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Side Scan Sonar Survey of Clinch River and Poplar Creek, Tennessee

by Keith J. Sjostrom, Rodney L. Leist, Thomas S. Harmon, Jr.

Prepared for Oak Ridge National Laboratory

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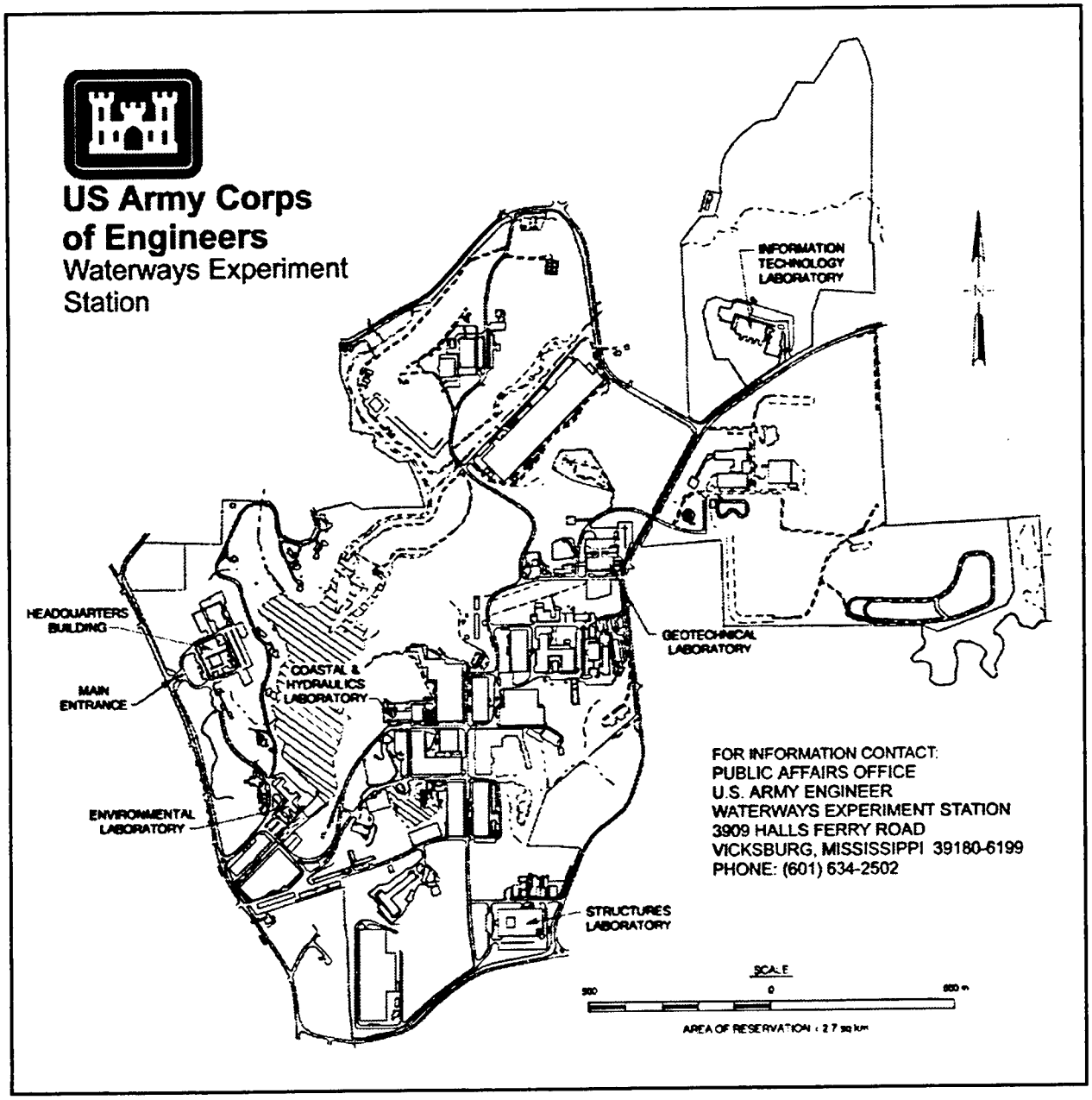

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Contents

Preface

A side scan sonar investigation was conducted in Clinch River and Poplar Creek, Tennessee, by personnel of the Geotechnical Laboratory (GL), U.S. Army Engineer Waterways Experiment Station (WES), during the period 3-17 February 1994. The investigation was performed under sponsorship of the U.S. Department of Energy (DOE), Oak Ridge National Laboratory (ORNL). The ORNL Project Coordinator was Dr. Daniel A. Levine.

The overall test program was conducted under the general supervision of Dr. W. F. Marcuson III, Director, GL, and Dr. A. G. Franklin (retired), Chief, Earthquake Engineering and Geosciences Division (EEGD). Mr. Keith J. Sjostrom was the principal investigator. This report was prepared by Messrs. Sjostrom and Rodney L. Leist under the supervision of Mr. J. R. Curro, Jr. (retired), Chief, Engineering Geophysics Branch. Instrumentation support was provided by Mr. Thomas S. Harmon, Jr., EEGD. Data acquisition assistance during this study was provided by Mr. Terry N. Waller, Hydraulic Structures Division (HSD), Hydraulics Laboratory (HL). Data presentation and graphics support was provided by Ms. Lori M. Davis, EEGD, Ms. Janie M. Vaughan, HSD, HL, and Mr. Grady A. Holley Jr., Applied Research Associates, Vicksburg, MS.

Acknowledgment is made to Captain Mat Methany for piloting the WES research vessel "Waterways Explorer." Personnel of the Environmental Sciences Division, ORNL, DOE, are also acknowledged for their assistance and logistical support during this field study.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Robin R. Cababa, EN.

Conversion Factors, Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
feet	0.3048	meters
miles (U.S. statute)	1.6093	kilometers

1 Introduction

Background

The U.S. Department of Energy, Oak Ridge National Laboratory (ORNL), Tennessee is a center for nuclear energy and weapons research. During the 1950's and 1960's, quantities of cesium and mercury were released into the Clinch River and Poplar Creek waterways in association with nuclear energy research at ORNL and weapons components production at the Y-12 Plant (Olsen et al. 1990). Water from Poplar Creek and Clinch River serve as transport media for contaminants released from ORNL. These two streams, located in the southeastern Tennessee, flow into the Tennessee River and Watts Bar Reservoir as shown in Figure 1. Riverine sediment samples acquired over the past 30 years, and summarized in Olsen et al. (1990), indicate that the quantities of cesium and mercury have an affinity for and accumulate in the clayey bottom sediments.

To address the need for characterizing the nature and extent of contamination, plans and specifications for studying the distribution and extent of fine-grained bottom sediments deposited in Clinch River and Poplar Creek since completion of the Watts Bar Dam in 1946 are presently being prepared by the Environmental Sciences Division, ORNL. Identification of recently deposited sediments are necessary for planning sampling programs in these streams in order to develop maps of the bottom sediment characteristics and better identify sites best suited for sediment coring. At the request of ORNL, the U.S. Army Engineer Waterways Experiment Station (WES) conducted a side scan sonar survey of Clinch River and Poplar Creek.

Purpose and Scope

The objective of this study is to delineate the characteristics and features of the river bottom topography and sediments along Clinch River and Poplar Creek. Sediment identification will be in terms of gross soil classification and correlated to bottom sediment sample information. The Clinch River project area extends from River Mile (RM) 0 at the confluence with the Tennessee River to RM 21.7 at the Highway 95 Bridge. The Poplar Creek project begins at the confluence with Clinch River (RM 0) and extends 2.2 miles upstream to

the first highway bridge. The resultant sonar bottom images are intended to highlight the distribution, extent, and continuity of fine-grained (clayey) sediment deposits on the bottom of the flooded stream channels. The results will supplement previously obtained soil samples and borings by providing continuous river bottom coverage along the length of each project area. This information will facilitate the accurate positioning of any post-survey sampling as may be required.

Overview of Site Geology

Clinch River and Poplar Creek are located in the Appalachian Valley and Ridge physiographic province in which the surface topography is characterized by parallel ridge and valley systems. These landforms are formed by preferential erosion of folded and faulted sedimentary rock units of the Paleozoic Era. Specific rock groups and formations that outcrop along the stream channels include the Rome formation of the Cambrian Period and the Knox, Stones River, and Nashville Groups of the Ordovician Period. A detailed description of these units may be found in Lemiszki (1994). The Ordovician strata are primarily limestones and dolomites whereas the Rome formation consists of sandstone, siltstone, and shale.

Prior to construction of Watts Bar Dam on the Tennessee River, sediment material entering the Clinch River and Poplar Creek stream channels, especially the fine-grained size particles, were fluvially transported through the river systems into the Tennessee River channel. The primary sediment deposition at the time were the larger size particles which formed point bar deposits (sand bars) along the inside of the river bends. Since completion of the dam in 1946, the sections of the Clinch River and Poplar Creek being studied are now flooded stream channels. Sediments, including the fine-grained size particles, now accumulate at greater rates within the river bends and along the river bottom. In fact, sediment transport is now only a major factor during high water flow events. At the present, the river bottom sediments consist primarily of fine sand, silt, and clay to thicknesses ranging from 1 to 10 ft. The greatest thickness of accumulated sediments exists between the confluences of the Emory River and Tennessee River (see Figure 1). Coarse sand and gravel deposits within the post-1946 sediment accumulation are sporadically located along the river bottom.

The quantities of cesium and mercury released during weapons research and production have a chemical affinity for the clayey particles within the river bottom sediments. It is the purpose of this study to remotely locate and define areas within the Clinch River and Poplar Creek where clayey, fine-grained sediments have accumulated along the river bottom since 1946 in order to provide focus to any post-survey bottom sampling.

2 Technical Approach

Side Scan Sonar Operation

Side scan sonar is an acoustic imaging device used to provide wide-area, large-scale images of the bottom of a body of water. The system consists of an onboard recording system and control modules, an underwater acoustic source and sensor (typically referred to as a towfish), and a cable linking the two units (Figure 2). During survey operations, the side scan sonar system continually charges capacitors in the towfish to set energy levels which are determined as a function of the imaging range. The range may be adjusted between 25 and 600 m. At discrete time intervals, the recorder transmits this stored power to the transducers in the towfish which in turn emit an acoustic pulse or 'ping' having a central frequency of either 100 or 500 kHz. The acoustic signals propagate through the water column over the set imaging range and reflect off differing interfaces along the bottom surface. The returning signals are received at the transducers, amplified using a time varied gain function, and digitally recorded. Data associated with each 'ping' is stored on field tapes with the corresponding positioning, time, date, towfish altitude above the bottom, and system parameters (imaging range, gain, signal frequency, etc.). The system performs further filtering, amplification, and digitizing functions before calculating the proper position of the signals on the final record. The recorder prints the resultant signatures one scan at a time to provide a continuous image of the bottom surface along the survey line and, whereby highlighting bottom features and variations in site characteristics. Further information concerning the side scan sonar theory of operation may be found in 'Sound Underwater Images' (Fish and Carr 1990).

The printed amplitude signatures received from various bottom features can be qualitatively interpreted for the feature geometry, identification, and possible material composition. The reflectivity potential of an underwater surface is a function of the side scan sonar's beam angle of incidence as it encounters that target. When the acoustic pulse ('ping') is normal to a surface, more energy returns to the towfish than when a beam strikes at a differing angle. This angle of incidence, along with the surface roughness, are the primary reasons for the darker and brighter areas on the sonar record. The various shades of signal intensities assist in better record interpretation. Cultural features such as submerged roads, pipelines, or man-made debris are easily imaged during typical survey conditions. Objects or features protruding above the bottom surface reflect the acoustic energy back to the transducers and cast an acoustic shadow

behind them. Such features may be mounds (Sjostrom, Leist, and Harmon 1997), geologic formations, or man-made objects such as timbers, weirs, and bridge piers. Sandy or gravelly material typically produces a darker gray pattern on the side scan record whereas lighter shades may be indicative of more silty or clayey material (Sjostrom, Leist, and Harmon 1996). However, the beam angle, towfish path, survey vessel speed, signal gain, and other physical parameters may all affect the appearance and resolution of the side scan sonar record.

Survey Layout and Equipment

The survey was conducted aboard the WES Research Vessel (R/V) *Waterways Explorer*. The towfish was rigidly attached to a telescoping arm and deployed along the starboard side of the research vessel. During data acquisition, the towfish was lowered to a depth of six feet below the water surface and operated at a frequency of 100 kHz. The imaging range was typically 100 or 150 m in order to provide bank-to-bank resolution of the river bottom. The received signatures are printed in a 'shades-of-gray' format during the survey and digitally recorded on field tapes for post-processing. Numbered fix points are printed incrementally along the side scan records in order to correlate the sonar images with the positioning information. The survey vessel speed ranged from 3 to 5 knots during data acquisition.

Positioning information for each survey line was provided using Trimble 4000 Series Differential Global Positioning System (DGPS) receivers. The positioning data were recorded simultaneously with the side scan sonar data using differential corrections received via the STARFIX satellite downlink provided by John E. Chance and Associates, Lafayette, Louisiana. The accuracy of the DGPS positioning data is limited to 3 to 5 m. The WGS-84 geographic coordinates (latitude/longitude) recorded during the investigation were translated to the Tennessee State Plane, North American Datum 1927 (NAD27) coordinate system (Easting/Northing) for data presentation and mapping. Precision bathymetric data were also simultaneously recorded along each survey line. River bottom elevations are referenced to the National Geodetic Vertical Datum (NGVD) 1929 using the Watts Bar Reservoir pool level and incorporating the daily pool level changes. Pool level fluctuations were recorded each day using the river stage gages located at the U.S. Highway 70 and Highway 58 Bridges. These values, along with the date and time recorded, are presented in Table 1. Positioning and corrected river bottom elevation data acquired along the channel centerline are listed in Appendices A through E with respect to the side scan sonar fix points.

Maps showing the location of the geophysical survey lines along Clinch River are presented in Figures 3 through 6. The Clinch River survey is subdivided into four sections as determined by the navigation and positioning equipment. The survey lines are spaced 100 ft apart and follow the centerline of the navigable channel. The survey line in Poplar Creek is illustrated in Figure 7.

The survey layout in each of the Clinch River sections and in Poplar Creek is described as follows.

Clinch River - Section 1

Section 1 of the Clinch River survey begins at Clinch River Mile (CRM) 0.0 and extends approximately 5.9 miles to CRM 5.9 as shown in Figure 3. Clinch River Mile 0.0 is at the confluence with the Tennessee River. The survey consists of seven profile lines labelled CS11 through CS17 (Figure 3). One survey, profile CS11, is conducted along the center line of the river channel and surveys CS12 and CS13 are positioned at a distance of 100 ft on either side of the center line. The remaining surveys, CS14 through CS17, are offset a distance of 200 ft from the channel centerline. Surveys CS14 and CS15 are performed between CRM 0.0 and the U.S. Highway 70 Bridge at approximately CRM 2.3. Surveys CS16 and CS17 are located between the Interstate Highway 40 Bridge at CRM 2.3 and the confluence of the Emory River at CRM 4.4.

Clinch River - Section 2

Three survey lines, profiles CS21 through CS23, are performed along the entire length of Section 2. Section 2 is 4.6 miles long and extends between CRM 5.9 and CRM 10.5 as shown in Figure 4. Survey line CS21 follows the centerline of the river channel. A fourth survey, line CS24, is performed in the backchannel at Brashear's Island near CRM 9.5 (Figure 4).

Clinch River - Section 3

Section 3 of the Clinch River survey extends from CRM 10.5 to the Highway 58 (Gallaher) Bridge at CRM 14.1 as illustrated in Figure 5. Three survey lines, profiles CS31 through CS33, are performed along the 3.6 mile distance with survey line CS31 tracking the centerline of the river channel.

Clinch River - Section 4

The fourth section of the Clinch River survey extends 7.6 miles between the Highway 58 (Gallaher) Bridge at CRM 14.1 and the Highway 95 Bridge at CRM 21.7 as illustrated in Figure 6. Survey lines CS41 and CS42 extend the entire length of the study area with survey CS41 following the centerline of the river channel. From the Highway 95 Bridge downstream to CRM 18.1, a third survey (line CS43) follows the north bank of the river and eventually extends into the backchannel of Grubb Island between CRM 18.1 and 18.8. At CRM 19.5, survey line CS44 diverges from the main river channel to extend into the backchannel of Jones Island (Figure 6).

Poplar Creek

The Poplar Creek survey begins at the confluence of Poplar Creek with Clinch River and extends 2.2 miles upstream to the first bridge crossing as shown in Figure 7. The confluence is located at CRM 12.0. One side scan sonar survey, line CPC1, is performed along the centerline of the river channel as shown in Figure 7.

3 Bottom Sediment Information

Following the geophysical investigation, 41 bottom samples were collected in Clinch River and Poplar Creek with locations determined in part from interpretation of the side scan sonar records. Sediment sampling was performed by ORNL in March 1994 and the sediment analysis was completed by May 1994. The 38 post-survey Clinch River sample locations, listed as samples 50169 through 51899, are illustrated in Figures 3 through 6 with the bottom sediment analysis results outlined in Table 2. The location of post-survey Poplar Creek samples 50891, 50898, and 51003 are displayed in Figure 7 with the measured laboratory results outlined at the end of Table 2. Sediment analysis yielded information on the following parameters: wet density, grain size percentages (percent sand and gravel, percent silt, percent clay), and an ORNL sediment classification. Wet density information was not provided for the Poplar Creek samples.

The fine grain size fraction, consisting of silts and clays, is the dominant sediment group within the bottom sediments of the Clinch River study area with silt material consistently having higher percentages than clay. In samples where the coarse grain size fraction is present, the prevailing grain sizes are very fine to fine sands with little to no coarse sand or gravel. The bottom sediments between CRM 0.0 and 4.3, between the Tennessee and Emory Rivers, consist of silts and clays which comprise greater than 70 percent of the sediment composition. From CRM 4.3 to 13.0, sediment grain sizes alternate between fine and coarse-size material and are largely dependent on the sample location. The four bottom samples collected in the remaining seven miles of the project area (CRM 13.0 to 21.5) indicate sediments consisting predominantly of sand with percentages in excess of 54.9 percent. Measured sediment density values for all samples ranged from 1.05 to 1.99 g/cm^3 with an average value of 1.36 g/cm^3.

The three samples collected in Poplar Creek indicate that percentages of silt material are the most prominent grain size with values exceeding 63.5 percent (see bottom of Table 2). Sands and gravels were found to be more common in the near-surface material with percentages ranging from 8.2 to 20.2 percent. The percent clay ranged from 12.9 to 17.1.

4 Data Analysis and Results

Side Scan Sonar Data Analysis

Continuous side scan sonar profiles for surveys performed in each section of Clinch River and Poplar Creek are interpreted to identify areas of fine-grain (clayey) bottom sediments. Bank-to-bank imaging of the river bottom along the channel also allows determination of the extent and continuity of deposited sediments. It is noted that the side scan sonar provides minimal, if any, sub-bottom information. The sonar records, annotated with project location and survey line designation, direction, and fix points, are correlated with the DGPS positioning information such that identified features and interpretations may be accurately located on maps of the project area. The survey line positioning data are referenced to the Tennessee State Plane, NAD27 coordinate system. The positioning data and corrected river bottom elevations (referenced to NGVD 1929) along the channel centerline for Clinch River Sections 1 through 4 are listed in Appendices A through D, respectively. The positioning and river bottom elevation data for the Poplar Creek survey are outlined in Appendix E.

The side scan sonar interpretations are determined from acoustic signatures collected by a remote sensing technique and should not be considered as absolute identification of river bottom features. As with any geophysical method, there are limitations with the technique's ability to accurately resolve, detect, or identify the target of interest. Some of the limitations and possible errors as applied to this study are outlined as follows.

a. *Signal-to-noise ratio.* The ability of the side scan sonar to accurately detect and resolve river bottom features is a function of data quality. Acoustic data with low signal-to-noise ratios will produce poor quality results or no results at all. Throughout the investigation, data quality along each survey line is good. Isolated occurrences of poor signal-to-noise data were caused by boat motor noise during survey vessel maneuvering and water turbulence generated by passing boats.

b. *Bottom feature identification.* As mentioned in "Side Scan Sonar Operation" (Chapter 2), the beam angle of the signal, towfish path, survey vessel speed, signal gain, and other physical parameters of the equipment and river bottom all affect the appearance and resolution of the side

scan sonar record. During this investigation, the river bottom sediments and characteristics were best resolved along survey lines conducted in the upstream direction.

c. *Positioning and water depth information.* To properly locate the interpreted side scan sonar anomalies and river bottom features, the survey positioning information must be accurate and complete. No problems occurred over the course of the survey and positioning and depth data coverage were obtained over the entire project area. However, heavy rainfall during a three day period caused the river levels to rise as much as 7 ft over the initial pool level. Only two river stage gages, located at the U.S. Highway 70 Bridge and Highway 58 Bridge, were available to monitor the rapid water level fluctuations. Therefore, some error may be present in the corrected river bottom elevations.

Results of Investigation

The interpreted side scan sonar results are illustrated on annotated maps of each river segment showing the general sediment characteristics, river bottom features, utility crossings, and other anomalous or notable images. Selected portions of sonar records that highlight or emphasize areas of interest are presented in the text. Areas of note are referenced with either sonar fix point numbers which can be correlated to an Easting/Northing position or to approximate river mile designations. River mile designations are noted on each of the maps (Figures 3 through 7) in one mile increments.

Clinch River - Section 1

The side scan sonar investigation in Section 1 of Clinch River, Clinch River Miles (CRM) 0.0 to 5.9, was directed along the survey lines indicated in Figure 3. Interpreted side scan sonar images and detected features are shown in Figure 8. At the confluence of the Tennessee and Clinch Rivers, the bottom signatures produce a relatively smooth texture indicative of silty bottom material. Small sediment waves along the channel bottom are detected between the confluence and CRM 1.8. Bottom sediment samples collected along this portion of Clinch River are classified by ORNL as soft mud and cohesive mud (Table 2). The percentages of silt and clay in the samples range from 68.1 to 97.5 percent. The sediment density varies from 1.13 to 1.66 g/cm^3 with an average value of 1.40 g/cm^3. Acoustic signals indicating a more coarse image texture are noted along the channel boundaries. Rock ridges originating from the high bluff (Stowe Bluff) extend into the river channel between CRM 1.0 and 1.5 (Figure 8). Some of these ridges may rise 3 to 5 ft above the existing channel bottom. Smooth textured bottom materials, likely silts, have been deposited between the ridges.

In the vicinity of the U.S. Highway 70 and Interstate 40 Bridges, the bottom signatures indicate an irregular bottom of mounds or pockets having a more coarse texture. Although the texture of these images are indicative of loose

rocks, cobbles, or gravels, ORNL personnel noted that areas of unconsolidated clays have been sampled along this stretch of the river. Upstream of the highway bridges, the river widens and the bottom signatures have a smooth, homogeneous texture indicative of silty material. These bottom signatures extend from the bridges, CRM 2.5, to the confluence of the Emory River at CRM 4.3. Bottom sediment samples in this area are categorized as soft or cohesive mud and the percentage of silts and clays is generally greater than 83 percent. Material density values range from 1.21 to 1.31 g/cm^3. A few interpreted rock ridges are detected near a rock outcrop along the northern edge of the river at CRM 3.5 (survey CS13, fix points 3021-3221) as indicated in Figure 8. These ridges as well as the bottom sediment sonar images are displayed in Figure 9.

A weir across the width of the river channel is noted at CRM 3.9 (Figure 8). The image of this structure is clearly defined and displayed in Figure 10 from data collected along survey CS13 (fix points 3421-3621). Downstream of the weir, bottom materials having a coarse texture are detected and likely represent loose rocks, cobbles, or gravels that have settled on the river bottom. Upstream of the weir at the confluence with the Emory River, sonar images indicate pockets of material also having a coarse texture. These areas may be zones of loose rock or cobbles that have settled out as the river widens. These zones are surrounded by bottom sediment images of moderate texture. Sediment sample 51889 (Table 2) does have a higher percentage of sand and gravel than any of the samples previously discussed.

Interpretation of the sonar records upstream of the confluence with the Emory River, CRM 4.4, and extending to the end of Section 1 at CRM 5.9 indicate rock ridges along the outside edges of the river bends as noted in Figure 8. These ridges extend from the bank line and, in some areas, beyond the channel centerline. In many areas, these ridges have some relief above the channel bottom. Images of the bottom sediment have a fine to moderate texture indicative of silts to fine sands. More coarse textured sediment signatures are located among the rock ridges and may indicate areas of loose rock, cobbles, or gravel deposits.

There are no utility or pipeline crossings apparent on the side scan records collected in Section 1 of Clinch River. Cultural features detected include the weir at CRM 3.9 and the bridge piers of the U.S. Highway 70, Interstate 40, and Center's Ferry Bridges. Sporadic occurrences of submerged brush and tree limbs are detected along the river margins.

Clinch River - Section 2

The side scan sonar investigation is conducted along the survey lines illustrated in Figure 4 and the interpreted bottom features and anomalies are noted in Figure 11. Sonar images interpreted as rock ridges are detected between CRM 5.9, the beginning of Section 2, to CRM 9.2 at the downstream end of Brashear's Island. These ridges are located along the outside edges of the river bends (Figure 11) and extend from the bank line outward beyond the channel centerline. In many areas, these ridges have good relief above the channel

bottom. Images of the bottom sediment have a fine to moderate-grained texture indicative of silts to fine sands. The sandy bottom surface material of moderate-grained texture is mostly found near the center of the channel. Figure 12 is a good illustration of the sonar image of the rock ridges and bottom sediment. This image was collected along survey CS21 (fix points 2121-2371) near CRM 8.0. Bottom samples collected along this reach of the river are composed of approximately 50 percent sand and gravel and 14 percent clay material (Table 2). More coarse textured signatures of the bottom sediments in this area are located among the rock ridges and likely indicate areas of loose rock, cobbles, or gravel deposits. One such area of interpreted loose rock is located below a steep bluff at CRM 7.7 (survey CS21, fix points 1771-2021) as shown in Figure 13. This may be an area of talus accumulation. Other areas interpreted as loose rock are noted in Figure 11. Another interesting feature detected along this portion of Section 2 is a delta formed at the confluence of a small stream. This feature, recorded along survey CS21 (fix points 571-821), is found near CRM 6.9 and presented in Figure 14.

At the downstream end of Brashear's Island, bottom sediment images of moderate to coarse texture partially bury some of the rock ridges. However, indications of the rock ridges still appear along the northern river bank. Along the island margin, the sediments have a fine to moderate texture indicative of silts and fine sand. Bottom sediment samples outlined in Table 2 for this area are categorized as sandy mud and consist primarily of silts and sand. The average material density is 1.52 g/cm^3. Beginning at CRM 10.2, images of rocky ridges become the dominant feature along the northern river edge and are detected through to the end of Section 2 and continue into Section 3. No utility crossings, debris, brush, or other cultural features were detected in Section 2.

Side scan sonar data were also collected in the backchannel of Brashear's Island along survey line CS24. Rock ridges and moderate to coarse textured sediment images are detected along the centerline of the backchannel. Detection of the ridges diminishes beyond the upstream end of the island as indicated in Figure 11. Along the bank lines, sediment images have a fine to moderate texture indicative of silty bottom material.

Clinch River - Section 3

The side scan sonar investigation within Section 3 of Clinch River is performed along the survey lines illustrated in Figure 5. Interpreted features and bottom conditions are located as shown in Figure 15. Along the first one half mile of section 3, fine to moderate textured bottom signatures are detected. This is a wide portion of the river and a sand bar is forming on the inside bend of the river (Figure 15). Analyzed samples collected in this reach (Table 2) indicate that the bottom sediments are composed of 50 to 63 percent sand and gravel while clay material constitutes less than 12 percent.

From near the beginning of Section 3 (CRM 10.5) to CRM 11.8 located just downstream of the confluence with Poplar Creek, rock ridges are detected

extending from the northern river bank to the center of the channel. The sonar images of the bottom sediments along the channel bottom and between the ridges have a moderate texture which is indicative of silty to fine sand. Pockets of coarser textured material are interpersed along the bottom. Isolated areas of debris (brush, tree limbs, etc.) are also found along the river margins. The underwater access to a pumping station is detected near RM 11.0.

A portion of the sonar record collected along survey CS32 (fix points 1611-1811) at the confluence of Poplar Creek (CRM 12) is presented in Figure 16. The river bottom signature in this area has a moderate-grained texture indicative of silty sand to sand. Small sand waves are detected near the centerline of the channel. Three bottom sediment samples were collected in this area (Table 2) and analysis categorizes the sediment as sandy mud. The samples have percentages of silt, sand, and gravel ranging from approximately 75 to 87 percent with the quantity of clay material less than 24 percent. The average material density is 1.36 g/cm^3. Upstream of the confluence and continuing to the end of Section 3 at the Highway 58 Bridge, the bottom signatures maintain a moderate texture and sand waves are common along the river channel. The bottom sediments likely range from silty sand to sand. Rock ridges extend into the river channel between CRM 12.2 to 12.6 along the southern river margin. These ridges are part of an impressive rock outcrop at CRM 12.3 (Figure 15). Rock ridges are also detected along the northern river bank from CRM 13.4 to 14.0. The side scan sonar images of these ridges as recorded along survey CS32 (fix points 2961-3111) are illustrated in Figure 17. At CRM 13.4, the entrance to a large bay is detected along the southern river boundary as shown in Figure 17. At the confluence of the bay, the bottom sediments have more of a fine-grained texture which may indicate a larger presence of silt and clay material. The bulkhead for the steamplant docking facility is noted at CRM 13.1 and a small, submerged water control structure is detected approximately 400 ft upstream of the bulkhead. No pipeline crossings or other cultural features were noted on the side scan records for Section 3.

Clinch River - Section 4

Side scan sonar surveys are performed along survey lines CS41 through CS43 in Section 4 (Figure 6) and the interpreted features and any noted anomalies are indicated in Figure 18. Beginning at the Highway 58 Bridge, the river bottom image is irregular with a moderate to coarse texture. Small sand waves are noted along the river channel. No bottom samples were collected along this portion of the river bottom. An area of coarse material, such as rocks or cobbles, is detected at CRM 14.5 near a small boat ramp. A large bay is also located along the northern side of the river at CRM 14.5. The bottom image from within the large bay is indicative of silts and clays.

Between CRM 14.5 and 15.7, small sand waves are detected along the river bottom. Beginning at CRM 15.1, signatures indicative of rock ridges are detected along a bluff on the southern side of the river and extend seven-tenths of a mile upstream. The sonar images collected along survey CS41 (fix points 1261-1461) are displayed in Figure 19 and illustrate these rock ridges and small sand waves along the river channel. On either side of CRM 16, an

extensive sand bar is detected and the sonar images have a fine to moderate texture. Upstream of the sand bar and extending to CRM 16.6, sand waves of moderate to coarse texture are noted along the channel bottom. At CRM 16.6, a linear anomaly extending across the width of the river is detected and may be indicative of a weir or pipeline crossing (Figure 18). This anomaly, detected along survey CS41 (fix points 2361-2611), is illustrated in Figure 20.

In the vicinity of CRM 17, a rock bluff exists along the southern river margin. Side scan sonar images at this location indicate rock ridges extending from the river bank to the center of the river channel (Figure 18). Moderate to coarse textured signatures are detected between the ridges which are indicative of sand or gravel accumulations. From CRM 17.2 to the upstream end of Grubb Island, the bottom images have a moderate texture indicative of silty sand or fine sand. No bottom samples are available along this portion of the river. Faint signatures representing rock ridges along the northern river bank are displayed which likely indicate almost complete burial of the ridges by sediment. Intermittent images of stumps, tree limbs, and other brush are also detected, especially along Grubb Island. In the backchannel of Grubb Island, the bottom has a relatively smooth texture indicative of more silty and clayey sediments. Signatures of tree limbs and brush on the channel bottom are also indicated.

Between Grubb Island and Jones Island, bottom signatures maintain a moderate texture indicative of silty sand or fine sand. Rock ridges are detected extending from the northern river bank to the center of the channel, some of which have good relief above the channel floor. Sporadic occurrences of brush and other natural debris are also detected. The pipeline crossing near CRM 19 was clearly defined as illustrated in Figure 21. The interpreted rock ridges and typical bottom signatures are also displayed. Bottom sample 50816 was collected near this location and consists of 54.9 percent sand and gravel and 26.9 percent silt. The measured material density is 1.39 g/cm^3. Along the downstream end of Jones Island (Figure 18), the river bottom images detect intermittent zones of coarser texture which may be indicative of rocks or rock piles. Surrounding these areas of coarse material are the more typical signatures of silty or fine sand which have a moderate texture. From this location at CRM 19.8 to the end of the survey at the Highway 95 Bridge, the river bottom image has a moderate to coarse texture indicative of areas of fine sand to sand and gravel. A representative portion of the side scan record, collected along survey CS41 (fix points 6651-6801), illustrating the river bottom image at the confluence of White Oak Creek is shown in Figure 22. Sample 50823 is collected at CRM 21.5 and found to contain 73.1 percent sand and gravel and approximately 10 percent clay material. ORNL personnel categorized the sample as sandy mud. Bottom debris, consisting of tree limbs and brush, are commonly detected along the northern river bank. Some rock ridges are also detected just downstream of the Highway 95 Bridge along the southern river margin.

Poplar Creek

The track line of the side scan sonar survey performed along the centerline of the Poplar Creek stream channel is illustrated in Figure 7 and interpreted sonar bottom features are identified in Figure 23. The river bottom image along most of the area surveyed has a relatively moderate texture indicative of bottom sediments comprised of silty sand to sand material. Three bottom samples were acquired in Poplar Creek and analysis categorizes the sediment as cohesive mud (Table 2). The samples are composed primarily of silt with percentages ranging from 63.5 to 78.9 percent. Sand and gravel comprise 8.2 to 20.2 percent of the samples and clay material comprises less than 17.1 percent. A portion of the side scan sonar record, collected along survey CPC1 (fix points 1871-2121), illustrating the typical river bottom texture is presented in Figure 24. A smoother river bottom texture is found along the wide river bend between RM 0.8 and 1.3. The smoother texture is likely due to the settling of finer-grained sediments in the slower water currents. The sonar images show few anomalous signatures that might indicate the presence of gravel or cobbles on the channel bottom. Debris on the river bottom interpreted as submerged trees, stumps, logs, and brush are detected in at least three areas along the river. These areas are noted in Figure 23. An area of man-made debris, possibly consisting of concrete slabs, is interpreted near RM 1.8. Two fence lines, on either side of a steep bank, extend into Poplar Creek near the river mouth (Figure 23). This may be the location of an old river crossing prior to the creation of the reservoir. A portion of the side scan sonar record illustrating these features is shown in Figure 25. An old fence line is also detected along the eastern riverbank near RM 1.4 as illustrated in Figure 24.

5 Project Summary

A side scan sonar investigation was performed in Clinch River, between RM 0.0 and 21.5, and Poplar Creek to provide an acoustic description of the bottom sediment materials and define the river bottom features and topography. Survey lines were oriented and performed parallel to the channel centerline in each project area.

As specified in the study objectives, results of the side scan sonar survey are successful in outlining and delineating the extent and continuity of fine-grained sediment materials along the river bottom. The sonar interpretations are correlated with bottom sediment samples following the geophysical investigation. Fine-grain sediments, composed primarily of clays and silts, are found almost exclusively between CRM 0.0 and 4.4 along the Clinch River. Near the confluence of the Tennessee and Clinch Rivers, the percentages of silt and clay in the bottom samples range from 68.1 to 97.5 percent and have an average density value of 1.40 g/cm^3. Upstream of the U.S. 70 and Interstate 40 Highway Bridges to the confluence of the Emory River, bottom samples are categorized as soft or cohesive mud and the percentage of silts and clays is generally greater than 83 percent. Material density values range from 1.21 to 1.31 g/cm^3. Along the remainder of the Clinch River project area, deposits of fine-grained material are found near and in the backchannel areas of Brashear, Grubb, and Jones Island and in the small bays adjacent to the river channel. Areas of clayey sediments are also found along the length of Poplar Creek.

The side scan sonar was also able to detect and delineate geologic features along the length of the project area. Rock ridges, exposed as outcrops in the high bluffs adjacent to the river, extend into the river channel along numerous sections of Clinch River. The ridges are clearly defined in most of the areas and are found to extend from the river margin to beyond the channel centerline. Some of these ridges may rise 3 to 5 ft above the existing channel bottom. Zones of loose rock are located among the rock ridges. Three such areas are located below a steep bluff near CRM 7.7 in Section 2. In other areas, sediments have been deposited between the ridges such that in some areas, the deposited materials nearly cover the rock ridges. Areas of this nature include along the northern edge of Clinch River at CRM 3.5, the backchannel of Brashear Island, and along the Clinch River between CRM 17.2 and Grubb Island.

Other features detected along Clinch River include a pipeline crossing at CRM 19.0, weirs at CRM 3.9 and CRM 16.6, a pumping station outlet at CRM 11.0, and a small, submerged water control structure near CRM 13.1. In Poplar Creek, the sonar survey detected a pile of construction debris, old fence lines, and possibly old bridge supports of a former river crossing.

Analysis of the sonar information provides a continuous image of the river bottom geometry and features. The images provide insight into the general sediment characteristics and highlight changes in the actual bottom conditions as well as delineating the extent of various sediment material and geologic features. The side scan sonar data and interpreted features should further supplement soil samples and field data acquired during previous field studies and be used to facilitate the accurate positioning of any additional bottom sediment sampling measures required in the future.

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Sjostrom, K. J., Leist, R. L., and Harmon, T. S., Jr. (1997). "High-frequency acoustic imaging of L Lake, Savannah River Site, South Carolina," Technical Report GL-97-17, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Table 1
Recorded Water Level Elevations, Clinch River, Tennessee

Date	Time, hrs	Location	Water Level, ft NGVD
7 Feb 1994	1325	Highway 58 Bridge	736.0
8 Feb 1994	1054	U.S. Highway 70 Bridge	736.0
8 Feb 1994	1326	U.S. Highway 70 Bridge	736.0
9 Feb 1994	1011	U.S. Highway 70 Bridge	736.0
9 Feb 1994	1551	U.S. Highway 70 Bridge	736.0
11 Feb 1994	1037	U.S. Highway 70 Bridge	741.0
11 Feb 1994	1259	Highway 58 Bridge	744.5
11 Feb 1994	1646	U.S. Highway 70 Bridge	742.5
12 Feb 1994	0918	U.S. Highway 70 Bridge	743.0
12 Feb 1994	1135	Highway 58 Bridge	744.0
13 Feb 1994	0846	U.S. Highway 70 Bridge	741.0
13 Feb 1994	1320	Highway 58 Bridge	742.0
14 Feb 1994	0910	U.S. Highway 70 Bridge	739.5
14 Feb 1994	1000	Highway 58 Bridge	740.5
15 Feb 1994	1012	U.S. Highway 70 Bridge	739.0
15 Feb 1994	1054	Highway 58 Bridge	740.0
15 Feb 1994	1439	Highway 58 Bridge	740.0
16 Feb 1994	1215	U.S. Highway 70 Bridge	738.5

Table 2
Summary of River Bottom Sediment Samples

Sample	River Mile	Easting	Northing	Sediment Type[1]	Wet Density (g/cm^3)	Percent Sand and Gravel	Percent Silt	Percent Clay
Clinch River Samples								
50169	0.00	2434941	538954	SM	1.24	14.1	59.6	26.3
50174	0.1	2435476	539131	SM	1.13	31.9	47.7	20.4
50179	0.2	2435986	539312	SM	1.24	22.3	58.7	19.0
50255	0.3	2436369	539459	SM	1.42	15.7	42.2	42.1
50260	0.4	2437015	539924	CM	1.66	3.5	46.7	49.8
50265	0.5	2437488	540543	CM	1.56	3.8	47.6	48.6
50270	0.6	2437847	541296	SM	1.54	7.0	48.5	44.5
50343	0.7	2437869	542222	SM	1.31	17.7	48.1	34.2
50348	0.8	2437629	542731	CM	1.27	30.5	36.3	33.2
50353	0.9	2437099	543456	CM	1.47	21.3	46.2	32.5
50358	1.0	2436132	543924	SM	1.51	30.8	31.8	37.4
51659	2.6	2437196	547944	SM	1.21	55.2	34.8	10.0
51790	2.7	2439198	549488	CM	1.31	10.8	62.4	26.8
51690	3.9	2444782	548369	CM	1.30	16.4	59.0	24.6
51664	4.3	2446194	548071	SM	1.26	14.0	61.1	24.9
51670	4.3	2446194	548071	SM	1.25	16.3	61.6	22.1
51889	4.8	2448583	546600	SM	1.31	49.2	37.0	13.8
51894	6.2	2453293	548500	SM	1.05	45.0	42.6	12.4
51581	6.5	2454759	547361	SM	1.15	52.5	37.1	10.4
51899	6.7	2454359	548941	SM	1.36	49.7	36.9	13.4
51576	7.2	2455541	551230	SM	1.29	11.0	81.0	8.0
50996	9.0	2461425	555519	SDM	-	81.1	10.8	8.1
50439	10.0	2464427	559853	SDM	1.42	91.6	6.5	1.9
50449	10.0	2464427	559853	SDM	1.47	89.2	7.0	3.8
50465	10.0	2464245	560357	SDM	1.34	23.6	61.7	14.7
50471	10.1	2465711	560536	SM	1.99	39.4	39.3	21.3
50476	10.1	2464665	560577	SM	1.39	59.7	30.7	9.6
50612	10.8	2466417	561345	SM	1.36	63.0	25.3	11.7
50618	10.8	2466039	561700	SM	1.29	50.3	38.6	11.1
50624	10.9	2466684	561723	SM	1.39	60.3	32.1	7.6
50629	10.9	2466302	562005	SDM	1.26	19.3	52.4	28.3
51497	12.1	2470421	561757	CM	1.33	55.9	32.2	11.9
51380	12.4	2469514	560855	SDM	1.39	31.9	43.9	24.2
51387	12.4	2469514	560855	SDM	1.33	37.3	40.8	21.9
51503	13.0	2469247	558672	CM	1.31	68.9	16.6	14.5
51512	13.4	2470434	557540	SG	1.65	98.1	1.9	0.00
50816	19.0	2485076	552424	SS	1.39	54.9	26.9	18.2
50823	21.5	2494582	550236	SDM	1.43	73.1	16.4	10.5

(Continued)

Table 2 (Concluded)

Sample	River Mile	Easting	Northing	Sediment Type[1]	Wet Density (g/cm^3)	Percent Sand and Gravel	Percent Silt	Percent Clay
Poplar Creek Samples								
50891	0.5	2471993	560936	CM	---	18.9	64.0	17.1
50898	0.5	2471993	560936	CM	---	20.2	63.5	16.3
51003	1.0	2473935	559859	CM	---	8.2	78.9	12.9

[1] SM - soft mud; CM - cohesive mud; SDM - sandy mud; SS - submerged soil; SG - sand and gravel.

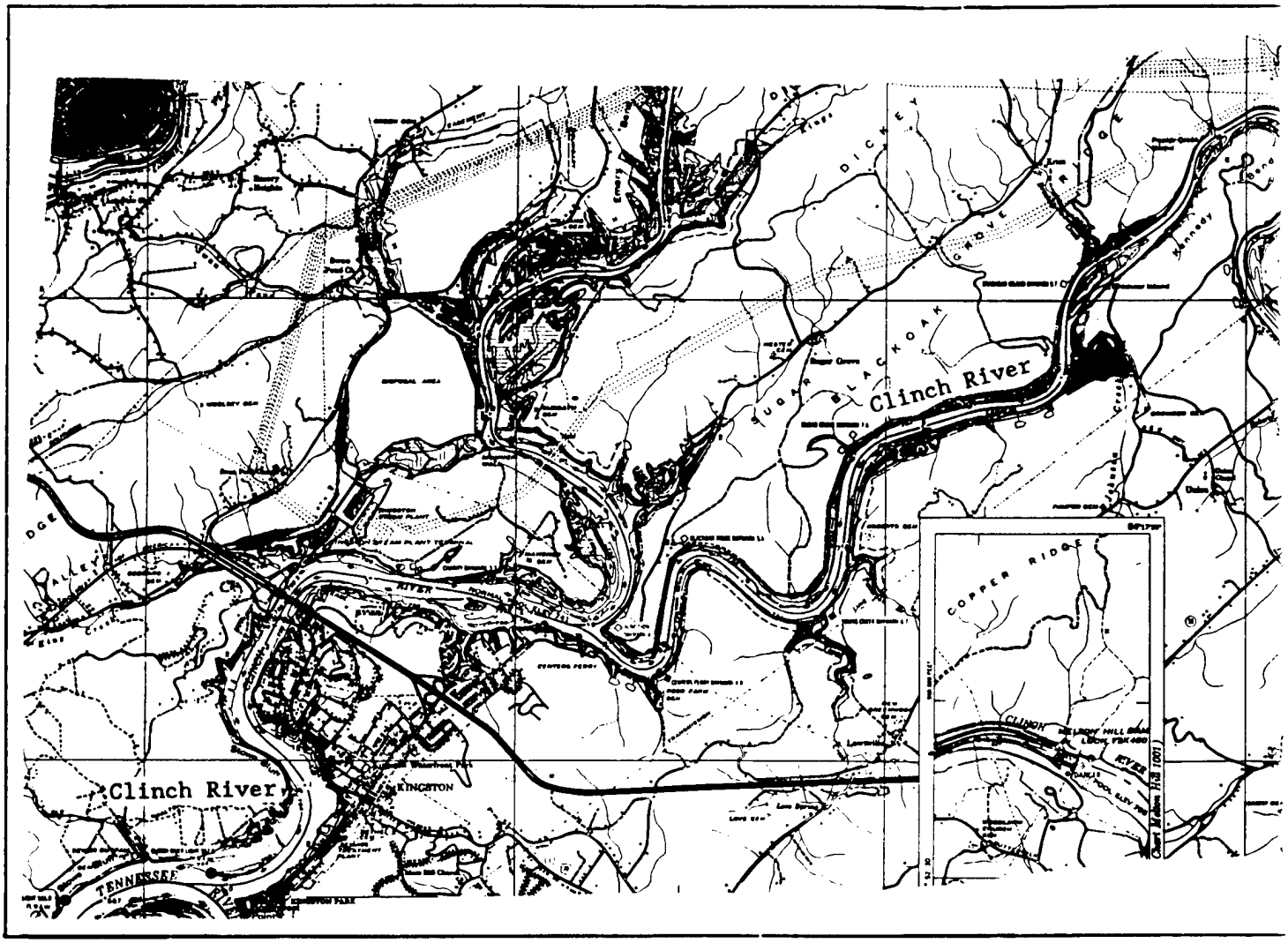
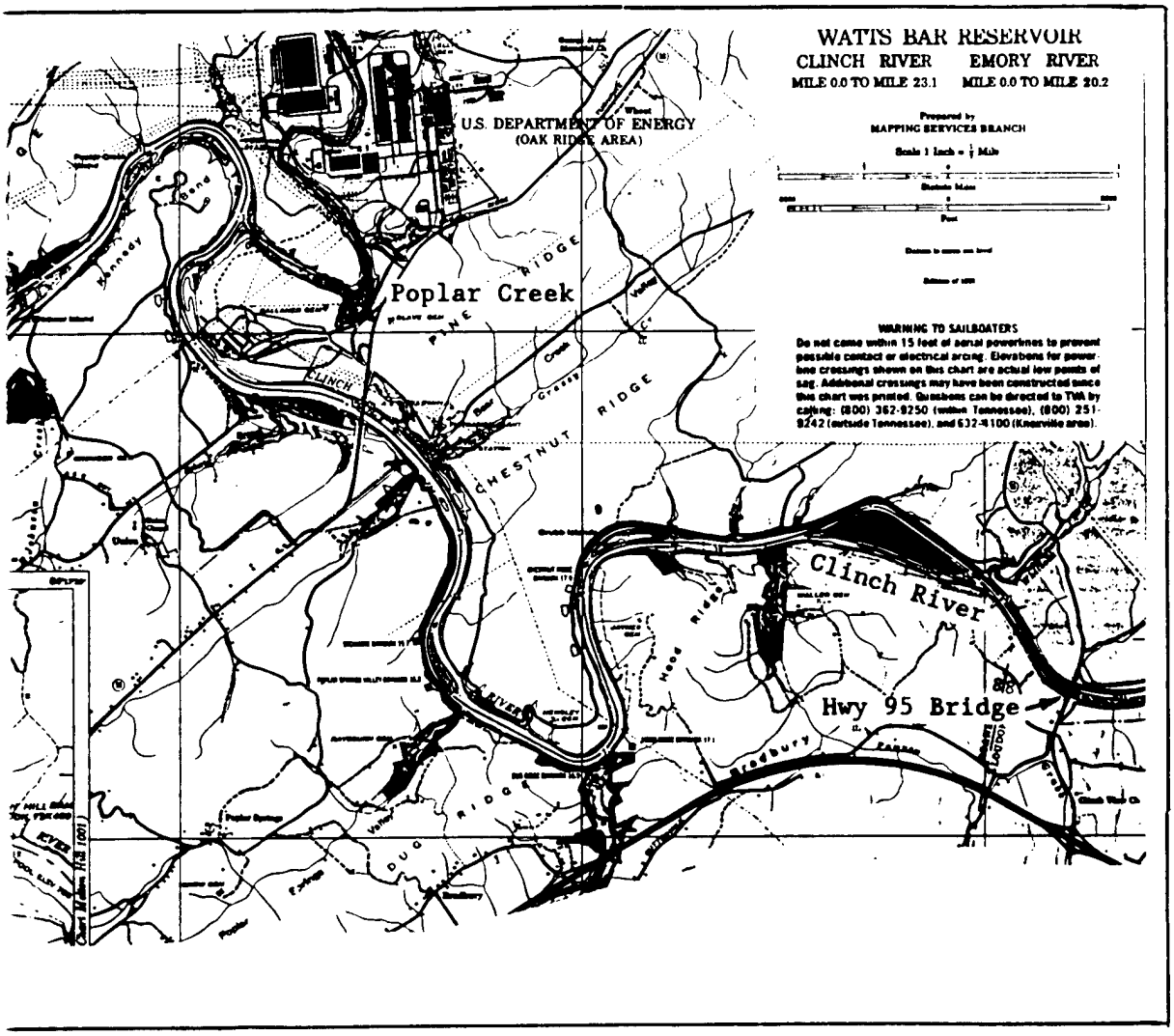


Figure 1. Site map of Clinch River and Poplar Creek, Tennessee


WATTS BAR RESERVOIR
CLINCH RIVER MILE 0.0 TO MILE 23.1
EMORY RIVER MILE 0.0 TO MILE 20.2
Prepared by
MAPPING SERVICES BRANCH
U.S. DEPARTMENT OF ENERGY
(OAK RIDGE AREA)
Poplar Creek
PINE RIDGE
CHESTNUT RIDGE
Clinch River
Hwy 95 Bridge
WARNING TO SAILBOATERS
Do not come within 15 feet of aerial powerlines to prevent possible contact or electrical arcing. Elevations for powerline crossings shown on this chart are actual low points of sag. Additional crossings may have been constructed since this chart was printed. Questions can be directed to TVA by calling: (800) 362-9250 (within Tennessee), (800) 251-8242 (outside Tennessee), and 632-4100 (Knoxville area).

2

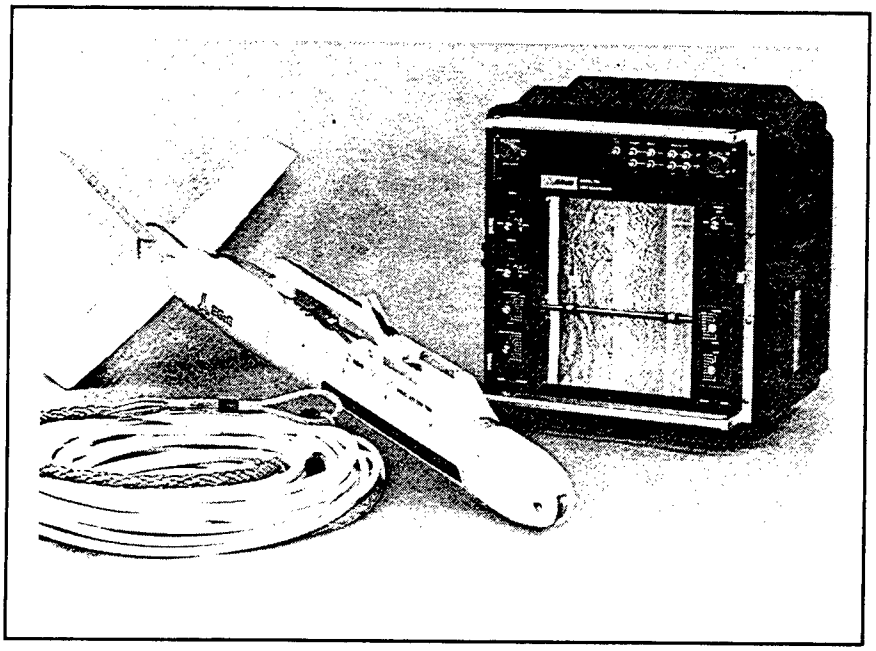


Figure 2. Illustration of the side scan sonar equipment

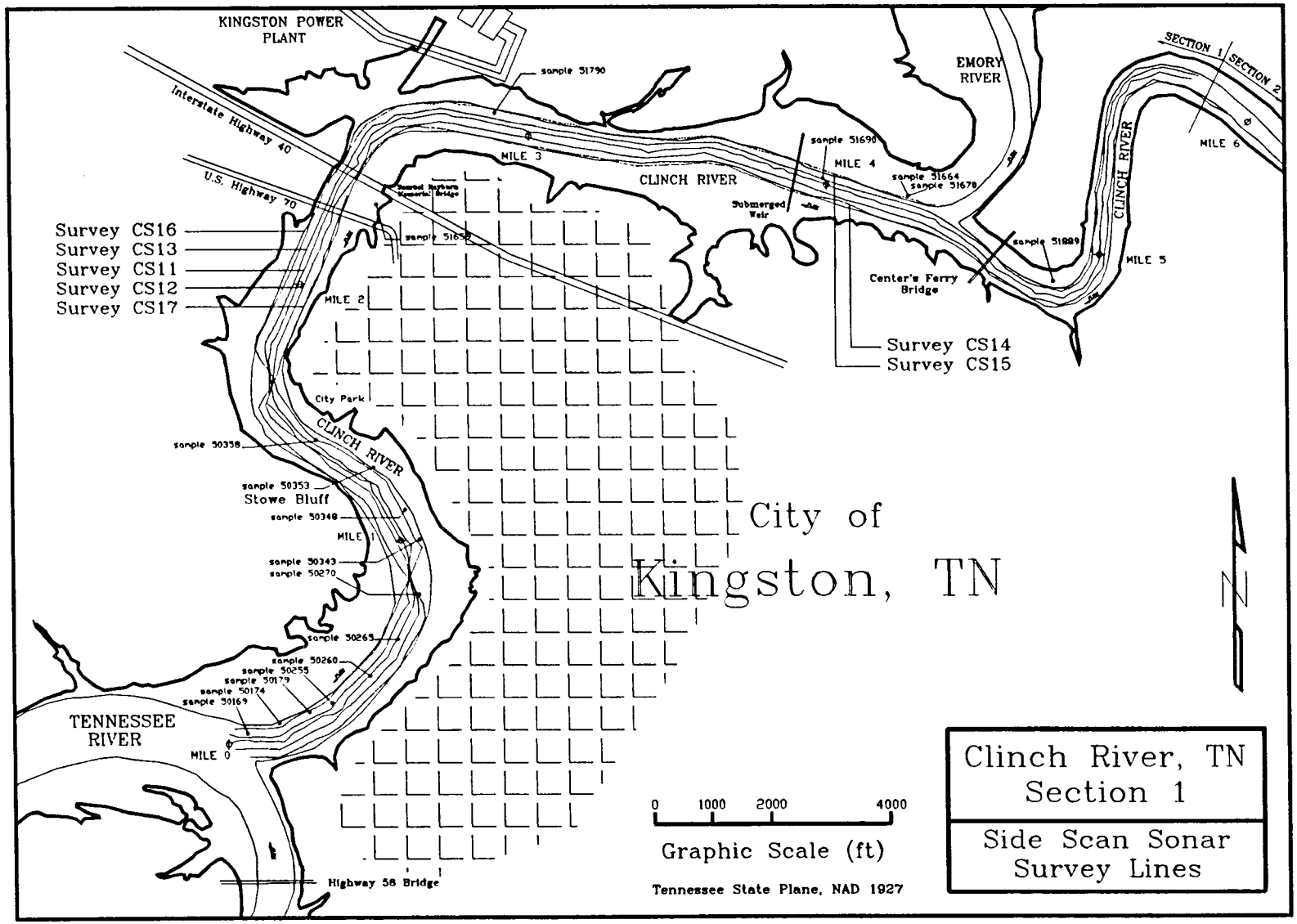


Figure 3. Site map of Section 1 (RM 0.0 to 5.9), Clinch River

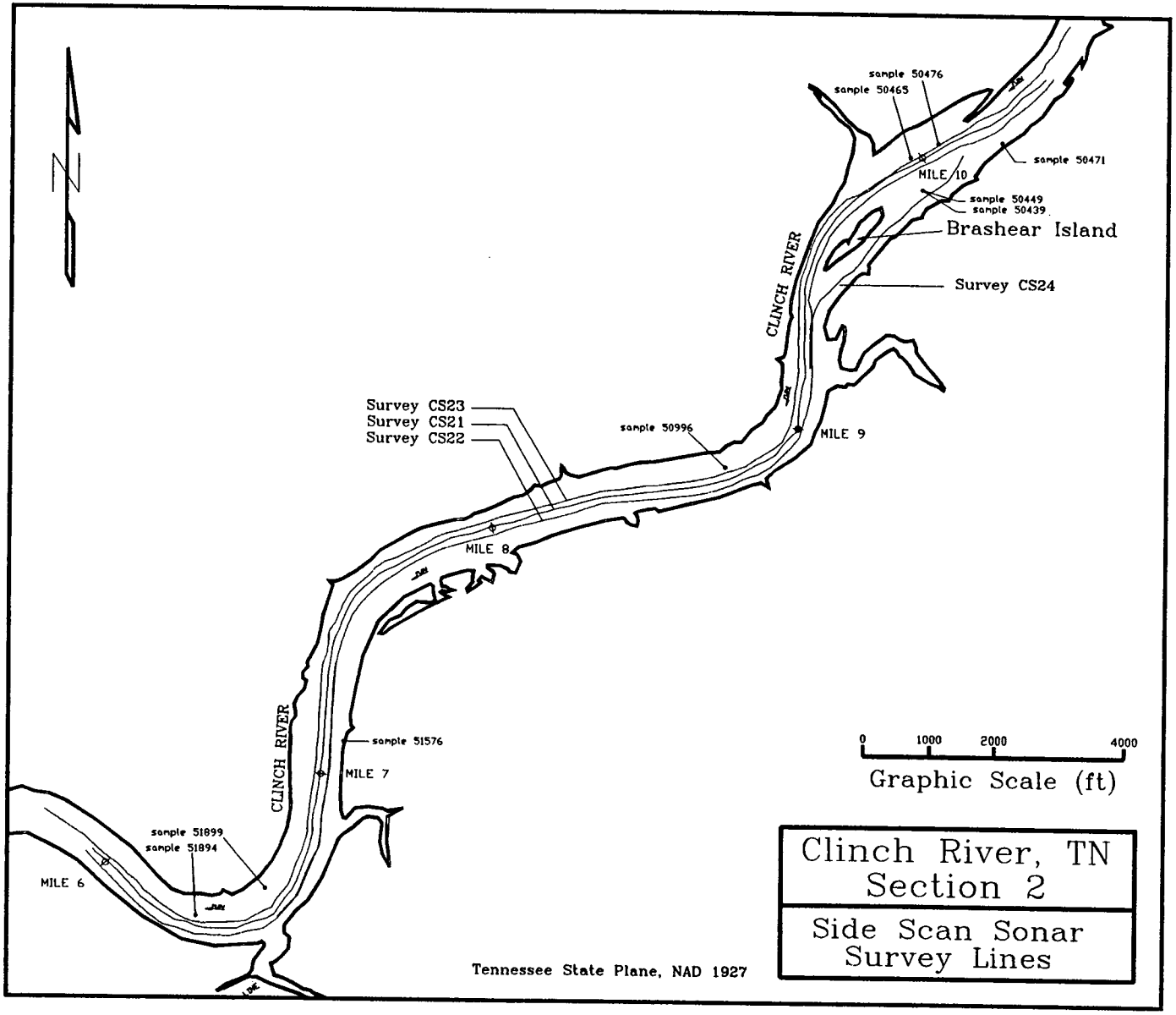


Figure 4. Site map of Section 2 (RM 5.9 to 10.5), Clinch River

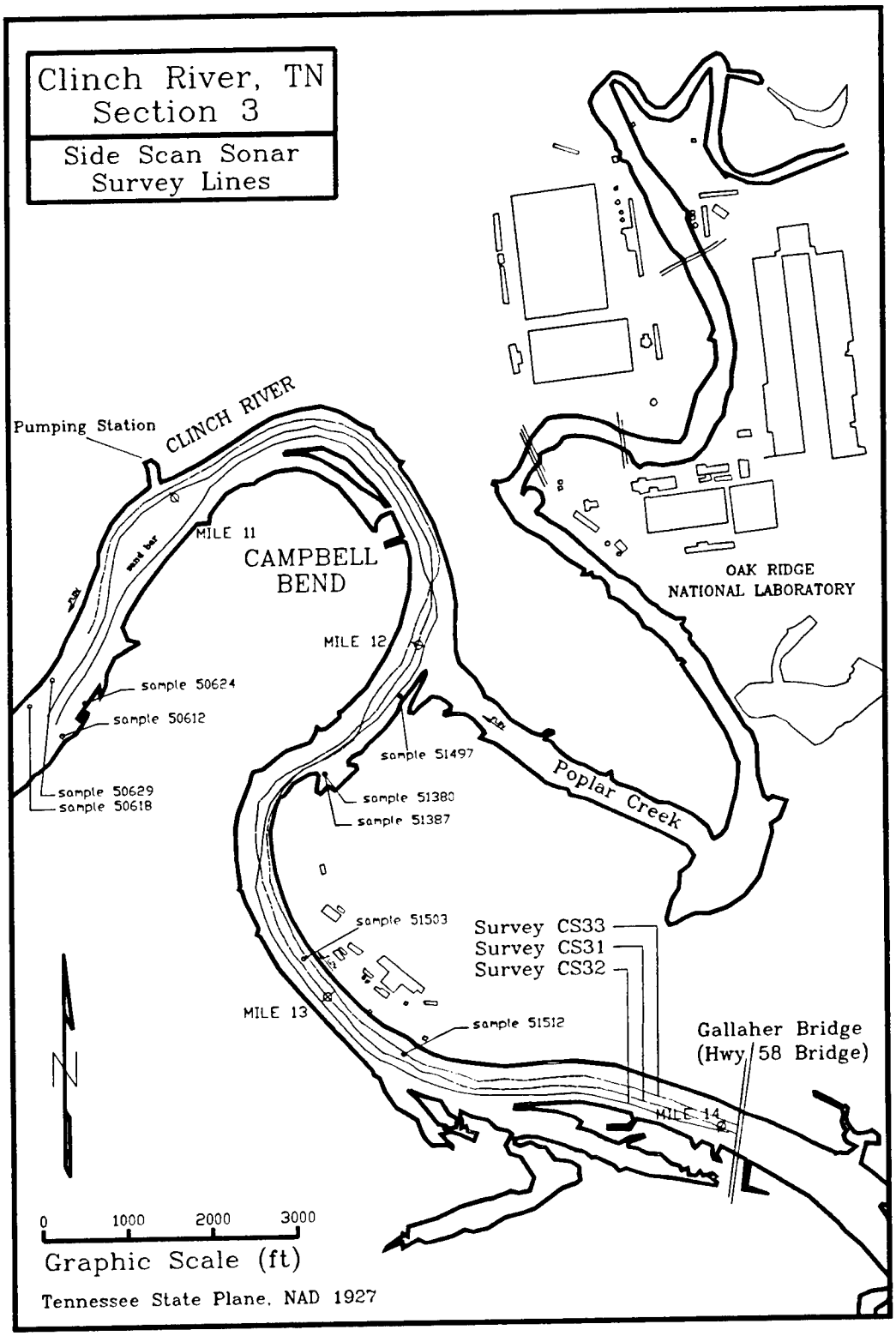


Figure 5. Site map of Section 3 (RM 10.5 to 14.1), Clinch River

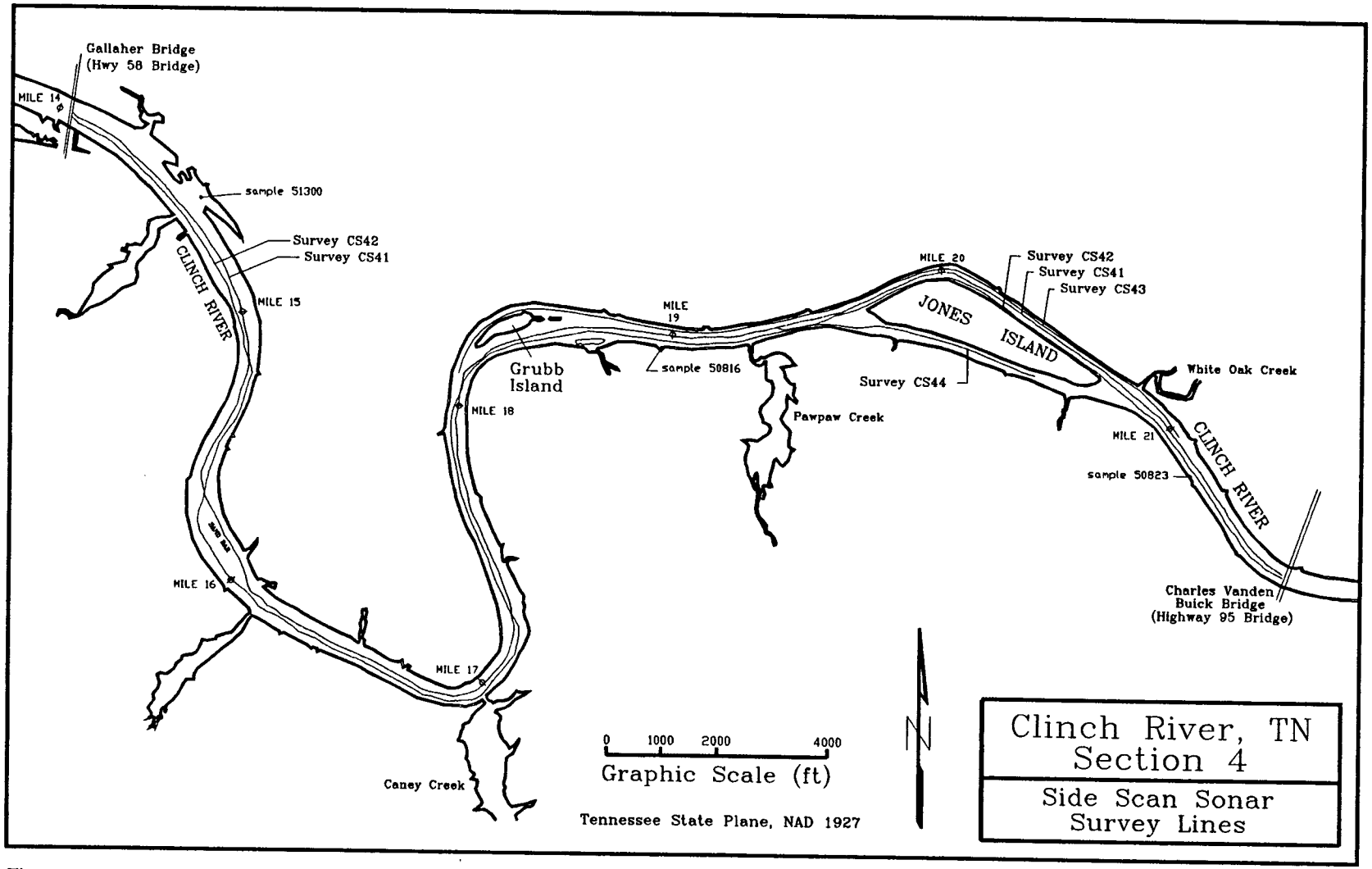


Figure 6. Site map of Section 4 (RM 14.1 to 21.7), Clinch River

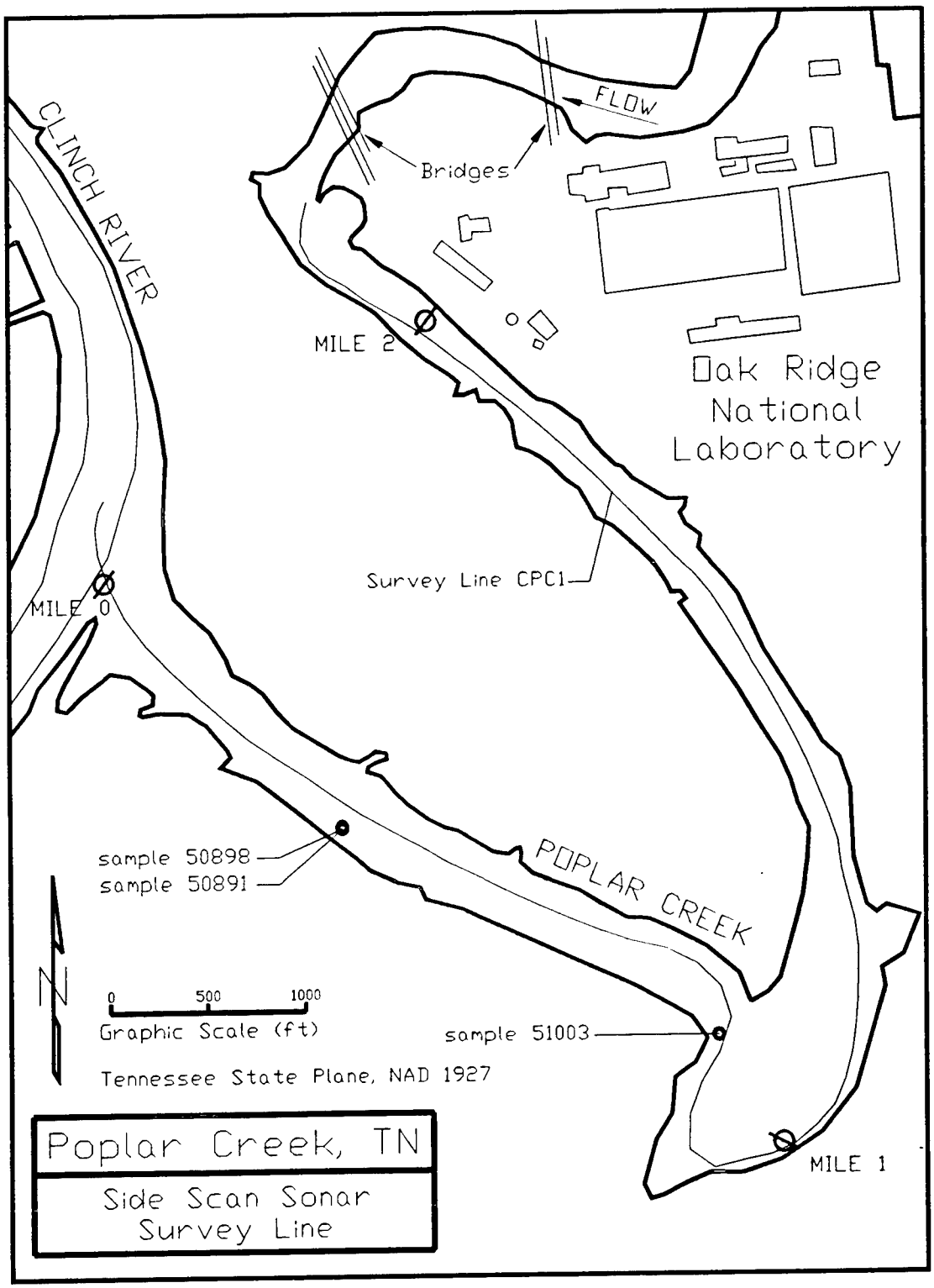


Figure 7. Site map of Poplar Creek (RM 0.0 to 2.2)

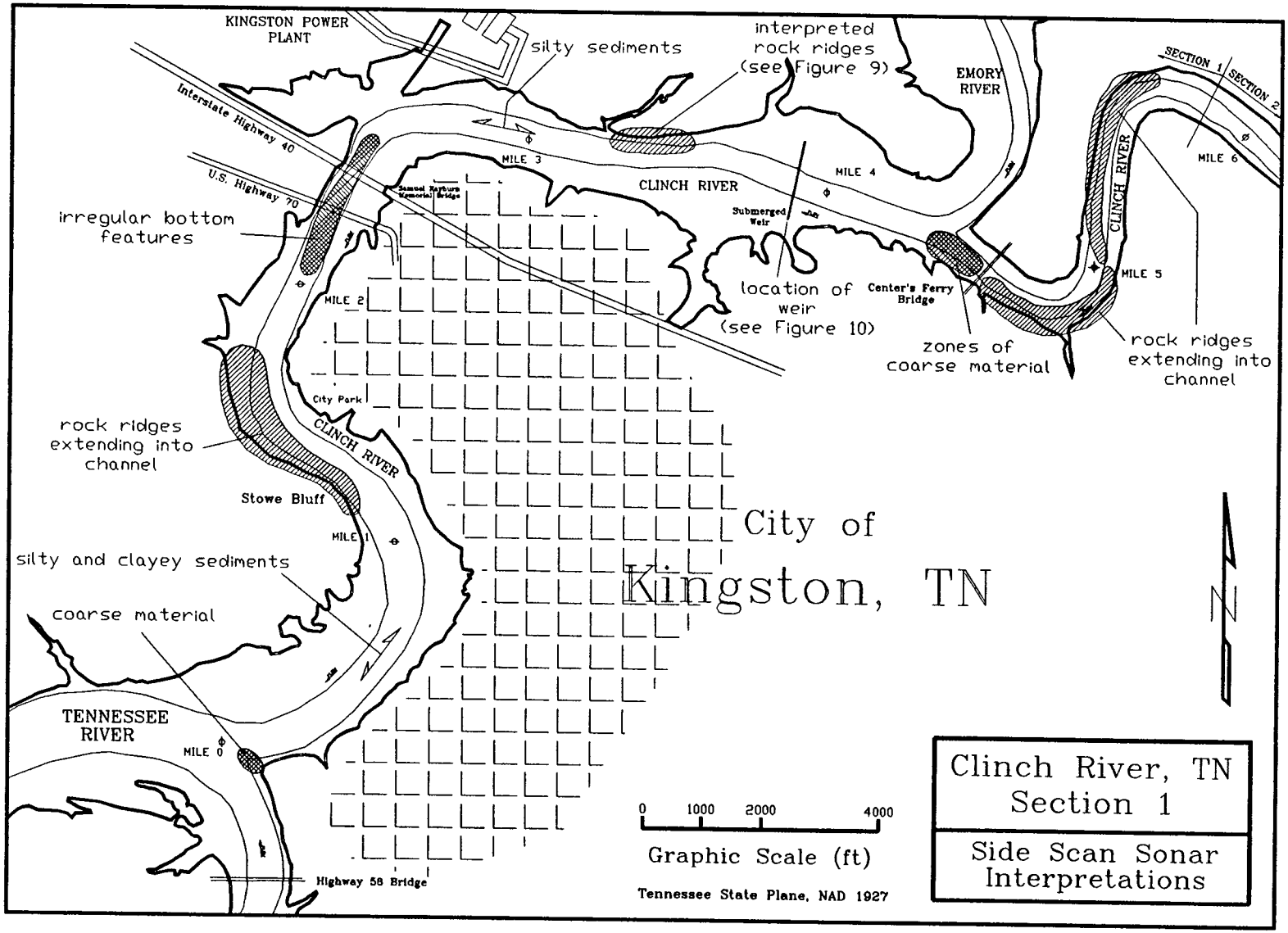


Figure 8. Interpreted side scan sonar results, Section 1, Clinch River

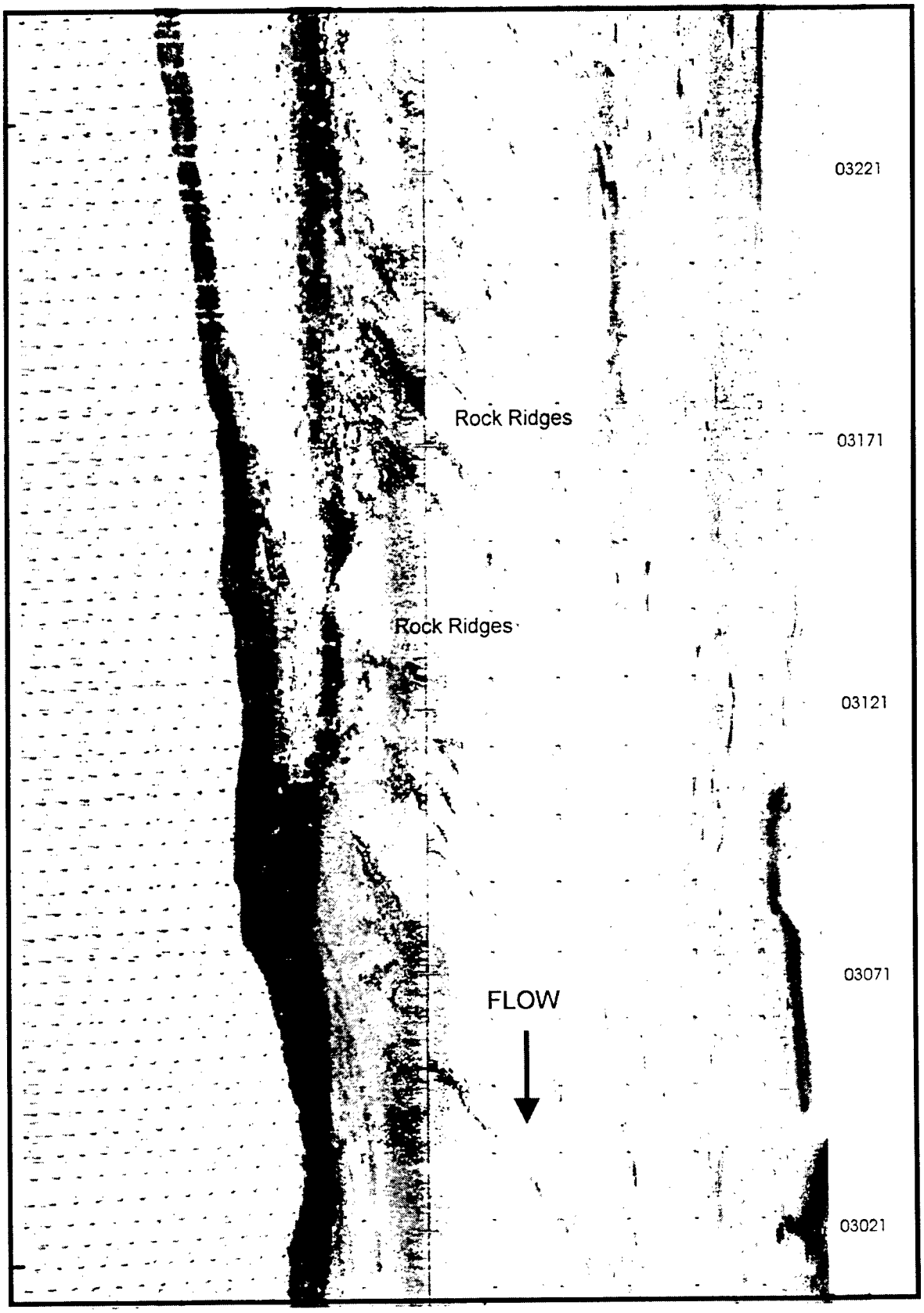


Figure 9. Side scan sonar images at CRM 3.5, Section 1, Clinch River

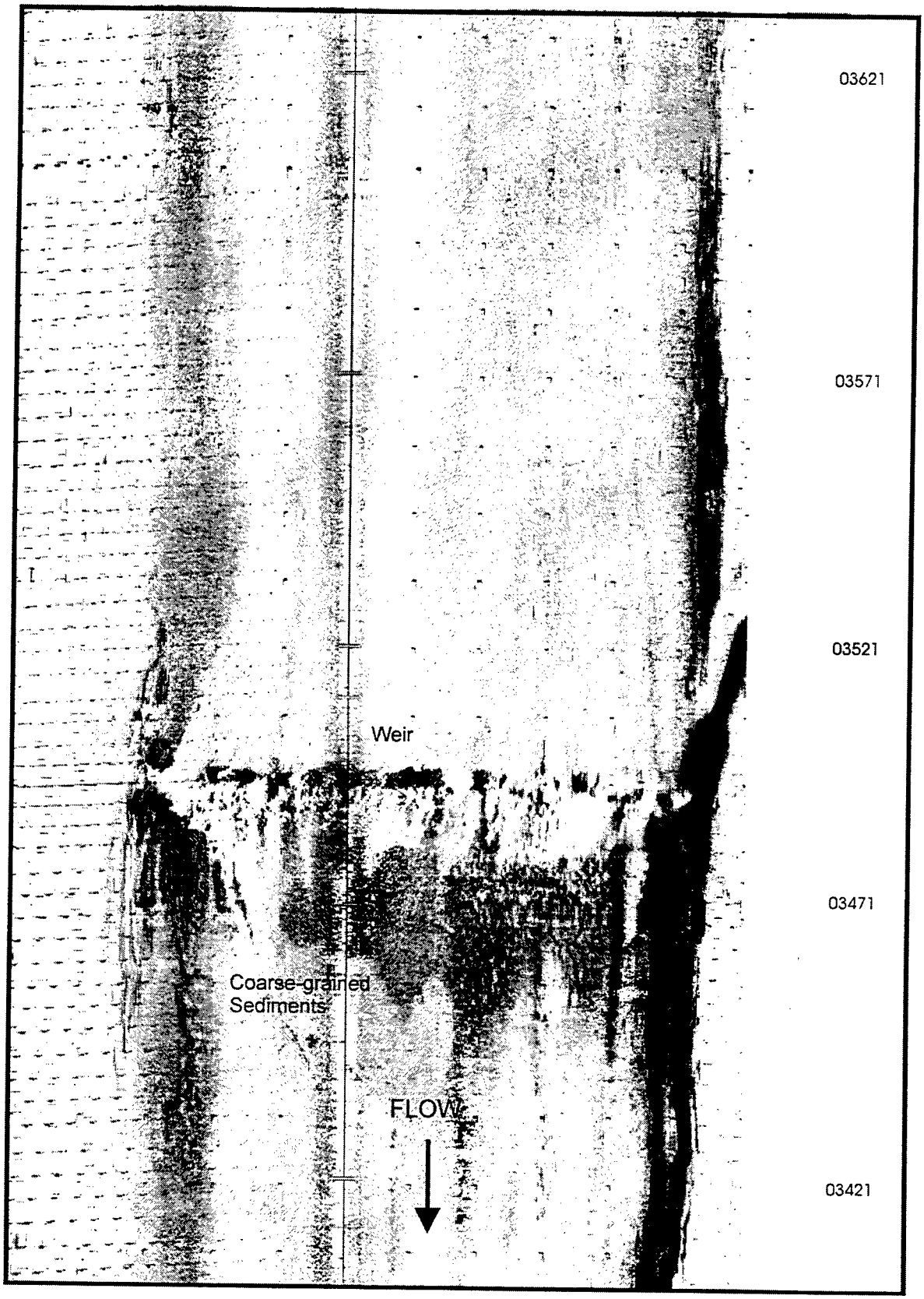


Figure 10. Side scan sonar image of a weir near CRM 3.9, Section 1, Clinch River

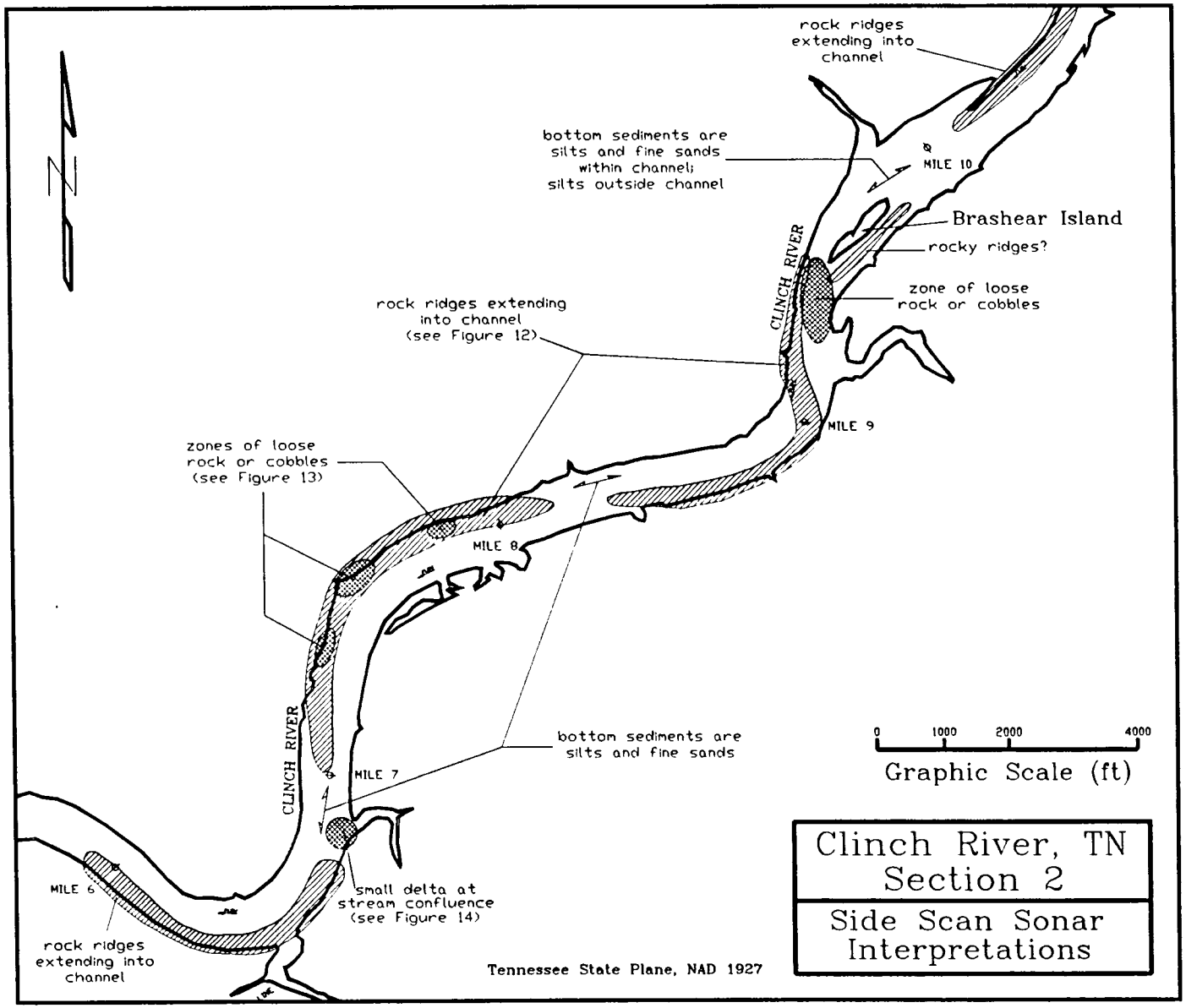


Figure 11. Interpreted side scan sonar results, Section 2, Clinch River

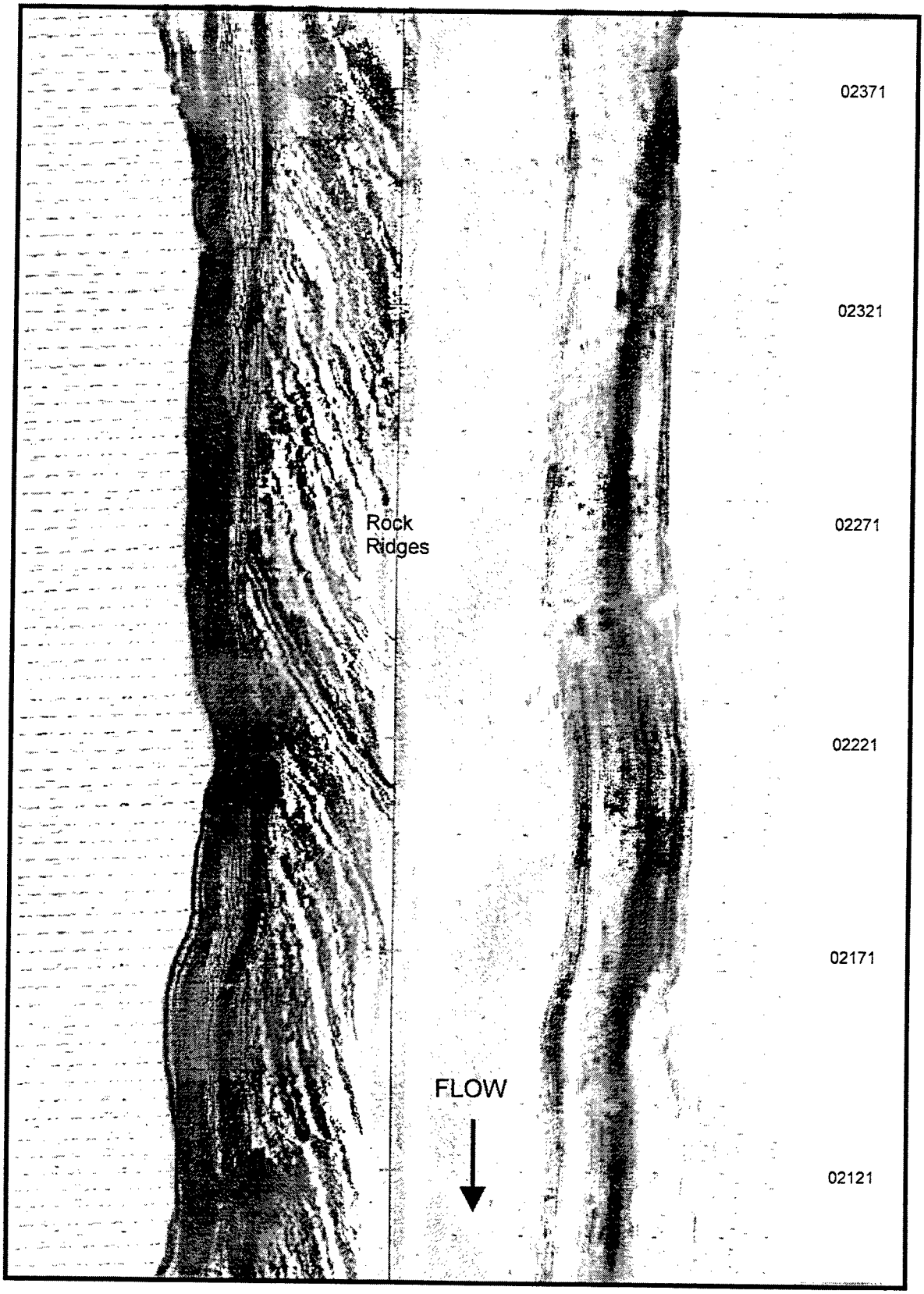


Figure 12. Portion of a side scan sonar record near CRM 8.0, Section 2, Clinch River

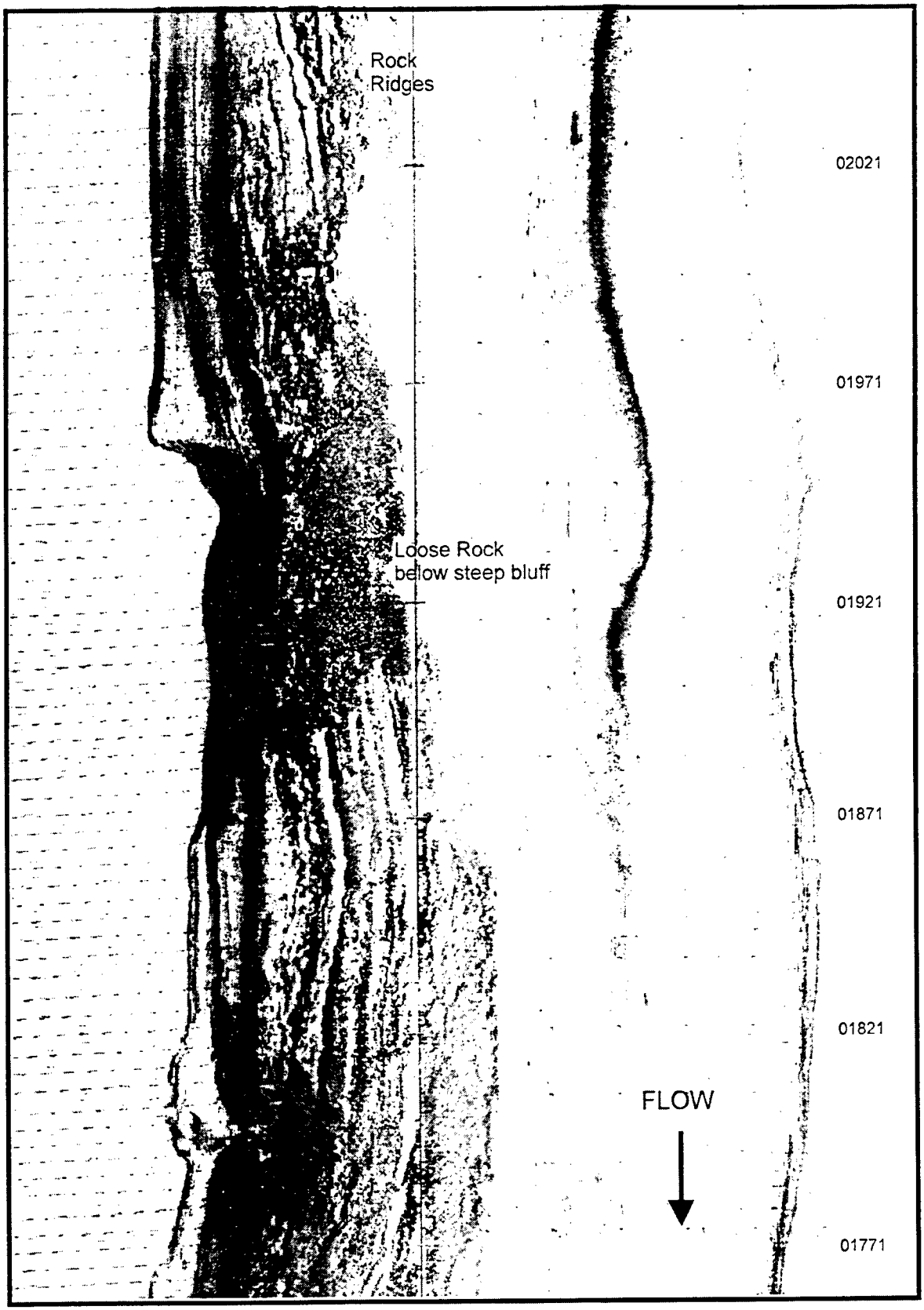


Figure 13. Image of loose rock along the channel at CRM 7.7, Section 2, Clinch River

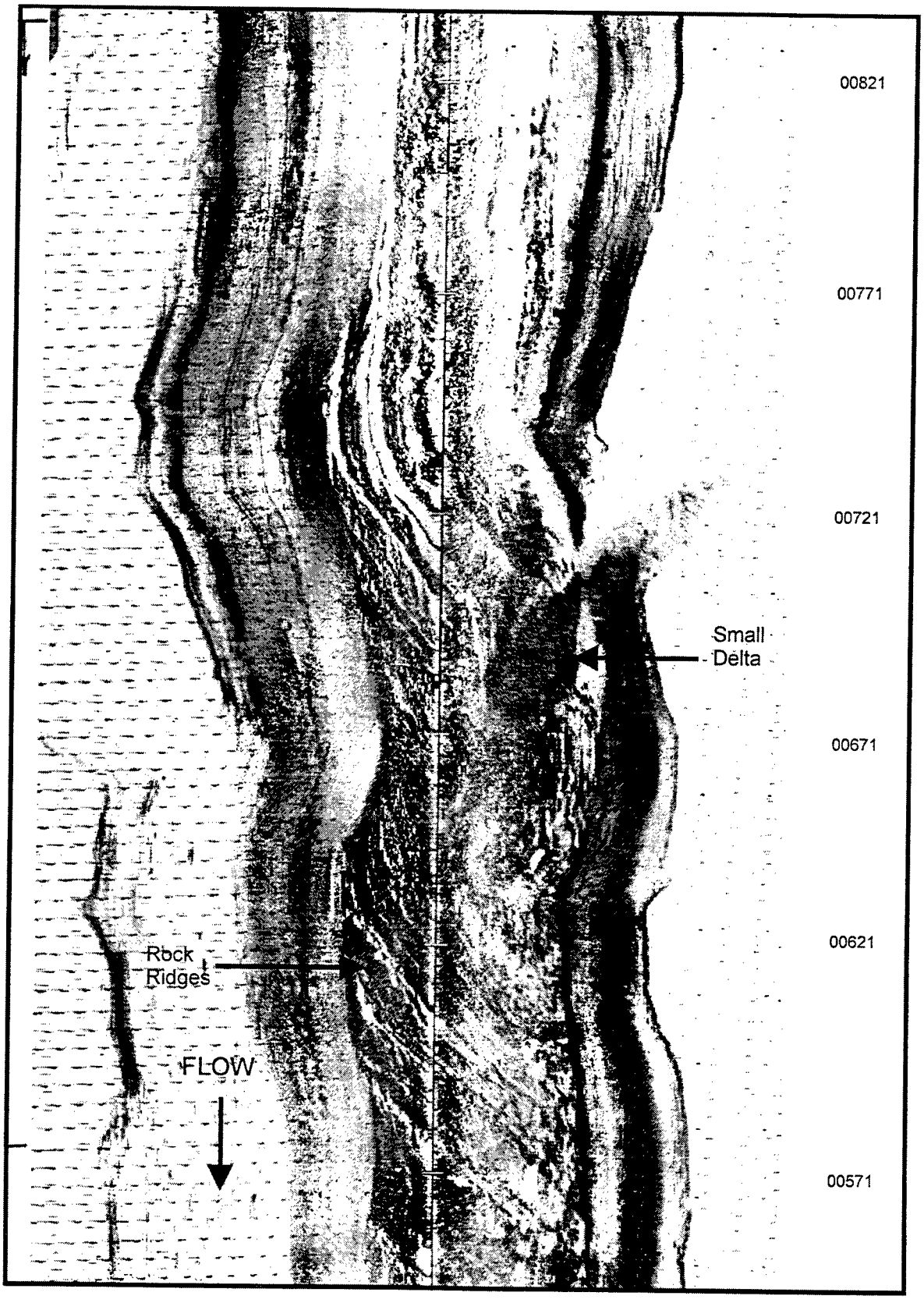


Figure 14. Image of a small delta among the rock ridges at CRM 6.9, Section 2, Clinch River

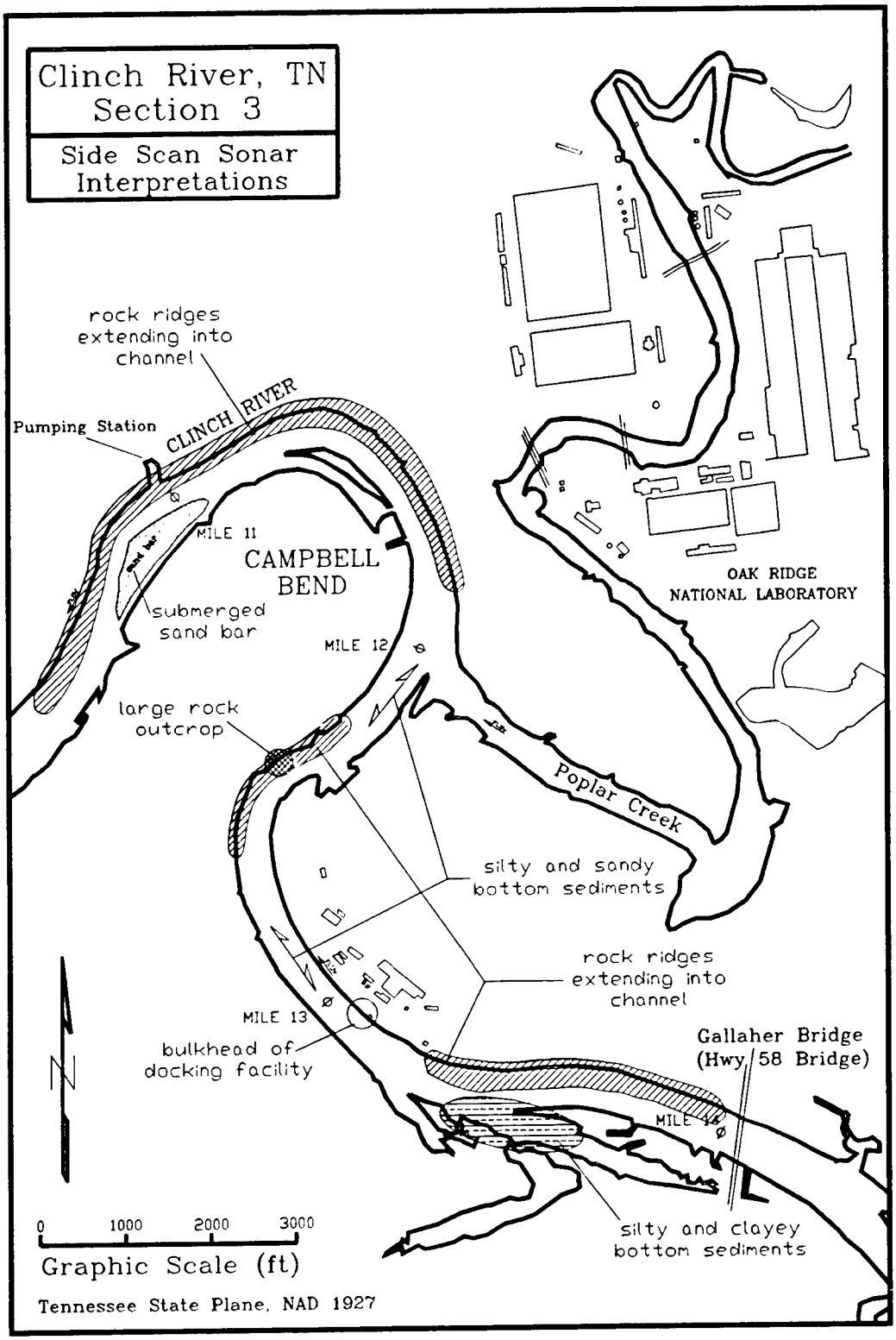


Figure 15. Interpreted side scan sonar results, Section 3, Clinch River

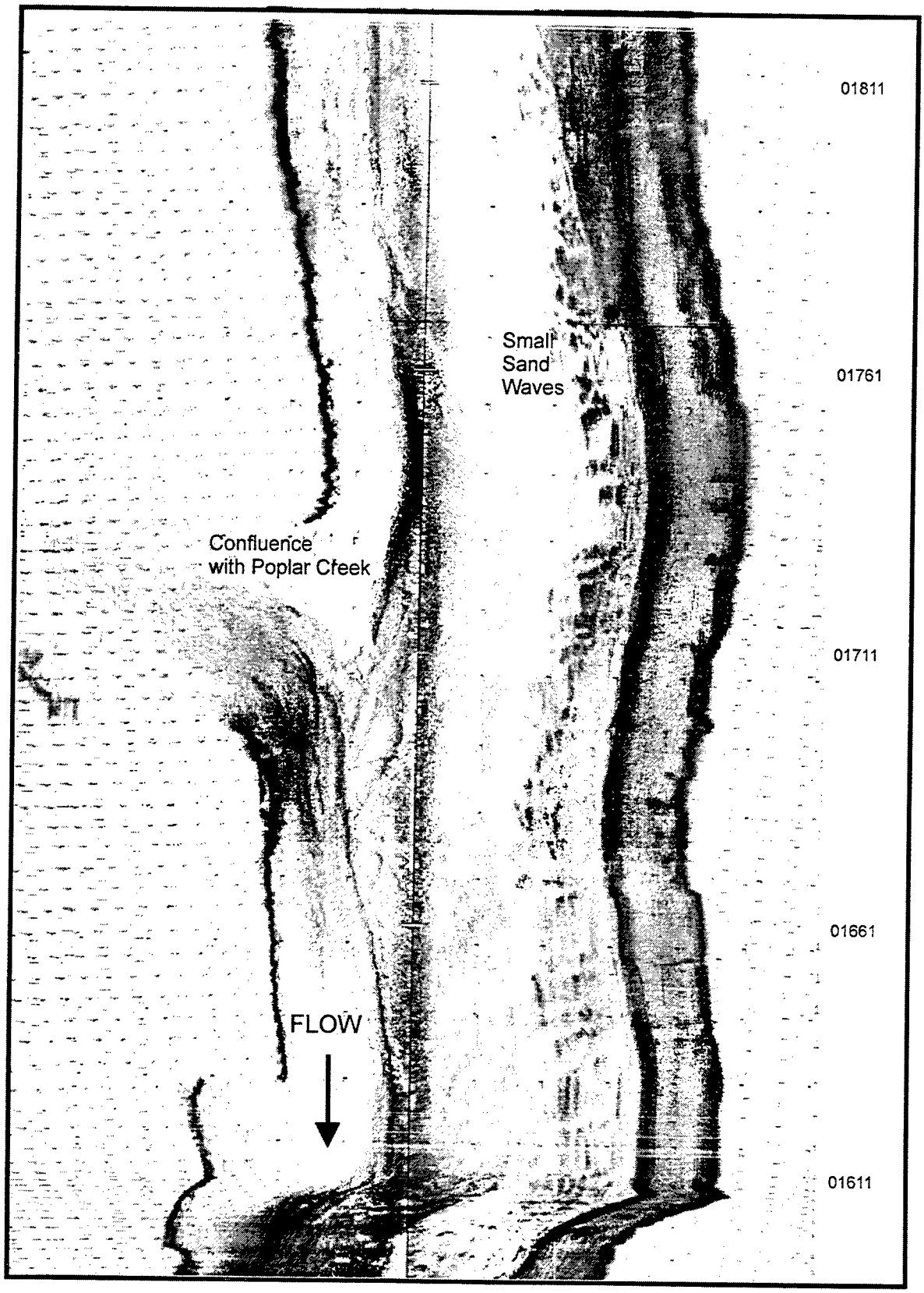


Figure 16. Sonar images recorded at the confluence with Poplar Creek, Section 3, Clinch River

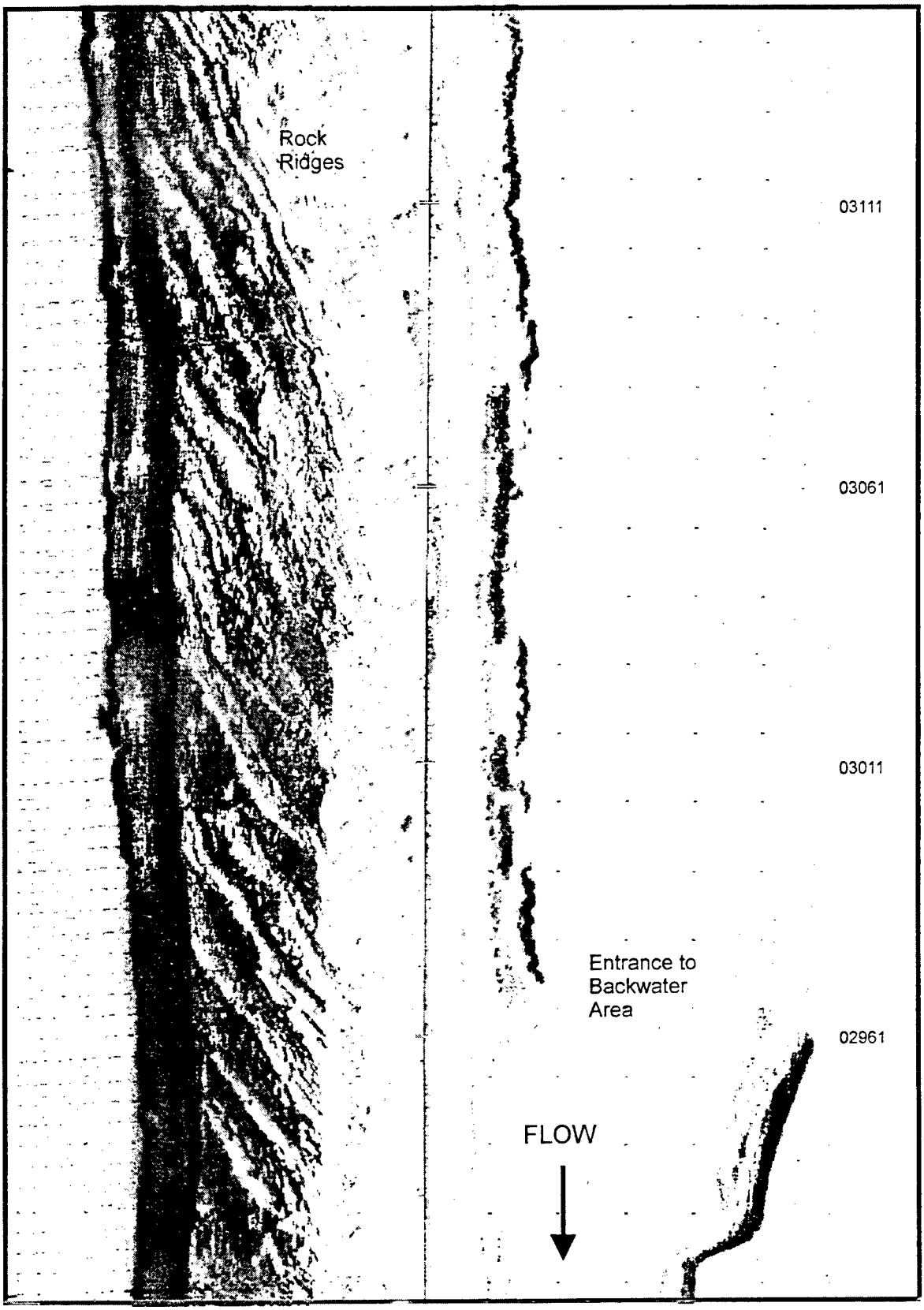


Figure 17. Portion of a side scan sonar record near CRM 13.4, Section 3, Clinch River

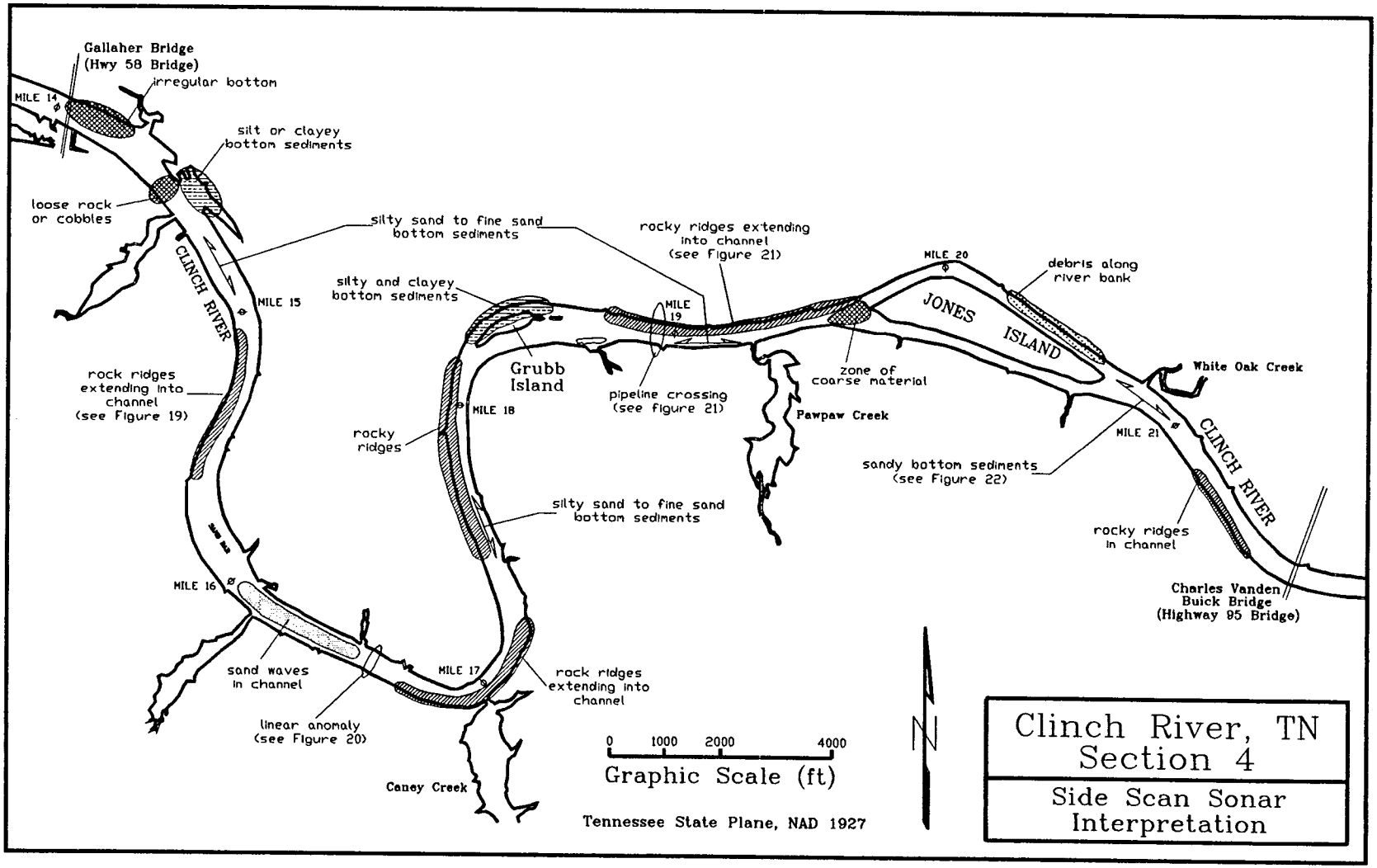


Figure 18. Interpreted side scan sonar results, Section 4, Clinch River

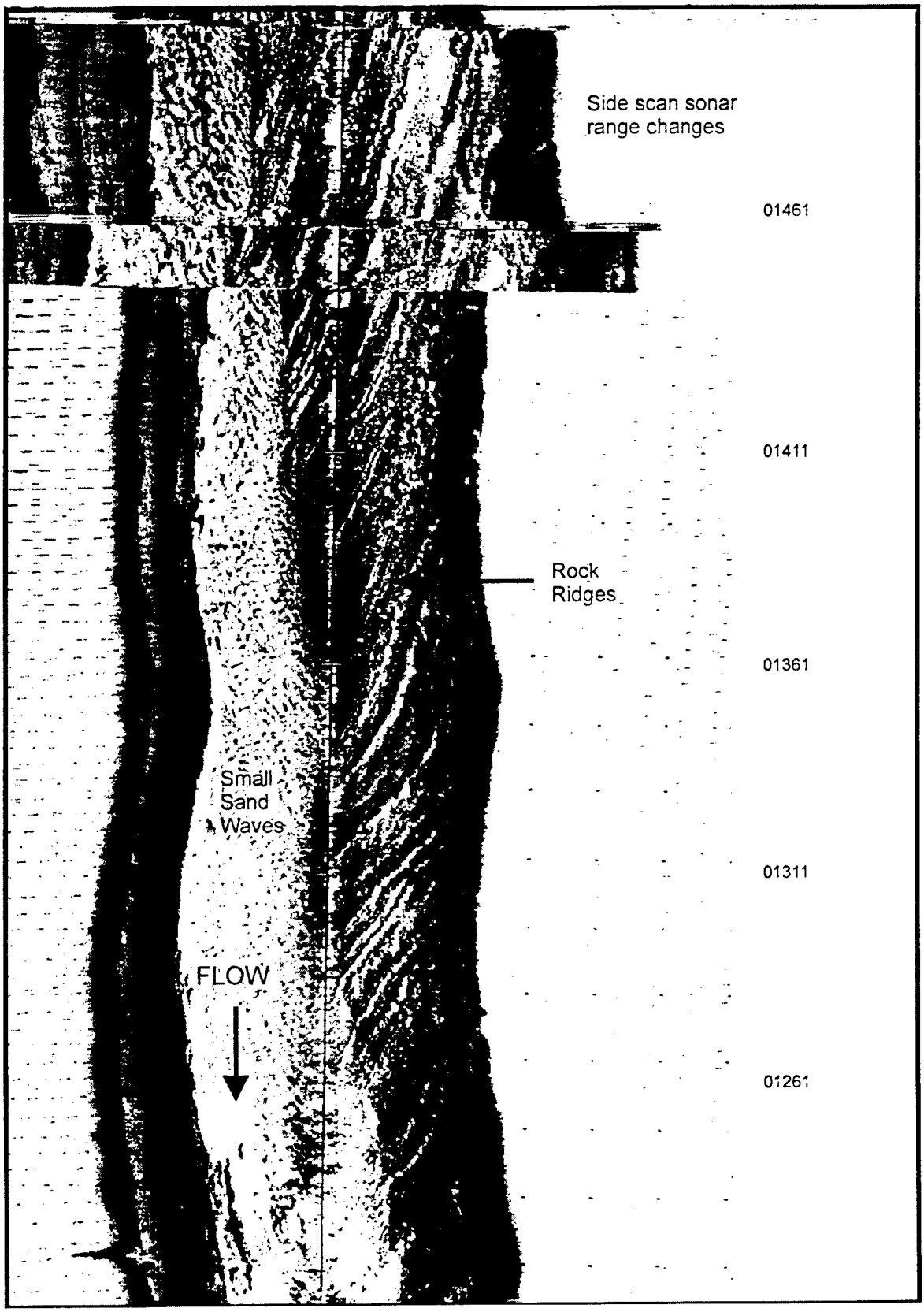


Figure 19. Images of small sand waves and rock ridges near CRM 15.3, Section 4, Clinch River

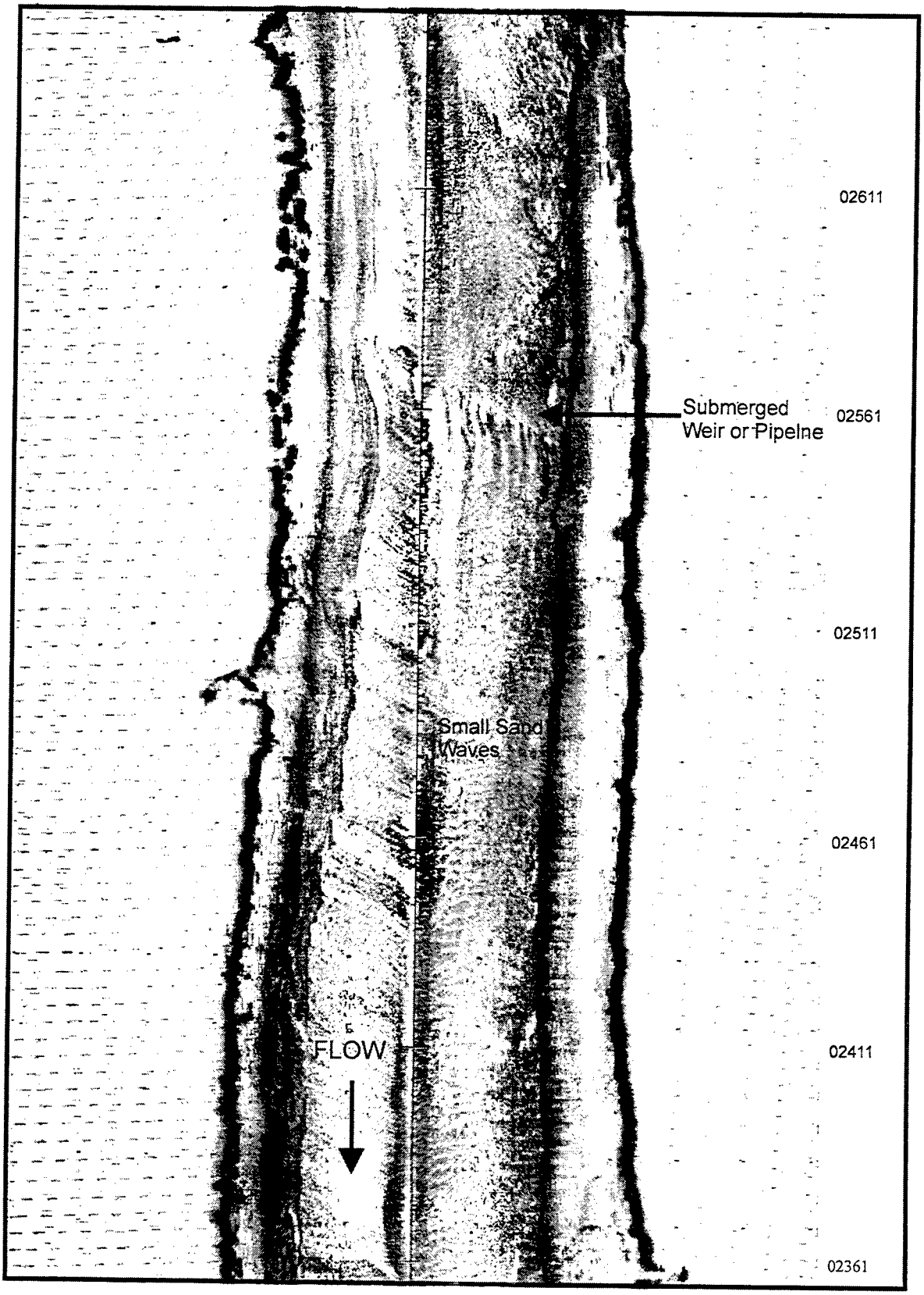


Figure 20. Image of a weir or pipeline crossing near CRM 16.6, Section 4, Clinch River

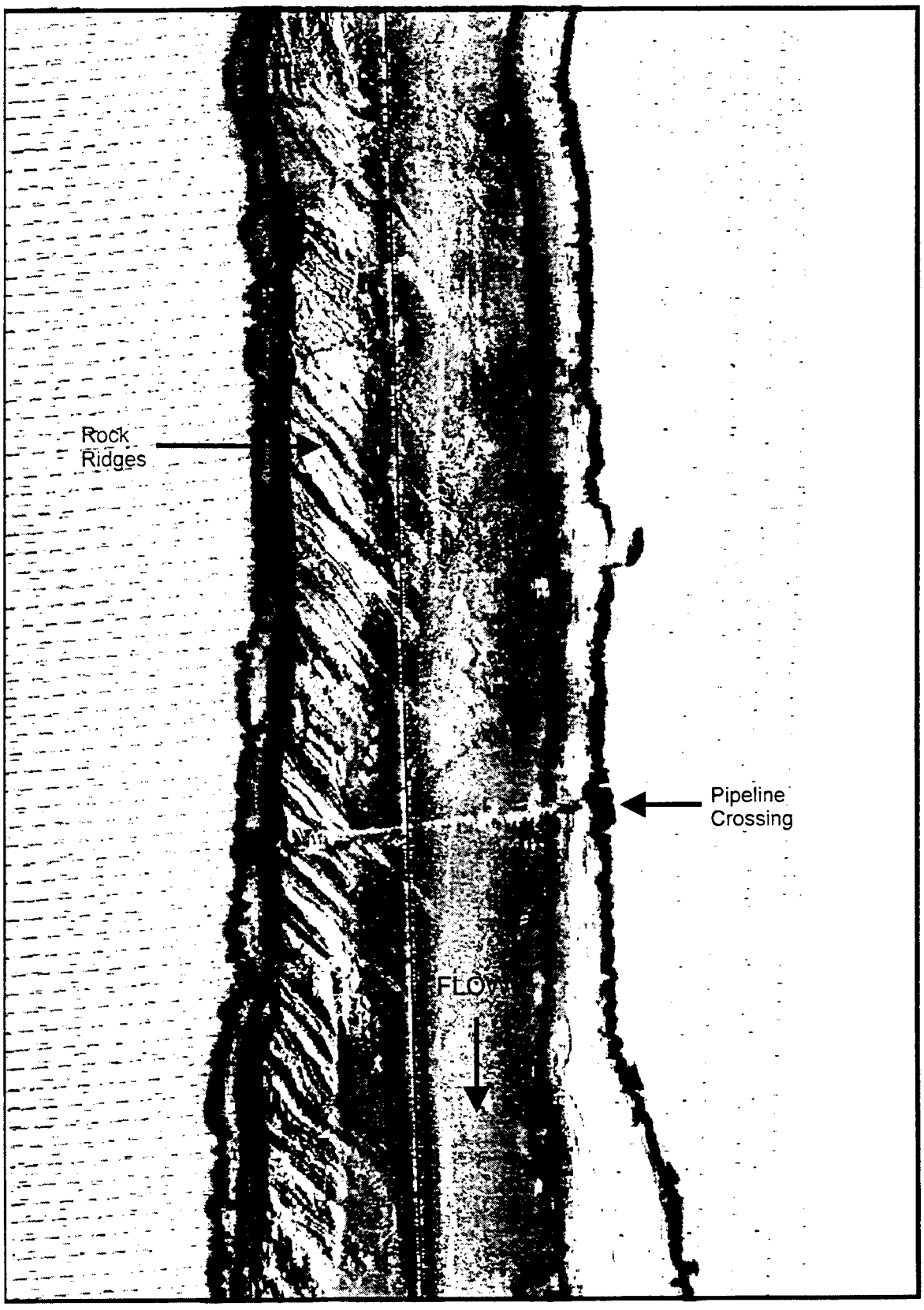


Figure 21. Image of a pipeline crossing and rock ridges at CRM 19.0, Section 4, Clinch River

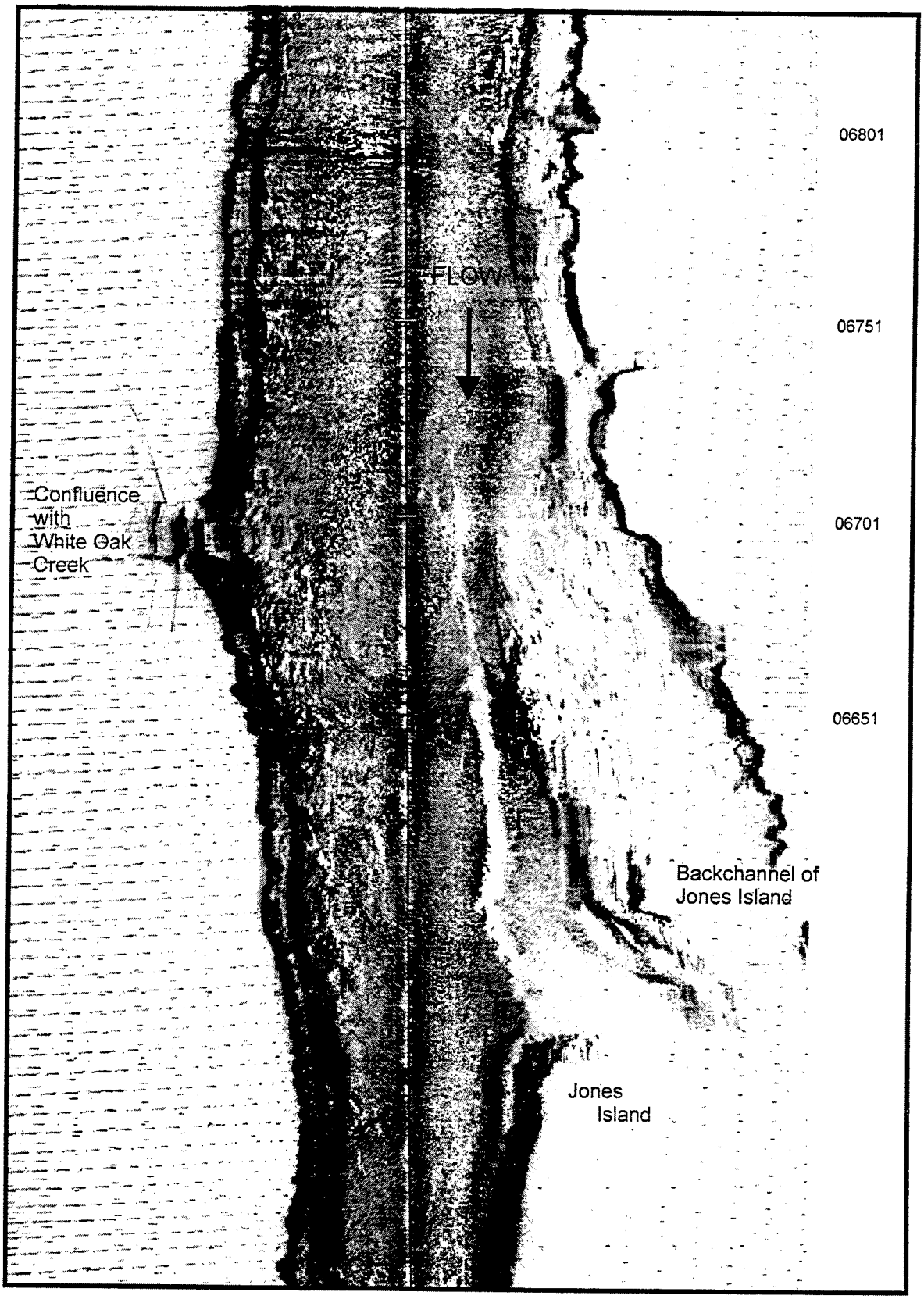


Figure 22. Portion of a side scan sonar record near CRM 20.8, Section 4, Clinch River

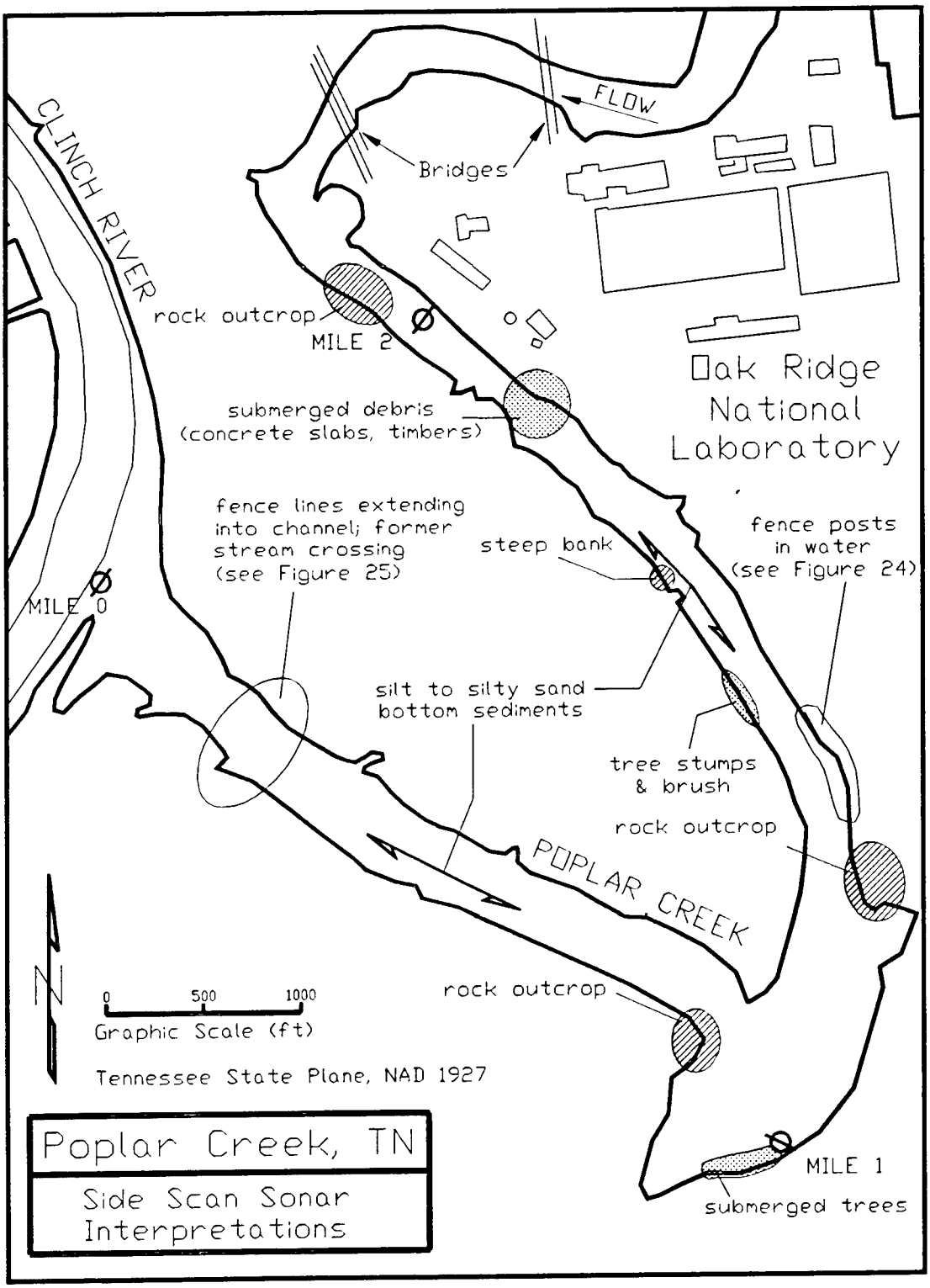


Figure 23. Interpreted side scan sonar results, Poplar Creek

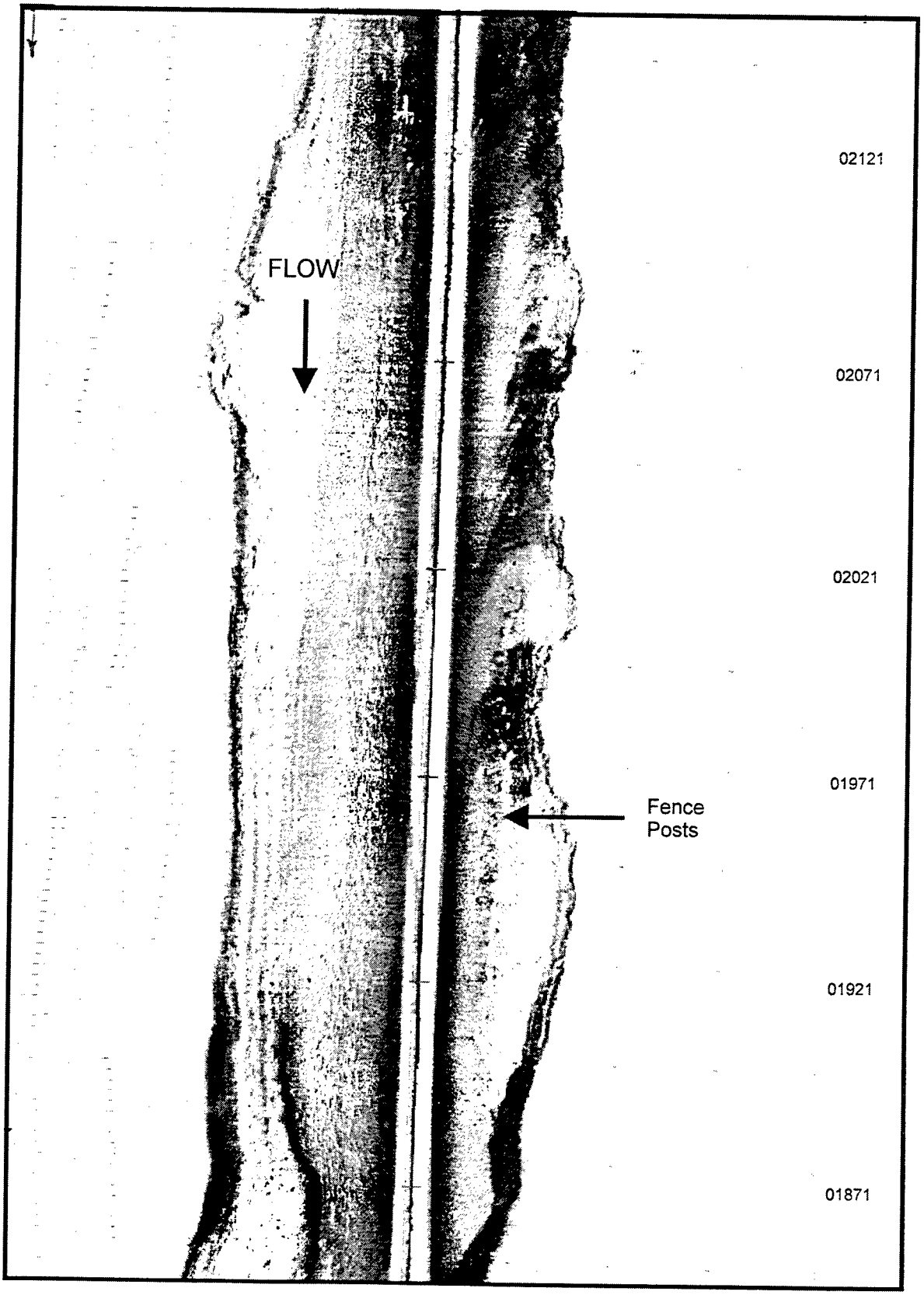


Figure 24. Sonar images recorded at RM 1.4, Poplar Creek

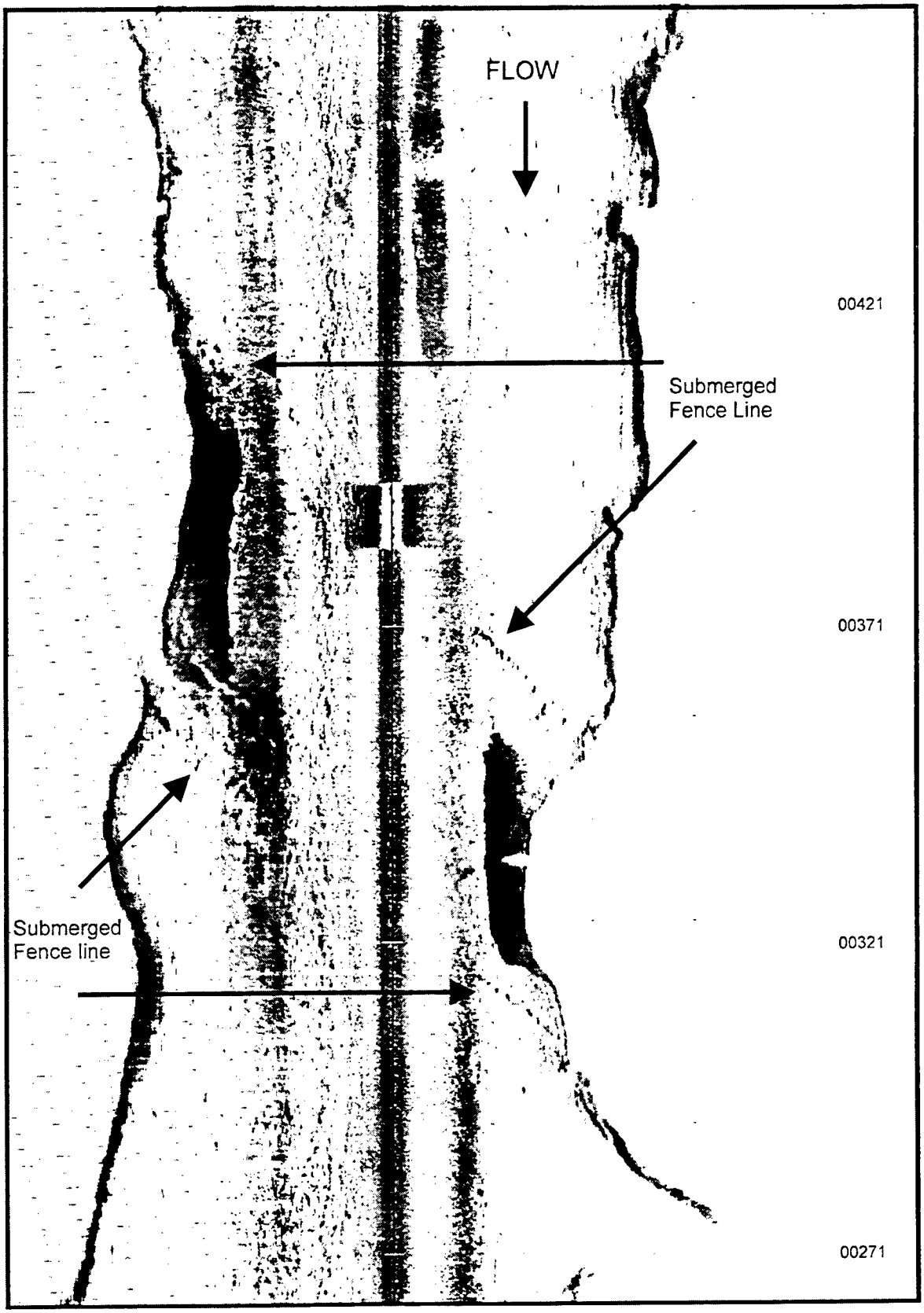


Figure 25. Portion of the side scan sonar record near RM 0.3, Poplar Creek

Appendix A
Centerline Positioning Data, Section 1, Clinch River

Survey Line CS11
Section 1, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 8 February 1994, 1010 to 1209 hours
Coordinate System : Tennessee State Plane, NAD 1927
Water Level Elevation : 736.0 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
0086	2434590	538793	690.1
0095	2434617	538778	690.0
0105	2434646	538774	691.2
0115	2434673	538791	693.3
0124	2434700	538814	695.3
0135	2434736	538830	696.0
0144	2434763	538829	696.9
0154	2434797	538828	697.7
0164	2434828	538831	698.5
0173	2434865	538834	699.3
0184	2434901	538839	699.9
0193	2434935	538837	700.2
0203	2434966	538834	700.2
0213	2435000	538831	700.6
0222	2435032	538826	700.3
0232	2435062	538814	700.3
0241	2435091	538809	700.5
0251	2435128	538808	701.1
0261	2435159	538819	701.7
0271	2435193	538830	701.9
0281	2435224	538824	700.9
0291	2435256	538812	700.7
0301	2435292	538803	699.9
0311	2435326	538801	700.4
0320	2435358	538814	700.5
0330	2435390	538824	700.2
0340	2435423	538828	699.8
0349	2435455	538822	698.8
0359	2435487	538808	698.4
0369	2435519	538791	698.3
0379	2435550	538799	698.8
0389	2435577	538817	699.2
0398	2435602	538843	699.8
0408	2435624	538872	700.5
0417	2435639	538900	701.0
0427	2435664	538931	701.4
0437	2435690	538954	702.1
0446	2435733	538978	702.4
0457	2435784	539004	702.3
0467	2435836	539027	702.6
0478	2435897	539062	702.4
0489	2435957	539095	702.8
0499	2436016	539131	702.2
0510	2436076	539166	702.8
0520	2436136	539205	702.4
0531	2436192	539247	702.9
0541	2436246	539279	702.4
0552	2436321	539291	701.0
0563	2436389	539275	699.7
0572	2436450	539276	699.9
0583	2436496	539323	700.1
0592	2436534	539365	700.4
0603	2436558	539436	701.1
0613	2436584	539495	701.6
0623	2436629	539548	701.4
0634	2436682	539592	701.0
0644	2436729	539639	701.5
0655	2436774	539688	701.2
0666	2436809	539741	701.7
0677	2436856	539793	700.9
0688	2436907	539830	700.7
0698	2436952	539873	700.8
0709	2436985	539927	700.4
0719	2437032	539971	700.0
0730	2437076	540013	699.5
0741	2437121	540061	698.8
0753	2437170	540116	698.4
0764	2437221	540154	698.6
0774	2437270	540193	698.4
0785	2437312	540239	698.3
0795	2437348	540290	698.6
0806	2437372	540347	698.2
0816	2437382	540403	698.2
0827	2437411	540466	698.2
0838	2437446	540517	698.3
0848	2437484	540569	698.1
0859	2437506	540628	698.5
0869	2437536	540685	698.7
0880	2437562	540743	698.5
0891	2437582	540804	699.2
0903	2437615	540873	699.2
0914	2437652	540922	699.2
0924	2437683	540978	699.5
0935	2437712	541034	699.5
0945	2437738	541093	699.5
0956	2437767	541149	699.5
0966	2437784	541199	699.7
0977	2437765	541258	700.4
0988	2437750	541316	700.7
0998	2437734	541374	700.9
1009	2437720	541432	700.7
1019	2437716	541494	701.2
1030	2437713	541553	701.2
1041	2437708	541614	701.1
1053	2437695	541682	701.1
1064	2437681	541740	701.4
1074	2437676	541798	701.3
1085	2437674	541860	701.0
1095	2437672	541918	701.2
1106	2437664	541977	701.5
1116	2437656	542030	701.1
1127	2437642	542095	700.5
1138	2437612	542145	701.2
1148	2437577	542194	700.4
1159	2437544	542244	700.0
1169	2437510	542290	699.7

Survey Line CS11
Section 1, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 8 February 1994, 1010 to 1209 hours
Coordinate System : Tennessee State Plane, NAD 1927
Water Level Elevation : 736.0 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
1180	2437475	542340	699.8
1191	2437450	542392	699.4
1203	2437419	542453	699.4
1214	2437391	542502	699.0
1224	2437364	542555	699.2
1235	2437336	542604	698.4
1245	2437306	542655	698.8
1256	2437278	542705	698.8
1266	2437252	542750	698.1
1277	2437226	542807	697.7
1288	2437198	542858	698.0
1298	2437173	542910	697.9
1309	2437147	542961	698.4
1319	2437117	543008	698.4
1330	2437078	543048	697.7
1341	2437048	543094	697.2
1353	2437042	543158	697.9
1364	2437039	543210	698.4
1374	2436994	543231	698.3
1385	2436935	543226	698.4
1395	2436881	543238	699.2
1406	2436840	543270	699.1
1416	2436803	543303	698.8
1427	2436757	543341	699.2
1438	2436709	543368	699.3
1448	2436659	543394	700.9
1459	2436614	543418	704.9
1469	2436572	543452	699.0
1480	2436533	543488	699.6
1491	2436488	543518	699.6
1503	2436435	543553	699.8
1514	2436390	543578	699.2
1524	2436340	543596	698.3
1535	2436290	543613	697.7
1545	2436250	543648	698.0
1556	2436216	543683	698.1
1566	2436175	543710	697.8
1577	2436129	543743	698.9
1588	2436086	543776	699.4
1598	2436042	543803	701.1
1609	2435992	543823	699.6
1619	2435945	543844	698.5
1630	2435904	543877	698.1
1641	2435867	543914	698.2
1653	2435816	543952	698.6
1664	2435791	543995	698.5
1674	2435766	544042	699.1
1685	2435740	544087	699.2
1695	2435706	544128	699.5
1706	2435671	544167	699.8
1716	2435641	544205	699.4
1727	2435602	544249	699.8
1738	2435568	544286	698.3
1748	2435533	544326	698.4
1759	2435498	544364	699.0
1769	2435464	544404	699.4
1780	2435430	544445	699.0
1791	2435392	544485	699.2
1803	2435349	544523	700.2
1813	2435319	544558	699.9
1823	2435328	544604	699.9
1833	2435345	544646	699.4
1843	2435360	544695	698.4
1853	2435366	544738	697.5
1863	2435361	544783	696.5
1873	2435356	544831	696.9
1884	2435355	544880	701.6
1894	2435356	544928	695.9
1905	2435360	544977	696.1
1916	2435364	545027	695.7
1928	2435366	545086	695.6
1939	2435362	545135	697.8
1949	2435360	545187	696.2
1960	2435356	545238	696.4
1970	2435351	545278	695.8
1980	2435358	545323	696.9
1991	2435370	545370	697.7
2003	2435383	545426	696.8
2014	2435376	545474	698.3
2024	2435366	545522	700.9
2035	2435392	545557	698.9
2045	2435416	545597	699.0
2056	2435443	545638	699.4
2066	2435474	545668	699.1
2077	2435503	545708	699.4
2088	2435520	545753	699.4
2098	2435540	545796	699.2
2108	2435556	545836	699.4
2118	2435573	545880	699.2
2129	2435590	545925	700.2
2140	2435612	545970	699.8
2150	2435636	546010	699.6
2161	2435652	546056	699.7
2171	2435662	546105	699.7
2182	2435677	546151	699.5
2192	2435697	546190	699.4
2203	2435716	546242	699.5
2214	2435736	546288	699.7
2224	2435756	546336	699.3
2235	2435778	546383	699.3
2245	2435795	546431	699.4
2256	2435812	546478	699.8
2266	2435828	546520	699.3
2277	2435847	546573	699.2
2288	2435867	546619	699.4
2298	2435884	546665	699.2
2309	2435906	546711	700.8
2319	2435926	546756	697.5

Survey Line CS11
Section 1, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 8 February 1994, 1010 to 1209 hours
Coordinate System : Tennessee State Plane, NAD 1927
Water Level Elevation : 736.0 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
2330	2435950	546798	696.8
2341	2435974	546842	697.6
2353	2435996	546893	698.3
2363	2436011	546934	697.7
2373	2436031	546979	697.2
2383	2436051	547019	697.5
2393	2436073	547062	698.9
2404	2436092	547106	696.1
2415	2436108	547152	696.5
2425	2436125	547197	695.7
2435	2436142	547237	695.3
2445	2436160	547282	696.6
2456	2436177	547328	696.0
2466	2436195	547366	694.8
2477	2436214	547415	695.6
2488	2436234	547461	695.5
2498	2436251	547507	697.6
2509	2436271	547553	695.5
2519	2436291	547598	694.4
2530	2436312	547642	699.0
2541	2436332	547687	698.6
2553	2436354	547740	695.8
2564	2436376	547789	698.1
2574	2436391	547830	697.8
2585	2436411	547880	698.9
2595	2436189	547911	697.6
2606	2436457	547965	696.1
2616	2436474	548007	697.3
2627	2436490	548051	698.1
2638	2436507	548097	697.9
2648	2436526	548143	696.3
2659	2436548	548188	697.6
2669	2436568	548234	698.5
2680	2436595	548274	698.5
2691	2436621	548314	698.5
2703	2436652	548364	698.0
2714	2436676	548405	698.2
2724	2436698	548448	698.5
2735	2436727	548490	698.4
2745	2436721	548457	698.4
2756	2436881	548612	700.6
2766	2436904	548632	700.3
2777	2436833	548652	700.8
2788	2436857	548698	699.1
2798	2436888	548737	700.3
2809	2436917	548779	699.7
2819	2436946	548821	700.5
2830	2436974	548868	698.4
2841	2437006	548908	698.9
2853	2437032	548957	698.5
2864	2437056	549002	700.3
2874	2437080	549047	698.5
2885	2437104	549092	697.6
2895	2437136	549135	697.3
2906	2437153	549185	699.3
2916	2437188	549211	701.1
2927	2437243	549208	698.4
2938	2437288	549228	698.0
2948	2437332	549256	698.0
2959	2437377	549286	697.1
2969	2437422	549313	697.8
2980	2437464	549339	698.0
2991	2437514	549358	698.6
3003	2437572	549381	698.0
3014	2437610	549415	700.0
3024	2437653	549422	697.9
3035	2437703	549420	697.7
3045	2437748	549407	698.1
3056	2437798	549399	697.8
3066	2437841	549407	698.3
3077	2437893	549417	698.5
3088	2437940	549428	698.6
3098	2437990	549437	698.6
3109	2438037	549446	698.6
3119	2438084	549455	698.7
3130	2438132	549461	698.7
3141	2438181	549473	698.8
3153	2438238	549486	698.8
3164	2438287	549490	698.9
3174	2438335	549487	698.8
3185	2438384	549486	699.1
3195	2438434	549487	699.1
3206	2438478	549464	699.2
3216	2438512	549432	699.7
3227	2438560	549414	700.1
3238	2438609	549413	700.2
3248	2438661	549416	700.6
3259	2438711	549417	700.7
3269	2438761	549412	701.2
3280	2438808	549404	701.6
3291	2438856	549393	701.5
3304	2438915	549380	701.6
3315	2438962	549371	701.6
3325	2439010	549358	701.5
3336	2439056	549346	701.7
3346	2439101	549333	701.7
3357	2439144	549317	701.7
3367	2439185	549304	702.0
3378	2439235	549296	702.2
3388	2439278	549291	702.0
3397	2439323	549285	702.0
3408	2439371	549277	702.5
3418	2439420	549270	702.3
3429	2439470	549259	702.0
3439	2439514	549245	702.2
3449	2439561	549229	702.1

Survey Line CS11
Section 1, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 8 February 1994, 1010 to 1209 hours
Coordinate System : Tennessee State Plane, NAD 1927
Water Level Elevation : 736.0 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
3460	2439614	549220	702.0
3470	2439663	549212	702.2
3481	2439718	549203	702.1
3491	2439756	549180	702.0
3502	2439793	549156	701.7
3513	2439838	549157	701.7
3523	2439886	549157	702.0
3534	2439933	549150	702.0
3544	2439976	549142	702.0
3555	2440024	549134	702.2
3566	2440071	549128	702.4
3578	2440128	549122	702.5
3589	2440171	549112	702.5
3599	2440216	549097	702.7
3610	2440262	549088	702.4
3620	2440307	549085	702.7
3631	2440354	549078	702.8
3641	2440398	549075	702.7
3652	2440450	549069	703.1
3663	2440497	549062	703.1
3673	2440547	549051	703.2
3684	2440597	549039	703.6
3694	2440647	549033	703.7
3705	2440699	549028	703.8
3716	2440751	549025	704.0
3728	2440808	549010	703.7
3739	2440858	549004	703.9
3749	2440905	548998	703.9
3760	2440952	548994	703.7
3770	2441000	548983	703.6
3781	2441046	548967	703.5
3791	2441086	548958	703.5
3802	2441136	548951	703.2
3813	2441184	548946	702.9
3823	2441231	548940	702.5
3834	2441279	548931	702.5
3844	2441324	548922	702.7
3855	2441372	548916	702.5
3866	2441417	548910	702.2
3879	2441476	548901	701.9
3890	2441522	548891	702.2
3900	2441569	548884	702.4
3911	2441619	548878	702.6
3921	2441668	548869	702.4
3932	2441718	548860	702.9
3942	2441762	548841	703.9
3953	2441810	548810	703.8
3964	2441857	548823	703.3
3974	2441900	548830	702.7
3985	2441950	548833	702.3
3995	2441999	548841	701.7
4006	2442051	548849	701.6
4016	2442096	548856	701.3
4027	2442148	548861	------
4038	2442195	548863	700.5
4048	2442240	548864	700.5
4059	2442288	548874	700.5
4069	2442335	548879	700.5
4080	2442380	548877	701.1
4091	2442426	548868	701.4
4104	2442482	548870	701.3
4115	2442530	548878	700.9
4125	2442577	548884	700.6
4136	2442627	548884	701.0
4146	2442679	548882	700.9
4157	2442728	548883	701.1
4167	2442776	548887	701.9
4178	2442832	548898	702.0
4189	2442886	548906	703.3
4199	2442936	548897	703.8
4210	2442984	548871	704.0
4220	2443034	548859	703.2
4231	2443084	548849	703.0
4241	2443129	548839	703.1
4252	2443181	548820	703.3
4263	2443224	548800	703.6
4273	2443270	548784	703.8
4284	2443318	548774	703.8
4294	2443365	548764	704.0
4305	2443413	548758	704.2
4316	2443460	548749	704.1
4329	2443513	548718	704.4
4340	2443552	548692	704.7
4350	2443597	548674	704.8
4361	2443645	548663	704.7
4371	2443697	548647	704.5
4382	2443749	548641	704.6
4391	2443792	548635	704.3
4402	2443844	548622	704.1
4413	2443892	548600	703.6
4422	2443924	548566	703.3
4433	2443963	548533	703.2
4443	2444013	548531	703.3
4454	2444063	548535	703.4
4465	2444112	548532	703.5
4475	2444154	548513	704.8
4486	2444186	548485	713.2
4496	2444218	548458	720.4
4507	2444254	548442	711.2
4517	2444292	548436	710.8
4528	2444344	548430	710.6
4539	2444390	548419	710.2
4549	2444431	548404	709.6
4560	2444470	548384	709.1
4570	2444513	548372	708.9
4580	2444549	548365	708.7
4591	2444590	548349	708.3
4604	2444642	548324	708.0

Survey Line CS11
Section 1, Clinch River, Tennessee

Survey Direction : Upstream
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Coordinate System : Tennessee State Plane, NAD 1927
Water Level Elevation : 736.0 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
4615	2444686	548306	707.6
4625	2444731	548297	707.4
4636	2444778	548283	707.3
4646	2444824	548273	706.6
4657	2444869	548254	706.5
4667	2444906	548231	706.2
4678	2444952	548206	706.1
4689	2444997	548192	705.9
4699	2445042	548182	705.9
4710	2445088	548169	705.7
4720	2445126	548154	705.8
4731	2445172	548144	705.6
4741	2445210	548134	705.4
4752	2445256	548119	705.2
4763	2445290	548095	704.8
4773	2445324	548072	704.6
4784	2445365	548062	704.4
4794	2445406	548050	704.2
4804	2445444	548041	704.1
4815	2445485	548029	704.0
4825	2445530	548020	704.3
4836	2445580	548015	704.3
4846	2445624	547998	703.9
4857	2445667	547982	704.4
4867	2445706	547962	704.6
4878	2445746	547937	704.2
4889	2445790	547925	704.4
4899	2445835	547914	704.4
4910	2445878	547903	704.3
4920	2445921	547891	704.2
4931	2445964	547879	704.1
4941	2446003	547868	704.3
4952	2446048	547852	703.8
4963	2446087	547838	704.2
4973	2446128	547825	704.2
4984	2446169	547810	703.8
4994	2446210	547797	704.4
5005	2446248	547787	704.0
5016	2446289	547778	704.6
5029	2446339	547762	703.0
5040	2446378	547747	703.2
5050	2446416	547727	702.9
5061	2446458	547706	703.4
5071	2446501	547693	702.5
5082	2446548	547686	702.6
5092	2446591	547679	702.8
5103	2446641	547661	702.3
5114	2446671	547629	701.6
5124	2446690	547586	700.7
5135	2446724	547558	701.0
5145	2446768	547540	701.5
5156	2446808	547523	701.4
5166	2446838	547498	701.7
5177	2446875	547473	702.3
5188	2446914	547454	702.8
5198	2446952	547436	703.3
5209	2446991	547418	703.4
5219	2447025	547393	703.2
5230	2447057	547366	703.0
5241	2447092	547339	702.2
5254	2447128	547297	702.2
5265	2447160	547273	702.3
5275	2447195	547248	702.2
5286	2447229	547224	702.1
5296	2447266	547202	702.4
5307	2447306	547185	702.7
5317	2447332	547156	701.9
5328	2447364	547119	701.2
5339	2447394	547086	700.3
5349	2447426	547053	700.5
5360	2447458	547021	699.5
5370	2447488	546984	699.3
5381	2447482	546942	699.2
5391	2447557	546918	699.4
5402	2447573	546885	698.5
5413	2447598	546856	699.2
5423	2447628	546825	700.4
5434	2447658	546800	699.2
5444	2447697	546784	699.9
5455	2447733	546764	699.6
5466	2447772	546744	700.1
5479	2447820	546715	701.7
5490	2447859	546695	701.2
5500	2447895	546670	701.4
5511	2447934	546645	698.8
5521	2447968	546612	698.2
5532	2448007	546589	698.5
5542	2448050	546569	699.7
5553	2448092	546543	698.8
5564	2448130	546519	699.3
5574	2448171	546496	705.9
5585	2448210	546475	700.1
5595	2448247	546448	700.5
5606	2448276	546415	706.5
5616	2448300	546381	702.7
5627	2448330	546355	703.3
5638	2448361	546364	703.4
5648	2448397	546391	701.9
5659	2448433	546395	702.0
5669	2448469	546385	703.4
5680	2448508	546380	702.3
5691	2448546	546367	705.3
5704	2448596	546348	704.2
5715	2448637	546338	------
5725	2448680	546323	704.3
5736	2448726	546310	704.8

Survey Line CS11
Section 1, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 8 February 1994, 1010 to 1209 hours
Coordinate System : Tennessee State Plane, NAD 1927
Water Level Elevation : 736.0 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
5746	2448769	546305	704.6
5757	2448800	546329	704.4
5767	2448822	546361	707.1
5778	2448860	546384	707.0
5789	2448898	546404	-----
5799	2448939	546420	------
5810	2448977	546434	------
5820	2449018	546449	------
5831	2449056	546466	------
5841	2449096	546481	------
5852	2449132	546492	705.4
5863	2449150	546526	706.5
5873	2449167	546564	707.5
5884	2449178	546601	------
5894	2449193	546638	------
5905	2449215	546670	706.3
5916	2449235	546706	705.8
5929	2449254	546758	710.6
5940	2449279	546795	705.6
5950	2449301	546838	706.2
5961	2449325	546876	706.5
5971	2449354	546912	707.3
5982	2449385	546945	708.6
5992	2449396	546981	707.9
6003	2449377	547027	706.0
6014	2449374	547070	705.7
6024	2449378	547111	706.2
6035	2449380	547154	707.2
6045	2449392	547188	707.9
6056	2449392	547227	706.4
6066	2449391	547263	711.3
6077	2449377	547317	705.6
6088	2449376	547356	------
6098	2449380	547395	------
6109	2449382	547432	------
6119	2449381	547470	------
6130	2449388	547509	------
6141	2449398	547548	------
6154	2449409	547598	------
6165	2449408	547642	------
6175	2449414	547684	------
6186	2449418	547726	------
6196	2449422	547769	------
6206	2449426	547808	703.1
6216	2449432	547847	------
6227	2449438	547894	------
6238	2449438	547936	703.2
6248	2449434	547979	701.9
6259	2449434	548019	702.1
6269	2449433	548055	701.6
6280	2449426	548095	701.7
6291	2449441	548134	701.1
6304	2449490	548176	702.3
6315	2449487	548221	702.8
6325	2449491	548271	701.6
6336	2449499	548326	702.3
6346	2449500	548381	702.7
6357	2449506	548435	------
6367	2449512	548484	703.6
6378	2449512	548545	704.4
6394	2449510	548626	------
6482	2449551	549046	694.5
6494	2449568	549103	693.7
6506	2449604	549149	694.7
6517	2449621	549197	695.5
6529	2449627	549259	694.0
6541	2449626	549318	694.0
6554	2449634	549384	694.1
6566	2449644	549442	694.5
6578	2449657	549503	695.8
6590	2449679	549555	697.2
6601	2449698	549609	698.2
6613	2449711	549668	697.8
6624	2449735	549717	698.5
6636	2449792	549740	699.7
6647	2449829	549779	697.6
6659	2449864	549827	699.9
6670	2449886	549883	699.5
6682	2449910	549937	700.0
6693	2449936	549995	700.5
6705	2449990	550015	699.9
6716	2450044	550028	696.4
6728	2450108	550021	697.9
6740	2450167	550026	699.0
6751	2450218	550053	699.6
6763	2450272	550078	699.9
6774	2450324	550109	699.8
6786	2450378	550135	700.0
6797	2450438	550147	699.0
6809	2450493	550130	698.9
6820	2450547	550110	699.3
6832	2450608	550109	699.9
6843	2450667	550102	700.5
6855	2450724	550086	700.9
6866	2450776	550063	701.2
6878	2450840	550045	702.5
6890	2450903	550040	703.8
6901	2450969	550037	704.5

Appendix B
Centerline Positioning Data, Section 2, Clinch River

Survey Line CS21
Section 2, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 9 February 1994, 1213 to 1334 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 736.3 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
0054	2451688	549530	710.3
0065	2451700	549507	705.3
0076	2451721	549496	705.5
0085	2451737	549481	705.3
0096	2451753	549462	705.2
0106	2451771	549446	705.1
0117	2451792	549432	705.3
0127	2451810	549417	705.4
0138	2451833	549398	705.5
0149	2451867	549375	705.6
0159	2451906	549345	705.5
0170	2451947	549312	705.6
0180	2451986	549277	705.6
0191	2452030	549241	706.0
0202	2452066	549202	705.3
0213	2452106	549159	705.2
0224	2452145	549119	704.4
0234	2452184	549081	704.6
0245	2452220	549041	704.7
0255	2452257	549003	703.9
0266	2452296	548966	702.7
0277	2452331	548922	702.1
0288	2452370	548878	701.5
0299	2452402	548836	700.6
0309	2452437	548792	701.5
0320	2452474	548755	704.2
0330	2452517	548725	702.6
0341	2452563	548695	707.3
0352	2452606	548664	704.1
0363	2452656	548633	702.7
0374	2452704	548605	704.4
0384	2452750	548576	705.1
0395	2452796	548546	704.9
0405	2452839	548514	704.7
0416	2452880	548480	703.1
0427	2452922	548443	705.8
0438	2452978	548424	704.8
0449	2453032	548421	702.8
0459	2453087	548413	705.0
0470	2453139	548398	701.1
0480	2453194	548378	701.8
0491	2453246	548356	702.1
0501	2453292	548339	701.9
0511	2453342	548316	701.3
0521	2453389	548299	704.7
0531	2453441	548302	703.7
0542	2453495	548310	701.5
0552	2453543	548308	704.3
0563	2453602	548306	701.5
0574	2453656	548308	702.6
0584	2453710	548308	702.7
0595	2453764	548300	704.6
0605	2453819	548293	705.4
0616	2453873	548292	703.6
0627	2453925	548302	705.3
0638	2453981	548308	704.3
0649	2454026	548332	703.7
0659	2454066	548365	703.1
0670	2454111	548392	704.1
0680	2454160	548407	704.5
0691	2454212	548418	703.8
0702	2454264	548432	705.3
0713	2454323	548447	705.9
0724	2454372	548463	706.2
0734	2454426	548476	706.8
0745	2454473	548495	703.7
0755	2454504	548536	704.5
0766	2454531	548583	705.4
0777	2454559	548628	705.3
0789	2454592	548677	705.2
0800	2454621	548721	705.2
0810	2454650	548763	705.6
0821	2454678	548806	706.0
0831	2454707	548850	706.0
0842	2454743	548892	706.2
0852	2454774	548926	705.3
0863	2454810	548971	706.9
0874	2454829	549020	707.6
0884	2454844	549069	706.0
0895	2454864	549116	705.9
0905	2454879	549165	706.5
0916	2454896	549214	704.2
0927	2454913	549263	704.0
0938	2454933	549317	704.2
0949	2454950	549366	704.2
0959	2454968	549415	704.4
0970	2454982	549464	704.4
0980	2455000	549514	704.6
0991	2455012	549564	704.8
1002	2455028	549613	705.0
1013	2455045	549668	705.4
1024	2455062	549718	705.7
1034	2455075	549767	706.0
1045	2455078	549817	705.6
1055	2455073	549869	704.9
1066	2455068	549921	704.2
1077	2455067	549971	705.0
1089	2455071	550032	705.9
1100	2455079	550082	705.4
1110	2455087	550131	704.4
1121	2455102	550178	704.8
1131	2455113	550228	705.6
1142	2455123	550278	705.4
1152	2455132	550323	705.5
1163	2455140	550377	705.5
1174	2455146	550429	705.4

Survey Line CS21
Section 2, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 9 February 1994, 1213 to 1334 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 736.3 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
1184	2455152	550479	706.4
1195	2455160	550528	706.0
1205	2455168	550579	705.9
1216	2455170	550632	705.7
1227	2455176	550682	706.0
1239	2455182	550740	706.8
1250	2455190	550790	706.0
1260	2455198	550842	707.2
1271	2455204	550893	706.3
1281	2455217	550944	706.8
1292	2455223	550995	706.6
1302	2455224	551042	706.0
1313	2455226	551098	706.0
1324	2455230	551148	705.8
1334	2455236	551199	705.4
1344	2455237	551247	705.3
1354	2455241	551297	705.2
1365	2455240	551348	705.5
1376	2455246	551398	705.5
1386	2455247	551448	705.6
1397	2455251	551500	705.8
1407	2455252	551550	706.4
1418	2455254	551601	705.9
1428	2455256	551647	705.0
1439	2455257	551704	706.1
1450	2455263	551754	705.3
1460	2455267	551804	705.4
1471	2455268	551853	705.5
1481	2455274	551901	708.1
1492	2455278	551950	706.6
1502	2455282	551994	708.3
1513	2455288	552049	708.8
1524	2455289	552097	707.1
1534	2455291	552146	708.1
1545	2455292	552195	707.1
1555	2455292	552243	705.1
1566	2455295	552292	707.8
1577	2455301	552336	705.7
1589	2455314	552391	706.6
1600	2455327	552438	706.7
1610	2455337	552484	707.4
1621	2455346	552532	707.6
1631	2455352	552579	706.9
1642	2455356	552628	704.9
1652	2455357	552672	707.4
1663	2455358	552723	707.3
1674	2455367	552771	708.9
1684	2455389	552811	708.4
1695	2455410	552853	708.4
1705	2455435	552895	708.1
1716	2455457	552939	708.0
1727	2455476	552984	708.9
1738	2455492	553034	709.5
1749	2455509	553081	709.3
1759	2455530	553126	709.2
1770	2455548	553174	708.0
1780	2455565	553220	709.8
1791	2455585	553266	709.9
1802	2455604	553311	708.9
1814	2455636	553362	708.8
1825	2455662	553407	707.6
1835	2455690	553454	707.6
1846	2455721	553498	706.0
1857	2455757	553542	706.1
1868	2455795	553579	708.1
1878	2455832	553609	707.6
1889	2455877	553644	707.4
1900	2455915	553678	706.8
1910	2455955	553712	705.9
1921	2455996	553746	704.7
1931	2456033	553780	704.4
1942	2456066	553821	703.7
1952	2456107	553849	705.2
1963	2456158	553876	705.9
1974	2456208	553894	706.5
1984	2456257	553912	707.6
1995	2456304	553934	708.6
2005	2456352	553956	708.9
2016	2456396	553980	709.0
2027	2456441	554004	709.1
2039	2456495	554034	709.3
2050	2456540	554060	709.5
2060	2456584	554086	709.3
2071	2456627	554114	709.1
2081	2456672	554142	709.0
2092	2456714	554172	709.0
2102	2456761	554194	709.1
2113	2456810	554220	709.3
2124	2456858	554243	709.5
2134	2456907	554264	709.9
2145	2456956	554282	710.0
2155	2457008	554299	710.2
2166	2457055	554322	710.0
2177	2457100	554352	709.1
2189	2457156	554381	707.5
2200	2457206	554398	708.1
2209	2457253	554411	708.8
2220	2457302	554426	706.6
2230	2457354	554432	708.5
2241	2457406	554436	708.9
2252	2457460	554444	708.7
2264	2457528	554463	708.8
2275	2457579	554479	709.6
2285	2457629	554496	709.0
2296	2457678	554511	710.0
2306	2457725	554531	708.9
2317	2457777	554549	707.8
2327	2457822	554568	708.6

Survey Line CS21
Section 2, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 9 February 1994, 1213 to 1334 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 736.3 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
2338	2457876	554586	707.0
2349	2457928	554601	709.9
2359	2457979	554612	710.1
2370	2458031	554621	706.6
2380	2458083	554626	706.8
2391	2458132	554636	707.9
2401	2458180	554648	709.7
2411	2458229	554664	709.6
2422	2458276	554679	709.4
2432	2458324	554696	707.4
2443	2458373	554712	709.5
2452	2458396	554718	710.4
2462	2458402	554722	710.3
2473	2458409	554727	710.2
2483	2458422	554733	709.7
2494	2458445	554745	708.6
2504	2458481	554764	707.1
2515	2458530	554779	709.5
2526	2458584	554788	710.4
2536	2458641	554803	706.7
2546	2458688	554815	707.6
2556	2458742	554833	709.5
2567	2458796	554854	710.0
2577	2458846	554859	709.3
2588	2458906	554867	706.3
2599	2458960	554879	710.5
2609	2459014	554892	710.4
2620	2459066	554908	709.5
2630	2459120	554924	709.1
2641	2459172	554943	707.7
2652	2459226	554962	707.6
2664	2459288	554982	706.9
2675	2459342	554997	707.2
2685	2459399	555009	705.4
2696	2459453	555024	705.1
2706	2459507	555037	705.5
2717	2459561	555048	708.7
2727	2459613	555053	705.0
2738	2459672	555059	705.2
2749	2459726	555067	705.1
2759	2459780	555075	705.5
2770	2459832	555080	708.6
2780	2459886	555085	709.9
2791	2459940	555093	705.6
2802	2459996	555096	705.6
2814	2460060	555103	708.6
2825	2460114	555111	708.4
2835	2460170	555117	705.3
2846	2460224	555124	704.9
2856	2460278	555130	707.0
2867	2460334	555136	705.9
2877	2460384	555143	706.5
2888	2460445	555151	709.1
2899	2460499	555158	709.6
2909	2460553	555164	707.0
2920	2460608	555171	706.7
2930	2460662	555178	706.5
2941	2460718	555186	703.7
2952	2460772	555191	704.4
2964	2460831	555193	706.3
2975	2460885	555201	707.0
2985	2460937	555211	706.7
2996	2460991	555220	707.0
3006	2461045	555232	708.5
3017	2461106	555246	706.1
3027	2461155	555252	709.4
3038	2461214	555264	709.7
3049	2461266	555278	707.7
3059	2461317	555292	706.2
3070	2461369	555307	708.0
3080	2461423	555322	705.8
3091	2461477	555336	706.0
3102	2461529	555355	706.0
3114	2461587	555381	705.2
3125	2461639	555402	705.6
3135	2461688	555422	705.6
3146	2461737	555452	705.5
3156	2461782	555486	705.2
3167	2461831	555514	705.0
3177	2461876	555540	704.7
3188	2461930	555571	704.2
3199	2461979	555599	705.5
3209	2462030	555623	705.8
3220	2462076	555636	706.3
3230	2462125	555663	708.6
3241	2462176	555686	708.3
3252	2462216	555725	709.0
3264	2462254	555779	706.3
3275	2462287	555822	707.9
3285	2462320	555867	707.0
3296	2462358	555907	707.6
3306	2462396	555951	708.2
3317	2462438	555991	709.0
3327	2462481	556023	707.9
3338	2462530	556063	707.7
3349	2462560	556111	709.4
3359	2462576	556166	707.6
3370	2462570	556223	707.2
3380	2462565	556282	708.5
3391	2462562	556336	710.3
3402	2462563	556391	708.0
3414	2462568	556458	707.2
3425	2462577	556514	708.5
3435	2462585	556568	708.8
3446	2462591	556621	707.0
3456	2462601	556675	708.2

Survey Line CS21
Section 2, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 9 February 1994, 1213 to 1334 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 736.3 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
3467	2462607	556729	708.4
3477	2462622	556775	710.4
3488	2462640	556831	710.2
3499	2462657	556883	708.2
3509	2462670	556933	708.2
3520	2462680	556986	708.0
3530	2462684	557038	711.7
3541	2462665	557089	708.3
3552	2462652	557141	710.8
3564	2462647	557205	710.4
3575	2462642	557256	711.1
3585	2462646	557308	707.3
3596	2462647	557359	708.4
3606	2462646	557412	710.5
3617	2462648	557465	711.3
3627	2462651	557509	708.9
3638	2462650	557567	707.8
3649	2462652	557623	711.1
3659	2462646	557680	709.2
3670	2462650	557736	709.3
3680	2462649	557795	708.7
3691	2462650	557856	708.8
3702	2462649	557917	710.8
3714	2462644	557996	712.0
3725	2462649	558055	712.1
3735	2462653	558116	711.6
3746	2462654	558176	711.7
3756	2462649	558235	710.5
3767	2462641	558292	710.5
3777	2462652	558342	711.1
3788	2462666	558401	710.4
3799	2462681	558455	710.6
3809	2462698	558510	710.3
3820	2462716	558564	712.3
3830	2462735	558620	711.4
3841	2462757	558673	710.8
3852	2462774	558729	709.7
3863	2462791	558790	712.7
3874	2462808	558845	711.4
3884	2462826	558901	712.4
3895	2462845	558955	711.3
3905	2462862	559010	713.3
3916	2462888	559060	714.7
3927	2462920	559108	712.4
3939	2462959	559162	713.9
3950	2462992	559207	713.9
3960	2463023	559258	713.2
3971	2463047	559314	712.7
3981	2463080	559362	712.8
3992	2463118	559404	712.7
4002	2463151	559442	712.4
4013	2463194	559486	713.0
4024	2463234	559525	713.2
4034	2463274	559566	712.9
4045	2463312	559604	712.7
4055	2463352	559648	712.7
4066	2463394	559685	711.9
4077	2463436	559720	711.3
4089	2463490	559761	713.3
4100	2463539	559788	712.4
4110	2463586	559817	712.6
4121	2463633	559848	713.3
4131	2463680	559880	713.8
4142	2463724	559915	714.2
4152	2463767	559942	714.6
4163	2463816	559980	715.0
4174	2463860	560017	715.9
4184	2463905	560051	716.4
4195	2463957	560078	716.5
4205	2464008	560104	717.6
4216	2464058	560136	716.9
4227	2464109	560161	716.9
4239	2464172	560190	716.6
4250	2464224	560214	716.8
4260	2464275	560238	717.0
4271	2464324	560266	716.8
4281	2464374	560296	716.9
4292	2464423	560327	717.2
4302	2464470	560357	717.5
4313	2464526	560392	717.8
4324	2464575	560422	718.3
4334	2464624	560457	719.0
4373	2464810	560578	719.5
4384	2464872	560605	718.4
4395	2464926	560634	717.6
4405	2464980	560661	716.7
4416	2465034	560689	715.7
4427	2465085	560720	714.8
4440	2465150	560757	713.2
4451	2465202	560782	712.3
4461	2465258	560799	712.7
4472	2465312	560818	712.2
4482	2465368	560837	713.9
4493	2465422	560860	714.2
4502	2465464	560880	714.7
4513	2465516	560912	714.4
4524	2465563	560947	715.0
4534	2465610	560978	714.1
4545	2465659	561006	714.3
4555	2465704	561031	715.2
4566	2465737	561069	714.2
4577	2465772	561107	714.3
4590	2465817	561158	714.0
4601	2465852	561196	712.7
4611	2465888	561234	712.8
4621	2465921	561267	712.3
4631	2465957	561301	713.3
4642	2465997	561332	713.2

Survey Line CS21
Section 2, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 9 February 1994, 1213 to 1334 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 736.3 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
4652	2466035	561359	712.5
4663	2466080	561391	713.2
4674	2466122	561421	714.7
4684	2466164	561448	714.0
4695	2466205	561480	714.6
4705	2466240	561513	714.0
4716	2466276	561550	714.0
4727	2466314	561585	713.7

Appendix C
Centerline Positioning Data, Section 3, Clinch River

Survey Line CS31
Section 3, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 11 February 1994, 1149 to 1259 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 742.8 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
0218	2466235	561576	714.3
0228	2466275	561600	713.3
0237	2466311	561620	713.7
0246	2466331	561655	711.1
0256	2466339	561700	712.2
0265	2466350	561737	711.2
0275	2466374	561768	711.9
0285	2466401	561803	713.5
0294	2466416	561847	712.6
0304	2466433	561884	711.8
0314	2466460	561918	708.3
0323	2466486	561951	709.2
0332	2466506	561983	712.8
0341	2466528	562014	713.8
0351	2466550	562056	711.4
0360	2466568	562091	710.6
0368	2466592	562123	708.8
0377	2466616	562156	712.2
0386	2466638	562191	712.1
0395	2466662	562230	709.9
0405	2466691	562268	709.4
0414	2466720	562299	710.6
0423	2466735	562345	710.7
0433	2466744	562394	710.3
0442	2466747	562442	710.9
0452	2466762	562490	709.9
0462	2466778	562536	711.3
0471	2466799	562575	712.9
0481	2466821	562617	712.1
0490	2466834	562659	709.8
0500	2466852	562706	709.2
0510	2466869	562751	710.9
0519	2466886	562796	710.9
0530	2466901	562846	711.3
0540	2466912	562892	713.2
0550	2466920	562944	714.5
0560	2466930	562987	710.5
0569	2466941	563032	709.2
0579	2466956	563075	711.8
0589	2466969	563122	708.1
0598	2466975	563171	709.8
0608	2466986	563217	707.0
0617	2466996	563262	711.1
0627	2467009	563306	711.9
0637	2467017	563354	711.1
0646	2467026	563401	711.3
0656	2467034	563447	710.5
0665	2467040	563491	710.3
0676	2467052	563551	711.5
0686	2467068	563599	711.2
0694	2467087	563639	711.0
0704	2467111	563683	710.1
0714	2467145	563719	710.7
0723	2467182	563749	709.2
0733	2467216	563787	710.8
0741	2467238	563818	712.1
0751	2467269	563863	712.4
0761	2467295	563901	712.7
0770	2467324	563939	712.2
0780	2467360	563970	711.6
0790	2467398	563994	711.1
0800	2467442	564019	713.2
0810	2467483	564044	711.8
0819	2467523	564070	711.2
0829	2467559	564097	710.1
0839	2467592	564125	710.5
0848	2467628	564151	711.9
0858	2467664	564168	709.9
0867	2467700	564184	710.8
0877	2467736	564207	711.6
0887	2467771	564229	712.8
0896	2467807	564254	711.0
0907	2467847	564270	711.3
0917	2467888	564281	710.5
0927	2467930	564297	714.3
0937	2467968	564315	711.4
0946	2468007	564329	712.9
0956	2468045	564345	709.6
0965	2468081	564359	712.2
0975	2468121	564381	709.7
0984	2468152	564404	710.0
0993	2468184	564433	710.3
1003	2468217	564459	711.7
1013	2468250	564480	712.7
1022	2468284	564502	710.9
1031	2468311	564524	711.1
1040	2468335	564550	711.1
1050	2468369	564570	712.9
1059	2468396	564587	711.1
1068	2468429	564604	707.5
1078	2468468	564614	711.1
1087	2468499	564629	710.2
1096	2468535	564647	711.0
1106	2468568	564671	709.9
1115	2468600	564691	709.1
1125	2468635	564717	708.4
1135	2468674	564733	707.1
1144	2468700	564764	707.9
1153	2468731	564782	709.1
1162	2468763	564800	710.0
1170	2468792	564811	710.1
1180	2468830	564827	709.2
1190	2468870	564829	704.7
1200	2468918	564838	708.7
1210	2468958	564853	708.6
1219	2468996	564871	709.5

Survey Line CS31
Section 3, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 11 February 1994, 1149 to 1259 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 742.8 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
1229	2469030	564896	707.8
1239	2469070	564900	709.2
1248	2469111	564914	709.5
1258	2469149	564929	710.0
1267	2469185	564942	707.1
1276	2469221	564942	709.7
1286	2469262	564946	709.0
1295	2469300	564953	708.7
1305	2469340	564963	707.5
1315	2469379	564960	708.3
1325	2469424	564952	707.0
1335	2469465	564947	708.2
1344	2469506	564942	706.2
1353	2469542	564940	708.7
1363	2469585	564936	705.6
1372	2469628	564934	708.8
1382	2469669	564923	708.3
1391	2469703	564908	708.5
1401	2469737	564883	708.3
1411	2469771	564864	707.2
1420	2469812	564855	707.5
1430	2469853	564851	706.3
1440	2469894	564837	705.8
1450	2469930	564809	706.2
1460	2469965	564783	703.3
1469	2469997	564756	704.1
1479	2470026	564726	704.7
1489	2470059	564697	705.1
1498	2470086	564668	704.8
1508	2470114	564640	705.7
1517	2470139	564608	704.9
1527	2470167	564576	705.0
1537	2470192	564545	705.3
1546	2470218	564513	708.4
1557	2470243	564476	708.3
1567	2470275	564449	706.0
1577	2470307	564426	704.3
1587	2470330	564396	704.3
1596	2470353	564364	704.4
1606	2470370	564328	704.9
1615	2470388	564295	704.4
1625	2470409	564257	704.9
1635	2470426	564221	706.5
1645	2470444	564181	706.0
1656	2470461	564141	705.3
1665	2470482	564112	705.2
1675	2470507	564076	705.6
1685	2470537	564046	705.5
1694	2470567	564018	706.7
1703	2470581	563986	706.0
1713	2470595	563950	705.5
1722	2470609	563914	705.4
1732	2470628	563877	704.6
1741	2470644	563844	702.8
1752	2470667	563800	704.9
1762	2470688	563764	704.7
1771	2470709	563734	705.3
1781	2470734	563702	705.0
1790	2470753	563674	704.9
1800	2470763	563631	705.0
1810	2470756	563589	704.8
1820	2470746	563546	704.5
1831	2470749	563501	705.0
1841	2470759	563463	705.5
1852	2470757	563415	707.1
1863	2470762	563368	707.1
1873	2470781	563324	706.0
1884	2470811	563283	704.9
1893	2470846	563249	704.7
1903	2470848	563209	703.6
1914	2470831	563164	705.2
1924	2470818	563119	705.5
1934	2470810	563079	706.1
1944	2470802	563033	706.0
1954	2470802	562988	705.8
1965	2470806	562940	705.9
1976	2470811	562886	705.6
1987	2470810	562832	706.0
1996	2470799	562787	706.8
2007	2470782	562737	707.4
2017	2470758	562695	707.8
2028	2470736	562648	708.0
2039	2470716	562604	707.8
2049	2470699	562560	707.7
2060	2470682	562513	707.6
2070	2470662	562468	707.5
2080	2470651	562422	707.5
2090	2470641	562379	707.4
2100	2470626	562329	707.5
2111	2470602	562281	707.4
2121	2470582	562231	707.2
2132	2470563	562178	707.1
2142	2470536	562126	707.1
2153	2470512	562074	707.1
2164	2470472	562033	707.2
2174	2470432	561994	707.1
2185	2470397	561951	706.7
2195	2470364	561910	706.0
2206	2470333	561868	706.6
2216	2470304	561829	706.5
2227	2470271	561780	707.0
2238	2470242	561734	707.0
2248	2470211	561690	707.5
2259	2470180	561646	706.4
2269	2470152	561602	706.9
2280	2470118	561559	709.1
2290	2470092	561519	709.5
2300	2470045	561490	709.1

Survey Line CS31
Section 3, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 11 February 1994, 1149 to 1259 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 742.8 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
2311	2469998	561463	709.2
2321	2469949	561436	705.8
2332	2469906	561398	705.2
2342	2469871	561355	706.4
2352	2469836	561321	704.5
2362	2469802	561289	703.5
2370	2469769	561261	704.9
2381	2469731	561225	704.7
2391	2469693	561194	702.2
2401	2469648	561167	705.0
2411	2469606	561146	706.4
2420	2469568	561127	705.2
2431	2469530	561103	706.6
2441	2469492	561083	705.5
2451	2469451	561060	704.1
2462	2469411	561038	704.2
2471	2469373	561015	704.3
2482	2469330	560988	703.9
2491	2469292	560974	704.6
2502	2469240	560956	704.4
2513	2469196	560935	704.9
2523	2469151	560910	704.9
2534	2469106	560885	706.2
2544	2469061	560860	707.9
2555	2469014	560840	698.7
2565	2468978	560812	707.7
2576	2468936	560775	707.0
2587	2468910	560732	708.5
2597	2468883	560689	707.4
2608	2468848	560650	707.9
2618	2468808	560613	708.9
2629	2468770	560574	708.3
2640	2468730	560536	708.5
2652	2468718	560473	709.5
2663	2468716	560417	708.8
2673	2468714	560366	708.9
2684	2468711	560313	708.7
2694	2468700	560263	707.0
2705	2468694	560211	707.5
2715	2468682	560165	707.6
2726	2468683	560108	709.2
2737	2468697	560060	710.3
2746	2468716	560009	710.3
2757	2468714	559959	710.1
2767	2468715	559905	711.3
2778	2468730	559855	711.3
2789	2468742	559803	712.2
2799	2468756	559750	712.4
2810	2468766	559696	712.4
2820	2468769	559643	711.6
2831	2468772	559589	711.0
2841	2468780	559542	710.5
2852	2468803	559491	711.6
2863	2468829	559444	712.3
2873	2468854	559396	712.5
2884	2468867	559344	712.4
2894	2468881	559291	711.6
2905	2468898	559240	711.4
2915	2468912	559194	710.7
2926	2468926	559138	711.1
2937	2468941	559086	709.5
2947	2468958	559037	709.3
2958	2468985	558991	709.2
2968	2469013	558947	710.9
2979	2469036	558899	709.2
2990	2469058	558851	709.9
3001	2469083	558800	709.2
3012	2469109	558753	709.1
3022	2469139	558713	709.0
3033	2469174	558676	709.8
3043	2469208	558637	709.3
3054	2469242	558598	709.7
3065	2469275	558557	709.9
3077	2469307	558506	709.0
3088	2469333	558464	708.6
3098	2469363	558421	708.7
3109	2469397	558384	709.1
3119	2469430	558346	710.9
3130	2469466	558309	711.0
3140	2469496	558270	709.9
3151	2469531	558225	710.6
3162	2469566	558191	710.0
3172	2469600	558154	709.8
3183	2469630	558113	708.8
3193	2469660	558072	707.3
3204	2469699	558036	707.7
3215	2469740	558006	708.6
3227	2469782	557961	706.7
3238	2469809	557919	707.8
3248	2469835	557875	706.9
3259	2469874	557845	707.8
3269	2469906	557805	709.3
3280	2469936	557766	708.8
3290	2469966	557731	710.5
3301	2470014	557700	709.2
3312	2470057	557671	709.6
3322	2470098	557634	709.4
3333	2470136	557589	710.7
3343	2470184	557562	711.2
3354	2470236	557541	710.3
3365	2470288	557522	709.5
3377	2470349	557500	710.3
3388	2470402	557477	710.8
3398	2470454	557457	710.0
3409	2470504	557433	711.2
3419	2470548	557400	710.0

Survey Line CS31
Section 3, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 11 February 1994, 1149 to 1259 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 742.8 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
3430	2470593	557368	710.4
3440	2470632	557338	713.0
3451	2470689	557316	710.5
3462	2470746	557309	710.7
3472	2470800	557304	711.9
3483	2470852	557281	713.4
3493	2470902	557260	712.8
3504	2470957	557237	712.4
3515	2471007	557214	712.1
3527	2471068	557185	712.7
3538	2471121	557164	716.0
3548	2471175	557151	713.7
3559	2471230	557139	714.0
3569	2471284	557123	713.6
3580	2471336	557116	714.5
3590	2471386	557122	713.2
3601	2471442	557126	713.8
3612	2471496	557125	714.7
3622	2471551	557116	714.5
3633	2471603	557110	715.9
3643	2471657	557113	713.4
3654	2471709	557115	713.6
3665	2471761	557113	713.8
3677	2471822	557115	714.1
3688	2471874	557116	713.0
3698	2471926	557120	713.7
3709	2471978	557130	713.0
3719	2472030	557133	713.1
3730	2472082	557140	714.1
3740	2472129	557145	711.0
3751	2472185	557145	713.0
3762	2472237	557146	712.7
3772	2472292	557142	712.9
3783	2472344	557139	714.5
3793	2472398	557139	713.3
3804	2472452	557144	712.9
3815	2472506	557151	712.9
3827	2472568	557127	713.5
3838	2472624	557117	715.0
3848	2472680	557115	713.2
3859	2472740	557111	714.3
3869	2472794	557099	715.4
3880	2472850	557088	716.6
3890	2472898	557072	714.7
3901	2472957	557052	715.5
3912	2473012	557036	715.4
3922	2473066	557020	716.4
3933	2473121	557006	715.5
3943	2473173	556982	717.6
3954	2473228	556959	717.8
3965	2473278	556926	718.0
3977	2473344	556914	718.3
3988	2473400	556906	717.9
3998	2473457	556891	718.4
4009	2473512	556875	716.9
4019	2473564	556856	717.1
4030	2473618	556835	717.2
4040	2473670	556816	717.4
4051	2473732	556796	716.6
4062	2473789	556778	717.5
4072	2473846	556755	716.8
4083	2473896	556728	717.1
4093	2473948	556710	717.4
4104	2473998	556692	716.2
4115	2474050	556675	716.1
4126	2474107	556654	715.9
4137	2474157	556628	715.3
4146	2474203	556610	715.4
4157	2474252	556599	714.6
4167	2474300	556574	715.0
4178	2474342	556547	715.4
4189	2474396	556530	715.0
4199	2474408	556509	715.8
4210	2474460	556486	715.7
4220	2474530	556455	714.7
4231	2474585	556448	715.0

Appendix D
Centerline Positioning Data, Section 4, Clinch River

Survey Line CS41
Section 4, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 11 February 1994, 1323 to 1539 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 744.5 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
0017	2474213	556668	715.5
0028	2474222	556660	715.3
0039	2474240	556645	714.5
0050	2474270	556633	716.2
0059	2474302	556614	715.3
0070	2474341	556590	716.7
0080	2474391	556574	715.8
0091	2474412	556531	715.6
0101	2474453	556503	717.3
0111	2474496	556474	717.3
0121	2474538	556456	717.2
0131	2474585	556440	717.4
0141	2474626	556422	716.1
0152	2474674	556399	715.2
0161	2474720	556379	716.6
0172	2474765	556356	716.3
0182	2474813	556335	713.7
0193	2474858	556311	716.1
0203	2474897	556288	715.5
0214	2474940	556255	715.9
0225	2474982	556231	717.6
0235	2475025	556207	715.9
0246	2475068	556184	714.6
0256	2475112	556158	715.1
0267	2475157	556134	715.7
0278	2475200	556109	715.5
0289	2475242	556074	715.5
0299	2475274	556041	715.5
0308	2475306	556010	715.5
0319	2475348	555965	714.7
0329	2475382	555925	715.3
0340	2475421	555882	715.7
0351	2475458	555847	716.3
0360	2475486	555811	716.3
0371	2475525	555777	715.7
0381	2475564	555746	715.7
0392	2475605	555716	715.8
0402	2475641	555692	716.0
0412	2475676	555655	716.0
0423	2475712	555616	716.3
0432	2475749	555578	715.9
0443	2475791	555539	716.0
0453	2475830	555503	716.7
0464	2475873	555459	716.4
0475	2475912	555417	716.1
0485	2475952	555379	715.7
0496	2475990	555339	716.1
0506	2476032	555300	716.5
0517	2476069	555260	715.9
0528	2476103	555215	715.8
0539	2476142	555164	716.0
0550	2476180	555113	715.0
0559	2476212	555068	716.2
0570	2476249	555017	716.3
0580	2476290	554966	717.5
0590	2476327	554921	717.3
0601	2476376	554876	717.0
0611	2476428	554838	717.1
0621	2476467	554794	716.9
0631	2476502	554748	717.2
0642	2476534	554701	716.9
0652	2476566	554660	717.2
0661	2476601	554619	717.3
0671	2476634	554579	717.4
0681	2476668	554534	717.5
0691	2476700	554494	717.6
0701	2476733	554453	717.8
0710	2476760	554406	717.7
0720	2476791	554364	718.0
0729	2476816	554325	718.1
0739	2476846	554277	718.4
0750	2476876	554230	718.4
0759	2476902	554186	718.2
0770	2476932	554138	719.0
0779	2476960	554102	718.3
0789	2476990	554056	718.4
0799	2477020	554016	718.6
0808	2477050	553975	717.9
0818	2477080	553931	717.4
0828	2477108	553887	717.4
0838	2477132	553836	717.9
0849	2477155	553781	719.1
0858	2477174	553732	718.4
0868	2477195	553686	719.8
0878	2477212	553639	719.3
0889	2477235	553579	719.7
0899	2477254	553531	719.1
0908	2477271	553481	719.0
0918	2477292	553432	719.6
0928	2477311	553382	718.2
0938	2477339	553328	718.5
0948	2477366	553283	717.7
0958	2477399	553232	718.3
0968	2477416	553182	718.2
0978	2477430	553134	717.6
0989	2477440	553074	717.9
0999	2477450	553024	718.8
1008	2477464	552973	718.3
1018	2477474	552922	717.4
1028	2477489	552871	718.2
1039	2477499	552804	718.7
1049	2477504	552755	717.4
1058	2477518	552703	719.2
1068	2477542	552654	718.8
1078	2477552	552604	716.3
1088	2477557	552550	715.6

Survey Line CS41
Section 4, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 11 February 1994, 1323 to 1539 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 744.5 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
1098	2477560	552500	717.3
1107	2477568	552452	715.3
1118	2477591	552400	718.1
1128	2477603	552355	718.2
1138	2477595	552302	716.6
1148	2477592	552253	717.0
1157	2477592	552206	716.7
1167	2477595	552159	716.9
1176	2477594	552114	716.5
1185	2477592	552069	716.8
1195	2477595	552021	718.9
1203	2477594	551984	717.3
1213	2477586	551935	717.4
1223	2477575	551889	716.7
1232	2477558	551843	717.1
1241	2477542	551802	716.5
1251	2477525	551758	716.7
1260	2477512	551714	716.9
1270	2477495	551671	716.8
1279	2477480	551632	717.2
1288	2477464	551592	716.4
1298	2477452	551548	716.4
1306	2477439	551508	717.1
1315	2477428	551469	716.3
1325	2477418	551424	717.4
1334	2477407	551378	717.5
1344	2477399	551332	716.1
1353	2477384	551292	715.4
1363	2477362	551244	715.0
1373	2477335	551206	713.4
1381	2477313	551171	713.8
1391	2477289	551133	713.8
1401	2477267	551094	715.1
1410	2477243	551053	714.6
1421	2477219	551010	714.3
1431	2477199	550965	716.0
1441	2477180	550924	717.9
1451	2477155	550886	715.7
1461	2477133	550843	717.7
1472	2477104	550801	714.5
1482	2477078	550759	718.8
1492	2477054	550721	715.2
1502	2477030	550686	714.7
1511	2477006	550648	714.7
1520	2476984	550614	714.9
1528	2476966	550583	716.4
1538	2476946	550539	716.0
1548	2476924	550499	715.4
1557	2476904	550459	717.5
1567	2476885	550417	717.6
1577	2476865	550372	718.7
1586	2476850	550329	716.3
1596	2476835	550283	718.2
1604	2476824	550245	716.5
1614	2476803	550195	717.5
1623	2476788	550151	718.7
1632	2476761	550106	719.7
1642	2476742	550058	719.0
1652	2476742	550005	720.3
1661	2476759	549952	719.0
1671	2476769	549902	714.7
1680	2476786	549854	717.3
1689	2476796	549810	718.9
1699	2476805	549760	716.5
1708	2476815	549710	716.0
1718	2476827	549659	715.9
1728	2476840	549605	713.9
1738	2476865	549553	716.8
1748	2476902	549510	717.4
1756	2476932	549473	719.2
1765	2476956	549429	719.4
1775	2476981	549382	718.7
1784	2477007	549333	719.0
1793	2477028	549289	719.2
1802	2477049	549243	719.4
1811	2477072	549195	718.8
1820	2477096	549148	719.0
1829	2477119	549103	718.7
1839	2477142	549043	718.2
1849	2477164	548994	718.0
1858	2477183	548944	718.3
1867	2477215	548910	717.4
1877	2477254	548870	717.9
1886	2477286	548824	719.6
1896	2477314	548774	720.9
1905	2477338	548723	721.9
1915	2477364	548674	722.1
1925	2477396	548628	722.5
1934	2477426	548582	721.9
1944	2477458	548535	722.4
1953	2477475	548489	721.6
1964	2477501	548427	721.0
1973	2477520	548380	720.6
1981	2477541	548336	720.9
1991	2477560	548285	721.2
2001	2477574	548234	720.8
2010	2477586	548181	721.3
2020	2477598	548129	721.2
2029	2477608	548082	721.0
2039	2477620	548024	720.6
2049	2477632	547974	719.1
2058	2477669	547944	719.1
2067	2477708	547920	719.1
2077	2477754	547899	719.2
2101	2477861	547836	717.3
2112	2477904	547794	717.0
2123	2477937	547750	719.0
2133	2477967	547704	717.3

Survey Line CS41
Section 4, Clinch River, Tennessee

Survey Direction : Upstream
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Coordinate System: Tennessee State Plane, NAD 1927
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Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
2144	2478010	547675	717.5
2154	2478060	547664	717.4
2165	2478113	547637	718.3
2176	2478150	547596	719.2
2186	2478193	547562	719.5
2197	2478236	547532	718.0
2207	2478284	547507	718.7
2218	2478337	547487	717.4
2228	2478380	547461	717.5
2239	2478430	547432	718.2
2250	2478474	547402	717.2
2260	2478520	547373	716.3
2271	2478568	547344	716.1
2281	2478615	547319	716.9
2292	2478668	547295	717.6
2303	2478718	547272	715.6
2315	2478772	547255	715.9
2326	2478822	547241	716.1
2336	2478872	547207	716.2
2347	2478918	547180	715.9
2357	2478962	547150	716.0
2368	2479007	547122	715.3
2378	2479053	547096	715.1
2389	2479110	547069	715.3
2400	2479160	547048	714.5
2410	2479206	547025	714.6
2421	2479254	547001	714.2
2431	2479301	546979	714.4
2442	2479351	546959	714.3
2453	2479399	546942	711.1
2465	2479458	546919	710.6
2476	2479506	546899	713.0
2486	2479552	546881	710.8
2497	2479599	546861	711.7
2507	2479647	546838	709.8
2518	2479697	546816	712.7
2528	2479740	546794	712.0
2539	2479795	546772	710.1
2550	2479845	546754	711.0
2560	2479898	546732	710.6
2571	2479946	546707	715.7
2581	2479991	546680	712.6
2592	2480039	546653	711.8
2603	2480087	546626	712.3
2615	2480142	546595	712.5
2626	2480187	546569	712.9
2636	2480233	546546	713.1
2647	2480276	546522	715.2
2657	2480317	546500	720.0
2668	2480358	546477	718.9
2678	2480395	546458	720.3
2689	2480440	546437	720.1
2700	2480484	546416	718.5
2710	2480525	546393	717.5
2721	2480566	546367	718.5
2731	2480609	546340	719.7
2742	2480648	546314	719.8
2753	2480689	546287	719.3
2765	2480737	546257	719.9
2776	2480776	546234	720.1
2786	2480819	546217	719.7
2797	2480862	546198	718.3
2807	2480910	546192	716.6
2818	2480958	546186	719.1
2828	2481003	546178	718.3
2839	2481055	546168	718.8
2850	2481103	546159	719.7
2860	2481148	546150	717.7
2871	2481196	546141	720.8
2881	2481241	546131	718.3
2892	2481286	546109	717.9
2903	2481336	546110	717.2
2915	2481393	546118	718.0
2926	2481445	546119	719.5
2936	2481490	546136	718.9
2947	2481534	546150	719.2
2957	2481584	546160	719.8
2968	2481632	546172	718.8
2978	2481676	546181	717.6
2989	2481726	546203	717.5
3000	2481766	546226	717.8
3010	2481809	546250	718.5
3021	2481844	546284	718.6
3031	2481875	546322	718.0
3042	2481908	546366	717.7
3053	2481942	546402	717.0
3065	2481984	546446	718.4
3076	2482017	546484	718.4
3086	2482048	546525	719.2
3097	2482084	546564	719.1
3107	2482124	546608	718.7
3118	2482162	546650	719.2
3128	2482197	546690	719.6
3139	2482234	546739	719.3
3150	2482270	546784	716.8
3160	2482301	546840	718.4
3171	2482322	546896	716.7
3181	2482344	546952	715.7
3192	2482356	547010	714.7
3203	2482372	547069	717.2
3215	2482391	547136	716.1
3226	2482403	547196	720.6
3236	2482432	547251	717.7
3247	2482442	547308	719.5
3257	2482428	547364	718.0
3268	2482413	547421	717.1

Survey Line CS41
Section 4, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 11 February 1994, 1323 to 1539 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 744.5 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
3278	2482392	547471	719.8
3289	2482380	547537	721.0
3300	2482374	547595	719.8
3310	2482371	547655	719.8
3321	2482363	547712	719.2
3331	2482351	547769	719.3
3342	2482336	547821	720.7
3353	2482320	547875	719.7
3365	2482294	547938	720.5
3376	2482275	547995	719.9
3386	2482249	548047	717.9
3397	2482226	548101	717.0
3407	2482206	548156	715.9
3418	2482188	548212	715.4
3428	2482171	548261	714.9
3439	2482147	548319	715.7
3450	2482133	548377	714.7
3460	2482112	548431	713.9
3471	2482086	548484	715.0
3481	2482053	548533	713.6
3492	2482028	548584	713.5
3503	2482004	548635	713.1
3515	2481976	548696	712.7
3526	2481955	548748	712.4
3536	2481934	548799	713.4
3547	2481910	548850	712.7
3557	2481887	548900	711.4
3568	2481863	548949	710.8
3578	2481842	548995	710.9
3589	2481823	549050	710.6
3600	2481802	549101	712.8
3610	2481781	549152	711.4
3621	2481760	549203	713.4
3631	2481736	549254	713.1
3642	2481708	549302	713.3
3653	2481687	549350	713.4
3665	2481657	549410	715.0
3676	2481629	549458	712.7
3686	2481614	549512	714.3
3697	2481602	549566	713.1
3707	2481588	549620	713.3
3718	2481580	549672	714.5
3728	2481568	549722	714.3
3739	2481562	549786	713.0
3750	2481548	549841	711.9
3760	2481527	549895	712.4
3771	2481503	549947	712.5
3781	2481480	550000	712.6
3792	2481463	550051	712.9
3803	2481453	550101	710.7
3815	2481438	550162	711.8
3826	2481426	550214	709.9
3836	2481416	550268	709.8
3847	2481404	550319	714.2
3857	2481388	550370	714.2
3868	2481380	550424	713.1
3878	2481379	550473	715.2
3889	2481376	550534	715.1
3900	2481373	550588	715.7
3910	2481374	550642	717.0
3921	2481373	550695	715.2
3931	2481370	550749	715.9
3942	2481369	550805	715.4
3953	2481366	550859	716.6
3965	2481352	550921	717.2
3976	2481339	550976	717.0
3986	2481329	551032	717.6
3997	2481333	551086	717.3
4007	2481348	551139	718.1
4018	2481360	551191	715.2
4028	2481369	551238	714.2
4039	2481363	551298	716.2
4050	2481376	551356	712.3
4060	2481391	551411	711.0
4071	2481404	551466	710.8
4081	2481412	551521	711.3
4092	2481413	551579	713.4
4103	2481412	551633	717.2
4115	2481436	551697	715.5
4126	2481450	551756	713.6
4136	2481456	551819	714.5
4147	2481462	551878	714.0
4157	2481486	551937	716.0
4168	2481528	551981	717.0
4178	2481566	552018	717.2
4189	2481602	552047	717.4
4199	2481622	552077	716.2
4209	2481632	552113	715.4
4220	2481654	552141	715.1
4265	2481778	552157	719.3
4277	2481803	552177	719.0
4288	2481823	552202	716.7
4299	2481845	552232	716.9
4310	2481867	552263	716.0
4321	2481887	552294	717.1
4332	2481914	552323	717.3
4343	2481942	552349	716.5
4354	2481978	552369	716.3
4365	2482021	552389	716.3
4376	2482061	552409	716.5
4387	2482106	552429	716.9
4398	2482151	552455	717.5
4409	2482200	552473	717.9
4420	2482254	552486	718.4
4431	2482306	552499	718.8
4442	2482358	552510	718.3
4453	2482410	552533	717.9
4464	2482461	552549	719.4

Survey Line CS41
Section 4, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 11 February 1994, 1323 to 1539 hours
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Water Level Elevation : 744.5 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
4475	2482515	552557	719.9
4486	2482574	552573	719.3
4497	2482630	552589	718.5
4508	2482686	552608	718.4
4519	2482744	552626	719.9
4530	2482805	552648	719.5
4541	2482866	552654	718.4
4552	2482927	552660	718.4
4563	2482988	552669	718.8
4574	2483049	552688	719.6
4585	2483109	552708	719.8
4596	2483170	552726	720.2
4607	2483231	552741	721.6
4618	2483292	552755	721.6
4629	2483355	552765	721.4
4640	2483418	552773	721.6
4651	2483481	552777	721.5
4662	2483544	552777	721.7
4673	2483608	552772	721.4
4684	2483669	552773	721.3
4695	2483730	552773	721.6
4706	2483791	552768	721.8
4717	2483854	552772	721.8
4728	2483913	552775	721.6
4739	2483974	552778	721.5
4750	2484035	552780	721.2
4761	2484094	552779	721.4
4772	2484154	552777	721.2
4783	2484216	552771	721.3
4794	2484274	552771	720.5
4805	2484336	552762	719.5
4816	2484394	552749	719.3
4827	2484451	552738	718.7
4838	2484512	552737	718.2
4849	2484571	552733	718.1
4860	2484632	552727	717.3
4871	2484691	552720	717.0
4882	2484750	552711	716.4
4893	2484807	552698	716.3
4904	2484866	552695	716.8
4915	2484920	552683	717.1
4926	2484976	552680	716.9
4937	2485033	552677	716.7
4948	2485090	552667	718.3
4959	2485146	552652	716.1
4970	2485205	552648	716.8
4981	2485264	552640	717.7
4992	2485318	552634	716.3
5003	2485375	552630	716.0
5014	2485432	552629	717.9
5025	2485488	552629	717.2
5036	2485547	552619	717.5
5047	2485602	552606	717.1
5058	2485660	552597	717.0
5069	2485716	552608	717.7
5080	2485773	552629	717.0
5091	2485827	552644	717.1
5102	2485881	552642	715.4
5113	2485938	552635	717.1
5124	2485994	552629	717.1
5135	2486053	552631	717.4
5146	2486109	552641	716.8
5157	2486166	552643	717.5
5168	2486224	552641	717.6
5179	2486281	552636	718.0
5190	2486340	552636	718.1
5201	2486396	552645	718.1
5212	2486450	552656	718.3
5223	2486504	552669	718.7
5234	2486558	552684	718.6
5245	2486612	552702	718.8
5256	2486666	552718	718.5
5267	2486720	552731	718.0
5278	2486774	552743	717.3
5289	2486828	552753	717.7
5300	2486885	552763	718.1
5311	2486941	552770	717.4
5322	2486995	552782	718.1
5333	2487047	552797	717.3
5344	2487101	552817	717.0
5355	2487155	552830	715.2
5366	2487211	552844	717.6
5377	2487267	552856	717.7
5388	2487324	552871	717.0
5399	2487380	552887	717.7
5410	2487434	552904	715.8
5421	2487488	552923	717.3
5432	2487546	552936	718.5
5443	2487602	552949	715.9
5454	2487661	552957	715.7
5465	2487720	552969	718.0
5476	2487778	552978	717.3
5487	2487834	552989	715.4
5498	2487891	553004	715.9
5509	2487947	553019	716.0
5520	2488003	553042	718.7
5531	2488062	553061	720.1
5542	2488122	553073	716.7
5553	2488181	553084	718.9
5564	2488244	553099	718.2
5575	2488309	553107	719.1
5586	2488368	553128	720.9
5597	2488424	553159	718.6
5608	2488478	553193	719.7
5619	2488531	553226	720.1
5630	2488585	553252	718.9

Survey Line CS41
Section 4, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 11 February 1994, 1323 to 1539 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 744.5 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
5641	2488643	553269	719.1
5652	2488702	553288	721.4
5663	2488758	553307	721.2
5674	2488812	553335	721.3
5685	2488866	553367	721.4
5696	2488919	553393	721.4
5707	2488971	553422	721.0
5718	2489024	553455	719.2
5729	2489076	553486	718.1
5740	2489132	553507	720.5
5751	2489188	553527	720.9
5762	2489244	553550	720.3
5773	2489300	553578	721.0
5784	2489354	553603	721.8
5795	2489410	553629	720.9
5806	2489464	553654	720.9
5817	2489520	553681	720.5
5828	2489572	553710	719.3
5839	2489625	553737	720.6
5850	2489677	553764	718.9
5861	2489733	553783	720.0
5872	2489787	553801	721.0
5883	2489838	553821	720.6
5894	2489897	553829	720.1
5905	2489958	553833	721.4
5916	2490019	553842	718.9
5927	2490078	553856	720.2
5938	2490138	553871	720.7
5949	2490201	553888	719.7
5960	2490260	553878	720.3
5971	2490315	553857	720.1
5982	2490367	553826	721.0
5993	2490420	553792	719.9
6004	2490472	553768	720.2
6015	2490522	553738	720.2
6026	2490572	553710	720.7
6037	2490618	553679	720.9
6048	2490673	553656	721.6
6059	2490728	553632	721.5
6070	2490776	553601	721.3
6081	2490824	553570	721.2
6092	2490876	553540	721.0
6103	2490933	553518	720.8
6114	2490983	553489	720.8
6125	2491031	553457	720.6
6136	2491081	553426	720.4
6147	2491132	553395	719.9
6158	2491182	553364	719.5
6169	2491230	553327	719.4
6180	2491278	553293	720.6
6191	2491330	553263	720.9
6202	2491381	553231	720.9
6213	2491429	553197	720.8
6224	2491479	553162	721.0
6235	2491527	553125	720.1
6246	2491577	553092	720.3
6257	2491625	553060	720.8
6268	2491676	553026	721.0
6279	2491724	552994	721.3
6290	2491770	552954	720.2
6301	2491818	552919	719.9
6312	2491866	552882	719.7
6323	2491916	552850	720.6
6334	2491966	552820	721.1
6345	2492018	552790	720.3
6356	2492067	552756	720.1
6367	2492115	552721	720.2
6378	2492163	552686	720.8
6389	2492208	552649	720.7
6400	2492254	552614	721.3
6411	2492300	552580	721.1
6422	2492350	552553	720.5
6433	2492398	552522	720.6
6444	2492448	552492	721.0
6455	2492499	552464	721.0
6466	2492544	552431	721.0
6477	2492590	552394	720.2
6488	2492638	552358	720.7
6499	2492686	552325	720.1
6510	2492734	552294	720.6
6521	2492787	552260	719.9
6532	2492837	552231	720.4
6543	2492885	552197	720.6
6554	2492938	552167	720.3
6565	2492992	552136	720.5
6576	2493043	552095	720.0
6587	2493091	552053	721.1
6598	2493135	552011	720.3
6609	2493178	551970	720.8
6620	2493231	551944	720.4
6631	2493281	551913	719.4
6642	2493329	551876	721.1
6653	2493370	551840	719.3
6664	2493412	551802	719.8
6675	2493455	551766	719.3
6686	2493492	551726	720.3
6697	2493534	551688	721.3
6708	2493577	551654	721.8
6719	2493620	551623	721.2
6730	2493668	551600	719.9
6741	2493710	551568	719.4
6752	2493746	551531	720.2
6763	2493783	551497	718.7
6774	2493824	551464	718.5
6785	2493863	551430	717.1
6795	2493900	551399	716.6
6806	2493941	551368	717.5
6817	2493984	551339	716.7

Survey Line CS41
Section 4, Clinch River, Tennessee

Survey Direction : Upstream
Survey Date/Time : 11 February 1994, 1323 to 1539 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 744.5 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
6828	2494028	551308	717.4
6839	2494067	551270	717.8
6850	2494100	551227	719.5
6861	2494132	551186	718.3
6872	2494162	551145	717.7
6883	2494192	551102	717.8
6894	2494215	551057	716.7
6905	2494250	551017	718.4
6916	2494287	550980	718.7
6927	2494314	550939	718.6
6938	2494349	550902	717.1
6949	2494379	550862	716.5
6960	2494409	550824	716.9
6971	2494444	550786	718.4
6982	2494472	550742	717.2
6993	2494500	550699	717.7
7004	2494525	550652	717.7
7015	2494553	550610	717.6
7026	2494581	550567	718.1
7037	2494611	550526	717.8
7048	2494639	550482	718.2
7059	2494673	550445	717.5
7070	2494710	550408	717.8
7081	2494745	550369	717.7
7092	2494779	550326	716.7
7103	2494812	550281	717.0
7114	2494835	550234	718.2
7125	2494861	550187	717.6
7136	2494891	550142	718.5
7147	2494919	550098	718.7
7158	2494949	550053	716.9
7169	2494974	550007	717.2
7180	2495005	549965	717.4
7191	2495035	549920	718.8
7202	2495063	549877	718.2
7213	2495095	549836	718.9
7224	2495128	549792	717.3
7235	2495158	549750	716.8
7246	2495188	549707	716.7
7257	2495222	549667	716.3
7268	2495243	549622	716.3
7279	2495267	549575	716.6
7290	2495290	549530	717.1
7301	2495318	549486	718.6
7312	2495350	549447	717.9
7323	2495385	549409	719.0
7334	2495408	549362	717.5
7345	2495434	549315	717.6
7356	2495466	549273	718.7
7367	2495494	549226	718.7
7378	2495529	549182	719.1
7389	2495561	549137	719.6
7400	2495598	549093	719.6
7411	2495630	549046	719.6
7422	2495658	548997	719.7
7433	2495686	548950	719.5
7444	2495719	548911	719.7
7455	2495762	548882	719.2
7466	2495804	548850	719.1
7477	2495845	548818	719.4
7488	2495882	548779	719.3
7499	2495914	548736	718.8
7510	2495953	548702	718.8
7521	2495994	548671	719.0
7532	2496035	548642	719.9
7543	2496076	548615	719.7
7554	2496122	548591	719.6
7565	2496166	548563	719.6
7576	2496211	548538	719.5
7587	2496250	548504	719.9
7598	2496289	548469	719.4
7609	2496354	548481	720.2

Appendix E
Poplar Creek Positioning Data

Survey Line CPC1
Poplar Creek, Tennessee

Survey Direction : Upstream
Survey Date/Time : 14 February 1994, 1037 to 1132 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 741.0 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
0023	2470760	562656	709.8
0034	2470749	562642	709.8
0045	2470741	562622	709.7
0056	2470732	562603	709.6
0067	2470721	562575	709.6
0078	2470717	562543	709.6
0089	2470716	562508	709.5
0100	2470716	562465	709.6
0111	2470721	562420	709.8
0122	2470729	562372	709.2
0133	2470739	562324	710.3
0144	2470760	562272	716.8
0155	2470781	562217	721.4
0166	2470820	562166	726.6
0177	2470842	562107	726.3
0188	2470865	562046	725.6
0199	2470896	561990	726.3
0210	2470935	561941	726.7
0221	2470978	561897	727.1
0232	2471022	561856	727.5
0243	2471066	561812	727.4
0254	2471102	561767	727.1
0265	2471144	561722	727.1
0276	2471188	561681	727.1
0287	2471231	561643	727.1
0298	2471277	561603	727.0
0309	2471320	561564	726.8
0320	2471366	561524	726.6
0331	2471410	561483	726.4
0342	2471453	561444	726.6
0353	2471502	561407	726.8
0364	2471550	561373	727.2
0375	2471598	561339	727.7
0386	2471648	561308	728.0
0396	2471693	561279	728.2
0407	2471741	561248	728.4
0418	2471792	561216	728.4
0429	2471839	561185	728.4
0440	2471885	561151	728.4
0451	2471933	561117	728.2
0462	2471981	561084	728.4
0473	2472029	561053	728.5
0484	2472079	561020	728.5
0495	2472130	560991	728.6
0506	2472180	560962	728.6
0517	2472232	560937	728.5
0528	2472282	560908	728.2
0539	2472334	560882	728.0
0550	2472387	560853	728.0
0561	2472437	560826	728.6
0572	2472487	560794	728.2
0583	2472538	560767	728.0
0594	2472592	560743	727.8
0605	2472644	560719	727.3
0616	2472697	560696	727.4
0627	2472747	560668	726.9
0638	2472802	560649	726.1
0649	2472852	560618	725.8
0660	2472904	560594	725.4
0671	2472956	560570	725.0
0682	2473009	560547	724.8
0693	2473061	560524	724.5
0704	2473114	560501	724.1
0715	2473166	560480	723.8
0726	2473218	560457	723.5
0737	2473272	560437	723.8
0748	2473325	560414	723.6
0759	2473380	560394	723.3
0770	2473432	560373	723.5
0781	2473486	560359	723.4
0792	2473545	560347	724.0
0803	2473602	560337	724.7
0814	2473658	560321	725.8
0825	2473711	560300	726.8
0836	2473763	560274	727.1
0846	2473809	560245	727.2
0857	2473855	560208	726.9
0868	2473898	560167	727.2
0879	2473935	560122	725.4
0890	2473968	560071	725.1
0901	2473986	560016	722.0
0912	2473988	559956	715.7
0923	2473975	559897	718.0
0934	2473956	559837	723.7
0945	2473930	559781	726.5
0956	2473899	559731	727.7
0967	2473863	559682	728.2
0978	2473835	559630	728.4
0989	2473808	559577	727.4
1000	2473791	559521	726.2
1011	2473774	559461	726.0
1022	2473760	559401	726.5
1033	2473760	559340	727.4
1044	2473770	559282	727.8
1055	2473807	559240	727.3
1066	2473858	559207	726.8
1080	2473901	559186	727.0
1417	2474065	559216	726.9
1428	2474072	559221	727.0
1439	2474085	559232	727.0
1450	2474114	559237	727.3
1461	2474151	559242	727.5
1472	2474193	559254	727.7
1483	2474238	559267	727.8
1494	2474281	559287	727.7
1505	2474319	559309	727.5

Survey Line CPC1
Poplar Creek, Tennessee

Survey Direction : Upstream
Survey Date/Time : 14 February 1994, 1037 to 1132 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 741.0 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
1516	2474355	559338	727.1
1527	2474390	559369	726.9
1538	2474426	559401	727.4
1549	2474462	559433	727.8
1560	2474495	559467	728.0
1571	2474522	559505	728.0
1582	2474543	559547	728.0
1593	2474561	559592	727.7
1604	2474576	559636	727.4
1615	2474588	559682	727.1
1626	2474601	559728	727.4
1637	2474612	559773	727.5
1648	2474620	559820	727.4
1659	2474626	559866	727.3
1670	2474632	559912	727.0
1681	2474636	559960	726.5
1692	2474642	560005	726.1
1703	2474644	560051	725.9
1714	2474643	560097	725.6
1725	2474644	560143	725.4
1736	2474646	560189	725.3
1747	2474647	560235	725.4
1758	2474646	560279	725.4
1769	2474646	560324	725.3
1780	2474645	560369	725.1
1791	2474640	560414	724.9
1802	2474630	560459	724.7
1813	2474618	560505	724.5
1824	2474606	560551	724.6
1835	2474594	560595	724.3
1846	2474580	560639	725.1
1857	2474568	560685	726.0
1868	2474560	560729	726.6
1879	2474552	560775	726.7
1890	2474547	560822	726.8
1901	2474542	560868	726.7
1912	2474530	560912	726.9
1923	2474516	560956	726.5
1934	2474499	561000	726.3
1945	2474480	561044	726.0
1956	2474462	561088	726.0
1967	2474443	561133	725.8
1978	2474426	561177	725.5
1989	2474408	561221	725.4
2000	2474389	561265	725.4
2011	2474370	561308	725.4
2022	2474346	561350	725.5
2033	2474326	561393	725.6
2044	2474302	561436	725.7
2055	2474279	561477	726.0
2066	2474256	561520	726.3
2077	2474232	561564	726.8
2088	2474207	561608	726.6
2099	2474184	561651	726.6
2110	2474158	561692	726.6
2121	2474135	561733	726.0
2132	2474109	561773	725.8
2143	2474086	561816	725.5
2154	2474065	561858	725.2
2165	2474042	561901	724.7
2176	2474018	561944	723.4
2187	2473993	561985	721.5
2198	2473970	562026	718.7
2209	2473944	562066	716.7
2220	2473918	562109	719.7
2231	2473893	562148	721.1
2242	2473863	562186	724.0
2253	2473833	562223	726.2
2264	2473801	562257	725.8
2275	2473766	562290	726.0
2286	2473732	562322	727.4
2296	2473700	562351	725.7
2307	2473666	562385	725.6
2318	2473633	562422	725.6
2329	2473601	562456	725.3
2340	2473567	562490	725.1
2351	2473534	562526	724.9
2362	2473500	562562	724.8
2373	2473466	562596	724.7
2384	2473431	562633	724.6
2395	2473396	562667	724.6
2406	2473362	562702	724.5
2417	2473328	562736	724.6
2428	2473293	562771	724.8
2439	2473266	562795	725.0
2450	2473252	562809	725.0
2709	2473197	562847	725.4
2721	2473185	562876	725.6
2732	2473160	562895	725.9
2743	2473137	562917	727.4
2754	2473112	562941	728.3
2765	2473084	562964	724.4
2776	2473057	562986	730.0
2787	2473030	563011	727.6
2798	2473002	563031	729.1
2809	2472977	563054	729.0
2820	2472952	563078	734.5
2831	2472926	563097	732.3
2842	2472906	563114	731.4
2853	2472881	563132	728.3
2864	2472858	563150	727.4
2875	2472832	563171	727.6
2886	2472808	563189	727.4
2897	2472780	563212	727.3
2908	2472752	563234	726.5
2919	2472725	563256	726.7
2930	2472698	563279	726.8
2941	2472670	563298	726.7

Survey Line CPC1
Poplar Creek, Tennessee

Survey Direction : Upstream
Survey Date/Time : 14 February 1994, 1037 to 1132 hours
Coordinate System: Tennessee State Plane, NAD 1927
Water Level Elevation : 741.0 ft NGVD at time of survey
Reference Reservoir Elevation: 741.0 ft NGVD

Fix Point	Easting	Northing	River Bottom Elevation, ft NGVD
2952	2472643	563318	726.7
2963	2472615	563339	726.5
2974	2472586	563359	726.5
2985	2472558	563381	726.5
2996	2472528	563402	726.3
3007	2472499	563424	726.0
3018	2472469	563446	725.8
3029	2472437	563468	726.9
3040	2472405	563491	725.4
3051	2472373	563512	725.2
3062	2472341	563531	725.1
3073	2472307	563552	725.1
3084	2472273	563572	725.1
3095	2472241	563591	724.9
3106	2472206	563608	724.8
3117	2472174	563627	724.5
3128	2472140	563646	723.5
3139	2472106	563664	722.7
3150	2472072	563685	722.4
3161	2472040	563707	730.7
3172	2472012	563732	716.5
3183	2471980	563752	716.8
3194	2471946	563768	716.2
3205	2471912	563786	717.3
3216	2471880	563802	718.9
3227	2471855	563826	719.6
3238	2471830	563854	720.1
3249	2471809	563881	721.0
3260	2471793	563916	721.4
3271	2471778	563949	723.0
3282	2471776	563983	723.4
3293	2471778	564018	724.0
3304	2471784	564053	723.3
3315	2471790	564089	723.3
3326	2471798	564124	723.1
3337	2471809	564162	722.6
3348	2471820	564185	722.0
3359	2471831	564208	721.3

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13. ABSTRACT ***(Maximum 200 words)***

During the 1950s, quantities of chemical materials were released into local waterways in association with nuclear energy research and weapons components production at the Oak Ridge National Laboratory (ORNL). Plans and specifications for studying the distribution and extent of any contamination are presently being prepared by ORNL. The objective of this study is to delineate the characteristics and features of the river bottom topography and sediments along Clinch River and Poplar Creek, Tennessee. A side scan sonar investigation was performed to provide insight into the general sediment characteristics and to highlight the distribution, extent, and continuity of fine-grain (clayey) sediment deposits. Sediments of this type are found almost exclusively on the bottom of Clinch River between river miles 0.0 and 4.4. The percentages of silt and clay sediments, as determined from bottom samples, are greater than 70 percent and have average density values ranging from 1.15 to 1.40 g/cm^3. Along the remainder of the Clinch River project area, less extensive deposits of fine-grained material are found. The results supplement previously obtained soil samples and better identify sites best suited for additional sediment coring. The side scan sonar was also able to detect and clearly define river bottom geologic and cultural features along the length of the project area.

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