REPORT OF INVESTIGATION & DEVELOPMENT OF PRELIMINARY COSTS TO REHABILITATE WORSHAM STREET BRIDGE

FOR
CITY OF DANVILLE, VIRGINIA
DEPARTMENT OF PUBLIC WORKS

AUGUST 2, 2004

Schwartz & Associates, Inc.

Consulting Engineers

Heritage Business Center
7331 Timberlake Road, Suite 305
Lynchburg, Virginia 24502

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PREPARED BY

SCHWARTZ & ASSOCIATES, INC.
CONSULTING ENGINEERS
HERITAGE BUSINESS CENTER
7331 TIMBERLAKE ROAD, STE. 305
LYNCHBURG, VIRGINIA 24502

WORSHAM STREET BRIDGE

A CLOSER LOOK

Schwartz & Associates, Inc. **Consulting Engineers**

Heritage Business Center
7331 Timberlake Road, Suite 305
Lynchburg, Virginia 24502
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MEMBER OF:
ACEC
ACI
AISC
APWA
AREA
ASCE
NSPE

August 2, 2004

Mr. A. Kent Shelton, P.E.
Deputy Director/City Engineer
Public Works Department
City of Danville
P. O. Box 3300
Danville, VA 24541

Re: Worsham Street Bridge Investigation and Construction Cost Estimates
City of Danville, Virginia
Our Commission No. 04011

Dear Mr. Shelton:

We have completed our Bridge Investigation Report and Development of Cost Estimates for your Worsham Street Bridge over Dan River and Route 58, Structure No. 8006. We are providing you with fifty (50) copies and a CD of this report. At the City's direction, we have reinspected the structure and updated our findings from those reported in our January 27, 2004 report. We have performed laboratory tests for concrete permeability and alkali-silica reaction and included those test findings in this report. We have reused the results of the twenty-five (25) concrete samples taken in 1994 and tested for chloride content. We have also re-used the results of the twelve (12) concrete cores taken in 1994 and tested for compression in this report.

We have determined that there are numerous deficiencies in the arch ribs, arch rings, and portion of the structure below them. Included in these deficiencies are the arches are in poor condition, chloride contaminated, the existing reinforcing steel is bare rather than epoxy coated, the arches under-reinforced and have very high permeability.

The general quality of the concrete in this bridge is poor. It is far inferior to the quality of the concrete in the adjacent Main Street bridge across the Dan River, which was constructed at approximately the same time. The concrete has very high permeability rates as evidenced by the testing of ten (10) cores. This means the concrete will absorb moisture at a much faster rate which is leading to deterioration of the concrete and corrosion of the reinforcing steel. We would expect a good quality non-air entrained concrete to have a significantly lower permeability.

In addition, there is an alkali-aggregate reaction ongoing between the aggregate and the cement paste. This is leading to cracking in the concrete and will shorten the useful life of the concrete.

It is not economically feasible to rehabilitate this structure to a 15 ton or 5 ton live load capacity nor is it economically feasible to rehabilitate the structure to serve as a pedestrian bridge.

During our investigations of this structure we found conditions that led us to recommend to the City the closing of this structure to all vehicular and pedestrian traffic (please see Exhibit 9 for a copy of our letters of recommendation).

We greatly appreciate the opportunity of providing this service for the City of Danville. Please contact us with any questions you may have. If you would like for us to come to Danville and discuss our findings and this report in greater detail, please contact us.

Yours truly,

SCHWARTZ & ASSOCIATES, INC.

RW Schwartz

R. W. Schwartz, P. E.

RWS:th

Attachments

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1 - Worsham Street Bridge, Plan and Elevation - 28' Roadway - (1 Sheet)
2 - Worsham Street Bridge, Transverse Section - 28' Roadway - (1 Sheet)
3 - Worsham Street Bridge, Transverse Section - 24' Roadway - (1 Sheet)
4 - Worsham Street Bridge, Pedestrian Bridge Transverse Section - (1 Sheet)
5 - Photographs (Sheets 1-57)
6 - Laboratory Tests (includes locations taken, description & results) - (6 Sheets)
7 - Worsham Street Bridge, Plan Showing Floorbeam Support Column Identification Number (7 sheets)

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EXHIBITS - Continued

8 - Load Capacity Ratings for Deck
9 - Recent correspondence concerning Worsham Street Bridge
a. - Letter of March 12, 2004 from VDOT concerning urban allocations
b. - Memo concerning Worsham Street electric system river crossings
c. - Letter of June 29, 2004 recommending closing sidewalk to pedestrians
d. - Letter of July 14, 2004 recommending closing bridge to vehicles
e. - Letter of July 16, 2004 recommending further removal of concrete over Route 58 and over the walking/biking trail
f. - Letter of July 19, 2004 concerning Schwartz & Associates, Inc.'s experience and qualifications
10 - Summary of March 23, 2003 Bridge Safety Inspection Report

PURPOSE AND SCOPE

The purpose of the investigation was an evaluation of the cost of replacing the existing bridge deck, floorbeams and columns and repairing the other portions of the structure as required, in order to raise the safe live load capacity of the bridge to 15 tons and to extend the life of the bridge. The second purpose of this investigation was the same as the first except to develop a structure with a safe live load capacity of 5 tons and to extend the life of the bridge. The third purpose of this investigation was to perform an evaluation and cost of rehabilitating this bridge and adapting it for usage as a pedestrians only bridge. The investigation was performed in 1994 and again in 2004 and included a field inspection to determine the nature and extent of the deterioration. Selected areas of the concrete arches and piers were cored and examined for quality in the laboratory. In addition, numerous areas of the arch were evaluated by taking samples of concrete and testing them for chloride content.

A structural analysis was performed of one of the spans and the bridge deck. Results of this inspection, testing and structural analysis were analyzed and evaluated to determine the nature and cost of repairs. Recommendations are presented.

FIELD INVESTIGATION

DESCRIPTION OF THE BRIDGE:

The Worsham Street Bridge, located in the City of Danville, Virginia, spans the Dan River and U. S. Route 58. The bridge connects Worsham Street on the north to Wilson Street on the south. This reinforced concrete structure was built in 1928 and consists of 10 spans plus an earth-filled bridge approach section approximately 180 feet in length at the south end of the structure. This section has earth fill retained by concrete retaining walls, which were constructed parallel to the centerline of the roadway. The total length of the bridge itself is approximately 1,150 feet and consists of 5 open spandrel arch spans, 2 arch spans that are half open spandrel and half filled spandrel and 3 filled spandrel arch spans. The 2002 traffic count was 7,200 vehicles per day. This structure was constructed with a 28-foot clear roadway with a 5-foot width walk on the upstream side.

In the summer of 2003 a twelve-hour pedestrian count revealed only forty-six (46) pedestrians crossing the bridge.

In the early 1970's a 10-ton weight restriction was placed on this bridge. In the early 1980's the roadway width, on the downstream side, was reduced by approximately 3 feet by the use of pavement markings and the posted weight limit was reduced to 5 tons. In 1985 a contract was awarded for approximately $125,000 for emergency repairs for sections of railing and railing supports which had weakened considerably on the downstream side of the structure. In the early 1990's the roadway width on the downstream side was reduced by approximately 4 feet 6 inches, from the original curb line, by the placement of concrete traffic barrier sections. This work was done under contract, and several spandrel columns were repaired under the same contract.

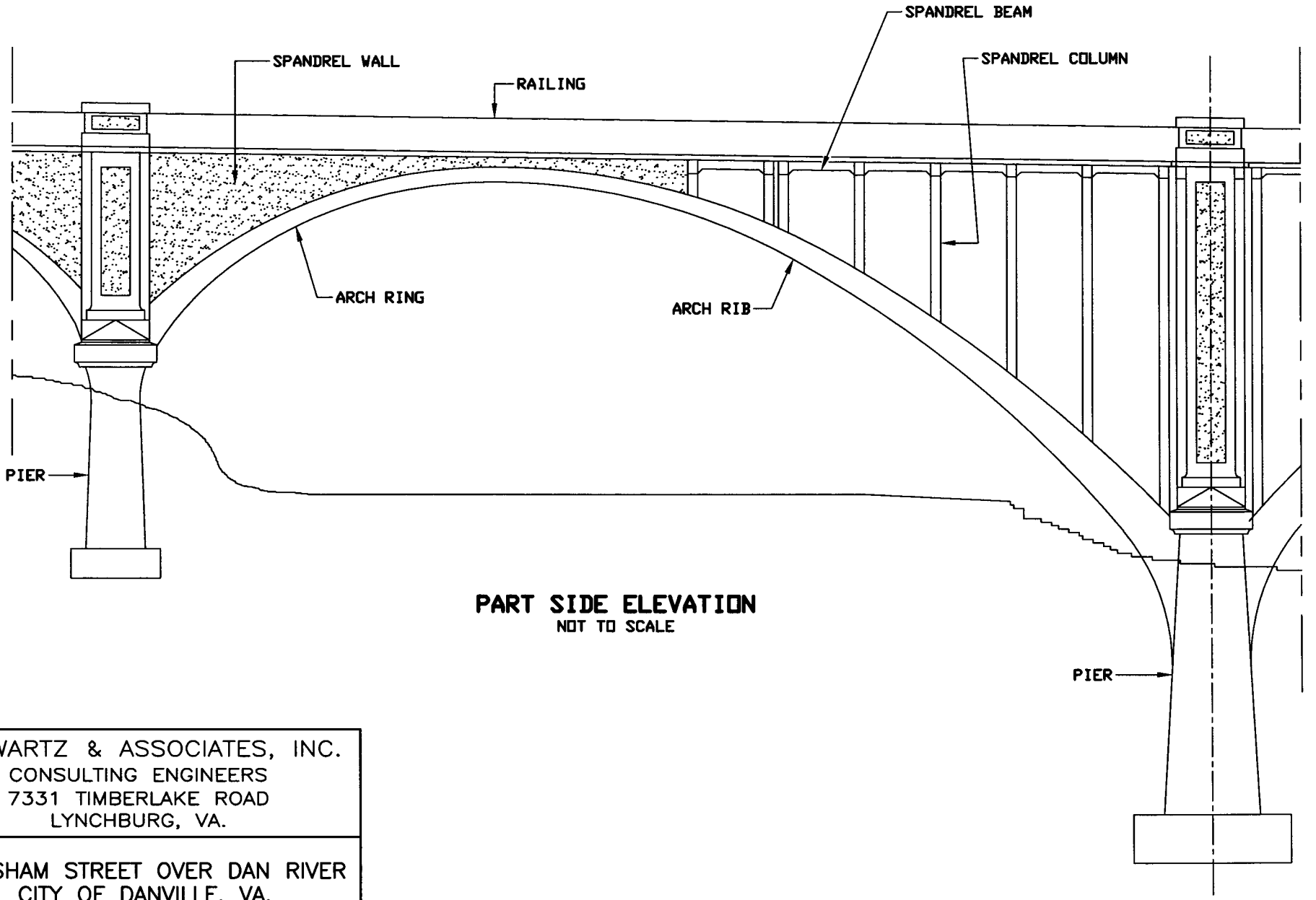
In the late 1990's the asphalt wearing surface, which was potholed and in very poor condition, was removed from the concrete deck portion of this structure and "band-aid" repairs were performed to the deck in an effort to maintain the structure in a condition safe for traffic until the adjacent Main Street bridge over the Dan River could be renovated.

At the time of these repairs it was determined over 90 percent of the top surface area of the deck was severely deteriorated. In many areas of the deck, concrete could be removed by simply blowing air on the concrete through a hose attached to an air compressor. In a very high percentage of these areas the concrete deck was deteriorated full depth. Approximately 700 square yards of the deck were repaired but in none of the repair areas was sound concrete encountered, even at a depth of 5". The poor deck condition is further supported by the fact that in the 1980's ten concrete cores were removed from the deck for compression testing but all of them fell apart and none could be tested.

In June 2004, a contractor's crew was working on repairs to the sidewalk when a section the full width of sidewalk and several feet long fell out to the ground leaving only the reinforcing bars in place. Inspection of other areas of sidewalk revealed a number of other areas that were in similar condition to the one that collapsed.

In an effort to prevent loose pieces of concrete from falling off of the bridge onto traffic on Route 58 and pedestrians under the bridge north of the river, the City has, on several occasions, had contractors to remove this concrete from the underside of the structure. This concrete is removed by hand-held masonry hammers. These are **not** of the pneumatic type. During the removal of this loose concrete in late June 2004, one of the floorbeam cantilevers supporting the sidewalk dropped down approximately 1 ½ feet and no longer renders support to the sidewalk. There are numerous other floorbeam cantilevers, some on the downstream side and some on the upstream side supporting the sidewalk, which are in extremely poor condition as a high percentage of the concrete has either fallen off or been removed with the masonry hammers. It is for this reason the sidewalk for this bridge was closed to all pedestrian traffic in June 2004. In July 2004, this structure was also closed to all vehicular traffic.

Exhibit 1 is a plan and elevation of the bridge showing span and pier designations. On Sheets 4 and 5 are sketches to assist the reader to understand the nomenclature used.

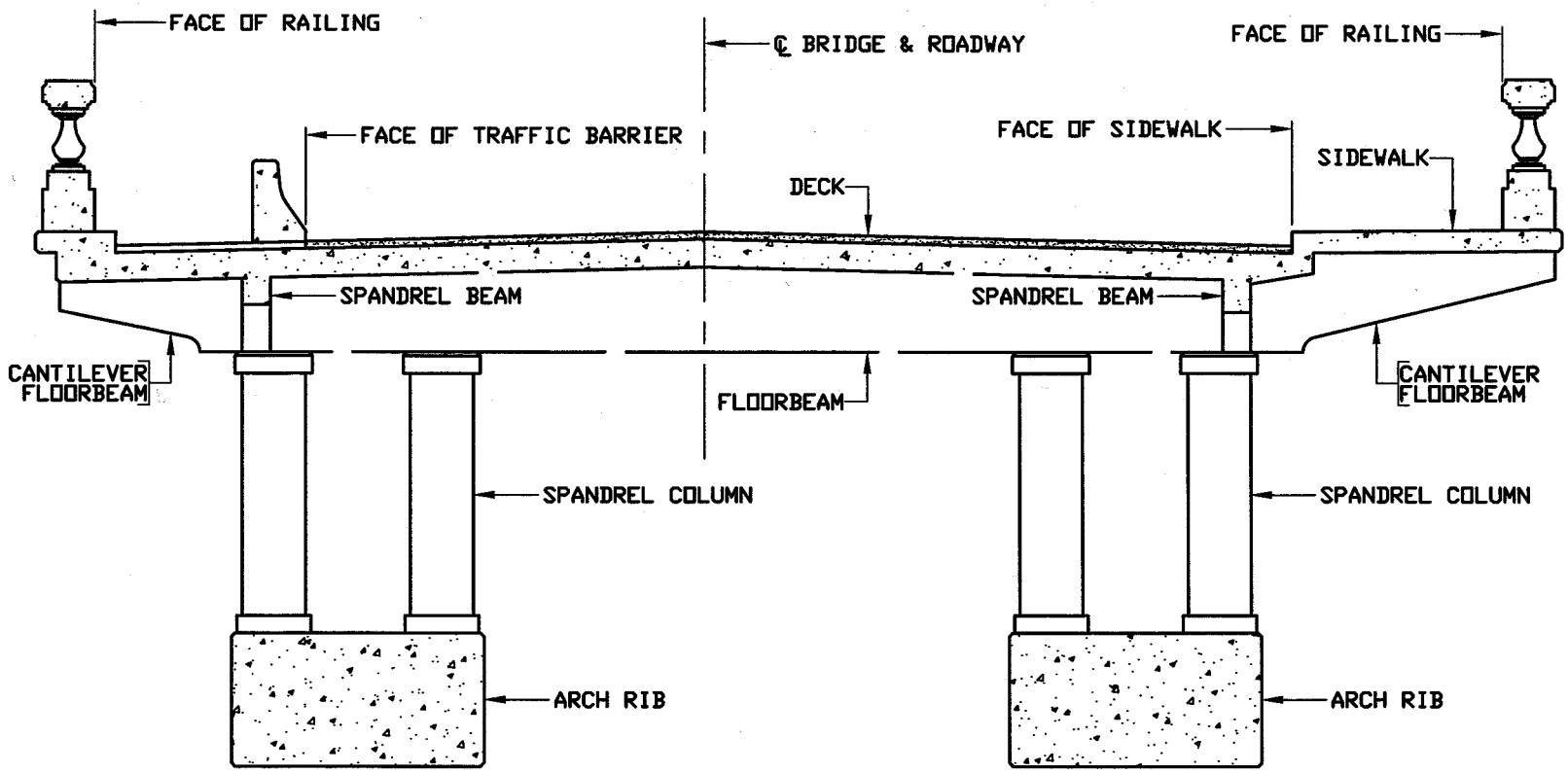


PART SIDE ELEVATION
NOT TO SCALE

SCHWARTZ & ASSOCIATES, INC.
CONSULTING ENGINEERS
7331 TIMBERLAKE ROAD
LYNCHBURG, VA.

WORSHAM STREET OVER DAN RIVER
CITY OF DANVILLE, VA.
PART SIDE ELEVATION

DESIGNED BY: RWS	DRAWN BY: JFG	CHECKED BY: RWS
SCALE: AS NOTED	PROJECT NO.:	
DATE: JULY 6, 2004	SHEET 4	



TRANSVERSE SECTION
NOT TO SCALE

SCHWARTZ & ASSOCIATES, INC.
CONSULTING ENGINEERS
7331 TIMBERLAKE ROAD
LYNCHBURG, VA.

WORSHAM STREET OVER DAN RIVER
CITY OF DANVILLE, VA.
TRANSVERSE SECTION

DESIGNED BY: RWS	DRAWN BY: JFG	CHECKED BY: RWS
SCALE: AS NOTED	PROJECT NO.:	
DATE: JULY 6, 2004	SHEET 5	

RAILINGS, SIDEWALK, DECK, FLOORBEAMS, SPANDREL BEAMS AND SPANDREL COLUMNS:

As it has been earlier determined that it is not economically feasible to rehabilitate and reuse the portion of the structure above the arches for a vehicular bridge, we will not elaborate on the conditions of those components at this time. For additional information concerning railings and sidewalk, deck, floor beams, spandrel beams and spandrel columns, please see our inspection report dated March 23, 2004. A summary of this report is included as Exhibit 10.

SPANDREL WALLS:

Spalls, delaminations and efflorescence are visible at many locations in the spandrel walls.

ARCH RIBS:

The arch ribs are in fair to poor condition. There are numerous areas delaminated, some of them quite extensive. There are numerous areas with concrete honeycomb. We also viewed extensive cracking in these arch ribs. Concrete samples were removed from these ribs and tested for chloride content, permeability, alkali-aggregate reaction and compressive strength. The extent of the delaminations and cracking is much greater than that which existed during the time of our inspections in the early 1980's and 1994.

ARCH RINGS:

The arch rings are in fair condition. There are numerous areas spalled, delaminated and showing efflorescence. These deteriorated areas appear to be more prevalent near the arch crown.

PIERS AND ABUTMENTS:

There is cracking, spalling and signs of efflorescence at the abutments. At Pier 2 there is a vertical crack approaching 1 1/2 inch in width which is located near the centerline of the roadway. The other piers show extensive cracking, varying in width from hairline to approximately 3/16 of an inch. This cracking appears to be most extensive at Piers 3 through 7. There is extensive concrete scaling on the tops of some of the pier caps. Pier 7 and 8 appear to be the most extensive. The general condition of the piers and abutments is fair.

Concrete samples were removed from some of the piers and tested for permeability and alkali-silica reaction. We noted concrete erosion in the pier stems near the tops of footings. We also noted some areas of undermining under Piers 5, 6 and 7 which are located in the river channel.

LABORATORY EXAMINATION AND TESTS

A. Chloride Contents

Twenty-five concrete samples were collected and tested for chloride content. These twenty-five concrete samples were taken from the arch ribs, arch rings and piers in the area immediately below the spring line. Four of these samples have very high chloride contents (greater than 2 pounds per cubic yard). There are an additional six samples with high chloride contents (1.3 to 2.0 pounds per cubic yard). Forty percent of these samples contained chloride contents high enough to likely cause corrosion of the rebar. The source of this chloride is likely the deicing chemicals applied to the bridge deck and roadway approaches in the winter time.

B. Compression Strength

Twelve concrete cores were taken for compression testing. Only ten of these could be tested however because two broke into pieces too short for testing. The compressive strengths ranged from 3,100 psi to 6,000 psi. Nine of the cores ranged between 3,400 psi and 4,600 psi. These strengths, while acceptable, are slightly less than was expected for a good, Class A3 concrete mix 76 years old. We must also remember that in the 1980's ten concrete cores were removed from the deck for compression testing but all of them fell apart and none could be tested.

C. Concrete Permeability Tests

Ten cores were removed from the bridge and tested for chloride ion penetration (permeability). These cores were removed from the arches in the vicinity of the spring line, the area below the spring line, and the piers. The results are shown in Exhibit 6. Eight of these ten cores tested high permeability with two testing moderate permeability. Properly cured concrete continues to lower its permeability with age. The scale which we are using to define low, moderate, high permeability is listed below:

TABLE 1 Chloride Ion Penetrability Based on Charge Passed (1) 1

Charge Passed (coulombs)	Chloride Ion Penetrability
>4,000	High
2,000 - 4,000	Moderate
1,000 - 2,000	Low
100 - 1,000	Very Low
<100	Negligible

These high permeability results for this seventy-six year old bridge structure are very disappointing. This means that moisture can penetrate the concrete quickly and deeply and lead to reinforcing steel corrosion (especially if the water has chloride in it) which in turn will lead to cracking of the concrete, delamination and spalling. The findings of these tests are consistent with conditions found in the field for this structure. There are approximately nine thousand (9,000) linear feet in the arches where the concrete is cracked along the reinforcing bar which is very likely a result of corrosion of the reinforcing bar. These areas may be expected to continue to corrode and in time lead to additional delaminations and spalls along the reinforcing steel. At this time, there are also approximately fourteen thousand (14,000) square feet of the arches that are already either spalled or delaminated as a result of corroded reinforcing steel. These are areas that will require cutting out and replacement of the concrete. These quantities represent an increase of appoximately thirty (30) percent over those found in 1994.

By comparison, the Main Street bridge over Dan River contract has estimates to repair 495 square feet of spalled and/or delaminated concrete and 253 linear feet of concrete crack repair. A comparison of the vast differences in the conditions of these two bridges is evident when you consider the differences in these four quantities.

In summary, the results of these tests tell us we have a high permeability concrete which is leading to much more rapid, than normal, deterioration of this reinforced concrete structure.

Concrete Permeability Tests

Number	Core Diameter	Core Length	Visual Condition	Location
1	4"	6"	1 piece, numerous entrapped air voids, some as much as 1/8" in diameter	Pier 4, downstream side, east face, south side
2	4"	6"	1 piece - 2" deep, crack in top surface, numerous entrapped air voids some as much as 3/16" in diameter	Pier 3, upstream arch, Span B, 3' below arch spring line, west face
3	4"	6 ½"	1 piece, concrete discolored top 1"	Pier 3, Span C, upstream arch, 3' below arch spring line
4	4"	6"	1 piece, numerous entrapped air voids, some as much as ¼" in diameter	Pier 3, Span C, on arch underside, downstream arch, west face, 7' below spring line
5	4"	6"	3 pieces, concrete discolored top ¾", entrapped air voids up to 1/8" in diameter	Pier 4, Span D, west arch, 5' below spring line, underside of arch
6	4"	5"	1 piece, concrete discolored up to 2" deep, numerous entrapped air voids up to 3/16" in diameter, cracks up to 1 ½" deep in top	Pier #10, 3' from upstream end, south side, 3' below top of cap
7	4"	4"	1 piece, concrete discolored up to ¼" deep at top, some entrapped air voids up to 1/8" in diameter	Pier #9, upstream face, 3' below top of cap
8	4"	5 ½"	1 piece, concrete discolored up to 1 ½" on top, some entrapped air voids	Span B, downstream arch near Pier 3, 2' below spring line on arch underside
9	4"	6"	1 piece, concrete discolored up to 1" deep on top, some air voids, some cracking 4" into core, some entrapped air voids up to 1/16" in diameter	Span C, downstream arch at Pier 4, west face, 7' below spring line
10	4"	6"	1 piece, concrete discoloration up to ¾" deep in top, cracks in top as much as 2" deep. A few entrapped air voids with some as much as ¼" in diameter	Span C, upstream arch at Pier 4, east face, 6' below spring line

D. Alkali-Silica Reaction in Concrete

Six of the eight cores tested for alkali-silica reaction in the concrete indicated, under the petrographic examination, that this reaction is occurring. The results of that testing are included in Exhibit 6.

When the alkali in the cement reacts with the silica that is present in some aggregates, with the presence of moisture being highly significant, gel is formed. As this reaction process continues, the gel expands and can lead to cracking of the aggregate particles or cracking of the cement paste.

The aggregate used in this concrete is one that is high in silica content. Two of the cores exhibit mature reaction between the alkali and the silica meaning there is cracking in the aggregate or cement paste as a result of the gel expansion. Four of the cores exhibit lesser amounts of gel formation but a definite reaction is occurring between the alkali and the silica. It simply has not advanced to the stage of the mature reactions. Therefore, in six of the eight cores, we are experience an alkali-silica reaction and with time it will worsen as the gel formation will continue and the pressures resulting from it which will crack the coarse aggregate and/or the cement paste will continue to increase.

There was no evidence of air entraining in any of these cores. The purpose of using air entraining in concrete, which began being used by VDOT in the 1940's, is to reduce the chances of concrete scaling due to freeze/thaw cycling, particularly in the presence of chlorides.

Ten (mostly 2" diameter concrete cores with one 4" and two 2 ¾" diameter) cores were removed from the structure in the area of the arches. Some of these samples were taken above and some below the arch spring line. These samples were lettered A through J and eight of the ten samples were tested to determine if there was evidence of alkali-silica reaction present. Core sample C and J were not tested because they were either in too many pieces or the pieces were too small to be tested.

Letter	Core Diameter	Core Length	Visual Condition	Location
A	2"	3 ½"	2 pieces, concrete discolored top ½"	Span D, downstream arch at pier 4, 7' below spring line arch, west face
B	2"	2 ¾"	2 pieces, some entrapped air voids up to 1/8" in diameter, some discoloration around coarse aggregate	Span C, upstream arch at pier 4, 6' below spring line arch, east face
C	2"	2 ½"	2 pieces	Span B, upstream arch at pier 4, 5' below spring line, east face
D	2 ¾"	4 ½"	1 piece, some discoloration, top 1 ½", crack top 1 ¼", few entrapped air voids up to 1/8" in diameter	Span C, upstream arch at pier 3, 3' below spring line, arch underside
E	2"	4"	2 pieces, some discoloration top ¾", some entrapped air voids up to 1/8" in diameter	Span D, upstream arch at pier 4, 8' below spring line, east face
F	4"	2"	1 piece, some discoloration around coarse aggregate	Pier #9, upstream face, 3' below top of cap
G	2"	1 ½"	1 piece, some discoloration around coarse aggregate	Span C, top of stream arch, 8' north of pier 4
H	2 ¾"	2 ½"	1 piece, some discoloration top 1", some discoloration around coarse aggregate, some cracks as much as 1" deep in top of core	Pier 10, 3' from upstream end, south side, 4' below top of cap
I	2"	2 ¾"	3 pieces, some discoloration around coarse aggregate	Span I, upstream side, west face of arch, 1' above spring line
J	2"	2 ½"	1 piece	Span H, upstream side, west face of arch 0.5' above spring line

STRUCTURAL EVALUATION

A structural evaluation of one of the arch ribs was performed. While the concrete compressive stresses in this arch rib were not unusually high, we are very alarmed at the lack of reinforcing steel used in these arch ribs if the structure were to remain in service as a 15 ton vehicular bridge. In some areas the actual values are only 50 percent of current AASHTO bridge design requirements.

Concerning the tie bar spacings, these are spaced 6 foot center to centers with the current AASHTO requirement being 1 foot 0 inches max. It was also determined the longitudinal bars are not adequately restrained by the tie bars. This lack of reinforcing steel, coupled with the extensive cracking found in these arch ribs give us cause for great concern.

In more technical terms, the current AASHTO Standard Specifications for Highway Bridges, Section 8.14.3.4 requires the longitudinal bars in the arch ribs to have an area at least equal to 0.01 of the gross concrete area. The actual values for these arches varies from 0.011 to 0.0049 at the location where the arches are 54" deep.

The same specification under Section 8.18.2.3.2 requires the tie-bar spacing to be no greater than the least member section or 12" max. In this case, 12" max would control. The actual tie-bar spacing in these arches is 6'-0".

Also the AASHTO specifications under Section 8.18.2.3.4 requires ties within the arches to restrain re-bars other than at corners with a maximum spacing equal to 4'. The only re-bars restrained in these are at the corners. These arches are 6'-0" in width, therefore, this requirement of the specifications is not met.

It is questionable if the Virginia Department of Transportation (VDOT) will allow state funding to be used to rehabilitate a structure with these deficiencies. They may allow it if the structure is to be used for pedestrian bridges because the loads would be lighter.

In the early 1980s the load capacity of this bridge, because of increasing concern with its poor condition, was reduced from a 10 ton to a 5 ton posting. This was a capacity based on judgment and observation of the structure under loading. There were no structural calculations performed at that time because there were no engineering drawings of the original structure available at that time.

The engineering drawings for this old structure have now been obtained from the City and we have used them to perform a load capacity rating of the existing concrete deck which, as we have earlier stated, is in very poor condition. The results of that analysis supported the 5 Ton posting which was in place on this structure until it was closed on July 14, 2004. These calculations are included in Exhibit 8.

7/12/2004

SCHEME A

PRELIMINARY ESTIMATED COST TO REHABILITATE BRIDGE
REPAIR ARCHES & SUBSTRUCTURE, REPLACE ALL CONCRETE ABOVE ARCHES
28'-0" CLEAR ROADWAY & ONE 5'-0" SIDEWALK
(15 TON LIVELOAD)

ITEM NO.	DESCRIPTION	UNIT PRICE	AMOUNT
1	MOBILIZATION	LUMP SUM	$ 405,000.00
2	DISMANTLE & REMOVE PORTION OF EXIST. STRUCTURE	LUMP SUM	$ 1,084,000.00
3	REHABILITATE ARCHES	LUMP SUM	$ 3,864,380.00
4	REHABILITATE SUBSTRUCTURE	LUMP SUM	$ 468,000.00
5	CONSTRUCT NEW SUPERSTRUCTURE (ALL ABOVE ARCHES)	LUMP SUM	$ 1,865,936.00
6	CAUSEWAYS & COFFERDAMS	LUMP SUM	$ 704,000.00
7	ROADWAY APPROACHES	LUMP SUM	$ 642,000.00
8	UTILITIES	LUMP SUM	$ 400,000.00
		SUBTOTAL	$ 9,433,316.00
		ENGINEERING & CONTINGENCY - 25%	$ 2,358,329.00
		TOTAL	**$ 11,791,645.00**

THIS ESTIMATE INCLUDES THE COSTS FOR WATERPROOFING THE ARCHES AND ENCASEMENT OF PIER FOOTINGS IN THE STREAM.

7/12/2004

SCHEME B

PRELIMINARY ESTIMATED COST TO REHABILITATE BRIDGE
REPAIR ARCHES & SUBSTRUCTURE, REPLACE ALL CONCRETE ABOVE ARCHES
24'-0" CLEAR ROADWAY & ONE 5'-0" SIDEWALK
(5 TON LIVELOAD)

ITEM NO.	DESCRIPTION	UNIT PRICE	AMOUNT
1	MOBILIZATION	LUMP SUM	$ 405,000.00
2	DISMANTLE & REMOVE PORTION OF EXIST. STRUCTURE	LUMP SUM	$ 1,084,000.00
3	REHABILITATE ARCHES	LUMP SUM	$ 1,691,460.00
4	REHABILITATE SUBSTRUCTURE	LUMP SUM	$ 468,000.00
5	CONSTRUCT NEW SUPERSTRUCTURE (ALL ABOVE ARCHES)	LUMP SUM	$ 1,789,254.00
6	CAUSEWAYS & COFFERDAMS	LUMP SUM	$ 704,000.00
7	ROADWAY APPROACHES	LUMP SUM	$ 642,000.00
8	UTILITIES	LUMP SUM	$ 400,000.00
		SUBTOTAL	$ 7,183,714.00
		ENGINEERING & CONTINGENCY - 25%	$ 1,795,929.00
		TOTAL	**$ 8,979,643.00**

THIS ESTIMATE INCLUDES THE COSTS FOR WATERPROOFING THE ARCHES AND ENCASEMENT OF PIER FOOTINGS IN THE STREAM.

7/12/2004

SCHEME C

COST ESTIMATE TO CONVERT TO A PEDESTRIAN BRIDGE (24'-6" CLEAR ROADWAY)

ITEM NO.	DESCRIPTION	UNIT PRICE	TOTAL AMOUNT
1	MOBILIZATION	LUMP SUM	$ 350,000.00
2	DISMANTLE & REMOVE PORTION OF EXIST. STRUCTURE	LUMP SUM	$ 1,084,000.00
3	REHABILITATE ARCHES	LUMP SUM	$ 1,691,460.00
4	REHABILITATE SUBSTRUCTURE	LUMP SUM	$ 378,000.00
5	CONSTRUCT NEW SUPERSTRUCTURE (ALL ABOVE ARCHES)	LUMP SUM	$ 1,356,975.00
6	CAUSEWAYS & COFFERDAMS	LUMP SUM	$ 676,000.00
7	ROADWAY APPROACHES	LUMP SUM	$ 60,000.00
8	UTILITIES	LUMP SUM	$ 400,000.00
		SUBTOTAL	$ 5,996,435.00
		ENGINEERING & CONTINGENCY - 25%	$ 1,499,109.00
		TOTAL	**$ 7,495,544.00**

THIS ESTIMATE INCLUDES THE COSTS FOR WATERPROOFING THE ARCHES AND ENCASEMENT OF PIER FOOTINGS IN THE STREAM.

7/12/2004

SCHEME D

COST ESTIMATE TO REPLACE STRUCTURE WITH NEW STRUCTURE (HAUNCHED STEEL GIRDERS) 28'-0" ROADWAY AND ONE 5'-0" SIDEWALK (HS20 LIVELOAD)

ITEM NO.	DESCRIPTION	UNIT PRICE	AMOUNT
1	MOBILIZATION	LUMP SUM	$ 500,000.00
2	NEW BRIDGE - 1,151 (35.33) $120.00	LUMP SUM	$ 4,879,780.00
3	DISMANTLE & REMOVE EXISTING STRUCTURE	LUMP SUM	$ 2,914,000.00
4	CAUSEWAYS & COFFERDAMS	LUMP SUM	$ 704,000.00
5	APPROACHES		
	NORTH APPROACH	LUMP SUM	$ 300,000.00
	SOUTH APPROACH - PARALLEL RETAINING WALLS	LUMP SUM	$ 600,000.00
6	UTILITIES	LUMP SUM	$ 400,000.00
		SUBTOTAL	$ 10,297,780.00
		ENGINEERING & CONTINGENCY - 25%	$ 2,574,445.00
		TOTAL	**$ 12,872,225.00**

NOTE: ESTIMATED LIFE OF STRUCTURE WITH REASONABLE MAINTENANCE - 60 YEARS.

7/12/2004

SCHEME E

PRELIMINARY ESTIMATED COST TO REPLACE STRUCTURE WITH NEW STRUCTURE (PRECAST CONC. ARCHES) 28'-0" ROADWAY AND ONE 5'-0" SIDEWALK (HS20 LIVELOAD)

ITEM NO.	DESCRIPTION	UNIT PRICE	AMOUNT
1	MOBILIZATION	LUMP SUM	$ 500,000.00
2	NEW BRIDGE - 1,151 (35.33) $210.00	LUMP SUM	$ 8,539,614.00
3	DISMANTLE & REMOVE EXISTING STRUCTURE	LUMP SUM	$ 2,914,000.00
4	CAUSEWAYS & COFFERDAMS	LUMP SUM	$ 704,000.00
5	APPROACHES		
	NORTH APPROACH	LUMP SUM	$ 300,000.00
	SOUTH APPROACH - PARALLEL RETAINING WALLS	LUMP SUM	$ 600,000.00
6	UTILITIES	LUMP SUM	$ 400,000.00
		SUBTOTAL	$ 13,957,614.00
		ENGINEERING & CONTINGENCY - 25%	$ 3,489,403.00
		TOTAL	**$ 17,447,017.00**

NOTE: ESTIMATED LIFE OF STRUCTURE WITH REASONABLE MAINTENANCE - 60 YEARS.

SUMMARY OF COST ESTIMATES

SCHEME	DESCRIPTION	PRELIMINARY ESTIMATED COST INCLUDING 25% FOR ENGINEERING & CONTINGENCY
A	Preliminary Estimated Cost to Rehabilitate Bridge Repair Arches & Substructure, Replace All Concrete Above Arches 28'-0" Clear Roadway & One 5'-0" Sidewalk (15 Ton Liveload)	$11,791,645.00
B	Preliminary Estimated Cost to Rehabilitate Bridge Repair Arches & Substructure, Replace All Concrete Above Arches 24'-0" Clear Roadway & One 5'-0" Sidewalk (5 Ton Liveload)	$ 8,979,643.00
C	Cost Estimate to Convert to a Pedestrian Bridge (24'-6" Clear Roadway)	$ 7,495,544.00
D	Cost Estimate to Replace Structure with New Structure (Haunched Steel Girders) 28'-0" Roadway & One 5'-0" Sidewalk (HS20 Liveload)	$12,872,225.00
E	Preliminary Estimated Cost to Replace Structure with New Structure (Precast Conc. Arches) 28'-0" Roadway & One 5'-0" Sidewalk (HS20 Liveload)	$17,447,017.00

CONCLUSIONS

We conclude that it is not "economically feasible" to replace the concrete above the arches and rehabilitate the arches and the substructure below to the level necessary for this structure to have a 15 ton live load capacity or a 5 ton live load capacity.

We further conclude it is not "economically feasible" to replace the deck, railings, sidewalk, floorbeams and columns above the arches and to rehabilitate the arches and substructure below the arches in order to convert the structure to a pedestrian bridge. The following factors are extremely important when considering these conclusions:

1. In general, the quality of the concrete in this bridge is far inferior to that of the adjacent Main Street bridge over the Dan River. This may be traced back to the time of construction.

2. The existing concrete is highly permeable. This means it will absorb much greater amounts of moisture than a good quality concrete and this will lead to deterioration of the concrete and corrosion of the reinforcing steel.

3. The existing arches are in fair to poor condition.

4. The existing arches are chloride contaminated in 40 percent of the locations tested.

5. The existing reinforcing steel is bare rather than epoxy coated. Therefore, it will begin to corrode at a much earlier age.

6. Existing concrete has slightly low compressive strength.

7. The presence of an alkali-aggregate reaction is ongoing between the aggregate and the cement paste. This will shorten the useful life of the concrete.

8. The existing arches are under-reinforced.

9. In short, the consequences of the conditions found tell us it will be extremely costly to rehabilitate this structure to a good condition that will last for very many years. Seventy-six (76) year old concrete that has high permeability values, contains chloride, contains reinforcing steel which is not epoxy coated, not air-entrained and has an alkali-aggregate reaction occurring, is not a very durable concrete. It will be very expensive to maintain.

ESTIMATED REMAINING LIFE OF STRUCTURE AFTER REPAIRS AND ESTIMATED ANNUAL MAINTENANCE COSTS

A. Vehicular Bridge with 15 ton live load capacity

1. Estimated remaining life - We estimate the remaining life of this structure after repairs to be thirty (30) years.

2. We estimate the annual maintenance cost to be $133,000.

B. Vehicular Bridge with 5 ton live load capacity

1. We estimate the remaining life of this structure after repairs to be thirty (30) years.

2. We estimate the annual maintenance cost to be $112,000.

C. Pedestrian Bridge

1. We estimate the remaining life of this bridge after repairs to be thirty-five (35) years.

2. We estimate the annual maintenance cost to be $84,000.

All of the above costs were developed using present-day costs.

RECOMMENDATIONS

We recommend the following:

1. That the City remove the existing bridge in its entirety and reroute all traffic to cross the newly widened and renovated Main Street bridge across Dan River. It is simply not economically feasible to retain this poor condition structure in service either as a vehicular or pedestrian bridge.

MR. ABBA LICHTENSTEIN'S LETTER OF DECEMBER 11, 2003

We are responding to Items 12, 13, 16-20, 23 and 24 of Mr. Lichtenstein's letter of December 11, 2003. For ready reference, a copy of that letter is re-printed on the following two pages.

Item 12
Our response to this item is contained in the structural evaluation section. The deck controls the capacity of this structure and is in very poor condition.

Item 13
Our response to this item concerning "the arches are under-reinforced" is found in the first six paragraphs of the section dealing with structural evaluation. The statement that the bridge is in poor condition is well documented with photographs, large areas of cracking, spalling and delaminations and the fact that the concrete is highly permeable.

Item 16
Costs for new Main Street Bridge over Dan River:

A - New Bridge	$ 8.2 million
B - Rehabilitate Existing Structure	$ 2.4 million
C - Roadway Approaches	$ 5.4 million
D - Preliminary Engineering	$ 3.3 million
E - Right of Way	$ 2.1 million
	$21.4 million

Item 17
VDOT demolition of Worsham Street Bridge
Estimate: **$2,914,000**

Item 18
Please see our cost estimates for rehabilitation of this structure. Many structures can be rehabilitated if enough money is spent on them. The issue here is whether or not it is practical to spend the millions of dollars that will be required to rehabilitate this structure and pay the ongoing annual maintenance costs.

The salt content issue is supported by the fact that twenty-five (25) concrete samples were collected and tested for chloride content. Four (4) of these samples have very high chloride contents (greater than 2 pounds per cubic yard). There are an additional six (6) samples with high chloride contents (1.3 to 2.0 pounds per cubic yard). These chloride contents are high enough that the areas they represent are likely to become troublesome in the very near future. We found thousands of linear feet of cracking in the arches with the cracking mostly following the reinforcing steel bars within the arches. This cracking is a result of moisture and/or chloride penetrating the concrete and causing the reinforcing steel within to corrode and swell as it corrodes, thus causing the concrete to crack.

The statement concerning the fact that this reinforcing steel is not epoxy-coated was simply meant to point out that the time to corrosion (for reinforcing steel that is not already corroded) will be much shorter because of the absence of the epoxy-protected coating.

Item 19
The adjacent Main Street bridge, which is being rehabilitated, has two bid items to repair the arches. They are repair cracks with the estimate being 253 linear feet and superstructure concrete repair with the estimate being 495 square feet. We have found thousands of linear feet of cracking in the Worsham Street bridge arches and thousands of square feet of spalled and delaminated concrete which must be removed and repaired. In addition, we have the concerns of future deterioration because of the chloride issue and the high permeability of the concrete in the arches. It is not practical to attempt repair to a structure with this much deterioration. If the bridge is repaired, it is very likely in a few years additional cracks, spalls and delaminations will appear and the structure will be very expensive to maintain.

Item 20
Because of the poor condition of the floorbeam cantilevers there are numerous sections in the bridge where the bridge railings are beginning to lean outward indicating the floorbeam cantilevers are failing. This is not unexpected given the condition of many of these floorbeam cantilevers. If the bridge is turned in to a pedestrian bridge cantilevers can be removed and new railings installed. However, there are areas of deteriorated concrete within these closed spandrel arches which must be dealt with. Also, we would need to deal with the problem allowing the walls over the piers in the closed spandrel spans to lean. This is the problem that was repaired in the 1970's by the addition of steel transverse rods tying the two walls at each pier together. The fill between the closed spandrel walls, under the bridge roadway, will require removal in order to address the repairs that are likely needed in the area below the roadway fill.

Item 23
Even for conversion to pedestrian bridge, there are huge expenditures that will be required to repair the arches. Because of the deterioration already present and the poor quality of concrete in the arches, the structure cannot be economically repaired.

Item 24
The scenario converting this bridge into a pedestrian bridge was studied closely. The cost estimate of $7.5 million to rehabilitate this structure and convert it to a pedestrian bridge is a huge expenditure for a bridge which would only serve pedestrians and bicycles. It can be done but the high cost makes it impractical.

McMullan & Associates, Inc.

December 11, 2003

Ms. Emyl Jenkins Sexton
Danville Historical Society (DHS)
416 Maple Lane
Danville, VA 24541

RE: *Worsham Street Bridge over The Dan River* *M&A#3131-1-L*

Dear Ms. Sexton:

As per our agreement we submit herewith our **Feasibility Report** on the Worsham Street Bridge at subject location.

The Worsham Street Bridge was constructed in 1927-1928 from plans prepared by noted engineer Daniel Luten. It is approximately 1150 feet long and contains ten concrete arch spans of variable length. The roadway width accommodates two 12 foot lanes and a sidewalk on one side as well as a safety walk on the other. The bridge rises about 50 feet above the Dan River offering a majestic view of the city. Another interesting and unusual feature is the combination of closed and open spandrel spans in one structure: 1.5 spans on the North end and 2.5 spans on the South side are filled in. The remaining six spans are well proportioned open spandrel arches.

The Worsham Bridge has become the subject of a controversial plan to be demolished. It is the intent of this assignment to propose other ways to deal with the future of the bridge such as possible rehabilitation and preservation.

Tasks Completed

1. I visited Danville on October 29 and 30, 2003 and observed the bridge from the deck level and below; I took some photographs and made notations. I was accompanied by members of the DHS and walked the neighboring streets and areas.

2. Several items of correspondence and newspaper clippings were furnished especially letters from the SHPO and the Secretary of VDOT, copies attached.

3. A Bridge Investigation Report by Schwartz & Associated dated August 26, 1994 was particularly important in our study.

4. A VDOT pamphlet dated 9/25/2003 addressed to the public was also of great interest.

Consulting Structural Engineers
8381 Old Courthouse Road, Suite 350 • Vienna, Virginia 22182
Telephone (703) 556-0651 • Facsimilie (703) 556-0378 • *E-mail: Mcma@mcmsc.com*

5. On Wednesday 10/29/03 in the afternoon we met with The City Engineer, representatives from VDOT district and several members of the DHS (attendance list enclosed) and discussed the various issues pertaining to the bridge project.

6. I requested to see a copy of the original construction plans by Luten and was given same by the City engineer. Copies of two sheets were made for us DHS.

7. We visited the Main Street Bridge over the Dan River located upstream of the Worsham and observed the new Main Street bridge virtually complete. The existing structure is still open to traffic.

8. The DHS members took me on an educational tour of Danville and we managed to have several important discussions relating to the history and future of the city.

9. In the evening I presented an informal lecture on the rehabilitation of historic bridges in general and responded to questions and suggestion from the public. This activity was videotaped.

Findings

10. The Worsham Bridge is owned by the City of Danville. VDOT is the managing and funding agency. It appears that the decision on the future of the bridge will be made by the City with input by VDOT and the SHPO.

11. The Worsham is listed on the Virginia and National Registers as a contributing resource and retains all protection and planning remedies afforded by Section 106 of the National Historic Preservation Act of 1966 (see SHPO letter).

12. The Worsham is presently posted for a 5 ton load limit. However, no calculations to back up this low limit are provided. My observations were that the main arch ribs appeared sound and so is the bottom surface of most of the decks. The concrete columns and floor beams show some deterioration in spots but no major cracks. The cantilever arms on both fascias are mostly cracked; the parapets and railing have some deteriorated areas. The lighting standards are of the modern type. A commemorative Plaque is located on one abutment. **Caveat:** these observations should not be considered an in-depth bridge inspection as prescribed by AASHTO and VDOT.

13. The Schwartz report in 1994 has found that the bridge was in "poor" condition and basically recommended its replacement. No calculations are provided to back up the conclusions of the report especially to such statements "the arches are under reinforced". However the testing of cores was beneficial in evaluating the quality of the concrete (3,000 to 6,000 psi).

14. Mr. Shelton has indicated that the Schwartz firm was commissioned to provide a new evaluation of the Worsham concentrating on three options: A 15 ton bridge, a community bridge, and no bridge.

15. The Main Street bridge project provided the impetus for the demolition cries. The new half bridge at Main Street when opened to traffic will permit the rehabilitation of the extant bridge, which is a brother-structure to the Worsham. It is an open spandrel long span arch bridge designed by Luten of the same vintage. The new Main Street Bridge is also an open spandrel concrete arch but of a modern design.

16. Based on information provided by VDOT at the meeting, the cost of the new Main Street Bridge is about $9 million while the rehabilitation contract for the existing structure is $5 million.

17. VDOT estimates that the demolition of the Worsham will cost about $5 million. The SHPO in her letter noted that this theoretical cost if not used to destroy a historic eligible bridge can be applied to its rehabilitation.

Discussion and recommendations

18. The 1994 Schwartz report should be revisited in line with a greater emphasis on rehabilitation. The new Schwartz report is due in January 2004. We trust that dead load and live calculations will be provided. The salt content issue should be restudied. Distribution reinforcement should not affect the ability of the reinforced ribs to carry loads. Obviously the bars in the Worsham and the extant Main street bridge have not been Epoxy coated but this is not a sufficient reason to downgrade their quality. Mr. Luten was a pioneer in inventing and enhancing reinforcement bar details and deformations that improved the product.

19. As part of Section 106, a rehabilitation alternate must be prudent and practical and must satisfy the SHPO. Therefore the new Schwartz in depth study will be crucial to the final decision. The utility facilities on the Worsham have been resolved by the City.

20. The span over the Rte 58 should be netted or similar to protect the traffic from falling pieces of the cantilevered beams. This particularly true on the east fascia. If the bridge is to be turned into a **community bridge** the cantilevers can be cut off and new railing/parapets installed similar in appearance to the railing on the new Main Street bridge. At the same time, consideration of a vehicular crossing for the bridge should not be ruled out.

21. The matter of financing the rehabilitation will become important. If Federal funds are involved they may be directed to a non-highway type of structure.

Summary

22. The Worsham Street Bridge is an important historic property for Danville and Virginia and every effort should be made to preserve it.

23. A reevaluation of existing reports and new studies may show that the basic elements of the arches appear to be sound and the structure could be economically repaired as needed. The cost of "non demolition" (presently estimated as $5 million) can be applied to the rehabilitation cost.

24. The most likely scenario appears to be the conversion into a community type bridge for pedestrians, bicycles and other activities. The under way study should explore this alternate carefully.

25. The rehabilitated Worsham Street Bridge will continue to contribute to the charm and significance of the City of Danville and at the same time preserve a fine piece of our heritage for many years to come.

Very truly yours,

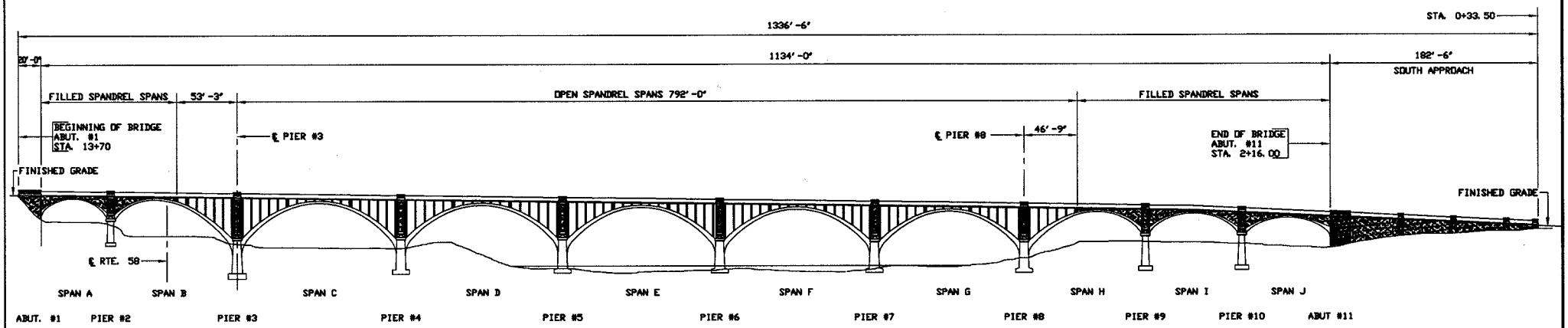
Abba Lichtenstein, P.E., Dr. Eng
Senior Bridge Engineer
McMullan & Associates

Enclosures

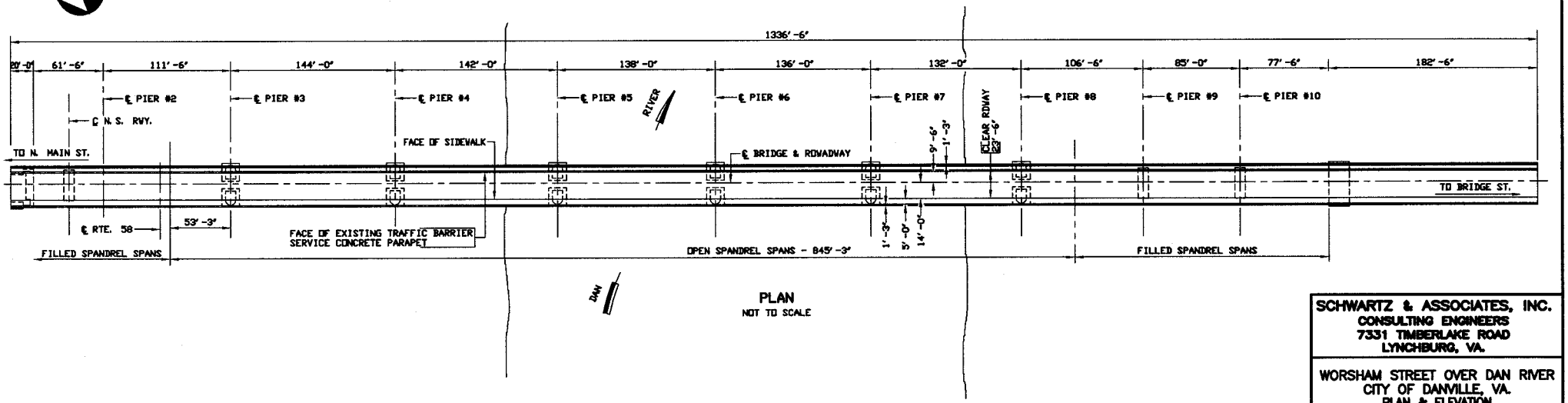
EXHIBIT 1

WORSHAM STREET BRIDGE

PLAN AND ELEVATION



ELEVATION
NOT TO SCALE



PLAN
NOT TO SCALE

SCHWARTZ & ASSOCIATES, INC.
CONSULTING ENGINEERS
7331 TIMBERLAKE ROAD
LYNCHBURG, VA.

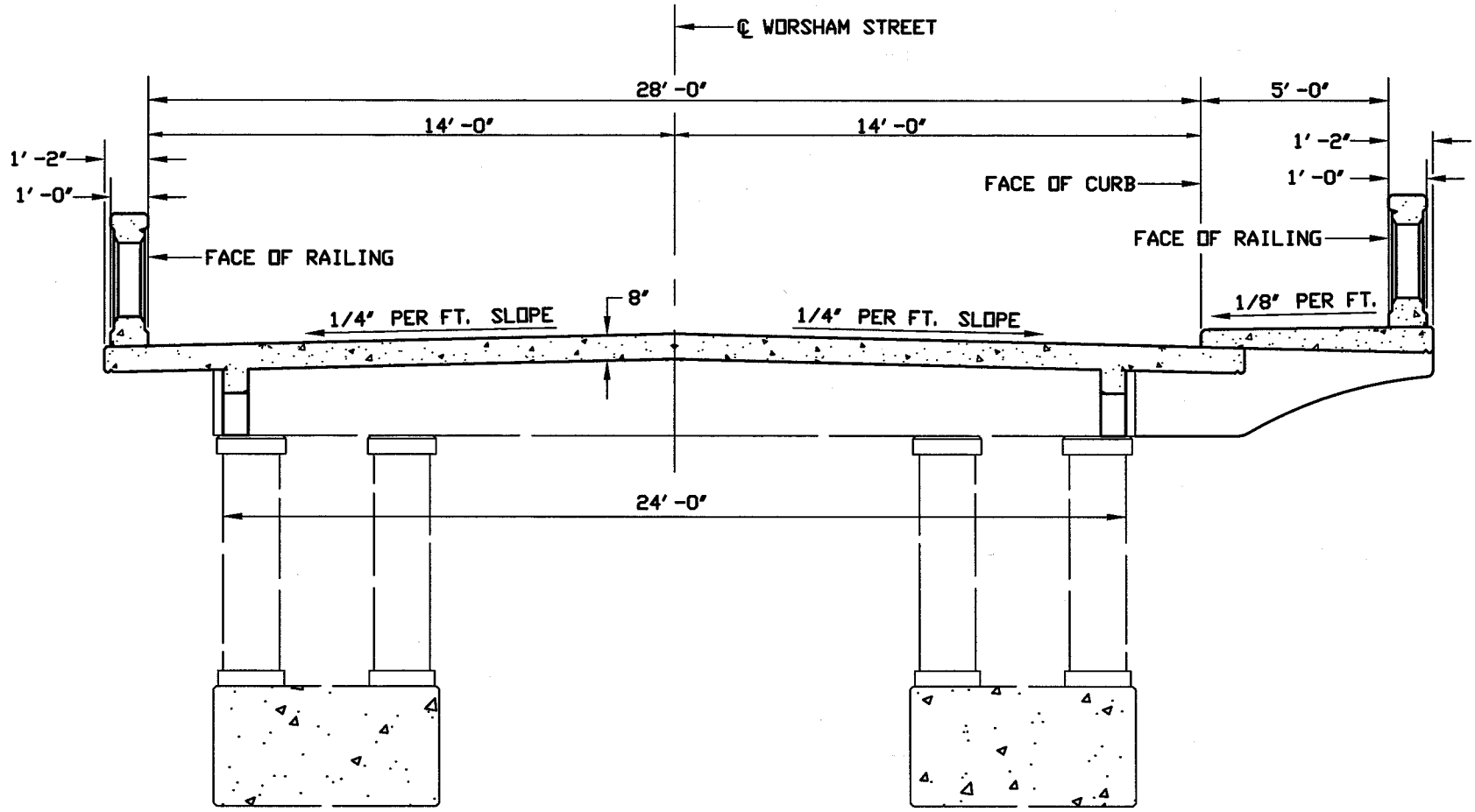
WORSHAM STREET OVER DAN RIVER
CITY OF DANVILLE, VA.
PLAN & ELEVATION

DESIGNED BY: RWS	DRAWN BY: RES	CHECKED BY: RWS
SCALE: NOT TO SCALE		PROJECT NO.:
DATE: JULY 6, 2004		SHEET 1 OF 1

EXHIBIT 2

WORSHAM STREET BRIDGE

TRANSVERSE SECTION
28' ROADWAY



TRANSVERSE SECTION
NOT TO SCALE

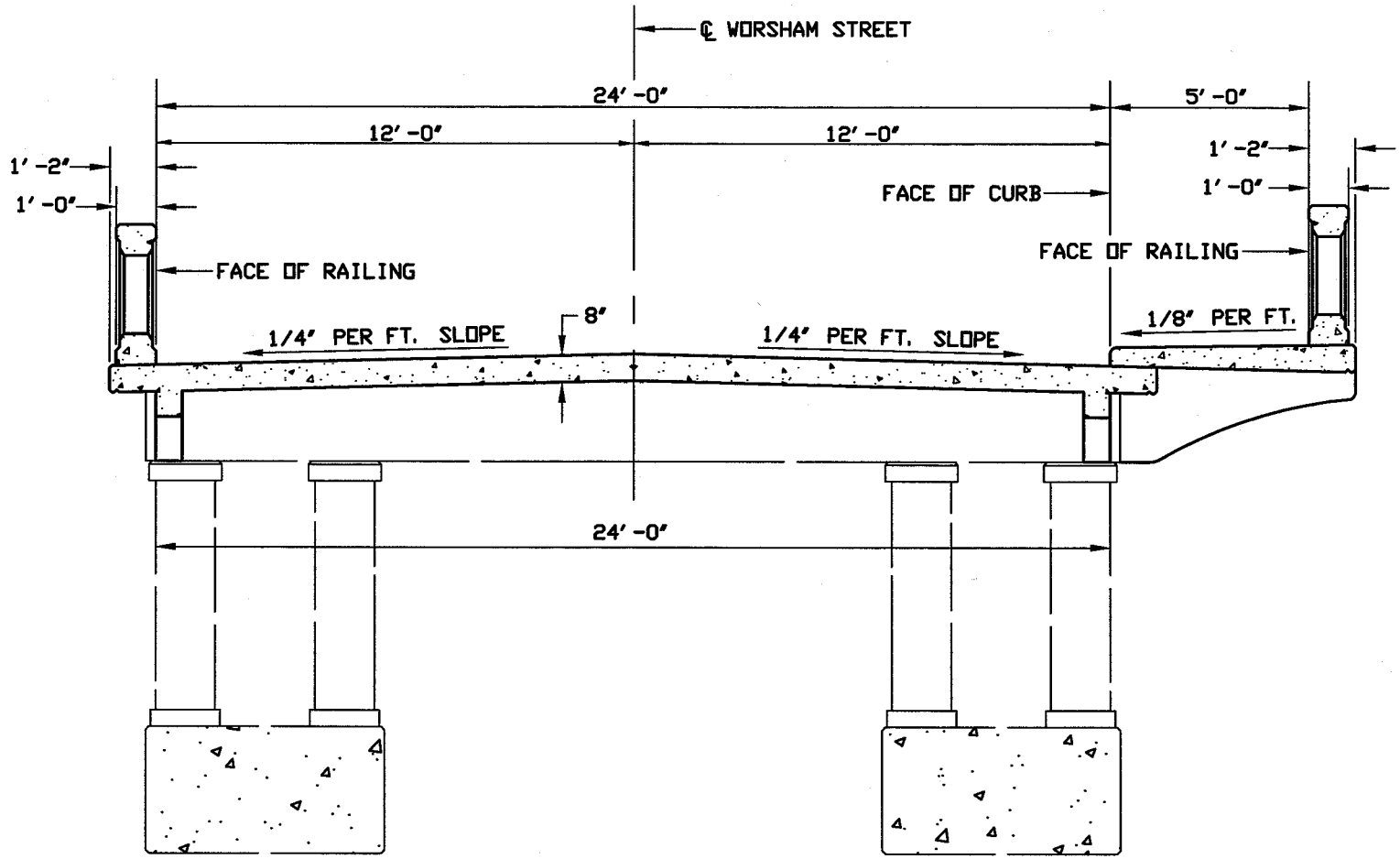
SCHWARTZ & ASSOCIATES, INC.
CONSULTING ENGINEERS
7331 TIMBERLAKE ROAD
LYNCHBURG, VA.

WORSHAM STREET OVER DAN RIVER
CITY OF DANVILLE, VA.
TRANSVERSE SECTION

DESIGNED BY: RWS	DRAWN BY: JFG	CHECKED BY: RWS
SCALE: AS NOTED	PROJECT NO.:	
DATE: JULY 6, 2004	SHEET 1 OF 1	

EXHIBIT 3
WORSHAM STREET BRIDGE

TRANSVERSE SECTION
24' ROADWAY



TRANSVERSE SECTION
NOT TO SCALE

SCHWARTZ & ASSOCIATES, INC.
CONSULTING ENGINEERS
7331 TIMBERLAKE ROAD
LYNCHBURG, VA.

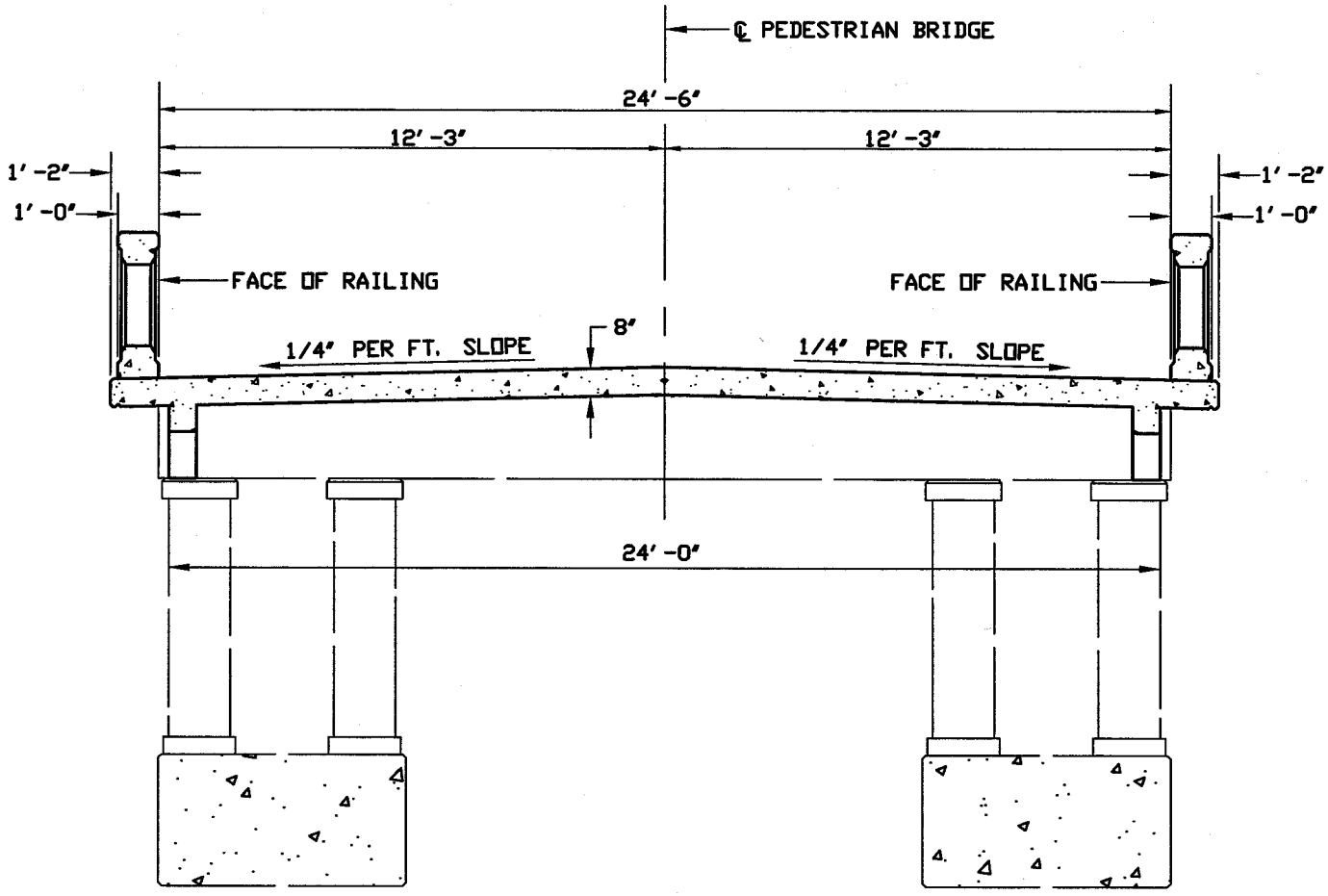
WORSHAM STREET OVER DAN RIVER
CITY OF DANVILLE, VA.
TRANSVERSE SECTION

DESIGNED BY: RWS	DRAWN BY: JFG	CHECKED BY: RWS
SCALE: AS NOTED	PROJECT NO.:	
DATE: JULY 6, 2004	SHEET 1 OF 1	

EXHIBIT 4

WORSHAM STREET BRIDGE

PEDESTRIAN BRIDGE TRANSVERSE SECTION



TRANSVERSE SECTION
SCALE: 3/16″ = 1′-0″

SCHWARTZ & ASSOCIATES, INC.
CONSULTING ENGINEERS
7331 TIMBERLAKE ROAD
LYNCHBURG, VA.

WORSHAM STREET OVER DAN RIVER
CITY OF DANVILLE, VA.
TRANSVERSE SECTION

DESIGNED BY: RWS	DRAWN BY: JFG	CHECKED BY: RWS
SCALE: AS NOTED	PROJECT NO.:	
DATE: JULY 6, 2004	SHEET 1 OF 1	

EXHIBIT 5

WORSHAM STREET BRIDGE

PHOTOGRAPHS (1-57)

(INCLUDES LOCATIONS TAKEN, DESCRIPTION)

PHOTO SHEET

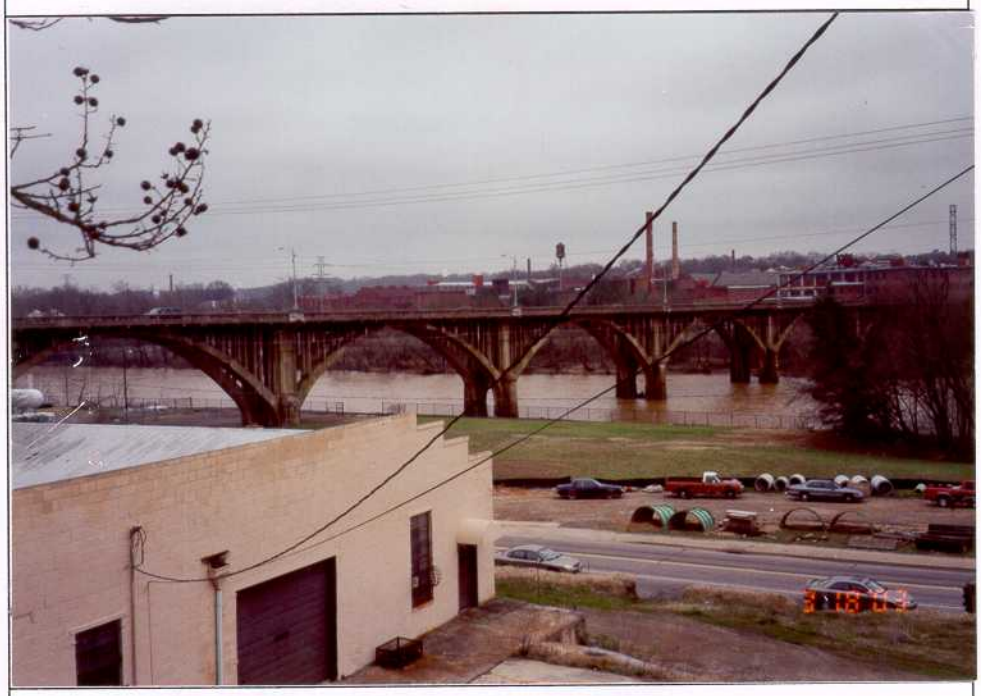
BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **1**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

K754-10

APPROACH ELEVATION LOOKING SOUTH. NOTE OBJECT MARKERS (TYPE 3) AND POSTED WEIGHT LIMIT SIGN.



K754-20

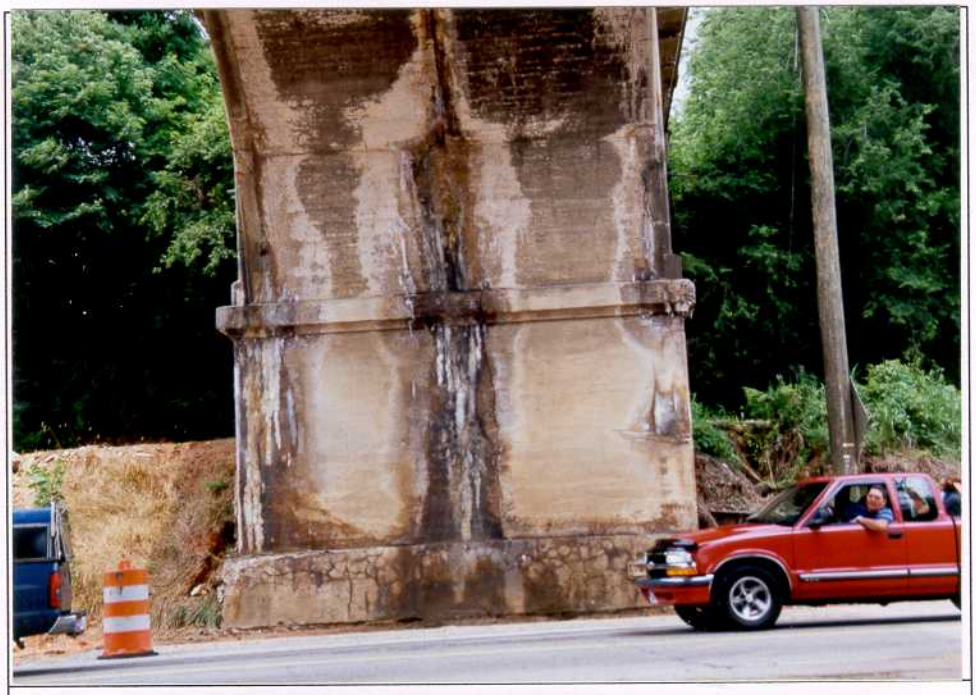
SIDE ELEVATION LOOKING AT UPSTREAM SIDE OF STRUCTURE.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **2**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**



C215-21

PIER 2, SPAN B - NOTE VERTICAL CRACK.

A104-9

SEVERE DETERIORATION, FLOORBEAM, DECK, COLUMNS, UPSTREAM SIDE, SPAN B OVER ROUTE 58.

PHOTO SHEET

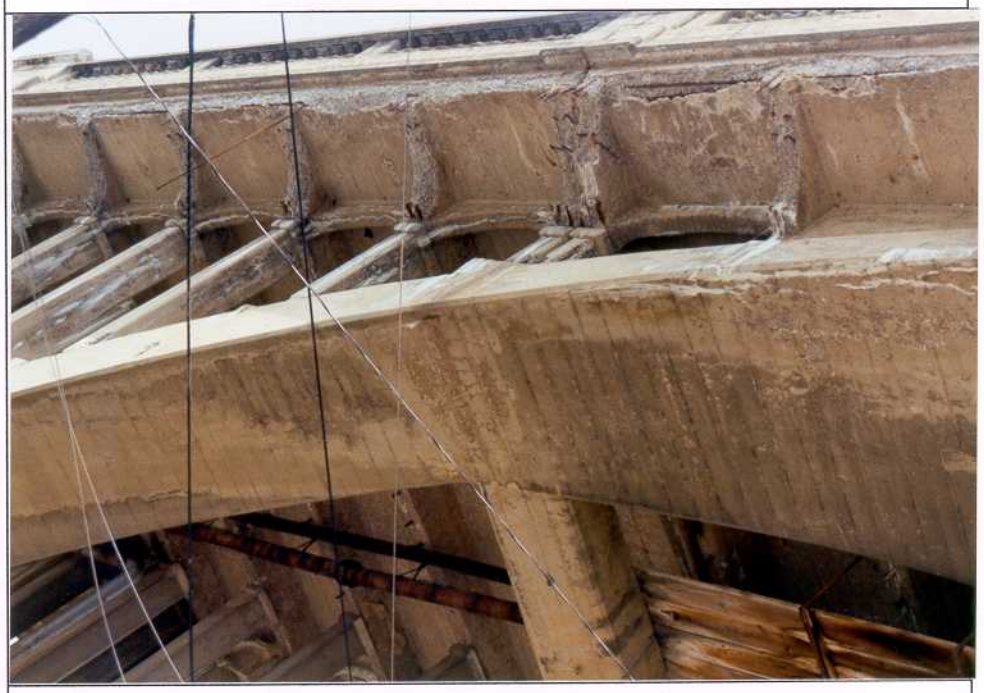
BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **3**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A106-1

SPALLED AND DELAMINATED CONCRETE, CORRODED REINFORCING STEEL, DOWNSTREAM SIDE, SPAN B FLOORBEAMS AND DECK.



A106-2

SPALLED AND DELAMINATED CONCRETE, CORRODED REINFORCING STEEL, DOWNSTREAM SIDE, SPAN B FLOORBEAMS AND DECK.

PHOTO SHEET

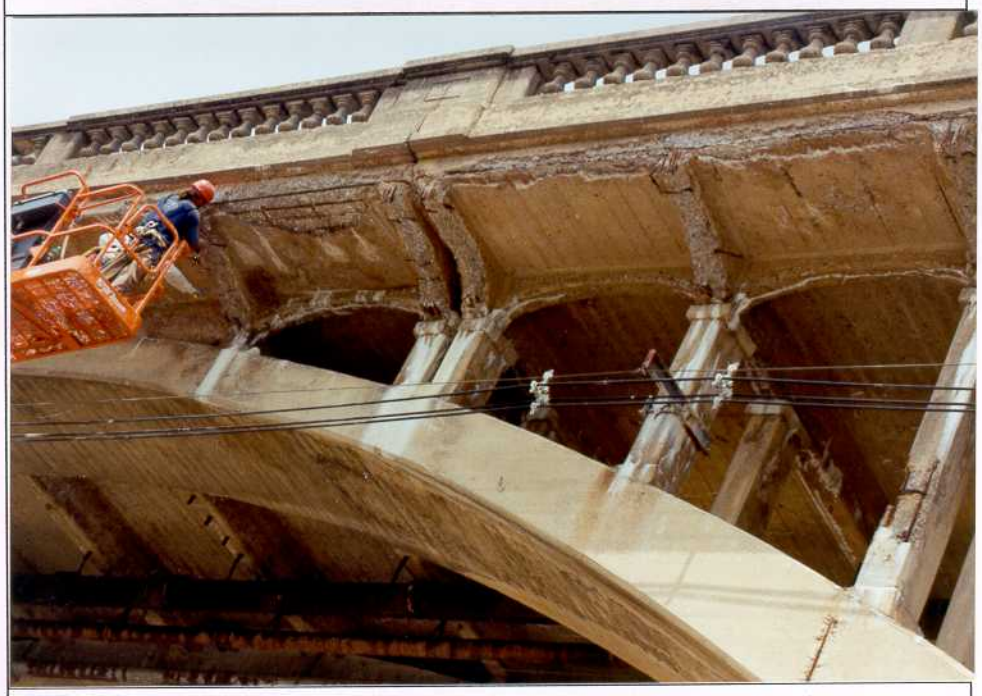
BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **4**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A106-3

SPALLED AND DELAMINATED CONCRETE, CORRODED REINFORCING STEEL, DOWNSTREAM SIDE, SPAN B FLOORBEAMS AND DECK.



A106-4

SPALLED AND DELAMINATED CONCRETE, CORRODED REINFORCING STEEL, DOWNSTREAM SIDE, SPAN D.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **5**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A106-5

SPALLED AND DELAMINATED CONCRETE, REINFORCING STEEL, UPSTREAM SIDE, SPAN B.

A106-6

SPALLED AND DELAMINATED CONCRETE, REINFORCING STEEL, UPSTREAM SIDE, SPAN C.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **6**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A106-7

SPALLED AND DELAMINATED CONCRETE, REINFORCING STEEL, UPSTREAM SIDE, SPAN D.

A106-8

SPALLED AND DELAMINATED CONCRETE, REINFORCING STEEL, UPSTREAM SIDE, SPAN D.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: 7

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A106-9

SPALLED AND DELAMINATED CONCRETE, REINFORCING STEEL, UPSTREAM SIDE, SPAN D. NOTE ONE FLOORBEAM CANTILEVER PRACTICALLY NON-EXISTENT.

A106-10

SPALLED AND DELAMINATED CONCRETE, REINFORCING STEEL, UPSTREAM SIDE, SPAN D. NOTE THE FLOORBEAM CANTILEVER THAT IS PRACTICALLY NON-EXISTENT.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **8**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A106-11

REMOVED LOOSE CONCRETE ON GROUND AT PIER 4.

A106-12

REMOVED LOOSE CONCRETE ON GROUND UNDER SPAN D.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **9**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C220-3

UPSTREAM SIDE OVER PED. TRAIL - NOTE CONT. REMOVING LOOSE CONC. WITH MASONRY HAMMER AT FLOORBEAM CANTILEVER THAT HAS SAGGED AWAY FROM THE SIDEWALK.

C220-5

UPSTREAM, SPAN D - NOTE PILE OF CONCRETE DEBRIS CONTRACTOR CHIPPED OFF.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **10**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C220-9

UPSTREAM SIDE, SPAN C, NEAR PIER 4 - NOTE HOLE THROUGH CURB FACE DUE TO CONCRETE REMOVAL OPERATION.

C220-12

UPSTREAM SIDE OVER EBL ROUTE 58 - NOTE HOLE ALONG CURBLINE.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **11**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C220-6

UPSTREAM, SPAN D - NOTE SIDEWALK SUPPORT ALMOST READY TO FALL OFF.

A106-13

APPROXIMATELY 20% OF CONCRETE REMOVED JUNE 28 - JULY 2, 2004.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **12**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A104-8

SEVERE DETERIORATION, FLOORBEAM, DECK, COLUMNS, ARCH, DOWNSTREAM SIDE, SPAN B OVER ROUTE 58.

A104-10

SEVERE DETERIORATION, FLOORBEAM, DECK, COLUMNS, ARCH, UPSTREAM SIDE, SPAN C.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **13**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C215-9

SPAN C, APPROXIMATELY 30' FROM PIER 3 - NOTE DETERIORATED CONCRETE ON UNDERSIDE OF DECK.

A105-1

SPALLED AND DELAMINATED CONCRETE AND CORRODED REBAR IN DECK, FLOORBEAM, COLUMN J AND UPSTREAM ARCH APPROXIMATELY 20' SOUTH OF CROWN, SPAN D.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **14**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A105-6

SEVERE DETERIORATION, DECK OVERHANG, FLOORBEAMS, UPSTREAM ARCH, NEAR CROWN, SPAN G.

A105-9

SEVERE DETERIORATION, DECK OVERHANG, SPAN G.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **15**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A105-5

SEVERE DETERIORATION, DECK OVERHANG, FLOORBEAMS, UPSTREAM ARCH, SPAN G.

A105-7

SEVERE DETERIORATION, DECK OVERHANG, FLOORBEAM, DOWNSTREAM ARCH NEAR CROWN, SPAN G .

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **16**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A105-13

AREA OF CONCRETE SIDEWALK, SPAN H, THAT FELL WH ILE BEING REPAIRED. NOTE ABSENCE OF MORTAR BONDING TO CONC. AGGREGATE INDICATING POOR QUALITY CONCRETE.

A104-4

SEVERE DETERIORATION, FLOORBEAM, DECK,COLUMNS, DOWNSTREAM SIDE, SPAN H.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **17**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A104-2

SPAN H - SIDEWALK FAILURE DURING REPAIR OPERATION.

A104-1

SEVERE DETERIORATION, FLOORBEAM, CANTILEVER AND DECK OVERHANG, SPAN J, UPSTREAM SIDE.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **18**

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CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C216-7

UPSTREAM STRINGER, SPAN C - NOTE DETERIORATED CONCRETE.

C216-3

SIDEWALK FLOORBEAM ON DOWNSTREAM SIDE OF SPAN C - NOTE DETERIORATED CONCRETE.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **19**

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A104-11

SEVERE DETERIORATION, FLOORBEAM, DECK, COLUMNS, DOWNSTREAM SIDE, SPAN C.

A104-12

SEVERE DETERIORATION, FLOORBEAM, DECK, COLUMNS, DOWNSTREAM SIDE, SPAN C.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **20**

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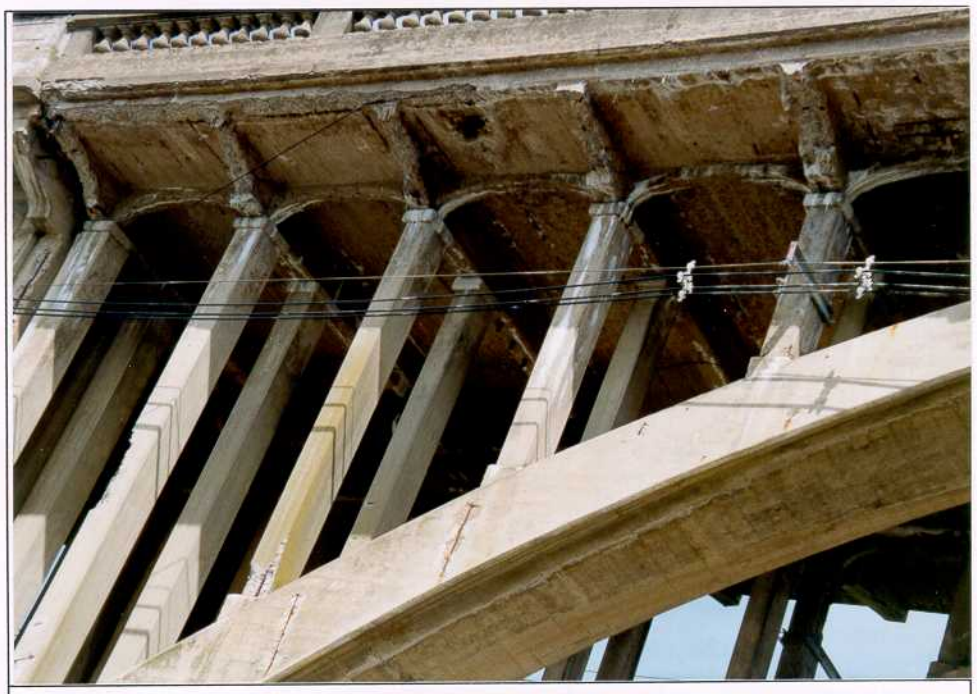
CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**



A104-13

SEVERE DETERIORATION, FLOORBEAM, DECK, COLUMNS, DOWNSTREAM SIDE, SPAN C.

A104-14

SEVERE DETERIORATION, FLOORBEAM, DECK, COLUMNS, DOWNSTREAM SIDE, SPAN C.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **21**

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CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C215-8

SPALLED CONCRETE WITH EXPOSED STEEL, COLUMN D6, SPAN C.

C216-18

UPSTREAM ARCH, COLUMN D5, SPAN C - NOTE SPALLED/ DELAMINATED CONCRETE.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **22**

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CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C216-16

UPSTREAM ARCH, COLUMN D6, SPAN C - NOTE SPALLED CONCRETE.

A104-17

SEVERE DETERIORATION, DECK, FLOORBEAMS, COLUMNS, SPAN D, DOWNSTREAM ARCH NEAR PIER 5.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **23**

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CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A104-20

SPALLING, CRACKING AND CORRODED REBAR IN DOWNSTREAM ARCH, SPAN D NEAR PIER 5.

C215-20

SPAN D, COLUMNS C1 AND C2 - NOTE DETERIORATED CONCRETE WITH EXPOSED REINFORCING STEEL.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **24**

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C216-8

COLUMN D4, SPAN D - NOTE SPALLED CONCRETE WITH EXPOSED REINFORCING STEEL AT BOTTOM OF COLUMN.

A105-2

SEVERE DETERIORATION, DECK, FLOORBEAMS, COLUMNS, DOWNSTREAM ARCH, NEAR CROWN, SPAN E.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **25**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C217-10

LONGITUDINAL CRACK WITH EFFLORESCENCE ON TOP OF DOWNSTREAM ARCH, SPAN G.

C217-12

COLUMN A1, SPAN H - NOTE SPALLING AND DELAMINATED CONCRETE.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **26**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C217-11

COLUMN A4, SPAN H - NOTE CRACKING WITH EFFLORESCENCE

C217-9

COLUMN D1, SPAN H - NOTE SPALLED CONCRETE WITH EXPOSED REINFORCING STEEL.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **27**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A104-5

SEVERE DETERIORATION, FLOORBEAM, DECK, COLUMNS, DOWNSTREAM SIDE, SPAN H.

C216-1

SPAN J, DOWNSTREAM SIDE, NEAR ABUTMENT 11 - NOTE SPALLED CONCRETE AND EFFLORESCENCE ON UNDERSIDE OF DECK OVERHANG AND ARCH.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **28**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A104-6

SEVERE DETERIORATION, FLOORBEAM, DECK, ARCH CROWN, DOWNSTREAM SIDE, SPAN B OVER ROUTE 58.

A104-7

SEVERE DETERIORATION, FLOORBEAM, DECK, ARCH CROWN, DOWNSTREAM SIDE, SPAN B OVER ROUTE 58.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **29**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C216-19

UPSTREAM ARCH, SPAN B - NOTE CRACKS AND EFFLORESCENCE ON SIDE OF ARCH.

C215-14

PIER 3, UPSTREAM SIDE - NOTE DELAMINATED AND SPALLED CONCRETE.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **30**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C215-13

PIER 3, UPSTREAM, INSIDE FACE OF ARCH - NOTE DELAMINATED CONCRETE AT GROUND LEVEL (TYPICAL) ON DOWNSTREAM SIDE.

C216-4

UPSTREAM ARCH, SPAN C - NOTE DELAMINATED CONCRETE ON INTERIOR SIDE.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **31**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C216-5

UPSTREAM ARCH, SPAN C - NOTE SPALLED CONCRETE WITH EXPOSED REINFORCING STEEL.

C216-6

UPSTREAM ARCH, SPAN C - NOTE DELAMINATED CONCRETE.

C216-14

UPSTREAM ARCH, SPAN C - NOTE SPALLED/DELAMINATED CONCRETE IN TOP OF ARCH.

C216-15

UPSTREAM ARCH, SPAN C - NOTE DELAMINATED CONCRETE IN TOP OF ARCH.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **33**

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C216-17

UPSTREAM ARCH, SPAN C - NOTE CRACKED AND DELAMINATED CONCRETE ON UPSTREAM SIDE.

C215-5

SPAN C, UPSTREAM ARCH - CRACK IN TOP OF ARCH APPROXIMATELY 20' FROM PIER 3.

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **34**

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CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C215-6

DELAMINATED CONCRETE, TOP OF ARCH, SPAN C, UPSTREAM SIDE, APPROXIMATELY 30' FROM PIER 3.

C215-17

DETERIORATED CONCRETE ON TOP OF ARCH, SPAN C, UPSTREAM SIDE (APPROXIMATELY 20' FROM PIER 4).

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **35**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A104-15

DELAMINATIONS, CRACKS AND CORRODED REBAR, SPAN C, DOWNSTREAM ARCH NEAR PIER 4.

C215-16

PIER 4, SPAN C, UPSTREAM SIDE - NOTE DETERIORATED CONCRETE WITH EXPOSED REINFORCING STEEL ON UNDERSIDE OF ARCH AT GROUND LINE.

C215-10

SPAN C, DOWNSTREAM SIDE, NEAR PIER 4 - NOTE DETERIORATED AND HONEYCOMBED CONCRETE ON SIDE OF ARCH.

C215-11

SPAN C, DOWNSTREAM SIDE, NEAR PIER 4 - NOTE DETERIORATED AND HONEYCOMBED CONCRETE ON SIDE OF ARCH.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **37**

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CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C215-7

SPALL CONCRETE WITH EXPOSED STEEL, TOP DOWNSTREAM ARCH, SPAN C.

C216-2

DOWNSTREAM ARCH, SPAN C - NOTE SPALLED CONCRETE WITH EXPOSED REINFORCING STEEL ON TOP OF ARCH.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **38**

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CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C215-15

PIER 4, UPSTREAM SIDE - NOTE DELAMINATED AND SPALLED CONCRETE.

C215-18

PIER 4, DOWNSTREAM SIDE - NOTE CRACKED AND DELAMINATED CONCRETE.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **39**

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CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C215-19

PIER 4, SPAN D, DOWNSTREAM SIDE - NOTE SPALLED AND CRACKED CONCRETE ON SIDE OF ARCH.

A104-18

SEVERE DETERIORATION, DECK, FLOORBEAMS, COLUMNS, ARCH, SPAN D, UPSTREAM ARCH NEAR CROWN.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **40**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A104-16

DELAMINATIONS, CRACKS AND CORRODED REBAR, SPAN D, DOWNSTREAM ARCH NEAR PIER 4.

C215-12

SPAN D, DOWNSTREAM SIDE NEAR PIER 4 - NOTE DETERIORATED CONCRETE ON SIDE OF ARCH.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **41**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A104-23

SPALLING, CRACKING AND CORRODED REINFORCING STEEL IN UPSTREAM ARCH SPAN E, NEAR CROWN.

A104-22

SPALLING, CRACKING AND CORRODED REBAR IN DOWNSTREAM ARCH, SPAN E, NEAR CROWN.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **42**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A104-21

SPALLING, CRACKING AND CORRODED REBAR IN DOWNSTREAM ARCH, SPAN E, NEAR CROWN.

A104-19

SPALLING, CRACKING AND CORRODED REBAR IN DOWNSTREAM ARCH, SPAN E, NEAR CROWN.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **43**

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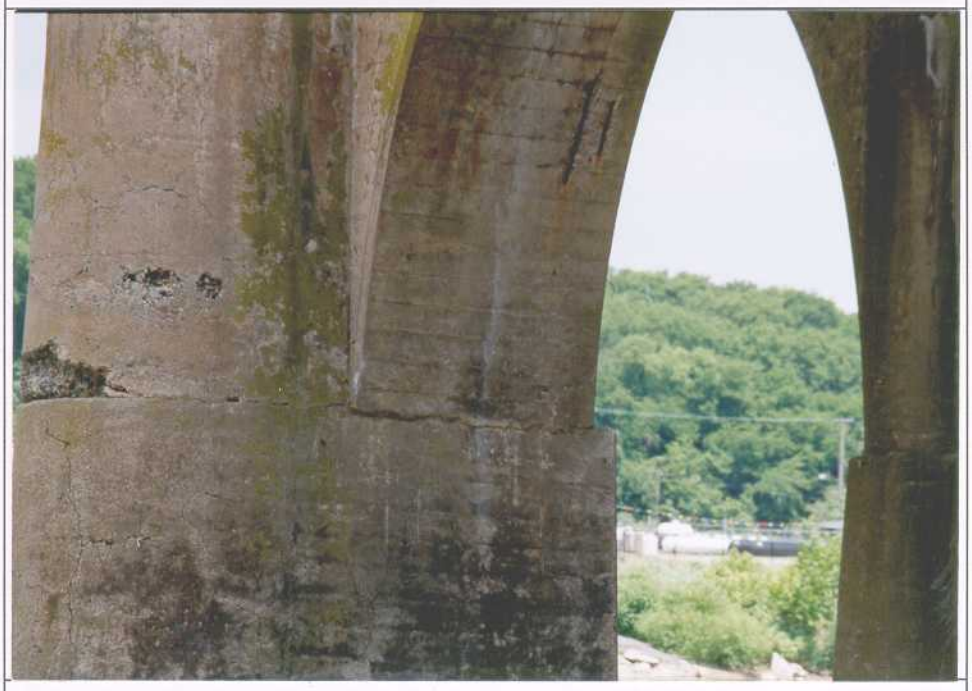
CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A104-24

SEVERE CONCRETE SCALE, UPSTREAM END, PIER 6.



A105-8

SEVERE HONEYCOMB, PIER 7, UPSTREAM SIDE.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **44**

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CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A105-10

SEVERE DETERIORATION IN DOWNSTREAM ARCHES AT PIER 7.

C217-8

DETERIORATED CONCRETE ON TOP OF ARCH, UPSTREAM SIDE, SPAN G, NEAR PIER 8.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **45**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A105-11

SEVERE DETERIORATION IN DOWNSTREAM ARCH, SPAN G, NEAR PIER 7.

A105-4

SEVERE SCALE, UPSTREAM END, PIER 8 CAP.

PHOTO SHEET

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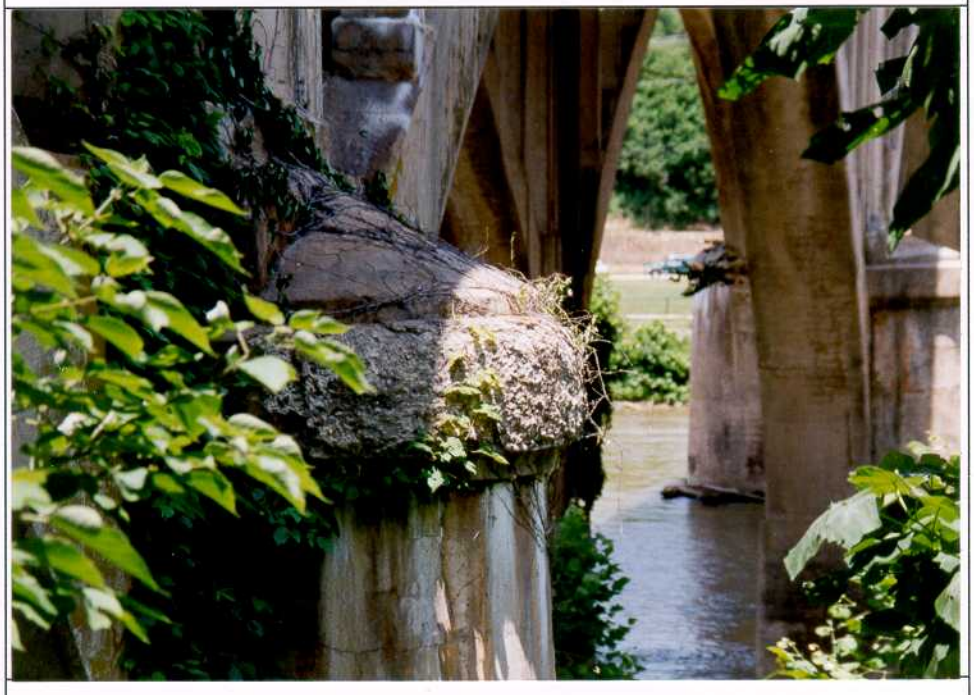
CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A105-12

SPALLED CONCRETE LYING ON GROUND NEAR PIER 8, TYP. OF NUMEROUS PIECES THAT HAVE FALLEN.



A105-3

SEVERE SCALE, DOWNSTREAM END, PIER 8 CAP.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **47**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

A104-3

SPAN H, UPSTREAM SIDE AT PIER 9 - SEVERE SCALING AND CRACKING AT SPRING LINE.

C217-7

DOWNSTREAM ARCH, SPANS C & D AT PIER 4, EAST FACE - NOTE CORE HOLE #1 ON RADIUS OF DECORATIVE COLUMN BASE.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **48**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C216-21

UPSTREAM ARCH, SPAN B, WEST FACE OF ARCH, 3' ABOVE GROUND LINE, AT PIER 3 - NOTE CORE HOLE #2.

C216-22

UPSTREAM ARCH, SPAN C, SOUTH FACE OF ARCH, 3' ABOVE GROUND LINE, AT PIER 3 - NOTE CORE HOLES D AND #3.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **49**

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CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C216-24

DOWNSTREAM ARCH, SPAN B, NORTH FACE OF ARCH, 4' ABOVE GROUND LINE, AT PIER 3 - NOTE CORE HOLE #8.

C217-4

DOWNSTREAM ARCH, SPANS C & D, PIER 4, WEST FACE - NOTE CORE HOLES #9 AND A LOCATED 4' ABOVE GROUND LINE.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **50**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C216-23

DOWNSTREAM ARCH, SPAN C, WEST FACE OF ARCH, 3' ABOVE GROUND LINE, AT PIER 3 - NOTE CORE HOLE #4.

C217-6

UPSTREAM ARCH, SPAN D AT PIER 4, SOUTH FACE - NOTE CORE HOLE #5 LOCATED 5' ABOVE GROUND LINE.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **51**

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C217-5

UPSTREAM ARCH, SPANS C & D AT PIER 4, EAST FACE - NOTE CORE HOLES B, E AND #10 LOCATED 3'-4' ABOVE GROUND LINE.

C216-20

UPSTREAM ARCH, SPAN B, EAST FACE OF ARCH, 3' ABOVE GROUND LINE, AT PIER 3 - NOTE CORE HOLE C.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **52**

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CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C216-9

SPAN C, NEAR PIER 4, UPSTREAM SIDE - 2" CORE G TAKEN ON TOP OF ARCH.

C216-10

SPAN I, UPSTREAM SIDE, WEST FACE OF ARCH, 1' ABOVE SPRING LINE - NOTE CORE HOLE I.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **53**

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C216-11

SPAN H, UPSTREAM SIDE, WEST FACE OF ARCH, 0.5' ABOVE SPRING LINE - NOTE CORE HOLE J.

C216-12

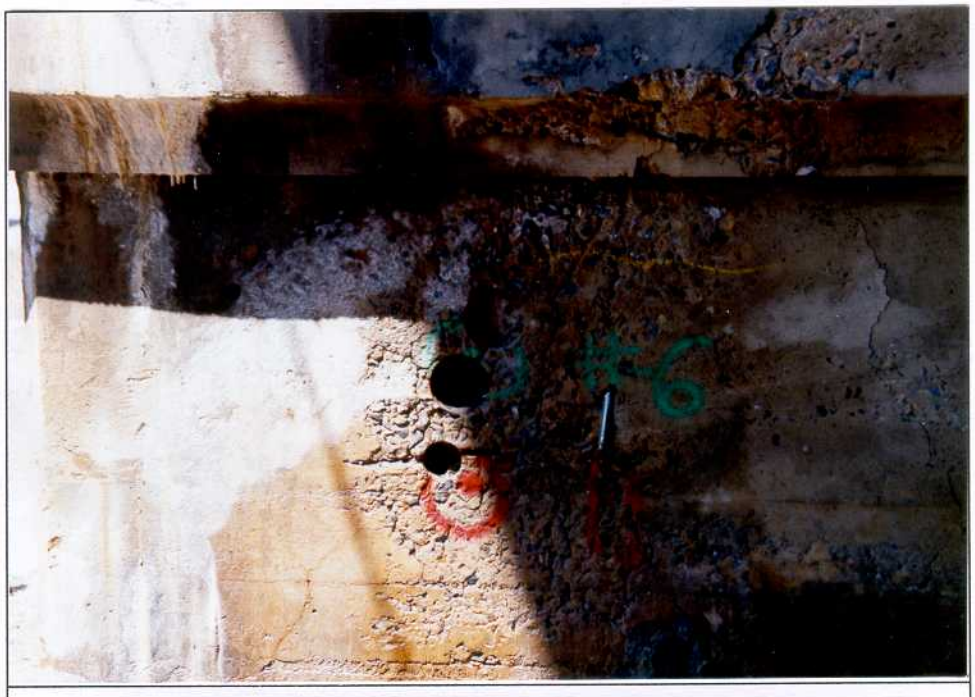
PIER #9, UPSTREAM FACE, 3' BELOW TOP OF CAP - CORE HOLES #7 AND F.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **54**

COMMISION NO: **04011** STRUCTURE NO. **8006**

CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**



C216-13

PIER 10, 3' FROM UPSTREAM END, SOUTH SIDE, 4' BELOW TOP OF CAP - NOTE CORES H AND #6.

C218-2

CORES 1-5.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **55**

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CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C218-1

CORES 1-5.

C218-3

CORES 6-10.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **56**

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CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C218-4

CORES 6-10.

C218-6

CORES A, B, C, D AND E.

PHOTO SHEET

BRIDGE: **WORSHAM STREET OVER DAN RIVER** PAGE: **57**

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CITY/TOWN: **CITY OF DANVILLE, VIRGINIA** DATE: **JULY 2, 2004**

C218-8

CORES F, G, H, I AND J.

SCHWARTZ AND ASSOCIATES, INC.

CONSULTING ENGINEERS

LYNCHBURG – BRISTOL, VIRGINIA

EXHIBIT 6

WORSHAM STREET BRIDGE

LABORATORY TESTS

(INCLUDES LOCATIONS TAKEN, DESCRIPTION & RESULTS)

WORSHAM STREET BRIDGE OVER DAN RIVER

7/27/94

ARCH EVALUATION

CHLORIDE SAMPLE LOCATIONS

SAMPLE NO.	LOCATION
#1	West Arch Rib - Span 2 - 2/3 Pt.
#2	West Arch Rib - Span 2 - 3/3 Pt.
#3	West Arch Rib - Span 3 - 1/3 Pt.
#4	East Arch Rib - Span 3 at delaminated area
#5	East Arch Rib - Span 2 - 1/3 Pt.
#6	West Arch Rib at Pier 4 inside face
#7	East Arch Rib at Pier 4 outside face
#8	West Arch Rib - Span 3 - 30′ from Pier 4
#9	East Arch Rib - Span 3 - 25′ from Pier 4
#10	Pier 3, Span 3 - upstream side on arch
#11	Downstream side front face of arch rib, Pier 5
#12	Upstream side inside face of arch rib, Span 4, Pier 5
#13	Downstream side inside face, Pier 5, middle of pier
#14	Upstream side front face of Pier 8, Span 7
#15	Upstream side inside face of Pier 8
#16	Downstream side inside face of Pier 8
#17	West Arch Rib - Span 8 - 30′± from Pier 8
#18	West Arch Rib - Span 7 - 15′± from Pier 8 (wet spot on west arch)
#19	East Arch Rib - Span 7 - 15′± from Pier 8 (Drilled 1" at crack with efflorescence)
#20	East Arch Rib - Span 8 - 30′± from Pier 8 (Drilled 1" at wet spot)
#21	Downstream side - 3′ above ground, Span 8, Pier 9
#22	Upstream side, Span 9, Pier 9 - 10′ above ground
#23	Downstream side, Span 9, Pier 9 - 3′ above ground
#24	Downstream side, Span 10, Pier 10 - 3′ above ground
#25	Pier 10, Span 10 - Middle of arch 6′ above ground

Schwartz & Associates , Inc.
Consulting Engineers

REPORT ON TOTAL CHLORIDE CONTENT

NOTE: All 25 chloride samples drilled very soft.

Project: Worsham/Dan River Arch Evaluation

Comm. No.: 93010 W

Client: City of Danville, VA

Sample No.: #1-#25

4,110 Concrete Wt.(LBS./C.Y.) Date : 7/27/94

Sample No.	Chloride %	Chloride lbs / yd³	Sample No.	Chloride %	Chloride lbs / yd³
#1	.043	1.77	#15	.015	0.62
#2	.033	1.36	#16	.0205	0.84
#3	.020	0.82	#17	.011	0.45
#4	.040	1.64	#18	.048	1.97
#5	.010	0.41	#19	.008	0.33
#6	.048	1.97	#20	.015	0.62
#7	.077	3.16	#21	.008	0.33
#8	.060	2.47	#22	.017	0.70
#9	.049	2.01	#23	.0054	0.22
#10	.034	1.40	#24	.014	0.58
#11	.015	0.62	#25	.058	2.38
#12	.0068	0.28			
#13	.0075	0.31			
#14	.0075	0.31			

Total No.. Tests Performed 25

By: Mike Hanson

WORSHAM STREET BRIDGE OVER DAN RIVER

7/24/94

CORE LOCATIONS

CORE NO.	LOCATION	CONDITION	COMPRESSIVE STRENGTH
1	Pier 2, upstream side (Span 2) 3′ east of upstream side, 10′ above sidewalk.	Concrete appears porous.	4,240
2	Pier 2, upstream side (Span 2) 10′ above sidewalk.	Concrete appears porous.	6,445
3	Pier 3, downstream side (inside face), Span 3, 5′ above ground line.	Concrete appears porous. Signs of alkali aggregate reaction.	3,128
4	Pier 3, upstream side (inside face) Span 2, 5′ above ground line.	Concrete appears porous. Signs of alkali aggregate reaction.	Not tested due to length limitations.
5	Pier 3, downstream side (outside face) Span 3, 6′ above ground line.	Concrete appears porous. Numerous voids.	4,478
6	Pier 4, downstream side (inside face) Span 3, 4′ above ground line	Concrete appears porous. Cracks in top.	4,579
7	Pier 4, upstream side (inside face) Span 3, 5′ above ground line.	Concrete appears porous.	3,901
8	Pier 4, upstream side (inside face) Span 4, 6′ above ground line.	Concrete appears porous.	3,384
9	Pier 8, downstream side (front face) Span 7, 3′ above ground line.	Concrete appears porous.	4,698
10	Pier 8, upstream side (front face) Span 7, 3′ above ground line.	Concrete appears porous.	4,481
11	Pier 9, Span 8 (3′ above ground line downstream side).	Concrete appears porous. Numerous cracks in top 3/4". Possible alkali aggregate reaction.	4,240
12	Pier 10, Span 10 (4′ above ground line) downstream side.	Concrete appears porous. Numerous cracks, broken into 3 pieces.	Not tested due to length limitations.

SINCE 1881

FROEHLING & ROBERTSON, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS
ENGINEERS • LABORATORIES
"OVER ONE HUNDRED YEARS OF SERVICE"

Richmond Branch Office
3015 Dumbarton Road, Richmond, Virginia 23228
(804) 264-2701 Fax (804) 264-3549

June 29, 2004

REVISED CHLORIDE ION PENETRATION TEST REPORT

PROJECT NO.: F60-0220T
CONTROL NO.: 60-04-91851
CLIENT: Schwartz & Associates
7331 Timberlake Road, Suite 305
Lynchburg, Virginia 24502
Attn: R. W. Schwartz, P.E.
PROJECT: Worsham Street Bridge over Dan River
City of Danville
STANDARD: ASTM C 1202-97, Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

Dear Mr. Schwartz,

Froehling & Robertson, Inc. is pleased to report the results of chloride ion penetration testing performed on ten core samples from the Worsham Street Bridge over Dan River. The test results are shown in the table below.

CORE	CHARGE PASSED (COULOMBS)	PERMEABILITY
1	2585	Moderate
2	7580	High
3	10711	High
4	6702	High
5	10694	High
6	7574	High
7	3946	Moderate
8	9571	High
9	5061	High
10	8423	High

Should you have any questions about these test results or require additional information or testing, please contact us at your convenience.

Respectfully Submitted,
FROEHLING & ROBERTSON, INC.

Robert A. Hill, III, P.E.
CMT Manager

RAH:tt

SINCE 1881

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GEOTECHNICAL • ENVIRONMENTAL • MATERIALS
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"OVER ONE HUNDRED YEARS OF SERVICE"

Richmond Branch Office
3015 Dumbarton Road, Richmond, Virginia 23228
(804) 264-2701 Fax (804) 264-7862

July 1, 2004

PETROGRAPHIC EXAMINATION OF HARDENED CONCRETE

PROJECT NO.: F60-0220T
CONTROL NO.: 60-04-91851
CLIENT: Schwartz & Associates
7331 Timberlake Road, Suite 305
Lynchburg, Virginia 24502
Attn: R. W. Schwartz, P.E.
PROJECT: Worsham Street Bridge over Dan River
City of Danville
STANDARD: ASTM C 856-02, Standard Practice for Petrographic Examination of Hardened Concrete

Dear Mr. Schwartz,

Froehling & Robertson, Inc. is pleased to submit the results of the petrographic analysis performed on eight concrete core samples. The cores were extracted from Worsham Bridge over the Dan River in Danville, Virginia. The concrete is approximately 80 years old. The samples were submitted for an examination to determine if evidence of alkali silica reaction is present. The samples were identified as A2, B1, D, E2, F, G, H and I8.

Data for the petrographic examination was gathered using methods of ASTM C 856-02, Standard Practice for Petrographic Examination of Hardened Concrete. For the examination, a section of each core was cut from the sample parallel to its length. The sewn sections were treated with uranyl acetate solution and allowed to react for 5 minutes. The solution was rinsed away and viewed with ultraviolet light for fluorescent gel accumulation indicative of alkali silica reaction. The sections were then lapped with progressively finer diamond polishing discs. Upon completion of grinding, the surfaces were cleaned in an ultrasonic bath. The results of the examination are as follows.

Core A2: Evidence of alkali silica reaction was observed in this sample. Minimal gel formations were noted at the periphery of a few aggregate particles. Micro fractures resulting from expansion of reaction products were not observed in this sample.

Core B1: Minor amount of gel formation observed. Gel formation was confined to the area at the periphery of the aggregate particles. At the time of this investigation no paste deterioration was noted due to the reaction. Some aggregate particles were cracked. However, the cracks were prior to the onset of reaction and the cracks did not extend into the paste.

Core D: Significant presence of gel formation in this sample. Multiple aggregate particles reacted and gel formation was observed at the periphery of aggregate particles and pockets in the paste. The heaviest zone of reaction was at a depth of

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JUL 06 2004
SCHWARTZ & ASSOCIATES
CONSULTING ENGINEERS

1/2 to 1 1/2 inches beneath the top surface. Expansion due to gel formation was minimal.

Core E2: Gel formation in this sample was observed at the periphery of the highly siliceous aggregate particles. Micro fractures and cracks in the aggregate particles were rare. Multiple particles showed gel formation. However, no cracks were observed within the aggregate particle.

Core F: Minor amount of reaction observed. Small coarse aggregate particles showed evidence of minimal gel deposits at the boundary of the aggregate.

Core G: No alkali silica reaction products observed at the time of this evaluation.

Core H: Significant presence of gel formation in this sample. Multiple aggregate particles reacted and gel formation was observed at the periphery of aggregate particles and pockets in the paste. The occurrence of gel formation was noted throughout the entire sample. Expansion from gel formation caused multiple cracks in aggregate particles and micro fractures were noted in the paste.

Core I8: No alkali silica reaction products observed at the time of this evaluation.

SUMMARY

1. The aggregate that appear to be the most reactive was a highly siliceous igneous rock with a glassy texture. The reactive particles were generally in the 3/4 to 3/8 inch range. Some aggregate particles were cracked due to the presence of gel formations and the associating expansion. Overall, gel deposits in most samples were located at the periphery of aggregate particles.

2. The samples that had evidence of alkali silica reaction were A2, B1, D, E2, F and H.

3. Samples showing no evidence of reaction at the time of this investigation were G and I8.

Should you have any questions about this report or require additional information or testing, please contact us at your convenience.

Respectfully Submitted,
FROEHLING & ROBERTSON, INC.

James Crenshaw (RA)

James L. Crenshaw, Jr.
Geologist

Robert A. Hill

Robert A. Hill, III, P.E.
CMT Manager

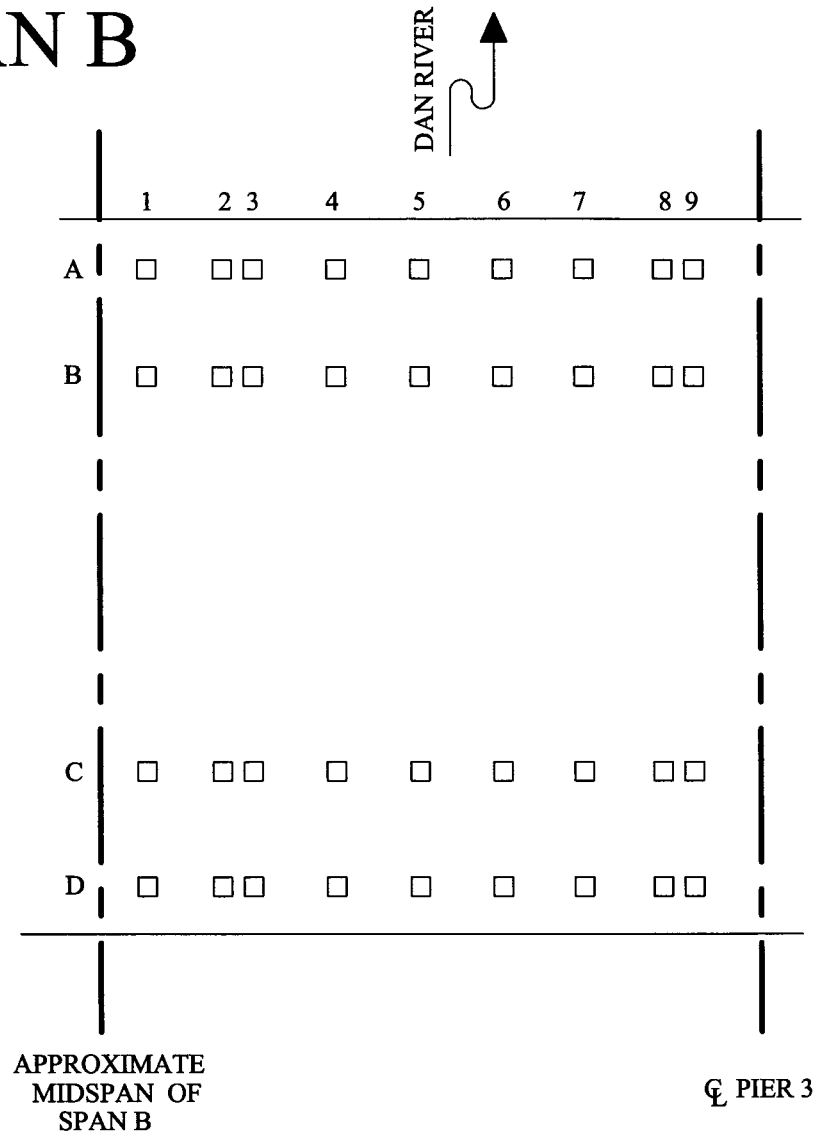
JLC:RAH:tt

EXHIBIT 7

WORSHAM STREET BRIDGE

PLAN SHOWING FLOORBEAM SUPPORT COLUMN IDENTIFICATION NUMBER

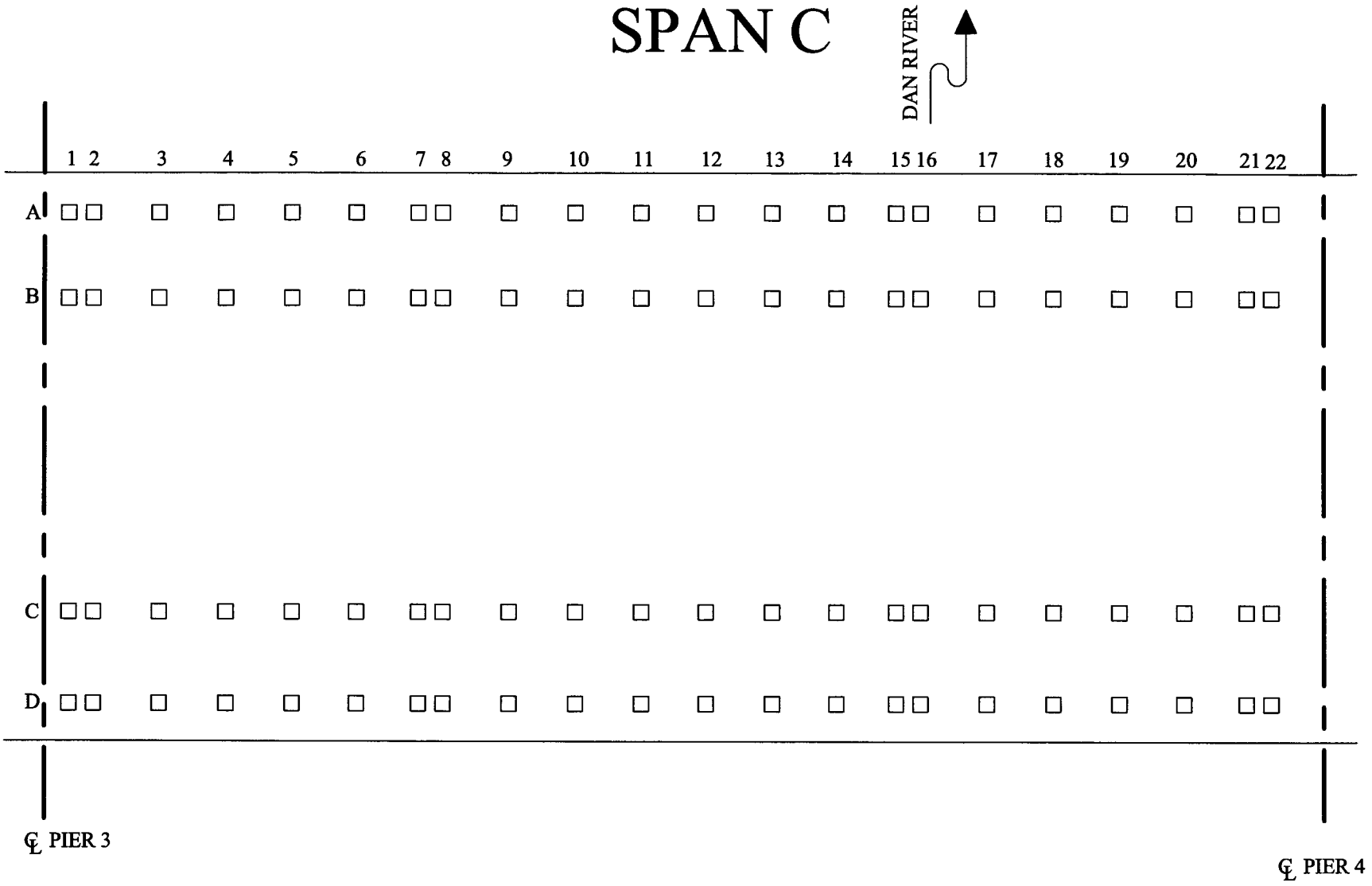
SPAN B



ROUTE:	58 (WORSHAM STREET)
OVER:	DAN RIVER
CITY:	DANVILLE
DATE:	JULY 6, 2004
STR. NO.:	8006
INITIALS:	BAM
DWG:	Z:\SKETCHES\DANVILLE\WORSHAM

SCHWARTZ & ASSOC. INC.
CONSULTING ENGINEERS

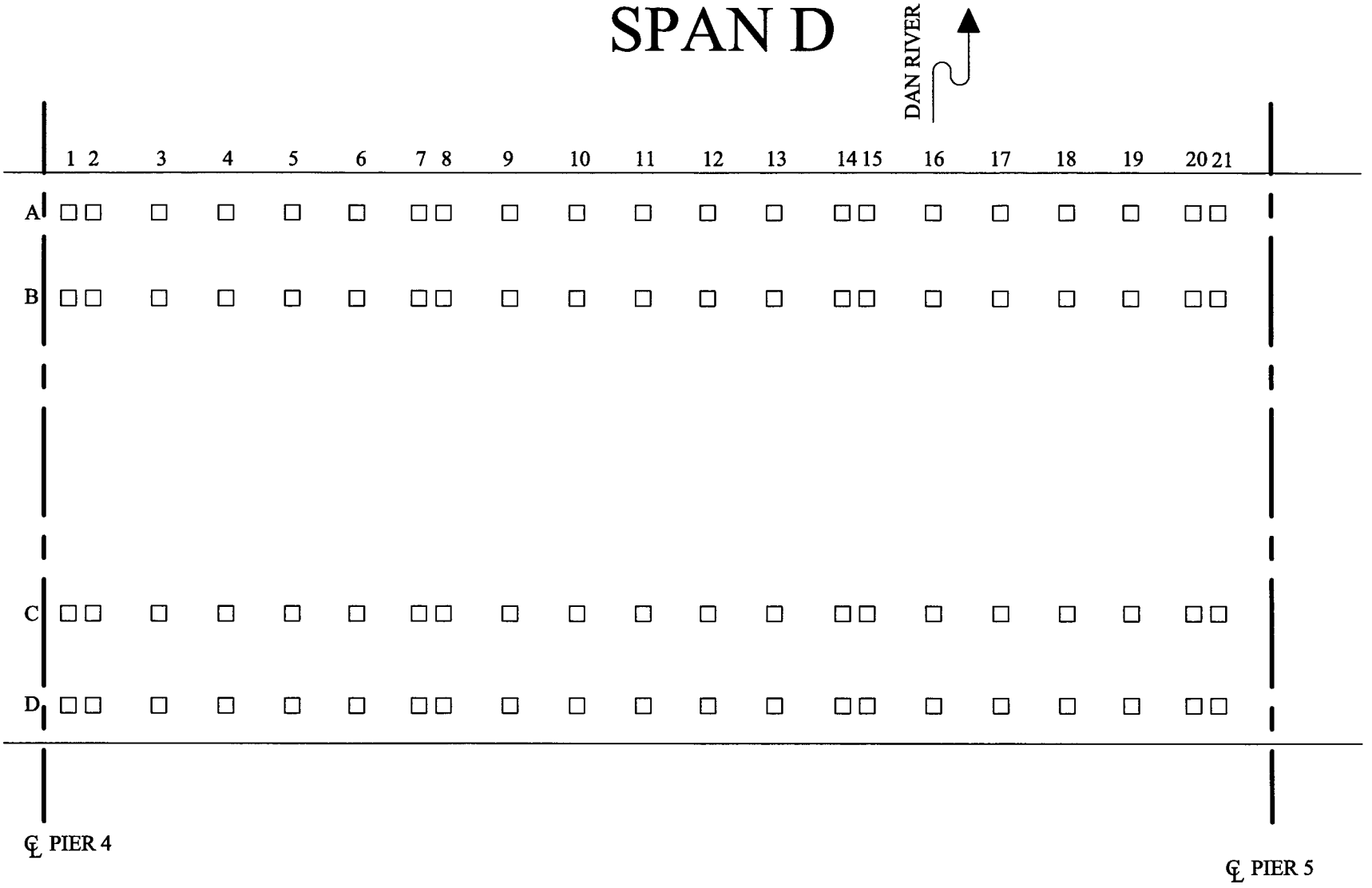
SPAN C



ROUTE:	58 (WORSHAM STREET)
OVER:	DAN RIVER
CITY:	DANVILLE
DATE:	JULY 6, 2004
STR. NO.:	8006
INITIALS:	BAM
DWG:	Z:\SKETCHES\DANVILLE\WORSHAM

SCHWARTZ & ASSOC. INC.
CONSULTING ENGINEERS

SPAN D



ROUTE:	58 (WORSHAM STREET)
OVER:	DAN RIVER
CITY:	DANVILLE
DATE:	JULY 6, 2004
STR. NO.:	8006
INITIALS:	BAM
DWG:	Z:\SKETCHES\DANVILLE\WORSHAM

SCHWARTZ & ASSOC. INC.
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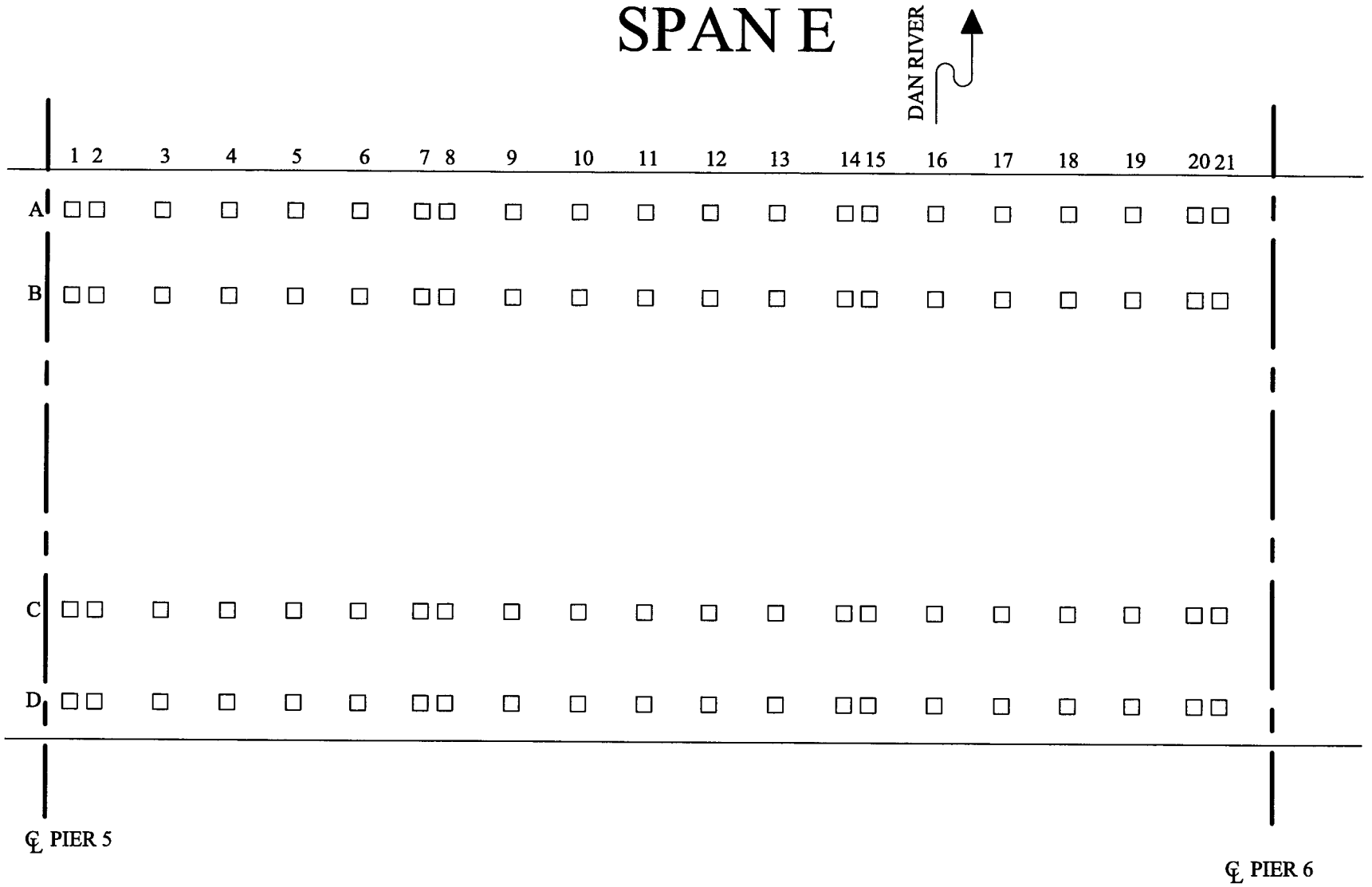
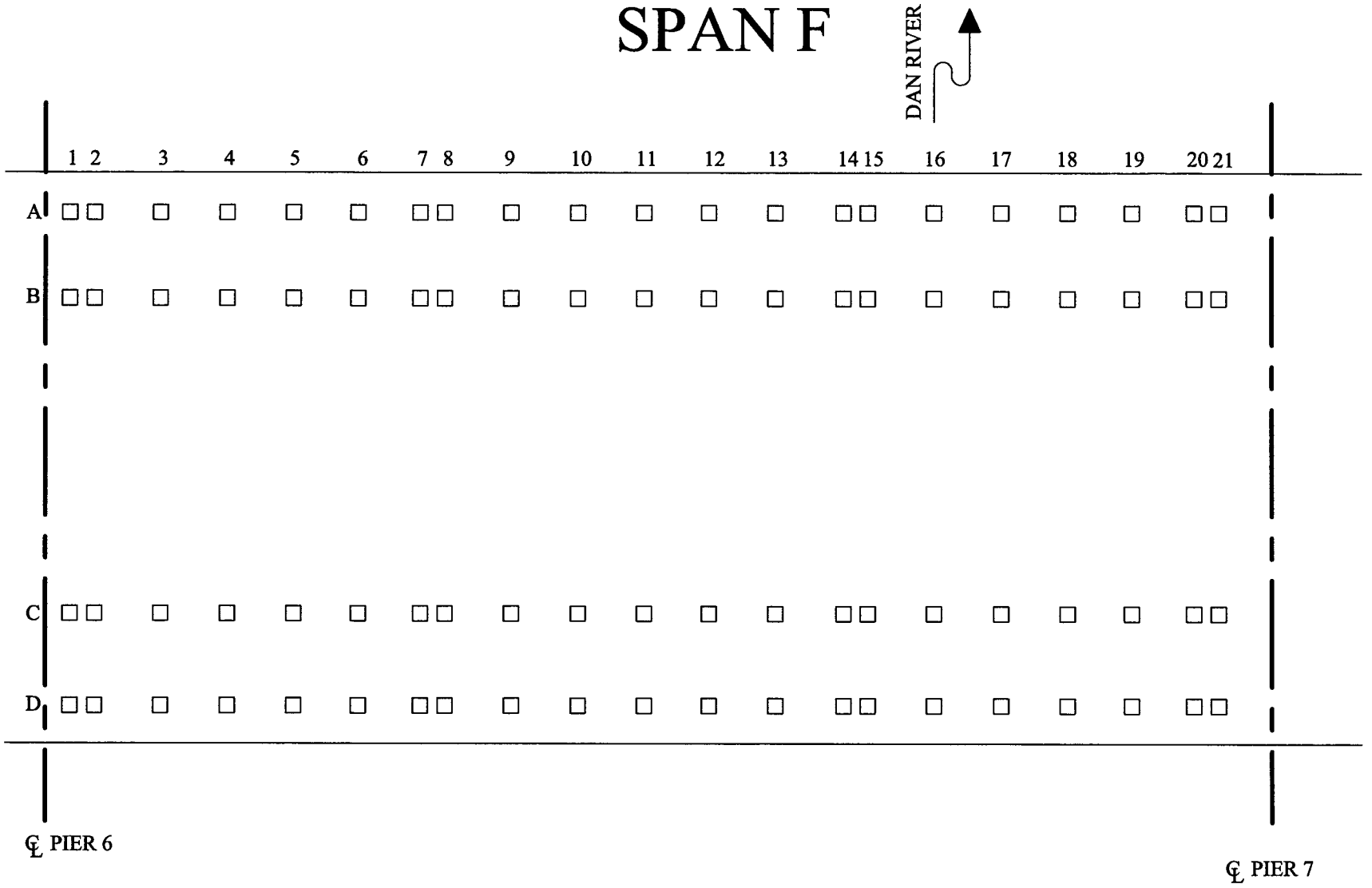
SPAN E



ROUTE:	58 (WORSHAM STREET)
OVER:	DAN RIVER
CITY:	DANVILLE
DATE:	JULY 6, 2004
STR. NO.:	8006
INITIALS:	BAM
DWG:	Z:\SKETCHES\DANVILLE\WORSHAM

SCHWARTZ & ASSOC. INC.
CONSULTING ENGINEERS

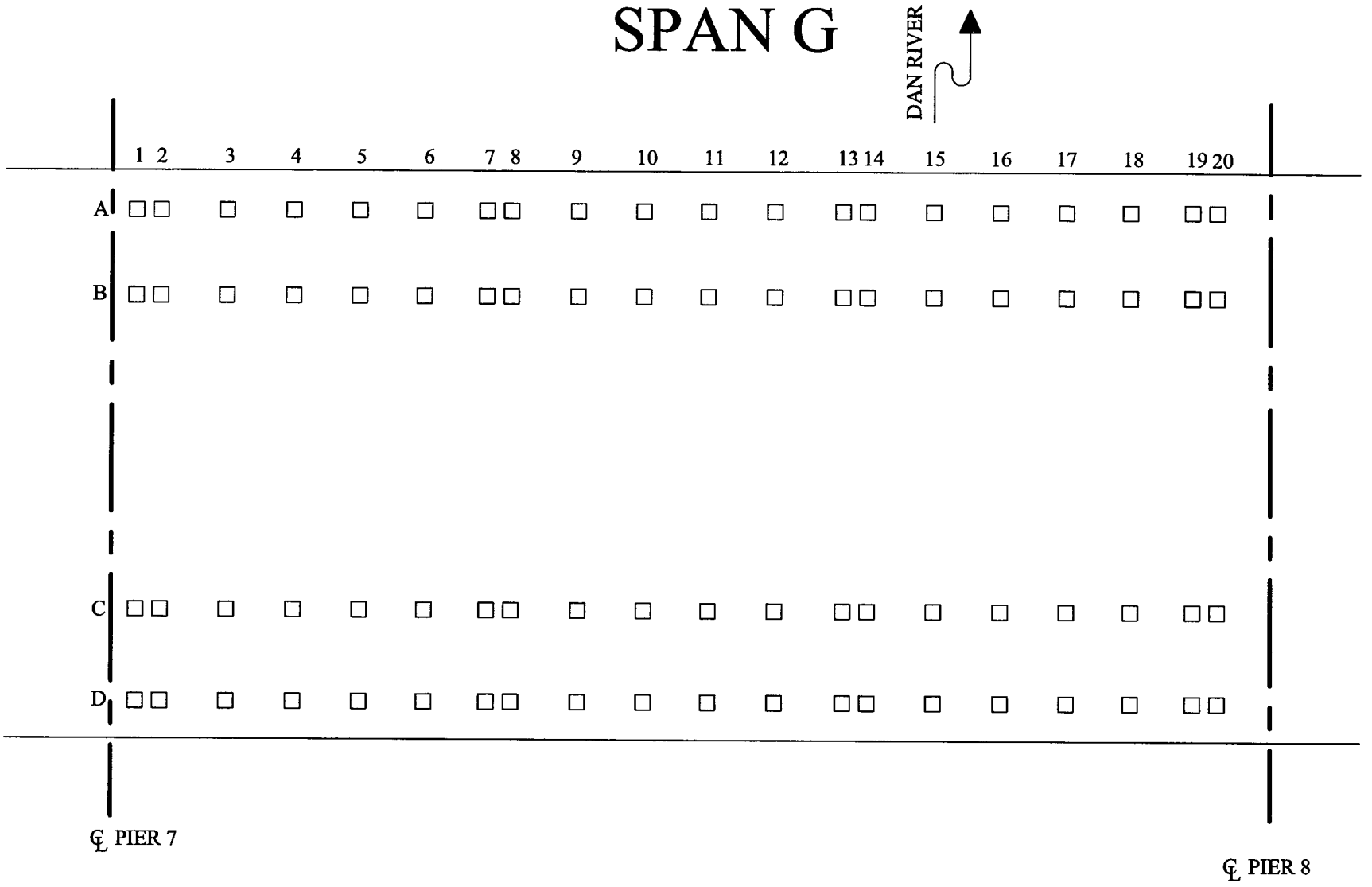
SPAN F



ROUTE:	58 (WORSHAM STREET)
OVER:	DAN RIVER
CITY:	DANVILLE
DATE:	JULY 6, 2004
STR. NO.:	8006
INITIALS:	BAM
DWG:	Z:\SKETCHES\DANVILLE\WORSHAM

SCHWARTZ & ASSOC. INC.
CONSULTING ENGINEERS

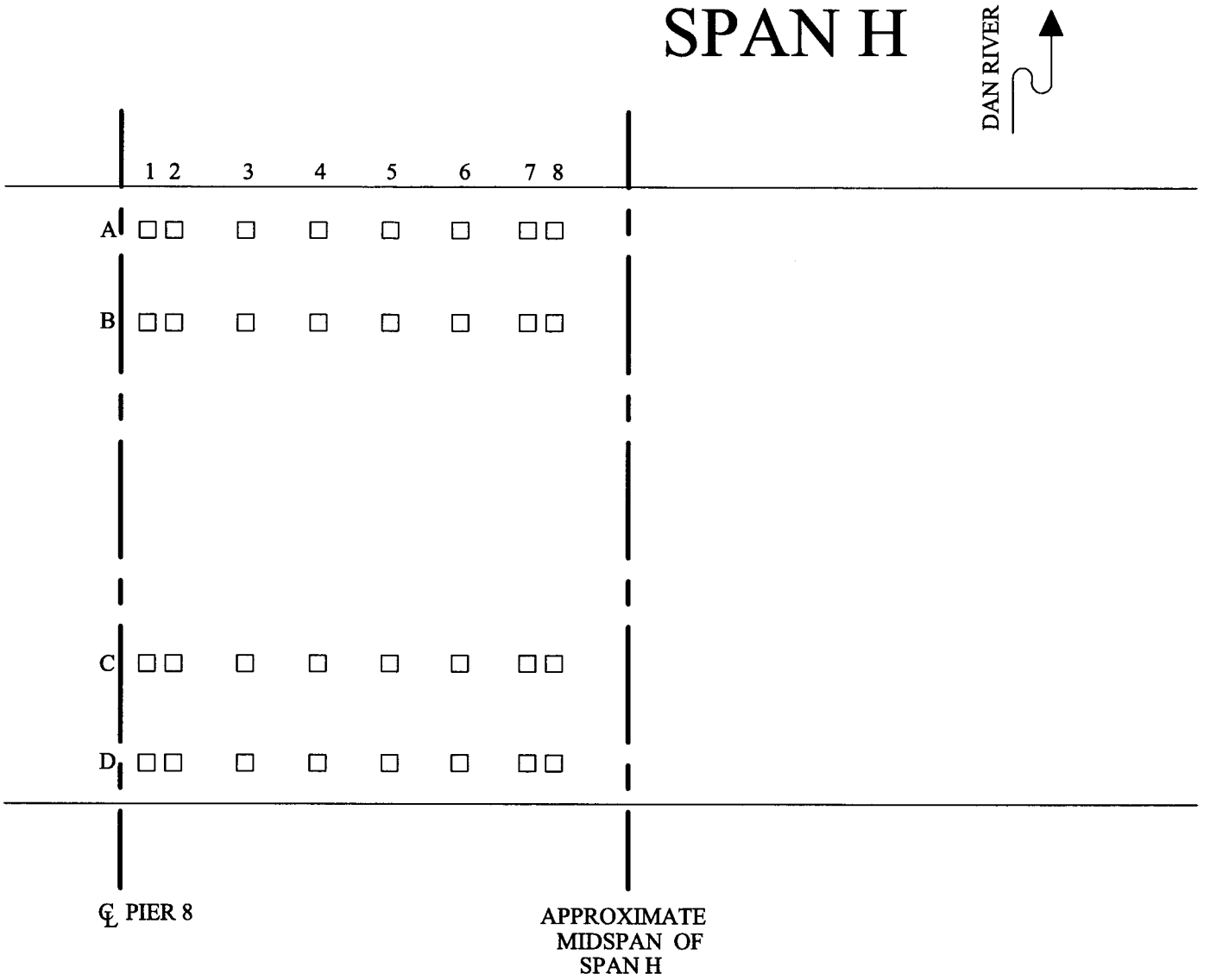
SPAN G



ROUTE:	58 (WORSHAM STREET)
OVER:	DAN RIVER
CITY:	DANVILLE
DATE:	JULY 6, 2004
STR. NO.:	8006
INITIALS:	BAM
DWG:	Z:\SKETCHES\DANVILLE\WORSHAM

SCHWARTZ & ASSOC. INC.
CONSULTING ENGINEERS

SPAN H



ROUTE:	58 (WORSHAM STREET)
OVER:	DAN RIVER
CITY:	DANVILLE
DATE:	JULY 6, 2004
STR. NO.:	8006
INITIALS:	BAM
DWG:	Z:\SKETCHES\DANVILLE\WORSHAM

SCHWARTZ & ASSOC. INC.
CONSULTING ENGINEERS

EXHIBIT 8

WORSHAM STREET BRIDGE

LOAD CAPACITY RATINGS FOR DECK

SCHWARTZ & ASSOCIATES, INC.
Consulting Engineers
Heritage Business Center
7331 Timberlake Road, Lynchburg, VA 24502
(434) 237-6584

JOB

SHEET NO. 1 OF 3

CALCULATED BY JFG DATE 7-2-04

CHECKED BY RWS DATE 7-7-04

SCALE COMM. NO. 04011

WORSHAM ST. BRIDGE

OVER

DAN RIVER

DECK RATING

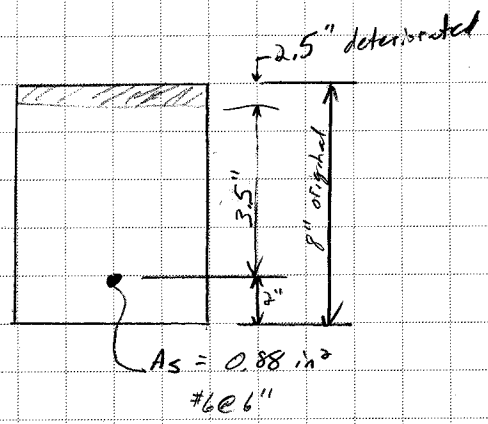
SCHWARTZ & ASSOCIATES, INC.
Consulting Engineers
Heritage Business Center
7331 Timberlake Road Lynchburg, VA 24502
(804) 237-6584

JOB Worsham St / Dan River
SHEET NO. 1A OF 3
CALCULATED BY JFG DATE 7-7-04
CHECKED BY RJJ DATE 7-7-04
COMM. NO. 04011
SCALE

Assume $f'c = 2100$ psi ∴ allowable compressive $= .4(2100) = 840$ psi due to deterioration in conc.

$n = 15$

1' section



Dist., $E = (4 + 0.06S)$
$= (4 + 0.06 \times 6.75')$
$= 4.405$

F.B. spacing = 8'-0" c-c max
$S = 8'-0" - 1'-3"$
$= 6'-9"$

Deck DL $\frac{8'' \times 150 \text{ lbs/cf}}{12} = 100.5$ lbs/ft width

W.S. $\frac{2''}{12} \times 150 \text{ lbs/cf} = 25$ lbs/ft

125.5 lbs/ft

$$M_{DL} = \frac{125 \text{ lbs/ft} (6.75)^2}{10} 12 = 68.34 \text{ in-lbs}$$

SCHWARTZ & ASSOCIATES, INC.
Consulting Engineers
Heritage Business Center
7331 Timberlake Road Lynchburg, VA 24502
(804) 237-6584

JOB Worsham St / Dan River
SHEET NO. 2 OF 3
CALCULATED BY JFG DATE 7-7-04
CHECKED BY RWS DATE 7-7-04
SCALE COMM. NO. 04011

$$kd = \frac{\sqrt{(A_s n)^2 + 2bd A_s n} - A_s n}{b}$$

$$kd = \frac{\sqrt{(0.88 \times 15)^2 + 2(12)(3.5)(0.88)(15)} - 0.88 \times 15}{12}$$

$$kd = \frac{\sqrt{174.24 + 1108.8} - 13.20}{12} = \frac{35.82 - 13.20}{12} = 1.88''$$

		A	d	Ad	d	I
conc	12(1.88")	22.62	½d = 0.94	21.26	⅔(d) = 1.25	26.58
steel	0.88(15)	13.20	3.5	46.20	3.5	161.70
		35.82		67.46		188.28

$$\bar{d} = \frac{67.46}{35.82} = 1.88''$$

$$\bar{d}_s = 3.5 - 1.88 = 1.62''$$

$$A\bar{d}^2 = 35.82(1.88)^2 = -126.60$$

$$61.68$$

$$M_{all\ conc} = \frac{2100\ (.4)(61.68)}{1.88} = 27{,}560 \text{ in-lbs}$$

$$M_{all\ steel} = \frac{18{,}000\ (61.68)}{15\ (1.62)} = 45{,}689 \text{ in-lbs}$$

$$M_{avail} = M_{all} - M_{DL} = 27{,}560 - 6834 = 20{,}726 \text{ in-lbs} = 1727 \text{ ft-lbs}$$

$$M_{LL} = \frac{Pl}{5E}(1.3) = \frac{4000\text{ lb}\ (6.75)\ (1.3)}{5 \times 4.405} = 1594 \text{ ft-lbs} = 19{,}128 \text{ in-lbs}$$

5 ton truck
8000 lb on Rear axle
and 2000 lb on Front axle

$$\text{Rating} = \frac{M_{avail}}{M_{LL}}(\text{wt truck}) = \frac{1727}{1594}(5 \text{ tons}) = 5.4 \text{ tons} = \underline{5 \text{ tons}}$$

$$\sigma_{conc} = \frac{Mc}{I} = \frac{(19{,}128 + 6834) \times 1.88}{61.68} = 791 \text{ psi} < 840 \text{ PSI} \therefore \text{ok}$$

$$\sigma_{steel} = \frac{25{,}962 \times 1.62 \times 15}{61.68} = 10{,}228 \text{ psi} < 18{,}000 \text{ PSI} \therefore \text{ok}$$

3/3

FS= 18000 PSI FY= 33000 PSI F'C= 2100 PSI TOTAL DEPTH= 8.00 IN.

N= 15 WIDTH(W)= 12.00 IN. MOMENT(M)= 25962 IN.-LBS

I= 61 IN.^4 CENTROID(C)= 1.88 IN. (FROM TOP OF SECTION)

CONCRETE STRESS= 799 PSI

A 0.88 IN.^2 d= 3.50 IN.

STEEL STRESS= 10274 PSI

V= 0 LBS AS= 0.00 IN.^2 F'C= 2100 PSI

SHEAR STRESS IS 0.0 PSI
SHEAR REINFORCEMENT IS NOT REQUIRED.
* * * * * * * * * * * *

EXHIBIT 9

WORSHAM STREET BRIDGE

RECENT CORRESPONDENCE CONCERNING WORSHAM STREET BRIDGE

A

COMMONWEALTH of VIRGINIA

DEPARTMENT OF TRANSPORTATION
1401 EAST BROAD STREET
RICHMOND, VIRGINIA 23219-2000

PHILIP A. SHUCET
COMMISSIONER

MICHAEL A. ESTES, PE
INTERIM DIRECTOR
LOCAL ASSISTANCE DIVISION

March 12, 2004

Mr. Kent Shelton
City Engineer
Municipal Building
Post Office Box 3300
Danville, Virginia 24543

Subject: Worsham Street Bridge
Project: U000-108-109, PE-101, B-606
UPC Number: 12521
City of Danville

Dear Mr. Shelton:

On February 10, 2004 you requested that several concerns be addressed. These matters have been reviewed and the following comments are offered.

Your first concern that I address is using your Urban allocation to rehabilitate the bridge as a pedestrian and bicycle bridge rather than demolition. Provided this link is a part of your overall bicycle plan, funds can be utilized for repairs and rehabilitation. However, this structure would not qualify for maintenance payments.

The final concern is what impact this effort would have on other city projects. The answer to this concern partly is dependent on how fast you want it operational as a pedestrian and bicycle facility. Currently you have $2.1 million in allocations, with another $1.7 million in '05 and '06, for a total of $3.8 million. Approximately $90,000.00 has been spent. Since the Franklin Turnpike project is the City's Number 1 priority, I would be reluctant to transfer funds from it. That leaves us with the Piedmont Drive project.

Currently, on the Piedmont Drive project there are sufficient previous funds to meet the Worsham Street Bridge Rehabilitation project, as you outlined. But this transfer of funds would delay the advertisement of Piedmont Drive 2 to 4 years.

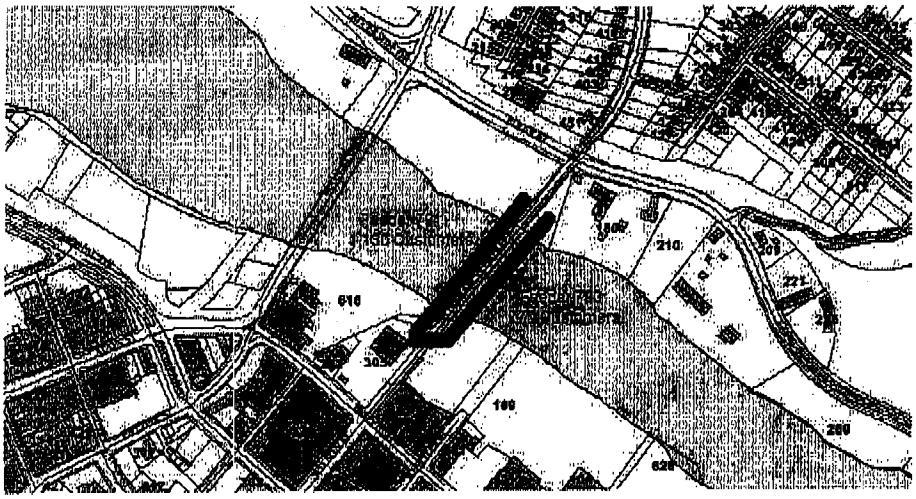
I trust that this information will aid you and your city council to finalize the direction of the Worsham Street project. If you desire more information, please contact me.

Sincerely,

Leo H. Rutledge, Jr.
Urban Programs Engineer

LHRjr/bpc
cc: Mr. Richard Drazenovich

B



Worsham Street Electric System River Crossings

Summary: The river crossing portion of two Bridge Street 12.4KV electric feeders serving 1,900 customers and fiber optic SCADA circuits are currently attached to the Worsham Street Bridge. Due to the deteriorated condition of the bridge these electric facilities attached to the bridge must be removed and replaced by new aerial river crossings. The proposed location of the new crossing will just west of the bridge. Steel poles are the current standard for utility river crossings and are proposed for this installation. To expedite the project schedule, authorization has been given to our design engineers for geotechnical soil borings on each side of the river and limited design work sufficient to produce river crossing permit drawings.

Depending upon the soil analysis and pole foundation requirements, the estimated cost for the new crossings could be as much as $460,000. It is our understanding that the engineering design fees and construction cost will be reimbursable after VDOT has reviewed the plan and estimate and authorizes the City to proceed with the project. We are pursuing expedited VDOT reimbursement authorization with VDOT Utilities Engineer, Ron Tucker. Critical aspects of the project are approval of the river crossing by the Corps of Engineers, Virginia Department of Environmental Quality and the Virginia Marine Resources Commission and fabrication of the steel poles.

Current Situation: Bridge Street Substation feeder 791 crosses the Dan River attached to the west side of the Worsham Street bridge and serves 1,130 customers along Worsham Street to Taft Street and along Old Richmond Road to Little Creek Road. Feeder 793 crosses the Dan River attached to the east side of the bridge and serves 700 customers along U.S. 58 East to Kentuck Road. These feeders also provide back-up connections for other feeders on the north side of the Dan River. Maintenance of these feeder river crossings is critical to the operation of our electric distribution system.

Project Plan: We are proceeding with the required soil borings to determine the pole support requirements. Preliminary engineering design sufficient to determine the river crossing design and preparation of drawings for the permit application has also been

initiated. It is our intent to limit further expenditures until the project has been authorized for reimbursement by VDOT.

The critical scheduling concern is the river crossing permit that is estimated to take from 90 days to 6 months to obtain. Perhaps VDOT can assist with expediting the permit process. Pole procurement is estimated to take six weeks and construction is estimated to take two weeks.

Budgetary cost estimates are:

Worsham Street Bridge Electric Feeder Relocation

Description	Est. Cost	Comments
Engineering	$ 60,000	
Geotechnical	$ 5,000	
Engineering Total	$ 65,000	
Drilled Pier Foundations	$ 211,950	* Based on previous Brantly test results
Steel Structures	$ 93,000	Based on previous cost estimates
Conductor	$ 10,000	
Hardware	$ 8,000	
Installation	$ 34,000	
Construction Total	$ 356,950	
Contingency 10%	$ 42,195	
Estimated Total Cost	**$ 464,145**	

* Worst case anticipated

Project Contacts: Carlis Wells 799-5268
Paul Kalv 799-5270

C

Gc #0503-W

Schwartz & Associates, Inc. **Consulting Engineers**

Heritage Business Center
7331 Timberlake Road, Suite 305
Lynchburg, Virginia 24502
(434) 237-6584

MEMBER OF:
ACEC
ACI
AISC
APWA
AREA
ASCE
NSPE

June 29, 2004

Mr. A. Kent Shelton, P.E.
Deputy Director/City Engineer
Public Works Department
City of Danville
P. O. Box 3300
Danville, VA 24541

Re: Worsham Street Bridge over Dan River, Structure #8006
City of Danville, VA
Our Commission No.: 03031-W

Dear Mr. Shelton:

Because of the conditions found yesterday afternoon with the removal of the loose concrete on the upstream side of the structure, it is our recommendation that this sidewalk be closed immediately to all pedestrian traffic. We have already found several floorbeam cantilevers that are severely disintegrated. In fact, one of them fell out yesterday while the loose concrete was being removed. The floorbeam cantilever is the only support member that supports the load of the sidewalk and the bridge railing.

It is our strong recommendation that this sidewalk be closed immediately and remain closed until these severely deteriorated floorbeam cantilevers, which support the sidewalk, are replaced to their full strength. Also, the area under the bridge between the river and Route 58 should be sealed off from vehicles and pedestrians. I will call you to discuss this situation further.

Yours truly,

SCHWARTZ & ASSOCIATES, INC.

R.W. Schwartz, P.E.

RWS:th

c: Mr. Rick Drazenovich, P.E.
Mr. Randy Saunders

D

Schwartz & Associates, Inc. **Consulting Engineers**

Heritage Business Center
7331 Timberlake Road, Suite 305
Lynchburg, Virginia 24502
(434) 237-6584

Danville BSI file
Str. # 8006

MEMBER OF:
ACEC
ACI
AISC
APWA
AREA
ASCE
NSPE

July 14, 2004

Mr. Jerry L. Gwaltney
City Manager
City of Danville
P. O. Box 3300
Danville, VA 24543

Re: Recommended Closing of
Worsham Street Bridge over Dan River (#8006)
City of Danville, Virginia
Our Commission No. 04011

Dear Mr. Gwaltney:

For nearly 25 years we have worked with the City of Danville and have inspected and engineered the repairs for numerous bridge repairs across the city. Throughout these 25 years, we have been aware of the worsening condition of the Worsham Street Bridge, and on numerous occasions "stop-gap" repairs have been performed to deal with areas of major concern. It has been anticipated for many years that the widening and rebuilding of the adjacent Main Street Bridge over Dan River would be completed in a timely manner. Because VDOT funding was not available, this Main Street project has been delayed for many years. It is now, thankfully, nearing completion.

For over 15 years it has been our understanding and our recommendation that once the Main Street Bridge was rebuilt, the Worsham Street Bridge traffic would be diverted to the new Main Street Bridge and the Worsham Street Bridge be dismantled and removed. As you know, we are currently working on a report on the Worsham Street Bridge that explains its condition and estimated cost to rehabilitate it.

In recent days, we have seen a number of components on this structure, which have either failed or are near failure. Components such as a section of sidewalk falling out a few weeks ago, a floor beam cantilever supporting a sidewalk dropping out from under the sidewalk, and numerous other floor beam cantilevers on each side of the structure that are severely deteriorated with concrete falling off of them onto the ground. This led to our recommendation to the City a couple of weeks ago that the sidewalk be closed to pedestrian traffic.

We have continued our assessment of this structure, and based on our recent structural viewing and calculations performed in this office, we have grave concerns for not only the safety of any pedestrians who might continue to use the sidewalk (even though it has been closed to pedestrians), but we also have grave concerns for the safety if a vehicle were to inadvertently get up on the sidewalk. If this were to happen, we believe the sidewalk and railing system would very likely collapse allowing the vehicle to fall more than 40 feet to the ground below. It is because of these grave concerns that we are now recommending to the City of Danville that this structure be closed to all traffic. This is an engineering decision, which is in the best interest of public health and safety.

We have further concerns with sections of the railing and sidewalk over Route 58 and over the walking trail (which is now closed off along with the section from the walking trail to Route 58). We will perform further investigation of those areas, and our findings may necessitate a recommendation for the removal of concrete in those areas to protect motorists traveling along Route 58 and anyone using the hiking and biking trail.

We regret having to make this decision, but you may be assured it is the decision that is in the best interest of our public health and safety. We will keep in close contact with Mr. Drazenovich and Mr. Shelton as we continue our investigation. In the meantime, if there are any questions, please do not hesitate to give us a call.

Yours truly,

SCHWARTZ & ASSOCIATES, INC.

R. W. Schwartz, P. E.

RWS:af

cc: Richard Drazenovich, P.E.
A. Kent Shelton, P.E.

E

Schwartz & Associates, Inc. **Consulting Engineers**

Heritage Business Center
7331 Timberlake Road, Suite 305
Lynchburg, Virginia 24502
(434) 237-6584

MEMBER OF:
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July 16, 2004

Mr. Jerry L. Gwaltney
City Manager
City of Danville
P. O. Box 3300
Danville, VA 24543

Re: Recommended Removal of Deteriorated Concrete on
Worsham Street Bridge over Dan River (#8006)
City of Danville, Virginia
Our Commission No. 04011

Dear Mr. Gwaltney:

In our letter of July 14, 2004, to you, we stated that we had further concerns with sections of the railing and sidewalk over Route 58 and over the walking trail and we would be performing further investigations of those areas. With the very able assistance of your public works department crew, we completed, last night, that additional assessment, and the purpose for this letter is to advise you of our findings.

The deck and floor beam cantilevers over the east-bound lane of Route 58 are severely deteriorated on the east side of the bridge. The deck over the east-bound lane of Route 58 on the west side is severely deteriorated also.

The sidewalk, floor beam cantilevers, and deck over your walking trail, west side, are severely deteriorated.

One section of railing over the east-bound lane of Route 58, east side, is leaning out of plumb by approximately 1 inch.

In order to protect motorists along Route 58 and hikers and bikers on the walking trail, we recommend the following concrete be removed with the usage of a crane:

1. Over the east-bound lane of Route 58, east side, remove the concrete rail, parapet, spandrel beam, floor beam cantilevers, and deck overhang to the face of the arch from the north side of Pier 3 northward, in Span B, to the second expansion joint. This is a distance of approximately 81 feet.

2. On the west side of Span B over the east-bound lane of Route 58 beginning at the expansion joint over the sidewalk, remove the deck overhang for the first two panels to the north of the expansion joint. Also remove the spandrel beam in these two panels. This is a distance of approximately 17 feet.

3. On the upstream side of your bridge near the walking trail there is an expansion joint, which is located approximately 40 feet north of Pier 5. There is severe deterioration in the concrete deck, sidewalk, floor beam cantilevers, and spandrel beam in this area. We would like to see approximately 16 feet of this concrete removed from the expansion joint to the south and approximately 24 feet to the north.

There are a number of locations in this bridge structure where the railings are leaning outward, some as much as 5 inches. This is a result of the yielding of the concrete in the floor beam cantilevers, which are in very poor condition. There is a risk that these sections of concrete rail will fall off of the structure and pull the electric lines that are attached to the structure below these areas to the ground. Some of these areas are on the upstream side and some on the downstream side of the structure. These areas are located from the sidewalk at Route 58 southward to Pier 9. It is, therefore, our recommendation that these electric lines be removed from this structure as early as possible.

Again, we greatly appreciate the assistance of the public works crew and Mr. Kent Shelton in our assessment of this structure last night. Should there be any questions, please contact us.

Yours truly,

SCHWARTZ & ASSOCIATES, INC.

R. W. Schwartz, P. E.

RWS:af

cc: Richard Drazenovich, P.E.
A. Kent Shelton, P.E.

F

Gen. Corresp. File #04011

Schwartz & Associates, Inc. **Consulting Engineers**

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MEMBER OF:
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July 19, 2004

Mr. Jerry L. Gwaltney
City Manager
City of Danville
P. O. Box 3300
Danville, VA 24543

Re: Experience and Qualifications

Dear Mr. Gwaltney:

You requested earlier this week that we provide you with information concerning our experience and qualifications, and the purpose of this letter is to provide you with that information. First we will provide you with information concerning our firm, and then we will provide you with information concerning the specific experience of Wayne Schwartz. The firm experience is described as follows:

Our firm was established in 1981 and specializes in bridge safety inspection, evaluation of bridge structures, development of rehabilitation plans for bridges, new bridge design, bridge construction and bridge repair inspection, and roadway design and construction inspection. We have engineers on our staff with over 40 years of experience working with bridges in Virginia. We also have bridge safety inspectors who have been inspecting bridges for nearly 35 years in Virginia.

In the past nine years, we have performed approximately 7,000 bridge safety inspections for VDOT, which is far more than any other Virginia engineering firm. We have recommended the closing of approximately 10 bridge structures for VDOT.

Concerning the experience of Wayne Schwartz, I was awarded a Bachelor of Science in Civil Engineering from Virginia Tech in 1962. I began working with VDOT in 1962, and went through their engineer training program. I worked in their bridge design and bridge maintenance sections until early 1967. At that time, I was promoted to the position of Lynchburg District Bridge Engineer where I worked for 13 years. In that job I was responsible for the development of a district bridge section, bridge safety inspection in the 10-county Lynchburg District, deciding which bridges to repair and which ones to recommend replacement. I also worked with the contractors on any field problems that were encountered during construction of bridges or bridge repair. In the 10-county Lynchburg District, we had approximately 2,000 structures that we were responsible for, and during my 13 years working in that area, we encountered approximately 20 structures that we closed because of poor conditions.

In 1979 I left employment with VDOT and went to work in private practice, and in 1981 I started the firm of Schwartz & Associates, Inc. Since 1981 we have served a number of municipalities in Virginia and one in Tennessee. We are currently providing bridge engineering services, which include bridge safety inspection, development of bridge repair plans, evaluation of existing bridges, design of new bridges, and construction inspection of bridges and roadways for approximately 25 Virginia municipalities. Since our inception in 1981, we have performed approximately 2,500 bridge safety inspections for municipalities.

I have been a licensed professional engineer in Virginia since 1968 and am a licensed professional engineer in the states of West Virginia, Tennessee, and North Carolina.

In the 1970's, while employed with VDOT, I helped to plan and taught in two, two-week long, Federal Highway Administration recognized bridge safety inspector training courses.

It is always our desire to serve the best interests of our clients. We are pleased to provide the information that has been provided herein and trust it will help you to know more about our firm's experience and my personal qualifications.

Yours truly,

SCHWARTZ & ASSOCIATES, INC.

R. W. Schwartz, P.E.

RWS:af

cc: Richard Drazenovich, P.E.
A. Kent Shelton, P.E.

EXHIBIT 10

WORSHAM STREET BRIDGE

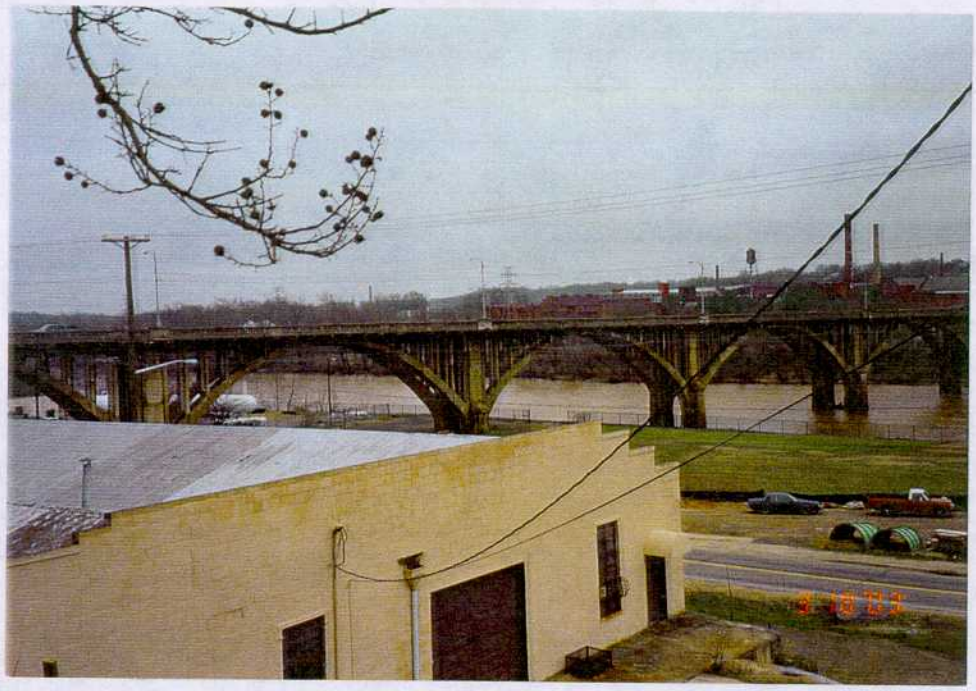
SUMMARY OF MARCH 23, 2003 BRIDGE SAFETY INSPECTION REPORT

2003 BRIDGE INSPECTION REPORT

FOR

STRUCTURE NO. 8006

WORSHAM STREET
OVER
ROUTE 58, DAN RIVER, AND NS RAILWAY



CITY OF DANVILLE, VIRGINIA

Schwartz & Associates, Inc.
Consulting Engineers

Virginia Department of Transportation

Structure and Bridge

STRUCTURE INSPECTION REPORT
Regular

Agency ID: 108 8006-000000000020171 **Date of Inspection:** 03/18/2003

County/City: CITY OF DANVILLE **Feature Intersected:** RT. 58, DAN RIVER & NS RWY
Main Route: **Facility Carried:** WORSHAM STREET
Lead Inspector: W. L. CARTER **Location:** 0.15 MI. FR. CRAIGHEAD ST.

Frequency: 6 | Due: SEPT

ATTACHMENTS

Inspection Notes	X	Channel Profile		Fatigue Prone Reference Guide	
Sketches		Vertical Clearance Sheet		HTRIS Sheet	X
Photo Sheets	X	Other _____			

CRITICAL FEATURE INSPECTIONS Fracture Critical [ ] Underwater [ ] Other Special [ ]

CONDITION RATINGS

Deck:	3
Superstructure:	3
Substructure:	5
Channel/Channel Prot.:	7
Culvert:	

FIELD POSTING

Sign Legibility:	G
Sign Visibility:	G
Capacity Sign R12-1 (tons):	5
Capacity Sign R12-5	
Single (tons):	
Semi (tons):	

TRAFFIC SAFETY FEATURES

Bridge Railings:	0
Transitions:	0
Approach Guardrail:	0
Approach Guardrail Ends:	0

Year Painted:

ELEMENT CONDITION STATE DATA:

No.	Description	ENV	Unit	State 1	State 2	State 3	State 4	State 5	Total

NOTE: Structure maintained by the City of Danville. Element Condition State Data (Pontis) is not required.

Date Printed 03/20/03

SCHWARTZ & ASSOCIATES, INC.
CONSULTING ENGINEERS
Lynchburg-Bristol, Virginia

STRUCTURE INSPECTION REPORT
Regular

Agency ID: 108 8006-000000000020171 **Date of Inspection:** 03/18/2003

County/City: CITY OF DANVILLE **Feature Intersected:** RT. 58, DAN RIVER & NS RWY
Main Route: **Facility Carried:** WORSHAM STREET
Location: 0.15 MI. FR. CRAIGHEAD ST.
Lead Inspector: W. L. CARTER
Additional Inspectors: B. A. MOSEBROOK

Signature of Lead Inspector	William L. Carter	PE Stamp of Reviewer: COMMONWEALTH OF VIRGINIA R. W. SCHWARTZ No. 4291 4-7-03 PROFESSIONAL ENGINEER
Signature & Date of City/Town Reviewer		

ORIENTATION	Abutment 1 and Pier 2 at north end of structure. Bridge elements are numbered left to right looking towards Abutment 11 (at south end of structure).
MISCELLANEOUS (Items that are structure specific and cannot be included in another section.)	Roadway, Spans 8, 9 & 10 over closed spandrel arches show additional settlement over last 3-4 years. Some years ago, transverse rods were added through pier walls (both walls at Pier 9, upstream wall at Pier 10 & downstream wall at Pier 2) to control transverse movement of wall.
SPECIAL REQUIREMENTS (Special Equipment needed or Special Inspections required such as: Fracture Critical, Underwater, Fatigue Prone, Scour Critical, Moveable Bridge, Segmental Concrete, Pin and Hanger, etc.)	None
WORK DONE	None
STRUCTURAL ANALYSIS	None
OVERALL CONDITION	Deck, wearing surface, spandrel beams, floorbeams, spandrel columns and floorbeam cantilevers - **POOR**. Arches, piers and abutments - **FAIR**. The east side of bridge (approximately 4'-6" width) remains closed to traffic.
RECOMMENDATIONS	-Program structure now for complete replacement within next 1-2 years. -Repair areas of severe concrete deterioration in sidewalk as soon as possible. -In meantime: * Repair potholes in deck wearing surface. * Be on the lookout in future for loose concrete falling into vacant lot and onto Route 58 on north side of river. **RECOMMENDATIONS Continued on Page 3**

SCHWARTZ & ASSOCIATES, INC.
CONSULTING ENGINEERS
Lynchburg-Bristol, Virginia

STRUCTURE INSPECTION REPORT
Regular

Agency ID: 108 8006-000000000020171 **Date of Inspection:** 03/18/2003

RECOMMENDATIONS (Continued)	* Leave posted weight limit sign at 5 Tons and no trucks. * On future inspections, check closely the horizontal cracks in Abutment 11, upstream wingwall. * Inspect entire structure annually and floorbeam cantilevers, deck overhangs, rails, curbs and parapets every 6 months. -Remove electrical lines attached to bridge structure. -Clean accumulation of debris from around piers.