HUNTSVILLE SPRING BRANCH - INDIAN CREEK HYDROGRAPHIC MAP

Prepared for

Olin

Olin Corporation
Charleston, Tennessee
December 1992

Woodward-Clyde

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Project No. 91N3901

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December 29, 1992

Ms. Anne L. Asbell
USEPA
345 Courtland Street Northeast
Atlanta, GA 30365

Dear Anne,

In January, 1992 the Review Panel requested that Olin conduct a survey of the sediments in the Huntsville Spring Branch - Indian Creek System. The purpose of the survey was to establish a baseline for monitoring future changes in the depositional and erosional patterns of HSB-IC sediments. The Review Panel and Olin agreed that this information would be useful in monitoring the effectiveness of the Huntsville Remedial Action.

The survey of HSB-IC sediments was conducted in May, 1992 by Olin and its consultant, Woodward Clyde Consultants. Survey data was compiled to produce a Hydrographic Map of the HSB-IC system. This map was superimposed over existing Corps of Engineer maps.

Woodward Clyde has prepared a report which describes the sediment survey and presents the HSB-IC Hydrographic Map. Copies of the report are enclosed for you and EPA's staff. Copies of the report are also being sent to each member of the Review Panel.

I will be prepared to discuss the report and associated field work at the next Technical Meeting and Review Panel Meeting. If you have any questions, please call me at 615-336-4388.

Sincerely,

OLIN CORPORATION

Keith D. Roberts
Principal Environmental Specialist

KDR/lb
125

cc: Review Panel
V. M. Norwood
R. W. Hyland
B. A. Brye
W. J. James
M. Carter
M. W. Schroder
H. T. Stone

NOTICE

The following report, including all graphical representations and maps, contains data and interpretations collected and formulated, in part, by Woodward-Clyde Consultants. The data and opinions in this document were derived from studies conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, expressed or implied, and no warranty or quarantee is included or intended in this report.

These maps are not to be used for navigation.

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1.0
INTRODUCTION

1.1 SITE HISTORY

Since 1977, the United States Army, the Tennessee Valley Authority (TVA), the Environmental Protection Agency (EPA) and other federal agencies have reported DDT residues in the Huntsville Spring Branch-Indian Creek (HSB-IC) tributary system of the Tennessee River. Reports have described the existence of DDT within the boundary of the Wheeler Wildlife Refuge and the Redstone Arsenal (RSA) near Huntsville, Alabama and to a limited extent, in Indian Creek downstream from the RSA boundary.

The Consent Decree among Olin Corporation, the United States of America, and the State of Alabama required Olin to develop and implement remedial action in the Huntsville Spring Branch-Indian Creek (HSB-IC) system consistent with "Joint Technical Proposal to Implement Remedial Activities Pursuant to Consent Decree". The purpose of the remedial action which Olin was required to implement under this Consent Decree was to isolate DDT in the HSB-IC system from people and the environment and to minimize transport of DDT out of the HSB-IC system to protect human health and the environment.

The Consent Decree established a performance standard which the remedial action must attain. The performance standard is a DDT level of 5 parts per million (ppm) in the filets of channel catfish, largemouth bass and smallmouth buffalo, in Reaches A, B, and C of the HSB-IC system. Reaches A, B, and C were defined as:

Reach A - Begins in HSBM 5.4 and extends to HSBM 2.4;
Reach B - Begins at HSBM 2.4 and extends to HSBM 0.0; and
Reach C - Begins at ICM 5.6 and extends to ICM 0.0

A Review Panel was established by the Consent Decree to review the data collected, approve the remedial action, and monitor Olin's progress in attaining the performance standard. The Review Panel consists of voting representatives from EPA, TVA, U.S. Fish and Wildlife Service, U. S. Army, and State of Alabama and non-voting participants from Town of Triana and Olin.

The Consent Decree required Olin to conduct monitoring studies of fish, water, sediment, and sediment transport in the HSB-IC system, as set forth in the Technical Proposal, to obtain baseline data, and to evaluate the effectiveness of the remedial action. Fish collections were conducted over a three-year period to determine DDT concentrations in performance standard (and other) fish and to determine fish species present in each Reach of HSB-IC. Water samples during normal flow and storm flow events were collected over a period of three years to characterize sediment transport. Extensive sediment sampling was conducted to define the quantity and distribution of DDT in each Reach of the HSB-IC system. Olin also conducted groundwater studies as set forth in the Proposal. Data from these studies were used to determine baseline DDT concentrations in fish, water, and sediment of the HSB-IC system. The baseline values are presented in Review Panel Decision Document No. 2-Baseline Data, Substitute Species, and Interim Goals for Fish and Water, dated October 28, 1986.

The data collected during the field and laboratory studies were presented to the Review Panel in Quarterly Reports. Evaluation of and conclusions from the studies were submitted to the Review Panel on June 1, 1984 as part of Olin's proposed remedial action plan. On July 1, 1985, Olin submitted a detailed report on field and laboratory investigations of Huntsville Spring Branch and Indian Creek per a requirement in the Review Panel Decision Document dated August 31, 1984 which specified that such a submission be made.

As specified by the Consent Decree, Olin proposed a Remedial Action Plan to the Review Panel on June 1, 1984. Olin's proposal for remedial action included a schedule for implementation, a long-term monitoring plan, and other information. On August 31, 1984 the Review Panel issued their Decision Document in which they accepted, with modifications, Olin's proposed remedial action. Construction began on April 1, 1986 following detailed design and permit issuance. The Decision Document also required

Olin to submit a plan for removal and/or isolation of DDT-contaminated sediments in Reach A between HSBM 4.0 and 2.4. Olin submitted a remedial plan for Lower Reach A on August 14, 1986. The Review Panel accepted Olin's remedial plan for Lower Reach A on November 20, 1986 (Decision Document No. 3). Permits for Lower Reach A were issued on November 28, 1986. Construction began November 29, 1986. Construction of the remedial action for all of Reach A was completed by October 14, 1987.

The Review Panel designated January 1, 1988 as the date of completion and implementation of the remedial action, i.e., completion of construction. The Consent Decree specified that within 10 years from the date of completion of the construction and implementation of the remedial action, Olin shall attain the performance standard in Reaches A, B, and C. Olin shall be deemed to "attain the performance standard: when the average DDT concentration in the filets of each of the three (3) performance standard fish is five (5) ppm (or less) in Reaches A, B, and C of the HSB-IC system.

After attainment of the performance standard, Olin shall demonstrate "continued attainment of the performance standard". "Continued attainment of the performance standard" occurs when the average DDT concentration in the filets of each of the three (3) fish species is five ppm (or less) for three (3) consecutive years (including year of attainment) in Reaches A, B, and C of the HSB-IC system.

After Olin (1) demonstrates to the Review Panel continued attainment of the performance standard and (2) demonstrates to the reasonable satisfaction of the Review Panel that the remedial action implemented pursuant to this Consent Decree has provided, is providing, and will continue to provide achievement of the performance standard once this Consent Decree terminates, Olin shall operate or maintain any remedial action for a period of seven additional years. At the conclusion of this seven-year period, if Olin is in compliance with the provisions of this Consent Decree and the performance standard, Olin shall be deemed to have completely fulfilled all of its obligations hereunder, and the Consent Decree shall terminate.

1.2 PROJECT PURPOSE

The primary objectives of the HSB-IC studies are monitoring the progress toward attainment of the performance standard and compliance with the provisions of the Consent Decree. The 1992 Hydrographic Map presented in this report was developed to serve two purposes in meeting these objectives:

1) As a baseline for determining future changes in channel morphology and sediment depositional/erosional patterns in the HSB-IC system.

2) As a tool to assess changes in channel morphology at selected transects in the HSB-IC system. These transects were previously established during sampling activities in the period 1982 - 1985. Comparison of the historical transects with the 1992 map allows insight into the erosional/depositional patterns at each location. Knowledge of these physical sediment and hydrological characteristics is beneficial in evaluating the transport and availability of DDT in the HSB-IC system.

2.0
FIELD PROCEDURES

2.1. CONTROL SURVEY

In March 1992, a field survey was conducted for the purpose of setting control points along Huntsville Spring Branch and Indian Creek. These control points, marked by wooden stakes and pieces of #4 (1/2") re-bar, are places from which the hydrographic survey would be conducted later in the year. Mathematical results of the control survey were x, y, and z coordinates of all control points. The x and y coordinates are distances in feet from the origin of the Alabama East zone, Transverse Mercator projection, state plane coordinate system, datum of 1927. The z coordinates are elevation in feet above mean sea level, datum of 1929 .

All data were gathered with the aid of a Kern DKM2-AE, one-second theodolite, equipped with a Kern DM503, electronic distance measuring instrument. The control points were spaced along left and right banks of the two streams so that a minimum number of hydrographic stations would be required. All adjacent points are inter-visible and close to the water. The horizontal and vertical controls for the project were taken from monuments located along Reach A of Huntsville Spring Branch. These six, brass monuments (set in concrete) were situated on the right bank of Huntsville Spring Branch, between mile marker 5.5 and the Dodd Road Bridge. Fifty-two (52) control points were established between mile marker 5.5 on Huntsville Spring Branch and the confluence of Indian Creek with the Tennessee River at Triana.

Elevations of the control points were determined by trigonometric leveling using the Kern "total station" equipment mentioned above. Vertical "closure" was attained by including the TVA vertical control monument at Triana (elevation 564 ft. a.s.l.). Vertical closure was 0.1 ft. No horizontal control station was available in the vicinity, thus, closure was determined by calculating latitude and longitude of the vertical control monument. The small magnitudes of horizontal and vertical closure in the control traverse meant that horizontal and vertical tolerances of the hydrographic survey would be limited by the hydrographic equipment.

All field data from the control traverse were processed with an IBM personal computer and the software "Survey 3.0" by Simplicity Systems, Inc., East Grand Forks, Minnesota.

2.2 HYDROGRAPHIC SURVEY

Between May 12 and May 28, 1992, hydrographic surveying was done on Huntsville Spring Branch and Indian Creek. The work began at (approximately) mile marker 5.5 on Huntsville Spring Branch, and progressed downstream to the confluence with Indian Creek, and then down Indian Creek to its confluence with the Tennessee River at Triana.

The field crew included Steve Anderson, Olin Corporation (pilot and navigator of the hydrographic system); Doug Heffinger and Barry Long, Woodward-Clyde Consultants (operators of shore-station theodolite and tracking unit) and H.T. Andrews, Woodward-Clyde Consultants (operator of ship computer and fathometer).

Hydrographic equipment consisted of two sets of apparatus; shore unit and ship unit. The shore unit included a Lietz electronic theodolite, Hydro I electronic distance measuring instrument, computer, and radio-wave receiver/transmitter. The ship unit was a radio-wave receiver/transmitter, prism assembly, computer, and Simrad fathometer with transducer.

At each of the occupied control points (Section 2.1) a tripod was positioned directly over the iron pin. The theodolite was centered on the tripod, and the Hydro I fastened to the top of the theodolite. The shore computer was initialized with x and y coordinates of its location, with a reference bearing, and with x and y coordinates of the beginning point of the hydrographic survey. The operator of the shore unit kept the cross-hairs of the theodolite centered on the prisms (fastened to the boat) throughout the period of data collection. The shore computer, which was fastened to the tripod, used angular and distance data to continuously update (0.7 sec. update cycle) the position (x and y coordinates) of the boat. The x and y coordinates (horizontal position) were transmitted to the boat computer by radio frequency telemetry.

Assembly of hydrographic equipment on the boat began by securely fastening the prisms and transducer to the side of the vessel. The prisms were fastened to the top of a telescopic range pole, located directly above the transducer. This configuration assured that the two pieces of equipment would always have the same x and y positions (i.e., they were super-imposed). The ship computer was configured with about fifteen settings which determined the type and order in which data would be collected (e.g., spacing of data points, type of fathometer, data units, etc.). This computer was also initialized with x and y coordinates of the beginning and ending points of the first line to be surveyed. As the hydrographic survey progressed, the ship computer received the telemetered x and y data, and coupled it with depth data (z coordinates) received from the fathometer. Storage capacity of the ship computer is 12,000 data points with each point consisting of x, y, and z coordinates. During each day of the hydrographic survey approximately one mile of river was surveyed and about 3,500 data points were collected.

Each evening the ship computer was downloaded into an IBM personal computer with the aid of software written and provided by Laser Technology, Inc., the company which built or integrated all parts of the hydrographic system. Various editing functions are available with this "proprietary" software. The transformed and edited data were output in an ASCII file. A limited amount of editing was done with Lotus® 1-2-3® during the evenings in Huntsville.

Accuracy of the data points is dependent upon both the skill of the field operators and idiosyncrasies of the instrumentation. At the shore station the operator of the theodolite must accurately "track" the prism assembly on the ship. Since horizontal position (x and y coordinates) is a function of the azimuth of the line being sighted (direction of the theodolite) and distance (from theodolite to the prisms), it is imperative that care be taken to assure proper positioning of the theodolite at all times. Manual setup and physical positioning of both ship and shore equipment are also primary tenets in the assurance of quality work. It is general practice that two people participate in the setup of both ship and shore units. In this way both individuals are involved in the assembly and alignment procedures, and each serves as a check for the other.

The Hydro I electronic distance measuring instrument is a very powerful unit and has been used to gather data from distances in excess of two miles. However, the distance measurements have a tolerance of two feet. Thus all distances, and therefore all horizontal positions, have an accuracy of plus or minus two feet. Many hundreds of data points were used by the topographic software (Surfer®) in the gridding of each reach of the river, and it is believed that this tolerance did not adversely affect the quality of the maps which were produced.

Accuracy of the fathometer was periodically checked by manually measuring the depth to the bottom with a scaled range pole. This depth was compared to the fathometer readout.

3.1. DATA PROCESSING AND MANIPULATION

The ASCII files, which had been downloaded from the ship computer, were edited in Lotus® 1-2-3®. The first task was to eliminate erroneous data such as extremely great depths, and incorrect horizontal positions (distance signals are sometimes received from nearby vegetation). Next, the z-coordinates were changed from depths (zero at the water surface) in meters to elevations in feet above sea level.

Contiguous data sets were combined and then sorted to limit sections of the river to sections of approximately one-half mile. There were two reasons for this distance limitation. First, the gridding computations in the topographic software are numerically intensive, and there are data limitations which must be observed. Second, the selected scale of 1:2400 (one inch = two hundred feet) allowed each section of the river to be printed on letter-size paper. As the river sections were combined and cut, they were saved as ASCII files (*.PRN) in Lotus® 1-2-3®.

3.2 CONTOURING

A grid-based contouring program, Surfer® (Golden Software, Golden, Colorado), was used to prepare contour lines from the x, y, z data. The first series of operations in Surfer® is to read in the *.PRN files and configure the gridding process. The products from gridding in Surfer® are *.GRD files. The second series of activities in Surfer® is to use the *.GRD files to prepare plot files (*.PLT). The plot files can be printed directly from Surfer®, or they can be converted to other formats and imported into CADD programs. Because of the ease of annotating and modifying maps, the *.PLT files were edited in CADD programs.

The twenty-six plot files generated by Surfer® were converted with Surf-2-Cad (a utility program written by Simplicity Systems, Inc.) into a format compatible with Generic Cadd® 6.0 (Generic Software, Autodesk Corp.). In Generic Cadd® the files were processed two ways in order to accommodate the two, eventual map products; large maps integrating U.S. Army Corps of Engineers terrestrial data; and small, 8½" x 11" maps. For preparation of the larger maps, the Generic Cadd® files were converted (using the utility program Autoconvert, Autodesk Corp.) to *.DXF format. The *.DXF files were used by Woodward-Clyde Consultants in Baton Rouge, Louisiana, in preparation of the final product. The smaller (letter-size) maps were printed directly from Generic Cadd® 6.0.

3.3 MAP INTEGRATION

The hydrographic maps were integrated with Redstone Arsenal base maps supplied by the U.S. Army Corps of Engineers in Huntsville, Alabama. The hydrographic maps (in *.DXF format) were converted to the Integraph *.DGN file format. Once converted, the hydrographic *.DGN files were rescaled to reflect the same scale as the Corps of Engineers base map *.DGN files. The two files sets were then spatially co-registered using state plane coordinates so that the hydrographic contours were correctly located on the base maps.

4.0
RESULTS

Resultant products of the hydrographic survey conducted in Huntsville Spring Branch and Indian Creek are two sets of maps. One set of maps (letter size) was prepared by using the hydrographic data and annotations. A second set of maps (D size) was prepared by combining terrestrial, topographic data of Redstone Arsenal with hydrographic data of this project. Both sets of maps were made to a scale of 1:2400 (one inch = 200 feet). All maps were produced with computer-controlled plotters or laser printers (300 dpi). Appendix B contains the 8½" x 11" hydrographic maps.

Appendix C contains the integrated hydrographic/U.S. Army Corps of Engineers base maps. Inspection of these maps reveals that the Surfer® generated shoreline (contour = 556 ft) does not always correspond with the shoreline contour depicted by the base map. Three possible reasons for this are discussed below:

1) It was not always possible to navigate the surveying vessel immediately adjacent to the shoreline due to shallow water, submerged obstructions, overhanging trees, etc. In such cases, the shoreline data were manually offset the prescribed distance from the closest boat "pass" to the shoreline. These manually inserted data were used by Surfer® along with the electronically collected data to generate the shoreline.

2) The U.S. Army Corps of Engineers base map was developed in the early 1980's and it may be that the shoreline locations and channel morphology have changed during this 10 - 12 year period. The degree of hydrodynamically induced change in the HSB-IC system has not been determined but field observations (eroded banks, vegetational changes, etc.) suggest that this may be a significant factor in at least some areas of the system.

3) The U.S. Army Corps of Engineers base map was developed prior to the remediation efforts and channelization of the mid-1980's. Apparently, the channelized portions of HSB were incorrectly located on the Corps maps during later revisions. The result is that hydrographic contours of the remediated sections (HSB 5.5 to HSB 4.3 and HSB 4.1 to HSB 2.4) are consistently offset from the remediated sections depicted by the Corps. Currently, it is not possible to provide a better match of hydrographic and base map contours in these sections. The natural channel contours, however, do provide an acceptable integration of the two maps.

Appendix A contains cross-sectional profiles of the HSB-IC system at various mile markers. These locations were originially profiled and sampled as reported in "Field and Laboratory Investigations of the Huntsville Spring Branch - Indian Creek System, July 1, 1985, Volume 1 (Olin Corporation 1985). Comparison of these profiled transects with the profiles depicted in the 1985 report will allow possible insights into the erosional/depositional patterns at these locations. The location of each profiled transect is depicted on the 8½" x 11" maps in Appendix B.

Appendix A
Cross-Sectional Profiles of the HSB-IC System

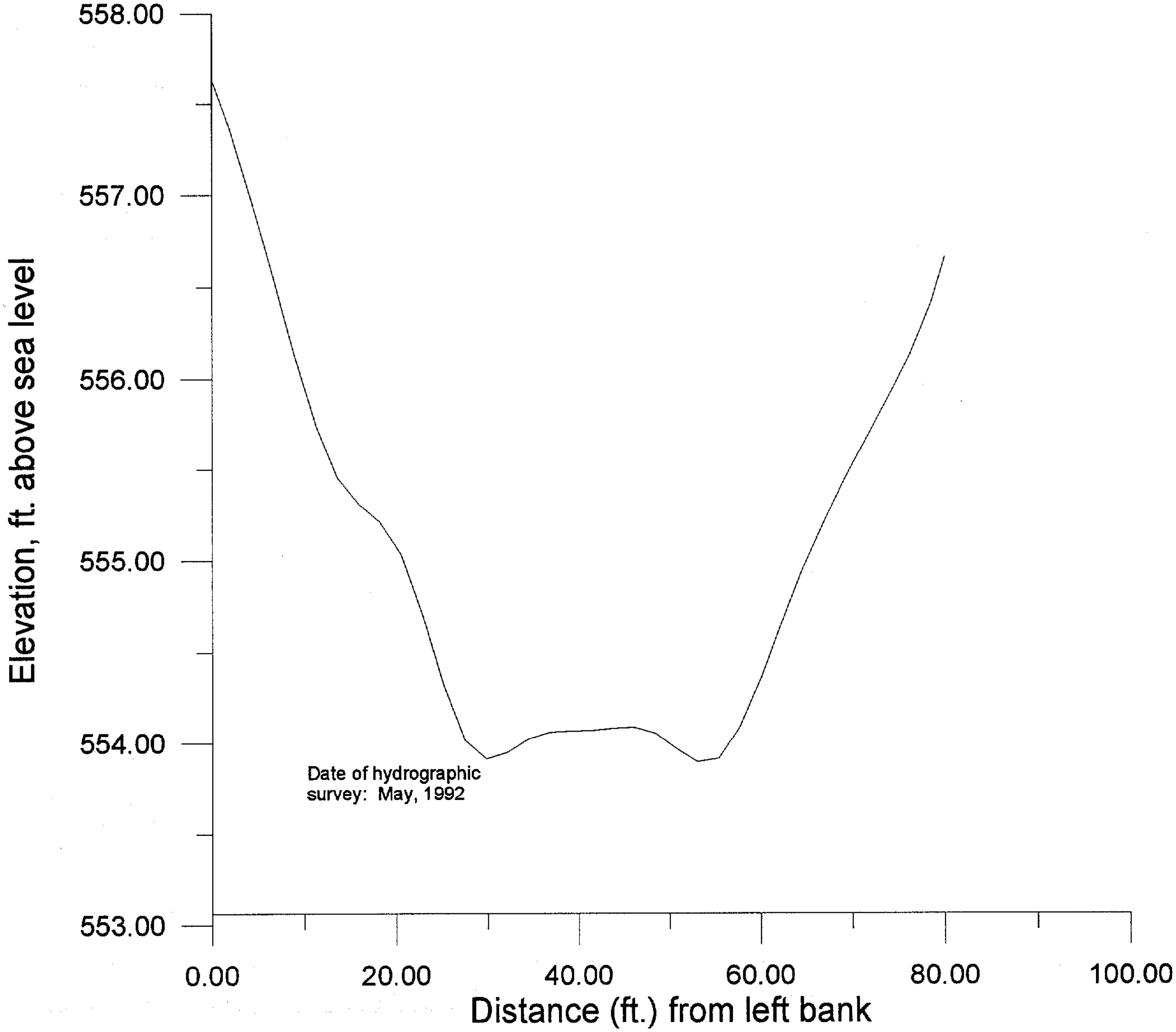
Cross-Sectional Transect Locations

HSB 5.4
HSB 5.0
HSB 4.6
HSB 3.6
HSB 3.4
HSB 2.6
HSB 2.46
HSB 2.361
HSB 2.285
HSB 2.2
HSB 2.029
HSB 1.6
HSB 1.4
HSB 0.4
HSB 0.0

IC 5.4
IC 5.2
IC 5.0
IC 4.4
IC 2.43
IC 0.68

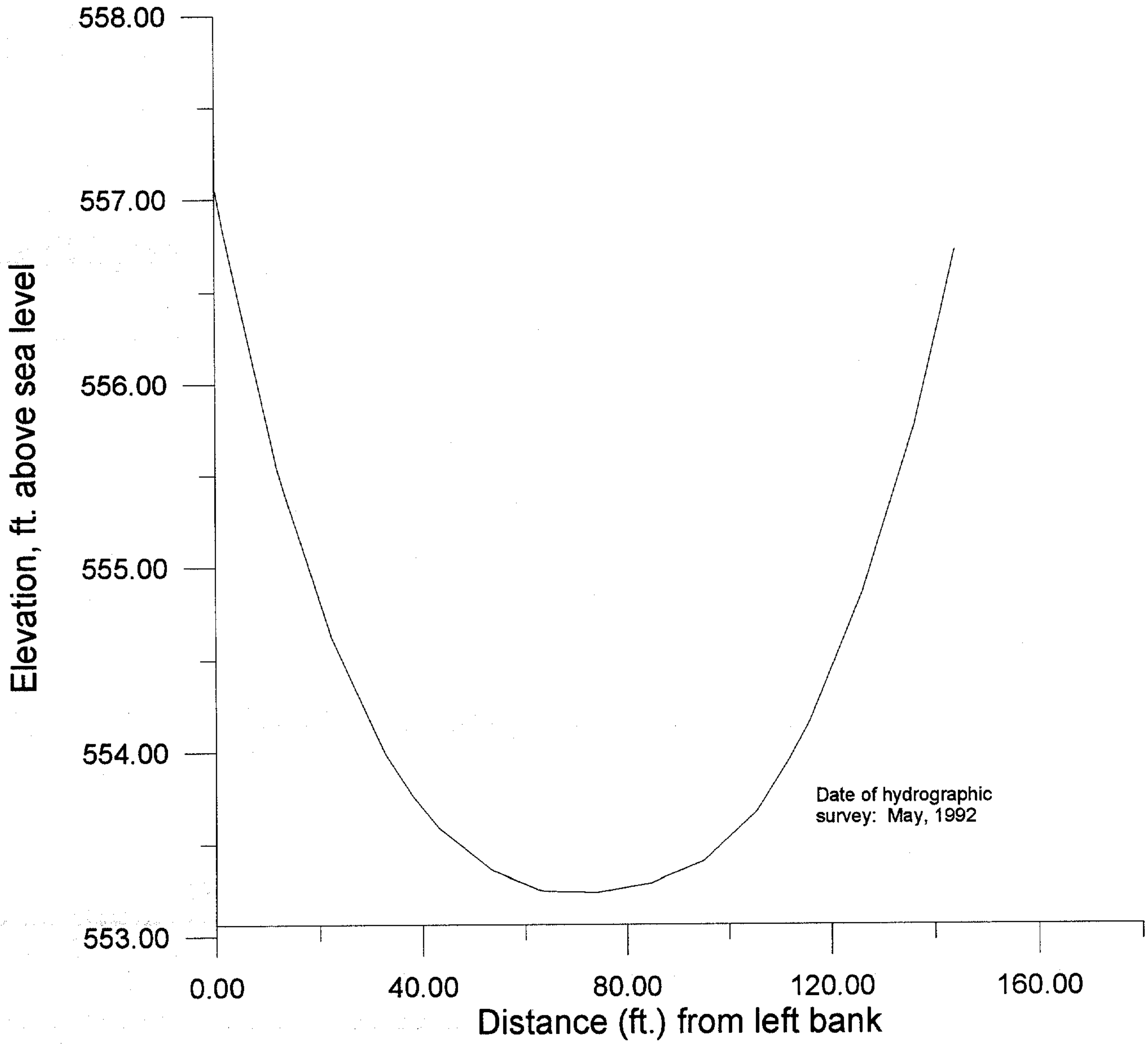
HUNTSVILLE SPRING BRANCH

Cross-section at mile 5.4
View: Downstream



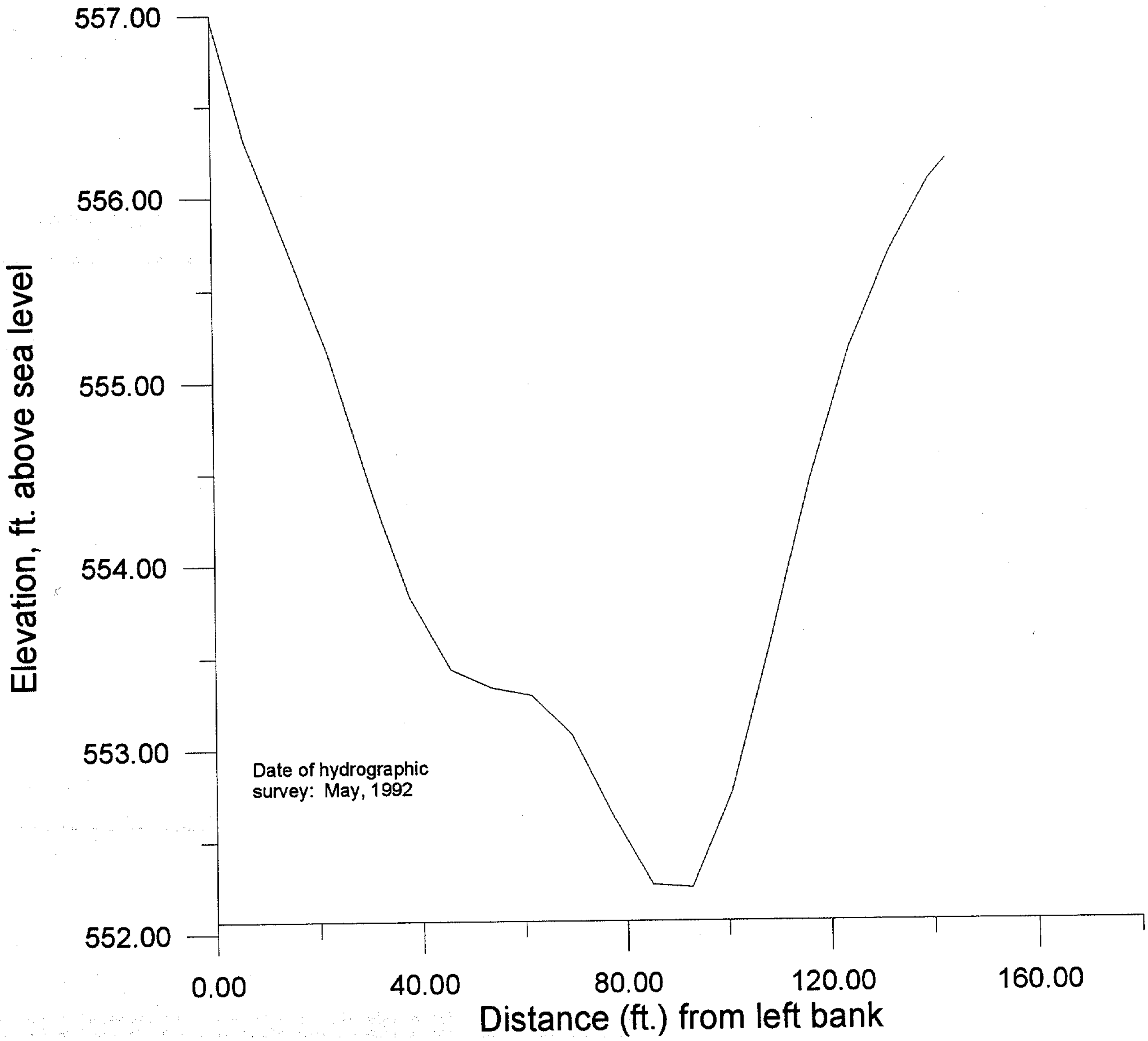
HUNTSVILLE SPRING BRANCH

Cross-section at mile 5.0
View: Downstream



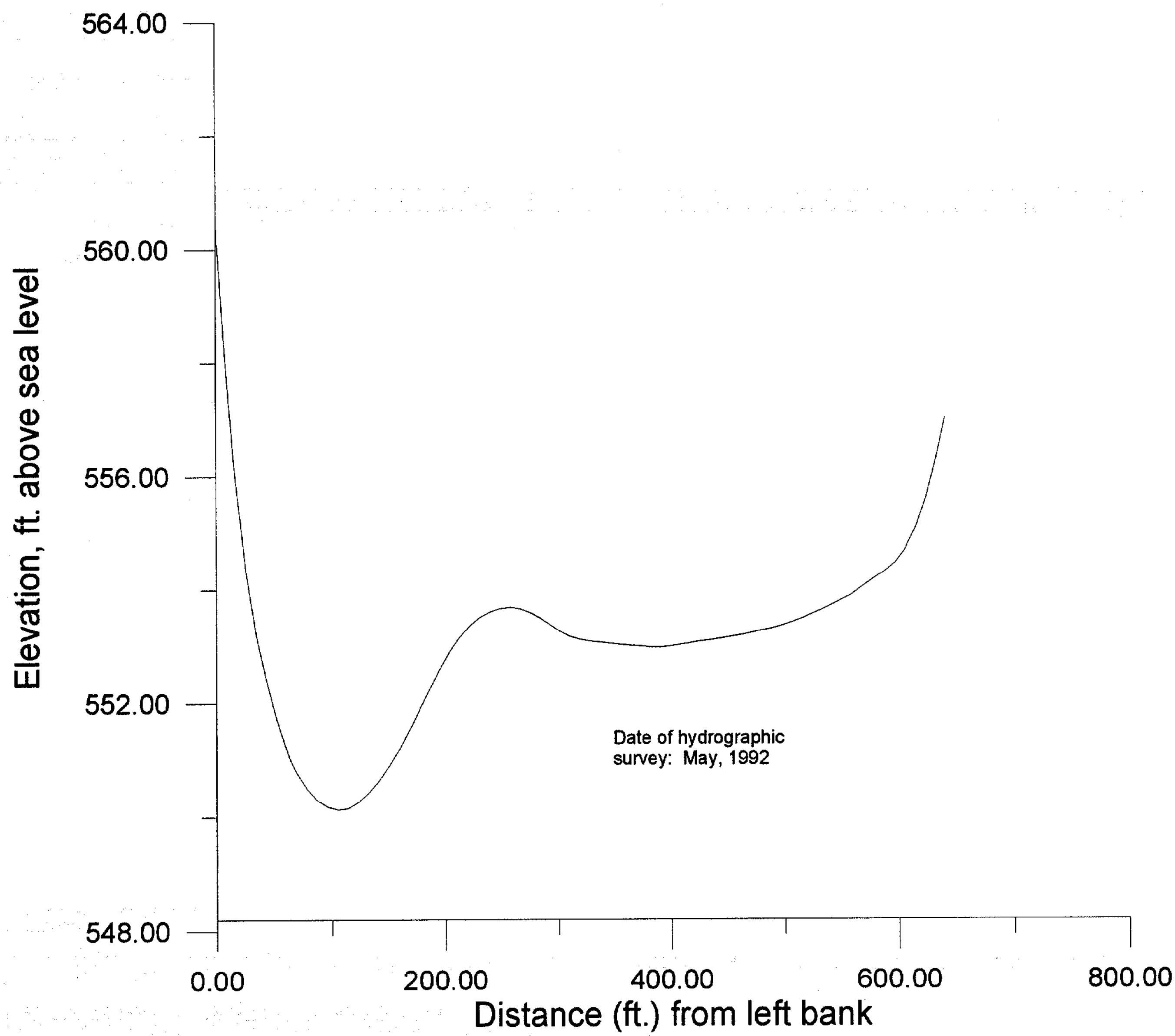
HUNTSVILLE SPRING BRANCH

Cross-section at mile 4.6
View: Downstream



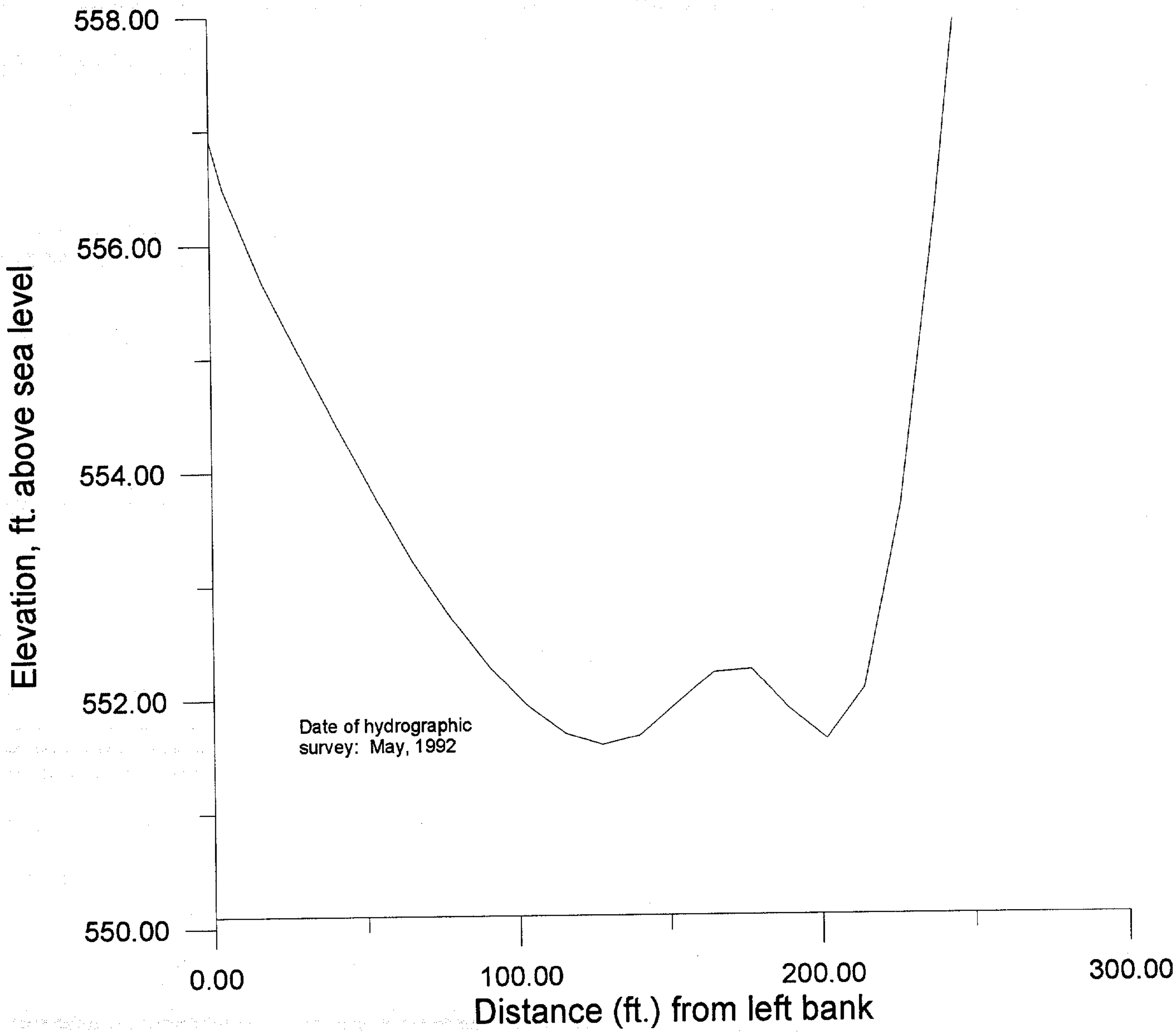
HUNTSVILLE SPRING BRANCH

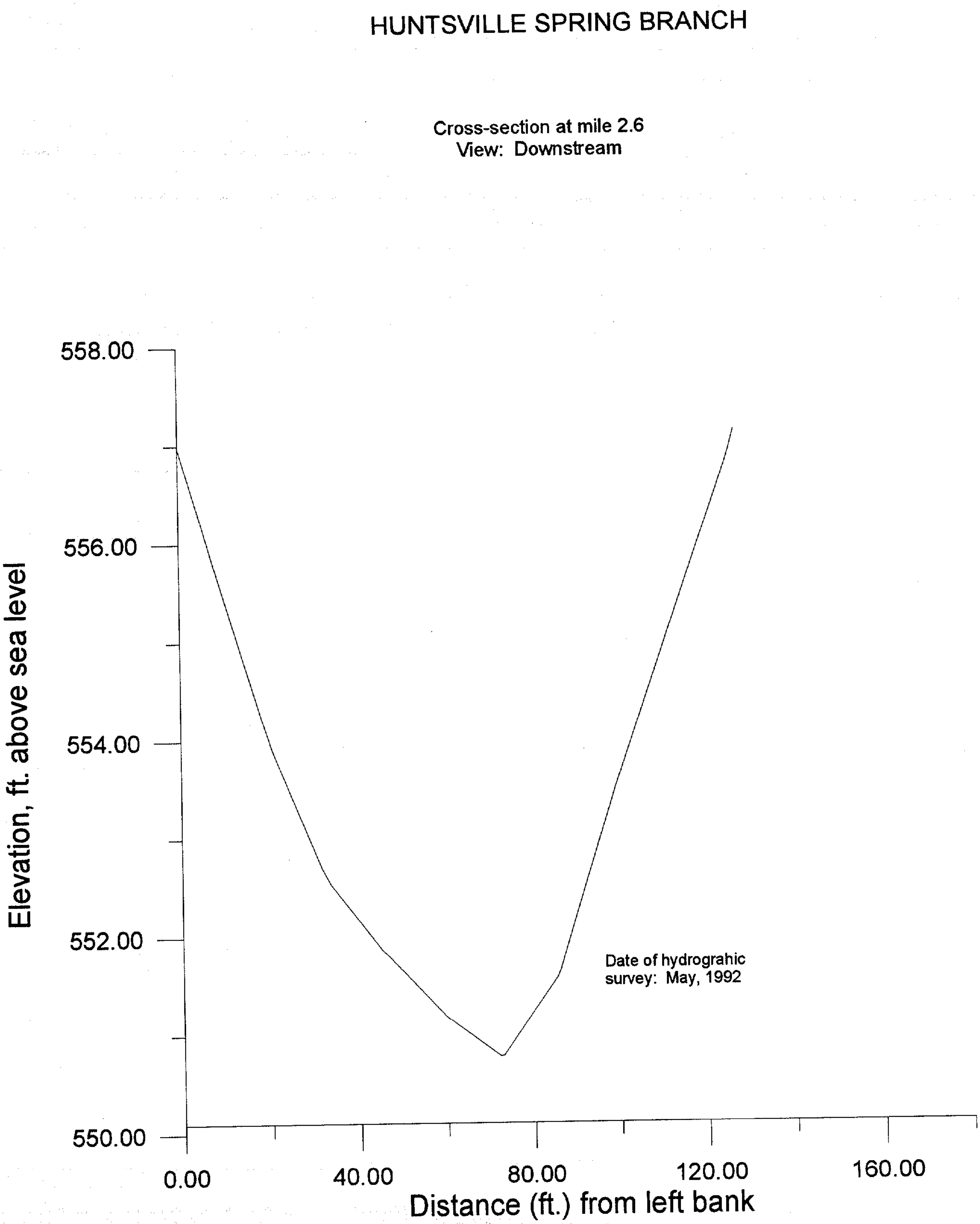
Cross-section at mile 3.6
View: Downstream



HUNTSVILLE SPRING BRANCH

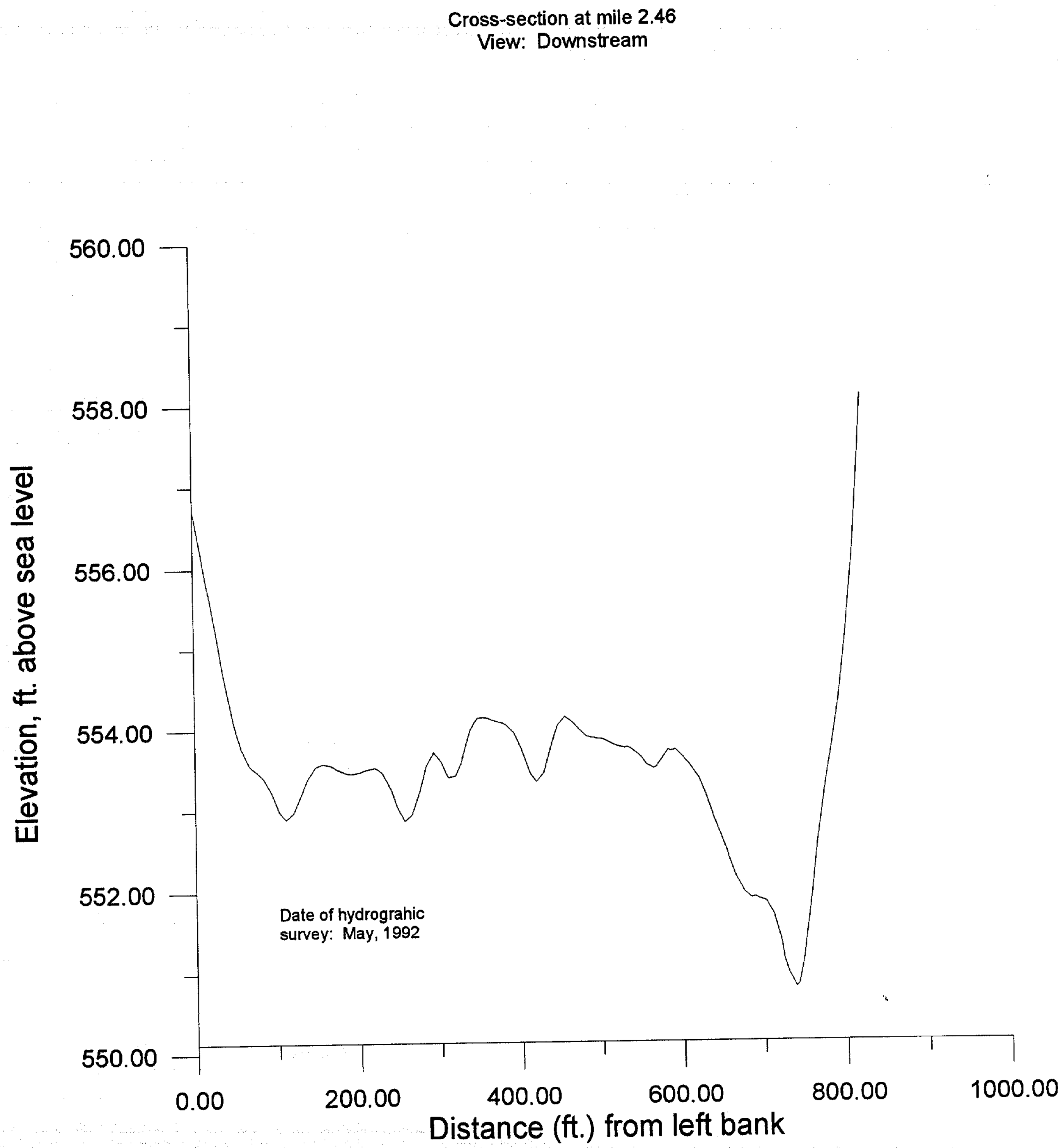
Cross-section at mile 3.4
View: Downstream





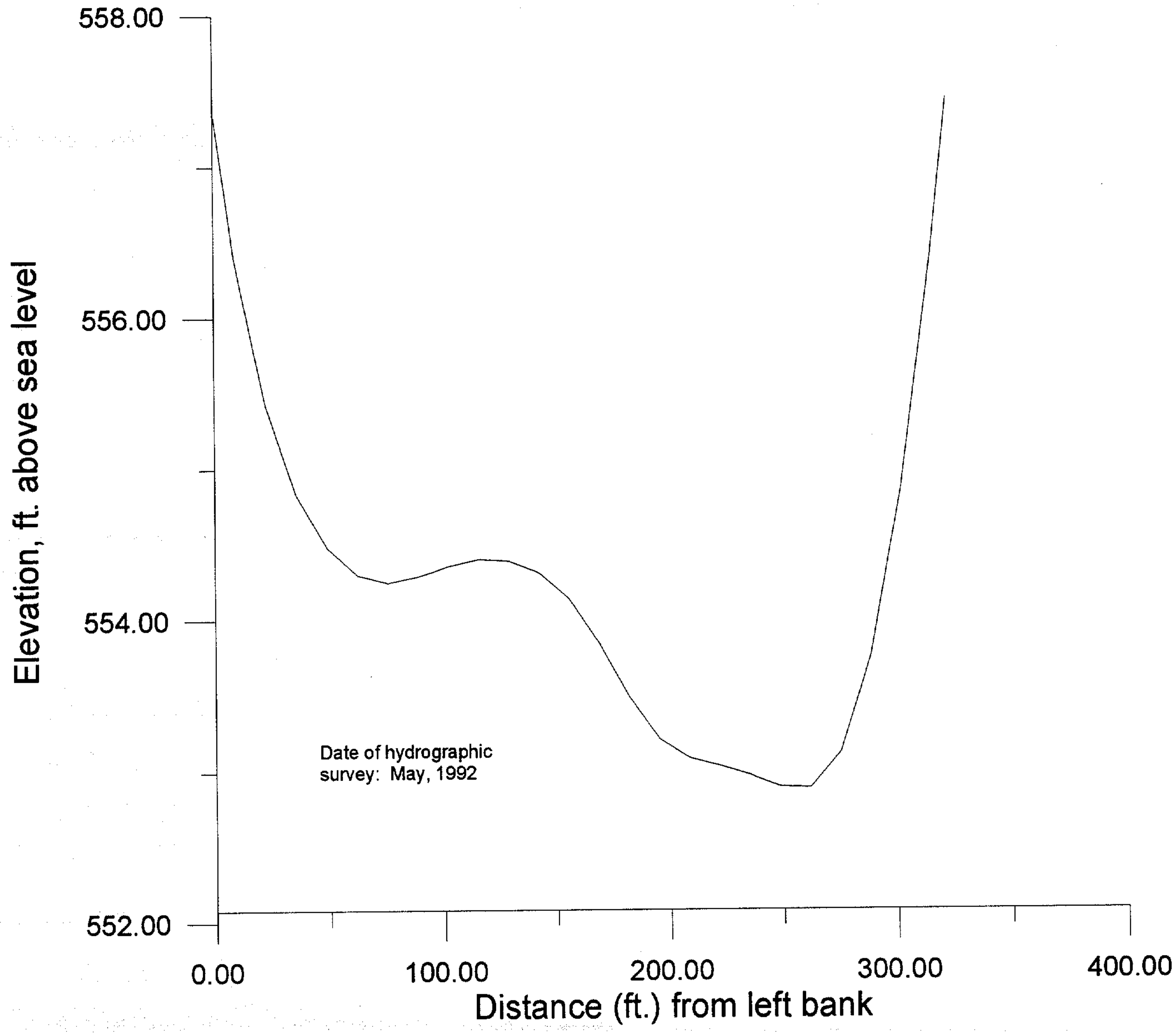
HUNTSVILLE SPRING BRANCH
Cross-section at mile 2.6
View: Downstream
558.00
556.00
554.00
552.00
550.00
Elevation, ft. above sea level
0.00
40.00
80.00
120.00
160.00
Distance (ft.) from left bank
Date of hydrograhic survey: May, 1992

HUNTSVILLE SPRING BRANCH



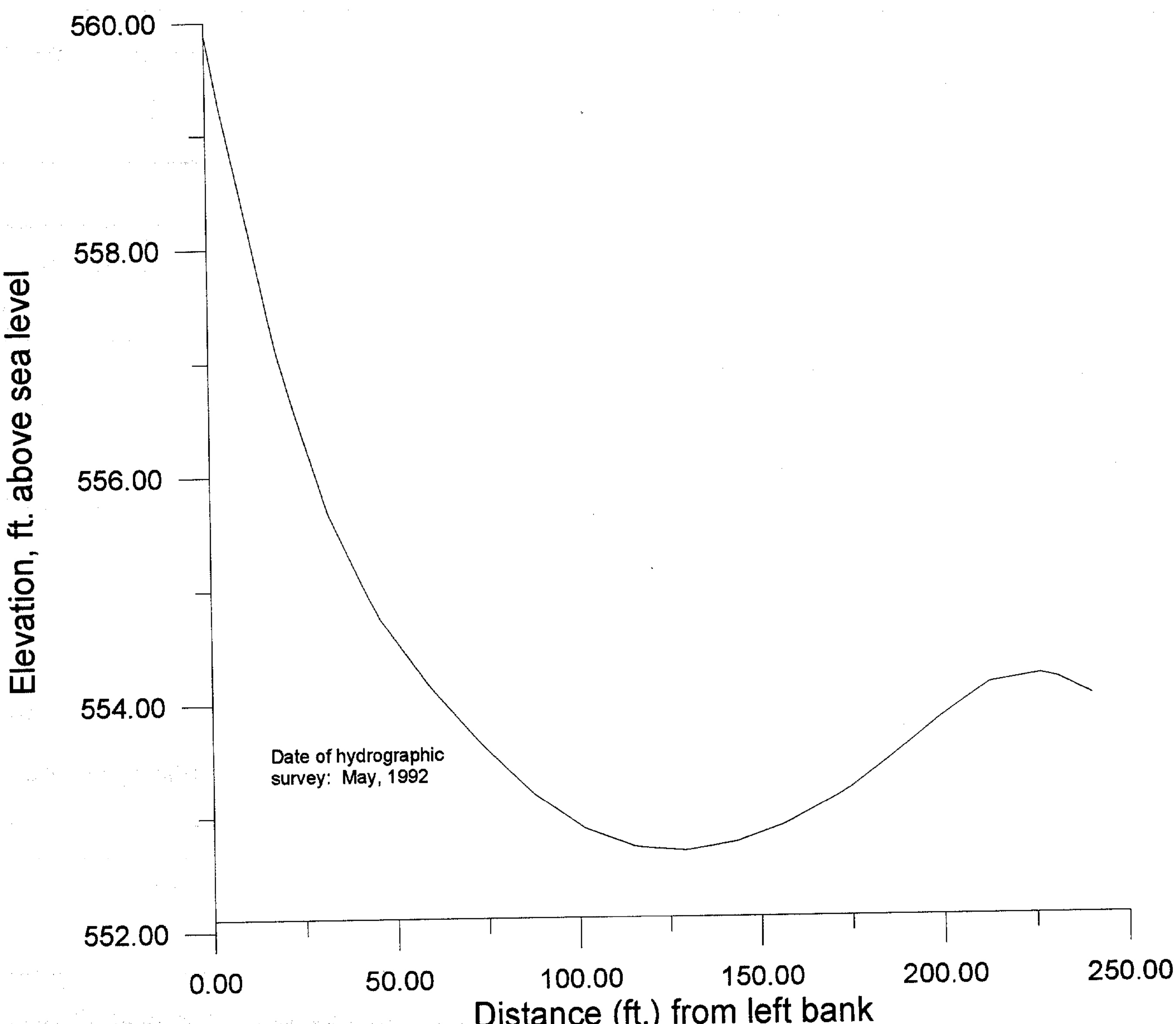
HUNTSVILLE SPRING BRANCH

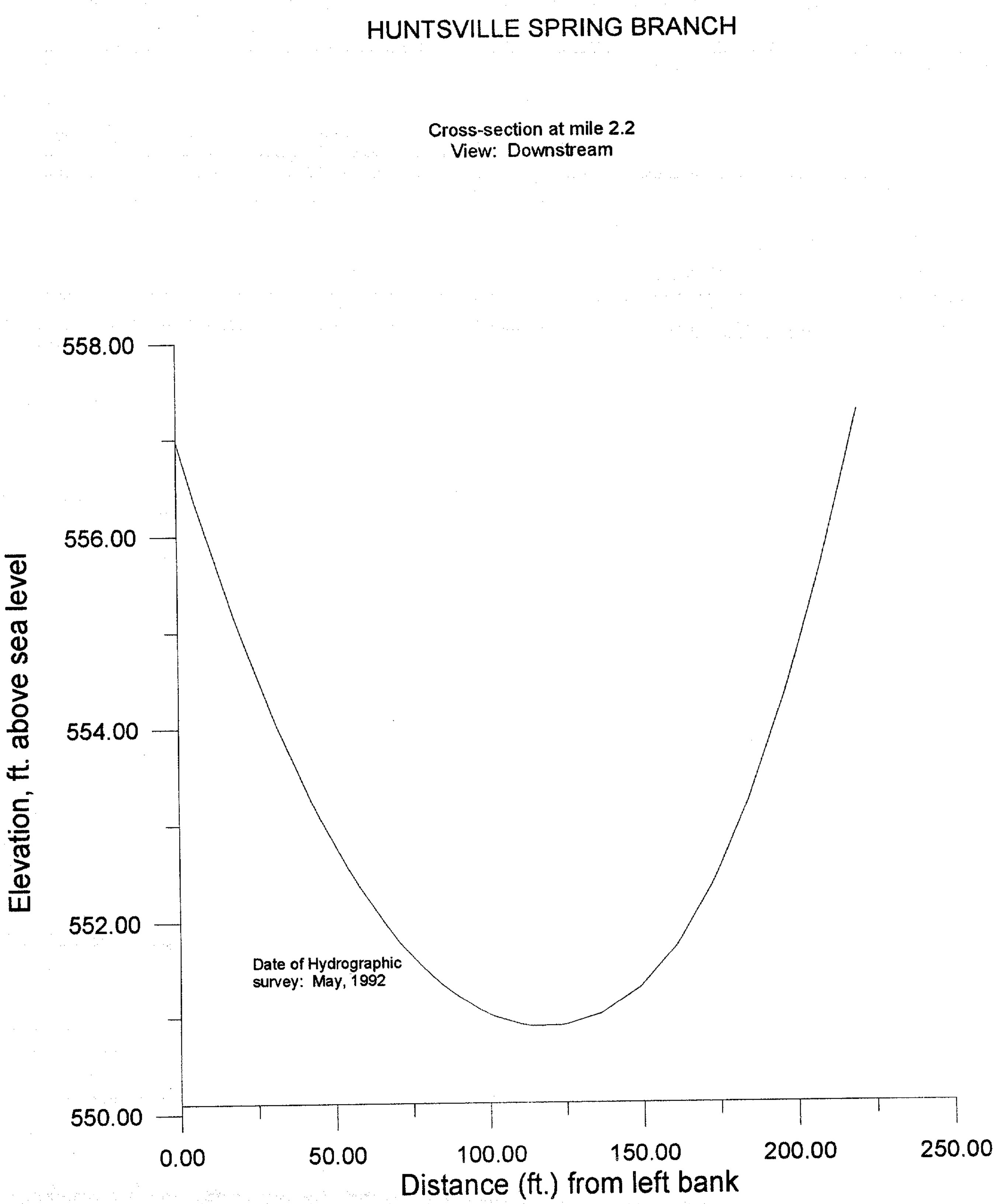
Cross-section at mile 2.361
View: Downstream



HUNTSVILLE SPRING BRANCH

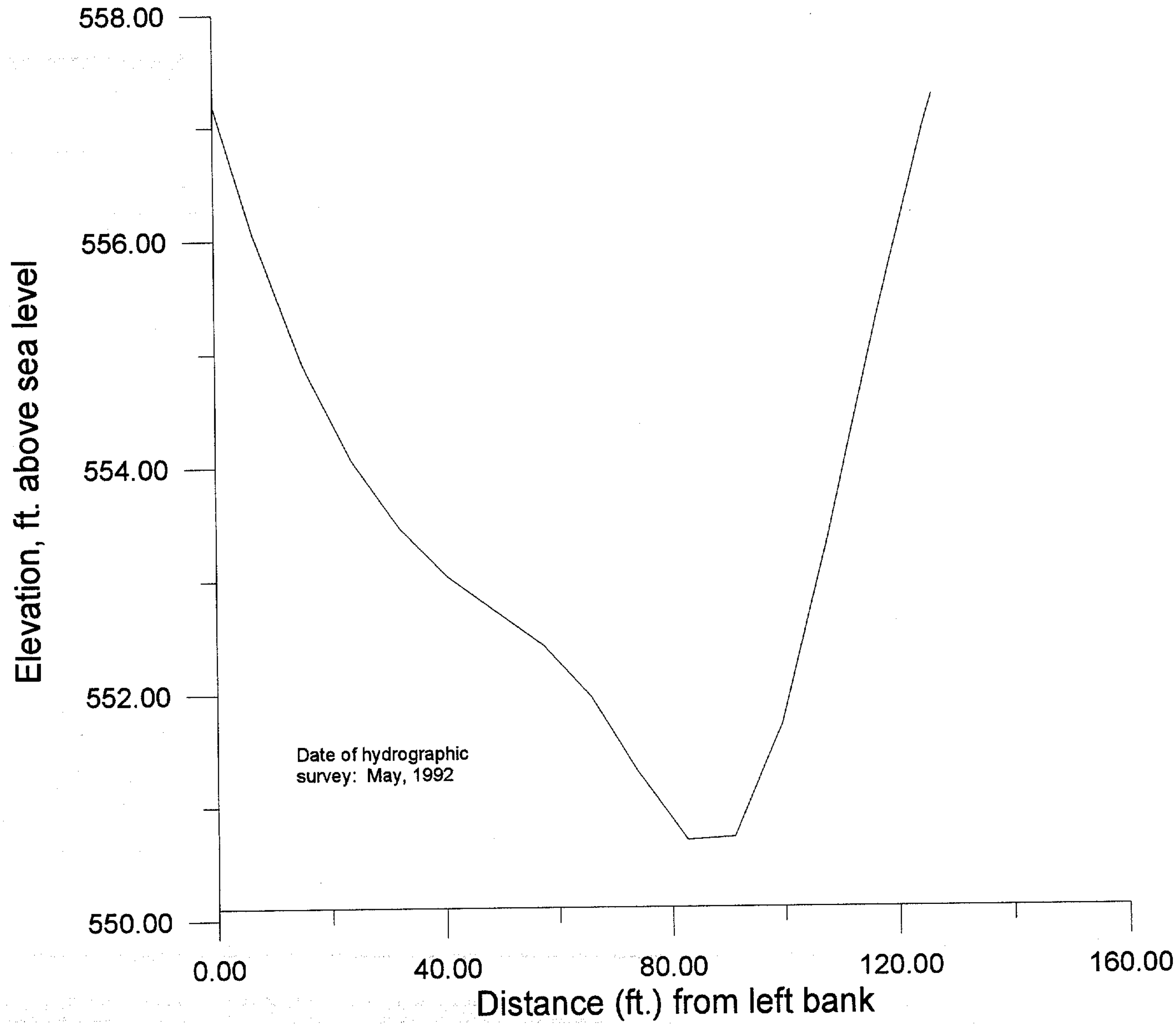
Cross-section at mile 2.285
View: Downstream




HUNTSVILLE SPRING BRANCH
Cross-section at mile 2.2
View: Downstream
558.00
556.00
554.00
552.00
550.00
Elevation, ft. above sea level
Date of Hydrographic
survey: May, 1992
0.00
50.00
100.00
150.00
200.00
250.00
Distance (ft.) from left bank

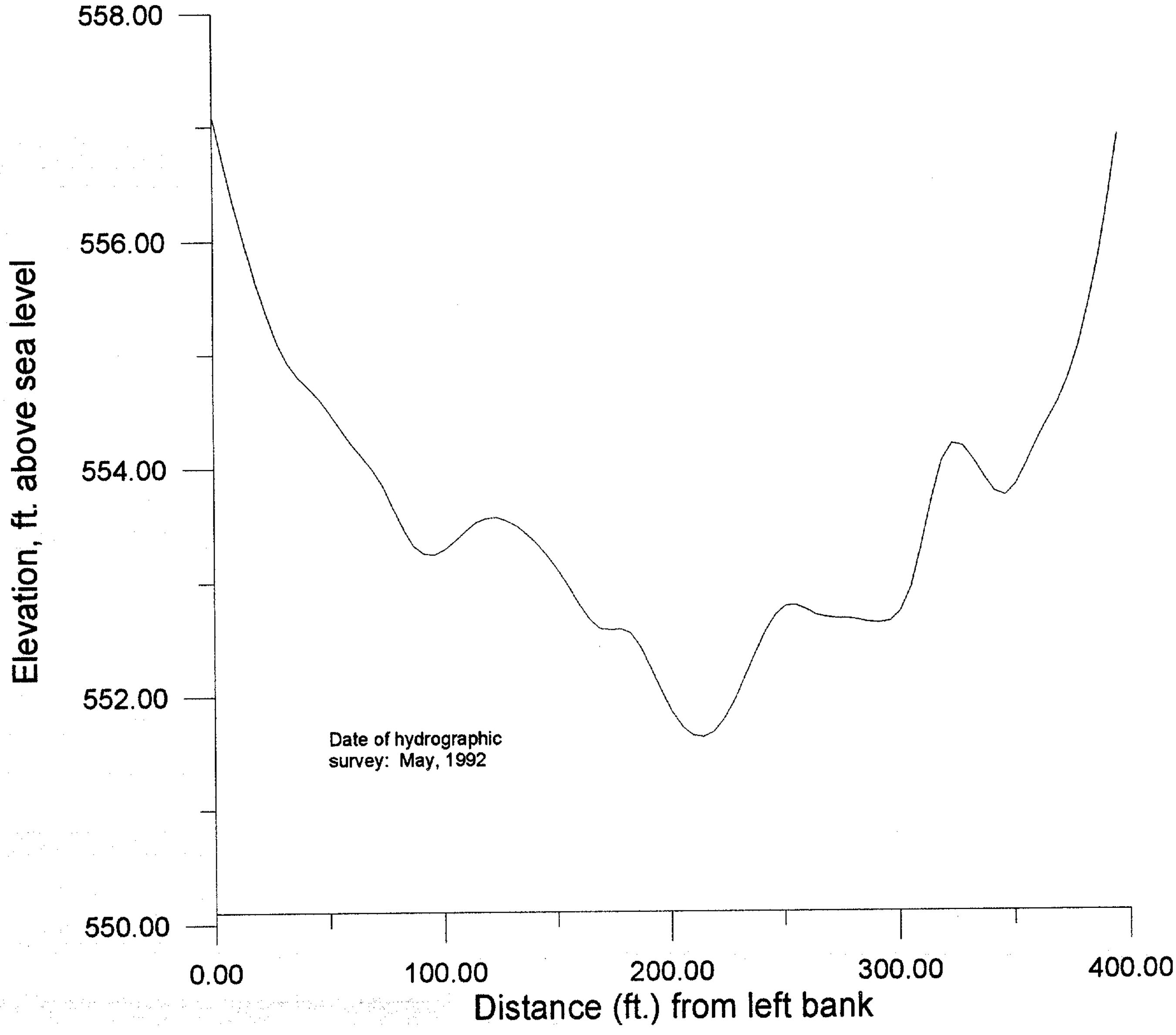
HUNTSVILLE SPRING BRANCH

Cross-section at mile 2.029
View: Downstream



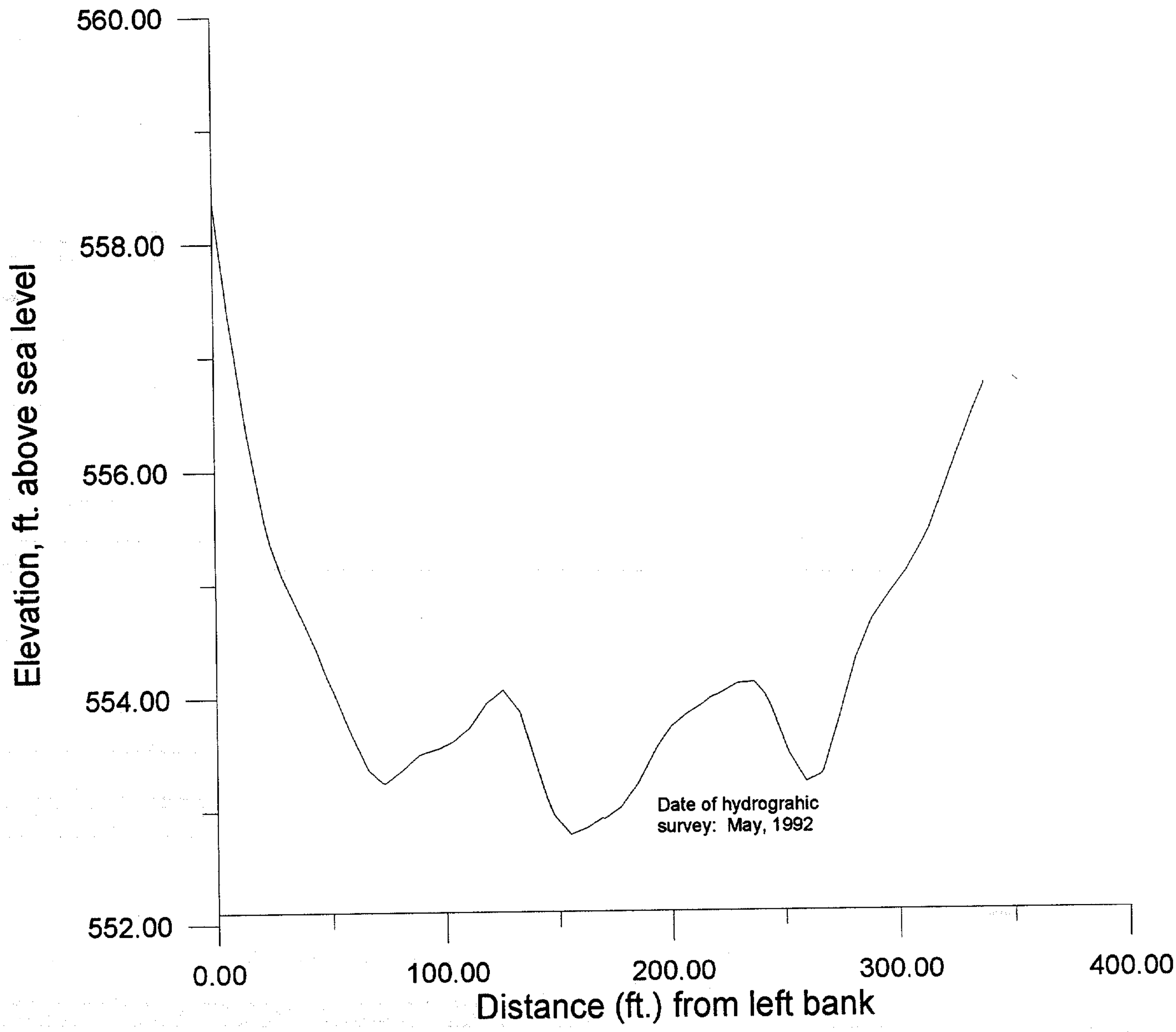
HUNTSVILLE SPRING BRANCH

Cross-section at mile 1.6
View: Downstream



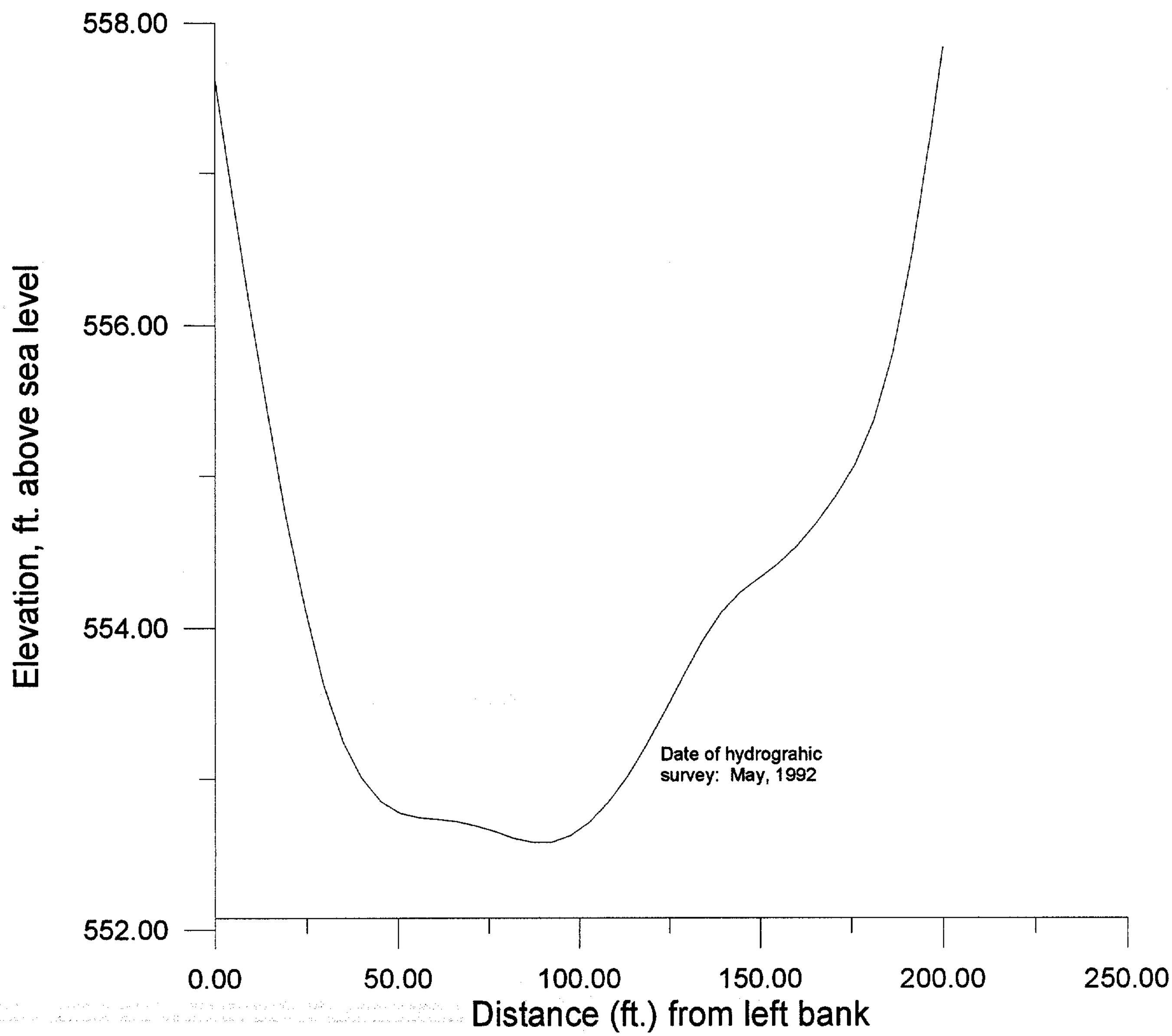
HUNTSVILLE SPRING BRANCH

Cross-section at mile 1.4
View: Downstream



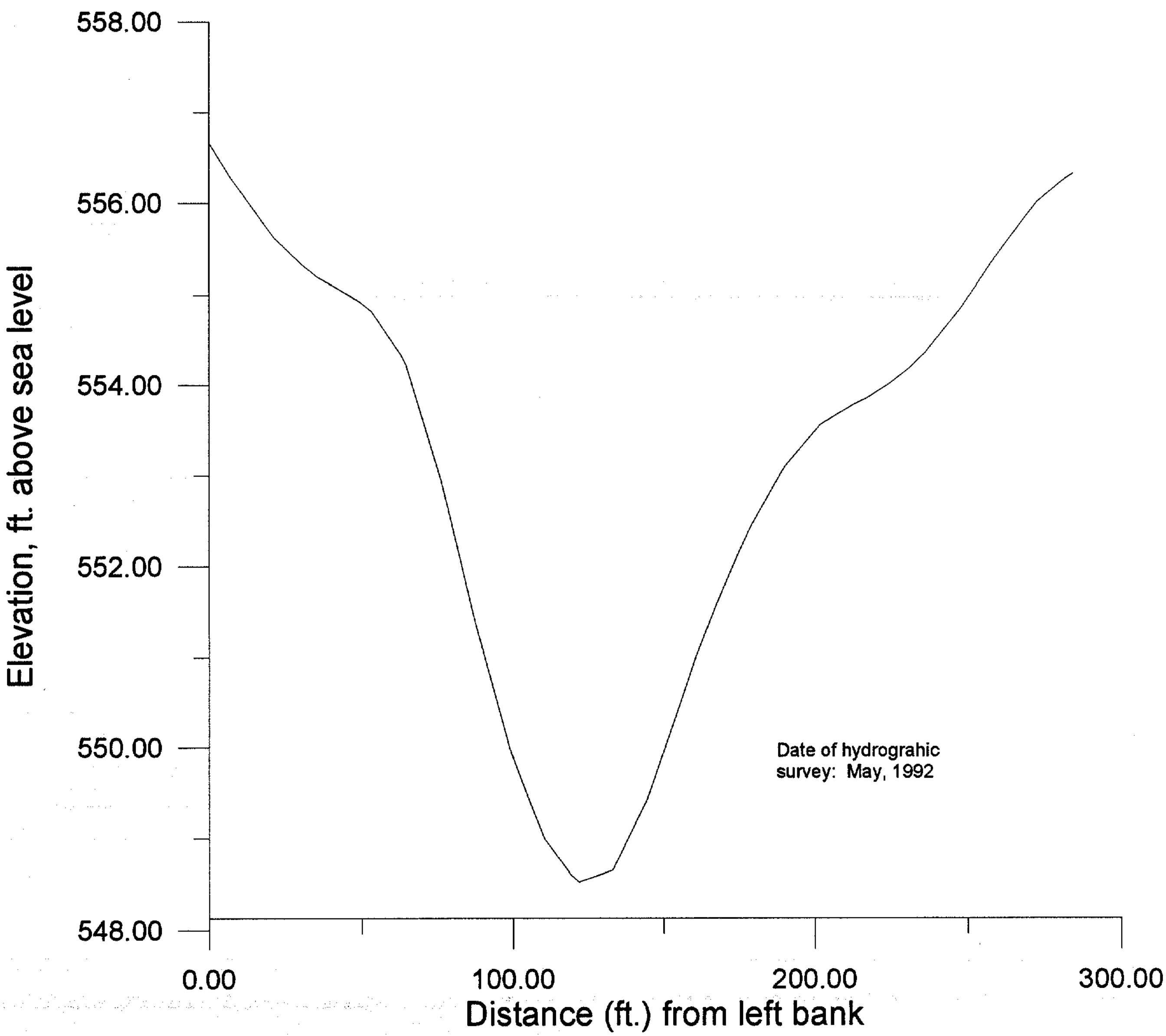
HUNTSVILLE SPRING BRANCH

Cross-section at mile 0.4
View: Downstream



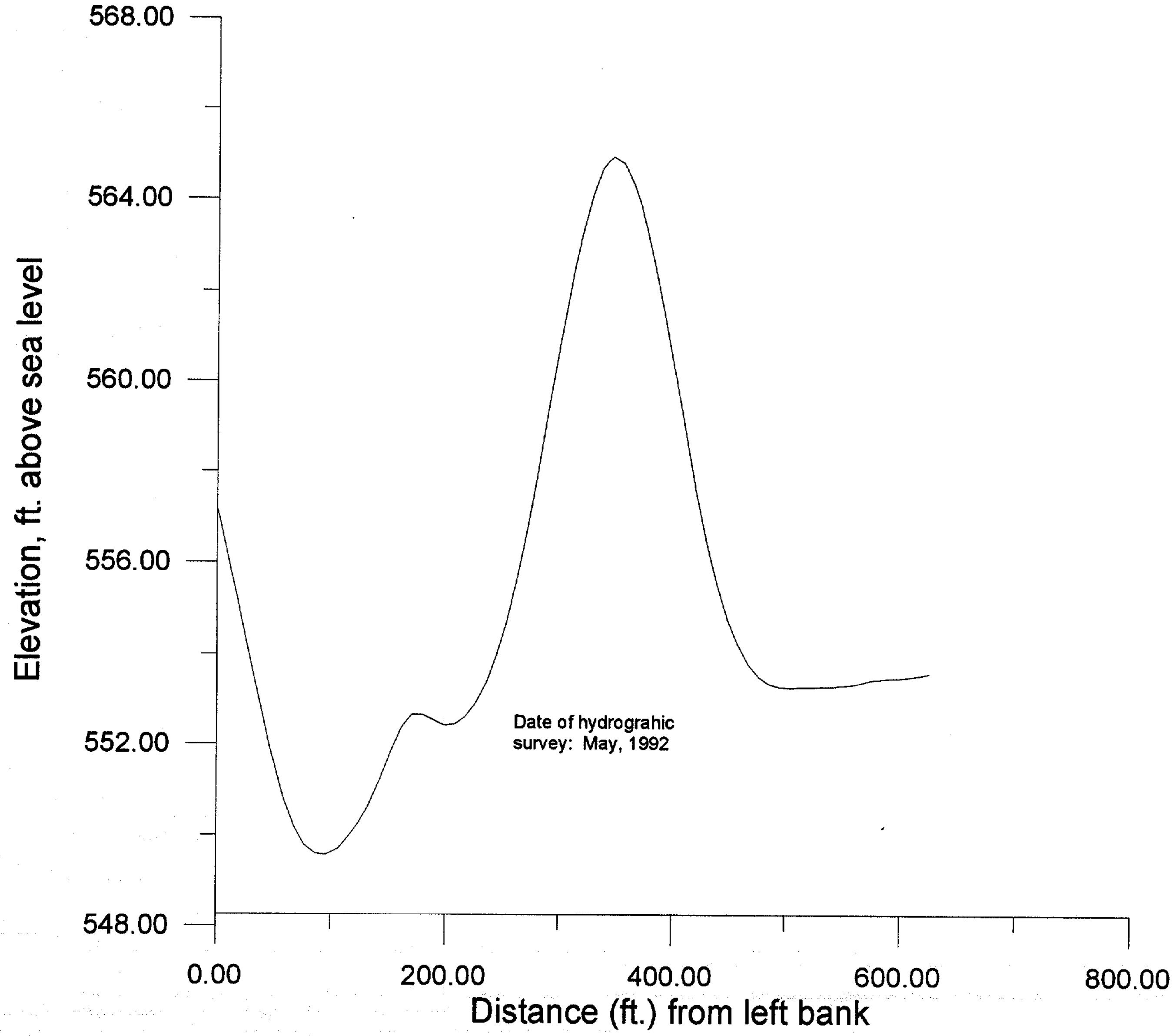
HUNTSVILLE SPRING BRANCH
(AT CONFLUENCE WITH INDIAN CREEK)

Cross-section at mile 0.0
View: Downstream



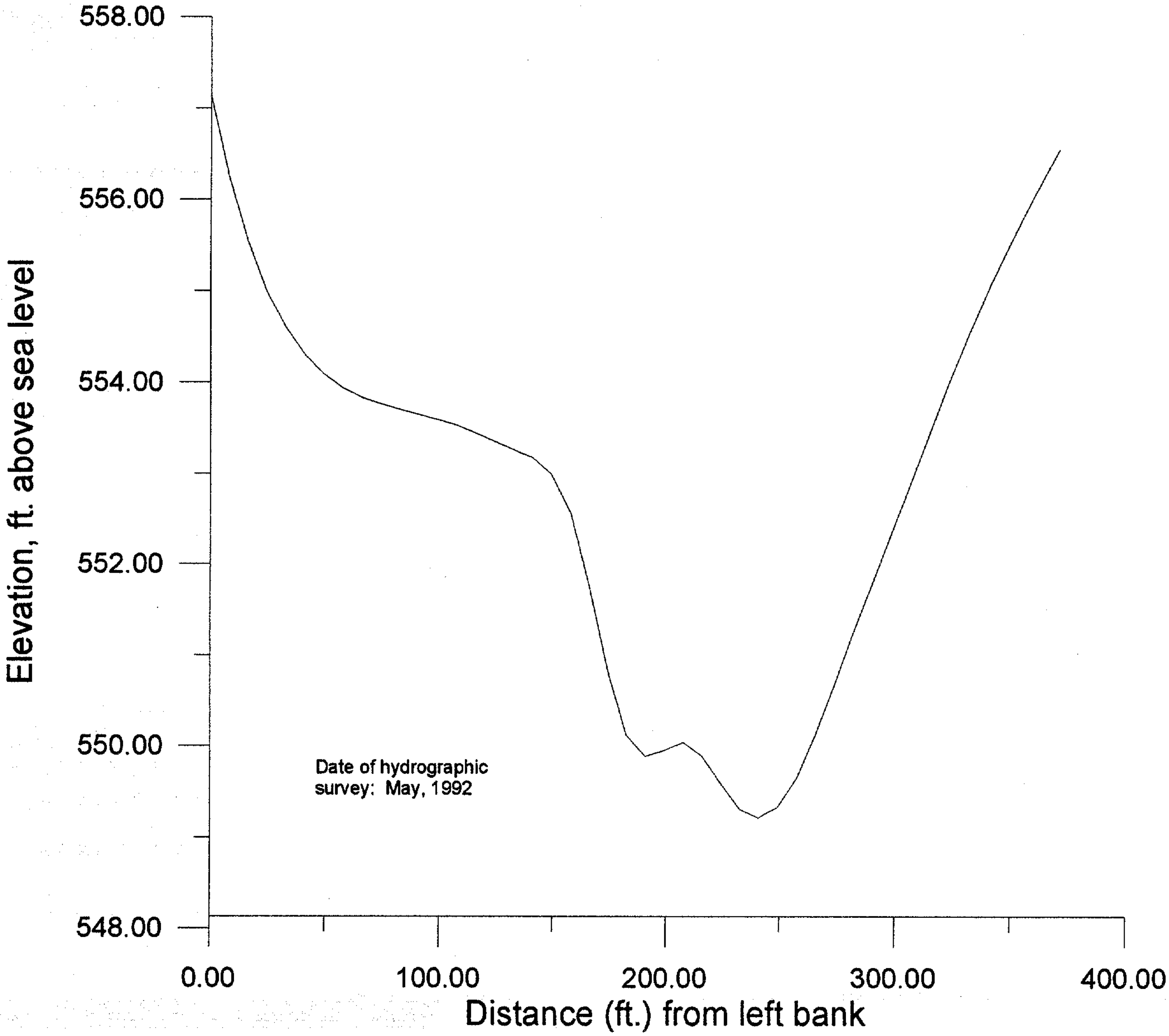
INDIAN CREEK

Cross-section at mile 5.4
View: Downstream



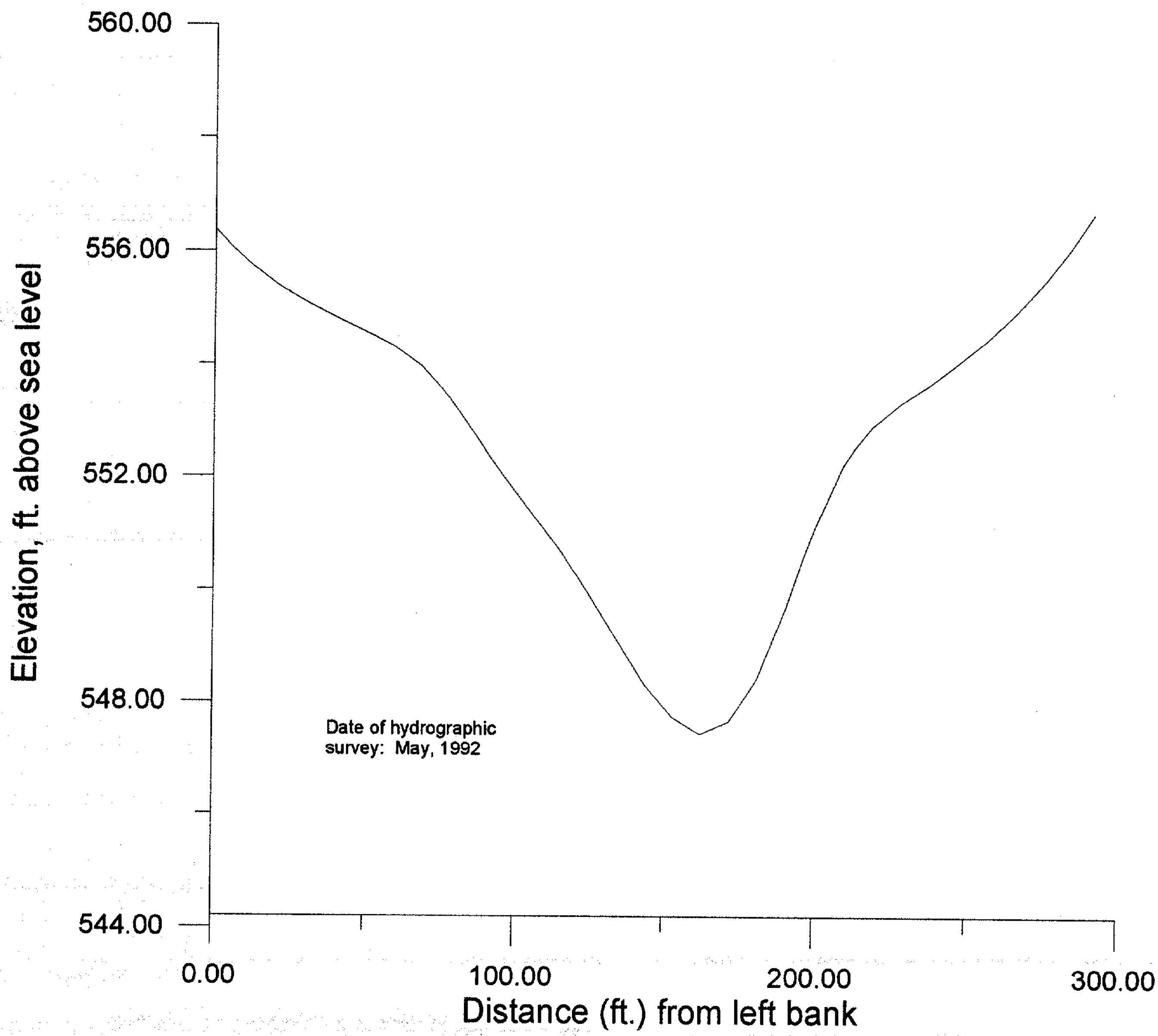
INDIAN CREEK

Cross-section at mile 5.2
View: Downstream



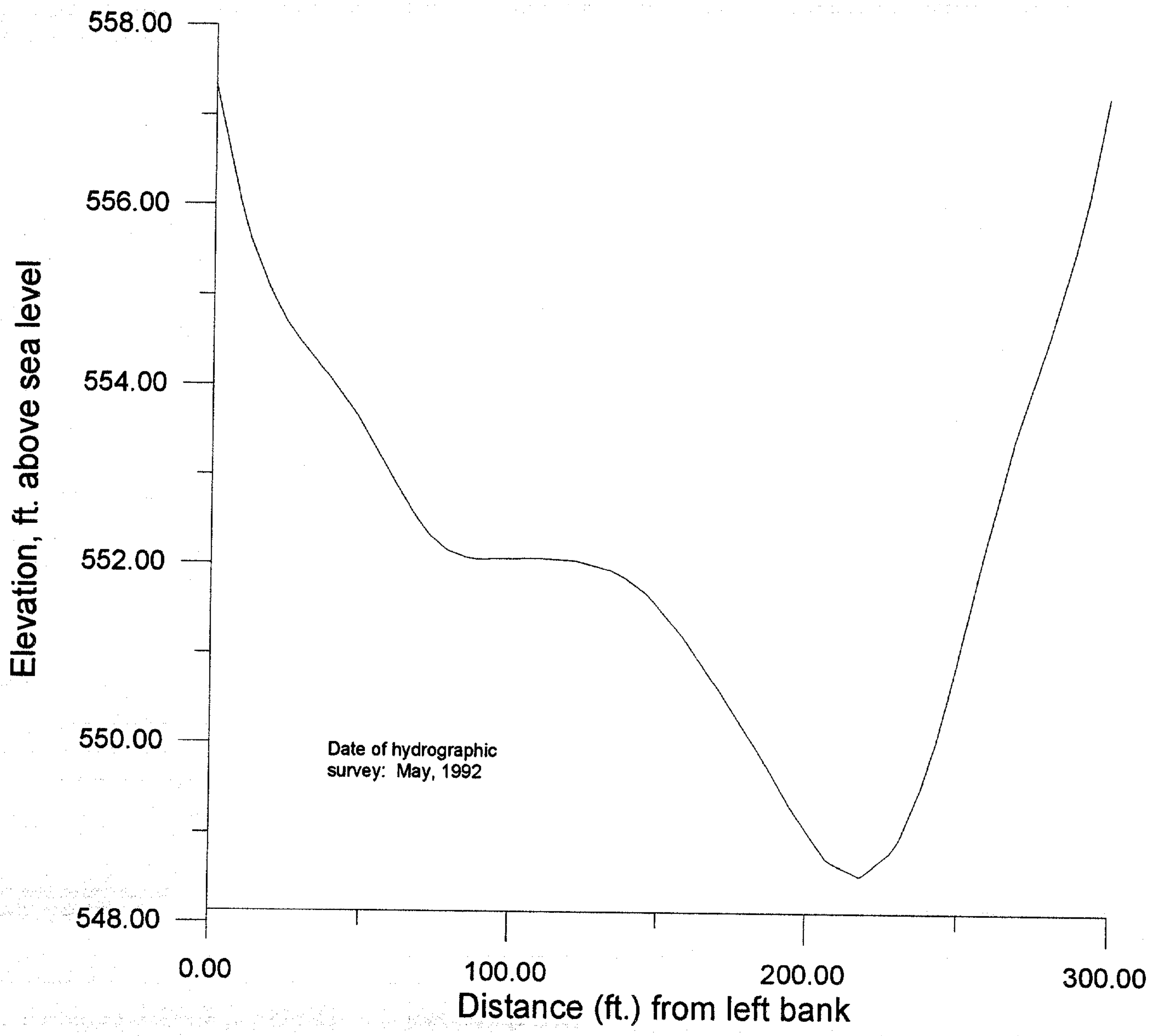
INDIAN CREEK

Cross-section at mile 5.0
View: Downstream



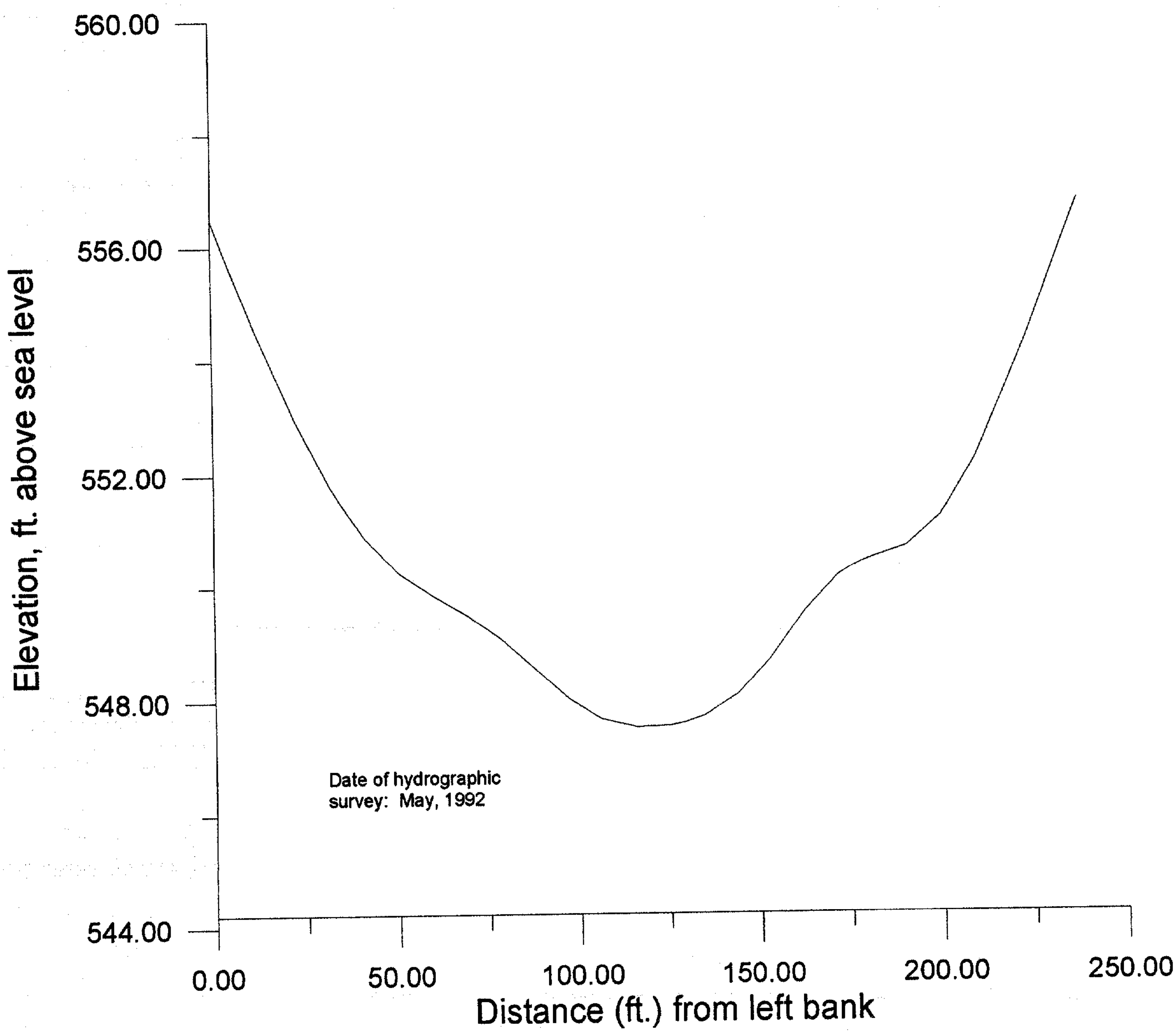
INDIAN CREEK

Cross-section at mile 4.4
View: Downstream



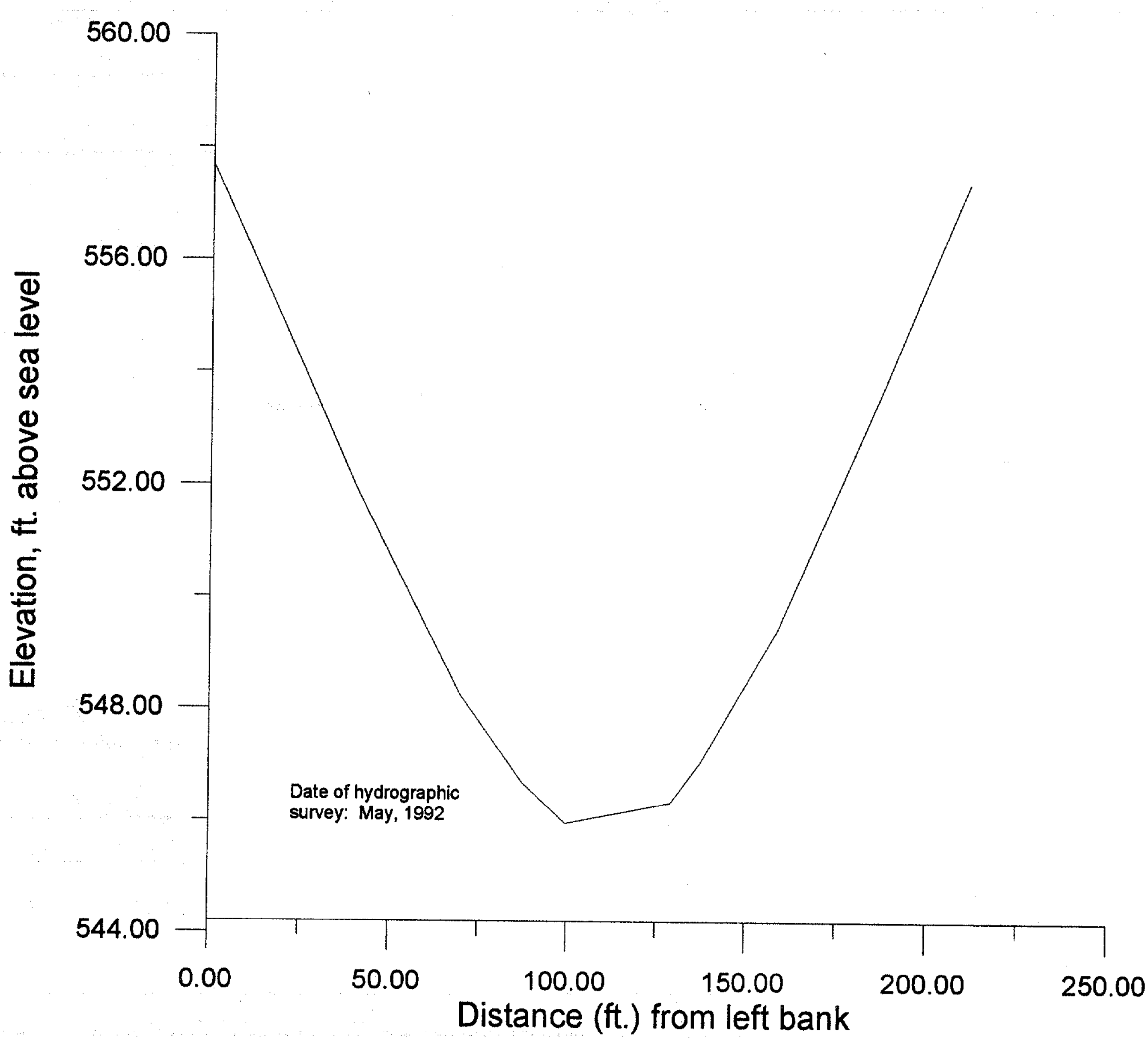
INDIAN CREEK

Cross-section at mile 2.43
View: Downstream



INDIAN CREEK

Cross-section at mile 0.68.
View: Downstream

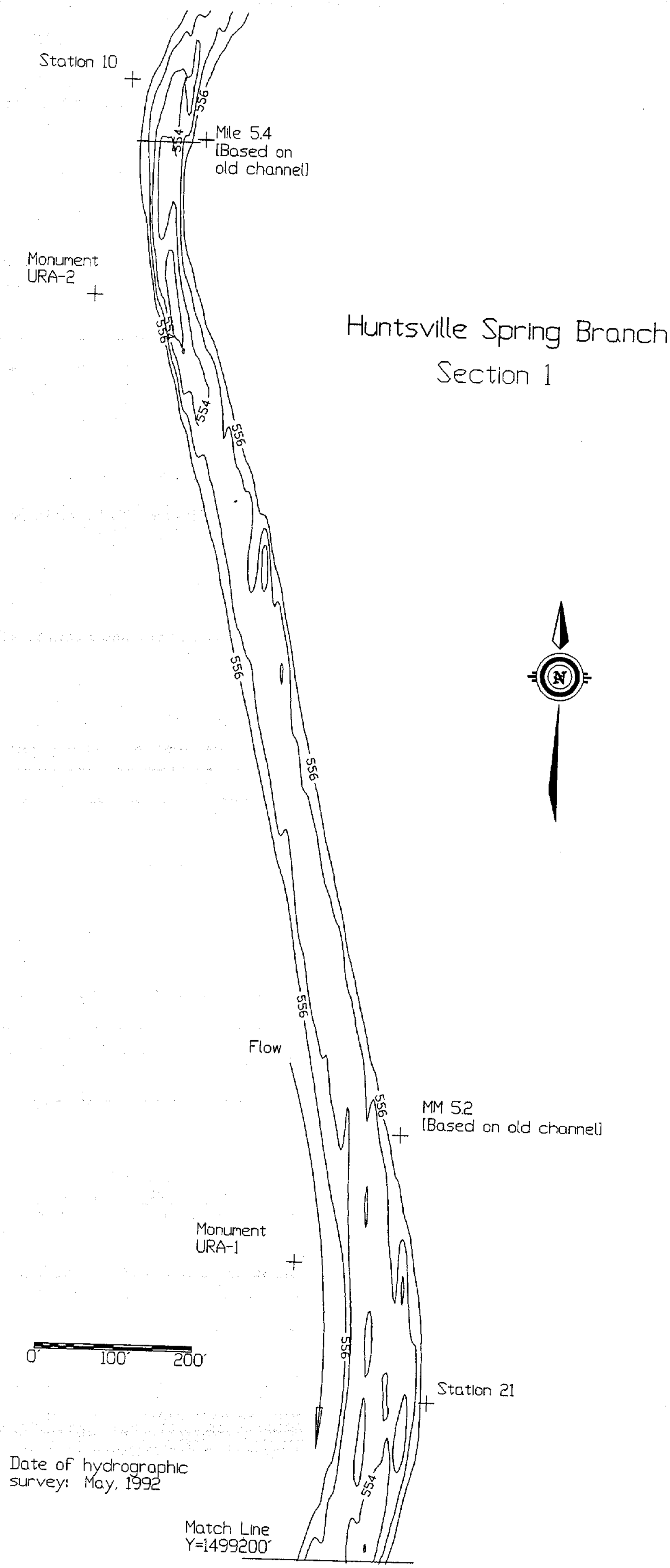


Appendix B
Hydrographic Maps of the HSB-IC System

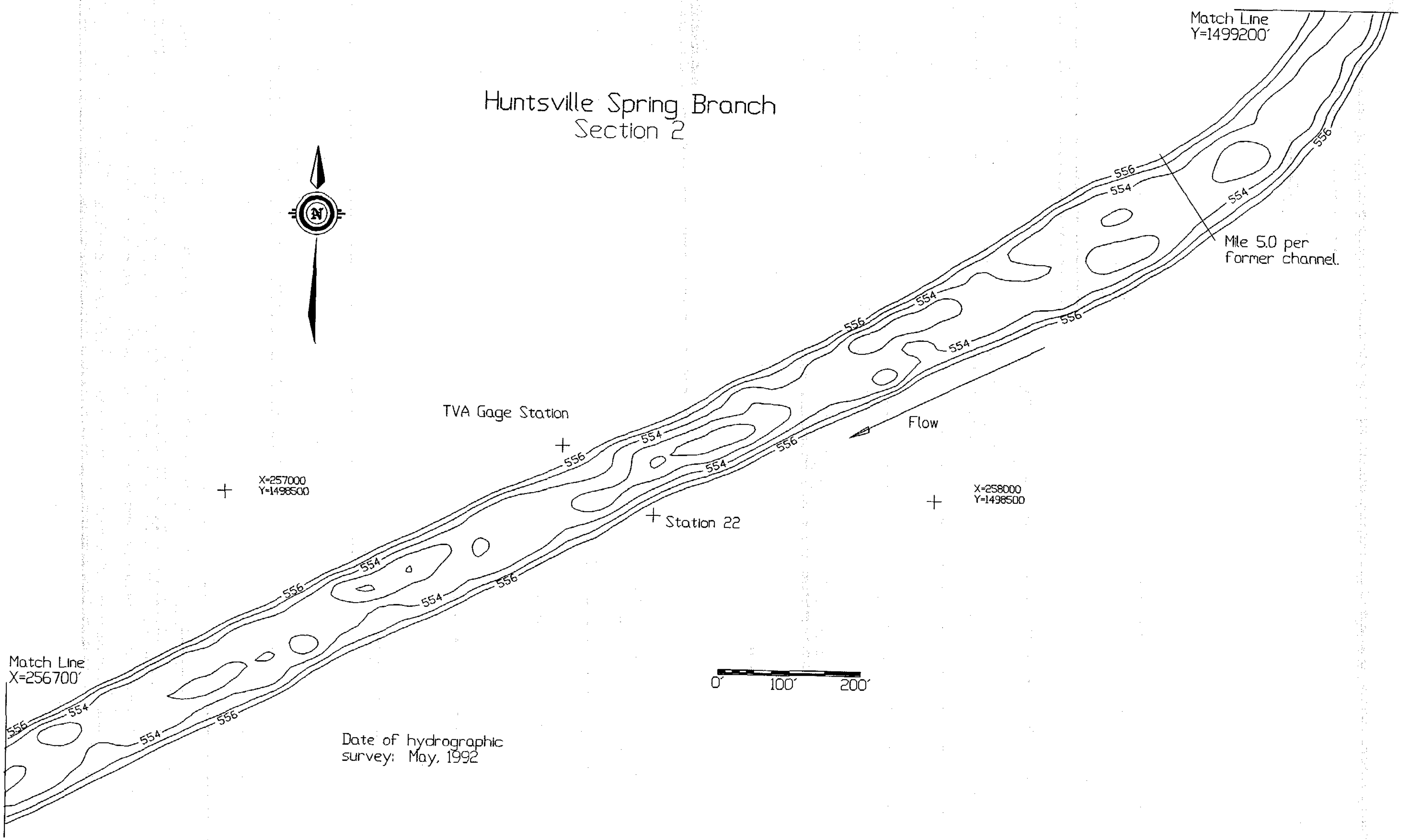
Key to 8½" x 11" HSB-IC Maps

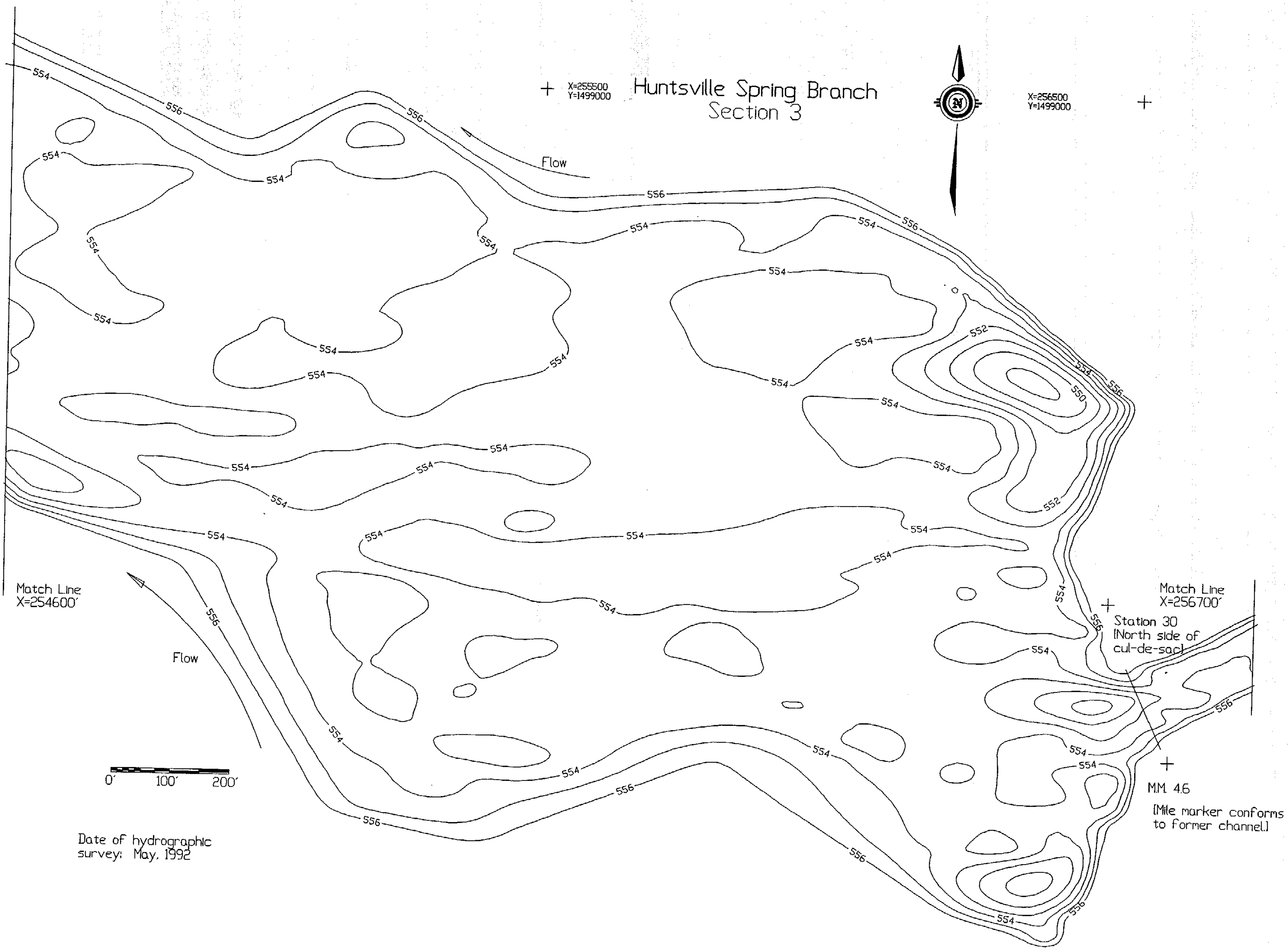
Map Section	Approximate River Mile
HSB Section 1	5.4 - 5.1
HSB Section 2	5.1 - 4.6
HSB Section 3	4.6 - 4.2
HSB Section 4	4.4 - 3.7
HSB Section 5	3.7 - 3.3
HSB Section 6	3.3 - 2.5
HSB Section 7	2.5 - 2.3
HSB Section 8	2.3 - 1.8
HSB Section 9	1.8 - 1.5
HSB Section 10	1.5 - 1.0
HSB Section 11	1.0 - 0.7
HSB Section 12	0.7 - 0.2
HSB Section 13	0.2 - ICM 5.3
IC Section 1	5.3 - 5.0
IC Section 2	5.0 - 4.6
IC Section 3	4.6 - 4.3
IC Section 4	4.3 - 3.9
IC Section 5	3.9 - 3.5
IC Section 6	3.5 - 3.0
IC Section 7	3.0 - 2.5
IC Section 8	2.5 - 2.2
IC Section 9	2.2 - 1.8
IC Section 10	1.8 - 1.4
IC Section 11	1.4 - 1.0
IC Section 12	1.0 - 0.3
IC Section 13	0.3 - 0.0

These maps are not to be used for navigation.

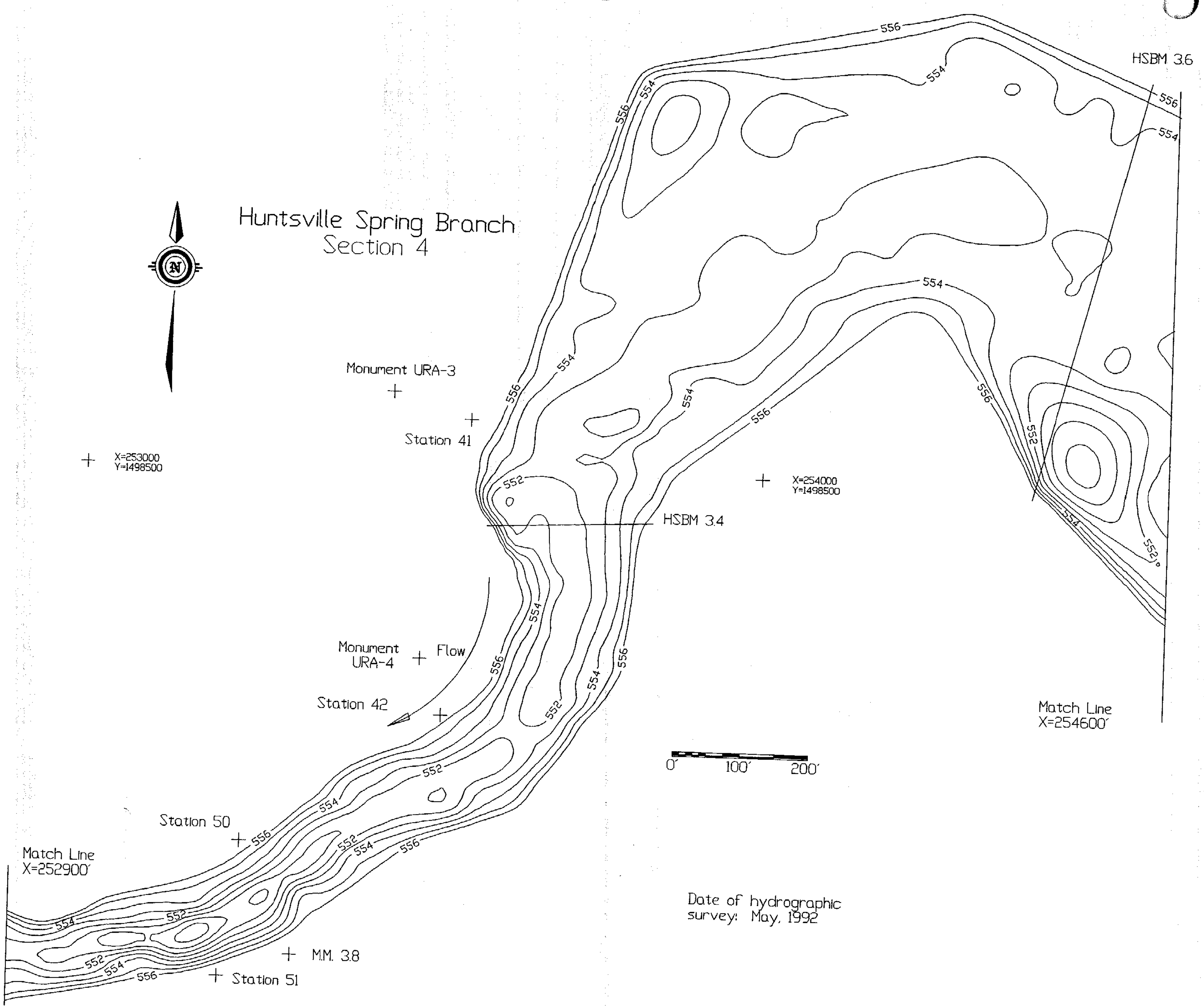

Huntsville Spring Branch
Section 1
Station 10
Mile 5.4
[Based on
old channel]
Monument
URA-2
556
554
MM 5.2
[Based on old channel]
Flow
Monument
URA-1
0'
100'
200'
Station 21
Date of hydrographic
survey: May, 1992
Match Line
Y=1499200'

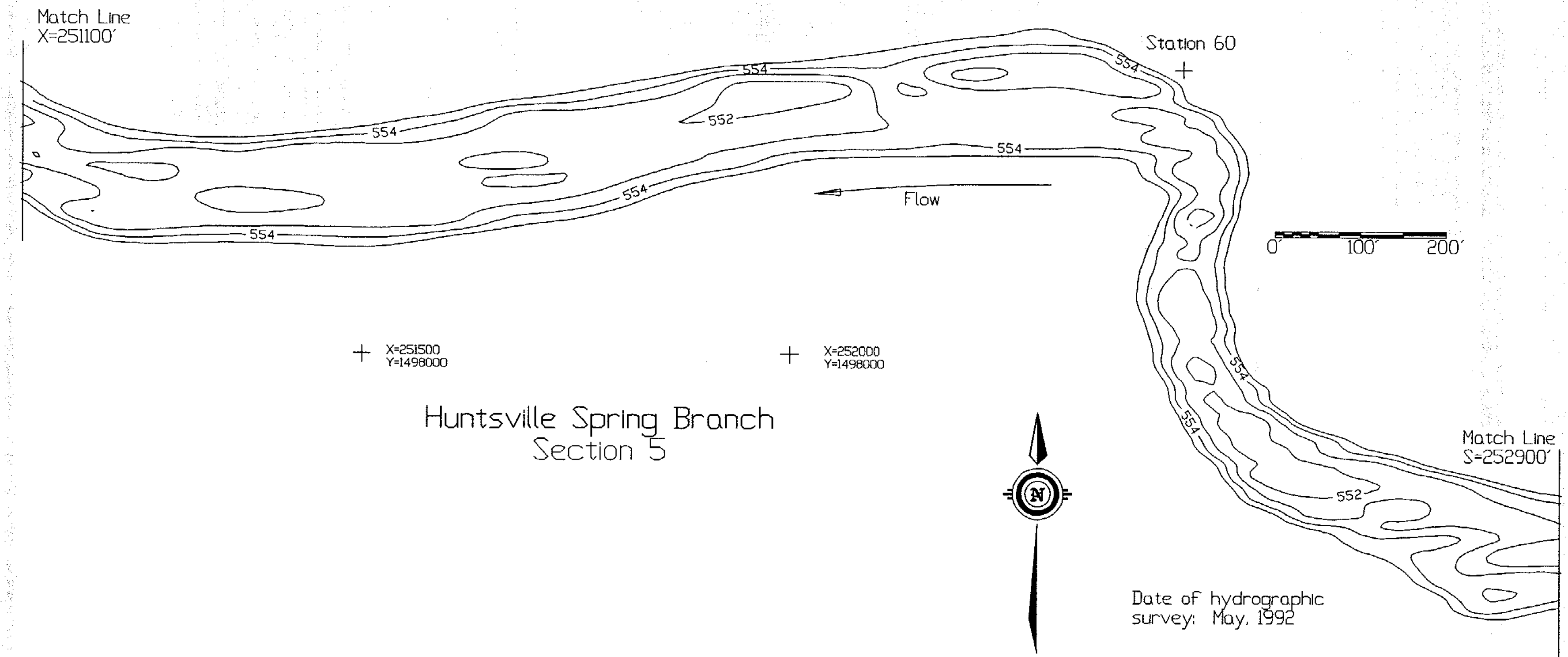
Huntsville Spring Branch
Section 2



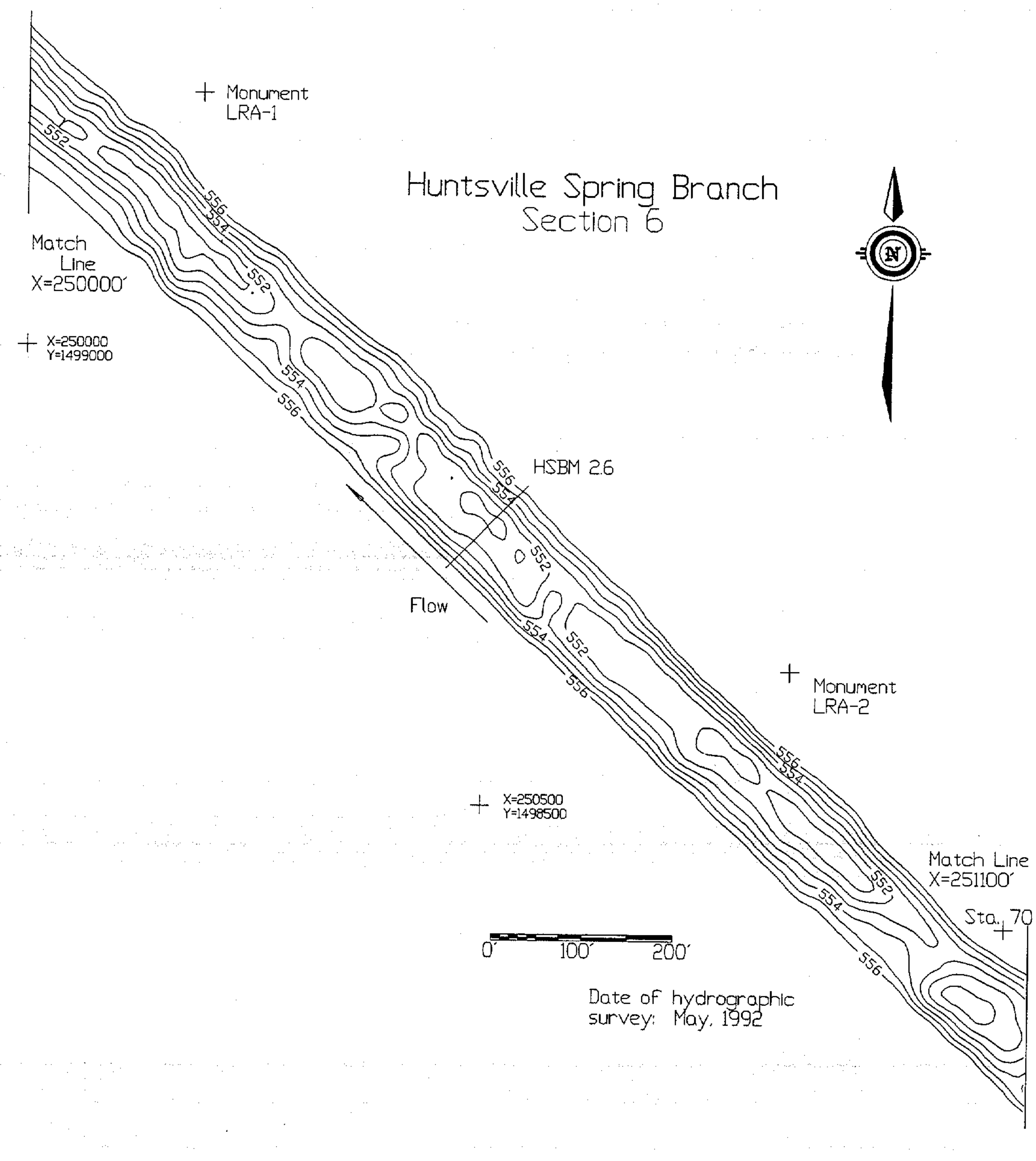


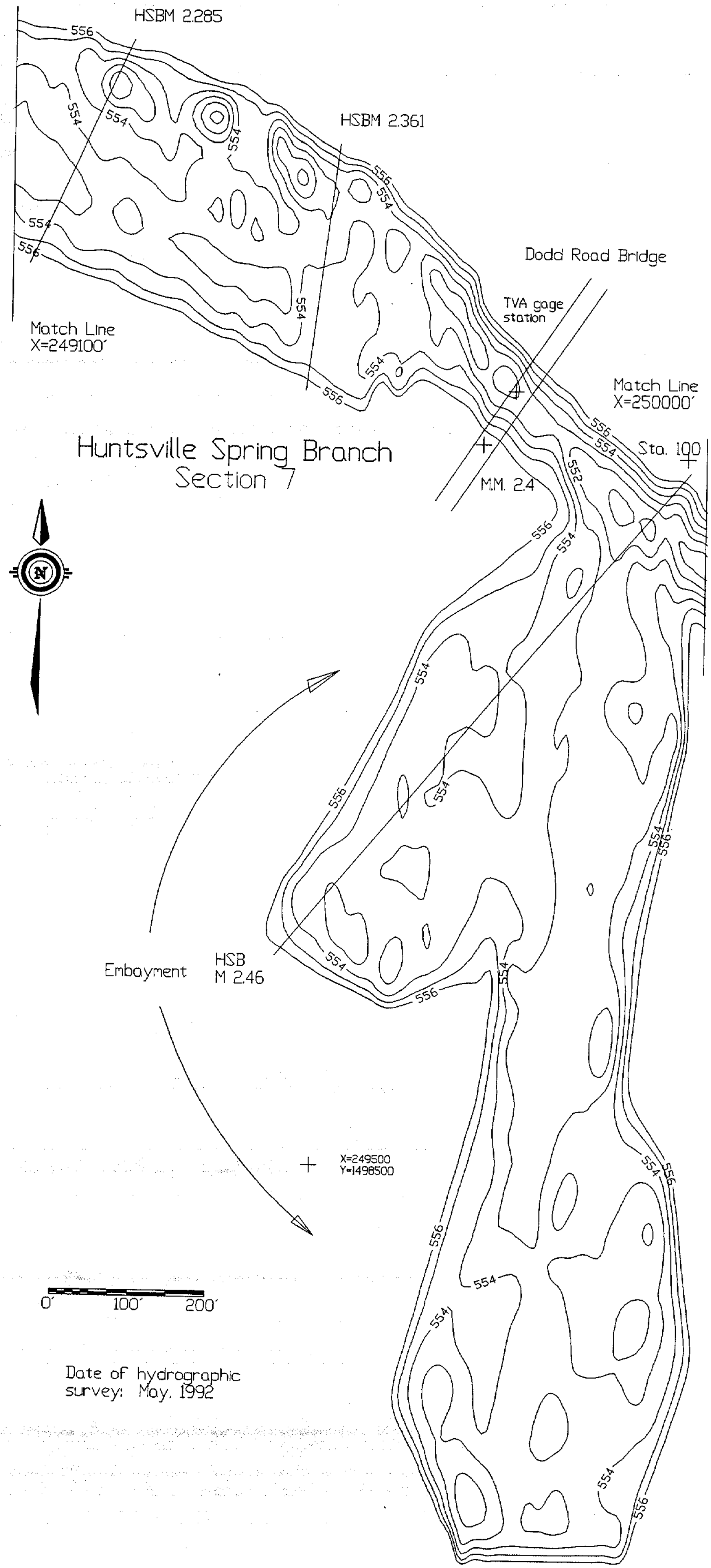
Huntsville Spring Branch
Section 3
X=255500
Y=1499000
X=256500
Y=1499000
N
Flow
Flow
Match Line
X=254600′
Match Line
X=256700′
Station 30
[North side of
cul-de-sac]
MM 4.6
[Mile marker conforms
to former channel.]
0′ 100′ 200′
Date of hydrographic
survey: May, 1992
556
554
552
550

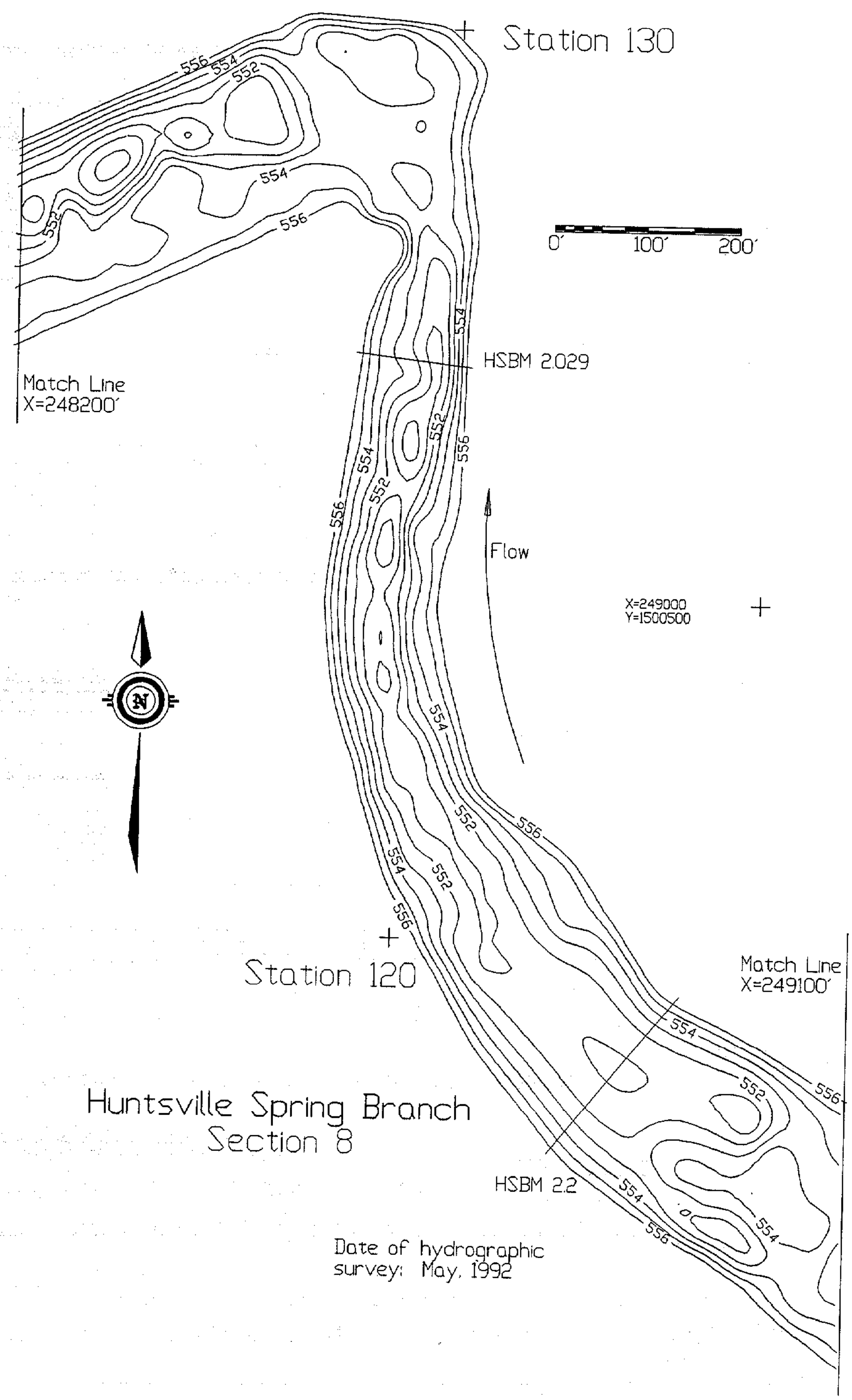

Huntsville Spring Branch
Section 4
HSBM 3.6
Monument URA-3
Station 41
X=253000
Y=1498500
X=254000
Y=1498500
HSBM 3.4
Monument
URA-4
Flow
Station 42
Match Line
X=254600′
0′
100′
200′
Station 50
Match Line
X=252900′
Date of hydrographic
survey: May, 1992
M.M. 3.8
Station 51
556
554
552

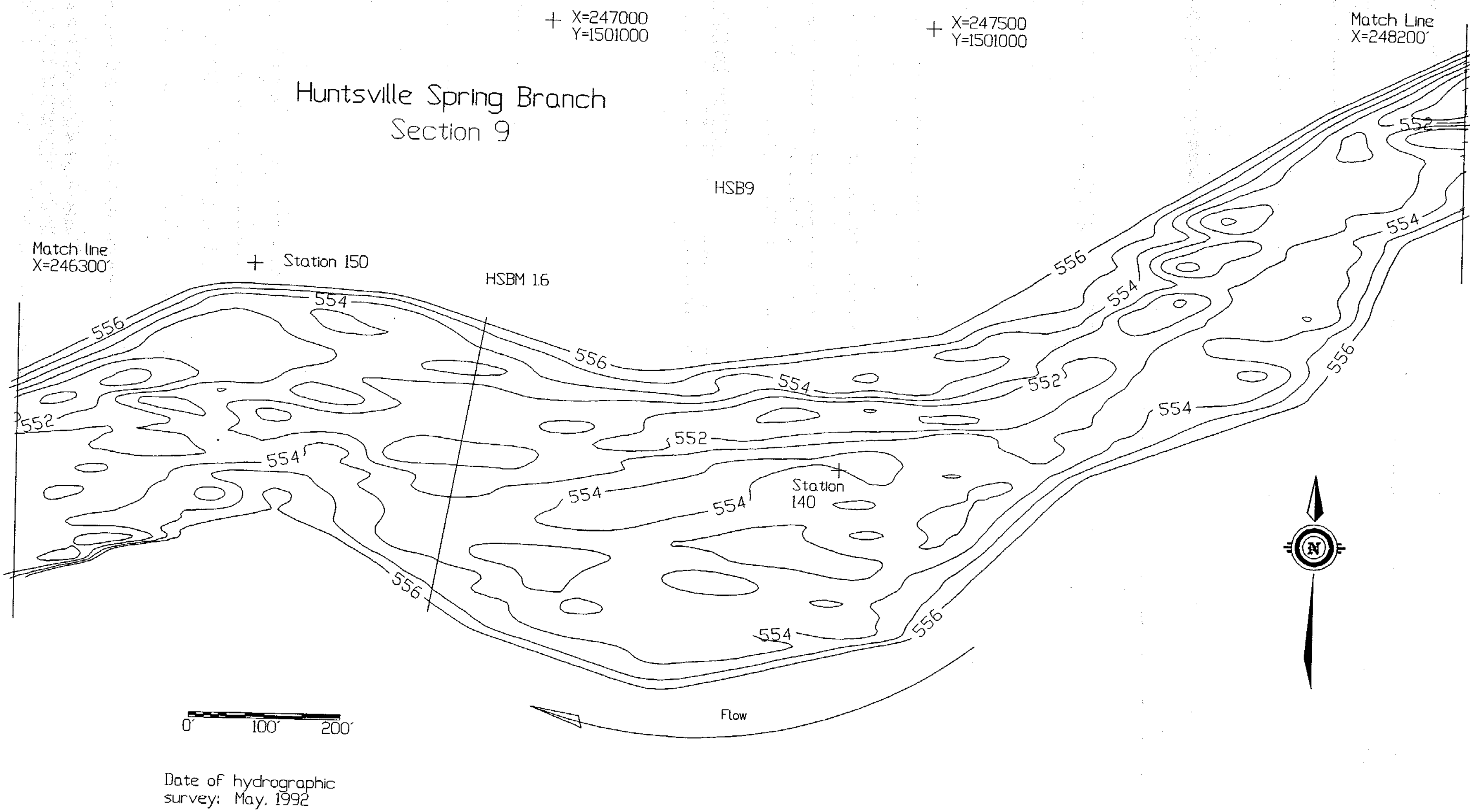


Match Line
X=251100'
Station 60
554
552
Flow
0'
100'
200'
X=251500
Y=1498000
X=252000
Y=1498000
Huntsville Spring Branch
Section 5
N
Match Line
S=252900'
Date of hydrographic
survey: May, 1992

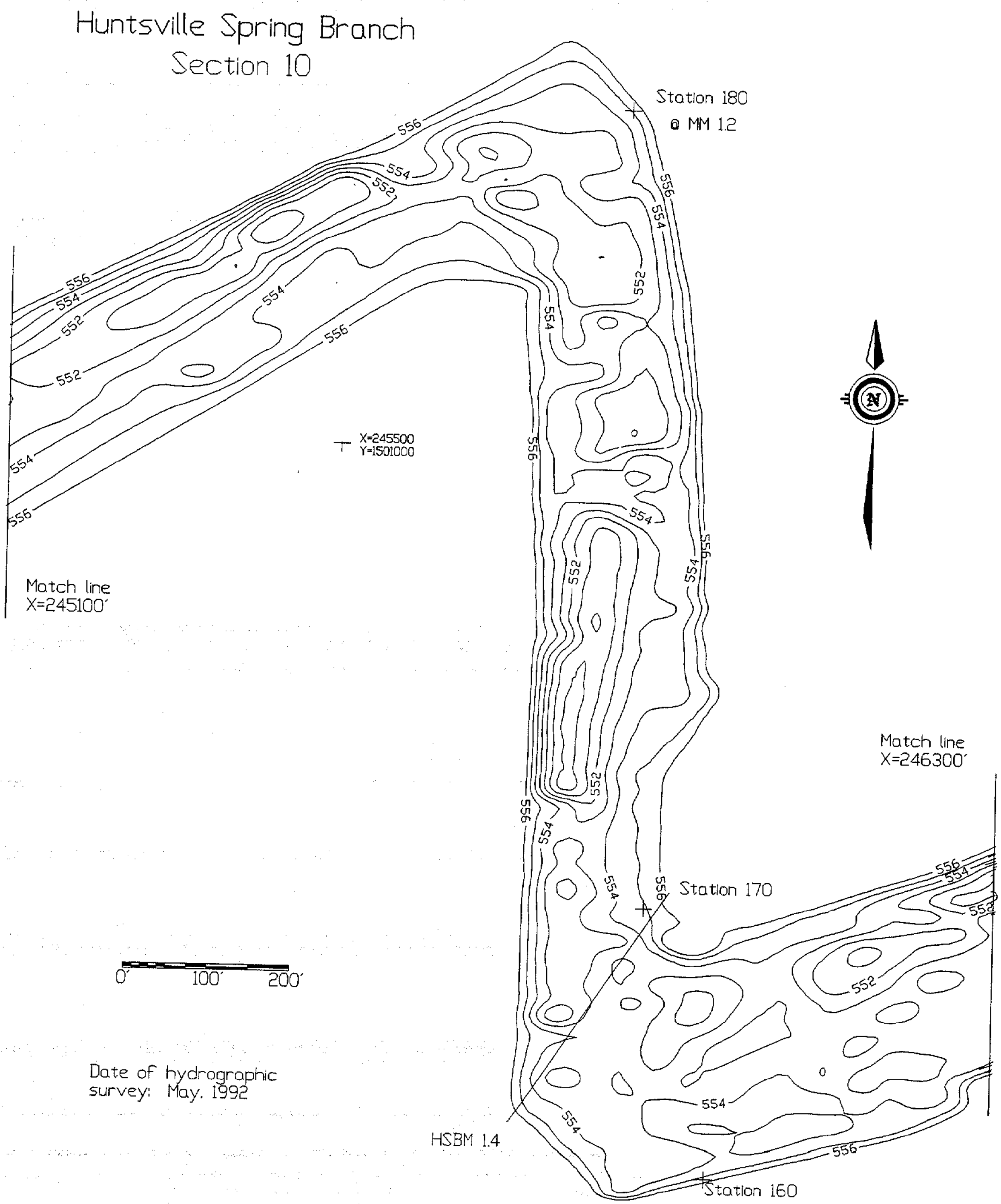

Huntsville Spring Branch
Section 6
Monument LRA-1
Match Line X=250000′
X=250000
Y=1499000
552
554
556
HSBM 2.6
Flow
Monument LRA-2
X=250500
Y=1498500
Match Line X=251100′
Sta. 70
0′ 100′ 200′
Date of hydrographic survey: May, 1992


HSBM 2.285
HSBM 2.361
Dodd Road Bridge
TVA gage station
Match Line X=249100´
Match Line X=250000´
Huntsville Spring Branch
Section 7
M.M. 2.4
Sta. 100
Embayment
HSB M 2.46
X=249500
Y=1496500
0´
100´
200´
Date of hydrographic survey: May, 1992
556
554
552

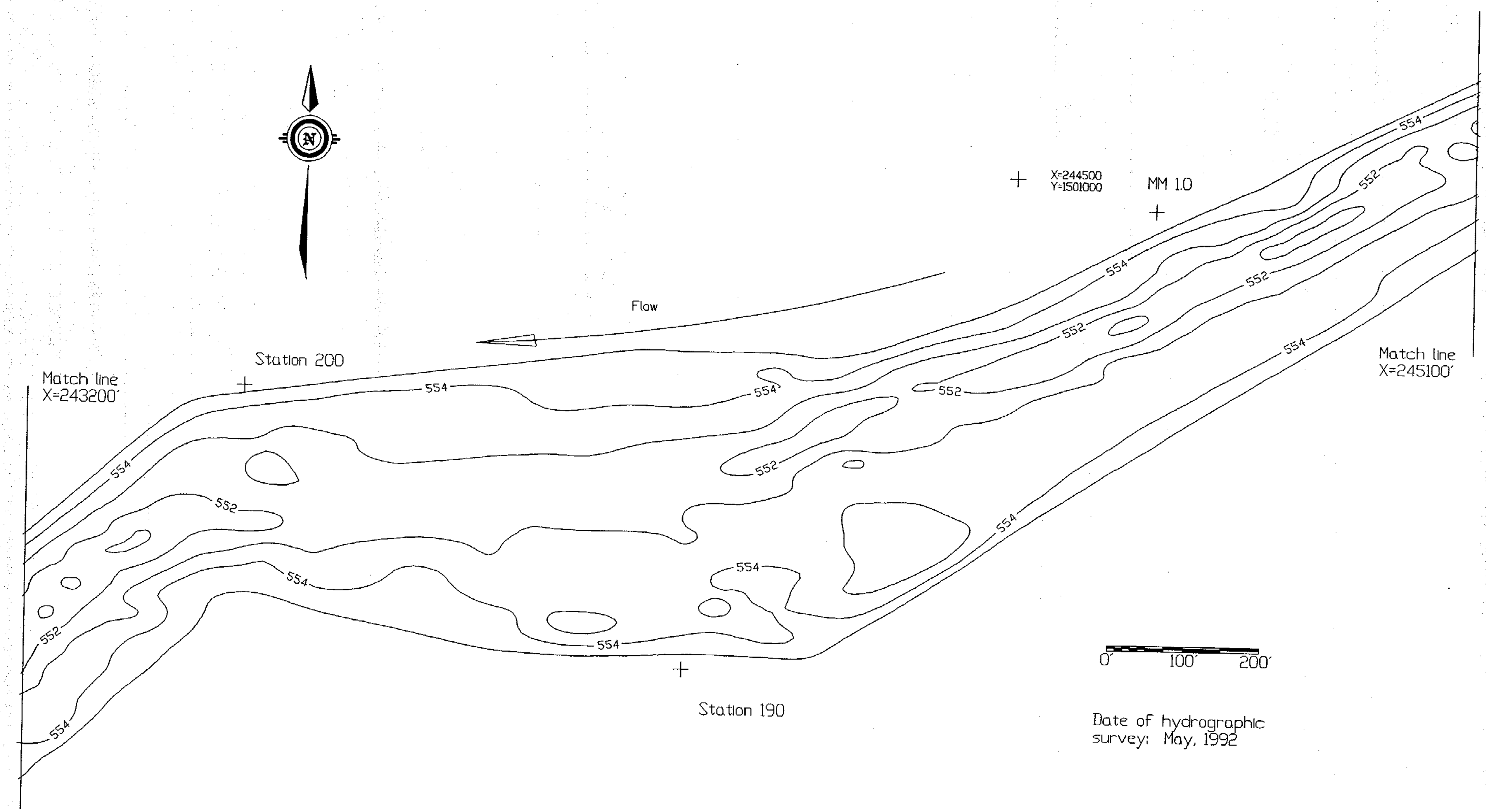

Station 130
556
554
552
554
556
552
0'
100'
200'
HSBM 2.029
554
552
556
554
552
556
Match Line
X=248200'
Flow
X=249000
Y=1500500
554
552
556
554
552
556
Station 120
Match Line
X=249100'
554
552
556
554
556
HSBM 2.2
Huntsville Spring Branch
Section 8
Date of hydrographic
survey: May, 1992



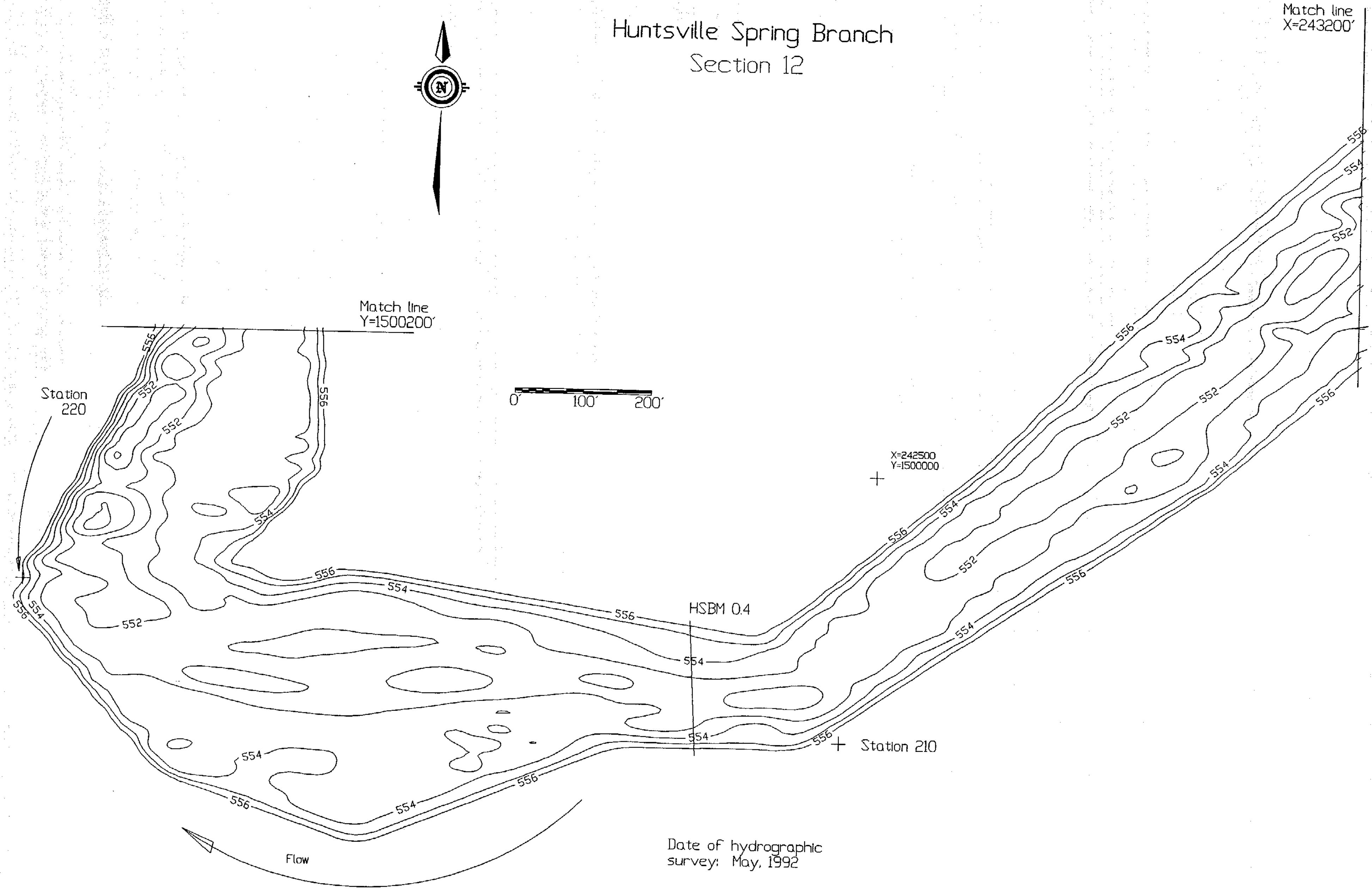
Huntsville Spring Branch
Section 9
X=247000
Y=1501000
X=247500
Y=1501000
Match Line
X=248200´
HSB9
Match line
X=246300´
Station 150
HSBM 1.6
556
554
552
Station
140
Flow
0´
100´
200´
N
Date of hydrographic
survey: May, 1992


Huntsville Spring Branch
Section 10
Station 180
@ MM 1.2
556
554
552
X=245500
Y=1501000
Match line
X=245100'
Match line
X=246300'
Station 170
0' 100' 200'
Date of hydrographic
survey: May, 1992
HSBM 1.4
Station 160

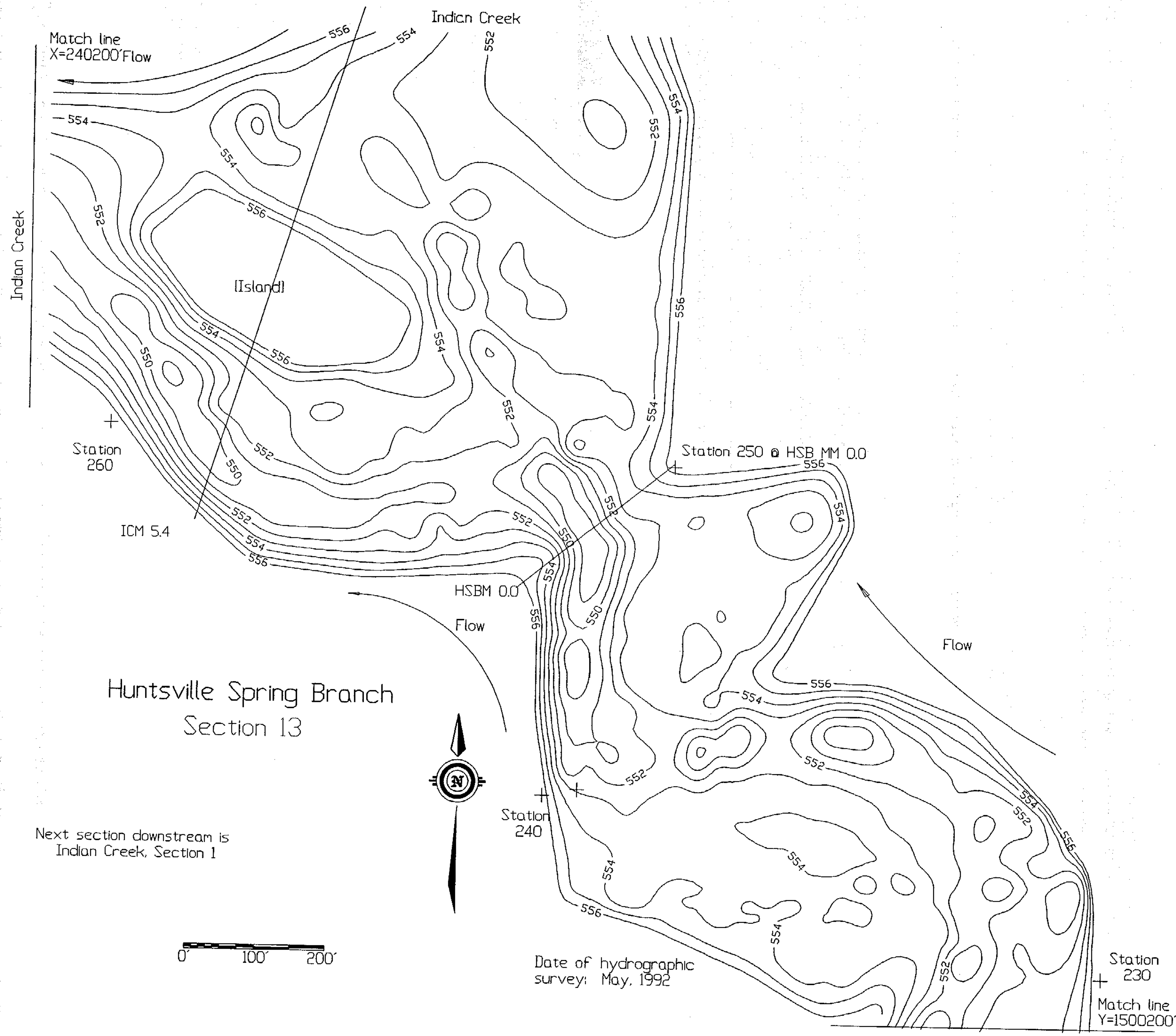
Huntsville Spring Branch
Section 11



Huntsville Spring Branch
Section 12

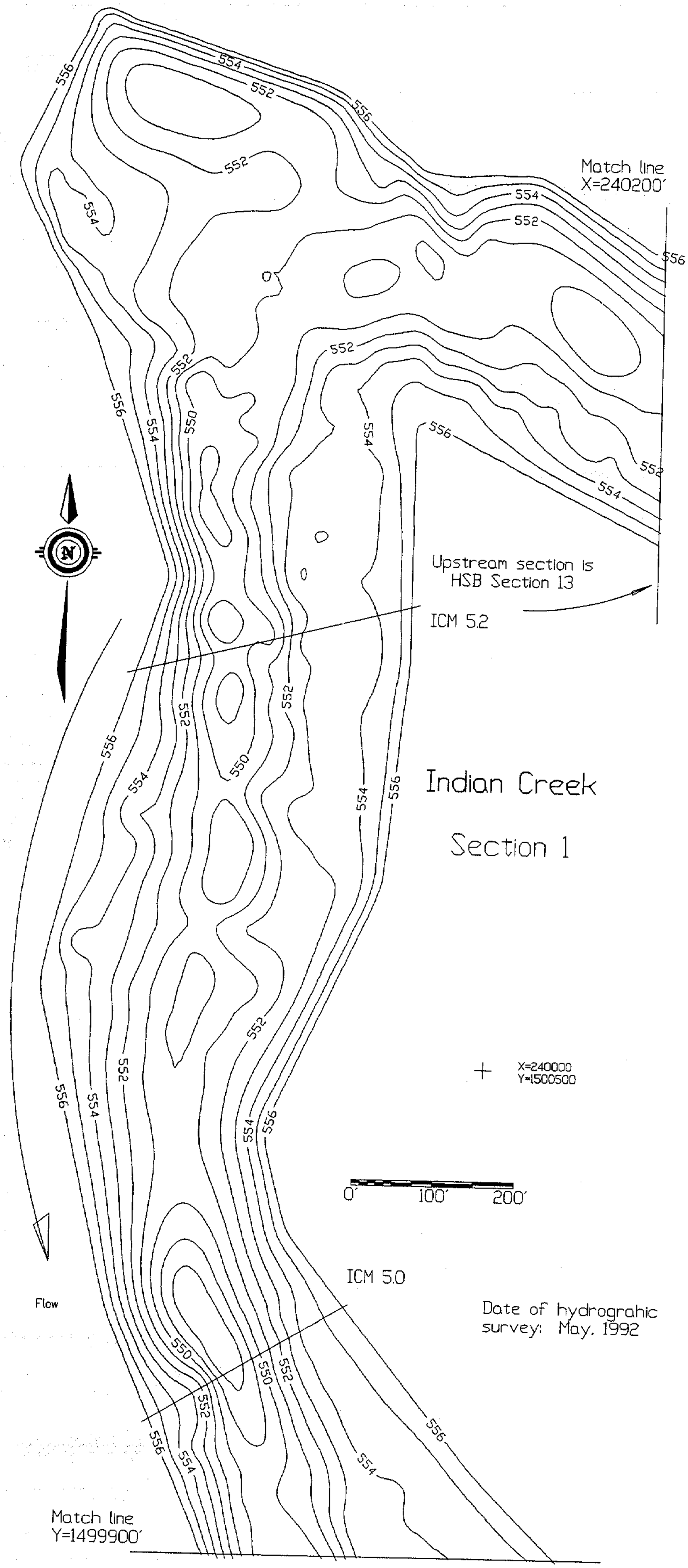


Date of hydrographic
survey: May, 1992

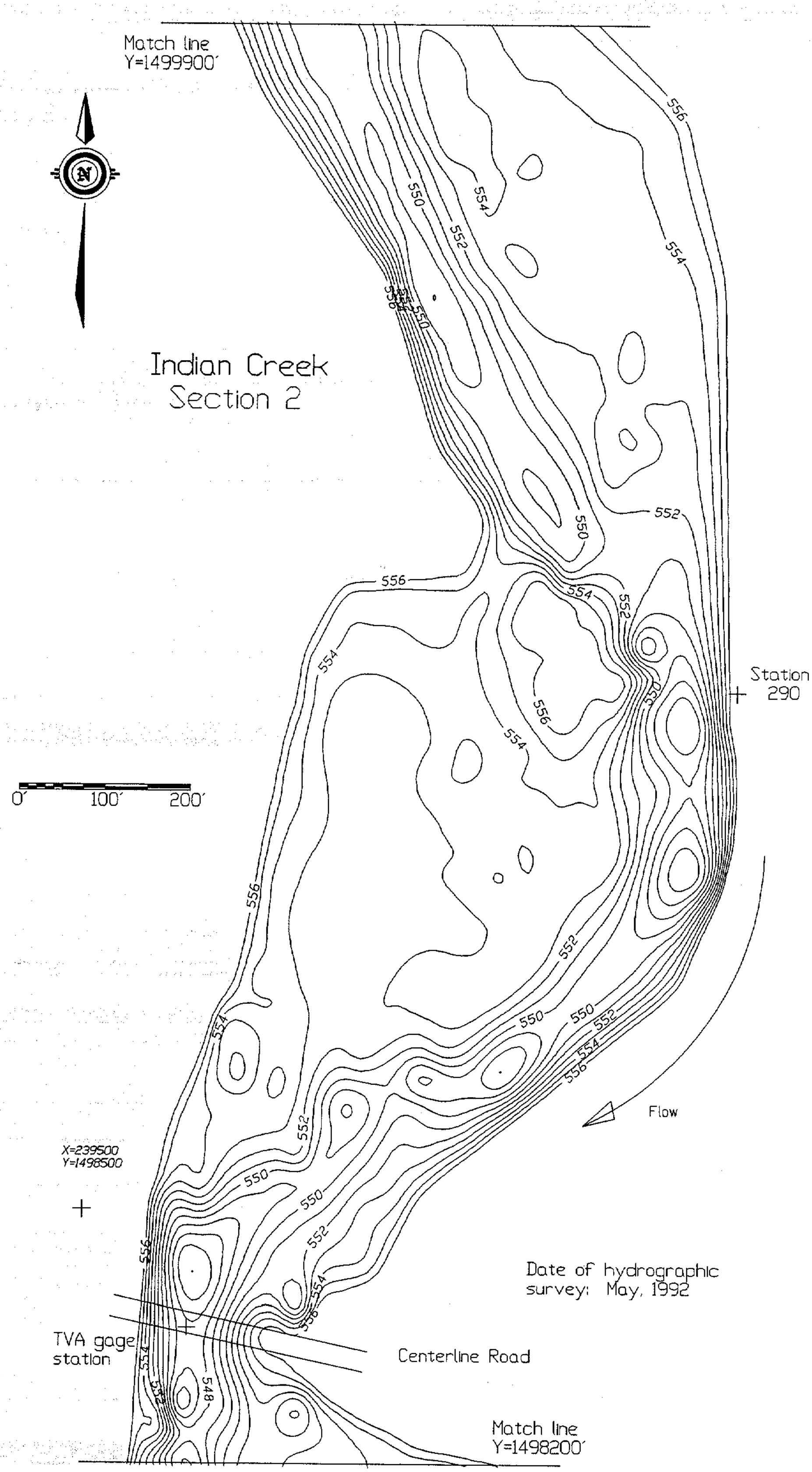


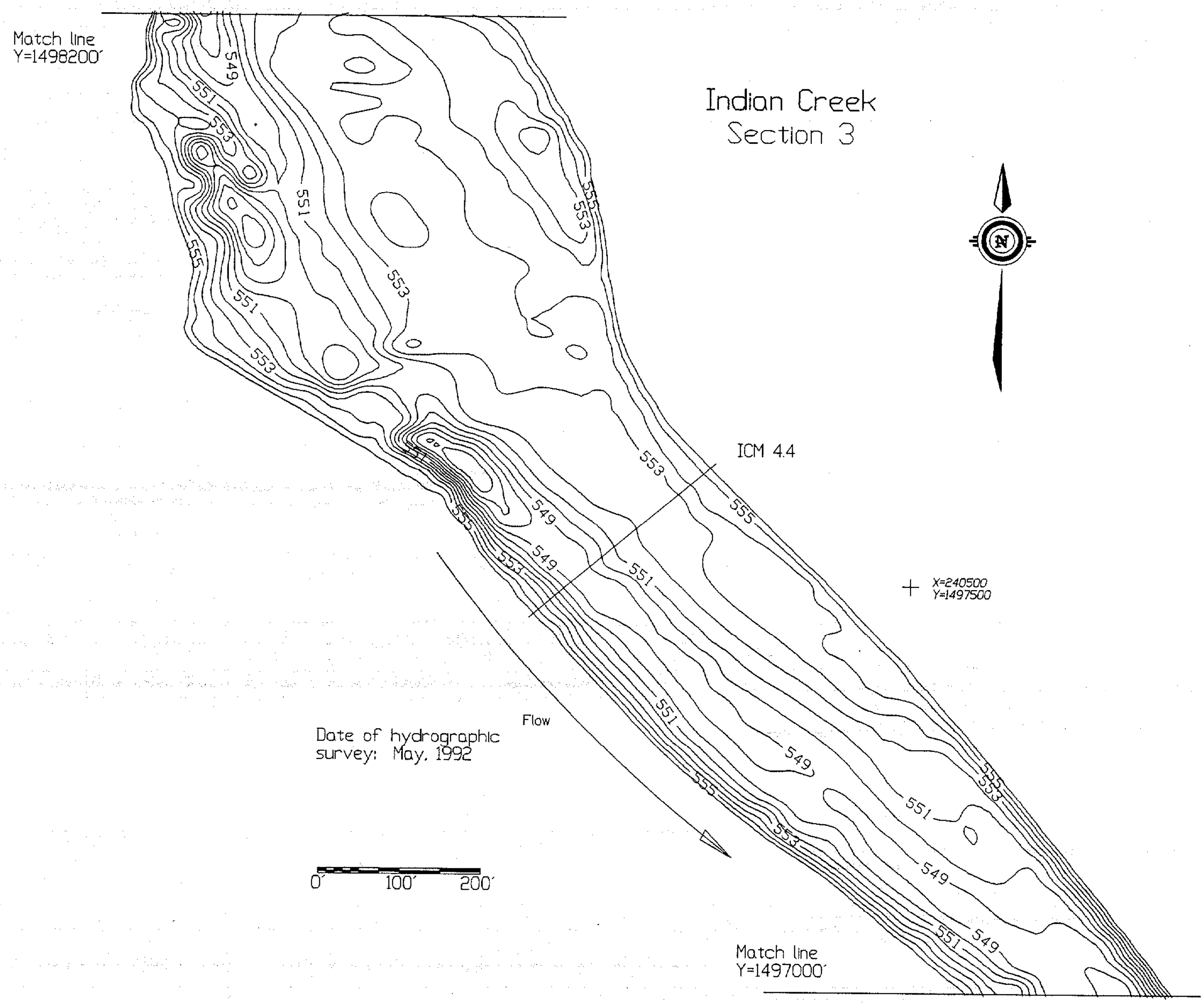
Huntsville Spring Branch
Section 13

Next section downstream is Indian Creek, Section 1

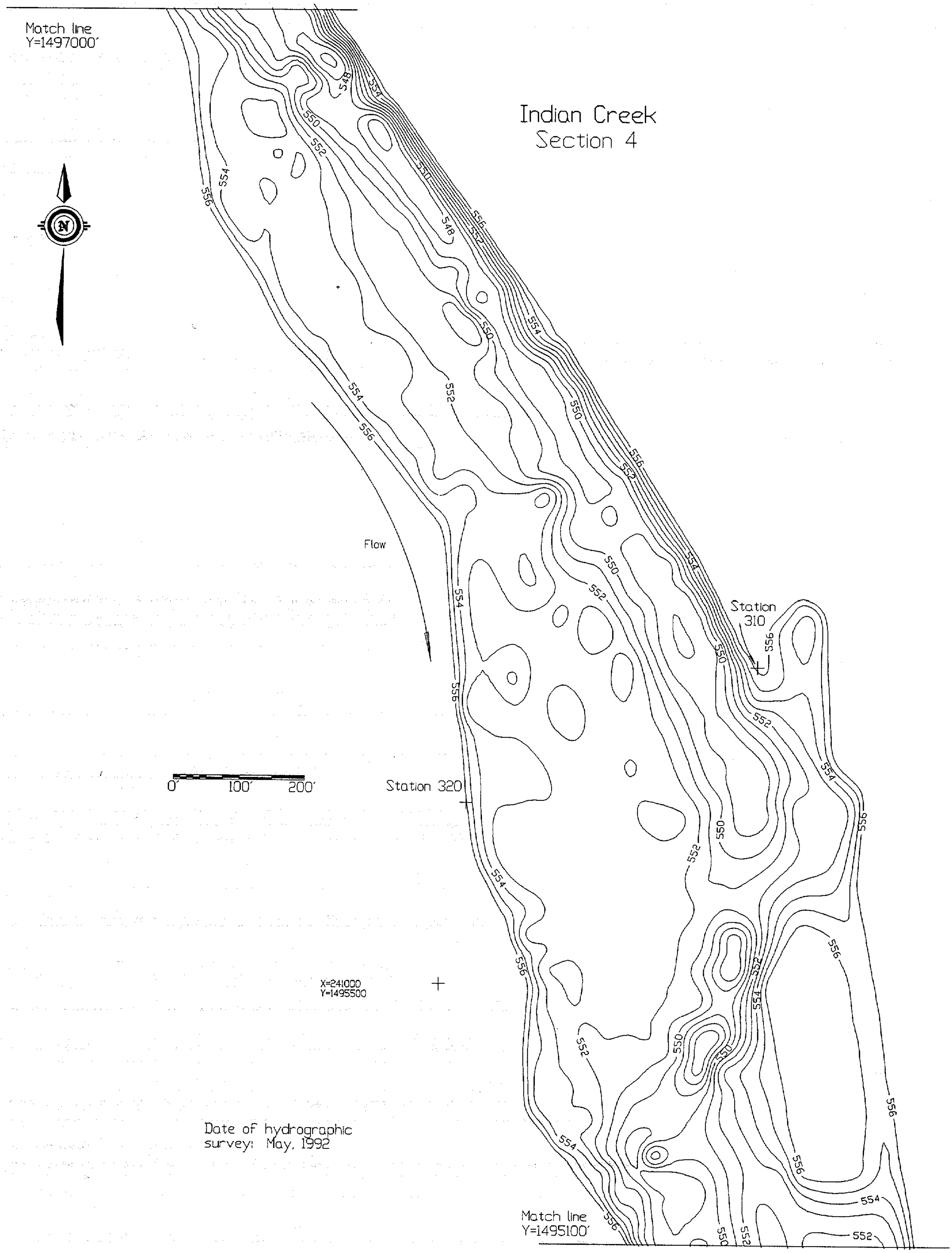


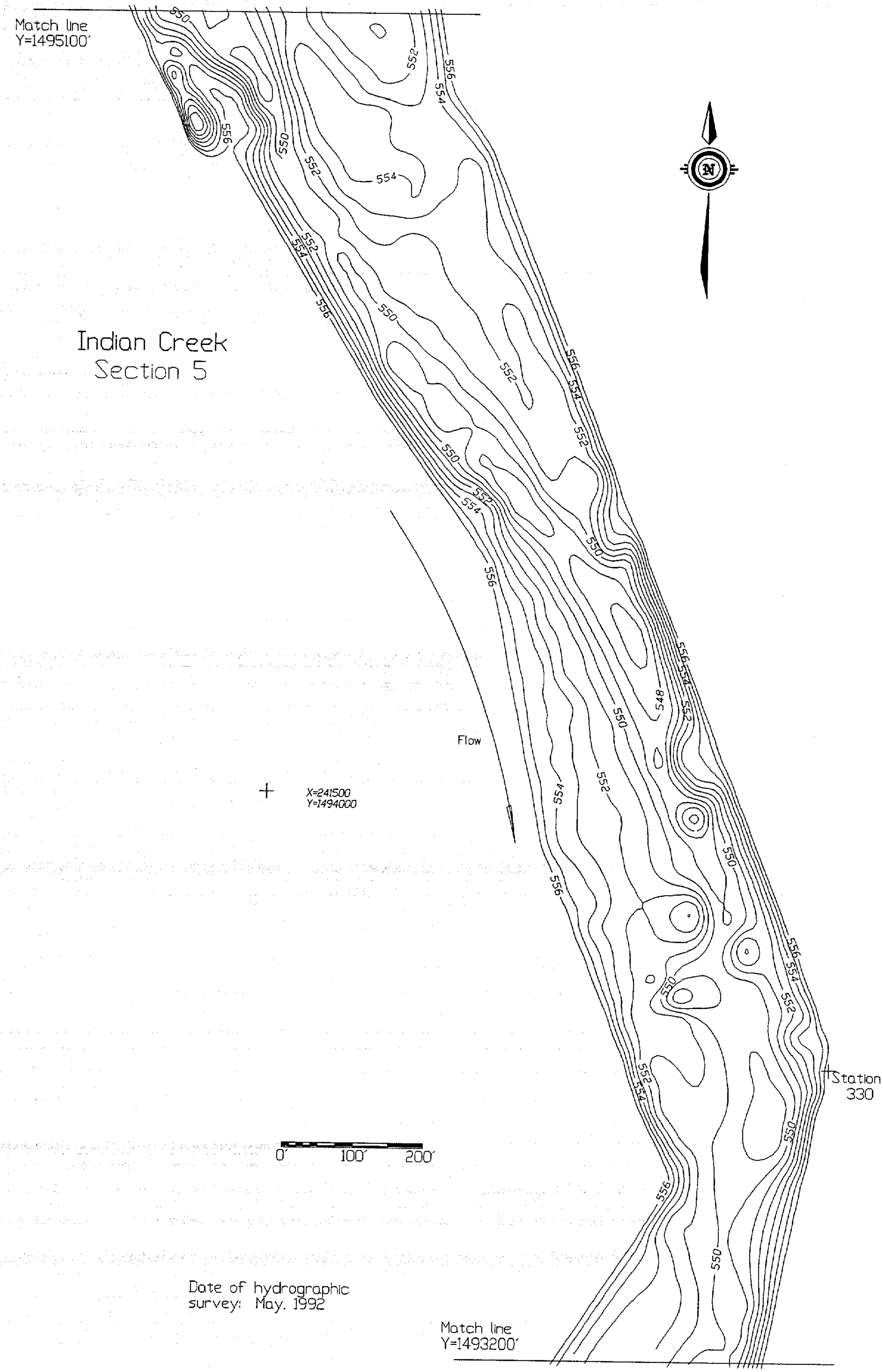
Match line
X=240200'
Upstream section is
HSB Section 13
ICM 5.2
Indian Creek
Section 1
X=240000
Y=1500500
0' 100' 200'
ICM 5.0
Flow
Date of hydrograhic
survey: May, 1992
Match line
Y=1499900'


Match line
Y=1499900'
N
Indian Creek
Section 2
0' 100' 200'
Station
290
Flow
X=239500
Y=1498500
TVA gage
station
Centerline Road
Date of hydrographic
survey: May, 1992
Match line
Y=1498200'

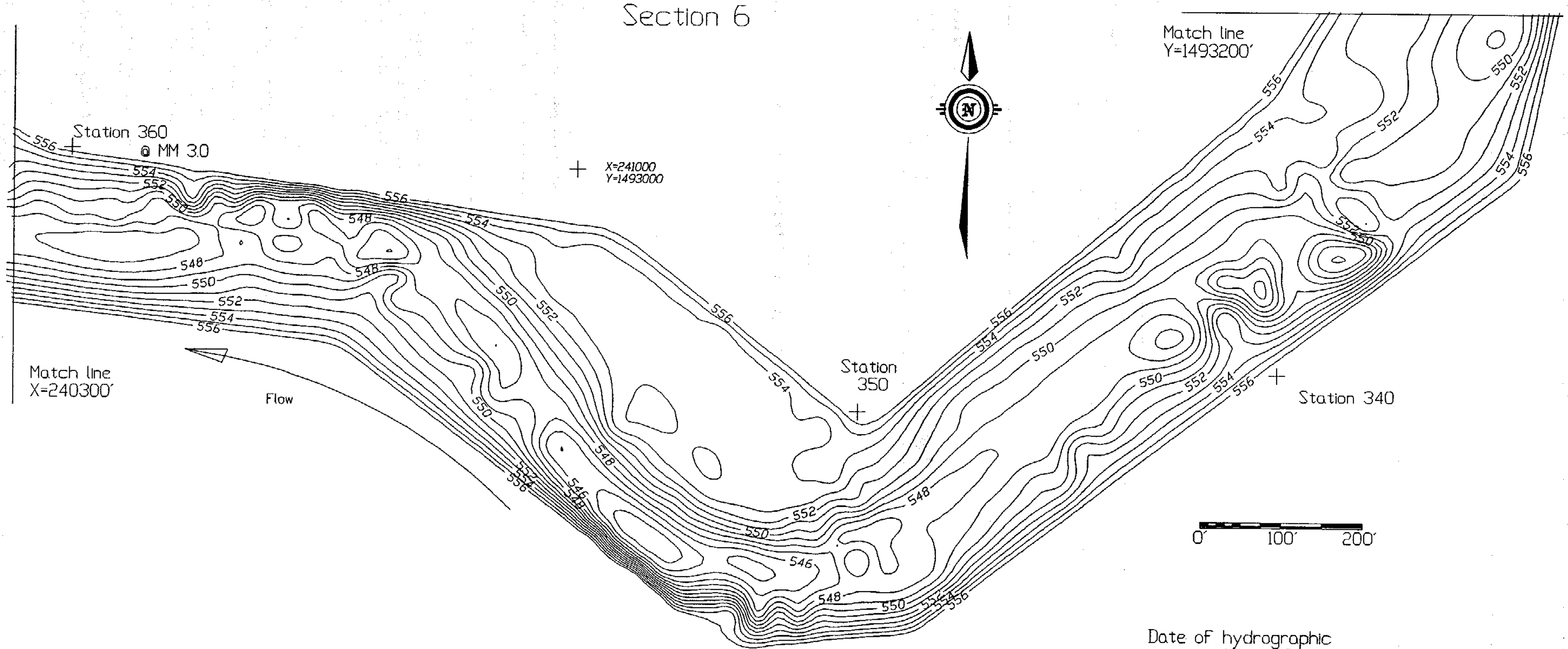

Match line
Y=1498200′
Indian Creek
Section 3
ICM 4.4
X=240500
Y=1497500
Flow
Date of hydrographic
survey: May, 1992
0′ 100′ 200′
Match line
Y=1497000′

Indian Creek
Section 4

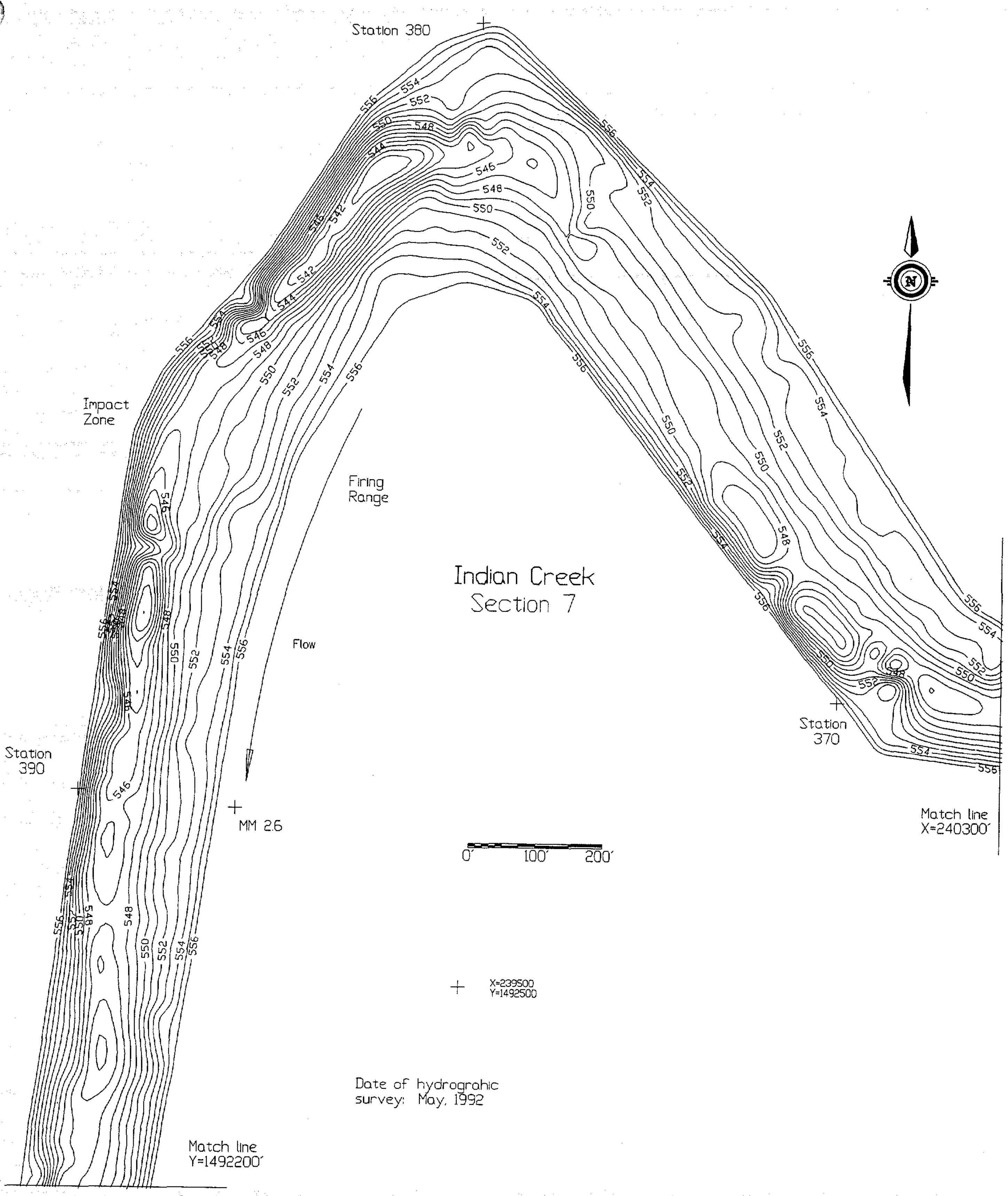


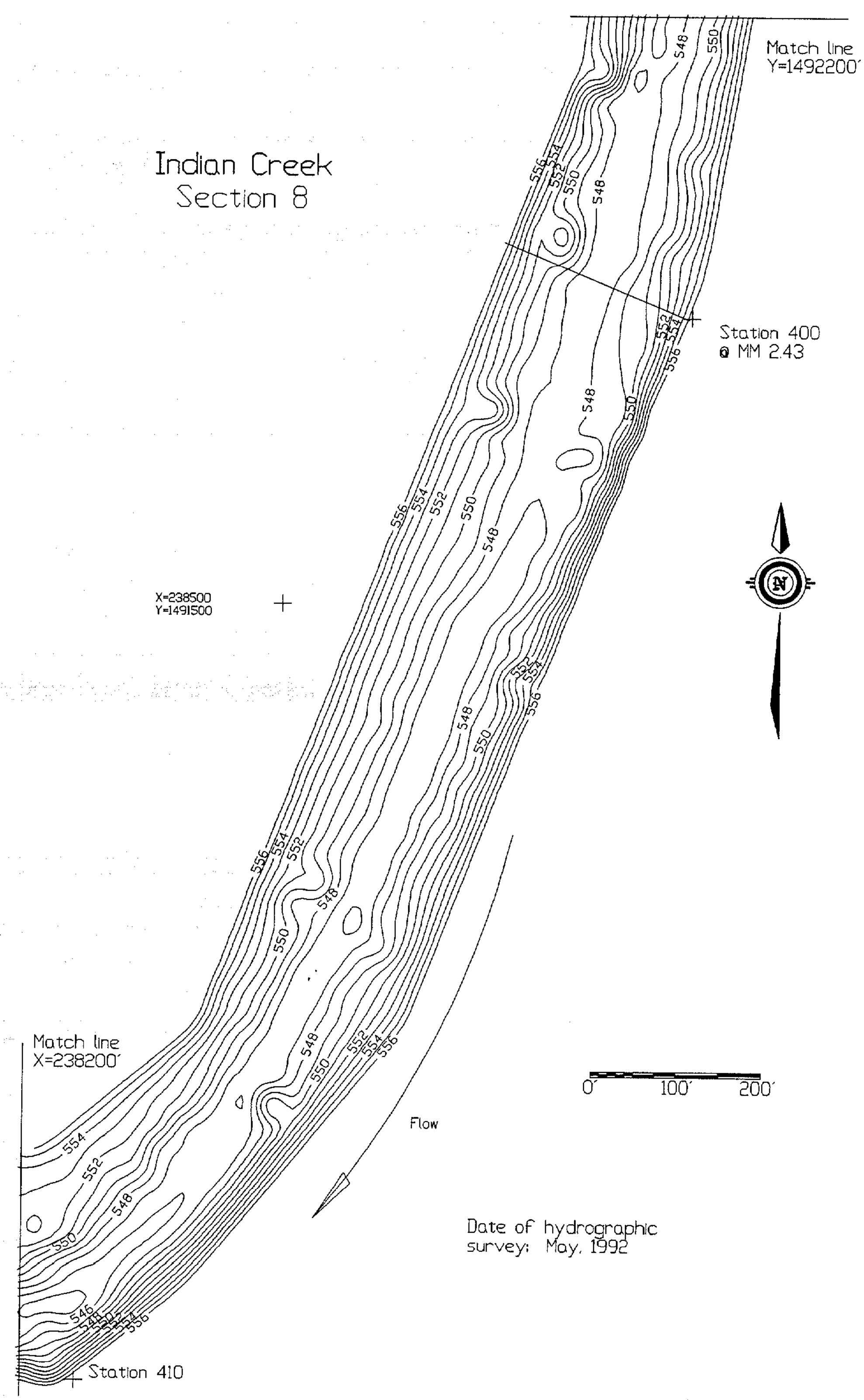

Match line
Y=1495100′
Indian Creek
Section 5
Flow
X=241500
Y=1494000
Station
330
0′
100′
200′
Date of hydrographic
survey: May, 1992
Match line
Y=1493200′
550
552
554
556
548

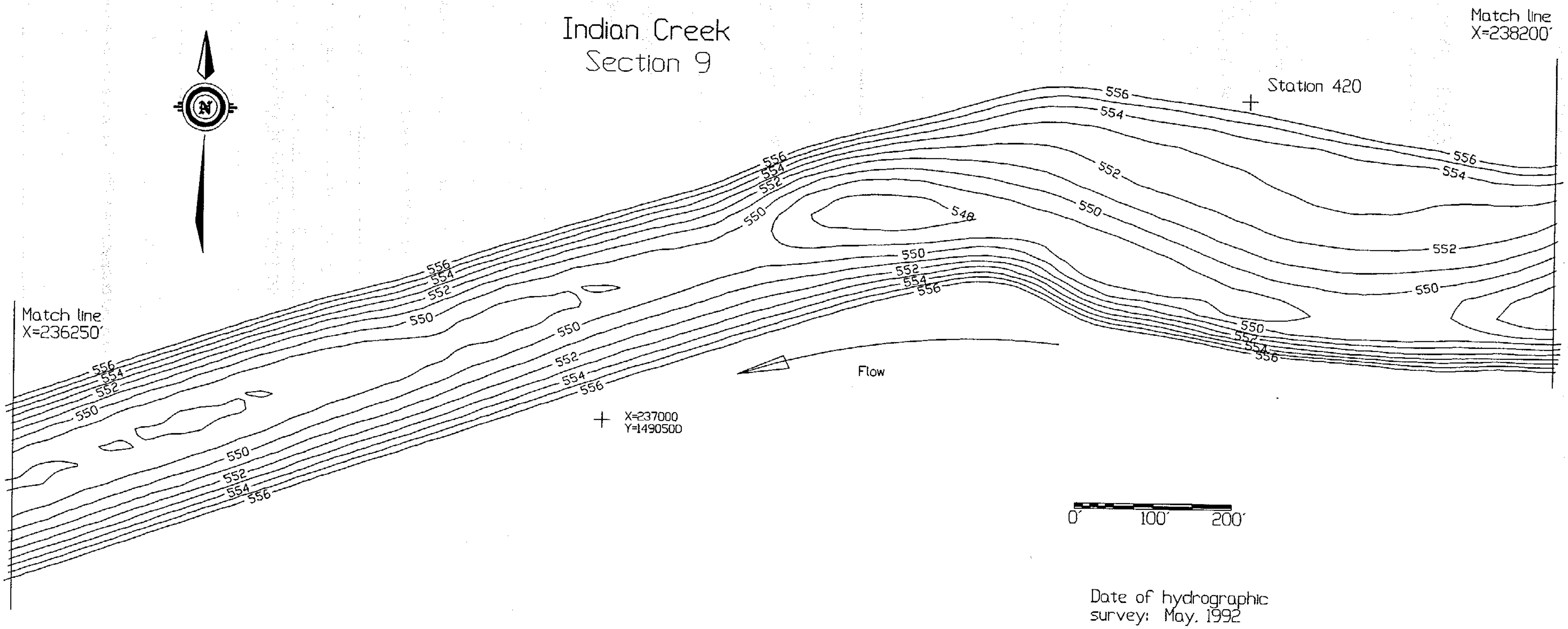
Indian Creek
Section 6



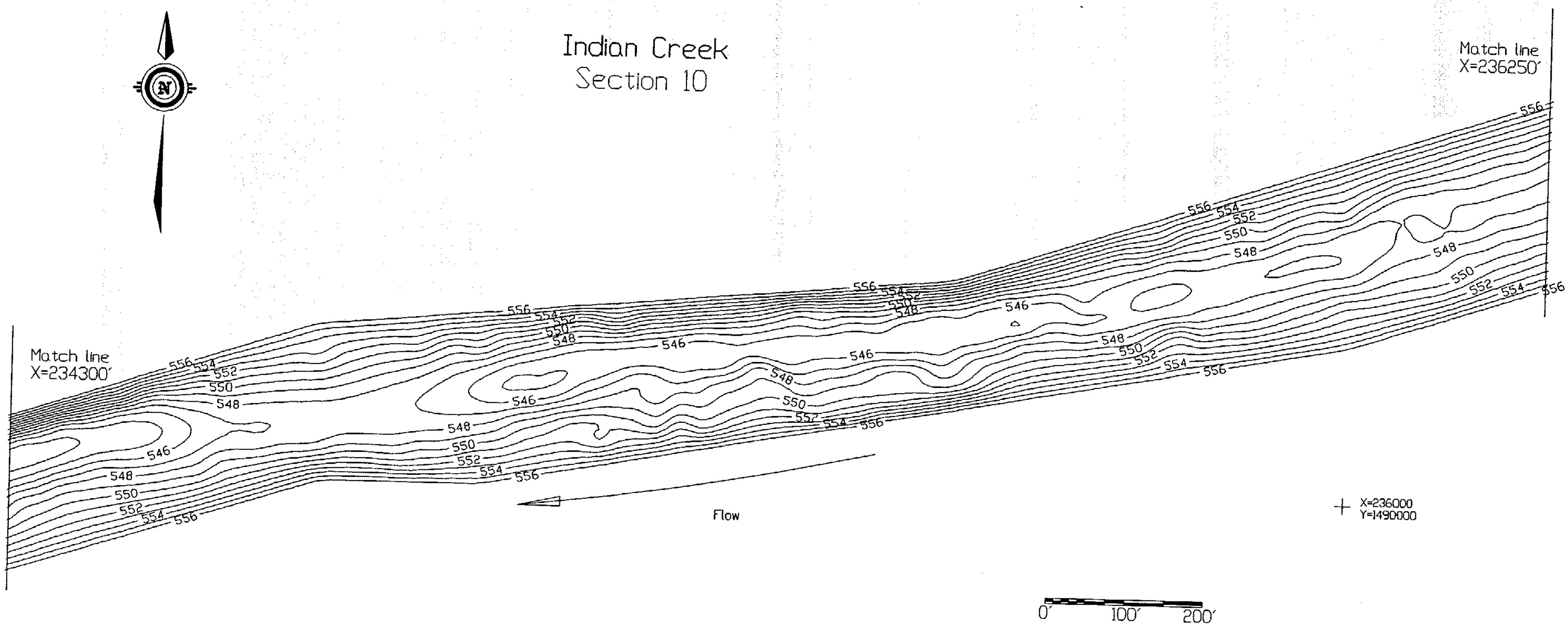
Date of hydrographic
survey: May, 1992


Station 380
Impact Zone
Firing Range
Indian Creek
Section 7
Flow
Station 390
MM 2.6
Station 370
Match line X=240300′
0′ 100′ 200′
X=239500
Y=1492500
Date of hydrograhic survey: May, 1992
Match line Y=1492200′


Indian Creek
Section 8
Match line
Y=1492200'
Station 400
@ MM 2.43
X=238500
Y=1491500
Match line
X=238200'
Station 410
Flow
0' 100' 200'
Date of hydrographic
survey: May, 1992
546
548
550
552
554
556

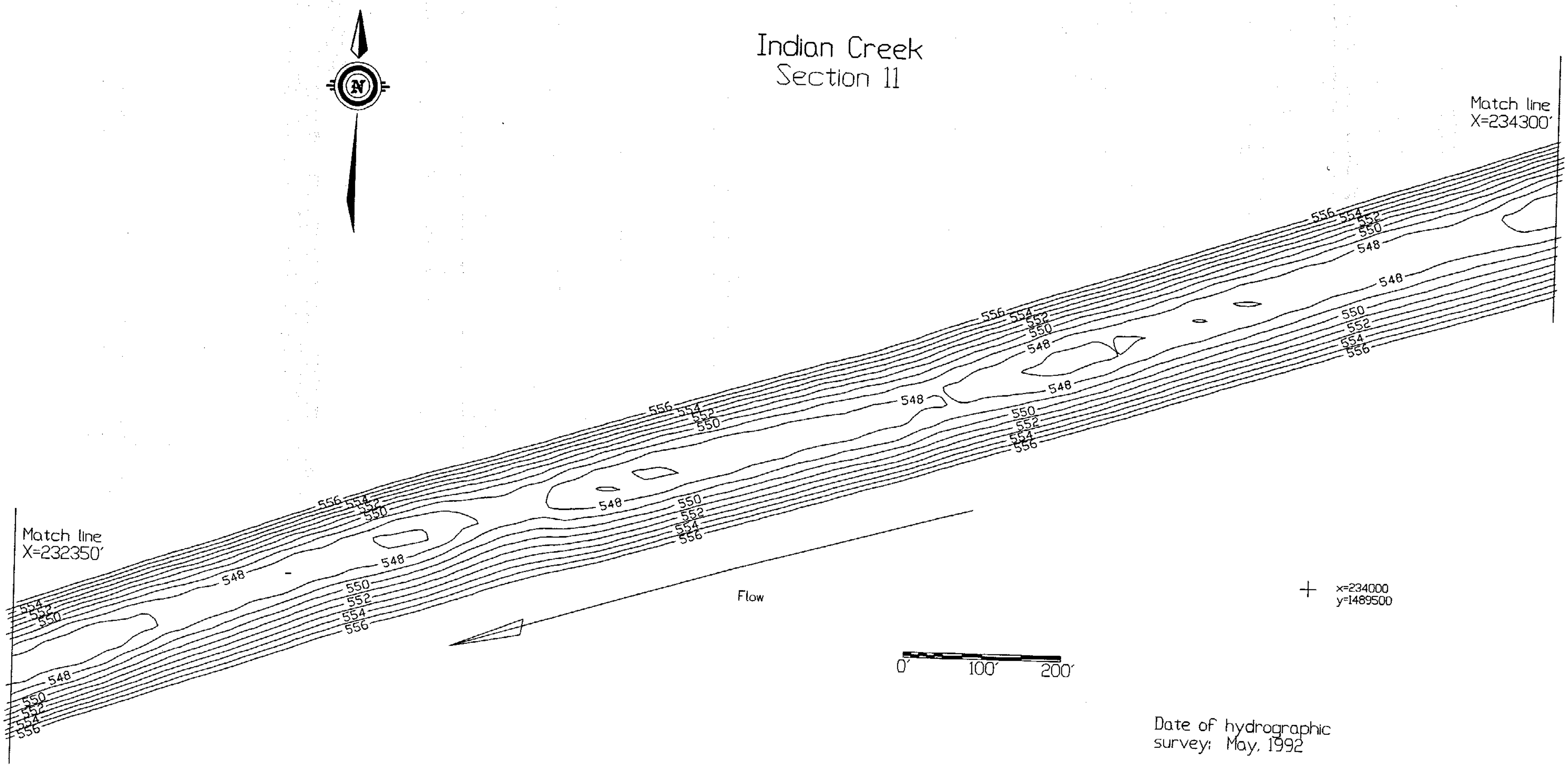

Indian Creek
Section 9
Match line
X=236250'
Match line
X=238200'
Station 420
X=237000
Y=1490500
Flow
556
554
552
550
548
0'
100'
200'
Date of hydrographic
survey: May, 1992

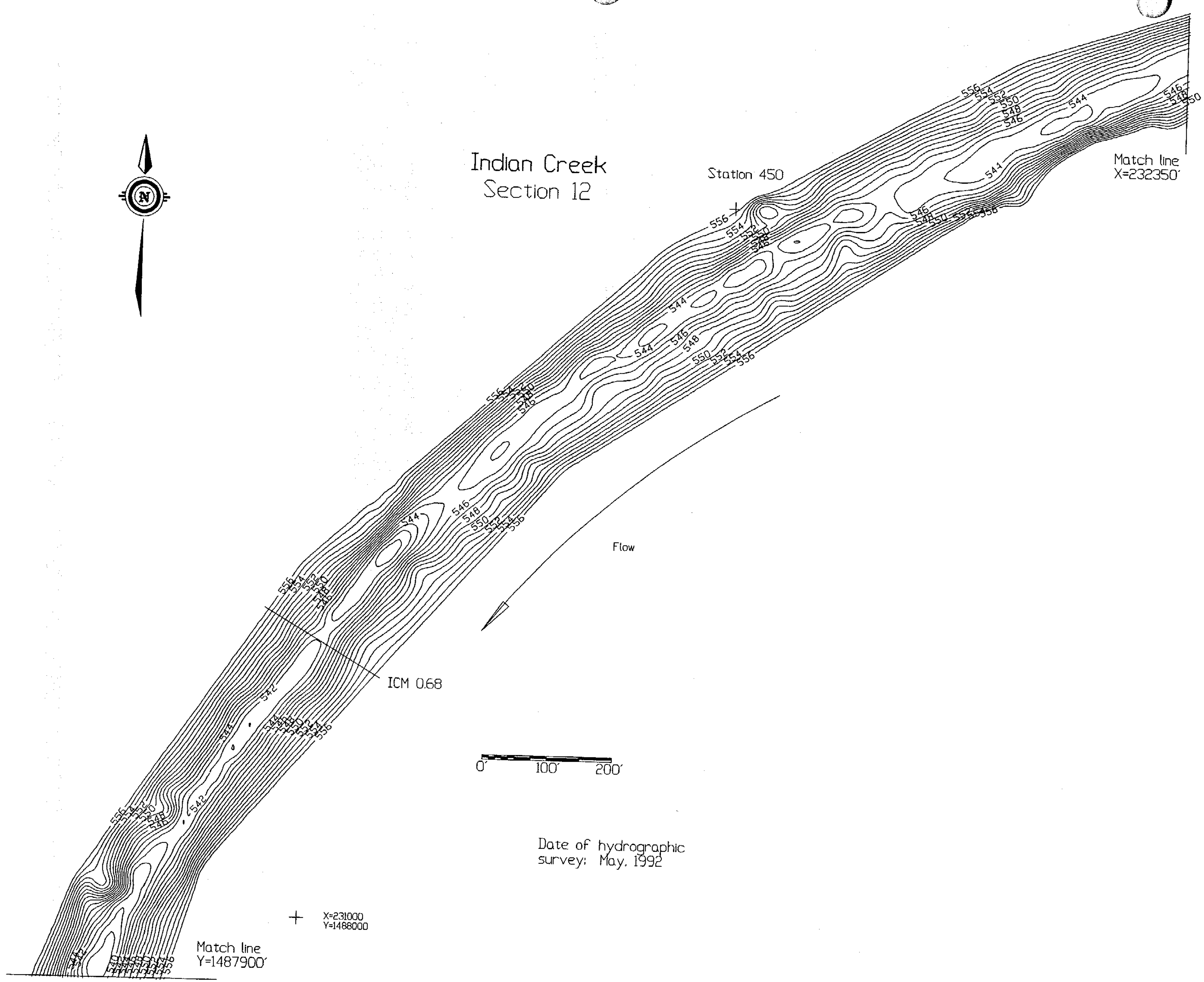
Indian Creek
Section 10



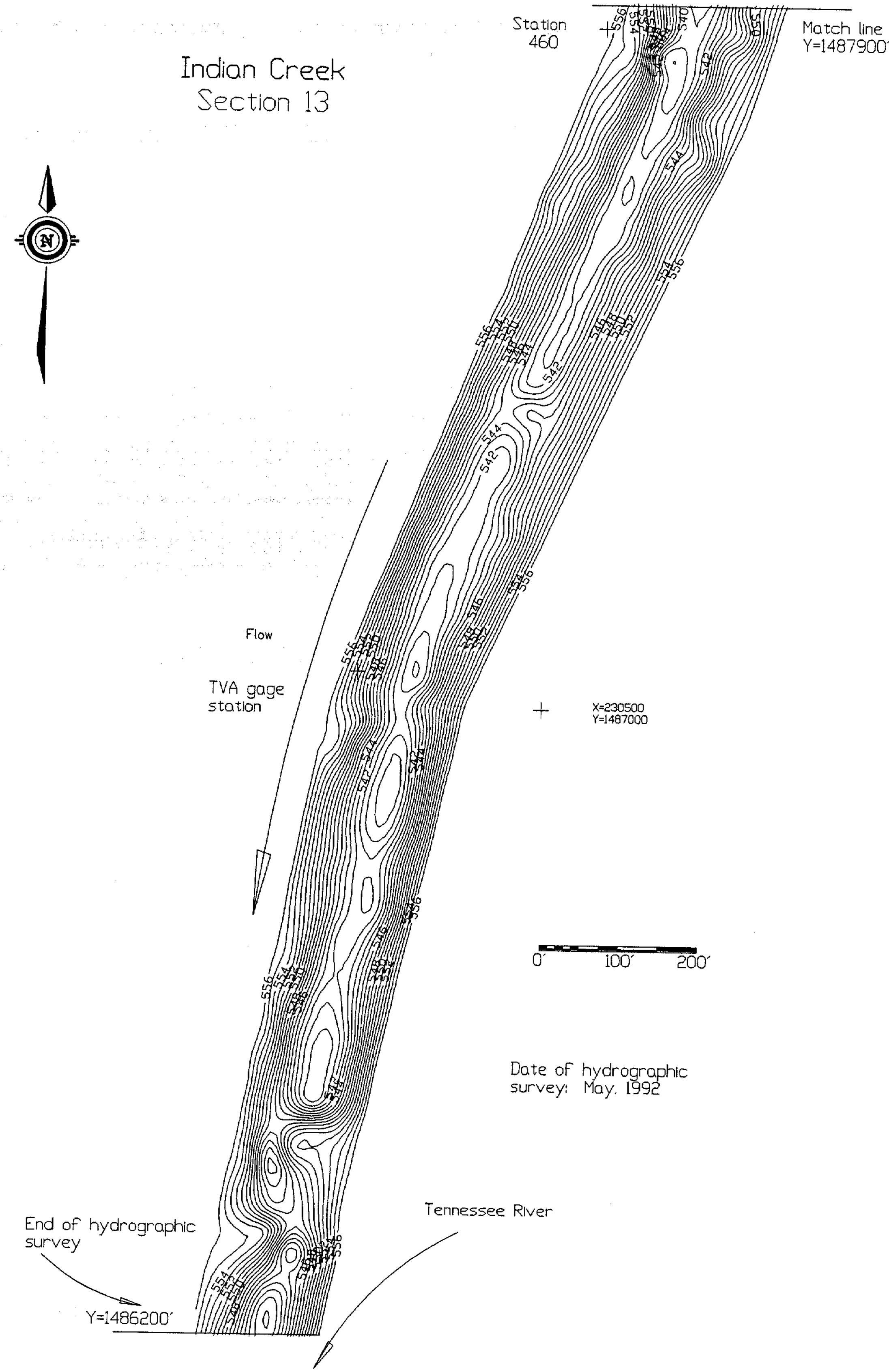
Date of hydrographic survey: May, 1992

Indian Creek
Section 11




Indian Creek
Section 12
Station 450
Match line
X=232350'
Flow
ICM 0.68
0' 100' 200'
Date of hydrographic survey: May, 1992
X=231000
Y=1488000
Match line
Y=1487900'

Indian Creek
Section 13



Appendix C
Integrated Hydrographic/U.S. Army Corps of Engineers Maps

Key

Figure No.	Approximate River Mile
1	HSB 5.4 - HSB 4.2
2	HSB 4.2 - HSB 2.18
3	HSB 2.18 - HSB 0.8
4	HSB 0.8 - IC 4.5
5	IC 5.4 - IC 3.7
6	IC 3.7 - IC 1.9
7	IC 1.9 - IC 0.77
8	IC 0.77 - IC 0.0

These maps are not to be used for navigation.