

**SCOUR EVALUATION**  
**FOR**  
**SOUTH CAROLINA DEPARTMENT OF**  
**HIGHWAYS AND PUBLIC TRANSPORTATION**  
**ON**  
**STRUCTURE # 164034000200**  
**SC-340 OVER JEFFRIES CREEK**  
**DARLINGTON COUNTY, SC**

**Prepared by:**

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**Charlotte, NC 28204**

**October 1994**



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## SCOUR EVALUATION FOR SC-340 OVER JEFFRIES CREEK

### 1.0 STREAM STABILITY

#### 1.1 Stream Characteristics

The stream characteristics were investigated in the field and recorded on Figure 1 and on forms contained in Appendix 1.

A portion of the USGS Quad map is presented as Figure 2 for location purposes.

#### 1.2 Land Use Changes

The bridge site is approximately 6 miles south of Darlington, South Carolina. The land use in the basin is of a rural character. No future land use changes are expected for the life of the structure.

#### 1.3 Overall Stream Stability

The overall stream stability appears to be stable. The 2-Year discharge and the stream slope have been plotted in the transitional zone on Figure 3 (Figure 8 in HEC-20). This shows that a sand bed stream at this site would be in transition between a meandering and braided pattern. The actual stream conditions include dense vegetation which will influence the behavior of the stream.

#### 1.4 Lateral Stability

The stream alignment is perpendicular to the bridge opening. Photographs of the site are presented in Appendix 2. Photographs show that the stream banks are vegetated and generally stable during average flow conditions.

#### 1.5 Vertical Stability

The stream bed profile is relatively stable. This is evidenced by similar thalweg elevations from the original construction plans and the soundings performed for this report. The channel may have even aggradated approximately 1 foot.

#### 1.6 Channel Response to Change

The channel may still be responding to the change resulting from the construction of the bridge. No site changes are anticipated at this time which would further influence the stream behavior.


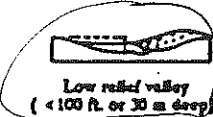





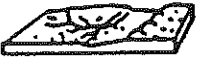











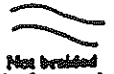


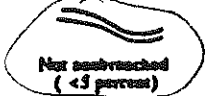
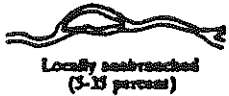
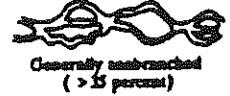
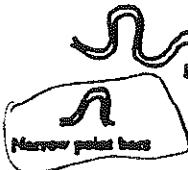
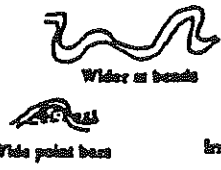
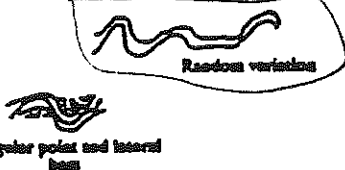
STREAM SIZE (SECT. 2.2.1)	Swamp (No channel)	Small ( $< 100$ ft. wide)	Medium ( $100-500$ ft.)	Large ( $> 500$ ft.)
FLOW HABIT (SECT. 2.2.2)	Ephemeral	(Intermittent)	Perennial but flashy	Perennial
BED MATERIAL (SECT. 2.2.3)	Silt-clay	Silt	Sand	Gravel Cobbles or boulder
VALLEY SETTING (SECT. 2.2.4)	 No valley; alluvial fan	 Low relief valley ( $< 100$ ft. or $30$ m deep)	 Moderate relief ( $100-1000$ ft. or $30-300$ m)	 High relief ( $> 1000$ ft. or $300$ m)
FLOOD PLAINS (SECT. 2.2.5)	 Little or none ( $< 2X$ channel width)	 Narrow ( $2-10$ channel width)	 Wide ( $> 10X$ channel width)	
NATURAL LEVELS (SECT. 2.2.6)	 Little or None	 Mainly on Concave	 Well Developed on Both Banks	
APPARENT INCISION (SECT. 2.2.7)	 Not Incised	 Probably Incised		
CHANNEL BOUNDARIES (SECT. 2.2.8)	 Alluvial	 Semi-alluvial	 Non-alluvial	
TREE COVER ON BANKS (SECT. 2.2.9)	$< 30$ percent of bankline	$50-90$ percent	$> 90$ percent	
SINUOSITY (SECT. 2.2.9)	 Straight Sinuosity 1-1.05	 Sinuous (1.06-1.25)	 Meandering (1.25-2.0)	 Highly meandering ( $> 2$ )
BRAIDED STREAMS (SECT. 2.2.10)	 Not braided ( $< 5$ percent)	 Locally braided ( $5-35$ percent)	 Generally braided ( $> 35$ percent)	
ANABRANCHED STREAMS (SECT. 2.2.11)	 Not anabranching ( $< 5$ percent)	 Locally anabranching ( $5-35$ percent)	 Generally anabranching ( $> 35$ percent)	
VARIABILITY OF WIDTH AND DEVELOPMENT OF BARS (SECT. 2.2.12)	 Narrow point bars	 Wide point bars	 Irregular point and lateral bars	

Figure 1. Geomorphic factors that affect stream stability (From HEC-20)

**TIMMONSVILLE QUADRANGLE  
SOUTH CAROLINA  
7.5 MINUTE SERIES (TOPOGRAPHIC)**



CONTOURS AND ELEVATIONS IN METERS  
1" = 2000'

**ROAD LEGEND**

- Improved Road .....
- Unimproved Road .....
- Trail .....
- Interstate Route
- U. S. Route
- State Route

**QUADRANGLE LOCATION**

1	2	3
4	5	6
7	8	

1 Hartsville South  
2 Darlington West  
3 Darlington East  
4 Lamar  
5 Florence West  
6 Lynchburg  
7 Sardis  
8 Effingham

ADJOINING 7.5' QUADRANGLE NAMES



NORTH

**TIMMONSVILLE, SOUTH CAROLINA  
PROVISIONAL EDITION 1986**

34079-B8-TM-024

STON, VIRGINIA-1987

DARLINGTON CO  
FLORENCE CO

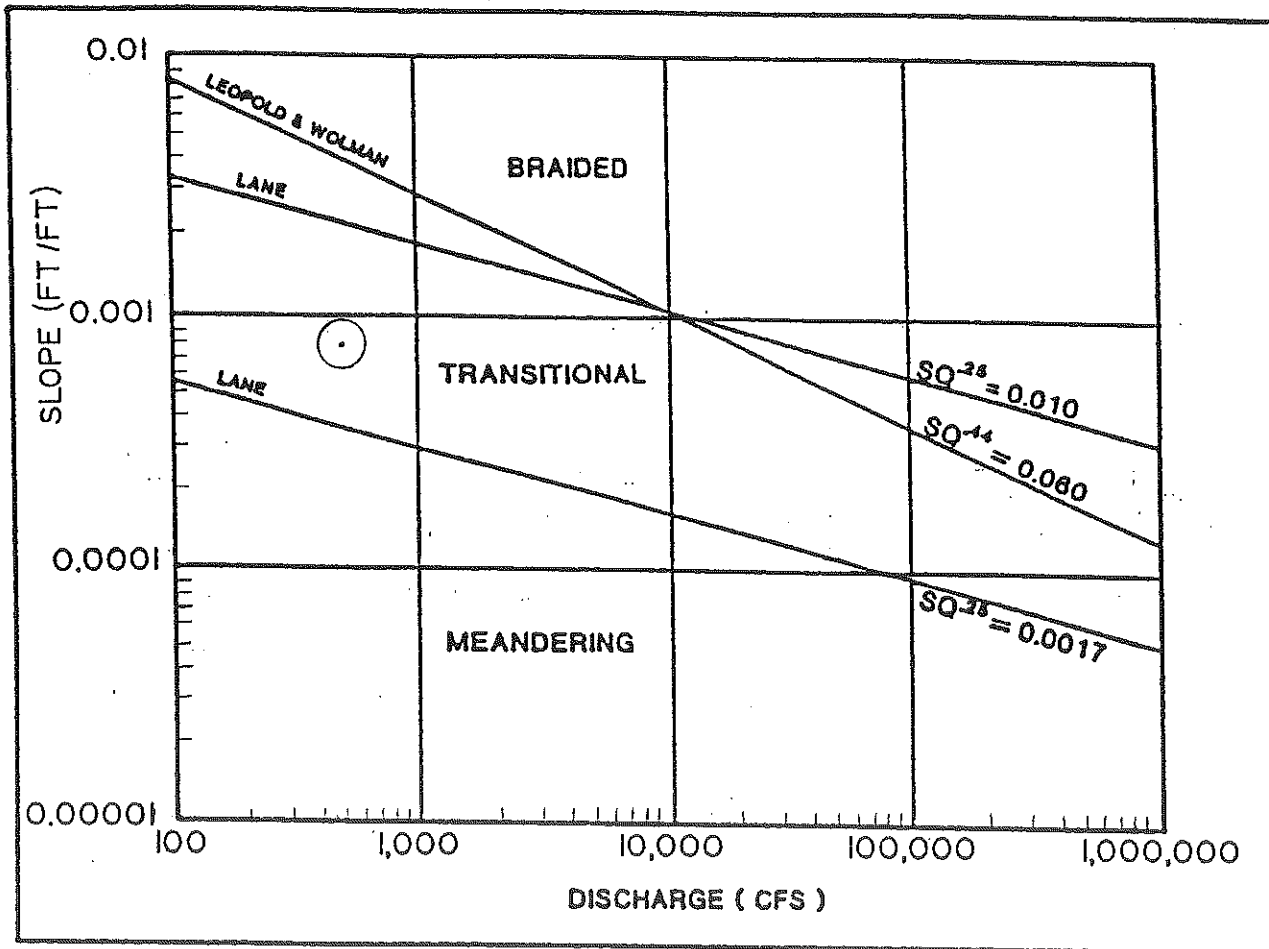


Figure 3. Slope-discharge relationship for braiding or meandering in sand bed streams (Figure 8 in HEC-20)

## 2.0 SCOUR ANALYSES

### 2.1 Flood History and Rainfall-Runoff Relations

The bridge construction plans show a 1916 H.W. El. = 126.4 FT MSL. This water surface elevation is similar to the elevation that was calculated for the 500-year storm by the WSPRO computer program.

The rainfall-runoff relations were obtained using the USGS Report 91-4157 titled "Techniques for Estimating Magnitude and Frequency of Floods in South Carolina, 1988". The results of the regression equations for the Lower Coastal Plain are listed below:

<u>Frequency</u> <u>(years)</u>	<u>Regression</u> <u>Equation</u> <u>Flowrate</u> <u>(cfs)</u>
2	465
10	1140
25	1605
50	1931
100	2352
500	3266

### 2.2 Hydraulic Conditions

The hydraulic conditions were investigated using the WSPRO computer program and the bridge geometry measured in the field. The approach and exit cross sections were developed by combining the channel geometry from the bridge soundings and the flood plain geometry from the original centerline profile. The soundings were taken from the upstream face of the bridge which is also representative of the downstream face of the bridge.

The results of the computer analysis show that the bridge opening is within the limits that would be allowed for a new bridge at this site. The existing bridge creates 0.70 feet of backwater and has a velocity of 5.1 fps in the bridge opening. Standard design practice for South Carolina is 1.0' backwater and 5 fps maximum for the 100-year event.

### 2.3 Bed and Bank Material Analysis

The field investigation visually identified the bed and bank materials as fine sand.

### 2.4 Watershed Sediment Yield Evaluation

The sediment yield for the watershed appears to be relatively stable as evidenced by the consistent stream bed geometry. A rural well vegetated drainage basin such as this one is generally characterized by relatively low sediment yields and discharge rates.

## 2.5 Rating Curve Shifts

Rating curve shifts have not been investigated at this time at the direction of SCDHPT.

## 2.6 Scour Condition Evaluation

The scour conditions were evaluated using the WSPRO computer program and the scour equations presented in HEC-18. The WSPRO computer output and the scour calculations are presented in Appendix 3. The results of the scour calculations have been summarized in Table 1.

This bridge had erosion problems in the past as evidenced by the repair at Bent 1. This erosion problem was likely caused by roadway or deck drainage and not by the bridge scour conditions that this report is based on. Although this erosion is a minor problem, SCDOT maintenance should monitor the situation since it could cause a traffic hazard if the pavement was undermined.

The thalweg for this stream could easily shift to any of the bents during the life of the structure. For this reason, the ground elevation at each bent was assumed to be the thalweg elevation.

The abutment scour at this site could aggravate the scour conditions at Bents 2 and 4. To address this situation, half the calculated abutment scour was added to the calculated scour for Bents 2 and 4.

The results of the scour calculations show that scour could expose a moderate length of the piles if they are driven in erodible material. The in-place pile lengths for each pile were available from the pile record summary sheet. Only the shortest pile lengths were listed in Table 1. A geotechnical and structural review of the information will be needed to determine if the foundations are stable.

## 2.7 Recommendations

The scour calculations for the bridge show moderate scour depths. We recommend a structural engineer and a geotechnical engineer review the scour conditions at this site to determine if the stability of the bridge can be determined with the currently available information. The geotechnical engineer will need to determine if the calculated scour depths can be reduced due to erosion resistant material. The recommendations of the geotechnical engineer should then be given to a structural engineer for a structural stability analysis. The structural engineer should review the pile length data to determine the individual pile lengths.

The northern abutment is not protected by stone and the southern abutment is partially protected with 12-inch stone. The bridge is not adequately protected from the calculated abutment scour depths of 6.7 to 7.4 feet. The northern abutment currently needs repair since the bottom of the pile cap is exposed along its entire length. We recommend that the abutments be repaired to meet the current SCDOT standards for new construction.

**Table 1 - Remaining pile/footing penetration at piers/bents for structure 164034000200 on Route SC-340, crossing Jeffries Creek in Darlington County, South Carolina**

Pier/bent <sup>1</sup>	Station <sup>1</sup>	Pile tip <sup>2</sup> elevation (feet)	Ground <sup>3</sup> elevation at pier/bent (feet)	Total <sup>4</sup> scour depth (feet)	Elevation of scour (feet)	Remaining <sup>5</sup> pile penetration (feet)
100-year discharge is 2352 cfs      -      500-year discharge is 3266 cfs						
Scour Information for 100-Year Storm:						
2	34420	97.52	119.1	14.1	105.0	7.5
3	34450	97.44	119.1	10.7	108.4	11.0
4	34480	97.44	119.1	14.1	105.0	7.6
Scour Information for 500-Year Storm:						
2	34420	97.52	119.1	16.4	102.7	5.2
3	34450	97.44	119.1	12.7	106.4	9.0
4	34480	97.44	119.1	16.4	102.7	5.3

<sup>1</sup>Pier/bent number and stations corresponds to South Carolina Department of Transportation bridge plans.

<sup>2</sup>Pile tip elevations obtained from SCDOT bridge plans. Shortest pile length listed.

<sup>3</sup>Thalweg elevation used since thalweg may shift during life of structure.

<sup>4</sup>Total scour depth is the sum of the contraction and pier/bent scour depths.

<sup>5</sup>A negative number signifies undermining of pile tip/footing.

APPENDIX 1  
FIELD INFORMATION

HYDRAULIC DESIGN  
AND  
RISK ASSESSMENT FOR  
BRIDGE/BRIDGE REPLACEMENT OVER  
stream name  
ROUTE/ROAD NUMBER SC-340  
FILE NO. \_\_\_\_\_ PROJECT NO. \_\_\_\_\_  
DARLINGTON COUNTY, SOUTH CAROLINA

DATE

Prepared By Daryl H. / Doug N.  
Checked By Doug Nichols

Signed and Sealed

(12/14/92)

**PROJECT DESCRIPTION**

County DARLINGTON, SC Rt./Rd. No. SC-340  
 Stream TEFFLES CREEK File No. \_\_\_\_\_ Project No. \_\_\_\_\_  
 PIN \_\_\_\_\_ Charge Code \_\_\_\_\_  
 Project Engineer D. NICHOLS Road Squad N/A

**COMPARATIVE DATA**

By DMP Date 9-6-94 Checked DYN Date 9-22-94

ROUTE/ROAD NO.	SC-340	S-255	I-20
DIST. FROM NEW BR. (MI.)	—	1.9	0.9
DRAINAGE AREA (SQ. MI.)	28.8	23.9	30.2
ZONE	LOWER COAST	LOWER COAST	LOWER COAST
Q <sub>10</sub> (CFS)	1140	1021	1172
Q <sub>25</sub>	1605	1438	1650
Q <sub>50</sub>	1931	1732	1925
Q <sub>100</sub>	2352	2111	2418
Q <sub>500</sub>	3266	2904	3247
BRIDGE LENGTH (FT.)	120'	75'	150'
AVG. F. G. (FT.)	131.242	—	—
OPENING FURN. (SQ. FT.)	888	503	1650
VELOCITY (FT./SEC.)	2.65	4.20	1.47
HIGH-WATER ELEV. (FT.)	26.4	—	—
HIGH-WATER DATE	1978	—	—
HIGH-WATER DEPTH	8.4	—	—
NORMAL-WATER ELEV. (FT.)	120.7	—	—
NORMAL-WATER DATE	SEPT 1994	SEPT 1994	SEPT 1994
NORMAL-WATER DEPTH	1.6'	6.1'	5.0
FILE/DOCKET/PROJ. NO.	16.247	—	—
LOCATION OF PLANS	SCDOT	SCDOT	SCDOT
DATUM/DATUM TIE	—	—	—
FLOODWAY MAP	—	—	—

SITE INSPECTION

County DARLINGTON Rt/Rd No. SC-340 Date 9-1-94  
Stream JEFFERIES CREEK PIN \_\_\_\_\_  
By \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

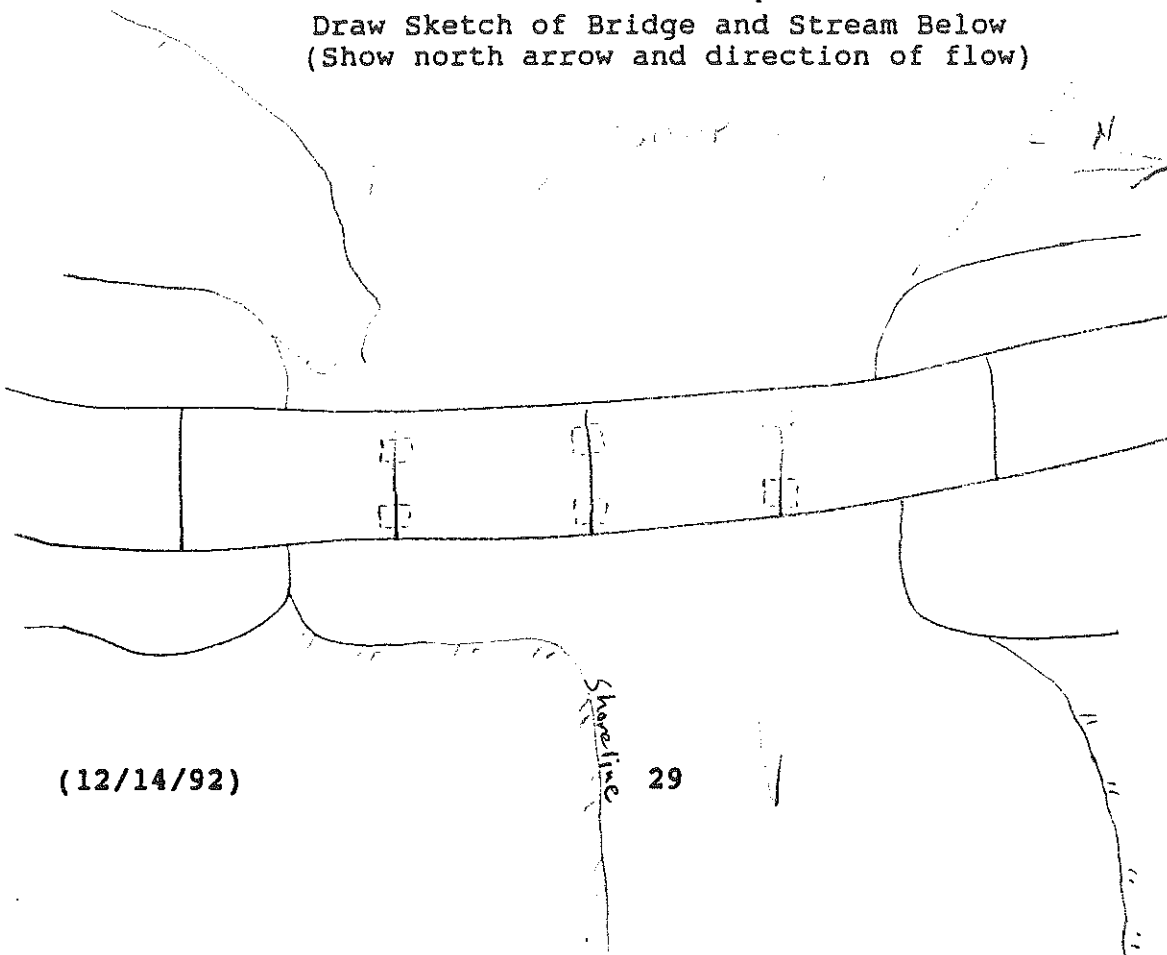
Note: All references to left and right are looking in the direction of flow.

EXISTING BRIDGE

Length 120 Ft. Width 33.0 Ft. Max. Span Length 30 FT.  
Alignment Tangent / Curved Bridge skewed Yes No Angle \_\_\_\_\_  
End Abutment Type Spill Thru  
Riprap on Fills? Yes/No Condition None on North Fair 1' Dso on South  
Superstructure Type RC Deck on RC Girders  
Substructure Type RC Columns and footings on wooden piles  
Utilities Present Yes/No Describe 10" water line on upstream face  
4 tubes for telephone on downstream face

Debris accumulations on bridge, percent channel blocked  
horizontal 5 Percent channel blocked vertical 5  
Hydraulic Problems? Yes/No Describe Upstream side of EB-1 has  
exposed pile beneath cap. It appears to be caused by bridge deck  
and roadway drainage. End bent 1 does not have riprap and the  
bottom of the cap is exposed along the entire length

Draw Sketch of Bridge and Stream Below  
(Show north arrow and direction of flow)



(12/14/92)

**STREAM BED SOUNDINGS**

BRIDGE NO. 164034000200 COUNTY DARLINGTON DATE 9-1-94 BY DYN & DMH

RECORD SOUNDINGS FROM TOP OF RAIL. OTHER LOCATION IF NEEDED: \_\_\_\_\_

DISTANCE H. W. MARK TO TOP OF RAIL 12.5 LOCATION H. W. MARK Water stain on B-1

DOWNSTREAM			PGI to Top of Rail = 3.6				UPSTREAM		
STATION	SOUNDING	DESCRIPTION	STATION	SOUNDING	DESCRIPTION	STATION	SOUNDING	DESCRIPTION	
			0+01.5	6.25	North Lower Chord				
			2.5	8.3					
			6.4	10.7					
			12.0	12.6					
			14.8	14.0	Edge H <sub>2</sub> O				
			19.8	15.4					
			30.0	15.0	B-1				
			40.0	15.4					
			49.5	15.0					
			60.0	14.7	B-2				
			70.3	14.9					
			79.8	14.8					
			90.0	15.7	B-3				
			99.6	14.8					
			1+03.9	14.2	Edge H <sub>2</sub> O				
			1+08.8	12.3					
			1+15.9	7.6					
			1+20.0	—	FF South				

### Site Characteristics

General Topography Flat to slightly rolling

Stream Type (circle one) Straight, Braided, or Meandering

Are Channel banks Stable? Yes/No If No, Describe \_\_\_\_\_

---

Are there any Hydraulic Controls Upstream or Downstream? Yes/No

Describe \_\_\_\_\_

---

Soil type Sand Exposed Rock Yes/No If so, give description and location \_\_\_\_\_

---

Describe potential for drift Moderate - Heavily forested

---

Give description and location of any structures or other property that could be damaged by backwater None

---

Describe any other features that might affect or be affected by the hydraulic performance of the proposed bridge None

---

### Mannings "n" Values

#### Channel

$$n = (n_b + n_1 + n_2 + n_3 + n_4) m$$

$n_b$ -- Base n for soil	Earth	.020
	Rock Cut	.025
	Fine Gravel	.024
	Course Gravel	.028
$n_1$ -- Degree of Irregularity	Smooth	.000
	Minor	.001-.005
	Moderate	.006-.010
	Severe	.011-.020
$n_2$ -- Variations of Channel Cross Sections	Gradual	.000
	Alternating occasionally	.001-.005
	Frequently	.010-.015
$n_3$ -- Relative Effect of Obstructions	Negligible	.000-.004
	Minor	.010-.015
	Appreciable	.020-.030
	Severe	.040-.060

$n_4$ -- Vegetation	Low	.002-.010
	Medium	.010-.025
	High	.025-.050
	Very High	.050-.100
$m$ -- Degree of Meandering	Minor	1.00
	Appreciable	1.15
	Severe	1.30

Field Observations  
for Channel

Channel Depth	$n_b$	$n_1$	$n_2$	$n_3$	$n_4$	$m$	Computed $n$
Upstream	0.02	0.01	0.005	0	0.02	1.15	0.063
Bridge	0.02	0.01	0	0	0.01	1.0	0.04
Downstream	0.02	0.01	0.005	0	0.02	1.15	0.063

Mannings "n"  
For Over Bank Areas

$$n = n_b + n_1 + n_3 + n_4$$

$n_b$ -- Base $n$ for soil	Earth	.020
	Rock Cut	.025
	Fine Gravel	.024
	Course Gravel	.028
$n_1$ -- Degree of Irregularity	Smooth	.000
	Minor	.001-.005
	Moderate	.006-.010
	Severe	.011-.020
$n_3$ -- Effect of Obstructions	Negligible	.000-.004
	Minor	.005-.019
	Appreciable	.020-.030
$n_4$ -- Amount of Vegetation	Small	.001-.010
	Medium	.011-.025
	Large	.025-.Very Large

**Field Observations  
For Over Bank Areas**

Location	Depth	$n_D$	$n_1$	$n_3$	$n_4$	Computed $n$
Upstream		0.02	0	0	.16	0.18
Bridge		0.02	0	0	.02	0.04
Downstream		0.02	0	0	.16	0.18

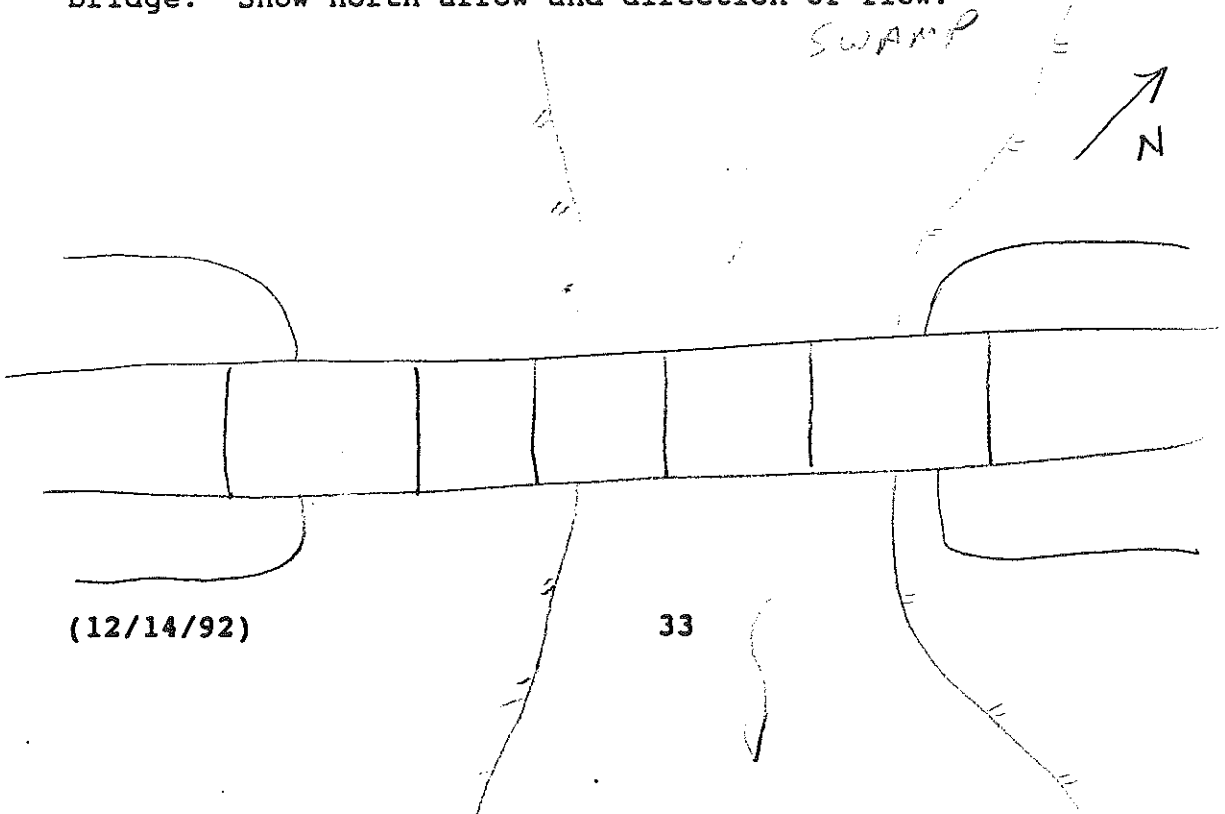
COMPARATIVE BRIDGE SITE INSPECTION FORM

County DARLINGTON Rt/Rd No. S-255  
Stream JEFFRIES CRK. Measured bridge length 75'-0"  
Maximum span length 15'-0" Superstructure type Flat Slab  
Substructure type RC Caps w/ Wood Piles End Abutment type Spill Thru  
Rip-rap present? Yes/No (No) Condition \_\_\_\_\_  
Stream type (circle one) Straight, Braided, Meander, or Anabranching. Alluvial or Rock. (circle)  
Any visible signs of scour problems (describe) None

Are banks stable (describe) Yes well vegetated  
Debris blockage; Percent of channel blocked horizontally 0  
vertically 0. Describe other signs of debris None

Any other problems None

Draw sketch and indicate problem areas. On sketch indicate location of woods, fields and other land uses in the vicinity of bridge. Show north arrow and direction of flow.



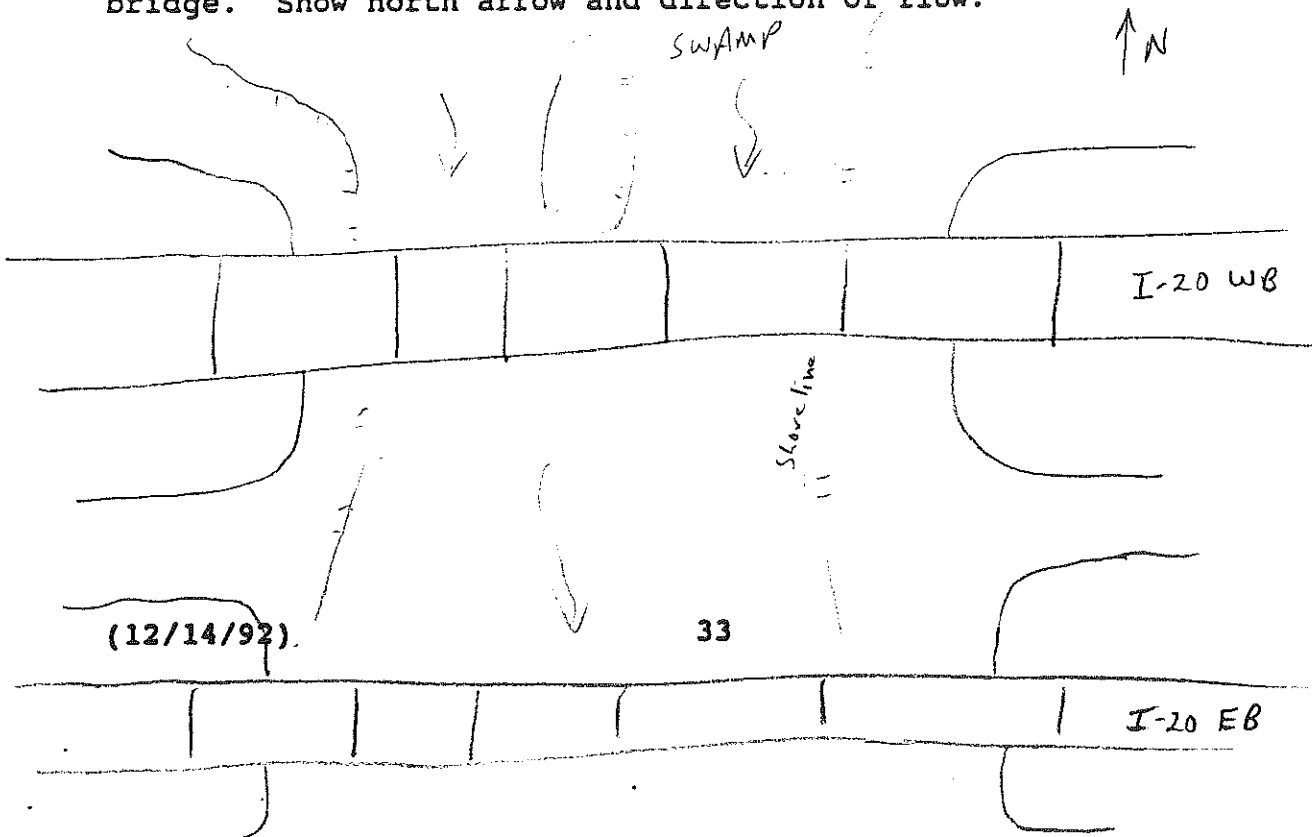
(12/14/92)



COMPARATIVE BRIDGE SITE INSPECTION FORM

County DARLINGTON Rt/Rd No. I-20  
 Stream JEFFERES CRK. Measured bridge length 150'  
 Maximum span length 30' Superstructure type Flat slab  
 Substructure type R.C. Piles End Abutment type Spill Thru  
 Rip-rap present? (Yes)/No Condition Excellent  $D_{50} = 1'$   
 Stream type (circle one) Straight, Braided Meander, or  
 Anabranch. Alluvial or Rock. (circle)  
 Any visible signs of scour problems (describe) Bent 2 has a  
3' ± scour hole around it.  
 Are banks stable (describe) Yes well vegetated  
 Debris blockage; Percent of channel blocked horizontally 0  
 vertically 0. Describe other signs of debris None  
 Any other problems None

Draw sketch and indicate problem areas. On sketch indicate location of woods, fields and other land uses in the vicinity of bridge. Show north arrow and direction of flow.





# Flood History

Local resident's name: Bobby Cottingham  
address: B+B Auto Service  
Phone #: 393-3481

Period of knowledge: 25 Yrs

High water mark location: Never close to bottom of bridge. Highest ab  
3 feet above normal.

Date of occurrence: Before dam was built 1979±

Frequency of flooding: Once a year

A dam was built on a small tributary to Jeffries  
Creek in 1981. He has not seen any large floods since  
then.

803-393-3481



**B & B Auto Service**

VOLKSWAGEN AND TOYOTA REPAIR

BOBBY COTTINGHAM

ROUTE 4, BOX 102  
DARLINGTON, SC 29532

APPENDIX 2  
PHOTOGRAPHS

SC-340 OVER JEFFRIES CREEK  
Darlington County



(1) Upstream



(2) Downstream

SC-340 OVER JEFFRIES CREEK  
Darlington County



(3) South along upstream face



(4) South beneath bridge

SC-340 OVER JEFFRIES CREEK  
Darlington County



(5) Exposed pile, upstream side, End Bent 1



(6) Downstream at End Bent 1

SC-340 OVER JEFFRIES CREEK  
Darlington County



(7) South along downstream face



(8) South along alignment

SC-340 OVER JEFFRIES CREEK  
Darlington County



(9) North along upstream face



(10) North along downstream face

SC-340 OVER JEFFRIES CREEK  
Darlington County



(11) Looking downstream at End Bent 2

APPENDIX 3  
WSPRO COMPUTER DATA  
and  
SCOUR CALCULATIONS

WSPRO  
P060188

FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

\*\*\* RUN DATE & TIME: 09-27-94 14:41

T1 STR. NO. 164034000200 DARLINGTON CO.

T2 SC-340 OVER JEFFRIES CREEK

\*F

Q 2352 3266

\*\*\* Q-DATA FOR SEC-ID, ISEQ = 1

SK 0.0008 0.0008

WSPRO  
P060188

FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.  
SC-340 OVER JEFFRIES CREEK  
\*\*\* RUN DATE & TIME: 09-27-94 14:41

\*\* START PROCESSING CROSS SECTION - "1 "

XT 1 1000

GR	0.0	127.0	1.0	127.0	100.0	126.5	120.0	123.0
GR	200.0	122.0	360.0	119.8	365.0	119.0	380.0	119.5
GR	390.0	119.0	409.8	119.4	420.0	119.8	430.0	119.4
GR	439.5	119.8	450.0	120.1	460.3	119.9	469.8	120.0
GR	480.0	119.1	510.0	119.0	520.0	119.5	535.0	119.0
GR	540.0	119.8	700.0	122.0	780.0	123.0	800.0	126.5
GR	900.0	127.0						

\*\* FINISH PROCESSING CROSS SECTION - "1 "

\*\*\* TEMPLATE CROSS SECTION "1 " SAVED INTERNALLY.

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FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.  
SC-340 OVER JEFFRIES CREEK  
\*\*\* RUN DATE & TIME: 09-27-94 14:41

\*\*\* START PROCESSING CROSS SECTION - "EXIT "  
XS EXIT 880 \* \* \* 0.0008

GT

N 0.18 0.063 0.18

SA 380 520

\*\*\* FINISH PROCESSING CROSS SECTION - "EXIT "  
\*\*\* CROSS SECTION "EXIT " WRITTEN TO DISK, RECORD NO. = 1

--- DATA SUMMARY FOR SECID "EXIT " AT SRD = 880. ERR-CODE = 0

SKEW	IHFNO	VSLOPE	EK	CK
.0	0.	.0008	.50	.00

X-Y COORDINATE PAIRS (NGP = 25):

X	Y	X	Y	X	Y	X	Y
.0	126.90	1.0	126.90	100.0	126.40	120.0	122.90
200.0	121.90	360.0	119.70	365.0	118.90	380.0	119.40
390.0	118.90	409.8	119.30	420.0	119.70	430.0	119.30
439.5	119.70	450.0	120.00	460.3	119.80	469.8	119.90
480.0	119.00	510.0	118.90	520.0	119.40	535.0	118.90
540.0	119.70	700.0	121.90	780.0	122.90	800.0	126.40
900.0	126.90						

X-Y MAX-MIN POINTS:

XMIN	Y	X	YMIN	XMAX	Y	X	YMAX
.0	126.90	365.0	118.90	900.0	126.90	.0	126.90

SUBAREA BREAKPOINTS (NSA = 3):  
380. 520.

ROUGHNESS COEFFICIENTS (NSA = 3):  
.180 .063 .180

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FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.  
SC-340 OVER JEFFRIES CREEK

\*\*\* RUN DATE & TIME: 09-27-94 14:41

\*\*\* START PROCESSING CROSS SECTION - "FULLV"  
XS FULLV 1000 \* \* \* 0.0008

GT

N 0.18 0.063 0.18

SA 380 520

\*\*\* FINISH PROCESSING CROSS SECTION - "FULLV"

\*\*\* CROSS SECTION "FULLV" WRITTEN TO DISK, RECORD NO. = 2

--- DATA SUMMARY FOR SECID "FULLV" AT SRD = 1000. ERR-CODE = 0

SKEW	IHFNO	VSLOPE	EK	CK
.0	0.	.0008	.50	.00

X-Y COORDINATE PAIRS (NGP = 25):

X	Y	X	Y	X	Y	X	Y
.0	127.00	1.0	127.00	100.0	126.50	120.0	123.00
200.0	122.00	360.0	119.80	365.0	119.00	380.0	119.50
390.0	119.00	409.8	119.40	420.0	119.80	430.0	119.40
439.5	119.80	450.0	120.10	460.3	119.90	469.8	120.00
480.0	119.10	510.0	119.00	520.0	119.50	535.0	119.00
540.0	119.80	700.0	122.00	780.0	123.00	800.0	126.50
900.0	127.00						

X-Y MAX-MIN POINTS:

XMIN	Y	X	YMIN	XMAX	Y	X	YMAX
.0	127.00	365.0	119.00	900.0	127.00	.0	127.00

SUBAREA BREAKPOINTS (NSA = 3):

380. 520.

ROUGHNESS COEFFICIENTS (NSA = 3):

.180 .063 .180

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FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.  
SC-340 OVER JEFFRIES CREEK  
\*\*\* RUN DATE & TIME: 09-27-94 14:41

\*\* START PROCESSING CROSS SECTION - "BRID "

BR	BRID	1000	128.5	0					
GR		391.5	128.6	392.5	126.5	396.4	124.1	402.0	122.2
GR		404.8	120.8	409.8	119.4	420.0	119.8	430.0	119.4
GR		439.5	119.8	450.0	120.1	460.3	119.9	469.8	120.0
GR		480.0	119.1	489.6	120.0	493.9	120.6	498.8	122.5
GR		505.9	127.2	510.0	128.5	391.5	128.6		
N		0.04	0.04	0.04					
SA		402	498.8						
CD		3	33	2.000	131.2	0	0	0	
PW 0		119.14	2	119.84	2	119.84	4	120.1	4 120.1 6
		128.59	6	128.59	0				
HP		1	BRID	124.54	*	124.54			

\*\* FINISH PROCESSING CROSS SECTION - "BRID "

\*\* CROSS SECTION "BRID " WRITTEN TO DISK, RECORD NO. = 3

-- DATA SUMMARY FOR SECID "BRID " AT SRD = 1000. ERR-CODE = 0

SKEW	IHFNO	VSLOPE	EK	CK
.0	0.	.0008	.50	.00

X-Y COORDINATE PAIRS (NGP = 19):

X	Y	X	Y	X	Y	X	Y
391.5	128.60	392.5	126.50	396.4	124.10	402.0	122.20
404.8	120.80	409.8	119.40	420.0	119.80	430.0	119.40
439.5	119.80	450.0	120.10	460.3	119.90	469.8	120.00
480.0	119.10	489.6	120.00	493.9	120.60	498.8	122.50
505.9	127.20	510.0	128.50	391.5	128.60		

X-Y MAX-MIN POINTS:

XMIN	Y	X	YMIN	XMAX	Y	X	YMAX
391.5	128.60	480.0	119.10	510.0	128.50	391.5	128.60

UBAREA BREAKPOINTS (NSA = 3):

402. 499.

ROUGHNESS COEFFICIENTS (NSA = 3):

.040 .040 .040

BRIDGE PARAMETERS:

BRTYPE	BRWDTH	LSEL	USERCD	EMBSS	EMBELV	ABSLPL	ABSLPR
3	33.0	128.50	*****	2.00	131.20	*****	*****

PELV	PWDTH	PELV	PWDTH	PELV	PWDTH	PELV	PWDTH
119.14	2.0	119.84	2.0	119.84	4.0	120.10	4.0
120.10	6.0	128.59	6.0	128.59	.0		

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FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.

SC-340 OVER JEFFRIES CREEK

\*\*\* RUN DATE & TIME: 09-27-94 14:41

CROSS-SECTION PROPERTIES: ISEQ = 3; SECID = BRID ; SRD = 1000.

WSEL	SA#	AREA	K	TOPW	WETP	ALPH	LEW	REW	QCR
	1	8.	330.	6.	7.				51.
	2	448.	45963.	97.	98.				5463.
	3	3.	105.	3.	4.				18.
124.54		459.	46398.	106.	108.	1.02	396.	502.	5351.

HP

1 BRID 125.43

\* 125.43

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FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.  
SC-340 OVER JEFFRIES CREEK

\*\*\* RUN DATE & TIME: 09-27-94 14:41

CROSS-SECTION PROPERTIES: ISEQ = 3; SECID = BRID ; SRD = 1000.

WSEL	SA#	AREA	K	TOPW	WETP	ALPH	LEW	REW	QCR
	1	14.	748.	8.	8.				109.
	2	534.	61632.	97.	98.				7114.
	3	6.	276.	4.	5.				45.
125.43		555.	62656.	109.	112.	1.03	394.	503.	6993.

HP

2 BRID 124.54

\* 124.54 2352.

FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.  
SC-340 OVER JEFFRIES CREEK  
\*\*\* RUN DATE & TIME: 09-27-94 14:41

VELOCITY DISTRIBUTION: ISEQ = 3; SECID = BRID ; SRD = 1000.

WSEL	LEW	REW	AREA	K	Q	VEL
124.54	395.7	501.9	458.8	46398.	2352.	5.13

STA.	395.7	408.5	412.8	417.1	421.7	426.2
A(I)	32.4	21.4	21.5	21.9	21.7	
V(I)	3.63	5.49	5.46	5.37	5.41	
X STA.	426.2	430.4	434.6	439.1	443.8	448.8
A(I)	21.5	21.0	22.1	21.9	22.7	
V(I)	5.47	5.61	5.32	5.36	5.19	
X STA.	448.8	453.9	458.9	463.7	468.7	473.4
A(I)	23.1	22.8	22.1	22.8	22.0	
V(I)	5.10	5.15	5.31	5.16	5.35	
STA.	473.4	477.7	481.6	485.8	490.5	501.9
A(I)	21.7	20.6	21.3	22.1	32.1	
V(I)	5.42	5.72	5.51	5.33	3.66	

HP

2 BRID 125.43

\* 125.43 3265.

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FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.  
SC-340 OVER JEFFRIES CREEK  
\*\*\* RUN DATE & TIME: 09-27-94 14:41

VELOCITY DISTRIBUTION: ISEQ = 3; SECID = BRID ; SRD = 1000.

WSEL	LEW	REW	AREA	K	Q	VEL
125.43	394.2	503.2	554.5	62656.	3265.	5.89

A STA.	394.2	407.7	412.2	416.7	421.3	425.9
A(I)	39.8	26.5	26.0	26.5	26.2	
V(I)	4.10	6.17	6.28	6.15	6.24	
X STA.	425.9	430.2	434.5	439.1	443.9	448.9
A(I)	25.8	25.6	26.6	26.5	27.5	
V(I)	6.34	6.37	6.15	6.16	5.94	
X STA.	448.9	454.0	459.0	463.9	468.9	473.7
A(I)	27.3	26.9	27.0	27.2	26.9	
V(I)	5.97	6.06	6.05	6.00	6.07	
STA.	473.7	478.0	482.0	486.4	491.4	503.2
A(I)	25.7	25.0	26.0	27.3	38.3	
V(I)	6.35	6.54	6.27	5.99	4.27	

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FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.  
SC-340 OVER JEFFRIES CREEK

\*\*\* RUN DATE & TIME: 09-27-94 14:41

\*\* START PROCESSING CROSS SECTION - "ROAD "

XR ROAD 1016.5 33 1

GR 0 131.2 900 131.2

\*\* FINISH PROCESSING CROSS SECTION - "ROAD "

\*\* NO ROUGHNESS DATA INPUT, WILL PROPAGATE FROM PREVIOUS CROSS SECTION.

\*\* CROSS SECTION "ROAD " WRITTEN TO DISK, RECORD NO. = 4

-- DATA SUMMARY FOR SECID "ROAD " AT SRD = 1017. ERR-CODE = 0

SKEW	IHFNO	VSLOPE	EK	CK
.0	0.	.0008	.50	.00

X-Y COORDINATE PAIRS (NGP = 2):

X	Y	X	Y	X	Y	X	Y
.0	131.20	900.0	131.20				

X-Y MAX-MIN POINTS:

XMIN	Y	X	YMIN	XMAX	Y	X	YMAX
.0	131.20	.0	131.20	900.0	131.20	.0	131.20

UBAREA BREAKPOINTS (NSA = 3):

380. 520.

ROUGHNESS COEFFICIENTS (NSA = 3):

.180 .063 .180

ROAD GRADE DATA: IPAVE RDWID USERCF

1. 33.0 \*\*\*\*\*

BRIDGE PROJECTION DATA: XREFLT XREFRT FDSTLT FDSTRT

\*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\*

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FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.  
SC-340 OVER JEFFRIES CREEK

\*\*\* RUN DATE & TIME: 09-27-94 14:41

\*\*\* START PROCESSING CROSS SECTION - "APPR "  
AS APPR 1153 \* \* \* 0.0008

GT

N 0.18 0.063 0.18

SA 380 520

HP 1 APPR 125.45 \* 125.45

\*\*\* FINISH PROCESSING CROSS SECTION - "APPR "  
\*\*\* CROSS SECTION "APPR " WRITTEN TO DISK, RECORD NO. = 5

--- DATA SUMMARY FOR SECID "APPR " AT SRD = 1153. ERR-CODE = 0

SKEW	IHFNO	VSLOPE	EK	CK
.0	0.	.0008	.50	.00

X-Y COORDINATE PAIRS (NGP = 25):

X	Y	X	Y	X	Y	X	Y
.0	127.12	1.0	127.12	100.0	126.62	120.0	123.12
200.0	122.12	360.0	119.92	365.0	119.12	380.0	119.62
390.0	119.12	409.8	119.52	420.0	119.92	430.0	119.52
439.5	119.92	450.0	120.22	460.3	120.02	469.8	120.12
480.0	119.22	510.0	119.12	520.0	119.62	535.0	119.12
540.0	119.92	700.0	122.12	780.0	123.12	800.0	126.62
900.0	127.12						

X-Y MAX-MIN POINTS:

XMIN	Y	X	YMIN	XMAX	Y	X	YMAX
.0	127.12	365.0	119.12	900.0	127.12	.0	127.12

SUBAREA BREAKPOINTS (NSA = 3):

380. 520.

ROUGHNESS COEFFICIENTS (NSA = 3):

.180 .063 .180

BRIDGE PROJECTION DATA: XREFLT XREFRT FDSTLT FDSTRT

\*\*\*\*\*

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FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.  
SC-340 OVER JEFFRIES CREEK

\*\*\* RUN DATE & TIME: 09-27-94 14:41

CROSS-SECTION PROPERTIES: ISEQ = 5; SECID = APPR ; SRD = 1153.

WSEL	SA#	AREA	K	TOPW	WETP	ALPH	LEW	REW	QCR
	1	1071.	22017.	273.	274.				12029.
	2	823.	63329.	140.	140.				11316.
	3	1071.	22017.	273.	274.				12029.
125.45		2964.	107363.	687.	687.	2.80	107.	793.	20900.

HP

1 APPR 126.57

\* 126.57

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FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.  
SC-340 OVER JEFFRIES CREEK

\*\*\* RUN DATE & TIME: 09-27-94 14:41

CROSS-SECTION PROPERTIES: ISEQ = 5; SECID = APPR ; SRD = 1153.

WSEL	SA#	AREA	K	TOPW	WETP	ALPH	LEW	REW	QCR
	1	1381.	33099.	280.	280.				17405.
	2	979.	84698.	140.	140.				14701.
	3	1381.	33099.	280.	280.				17405.
126.57		3741.	150897.	699.	700.	2.73	100.	800.	29687.

HP

2 APPR 125.45

\* 125.45 2352.

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FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.  
SC-340 OVER JEFFRIES CREEK  
\*\*\* RUN DATE & TIME: 09-27-94 14:41

VELOCITY DISTRIBUTION: ISEQ = 5; SECID = APPR ; SRD = 1153.

WSEL	LEW	REW	AREA	K	Q	VEL
125.45	106.7	793.3	2964.5	107363.	2352.	.79

X STA.	106.7	235.8	296.3	341.0	376.3	390.0
A(I)	369.7	256.4	221.7	201.1	82.7	
V(I)	.32	.46	.53	.58	1.42	
X STA.	390.0	401.0	412.3	425.0	437.2	451.0
A(I)	68.2	67.9	71.9	70.7	74.6	
V(I)	1.73	1.73	1.64	1.66	1.58	
X STA.	451.0	464.8	477.8	488.6	499.4	510.0
A(I)	73.9	72.0	67.7	67.6	66.9	
V(I)	1.59	1.63	1.74	1.74	1.76	
STA.	510.0	523.6	559.1	604.8	664.9	793.3
A(I)	82.1	202.5	226.0	254.1	366.8	
V(I)	1.43	.58	.52	.46	.32	

HP

2 APPR 126.57

\* 126.57 3265.

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FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.  
SC-340 OVER JEFFRIES CREEK  
\*\*\* RUN DATE & TIME: 09-27-94 14:41

VELOCITY DISTRIBUTION: ISEQ = 5; SECID = APPR ; SRD = 1153.

WSEL	LEW	REW	AREA	K	Q	VEL
126.57	100.3	799.7	3740.6	150897.	3265.	.87

STA.	100.3	218.0	278.0	326.6	366.3	387.4
A(I)	432.1	306.4	284.3	259.6	151.0	
V(I)	.38	.53	.57	.63	1.08	
X STA.	387.4	398.8	410.9	424.0	436.7	450.7
A(I)	83.7	86.9	88.6	88.0	91.3	
V(I)	1.95	1.88	1.84	1.86	1.79	
X STA.	450.7	465.0	478.5	489.8	501.3	512.6
A(I)	92.9	90.3	83.2	84.8	84.4	
V(I)	1.76	1.81	1.96	1.92	1.93	
STA.	512.6	532.9	573.0	620.9	682.5	799.7
A(I)	144.6	263.0	280.7	314.7	429.9	
V(I)	1.13	.62	.58	.52	.38	

EX

+++ BEGINNING PROFILE CALCULATIONS -- 2

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FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.

SC-340 OVER JEFFRIES CREEK

\*\*\* RUN DATE & TIME: 09-27-94 14:41

XSID:CODE	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
XIT :XS	*****	111.	2480.	.04	*****	124.56	121.19	2352.	124.52
880.	*****	789.	83089.	2.85	*****	*****	.15	.95	

ULLV:FV	120.	111.	2483.	.04	.10	124.66	*****	2352.	124.62
1000.	120.	789.	83222.	2.85	.00	.00	.15	.95	

<<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>

PPR :AS	153.	111.	2486.	.04	.12	124.79	*****	2352.	124.75
1153.	153.	789.	83367.	2.85	.00	.00	.15	.95	

<<<<<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	
BRID :BR	120.	396.	459.	.66	.17	125.21	122.69	2352.	124.54
1000.	120.	502.	46462.	1.63	.47	.00	.55	5.12	

TYPE	PPCD	FLOW	C	P/A	LSEL	BLN	XLAB	XRAB
3.	0.	1.	.784	.063	128.50	*****	*****	*****

XSID:CODE	SRD	FLEN	HF	VHD	EGL	ERR	Q	WSEL
ROAD :RG	1017.							

<<<<<EMBANKMENT IS NOT OVERTOPPED>>>>

XSID:CODE	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
APPR :AS	120.	107.	2962.	.03	.15	125.47	121.41	2352.	125.45
1153.	136.	793.	107232.	2.80	.11	.00	.11	.79	

M(G)	M(K)	KQ	XLKQ	XRKQ	OTEL
.843	.564	46790.	398.	504.	125.39

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

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FEDERAL HIGHWAY ADMINISTRATION - U. S. GEOLOGICAL SURVEY  
MODEL FOR WATER-SURFACE PROFILE COMPUTATIONS  
(Input modified to free format by GKY&A 01/92)

STR. NO. 164034000200 DARLINGTON CO.  
SC-340 OVER JEFFRIES CREEK

\*\*\* RUN DATE & TIME: 09-27-94 14:41

XSID:CODE	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
XIT :XS	*****	105.	3116.	.05	*****	125.50	121.58	3266.	125.45
880.	*****	795.	115419.	2.78	*****	*****	.14	1.05	

ULLV:FV	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
1000.	120.	105.	3118.	.05	.10	125.60	*****	3266.	125.55
	120.	795.	115546.	2.78	.00	.00	.14	1.05	

<<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

PPR :AS	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
1153.	153.	105.	3121.	.05	.12	125.72	*****	3266.	125.68
	153.	795.	115680.	2.78	.00	.00	.14	1.05	

<<<<<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	
BRID :BR	120.	394.	555.	.90	.18	126.33	123.37	3266.	125.43
1000.	120.	503.	62674.	1.67	.66	.00	.59	5.89	

TYPE	PPCD	FLOW	C	P/A	LSEL	BLEN	XLAB	XRAB
3.	0.	1.	.774	.062	128.50	*****	*****	*****

XSID:CODE	SRDL	FLEN	HF	VHD	EGL	ERR	Q	WSEL
ROAD :RG	1017.							

<<<<<EMBANKMENT IS NOT OVERTOPPED>>>>>

XSID:CODE	SRDL	LEW	AREA	VHD	HF	EGL	CRWS	Q	WSEL
SRD	FLEN	REW	K	ALPH	HO	ERR	FR#	VEL	
APPR :AS	120.	100.	3741.	.03	.16	126.60	121.80	3266.	126.57
1153.	138.	800.	150916.	2.73	.11	.00	.11	.87	

M(G)	M(K)	KQ	XLKQ	XRKQ	OTEL
.841	.571	64729.	396.	505.	126.51

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

ER

NORMAL END OF WSPRO EXECUTION.

=====

STRUCTURE NO. 164034000200 DARLINGTON CO.  
100 YEAR CHANNEL CONTRACTION SCOUR

Y1= 6.3 ft  
Wc1= 140 ft  
Wc2= 96.8 ft  
Qmc1= 1387 cfs  
Qmc2= 2330 cfs  
K1= 0.59

Y2=  $Y1 * (Qmc2/Qmc1)^{(6/7)} * (Wc1/Wc2)^{K1}$   
Y2= 12.3 ft  
Ys=Y2-Y1= 5.9 ft

500 YEAR CHANNEL CONTRACTION SCOUR

Y1= 7.4 ft  
Wc1= 140 ft  
Wc2= 96.8 ft  
Qmc1= 1833 cfs  
Qmc2= 3213 cfs  
K1= 0.59

Y2=  $Y1 * (Qmc2/Qmc1)^{(6/7)} * (Wc1/Wc2)^{K1}$   
Y2= 15.0 ft  
Ys=Y2-Y1= 7.5 ft

100 YEAR CHANNEL PIER SCOUR

Y1= 5.44  
K1= 1.1  
K2= 1.0  
K3= 1.1  
a= 2.0 ft  
V1= 5.7  
Fr1= 0.432

Ys=  $Y1 * 2 * K1 * K2 * K3 * (a/Y1)^{0.65} * Fr1^{0.43}$   
Ys= 4.8

500 YEAR CHANNEL PIER SCOUR

Y1= 6.3  
K1= 1.1  
K2= 1.0  
K3= 1.1  
a= 2.0 ft  
V1= 6.54  
Fr1= 0.458

Ys=  $Y1 * 2 * K1 * K2 * K3 * (a/Y1)^{0.65} * Fr1^{0.43}$   
Ys= 5.2

STRUCTURE NO. 164034000200 DARLINGTON CO.  
100 YR NORTH AND SOUTH ABUTMENT SCOUR

a' LENGTH OF ABUT.

PROJ. NORMAL TO FLOW= 300.0  
OBSTRUCTED FLOW AREA= 1268  
Ya= 4.2

VERT. WALL 1  
VERT. WALL W/ WINGS 0.82  
SPILL THROUGH 0.55  
K1= 0.55

EMB. ANGLE (PERP.=90) 90 SIDE WITH FLOW REVERSAL HAS HIGHER ANGLE  
K2= 1.000

OBSTRUCTED FLOW (cfs) 823  
Ve= 0.65  
Fre=Ve/(gYa)<sup>0.5</sup>= 0.0557

Ys/Ya=2.27 K1 K2 (a'/Ya)<sup>0.43</sup> Fre<sup>0.61</sup> + 1  
Ys= 6.7

500 YR ABUTMENT SCOUR

a' LENGTH OF ABUT.

PROJ. NORMAL TO FLOW= 310.0  
OBSTRUCTED FLOW AREA= 1604  
Ya= 5.2

VERT. WALL 1  
VERT. WALL W/ WINGS 0.82  
SPILL THROUGH 0.55  
K1= 0.55

EMB. ANGLE (PERP.=90) 90 SIDE WITH FLOW REVERSAL HAS HIGHER ANGLE  
K2= 1.000

OBSTRUCTED FLOW (cfs) 1142  
Ve= 0.71  
Fre=Ve/(gYa)<sup>0.5</sup>= 0.0552

Ys/Ya=2.27 K1 K2 (a'/Ya)<sup>0.43</sup> Fre<sup>0.61</sup> + 1  
Ys= 7.4