1811	78
328	"	3	0.3	2.5	0.6	1.5	3726	87

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
358	24.0	10.3	5	10.3	5	13.5	6	28.9	14	66.2	32	59.1	28	21.6	10
356	22.0	12.2	6	11.7	6	14.2	7	40.7	20	63.4	32	41.9	21	15.1	8
354	20.0	14.0	7	13.1	7	15.0	8	52.5	28	60.5	32	24.7	13	8.7	5
352	17.5	15.3	9	17.1	10	19.3	11	55.4	31	50.5	29	13.6	8	4.8	3
350	15.5	16.0	10	23.6	15	27.3	17	49.4	31	33.3	21	8.5	5	3.4	2
348	13.5	16.7	11	30.0	20	35.2	24	43.4	30	16.1	11	3.5	2	2.0	1
346	11.5	21.2	18	25.4	21	30.0	25	28.7	24	11.0	9	2.9	2	1.2	1
344	9.5	25.6	27	20.8	22	24.8	26	13.9	15	6.0	6	2.3	2	0.5	0
342	7.0	24.8	36	15.4	22	18.1	26	5.8	8	3.2	5	1.6	2	0.0	0
340	5.0	18.6	41	9.1	20	9.8	22	4.3	10	2.6	6	0.8	2	0.0	0
338	2.5	12.4	57	2.9	13	1.5	7	2.8	13	2.0	9	0.1	0	0.0	0
336	0.0	7.9	52	2.2	14	1.7	11	2.1	14	1.2	8	0.0	0	0.0	0
334	-2.0	3.5	40	1.5	17	1.9	21	1.4	16	0.4	5	0.0	0	0.0	0
332	<-3.5	1.3	27	1.0	22	1.6	33	0.8	17	0.0	1	0.0	0	0.0	0
330	"	1.3	37	0.8	23	0.9	27	0.4	12	0.0	1	0.0	0	0.0	0
328	"	1.2	62	0.5	26	0.2	12	0.0	0	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

STATION 1		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
358	24.0	8666
356	22.5	7636
354	21.0	6635
352	18.0	5665
350	16.0	4785
348	14.0	3816
346	12.0	2954
344	10.0	2148
342	8.0	1397
340	5.5	705
338	3.5	112
336	1.0	0

STATION 2		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
358	23.5	5579
356	21.5	4790
354	20.0	4034
352	17.5	3350
350	15.5	2731
348	13.5	2160
346	11.5	1639
344	9.5	1167
342	7.5	751
340	5.0	398
338	2.5	109
336	0.0	0

STATION 3		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
358	22.5	1027
356	21.0	776
354	19.0	549
352	17.0	346
350	14.5	167
348	12.5	24
346	10.5	0

CALCULATIONS OF PROFILE CROSS SECTION

Table 12

Results of Calculations for

Side Channel Picayune

SIDE CHANNEL LENGTH = 7.83 MILES = 12.60 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.09 MILES = 0.15 KILOMETERS = 484.39 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
343	31.0	8560	19.2	442.2	1.3	6.5	273	28
341	28.0	7935	19.3	430.4	7.9	6.6	286	29
339	26.0	7310	19.4	418.7	14.5	6.8	302	30
337	24.0	6624	19.3	397.8	16.9	6.9	317	31
335	22.0	5878	19.0	367.6	15.0	7.1	330	33
333	19.5	5132	18.7	337.5	13.2	7.3	347	35
331	17.5	4505	18.5	318.2	11.3	7.4	373	37
329	15.5	3878	18.3	298.8	9.5	7.6	407	39
327	13.0	3300	18.1	280.6	8.5	7.7	449	41
325	10.5	2772	18.0	263.5	8.4	8.0	502	44
323	8.0	2244	18.0	246.3	8.4	8.2	580	47
321	5.5	1818	17.7	225.5	12.1	8.4	655	50
319	3.0	1392	17.4	204.6	15.8	8.7	776	55
317	0.5	1039	15.9	171.7	17.7	8.7	873	59
315	-1.5	760	13.0	126.7	17.9	8.4	881	66
313	-3.5	480	10.1	81.7	18.1	8.0	898	79
311	<-3.5	385	7.5	60.8	13.3	6.6	833	79
309	"	290	4.8	39.8	8.5	5.2	726	77
307	"	222	3.0	26.0	5.2	4.1	617	73
305	"	182	2.1	19.2	3.3	3.2	556	69
303	"	143	1.2	12.5	1.5	2.4	461	61
301	"	122	1.1	11.0	1.0	2.3	476	62
299	"	102	0.9	9.6	0.6	2.2	498	63
297	"	84	0.9	8.5	0.4	2.1	530	66
295	"	69	0.8	7.6	0.4	2.2	577	70
293	"	55	0.8	6.7	0.5	2.2	649	76
291	"	44	0.8	5.7	0.5	2.4	683	87
289	"	34	0.8	4.7	0.5	2.5	739	104
287	"	25	0.7	3.8	0.4	2.5	797	114
285	"	19	0.5	3.0	0.4	2.2	842	113
283	"	13	0.4	2.2	0.3	1.8	931	110
281	"	9	0.3	1.7	0.3	1.8	982	121
279	"	5	0.2	1.1	0.3	1.7	1113	144

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
343	31.0	6.3	1	24.3	5	33.0	7	58.5	13	47.7	10	42.3	9	247.0	54
341	28.0	18.1	4	26.2	6	28.7	7	49.9	11	45.6	10	46.5	11	225.9	51
339	26.0	29.8	7	28.0	7	24.3	6	41.3	10	43.4	10	50.7	12	204.8	48
337	24.0	32.7	8	26.8	7	21.1	5	36.4	9	44.4	11	63.8	16	172.7	43
335	22.0	26.7	7	22.6	6	19.1	5	35.1	10	48.6	13	85.8	23	129.6	35
333	19.5	20.7	6	18.4	5	17.1	5	33.9	10	52.8	16	107.7	32	86.5	26
331	17.5	19.2	6	17.8	6	17.3	5	37.9	12	74.8	24	86.9	27	64.2	20
329	15.5	17.6	6	17.2	6	17.4	6	41.9	14	96.7	32	66.2	22	41.9	14
327	13.0	17.2	6	17.8	6	19.5	7	53.8	19	97.3	35	48.2	17	27.2	10
325	10.5	17.8	7	19.8	7	23.3	9	73.4	28	76.5	29	33.0	13	20.0	8
323	8.0	18.5	7	21.7	9	27.2	11	93.1	38	55.8	23	17.8	7	12.9	5
321	5.5	24.3	11	31.8	14	36.4	16	69.2	31	40.6	18	12.2	5	11.4	5
319	3.0	30.1	15	41.9	20	45.5	22	45.4	22	25.4	12	6.5	3	10.0	5
317	0.5	33.6	19	40.4	23	42.2	24	29.3	17	15.0	9	3.4	2	8.7	5
315	-1.5	34.8	27	27.4	21	26.2	20	21.1	16	9.3	7	3.0	2	7.7	6
313	-3.5	36.0	42	14.3	17	10.3	12	12.9	15	3.7	4	2.6	3	6.7	8
311	<-3.5	25.0	39	11.2	18	7.7	12	8.8	14	3.2	5	2.4	4	5.8	9
309	"	14.0	33	8.2	19	5.1	12	4.6	11	2.8	7	2.3	5	4.9	12
307	"	7.2	27	5.5	20	3.3	12	2.4	9	2.5	9	2.2	8	4.1	15
305	"	4.5	23	3.4	17	2.2	11	2.2	11	2.3	12	2.1	11	3.3	16
303	"	1.9	15	1.2	9	1.1	8	2.1	16	2.2	17	2.1	16	2.4	19
301	"	1.5	13	1.1	10	1.0	9	1.9	17	2.1	19	1.7	15	2.0	17
299	"	1.2	12	1.1	11	1.0	10	1.8	18	2.1	21	1.3	13	1.6	16
297	"	1.0	11	1.0	12	0.9	11	1.7	19	1.9	21	1.1	12	1.2	13
295	"	0.9	12	0.9	12	0.9	12	1.6	21	1.5	19	1.0	13	0.8	10
293	"	0.9	13	0.8	13	0.9	14	1.6	24	1.1	16	0.9	14	0.4	6
291	"	0.9	16	0.8	14	0.8	14	1.3	22	1.0	18	0.7	12	0.3	5
289	"	1.0	20	0.8	16	0.6	13	1.0	20	0.9	19	0.5	9	0.1	3
287	"	0.9	22	0.7	17	0.5	13	0.8	20	0.8	20	0.3	7	0.1	1
285	"	0.7	21	0.6	17	0.5	14	0.8	24	0.6	18	0.2	6	0.0	1
283	"	0.5	20	0.4	17	0.4	16	0.7	30	0.4	15	0.1	3	0.0	0
281	"	0.4	22	0.4	20	0.3	17	0.5	27	0.2	12	0.0	2	0.0	0
279	"	0.4	25	0.4	25	0.3	19	0.3	22	0.1	8	0.0	1	0.0	0

CALCULATED DEPTH CLASS RANGES

STATION 1		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
343	32.5	12935
341	30.0	12395
339	27.5	11263
337	25.0	10438
335	22.5	9621
333	21.0	8812
331	19.0	8011
329	17.0	7225
327	15.0	6453
325	12.5	5697
323	10.0	4955
321	7.5	4244
319	4.5	3567
317	2.5	2926
315	0.5	2320
313	-2.0	1749
311	<-3.5	1218
309	"	741
307	"	333
305	"	54
303	"	2

STATION 2		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
343	31.0	5974
341	28.0	5151
339	26.0	4391
337	23.0	3633
335	21.0	2934
333	19.0	2342
331	17.0	1834
329	15.0	1381
327	13.0	976
325	10.5	624
323	8.0	319
321	5.0	86
319	3.0	2

STATION 3		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
343	28.0	4337
341	26.0	3558
339	24.0	2789
337	22.0	2173
335	20.0	1731
333	18.0	1341
331	16.0	1002
329	14.0	712
327	11.5	473
325	9.0	282
323	6.5	141
321	4.0	48
319	1.5	4

CALCULATIONS OF PROFILE CROSS SECTION

Table 13

Results of Calculations for

Side Channel Cape Bend

SIDE CHANNEL LENGTH = 3.67 MILES = 5.91 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.43 MILES = 0.69 KILOMETERS = 2259.08 FEET

RIVER STAGE, FT. MEAN SEA LEVEL	RIVER STAGE, FT. GAGE READING ST. LOUIS EQUIVALENT	SIDE CHANNEL PARAMETERS V	L	A	DAS	D	A/V	L/A
333	24.0	12513	12.8	972.2	50.5	2.9	410	8
331	22.5	10801	13.1	879.8	47.1	3.2	430	10
329	20.0	9088	13.4	787.3	43.6	3.4	457	11
327	18.0	7567	13.3	703.5	39.9	3.6	491	12
325	16.5	6238	12.8	628.4	36.0	3.7	532	13
323	14.5	4908	12.3	553.3	32.1	3.7	595	14
321	12.0	3958	11.8	495.2	31.6	3.8	661	15
319	9.5	3007	11.3	437.2	31.2	3.9	768	17
317	6.5	2196	11.0	373.6	32.4	4.1	898	19
315	4.0	1524	10.8	304.4	35.3	4.5	1054	23
313	1.5	853	10.6	235.2	38.3	4.9	1456	29
311	-0.5	583	8.3	162.3	32.4	4.8	1469	33
309	-3.0	314	5.9	89.4	26.4	4.7	1504	43
307	<-3.5	148	4.0	44.0	19.8	4.3	1567	59
305	"	87	2.5	26.3	12.4	3.4	1587	62
303	"	26	1.1	8.5	5.1	2.6	1702	80
301	"	17	0.8	6.0	3.6	2.4	1820	87
299	"	8	0.6	3.4	2.0	2.2	2205	106

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT. MEAN SEA LEVEL	RIVER STAGE, FT. GAGE READING ST. LOUIS EQUIVALENT	DEPTH CLASS RANGES 0-2 FT ACRES	0-2 FT %	>2-4 FT ACRES	>2-4 FT %	>4-6 FT ACRES	>4-6 FT %	>6-10 FT ACRES	>6-10 FT %	>10-15 FT ACRES	>10-15 FT %	>15-20 FT ACRES	>15-20 FT %	>20 FT ACRES	>20 FT %
333	24.0	84.2	9	105.8	11	63.0	7	157.8	16	146.1	15	167.3	17	242.3	25
331	22.5	72.1	8	94.9	11	74.1	8	138.2	16	154.6	18	170.6	19	172.0	20
329	20.0	59.9	8	84.0	11	85.2	11	118.6	15	163.0	21	174.0	22	101.8	13
327	18.0	57.0	8	73.4	10	82.6	12	115.3	16	169.0	24	151.8	22	55.4	8
325	16.5	63.4	10	62.9	10	66.3	11	128.2	20	172.3	27	104.1	17	32.8	5
323	14.5	69.9	13	52.5	9	50.0	9	141.0	25	175.7	32	56.4	10	10.3	2
321	12.0	64.1	13	57.9	12	70.4	14	132.9	27	128.0	26	37.0	7	7.0	1
319	9.5	58.3	13	63.2	14	90.7	21	124.8	28	80.2	18	17.7	4	3.8	1
317	6.5	64.2	17	63.7	17	88.6	24	104.3	28	46.7	12	6.9	2	1.8	0
315	4.0	81.8	26	59.2	19	64.1	21	71.3	23	27.4	9	4.5	1	0.9	0
313	1.5	99.3	41	54.7	23	39.7	16	38.4	16	8.0	3	2.2	1	0.1	0
311	-0.5	72.8	42	40.3	23	26.9	16	25.0	15	5.7	3	1.3	1	0.0	0
309	-3.0	46.4	46	25.8	25	14.2	14	11.6	11	3.3	3	0.5	0	0.0	0
307	<-3.5	27.6	50	15.3	28	6.5	12	4.2	8	1.7	3	0.0	0	0.0	0
305	"	16.3	50	8.8	27	3.9	12	2.9	9	0.9	3	0.0	0	0.0	0
303	"	5.1	49	2.2	22	1.4	13	1.5	15	0.1	1	0.0	0	0.0	0
301	"	3.5	50	1.7	23	0.9	13	0.9	13	0.0	0	0.0	0	0.0	0
299	"	2.0	52	1.1	28	0.5	12	0.3	8	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

STATION 1

RIVER STAGE, FT. MEAN SEA LEVEL	RIVER STAGE, FT. GAGE READING ST. LOUIS EQUIVALENT	AREA SQUARE FEET
333	26.0	42384
331	23.0	35207
329	21.0	30239
327	19.0	25646
325	17.5	21412
323	15.5	17598
321	13.0	14250
319	10.5	11175
317	8.0	8386
315	5.5	5966
313	2.5	3798
311	0.5	1924
309	-1.5	842
307	<-3.5	205
305	"	0

STATION 2

MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
333	25.0	30699
331	22.5	27470
329	21.0	24443
327	18.5	21556
325	16.5	18818
323	15.0	16346
321	12.5	14071
319	10.0	11893
317	7.0	9802
315	4.5	7807
313	2.0	5971
311	0.0	4525
309	-2.5	3383
307	<-3.5	2399
305	"	1544
303	"	813
301	"	252
299	"	2

STATION 3

MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
333	23.0	9556
331	21.0	6156
329	19.0	3527
327	17.5	1699
325	15.5	417
323	13.5	49
321	10.5	0

CALCULATIONS OF PROFILE CROSS SECTION

Table 14

Results of Calculations for

Side Channel Santa Fe

SIDE CHANNEL LENGTH = 4.87 MILES = 7.84 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.22 MILES = 0.36 KILOMETERS = 1183.23 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
333	35.0	15378	12.8	737.8	0.9	3.4	253	11
331	30.0	14616	12.9	729.1	5.4	3.4	263	11
329	27.5	13855	13.1	720.5	9.9	3.5	275	12
327	25.0	12817	13.2	705.0	11.8	3.6	290	12
325	22.5	11503	13.4	682.7	11.3	3.7	313	13
323	21.0	10189	13.5	660.5	10.7	3.8	342	13
321	19.0	8978	13.4	642.3	9.7	3.8	378	13
319	17.5	7766	13.3	624.0	8.8	3.8	424	14
317	15.5	6600	13.4	605.8	8.4	3.9	485	14
315	13.5	5479	13.6	587.6	8.5	4.0	566	15
313	11.0	4358	13.8	569.4	8.7	4.1	690	16
311	8.5	3367	15.0	535.3	24.3	4.7	839	18
309	6.5	2375	16.2	501.1	39.9	5.2	1114	21
307	4.0	1578	15.3	414.2	49.1	5.5	1386	24
305	1.5	974	12.2	274.5	51.9	5.5	1488	28
303	-1.0	370	9.1	134.8	54.7	5.6	1921	43
301	-3.5	226	5.6	81.8	34.8	3.9	1910	44
299	<-3.5	82	2.1	28.9	14.8	2.3	1858	46
297	"	8	0.3	2.2	3.9	1.6	1354	93
295	"	5	0.3	1.7	2.1	1.7	1650	114
293	"	2	0.3	1.1	0.3	1.9	2858	157

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/(2(\pi A)^{1/2})$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
333	35.0	7.2	1	15.4	2	14.1	2	45.7	6	45.4	6	43.5	6	538.2	76
331	30.0	11.1	2	19.4	3	15.3	2	42.0	6	44.7	6	61.5	9	502.8	72
329	27.5	15.0	2	23.4	3	18.6	3	38.4	6	43.9	6	79.5	12	467.4	68
327	25.0	17.0	3	24.0	4	19.2	3	36.4	5	52.5	8	135.1	20	385.4	58
325	22.5	17.3	3	21.3	3	18.1	3	36.1	6	70.5	11	228.3	35	256.8	40
323	21.0	17.6	3	18.5	3	17.0	3	35.8	6	88.5	14	321.4	51	128.3	20
321	19.0	16.7	3	17.9	3	20.1	3	51.5	8	181.7	30	239.2	39	82.0	13
319	17.5	15.8	3	17.3	3	23.1	4	67.2	11	274.8	47	156.9	27	35.7	6
317	15.5	18.0	3	20.8	4	30.4	5	118.4	21	280.3	49	94.9	17	10.2	2
315	13.5	23.3	4	28.5	5	41.8	8	205.1	37	198.0	36	53.2	10	5.6	1
313	11.0	28.5	5	36.2	7	53.3	10	291.9	54	115.7	22	11.5	2	1.0	0
311	8.5	54.5	11	93.5	19	59.9	12	212.9	42	74.0	15	7.3	1	0.6	0
309	6.5	80.5	17	150.7	32	65.5	14	133.9	29	32.4	7	3.1	1	0.2	0
307	4.0	82.8	21	153.3	40	63.3	16	75.8	20	9.4	2	0.8	0	0.0	0
305	1.5	61.2	24	101.1	39	50.3	20	38.6	15	5.2	2	0.4	0	0.0	0
303	-1.0	37.7	31	49.0	38	37.2	29	1.4	1	1.0	1	0.0	0	0.0	0
301	-3.5	28.1	34	29.6	36	22.5	27	1.2	1	0.6	1	0.0	0	0.0	0
299	<-3.5	15.5	46	10.3	29	7.8	22	0.9	3	0.2	1	0.0	0	0.0	0
297	"	3.6	84	0.6	6	0.4	4	0.6	6	0.0	0	0.0	0	0.0	0
295	"	4.5	80	0.5	9	0.3	5	0.3	6	0.0	0	0.0	0	0.0	0
293	"	0.4	40	0.4	41	0.2	19	0.0	0	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

STATION 1		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
333	37.5	26203
331	32.5	24218
329	28.0	22237
327	26.0	20266
325	24.0	18310
323	22.0	16369
321	21.0	14442
319	18.5	12530
317	17.0	10633
315	15.5	8752
313	13.0	6913
311	10.5	5138
309	8.5	3681
307	6.0	2494
305	3.5	1551
303	1.5	910
301	-1.0	402
299	-3.0	44
297	<-3.5	0

STATION 3		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
333	35.5	24583
331	30.0	22426
329	27.5	20476
327	25.0	18655
325	23.0	16937
323	21.0	15267
321	19.5	13631
319	17.5	12031
317	16.0	10466
315	14.0	8936
313	11.5	7496
311	9.0	6186
309	7.0	4984
307	4.5	3847
305	2.5	2777
303	0.0	1783
301	-3.0	890
299	<-3.5	143
297	"	0

CALCULATIONS OF PROFILE CROSS SECTION

Table 15

Results of Calculations for Side Channel Billings

SIDE CHANNEL LENGTH = 1.34 MILES = 2.16 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.21 MILES = 0.34 KILOMETERS = 1109.27 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
323	23.0	1606	4.2	163.9	8.9	2.3	539	16
321	21.5	1310	4.6	146.1	8.9	2.8	589	20
319	20.0	1013	5.1	128.4	9.0	3.2	669	25
317	18.0	769	5.3	110.6	9.1	3.6	760	31
315	16.5	578	5.4	92.9	9.1	4.0	848	37
313	14.5	387	5.4	75.1	9.1	4.4	1024	46
311	12.0	292	4.8	58.1	8.0	4.6	1048	52
309	10.0	198	4.1	41.0	6.9	4.7	1096	64
307	8.0	127	3.5	28.6	5.6	4.6	1188	77
305	5.5	81	2.8	20.8	4.2	4.5	1353	87
303	3.5	36	2.2	13.1	2.8	4.3	1943	107
301	1.0	24	1.5	8.7	2.2	3.4	1925	109
299	-1.5	12	0.8	4.4	1.6	2.5	1874	114
297	-3.5	5	0.4	1.9	1.1	2.1	1874	132
295	<-3.5	3	0.3	1.3	0.7	2.1	2275	160
293	"	1	0.3	0.7	0.3	2.2	5231	233

CALCULATED PARAMETERS

DEFINITIONS

- V = WATER VOLUME, ACRE-FT
- L = SHORELINE LENGTH, MILES
- A = WATER SURFACE AREA, ACRES
- DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT
- D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$
- A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE
- L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
323	23.0	11.4	7	6.6	4	35.2	22	34.7	21	40.8	25	19.7	12	13.4	8
321	21.5	19.1	13	10.2	7	27.3	18	34.0	23	32.4	22	16.3	11	8.9	6
319	20.0	26.9	20	13.9	10	19.4	14	33.3	25	23.9	18	12.9	10	4.4	3
317	18.0	29.1	25	15.7	13	13.5	12	29.7	25	18.0	15	9.3	8	1.8	2
315	16.5	25.8	27	15.6	16	9.6	10	23.3	24	14.6	15	5.3	6	1.3	1
313	14.5	22.5	30	15.6	21	5.6	8	16.8	23	11.3	15	1.4	2	0.7	1
311	12.0	15.9	28	12.8	22	6.7	12	13.2	23	7.3	13	1.1	2	0.4	1
309	10.0	9.3	23	10.1	25	7.8	19	9.6	23	3.4	8	0.8	2	0.1	0
307	8.0	6.1	21	7.8	27	6.9	24	6.5	22	1.3	4	0.6	2	0.0	0
305	5.5	6.4	30	5.8	27	4.0	19	3.8	18	1.0	5	0.3	1	0.0	0
303	3.5	6.6	49	3.8	28	1.2	9	1.1	8	0.7	5	0.0	0	0.0	0
301	1.0	4.2	48	2.5	28	0.9	10	0.8	9	0.4	5	0.0	0	0.0	0
299	-1.5	1.8	42	1.2	27	0.6	14	0.6	14	0.1	3	0.0	0	0.0	0
297	-3.5	0.6	33	0.5	25	0.4	20	0.4	21	0.0	0	0.0	0	0.0	0
295	<-3.5	0.6	45	0.3	26	0.2	14	0.2	15	0.0	0	0.0	0	0.0	0
293	"	0.5	73	0.2	27	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

STATION 2		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
323	23.0	5598
321	21.5	4378
319	20.0	3382
317	18.0	2499
315	16.5	1724
313	14.5	1069
311	12.0	609
309	10.0	375
307	7.5	181
305	5.5	31
303	3.5	0

STATION 3		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
323	22.5	5608
321	21.0	3604
319	19.5	2105
317	18.0	1138
315	16.0	616
313	14.0	410
311	12.0	247
309	9.5	124
307	7.5	44
305	5.5	4
303	3.0	0

CALCULATIONS OF PROFILE CROSS SECTION

Table 16

Results of Calculations for

Side Channel Buffalo

SIDE CHANNEL LENGTH = 2.02 MILES = 3.24 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.12 MILES = 0.19 KILOMETERS = 634.05 FEET

RIVER STAGE, FT. MEAN SEA LEVEL	RIVER STAGE, FT. GAGE READING ST. LOUIS EQUIVALENT	SIDE CHANNEL PARAMETERS V	L	A	DAS	D	A/V	L/A
318	22.5	1958	5.1	152.5	6.8	2.9	411	21
316	21.0	1678	5.2	140.2	6.0	3.1	441	24
314	19.5	1398	5.3	127.8	5.1	3.4	483	26
312	18.0	1147	5.4	116.7	4.7	3.5	537	29
310	16.0	927	5.4	106.9	4.6	3.7	609	32
308	14.0	706	5.4	97.2	4.5	3.9	727	35
306	11.5	541	5.4	86.7	6.2	4.1	846	40
304	9.5	377	5.3	76.3	8.0	4.4	1069	45
302	7.5	250	4.7	60.1	8.5	4.3	1269	50
300	6.0	162	3.4	38.2	7.8	4.0	1247	56
298	3.5	73	2.0	16.2	7.1	3.6	1171	81
296	1.0	52	1.5	12.1	4.8	3.1	1230	81
294	-1.5	31	1.0	8.0	2.6	2.5	1369	82
292	-3.5	17	0.7	5.1	1.3	2.3	1591	88
290	<-3.5	10	0.5	3.2	0.8	2.3	1784	107
288	"	2	0.4	1.4	0.4	2.4	3193	179

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT
L = SHORELINE LENGTH, MILES
A = WATER SURFACE AREA, ACRES
DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT
D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$
A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE
L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT. MEAN SEA LEVEL	RIVER STAGE, FT. GAGE READING ST. LOUIS EQUIVALENT	DEPTH CLASS RANGES 0-2 FT ACRES	0-2 FT %	>2-4 FT ACRES	>2-4 FT %	>4-6 FT ACRES	>4-6 FT %	>6-10 FT ACRES	>6-10 FT %	>10-15 FT ACRES	>10-15 FT %	>15-20 FT ACRES	>15-20 FT %	>20 FT ACRES	>20 FT %
318	22.5	3.1	2	20.8	14	10.2	7	19.6	13	26.2	17	53.8	36	16.8	11
316	21.0	5.0	4	16.1	12	11.2	8	19.7	14	37.3	27	36.5	26	12.6	9
314	19.5	6.9	5	11.4	9	12.2	10	19.9	16	48.3	38	19.2	15	8.4	7
312	18.0	8.4	7	9.2	8	12.6	11	25.4	22	45.2	39	9.4	8	5.3	5
310	16.0	9.7	9	9.5	9	12.5	12	36.2	34	27.8	26	7.1	7	3.4	3
308	14.0	10.9	11	9.8	10	12.4	13	47.0	49	10.5	11	4.8	5	1.5	2
306	11.5	12.9	15	17.2	20	12.7	15	31.0	36	8.2	10	3.4	4	0.9	1
304	9.5	15.0	20	24.6	32	12.9	17	15.0	20	5.9	8	2.0	3	0.4	1
302	7.5	13.8	23	23.3	39	11.0	18	6.3	11	4.1	7	1.1	2	0.1	0
300	6.0	9.6	25	13.4	35	7.0	18	5.0	13	2.7	7	0.6	2	0.1	0
298	3.5	5.3	31	3.5	21	2.9	17	3.7	22	1.3	8	0.1	1	0.0	0
296	1.0	3.9	31	2.8	23	2.4	19	2.5	20	0.9	7	0.1	1	0.0	0
294	-1.5	2.6	31	2.2	26	1.9	23	1.3	15	0.4	4	0.0	0	0.0	0
292	-3.5	1.7	33	1.5	29	1.4	26	0.6	11	0.1	2	0.0	0	0.0	0
290	<-3.5	1.3	40	0.9	27	0.8	22	0.3	10	0.1	2	0.0	0	0.0	0
288	"	1.0	65	0.3	19	0.1	10	0.1	6	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

STATION 1

RIVER STAGE, FT. MEAN SEA LEVEL	RIVER STAGE, FT. GAGE READING ST. LOUIS EQUIVALENT	AREA SQUARE FEET
318	22.5	11012
316	21.0	9960
314	20.0	8928
312	18.5	7928
310	16.5	6966
308	14.5	6043
306	12.5	5159
304	10.0	4314
302	8.0	3513
300	6.0	2756
298	4.0	2045
296	1.5	1388
294	-1.0	815
292	-3.0	347
290	<-3.5	32

STATION 2

MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
318	22.5	8639
316	21.0	7824
314	19.5	7036
312	18.0	6266
310	16.5	5514
308	14.5	4796
306	12.0	4115
304	9.5	3471
302	8.0	2864
300	6.0	2294
298	3.5	1761
296	1.5	1281
294	-1.0	859
292	-3.0	497
290	<-3.5	197
288	"	4

STATION 3

MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
318	22.0	13539
316	21.0	11565
314	19.5	9592
312	17.5	7620
310	16.0	5650
308	14.0	3891
306	11.5	2715
304	9.5	1751
302	7.5	918
300	5.5	253
298	3.5	0

CALCULATIONS OF PROFILE CROSS SECTION

Table 17

Results of Calculations for Side Channel Browns

SIDE CHANNEL LENGTH = 1.09 MILES = 1.75 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.12 MILES = 0.19 KILOMETERS = 614.87 FEET

RIVER STAGE, FT		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
318	23.0	6127	6.6	317.9	10.8	2.6	274	13
316	22.0	5473	6.9	300.5	8.1	2.8	290	15
314	21.0	4820	7.1	283.1	5.4	3.0	310	16
312	19.0	4208	7.2	269.9	4.1	3.1	339	17
310	17.5	3639	7.1	261.0	4.0	3.1	379	17
308	15.5	3069	7.0	252.0	3.9	3.1	434	18
306	13.5	2555	7.2	241.6	5.5	3.3	499	19
304	11.0	2041	7.2	231.3	7.1	3.4	598	20
302	9.0	1567	7.6	213.8	10.2	3.7	720	23
300	7.0	1133	8.1	189.3	14.9	4.2	882	27
298	5.0	790	6.6	164.8	19.6	4.8	1244	33
296	3.0	516	6.4	118.5	18.4	4.2	1213	35
294	0.5	332	4.3	72.2	17.1	3.6	1147	38
292	-2.0	213	2.8	41.9	13.8	3.0	1040	43
290	<-3.5	158	1.8	27.7	8.4	2.3	927	42
288	"	102	0.9	13.4	3.0	1.7	693	41
286	"	82	0.7	10.5	2.0	1.5	679	42
284	"	61	0.5	7.6	1.0	1.4	657	45
282	"	46	0.4	5.6	0.5	1.3	644	50
280	"	36	0.4	4.5	0.4	1.4	660	58
278	"	26	0.4	3.4	0.3	1.4	690	70
276	"	20	0.3	2.9	0.3	1.5	751	78
274	"	14	0.3	2.3	0.2	1.5	865	90
272	"	9	0.3	1.8	0.2	1.6	1036	107
270	"	6	0.3	1.4	0.2	1.8	1292	131
268	"	2	0.3	1.0	0.2	2.0	2294	174
266	"	1	0.2	0.7	0.1	2.3	2639	220
264	"	0	0.2	0.4	0.1	2.7	4368	342

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/(2\sqrt{\pi}A^{1/2})$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
318	23.0	13.7	4	9.8	3	28.1	8	19.4	6	29.7	9	76.8	22	165.5	48
316	22.0	15.7	5	9.9	3	20.2	6	21.9	7	48.5	15	90.7	28	120.9	37
314	21.0	17.8	6	10.0	3	12.4	4	24.3	8	67.4	22	104.6	33	76.3	24
312	19.0	17.1	6	10.7	4	9.2	3	34.6	12	83.8	28	97.2	33	46.0	15
310	17.5	13.7	5	12.0	4	10.6	4	52.6	18	97.6	34	68.5	24	30.1	11
308	15.5	10.4	4	13.4	5	12.1	4	70.7	26	111.5	41	39.9	15	14.1	5
306	13.5	11.3	4	19.4	7	39.0	15	69.5	27	82.8	32	26.8	10	11.3	4
304	11.0	12.3	5	25.4	10	65.9	27	68.4	28	54.2	22	13.7	6	8.4	3
302	9.0	24.6	11	28.5	13	67.5	30	60.4	27	33.3	15	6.3	3	6.4	3
300	7.0	48.1	25	28.6	15	43.8	22	45.7	23	20.2	10	4.7	2	5.1	3
298	5.0	71.6	43	28.7	17	20.1	12	31.0	19	7.1	4	3.1	2	3.9	2
296	3.0	52.7	44	22.8	19	13.2	11	20.9	17	5.5	5	2.5	2	3.2	3
294	0.5	33.8	44	16.9	22	6.2	8	10.8	14	3.9	5	1.9	2	2.6	3
292	-2.0	20.0	44	11.8	26	2.7	6	5.1	11	2.8	6	1.5	3	2.1	5
290	<-3.5	11.3	38	7.5	25	2.5	8	3.6	12	2.2	7	1.3	4	1.6	5
288	"	2.6	18	3.2	23	2.2	16	2.2	16	1.5	11	1.2	8	1.1	8
286	"	2.3	20	2.4	21	1.6	14	1.8	16	1.4	12	1.1	9	0.8	7
284	"	1.9	23	1.5	18	1.0	12	1.4	17	1.2	15	1.0	11	0.4	5
282	"	1.5	24	1.0	15	0.7	11	1.1	18	1.1	18	0.8	12	0.2	3
280	"	1.1	21	0.8	15	0.6	12	1.0	20	1.0	20	0.5	10	0.1	2
278	"	0.7	17	0.6	16	0.6	14	0.9	23	0.9	23	0.2	6	0.0	0
276	"	0.6	19	0.5	17	0.5	15	0.8	25	0.6	20	0.1	4	0.0	0
274	"	0.6	21	0.5	18	0.4	16	0.7	28	0.4	14	0.0	2	0.0	0
272	"	0.5	24	0.4	20	0.4	18	0.6	28	0.2	9	0.0	0	0.0	0
270	"	0.4	27	0.4	24	0.3	21	0.3	21	0.1	6	0.0	0	0.0	0
268	"	0.4	33	0.3	31	0.3	27	0.1	9	0.0	0	0.0	0	0.0	0
266	"	0.3	40	0.2	28	0.2	24	0.1	8	0.0	0	0.0	0	0.0	0
264	"	0.2	59	0.1	21	0.1	15	0.0	5	0.0	0	0.0	0	0.0	0

CALCULATED DEPTH CLASS RANGES

STATION 1		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
318	23.5	19405
316	22.5	17339
314	21.5	15140
312	20.0	13271
310	18.0	11385
308	16.0	9597
306	14.0	7641
304	12.0	6141
302	9.5	4553
300	8.0	2972
298	6.0	1594
296	3.5	375
294	1.0	7

STATION 2		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
318	23.0	21591
316	22.0	19926
314	21.0	17979
312	19.5	16139
310	17.5	14026
308	16.0	12035
306	14.0	10439
304	11.5	9295
302	9.5	7063
300	7.5	5417
298	5.5	4844
296	3.0	2735
294	0.5	1324
292	-1.5	368
290	<-3.5	8

STATION 3		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
318	22.5	10138
316	21.5	9644
314	20.5	7321
312	18.5	5538
310	17.0	4360
308	15.0	3371
306	13.0	2499
304	10.5	1718
302	8.5	1262
300	6.5	541
298	4.5	166
296	2.0	9

CALCULATIONS OF PROFILE CROSS SECTION

Table 18

Results of Calculations for

Side Channel Thompson

SIDE CHANNEL LENGTH = 2.63 MILES = 4.23 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.07 MILES = 0.11 KILOMETERS = 368.29 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
318	24.0	907	6.4	84.9	6.2	4.9	494	48
316	23.0	776	6.2	74.7	4.9	5.2	506	53
314	22.5	645	6.0	64.6	3.6	5.4	528	60
312	21.5	531	5.9	56.7	2.9	5.6	563	67
310	20.5	435	5.8	51.0	2.6	5.8	619	73
308	19.0	339	5.7	45.4	2.4	6.0	707	80
306	17.5	272	5.6	40.4	2.6	6.3	785	89
304	15.5	204	5.5	35.4	2.7	6.6	916	100
302	13.5	150	5.3	30.0	2.8	6.9	1056	112
300	11.0	109	4.9	24.2	2.9	7.2	1170	129
298	9.0	69	4.5	18.5	3.0	7.4	1416	155
296	7.0	51	3.6	13.9	2.6	6.9	1438	166
294	5.0	33	2.7	9.2	2.3	6.4	1484	187

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/[2(\pi A)^{1/2}]$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
318	24.0	12.4	16	8.4	11	5.8	7	10.5	13	11.7	15	12.5	16	17.0	22
316	23.0	9.6	14	7.2	10	5.5	8	10.0	15	12.0	17	11.7	17	12.8	19
314	22.5	6.8	12	5.9	10	5.1	9	9.5	16	12.3	21	10.8	18	8.7	15
312	21.5	5.3	10	5.1	10	4.9	9	9.5	18	12.1	23	9.3	18	5.6	11
310	20.5	5.0	11	4.9	10	4.8	10	9.8	21	11.2	24	7.2	15	3.6	8
308	19.0	4.8	12	4.6	11	4.7	11	10.1	25	10.4	25	5.0	12	1.6	4
306	17.5	4.7	13	4.9	13	4.7	13	9.3	26	8.2	23	3.3	9	1.3	4
304	15.5	4.7	15	5.1	16	4.8	15	8.5	27	6.1	19	1.5	5	1.1	3
302	13.5	4.7	17	4.9	18	4.8	18	7.0	26	4.1	15	0.6	2	0.8	3
300	11.0	4.6	21	4.4	20	4.6	21	4.8	22	2.4	11	0.6	3	0.6	3
298	9.0	4.5	26	3.9	23	4.4	26	2.6	15	0.7	4	0.5	3	0.4	3
296	7.0	4.3	33	2.7	21	2.8	22	1.8	14	0.6	5	0.4	3	0.3	2
294	5.0	4.0	46	1.4	17	1.2	14	0.9	10	0.5	6	0.3	4	0.2	2

CALCULATED DEPTH CLASS RANGES

STATION 1		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
318	24.0	3886
316	23.0	3479
314	22.5	3086
312	21.5	2736
310	21.0	2348
308	19.5	1988
306	18.0	1649
304	16.0	1323
302	14.0	1012
300	11.5	718
298	9.5	461
296	7.5	243
294	5.5	69
292	3.0	0

STATION 2		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
318	24.0	2463
316	22.0	2018
314	22.0	1616
312	21.0	1256
310	20.0	938
308	18.5	658
306	17.0	415
304	15.0	211
302	12.5	46

STATION 3		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
318	23.5	3252
316	22.5	2645
314	22.0	2119
312	21.0	1624
310	20.0	1197
308	18.0	885
306	16.5	624
304	14.5	409
302	12.0	239
300	9.5	115
298	8.0	35
296	6.0	1

CALCULATIONS OF PROFILE CROSS SECTION

Table 19

Results of Calculations for

Side Channel Sister

SIDE CHANNEL LENGTH = 2.25 MILES = 3.61 KILOMETERS

AVERAGE CHANNEL WIDTH = 0.08 MILES = 0.14 KILOMETERS = 445.79 FEET

RIVER STAGE, FT.		SIDE CHANNEL PARAMETERS						
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	V	L	A	DAS	D	A/V	L/A
318	25.0	2454	5.5	121.2	1.9	3.6	261	29
316	24.0	2218	5.5	117.2	1.8	3.7	279	30
314	23.0	1981	5.6	113.1	1.8	3.7	301	31
312	22.0	1754	5.5	108.8	1.9	3.8	328	33
310	21.5	1535	5.5	104.3	2.4	3.9	359	34
308	21.0	1317	5.5	99.8	2.9	3.9	400	35
306	19.5	1128	5.4	93.1	2.9	4.0	436	37
304	17.5	939	5.3	86.4	2.9	4.1	485	40
302	15.5	768	5.3	80.3	3.1	4.2	552	42
300	13.5	615	5.2	74.8	3.4	4.3	642	45
298	11.5	462	5.2	69.3	3.7	4.4	791	48
296	9.0	346	5.0	59.2	4.8	4.7	904	54
294	7.0	229	4.8	49.1	5.8	5.0	1130	63
292	5.0	146	4.2	37.6	5.9	4.9	1359	71
290	2.0	96	3.0	24.7	5.1	4.4	1357	79
288	-0.5	46	1.9	11.7	4.2	3.9	1352	103
286	-2.5	31	1.5	8.6	3.0	3.8	1469	114
284	<-3.5	16	1.2	5.5	1.7	3.7	1803	138
282	"	7	0.9	3.3	0.9	3.3	2475	166
280	"	4	0.6	2.0	0.5	2.7	2832	175
278	"	1	0.3	0.8	0.2	2.1	7553	216

CALCULATED PARAMETERS

DEFINITIONS

V = WATER VOLUME, ACRE-FT

L = SHORELINE LENGTH, MILES

A = WATER SURFACE AREA, ACRES

DAS = DERIVATIVE OF WATER SURFACE AREA WITH RESPECT TO RIVER STAGE, ACRES/FT

D = SHORELINE DEVELOPMENT, $D = L/(2\sqrt{\pi A})$

A/V = RATIO OF WATER SURFACE AREA TO WATER VOLUME, 1/MILE

L/A = RATIO OF SHORELINE LENGTH TO WATER SURFACE AREA, 1/MILE

RIVER STAGE, FT.		DEPTH CLASS RANGES													
		0-2 FT		>2-4 FT		>4-6 FT		>6-10 FT		>10-15 FT		>15-20 FT		>20 FT	
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
318	25.0	3.3	3	3.0	2	4.4	4	9.6	8	17.3	14	14.4	12	70.7	58
316	24.0	3.5	3	3.7	3	5.3	4	11.3	10	16.1	14	19.1	16	60.2	50
314	23.0	3.7	3	[illegible]	4	6.2	5	13.0	11	15.0	13	23.9	21	49.7	43
312	22.0	4.4	4	[illegible]	5	6.7	6	13.3	12	16.8	15	27.2	24	38.2	34
310	21.5	5.5	5	6.0	6	6.7	6	12.3	12	21.5	20	29.3	27	25.7	24
308	21.0	6.7	7	6.9	7	6.8	7	11.3	11	26.2	26	31.3	31	13.1	13
306	19.5	6.4	7	6.3	7	6.5	7	16.0	17	28.3	30	22.4	24	9.5	10
304	17.5	6.1	7	5.8	7	6.2	7	20.7	23	30.3	34	13.6	15	5.8	7
302	15.5	6.1	7	6.5	8	8.7	11	22.8	28	26.9	33	7.9	10	3.4	4
300	13.5	6.3	8	8.3	11	14.0	18	22.2	29	18.0	24	5.6	7	2.1	3
298	11.5	6.5	9	10.1	14	19.3	27	21.6	31	9.1	13	3.3	5	0.7	1
296	9.0	10.7	18	10.1	17	14.5	24	15.4	26	6.8	11	2.3	4	0.4	1
294	7.0	14.9	30	10.0	20	9.7	20	9.2	19	4.4	9	1.2	3	0.1	0
292	5.0	14.5	38	8.6	22	6.4	17	5.3	14	2.8	7	0.6	2	0.0	0
290	2.0	9.6	38	5.7	22	4.5	17	3.7	15	1.8	7	0.3	1	0.0	0
288	-0.5	4.7	36	2.9	22	2.6	20	2.2	16	0.7	6	0.0	0	0.0	0
286	-2.5	3.5	37	2.1	23	1.9	20	1.4	15	0.4	5	0.0	0	0.0	0
284	<-3.5	2.4	40	1.4	24	1.3	22	0.7	12	0.1	3	0.0	0	0.0	0
282	"	1.5	46	0.8	24	0.7	22	0.3	8	0.0	0	0.0	0	0.0	0
280	"	1.1	54	0.4	22	0.4	18	0.1	6	0.0	0	0.0	0	0.0	0
278	"	0.7	89	0.1	11	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0

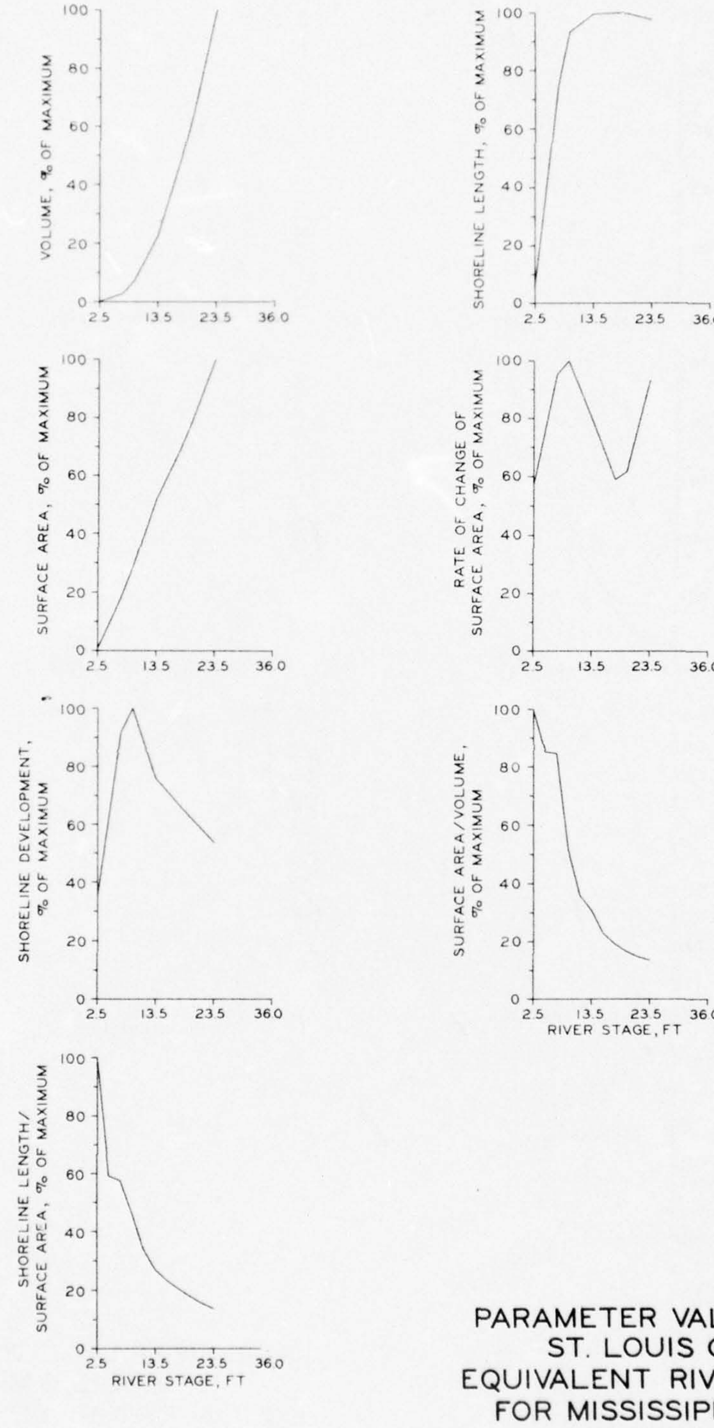
CALCULATED DEPTH CLASS RANGES

STATION 1		
RIVER STAGE, FT.		AREA
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
318	24.5	4964
316	24.0	4349
314	22.5	3611
312	21.5	3296
310	21.0	2800
308	21.0	2325
306	19.5	1870
304	18.0	1435
302	16.5	1020
300	14.5	630
298	12.0	314
296	9.5	92
294	7.5	0
292	5.5	0

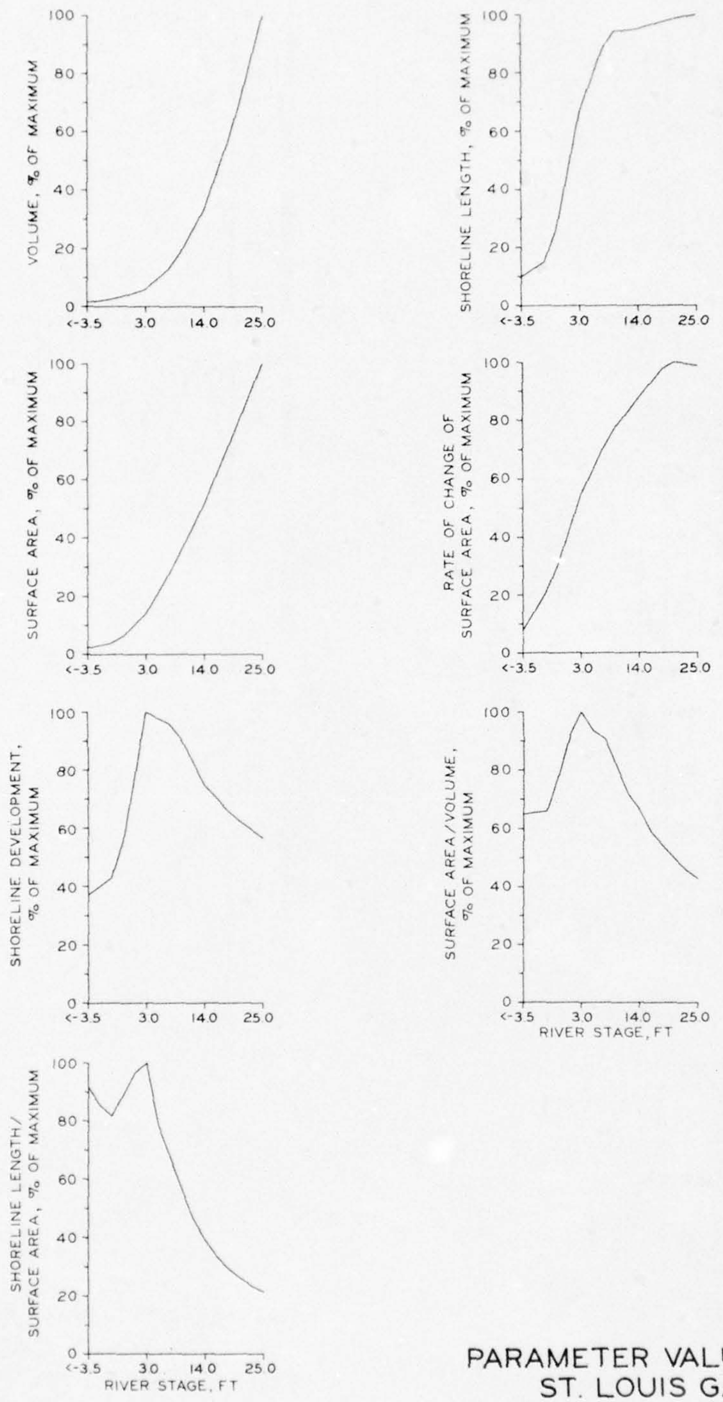
STATION 2		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
318	24.5	7735
316	23.5	7045
314	22.5	6361
312	22.0	5688
310	21.5	5032
308	20.5	4395
306	19.5	3776
304	17.5	3175
302	16.0	2593
300	14.0	2028
298	11.5	1483
296	9.5	981
294	7.0	551
292	5.0	204
290	2.5	0

STATION 3		
MEAN SEA LEVEL	GAGE READING ST. LOUIS EQUIVALENT	SQUARE FEET
318	24.5	12929
316	23.5	11976
314	22.5	11029
312	21.5	10086
310	21.0	9155
308	20.5	8250
306	19.0	7370
304	17.0	6515
302	15.5	5686
300	13.0	4888
298	11.0	4108
296	8.5	3386
294	6.5	2720
292	4.5	2108
290	1.5	1543
288	-1.0	1021
286	-3.0	544
284	<-3.5	117
282	"	0

CALCULATIONS OF PROFILE CROSS SECTION

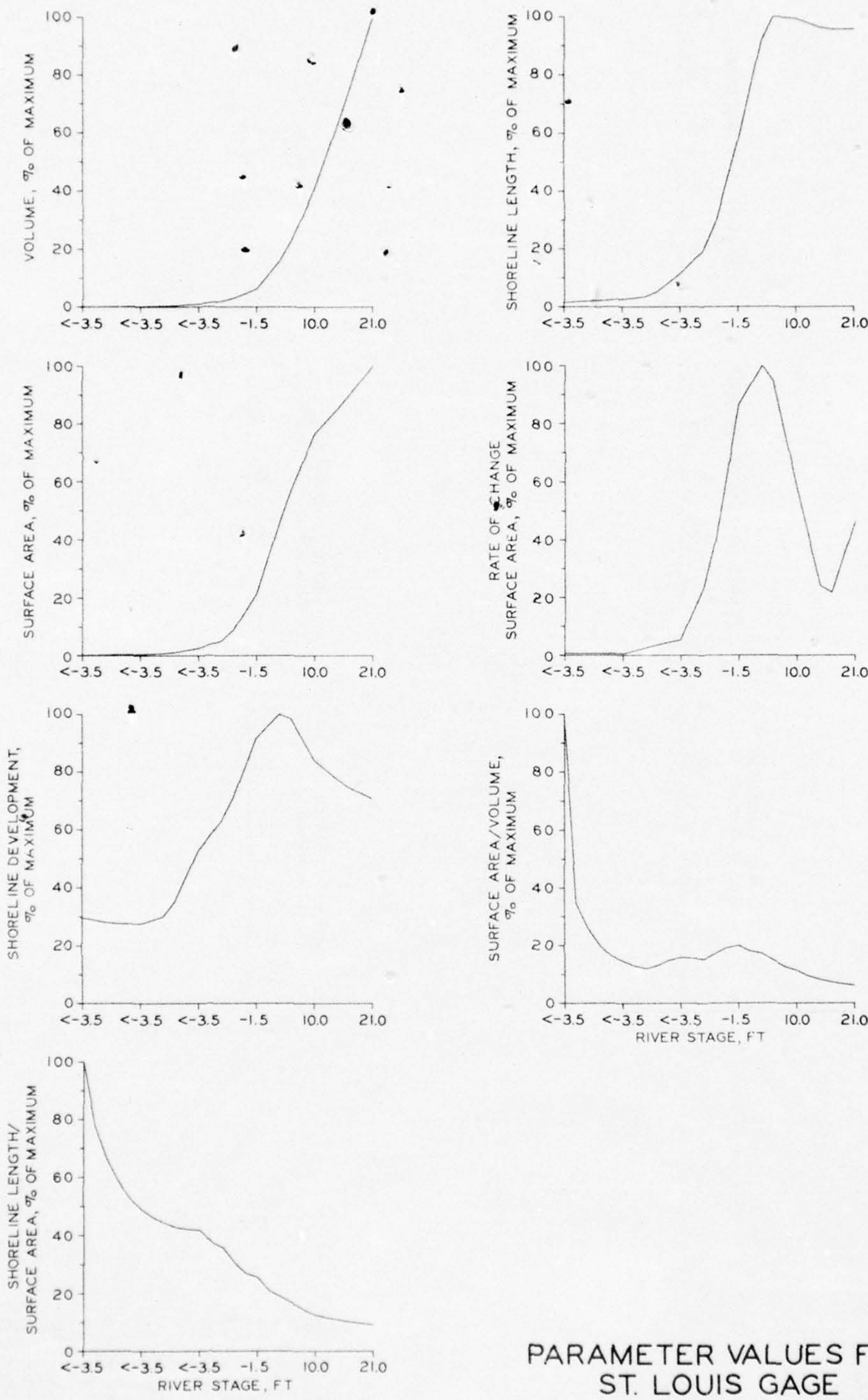


PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER
SIDE CHANNEL
JEFFERSON BARRACKS

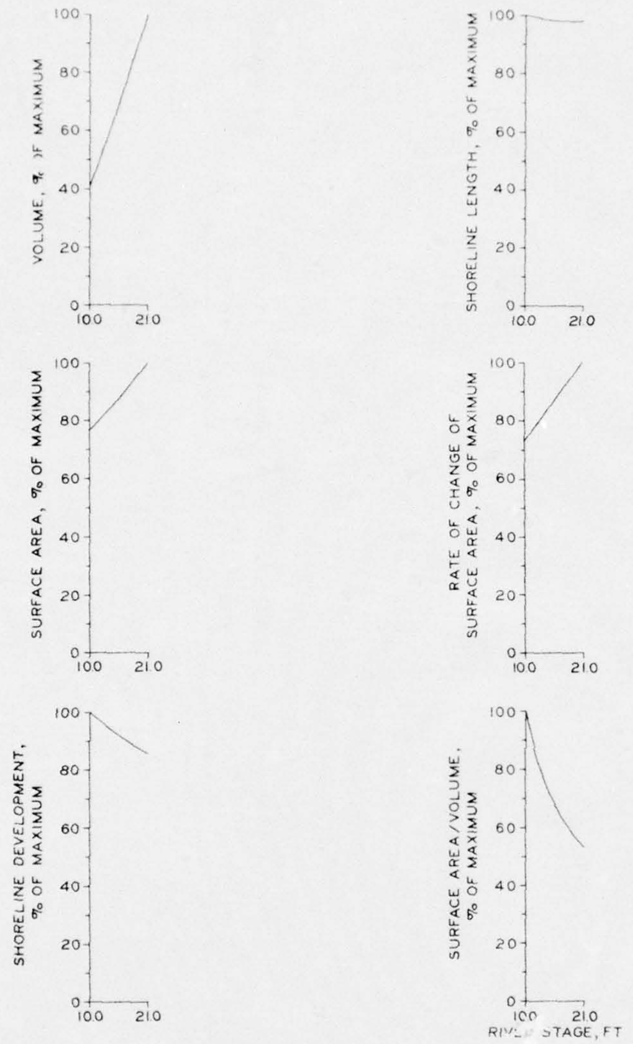


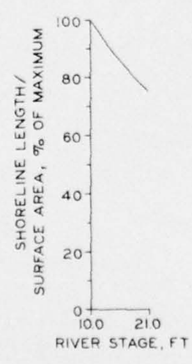
PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER
SIDE CHANNEL CALICO

PLATE 2



PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER
SIDE CHANNEL OSBORNE

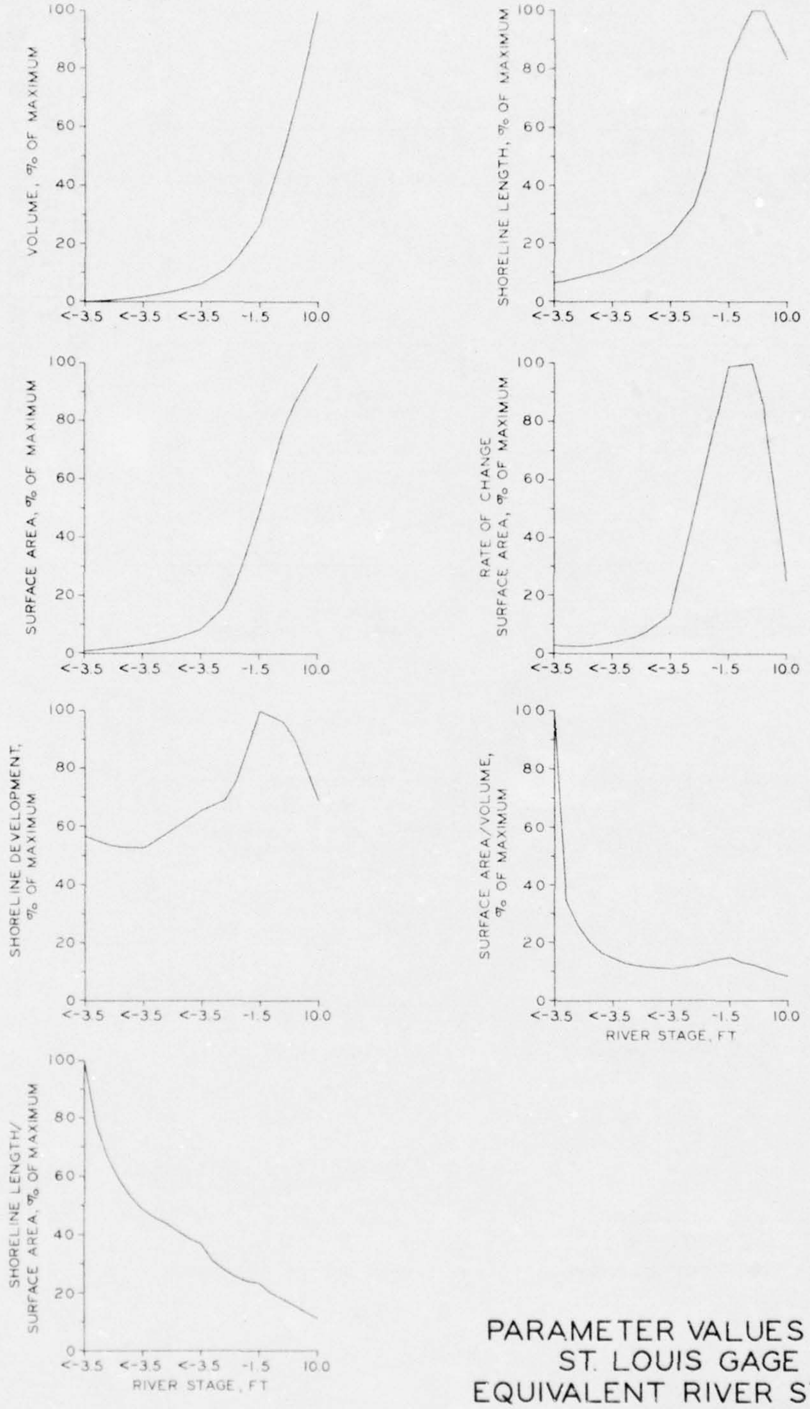




PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER

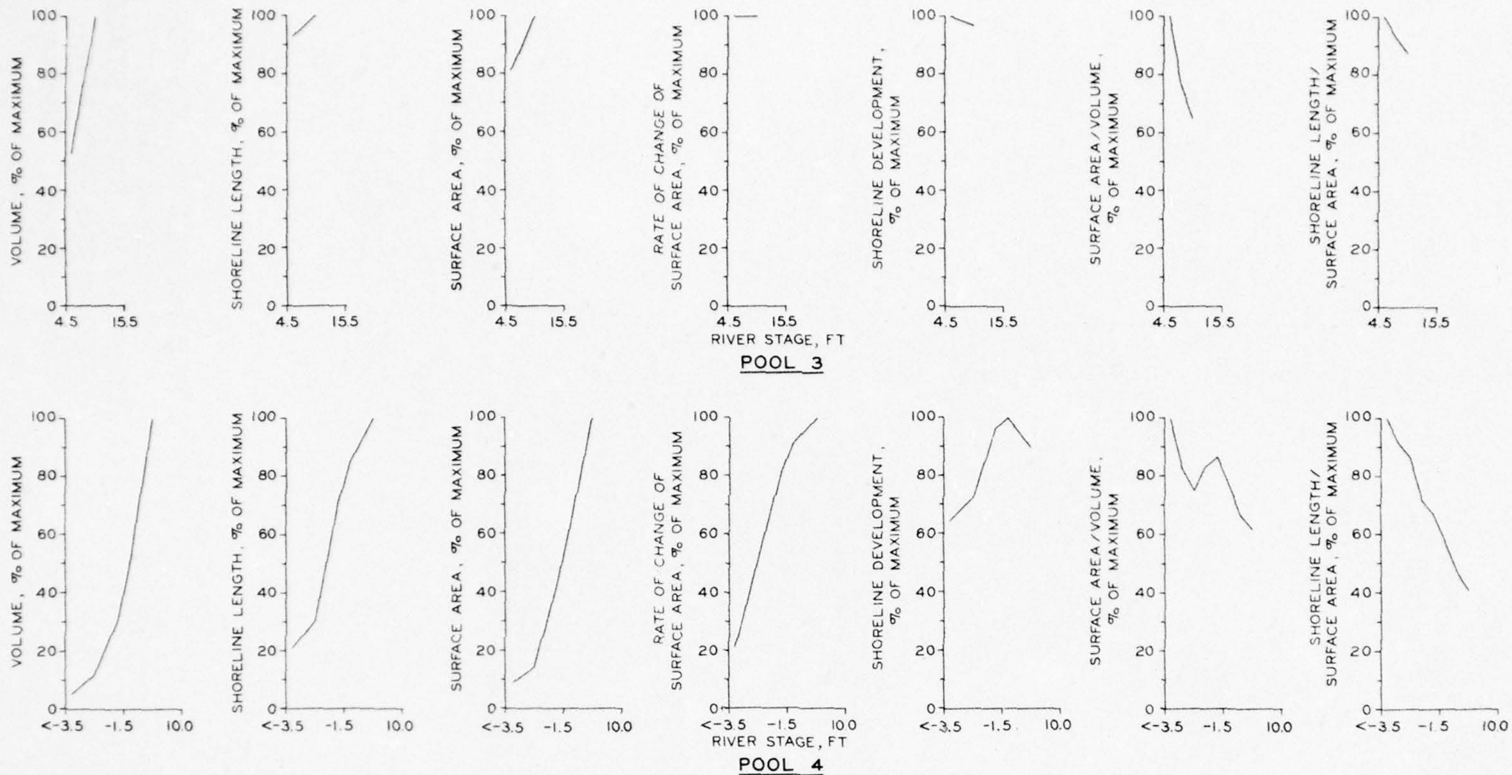
SIDE CHANNEL OSBORNE
POOL 1

PLATE 3B



PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER

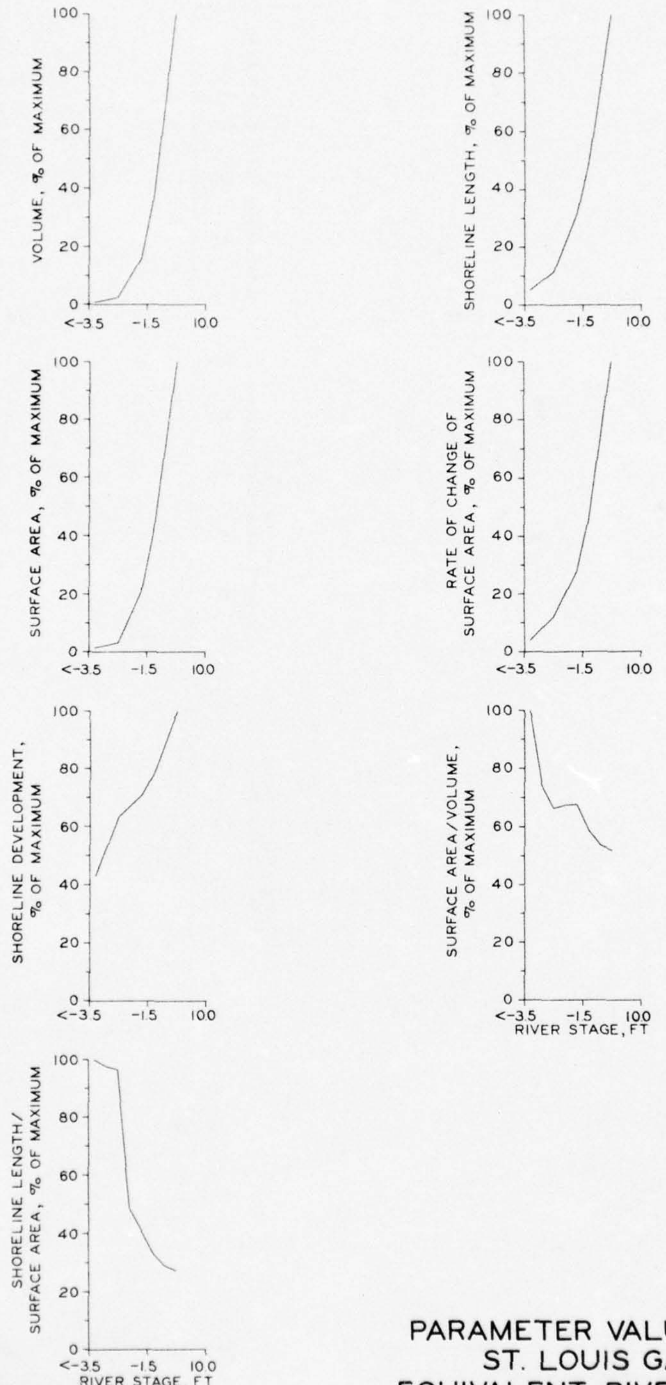
SIDE CHANNEL OSBORNE
POOL 2



PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER

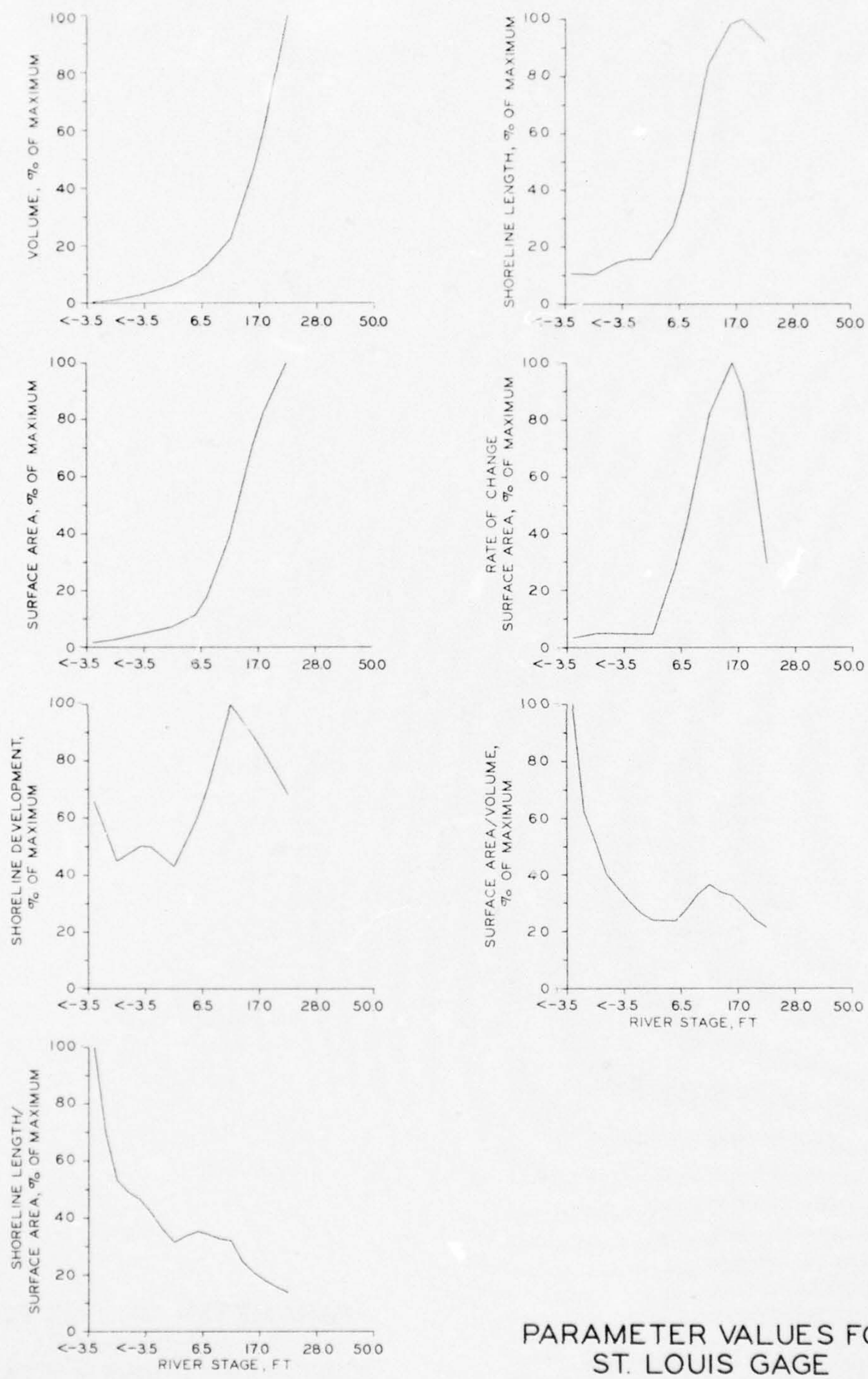
SIDE CHANNEL OSBORNE
POOLS 3 AND 4

PLATE 3D



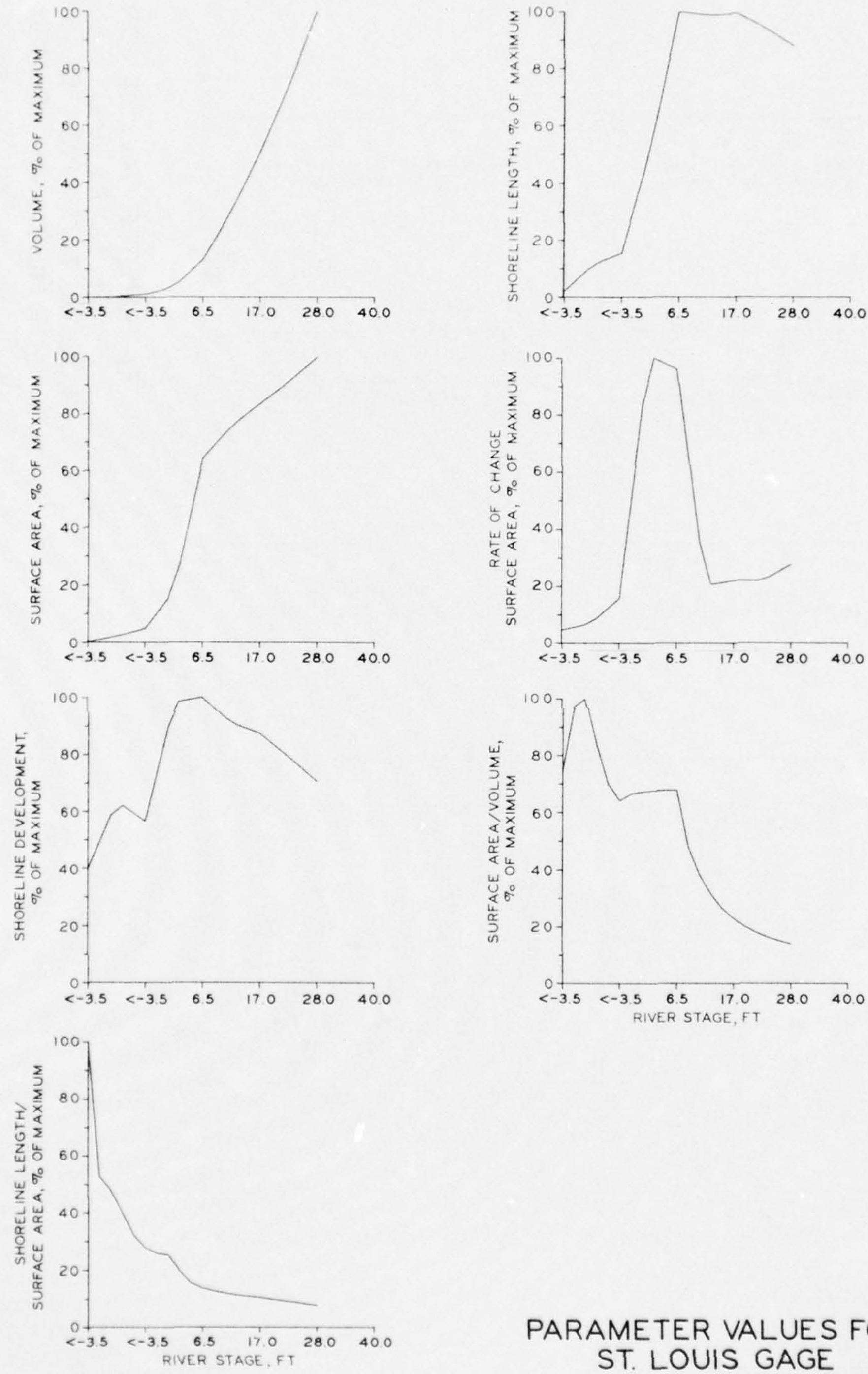
PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER

SIDE CHANNEL OSBORNE
POOL 5

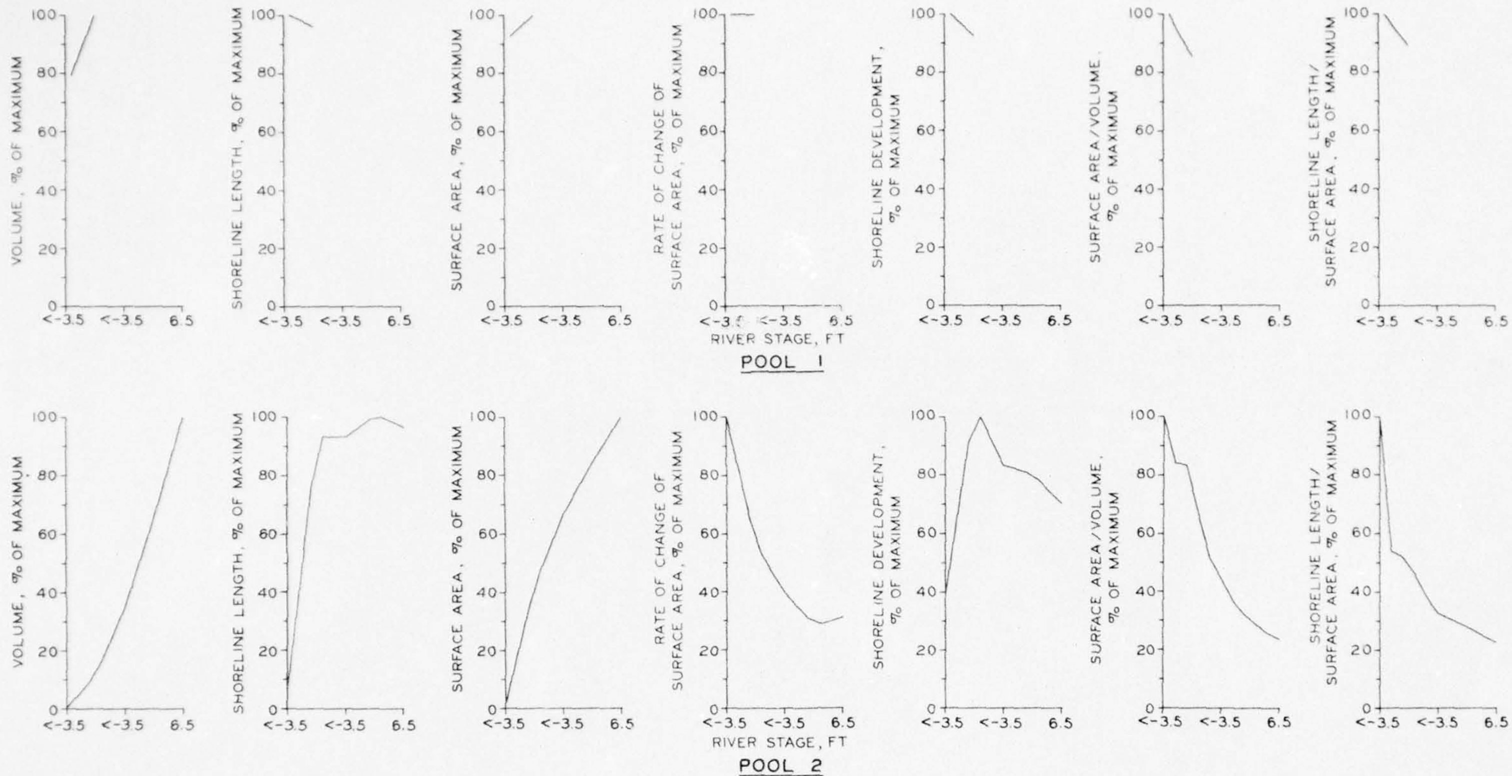


PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER

SIDE CHANNEL HARLOW



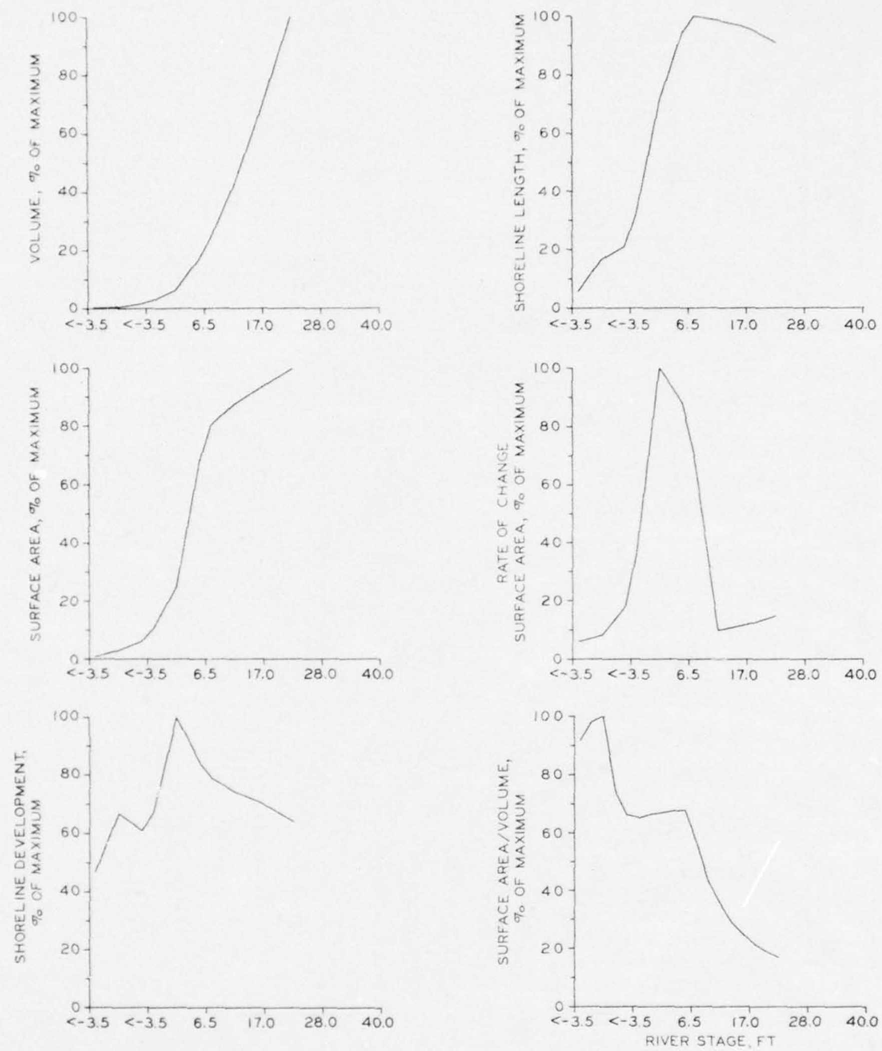
PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER
SIDE CHANNEL FORT CHARTRES

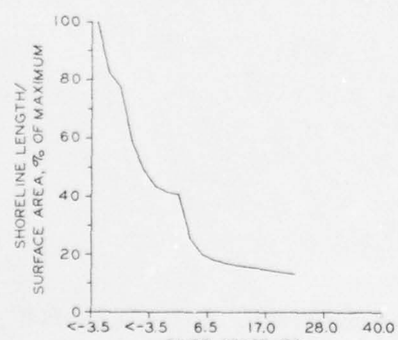


PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER

SIDE CHANNEL FORT CHARTRES
POOLS 1 AND 2

PLATE 5B





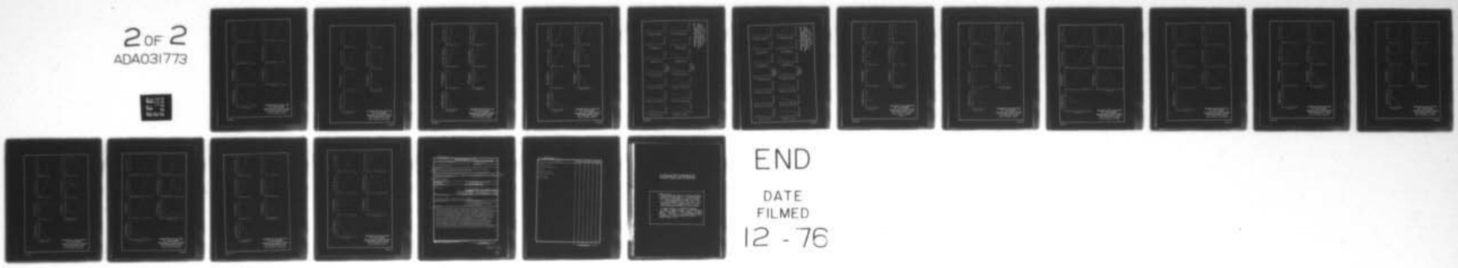
PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER

SIDE CHANNEL
FORT CHARTRES POOL 3

AD-A031 773 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MISS F/G 8/8
COMPUTER-CALCULATED GEOMETRIC CHARACTERISTICS OF MIDDLE MISSISS--ETC(U)
JUN 74 V E LAGARDE, S J WINFREY

UNCLASSIFIED WES-TR-M-74-5-VOL-1 NL

2 OF 2
ADA031773



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DATE
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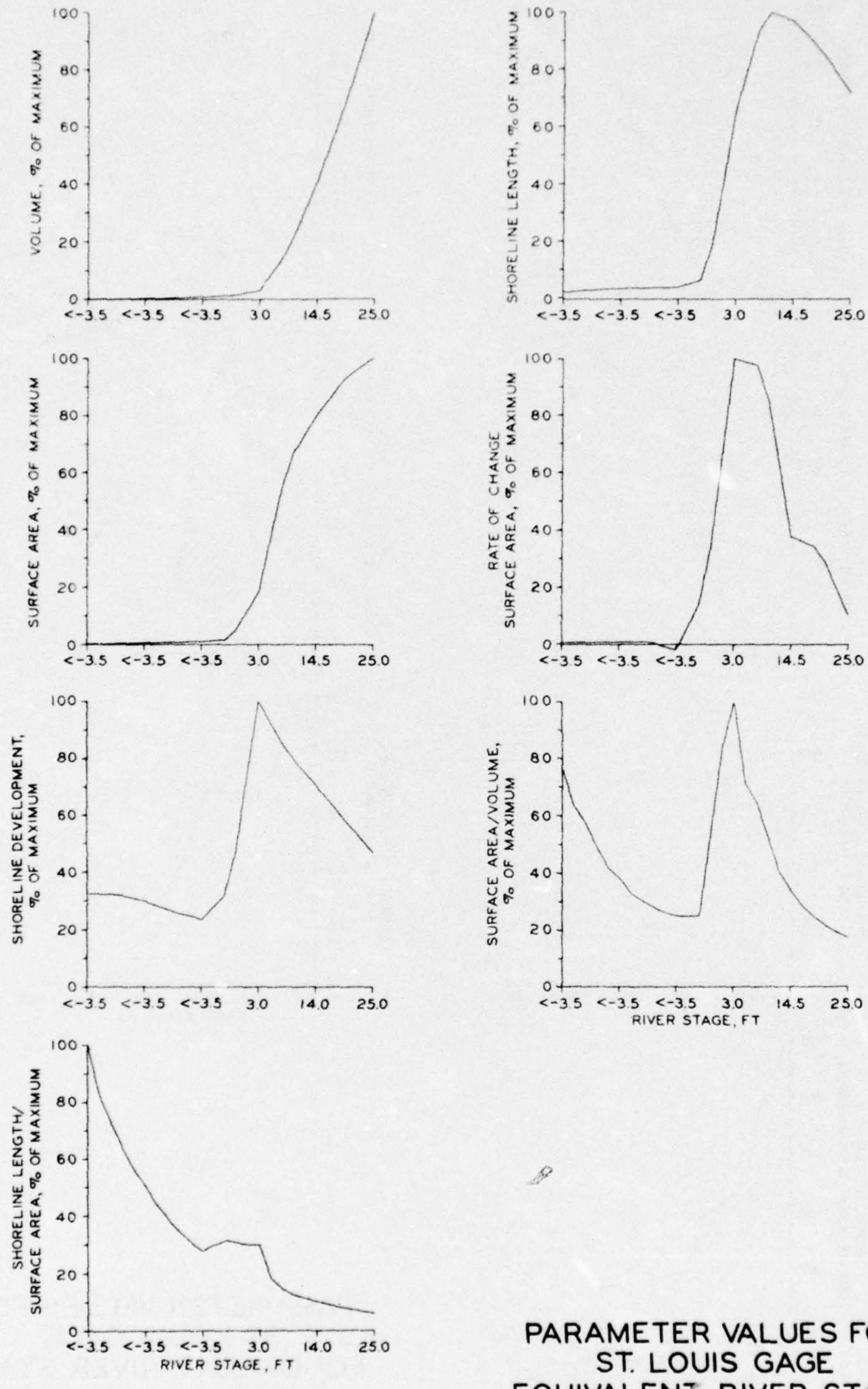
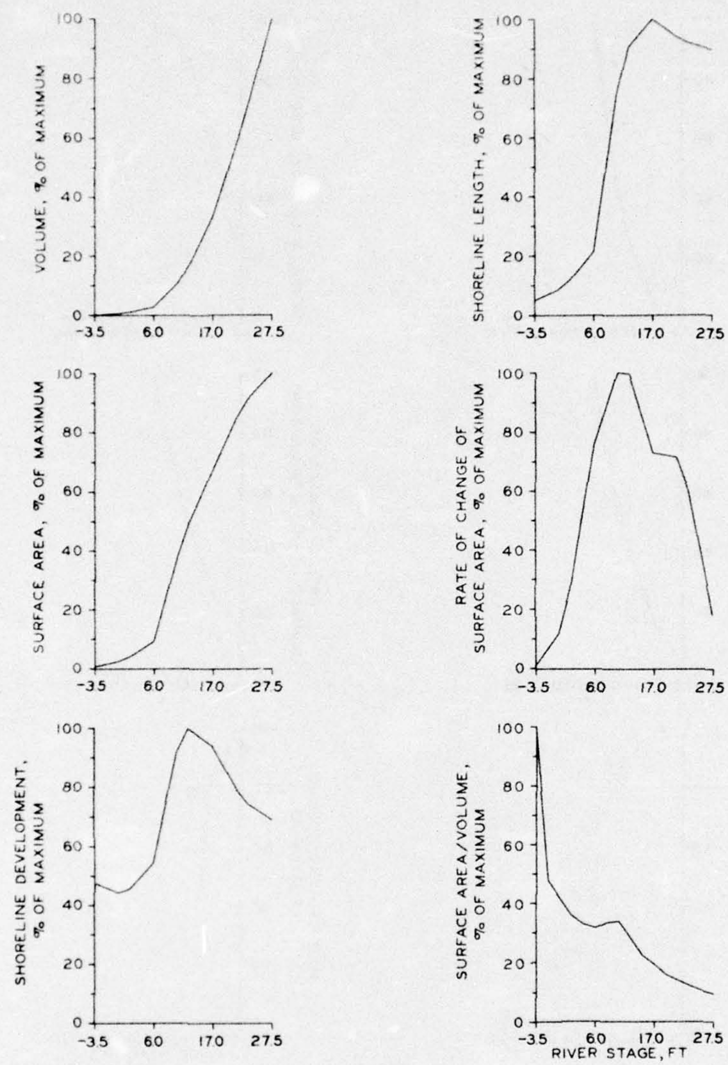
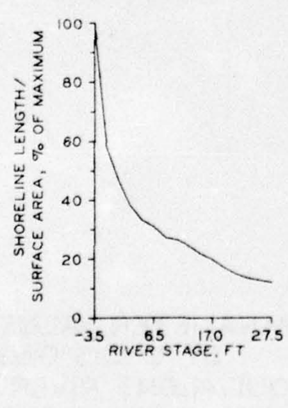
12 - 76



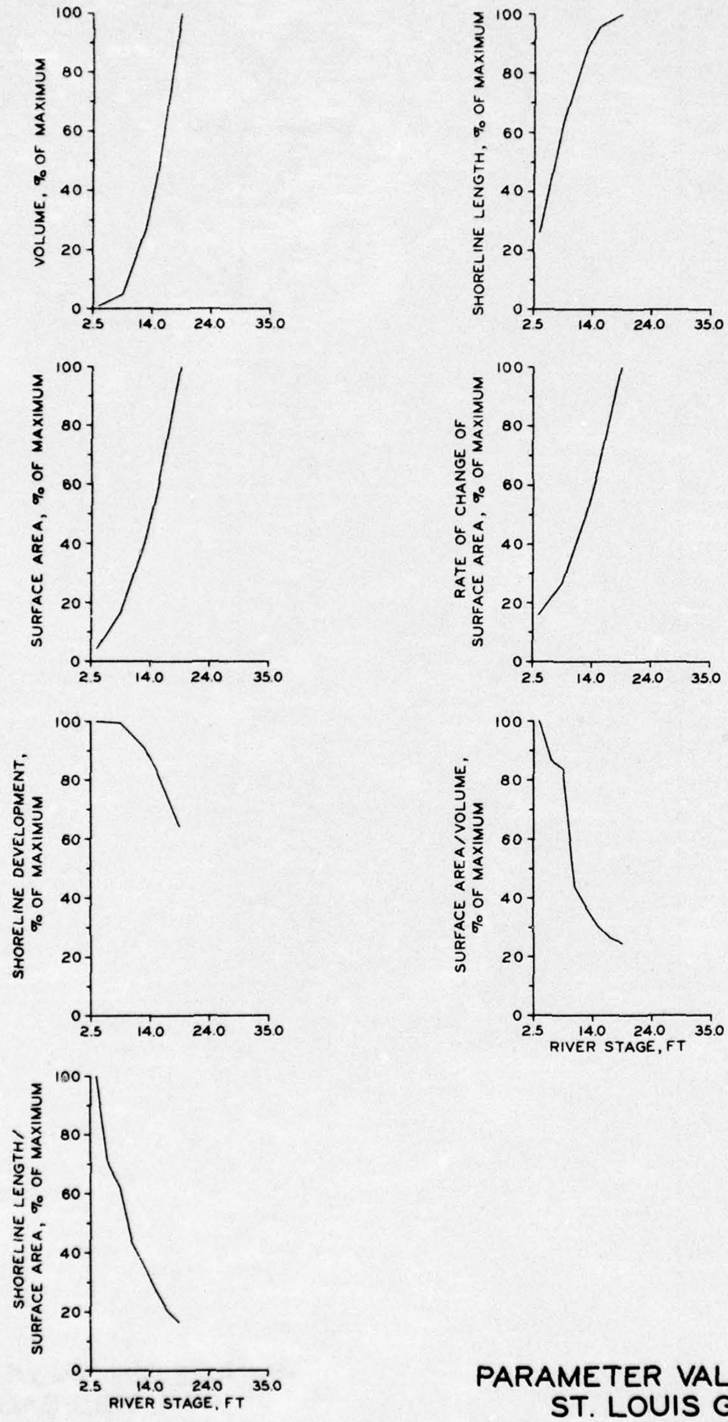
PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER
SIDE CHANNEL MORO

PLATE 6

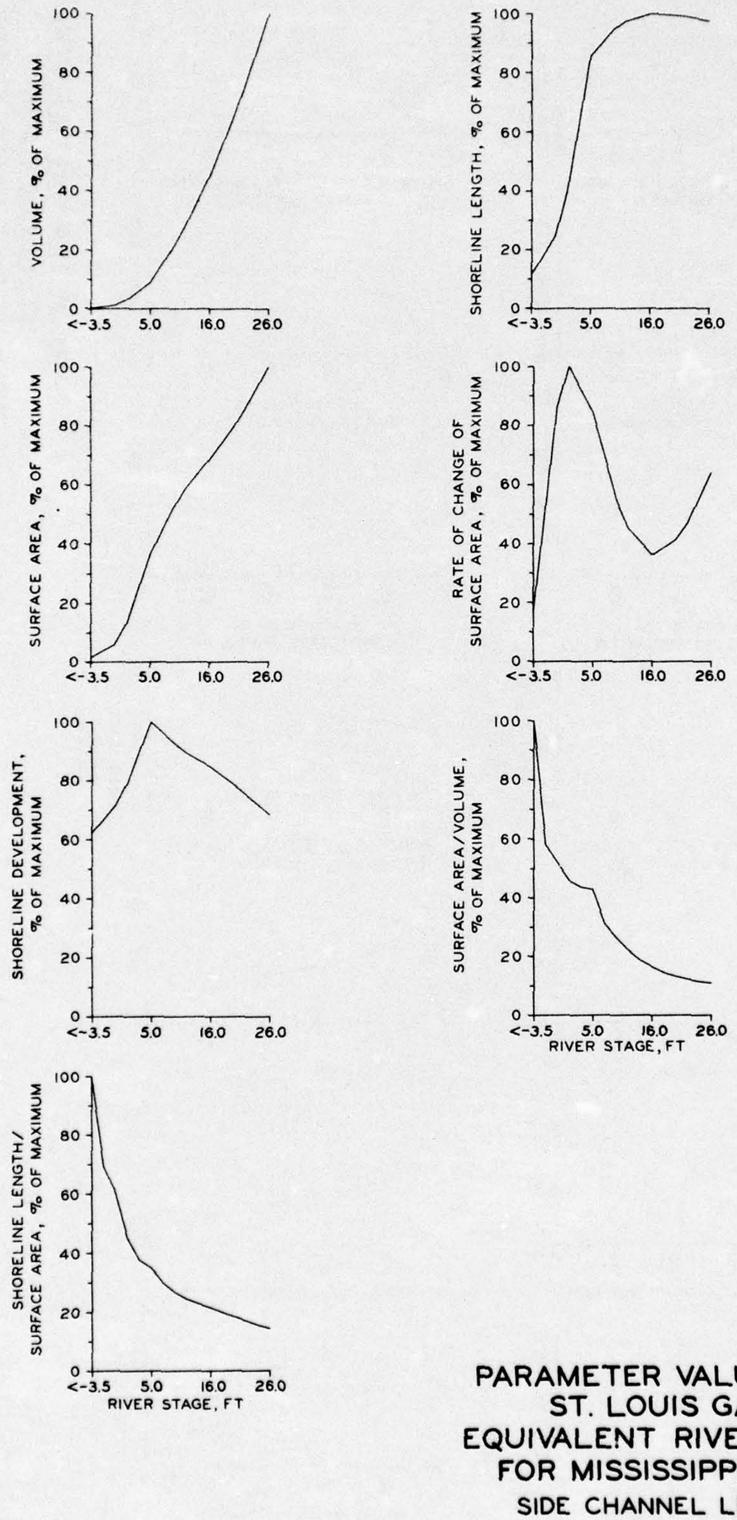




PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER
SIDE CHANNEL KASKASKIA



PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER
SIDE CHANNEL CRAINS



PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER
SIDE CHANNEL LIBERTY

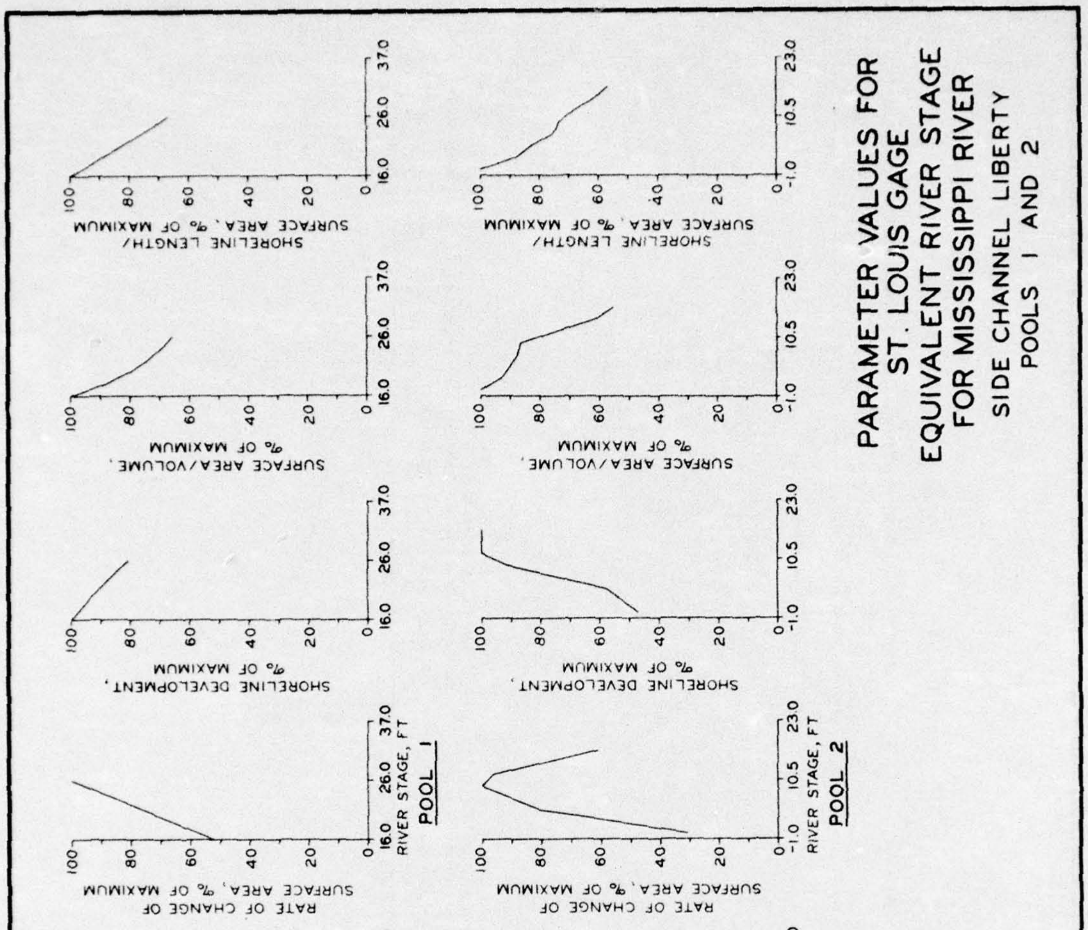
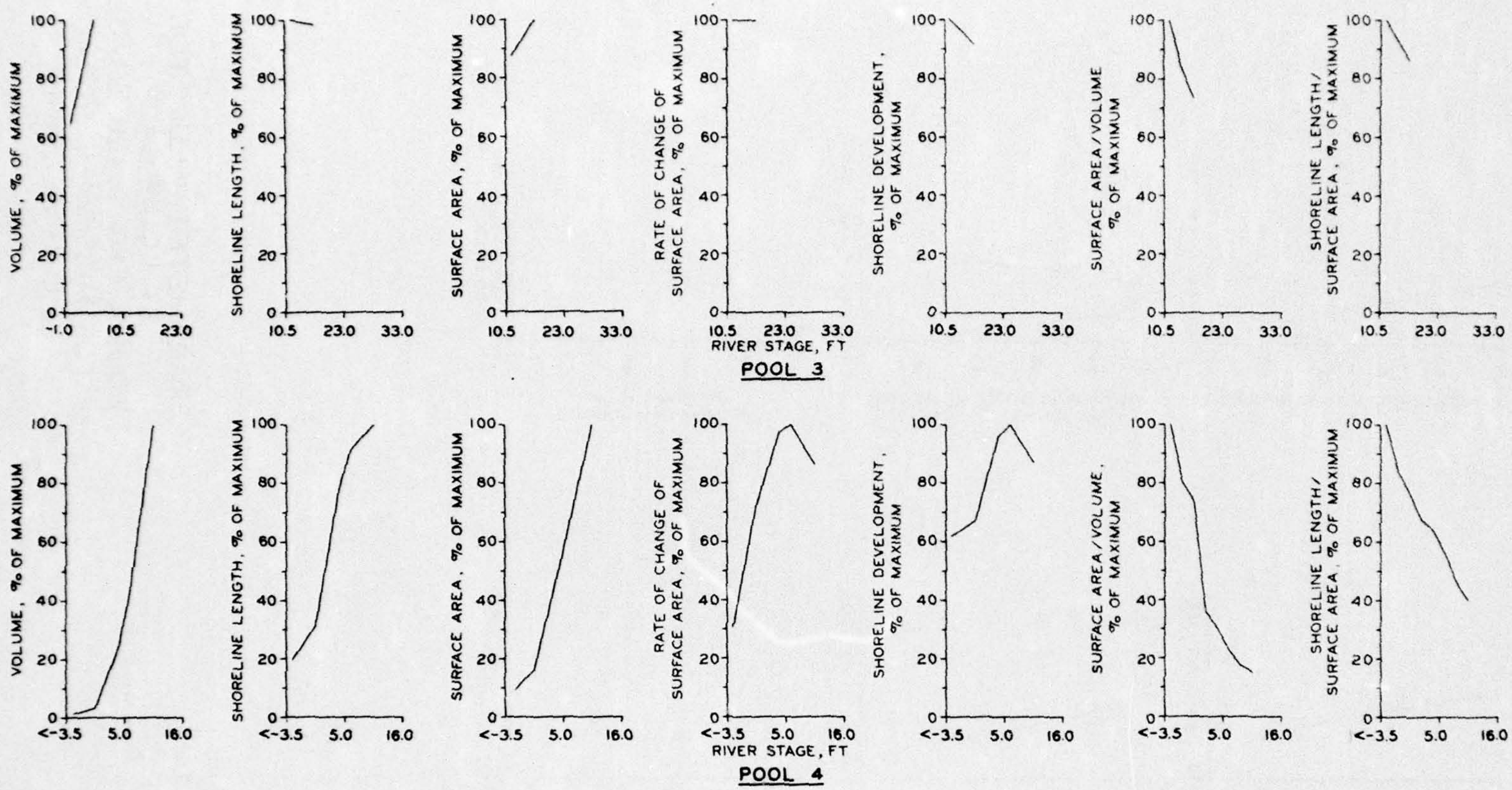

PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER
SIDE CHANNEL LIBERTY
POOLS 1 AND 2
POOL 1
POOL 2
RIVER STAGE, FT
VOLUME, % OF MAXIMUM
SHORELINE LENGTH, % OF MAXIMUM
SURFACE AREA, % OF MAXIMUM
RATE OF CHANGE OF SURFACE AREA, % OF MAXIMUM
SHORELINE DEVELOPMENT, % OF MAXIMUM
SURFACE AREA/VOLUME, % OF MAXIMUM
SHORELINE LENGTH/ SURFACE AREA, % OF MAXIMUM
0
20
40
60
80
100
16.0
26.0
37.0
-1.0
10.5
23.0

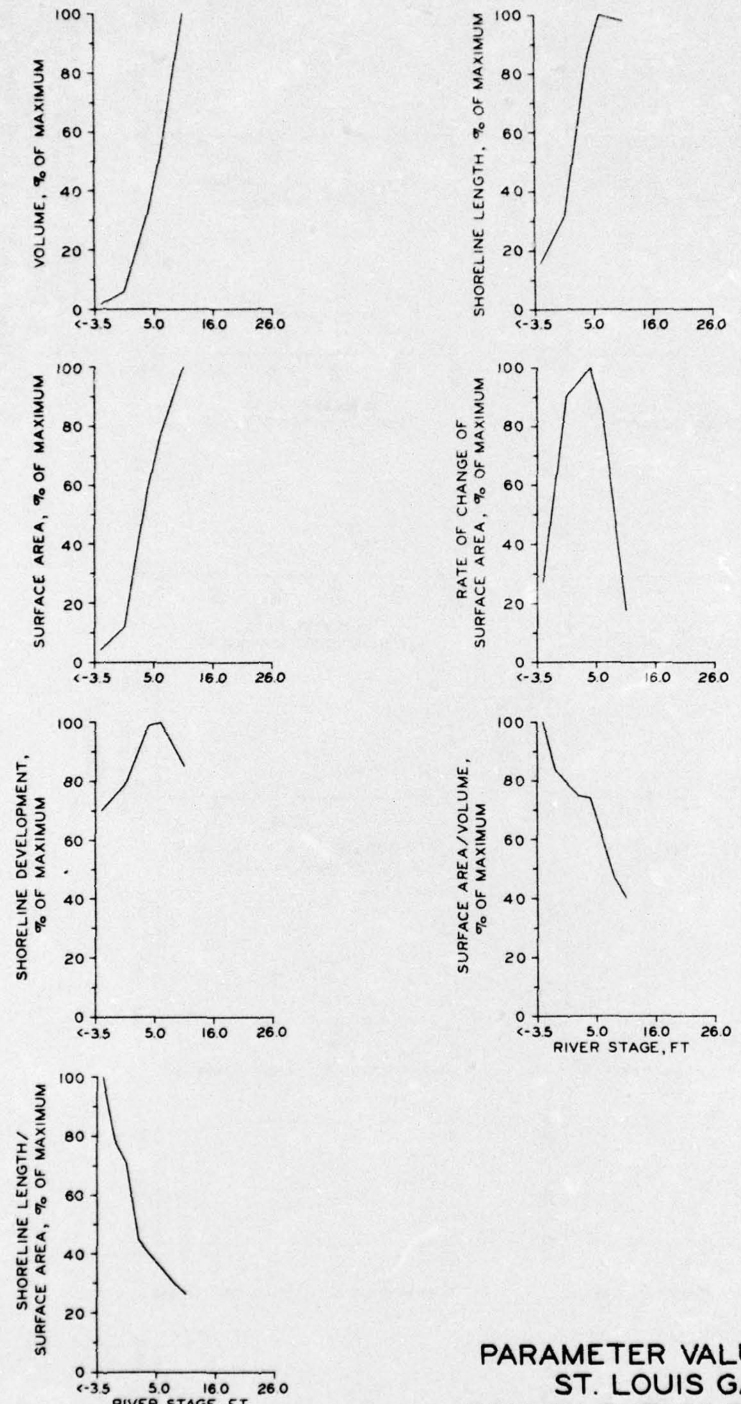
PLATE 9B



PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER

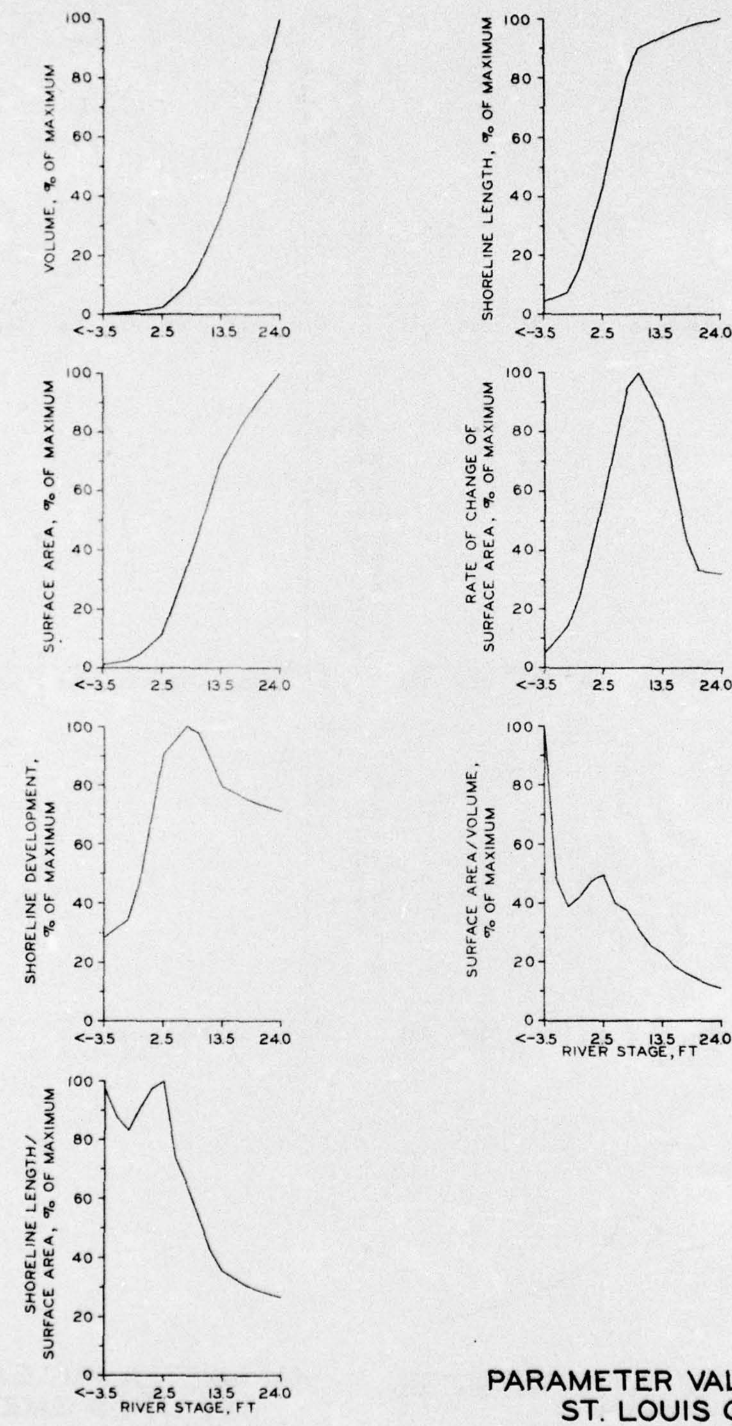
SIDE CHANNEL LIBERTY
POOLS 3 AND 4

PLATE 9C



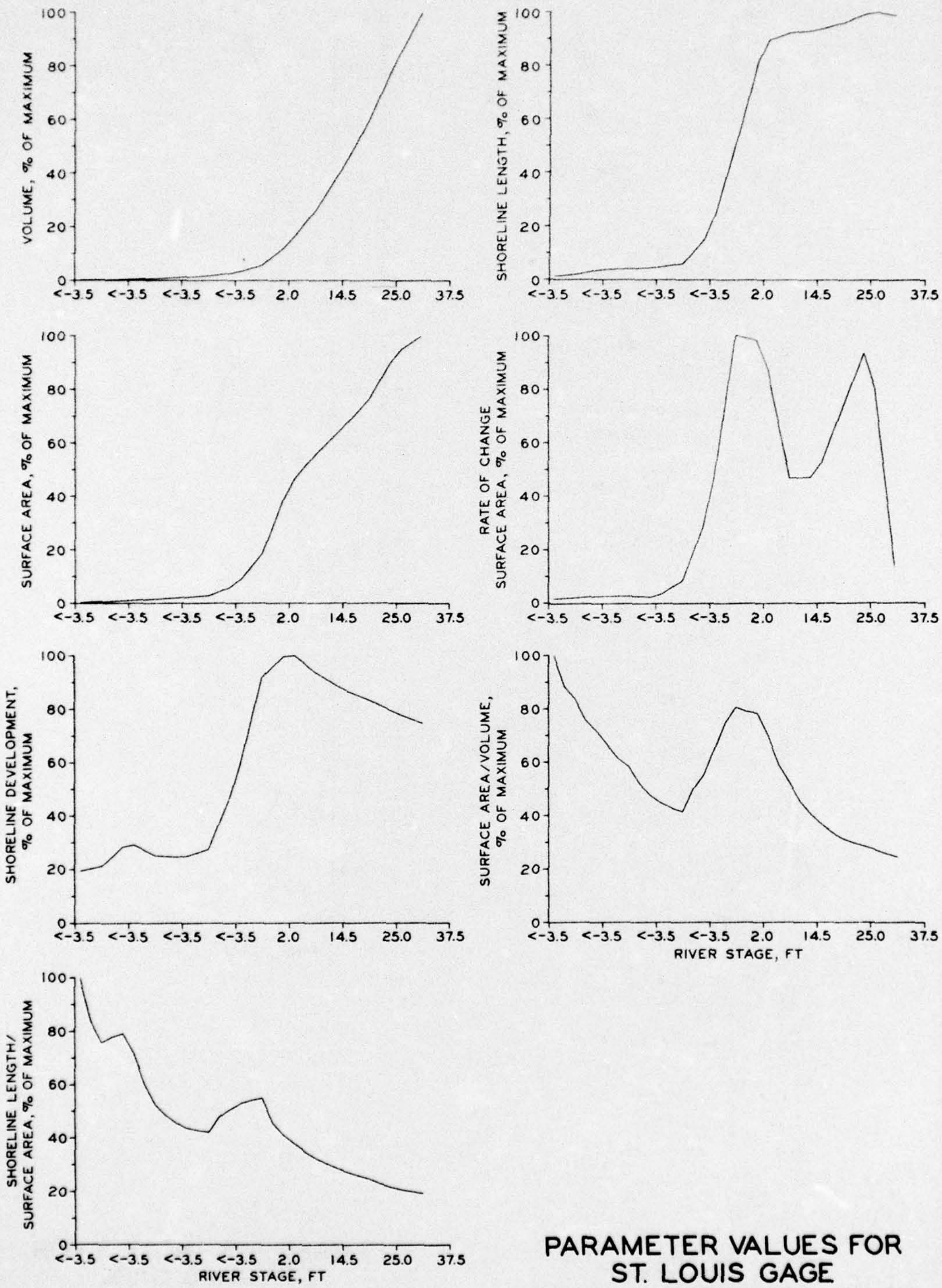
PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER
SIDE CHANNEL LIBERTY
POOL 5

PLATE 9D



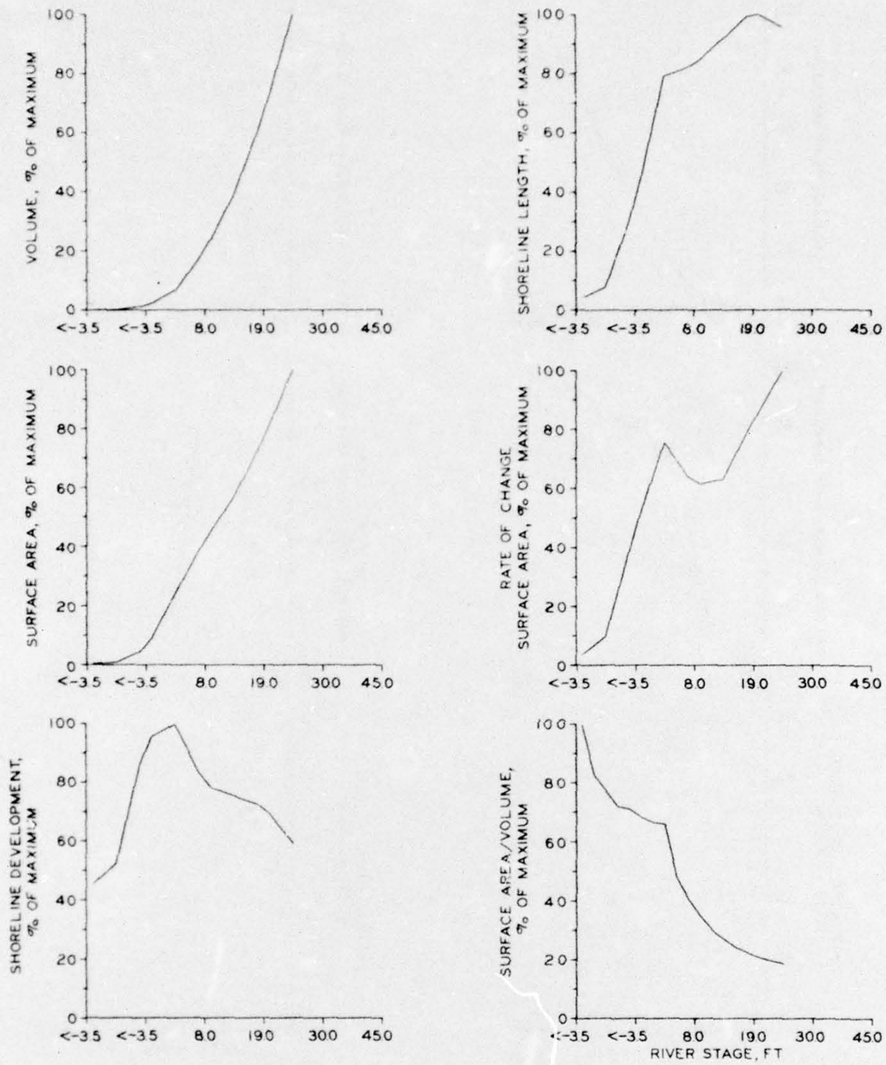
PARAMETER VALUES FOR ST. LOUIS GAGE EQUIVALENT RIVER STAGE FOR MISSISSIPPI RIVER

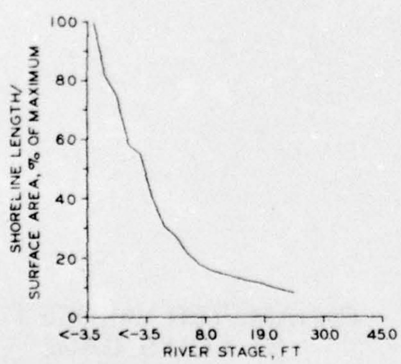
SIDE CHANNEL JONES



PARAMETER VALUES FOR ST. LOUIS GAGE EQUIVALENT RIVER STAGE FOR MISSISSIPPI RIVER

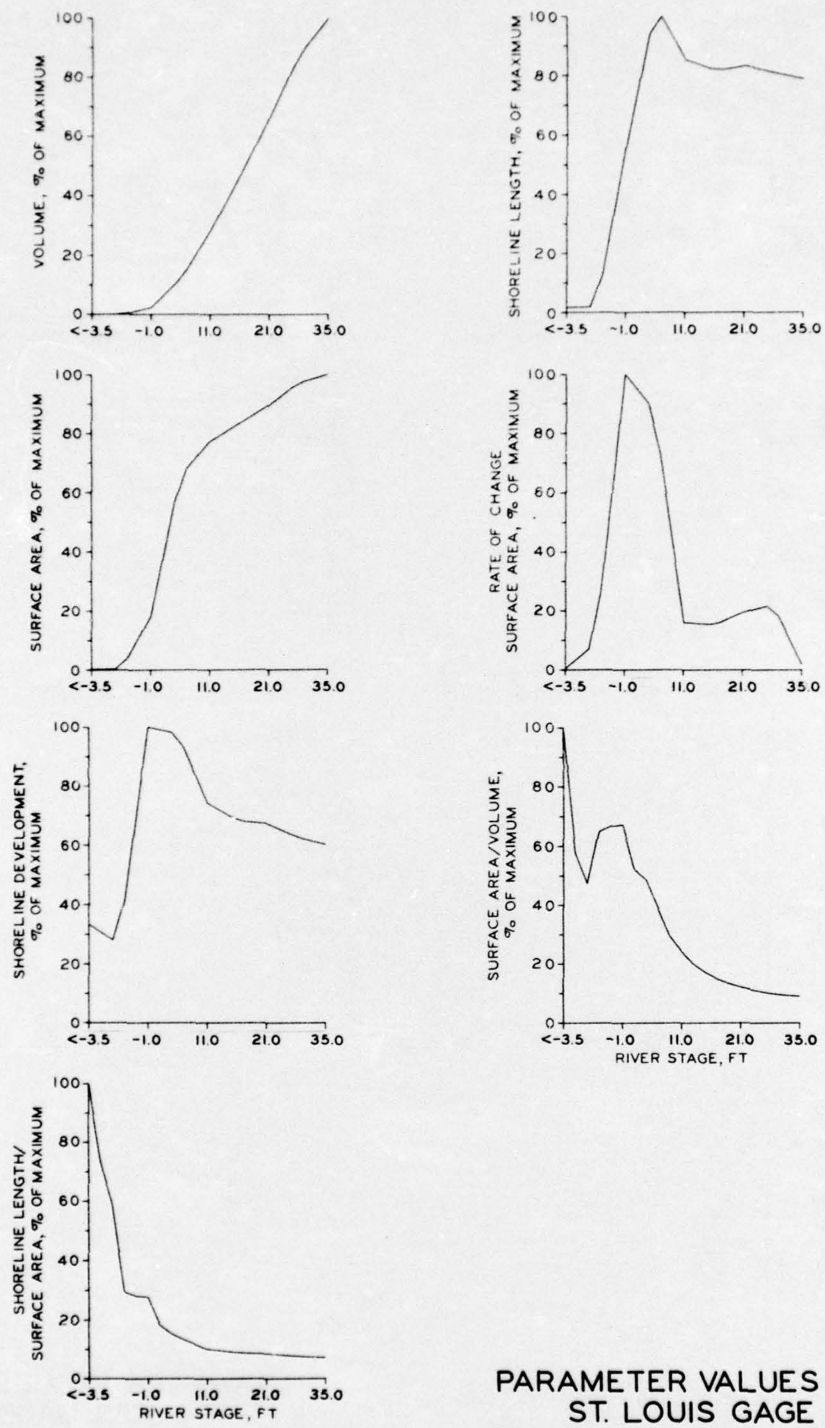
SIDE CHANNEL PICAYUNE





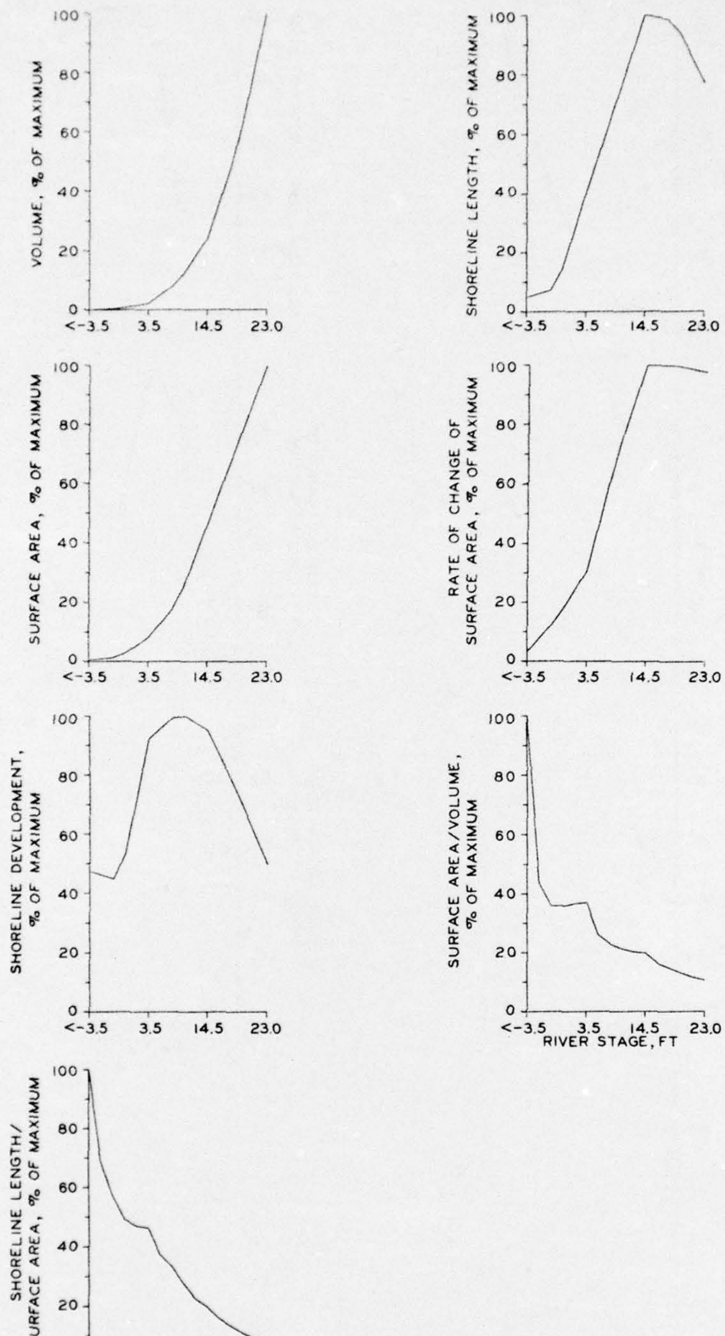
PARAMETER VALUES FOR ST. LOUIS GAGE EQUIVALENT RIVER STAGE FOR MISSISSIPPI RIVER

SIDE CHANNEL CAPE BEND

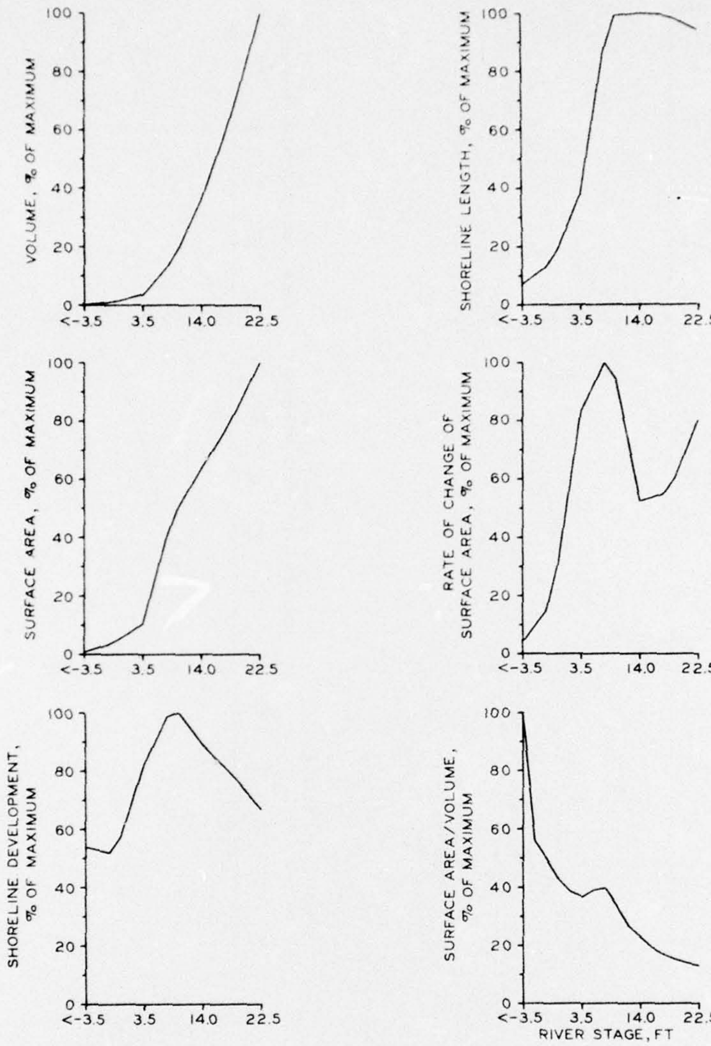


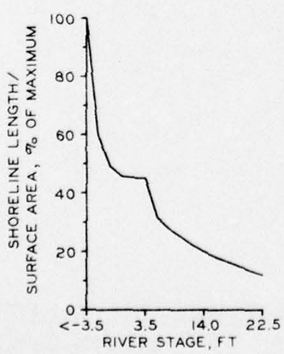
PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER
SIDE CHANNEL SANTA FE

PLATE 13

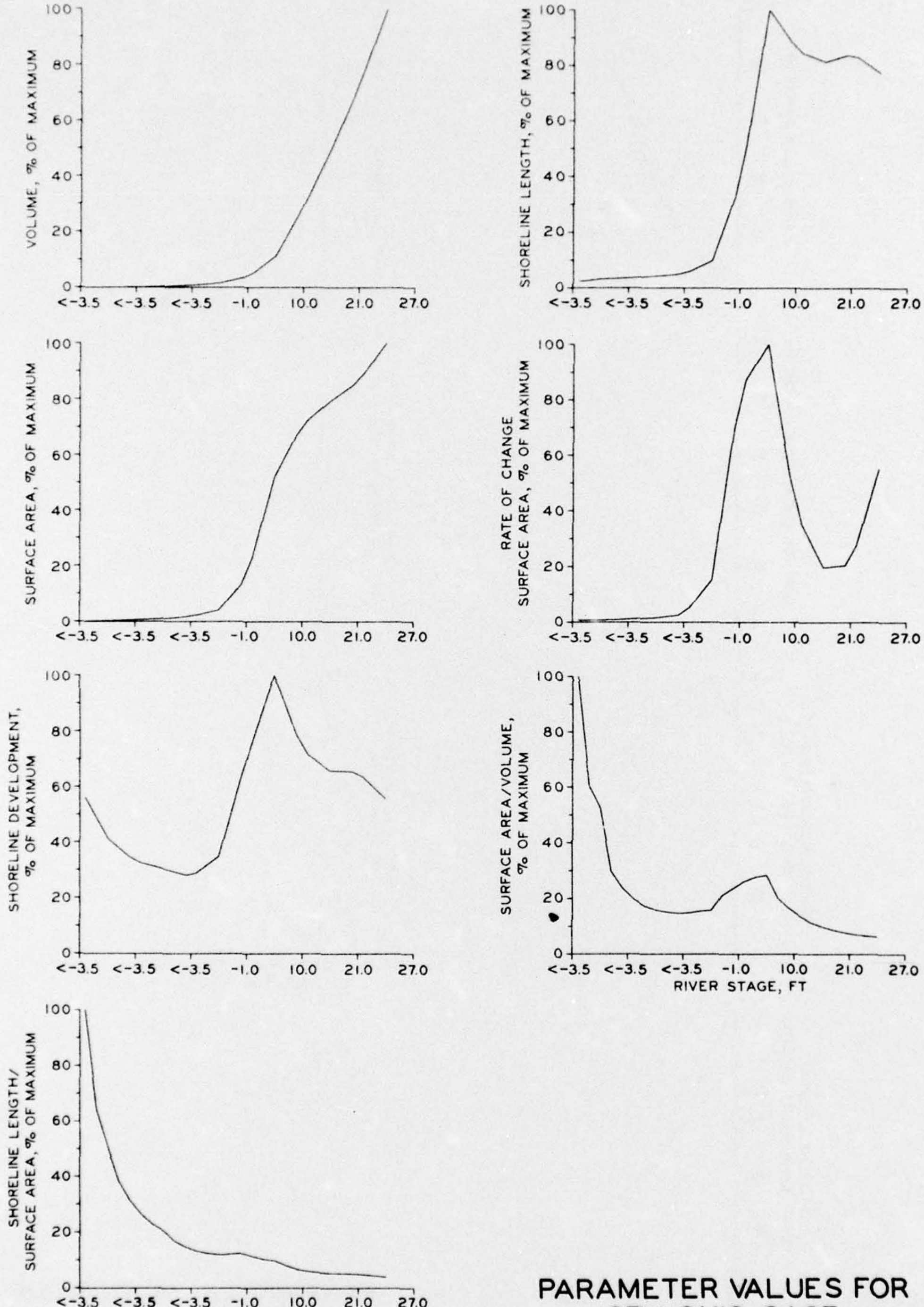


PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER
SIDE CHANNEL BILLINGS



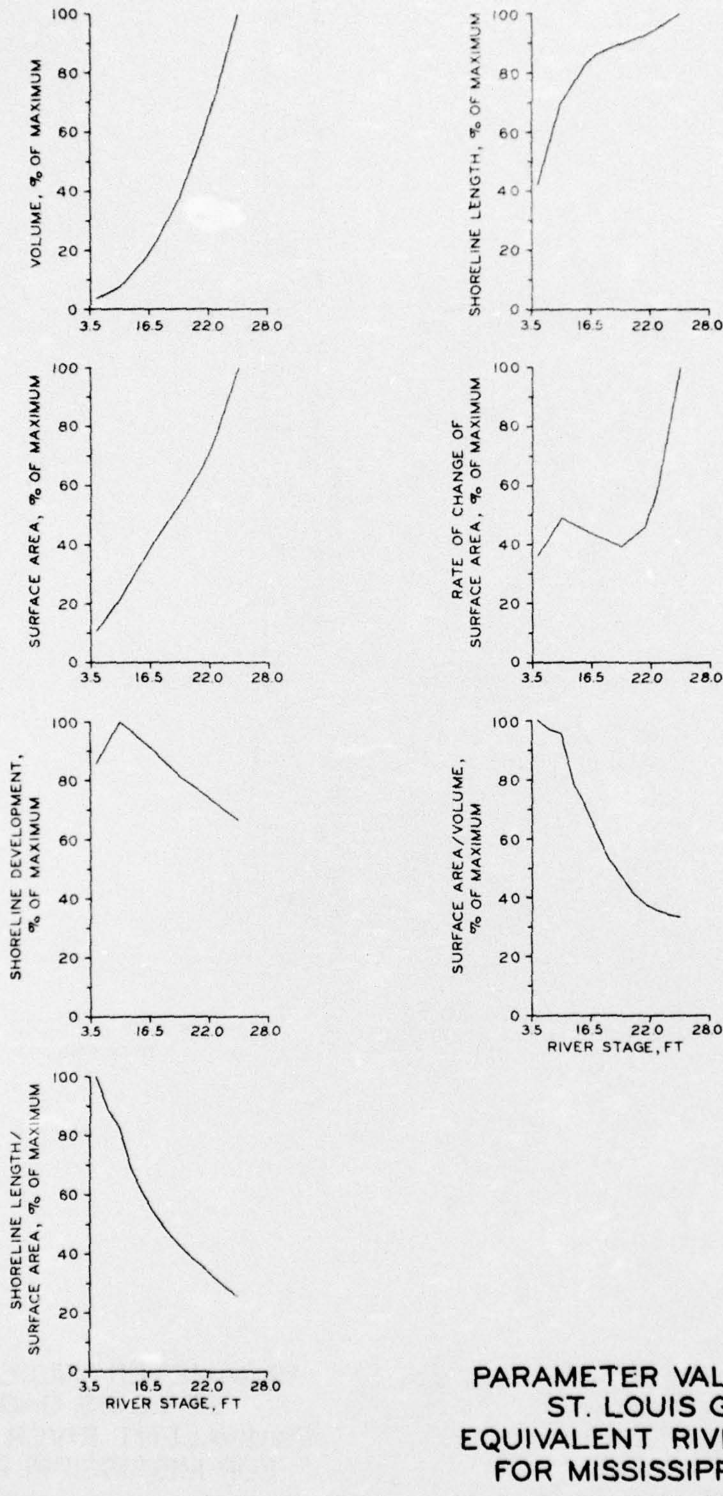


PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER
SIDE CHANNEL BUFFALO



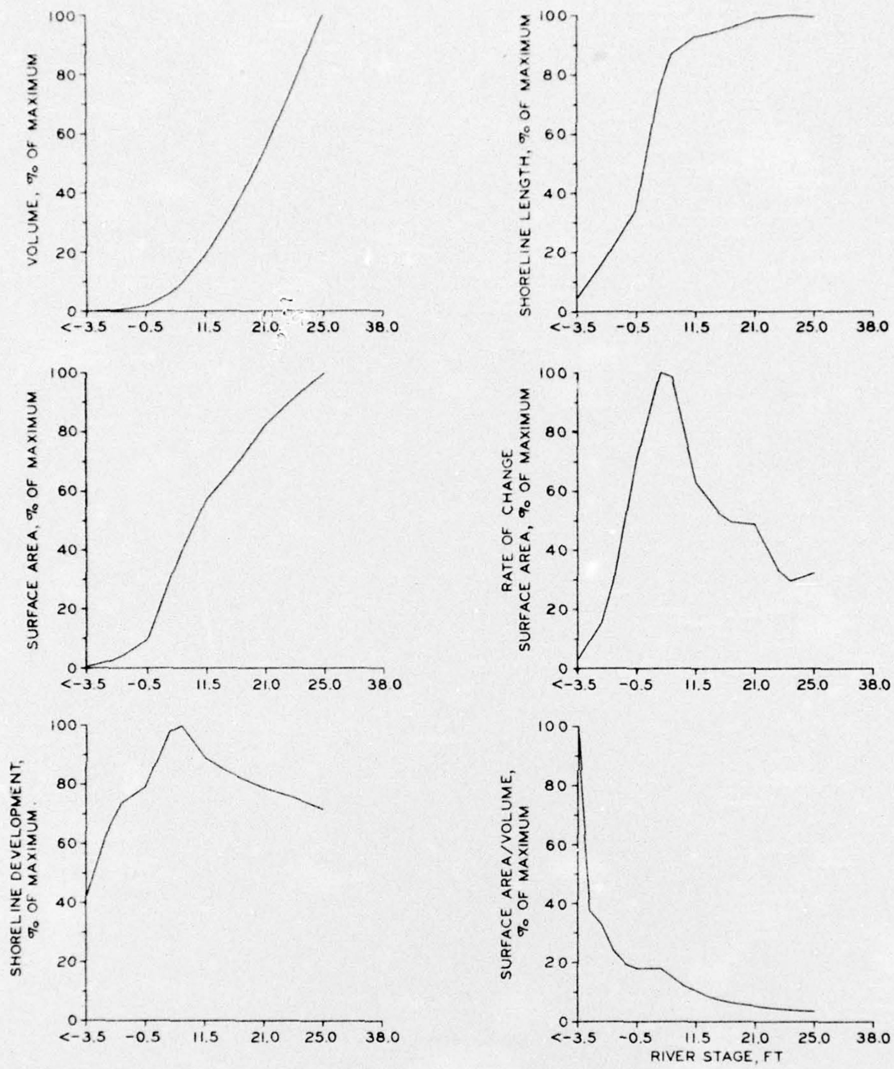
PARAMETER VALUES FOR ST. LOUIS GAGE EQUIVALENT RIVER STAGE FOR MISSISSIPPI RIVER

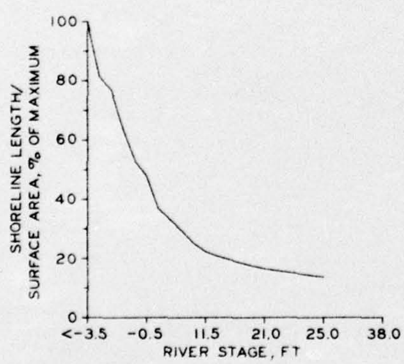
SIDE CHANNEL BROWNS



PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER

SIDE CHANNEL THOMPSON





PARAMETER VALUES FOR
ST. LOUIS GAGE
EQUIVALENT RIVER STAGE
FOR MISSISSIPPI RIVER
SIDE CHANNEL SISTER

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13. ABSTRACT

Several geometric characteristics of water-basin regimes, including basin size and shape, area underwater at specific water depth, and cross-sectional area, are commonly associated with benthic, plankton, and fish community population structures, although little quantitative data are available to support the association. This two-volume report describes a general procedure that was developed to calculate values of selected parameters used to define the above-mentioned geometric characteristics of any water-basin regime. The procedure was successfully applied to yield quantitative information for those parameters for 18 side channels of the Middle Mississippi River. Which of the parameters selected as quantitative descriptors of the characteristics are best indicators of animal community population structures is expected to be determined as a result of other projects currently under way at the U. S. Army Engineer Waterways Experiment Station. Volume I contains a description of the procedure and the results of implementing it; Volume II contains a set of computer-plotted contour maps for the 18 side channels.

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