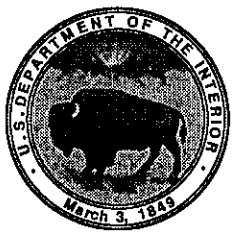
U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

LEVEL II BRIDGE SCOUR ANALYSIS FOR STRUCTURE 124007200400 ON ROUTE SC 72, CROSSING CANEY FORK CREEK IN CHESTER COUNTY, SOUTH CAROLINA

By Whitney J. Stringfield and Michael G. Zalants

Prepared in cooperation with the
SOUTH CAROLINA DEPARTMENT
OF TRANSPORTATION



Columbia, South Carolina

1995

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.

Level II bridge scour analysis for structure 124007200400 on Route SC 72, crossing Caney Fork Creek in Chester County, South Carolina

by Whitney J. Stringfield and Michael G. Zalants

This report provides the results of the detailed Level II analysis of scour potential at structure 124007200400 on Route SC 72, crossing Caney Fork Creek in Chester County, South Carolina (figure 1 in pocket; figures 4-6). The site is located in the Piedmont physiographic province near the town of Chester in the central part of Chester County. The drainage area for the site is 9.4 mi^2, and is a predominantly rural drainage basin with little development in recent years. In the vicinity of the study site, the land is covered by pasture with areas of sparse hardwoods.

In the study area, Caney Fork Creek has a meandering channel with a slope of approximately 0.0023 ft/ft (12.1 ft/mi), an average channel top width of 28 ft and an average channel depth of 6.0 ft. The predominant channel bed material is medium sand (D_{50} is 0.54 mm) and the channel banks consist of a silty fine sand (D_{50} is 0.19 mm). In general, the banks have light to moderate woody vegetative cover and were noted to be relatively stable at the time of the Level I site visit, July 16, 1990 and the Level II site visits, August 31 and September 1, 1993.

The Route SC 72 crossing of Caney Fork Creek is a 100-ft-long, two-lane bridge consisting of four 25-ft concrete spans, supported by concrete and steel bents with spillthrough abutments. The right and left abutments are protected by riprap. In this report, the words "right" and "left" refer to directions that would be reported by an observer facing downstream. Additional details describing conditions at the site are included in the Scour Report Summary.

Scour depths were computed using engineering judgement and the general guidelines described in Hydraulic Engineering Circular 18 (Richardson and others, 1993) and the Transportation Research Board Draft Paper, "Evaluating scour at bridges using WSPRO" (Arneson and others, 1992). Scour depths were calculated assuming an infinite depth of erosive material and a homogeneous particle-size distribution. The results of the scour analysis are presented in tables 1 and 2 and a graph of the scour depths is shown on figure 2.

Pile penetration depths were obtained from the SCDOT bridge plans (docket number 12.338). Scour caused by the 100- and 500-year discharge will cause maximum pile tip exposure at bent 3 of 11.7 and 20.1 ft, respectively.

It should be noted that the SCDOT bridge plan borings (docket number 12.338) 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 1. *--Remaining pile/footing penetration at piers/bents for the 100- and 500-year discharges at structure 124007200400 on Route SC 72, crossing Caney Fork 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)
100-year discharge is 3,040 cubic feet per second							
4	25	382.0	75.6	87.2	22.0	65.2	-10.4
3	50	381.8	75.4	85.7	22.0	63.7	-11.7
2	75	381.5	75.1	86.0	22.0	64.0	-11.1
500-year discharge is 4,590 cubic feet per second							
4	25	382.0	75.6	87.2	30.4	56.8	-18.8
3	50	381.8	75.4	85.7	30.4	55.3	-20.1
2	75	381.5	75.1	86.0	30.4	55.6	-19.5

[1] Pier/bent number corresponds to the South Carolina Department of Transportation (SCDOT) bridge plans (docket number 12.338).

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

[3] Pile tip/footing elevations obtained from the SCDOT bridge plans represent the highest pile tip elevation for the bridge.

[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 12.338) show subsurface rock that could affect the scour depths shown in the above table. For more information, see the SCDOT plans in report pocket.

Table 2. *--Cumulative scour depths at piers/bents for the 100- and 500-year discharges at structure 124007200400 on Route SC 72, crossing Caney Fork 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)
100-year discharge is 3,040 cubic feet per second				
4	25	15.2	6.8	22.0
3	50	15.2	6.8	22.0
2	75	15.2	6.8	22.0
500-year discharge is 4,590 cubic feet per second				
4	25	23.0	7.4	30.4
3	50	23.0	7.4	30.4
2	75	23.0	7.4	30.4

[1] Pier/bent number corresponds to the 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.

NOTE: The SCDOT bridge plan borings (docket number 12.338) show subsurface rock that could affect 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.

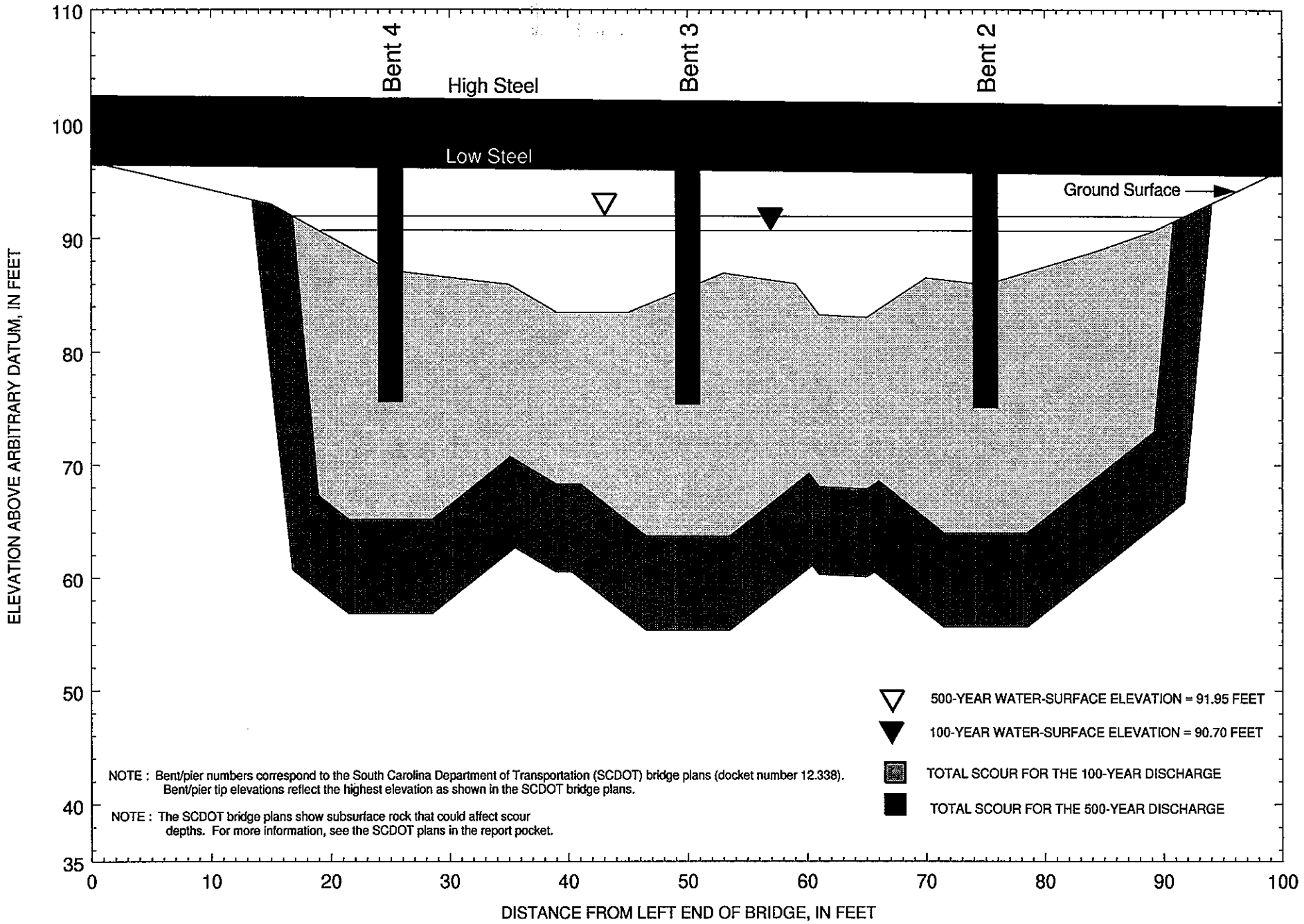


Figure 2.--Total scour depths for the 100- and 500-year discharges at structure 124007200400 on Route SC 72, crossing Caney Fork Creek in Chester County, South Carolina.

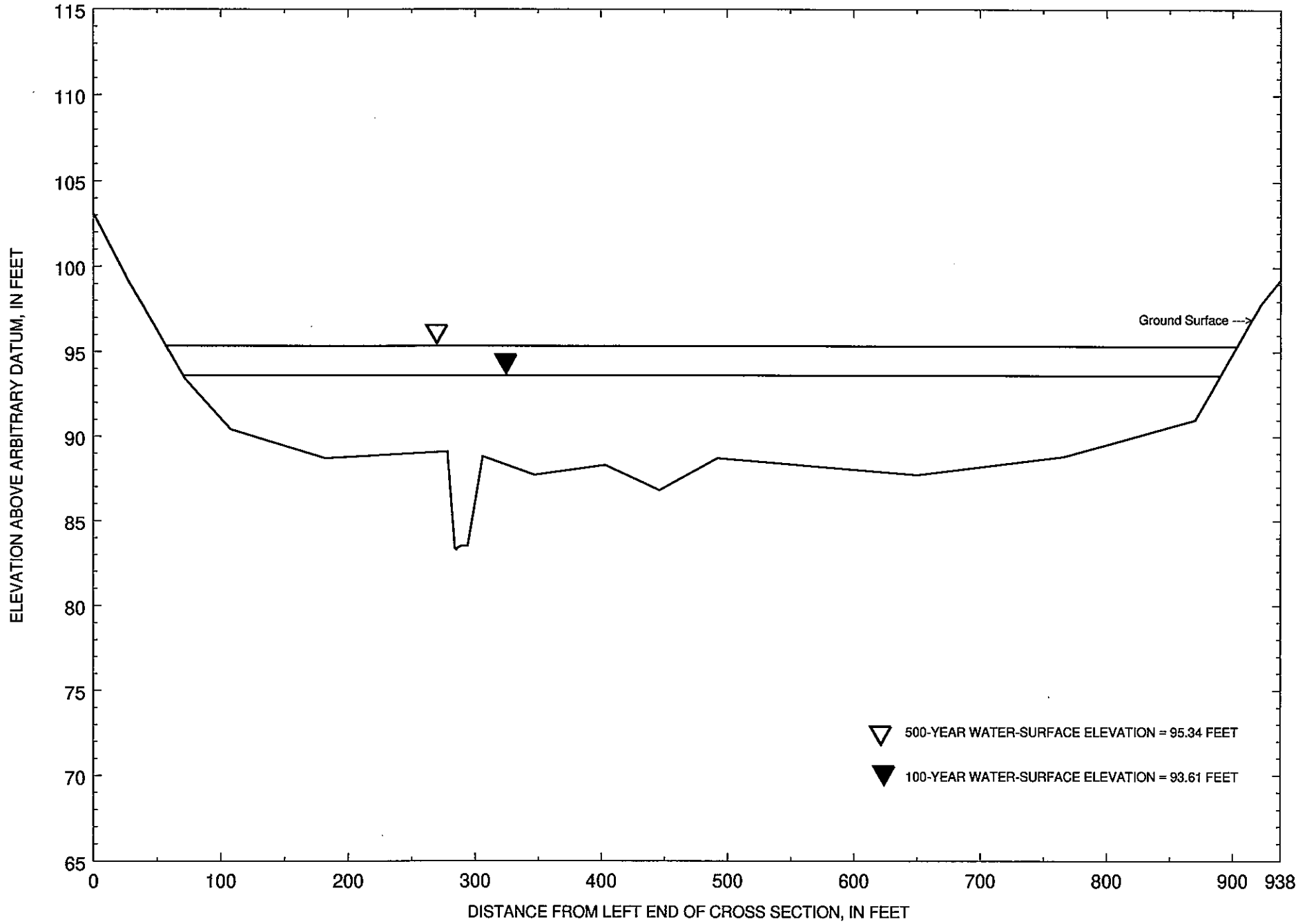


Figure 3.-- Approach cross section of structure 124007200400 on Route SC 72, crossing Caney Fork Creek in Chester County, South Carolina.

Figure 4.--Structure 124007200400 on Route SC 72, crossing Caney Fork Creek in Chester County, South Carolina as viewed from downstream (September 1, 1993).

Figure 5.--Downstream channel as viewed from under structure 124007200400 on Route SC 72, crossing Caney Fork Creek in Chester County, South Carolina (July 16, 1990).

Figure 6.--Channel under structure 124007200400 on Route SC 72, crossing Caney Fork Creek in Chester County, South Carolina (September 1, 1993).

SELECTED REFERENCES

Arcement, G.J., Jr., and Schneider, V.R., 1989, Guide for selecting Manning's roughness coefficients for natural channels and flood plains: U.S. Geological Survey Water-Supply Paper 2339, 38 p.

Arneson, L. A., Shearman, J. O., Jones, J. S., 1992, Evaluating scour at bridges using WSPRO: Transportation Research Board Draft Paper, 40 p.

Bohman, L. R., 1990, Determination of flood hydrographs for streams in South Carolina: Volume 1. Simulation of flood hydrographs for rural watersheds in South Carolina: U.S. Geological Survey Water-Resources Investigations Report 89-4087, 53 p.

Bohman, L. R., 1992, Determination of flood hydrographs for streams in South Carolina: Volume 2. Estimation of peak-discharge frequency, runoff volumes, and flood hydrographs for urban watersheds: U.S. Geological Survey Water-Resources Investigations Report 92-4040, 79 p.

Froehlich, D. C., 1989, Local scour at bridge abutments *in* Ports, M. A., ed., Hydraulic Engineering--Proceedings of the 1989 National Conference on Hydraulic Engineering: New Chester, American Society of Civil Engineers, p. 13-18.

Guimaraes, W. B., and Bohman, L. R., 1991, Techniques for estimating magnitude and frequency of floods in South Carolina, 1988: U.S. Geological Survey Water-Resources Investigation Report, 91-4157, 174 p.

Gunter, H.E., Mason, R.R., and Stamey, T.C., 1987, Magnitude and frequency of floods in rural and urban basins in North Carolina: U.S. Geological Survey Water-Resources Investigations Report, 87-4096, 54 p.

Laursen, E. M., 1960, Scour at bridge crossings: Journal of the Hydraulics Division, American Society of Civil Engineers, v. 86, no. HY2, p. 39-53.

Laursen, E. M., 1963, An analysis of relief bridge scour: Journal of the Hydraulics Division, American Society of Civil Engineers, v. 89, no. HY3, p. 93-118.

Richardson, E. V., Harrison, L. J., Richardson, J. R., and Davis, S. R., 1993, Evaluating scour at bridges: Federal Highway Administration Hydraulic Engineering Circular No. 18, Publication FHWA-IP-90-017, 131 p.

Richardson, E. V., Simons, D. B., and Julien, P. Y., 1990, Highways in the river environment: Federal Highway Administration Publication FHWA-HI-90-016.

Richardson, E. V., Simons, D. B., Karaki, S., Mahmood, K., and Stevens, M. A., 1975, Highways in the river environment: hydraulic and environmental design considerations: Federal Highway Administration.

Shearman, J. O., 1990, User's manual for WSPRO--a computer model for water surface profile computations: Federal Highway Administration Publication FHWA-IP-89-027, 187 p.

Shearman, J. O., Kirby, W. H., Schneider, V. R., and Flippo, H. N., 1986, Bridge waterways analysis model; research report: Federal Highway Administration Publication FHWA-RD-86-108, 112 p.

U.S. Geological Survey, Interagency Advisory Committee on Water Data, 1982, Guidelines for determining flood flow frequency, Bulletin 17B of the Hydrology Subcommittee, 190 p.

SCOUR REPORT SUMMARY

Structure Number 124007200400 *Stream* Caney Fork Creek

County Chester *Road* SC 72 *District* 4

Description of Bridge

Bridge length 100 *ft* *Bridge width* 35 *ft* *Max span length* 25 *ft*

Alignment of bridge to road (on curve or straight) Straight

Abutment type Spillthrough *Embankment type* Sloping

Riprap on abutment? Yes *Date of inspection* 9-1-1993

Description of riprap Both abutments are fully covered by 6- to 24-inch granite riprap.

Brief description of piers/pile bents Three interior bents, each consisting two 0.8-ft square steel exterior piles and two 2.0-ft square concrete interior piles. Footings are present at the base of the interior piles.

Is bridge skewed to flood plain according to USGS topo map? Yes *Angle* 33

Is bridge located on a bend in channel? Yes *If so, describe (mild, moderate, severe)* The stream bends slightly to the right at the bridge.

Debris accumulation on bridge at time of Level I or Level II site visit:

	Date of inspection	*Percent of channel blocked horizontally*	*Percent of channel blocked vertically*
Level I	7-16-1990	0	0
Level II	8-31-1993	--	--

Potential for debris Low because of pasture upstream

Describe any features near or at the bridge that may affect flow (include observation date). None observed on 8-31-1993.

Description of Flood Plain

General topography Typical Piedmont topography with rolling hills.

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

Date of inspection 9-1-1993

D/S left: Pasture with short grass and sparse hardwoods

D/S right: Pasture with short grass

U/S left: Pasture with short grass

U/S right: Pasture with short grass

Description of Channel

Average top width 28 *ft* *Average depth* 6.0 *ft*

Predominant bed material Medium sand *Bank material* Silty fine sand

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

Vegetative cover on channel banks near bridge: *Date of inspection* 9-1-1993

D/S left: Moderate undergrowth

D/S right: Moderate undergrowth

U/S left: Small pines and light undergrowth

U/S right: Small pines and light undergrowth

Do banks appear stable? Yes *If not, describe location and type of instability and date of observation.*

Describe any obstructions in channel and date of observation. None observed on 9-1-1993.

Hydrology

Drainage area 9.4 mi^2

Percentage of drainage area in physiographic provinces:

Physiographic province	*Percent of drainage area*
Piedmont (high flow)	100

Is drainage area considered rural or urban? Rural *Describe any significant urbanization and potential for development.* The drainage area encompasses a predominantly rural area with little development in recent years.

Is there a USGS gage on the stream of interest? No

USGS gage description _____

USGS gage number _____

Gage drainage area _____ mi^2

Is there a lake/pond that will significantly affect hydrology/hydraulics? No

If so, describe A small lake is present upstream but the effect on the hydrology/ hydraulics is assumed to be negligible.

Calculated Discharges

Q100 3,040 ft^3/s *Q500* 4,590 ft^3/s

Method used to determine discharges The method recommended by C. L. Sanders (written commun., 11-1993) was used to compute flood discharges. This method uses North Carolina USGS flood discharge equations (WRIR 87-4096) to compute the 100-year discharge, and extrapolates the 500-year discharge using the 2-, 10-, and 100-year discharges (USGS Bulletin 17B, p. 5-2).

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 306.4 ft to the USGS survey datum to obtain the SCDOT plans' datum (docket number 12.338).

Description of reference marks used to determine USGS datum. RM 1 is a chiseled square on the downstream left headwall of the Route SC 72 bridge (assumed elevation is 100.00 ft). RM 2 is a chiseled square on the upstream right headwall of the Route SC 72 bridge (surveyed elevation is 99.07 ft).

Cross Sections Used in WSPRO Analysis

*Cross section ID	*Section Reference Distance (SRD) in feet*	**How cross section was developed*	*Comments*
EXIT	-299	1	Exit cross section
FULV	0	2	Full-valley cross section
BRDG1	0	1	U/S bridge face
APPR	135	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

Description of data and assumptions used in developing WSPRO model.

Caney Fork Creek has a relatively uniform flood-plain width in the study area, with no downstream natural or man-made contractions of flow that cause significant backwater at the Route SC 72 crossing. Therefore, it was assumed that slope-conveyance methodology would be adequate for estimating the starting water-surface elevation for the water-surface profile computations.

For this study, the WSPRO model requires, as a minimum, an exit cross section one bridge width downstream of the bridge, a full-valley cross section at the downstream face of the bridge, the bridge cross section, and an approach cross section one bridge width upstream of the bridge. Cross sections at the upstream and downstream faces of the bridge were directly surveyed and the more constricted (upstream) bridge face was used in the WSPRO model. The section reference distance (SRD) at the downstream face of the bridge was set to zero. An exit channel cross section was surveyed 299 ft downstream of the downstream face of the Route SC 72 bridge and was used by the model at this SRD instead of one bridge width downstream of the bridge. An approach cross section was surveyed 191 ft upstream of the downstream face of the Route SC 72 bridge. The approach cross section was shifted by the channel slope to the appropriate SRD to represent the full-valley and approach cross sections required by the WSPRO model.

Bridge Hydraulics

Average embankment elevation 99.6 *ft*

Average low steel elevation 96.0 *ft*

100-year discharge 3,040 ft^3/s

Water-surface elevation at D/S bridge face 90.70 *ft*

Area of flow at D/S bridge face 315 ft^2

Average velocity in bridge opening 9.65 *ft/s*

Maximum WSPRO tube velocity at bridge 12.61 *ft/s*

Water-surface elevation at Approach section with bridge 93.61 *ft*

Water-surface elevation at Approach section without bridge 91.14 *ft*

Amount of backwater caused by bridge 2.47 *ft*

500-year discharge 4,590 ft^3/s

Water-surface elevation at D/S bridge face 91.95 *ft*

Area of flow at D/S bridge face 406 ft^2

Average velocity in bridge opening 11.31 *ft/s*

Maximum WSPRO tube velocity at bridge 14.72 *ft/s*

Water-surface elevation at Approach section with bridge 95.34 *ft*

Water-surface elevation at Approach section without bridge 92.07 *ft*

Amount of backwater caused by bridge 3.27 *ft*

Scour

Describe any special assumptions or considerations made in bridge scour analysis.

Scour depths were computed using engineering judgement and the general guidelines described in Hydraulic Engineering Circular 18 (Richardson and others, 1993) and the Transportation Research Board Draft Paper, "Evaluating scour at bridges using WSPRO" (Arneson and others, 1992). Scour depths were calculated assuming an infinite depth of erosive material and a homogeneous particle-size distribution. The results of the scour analysis are presented in tables 1 and 2 and a graph of the scour depths is shown on figure 2.

The local pier scour was determined using the Colorado State University pier scour equation (Richardson and others, 1993). Bents 2 through 4 are located in the channel and were analyzed using 90 percent of the maximum WSPRO tube velocity and the maximum depth within the channel at the bridge. The maximum depth within the channel was used to account for possible changes in the thalweg during a flood.

Clear-water scour conditions will dominate due to the pasture on the upstream flood plain carrying a large part of the flow which reduces the velocities in the approach channel, thereby decreasing sediment bed transport. In addition, the velocity of incipient motion for the D_{50} is greater than maximum tube velocity at the approach cross section for the 100- and 500-year flow. Therefore, it was decided that clear-water scour would best represent the contraction scour processes at the bridge, and the potential contraction scour was determined using Laursen's clear-water contraction scour equation (Richardson and others, 1993).

No abutment scour computations were made because the abutments are protected by riprap.

It should be noted that the SCDOT bridge plan borings (docket number 12.338) show subsurface rock that could affect the scour depths shown in this study. Footings are present at the interior piles, but no special analysis was made because the footings are set on rock. For more information, see the SCDOT bridge plans in the pocket at the back of the report.

Large discharges are typically found in the high-flow region of South Carolina. This bridge creates a significant amount of backwater which in turn creates a large amount of bridge scour. Because of the severe scour, a contraction width at the bridge of 60 ft was used in the scour analysis. The adjustment for pier widths was neglected.

WSPRO INPUT FILE

```
T1         Structure 124007200400, (100 ft bridge)
T2         Caney Fork Creek at SC 72, Chester County
T3         WJS 3-14-1995, file: wspro.cane
*
*           Q100     Q500
Q           3040     4590
*
SK          0.0023   0.0023
*
*          EXIT was surveyed 299 ft D/S of Route SC 72 and used as
*          the exit section at this location, even though it is more
*          than 1 bridge length downstream of the bridge.
*          Even though there is a small dam U/S, no flood routing was
*          assumedto be needed.  There is 4.4 ft of fall from the
*          Route SC 72 crossing to the railway trestle; therefore the
*          backwater effects from the railway trestle were considered
*          negligible and not included in the model.
*
XS    EXIT  -299
GR           0  101.0   5   96.8   24  89.2   42  87.1   52  88.6
GR          63   82.5  69   82.4   73  82.5   79  89.2  100  86.9
GR         139   86.4 321   89.0  407  94.6  468 100.4
N           0.10  0.04  0.045
SA             52     79
*
*          Approach data was shifted by WSPRO to the FULV section
*          using the appropriate section reference distance (SRD).
*
XT    SURV1  191  0.0023
GR           0  103.2 27 99.3  72 93.5 108 90.5 182 88.8 278 89.2
GR         284  83.5 285 83.4 286 83.5 289 83.6 291 83.6 294 83.6
GR         306  88.9 347 87.8 403 88.4 446 86.9 492 88.8 650 87.8
GR         766  88.9 870 91.1 922 97.9 938 99.4
*
XS    FULV    0
GT
N              0.10   0.040   0.08
SA                 278     306
*
*                      U/S FACE OF BRIDGE
*
BR    BRDG1  0  96.0
GR           0 96.4 1.1 96.4 15   93.0  25 87.2 35 86.0 39 83.5 45 83.5
GR          50 85.7  53 87.0 59   86.1  61 83.3 65 83.1 70 86.6 75 86.0
GR          84 88.8  89 90.6 98.9 95.5 100 95.5  0 96.4
N          0.040  0.035  0.040
SA             35      70
CD         3  35 1.5  99.6
KD         *   *   *   261  326
PW 1       85.7 2.0 86.0 2.0 86.0 4.0 87.2 4.0 87.2 6.0 96.0 6.0 96.0 0
*          SRD OF APPROACH( 100 FT + 35 FT )= 135 FT
*
AS    APPR   135
BP           243
GT
N              0.040   0.040   0.045
SA                 278     306
*
```

WSPRO INPUT FILE --Continued

```
*
HP 1 BRDG1 90.70 0 90.70
HP 2 BRDG1 91.03 0 91.03 3040
HP 1 APPR  93.61 0 93.61
HP 2 APPR  93.61 0 93.61 3040
*
HP 1 BRDG1 91.95 0 91.95
HP 2 BRDG1 92.29 0 92.29 4590
HP 1 APPR  95.34 0 95.34
HP 2 APPR  95.34 0 95.34 4590
*
EX
ER
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WSPRO OUTPUT

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WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V042094            MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

        Structure 124007200400, (100 ft bridge)
        Caney Fork Creek at SC 72, Chester County
        WJS 3-14-1995, file: wspro.cane
           *** RUN DATE & TIME: 03-16-95  13:01
    CROSS-SECTION PROPERTIES:  ISEQ =  3;  SECID = BRDG1;  SRD =       0.

     WSEL  SA#      AREA         K   TOPW   WETP  ALPH     LEW     REW      QCR
             1        52      4017     16     17                              525
             2       207     26719     35     39                             2850
             3        57      4232     19     20                              553
    90.70            315     34968     70     76  1.15      19      89      3534


    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRDG1;  SRD =       0.

         WSEL      LEW      REW     AREA         K         Q     VEL
        91.03     18.4     89.9    338.4   38817.    3040.    8.98

X STA.        18.4        29.0        33.5        36.8        38.9        40.5
  A(I)            28.9        20.6        17.3        14.3        12.4
  V(I)            5.26        7.37        8.77       10.60       12.30

X STA.        40.5        42.1        43.8        45.4        47.4        49.9
  A(I)            12.2        12.4        12.3        13.7        15.0
  V(I)           12.47       12.27       12.39       11.13       10.11

X STA.        49.9        54.0        57.9        61.2        62.7        64.3
  A(I)            18.5        17.6        19.3        12.0        12.1
  V(I)            8.24        8.63        7.89       12.61       12.57

X STA.        64.3        66.0        68.3        72.4        76.8        89.9
  A(I)            13.1        15.2        19.2        21.2        31.1
  V(I)           11.64        9.98        7.94        7.16        4.89
```

WSPRO OUTPUT --Continued

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WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V042094            MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

      Structure 124007200400, (100 ft bridge)
      Caney Fork Creek at SC 72, Chester County
      WJS 3-14-1995, file: wspro.cane
         *** RUN DATE & TIME: 03-16-95  13:01
   CROSS-SECTION PROPERTIES:  ISEQ =  4;  SECID = APPR ;  SRD =     135.

    WSEL  SA#      AREA         K   TOPW   WETP  ALPH     LEW     REW      QCR
          1         822     76575    208    208                              9281
          2         236     33802     28     31                              3896
          3        2975    291481    584    585                             38097
   93.62           4034    401859    820    824  1.04      70     890     49745


   VELOCITY DISTRIBUTION:  ISEQ =  4;  SECID = APPR ;  SRD =     135.

        WSEL      LEW      REW     AREA         K         Q      VEL
       93.62     70.1    890.3   4033.9   401859.    3040.     0.75

X STA.          70.1       160.1       202.6       243.9       283.3       295.3
  A(I)             263.6       203.9       197.1       195.0       121.8
  V(I)              0.58        0.75        0.77        0.78        1.25

X STA.         295.3       326.3       359.3       393.4       427.5       454.1
  A(I)             181.3       189.5       192.1       193.8       174.8
  V(I)              0.84        0.80        0.79        0.78        0.87

X STA.         454.1       486.5       528.0       565.4       601.0       634.9
  A(I)             189.0       210.4       197.9       196.5       194.7
  V(I)              0.80        0.72        0.77        0.77        0.78

X STA.         634.9       668.3       703.4       744.2       793.1       890.3
  A(I)             196.8       196.6       214.1       232.1       292.9
  V(I)              0.77        0.77        0.71        0.66        0.52
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WSPRO OUTPUT --Continued

```
WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V042094            MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

        Structure 124007200400, (100 ft bridge)
        Caney Fork Creek at SC 72, Chester County
        WJS 3-14-1995, file: wspro.cane
           *** RUN DATE & TIME: 03-16-95  13:01
    CROSS-SECTION PROPERTIES:  ISEQ =  3;  SECID = BRDG1;  SRD =       0.

     WSEL  SA#      AREA         K   TOPW   WETP  ALPH    LEW     REW      QCR
           1          73      6540     18     20                              829
           2         250     36795     35     39                             3802
           3          82      7209     22     23                              909
    91.95            406     50544     75     81  1.15     17      92      4996


    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRDG1;  SRD =       0.

         WSEL      LEW      REW     AREA         K         Q     VEL
        92.29     16.2     92.4    431.4   55247.    4590.   10.64

X STA.        16.2        27.8        32.4        36.1        38.5        40.3
  A(I)          37.0        26.5        22.8        18.5        16.3
  V(I)          6.20        8.66       10.06       12.43       14.12

X STA.        40.3        42.1        43.9        45.7        47.9        50.7
  A(I)          15.6        15.6        16.2        17.3        19.2
  V(I)         14.69       14.72       14.16       13.30       11.97

X STA.        50.7        54.7        58.2        61.3        63.1        64.8
  A(I)          22.4        20.4        23.3        15.8        15.6
  V(I)         10.22       11.26        9.86       14.54       14.70

X STA.        64.8        66.8        69.8        74.0        78.6        92.4
  A(I)          17.4        20.6        24.8        26.7        39.4
  V(I)         13.20       11.17        9.26        8.58        5.82
```

WSPRO OUTPUT --Continued

```
WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V042094            MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

     Structure 124007200400, (100 ft bridge)
     Caney Fork Creek at SC 72, Chester County
     WJS 3-14-1995, file: wspro.cane
        *** RUN DATE & TIME: 03-16-95  13:01
  CROSS-SECTION PROPERTIES:  ISEQ =  4;  SECID = APPR ;  SRD =     135.

  WSEL  SA#      AREA         K    TOPW   WETP  ALPH    LEW    REW      QCR
        1        1192    136242     221    222                        15689
        2         284     46046      28     31                         5145
        3        3991    468602     597    598                        58543
 95.34           5467    650890     847    851  1.02     57    903      77907


  VELOCITY DISTRIBUTION:  ISEQ =  4;  SECID = APPR ;  SRD =     135.

       WSEL      LEW      REW     AREA         K         Q      VEL
      95.34     56.7    903.4   5467.4   650890.    4590.     0.84

X STA.        56.7     147.4     190.9     230.4     270.2     292.8
  A(I)       353.5     276.3     258.6     254.2     208.8
  V(I)        0.65      0.83      0.89      0.90      1.10

X STA.       292.8     322.3     357.0     392.1     427.6     456.9
  A(I)       235.3     257.4     259.0     261.6     243.1
  V(I)        0.98      0.89      0.89      0.88      0.94

X STA.       456.9     492.6     532.9     571.4     608.0     642.9
  A(I)       263.1     274.6     271.1     266.6     261.9
  V(I)        0.87      0.84      0.85      0.86      0.88

X STA.       642.9     677.3     715.7     756.7     805.7     903.4
  A(I)       260.4     277.6     280.8     305.9     397.4
  V(I)        0.88      0.83      0.82      0.75      0.58
```

WSPRO OUTPUT --Continued

```
WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V042094            MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

        Structure 124007200400, (100 ft bridge)
        Caney Fork Creek at SC 72, Chester County
        WJS 3-14-1995, file: wspro.cane
           *** RUN DATE & TIME: 03-16-95  13:01

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

EXIT :XS    ******      21       924  0.22  *****   90.60   89.18     3040   90.38
      -298  ******     342     63376  1.31  ***** *******    0.39     3.29

 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                              "FULV "     KRATIO =  1.45

FULV :FV       299      97      2201  0.07  0.47   91.08 *******     3040   91.01
         0     299     873     91915  2.27  0.00    0.01    0.22     1.38
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                              "APPR "     KRATIO =  1.51

APPR :AS       135      99      2059  0.04  0.10   91.18 *******     3040   91.14
       135     135     871    139087  1.15  0.00    0.00    0.17     1.48
         <<<<<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

BRDG1:BR       299      19       315  2.49  1.25   93.20   90.48     3040   90.70
         0     299      89     34985  1.72  1.35    0.00    1.05     9.65

     TYPE PPCD FLOW      C     P/A    LSEL   BLEN   XLAB   XRAB
       3.   1.   1.  0.762   0.084   96.00 ****** ****** ******

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

APPR :AS       100      70      4029  0.01  0.10   93.62   89.31     3040   93.61
       135     149     890    401057  1.04  0.33    0.01    0.06     0.75

      M(G)    M(K)       KQ    XLKQ    XRKQ    OTEL
     0.908   0.871   51701.    261.    326.    93.61

                  <<<<<END OF BRIDGE COMPUTATIONS>>>>>
```

WSPRO OUTPUT --Continued

```
WSPRO          FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY
V042094            MODEL  FOR  WATER-SURFACE  PROFILE  COMPUTATIONS

        Structure 124007200400, (100 ft bridge)
        Caney Fork Creek at SC 72, Chester County
        WJS 3-14-1995, file: wspro.cane
           *** RUN DATE & TIME: 03-16-95  13:01

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

EXIT :XS    ******      19      1224  0.27  *****   91.56    89.67     4590    91.29
      -298  ******     356     95703  1.23  ***** *******     0.39     3.75

 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                              "FULV "      KRATIO =  1.48

FULV :FV       299      85      2942  0.07  0.47    92.03 *******     4590    91.96
          0    299     880    141540  1.93  0.00     0.00     0.20     1.56
          <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                              "APPR "      KRATIO =  1.58

APPR :AS       135      88      2788  0.05  0.09    92.12 *******     4590    92.07
       135     135     878    224144  1.08  0.00     0.00     0.16     1.65
          <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===285 CRITICAL WATER-SURFACE ELEVATION  A _ S _ S _ U _ M _ E _ D !!!!!
                    SECID "BRDG1"     Q,CRWS =     4590.       91.95

              <<<<<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

BRDG1:BR       299      17       406  2.96  *****   94.91    91.95     4590    91.95
          0    299      92     50572  1.49  ***** *******     1.05    11.31

      TYPE PPCD FLOW       C     P/A     LSEL   BLEN   XLAB   XRAB
        3.   1.   1.   0.820   0.084    96.00 ****** ****** ******

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

APPR :AS       100      57      5467  0.01  0.10    95.35    89.61     4590    95.34
       135     153     903    650851  1.02  0.34    -0.02     0.06     0.84

       M(G)   M(K)        KQ    XLKQ    XRKQ     OTEL
      0.905  0.883    76246.    261.    326.     95.33

                    <<<<<END OF BRIDGE COMPUTATIONS>>>>>
```

PIER SCOUR COMPUTATIONS
FOR
Caney Fork Creek at SC 72, Struc. 124007200400, Chester Co.,
Q100, WJS 3-16-95, file scour.1.cane

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	4	3	2
PIER STATION (FT)	25	50	75
LOCATION OF PIER	lb	mcm	rb
Y1: DEPTH (FT)	7.9	7.9	7.9
V1: VEL. (FPS)	11.3	11.3	11.3
a: PIER WIDTH (FT)	2.0	2.0	2.0
L: PIER LENGTH (FT)	5.6	5.6	5.6
PIER SHAPE	1	1	1
ATTACK ANGLE	0	0	0
K1 (SHAPE COEF.)	1.10	1.10	1.10
K2 (ANGLE COEF.)	1.00	1.00	1.00
FROUDE NO.	0.71	0.71	0.71

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	6.14	6.14	6.14
MAX SCOUR DEPTH (FT)	6.75	6.75	6.75

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

CONTRACTION SCOUR COMPUTATIONS
FOR
Caney Fork Creek at SC 72, Struc. 124007200400, Chester Co.,
Q100, WJS 3-16-95, file scour.1.cane

MAIN CHANNEL IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	3040.
WIDTH OF CONTRACTED SECTION (FT)	=	60.0
MEDIAN GRAIN SIZE (FT)	=	0.0022
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	21.3
AVERAGE FLOOD PLAIN DEPTH (FT)	=	6.0
DEPTH OF CONTRACTION SCOUR (FT)	=	15.2

PIER SCOUR COMPUTATIONS
FOR
Caney Fork Creek at SC 72, Struc. 124007200400, Chester Co.,
Q500, WJS 3-16-95, file scour.5.cane

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	4	3	2
PIER STATION (FT)	25	50	75
LOCATION OF PIER	lb	mcm	rb
Y1: DEPTH (FT)	9.2	9.2	9.2
V1: VEL. (FPS)	13.2	13.2	13.2
a: PIER WIDTH (FT)	2.0	2.0	2.0
L: PIER LENGTH (FT)	5.6	5.6	5.6
PIER SHAPE	1	1	1
ATTACK ANGLE	0	0	0
K1 (SHAPE COEF.)	1.10	1.10	1.10
K2 (ANGLE COEF.)	1.00	1.00	1.00
FROUDE NO.	0.77	0.77	0.77

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	6.70	6.70	6.70
MAX SCOUR DEPTH (FT)	7.37	7.37	7.37

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

CONTRACTION SCOUR COMPUTATIONS
FOR
Caney Fork Creek at SC 72, Struc. 124007200400, Chester Co.,
Q500, WJS 3-16-95, file scour.5.cane

MAIN CHANNEL IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	4590.
WIDTH OF CONTRACTED SECTION (FT)	=	60.0
MEDIAN GRAIN SIZE (FT)	=	0.0022
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	30.3
AVERAGE FLOOD PLAIN DEPTH (FT)	=	7.3
DEPTH OF CONTRACTION SCOUR (FT)	=	23.0

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Water Resources Division
Stephenson Center, Suite 129
720 Gracern Road
Columbia, SC 29210-7651

March 20, 1995

William H. Hulbert, P.E.
Hydraulic Engineer
South Carolina Department of Transportation
955 Park Street
Columbia, South Carolina 29202

Dear Mr. Hulbert:

We are pleased to transmit another report of the Level II Bridge Scour Program titled, "Level II bridge scour analysis for structure 124007200400 on Route SC 72, crossing Caney Fork Creek in Chester County, South Carolina", by Whitney J. Stringfield and Michael G. Zalants. The technical aspects of the report have been reviewed and approved by the South Carolina District Hydraulic Section Chief.

If you have any questions concerning this report, please contact me (750-6131) or Michael Zalants (750-6159) and we will be glad to assist you.

Sincerely,

Whitney J. Stringfield

Whitney J. Stringfield
Hydrologist

Enclosure

INDEX OF SHEETS

Sheet No 1 Title Sheet
" " 2 Traffic Control Devices
" " 3 Plan and Profile of Roadway
" " 4 Plan and Profile of Soil
" " 5 Masonry Details - Substructure
" " 6 " " Superstructure
" " 7 Existing Structure
" " 8 Typical Plan and Profile

STATE HI

DEPARTMENT

PROPOSED

STATE

F.A.P.

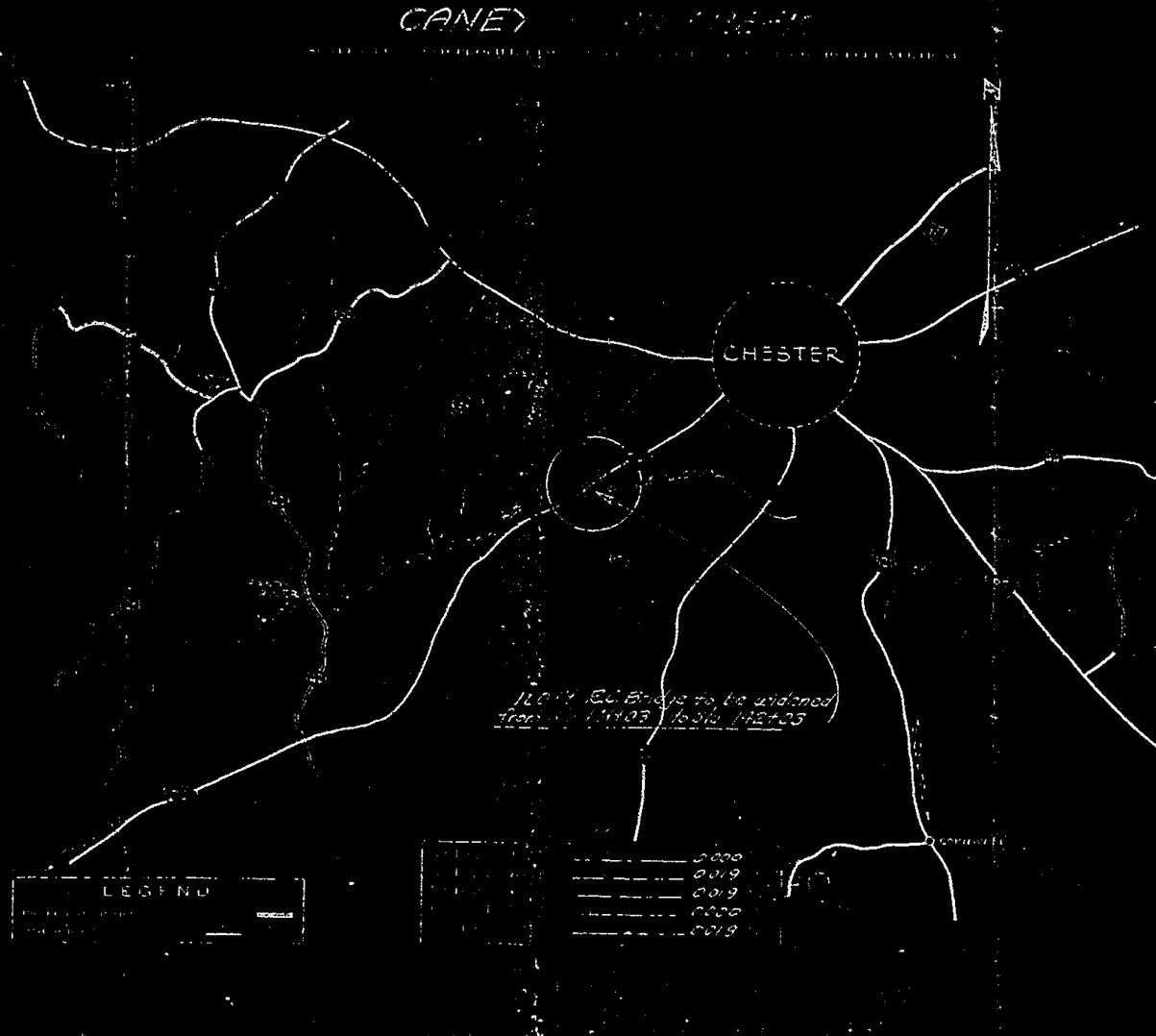
CHEST

DOCK

&

WIDEN

CANEY



SUMMARY OF ESTIMATED QUANTITIES

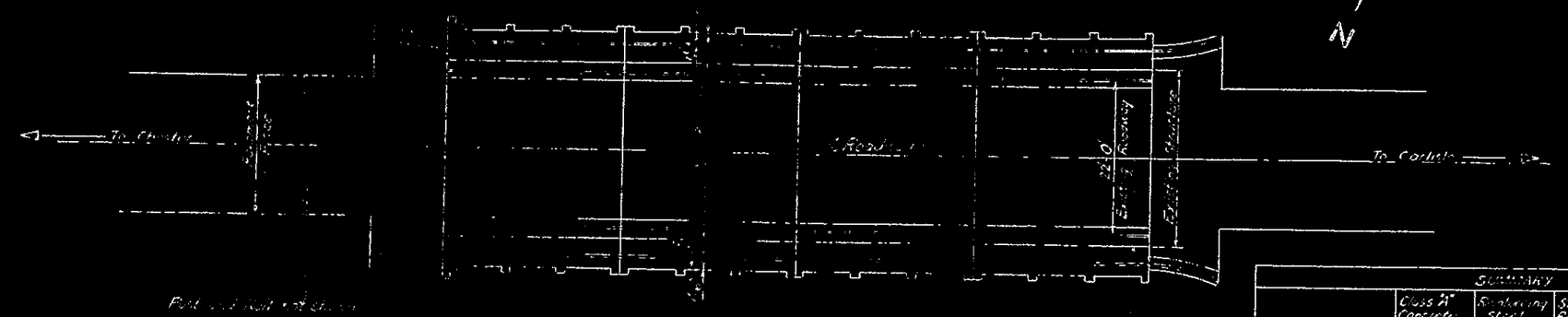
SUMMARY OF QUANTITIES

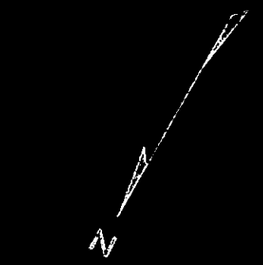
Class 'A' Concrete (Bridge)	630 CY
Reinforcing Steel	11851 Lbs
Steel H-Piling	220 LF

5-17 Leaman 4/1/

DEPARTMENT OF COMMERCE

Co. No.	State	County	Sheet No.	Total Sheets	Item No.
3	S.C.	Chester	12338	12	4





SUMMARY OF QUANTITIES

	Class A Concrete	Reinforcing Steel	Steel H Piling Pcs.				
Bents 1-2	75 CY	7754 lbs	See Tab. 1				
End Spans 1 & 4	276 CY	5500 Lbs	—				
Int. Spans 2-3	260 CY	5414 Lbs	—				
Curb & Gutter	19 CY	—	—				
Total	630 CY	11,854 lbs	220 L.F.				

B.M. No. 1 Nail in 16" Pine 35' Rt. of Sta. 1+15 Elev. = 396.44

B.M. No. 2 Nail in 16" Pine 45' Rt. Sta. 1+13 Elev. = 402.19

NOTES:

Maintenance of Traffic

Two way traffic shall be maintained over the bridge at all times and the existing roadway width shall not be reduced.

The Department can furnish steel piling in the approximate lengths shown on the plans but not to exact length that may be called for by the contractor. These piles will be loaded on the contractors trucks at the Sloan Street Yard in Columbia and the contractor will be charged at the rate of $ 2.65 per linear ft. for the total length furnished.

NOTES:

Construct Curb & Gutter on both sides of roadway. Earthfills at Bridge Approaches to be Concrete Block supported with rods of reinforcement through every other block and grouted.

Reset M.E. Engineer to establish elevation of finished grade at the Roadway of the end of bridge approach about 10 ft. Rt. and Lt. of about 100 ft back from each end of bridge for the purpose of matching grade.

Finished grade for the reconstructed Bridge. New finished grade to be set approximately 4" above existing finished grade.

State Maintenance Forces will resurface the existing bridge with asphalt to a compacted depth of 1" at the ℄ of roadway.

The finished grade for the new bridge shall be established and tapered to the existing roadway finished grade by extending the new approach to the adjacent road for an approximate distance of 100 ft.

Work to be done consists of removing designated portions of the existing bridge and widening in accordance with these plans.

Note See Profile on Rocky Creek Profile regards to the Department furnishing the H Piles.

STATE HIGHWAY DEPARTMENT
COLUMBIA

PLAN AND PROFILE
FOR WIDENING BRIDGE OVER
CANEY FORK CREEK

Docket No. 12338 CHESTER Co.
Route No. 72 MARCH 1956

Drawn Marked by R.C.H. 3-56
Checked By C.H.B. 3-56

PILE RECORD ON [illegible] NO.

Carney Fork Creek

FED. ROAD DIV. NO.	STATE	COUNTY	DOCKET NO.	ROUTE NO.	SHEET NO.	TOTAL SHEETS
[illegible]	S.C.	[illegible]	[illegible]	72	31	[illegible]

WEIGHT OF HAMMER 3500 lbs? TYPE Drop

DATE 1956	BENT NO.	FOOTING	PILE NO.	DIAM. AT BUTT	DIAM. AT TIP	ORIG. LENGTH	BUILD-UP OR SPLICE	TOTAL LENGTH	LENGTH C.O.	NET LENGTH	ELEV. C.O.	ELEV. PILE TIP	ELEV. ORIG. GROUND OR BOTTOM OF FOOTING	PEN. IN GROUND OR BELOW FOOTING	PEN. PER BLOW	FALL OF HAMMER	BEARING VALUE Tons	PAY LENGTH L.F.	C.O. @ 40%	C.O. @ 25%
[illegible]	3	—	[illegible]	14"?	—	25.00	—	25.00	2.00	23.00	402.37?	377.45?	390.42?	10.97?	0.42?	[illegible]	30.4	23.00		
[illegible]	3	—	[illegible]	[illegible]	—	25.00	—	25.00	3.12	21.88	[illegible]	[illegible]	[illegible]	10.75	0.42?	[illegible]	30.2?	21.88		
[illegible]	2	—	[illegible]	[illegible]	—	30.00	—	30.00	4.75	[illegible]	[illegible]	[illegible]	[illegible]	11.80?	[illegible]	[illegible]	31.9	25.25		
[illegible]	4	—	[illegible]	[illegible]	—	27.50	—	27.50	0.67?	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.65?	[illegible]	30.0	26.83		
[illegible]	4	—	[illegible]	[illegible]	—	27.50	—	27.50	3.17	[illegible]	[illegible]	[illegible]	[illegible]	16.60?	0.60	[illegible]	[illegible]	24.33		
[illegible]	2	—	[illegible]	[illegible]	—	27.50	—	27.50	0.00	27.50	[illegible]	[illegible]	[illegible]	17.85?	0.65	[illegible]	30.0	27.50		
[illegible]	1	—	[illegible]	[illegible]	—	27.50	—	27.50	6.75	20.75	[illegible]	381.23?	400.66?	19.43?	0.60	[illegible]	30.9?	20.75		
[illegible]	1	—	[illegible]	[illegible]	—	30.00	—	30.00	5.17	[illegible]	[illegible]	[illegible]	400.66?	[illegible]	0.6?	[illegible]	31.9	24.83		
[illegible]	5	—	[illegible]	[illegible]	—	27.50	—	27.50	1.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.55?	[illegible]	30.0	26.50		
[illegible]	5	—	[illegible]	[illegible]	—	27.50	—	27.50	4.93	[illegible]	[illegible]	[illegible]	[illegible]	21.24?	0.65?	[illegible]	30.0	22.57		
TOTAL								275.00	31.56	243.44								243.44		

Bent #		Footing Elev.
2	376.98	381.5 (use)
3	380.37	381.8
4	378.35	382.0

	TOTAL LENGTH	LENGTH C.O.	NET LENGTH	PAY LENGTH
TOTAL	275.00	31.56	243.44	243.44
GRAND TOTAL	275.00	31.56	243.44	243.44

NOTES CONCERNING ANY UNUSUAL FOUNDATION CONDITIONS

BENT NO.	FOOTING	PILE NO.	REMARKS
2	—	[illegible]	Pile driven 6" below grade [illegible] minimum bearing value obtained — No splice

NOTES:

PAY LENGTH SHOULD INCLUDE ALLOWANCE FOR SPLICING STEEL PILES AND ANY OTHER AUTHORIZED ALLOWANCES.

NUMBERING PILES: A SKETCH OF BENT OR FOOTING TO BE DRAWN ON THIS SHEET AND PILES TO BE NUMBERED. ALSO FLOW OF STREAM TO BE SHOWN.

PENETRATION PER BLOW: GIVE THIS INFORMATION IN DECIMALS OF AN INCH.

[illegible signature/initials]

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

BATON ROUGE QUADRANGLE
SOUTH CAROLINA—CHESTER CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

(SHARON 1:62 500) 4753 IV

(ROCK HILL 1:62 500) 4753 I

81°22'30" 81°15' 34°45' 34°37'30" 42'30" 40' 20' 17'30"

466000m E. 467 468 469 470 471 472 473 474 475 476

1 890 000 FEET 1 920 000 FEET 630 000 FEET 600 000 FEET

3845000m N. 3844 3843 3842 3841 3840 3839 3838 3837 3836 3835 3834 3833 3832

LOWRYS 6 MI. (SHARON 1:62 500) 4753 IV

HICKORY GROVE 21 MI.

19 MI. TO U.S. 176 LOCKHART 6 MI.

CHESTER 3.2 MI. 28 MI. TO U.S. 21

CHESTER 2 MI.

CHESTER 2.6 MI. ROCK HILL 22 MI.

LEEDS 1.7 MI.

CARLISLE 8 MI. 38 MI. TO INT. 26

4753 III NW (LEEDS)

4753 II NW (CHESTER)

(CARLISLE) 4753 III SW

(BLACKSTOCK) 4753 II SW

STUDY AREA

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography by photogrammetric methods from aerial photographs taken 1968. 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

MN GN
2½° 44 MILS 0°11' 3 MILS
UTM GRID AND 1969 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24000
1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER
CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

EXPLANATION
EXIT cross section

S.C.
QUADRANGLE LOCATION

ROAD CLASSIFICATION
Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
Interstate Route U. S. Route State Route

Figure 1.--Topography of study area and location of cross sections used in WSPRO analysis for structure 124007200400 on Route SC 72, crossing Caney Fork Creek in Chester County, South Carolina.

BATON ROUGE, S. C.
N3437.5—W8115/7.5
1969
AMS 4753 III NE—SERIES V846

★U.S. GOVERNMENT PRINTING OFFICE: 1973—516—079/5