U.S. DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

LEVEL II BRIDGE SCOUR ANALYSIS FOR STRUCTURE 124000901100 ON ROUTE SC 9, CROSSING FISHING CREEK IN CHESTER COUNTY, SOUTH CAROLINA

By Andy W. Caldwell and Michael G. Zalants

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.

Level II bridge scour analysis for structure 124000901100 on Route SC 9, crossing Fishing Creek in Chester County, South Carolina

by Andy W. Caldwell and Michael G. Zalants

This report provides the results of the detailed Level II analysis of scour potential at structure 124000901100 on Route SC 9, crossing Fishing Creek in Chester County, South Carolina (figure 1 in pocket; figures 4-7). The site is located in the Piedmont physiographic province near the town of Fort Lawn in the eastern part of Chester County. The drainage area for the site is 246 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 moderate woods consisting of hardwoods and a pasture on the downstream left flood plain.

In the study area, Fishing Creek has a meandering channel with a slope of approximately 0.00037 ft/ft (2.0 ft/mi), an average channel top width of 107 ft and an average channel depth of 11.7 ft. The predominant channel bed material is sand (D_{50} is 0.97 mm) and the channel banks consist of a silty sand (D_{50} is 0.31 mm). In general, the banks have moderate woody vegetative cover and were noted to be relatively stable at the time of the Level I and Level II site visits, July 19, 1990, and August 3 and September 2, 1993, respectively.

The Route SC 9 crossing of Fishing Creek is a 445-ft-long, two-lane bridge consisting of one 50-ft, two 40-ft, and nine 35-ft concrete spans, with the original structure supported by concrete piers and the widened part of the structure supported by concrete pile bents with spillthrough abutments at each end of the bridge. The left abutment is protected by riprap but the riprap at the right abutment has slumped due to road drainage. 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 through 5 and a graph of the scour depths is shown on figure 2.

Pile penetration depths were obtained from the SCDOT bridge plans. The minimum remaining pile penetration depth for the 100-year discharge is 2.4 ft and occurs at bent 7. Undermining of the pile tips occurs for the 500-year discharge. The maximum undermining depth is 3.0 ft and occurs at bent 7.

It should be noted that the SCDOT bridge plan borings (docket number 12.407) 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-year discharge at structure 124000901100 on Route SC 9, 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 pile/footing penetration (feet)
100-year discharge is 24,800 cubic feet per second							
8	35	465.9	65.4	79.2	9.0	70.2	4.8
7	70	464.1	63.6	75.1	9.1	66.0	2.4
6	105	461.0	60.5	74.1	9.2	64.9	4.4
5	140	457.7	57.2	74.9	9.1	65.8	8.6
D	175	457.7	57.2	75.5	9.1	66.4	9.2
C	215	456.8	56.3	64.5	3.3	61.2	4.9
B	265	457.3	56.8	63.2	3.3	59.9	3.1
A	305	457.7	57.2	73.6	11.8	61.8	4.6
4	340	456.8	56.3	74.9	11.8	63.1	6.8
3	375	458.0	57.5	74.2	11.8	62.4	4.9
2	410	457.7	57.2	74.4	11.8	62.6	5.4

[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] Pile tip/footing elevations obtained from the 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.

NOTE: The SCDOT bridge plan borings (docket number 12.407) 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. *--Remaining pile/footing penetration at piers/bents for the 500-year discharge at structure 124000901100 on Route SC 9, 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 36,000 cubic feet per second							
8	35	465.9	65.4	79.2	14.4	64.8	-0.6
7	70	464.1	63.6	75.1	14.5	60.6	-3.0
6	105	461.0	60.5	74.1	14.5	59.6	-0.9
5	140	457.7	57.2	74.9	14.5	60.4	3.2
D	175	457.7	57.2	75.5	14.5	61.0	3.8
C	215	456.8	56.3	64.5	3.6	60.9	4.6
B	265	457.3	56.8	63.2	3.6	59.6	2.8
A	305	457.7	57.2	73.6	18.2	55.4	-1.8
4	340	456.8	56.3	74.9	18.2	56.7	0.4
3	375	458.0	57.5	74.2	18.2	56.0	-1.5
2	410	457.7	57.2	74.4	18.2	56.2	-1.0

[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] Pile tip/footing elevations obtained from the 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 12.407) 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 3. --*Cumulative scour depths at piers/bents for the 100-year discharge at structure 124000901100 on Route SC 9, 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)
100-year discharge is 24,800 cubic feet per second				
8	35	6.5	2.5	9.0
7	70	6.5	2.6	9.1
6	105	6.5	2.7	9.2
5	140	6.5	2.6	9.1
D	175	6.5	2.6	9.1
C	215	0[4]	3.3	3.3
B	265	0[4]	3.3	3.3
A	305	9.1	2.7	11.8
4	340	9.1	2.7	11.8
3	375	9.1	2.7	11.8
2	410	9.1	2.7	11.8

[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.

[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 12.407) 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.

Table 4. *--Cumulative scour depths at piers/bents for the 500-year discharge at structure 124000901100 on Route SC 9, 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 36,000 cubic feet per second				
8	35	11.2	3.2	14.4
7	70	11.2	3.3	14.5
6	105	11.2	3.3	14.5
5	140	11.2	3.3	14.5
D	175	11.2	3.3	14.5
C	215	0[4]	3.6	3.6
B	265	0[4]	3.6	3.6
A	305	15.1	3.1	18.2
4	340	15.1	3.1	18.2
3	375	15.1	3.1	18.2
2	410	15.1	3.1	18.2

[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.

[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 12.407) 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.

Table 5. --*Abutment scour depths for the 100- and 500-year discharges at structure 124000901100 on Route SC 9, crossing Fishing Creek in Chester County, South Carolina*

Recurrence interval for discharge	Discharge (cubic feet per second)	Depth of scour[1, 2] at left abutment (feet)	Depth of scour[1, 2] at right abutment (feet)
100-year	24,800	----	21.3
500-year	36,000	----	27.6

[1] Abutment scour depths were calculated using the Froehlich (1989) live-bed abutment scour equation, assuming no abutment protection.

[2] The words "right" and "left" refer to directions that would be reported by an observer facing downstream.

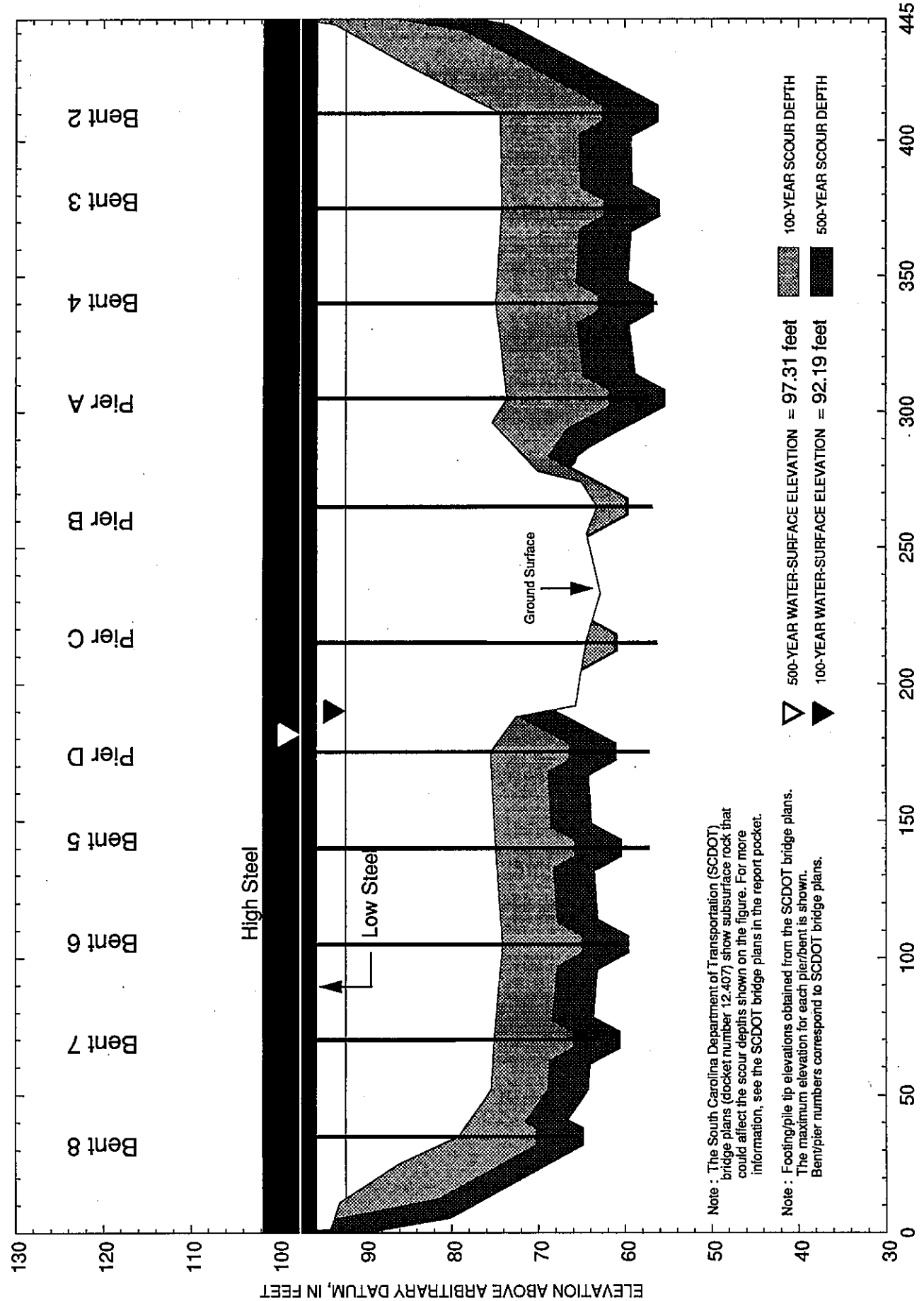

Figure 2.--Total scour depths for the 100- and 500-year discharges at the upstream face of structure 12400090l100 on SC 97, crossing Fishing Creek in Chester County, South Carolina.

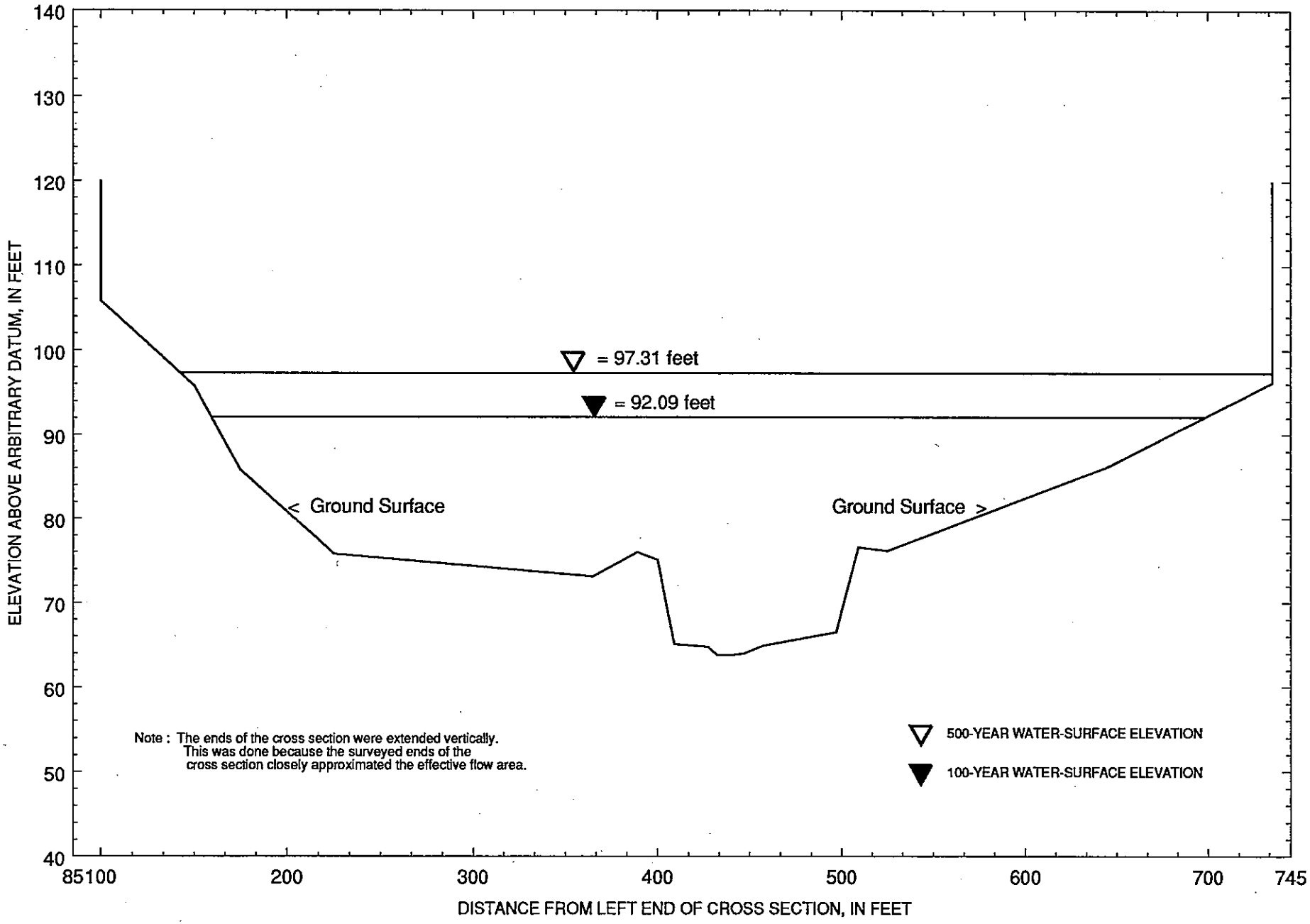

Figure 3.--Approach cross section at structure 124000901100 on Route SC 9, crossing Fishing Creek in Chester County, South Carolina.

Figure 4.--Structure 124000901100 on Route SC 9, crossing Fishing Creek in Chester County, South Carolina as viewed from downstream (July 19, 1990).

Figure 5.--Structure 124000901100 on Route SC 9, crossing Fishing Creek in Chester County, South Carolina as viewed from upstream (July 19, 1990).

Figure 6.--Downstream channel as viewed from structure 124000901100 on Route SC 9, crossing Fishing Creek in Chester County, South Carolina (July 19, 1990).

Figure 7.--Upstream channel as viewed from structure 124000901100 on Route SC 9, crossing Fishing Creek in Chester County, South Carolina (July 19, 1990).

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SCOUR REPORT SUMMARY

Structure Number 124000901100 *Stream* Fishing Creek

County Chester *Road* SC 9 *District* 4

Description of Bridge

Bridge length 445 *ft* *Bridge width* 49 *ft* *Max span length* 50 *ft*

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

Abutment type spillthrough *Embankment type* sloping

Riprap on abutment? yes *Date of inspection* 7-19-1990

Description of riprap Six- to 16- inch granite present at both abutments. Riprap is slumped at the right abutment due to road drainage.

Brief description of piers/pile bents Eleven interior concrete piers support the original structure. The structure has been widened at the upstream and downstream ends of the bridge and the widened structure is supported by three 1.0-ft square concrete piles.

Is bridge skewed to flood plain according to USGS topo map? no *Angle* 0

Is bridge located on a bend in channel? _____ *If so, describe (mild, moderate, severe)*

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	7-19-1990	25	15
Level II	8-3-1993	---	---

Potential for debris Moderate to high due to high flow velocities and the large amount of debris along the channel banks and on the flood plain.

Describe any features near or at the bridge that may affect flow (include observation date). Several timber pile stumps approximately 15 ft upstream of the bridge, possibly from a previous structure, were observed in the channel during the Level I inspection on July 19, 1990.

Description of Flood Plain

General topography Typical Piedmont topography

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

Date of inspection 9-2-1993

D/S left: Pasture with short grass

D/S right: Moderately thick hardwoods and some undergrowth

U/S left: Moderately thick hardwoods and some undergrowth

U/S right: Moderately thick hardwoods and some undergrowth

Description of Channel

Average top width 107 *ft* *Average depth* 11.7 *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* 9-2-1993

D/S left: Moderate woody vegetative cover

D/S right: Moderate woody vegetative cover

U/S left: Moderate woody vegetative cover

U/S right: Moderate woody vegetative cover

Do banks appear stable? yes *If not, describe location and type of instability and date of observation.* Some bank failure was noted on the upstream left bank at the time of the Level I inspection on 7-19-1990.

Describe any obstructions in channel and date of observation. None observed.

Hydrology

Drainage area 246 mi^2

Percentage of drainage area in physiographic provinces:

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

Is drainage area considered rural or urban? rural *Describe any significant urbanization and potential for development.* There is no significant urbanization and a low potential for future development in the drainage basin.

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 _____

Calculated Discharges

Q100 24,800 ft^3/s *Q500* 36,000 ft^3/s

Method used to determine discharges The drainage basin is located in the "high-flow" area of the State; therefore, the method described by C.L. Sanders (11-30-1993) was used to compute flood discharges. In general, this method uses North Carolina USGS flood discharge equations (WRIR 87-4096) to compute the 100-year discharge, and extrapolation using 2-, 10-, and 100-year discharges to compute the 500-year discharge.

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 400.5 ft to USGS survey datum to obtain SCDOT bridge plan's datum (docket number 12.407). Add 319.7 ft to the USGS datum to obtain the SCDOT road plan's datum (project number 68reop.sect.2cont.2).

Description of reference marks used to determine USGS datum. RM 1 is a chiseled square on the upstream right headwall of the Route SC 9 bridge with an assumed elevation of 100.00 ft. RM 2 is a chiseled square on the downstream left headwall of the Route SC 9 bridge with a surveyed elevation of 100.00 ft.

*Cross section ID	*Section Reference Distance (SRD) in feet	**How cross section was developed	Comments
EXITA	-4019	2,3	Exit cross section at railway
FULVA	-3688	2,3	Full-valley section at railway
BRDGA	-3688	1	U/S face of railway bridge
APPRA	-3410	1,3	First Approach cross section
APPRB	-3293	1,3	Second Approach cross section
EXITB	-600	2,4	Transition cross section at SC 9
EXITC	-445	2,4	Exit cross section at SC 9 bridge
FULVB	0	2,4	Full-valley section at SC 9 bridge
BRDGB	0	1	U/S face of SC 9 bridge
ROAD	24	5	Road grade cross section at SC 9
APPRC	494	2,4	Approach cross section at SC 9

* 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.

The drainage basin for the Route SC 9 crossing of Fishing Creek is located in the Piedmont physiographic province of South Carolina. The basin is located in the South Carolina high-flow area. The hydraulics at Route SC 9 are influenced by the backwater effects of the railway crossing approximately 3,650 ft downstream of the downstream bridge face.

To model the backwater effects of the railway crossing, the WSPRO model begins at the exit cross section (EXITA) 4,019 ft downstream of Route SC 9, proceeds upstream through the railway bridge, and ends at the approach cross section (APPRC) 494 ft upstream of the Route SC 9 bridge face. It was assumed that slope-conveyance methodology would be adequate for estimating the starting water-surface elevation at the exit cross section of the railway bridge.

The survey data collected at the railway bridge includes two approach cross sections and tapedowns at the upstream face of the railway. The first approach cross section (APPRA) was surveyed 240 ft upstream of the railway and the second approach cross section (APPRB) was surveyed 357 ft upstream of the railway. The cross section data for APPRA also was used for the exit and full valley cross sections of the railway bridge by shifting the survey data to the appropriate section-reference distance (SRD) and adjusting the cross section elevation by the channel slope. Contours from the USGS topographic map were used to define the left and right flood plains of APPRA, APPRB, FULVA, and EXITA.

The survey data collected at the Route SC 9 bridge includes tapedowns at the U/S and D/S faces of the bridge, an approach channel survey, and an exit channel survey. The approach channel was surveyed approximately 441 ft upstream of the upstream face of the Route SC 9 bridge. The exit channel was surveyed 478 ft downstream of the upstream face of the Route SC 9 bridge. The flood plain data was obtained from the SCDOT road plans (federal aid project number 68reop.sec.2cont.2.). The channel sections were then superimposed onto the flood plain data for the approach (APPRC) and exit (EXITB and EXITC) cross sections and shifted by the slope to the appropriate SRD. The exit cross section data also was used to represent a cross section (EXITB) of the transition from moderate woods to pasture on the downstream left flood plain. In addition, the full valley cross section at the Route SC 9 bridge used the exit cross section data. Contours from the USGS topographic map were used to define the left and right flood plain of APPRC.

Cross sections at the upstream and downstream faces of the Route SC 9 bridge were directly surveyed and the more constricted (upstream) face was used in the WSPRO model.

Bridge Hydraulics

Average embankment elevation 99.8 *ft*

Average low steel elevation 95.6 *ft*

100-year discharge 24,800 ft^3/s

Water-surface elevation at D/S bridge face 92.19 *ft*

Area of flow at D/S bridge face 7,902 ft^2

Average velocity in bridge opening 3.14 *ft/s*

Maximum WSPRO tube velocity at bridge 4.51 *ft/s*

Water-surface elevation at Approach section with bridge 92.09 *ft*

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

Amount of backwater caused by bridge 0.02 *ft*

500-year discharge 36,000 ft^3/s

Water-surface elevation at D/S bridge face 97.31* *ft*

Area of flow at D/S bridge face 9,125 ft^2

Average velocity in bridge opening 3.96 *ft/s*

Maximum WSPRO tube velocity at bridge 5.40 *ft/s*

Water-surface elevation at Approach section with bridge 97.31 *ft*

Water-surface elevation at Approach section without bridge 97.15 *ft*

Amount of backwater caused by bridge 0.16 *ft*

*The water-surface elevation at the downstream bridge face is determined from the full-valley section because the bridge is in pressure flow.

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 through 5 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). Pier D and bents 5 through 8 are located on the left overbank and were analyzed using the maximum left overbank WSPRO tube velocity and the depth of flow at each bent. Pier A and bents 2 through 4 are located on the right overbank and were analyzed using the maximum right overbank WSPRO tube velocity and the depth of flow at each bent. Piers B and C 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.

The left and right overbanks at the bridge were analyzed for contraction scour using Laursen's clear-water contraction scour equation (Richardson and others, 1993). The channel contraction scour was analyzed using Laursen's modified live-bed contraction scour equation (Richardson and others, 1993).

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 1through 4 and figure 2.

The left abutment is protected by riprap, but the riprap at the right abutment is slumped. Therefore, abutment scour was calculated for the right abutment using the Froehlich (1989) live-bed abutment scour equation.

It should be noted that the SCDOT bridge plan borings (docket number 12.407) 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

```
T1          Structure #124000901100              (445 ft. bridge)
T2          Fishing Creek at SC 9              file: fish.sc9
T3          Chester County, South Carolina      AWC   September 1994
*
*
*
*           Q100       Q500
Q           24800      36000
SK          .00037     .00037
J1          *  *  .005
*
*
*
*           ************************************************************
*           * This WSPRO run begins at the railway crossing of Fishing*
*           * Creek which is approximately 3,650 ft downstream of the *
*           * downstream bridge face of the Route SC 9 bridge crossing*
*           * of Fishing Creek. This was necessary in order to model  *
*           * the backwater effects caused by the constriction at the *
*           * railway crossing.                                       *
*           ************************************************************
*
*           Survey data for the EXITA cross section was taken at
*           240 ft upstream of the upstream face of the railway
*           crossing of Fishing Creek. The distance is determined
*           from the survey of 1-27-1993. The cross sections
*           were extended by the slope of the contours. The left flood
*           plain was extended from contour 400 (sta. 122) to contour
*           430 (sta. -25). The right flood plain was extended from
*           contour 400 (sta. 390) to the top of the railway.
*
XT    SURV1 -3410   0.00037
GR          -25  101.0   50  91.0   90  81.0   122  71.0   147  70.9
GR          163  70.2   184  71.1   211  71.9   216  70.0   219  63.5
GR          225  61.9   235  62.0   247  61.7   258  61.7   272  61.9
GR          283  62.4   291  63.6   298  68.2   307  70.8   316  73.8
GR          330  75.2   336  70.8   343  70.4   390  71.0   590  81.0
GR          700  91.0   900  113.2
*
XS    EXITA -4019
GT
N           .20   .043   .14   .08
SA             219    298   336
PX
*
XS    FULVA -3688
GT
PX
*
*
```

```
*           ++++++  Railway Bridge  ++++++
*           U/S Face of Railway Bridge
*
BR    BRDGA  -3688  78.3  20
GR           0  113.2   2  107.8   10  105.9   10.1  109.9  35.5  109.9
GR           35.6  91.2   52  87.7   69  79.1   77  75.2   93  73.4
GR           100  64.6   109  60.3   116  57.9   125  57.1   136  60.3
GR           148  60.3   158  61.7   158.3  89.8   162  89.8   165.3  89.7
GR           165.5  60.6   171  61.6   179  64.5   190  67.4   200  70.6
GR           203  72.4   225  71.3   250  73.4   276.9  78.6   277  79.1
GR           277.1  89.7   283.4  89.7   283.5  87.1   293  90.1   300  92.0
GR           306  95.7   319  101.5   329.6  105.2   329.7  113.2
GR           331  113.2   0  113.2
N            0.045  0.04   0.045
SA                93   203
CD           3  38  1.5  113.2
PW 1         90.0  1.0   95.6  1.0   95.6  2.0   105.1  2.0   105.1  3.0
PW           113.2  3.0   113.2  0
PX
*
*
*           Data for APPRA was surveyed 240 ft upstream
*           of the upstream face of the railway crossing of Fishing
*           Creek. The distance is determined from the survey
*           of 1-27-1993.  The cross sections were extended by the slope
*           of the contours. The left flood plain was extended from
*           contour 400 (sta. 102) to contour 420 (sta. -152).
*           The right flood plain was extended from contour 400 (sta. 371)
*           to the top of the railway.
*
XT    SURV2  -3410   0.00037
GR           -152  99.4   -102  89.4  102  79.4   122  71.0   147  70.9
GR           163  70.2   184  71.1   211  71.9   216  70.0   219  63.5
GR           225  61.9   235  62.0   247  61.7   258  61.7   272  61.9
GR           283  62.4   291  63.6   298  68.2   307  70.8   316  73.8
GR           330  75.2   336  70.8   343  70.4   355  74.5   369  78.6
GR           371  79.4   400  89.4   410  113.2
*
AS    APPRA  -3410
GT
N            .20   .043   .14   .20
SA              219    298   336
BP           126
PX
*
*
```

```
*          Data for APPRB was surveyed at 357 ft upstream of the
*          upstream face of the railway crossing of Fishing Creek.
*          The distance is determined from the survey
*          of 1-27-1993. The cross sections were extended by the slope
*          of the contours. The left flood plain was extended from
*          contour 400 (sta. -30) to contour 420 (sta. -210).
*          The right flood plain was extended from contour 400 (sta. 536)
*          to the top of the railway.
*
*


XS   APPRB  -3293   0.00037
GR           -210  100.8   -120  90.8   -30  80.8
GR             0  79.2    14  74.3    35  73.2    83  73.1    124  71.9
GR           130  68.1    133  68.0    136  71.5    173  71.0    224  70.1
GR           250  74.6    282  73.4    302  70.3    316  71.9    330  67.3
GR           336  65.5    345  66.6    353  73.8    360  70.6    365  63.6
GR           371  61.8    380  62.2    397  62.0    411  61.4    415  61.3
GR           436  62.3    441  64.6    446  72.6    450  73.0    463  76.3
GR           487  75.6    517  74.3    529  77.5    533  79.4    536  80.8
GR           596  90.8    636  113.2
N            .20   .08    .15   .043   .14
SA              316   353   360    446
PX
*
*
*           ++++++++++  SURVEY DATA FOR ROUTE SC 9  ++++++++++
*
*          Flood plain data was taken from SCDOT road plans (fed.
*          aid project no. 68reop.sec2.cont.2.). An exit channel
*          cross section was surveyed at 478 ft downstream of the
*          upstream face of the Route SC 9 bridge and superimposed
*          onto the flood plain survey. EXITB is a cross section to
*          model the transition from woods to pasture on the left
*          flood plain. EXITC is a cross section that models the
*          pasture on the left flood plain.
*
XT   SURV3  -478    0.00037
GR           -155  105.3  0  90.8   12  88.3   25  87.3   50  83.8   75  82.8
GR           125  79.5    225  75.8    365  73.1    383  74.4    400  75.6
GR           406  67.8    424  64.9    432  64.8    444  65.0    457  65.1
GR           466  64.8    472  64.3    480  64.5    487  64.0    493  64.8
GR           500  74.1    505  75.1    525  76.2    540  75.8    560  77.8
GR           600  72.5    625  71.8    665  74.4    725  74.3    925  82.6
GR           1025  88.1    1125  92.4    1190  92.5    1275  104.3
*
*
XS   EXITB  -600
GT
N            .16   .043   .16
SA              400    505
PX
*
```

```
XS    EXITC  -445
GT
N            .03    .043    .16
SA              400     505
PX
*
XS    FULVB  0
GT
PX
*
*            ++++++  ROUTE SC 9 BRIDGE  ++++++
*
*
BR    BRDGB  0 95.6
GR            0  95.6    1  95.6    1.1  94.0    11  92.9    25  86.1
GR           35  79.2    52  75.4    70  75.1    105  74.1    140  74.9
GR           175  75.5    188  72.5    192  65.7    215  64.5    233  62.8
GR           255  64.4    265  63.2    274  65.0    278  70.0    296  75.3
GR           305  73.6    340  74.9    375  74.2    410  74.4    428  85.2
GR           443  93.5    444  95.5    445  95.5    0  95.6
N            .045    .04    .045
SA              188    278
CD           3  49  2  99.8
PW 1         63.2  1.0    64.5  1.0    64.5  2.0    73.6  2.0    73.6  3.0
PW           74.1  3.0    74.1  4.0    74.2  4.0    74.2  5.0    74.4  5.0
PW           74.4  6.0    74.9  6.0    74.9  8.0    75.1  8.0    75.1  9.0
PW           75.5  9.0    75.5  10.0    79.2  10.0    79.2  11.0    95.6  11.0
PW           95.6  0
PX
*
*
*            Road Cross Section
*
XR    ROAD   24  49
GR           -400  105.3    -210  101.3    -100  99.3    0  99.3
GR           0.1  101.7    444.9  101.7    445  99.3    805  99.3
GR           895  100.3    1045  102.8
*
*
*            Flood plain data was taken from SCDOT road plans (fed.
*            aid project no. 68reop.sec2.cont.2.). An approach channel
*            cross section was surveyed at 441 ft upstream of the
*            upstream face of the Route SC 9 bridge and superimposed
*            onto the flood plain survey. The left flood plain data
*            was extended by the slope of the contours from the
*            contour 400 (sta. 225) to contour 430 (sta. 100).
*
*



XT    SURV4  441    0.00037
GR           99.9  120.0    100  105.8    150  95.8    175  85.8
GR           225  75.8    365  73.1    389  76.0    400  75.1
GR           409  65.1    427  64.8    432  63.8    441  63.8    447  64.0
GR           457  64.9    497  66.5    509  76.6    525  76.2    645  86.2
GR           735  96.2    735.1  120.0
*
```

```
AS   APPRC  494
*
GT
N           .16   .043   .16
SA             400    509
BP          212
PX
*
*
*
*
HP 1 BRDGB   92.19  0  92.19
HP 2 BRDGB   92.20  0  92.20   24800
HP 1 APPRC   92.09  0  92.09
HP 2 APPRC   92.09  0  92.09   24800
HP 1 BRDGB   95.60  0  95.60
HP 2 BRDGB   97.08  0  97.08   36000
HP 1 APPRC   97.31  0  97.31
HP 2 APPRC   97.31  0  97.31   36000
*
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 #124000901100                (445 ft. bridge)
          Fishing Creek at SC 9                file: fish.sc9
          Chester County, South Carolina        AWC   September 1994
           *** RUN DATE & TIME: 10-27-94  12:05
    CROSS-SECTION PROPERTIES:  ISEQ =  9;  SECID = BRDGB;  SRD =        0.

  WSEL  SA#      AREA          K    TOPW   WETP  ALPH     LEW     REW      QCR
          1      2758     563451     176    180                             62019
          2      2494     810683      90     97                             74481
          3      2650     551041     163    168                             60701
 92.19           7901    1925175     428    445  1.16      12     441     178520


    VELOCITY DISTRIBUTION:  ISEQ =  9;  SECID = BRDGB;  SRD =        0.

        WSEL      LEW      REW     AREA          K         Q      VEL
       92.20     12.4    440.7   7905.4  1926731.    24800.     3.14

X STA.        12.4        64.3        91.4       115.9       140.7       166.8
  A(I)         594.8       470.1       438.5       436.5       446.1
  V(I)          2.08        2.64        2.83        2.84        2.78

X STA.       166.8       191.9       203.5       214.1       224.2       233.7
  A(I)         463.1       310.3       290.4       283.4       274.9
  V(I)          2.68        4.00        4.27        4.38        4.51

X STA.       233.7       243.2       253.0       263.1       273.4       293.1
  A(I)         276.2       278.1       285.8       289.7       417.8
  V(I)          4.49        4.46        4.34        4.28        2.97

X STA.       293.1       317.3       341.8       366.8       392.1       440.7
  A(I)         435.6       433.5       438.9       455.4       586.4
  V(I)          2.85        2.86        2.83        2.72        2.11
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WSPRO OUTPUT --Continued

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

          Structure #124000901100              (445 ft. bridge)
          Fishing Creek at SC 9              file: fish.sc9
          Chester County, South Carolina       AWC   September 1994
           *** RUN DATE & TIME: 10-27-94  12:05
    CROSS-SECTION PROPERTIES:  ISEQ = 11;  SECID = APPRC;  SRD =      494.

     WSEL  SA#      AREA          K    TOPW   WETP  ALPH     LEW     REW       QCR
             1      3682     209870     241    243                             81713
             2      2825     816518     109    117                             81630
             3      1710      69019     189    190                             29206
    92.09           8217    1095408     539    550  3.54     159     698      96759


    VELOCITY DISTRIBUTION:  ISEQ = 11;  SECID = APPRC;  SRD =      494.

         WSEL      LEW      REW     AREA          K         Q     VEL
        92.09    159.3    697.8   8217.5  1095408.    24800.    3.02

X STA.        159.3       257.3       309.9       358.2       402.9       412.3
  A(I)           1147.9       915.2       887.5       785.3       232.3
  V(I)             1.08        1.35        1.40        1.58        5.34

X STA.        412.3       419.0       425.6       432.1       438.2       444.3
  A(I)           182.8       179.7       177.3       172.9       172.7
  V(I)            6.78        6.90        6.99        7.17        7.18

X STA.        444.3       450.5       456.8       463.4       470.0       476.9
  A(I)           172.8       174.9       177.7       177.8       182.5
  V(I)            7.17        7.09        6.98        6.98        6.80

X STA.        476.9       483.9       491.2       498.9       527.5       697.8
  A(I)           182.6       190.2       195.5       489.4      1420.4
  V(I)            6.79        6.52        6.34        2.53        0.87
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WSPRO OUTPUT --Continued

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

          Structure #124000901100              (445 ft. bridge)
          Fishing Creek at SC 9              file: fish.sc9
          Chester County, South Carolina       AWC   September 1994
           *** RUN DATE & TIME: 10-27-94  12:05
    CROSS-SECTION PROPERTIES:  ISEQ =  9;  SECID = BRDGB;  SRD =        0.

     WSEL  SA#      AREA          K   TOPW   WETP  ALPH     LEW     REW       QCR
           1        3378     479073      0    381                              0
           2        2796     632682      0    187                              0
           3        3199     470787      0    341                              0
    95.60           9373    1582543      0    909  1.16       0     445         0


    VELOCITY DISTRIBUTION:  ISEQ =  9;  SECID = BRDGB;  SRD =        0.

         WSEL      LEW      REW     AREA          K         Q     VEL
        97.08      0.0    445.0   9372.5  1581706.    36000.    3.84

X STA.          0.0       62.0       88.8      113.2      137.6      162.4
  A(I)         750.7      553.5      517.6      513.8      507.1
  V(I)          2.40       3.25       3.48       3.50       3.55

X STA.        162.4      186.8      201.1      212.3      223.3      233.6
  A(I)         508.7      405.7      342.1      344.5      333.8
  V(I)          3.54       4.44       5.26       5.23       5.39

X STA.        233.6      243.9      254.5      265.1      277.0      298.2
  A(I)         333.2      335.7      336.0      364.8      483.1
  V(I)          5.40       5.36       5.36       4.93       3.73

X STA.        298.2      321.5      345.6      370.2      395.4      445.0
  A(I)         502.9      503.1      514.8      537.6      683.8
  V(I)          3.58       3.58       3.50       3.35       2.63
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WSPRO OUTPUT --Continued

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

          Structure #124000901100                (445 ft. bridge)
          Fishing Creek at SC 9                file: fish.sc9
          Chester County, South Carolina        AWC   September 1994
           *** RUN DATE & TIME: 10-27-94  12:05
     CROSS-SECTION PROPERTIES:  ISEQ = 11;  SECID = APPRC;  SRD =      494.

      WSEL  SA#      AREA          K   TOPW   WETP  ALPH     LEW     REW      QCR
              1      4975     330792    257    261                             124096
              2      3394    1108571    109    117                             107490
              3      2813     139863    226    228                              56322
     97.31           11183    1579225    592    606  3.81     143     735     141210


     VELOCITY DISTRIBUTION:  ISEQ = 11;  SECID = APPRC;  SRD =      494.

          WSEL      LEW      REW     AREA          K         Q     VEL
         97.31    142.5    735.0  11182.6  1579225.   36000.    3.22

X STA.       142.5      248.7      297.7      344.7      390.0      409.8
  A(I)        1507.6     1097.7     1098.3     1052.7      489.0
  V(I)          1.19       1.64       1.64       1.71       3.68

X STA.       409.8      417.1      424.2      431.2      437.9      444.6
  A(I)         236.6      229.0      229.1      223.6      223.5
  V(I)          7.61       7.86       7.86       8.05       8.05

X STA.       444.6      451.2      458.1      465.2      472.4      479.7
  A(I)         221.6      224.6      228.9      229.2      230.0
  V(I)          8.12       8.01       7.87       7.85       7.83

X STA.       479.7      487.2      494.8      505.3      558.0      735.0
  A(I)         234.7      237.7      292.6     1068.0     1828.1
  V(I)          7.67       7.57       6.15       1.69       0.98
```

WSPRO OUTPUT --Continued

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

          Structure #124000901100              (445 ft. bridge)
          Fishing Creek at SC 9              file: fish.sc9
          Chester County, South Carolina       AWC   September 1994
           *** RUN DATE & TIME: 10-27-94  12:05

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

EXITA:XS    ******      53      9800   0.33  *****    90.42    76.74    24800    90.09
     -4018  ******     692   1288648   3.28  ***** *******     0.21     2.53

FULVA:FV       331      53      9803   0.33   0.12    90.54 *******    24800    90.22
     -3687     331     693   1289173   3.28   0.00     0.00     0.21     2.53
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                              "APPRA"      KRATIO =  0.67

APPRA:AS       278    -104      6881   0.98   0.15    91.02 *******    24800    90.04
     -3409     278     400    867942   4.84   0.33     0.00     0.38     3.60
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===255 ATTEMPTING FLOW CLASS 3 (6) SOLUTION.
                         WS3N,LSEL =     90.22       78.30

             <<<<<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

BRDGA:BR       331      40      4299   0.56  *****    90.78    76.14    24779    90.22
     -3687  ******     293    890362   1.09  ***** *******     0.25     5.76

     TYPE PPCD FLOW       C     P/A     LSEL   BLEN   XLAB   XRAB
       3.   1.   3.   0.800   0.000    78.30 ****** ****** ******

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

APPRA:AS       240    -105      6991   0.95   0.19    91.21    77.09    24800    90.26
     -3409     244     400    882541   4.87   0.00     0.00     0.37     3.55

       M(G)   M(K)        KQ    XLKQ    XRKQ     OTEL
     ****** ****** ******** ****** ******     90.07

                     <<<<<END OF BRIDGE COMPUTATIONS>>>>>
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WSPRO OUTPUT --Continued

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 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                              "APPRB"     KRATIO =  1.42

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

APPRB:XS       117    -120     11761   0.34   0.07    91.28  *******    24800    90.94
     -3292     117     596   1249138   4.92   0.00     0.00     0.20     2.11

EXITB:XS      2693     -12     15684   0.21   0.92    92.21  *******    24800    91.99
      -599    2693    1117   1434624   5.48   0.00     0.00     0.18     1.58

 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                              "EXITC"     KRATIO =  1.89

EXITC:XS       155     -13     15785   0.09   0.02    92.23  *******    24800    92.14
      -444     155    1119   2716698   2.35   0.00     0.00     0.11     1.57

FULVB:FV       445     -12     15640   0.09   0.04    92.27  *******    24800    92.18
         0     445    1116   2683875   2.34   0.00     0.00     0.11     1.59
        <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                              "APPRC"     KRATIO =  0.41
 XSID:CODE    SRDL     LEW      AREA     VHD     HF      EGL     CRWS        Q     WSEL
       SRD    FLEN     REW         K   ALPH     HO      ERR      FR#      VEL

APPRC:AS       494     159      8209   0.50   0.10    92.58  *******    24800    92.07
       494     494     698   1094075   3.54   0.21     0.00     0.26     3.02
        <<<<<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

BRDGB:BR       445      12      7902   0.15   0.09    92.34    78.34    24800    92.19
         0     445     441   1925323   1.00   0.02     0.01     0.13     3.14

     TYPE PPCD FLOW      C     P/A     LSEL   BLEN   XLAB   XRAB
       3.   1.   1.  0.998   0.027    95.60 ****** ****** ******

   XSID:CODE     SRD   FLEN     HF    VHD     EGL     ERR        Q    WSEL
  ROAD :RG       24.        <<<<<EMBANKMENT IS NOT OVERTOPPED>>>>>

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

APPRC:AS       445     159      8217   0.50   0.24    92.59    78.37    24800    92.09
       494     456     698   1095341   3.54   0.01     0.02     0.26     3.02

      M(G)    M(K)        KQ    XLKQ    XRKQ     OTEL
     0.205   0.010   1083559.    223.    651.    91.86
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WSPRO OUTPUT --Continued

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

          Structure #124000901100              (445 ft. bridge)
          Fishing Creek at SC 9              file: fish.sc9
          Chester County, South Carolina       AWC   September 1994
           *** RUN DATE & TIME: 10-27-94  12:05

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

EXITA:XS    ******      18     13139  0.38  *****    95.38    79.37    36000    95.00
     -4018  ******     738   1869942  3.22  ***** *******     0.20     2.74

FULVA:FV       331      18     13142  0.38   0.12    95.51 *******    36000    95.13
     -3687     331     738   1870580  3.22   0.00     0.00     0.20     2.74
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                              "APPRA"      KRATIO =  0.65

APPRA:AS       278    -128      9384  1.21   0.16    96.08 *******    36000    94.87
     -3409     278     402   1217782  5.30   0.42     0.00     0.37     3.84
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===255 ATTEMPTING FLOW CLASS 3 (6) SOLUTION.
                         WS3N,LSEL =     95.13       78.30

           <<<<<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

BRDGA:BR       331      36      5515  0.72  *****    95.85    79.29    36173    95.13
     -3687  ******     305   1279821  1.08  ***** *******     0.26     6.56

      TYPE PPCD FLOW       C     P/A     LSEL   BLEN   XLAB   XRAB
        3.   1.   3.   0.800   0.001    78.30 ****** ****** ******

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

APPRA:AS       240    -130      9561  1.17   0.20    96.38    79.82    36000    95.20
     -3409     246     402   1243845  5.32   0.01     0.00     0.36     3.77

        M(G)   M(K)         KQ    XLKQ    XRKQ     OTEL
      ******  ******  ********  ******  ******    95.01

                    <<<<<END OF BRIDGE COMPUTATIONS>>>>>
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WSPRO OUTPUT --Continued

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 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                              "APPRB"      KRATIO =  1.42

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

APPRB:XS       117    -166     15552  0.42   0.07    96.44  *******    36000    96.03
     -3292     117     605   1770739  5.01   0.00     0.00      0.20     2.31

EXITB:XS      2693     -67     22055  0.23   0.91    97.36  *******    36000    97.13
      -599    2693    1224   2157192  5.53   0.00     0.00      0.16     1.63

 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                              "EXITC"      KRATIO =  1.97

EXITC:XS       155     -68     22175  0.10   0.02    97.38  *******    36000    97.28
      -444     155    1224   4239102  2.46   0.00     0.00      0.11     1.62

FULVB:FV       445     -67     22004  0.10   0.03    97.41  *******    36000    97.31
         0     445    1223   4194812  2.46   0.00     0.00      0.11     1.64
        <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===135 CONVEYANCE RATIO OUTSIDE OF RECOMMENDED LIMITS.
                              "APPRC"      KRATIO =  0.37
 XSID:CODE    SRDL     LEW      AREA    VHD     HF      EGL      CRWS        Q     WSEL
       SRD    FLEN     REW         K  ALPH     HO      ERR       FR#      VEL

APPRC:AS       494     143     11087  0.62   0.10    97.77  *******    36000    97.15
       494     494     735   1562817  3.81   0.26     0.00      0.26     3.25
        <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===255 ATTEMPTING FLOW CLASS 3 (6) SOLUTION.
                         WS3N,LSEL =    97.31      95.60

          <<<<<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

BRDGB:BR       445       0      9125  0.28  *****   95.88    80.12    36145    95.60
         0 ******     445   1582543  1.16  ***** *******     0.17     3.96

     TYPE PPCD FLOW      C     P/A    LSEL   BLEN   XLAB   XRAB
       3.   1.   3.  0.800  0.026   95.60 ****** ****** ******

    XSID:CODE     SRD   FLEN     HF    VHD      EGL      ERR        Q     WSEL
   ROAD :RG       24.         <<<<<EMBANKMENT IS NOT OVERTOPPED>>>>>

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

APPRC:AS       445     143     11185  0.61   0.23    97.93    81.14    36000    97.31
       494     453     735   1579577  3.81   0.01     0.00      0.25     3.22
      M(G)    M(K)        KQ    XLKQ    XRKQ     OTEL
    ****** ****** ******** ****** ******     97.08
```

PIER SCOUR COMPUTATIONS
FOR
FISHING CREEK AT SC 9 IN CHESTER COUNTY (445 FT BRIDGE)
Q100 = 24,800 CFS AWC 10-26-1994

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	8	7	6	5	D	C	B	A
PIER STATION (FT)	35	70	105	140	175	215	265	305
LOCATION OF PIER	LFP	LFP	LFP	LFP	LFP	MCL	MCR	RFP
Y1: DEPTH (FT)	13.0	17.1	18.1	17.3	16.7	29.4	29.4	18.6
V1: VEL. (FPS)	2.8	2.8	2.8	2.8	2.8	4.1	4.1	3.0
a: PIER WIDTH (FT)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
L: PIER LENGTH (FT)	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
PIER SHAPE	1	1	1	1	1	1	1	1
ATTACK ANGLE	0	0	0	0	0	0	0	0
K1 (SHAPE COEF.)	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.1
K2 (ANGLE COEF.)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
FROUDE NO.	0.14	0.12	0.12	0.12	0.12	0.13	0.13	0.12

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	2.31	2.40	2.42	2.40	2.39	3.01	3.01	2.4
MAX SCOUR DEPTH (FT)	2.54	2.64	2.66	2.64	2.63	3.31	3.31	2.7

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	4	3	2
PIER STATION (FT)	340	375	410
LOCATION OF PIER	RFP	RFP	RFP
Y1: DEPTH (FT)	17.3	18.0	17.8
V1: VEL. (FPS)	3.0	3.0	3.0
a: PIER WIDTH (FT)	1.0	1.0	1.0
L: PIER LENGTH (FT)	26.0	26.0	26.0
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.	0.13	0.12	0.12

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	2.45	2.46	2.46
MAX SCOUR DEPTH (FT)	2.69	2.71	2.70

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

CONTRACTION SCOUR COMPUTATIONS
FOR
FISHING CREEK AT SC 9 IN CHESTER COUNTY (445 FT BRIDGE)
Q100 = 24,800 CFS AWC 10-26-1994

LIVE-BED SCOUR COMPUTATIONS

	MAIN CHANNEL	CONTRACTED SECTION
DISCHARGE (CFS)	18486.	10443.
BOTTOM WIDTH (FT)	109.0	88.0
MANNINGS n	0.040	0.040
AVERAGE DEPTH (FT)	28.2	

ENERGY SLOPE	0.00055
D50 (FT)	0.0032
FALL VELOCITY (FPS)	0.04
K1 COEF.	0.69
K2 COEF.	0.37

COMPUTED DEPTH AT CONTRACTED SECTION (FT)	=	20.1
DEPTH AT MAIN CHANNEL (FT)	=	28.2
DEPTH OF CONTRACTION SCOUR (FT)	=	-8.1

LEFT OVERBANK IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	7258.
WIDTH OF CONTRACTED SECTION (FT)	=	153.0
MEDIAN GRAIN SIZE (FT)	=	0.0013
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	23.6
AVERAGE FLOOD PLAIN DEPTH (FT)	=	17.1
DEPTH OF CONTRACTION SCOUR (FT)	=	6.5

RIGHT OVERBANK IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	7098.
WIDTH OF CONTRACTED SECTION (FT)	=	132.0
MEDIAN GRAIN SIZE (FT)	=	0.0013
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	26.2
AVERAGE FLOOD PLAIN DEPTH (FT)	=	17.1
DEPTH OF CONTRACTION SCOUR (FT)	=	9.1

ABUTMENT SCOUR COMPUTATIONS
FOR
FISHING CREEK AT SC 9 IN CHESTER COUNTY (445 FT BRIDGE)
Q100 = 24,800 CFS AWC 10-26-1994

RIGHT ABUTMENT
SCOUR COMPUTATIONS

ABUTMENT TYPE	3 -SPILL THROUGH
DISCHARGE BLOCKED BY ABUTMENT (CFS)	414.
AREA BLOCKED BY ABUTMENT (SQ FT)	474.0
DEPTH OF FLOW AT ABUTMENT (FT)	17.8
LENGTH OF ABUT. 90 DEG. TO FLOW (FT)	57.0
ABUTMENT SKEW (DEG)	0
AJUSTED ABUTMENT LENGTH (FT)	26.6
AVERAGE F/P VELOCITY U/S OF ABUT. (FPS)	0.9
FROUDE NUMBER	0.036
K1 COEF.	0.6
K2 COEF.	1.0

DESIGN DEPTH OF SCOUR (FROELICH EQUATION, 1989) (FT) = 21.3

PIER SCOUR COMPUTATIONS
FOR
FISHING CREEK AT SC 9 IN CHESTER COUNTY (445 FT BRIDGE)
Q500 = 36,000 CFS AWC 10-26-1994

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	8	7	6	5	D	C	B	A
PIER STATION (FT)	35	70	105	140	175	215	265	305
LOCATION OF PIER	LFP	LFP	LFP	LFP	LFP	MCL	MCR	RFP
Y1: DEPTH (FT)	17.9	22.0	23.0	22.2	21.6	34.3	34.3	23.5
V1: VEL. (FPS)	4.4	4.4	4.4	4.4	4.4	4.9	4.9	3.7
a: PIER WIDTH (FT)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
L: PIER LENGTH (FT)	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
PIER SHAPE	1	1	1	1	1	1	1	1
ATTACK ANGLE	0	0	0	0	0	0	0	0
K1 (SHAPE COEF.)	1.10	1.10	1.10	1.10	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.	0.19	0.17	0.16	0.17	0.17	0.15	0.15	0.14

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	2.92	3.00	3.02	3.01	3.00	3.32	3.32	2.81
MAX SCOUR DEPTH (FT)	3.21	3.31	3.32	3.31	3.30	3.65	3.65	3.09

HYDRAULIC VARIABLES USED IN CSU EQUATION

PIER NUMBER	4	3	2
PIER STATION (FT)	340	375	410
LOCATION OF PIER	RFP	RFP	RFP
Y1: DEPTH (FT)	22.2	22.9	22.7
V1: VEL. (FPS)	3.7	3.7	3.7
a: PIER WIDTH (FT)	1.0	1.0	1.0
L: PIER LENGTH (FT)	26.0	26.0	26.0
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.	0.14	0.14	0.14

COMPUTED SCOUR DEPTHS USING CSU EQUATION

SCOUR DEPTH (FT)	2.79	2.80	2.80
MAX SCOUR DEPTH (FT)	3.07	3.08	3.08

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

CONTRACTION SCOUR COMPUTATIONS
FOR
FISHING CREEK AT SC 9 IN CHESTER COUNTY (445 FT BRIDGE)
Q500 = 36,000 CFS AWC 10-26-1994

LIVE-BED SCOUR COMPUTATIONS

	MAIN CHANNEL	CONTRACTED SECTION
DISCHARGE (CFS)	25271.	14450.
BOTTOM WIDTH (FT)	109.0	88.0
MANNINGS n	0.040	0.040
AVERAGE DEPTH (FT)	28.0	

ENERGY SLOPE	0.00450
D50 (FT)	0.0032
FALL VELOCITY (FPS)	0.42
K1 COEF.	0.69
K2 COEF.	0.37

COMPUTED DEPTH AT CONTRACTED SECTION (FT)	=	20.1
DEPTH AT MAIN CHANNEL (FT)	=	28.0
DEPTH OF CONTRACTION SCOUR (FT)	=	-7.9

LEFT OVERBANK IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	10942.
WIDTH OF CONTRACTED SECTION (FT)	=	153.0
MEDIAN GRAIN SIZE (FT)	=	0.0013
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	33.5
AVERAGE FLOOD PLAIN DEPTH (FT)	=	22.3
DEPTH OF CONTRACTION SCOUR (FT)	=	11.2

RIGHT OVERBANK IN BRIDGE OPENING
CLEAR-WATER CONTRACTION SCOUR COMPUTATIONS

DISCHARGE IN CONTRACTED SECTION (CFS)	=	10753.
WIDTH OF CONTRACTED SECTION (FT)	=	132.0
MEDIAN GRAIN SIZE (FT)	=	0.0013
COMPUTED DEPTH OF CONTRACTED SECTION (FT)	=	37.4
AVERAGE FLOOD PLAIN DEPTH (FT)	=	22.3
DEPTH OF CONTRACTION SCOUR (FT)	=	15.1

ABUTMENT SCOUR COMPUTATIONS
FOR
FISHING CREEK AT SC 9 IN CHESTER COUNTY (445 FT BRIDGE)
Q500 = 36,000 CFS AWC 10-26-1994

RIGHT ABUTMENT
SCOUR COMPUTATIONS

ABUTMENT TYPE	3 -SPILL THROUGH
DISCHARGE BLOCKED BY ABUTMENT (CFS)	956.
AREA BLOCKED BY ABUTMENT (SQ FT)	971.0
DEPTH OF FLOW AT ABUTMENT (FT)	22.7
LENGTH OF ABUT. 90 DEG. TO FLOW (FT)	94.0
ABUTMENT SKEW (DEG)	0
AJUSTED ABUTMENT LENGTH (FT)	42.8
AVERAGE F/P VELOCITY U/S OF ABUT. (FPS)	1.0
FROUDE NUMBER	0.036
K1 COEF.	0.6
K2 COEF.	1.0

DESIGN DEPTH OF SCOUR (FROELICH EQUATION, 1989) (FT) = 27.6

United States Department of the Interior

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

November 2, 1994

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 to you another report of the Level II Bridge Scour Program titled, "Level II bridge scour analysis for structure 124000901100 on Route SC 9, crossing Fishing Creek in Chester County, South Carolina," by Andy W. Caldwell and Michael G. Zalants. The technical aspects have been reviewed by the South Carolina District Surface-Water Specialist and the report has been approved by the South Carolina District Reports Specialist.

If you have any questions concerning this report please contact me (750-6101) or Michael G. Zalants (750-6159) and we will be glad to assist you.

Sincerely,

Andy W. Caldwell
Civil Engineer

Enclosure

FED. ROAD DIST. No.	STATE	COUNTY	FED. AID PROJ. No.	ROUTE No.	SHEET No.	TOTAL SHEETS
8	S. C.	CHESTER	68 REOP. SEC.2 CONT.2	9	1	23

F.A. PROJ. 68 REOP
INDEX OF SHEETS

SHEET No. 1 TITLE PAGE
" 2 TYPICAL CROSS SECTION OF IMPROVEMENT
" 3 ENDWALLS FOR PIPE CULVERTS
" 4 STANDARD FOR SUPERELEVATION
" 5-20 PLAN AND PROFILE STA. 702+80.3 TO STA. 1136+82.0
" 21 3'x3'x76' R.C. BOX CULVERT STA. 746+20
" 22 3'x3'x70' R.C. BOX CULVERT STA. 934+35
" 23-64 CROSS SECTIONS STA. 702+803 TO STA. 1136+82.0

F.A. PROJ. 68 REOP SEC. 1 CONT. 2
INDEX OF SHEETS

SHEET NO. 1 TITLE PAGE
" " 2 TYPICAL CROSS SECTION OF IMPROVEMENT
" " 3 SUMMARY OF ESTIMATED QUANTITIES
" " 4 STANDARD DESIGN FOR SUPERELEVATION
" " 5 STANDARD DESIGN FOR REINFORCING IN PAVEMENT
" " 6-7 DETAIL DESIGN FOR TURN-OUTS STA. 1058+24.3 & STA. 1073+17.9
" " 8-12 PLAN-PROFILE FROM STA. 1027+00 TO STA. 1136+82.

F.A. PROJ. 68 REOP. SEC. 2 CONT. 2
INDEX OF SHEETS

SHEET NO 1. TITLE PAGE
" 2A.B TYPICAL CROSS SECTION OF IMPROVEMENT.
" 3 ENDWALLS FOR PIPE CULVERTS
" 4 STANDARD DESIGN FOR SUPERELEVATION
" 5 STANDARD DESIGN FOR REINFORCING IN PAVEMENT
" 6-19 PLAN AND PROFILE FROM STA. 702+80.3 - 1026+75
" 20-23 CROSS SECTIONS FROM STA. 947+00 - 983+49.0

STATE OF SOUTH CAROLINA
STATE HIGHWAY DEPARTMENT

PLAN AND PROFILE OF PROPOSED STATE HIGHWAY

FED. AID PROJECT
NO. 68 REOP. SEC. 2 CONT. 2
ROUTE NO. 9

CHESTER COUNTY

FROM LEWISVILLE-LANDSFORD TOWNSHIP LINE TO ~~BEGINNING OF F.A. PROJ. 269 REOP. SEC. 1 NEAR CATAWBA RIVER~~ ~~FORT LAWN~~ FORT LAWN

SCALES: PLAN AND PROFILE, 1 INCH = 100 FEET HORIZONTAL; 1 INCH = 10 FEET VERTICAL.

SUMMARY OF ESTIMATED QUANTITIES

STATION	SHEET NO.	ITEM	CONCRETE (CUBIC YARDS) CLASS "A"	CLASS "B"	CLASS "C"	REINFORCING STEEL (LBS.)	EXCAVATION (CU. YDS.) FOR STRUCTURES	PILES (LINEAL FEET) TREATED	UNTREATED	RIP RAP TONS
	3	ENDWALLS FOR PIPE CULVERTS	—	54.01		.152	—			—
		RIP-RAP FOR FILL AT FISHING CR.	—	—		—	—			300
746+20	7-21	3'x3'x76' R.C. BOX CULVERT	25.56	—		3600	22.0			—
934+35	13-22	3'x3'x70 R.C. BOX CULVERT	23.78	—		3358	20.0			—
		TOTALS	49.34	54.01		7090	42.0			300

TOTAL PIPE FOR CULVERTS

DIAM.	CORRUGATED IRON	VITRIFIED CLAY	REINF. CONCRETE
15"	166	X	84
18"	—	X	654
24"	—	X	75
30"	—	X	153
36"	—	X	54

TOTAL CLEARING & GRUBBING ON PITS	— 2.00	ACRES
TOTAL ROCK EXCAVATION	— 2744.0	CUBIC YARDS
TOTAL OVERHAUL ON EXCAVATION	— 24,586.0	CUBIC YARD STATIONS
TOTAL EXCAVATION COMMON	— *94,041.0	CUBIC YARDS
TOTAL FINISHING EARTH GRADED ROADS	— †42,780	M. LIN. FEET
TOTAL CLEARING & GRUBBING WITHIN R/W	— 8.12	ACRES
TOTAL OVERHAUL ON SURFACING	—	CUBIC YARD STATIONS

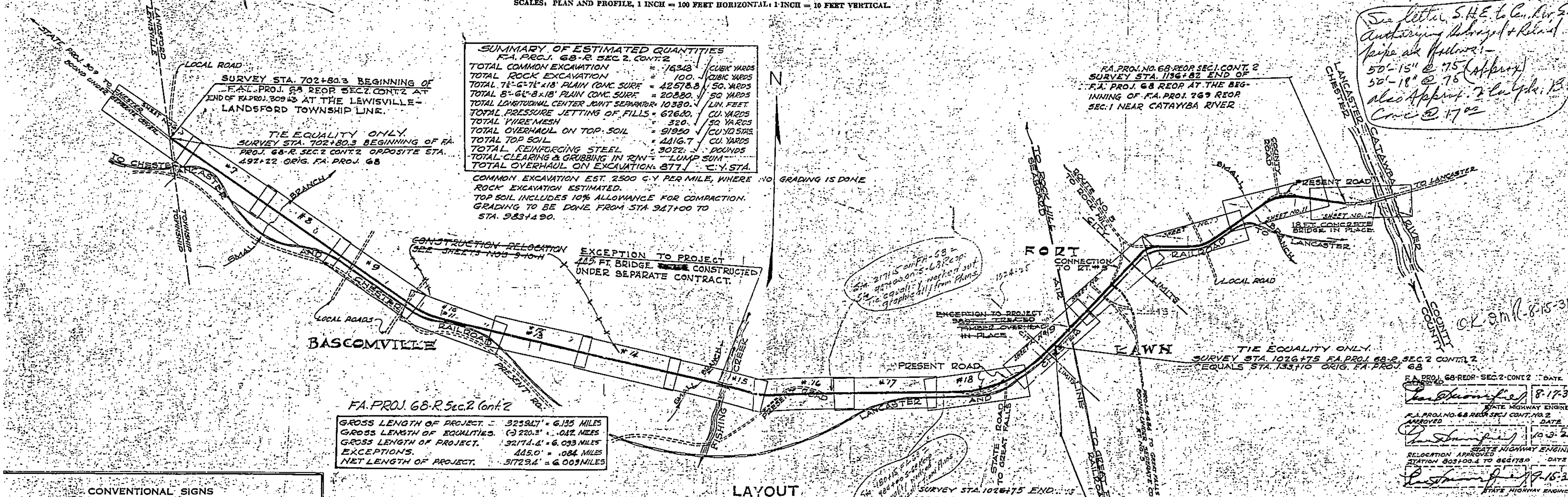
* Includes 2234 C.Y. allowed for ditches and ramps
Does not include 92 C.Y. to be obtained from proj 309
Does not include 2744 C.Y. Rock nor 0 C.Y. of swell.
† 498.9 lin. ft. omitted for bridges.

See letter S.H.E. to Co. Div. Eng. authorizing salvage & relaid pipe as follows: 50'-15" @ .75 (approx) 50'-18" @ .75 also approx. 2 lin. yds. R. Conc. @ 17.00

SUMMARY OF ESTIMATED QUANTITIES
F.A. PROJ. 68-R. SEC. 2. CONT. 2

TOTAL COMMON EXCAVATION	=	16348	CUBIC YARDS
TOTAL ROCK EXCAVATION	=	100.	CUBIC YARDS
TOTAL 7½"-6"-7½"x18' PLAIN CONC. SURF.	=	42578.8	SQ. YARDS
TOTAL 8"-6½"-8x18' PLAIN CONC. SURF.	=	20880.	SQ. YARDS
TOTAL LONGITUDINAL CENTER JOINT SEPARATOR	=	10380.	LIN. FEET
TOTAL PRESSURE JETTING OF FILLS	=	62640.	CU. YARDS
TOTAL WIRE MESH	=	320.	SQ. YARDS
TOTAL OVERHAUL ON TOP-SOIL	=	91950	CU. YD. STAS.
TOTAL TOP SOIL	=	4416.7	CU. YARDS
TOTAL REINFORCING STEEL	=	3022.	POUNDS
TOTAL CLEARING & GRUBBING IN R/W	=	LUMP SUM	
TOTAL OVERHAUL ON EXCAVATION	=	877	C.Y. STA.

COMMON EXCAVATION EST. 2500 C.Y. PER MILE, WHERE NO GRADING IS DONE
ROCK EXCAVATION ESTIMATED.
TOP SOIL INCLUDES 10% ALLOWANCE FOR COMPACTION.
GRADING TO BE DONE FROM STA. 947+00 TO STA. 983+490.



STATE PROJ. 309 TO CHESTER
LANDSFORD
LEWISVILLE
LOCAL ROAD
SURVEY STA. 702+80.3 BEGINNING OF F.A. PROJ. 68 REOP SEC. 2 CONT. 2 AT END OF F.A. PROJ. 309 B AT THE LEWISVILLE-LANDSFORD TOWNSHIP LINE.
TIE EQUALITY ONLY.
SURVEY STA. 702+80.3 BEGINNING OF F.A. PROJ. 68-R. SEC. 2 CONT. 2 OPPOSITE STA. 497+22 ORIG. F.A. PROJ. 68
TO CHESTER
LANCASTER
TOWNSHIP
BRANCH
SMALL
AND
CHESTER
RAILROAD
LOCAL ROADS
BASCOMVILLE
CONSTRUCTION RELOCATION SEE SHEETS NOS 9-10-11
EXCEPTION TO PROJECT 445 FT. BRIDGE CONSTRUCTED UNDER SEPARATE CONTRACT.
PRESENT RD.
SMALL BRANCH
FISHING CREEK
PRESENT ROAD
LANCASTER
AND
N
TO ROCK HILL SEABOARD
ROUTE NO. 5 TO ROCK HILL
FORT LAWN
CONNECTION TO RT. 5
EXCEPTION TO PROJECT
LIMITS
LOCAL ROAD
TO STATE ROAD GREAT FALLS
TO GREAT FALLS RAILROAD
F.A. PROJ. NO. 68 REOP SEC. 1 CONT. 2 SURVEY STA. 1136+82 END OF F.A. PROJ. 68 REOP. AT THE BEGINNING OF F.A. PROJ. 269 REOP. SEC. 1 NEAR CATAWBA RIVER
LANCASTER
CHESTER
CATAWBA RIVER
PRESENT ROAD
TO LANCASTER
COUNTY ROAD
BRIDGE IN PLACE
LANCASTER
RAILROAD
COUNTY
COUNTY
OK. 9 m R. 8-15-31
TIE EQUALITY ONLY.
SURVEY STA. 1026+75 F.A. PROJ. 68-R SEC. 2 CONT. 2 EQUALS STA. 1331+10 ORIG. F.A. PROJ. 68
SURVEY STA. 1026+75 END OF F.A. PROJ. NO. 68-REOP SEC. 2 CONT. NO. 2 POINT IN TOWN OF FORT LAWN NEAR CITY LIMITS.

F.A. PROJ. 68-R. Sec. 2 Cont. 2

GROSS LENGTH OF PROJECT.	32394.7' = 6.135 MILES
GROSS LENGTH OF EQUALITIES.	(-) 220.3' = .042 MILES
GROSS LENGTH OF PROJECT.	32174.4' = 6.093 MILES
EXCEPTIONS.	445.0' = .084 MILES
NET LENGTH OF PROJECT.	31729.4' = 6.009 MILES

LAYOUT
Scale: 1 inch = 1600 feet.

CONVENTIONAL SIGNS

State Line, County Line, City or Town Limits, Property Line, Fence, Retaining Wall, Existing Road, Road and R.O.W. Lines of Proposed Road, Railroad, Fill or Embankment, Standard Rail, Point of Intersection (P.I.), Trolley Poles, Power Poles, Telephone or Telegraph Poles, Marsh, Trees, Brush, Stumps, Buildings, Bridge, Concrete Box Culvert, Pipe Culvert, Drop Inlet and Culvert, Hub on Center Line

LEGEND

PROPOSED PROJECT	(solid line)
OTHER ROADS	(dotted line)

68-REOP

Gross Length of Project =	8.198	Miles
Exceptions (Bridges) =	0.105	Miles
Net Length of Project =	8.093	Miles

Equalities in Stationing
68 REOP: 926+71.6 (LINE "B") = 928+89.9; 1053+00 = 1052+00; 1073+17.9 = 1073+20.2
STA. 866/78 = 866/80

Note: All workmanship and material on this project to conform with South Carolina State Highway Department Specifications, Contract and Bond; for Roads and Culverts, revised AUG. 1st 1930 and for Bridges, revised MAY 1st, 1930 as amended and approved by the U. S. Secretary of Agriculture.

SUMMARY OF ESTIMATED QUANTITIES
F.A. PROJ. NO. 68-REOP. SEC. 1 CONT. 2

TOTAL COMMON EXCAVATION	*4294.	CUBIC YARDS
TOTAL 7½-6-7½ PLAIN CONCRETE SURFACING 20' WIDE	*21,154.3	SQUARE YARDS
TOTAL 8-6½-8 PLAIN CONCRETE SURFACING 20' WIDE	3,444.4	SQUARE YARDS
TOTAL LONGITUDINAL CENTER JOINT	φ1490.	LINEAR FEET
TOTAL TOPSOIL FOR SHOULDERS	⊙1529.	CUBIC YARDS
TOTAL PAVING RESTS	2.	ONLY
TOTAL REINFORCING STEEL IN PAVEMENT	3278.	POUNDS
TOTAL NET LENGTH	2.079	MILES.

*Fine grading estimated @ 30 C.Y. Per Sta. Includes 1000 C.Y. for widening fills from 28 ft. to 30 ft.
*Includes 197 Sq. Yds. for turnouts at sta. 1058+24.3 & Sta. 1073+17.9. See sheets 6 & 7.
φ 60 Lin. ft. omitted for reinforcing in pavement.
⊙ Includes 10% for any extra TopSoil necessary.

Equalities. 1053+00 = 1052+00

F.A. PROJ. 68-REOP-SEC. 2-CONT. 2 APPROVED — DATE 8-17-31
STATE HIGHWAY ENGINEER

F.A. PROJ. NO. 68 REOP SEC. 1 CONT. NO. 2 APPROVED — DATE 10-3-[illegible]
STATE HIGHWAY ENGINEER

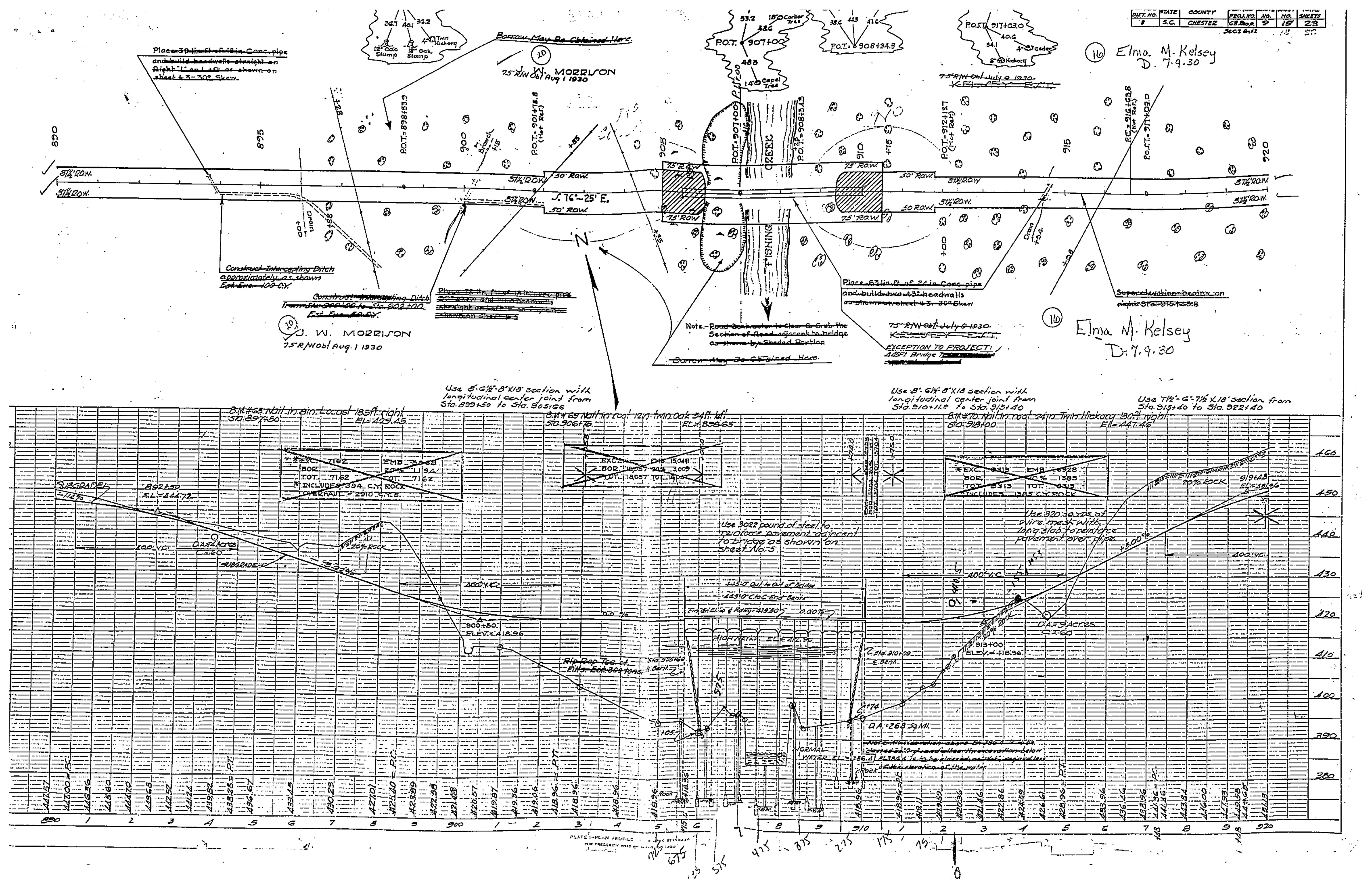
RELOCATION APPROVED STATION 803+00.4 TO 866+78.0 — DATE 9-15-30
STATE HIGHWAY ENGINEER

APPROVED — DATE 6-20-30
STATE HIGHWAY ENGINEER

RECOMMENDED FOR APPROVAL — DATE
[redacted]
DISTRICT ENGINEER - BUREAU OF PUBLIC ROADS

RECOMMENDED FOR APPROVAL — DATE
[redacted]
CHIEF ENGINEER - BUREAU OF PUBLIC ROADS

APPROVED — DATE
[redacted]
DIRECTOR - BUREAU OF PUBLIC ROADS


DIST. NO. 8 | STATE S.C. | COUNTY CHESTER | PROJ. NO. C.B. Resp. | SHEET NO. 15 | TOTAL SHEETS 23
Place 38 lin. ft. of 18 in. Conc. pipe and build headwalls straight on Right "L" on Left or shown on sheet 4 3-30° Skew.
Borrow May Be Obtained Here.
J. W. MORRISON
75' R/W Obl Aug 1 1930
Elma M. Kelsey
D. 7.9.30
75' R/W Obl July 9 1930
P.O.T. = 898+53.9
P.O.T. = 901+78.8 (Not Ref.)
P.O.T. 907+00
P.O.T. = 908+34.3
P.O.T. 917+03.0
P.O.T. = 912+13.7 (Not Ref.)
P.C. = 916+63.8 (Not Ref.)
P.O.T. = 917+03.0
CREEK
FISHING
S. 76°-25' E.
31½' ROW.
30' ROW.
50' ROW.
75' ROW.
N
Construct Intercepting Ditch approximately as shown Est. Exc. 100 C.Y.
Construct Intercepting Ditch From Sta. 900+00 to Sta. 902+00 Est. Exc. 50 C.Y.
Place 72 lin. ft. of 18 in. Conc. pipe 30° Skew and build headwalls straight or Left as shown on sheet 4 3.
Note - Road Contractor to Clear & Grub the Section of Road adjacent to bridge as shown by Shaded Portion
Borrow May Be Obtained Here.
Place 63 lin. ft. of 24 in. Conc. pipe and build two 43° headwalls as shown on sheet 4 3 - 30° Skew
EXCEPTION TO PROJECT: 445 Ft. Bridge
Superelevation begins on right Sta. 915+23.8
Use 8'-6½'-8' X 18' section with longitudinal center joint from Sta. 899+50 to Sta. 905+66
Use 8'-6½'-8' X 18' section with longitudinal center joint from Sta. 910+11.9 to Sta. 915+40
Use 7½'-6'-7½' X 18' section from Sta. 915+40 to Sta. 922+40
B.M. #68 Nail in 8 in. Locust 18 ft. right Sta. 897+60 EL = 429.45
B.M. #69 Nail in root 12 in. twin oak 54 ft. left Sta. 906+76 EL = 398.65
B.M. #70 Nail in root 24 in. Twin Hickory 130 ft. right Sta. 918+00 EL = 441.46
SUBGRADE -1.12%
892+50 EL = 444.72
D.A. = 4 Acres C = .60
SUBGRADE
-3.32%
400' V.C.
20% ROCK
900+50 ELEV. = 418.96
0.0%
Rip Rap Toe of Fills. Est. 308 tons
Use 3022 pound of steel to reinforce pavement adjacent to bridge as shown on sheet No. 5
445'0" Out to Out of Bridge
443'0" C. to C. End Bents
Fin. Gr. El. at Rdwy. 418.50 0.00%
HIGH WATER EL = 412.90
NORMAL WATER EL = 386.4
D.A. = 268 Sq. MI.
913+00 ELEV. = 418.96
D.A. = 9 Acres C = .60
Use 320.30 yds. of wire mesh with long slab to reinforce pavement over pipe.
+5.00%
919+68 EL = 451.36
EXC. 7162 | EMB. 3548 | BOR. | 20% 1194 | TOT. 7162 | TOT. 7162 | INCLUDES 394 C.Y. ROCK | OVERHAUL = 2910 C.Y.S.
EXC. | EMB. 15048 | BOR. 18057 | 20% 3009 | TOT. 18057 | TOT. 18057
EXC. 8313 | EMB. 6928 | BOR. | 20% 1385 | TOT. 8313 | TOT. 8313 | INCLUDES 1385 C.Y. ROCK
460 450 440 430 420 410 400 390 380
890 1 2 3 4 5 6 7 8 9 900 1 2 3 4 5 6 7 8 9 910 1 2 3 4 5 6 7 8 9 920
PLATE 1 - PLAN PROFILE

STATE HIGHWAY DEPARTMENT
COLUMBIA

PLAN AND PROFILE OF PROPOSED STATE HIGHWAY

FED. AID PROJECT NO. F-68(1)
DOCKET NO. 12407
S.C. ROUTE 9

CHESTER COUNTY

WIDENING BRIDGE OVER FISHING CREEK

TRAFFIC CONTROL DEVICES
CONSTRUCTION IDENTIFICATION SIGNS
FLARED CURB AND GUTTER
SLOPE DRAINS
STANDARD NOTES
STANDARD DETAILS
PLAN AND PROFILE
INTERIOR BENTS
PIERS A, B, C AND D
18" SQUARE PRESTRESSED CONCRETE PILING
SUPERSTRUCTURE 35' SPAN AND 40' SPAN
SUPERSTRUCTURE 50' SPAN
SUPERSTRUCTURE DETAILS
17 PRESTRESSED CONCRETE BEAM DETAILS
EXISTING STRUCTURE

SUMMARY OF ESTIMATED QUANTITIES	
CLASS "A" CONCRETE	522.8 C.Y.
REINFORCING STEEL	91,152 Lbs.
CREOSOTED TIMBER PILING	560 L.F.
18" SQUARE PRESTRESSED CONCRETE PILING	2,520 L.F.
8" GALV. C.M. PIPE SLOPE DRAINS (ALTERNATE 1)	165 L.F.
8" BITUMINIZED FIBER PIPE SLOPE DRAINS (ALTERNATE 2)	165 L.F.
INTAKE SPILLWAY ASSEMBLIES	4 Ea.
35' PRESTRESSED CONCRETE BEAMS	54 Ea.
40' PRESTRESSED CONCRETE BEAMS	12 Ea.
50' PRESTRESSED CONCRETE BEAMS	6 Ea.

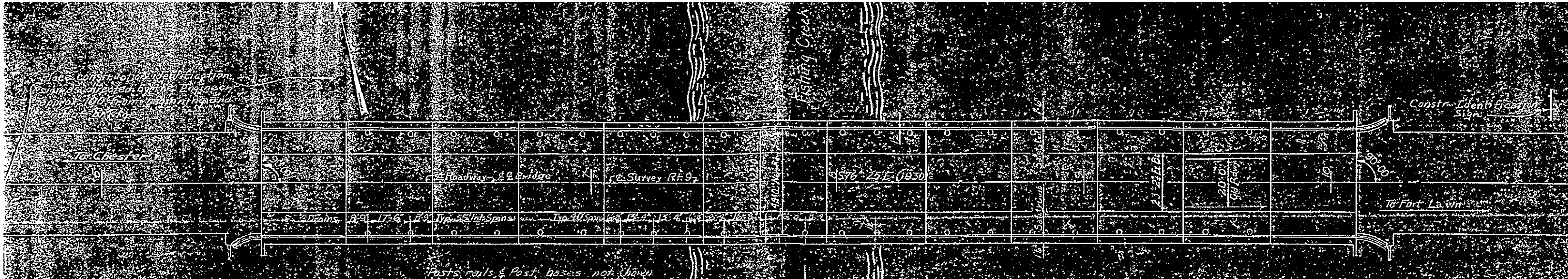
Net Length of Roadway	0.000 Miles
Net Length of Bridges	0.084 Miles
Net Length of Project	0.084 Miles
Length of Exceptions	0.000 Miles
Gross Length of Project	0.084 Miles

CONVENTIONAL SIGNS

LEGEND
PROPOSED PROJECT
OTHER ROADS

APPROVED:
STATE HIGHWAY ENGINEER DATE

DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS
APPROVED:
DISTRICT ENGINEER DATE

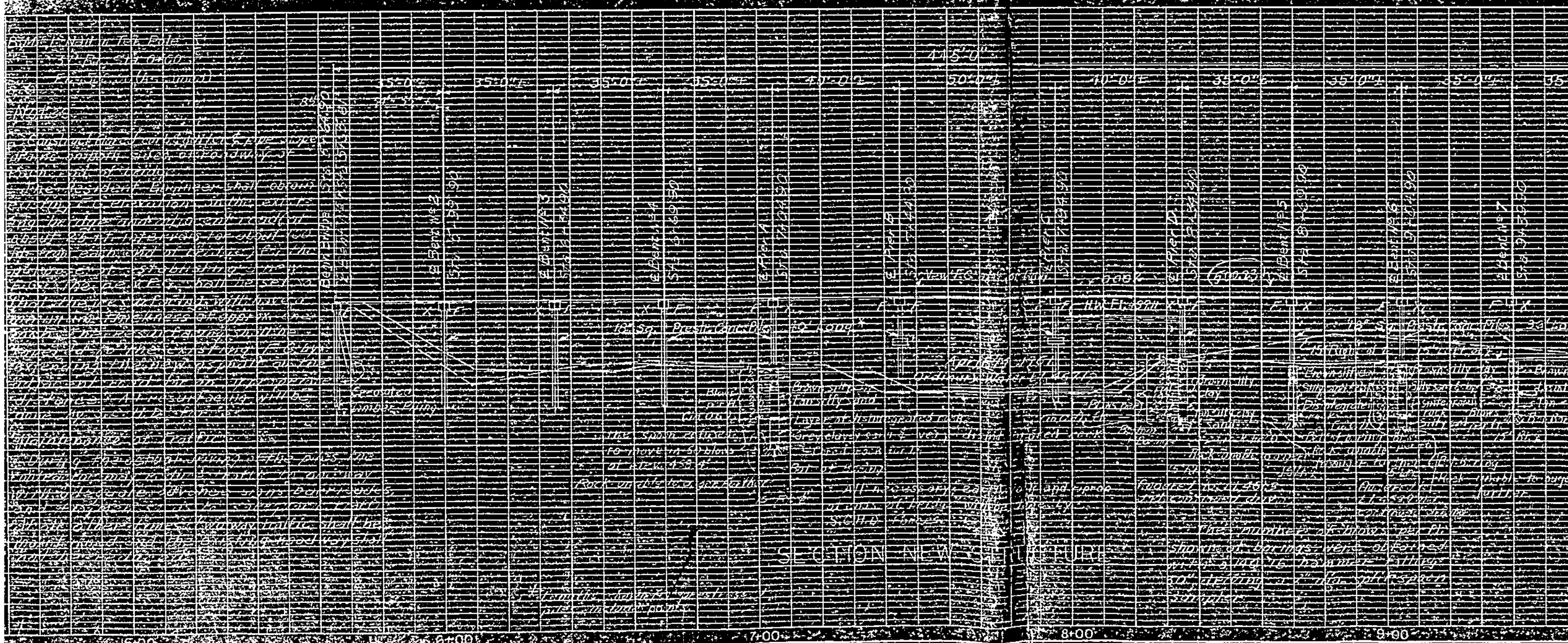


Posts, rails, & Post bases not shown.
Fixed & expansion ends of new beams shall match fixed & expansion ends of existing beams.

NOTE TO RESIDENT ENGINEER

The stations shown for ℄ of Bent (New portion) are not necessarily final. Since the superstructure [illegible] to definite lengths, the bents [illegible] be located so as to accomodate them; but the portion of the bent cap must also be tied to the [illegible] shown on plans for the bents. The location [illegible] and piers should be shifted slightly from [illegible] shown if deemed advisable by the Engineer for [illegible]

SUMMARY OF QUANTITIES										
ITEM	No.	Class "A" Concrete	Reinf. Steel	Creosoted Timber Piling	18" Square Prestr. Conc. Piling	8" Pipe Slope Dr.	Intake Spillway Assemblies	35' Prestr. Concrete Beams	40' Prestr. Concrete Beams	50' Prestr. Concrete Beams
UNITS	→	C.Y.	Lbs.	L.F.	L.F.	L.F.	Ea.	Ea.	Ea.	Ea.
End Bents 1 & 9	2	11.8	1,896	560	—	—	—	—	—	—
Int. Bents 2-8	7	57.4	7,378	—	1,584	—	—	—	—	—
Piers A-D	4	86.2	9,496	—	936	—	—	—	—	—
35' End Spans	2	62.4	11,692	—	—	—	—	12	—	—
35' Int. Spans	7	200.2	39,991	—	—	—	—	42	—	—
40' Int. Spans	2	64.0	12,762	—	—	—	—	—	12	—
50' Int. Span	1	39.0	7,807	—	—	—	—	—	—	6
Curb and Gutter	2	1.8	130	—	—	165	4	—	—	—
TOTALS		522.8	91,152	560	2520	165	4	54	12	6



S.C. STATE HIGHWAY DEPARTMENT
BRIDGE DIVISION
COLUMBIA S.C.

PLAN & PROFILE FOR WIDENING BRIDGE OVER FISHING CREEK

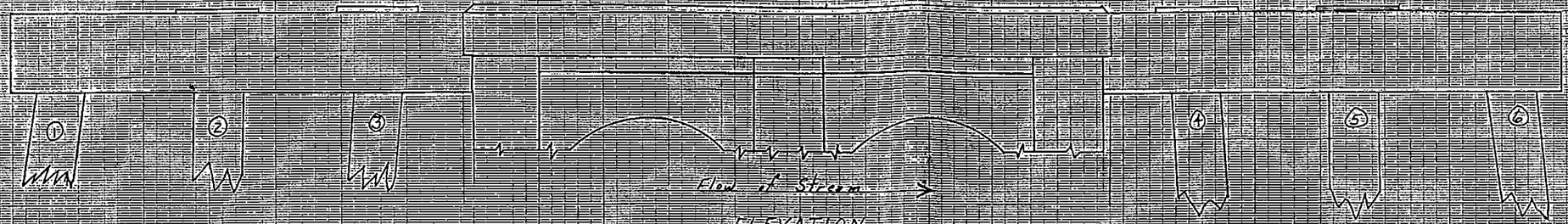
DOCKET NO.	COUNTY	ROUTE NO.	DATE
12407	CHESTER	9	1-63

	BY	CHKD	DATE
REV.			
REV.			
REV.			
REV.			
REVIEWED		DFD IN CHARGE	
QUAN.			
TR.			
DR.	RSW		1-63
DES.			

APPROVED BY: BRIDGE DESIGN & PLANS ENGR. — APPROVED BY: BRIDGE ENGINEER

10+00 11+00

BENTS 2,3,4,5,6,7,8,9 & 10 PIERS A, B, C and D



ELEVATION
(Looking in direction of stationing)

Bent Nos.	Pile Nos.	Elev. Ore Ground	Elev. Pile Tip	Pen. in Ground	Pier Nos.	Pile Nos.	Elev. Ore Ground	Elev. Pile Tip	Pen. in Ground	Bent Nos.	Pile Nos.	Elev. Ore Ground	Elev. Pile Tip	Pen. in Ground
2	1	47694	45701	1993	A	1	47434	45547	1887	5	1	47470	45772	1698
2	2	47694	45712	1982	A	2	47434	45772	1662	5	2	47474	45772	1702
2	3	47624	45757	1937	A	3	47454	45772	1732	5	3	47484	45548	1932
2	4	47615	45587	1928	A	4	47430	45464	1966	5	4	47481	45697	1784
2	5	47531	45647	1884	A	5	47445	45724	1721	5	5	47467	45772	1689
2	6	47514	45694	1820	A	6	47465	45590	1875	5	6	47459	45672	1787
3	1	47434	45545	1889	B	1	46619	45372	1247	6	1	47473	45772	1701
3	2	47434	45797	1637	B	2	46619	45456	1153	6	2	47506	45713	1793
3	3	47434	45527	1907	B	3	46619	45372	1247	6	3	47496	45772	1724
3	4	47423	45655	1768	B	4	46598	45700	898	6	4	47471	45772	1699
3	5	47461	45733	1728	B	5	46598	45629	969	6	5	47481	45772	1709
3	6	47471	45740	1737	B	6	46598	45670	928	6	6	47487	46102	1385
4	1	47489	45597	1892	C	1	46602	45678	922	7	1	47550	46200	1350
4	2	47489	45682	1807	C	2	46620	45463	1157	7	2	47562	46407	1155
4	3	47489	45487	2002	C	3	46600	45513	1087	7	3	47556	46174	1382
4	4	47525	45505	2020	C	4	46620	45523	1097	7	4	47591	46144	1447
4	5	47533	45598	1935	C	5	46620	45574	1046	7	5	47591	46172	1419
4	6	47557	45567	1990	C	6	46620	45469	1151	7	6	47574	45975	1699
					D	1	47490	45772	1718	8	1	48079	46307	1772
					D	2	47576	45609	1967	8	2	48086	46587	1499
					D	3	47506	45444	2062	8	3	48086	46432	1654
					D	4	47601	45730	1871	8	4	48041	46368	1673
					D	5	47621	45772	1849	8	5	48041	46481	1560
					D	6	47435	45739	1696	8	6	48041	46342	1699

Notes:
Accept as info. except that "Elev. Pile Tip" was checked on Pile Record Sheet No. 28.

WBB

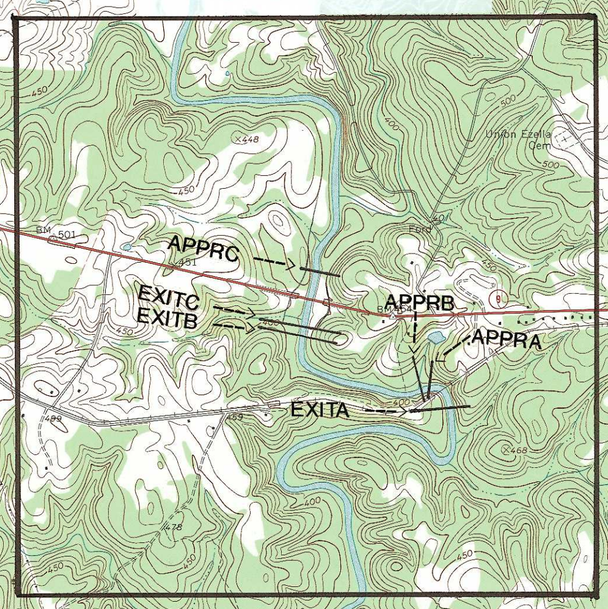
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

FORT LAWN QUADRANGLE
SOUTH CAROLINA
7.5 MINUTE SERIES (TOPOGRAPHIC)

(ROCK HILL 1:62 500)

4853 IV SE (VAN WYCK)

STUDY AREA



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

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

EXPLANATION

EXIT cross section

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

Figure 1.--Topography of study area and location of cross sections used in WSPRO analysis for structure 124000901100 on Route SC 9, crossing Fishing Creek in Chester County, South Carolina.

FORT LAWN, S. C.
N3437.5—W8052.5/7.5

1969

AMS 4853 III NW—SERIES V...