U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

LEVEL II BRIDGE SCOUR ANALYSIS FOR STRUCTURE 124022300100 ON ROUTE SC 223, CROSSING FISHING CREEK IN CHESTER COUNTY, SOUTH CAROLINA

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Prepared in cooperation with the
SOUTH CAROLINA DEPARTMENT
OF TRANSPORTATION

Columbia, South Carolina

1994

UNIT ABBREVIATIONS

cubic foot per second	ft^3/s
feet per second	ft/s
foot	ft
mile	mi
millimeter	mm
square foot	ft^2
square mile	mi^2

OTHER ABBREVIATIONS

downstream	D/S
upstream	U/S
flood plain	f/p
median diameter of bed material	D_{50}
Water -Surface Profile computation model	WSPRO
South Carolina Department of Transportation	SCDOT

In this report, the words "right" and "left" refer to directions that would be reported by an observer facing downstream.

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929-- a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Pile penetration depths were obtained from SCDOT bridge plans. Scour depth calculations indicate that pile tip exposure will occur at bent 3 during the 100-year discharge and at bents 3, 4, 7, 9, and 10 during the 500-year discharge. Scour caused by the 100- and 500-year discharges will undermine bent 3 by 4.6 and 14.4 ft, respectively. Scour caused by the 500-year discharge will undermine bents 4, 7, 9, and 10 by 8.8, 2.2, 0.4, and 0.8 ft, respectively.

It should be noted that the SCDOT bridge plan borings (docket number 12.250) show subsurface rock that could affect the scour depths shown in this study. For more information, see the SCDOT bridge plans in the pocket at the back of the report.

Table 2. *--Remaining pile/footing penetration at piers/bents for the 500-year discharge at structure 124022300100 on Route SC 223, crossing Fishing Creek in Chester County, South Carolina*

Pier/bent [1] number	Station from[2] left end of bridge (feet)	Pile tip/ [3] footing elevation, SCDOT datum (feet)	Pile tip/ footing elevation, USGS datum (feet)	Ground elevation at pier/bent, USGS datum (feet)	Total [4] scour depth (feet)	Elevation of scour, USGS datum (feet)	Remaining[5] pile/footing penetration (feet)
500-year discharge is 34,200 cubic feet per second							
11	25	389.9	50.9	86.0	2.5	83.5	32.6
10	50	388.6	49.6	75.2	26.4	48.8	-0.8
9	75	388.4	49.4	75.4	26.4	49.0	-0.4
8	100	388.3	49.3	75.9	26.4	49.5	0.2
7	125	386.5	47.5	76.0	30.7	45.3	-2.2
6	190	385.8	46.8	66.7	11.0	55.7	8.9
5	270	386.5	47.5	59.3	10.2	49.1	1.6
4	335	395.6	56.6	77.2	29.4	47.8	-8.8
3	360	409.4	70.4	80.0	24.0	56.0	-14.4
2	385	422.2	83.2	92.8	0	92.8	9.6

[1] Pier/bent number corresponds to South Carolina Department of Transportation (SCDOT) bridge plans.

[2] Stations are determined from left to right looking downstream.

[3] Pile tip/footing elevations obtained from SCDOT bridge plans. The maximum elevation at each pier/bent is used.

[4] Total scour depth is the sum of the contraction and pier/bent scour depths.

[5] A negative number signifies undermining of pile tip/footing.

NOTE: The SCDOT bridge plan borings (docket number 12.250) show subsurface rock that could reduce the scour depths shown in the above table. For more information, see the SCDOT plans in report pocket.

Table 4. --*Cumulative scour depths at piers/bents for the 500-year discharge at structure 124022300100 on Route SC 223, crossing Fishing Creek in Chester County, South Carolina*

Pier/bent [1] number	Station from [2] left end of bridge (feet)	Contraction scour depth (feet)	Pier/bent scour depth **without** debris (feet)	Total [3] scour depth **without** debris (feet)
500-year discharge is 34,200 cubic feet per second				
11	25	0.0	2.5	2.5
10	50	23.6	2.8	26.4
9	75	23.6	2.8	26.4
8	100	23.6	2.8	26.4
7	125	23.6	7.1	30.7
6	190	0.0 [4]	11.0	11.0
5	270	0.0 [4]	10.2	10.2
4	335	21.3	8.1	29.4
3	360	21.3	2.7	24.0
2	385	0.0	0.0	0.0

[1] Pier/bent number corresponds to South Carolina Department of Transportation (SCDOT) bridge plans.

[2] Stations are determined from left to right looking downstream.

[3] Total scour depth is the sum of the contraction and pier/bent scour depths.

[4] The calculated contraction scour is a negative value, but was set equal to zero to reflect a more reasonable estimate of scour during peak flood conditions.

NOTE: The SCDOT bridge plan borings (docket number 12.250) show subsurface rock that could reduce the scour depths shown in the above table. For more information, see the SCDOT plans in report pocket.

NOTE: The pier and contraction scour equations used in this scour analysis were those recommended in Hydraulic Engineering Circular 18 (Richardson and others, 1993). Scour depths were calculated assuming an infinite depth of erosive material and a homogeneous particle-size distribution.

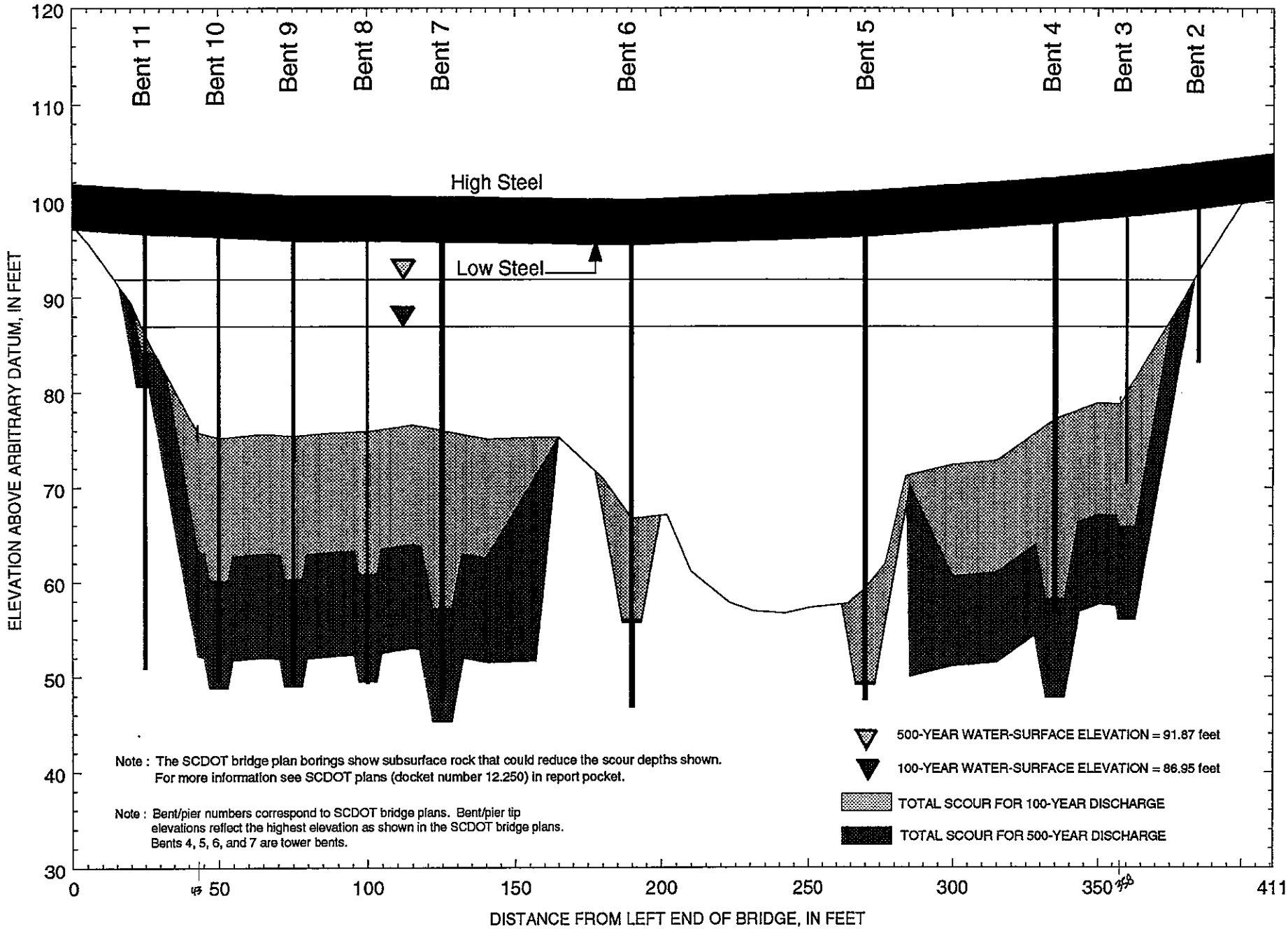

Figure 2.--Total scour depths for the 100-year and 500-year discharges at the U/S face of structure 124022300100 on Route SC 223, crossing Fishing Creek in Chester County, South Carolina.

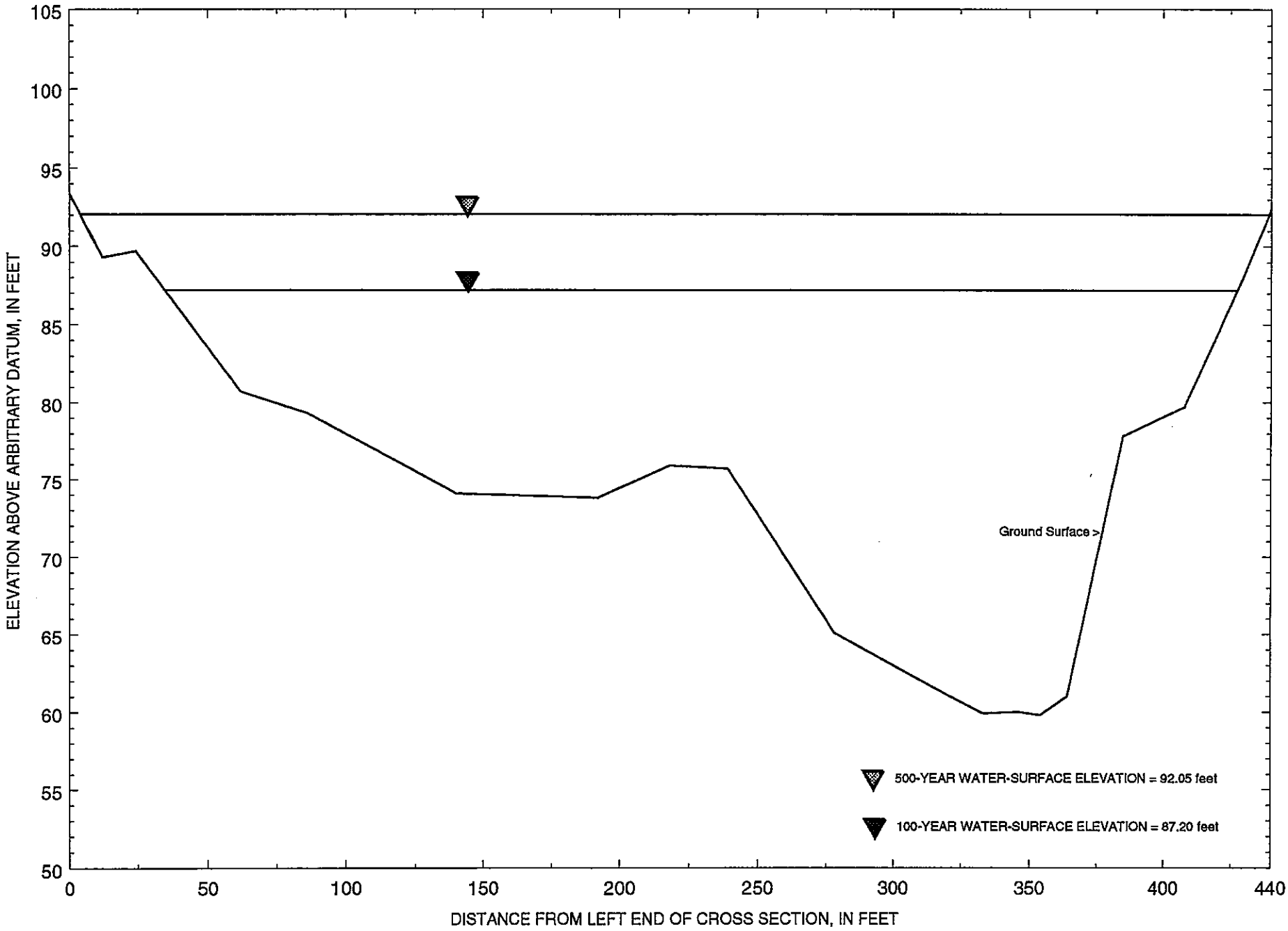

Figure 3.--Approach cross section of structure 124022300100 on Route SC 223, crossing Fishing Creek in Chester County, South Carolina.

Figure 4.--Structure 124022300100 on Route SC 223, crossing Fishing Creek in Chester County, South Carolina as viewed from the upstream right bank (July 19, 1990).

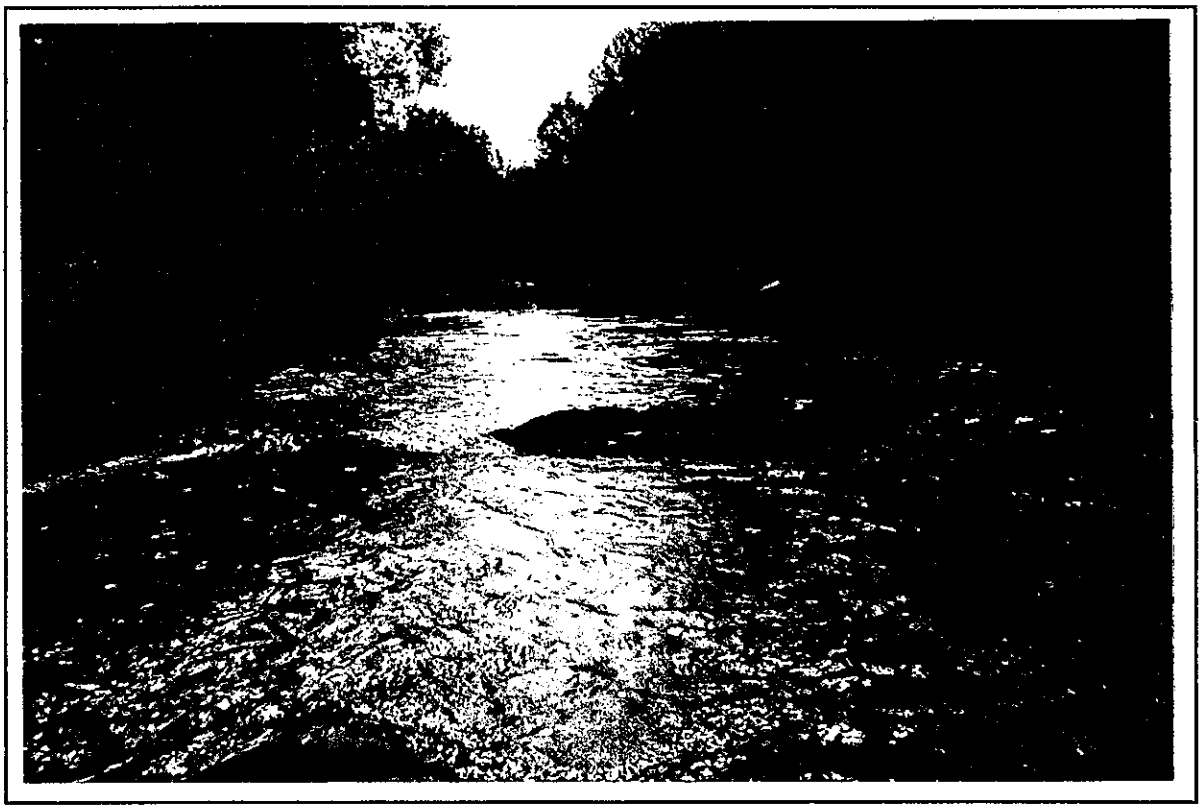

Figure 5.--Downstream channel as viewed from the channel D/S of structure 124022300100 on Route SC 223, crossing Fishing Creek in Chester County, South Carolina (May 18, 1993).

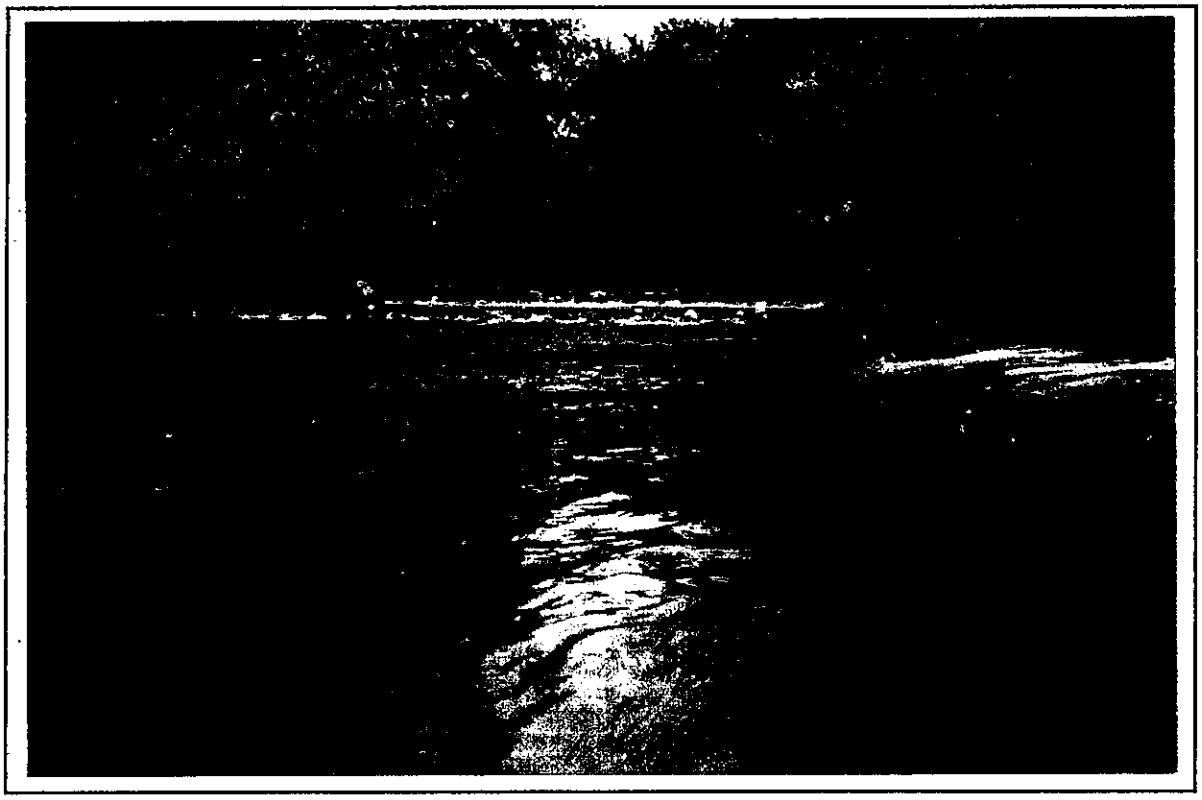

Figure 6.--Upstream channel as viewed from structure 124022300100 on Route SC 223, crossing Fishing Creek in Chester County, South Carolina (May 18, 1993).

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Description of Flood Plain

General topography Gently rolling Piedmont topography with a right flood plain that rises quickly.

Flood-plain conditions at bridge site: downstream (D/S), upstream (U/S)

Date of inspection 5-18-1993

D/S left: Moderate hardwoods with sparse undergrowth

D/S right: Clear-cut area with tall grass, then moderate hardwoods at right edge

U/S left: Light to moderate hardwoods with moderate undergrowth

U/S right: Moderate hardwoods with moderate undergrowth

Description of Channel

Average top width 135 *ft* *Average depth* 18.4 *ft*

Predominant bed material sand *Bank material* silty sand

Stream type (straight, meandering, braided, swampy, channelized) meandering

Vegetative cover on channel banks near bridge: Date of inspection 7-19-1990

D/S left: Full coverage of woody and herbaceous vegetation

D/S right: Light coverage of woody and herbaceous vegetation

U/S left: Full coverage of woody and herbaceous vegetation

U/S right: Light coverage of woody and herbaceous vegetation

Do banks appear stable? Yes * *If not, describe location and type of instability and date of observation.* *Normal fluvial bank erosion was observed on the downstream right bank during the Level I inspection of 7-19-1990.

Describe any obstructions in channel and date of observation. A run-of-the-river dam is located across the channel approximately 550 ft upstream of the Route SC 223 crossing. The dam has no effect on the hydrology at that crossing.

Brief Description of the Water-Surface Profile Model (WSPRO) Analysis

Datum for WSPRO analysis (USGS survey, sea level, SCDOT plans) USGS survey

Datum tie between USGS survey and SCDOT plans Add 339.0 ft to the USGS datum to obtain the SCDOT plan's datum (docket number 12.250).

Description of reference marks used to determine USGS datum. R.M. 1 is a chiseled square on the upstream left abutment headwall of the Route SC 223 bridge with an assumed elevation of 100.00 ft. R.M. 2 is a chiseled square on the downstream right abutment headwall of the Route SC 223 bridge with a surveyed elevation of 103.22 ft.

Cross Sections Used in WSPRO Analysis

**Cross section ID*	*Section Reference Distance (SRD) in feet*	***How cross section was developed*	*Comments*
EXIT	-411	2	Exit cross section
FULV	0	2	Full valley template
BRIDG	0	1	U/S bridge face
APPR	440	2	Approach cross section

* For location of cross sections see topographic map included with report (figure 1). For more detail on how cross sections were developed see WSPRO input file.

** Cross section development: 1) survey at SRD 2) shift of survey data to SRD 3) modification of survey data based on topographic map 4) synthesized by combining channel survey data and topographic contours 5) other

Bridge Hydraulics

Average embankment elevation 100.8 *ft*

Average low steel elevation 97.0 *ft*

100-year discharge 23,500 ft^3/s

Water-surface elevation at D/S bridge face 86.95 *ft*

Area of flow at D/S bridge face 5,335 ft^2

Average velocity in bridge opening 4.40 *ft/s*

Maximum WSPRO tube velocity at bridge 6.85 *ft/s*

Water-surface elevation at Approach section with bridge 87.20 *ft*

Water-surface elevation at Approach section without bridge 87.15 *ft*

Amount of backwater caused by bridge 0.05 *ft*

500-year discharge 34,200 ft^3/s

Water-surface elevation at D/S bridge face 91.87 *ft*

Area of flow at D/S bridge face 7,104 ft^2

Average velocity in bridge opening 4.81 *ft/s*

Maximum WSPRO tube velocity at bridge 7.00 *ft/s*

Water-surface elevation at Approach section with bridge 92.05 *ft*

Water-surface elevation at Approach section without bridge 92.03 *ft*

Amount of backwater caused by bridge 0.02 *ft*

The live-bed contraction scour equation indicates the deposition of sediment in the channel at the bridge during the 100- and 500-year floods. (See negative scour values determined in scour calculations included at the end of the report). However, it seems unreasonable to expect sediment deposition at the bridge during peak flood conditions. Therefore, the negative scour values were set equal to zero as reflected in tables 1 through 4 and figure 2.

The abutments are not protected by riprap, therefore abutment scour was calculated using the Froehlich (1989) live-bed abutment scour equation. There is no contraction of flow at the right abutment during the 100- or 500-year discharges; therefore, the flood discharges do not produce abutment scour at the right abutment. It should be noted that the SCDOT bridge plans (docket number 12.250) show that the right abutment is the actual ground surface, not fill material, in that area.

It should be noted that the SCDOT bridge plan borings (docket number 12.250) show subsurface rock that could affect the scour depths shown in this study. For more information, see the SCDOT bridge plans in the pocket at the back of the report.

WSPRO INPUT FILE -- Continued

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*
*           Survey data for an approach cross section surveyed at 570 ft U/S
*           of D/S bridge face.  Distance is determined from survey data.
*
XT   SURV2  570   0.0008
GR            0   93.5   12   89.4   24   89.8   62   80.8   86   79.4
GR          140   74.2  192   73.9  218   76.0  239   75.8  278   65.2
GR          321   61.1  333   60.0  346   60.1  354   59.9  364   61.1
GR          385   77.9  408   79.8  418   83.7  430   88.3  440   92.5
*
*
AS   APPR  440
GT
*
N          0.15   0.06   0.16
SA            239      385
*
BP         74
PX
*
HP 1 BRIDG  86.95  0  86.95
HP 2 BRIDG  86.97  0  86.97  23500
HP 1 APPR   87.20  0  87.20
HP 2 APPR   87.20  0  87.20  23500
HP 1 BRIDG  91.87  0  91.87
HP 2 BRIDG  91.89  0  91.89  34200
HP 1 APPR   92.05  0  92.05
HP 2 APPR   92.05  0  92.05  34200
EX
ER
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WSPRO OUTPUT --Continued

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WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V060188             MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

        Structure No. 124022300100   (411 ft. Bridge)
        Fishing Creek at SC 223           File:  fish.sc223
        Chester County, South Carolina   MGZ 8/94
           *** RUN DATE & TIME: 08-23-94  10:43
    CROSS-SECTION PROPERTIES:  ISEQ =  4;  SECID = APPR ;  SRD =     440.

     WSEL  SA#      AREA         K   TOPW   WETP  ALPH    LEW     REW      QCR
           1     2079.    96594.   204.   206.                          37627.
           2     3230.   610925.   146.   154.                          86197.
           3      267.     8283.    42.    44.                           3800.
    87.20         5576.   715802.   393.   403.  1.87     35.    427.   87135.
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WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V060188             MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

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        Fishing Creek at SC 223           File:  fish.sc223
        Chester County, South Carolina   MGZ 8/94
           *** RUN DATE & TIME: 08-23-94  10:43


    VELOCITY DISTRIBUTION:  ISEQ =  4;  SECID = APPR ;  SRD =     440.

         WSEL      LEW      REW     AREA         K         Q     VEL
        87.20     34.5    427.4   5575.9   715802.    23500.    4.21

X STA.        34.5      149.3      197.5      247.4      263.5      274.2
  A(I)           951.2      639.6      595.0      256.4      210.3
  V(I)            1.24       1.84       1.97       4.58       5.59

X STA.       274.2      282.7      290.4      297.8      305.0      311.6
  A(I)           186.6      176.3      176.7      173.0      166.9
  V(I)            6.30       6.67       6.65       6.79       7.04

X STA.       311.6      318.2      324.6      330.9      336.8      342.9
  A(I)           168.3      167.0      169.4      160.6      166.3
  V(I)            6.98       7.04       6.94       7.32       7.07

X STA.       342.9      348.8      354.7      360.9      368.2      427.4
  A(I)           162.2      161.1      165.9      184.6      538.7
  V(I)            7.24       7.30       7.08       6.37       2.18
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WSPRO OUTPUT --Continued

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WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V060188             MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

        Structure No. 124022300100   (411 ft. Bridge)
        Fishing Creek at SC 223           File:  fish.sc223
        Chester County, South Carolina   MGZ 8/94
           *** RUN DATE & TIME: 08-23-94  10:43
    CROSS-SECTION PROPERTIES:  ISEQ =  4;  SECID = APPR ;  SRD =     440.

     WSEL  SA#      AREA         K   TOPW   WETP  ALPH    LEW     REW      QCR
             1    3151.   175653.   235.   237.                        65455.
             2    3938.   850109.   146.   154.                       116046.
             3     502.    19998.    54.    57.                         8660.
    92.05          7590.  1045760.   435.   447.  2.02      4.   439. 126395.
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WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V060188             MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

        Structure No. 124022300100   (411 ft. Bridge)
        Fishing Creek at SC 223           File:  fish.sc223
        Chester County, South Carolina   MGZ 8/94
           *** RUN DATE & TIME: 08-23-94  10:43


    VELOCITY DISTRIBUTION:  ISEQ =  4;  SECID = APPR ;  SRD =     440.

         WSEL      LEW      REW     AREA         K         Q    VEL
        92.05      3.9    439.2   7590.0   1045760.   34200.   4.51

X STA.          3.9      133.2      176.8      220.7      251.6      265.2
  A(I)        1301.1      784.3      768.2      524.8      293.1
  V(I)          1.31       2.18       2.23       3.26       5.83

X STA.        265.2      275.4      284.0      292.3      300.2      307.6
  A(I)        255.4      230.9      231.7      226.4      218.1
  V(I)         6.70       7.40       7.38       7.55       7.84

X STA.        307.6      314.8      322.1      328.9      335.5      342.2
  A(I)        218.1      223.1      214.7      213.5      212.6
  V(I)         7.84       7.66       7.96       8.01       8.04

X STA.        342.2      348.8      355.3      362.1      371.3      439.2
  A(I)        211.6      210.0      216.0      264.9      771.4
  V(I)         8.08       8.14       7.92       6.46       2.22
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WSPRO OUTPUT --Continued

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WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V060188            MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

        Structure No. 124022300100   (411 ft. Bridge)
        Fishing Creek at SC 223          File:  fish.sc223
        Chester County, South Carolina   MGZ 8/94
           *** RUN DATE & TIME: 08-23-94  10:43

 XSID:CODE    SRDL     LEW      AREA    VHD     HF      EGL     CRWS        Q     WSEL
       SRD    FLEN     REW         K  ALPH     HO      ERR      FR#      VEL

EXIT :XS    ******     -6.     9211.  0.46 *****   91.85   75.80  34200.   91.39
     -411. ******    604. 1216749.  2.16 ***** *******    0.25    3.71

FULV :FV       411.     -6.     9211.  0.46  0.32   92.18 *******  34200.   91.72
        0.     411.    604. 1216707.  2.16  0.00    0.00    0.25    3.71
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

APPR :AS       440.      4.     7583.  0.64  0.40   92.67 *******  34200.   92.03
      440.     440.    439. 1044465.  2.02  0.09    0.00    0.27    4.51
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

            <<<<<RESULTS REFLECTING THE CONSTRICTED FLOW FOLLOW>>>>>

 XSID:CODE    SRDL     LEW      AREA    VHD     HF      EGL     CRWS        Q     WSEL
       SRD    FLEN     REW         K  ALPH     HO      ERR      FR#      VEL

BRIDG:BR       411.     14.     7104.  0.36  0.38   92.23   77.97  34200.   91.87
        0.     411.    383. 1737053.  1.00  0.00    0.01    0.19    4.81

     TYPE PPCD FLOW      C     P/A    LSEL   BLEN   XLAB   XRAB
       3.    1.    1.  1.000  0.029   97.00 ****** ****** ******

 XSID:CODE    SRDL     LEW      AREA    VHD     HF      EGL     CRWS        Q     WSEL
       SRD    FLEN     REW         K  ALPH     HO      ERR      FR#      VEL

APPR :AS       411.      4.     7589.  0.64  0.44   92.69   77.54  34200.   92.05
      440.     413.    439. 1045625.  2.02  0.02    0.00    0.27    4.51

      M(G)    M(K)        KQ   XLKQ   XRKQ     OTEL
     0.153   0.000 1045314.    71.   440.     91.61

                <<<<<END OF BRIDGE COMPUTATIONS>>>>>
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CONTRACTION SCOUR COMPUTATIONS
FOR
Fishing Creek at SC 223; Chester County; Struc.# 124022300100; MGZ 8-24-94
Scour Analysis for Q100

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LEFT OVERBANK IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	4792.
WIDTH OF CONTRACTED SECTION (FT)	=	122.0
MEDIAN GRAIN SIZE (FT)	=	0.0008
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	22.8
AVERAGE FLOOD PLAIN DEPTH (FT)	=	10.2
DEPTH OF CONTRACTION SCOUR (FT)	=	12.6

RIGHT OVERBANK IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	3090.
WIDTH OF CONTRACTED SECTION (FT)	=	74.0
MEDIAN GRAIN SIZE (FT)	=	0.0008
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	24.0
AVERAGE FLOOD PLAIN DEPTH (FT)	=	12.2
DEPTH OF CONTRACTION SCOUR (FT)	=	11.8

LIVE-BED SCOUR COMPUTATIONS

	MAIN CHANNEL	CONTRACTED SECTION
DISCHARGE (CFS)	20057.	15618.
BOTTOM WIDTH (FT)	146.0	115.8
MANNINGS n	0.045	0.045
AVERAGE DEPTH (FT)	26.8	

ENERGY SLOPE	0.00110
D50 (FT)	0.0010
FALL VELOCITY (FPS)	0.14
K1 COEF.	0.69
K2 COEF.	0.37

COMPUTED DEPTH AT CONTRACTED SECTION (FT)	=	25.4
DEPTH AT MAIN CHANNEL (FT)	=	26.8
DEPTH OF CONTRACTION SCOUR (FT)	=	-1.4

PIER SCOUR COMPUTATIONS
FOR
Fishing Creek at SC 223; Chester County; Struc. #124022300100; MGZ 8-24-94
Scour Analysis for Q500

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	11	10	9	8	7	6	5	4
PIER STATION (FT)	25	50	75	100	125	190	270	335
LOCATION OF PIER	lfp	lfp	lfp	lfp	lfp	mcl	mcr	rfp
Y1: DEPTH (FT)	5.9	16.7	16.5	16.0	15.9	35.2	35.2	14.7
V1: VEL. (FPS)	4.2	4.2	4.2	4.2	4.2	6.3	6.3	4.8
a: PIER WIDTH (FT)	1.0	1.0	1.0	1.0	3.6	4.6	4.1	4.1
L: PIER LENGTH (FT)	5.0	5.0	5.0	5.0	3.6	4.6	4.1	4.1
PIER SHAPE	5	5	5	5	1	1	1	1
ATTACK ANGLE	0	0	0	0	0	0	0	0
K1 (SHAPE COEF.)	1.00	1.00	1.00	1.00	1.10	1.10	1.10	1.10
K2 (ANGLE COEF.)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FROUDE NO.	0.31	0.18	0.18	0.19	0.19	0.19	0.19	0.22

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	2.24	2.58	2.58	2.57	6.48	10.03	9.31	7.34
MAX SCOUR DEPTH (FT)	2.47	2.84	2.83	2.82	7.13	11.04	10.24	8.07

****

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	3	2
PIER STATION (FT)	360	385
LOCATION OF PIER	rfp	rfp
Y1: DEPTH (FT)	11.9	0.0
V1: VEL. (FPS)	4.8	0.0
a: PIER WIDTH (FT)	0.8	1.0
L: PIER LENGTH (FT)	4.0	5.0
PIER SHAPE	1	5
ATTACK ANGLE	0	0
K1 (SHAPE COEF.)	1.10	1.00
K2 (ANGLE COEF.)	1.00	1.00
FROUDE NO.	0.24	0.00

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	2.46	0.00
MAX SCOUR DEPTH (FT)	2.71	0.00

"MAX SCOUR DEPTH" includes an additional 10 percent of the computed CSU scour depth as recommended in HEC 18

ABUTMENT SCOUR COMPUTATIONS
FOR
Fishing Creek at SC 223; Chester County; Struc. #124022300100; MGZ 8-24-94
Scour Analysis for Q500

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LEFT ABUTMENT
SCOUR COMPUTATIONS

ABUTMENT TYPE	3 -SPILL THROUGH
DISCHARGE BLOCKED BY ABUTMENT (CFS)	1496.
AREA BLOCKED BY ABUTMENT (SQ FT)	1138.0
DEPTH OF FLOW AT ABUTMENT (FT)	16.1
LENGTH OF ABUT. 90 DEG. TO FLOW (FT)	113.0
ABUTMENT SKEW (DEG)	0
AJUSTED ABUTMENT LENGTH (FT)	70.7
AVERAGE F/P VELOCITY U/S OF ABUT. (FPS)	1.3
FROUDE NUMBER	0.058
K1 COEF.	0.6
K2 COEF.	1.0

DESIGN DEPTH OF SCOUR (FROELICH EQUATION, 1989) (FT) = 22.8

12402.2300200047

INDEX OF SHEETS

CHESTER 12,250 | S-166(2) | 223

SOUTH CAROLINA
STATE HIGHWAY DEPARTMENT
COLUMBIA

PLAN AND PROFILE OF PROPOSED STATE HIGHWAY

FEDERAL AID PROJ. NO. S-166(2)
DOCKET NO. 12.250
ROUTE NO. 223

CHESTER COUNTY

BRIDGES OVER FISHING CREEK & TINKERS CREEK

SUMMARY OF ESTIMATED QUANTITIES

Item	Fishing Cr.	Tinkers Cr.	Total
Class "A" Concrete	310.44	103.84	414.28 C.Y.
Reinforcing Steel	54,633	19,156	73,789 lbs.
Treated Lumber	2.823	2.369	5.192 M.B.M.
Hardware	756.2	559.8	1316.0 lbs.
Structural Steel	213,051	41,525	254,5[illegible] lbs.
Creosoted Timber Piling	1,400	950	2350 L.F.
10" @ 42" H Piling	1,440		1,440 L.F.
Pre-cast Concrete Tile Slope Drains	96	100	196 L.F.

CONVENTIONAL SIGNS

LEGEND
PROPOSED PROJECT
OTHER ROADS

DOCKET NO. 12.250

VICINITY MAP

PILE RECORD ON DOCKET NO. 12250

FED ROAD DIST. NO.	STATE	COUNTY	DOCKET NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
14	S.C.	Chester	12.250	223	14	16

WEIGHT OF HAMMER 2990 LBS STEEL PILES 2000 LBS TIMBER PILES FALL 15 FEET TYPE DROP

FOOTING	PILE NO.	DATE DRIVEN	DIAMETER BUTT	DIAMETER TIP	PENETRATION	PEN. PER BLOW	BEARING	ELEVATION PILE TIP	ELEVATION CUT-OFF	LENGTH IN PLACE	ORIGINAL LENGTH	LENGTH CUT-OFF	PAY LENGTH	C.O. AT 0.40 OF UNIT PRICE	C.O. AT 0.25 OF UNIT PRICE
					TIMBER PILES			FISHING CREEK							
	1	3-20-48	12½"	9¼"	9.64'	—	Refusal	428.61	438.25	9.64	12.36	2.72	9.64	0.72	
	2	3-20-48	12½"	9"	8.73'	—	Refusal	429.52	438.25	8.73	10.58	1.85	8.73	—	
	3	3-20-48	12 5/8"	10"	9.58'	—	Refusal	428.67	438.25	9.58	11.17	1.59	9.58	—	
	4	3-19-48	14 1/2"	12¼"	9.29'	—	Refusal	428.96	438.25	9.29	15.07	5.78	9.29	3.78	
	5	3-19-48	13¼"	11"	10.17'	0.225	Refusal	428.08	438.25	10.17	14.95	4.78	10.17	2.78	
							Total	Bt. 1		47.41	64.13	16.72	47.41		
	1	3-18-48	13 3/16"	10"	9.77'	0.260	25.00	420.74	437.27	16.53	16.82	0.29	16.53	—	
	2	3-19-48	12¾"	8¾"	10.07'	0.275	23.53	420.44	437.27	16.83	17.32	0.49	16.83	—	
	3	3-19-48	15½"	13"	8.29'	—	Refusal	422.22	437.27	15.05	27.85	12.80	15.05		10.80
	4	3-19-48	15"	12¼"	10.27'	0.250	24.00	420.24	437.27	17.03	27.69	10.66	17.03		8.66
	5	3-19-48	12⅞"	9"	9.21'	—	Refusal	421.30	437.27	15.97	16.15	0.18	15.97	—	
							Total	Bt. 2		81.41	105.83	24.42	81.41		
	1	3-8-48	13¼"	8"	33.21'	0.500	20.00	391.41	433.64	52.23	59.50	7.27	52.23	5.27	
	2	3-8-48	14 1/8"	8"	36.80'	0.425	21.05	377.82	433.64	55.82	59.80	3.98	55.82	4.98	
	3	3-8-48	13"	7¾"	32.28'	0.400	21.43	382.34	433.64	51.30	60.08	8.78	51.30		6.78
	4	3-9-48	13½"	8 3/16"	26.30'	0.250	24.00	388.32	433.64	45.32	59.86	14.54	45.82		12.54
	5	3-9-48	13½"	8½"	26.53'	0.175	25.53	388.09	433.64	45.55	59.72	14.17	45.55		12.17
							Total	Bt. 8		250.22	299.96	49.74	250.22		
	1	3-9-48	14 3/8"	8"	28.06'	0.250	24.00	396.36	433.95	47.59	57.06	9.47	47.59		7.47
	2	3-9-48	14 7/8"	9"	31.62'	0.350	22.22	382.80	433.95	51.15	59.68	8.53	51.15		6.53
	3	3-9-48	14"	8½"	26.01'	0.375	21.82	388.41	433.95	45.54	59.70	14.16	45.54		12.16
	4	3-10-48	14¼"	9"	26.28'	0.450	20.69	388.14	433.95	45.81	49.95	4.14	45.81	2.14	
	5	3-10-48	13 3/8"	7 3/4"	26.68'	0.325	22.64	387.74	433.95	46.21	50.00	3.79	46.21	1.79	
							Total	Bt. 9		236.30	276.39	40.09	236.30		
	2	2-21-48	15"	9¼"	25.86'	0.325	22.64	388.16	434.35	46.19	50.00	3.81	46.19	1.81	To Extra Pile Being
	3	2-21-48	15 1/8"	9½"	25.57'	0.450	20.69	388.45	434.35	45.90	49.75	3.85	45.90	1.85	
	4	2-21-48	14¾"	9 1/2"	27.14'	0.475	20.34	386.88	434.35	47.47	50.58	3.11	47.47	1.11	
	1	2-21-48	14 1/4"	8⅛"	25.40'	0.350	22.22	388.62	434.35	45.73	50.00	4.27	45.73	2.27	
	5	2-23-48	15 1/16"	8⅛"	26.49'	0.300	23.08	387.53	434.35	46.82	50.33	3.51	46.82	1.51	
							Total	Bt. 10		232.11	250.66	18.55	232.11		
	4	2-23-48	14⅝"	8"	27.56'	0.400	19.75	386.66	434.85	48.19	50.17	1.38	48.79	—	
	5	2-23-48	13¼"	8"	25.42'	0.225	24.49	388.20	434.85	46.65	50.13	3.48	46.65	1.48	
	3	2-23-48	14⅜"	9"	24.45'	0.300	23.08	388.97	434.85	45.88	49.83	3.95	45.88	1.95	
	2	2-26-48	15"	8"	24.89'	0.300	23.08	388.73	434.85	46.12	50.00	3.88	46.12	1.88	
	1	2-26-48	15⅜"	8½"	23.75'	0.350	22.22	388.87	434.85	45.98	50.00	5.02	44.98	3.02	
							Total	Bt. 11		232.42	250.13	17.71	232.42		
	1	2-27-48	14½"	10½"	11.19'	0.350	22.22	402.93	435.50	32.57	49.70	17.13	32.57		15.13
	2	2-27-48	15¼"	9 3/4"	15.43'	0.300	23.08	398.69	435.50	36.81	50.70	13.89	36.81		11.89
	3	2-27-48	15¼"	8"	9.19'	0.225	24.49	404.93	435.50	30.57	49.94	19.37	30.57		17.37
	4	2-27-48	14 5/8"	9½"	8.21'	0.175	25.53	405.91	435.50	29.59	39.70	10.11	29.59		8.11
	5	2-27-48	14⅞"	11¼"	5.66'	—	Refusal	408.46	435.50	27.04	35.43	8.39	27.04		6.39
							Total	Bt. 12		156.58	225.47	68.89	156.58		
					Total Timber Piles			Fishing Creek		1,236.45	1,471.57	235.12	1,236.45	35.34	136.00
					STEEL "H" PILING 10"@42#										
	1	3-18-48	10" @ 42#		11.68'	0.500	29.90	407.72	436.44	28.72	29.53	0.81	29.72	30.72	
	2	3-18-48	10" @ 42#		11.42'	0.450	30.93	407.98	436.44	28.46	29.00	0.54	29.46	30.46	
	3	3-18-48	10" @ 42#		11.84'	0.475	30.41	407.56	436.44	28.88	29.00	0.12	29.88	30.88	
	4	3-18-48	10" @ 42#		10.41'	0.350	33.22	408.99	436.44	27.45	29.00	1.55	28.45	29.45	
	5	3-18-48	10" @ 42#		10.01'	0.500	29.90	409.39	436.44	27.05	27.88	0.83	28.05	29.05	
							Total	Bt. 3		140.56	144.41	3.85	140.56	150.56	
	1	3-15-48	10" @ 42#		21.83'	0.250	35.88	392.42	433.20	40.78	50.00	9.22	41.78	42.78	
	2	3-15-48	10" @ 42#		18.69'	0.175	38.17	395.56	433.20	37.64	50.00	12.36	38.64	39.64	
	3	3-15-48	10" @ 42#		26.32'	0.300	36.50	387.93	433.20	45.27	50.00	4.73	46.27	47.27	
	4	3-15-48	10" @ 42#		29.33'	0.350	33.22	384.92	433.20	48.28	50.00	1.72	49.28	50.28	
	5	3-16-48	10" @ 42#		25.40'	0.400	31.04	388.85	433.20	44.35	50.00	5.65	45.35	46.35	
	6	3-16-48	10" @ 42#		24.21'	0.325	33.85	390.04	433.20	43.16	50.00	6.84	44.16	45.16	
	7	3-16-48	10" @ 42#		27.62'	0.375	32.62	386.63	433.20	46.57	50.00	3.43	47.57	48.57	
	8	3-16-48	10" @ 42#		24.46'	0.200	37.38	389.79	433.20	43.41	50.00	6.59	44.41	45.41	
							Total	Bt. 4		349.41	400.00	50.54	349.46	357.46	
	1	3-17-48	10" @ 42#		45.65'	0.375	32.62	386.02	431.74	45.72	67.29	1.57	47.72	48.72	
	2	3-17-48	10" @ 42#		29.20'	0.400	31.04	382.47	431.74	49.27	50.00	0.73	50.27	51.27	
	3	3-17-48	10" @ 42#		25.12'	0.250	35.88	386.53	431.74	45.21	50.00	4.79	46.21	47.21	
	4	3-17-48	10" @ 42#		27.18'	0.375	32.62	384.49	431.74	47.25	50.00	2.75	48.25	49.25	
	5	3-17-48	10" @ 42#		38.62'	0.350	33.22	374.05	431.74	57.69	58.90	1.21	59.69	60.69	
	6	3-17-48	10" @ 42#		25.75'	0.325	33.85	385.92	431.74	45.82	50.00	4.18	46.82	47.82	
	7	3-17-48	10" @ 42#		26.65'	0.350	33.22	385.02	431.74	46.72	50.00	3.28	47.72	48.72	
	8	3-17-48	10" @ 42#		26.50'	0.200	37.38	385.17	431.74	46.57	50.00	3.43	47.57	48.57	
							Total	Bt. 5		404.25	426.19	21.94	414.25	422.25	
	3	3-3-48	10" @ 42#		21.18'	0.325	33.85	385.61	430.88	45.27	50.00	4.73	46.27	47.27	
	2	3-3-48	10" @ 42#		21.45'	0.375	32.62	385.77	430.88	45.11	50.00	4.89	46.11	47.11	
	4	3-3-48	10" @ 42#		22.28'	0.275	35.18	385.14	430.88	45.74	50.00	4.26	46.74	47.74	
	1	3-4-48	10" @ 42#		25.50'	0.375	32.62	381.92	430.88	48.96	50.00	1.04	49.96	50.96	
	8	3-4-48	10" @ 42#		22.69'	0.375	32.62	384.73	430.88	46.15	50.00	3.85	47.15	48.15	
	7	3-4-48	10" @ 42#		22.03'	0.200	37.38	385.39	430.88	45.49	50.00	4.51	46.49	47.49	
	6	3-4-48	10" @ 42#		22.86'	0.300	34.50	384.58	430.88	46.30	50.00	3.70	47.30	48.30	
	5	3-4-48	10" @ 42#		26.54'	0.425	31.47	390.88	430.88	50.00	50.00	0.00	51.00	52.00	
							Total	Bt. 6		373.02	400.00	26.98	381.02	389.02	

BENT NO.	FOOTING	PILE NO.	DATE DRIVEN	DIAMETER BUTT	DIAMETER TIP	PENETRATION	PEN. PER BLOW	BEARING	ELEVATION PILE TIP	ELEVATION CUT-OFF	LENGTH IN PLACE	ORIGINAL LENGTH	LENGTH CUT-OFF	PAY LENGTH	C.O. AT 0.40 OF UNIT PRICE	C.O. AT 0.25 OF UNIT PRICE
7		6	3-1-48	10" @	42#	29.35'	0.375	32.67	384.46	430.94	46.48	50.00	3.52	47.48		
*7		7	3-1-48	10" @	42#	36.56'	0.350	33.22	377.25	430.94	53.69	54.44	0.75	55.69		
*7		5	3-1-48	10" @	42#	37.64'	0.400	31.04	376.18	430.94	54.76	55.45	0.69	56.76		
7		8	3-1-48	10" @	42#	27.94'	0.350	33.22	385.88	430.94	45.06	50.00	4.94	46.06		
7		3	3-2-48	10" @	42#	29.29'	0.375	32.62	384.53	430.94	46.41	50.00	3.59	47.41		
7		2	3-2-48	10" @	42#	29.59'	0.300	34.50	384.23	430.94	46.71	50.00	3.29	47.71		
*7		1	3-2-48	10" @	42#	36.07'	0.300	34.50	377.75	430.94	53.19	54.27	1.08	55.19		
7		4	3-2-48	10" @	42#	27.32'	0.350	33.22	386.50	430.94	44.44	50.00	5.56	45.44		
									Total	Bt. 7	390.74	414.16	23.42	401.72		
						TINKER'S CREEK TIMBER PILES					1,658.03	1,994.76	216.73	1,700.03	Total Steel H Piling Fishing Creek	
7		1	1-23-48	12⅝"	9¼"	14.93'	0.350	22.22	413.98	439.20	25.22	29.90	4.68	25.22	2.68	
7		2	1-23-48	12 5/8"	8½"	15.34'	0.400	21.43	413.55	439.20	25.65	30.00	4.35	25.65	2.35	
7		3	1-23-48	13½"	9½"	11.88'	0.125	24.67	417.03	439.20	22.17	30.00	7.83	22.17	5.83	
7		4	1-23-48	13½"	10"	11.98'	0.0625	28.23	414.93	439.20	22.27	30.80	8.53	22.27		6.53
7		5	1-23-48	12⅝"	9¼"	14.63'	0.600	18.75	414.28	439.20	24.92	31.25	6.33	24.92	4.33	
									Total	Bt. 7	120.23	151.95	31.72	120.23		
6		1	1-28-48	14"	10⅛"	20.05'	0.500	20.00	408.86	438.06	29.20	30.50	1.30	29.20		
6		2	1-28-48	14½"	10½"	19.21'	0.625	18.46	409.70	438.06	28.36	30.50	2.14	28.36		
6		3	1-28-48	14⅛"	11"	18.74'	0.600	18.75	410.17	438.85	28.68	30.00	1.32	28.68		
6		4	1-29-48	12½"	8"	22.68'	0.600	18.75	406.23	438.85	32.62	34.92	2.30	32.62		
6		5	1-29-48	13½"	8"	19.06'	0.375	21.82	409.85	438.85	29.00	35.08	6.08	29.00		
			See Detail of Bt. 6							Total	Bt. 6	147.86	161.00	13.14	147.86	
5		5	1-30-48	12 7/8"	8¾"	16.08'	0.425	21.05	411.17	438.62	27.45	35.08	7.63	27.45		
5		4	1-30-48	12½"	8¼"	18.70'	0.500	20.00	408.55	438.62	30.07	35.08	5.01	30.07		
5		3	1-30-48	12¼"	8¼"	21.40'	0.500	20.00	405.85	438.62	32.77	35.33	2.56	32.77		
5		2B	2-6-48	12½"	8¼"	22.77'	0.475	20.34	404.48	438.62	34.14	35.30	1.16	34.14		
5		2A	2-6-48	12 7/8"	10¼"	21.77'	0.300	23.08	405.48	438.62	33.14	35.35	2.21			
5		1	2-6-48	15⅛"	11¼"	21.16'	0.200	23.08	406.09	438.62	32.53	35.15	2.62	32.53		
			No Compensation Was Allowed Contractor For Pile No. 2A But Bt. 5								196.10	211.29	21.19	12443		
			Was Allowed To Drive Piles 2A + 2B In Place Of Pile #2 One On Each Side Of Log													
1		1	2-3-48	12⅝"	8"	21.06'	0.450	20.69	406.87	438.62	31.75	35.00	3.25	31.75		
1		2	2-3-48	12½"	8"	22.52'	0.525	19.67	405.41	438.62	33.21	35.20	1.99	33.21		
1		3	2-3-48	14⅜"	9⅛"	18.85'	0.200	25.00	409.08	438.62	29.54	35.00	5.46	29.54	3.46	
1		4	2-3-48	12⅜"	8¼"	23.76'	0.8215	16.55	404.17	438.62	34.45	35.25	0.80	34.45		
1		5	2-3-48	13½"	9⅝"	20.88'	0.575	19.05	407.05	438.62	31.57	35.00	3.43	31.75	1.43	
									Total	Bt. 1	160.52	175.45	14.93	160.70		
2		1	2-3-48	15⅝"	10⅞"	22.75'	0.200	25.00	405.28	438.96	33.18	40.00	6.82	33.18	4.82	
2		2	2-4-48	12"	9"	21.46'	0.275	23.53	406.07	438.46	32.39	40.06	7.67	32.39	5.67	
2		3	2-4-48	12 3/8"	9"	23.27'	0.225	24.43	404.76	438.46	33.70	40.20	6.50	33.70	4.50	
2		4	2-4-48	13"	9¼"	23.33'	0.350	22.22	404.70	438.46	33.76	39.40	5.64	33.76	3.64	
2		5	2-4-48	12⅜"	10⅛"	24.83'	0.325	22.64	403.20	438.46	35.26	39.90	4.64	35.26	2.64	
									Total	Bt. 2	168.29	199.56	31.27	168.29		
3		1	2-4-48	12⅜"	8⅛"	26.41'	0.375	21.82	401.26	438.42	37.16	39.95	2.79	37.16	0.79	
3		2	2-4-48	12½"	9⅛"	26.31'	0.475	20.34	401.41	438.42	37.01	39.90	2.89	37.01	0.89	
3		3	2-4-48	12"	10⅛"	24.44'	0.150	26.09	403.08	438.42	35.34	40.18	4.84	35.34	2.84	
3		4	2-4-48	12 5/8"	9⅛"	24.57'	0.350	22.22	403.15	438.42	35.27	40.08	4.81	35.27	2.81	
3		5	2-4-48	14⅞"	9½"	24.21'	0.350	22.22	403.51	438.42	34.91	39.95	5.04	34.91	3.04	
									Total	Bt. 3	179.69	200.06	20.37	179.69		
4		1	2-4-48	14⅞"	9⅞"	21.74'	0.150	26.09	406.08	438.47	32.39	40.00	7.61	32.39	5.61	
4		2	2-5-48	12 5/8"	11"	20.95'	0.225	24.49	406.87	438.47	31.60	40.08	8.48	31.60	6.48	
4		3	2-5-48	14½"	10"	20.78'	0.300	23.08	407.04	438.47	31.43	39.80	8.37	31.43	6.37	
4		4	2-5-48	15"	10"	22.25'	0.150	26.09	405.57	438.47	32.90	39.92	7.02	32.90	5.02	
4		5	2-5-48	15½"	10"	19.16'	0.175	25.53	408.68	438.47	29.79	38.98	10.19	29.79	8.19	
									Total	Bt. 4	158.11	198.78	41.67	158.11		
								Total Far Tinker's Creek			1,124.80	1,299.09	174.29	1059.31	78.15	27.57
TOTAL																
GRAND TOTAL																

NOTES CONCERNING ANY UNUSUAL FOUNDATION CONDITION

BENT NO.	FOOTING	PILE NO.	REMARKS
3			STEEL "H" PILING 10"@42" WAS SUBSTITUTED FOR CREOSOTED TIMBER PILING AT THE DIRECTION OF THE BRIDGE ENGINEER
5	*	1	50.00 - 1.57 + 17.29 = 65.72
5	⌀	5	50.00 - 1.21 + 8.90 = 57.69
7	*	7	50.00 - 0.75 + 4.44 = 53.69
7	■	5	50.00 - 0.69 + 5.45 = 54.76
7	⌀	1	50.00 - 1.08 + 4.27 = 53.19
			ABOVE WERE DRIVEN BELOW GRADE TO OBTAIN REQUIRED BEARING AND WERE BUILT UP AS SHOWN ABOVE.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

FORT LAWN QUADRANGLE
SOUTH CAROLINA
7.5 MINUTE SERIES (TOPOGRAPHIC)

EXPLANATION

EXIT — cross section

Mapped, edited, and published by the Geological Survey

Control by USGS, USC&GS, and South Carolina Geodetic Survey

Topography by photogrammetric methods from aerial photographs photographs taken 1964. Field checked 1969

Polyconic projection. 1927 North American datum
10,000-foot grid based on South Carolina coordinate system, north zone
1000-meter Universal Transverse Mercator grid ticks,
zone 17, shown in blue

Fine red dashed lines indicate selected fence and field lines where generally visible on aerial photographs. This information is unchecked

UTM GRID AND 1969 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

1 MILE
7000 FEET
1 KILOMETER

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Primary highway, all weather, hard surface
Secondary highway, all weather, hard surface
Light-duty road, all weather, improved surface
Unimproved road, fair or dry weather
U. S. Route
State Route

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—1971

FORT LAWN, S. C.
N3437.5—W8052.5/7.5

1969

AMS 4853 III NW—SERIES V846

Figure 1.--Topography of study area and location of cross sections used in WSPRO analysis for structure 124022300100 on Route SC 223, crossing Fishing Creek in Chester County, South Carolina.