HYDRAULIC TECHNICAL MEMORANDUM

I-26 Widening Henderson and Buncombe Counties

STIP Project No. I-4400 / I-4700

Submitted to:

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1. PROJECT NARRATIVE

1.1. Project Description

The North Carolina Department of Transportation (NCDOT), in cooperation with the Federal Highway Administration (FHWA), proposes transportation improvements to a segment of the I-26 corridor from the US-25 system interchange in Henderson County, north to I-40/I-240 in Buncombe County. The project is located in northern Henderson County, just south of Hendersonville, and southern Buncombe County, just south of Asheville. The project is designated as STIP Project No. I-4400/I-4700 in the NCDOT's *2013-2023 State Transportation Improvement Program (STIP).* See Appendix A for site maps.

There are three roadway alternatives associated with this project. The first is a *"Best Fit" 6-Lane Widening Alternative* which would widen I-26 along the full project corridor to a 6-lane facility. The second is a *"Best Fit" 8-Lane Widening Alternative* which would widen I-26 along the full project corridor to an 8-lane facility. The third alternative is a *"Best Fit" Traffic Report Recommendations Widening Alternative* which would widen I-26 to 6-lanes from the southern terminus of project to the US 25/Asheville Highway Interchange where it would transition to an 8-lane facility to the northern terminus of the project. . All three alternatives would be asymmetrical at locations that "best fit" the current roadway location and surrounding land uses. Please see Appendix B for the Roadway Typical Sections.

1.2. Report Purpose

The purpose of this report is to assess the current condition of existing major drainage crossings and make preliminary hydraulic recommendations to aide in the development of project planning documents.

Existing stream crossings in the project corridor have been reviewed and evaluated based on current hydraulic design criteria. Of the 28 stream crossings in the study corridor, 4 are bridges, 15 are major culvert crossings (conveyance greater than or equal to a 72 inch pipe), and 9 are 66 inch pipes. See Table 1 for a summary of the existing crossings.

It should be noted that at this preliminary stage, there is insufficient data to perform final designs for any crossing.

Table 1 - Existing Crossing Summary

Crossing ID	Existing Structure (Size & Type)	DA (Acres)	50-Year		100-Year	
			Q (cfs)	HW/D	Q (cfs)	HW/D
1	2 @ 5' x 6' RCBC	194	290	0.77	320	0.79
2	1 @ 72" CMP W/ HW	210	350[3]	1.69	-	-
3	1 @ 6' x 6' RCBC	178	340	1.26	350	1.30
4	2 @ 8' x 8' RCBC	1649	1700	1.51	1900	1.72
5	1 @ 66" STR. PLATE PIPE w/ HW	197	290[2]	1.71	340	2.05
6	1 @ 66" STR. PLATE PIPE w/ HW	203	300[2]	1.80	350	2.21
7	3 @ 9' x 10' RCBC	4350	2600	1.02	3000	1.17
8	1 @ 66" STR. PLATE PIPE w/ HW	140	220[2]	1.30	260	1.54
9	1 @ 66" CMP w/ HW	137	230	1.35	250	1.48
10	1 @ 6' x 6' RCBC	185	350	1.30	360	1.31
11	BRIDGE	44.3 Sq. Mi.	N/A			
12	1 @ 7' x 7' RCBC	296	500	1.26	500	1.26
13	3 @ 8' x 8' RCBC	2616	1900	1.46[1]/1.15	2200	1.61[1]/1.31
14	2 @ 8' x 8' RCBC	1550	1600	1.45	1800	1.62
15	1 @ 66" STR. PLATE PIPE w/ HW	129	260	1.54	270	1.60
16	BRIDGE	83.8 Sq. Mi.	N/A			
17	3 @ 7' x 7' RCBC	1594	1700	1.41	1900	1.59
18	1 @ 6' x 5' RCBC to 66" RCP w/ HW	88	210[2]	1.10	330	1.55
19	1 @ 6' x 6' RCBC	228	420	1.56	430	1.60
20	1 @ 66" CMP w/ HW	152	250	1.48	280	1.67
21	1 @ 66" RCP w/ HW	108	170	1.07	190	1.16
22	1 @ 66' CMP w/ HW	75	130	0.87	140	0.92
23	2 @ 10' x 10' RCBC	3240	2800	1.44	3000	1.55
24	1 @ 8' x 8' RCBC	632	850	1.50	900	1.63
25	BRIDGE	678 Sq. Mi.	N/A			
26	1 @ 66" STR PLATE PIPE w/ HW	158	320	1.98	320	1.98
27	1 @ 72" STR PLATE PIPE w/ HW	154	310	1.48	310	1.48
28	BRIDGE	94.6 Sq. Mi.	N/A			

[1] Computed HW/D for RCBC with 1' of Silt.
[2] 25 Year Design Storm.
[3] 10 Year Design Storm.

2. EXISTING CONDITIONS

2.1. Land Use

Land Use and Zoning Plans for Buncombe County, Henderson County and the City of Asheville were reviewed and utilized in development of project discharge values. These plans indicate that at full build out, the contributing drainage areas will be predominantly urban in nature. Land usage and zoning data within the study area were obtained from:

- Buncombe County (www.buncombecounty.org/Governing/Depts/GIS/Default.aspx)
- Henderson County (www.hendersoncountync.org/gis/)
- City of Asheville (opendatacatalog.ashevillenc.gov/)

2.2. Surface Waters / Drainage Basins

Sites 1-2 are contained within the Broad River Basin while Sites 3-28 are contained within the French Broad River Basin. See Table 2 for a summary of all streams crossed by the proposed project.

Table 2 - Stream Summary

Stream	Class	Stream Index	River Basin	FEMA Studied	Detailed Study	303(d)
Hominy Creek	C	6-76	French Broad	Yes	Yes	No
Long Valley Branch	C	6-75	French Broad	No	No	No
Dellwood Lake	C	6-69	French Broad	No	No	No
French Broad River	B	6-54.5	French Broad	Yes	Yes	No
Ducker Creek	C	6-63	French Broad	No	No	No
Powell Creek (Lake Julian)	C	6-62	French Broad	No	No	No
French Broad River Tributary 149	N/A	N/A	French Broad	Yes	No	N/A
Kimsey Creek	C	6-57-22	French Broad	Yes	Yes	No
Cane Creek	C	6-57-(9)	French Broad	Yes	Yes	No
Byers Creek	C	6-55-13	French Broad	No	No	No
Featherstone Creek	C	6-55-12	French Broad	Yes	No	No
Clear Creek	C	6-55-11-(5)	French Broad	Yes	Yes	No
Camp Branch	B	6-55-8-2-1	French Broad	No	No	No
Devils Fork	C	6-55-8-2	French Broad	Yes	Yes	Yes
Dunn Creek	C	6-55-8-1-1	French Broad	Yes	No	No
Beck Creek	C; Tr	9-29-27	Broad	No	No	No

Class C Waters are waters protected for secondary fresh water recreation, fishing, and aquatic life. Class B Waters are protected for all Class C uses in addition to primary recreation. Trout Waters (Tr) are waters that have conditions which sustain and allow for trout propagation and survival of stocked trout on a year-round basis.

2.3. FEMA Regulated Streams

Of the 28 crossings evaluated in this report, 10 are located on FEMA studied streams. FEMA Flood Insurance Studies (FIS) and Flood Insurance Rate Map (FIRM) Panels for the study area were obtained from the North Carolina Flood Mapping Program (NCFMP) website (www.ncfloodmaps.com/). See Table 3 for a summary of FEMA stream crossings by the proposed project.

Table 3 – FEMA Stream Crossing Summary

Project Site	Stream	Facility Crossed	FEMA Classification
4	Dunn Creek	I-26	Limited Detail Study
7	Devils Fork	I-26	Detailed Study
11	Clear Creek	I-26	Detailed Study
13	Featherstone Creek	I-26	Limited Detail Study
16	Cane Creek	I-26	Detailed Study
17	Kimsey Creek	I-26	Limited Detail Study
20	French Broad Tributary 149	I-26	Limited Detail Study
25	French Broad River	I-26	Detailed Study
28	Hominy Creek	I-26	Detailed Study

Since detailed hydraulic computations are not being performed on these crossings, no determination of potential FEMA impacts is provided at this time. The Hydraulics Unit will coordinate with the NC Floodplain Mapping Program (FMP), to determine status of project with regard to applicability of NCDOT'S Memorandum of Agreement, or approval of a Conditional Letter of Map Revision (CLOMR) and subsequent final Letter of Map Revision (LOMR). Also, since the project will involve construction activities on or adjacent to FEMA-regulated streams, the Division shall submit sealed as-built construction plans to the Hydraulics Unit upon completion of project construction, certifying that the drainage structures and roadway embankment that are located within 100-year floodplains were built as shown in the construction plans, both horizontally and vertically.

2.4. USGS Gage Locations

USGS Stream Gauge Station Number 03447687 is located downstream of the study area on the French Broad River near Fletcher, NC. See Appendix C for peak flow gauge data.

2.5. Documented Flooding Problems

NCDOT Bridge Maintenance Engineers Chris Lee and Christopher Medlin were contacted and noted there are no known flooding issues associated with any of the studied crossings (Personal Communication, April 28, 2014).

3. HYDROLOGIC / HYDRAULIC ANALYSIS

3.1. Drainage Basin Delineations

USGS Quad maps and StreamStats were used for drainage basin delineations. (water.usgs.gov/osw/streamstats/north_carolina.html)

3.2. Hydrologic Computations

Site discharge values were computed in accordance with NCDOT *Guidelines for Drainage Studies and Hydraulic Design, Memos and Additional Guidelines,* and *USGS Scientific Investigations Report (SIR) 2014-5030.* Impervious area values were computed from zoning classifications and may in some cases be significantly higher than existing conditions. This was done in accordance with NCDOT Hydraulic Guidelines to insure discharge values reflect what "could" be the future conditions at the crossings. Please note that per SIR 2014-5030, Urban Regression Equations have not been developed for Hydrologic Region 2 (Blue Ridge) where this project is located. Therefore, based on discussions with the NCDOT Hydraulics Unit, Urban Regression Equations for Region 1 (Piedmont-Ridge Valley) will be utilized for this report where applicable. Note, the applicable range of percent impervious area for the Region 1 Urban Regression Equations is 0.0 to 47.9 percent. Therefore, for drainage areas greater than 100 acres with percent impervious values outside the applicable range, 47.9 percent was used to compute site discharge values. This methodology is justified on page 23 of SIR 2014-5030 under the *Influence of Urbanization*.

3.3. Hydraulic Computations

Since detailed field survey data in the study area is not available, all crossings were evaluated using the discharge values discussed in Section 3.2 and design charts found in Appendix D of the *Hydraulic Design Series Number 5 (HDS-5): Hydraulic Design of Highway Culverts.* In accordance with NCDOT Hydraulic Guidelines, structures with a HW/D > 1.2 for the design year event (Q50 for Primary Roads and Q25 for Secondary Roads) are considered to be undersized. Please note that a structure may perform adequately even if it has a HW/D > 1.2.

4. SITE SUMMARIES

Existing conditions and preliminary recommendations for all sites within the project corridor with an existing pipe size greater than or equal to a 66 inches are evaluated for this Hydraulic Technical Memorandum. This deviation from standard practice is based on our preliminary analyses of the existing crossings which indicated that nearly all 66 inch crossings were undersized and required a conveyance equal to or greater than a 72 inch pipe. Please see Appendices D - EE for detailed site information and calculations for each site.

Site 1

Site 1 is a 2 @ 5' x 6' (Throat Section) Reinforced Concrete Box Culvert (RCBC) with a slope tapered inlet and a debris deflector that conveys 194 acres of Beck Creek from north to south under I-26. The RCBC has a design year discharge of 290cfs and a HW/D of 0.77. For the 100-year event, the discharge is 320cfs with a HW/D of 0.79.

The left barrel invert matches the stream bed and is free of sediment and debris. The right barrel contains approximately 4 feet of sediment which increases towards the outlet. At the outlet, both RCBC barrels contain approximately 5.0 feet of sediment and allow only minimal flow. Based on this sedimentation, only the left barrel could be visually investigated internally. The RCBC is in fair condition with areas of minor sporadic cracking.

The upstream and downstream channels are vegetated and stable. Approximately 15 feet downstream of the outlet, the channel intersects the outlet channel from Site 2. At this confluence, the channel is severely eroded and unstable.

The preliminary analysis of future conditions indicates that the culvert is adequately sized for the drainage area. However, the presence of significant sediment in both the left and right RCBC barrels indicates that severe erosion or channel degradation has occurred upstream. For the 6-lane alternative we recommend retaining the existing RCBC and removing all but 1 foot of sediment from both barrels. For the 8-lane alternative we recommend retaining and extending the existing RCBC at the face dimensions and the addition of top edge bevels. We also recommend removing all but 1 foot of sediment from both barrels. See Appendix D for detailed calculations and graphics.

Site 2

Site 2 is a 72" Structural Plate Pipe (SPP) with a paved invert and concrete headwall that conveys 210 acres of an unnamed tributary to Beck Creek from west to east under the existing I-26 embankment. Please note, this pipe does not cross under I-26. The SPP has a design year discharge (Q10) of 350cfs and a HW/D of 1.69.

The invert out of the existing pipe is completely rusted through and there is significant rust throughout the pipe. Pipe separation was also observed in several locations throughout the pipe. The majority of the asphalt coating is cracked or missing. Overall, the pipe is in poor condition.

A sediment deposit upstream of the structure has shifted normal stream flow away from the inlet into the right headwall causing significant erosion of the adjacent stream bank and fill slope. The undersized pipe in conjunction with a lack of outlet protection has formed a 40 feet wide, 5 feet deep scour hole at the outlet of the 72" SPP.

Existing conditions and preliminary analysis of the future conditions indicate the existing culvert is undersized for the drainage area. Our recommendation for all alternatives is removal and replacement of the existing culvert with an 84" SPP. We also recommend repairs to the downstream channel and the addition of bank stabilization. See Appendix E for detailed calculations and graphics.

Site 3

Site 3 is a 1 @ 6' x 6' RCBC without a top edge bevel that conveys 178 acres of an unnamed tributary to Dunn Creek from east to west under I-26. The RCBC has a design year discharge of 340cfs and a HW/D of 1.26. For the 100-year event, the discharge is 350cfs and the HW/D is 1.30.

The RCBC appears to be in fair condition with only sporadic minor cracking observed. The upstream and downstream channels are vegetated and relatively stable. The RCBC is perched 0.5 feet upstream and 1.2 feet downstream. The downstream degradation appears to have been stopped by the placement of Class 'I' riprap in the streambed. No other significant issues were noted upstream or downstream of the site.

The preliminary analysis of future conditions indicates that the culvert is slightly undersized for the drainage area. For the 6-lane alternative we recommend retaining the existing RCBC with no improvements. For the 8-lane alternative we recommend retaining and extending the existing RCBC and adding a top edge bevel to the upstream extension. See Appendix F for detailed calculations and graphics.

Site 4

Site 4 is a 2 @ 8' x 8' RCBC without a top edge bevel that conveys 2.58 square miles of Dunn Creek from north to south under I-26. The RCBC has a design year discharge of 1,700cfs and a HW/D of 1.51. The 100-year event discharge is 1,900cfs with a HW/D of 1.72. Dunn Creek is FEMA Limited Detailed Study stream with a 100-year discharge of 1,500cfs at the project site.

The RCBC appears to be in fair condition with only sporadic minor cracking observed. Accumulated debris on the RCBC inlet is currently causing backwater upstream of the culvert. The upstream and downstream channel banks are vegetated and stable. Riprap at the RCBC outlet has caused water to pool and sediment to accumulate at the outlet. The depth of sediment varies but is approximately 3.5 feet deep.

The preliminary analysis of future conditions indicates that the culvert is undersized for the drainage area. For the 6-lane alternative, we recommend retaining the existing RCBC and the addition of a supplemental pipe. We also recommend removal of accumulated downstream sediment and the placement of bank stabilization. For the 8-lane alternative we recommend retaining and extending the existing RCBC. We also recommend adding a supplemental pipe and a top edge bevel to the upstream extension. See Appendix G for detailed calculations and graphics.

Site 5

Site 5 is a 66" SPP with a concrete headwall that conveys 197 acres of an unnamed tributary to Devils Fork from east to west under SR 1793 (Tracy Grove Road). The SPP has a design year discharge of 290cfs with a HW/D of 1.71. The 100-year discharge is 340cfs with a HW/D of 2.05.

The majority of the existing SSP is rusted through at the invert. Also, moderate to severe erosion was observed around the downstream headwall. However, the upstream and downstream channels are vegetated and stable.

The preliminary analysis of future conditions indicates that the culvert is undersized for the drainage area. We recommend retaining and lining the existing pipe. We also recommend supplementing the crossing with an additional pipe. See Appendix H for detailed calculations and graphics.

Site 6

Site 6 is a 66" SPP with a paved invert and concrete headwall that conveys 203 acres of an unnamed tributary to Devils Fork from east to west under SR 1893 (Mid Allen Rd). The SPP has a design year discharge of 300cfs and a HW/D of 1.80. The 100-year discharge is 350cfs with a HW/D of 2.21.

The existing pipe is buried 0.5 feet below the streambed along it entire length. The pipe is in fair condition with cracked or missing asphalt coating for most its length. The upstream and downstream channels are vegetated and stable.

The preliminary analysis of future conditions indicates that the culvert is undersized for the drainage area. We recommend retaining and extending the existing pipe. We also recommend supplementing the crossing with an additional pipe. See Appendix I for detailed calculations and graphics.

Site 7

Site 7 is a 3 @ 9' x 10' RCBC without a top edge bevel that conveys 6.8 square miles of Devils Fork from east to west under I-26. The RCBC has a design year discharge of 2,600cfs and a HW/D of 1.02. The 100-year discharge is 3,000cfs with a HW/D of 1.17. Devils Fork is a FEMA Detailed Study stream with a 100-year discharge of 2,400cfs at the project site.

The RCBC appears to be in fair condition with only sporadic minor cracking observed. Significant debris was present at the inlet of the culvert at the time of the field survey. The upstream and downstream banks show signs of recent flooding but appear well vegetated and stable. There is a 1.5 foot drop in the existing streambed just downstream of the culvert.

The preliminary analysis of future conditions indicates that the existing culvert is adequately sized. For the 6-lane alternative we recommend retaining the existing RCBC. We also recommend removal of accumulated downstream sediment and the placement of bank stabilization. For the 8-lane alternative we recommend retaining and extending the existing RCBC. We also recommend adding a top edge bevel to the upstream extension. See Appendix J for detailed calculations and graphics.

Site 8

Site 8 is a 66" SPP with concrete headwalls upstream and downstream that conveys 140 acres of an unnamed tributary to Devils Fork from north to south under SR 1525 (Dana Rd). The SSP has a design year discharge of 220cfs and a HW/D of 1.30. The 100-year discharge is 260cfs with a HW/D of 1.54.

The majority of the existing SSP is rusted through at the invert and the outlet is buried 1 foot below the streambed. The upstream channel is stable and banks are vegetated. The downstream channel banks are minimally vegetated and subject to failure due to the presence of severe slopes.

The preliminary analysis of future conditions indicates that the existing culvert is slightly undersized. We recommend retaining, lining, and extending the existing pipe. We also recommend the placement of bank stabilization downstream. See Appendix K for detailed calculations and graphics.

Site 9

Site 9 is a 66" SPP with a paved invert and concrete headwalls upstream and downstream that conveys 137 acres of an unnamed tributary to Devils Fork from east to west under the I-26. The SPP has a design year discharge of 230cfs and a HW/D of 1.35. The 100-year discharge is 250cfs with a HW/D of 1.48.

Much of the asphalt coating is cracked or missing and minimal rusting was observed throughout the pipe which appears to be in fair condition.

The upstream channel is vegetated and stable. There is an 18 feet wide scour hole 2 feet below the normal streambed at the pipe outlet likely caused by the undersized structure.

Existing conditions and preliminary analysis of the future conditions indicate the existing culvert is undersized for the drainage area. The undersized pipe and lack of outlet protection has caused a scour hole to form at the outlet. Downstream of the scour hole, the channel to Site 8 is vegetated and stable. For the 6-lane alternative, we recommend retaining and lining the existing pipe. We also recommend adding Class 'I' riprap in the downstream scour hole to prevent further degradation. For the 8-lane alternative, we recommend retaining, lining, and extending the existing pipe. We also recommend adding Class 'I' riprap in the downstream scour hole to prevent further degradation. See Appendix L for detailed calculations and graphics.

Site 10

Site 10 is a 1 @ 6' x 6' RCBC without a top edge bevel that conveys 185 acres of an unnamed tributary to Devils Fork from east to west under I-26. The RCBC has a design year discharge of 350cfs and a HW/D of 1.30. The 100-year discharge is 360cfs with an HW/D of 1.31.

The RCBC appears to be in fair condition with only sporadic minor cracking observed. The upstream and downstream channels are vegetated and stable. The downstream channel also contains a large amount of Class 'I' riprap.

The preliminary analysis of future conditions indicates that the existing culvert is slightly undersized. For the 6-lane alternative we recommend retaining the RCBC. For the 8-lane alternative we recommend retaining and extending the existing RCBC and adding a top edge bevel to the upstream extension. See Appendix M for detailed calculations and graphics.

Site 11

Site 11 consists of dual 3-span reinforced concrete deck bridges over Clear Creek on steel girders and reinforced concrete piers. Both bridges are 220.14 feet in length with crown to bed heights of approximately 57 feet. Bridge Nos. 440211 and 440212 convey 44.3 square miles of Clear Creek from east to west under I-26. Clear Creek is a FEMA Detailed Study stream with a 100-year discharge of 7,000cfs at the project site.

Bridge No. 440211 was constructed in 1963, rehabbed in 1989, and has a Sufficiency Rating of 76.39. The current Bridge Inspection Report lists the Status of Bridge No. 440211 as Functionally Obsolete. Bridge No. 440212 was also constructed in 1963 and rehabbed in 1989, and has a Sufficiency Rating of 6. The current Bridge Inspection Report lists the Status of Bridge No. 440212 as Structurally Deficient. Both bridges are rated Fair to Good with respect to Bridge Inspection Item 45. "Channel & Channel Protection" and have Estimated Remaining Life's of 13 and 12 years respectively. While there are no visible or documented signs of instability or scour at either crossing and both crossings are of sufficient hydraulic length, we recommend both bridges be replaced. This recommendation is based on the above noted Bridge Inspection Report Status and Estimated Remaining Life for each structure. See Appendix N for detailed calculations and graphics.

Site 12

Site 12 is a 1 @ 7' x 7' RCBC without a top edge bevel that conveys 296 acres of an unnamed tributary to Mud Creek from east to west under I-26. The RCBC has a design discharge of 500cfs and a HW/D of 1.26. The 100-year discharge is 500cfs with a HW/D of 1.26.

The RCBC appears to be in fair condition with only sporadic minor cracking observed. Silt has begun to deposit on the downstream right side of the culvert but does not appear to affect performance.

Both upstream and downstream channels are vegetated and stable. Approximately 40 feet downstream of the RCBC outlet is a farm crossing with a 54" Corrugated Metal Pipe (CMP). Class 'II' riprap faces the crossing which shows signs of degradation.

The preliminary analysis of future conditions indicates that the existing culvert is slightly undersized. However, the downstream channel is stable and the culvert performance is likely controlled by the downstream crossing. For the 6-lane alternative we recommend retaining the RCBC. For the 8-lane alternative we recommend retaining and extending the existing RCBC. We also recommend adding a top edge bevel to the upstream extension, adding bank stabilization at the culvert outlet and relocation the existing farm crossing outside the NCDOT right-of-way. See Appendix O for detailed calculations and graphics.

Site 13

Site 13 is a 3 @ 8' x 8' RCBC without a top edge bevel that conveys 4.09 square miles of Featherstone Creek from east to west under I-26. The RCBC has a design discharge of 1,900cfs and a HW/D of 1.46. The 100-year discharge is 2,200cfs with a HW/D of 1.61. Featherstone Creek is a FEMA Limited Detailed Study stream with a 100-year discharge of 1,810cfs at the project site.

The RCBC appears to be in fair condition with only sporadic minor cracking observed. The left RCBC barrel contains approximately 2 feet of sediment while the right RCBC barrel contains approximately 4 feet of sediment. The center barrel contains less than 1 foot of sediment.

The upstream channel is well vegetated and stable. The downstream channel is mostly vegetated and stable between the RCBC and a 78" CMP located approximately 80 feet downstream. The channel downstream of the 78" CMP is degraded and scoured due to frequent overtopping of the undersized crossing.

Existing conditions and preliminary analysis of the future conditions indicate the existing culvert is undersized for the drainage area. For the 6-lane alternative we recommend retaining the RCBC. We also recommend removing all but 1 foot of sediment from the left and right RCBC barrels and grading flood plain benches left and right in the upstream and downstream channels. For the 8-lane alternative we recommend retaining and extending the existing RCBC. We also recommend adding a supplemental pipe, a top edge bevel to the upstream extension and the above recommendations of the 6-lane alternative. See Appendix P for detailed calculations and graphics.

Site 14

Site 14 is a 2 @ 8' x 8' RCBC without a top edge bevel that conveys 2.42 square miles of Byers Creek from east to west under I-26. The RCBC has a design discharge of 1,600cfs and a HW/D of 1.45. The 100-year discharge is 1,800cfs with a HW/D of 1.62.

The RCBC appears to be in fair condition with only sporadic minor cracking observed. Both the left and right barrels are silted-in approximately 3.5 feet at the outlet.

The upstream and downstream channels are vegetated and stable. The preliminary analysis of future conditions indicates that the existing culvert is undersized. For the 6-lane alternative we recommend retaining the RCBC and removing all but 1 foot of sediment from both barrels. For the 8-lane alternative we recommend retaining and extending the existing RCBC. We also recommend adding a supplemental pipe, a top edge bevel to the upstream extension, and removal of all but 1 foot of sediment from both barrels. See Appendix Q for detailed calculations and graphics.

Site 15

Site 15 is a 66" SPP with a concrete headwall that conveys 129 acres of an unnamed tributary to Mud Creek from north to south under I-26. The SPP has a design year discharge of 260cfs and a HW/D of 1.54. The 100-year discharge is 270cfs with a HW/D of 1.60.

The existing pipe is in good condition. Sediment has accumulated on the downstream side of the culvert due to the bank erosion upstream of the culvert.

Upstream channel banks are steep and unstable with moderate to severe erosion present. A large ditch conveying railroad drainage that enters the channel just upstream of the SPP is also severely eroded. The downstream channel is vegetated and stable.

The preliminary analysis of future conditions indicates that the existing culvert is undersized. For the 6-lane alternative we recommend retaining the existing SPP. We also recommend bank stabilization be placed in the upstream channel. For the 8-lane alternative we recommend retaining and extending the existing SPP. We also recommend adding a supplemental pipe and placement of bank stabilization in the upstream channel. See Appendix R for detailed calculations and graphics.

Site 16

Site 16 consists of dual 3-span reinforced concrete deck bridges over Cane Creek on steel girders and reinforced concrete piers. Both bridges are 198.25 feet in length with crown to bed heights of approximately 28 feet. Bridge Nos. 440233 and 440234 convey 83.8 square miles of Cane Creek from east to west under I-26. Cane Creek is FEMA Detailed Study stream with a 100-year discharge of 11480cfs at the project site.

Bridge No. 440233 was constructed in 1964 and has a Sufficiency Rating of 63.87. The current Bridge Inspection Report lists the Status of Bridge No. 440233 as Functionally Obsolete. Bridge No. 440234 was also constructed in 1964 and has a Sufficiency Rating of 64.7. The current Bridge Inspection Report lists the Status of Bridge No. 440234 as Functionally Obsolete. Both bridges are rated Fair to Good with respect to Bridge Inspection Item 45. "Channel & Channel Protection" and have Estimated Remaining Life's of 6 and 10 years respectively. While there are no visible or documented signs of instability or scour at either crossing and both crossings are of sufficient hydraulic length, we recommend both bridges be replaced. This recommendation is based on the above noted Bridge Inspection Report Status and Estimated Remaining Life for each structure. See Appendix S for detailed calculations and graphics.

Site 17

Site 17 is a 3 @ 7' x 7' RCBC without a top edge bevel that conveys 2.49 square miles of Kimsey Creek from north to south under I-26. The RCBC has a design discharge of 1,700cfs and a HW/D of 1.41. The 100-year discharge is 1,900cfs with a HW/D of 1.59. Kimsey Creek is a FEMA Detailed Study stream with a 100-year discharge of 1,426cfs at the project site.

The RCBC appears to be in good condition with only sporadic minor cracking observed. The outlet of the left barrel contains approximately 2.5 feet of sediment while the center and right barrels each contain approximately 1.5 feet of sediment.

The upstream and downstream channels are well vegetated and stable. However, there is a scour hole near the left upstream wing wall.

The preliminary analysis of future conditions indicates that the culvert is undersized. For the 6-lane alternative we recommend retaining the existing RCBC and removing all but 1 foot of sediment from all culvert barrels. For the 8-lane alternative we recommend retaining and extending the existing RCBC. We also recommend adding a supplemental pipe, top edge bevels to the upstream extensions and removal of all but 1 foot of sediment from all barrels. See Appendix T for detailed calculations and graphics.

Site 18

Site 18 is a 1 @ 6' x 5' RCBC with an inlet sump and top edge bevel that conveys 88 acres of an unnamed tributary to the French Broad River from north to south under SR 1358 (Fanning Bridge Road). The RCBC has a design discharge of 210cfs and a HW/D of 1.10. The 100-year discharge is 330cfs with a HW/D of 1.55.

The RCBC outlets into a junction box with a 66" RCP outlet pipe. The entire system is in good condition with no noted issues.

The preliminary analysis of future conditions indicates that the culvert is adequately sized. If the RCBC requires extension for proposed roadway designs, cover may be an issue. We recommend retaining the existing culverts and extending the RCBC with a culvert that provides equal or greater conveyance and meets cover requirements. See Appendix U for detailed calculations and graphics.

Site 19

Site 19 is a 1 @ 6' x 6' RCBC without a top edge bevel that conveys 228 acres of an unnamed tributary to the French Broad River from east to west under I-26. The RCBC has a design discharge of 420cfs and a HW/D of 1.56. The 100-year discharge is 430cfs with a HW/D of 1.60.

There is a 1 @ 6' x 6' RCBC approximately 25 feet downstream of the I-26 structure that carries the unnamed tributary under Hidden Creek Rd. Both culverts are in fair condition with minimal sporadic cracking.

The channel between these culverts is scoured approximately 2 feet below the culvert inverts and natural channel bed. There is also a 2-3 feet deep scour hole downstream of the second culvert. Of particular concern downstream of the second culvert is a single-family dwelling in the left overbank area. The near corner of the dwelling is within 15 feet of the left top of bank. The channel banks in this area are unstable and failing. Previously placed geotextile fabric is visible along the left channel bank.

Existing conditions and preliminary analysis of the future conditions indicate the existing culvert is undersized for the drainage area. For the 6-lane alternative we recommend adding a supplemental pipe right of the existing RCBCs. We also recommend channel and bank stabilization be added at the outlets of both 6' x 6' RCBCs to protect against further degradation. For the 8-lane alternative we recommend retaining and extending the 1 @ 6' x 6' RCBC under I-26 to connect with the 1 @ 6' x 6' RCBC under Hidden Creek Road. We also recommend the addition of a supplemental pipe right of existing culverts and the placement of channel and bank stabilization material. See Appendix V for detailed calculations and graphics.

<u>Site 20</u>
Site 20 consists of separate 66" SPP with concrete headwalls upstream and downstream under each lane of I-26 that convey 152 acres of French Broad River Tributary 149 from east to west. The SPPs have a design year discharge of 250cfs and a HW/D of 1.48. The 100-year discharge is 280cfs with a HW/D of 1.67. French Broad River Tributary 149 is a FEMA Limited Detailed Study stream with a 100-year discharge of 490cfs at the project site.

The SPPs are in poor condition with both inverts showing signs of moderate rust. The upstream, median, and downstream channels are well vegetated and stable. There is a 60" Welded Steel Pipe (WSP) approximately 30 feet downstream of the outlet that carries Tributary 149 under a private drive. The drive pipe appears to be in fair condition and the channel is stable.

The preliminary analysis of future conditions indicates that the crossing is undersized. For the 6-lane alternative we recommend retaining, lining, and connecting the existing pipes. For the 8-lane alternative we recommend retaining, lining, and extending the existing pipes upstream and downstream. We also recommend adding a supplemental pipe and relocating the downstream private crossing outside of the NCDOT right-of-way. See Appendix W for detailed calculations and graphics.

<u>Site 21</u>
Site 21 is a 66" Reinforced Concrete Pipe (RCP) with concrete headwalls upstream and downstream that convey 108 acres of an unnamed tributary to the French Broad River from east to west under I-26. The RCP has a design year discharge of 170cfs and a HW/D of 1.07. The 100 year storm event discharge is 190cfs with a HW/D of 1.16.

The RCP is in good condition with no observed issues. The upstream channel is vegetated and stable. There is no defined channel downstream of the RCP and no issues were observed.

The preliminary analysis of future conditions indicates that the culvert is adequately sized. For the 6-lane alternative we recommend retaining the existing RCP. For the 8-lane alternative we recommend retaining and extending the existing RCP. See Appendix X for detailed calculations and graphics.

Site 22

Site 22 is a 66" SPP with concrete headwalls upstream and downstream that convey 75 acres of an unnamed tributary to the French Broad River from east to west under I-26. The SPP has a design year discharge of 130cfs and a HW/D of 0.87. The 100-year discharge is 140cfs with a HW/D of 0.92.

The SPP is in poor condition with both inverts showing moderate to severe rust. The upstream channel is vegetated and stable. Upstream of the SPP is a concrete spillway from a Duke Energy impoundment. Downstream, the SPP invert is perched 5 feet above the receiving channel and undermined. The downstream channel is severely eroded likely from large discharges from the upstream spillway.

Existing conditions and preliminary analysis of the future conditions indicate the existing culvert is undersized for the drainage area. However, this analysis does not take into account effects from the upstream impoundment. For the 6-lane alternative we recommend retaining and lining the existing SPP. For the 8-lane alternative we recommend retaining, lining, and extending the existing SPP. For both alternatives, we recommend the placement of Class 'I' riprap in the downstream channel and the addition of bank stabilization. See Appendix Y for detailed calculations and graphics.

Site 23

Site 23 is a 2 @ 10' x 10' RCBC without a top edge bevel that conveys 5.06 square miles of Powell Creek and Lake Julian to the French Broad River from east to west under I-26. The RCBC has a design discharge of 2,800cfs and a HW/D of 1.44. The 100-year discharge is 3,000cfs with a HW/D of 1.55.

The RCBC is in fair condition with only sporadic minor cracking observed in both barrels. The channel bends approximately 90^0 just upstream of the culvert and is stabilized with riprap on the outside of the bend (left bank). The right bank is vegetated and stable. The downstream channel is stable and the banks are lined with riprap. The confluence with the French Broad River is approximately 150 feet downstream of the RCBC outlet. There are two large utility pipes crossing Powell Creek approximately 50 feet downstream of the culvert that do not appear to have any impacts on the RCBC or channel.

The preliminary analysis of future conditions indicates that the culvert is undersized for the drainage area. However, these computations do not account for any storage or attenuation of peak flows provided by Lake Julian. Therefore, for the 6-lane alternative we recommend retaining the existing RCBC and not adding a supplemental pipe. For the 8-lane alternative we recommend retaining and extending the existing RCBC. We also recommend adding a top edge bevel to the upstream extension. See Appendix Z for detailed calculations and graphics.

Site 24

Site 24 is a 1 @ 8' x 8' RCBC without a top edge bevel that conveys 632 acres of Ducker Creek into the French Broad River from east to west under I-26 and the I-26 ramps for NC 146 (Long Shoals Rd). The RCBC has a design discharge of 850cfs and a HW/D of 1.50. The 100-year discharge is 900cfs with a HW/D of 1.63.

The RCBC appears to be in fair condition with only sporadic minor cracking observed. However, the outlet is perched approximately 3 feet and undermined. Additionally, the RCBC contains an exposed concrete footing and utility line.

The upstream channel is riprap lined and stable. As noted above, the downstream channel is perched approximately 3 feet below the culvert invert. Concrete rubble and riprap placed in the channel appear to have stabilized it. There are two large utility pipes crossing the downstream channel between the RCBC outlet and the French Broad River.

Existing conditions and preliminary analysis of the future conditions indicate the existing culvert is undersized for the drainage area. While a supplemental pipe is warranted at this location, we feel that the required 550 foot directional bore and proximity to the French Broad River likely make it unfeasible. We recommend that the RCBC be retained and the outlet stabilized against additional undermining. See Appendix AA for detailed calculations and graphics.

Site 25

Site 25 consists of dual 6-span reinforced concrete deck bridges over the French Broad River on steel girders and reinforced piers. Bridge No. 100211 is 440.9 feet in length with a height crown to bed of 33 feet. Bridge No. 100214 is 453.4 feet in length with a height crown to bed of 32 feet. Both bridges convey 678 square miles of the French Broad River from north to south under I-26. The French Broad River is a FEMA Detailed Study stream with a 100-year discharge of 50,000cfs at the project site.

Bridge No. 100211 was constructed in 1967 and has a Sufficiency Rating of 58.28. The current Bridge Inspection Report lists the Status of Bridge No. 100211 as Functionally Obsolete. Bridge No. 100214 was also constructed in 1967 and has a Sufficiency Rating of 62.63. The current Bridge Inspection Report lists the Status of Bridge No. 100214 as Functionally Obsolete. Both bridges are rated Good with respect to Bridge Inspection Item 45. "Channel & Channel Protection" and have Estimated Remaining Life's of 23 and 15 years respectively. While there are no visible or documented signs of instability or scour at either crossing and both crossings are of sufficient hydraulic length, we recommend

both bridges be replaced. This recommendation is based on the above noted Bridge Inspection Report Status and Estimated Remaining Life for each structure. See Appendix BB for detailed calculations and graphics.

Site 26

Site 26 consists of a 66" SPP with concrete headwalls upstream and downstream that convey 158 acres of Long Valley Branch from west to east under I-26. The SPP has a design year discharge of 320cfs and a HW/D of 1.98. The 100-year discharge is 320cfs with a HW/D of 1.98.

The existing SPP is in fair condition with minimal rust observed. Upstream of the crossing is a stormwater pond that controls flows from a large commercial development. There is also an "abandoned" RCBC vehicle underpass (NCDOT Structure No. 100226) to the left of the SPP that allows flows under I-26. The upstream channel is stable and vegetated. The downstream channel enters a pond and is stable.

The preliminary analysis of future conditions indicates that the culvert is undersized for the drainage area. However, these computations do not account for the upstream stormwater pond or the conveyance provided by the RCBC vehicle underpass. For the 6-lane alternative we recommend retaining both the SPP and RCBC vehicle underpass. We also recommend that the SPP be lined. For the 8-lane alternative we recommend retaining and extending both the SPP pipe and RCBC vehicle underpass. We also recommend lining the SPP. See Appendix CC for detailed calculations and graphics.

Site 27

Site 27 consists of a 72" SPP with a concrete headwall that conveys 154 acres of an unnamed tributary to Hominy Creek from south to north under I-26. The SPP has a design year discharge of 310cfs and a HW/D of 1.48. The 100-year discharge is 310cfs with a HW/D of 1.48.

The SPP is in poor condition with rusted out inverts in several places. The outlet is completely rusted through and undermined.

Sediment deposits in the upstream channel have shifted normal flows into the right headwall, causing the bank and concrete ditch to become undermined. The remainder of the upstream channel is vegetated and stable. The SPP outlet is perched above the receiving channel and a 1 foot deep scour hole has formed. The downstream channel and banks are severely eroded due to the lack of outlet protection and a 90° channel bend 30 feet from the SPP outlet.

Existing conditions and preliminary analysis of the future conditions indicate the existing culvert is undersized for the drainage area. For the 6-lane alternative we recommend retaining, lining, and supplementing the existing SPP. For the 8-lane alternative we recommend retaining, lining, and extending the existing SPP and supplementing it with another pipe. For both alternatives, we recommend the placement of Class 'I' riprap in the downstream channel and the addition of bank stabilization. See Appendix DD for detailed calculations and graphics.

Site 28

Site 28 consists of dual 4-span reinforced concrete deck bridges over Hominy Creek on steel girders and reinforced concrete piers. Bridge No. 100235 is 251.8 feet in length with a height crown to bed of 52 feet. Bridge No. 100238 is 312.0 feet in length with a height crown to bed of 49 feet. Both bridges convey 94.6 square miles of Hominy Creek from south to north under I-26. Hominy Creek is a FEMA Detailed Study stream with a 100-year discharge of 14,700cfs at the project site.

Bridge No. 100235 was constructed in 1966 and has a Sufficiency Rating of 60.1. The current Bridge Inspection Report lists the Status of Bridge No. 100235 as Functionally Obsolete. Bridge No. 100238 was also constructed in 1966 and has a Sufficiency Rating of 3. The current Bridge Inspection Report lists the Status of Bridge No. 100238 as Structurally Deficient. Both bridges are rated Good with respect to Bridge Inspection Item 45. "Channel & Channel Protection" and have Estimated Remaining Life's of 7 years each. While there are no visible or documented signs of instability or scour at either crossing and both crossings are of sufficient hydraulic length, we recommend both bridges be replaced. This recommendation is based on the above noted Bridge Inspection Report Status and Estimated Remaining Life for each structure. It's also based on the Approved Bridge Survey and Hydraulic Design Report (BSR) dated 4/30/12. See Appendix EE for detailed calculations, graphics and Approved BSR.

5. PRELIMINARY HYDRAULIC RECOMMENDATIONS FOR MAJOR CROSSINGS

See Appendix FF for a table summarizing site specific information and data for all proposed crossings.

6. STORMWATER COMPLIANCE

NCDOT will comply with all stormwater requirements through the Post-Construction Stormwater Program under the Department's National Pollutant Discharge Elimination (NPDES) Stormwater Permit.

7. ENVIRONMENTAL PERMITTING

Minimal impacts are anticipated for the 6-lane alternative since all widening on I-26 will be towards the median. The proposed 8-lane alternative incorporates widening towards the median as well as additional northbound and southbound lanes outside the existing travel lanes. This alternative is expected to have substantially more impacts than the 6-lane alternative due the required roadway embankment and culvert extensions.

Potential permitting issues may occur in areas where supplemental structures are needed because existing structures are undersized. Accessing floodplains for installation of supplemental pipes could potentially impact jurisdictional wetlands. Any channel improvements that are made may result in impacts to existing surface waters.

APPENDIX A

SITE MAPS

QUAD MAP WITH SITE LOCATIONS

STIP No. I-4400/I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County

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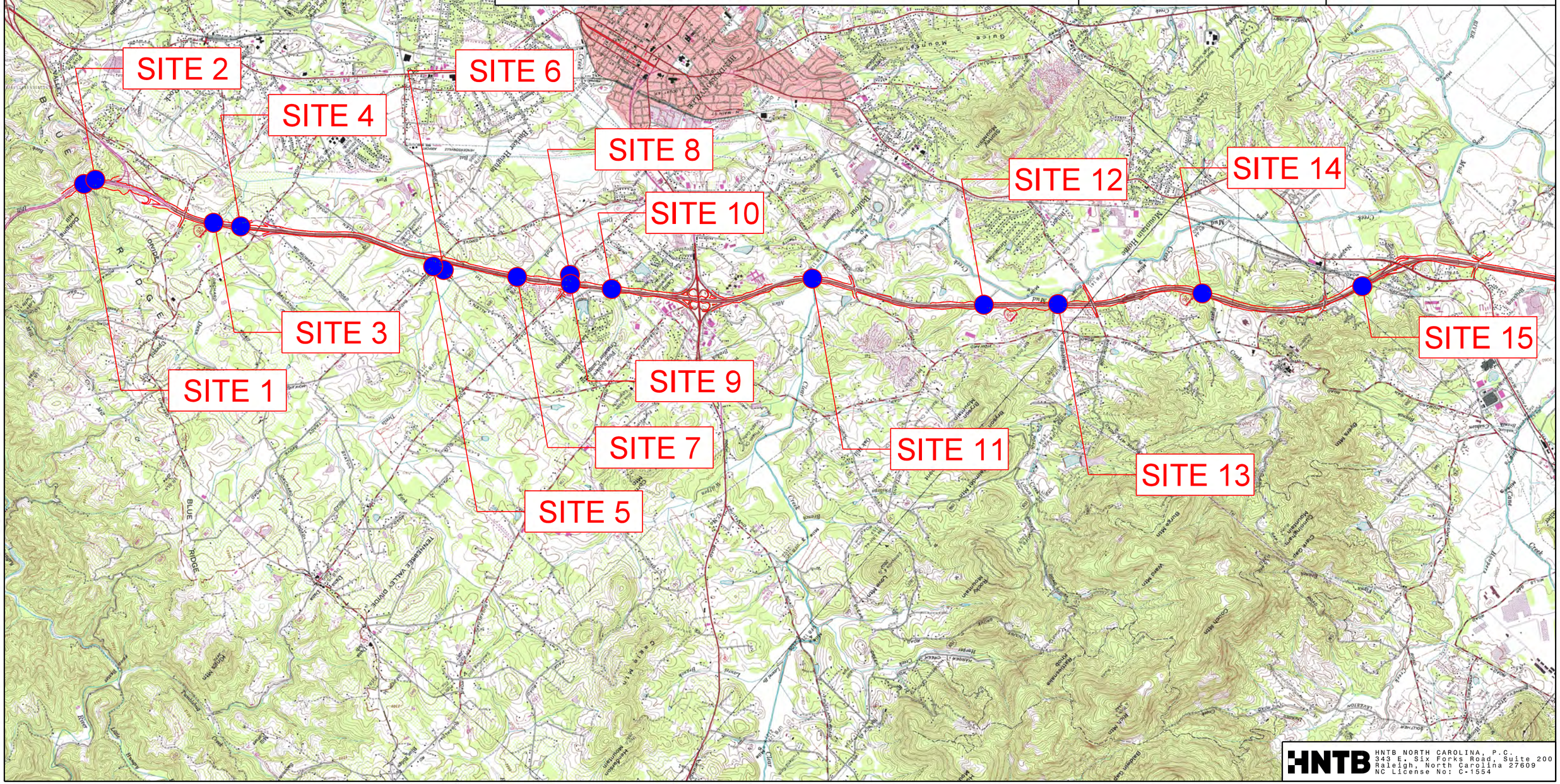

HNTB
HNTB NORTH CAROLINA, P.C.
343 E. Six Forks Road, Suite 200
Raleigh, North Carolina 27609
NC License No: C-1554

QUAD MAP WITH SITE LOCATIONS

STIP No. I-4400/I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County

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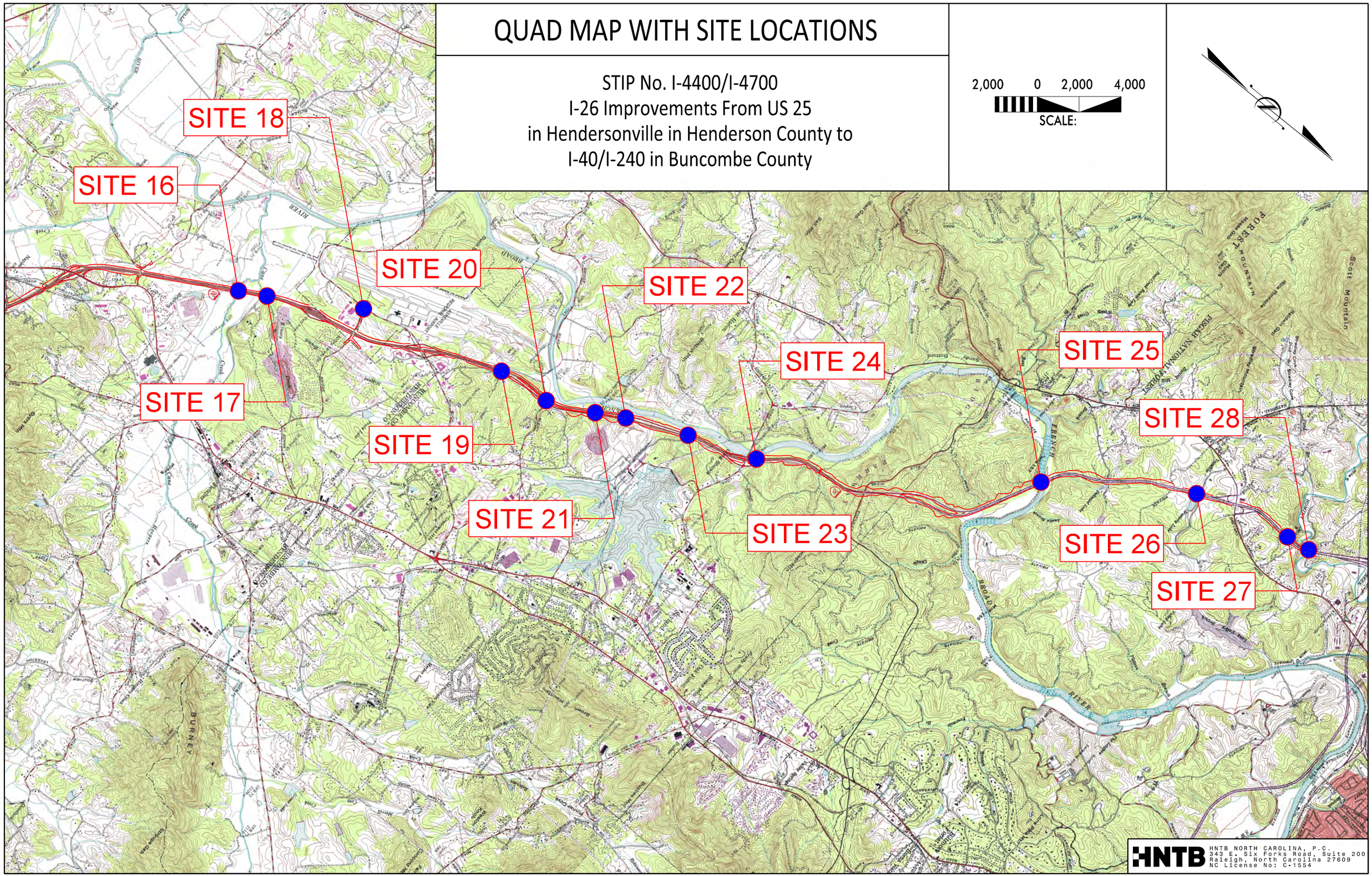

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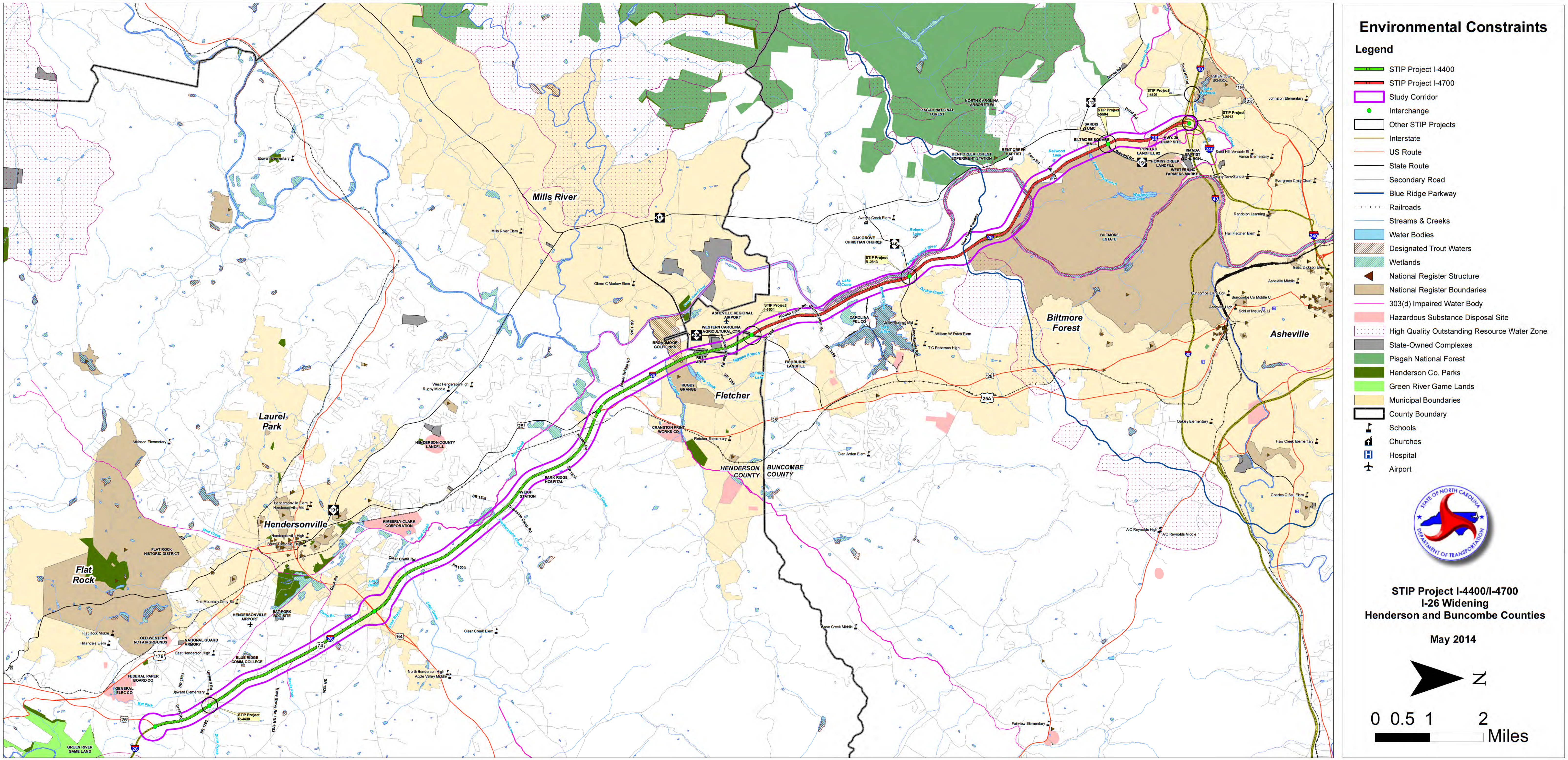
HNTB NORTH CAROLINA, P.C.
343 E. Six Forks Road, Suite 200
Raleigh, North Carolina 27609
NC License No: C-1554


Environmental Constraints
Legend
STIP Project I-4400
STIP Project I-4700
Study Corridor
Interchange
Other STIP Projects
Interstate
US Route
State Route
Secondary Road
Blue Ridge Parkway
Railroads
Streams & Creeks
Water Bodies
Designated Trout Waters
Wetlands
National Register Structure
National Register Boundaries
303(d) Impaired Water Body
Hazardous Substance Disposal Site
High Quality Outstanding Resource Water Zone
State-Owned Complexes
Pisgah National Forest
Henderson Co. Parks
Green River Game Lands
Municipal Boundaries
County Boundary
Schools
Churches
Hospital
Airport
STIP Project I-4400/I-4700
I-26 Widening
Henderson and Buncombe Counties
May 2014
N
0 0.5 1 2
Miles
Mills River
Laurel Park
Hendersonville
Flat Rock
Fletcher
Biltmore Forest
Asheville
HENDERSON COUNTY
BUNCOMBE COUNTY
PISGAH NATIONAL FOREST
NORTH CAROLINA ARBORETUM
BENT CREEK FOREST EXPERIMENT STATION
BILTMORE ESTATE
ASHEVILLE REGIONAL AIRPORT
WESTERN CAROLINA AGRICULTURAL CTR
BROADMOOR GOLF LINKS
REST AREA
RUGBY GRANGE
FISHBURNE LANDFILL
CAROLINA P&L CO
CRANSTON PRINT WORKS CO
PARK RIDGE HOSPITAL
WEIGH STATION
HENDERSON COUNTY LANDFILL
KIMBERLY-CLARK CORPORATION
FLAT ROCK HISTORIC DISTRICT
OLD WESTERN NC FAIRGROUNDS
NATIONAL GUARD ARMORY
HENDERSONVILLE AIRPORT
BAT FORK BOG SITE
BLUE RIDGE COMM. COLLEGE
FEDERAL PAPER BOARD CO
GENERAL ELEC CO
GREEN RIVER GAME LAND
BILTMORE SQUARE MALL
POND RD LANDFILL #2
HWY. 29 DUMP SITE
HOMINY CREEK LANDFILL
WESTERN NC FARMERS MARKET
INANDA BAPTIST CHURCH
ASHEVILLE SCHOOL
STIP Project I-4401
STIP Project I-5504
STIP Project I-2513
STIP Project R-2813
STIP Project I-5501
STIP Project R-4430

APPENDIX B

TYPICAL ROADWAY SECTIONS

PROJECT REFERENCE NO.	SHEET NO.
14400-4700	2-A
R/W SHEET NO.	
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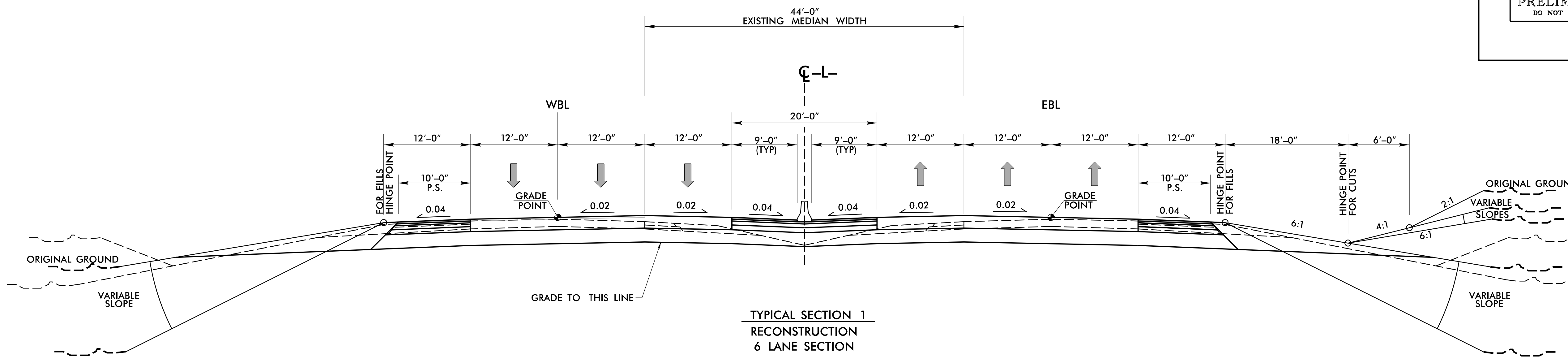
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION



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RECONSTRUCTION
6 LANE SECTION

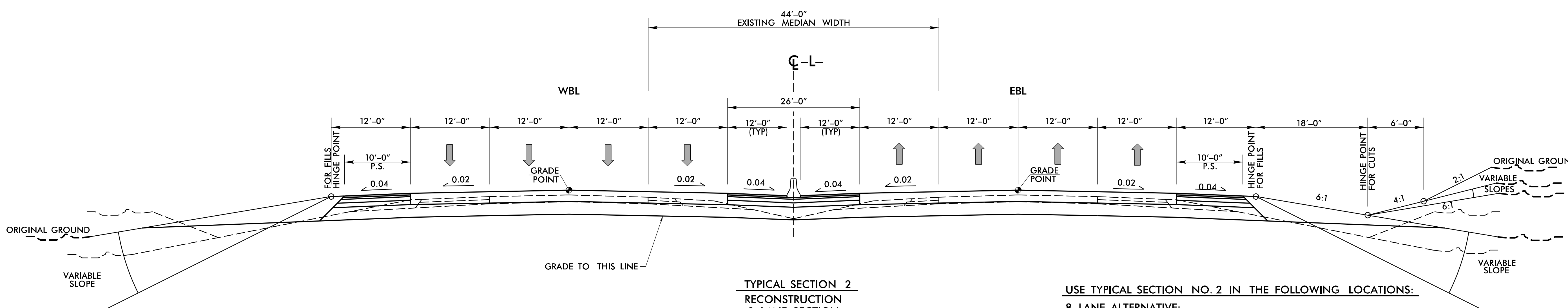
USE TYPICAL SECTION NO. 1 IN THE FOLLOWING LOCATIONS:

6 LANE ALTERNATIVE:
-L4400- STA 14+00.00 TO STA 791+00.00
-L47001- STA 909+00.00 TO STA 991+18.00
-L47002- STA 1049+91.12 TO STA 1221+00.00

HYBRID ALTERNATIVE:
-L4400- STA 14+00.00 TO STA 591+00

TRANSITION FROM TYPICAL SECTION NO. 1
TO TYPICAL NO. 2 IN THE FOLLOWING LOCATIONS:

HYBRID ALTERNATIVE:
-L4400- STA 591+00 TO STA 594+00



TYPICAL SECTION 2
RECONSTRUCTION
8 LANE SECTION

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8 LANE ALTERNATIVE:
-L4400- STA 14+00.00 TO STA 791+00.00
-L47001- STA 909+00.00 TO STA 991+18.00
-L47002- STA 1049+91.12 TO STA 1221+00.00

HYBRID ALTERNATIVE:
-L4400- STA 594+00.00 TO STA 791+00.00
-L47001- STA 909+00.00 TO STA 991+18.00
-L47002- STA 1049+91.12 TO STA 1221+00.00

REVISIONS

8/17/99

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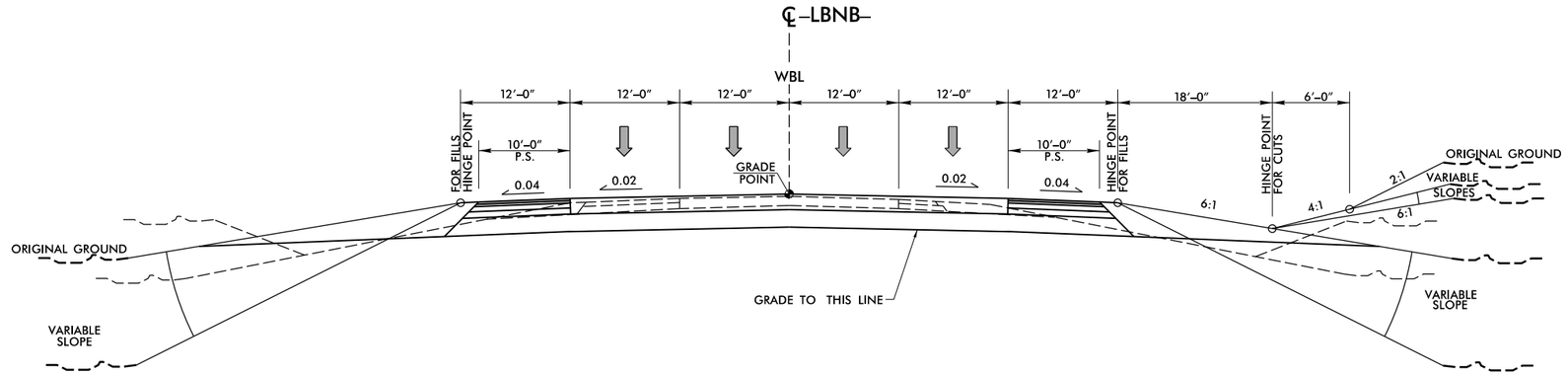
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

8/17/99

REVISIONS



TYPICAL SECTION 3
NORTHBOUND BIFURCATED
8 LANE SECTION

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–LBNB47002– STA 991+18.00 TO STA 1049+30.93

HYBRID ALTERNATIVE:
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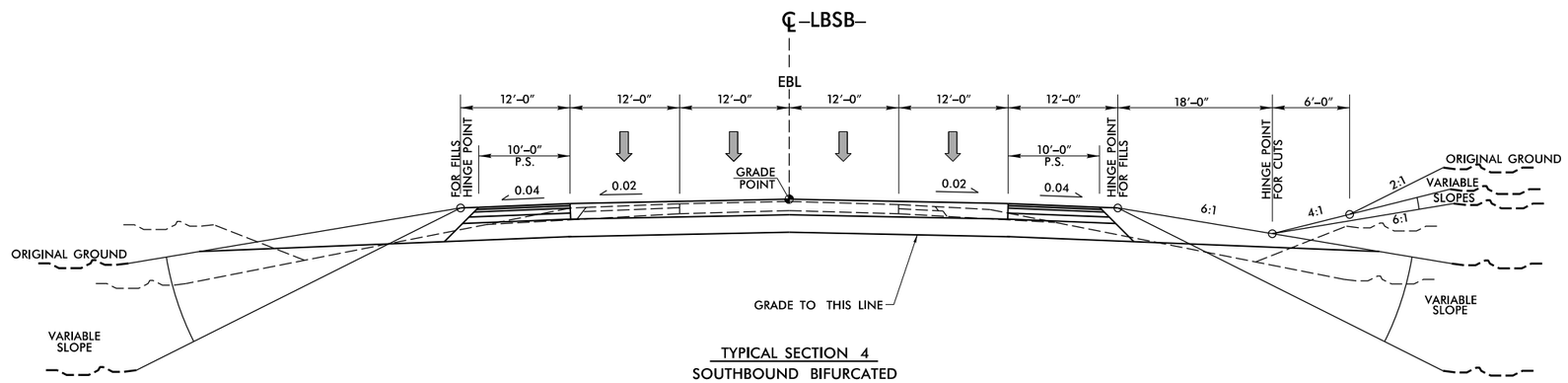
–LBNB47002– STA 991+18.00 TO STA 1049+30.93



TYPICAL SECTION 4
SOUTHBOUND BIFURCATED
8 LANE SECTION

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–LBSB47002– STA 991+18.00 TO STA 1049+91.12

HYBRID ALTERNATIVE:
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–LBSB47002– STA 991+18.00 TO STA 1049+91.12

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R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

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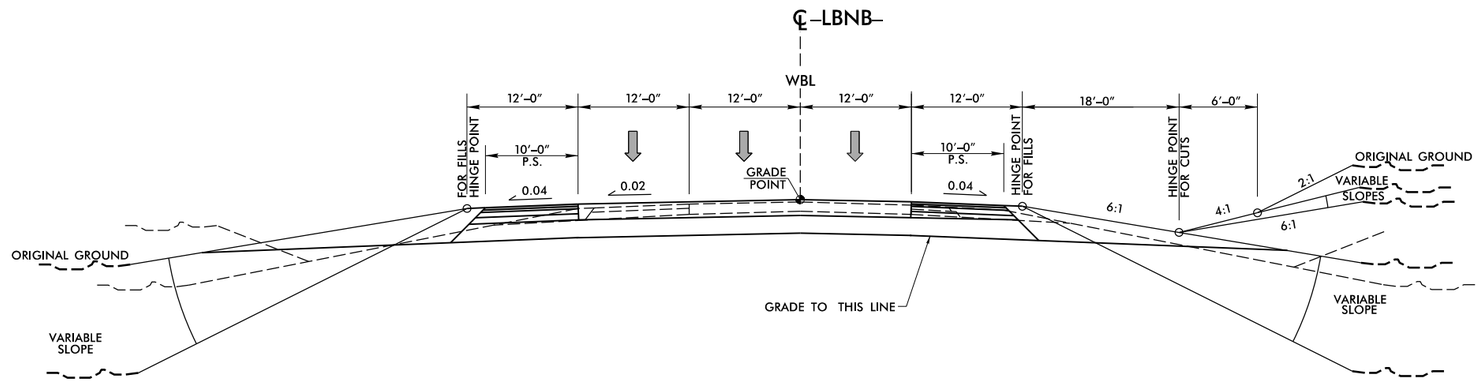
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

8/17/99

REVISIONS



TYPICAL SECTION 5
NORTHBOUND BIFURCATED
6 LANE SECTION

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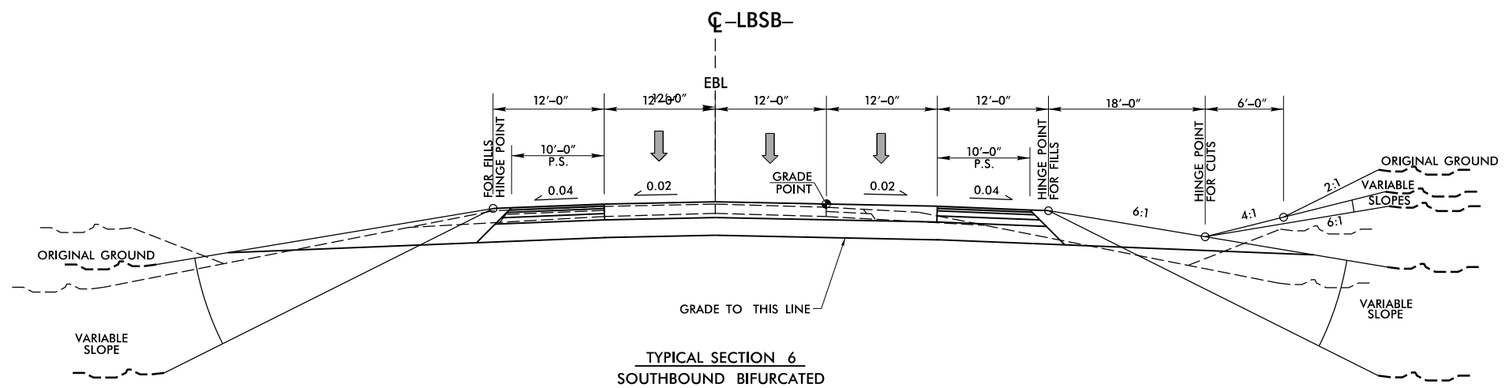

TYPICAL SECTION 6
SOUTHBOUND BIFURCATED
6 LANE SECTION

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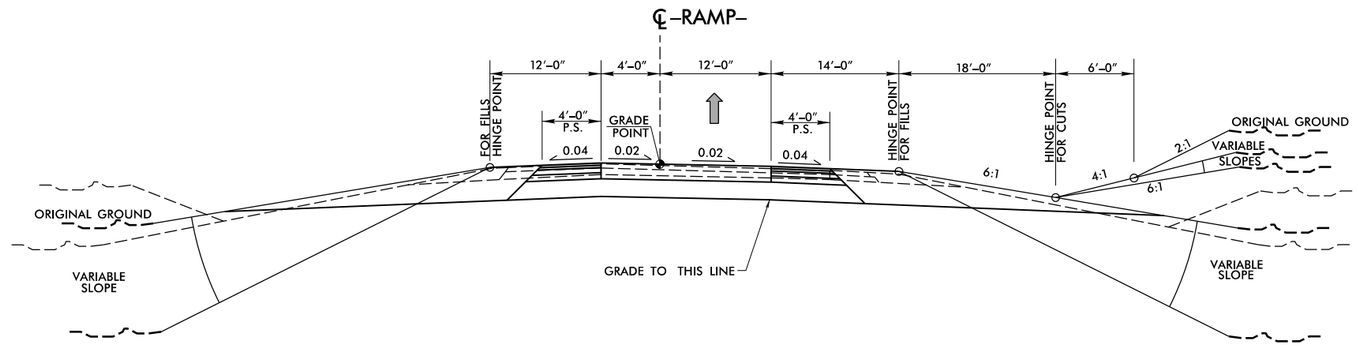
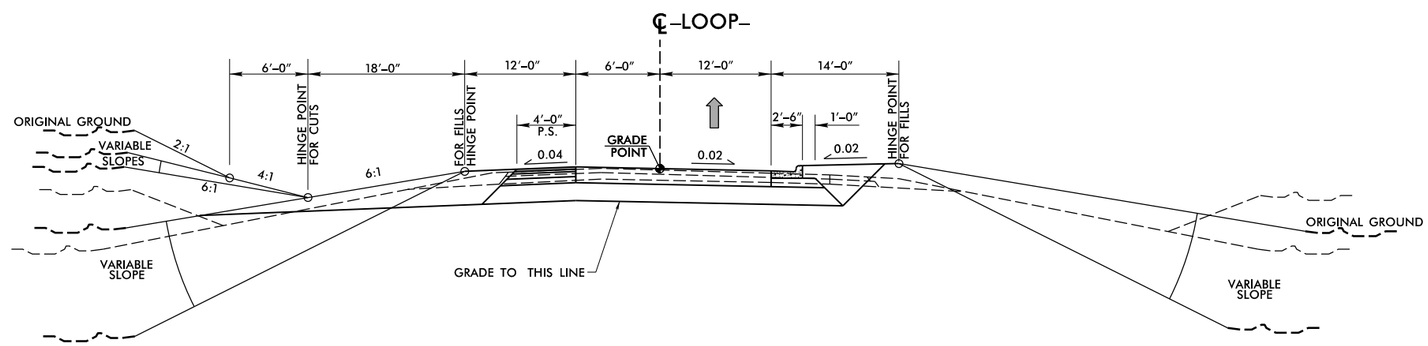


TYPICAL SECTION 7
RAMPS

USE TYPICAL SECTION NO. 7 IN THE FOLLOWING LOCATIONS:
-Y1- RAMP A, B AND C (US 25)
-Y3- RAMP A, B, C AND D (UPWARD RD)
-Y6- RAMP A, B, C AND D (US 64)
-WS1- RAMP A, B, C AND D (WEIGH STATION)
-Y10- RAMP A, B, C AND D (US 25)
-REST1- RAMP A, B, C AND D (REST AREA)
-Y13- RAMP A, B, C AND D (NC 280)
-Y15- RAMP A, B, C AND D (NC 146)



TYPICAL SECTION 8
LOOPS

USE TYPICAL SECTION NO. 8 IN THE FOLLOWING LOCATIONS:
-Y1- LOOP D (US 25)
-Y3- LOOP A, B, C AND D (US 64)

REVISIONS

8/17/99

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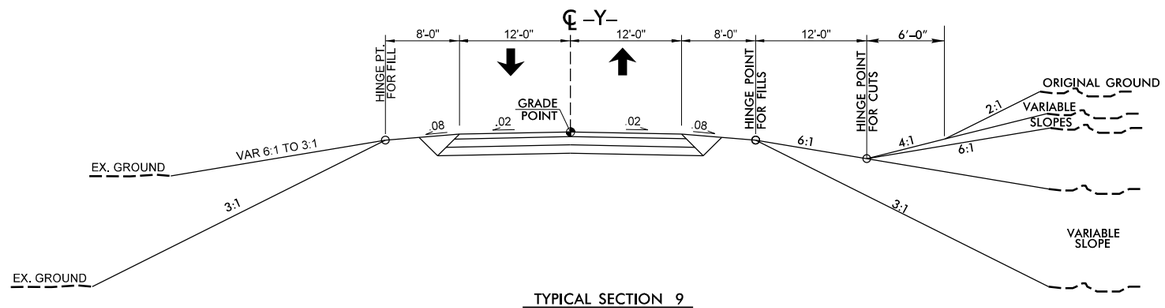
14400-4700	2-E
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION



TYPICAL SECTION 9
2 LANE -Y- LINES

USE TYPICAL SECTION NO. 9 IN THE FOLLOWING LOCATIONS:

-Y2- SR1803 (CREST RD.)
-Y3- SR1783 (UPWARD RD.)
-Y4- SR1793 (TRACEY GROVE RD.)
-Y5- SR1525 (DANA RD.)
-Y7- SR1503 (CLEAR CREEK RD.)
-Y8- SR1528 (BROOKSIDE CAMP RD.)
-Y9- SR1534 (NAPLES RD.)
-Y11- SR1345 (BUTLER BRIDGE RD.)
-Y12- SR3539 (FANNING BRIDGE RD.)

8/17/99

REVISIONS

9:09:44 AM
14400-4700_rdy_typ.dgn
$$$$USERNAME$$$$

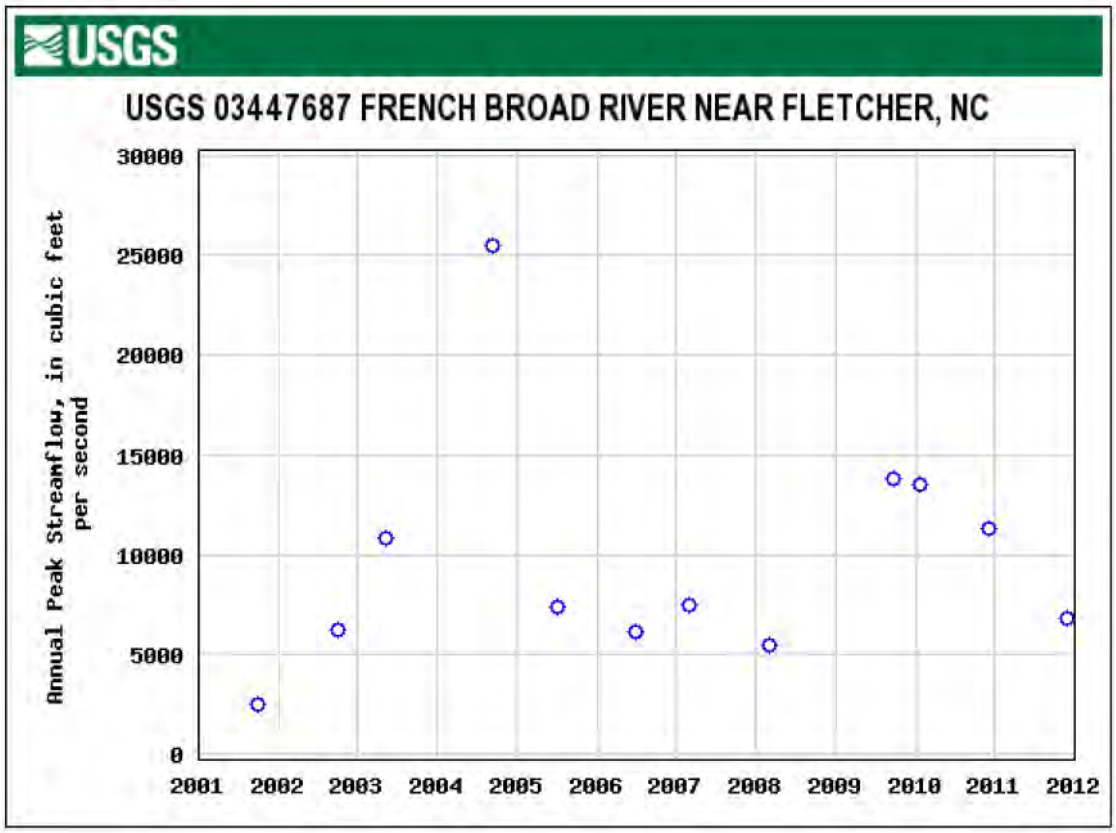
APPENDIX C

GAUGE DATA

USGS 03447687 FRENCH BROAD RIVER NEAR FLETCHER, NC

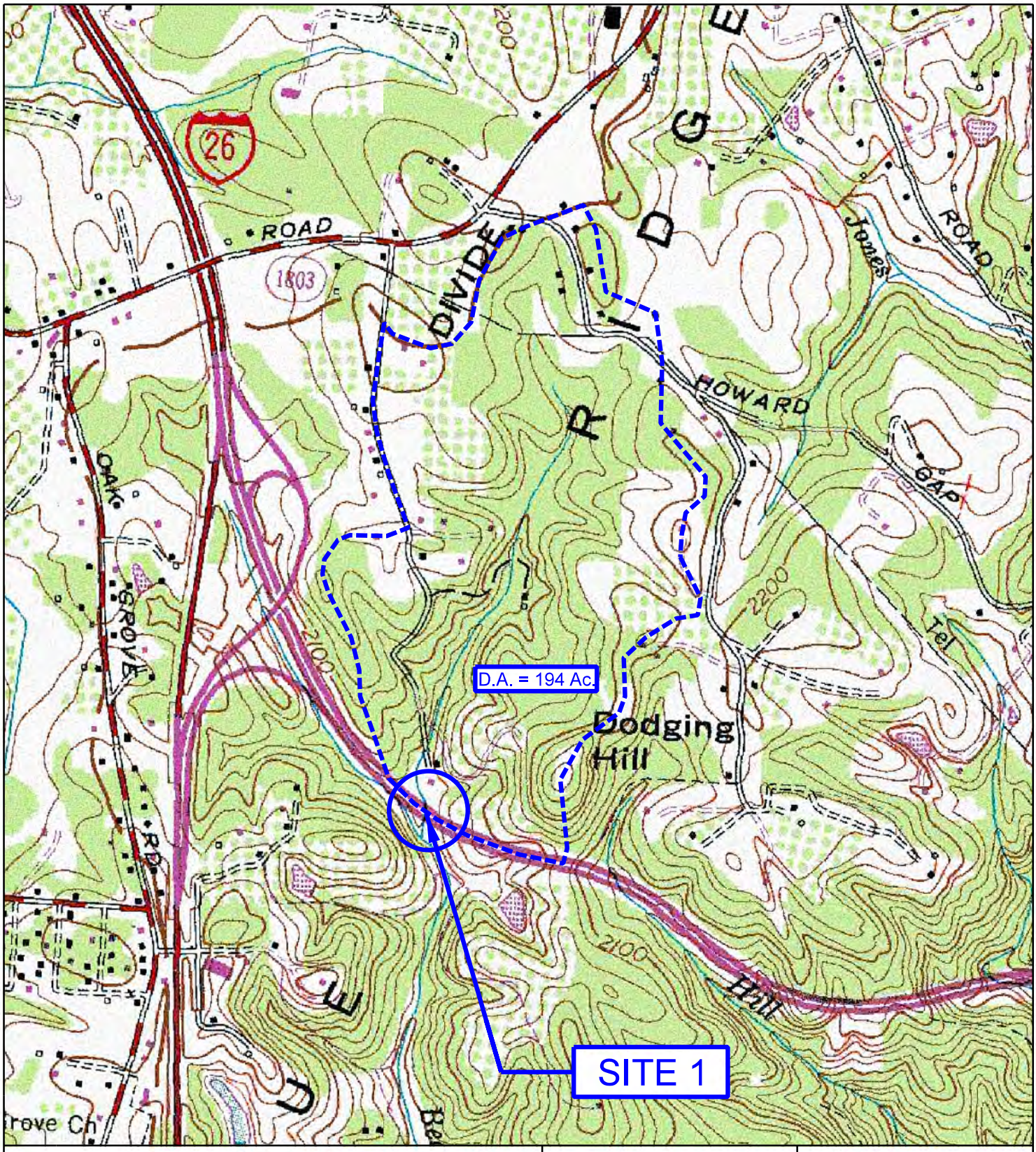
Water Year	Date	Gage Height (feet)	Stream-flow (cfs)
2001	Sep. 25, 2001	6.36	2,480
2002	Sep. 27, 2002	8.55	6,240
2003	May 07, 2003	12.50	10,800
2004	Sep. 08, 2004	20.13	25,500[9]
2005	Jul. 07, 2005	10.84	7,390
2006	Jun. 27, 2006	9.92	6,150
2007	Mar. 02, 2007	10.85	7,410
2008	Mar. 05, 2008	9.40	5,480
2009	Sep. 22, 2009	14.81	13,800
2010	Jan. 25, 2010	14.65	13,500
2011	Dec. 01, 2010	13.40	11,300
2012	Nov. 29, 2011	10.43	6,820

- 9 -- Discharge due to Snowmelt, Hurricane, Ice-Jam or Debris Dam breakup



APPENDIX D

SITE 1



QUAD MAP - SITE 1

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 1

Stream Name: Beck Creek

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	0	0.0	0.000
Low - Medium Density Residential	2 - 5	20%	194	38.8	0.200
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	0	0.0	0.000
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	0	0.0	0.000
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	0	0.0	0.000
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	0	0.0	0.000
Totals			**194**	**38.8**	**20.0%**

Drainage Area = 194 acres

Project: I-4400 / I-4700

Site #: 1

Stream Name: Beck Creek

Drainage Area (sq mi): 0.30

Impervious Area (%): 20.0%

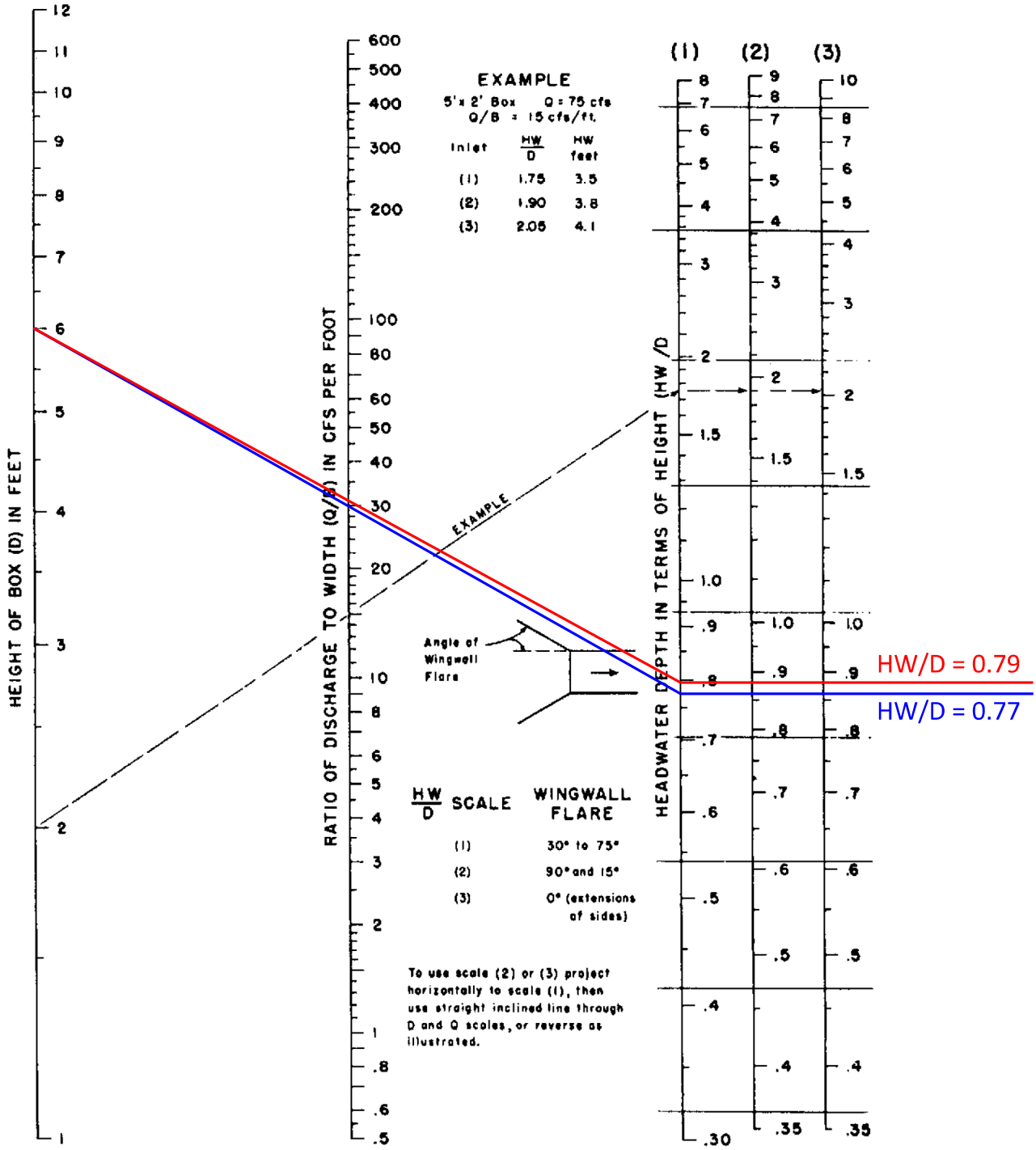
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	129	-	-
5	184	-	-
10	220	-	-
25	262	-	-
50	292	-	-
100	322	-	-
200	350	-	-
500	395	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	-
50	-
100	-
500	-

50 Year	100 Year
2 @ 5' x 6' RCBC	2 @ 5' x 6' RCBC
Q = 290 CFS	Q = 320 CFS
Q/NB = 29 CFS/FT.	Q/NB = 32 CFS/FT.

SITE 1

CHART 8B



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/4/2014

SITE NUMBER 1 STREAM BECK CREEK ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 2 @ 5' x 6' RCBC WITH A SLOPE TAPERED INLET. THERE IS A DEBRIS DEFLECTOR IN BETWEEN THE TWO BARRELS. UPSTREAM - LEFT BARREL HAS NO SILT AND THE RIGHT BARREL HAS 4.5' OF SILT. DOWNSTREAM - BOTH BARRELS ARE SILTED IN APPROX. 5'. INSIDE - GOOD CONDITION

UPSTREAM CHANNEL: TOP WIDTH 11 FT BOTTOM WIDTH 6 FT BANKFULL DEPTH 3 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL

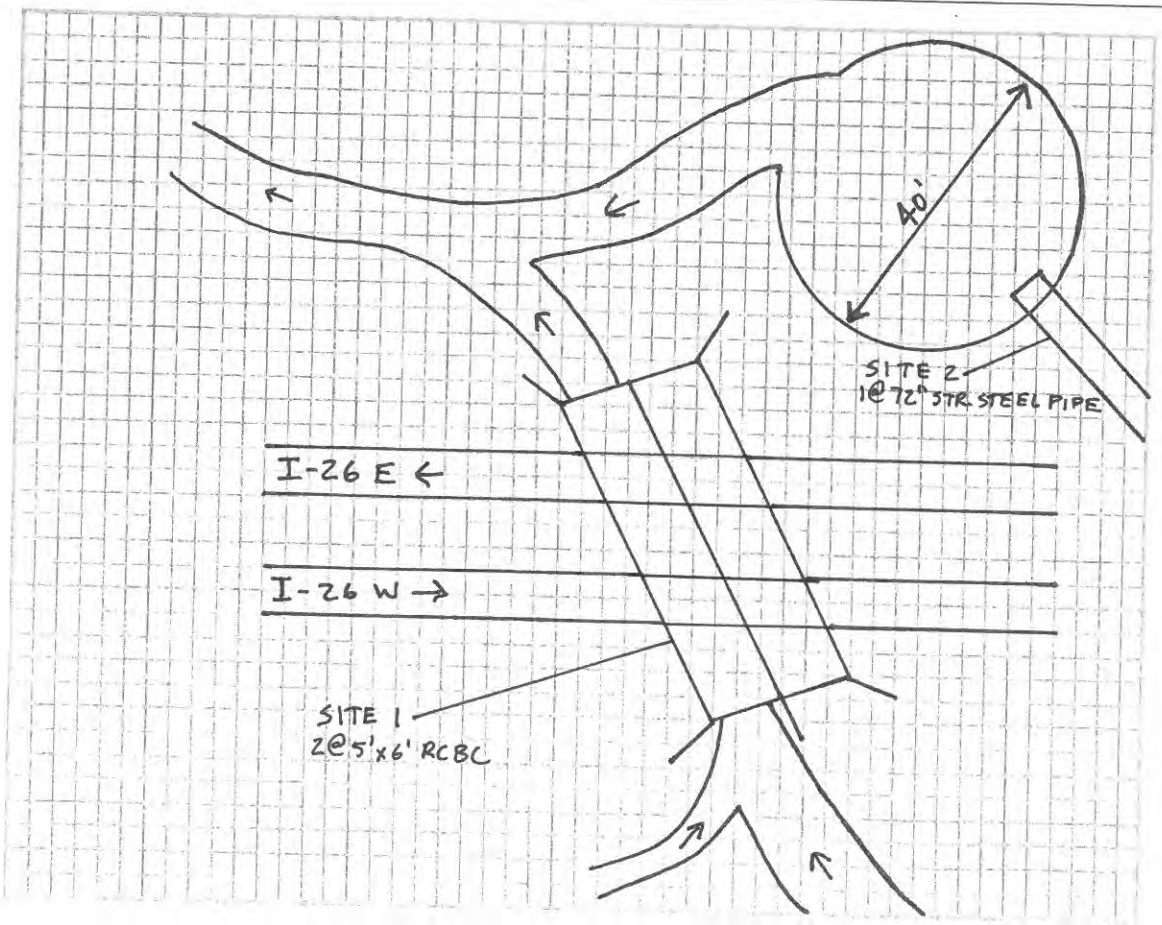
BANK/ CHANNEL CONDITIONS MAIN CHANNEL IS COMING STRAIGHT IN. THERE IS A SMALLER CHANNEL COMING FROM THE LEFT. BANKS ARE STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 11 FT BOTTOM WIDTH 4 FT BANKFULL DEPTH 1.5 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS SHORT CHANNEL THAT RUNS INTO A CONFLUENCE. BANKS ARE STABLE AND VEGETATED.

COMMENTS THERE IS A 66" STR. STEEL PIPE RIGHT OF THE STRUCTURE ON THE DOWNSTREAM SIDE. THESE TWO STRUCTURERS CHANNELS MEET AT THE CONFLUENCE.



Looking at Upstream Face of 2 @ 5' x 6' RCBC under I-26

Looking Upstream from RCBC Inlet

Looking at Upstream Left Ditch from RCBC Inlet

Looking Upstream In Left Barrel

Looking Downstream In Right Barrel

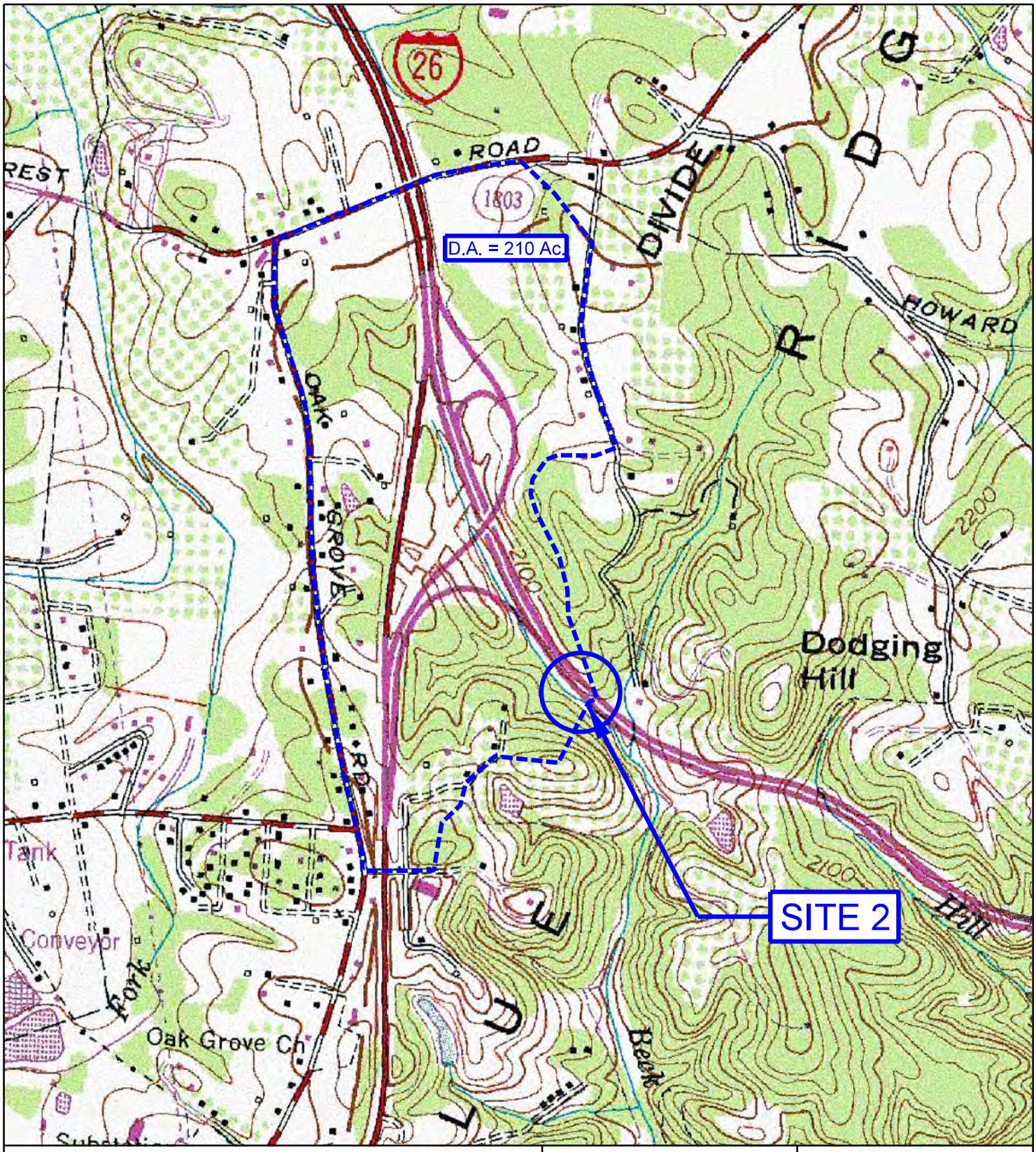
Looking at Downstream Face of 2 @ 5' x 6' RCBC under I-26

Looking Downstream from RCBC Outlet at the Confluence
of the 2 @ 5' x 6' RCBC and the 72" SSP

Looking Downstream from RCBC Outlet of the Confluence
of the 2 @ 5' x 6' RCBC and the 72" SSP

APPENDIX E

SITE 2



QUAD MAP - SITE 2

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 2

Stream Name: UT to Beck Creek

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	0	0.0	0.000
Low - Medium Density Residential	2 - 5	20%	71	14.2	0.067
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	85	29.7	0.141
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	0	0.0	0.000
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	0	0.1	0.000
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	55	46.5	0.221
Totals			**210**	**90.4**	**43.0%**

Drainage Area = 210 acres

Project: I-4400 / I-4700

Site #: 2

Stream Name: UT to Beck Creek

Drainage Area (sq mi): 0.33

Impervious Area (%): 43.0%

USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	276	-	-
5	324	-	-
10	349	-	-
25	369	-	-
50	378	-	-
100	390	-	-
200	397	-	-
500	422	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	-
50	-
100	-
500	-

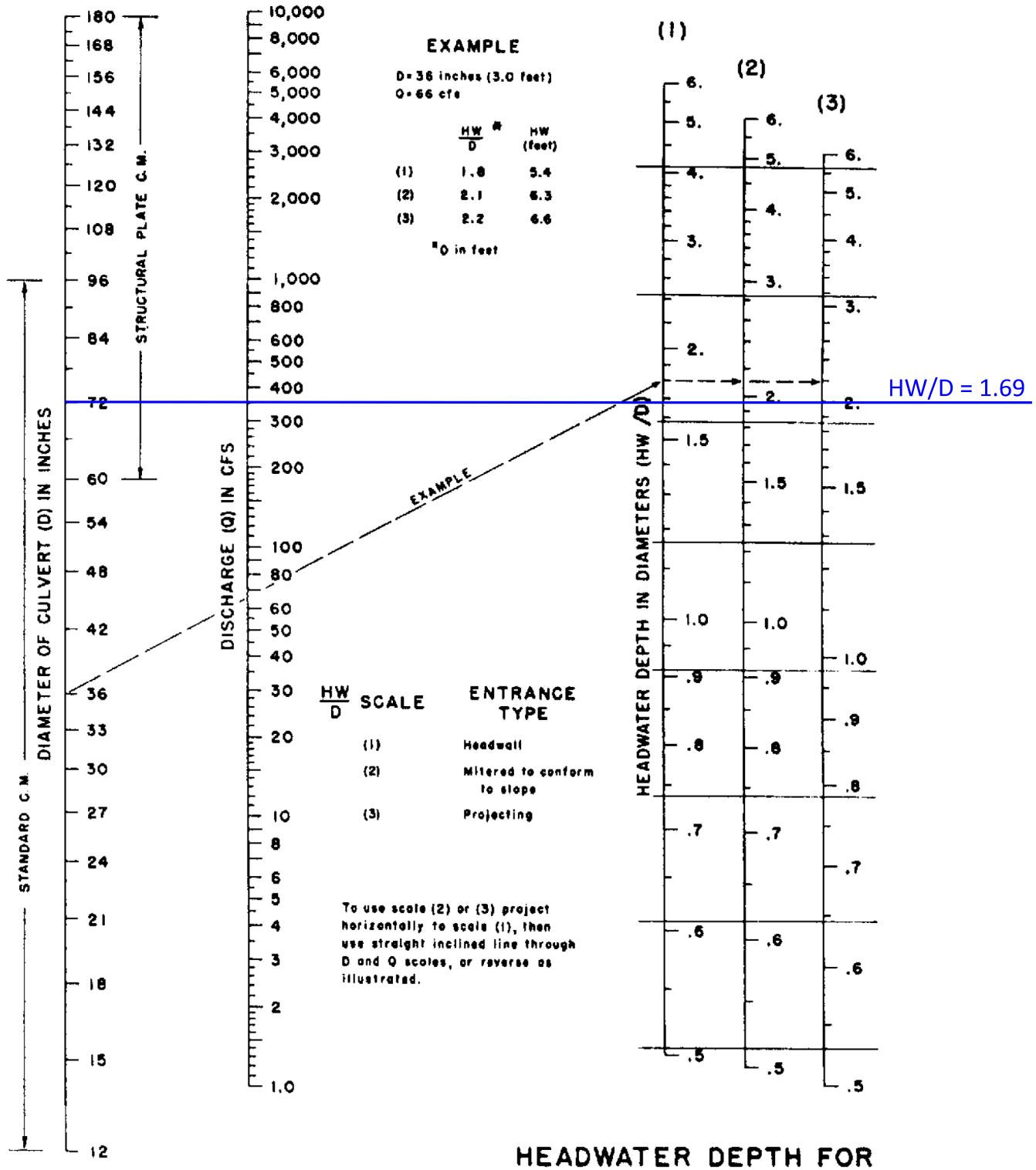
SITE 2

10 Year

1 @ 72" CMP W/ HW

Q = 350 CFS

CHART 2B



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

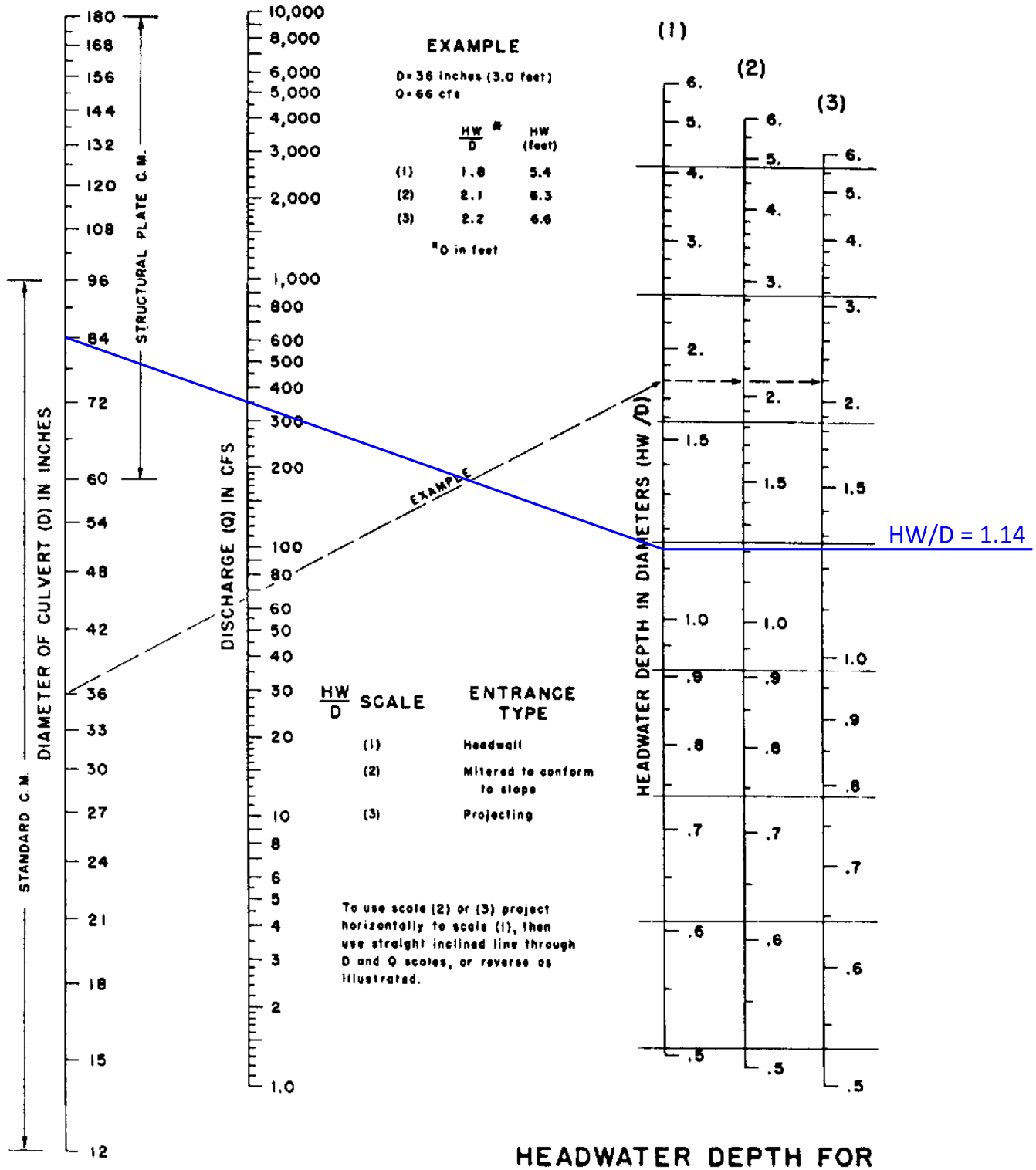
SITE 2

10 Year

1 @ 84" SPP W/ HW

Q = 350 CFS

CHART 2B



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

PROPOSED

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/5/14

SITE NUMBER 2 STREAM UT TO BECK CREEK ROUTE

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 72" STRUCTURAL PLATE PIPE WITH A HEADWALL. RUST THROUGHOUT THE PIPE. THE INVERT OF THE OUTLET IS COMPLETELY RUSTED THROUGH. ASPHALT COATING INSIDE THE PIPE IS EITHER CRACKED OR MISSING. SOME SEPARATION IN THE PIPE.

UPSTREAM CHANNEL: TOP WIDTH 15 FT BOTTOM WIDTH 6.5 FT BANKFULL DEPTH 3 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.3 FT BED MATERIAL

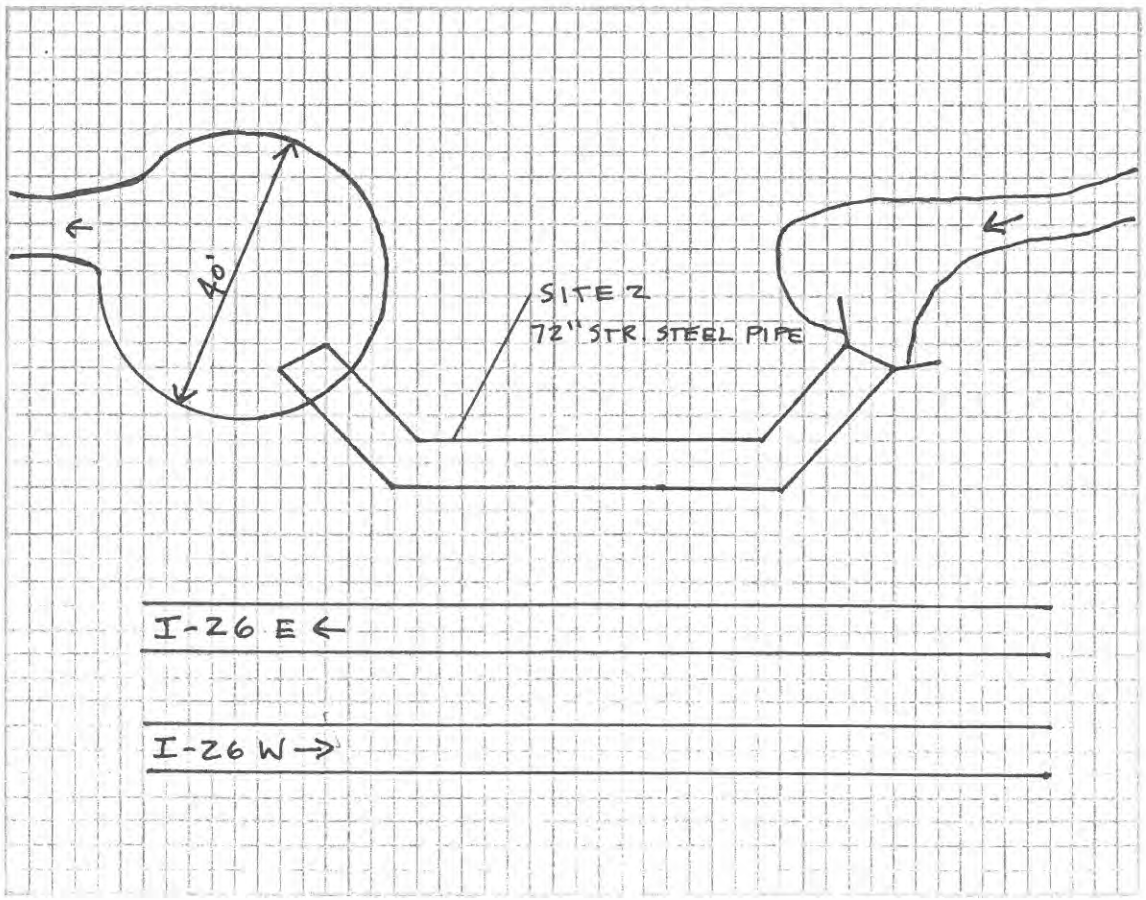
BANK/ CHANNEL CONDITIONS MINOR DEBRIS IN CHANNEL. EROSION RIGHT OF THE HEADWALL. BANKS ARE STABLE EXCEPT AROUND INLET. BANKS ARE VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH ____FT BOTTOM WIDTH ____FT BANKFULL DEPTH ____FT

DEPTH OF FLOW (AT TIME OF VISIT)_____FT BED MATERIAL

BANK/ CHANNEL CONDITIONS 40' SCOUR HOLE. INVERT OF THE PIPE IS 5' ABOVE THE BED OF THE SCOUR HOLE.

COMMENTS THERE IS A CONFLUENCE DOWNSTREAM WITH SITE 1.



Upstream Face of 72" SPP

Looking Upstream from 72" SPP

Looking Downstream at Bend in 72" SPP

Looking Inside of 72" SPP

Looking Inside of 72" SPP

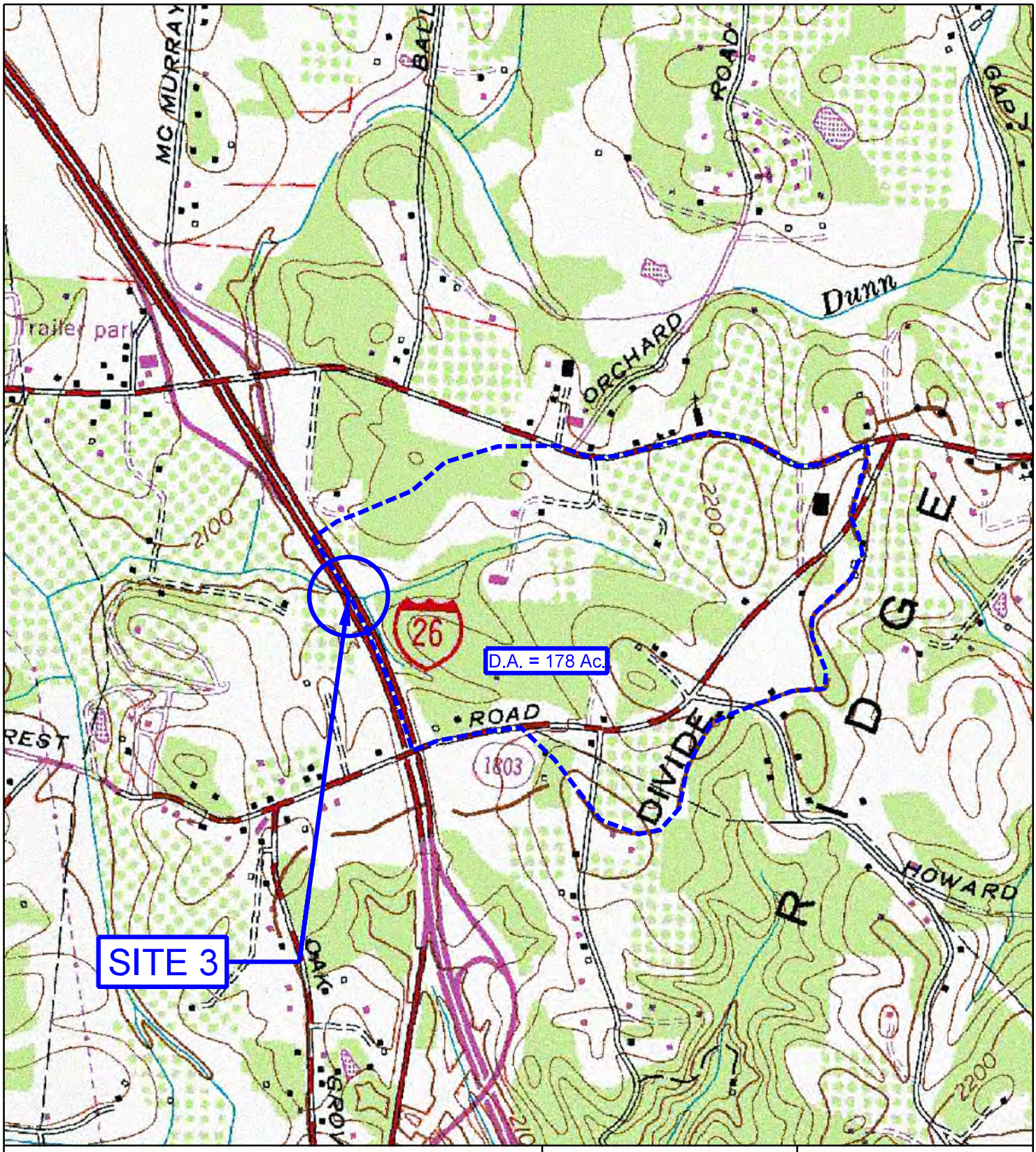
Looking at Downstream Face of 72" SPP

Looking at Downstream Face of 72" SPP and Scour Hole

Looking Downstream from 72" SPP

APPENDIX F

SITE 3



QUAD MAP - SITE 3

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/15/2014

Project: I-4400 / I-4700

Site #: 3

Stream Name: UT to Dunn Creek

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	41	4.1	0.023
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	23	6.9	0.039
Medium - High Density Residential	5 - 9	35%	0	0.0	0.000
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	42	23.1	0.130
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	72	50.4	0.283
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	0	0.0	0.000
Totals			**178**	**84.5**	**47.5%**

Drainage Area = 178 acres

Project: I-4400 / I-4700

Site #: 3

Stream Name: UT to Dunn Creek

Drainage Area (sq mi): 0.28

Impervious Area (%): 47.5%

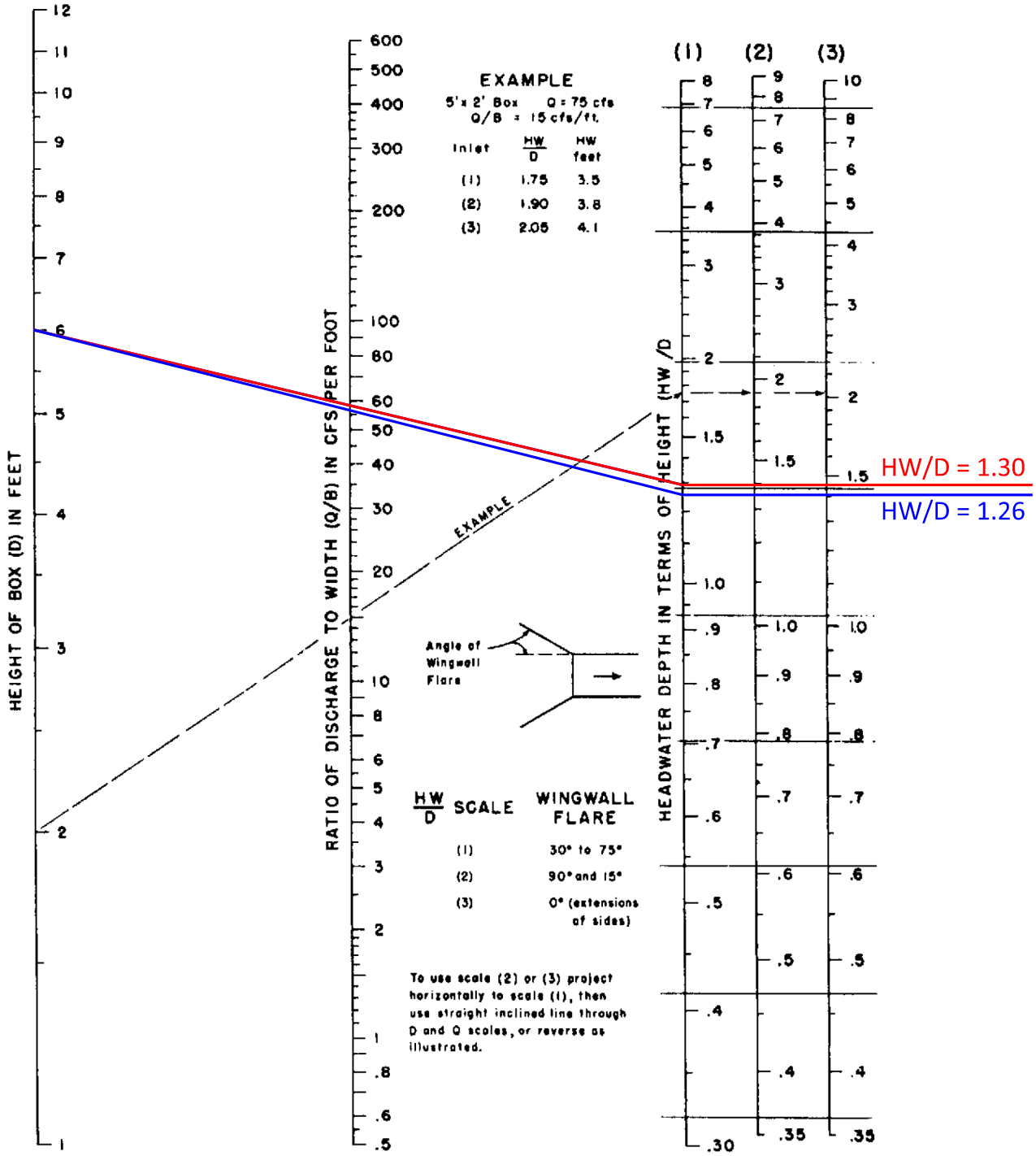
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	DISCHARGE (cfs)		
	PIEDMONT - RIDGE AND VALLEY	SAND HILLS	COASTAL PLAIN
2	282	-	-
5	317	-	-
10	333	-	-
25	343	-	-
50	344	-	-
100	350	-	-
200	350	-	-
500	368	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	DISCHARGE (cfs)
10	-
50	-
100	-
500	-

50 Year	100 Year
1 @ 6' x 6' RCBC	1 @ 6' x 6' RCBC
Q = 340 CFS	Q = 350 CFS
Q/NB = 57 CFS/FT.	Q/NB = 58 CFS/FT.

SITE 3

CHART 8B



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/4/14

SITE NUMBER 3 STREAM VT TO DUNN CREEK ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 1@6' x 6' RCBC. MINOR CRACKS THROUGHOUT THE STRUCTURE. CRACKS ARE MORE SIGNIFICANT AT THE INLET AND IN THE MIDDLE OF THE STRUCTURE.

UPSTREAM CHANNEL: TOP WIDTH 10 FT BOTTOM WIDTH 6 FT BANKFULL DEPTH 3 FT

DEPTH OF FLOW (AT TIME OF VISIT) 1 FT BED MATERIAL

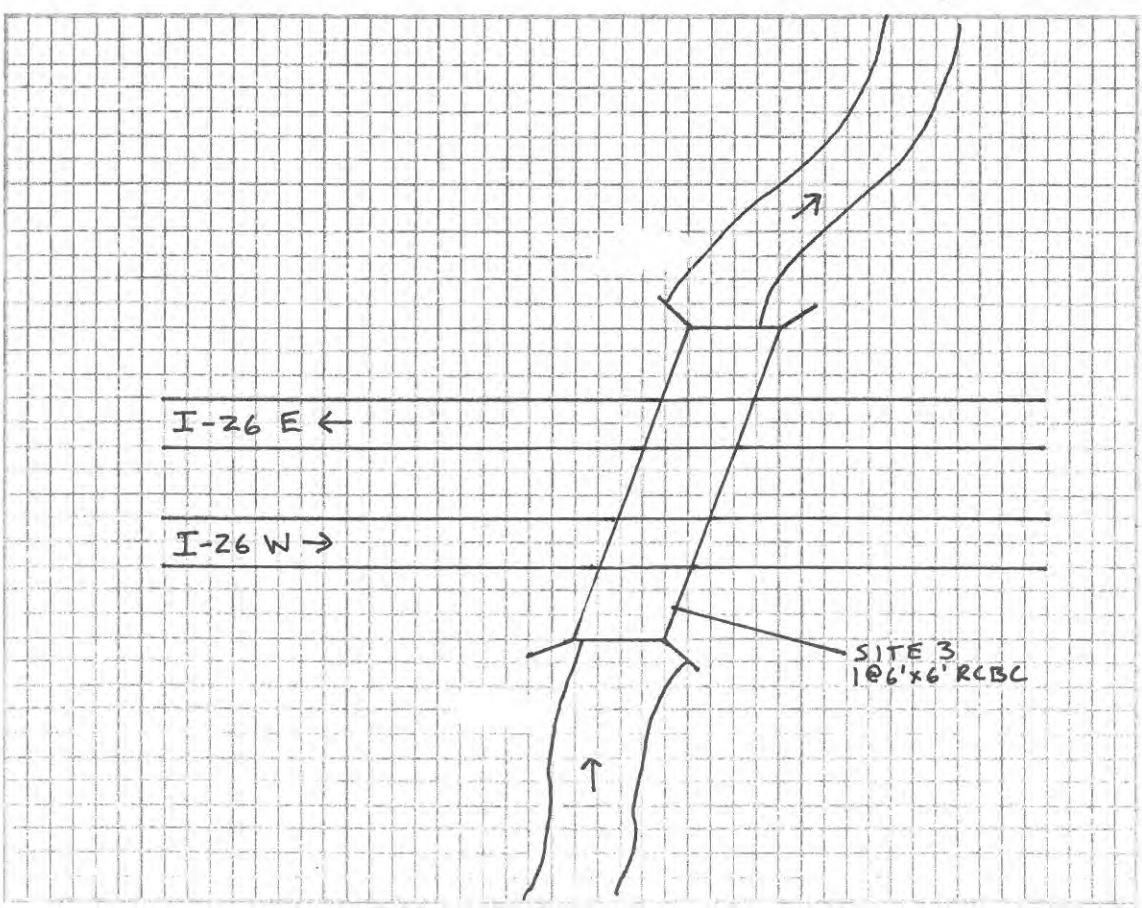
BANK/ CHANNEL CONDITIONS PERCHED 0.5 FT. AT INLET. BANKS ARE STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 12 FT BOTTOM WIDTH 8 FT BANKFULL DEPTH 3 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.7 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS PERCHED 1.2 FT. AT OUTLET. EROSION AT OUTLET. PAST OUTLET, BANKS ARE STABLE AND VEGETATED. RIP RAP AT OUTLET.

COMMENTS



Looking at Upstream Face of 1 @ 6' x 6' RCBC under I-26

Looking Upstream from 1 @ 6' x 6' RCBC Inlet

Looking Inside of 1 @ 6' x 6' RCBC

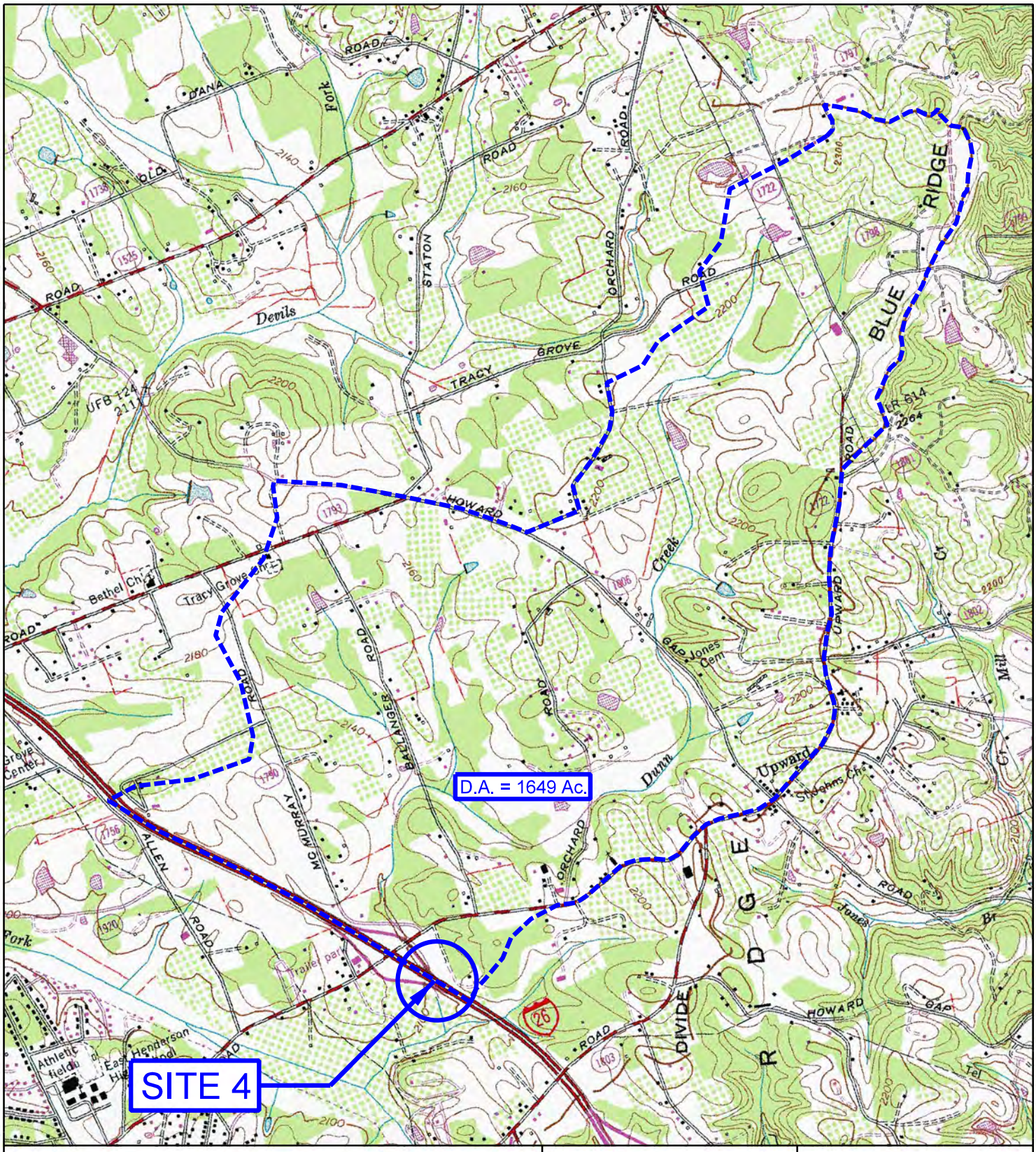
Outlet of Drop Inlet Inside 1 @ 6' x 6' RCBC

Looking at Downstream Face of 1 @ 6' x 6' RCBC under I-26

Looking Downstream from 1 @ 6' x 6' RCBC Outlet

APPENDIX G

SITE 4



QUAD MAP - SITE 4

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

1,000 0 1,000 2,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 4

Stream Name: Dunn Creek

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	1059	105.9	0.064
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	294	102.8	0.062
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	1	0.8	0.000
Cities	-	55%	9	4.9	0.003
Industrial	-	70%	108	75.7	0.046
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	178	151.4	0.092
Totals			**1649**	**441.4**	**26.8%**

Drainage Area = 1649 acres

Project: I-4400 / I-4700

Site #: 4

Stream Name: Dunn Creek

Drainage Area (sq mi): 2.58

Impervious Area (%): 26.8%

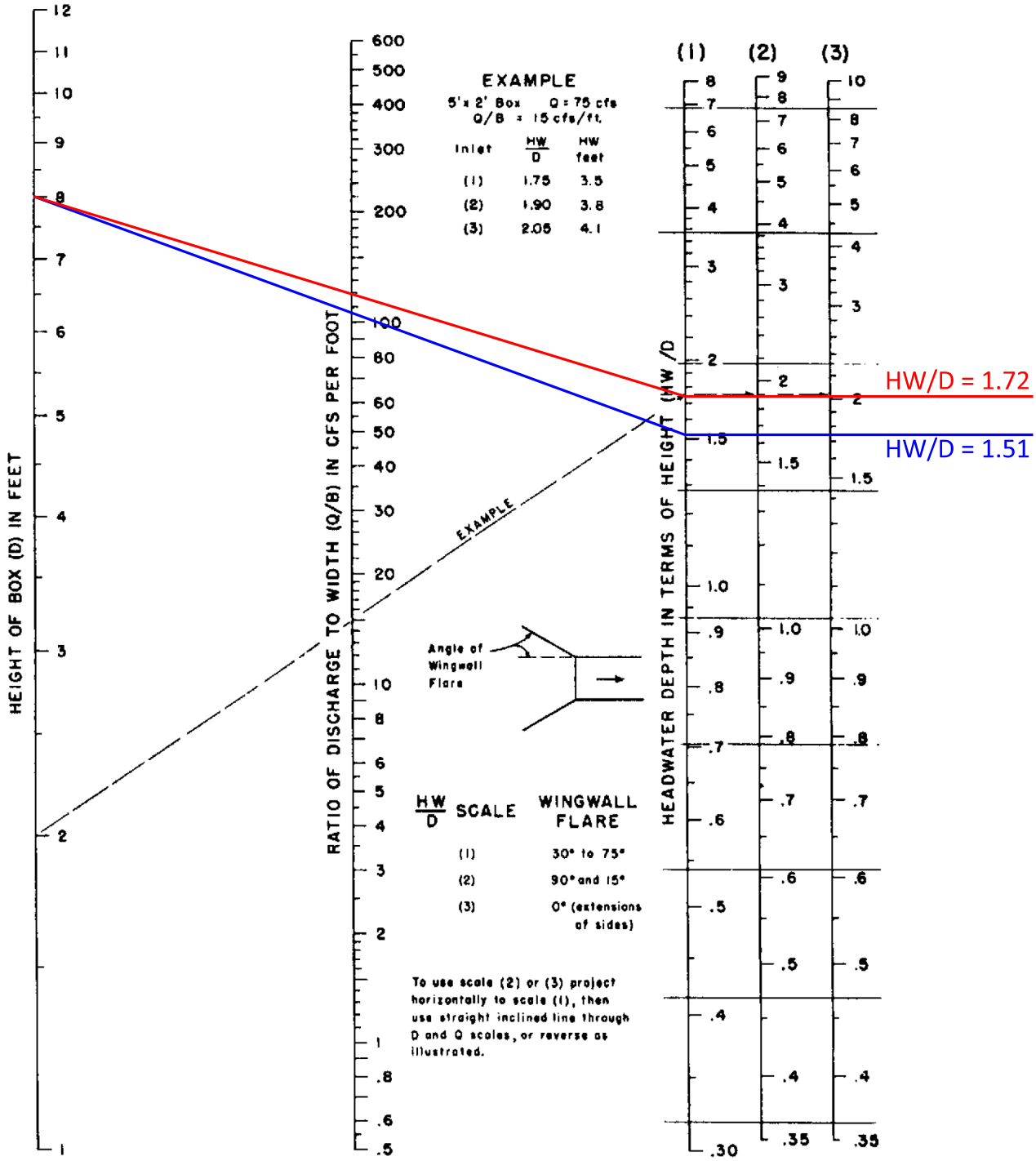
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	DISCHARGE (cfs)		
	PIEDMONT - RIDGE AND VALLEY	SAND HILLS	COASTAL PLAIN
2	724	-	-
5	1029	-	-
10	1242	-	-
25	1496	-	-
50	1677	-	-
100	1868	-	-
200	2052	-	-
500	2262	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	DISCHARGE (cfs)
10	-
50	-
100	1390
500	-

SITE 4

50 Year	100 Year
2 @ 8' x 8' RCBC	2 @ 8' x 8' RCBC
Q = 1700 CFS	Q = 1900 CFS
Q/NB = 106 CFS/FT.	Q/NB = 119 CFS/FT.

CHART 8B



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 9588

FEMA

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
HENDERSON COUNTY	370125	9588	J
HENDERSONVILLE, CITY OF	370128	9588	J

Site 4

MAP NUMBER
3700958800J

MAP REVISED
10/2/2008

Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 9587

FEMA

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
HENDERSON COUNTY	370125	9587	J
HENDERSONVILLE, CITY OF	370128	9587	J

Site 4

MAP NUMBER
3700958700J

MAP REVISED
10/2/2008

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

A Report of Flood Hazards in

HENDERSON COUNTY, NORTH CAROLINA AND INCORPORATED AREAS

Community Name	Community Number
CITY OF HENDERSONVILLE	370128
HENDERSON COUNTY	370125
TOWN OF FLETCHER	370568
TOWN OF LAUREL PARK	370384
VILLAGE OF FLAT ROCK	370565

NORTH CAROLINA
Cooperating Technical State
FEMA'S COOPERATING TECHNICAL PARTNER

EFFECTIVE: 10/2/2008
REVISED: 1/6/2010
Federal Emergency Management Agency
State of North Carolina
Flood Insurance Study Number
37089CV000
www.fema.gov and www.ncfloodmaps.com

Table 10 - Flooding Sources Studied by Detailed Methods: Limited Detailed

Source	Riverine Sources		Affected Communties
	From	To	
Allen Branch	The confluence with Clear Creek	Approximately 200 feet upstream of the Luther Capell Lane	City Of Hendersonville Henderson County
Bat Fork Creek	Approximately 1,500 feet upstream of New Hope Road (SR 1757)	Approximately 200 feet upstream of US Route 176	City Of Hendersonville Henderson County
Battle Creek	The confluence with Shaw Creek	Approximately 0.5 mile upstream US Route 64	Henderson County
Big Willow Creek	The confluence with French Broad River	The confluence of South Fork Big Willow Creek and North Fork Big Willow Creek	Henderson County
Big Willow Creek Tributary 1	The confluence with Big Willow Creek	Approximately 50 feet upstream of Lakeshore Drive	Henderson County
Boylston Creek	Approximately 100 feet upstream of Gonce Drive	Approximately 280 feet upstream of King Road (SR 1502) (SR 1502)	Town Of Mills River
Britton Creek	New Village Drive	Approximately 90 feet upstream of Mistletoe Trail	City Of Hendersonville Henderson County
Britton Creek Tributary 2	The confluence with Britton Creek	Approximately 150 feet upstream of Stonebrook Drive	City Of Hendersonville
Broad River	The Henderson/Rutherford County boundary	Approximately 120 feet upstream of the Henderson/Buncombe County boundary	Henderson County
Clear Creek	Approximately 150 feet downstream of the confluence of Kyles Creek	Approximately 1.0 mile upstream of Apple Valley Road (SR 1572)	Henderson County
Dunn Creek	The confluence with Bat Fork Creek	Approximately 700 feet upstream of Howard Gap Road (SR 1006)	City Of Hendersonville Henderson County
Featherstone Creek	The confluence with Mud Creek	Approximately 250 feet upstream of Locust Grove Road (SR 1528)	Henderson County
Finley Creek	The confluence with Shepherd Creek and Perry Creek	Approximatley 0.4 mile upstream of Old Kanuga Road (SR 1138)	City Of Hendersonville Henderson County
Gash Creek	The confluence with French Broad River	Approximately 1,300 feet upstream of US Route 64	Henderson County
Green River	Approximately 90 feet downstream of the confluence of Wheat Creek	Approximately 0.7 mile downstream of NC Route 225	Henderson County
Henderson Creek	The confluence with Clear Creek	Approximately 1,300 feet upstream of Pace Rd (SR 1726)	Henderson County
Hickory Creek (near Gerton)	The confluence with Broad River	Approximately 0.6 mile upstream of Bearwallow Mountain Road (SR 1693)	Henderson County
King Creek	The confluence with Bat Fork Creek	Approximately 2,400 feet upstream of W. Blue Ridge Road	City Of Hendersonville Henderson County Village Of Flat Rock
King Creek Tributary 3	The confluence with King Creek	Approximately 200 feet upstream of Rutledge Drive (SR 1166)	City Of Hendersonville Henderson County Village Of Flat Rock
Kyles Creek	The confluence with Clear Creek	Approximately 150 feet downstream of Terrys Gap Road (SR 1565)	Henderson County
Lanning Mill Creek	The confluence with Kyles Creek	Approximately 800 feet upstream of the confluence with Kyles Creek	Henderson County
Lewis Creek	The confluence with Clear Creek	Approximately 140 feet downstream of Pilot Mountain Road (SR 1783)	Henderson County
Little Willow Creek	The confluence with French Broad River	Approximately 1.0 mile upstream of Pleasant Grove Church (SR 1191)	Henderson County
Mill Pond Creek	Approximately 40 feet downstream of North Hills Drive	Approximately 400 feet upstream of Stoney Mountain Road (SR 1383)	Henderson County
North Fork Big Willow Creek	The confluence with Big Willow Creek	Approximately 0.6 mile upstream of the confluence with Big Willow Creek	Henderson County
North Fork Mills River	The confluence with Mills River	Approximately 1.3 miles upstream of Rush Branch Road	Henderson County Town Of Mills River
Perry Creek	The confluence with Finley Creek and Shepherd Creek	Approximately 1,500 feet upstream of Price Road (SR 1137)	Henderson County
Piney Branch	The confluence with South Fork Big Willow Creek	Approximately 0.8 mile upstream of Big Willow Road (SR 1191)	Henderson County
Reedypatch Creek	The confluence with Broad River	Approximately 600 feet upstream of Bald Rock Road (SR 1710)	Henderson County
Rock Creek (into Green River)	The confluence with Green River	Approximately 0.4 mile upstream of Green River Road (SR 1106)	Henderson County
Shaw Creek	The confluence with French Broad River	Approximately 1,400 feet upstream of Turley Falls Road (SR 1215)	Henderson County
Shepherd Creek	Approximately 50 feet downstream of S. Lakeside Drive (SR 1148)	The confluence of Finley Creek and Perry Creek	City Of Hendersonville Henderson County
South Fork Big Willow Creek	The confluence with Big Willow Creek	Approximately 0.4 mile upstream of Patterson Road (SR 1194)	Henderson County
South Fork Mills River	The confluence with Mills River	Approximately 3.2 miles upstream of Dalton Road (SR 1340)	Henderson County Town Of Mills River
Tonys Creek	The confluence with Shepherd Creek	Approximately 0.5 mile upstream of Willow Road (SR 1171)	City Of Hendersonville Henderson County Town Of Laurel Park

Table 13 - Summary of Discharges

Flooding Source		Discharges (cfs)			
Location	Drainage Area (square miles)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Approximately 300 feet downstream of Howard Gap Road (SR 1006)	79.77	*	*	11,340	*
Approximately 50 feet upstream of confluence of Hoopers Creek	63.63	*	*	10,690	*
Approximately 100 feet upstream of Mills Gap Road (SR 1551)	63.14	*	*	10,670	*
Approximately 1,200 feet upstream of Mills Gap Road (SR 1551)	60.64	*	*	8,160	*
At the Henderson/Buncombe County boundary	60.31	*	*	8,150	*
Clear Creek					
At the confluence with Mud Creek	44.44	3,550	5,970	7,200	10,620
Approximately 50 feet upstream of Allen Branch	42.98	3,430	5,790	7,000	10,340
Approximately 200 feet upstream of Nix Road (SR 1513)	42.57	3,400	5,740	6,940	10,260
Approximately 900 feet downstream of Howard Gap Road (SR 1006)	42.32	3,380	5,710	6,900	10,220
Approximately 100 feet downstream of Howard Gap Road (SR 1006)	39.23	3,290	5,540	6,690	9,880
Approximately 0.6 mile upstream of the confluence with Wolfpen Creek	37.10	3,100	5,300	6,500	9,700
Approximately 0.4 mile upstream of Lancaster Road (SR 1582)	34.10	2,950	5,000	6,200	9,200
Approximately 1,500 feet upstream of Fruitland Road (SR 1574)	28.00	2,600	4,500	5,500	8,100
Approximately 50 feet upstream of confluence of Kyles Creek	23.70	*	*	5,320	*
At the confluence of Puncheon Camp Creek	10.67	*	*	3,270	*
Devils Fork					
At the confluence with Bat Fork Creek	8.53	1,380	2,350	2,840	4,240
Approximately 100 feet upstream of Tracy Grove Road (SR 1793)	8.23	1,350	2,300	2,780	4,150
Approximately 1,500 feet upstream of Tracy Grove Road (SR 1793)	7.80	1,300	2,220	2,690	4,020
Approximately 0.5 mile upstream of Tracy Grove Road (SR 1793)	7.42	1,260	2,150	2,610	3,900
Approximately 0.4 mile downstream of Interstate 26	6.83	1,190	2,040	2,480	3,710
Approximately 200 feet upstream of Interstate 26	6.27	1,130	1,930	2,350	3,520
Approximately 0.4 mile upstream of Interstate 26	5.80	1,080	1,850	2,250	3,390
Approximately 0.7 mile upstream of Interstate 26	4.95	960	1,660	2,020	3,050
Approximately 300 feet upstream of Howard Gap Road (SR 1006)	4.55	910	1,570	1,920	2,900
Approximately 0.5 mile upstream of Howard Gap Road (SR 1006)	4.00	840	1,450	1,770	2,680
Approximately 0.5 mile downstream of Dana Road (SR 1525)	2.44	600	1,060	1,300	1,990
Approximately 1,500 feet downstream of Dana Road (SR 1525)	1.86	500	890	1,100	1,690
Dunn Creek					
At the confluence with Bat Fork Creek	3.07	*	*	1,500	*
Approximately 600 feet downstream of Howard Gap Road (SR 1006)	1.01	*	*	750	*
Featherstone Creek					
At the confluence with Mud Creek	4.12	*	*	1,810	*
Approximately 1,100 feet downstream of Locust Grove Road (SR 1528)	1.37	*	*	910	*
Finley Creek					
At the confluence with Shepherd Creek	2.22	*	*	1,230	*
French Broad River					
Approximately 0.4 mile downstream of the confluence of Bent Creek	676.00	*	*	50,000	*
At the confluence of Cane Creek	633.00	*	*	48,500	*
Mile 166.9 above Cane Creek	546.00	*	*	46,000	*
Mile 168.5 above Mud Creek	432.00	*	*	41,500	*
Mile 169.2 above Mill River	357.00	17,000	30,600	38,000	58,500
Gash Creek					

5.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the flood elevations for the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles and/or Water-surface elevation rasters. For stream segments for which BFEs were computed, selected cross-section locations are also shown on the FIRM. Flood Profiles and/or Water-surface elevation rasters were developed showing computed water-surface elevations for floods of the selected recurrence intervals.

Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles and/or Water-surface elevation rasters or in the Floodway Data tables in the FIS Report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in the FIS in conjunction with the data shown on the FIRM.

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the Flood Profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For details on the county's hydraulic analyses, the hydraulic report is available by request.

For the streams studied by detailed methods, water surface elevations of floods of the selected recurrence intervals were computed through use of the Army Corps of Engineers' HEC RAS step backwater computer program . The hydraulic analyses were based on unobstructed flow. The flood elevations shown on the Profiles and/or Water-surface elevation rasters are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail. The computer models were calibrated using historic high water data collected during field investigations.

The cross section geometries were obtained from a combination of digital elevation data obtained by Light Detection and Ranging (LIDAR) and field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Natural floodplain cross sections were surveyed approximately every 4000 feet along the detail study reaches to obtain the channel geometry between bridges and culverts. Overbank cross section data for the backwater analyses were obtained from recently flown LIDAR data.

Channel roughness factors (Manning's "n") used in the hydraulic computations were made in the field by an engineer where stream access was possible, with orthophotos used to supplement areas that could not be accessed. The channel and overbank "n" values for all of the streams studied by detailed methods are shown in Table 16, "Roughness Coefficients".

Table 16 - Roughness Coefficients

Stream	Channel "n"	Overbank "n"
Allen Branch	0.045 to 0.050	0.030 to 0.090
Bat Fork Creek	0.040 to 0.060	0.022 to 0.150
Battle Creek	0.035 to 0.040	0.040 to 0.090
Big Willow Creek	0.040	0.050 to 0.090
Big Willow Creek Tributary 1	0.025 to 0.050	0.050 to 0.090
Boylston Creek	0.035 to 0.090	0.040 to 0.120
Boylston Creek Tributary 7	0.040 to 0.090	0.050 to 0.090
Britton Creek	0.035 to 0.060	0.030 to 0.160
Britton Creek Tributary 2	0.040 to 0.050	0.030 to 0.090
Broad River	0.028 to 0.100	0.010 to 0.130
Cane Creek	0.040 to 0.050	0.025 to 0.250
Clear Creek	0.035 to 0.060	0.030 to 0.140
Crab Creek	0.055 to 0.061	0.080 to 0.660
Devils Fork	0.040 to 0.070	0.010 to 0.150
Dunn Creek	0.035 to 0.050	0.030 to 0.090
Featherstone Creek	0.045 to 0.090	0.030 to 0.090
Finley Creek	0.040 to 0.050	0.040 to 0.090
French Broad River	0.024 to 0.064	0.030 to 0.200
Gash Creek	0.037 to 0.057	0.030 to 0.125
Green River	0.032 to 0.090	0.025 to 0.100
Hickory Creek (near Gerton)	0.060 to 0.100	0.060 to 0.100
Higgins Branch	0.050 to 0.065	0.025 to 0.100
Hoopers Creek	0.045 to 0.070	0.025 to 0.150
Kimsey Creek	0.040 to 0.045	0.025 to 0.100
King Creek	0.045 to 0.050	0.030 to 0.090
King Creek Tributary 3	0.045 to 0.050	0.030 to 0.090
Kyles Creek	0.045 to 0.050	0.006 to 0.090
Lanning Mill Creek	0.050	0.050 to 0.090
Lewis Creek	0.045 to 0.050	0.030 to 0.090

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/4/14

SITE NUMBER 4 STREAM DUNN CREEK ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 2 @ 8' x 8' RCBC. MINOR CRACKS THROUGHOUT THE STRUCTURE. DROP INLET IN LEFT BARREL

UPSTREAM CHANNEL: TOP WIDTH 20 FT BOTTOM WIDTH 15 FT BANKFULL DEPTH 5 FT

DEPTH OF FLOW (AT TIME OF VISIT) 3 FT BED MATERIAL

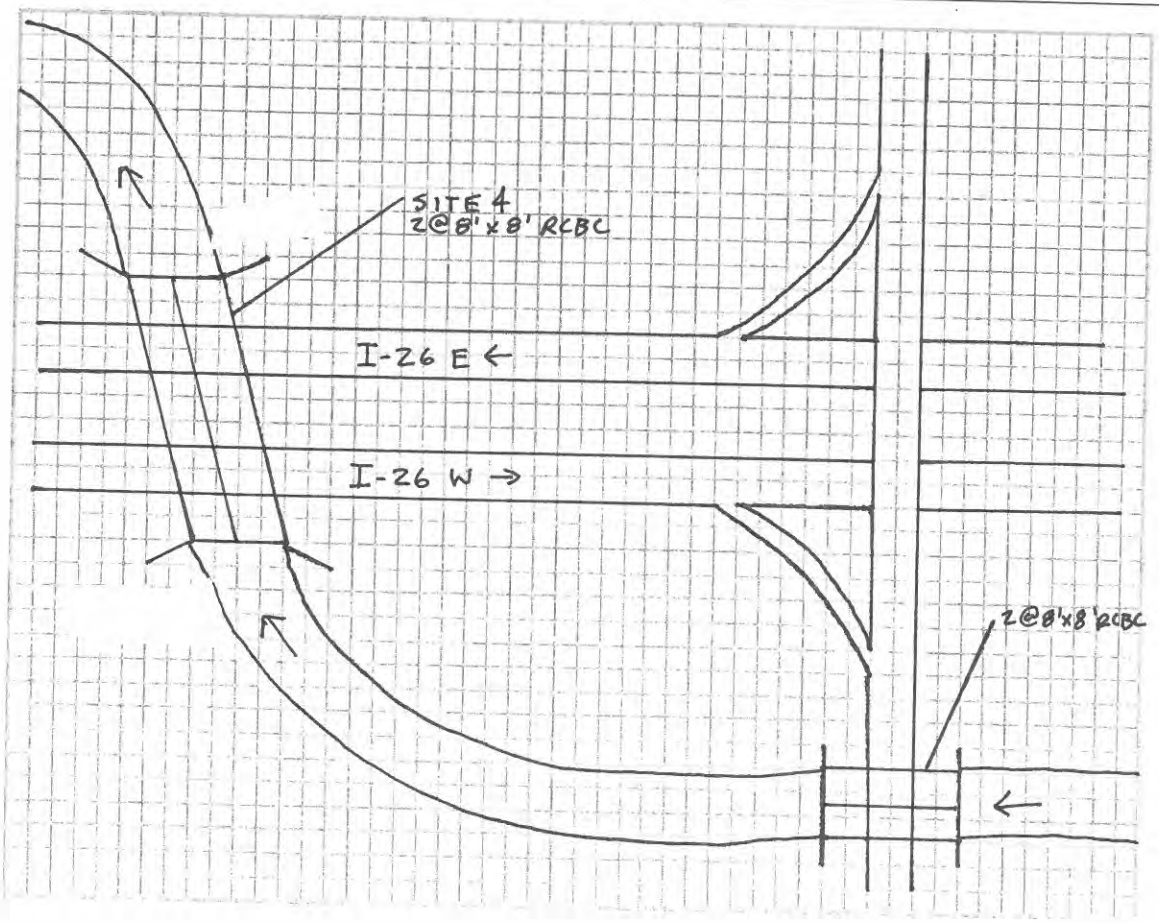
BANK/ CHANNEL CONDITIONS HIGH DEBRIS. BANKS ARE STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 33 FT BOTTOM WIDTH 14 FT BANKFULL DEPTH 7 FT

DEPTH OF FLOW (AT TIME OF VISIT) 2 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS 2' OF SILT IN LEFT BARREL. 3-4' OF SILT IN RIGHT BARREL. RIP RAP AT OUTLET. BANKS ARE STABLE AND VEGETATED.

COMMENTS THE UPSTREAM STRUCTURE IS A 2@8'x8' RCBC.



Looking at Upstream Face of 2 @ 8′ x 8′ RCBC under I-26

Looking at Upstream Left Ditch

Looking Upstream from 2 @ 8' x 8' RCBC Inlet

Looking Inside of Left Barrel

Looking Inside of Right Barrel

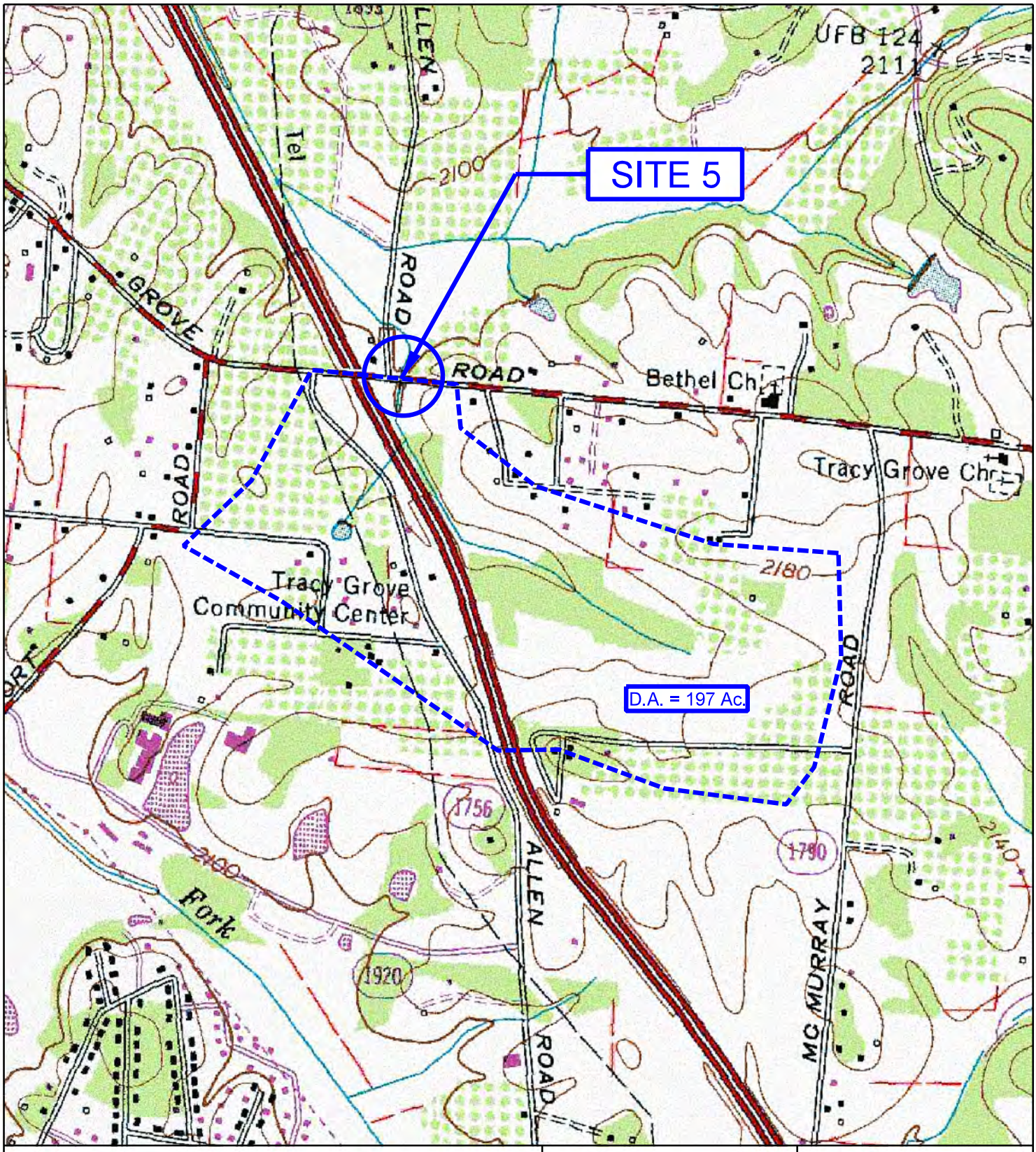
Crack in Right Barrel

Looking at Downstream Face of 2 @ 8' x 8' RCBC under I-26

Looking Downstream from 2 @ 8' x 8' RCBC Outlet

APPENDIX H

SITE 5



QUAD MAP - SITE 5

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 5

Stream Name: UT to Devils Fork

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	118	11.8	0.060
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	37	13.1	0.066
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	0	0.0	0.000
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	42	29.5	0.150
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	0	0.0	0.000
Totals			**197**	**54.3**	**27.6%**

Drainage Area = 197 acres

Project: I-4400 / I-4700

Site #: 5

Stream Name: UT to Devils Fork

Drainage Area (sq mi): 0.31

Impervious Area (%): 27.6%

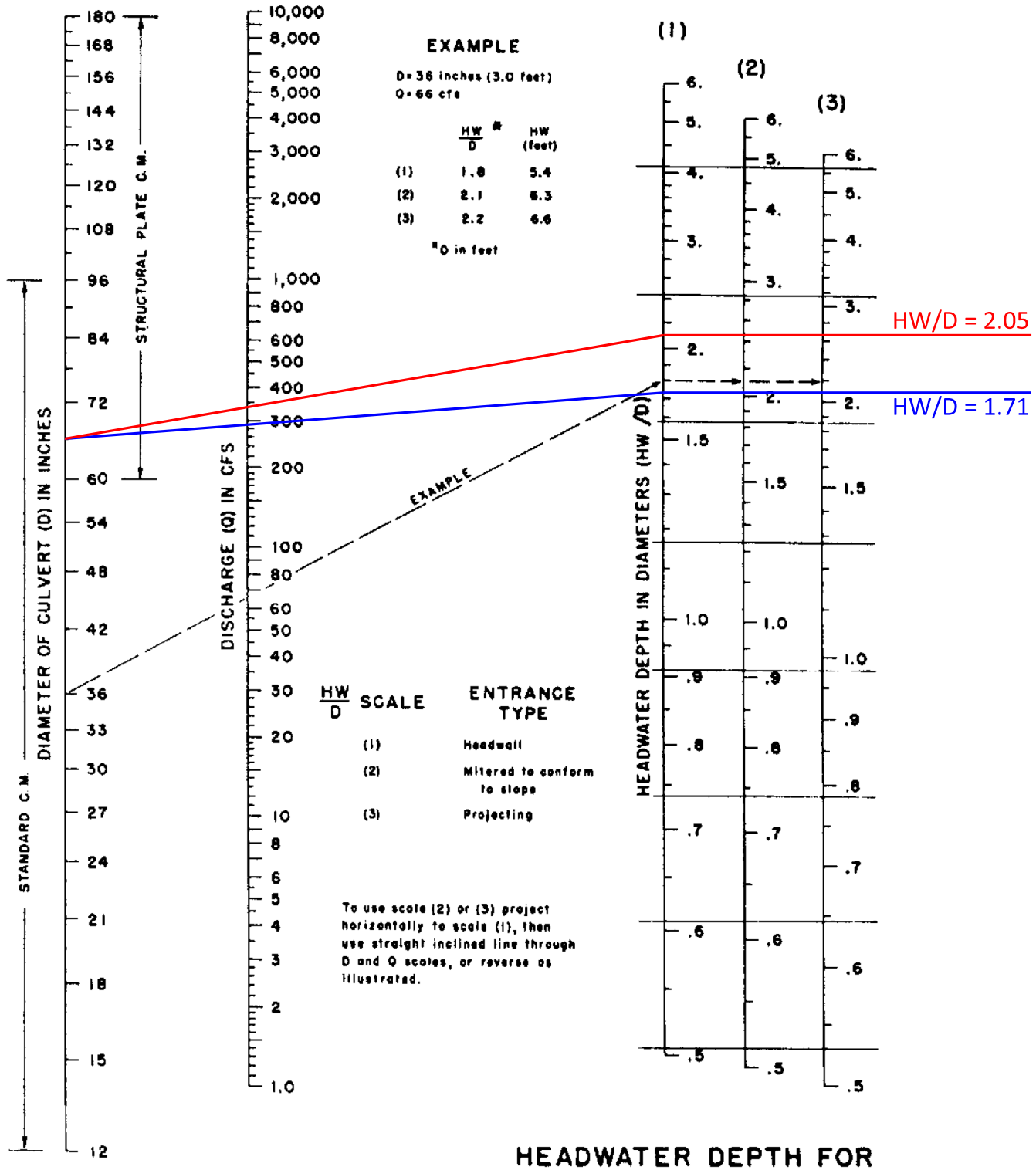
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	164	-	-
5	220	-	-
10	254	-	-
25	291	-	-
50	315	-	-
100	340	-	-
200	362	-	-
500	400	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	-
50	-
100	-
500	-

SITE 5

25 Year	100 Year
1 @ 66" STRUCTURAL PLATE PIPE W/ HW	1 @ 66" STRUCTURAL PLATE PIPE W/ HW
Q = 290 CFS	Q = 340 CFS

CHART 2B



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/5/14
SITE NUMBER 5 STREAM UT TO DEVILS FORK ROUTE TRACY GROVE RD.
ASSESSMENT PREPARED BY HNTB DATE

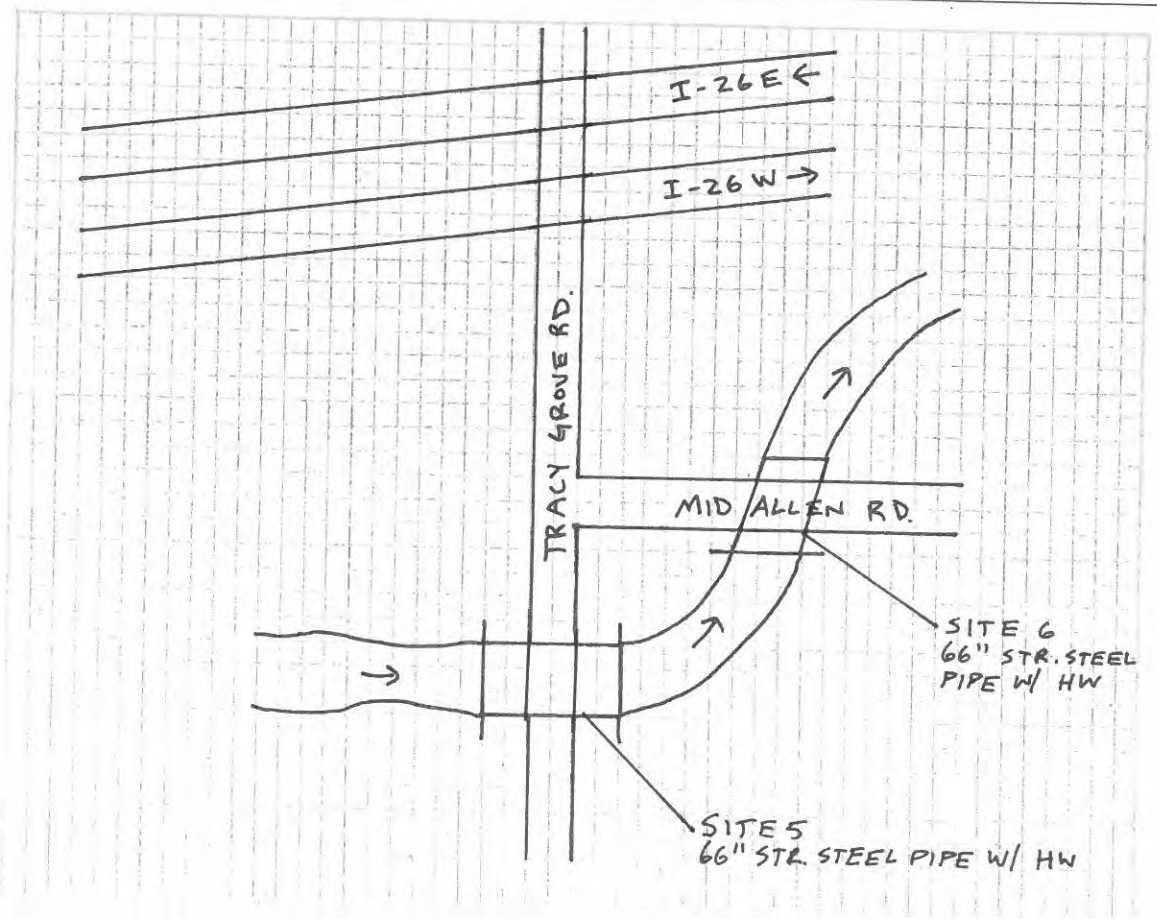
EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 66" STRUCTURAL PLATE PIPE WITH A HEADWALL. BOTTOM OF THE PIPE IS RUSTED THROUGH FOR 80% OF THE PIPE

UPSTREAM CHANNEL: TOP WIDTH 15 FT BOTTOM WIDTH 5 FT BANKFULL DEPTH 4 FT
DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL
BANK/ CHANNEL CONDITIONS MINOR EROSION BEHIND THE HEADWALL. BANKS STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 19 FT BOTTOM WIDTH 9 FT BANKFULL DEPTH 3 FT
DEPTH OF FLOW (AT TIME OF VISIT) 1 FT BED MATERIAL
BANK/ CHANNEL CONDITIONS SEVERE EROSION BEHIND THE HEADWALL. THE HEADWALL IS LEANING FORWARD. BANKS STABLE AND VEGETATED.

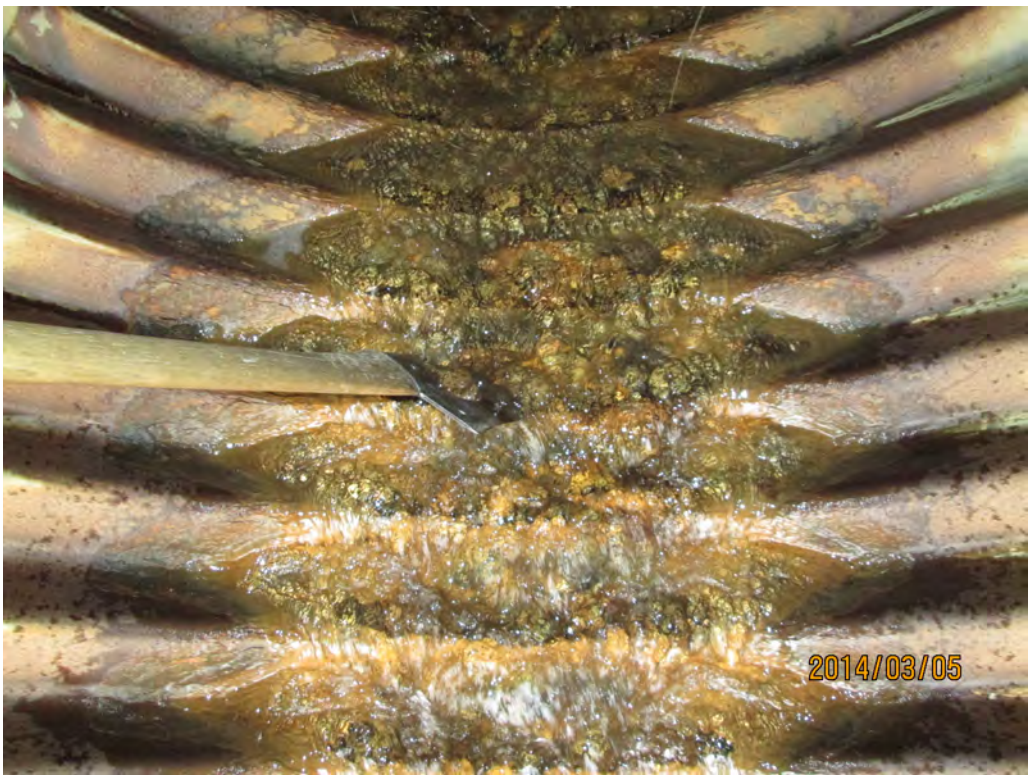
COMMENTS SITE 6 IS LOCATED DOWNSTREAM. SITE 6 IS A 66" STRUCTURAL PLATE PIPE WITH A HEADWALL.



Looking at Upstream Face of 66" SSP Pipe under Tracy Grove Rd.

Looking Upstream from Inlet of 66" SPP

Looking Inside 66" SPP



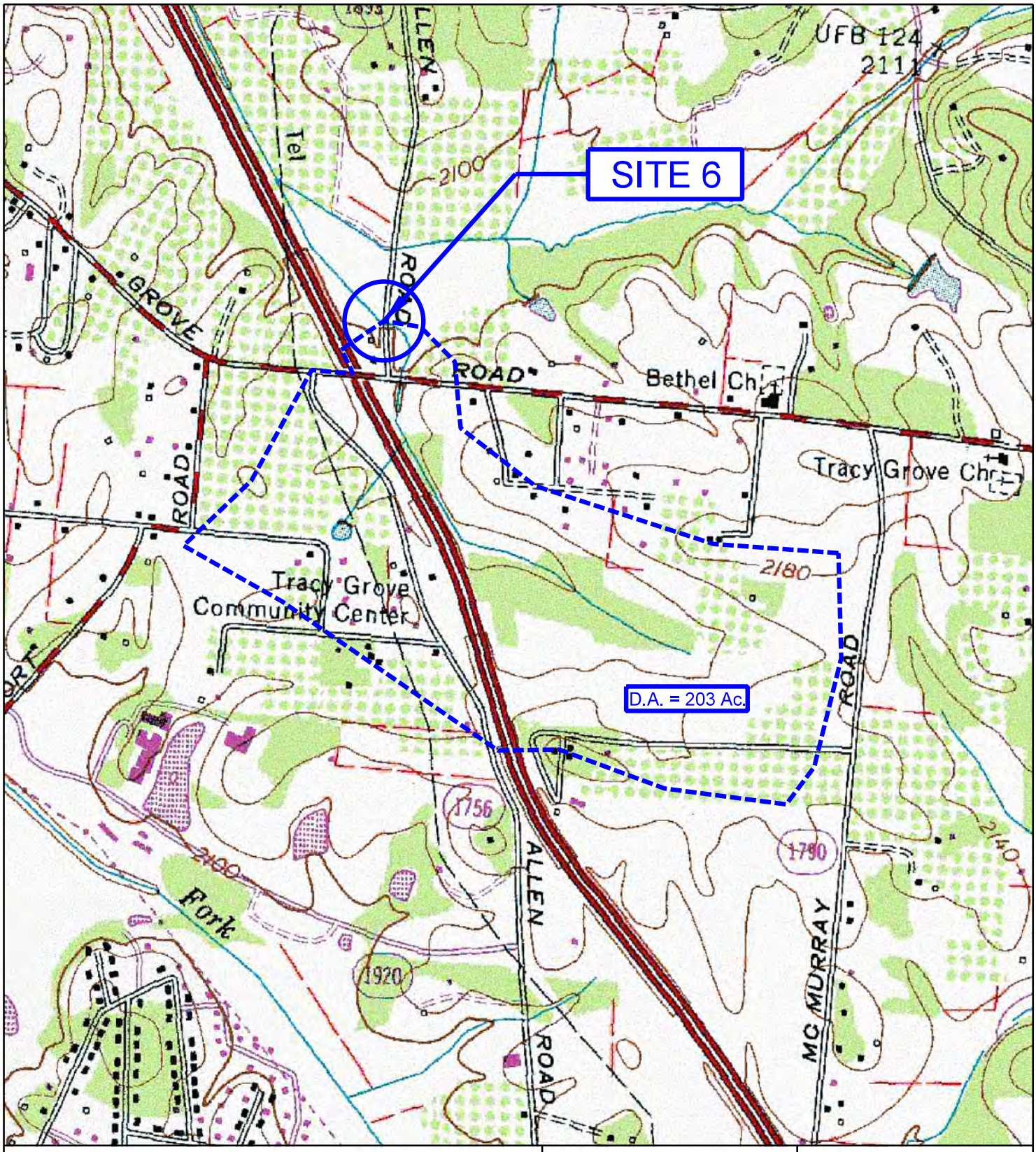
Looking at the bottom of 66" SPP

Looking at Downstream Face of 66" SPP under Tracy Grove Rd.

Looking Downstream from Outlet of 66" SPP

APPENDIX I

SITE 6



QUAD MAP - SITE 6

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 6

Stream Name: UT to Devils Fork

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	121	12.1	0.060
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	39	13.8	0.068
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	0	0.2	0.001
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	42	29.5	0.145
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	0	0.0	0.000
Totals			**203**	**55.6**	**27.4%**

Drainage Area = 203 acres

Project: I-4400 / I-4700

Site #: 6

Stream Name: UT to Devils Fork

Drainage Area (sq mi): 0.32

Impervious Area (%): 27.4%

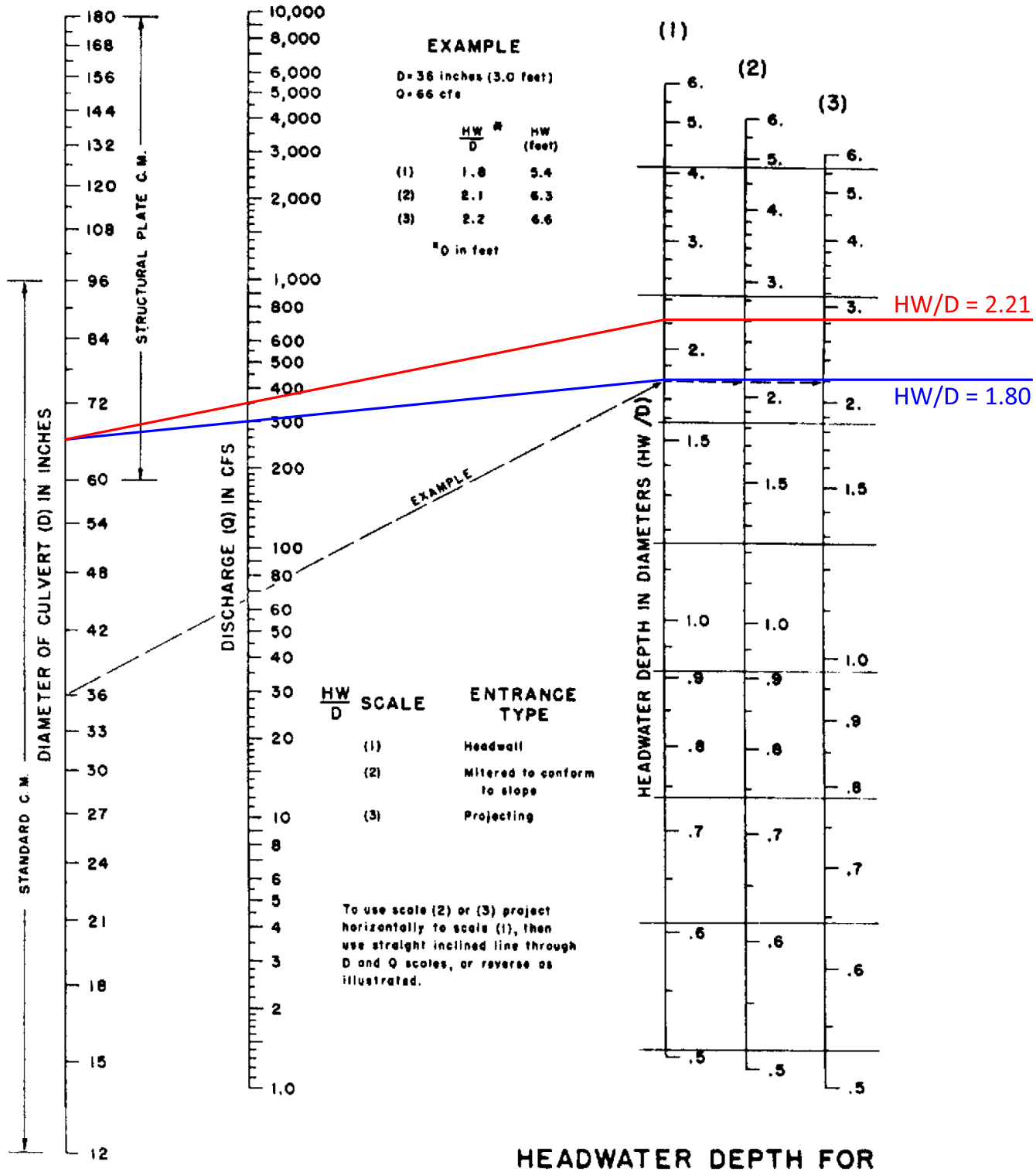
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	167	-	-
5	224	-	-
10	259	-	-
25	297	-	-
50	322	-	-
100	348	-	-
200	371	-	-
500	410	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	-
50	-
100	-
500	-

SITE 6

25 Year	100 Year
1 @ 66" STRUCTURAL PLATE PIPE W/ HW	1 @ 66" STRUCTURAL PLATE PIPE W/ HW
Q = 300 CFS	Q = 350 CFS

CHART 2B



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/5/14

SITE NUMBER 6 STREAM UT TO DEVILS FORK ROUTE MID ALLEN RD.

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 66" STRUCTURAL PLATE WITH HEADWALL. 0.5 FT. OF SILT THROUGHOUT THE PIPE. ASPHALT COATING IS EITHER CRACKED OR MISSING.

UPSTREAM CHANNEL: TOP WIDTH 16 FT BOTTOM WIDTH 7 FT BANKFULL DEPTH 4 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.3 FT BED MATERIAL

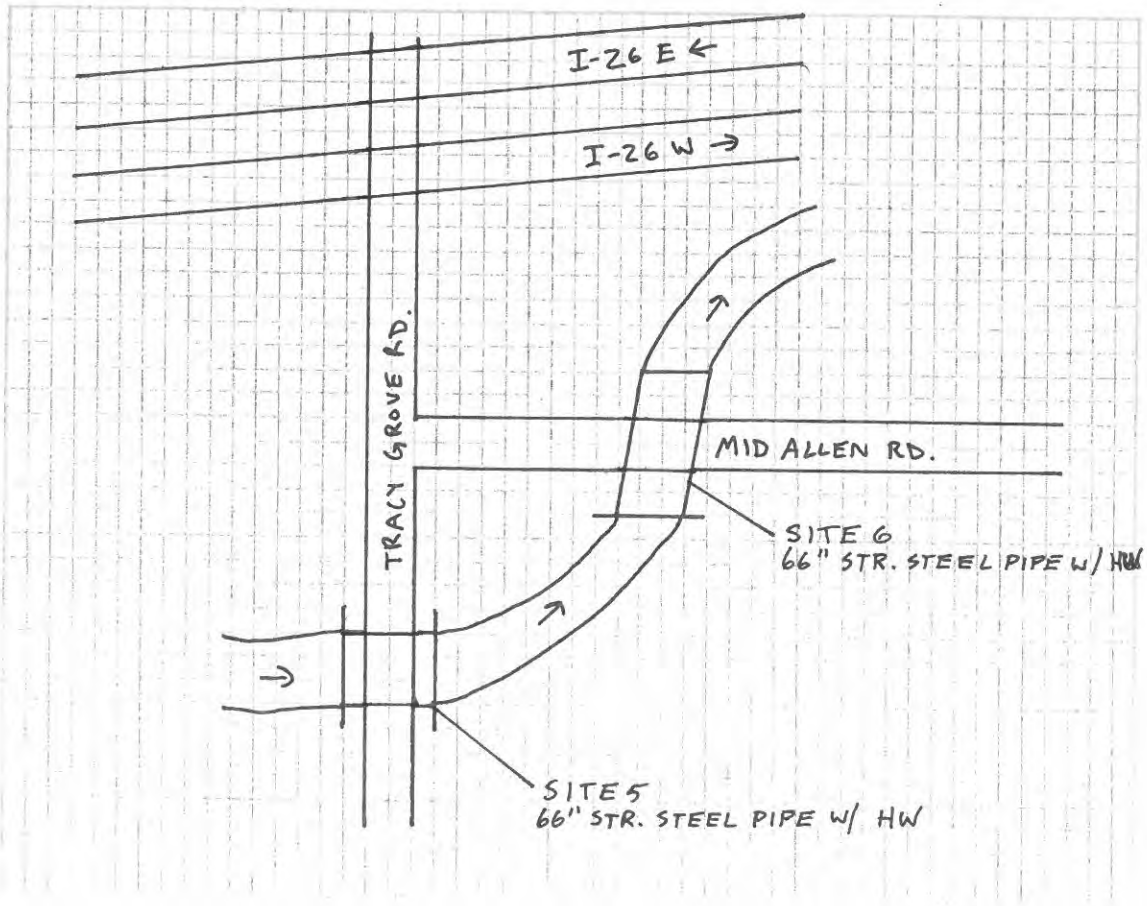
BANK/ CHANNEL CONDITIONS DEBRIS IN CHANNEL. BANKS ARE STABLE AND VEGETATED. 0.5 FT. OF SILT AT INLET.

DOWNSTREAM CHANNEL: TOP WIDTH 10 FT BOTTOM WIDTH 4.5 FT BANKFULL DEPTH 6 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS BANKS ARE STABLE AND VEGETATED. 0.5 FT. OF SILT AT OUTLET

COMMENTS SITE 5 IS LOCATED UPSTREAM. SITE 5 IS A 66" STRUCTURAL PLATE PIPE WITH A HEADWALL.



Looking at Upstream Face of 66" SPP under Mid Allen Rd.

Looking Upstream from 66" SPP

Looking Inside 66" SPP

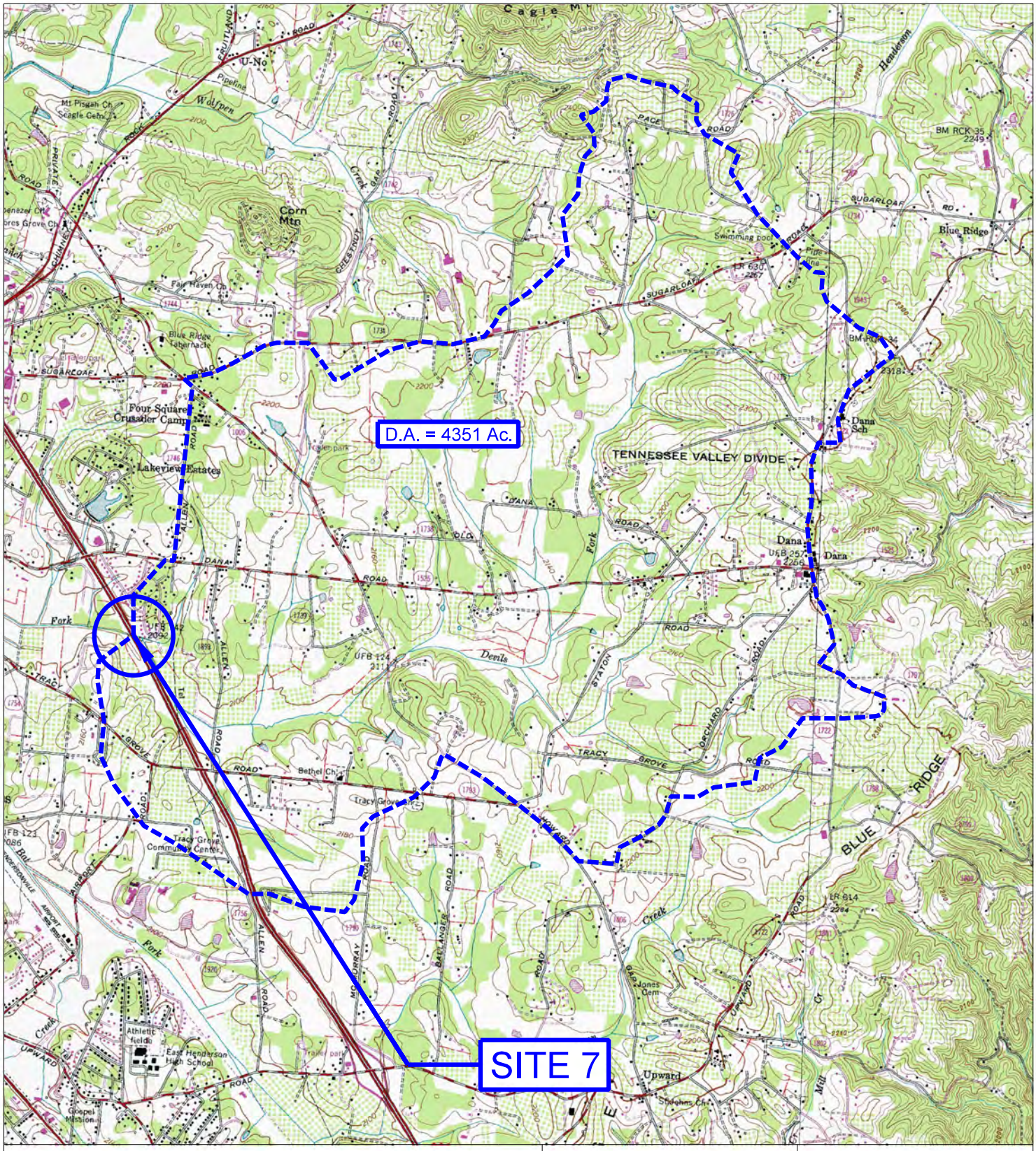
Looking Inside 66" SPP

Looking at Downstream Face of 66" SPP under Mid Allen Rd.

Looking Downstream from 66" SPP

APPENDIX J

SITE 7



QUAD MAP - SITE 7

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

1,500 0 1,500 3,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 7

Stream Name: Devils Fork

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	3703	370.3	0.085
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	237	83.0	0.019
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	0	0.2	0.000
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	219	153.3	0.035
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	191	161.9	0.037
Totals			**4350**	**768.7**	**17.7%**

Drainage Area = 4350 acres

Project: I-4400 / I-4700

Site #: 7

Stream Name: Devils Fork

Drainage Area (sq mi): 6.80

Impervious Area (%): 17.7%

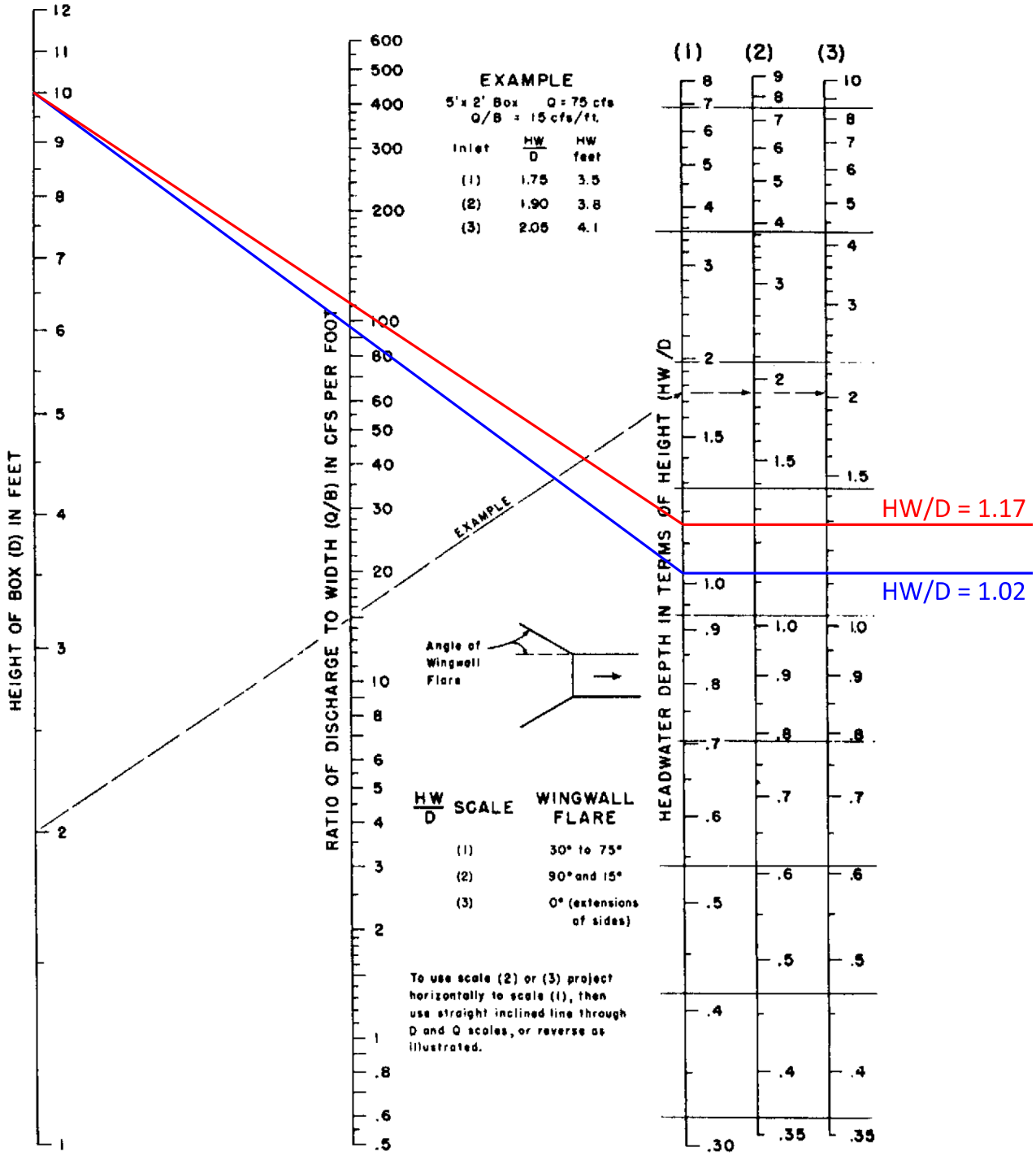
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	896	-	-
5	1420	-	-
10	1786	-	-
25	2260	-	-
50	2612	-	-
100	2960	-	-
200	3329	-	-
500	3813	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	1130
50	1930
100	2350
500	3520

50 Year	100 Year
3 @ 9' x 10' RCBC	1 @ 9' x 10' RCBC
Q = 2600 CFS	Q = 3000 CFS
Q/NB = 96 CFS/FT.	Q/NB = 111 CFS/FT.

SITE 7

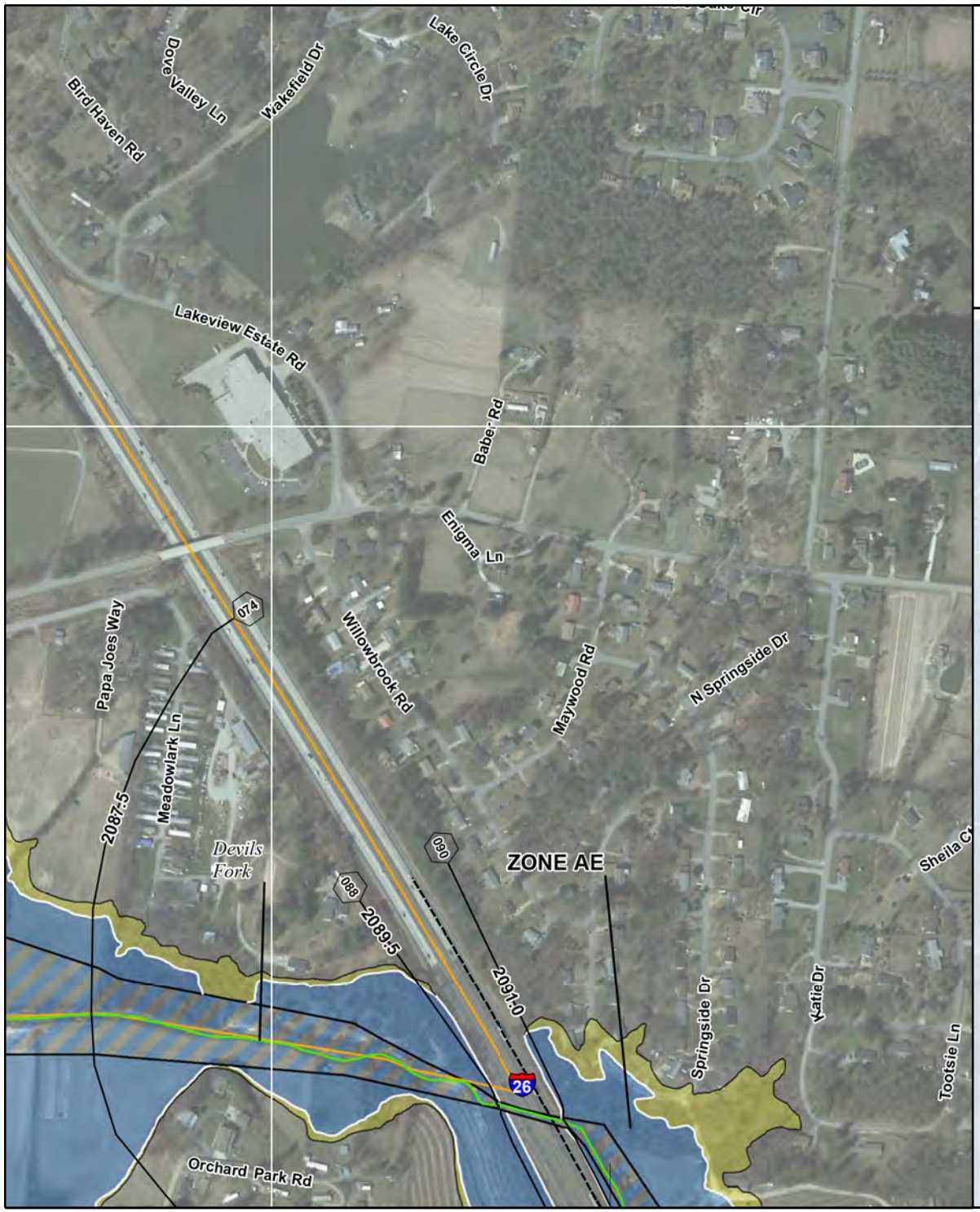
CHART 8B



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING



Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 9579

FEMA

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
HENDERSON COUNTY	370125	9579	J
HENDERSONVILLE, CITY OF	370128	9579	J

Site 7

MAP NUMBER
3700957900J

MAP REVISED
10/2/2008

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

A Report of Flood Hazards in

HENDERSON COUNTY, NORTH CAROLINA AND INCORPORATED AREAS

Community Name	Community Number
CITY OF HENDERSONVILLE	370128
HENDERSON COUNTY	370125
TOWN OF FLETCHER	370568
TOWN OF LAUREL PARK	370384
VILLAGE OF FLAT ROCK	370565

NORTH CAROLINA
Cooperating Technical State
FEMA'S COOPERATING TECHNICAL PARTNER

EFFECTIVE: 10/2/2008
REVISED: 1/6/2010
Federal Emergency Management Agency
State of North Carolina
Flood Insurance Study Number
37089CV000
www.fema.gov and www.ncfloodmaps.com

Table 8 - Flooding Sources Studied by Detailed Methods: Revised or Newly Studied

Source	Riverine Sources		Affected Communties
	From	To	
Bat Fork Creek	The confluence with Mud Creek	Approximately 1,500 feet upstream of New Hope Road (SR 1757)	City Of Hendersonville Henderson County
Boylston Creek	Approximately 500 feet downstream of Banner Farm Road	Approximately 100 feet upstream of Gonce Drive	Town Of Mills River
Boylston Creek Tributary 7	The confluence with Boylston Creek	Approximately 1,100 feet upstream of Cross Creek Court	Henderson County Town Of Mills River
Broad River	Approximately 500 feet upstream of US HWY 64 / 74 A	The Henderson / Rutherford County boundary	Henderson County
Cane Creek	The confluence with French Broad River	Approximately 600 feet upstream of Cross Creek Farm Road	City Of Asheville Henderson County Town Of Fletcher
Clear Creek	The confluence with Mud Creek	Approximately 600 feet upstream of Howard Gap Road (SR 1006)	City Of Hendersonville Henderson County
Devils Fork	The confluence with Bat Fork Creek	Approximately 500 feet upstream of Old Dana Road (SR 1738)	City Of Hendersonville Henderson County
Green River	Approximately 0.7 mile downstream of NC Route 225	Approximately 400 feet upstream of Bear Paw Ridge Road	Henderson County
Higgins Branch	The confluence with Kimsey Creek	Approximately 50 feet downstream of the Henderson/Buncombe County boundary	Town Of Fletcher
Hoopers Creek	The confluence with Cane Creek	Approximately 120 feet upstream of Lindsey Loop Road (SR 1571)	Henderson County Town Of Fletcher
Kimsey Creek	The confluence with Cane Creek	Approximately 50 feet downstream of the Henderson/Buncombe County boundary	Henderson County Town Of Fletcher
Mill Pond Creek	At Hysong Lane	Approximately 40 feet downstream of North Hills Drive	Henderson County
Mills River	The confluence with French Broad River	The confluence with South Fork Mills River and North Fork Mills River	Henderson County Town Of Mills River
Mud Creek	The confluence with French Broad River	Approximately 500 feet upstream of Walnut Cove Road (SR 1125)	City Of Hendersonville Henderson County Town Of Fletcher Village Of Flat Rock
South Wash Creek	The confluence with Wash Creek	Approximately 50 feet downstream of Lake Drive	Town Of Laurel Park
Wash Creek	The confluence with Mud Creek	Approximately 1,400 feet upstream of Glasgow Lane (SR 1185)	City Of Hendersonville Henderson County Town Of Laurel Park

Table 9, “Flooding Sources Studied by Detailed Methods: Redelineated”, lists all flooding sources that were studied by detailed methods for the pre-statewide FIS and redelineated for previous FISs. These flooding sources were not part of this revision and their effective analyses remain valid.

Table 9 - Flooding Sources Studied by Detailed Methods: Redelineated

Source	Riverine Sources		Affected Communties
	From	To	
Boylston Creek	The confluence with French Broad River	Approximately 500 feet downstream of Banner Farm Road	Henderson County Town Of Mills River
Britton Creek	The confluence with Mud Creek	New Village Drive	City Of Hendersonville
Clear Creek	Approximately 600 feet upstream of Howard Gap Road (SR 1006)	Approximately 150 feet downstream of the confluence of Kyles Creek	City Of Hendersonville Henderson County
Crab Creek	The confluence with Little River	The Henderson/Transylvania County boundary Transylvania County boundary	Henderson County
French Broad River	Approximately 1.1 miles downstream of the Buncombe/Madison County boundary	Approximately 3 miles upstream of the Buncombe/Henderson County boundary	City Of Asheville Henderson County Town Of Fletcher Town Of Mills River
French Broad River	Approximately 3 miles upstream of the Buncombe/Henderson County boundary	The confluence of North Fork French Broad River and West Fork French Broad River	Henderson County Town Of Mills River
McDowell Creek	The confluence with French Broad River	Pennsylvania Road (SR 1348)	Henderson County Town Of Mills River
Mill Pond Creek	The confluence with French Broad River	At Hysong Lane	Henderson County
Shepherd Creek	The confluence with Mud Creek	Approximately 50 feet downstream of S. Lakeside Drive (SR 1148) (SR 1148)	City Of Hendersonville

Table 10, “Flooding Sources Studied by Detailed Methods: Limited Detailed”, lists all flooding sources within the county that were studied by limited detailed methods for either this FIS or previous FISs.

Table 13 - Summary of Discharges

Flooding Source		Discharges (cfs)			
Location	Drainage Area (square miles)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Approximately 300 feet downstream of Howard Gap Road (SR 1006)	79.77	*	*	11,340	*
Approximately 50 feet upstream of confluence of Hoopers Creek	63.63	*	*	10,690	*
Approximately 100 feet upstream of Mills Gap Road (SR 1551)	63.14	*	*	10,670	*
Approximately 1,200 feet upstream of Mills Gap Road (SR 1551)	60.64	*	*	8,160	*
At the Henderson/Buncombe County boundary	60.31	*	*	8,150	*
Clear Creek					
At the confluence with Mud Creek	44.44	3,550	5,970	7,200	10,620
Approximately 50 feet upstream of Allen Branch	42.98	3,430	5,790	7,000	10,340
Approximately 200 feet upstream of Nix Road (SR 1513)	42.57	3,400	5,740	6,940	10,260
Approximately 900 feet downstream of Howard Gap Road (SR 1006)	42.32	3,380	5,710	6,900	10,220
Approximately 100 feet downstream of Howard Gap Road (SR 1006)	39.23	3,290	5,540	6,690	9,880
Approximately 0.6 mile upstream of the confluence with Wolfpen Creek	37.10	3,100	5,300	6,500	9,700
Approximately 0.4 mile upstream of Lancaster Road (SR 1582)	34.10	2,950	5,000	6,200	9,200
Approximately 1,500 feet upstream of Fruitland Road (SR 1574)	28.00	2,600	4,500	5,500	8,100
Approximately 50 feet upstream of confluence of Kyles Creek	23.70	*	*	5,320	*
At the confluence of Puncheon Camp Creek	10.67	*	*	3,270	*
Devils Fork					
At the confluence with Bat Fork Creek	8.53	1,380	2,350	2,840	4,240
Approximately 100 feet upstream of Tracy Grove Road (SR 1793)	8.23	1,350	2,300	2,780	4,150
Approximately 1,500 feet upstream of Tracy Grove Road (SR 1793)	7.80	1,300	2,220	2,690	4,020
Approximately 0.5 mile upstream of Tracy Grove Road (SR 1793)	7.42	1,260	2,150	2,610	3,900
Approximately 0.4 mile downstream of Interstate 26	6.83	1,190	2,040	2,480	3,710
Approximately 200 feet upstream of Interstate 26	6.27	1,130	1,930	2,350	3,520
Approximately 0.4 mile upstream of Interstate 26	5.80	1,080	1,850	2,250	3,390
Approximately 0.7 mile upstream of Interstate 26	4.95	960	1,660	2,020	3,050
Approximately 300 feet upstream of Howard Gap Road (SR 1006)	4.55	910	1,570	1,920	2,900
Approximately 0.5 mile upstream of Howard Gap Road (SR 1006)	4.00	840	1,450	1,770	2,680
Approximately 0.5 mile downstream of Dana Road (SR 1525)	2.44	600	1,060	1,300	1,990
Approximately 1,500 feet downstream of Dana Road (SR 1525)	1.86	500	890	1,100	1,690
Dunn Creek					
At the confluence with Bat Fork Creek	3.07	*	*	1,500	*
Approximately 600 feet downstream of Howard Gap Road (SR 1006)	1.01	*	*	750	*
Featherstone Creek					
At the confluence with Mud Creek	4.12	*	*	1,810	*
Approximately 1,100 feet downstream of Locust Grove Road (SR 1528)	1.37	*	*	910	*
Finley Creek					
At the confluence with Shepherd Creek	2.22	*	*	1,230	*
French Broad River					
Approximately 0.4 mile downstream of the confluence of Bent Creek	676.00	*	*	50,000	*
At the confluence of Cane Creek	633.00	*	*	48,500	*
Mile 166.9 above Cane Creek	546.00	*	*	46,000	*
Mile 168.5 above Mud Creek	432.00	*	*	41,500	*
Mile 169.2 above Mill River	357.00	17,000	30,600	38,000	58,500
Gash Creek					

5.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the flood elevations for the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles and/or Water-surface elevation rasters. For stream segments for which BFEs were computed, selected cross-section locations are also shown on the FIRM. Flood Profiles and/or Water-surface elevation rasters were developed showing computed water-surface elevations for floods of the selected recurrence intervals.

Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles and/or Water-surface elevation rasters or in the Floodway Data tables in the FIS Report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in the FIS in conjunction with the data shown on the FIRM.

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the Flood Profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For details on the county's hydraulic analyses, the hydraulic report is available by request.

For the streams studied by detailed methods, water surface elevations of floods of the selected recurrence intervals were computed through use of the Army Corps of Engineers' HEC RAS step backwater computer program . The hydraulic analyses were based on unobstructed flow. The flood elevations shown on the Profiles and/or Water-surface elevation rasters are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail. The computer models were calibrated using historic high water data collected during field investigations.

The cross section geometries were obtained from a combination of digital elevation data obtained by Light Detection and Ranging (LIDAR) and field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Natural floodplain cross sections were surveyed approximately every 4000 feet along the detail study reaches to obtain the channel geometry between bridges and culverts. Overbank cross section data for the backwater analyses were obtained from recently flown LIDAR data.

Channel roughness factors (Manning's "n") used in the hydraulic computations were made in the field by an engineer where stream access was possible, with orthophotos used to supplement areas that could not be accessed. The channel and overbank "n" values for all of the streams studied by detailed methods are shown in Table 16, "Roughness Coefficients".

Table 16 - Roughness Coefficients

Stream	Channel "n"	Overbank "n"
Allen Branch	0.045 to 0.050	0.030 to 0.090
Bat Fork Creek	0.040 to 0.060	0.022 to 0.150
Battle Creek	0.035 to 0.040	0.040 to 0.090
Big Willow Creek	0.040	0.050 to 0.090
Big Willow Creek Tributary 1	0.025 to 0.050	0.050 to 0.090
Boylston Creek	0.035 to 0.090	0.040 to 0.120
Boylston Creek Tributary 7	0.040 to 0.090	0.050 to 0.090
Britton Creek	0.035 to 0.060	0.030 to 0.160
Britton Creek Tributary 2	0.040 to 0.050	0.030 to 0.090
Broad River	0.028 to 0.100	0.010 to 0.130
Cane Creek	0.040 to 0.050	0.025 to 0.250
Clear Creek	0.035 to 0.060	0.030 to 0.140
Crab Creek	0.055 to 0.061	0.080 to 0.660
Devils Fork	0.040 to 0.070	0.010 to 0.150
Dunn Creek	0.035 to 0.050	0.030 to 0.090
Featherstone Creek	0.045 to 0.090	0.030 to 0.090
Finley Creek	0.040 to 0.050	0.040 to 0.090
French Broad River	0.024 to 0.064	0.030 to 0.200
Gash Creek	0.037 to 0.057	0.030 to 0.125
Green River	0.032 to 0.090	0.025 to 0.100
Hickory Creek (near Gerton)	0.060 to 0.100	0.060 to 0.100
Higgins Branch	0.050 to 0.065	0.025 to 0.100
Hoopers Creek	0.045 to 0.070	0.025 to 0.150
Kimsey Creek	0.040 to 0.045	0.025 to 0.100
King Creek	0.045 to 0.050	0.030 to 0.090
King Creek Tributary 3	0.045 to 0.050	0.030 to 0.090
Kyles Creek	0.045 to 0.050	0.006 to 0.090
Lanning Mill Creek	0.050	0.050 to 0.090
Lewis Creek	0.045 to 0.050	0.030 to 0.090

PRELIMINARY DESIGN AND ASSESSMENT OF
STREAM CROSSINGS AND ENCROACHMENTS

COUNTY Henderson PROJECT NUMBER I-4400/I-4700

STREAM Devils Fork ROUTE I-26

ASSESSMENT PREPARED BY HNTB Corporation DATE _____

HYDROLOGIC EVALUATION

NEAREST GAGING STATION ON THIS STREAM _____ (NONE X) _____

ARE FLOOD STUDIES AVAILABLE ON THIS STREAM: Yes

FLOOD DATA:
Q10 1800 CFS EST BKWTR. - FT. Q25 2300 CFS EST BKWTR. - FT.
Q50 2600 CFS EST BKWTR. - FT. Q100 3000 CFS EST BKWTR. - FT.
Q500 3800 CFS OR OVERTOPPING CFS EST BKWTR. - FT.

DRAINAGE AREA 6.80 Sq. Miles

METHOD USED TO COMPUTE Q USGS Urban Regression

PROPERTY RELATED EVALUATIONS

DAMAGE POTENTIAL: LOW X MODERATE _____ HIGH _____

COULD THIS BE SIGNIFICANTLY INCREASED BY PROPOSED

ENCROACHMENT: YES _____ NO X

EXPLANATION: Limited changes will be made to this site.

_____

LIST BUILDINGS IN FLOOD PLAIN None LOCATION N/A

FLOOR ELEVATION Unknown

UPSTREAM LAND USE Residential/ Agricultural

ANTICIPATE ANY CHANGE? Yes, Residential/ Industrial Zoning

ANY FLOOD ZONING? (FIS STUDIES, ETC.) YES X NO _____

TYPE OF STUDY FEMA_Detailed

BASE FLOOD ELEVATION 2091.0 ft (100 YEAR)

REGULATORY FLOODWAY WIDTH 38 (AS NOTED IN FIS STUDIES)

COMMENTS: Cross Section 090

TRAFFIC RELATED EVALUATIONS

PRESENT YEAR 2011 TRAFFIC COUNT 48700 VPD % TRUCKS 16

DESIGN YEAR 2040 TRAFFIC COUNT 70100 VPD % TRUCKS 16

EMERGENCY ROUTE _____ SCHOOL BUS ROUTE _____ MAIL ROUTE _____

DETOUR AVAILABLE? _____ LENGTH OF DETOUR _____ MILES

DOES THE LEVEL OF TRAFFIC SERVICE OF AN EXISTING CROSSING VARY GREATLY FROM STANDARD DESIGN LEVELS? _____

_____

IS THE TRAFFIC VOLUME, TYPE, USAGE SUCH TO WARRANT CONSIDERATION FOR VARIANCE FROM STANDARDS OR EXISTING LEVEL OF INTERRUPTION?

_____

COMMENTS: _____

_____

HIGHWAY AND BRIDGE (CULVERT) RELATED EVALUATIONS

NOTE ANY OUTSIDE FEATURES WHICH MIGHT AFFECT STAGE, DISCHARGE OR FREQUENCY.

LEVEES _____ AGGRADATION/DEGRADATION _____ RESERVOIRS _____

DIVERSIONS _____ DRAINAGE DISTRICT _____ NAVIGATION _____

BACKWATER FROM ANOTHER SOURCE _____

EXPLANATION: _____

_____

ROADWAY OVERFLOW SECTION (NONE __) LENGTH _____ ELEVATION _____

EMBANKMENT: SOIL TYPE Codorus Loam/ Hatboro Loam

TYPE SLOPE COVER Vegetated

COMMENTS: USDS Soil Map NC089

ENVIRONMENTAL CONSIDERATIONS

LIST SPECIAL CONDITIONS OR CONSIDERATIONS WHICH AFFECT HYDRAULIC DESIGN (NONE _____)

_____

_____

MISCELLANEOUS COMMENTS

IS THERE UNUSUAL SCOUR POTENTIAL? YES _ NO X PROTECTION NEEDED _

ARE BANKS STABLE? Yes PROTECTION NEEDED Yes

DOES STREAM CARRY APPRECIABLE AMOUNT OF LARGE DEBRIS? Yes

COMMENTS:

_____

_____

_____

ALTERNATIVES

RECOMMENDED DESIGN Retain Existing Structure

DETOUR STRUCTURE N/A

WERE OTHER HYDRAULIC ALTERNATES CONSIDERED? YES _____ NO X

THIS SITE ASSESSMENT INDICATES THE DESIGN SHOULD FOLLOW:

(1) X NORMAL PROCESS

(2) _____ NORMAL PROCESS WITH SPECIAL SPECIFIC CONSIDERATION FOR

_____

(3) _____ SPECIFIC DESIGN PROCESS WITH APPROPRIATE RISK/ECONOMIC EVALUATION ADDRESSING: _____

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/4/14

SITE NUMBER 7 STREAM DEVILS FORK ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 3 @ 9' x 10' RCBC. MINIMUM SILT DEPTH THROUGHOUT THE STRUCTURE. THERE ARE MINOR CRACKS BUT NO MAJOR INTERNAL ISSUES.

UPSTREAM CHANNEL: TOP WIDTH 30 FT BOTTOM WIDTH 22 FT BANKFULL DEPTH 6 FT

DEPTH OF FLOW (AT TIME OF VISIT) 1 FT BED MATERIAL

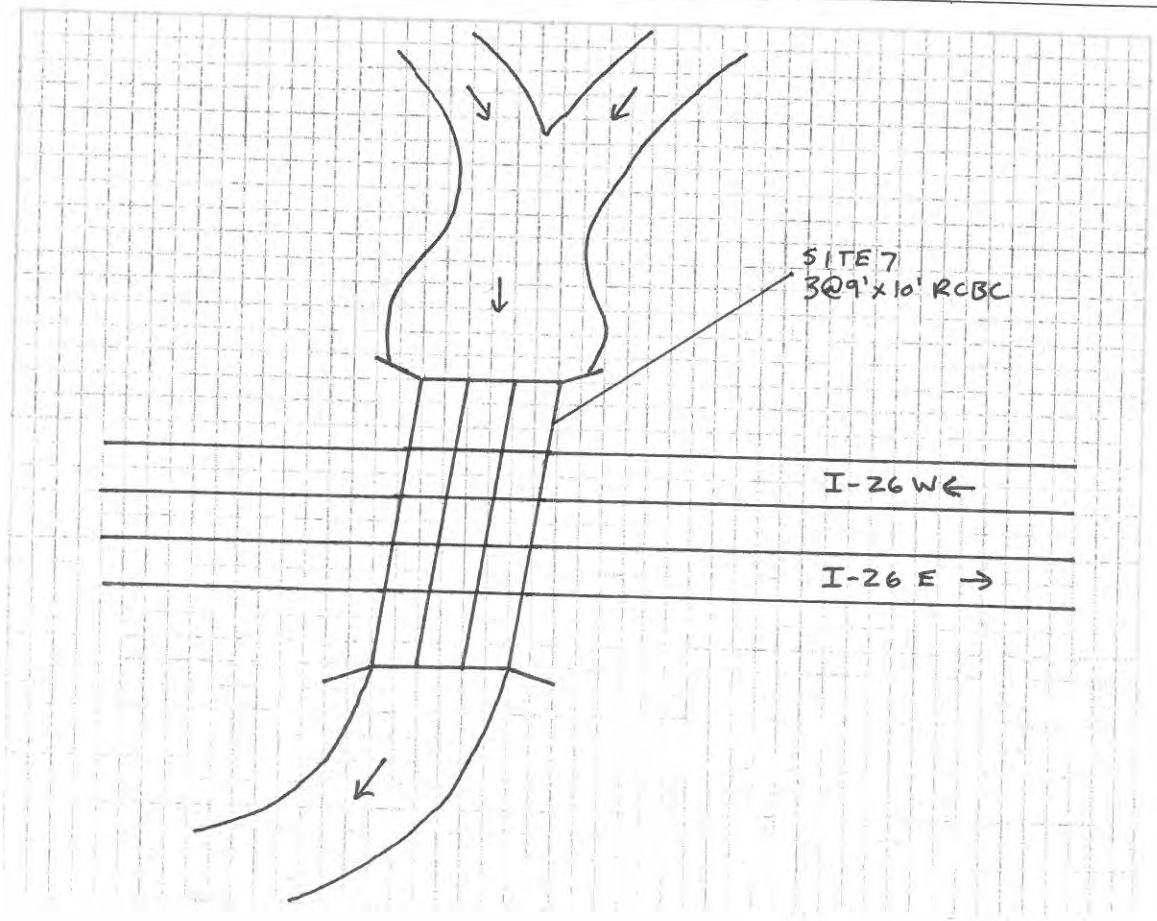
BANK/ CHANNEL CONDITIONS MAJOR DEBRIS AT INLET. 0.5 FT PERCHED AT INLET. BANKS ARE STABLE + VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 40 FT BOTTOM WIDTH 15 FT BANKFULL DEPTH 5 FT

DEPTH OF FLOW (AT TIME OF VISIT) 1 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS MINOR DEBRIS AND RIP RAPE AT OUTLET. 1.5 FT. PERCHED AT OUTLET. BANKS ARE STABLE AND VEGETATED.

COMMENTS



NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
BRIDGE MANAGEMENT UNIT

ATTENTION

BRIDGE INSPECTION REPORT

INSPECTION TYPE: Routine Inspection

COUNTY HENDERSON BRIDGE NUMBER 440178 INSPECTION CYCLE 2 YRS

ROUTE I-26,US74 ACROSS DEVILS FORK CREEK M.P. 50.90

LOCATION 1.4 MI.S.JCT.US64

SUPERSTRUCTURE TRIPLE 9'X10'RC BOX CULVERT;203'-9 ALONG CENTERLINE CULVERT

SUBSTRUCTURE

SPANS

LONGITUDE 82° 25' 33.78" LATITUDE 35° 19' 24.95"

INSPECTION DATE 03/06/2013 PRESENT CONDITION FAIR

PRESENT POSTING N NOT POSTED PROPOSED POSTING

OTHER SIGNS PRESENT NONE

EAST

Fracture Critical	No
Temporary Shoring	No
Scour Critical	No
Scour POA	No

SIGN NOTICE ISSUED FOR		NUMBERED REQUIRED
No	WEIGHT LIMIT	
No	DELINEATORS	
No	NARROW BRIDGE	
No	ONE LANE BRIDGE	
No	LOW CLEARANCE	

NATIONAL BRIDGE INVENTORY-------- STRUCTURE INVENTORY AND APPRAISAL Run Date: 04/12/2013

IDENTIFICATION

(1) STATE NAME -NORTH CAROLINA BRIDGE 440178
(8) STRUCTURE NUMBER(FEDERAL) 000000000890178
(5) INVENTORY ROUTE (ON/UNDER) - ON 11000260
(2) STATE HIGHWAY DEPARTMENT DISTRICT 1
(3) COUNTY CODE 89 (4) PLACE CODE 0
(6) FEATURE INTERSECTED - DEVILS FORK CREEK
(7) FACILITY CARRIED I-26,US74
(9) LOCATION 1.4 MI.S.JCT.US64
(11)MILEPOINT 50.9
(16)LAT 35° 19' 24.95" (17)LONG 82° 25' 33.78"
(98)BORDER BRIDGE STATE CODE PCT SHARE
(99)BORDER BRIDGE STRUCTURE NO

STRUCTURE TYPE AND MATERIAL

(43) STRUCTURE TYPE MAIN: Concrete continuous
TYPE - Culverts (includes frame culverts) CODE 219
(44) STRUCTURE TYPE APPR :
TYPE - CODE 000
(45) NUMBER OF SPANS IN MAIN UNIT 3
(46) NUMBER OF APPROACH SPANS
(107)DECK STRUCTURE TYPE - N CODE
(108)WEARING SURFACE / PROTECTIVE SYSTEM :
(A) TYPE OF WEARING SURFACE - CODE
(B) TYPE OF MEMBRANE - CODE
(C) TYPE OF DECK PROTECTION - CODE

AGE AND SERVICE

(27) YEAR BUILT 1963
(106)YEAR RECONSTRUCTED
(42) TYPE OF SERVICE : ON - Highway
UNDER - Waterway CODE 15
(28) LANES: ON STRUCTURE 4 UNDER STRUCTURE 0
(29) AVERAGE DAILY TRAFFIC 52000
(30) YEAR OF ADT 2010 (109) TRUCK ADT PCT 23%
(19) BYPASS OR DETOUR LENGTH 1 MI

GEOMETRIC DATA

(48) LENGTH OF MAXIMUM SPAN 9 FT
(49) STRUCTURE LENGTH 43 FT
(50)CURB OR SIDEWALK: LEFT 0 FT RIGHT 0 FT
(51) BRIDGE ROADWAY WIDTH CURB TO CURB 0 FT
(52) DECK WIDTH OUT TO OUT 0 FT
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS) 77 FT
(33) BRIDGE MEDIAN - No Median CODE 2
(34) SKEW 45° (35) STRUCTURE FLARED 0
(10) INVENTORY ROUTE MIN VERT CLEAR 999.9 FT
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR 76.75 FT
(53) MIN VERT CLEAR OVER BRIDGE RDWY 999.9 FT
(54) MIN VERT UNDERCLEAR REF Not a Highway or Railroad 0 FT
(55) MIN LAT UNDERCLEAR RT REF Not a Highway or Railroad 000 FT
(56) MIN LAT UNDERCLEAR LT REF - 000 FT

NAVIGATION DATA

(38) NAVIGATION CONTROL - No Navigational Control CODE 0
(111)PIER PROTECTION - CODE
(39) NAVIGATION VERTICAL CLEARANCE 0
(116)VERT - LIFT BRIDGE NAV MIN VERT CLEAR FT
(40) NAVIGATION HORIZONTAL CLEARANCE 0 FT

SUFFICIENCY RATING = 82.52
STATUS = Not Deficient

CLASSIFICATION — CODE

(112)NBIS BRIDGE SYSTEM - YES
(104)HIGHWAY SYSTEM Is on the NHS 1
(26) FUNCTIONAL CLASS - Arterial - Interstate 01
(100)STRAHNET HIGHWAY - Interstate STRAHNET Route 1
(101)PARALLEL STRUCTURE - No Parallel Structure N
(102)DIRECTION OF TRAFFIC - 2-way Traffic 2
(103)TEMPORARY STRUCTURE -
(110)DESIGNATED NATIONAL NETWORK - On the National Network 1
(20) TOLL On Free Road 3
(31) MAINTAIN - State Highway Agency 01
(22) OWNER - State Highway Agency 01
(37) HISTORICAL SIGNIFICANCE - Not Eligible 5

CONDITION — CODE

(58) DECK N
(59) SUPERSTRUCTURE N
(60) SUBSTRUCTURE N
(61) CHANNEL & CHANNEL PROTECTION 5
(62) CULVERTS 5

LOAD RATING AND POSTING — CODE

(31) DESIGN LOAD HS 20 + MOD 6
(63) OPERATING RATING METHOD - Load Factor 1
(64) OPERATING RATING - HS-26 46
(65) INVENTORY RATING METHOD - Load Factor 1
(66) INVENTORY RATING - HS-20 36
(70) BRIDGE POSTING - No Posting Required 5
(41) STRUCTURE OPEN, POSTED ,OR CLOSED A
DESCRIPTION - Open, No Restriction

APPRAISAL — CODE

(67) STRUCTURAL EVALUATION 5
(68) DECK GEOMETRY N
(69) UNDERCLEARANCES,VERTI & HORIZ N
(71) WATERWAY ADEQUACY 7
(72) APPROACH ROADWAY ALIGNMENT 8
(36) TRAFFIC SAFETY FEATURES NNNN
(113)SCOUR CRITICAL BRIDGES 8

PROPOSED IMPROVEMENTS

(75) TYPE OF WORK - CODE
(76) LENGTH OF STRUCTURE IMPROVEMENT
(94) BRIDGE IMPROVEMENT COST
(95) ROADWAY IMPROVEMENT COST
(96) TOTAL PROJECT COST
(97) YEAR OF IMPROVEMENT COST ESTIMATE
(114)FUTURE ADT 104000 (115) YEAR FUTURE ADT 2025

INSPECTIONS

(90) INSPECTION DATE 03/06/2013
(92) CRITICAL FEATURE INSPECTION : (93) CFI DATE
A) FRACTURE CRIT DETAIL - NO A)
B) UNDERWATER INSP - NO B)
C) OTHER SPECIAL INSP NO C)
SCOUR

BRIDGE MANAGEMENT UNIT

DATA ON EXISTING STRUCTURE Run Date: 04/12/2013

COUNTY : HENDERSON
DIVISION : 14
DISTRICT: 1
STRUCTURE NUMBER : 440178
LENGTH : 43 FEET

ROUTE CARRIED : I-26,US74
FEATURE INTERSECTED : DEVILS FORK CREEK

LOCATED : 1.4 MI.S.JCT.US64
BRIDGE NAME :
CITY :

FUNC. CLASS : 01
SYST.ON : FA
SYST.UNDER : NFA
ADT & YR : 52000 2010
RAIL TYPE : LT 0 RT 0

BUILT : 1963
BY : SHC
PROJ : 8.1888817
FED.AID PROJ :
DESIGN LOAD : HS 20 + MOD

REHAB :
BY :
PROJ :
ALIGNMENT : TAN
SKEW : 135
LANES : ON 4 UNDER 0

NAVIGATION : VC 0 FT HC 0 FT
HT. CRN. TO BED : 16 FT
WATER DEPTH : 1 FT

SUPERSTRUCTURE : TRIPLE 9'X10'RC BOX CULVERT;203'-9 ALONG CENTERLINE CULVERT

SUBSTRUCTURE :

SPANS :

BEAMS OR GIRDERS :

FLOOR :
ENCROACHMENT :
DECK (OUT TO OUT) : 0 FT

CLEAR ROADWAY : 0 FT
BETWEEN RAILS : 0 FT
SIDEWALK OR CURB : LT 0 FT RT 0 FT

VERT.CL.OVER : 999.9 FT

INV.RTG. : HS-20
OPE.RTG. : HS-26
CONTR.MEMBER :
POSTED : SV TTST DATE

SYSTEM : Primary Interstate
GREEN LINE ROUTE : Y

UNDER ROUTES AND CLEARANCES

REMARKS :

DRIFT AND DEBRIS AT INLET

RIP RAP PLACED AT INLET

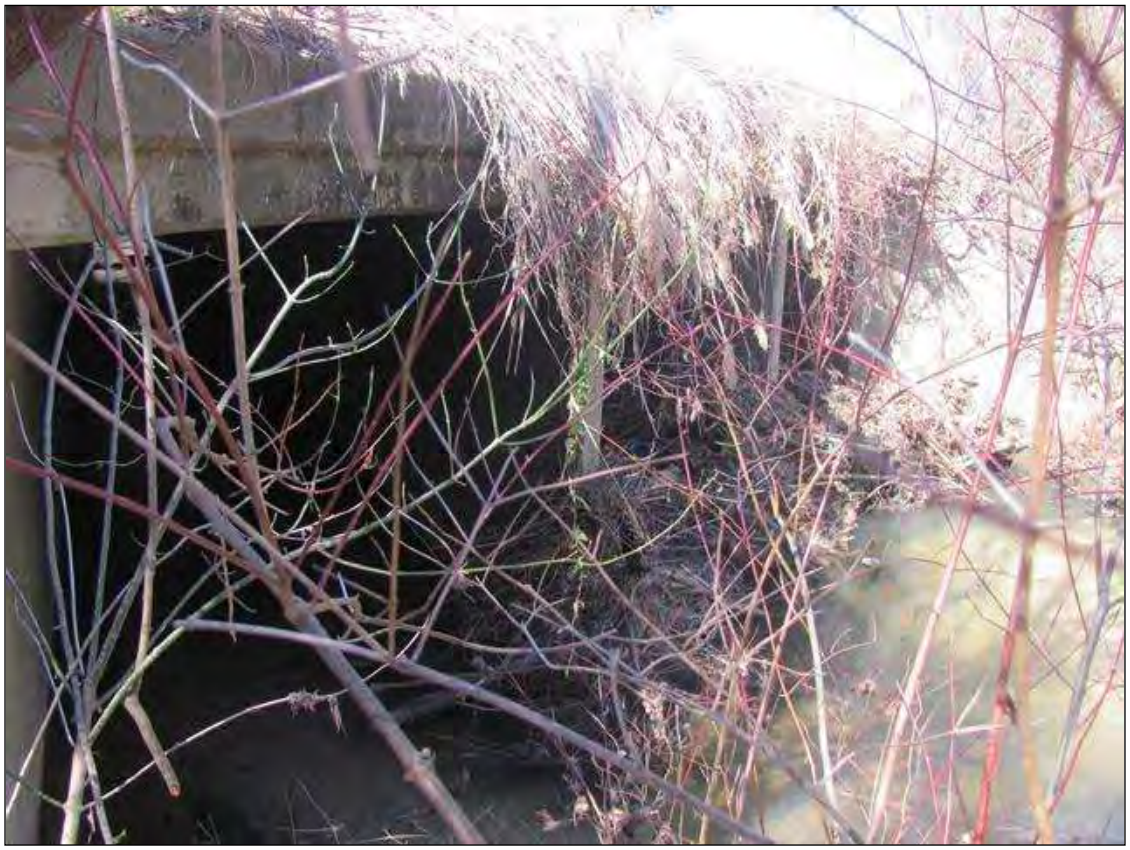
Structure 440178 County HENDERSON Date: 03/06/2013 Structure Photos

EAST

WEST

Structure 440178 County HENDERSON Date: 03/06/2013 Structure Photos

UPSTREAM NORTH



DOWNSTREAM SOUTH

Structure 440178 County HENDERSON Date: 03/06/2013 Structure Photos

DOWNSTREAM SOUTH

UPSTREAM NORTH

Looking at Upstream Face of 3 @ 9' x 10' RCBC under I-26

Looking Upstream from 3 @ 9' 10' RCBC Inlet

Looking Downstream in Left Barrel

Cracks in Left Barrel

Looking Downstream in Center Barrel

Looking Downstream in Right Barrel

Damage on Downstream Center Barrel

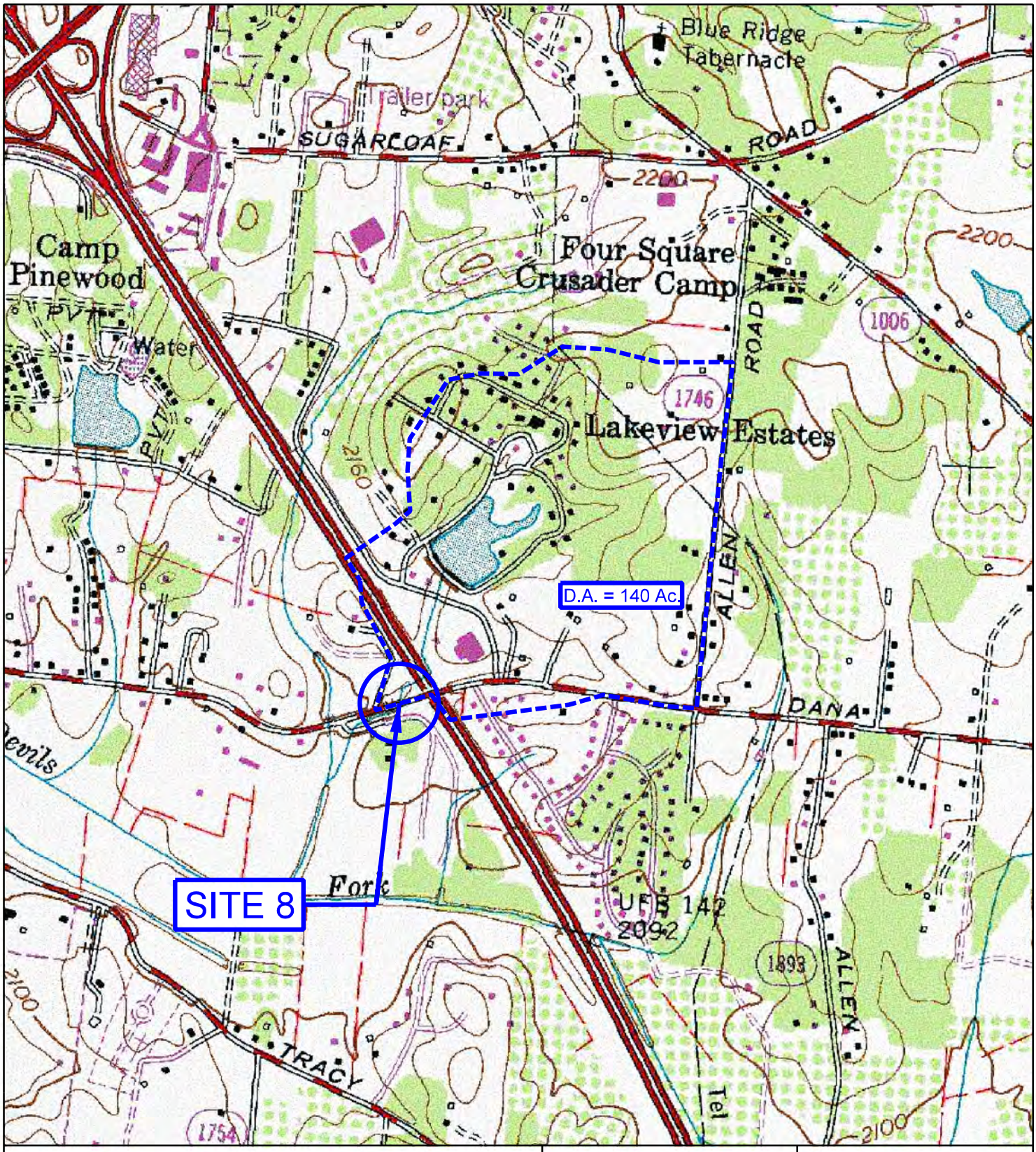
Looking at Upstream Face of 3 @ 9' x 10' RCBC under I-26

Looking Downstream from 3 @ 9' x 10' RCBC Outlet

Looking Downstream

APPENDIX K

SITE 8



QUAD MAP - SITE 8

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 8

Stream Name: UT to Devils Fork

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	1	0.1	0.001
Low - Medium Density Residential	2 - 5	20%	124	24.8	0.177
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	0	0.0	0.000
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	0	0.0	0.000
Cities	-	55%	3	1.8	0.013
Industrial	-	70%	0	0.0	0.000
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	12	10.4	0.074
Totals			**140**	**37.0**	**26.4%**

Drainage Area = 140 acres

Project: I-4400 / I-4700

Site #: 8

Stream Name: UT to Devils Fork

Drainage Area (sq mi): 0.22

Impervious Area (%): 26.4%

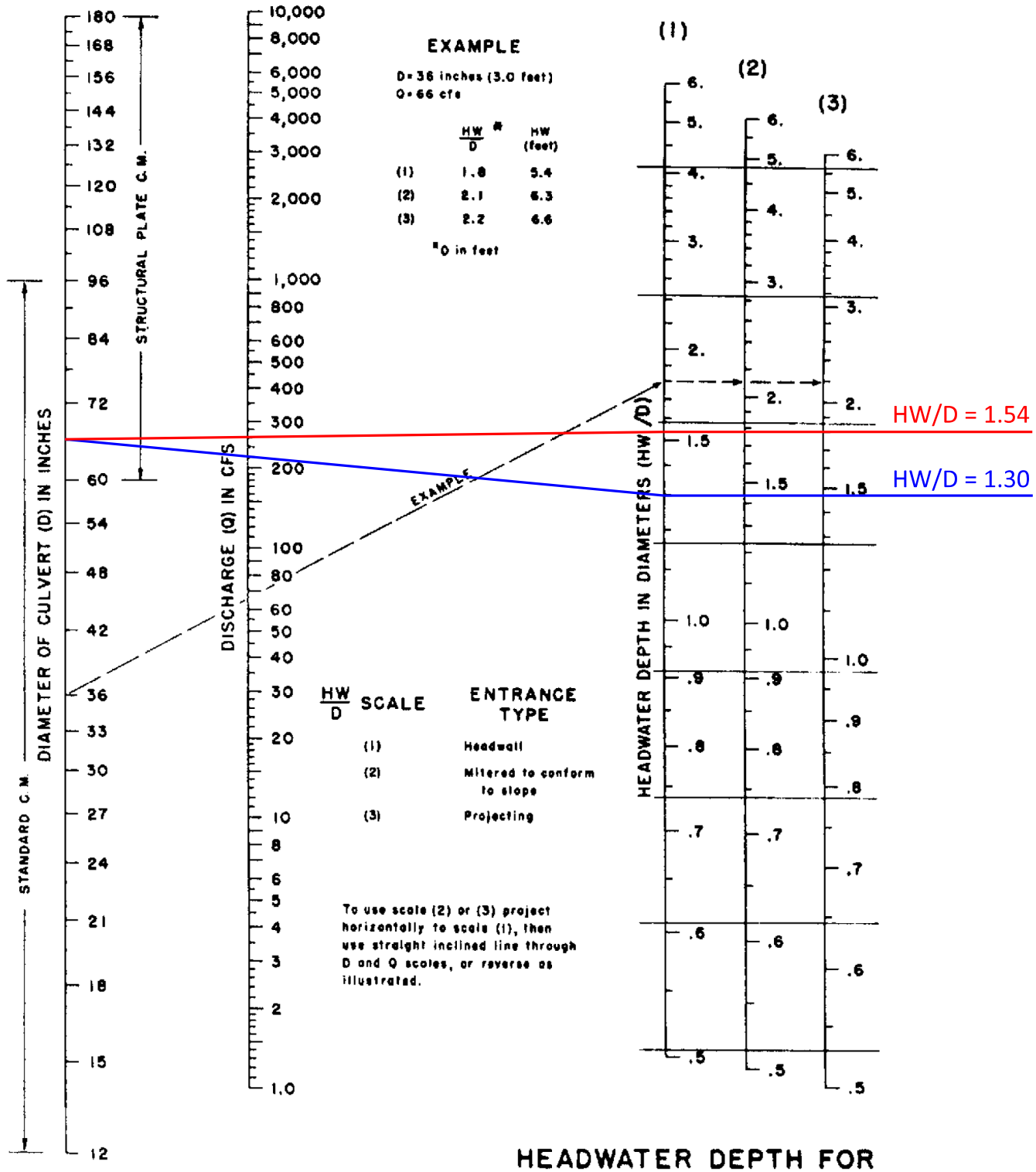
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	125	-	-
5	167	-	-
10	193	-	-
25	220	-	-
50	238	-	-
100	257	-	-
200	273	-	-
500	303	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	-
50	-
100	-
500	-

SITE 8

25 Year	50 Year
1 @ 66" STRUCTURAL PLATE PIPE W/ HW	1 @ 66" STRUCTURAL PLATE PIPE W/ HW
Q = 220 CFS	Q = 260 CFS

CHART 2B



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/4/14

SITE NUMBER 8 STREAM UT TO DEVILS FORK ROUTE DANA RD.

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 66" STRUCTURAL STEEL PIPE WITH A HEADWALL. RUST THROUGHOUT THE STRUCTURE. THE DOWNSTREAM END OF THE STRUCTURE IS SILTED 1'.

UPSTREAM CHANNEL: TOP WIDTH 16 FT BOTTOM WIDTH 5 FT BANKFULL DEPTH 3 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL

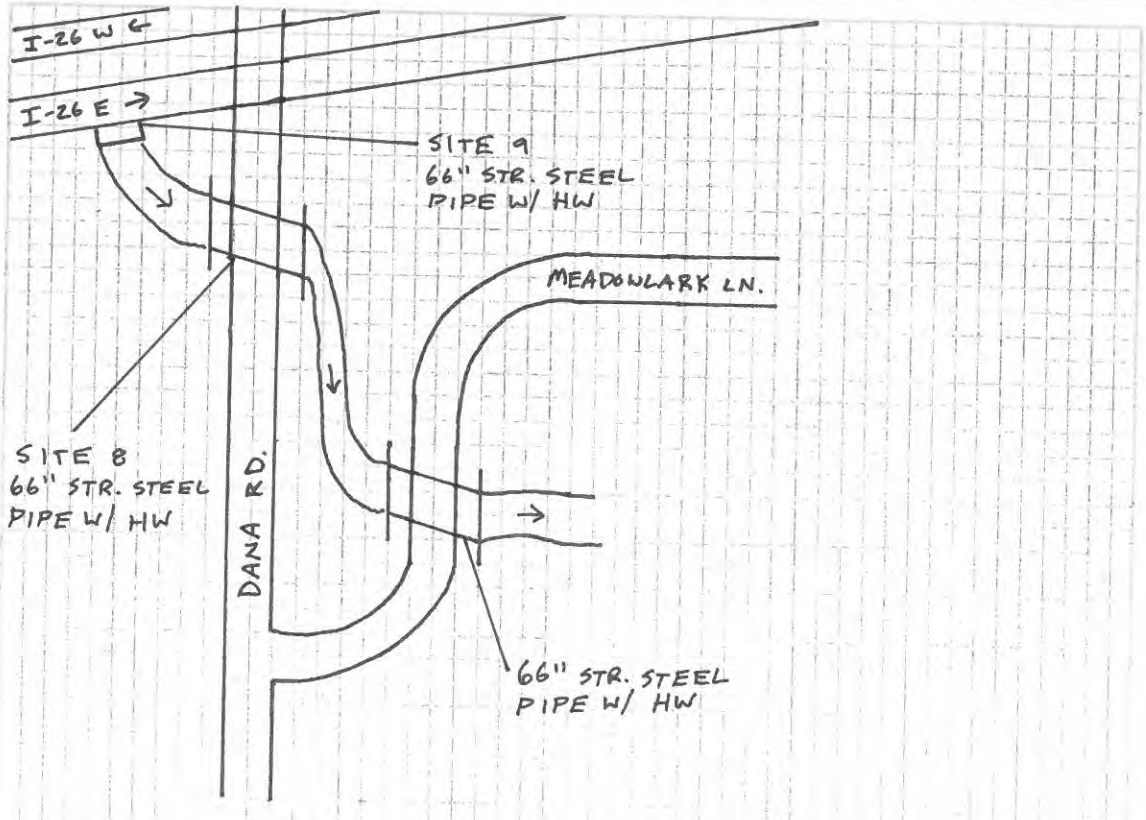
BANK/ CHANNEL CONDITIONS MINOR SCOUR BEHIND THE HEADWALL. BANKS ARE STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 12 FT BOTTOM WIDTH 6 FT BANKFULL DEPTH 9 FT

DEPTH OF FLOW (AT TIME OF VISIT) 1 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS OUTLET IS SILTED 1'. EROSION ON CHANNEL SIDES. BANKS ARE STEEP AND VEGETATED.

COMMENTS SITE 9, 66" STR. STEEL PIPE WITH A HEADWALL, IS UPSTREAM OF THE STRUCTURE. DOWNSTREAM OF THE STRUCTURE IS ALSO A 66" STR. STEEL PIPE WITH A HEADWALL.



Looking at Upstream Face of 66" SPP with Headwall under Dana Rd.

Looking Upstream from on top of 66" SPP with Headwall

Looking Downstream Inside of 66" SPP

Looking Downstream Inside of 66" SPP

Looking at Downstream Face of 66" SPP with Headwall under Dana Rd.

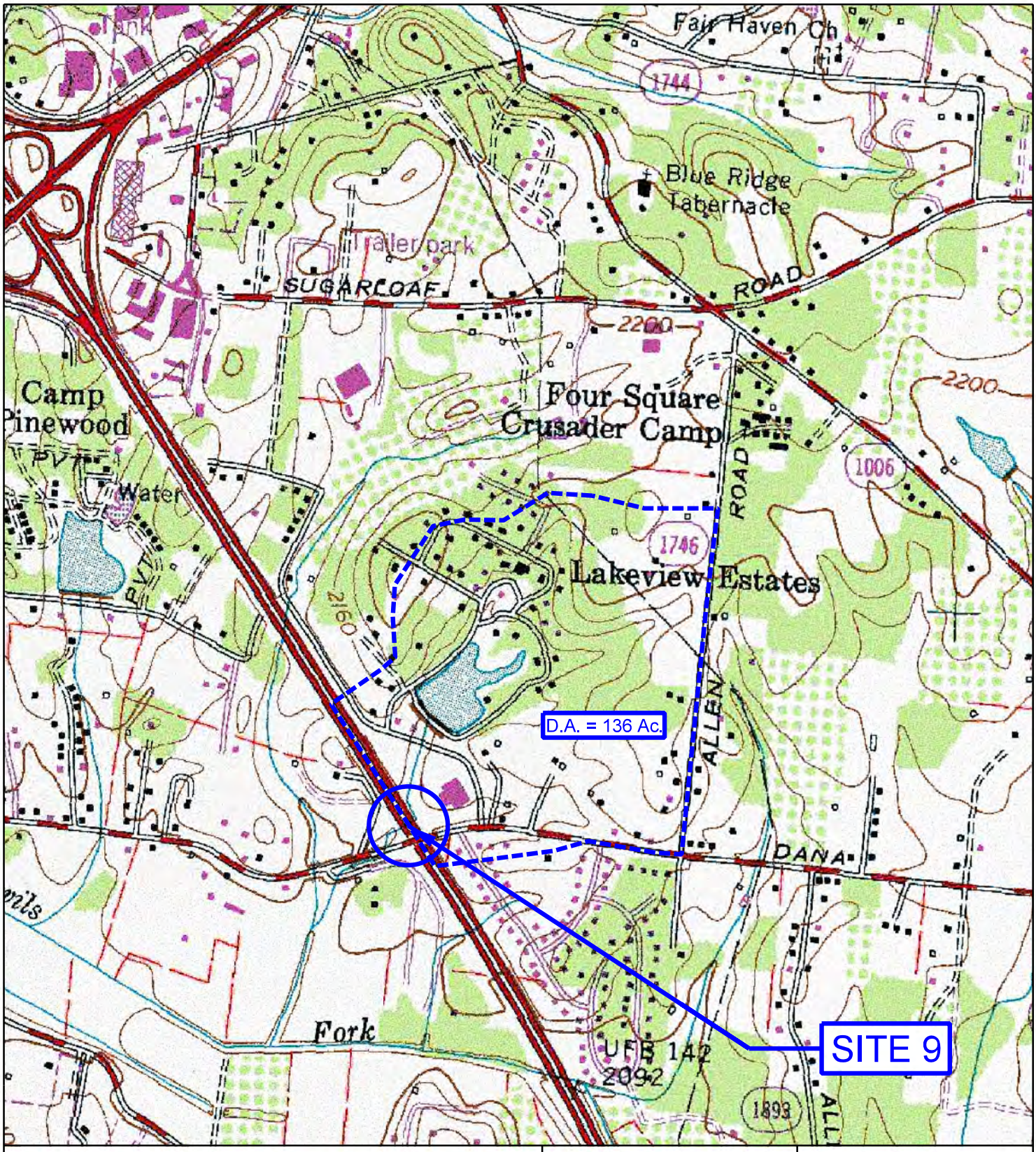
Looking Downstream from 66" SPP with Headwall

Looking Downstream

Downstream Slope Failure

APPENDIX L

SITE 9



QUAD MAP - SITE 9

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 9

Stream Name: UT to Devils Fork

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	0	0.0	0.000
Low - Medium Density Residential	2 - 5	20%	125	24.9	0.183
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	0	0.0	0.000
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	0	0.0	0.000
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	0	0.0	0.000
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	12	10.1	0.074
Totals			**137**	**35.0**	**25.7%**

Drainage Area = 137 acres

5/7/2014

Project: I-4400 / I-4700

Site #: 9

Stream Name: UT to Devils Fork

Drainage Area (sq mi): 0.21

Impervious Area (%): 25.7%

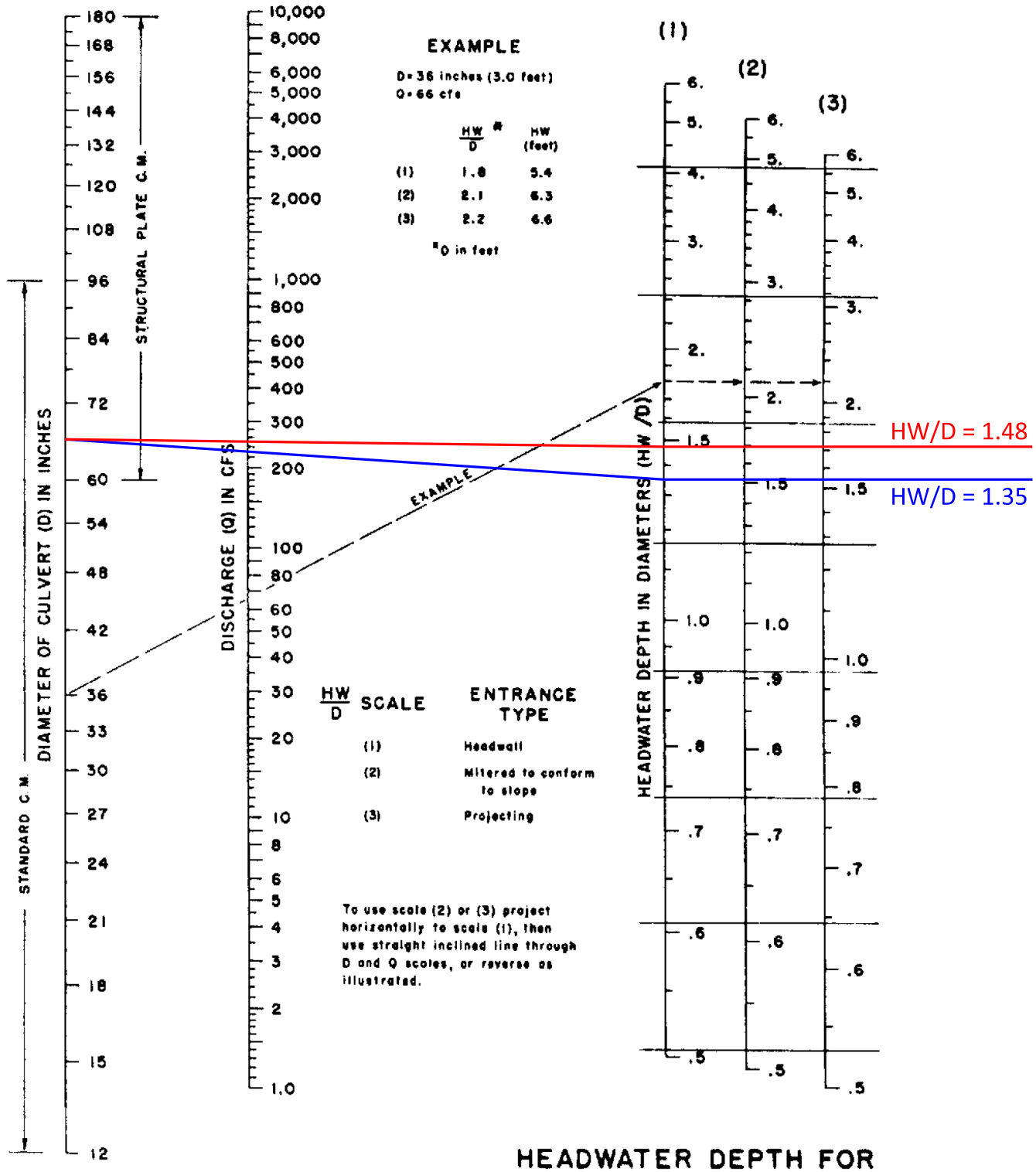
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	120	-	-
5	161	-	-
10	186	-	-
25	214	-	-
50	232	-	-
100	251	-	-
200	267	-	-
500	296	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	-
50	-
100	-
500	-

SITE 9

50 Year	100 Year
1 @ 66" CMP W/ HW	1 @ 66" CMP W/ HW
Q = 230 CFS	Q = 250 CFS

CHART 2B



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/4/14

SITE NUMBER 9 STREAM UT TO DEVILS FORK ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 66" STRUCTURAL PLATE PIPE WITH A HEADWALL. FAIR CONDITION. ASPHALT COATING IS EITHER CRACKED OR MISSING THROUGHOUT THE PIPE.

UPSTREAM CHANNEL: TOP WIDTH 14 FT BOTTOM WIDTH 3 FT BANKFULL DEPTH 4 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.1 FT BED MATERIAL

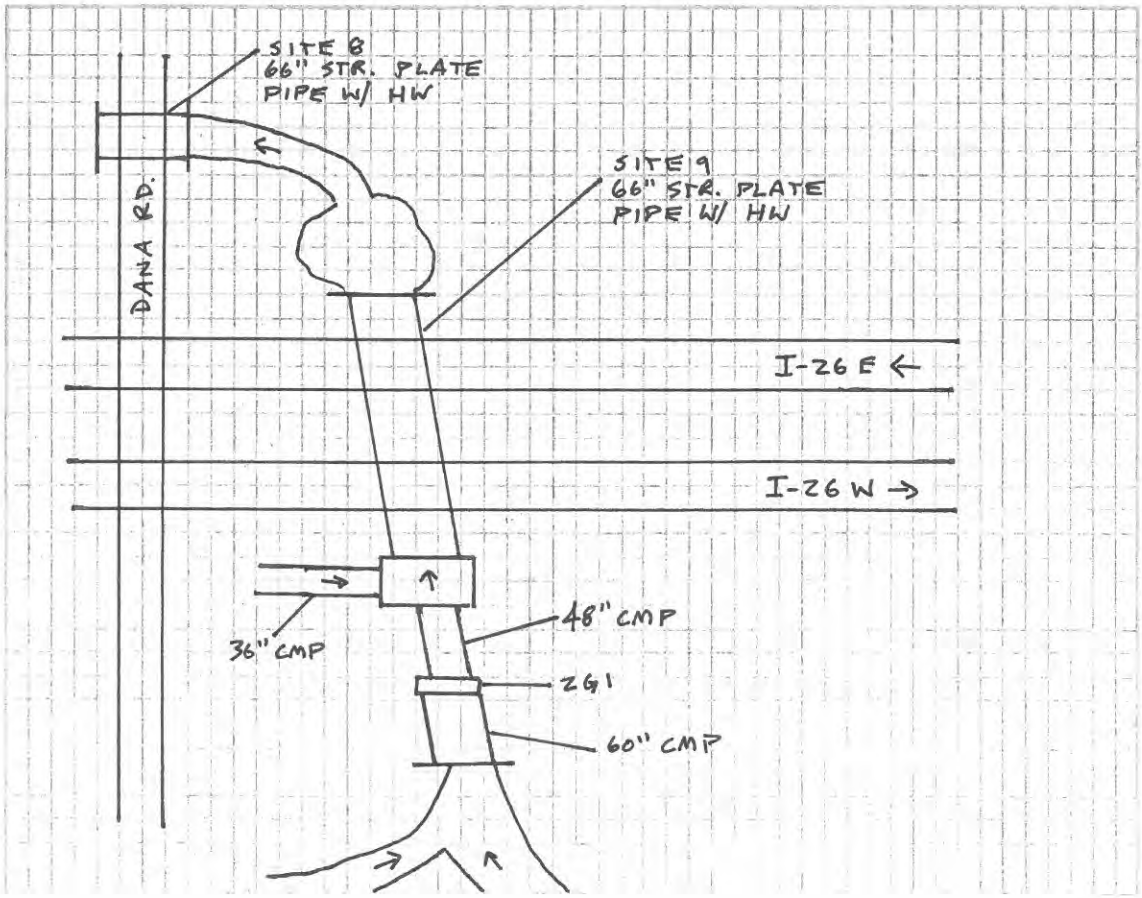
BANK/ CHANNEL CONDITIONS HIGH DEBRIS. SMALL SCOUR AROUND HEADWALL. BANKS ARE STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 40 FT BOTTOM WIDTH 25 FT BANKFULL DEPTH 5 FT

DEPTH OF FLOW (AT TIME OF VISIT) 2 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS OUTLET PERCHED 0.25'. SCOUR HOLE A OUTLET (25'L x 18'W) BANKS ARE STEEP AND VEGETATED.

COMMENTS SITE 8, 66" STR. PLATE PIPE WITH A HEADWALL, IS DOWNSTREAM OF THE STRUCTURE.



Looking at Upstream Face of 66" SPP with Headwall under I-26

Looking Upstream from 66" SPP

Looking Upstream from 66" SPP

Looking Downstream Inside 66" SPP

Drop Inlet

Drop Inlet Grate

Junction Box

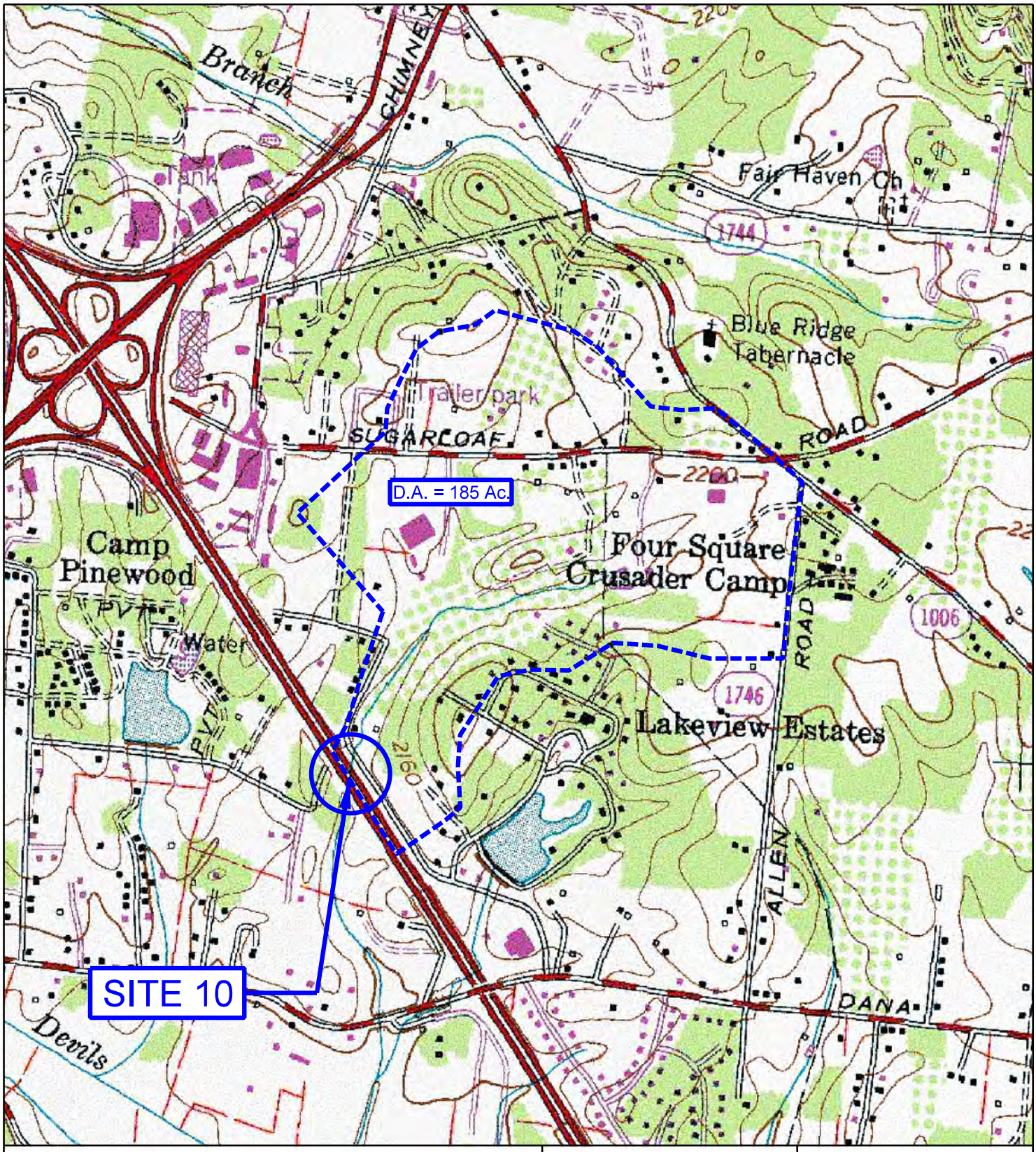
Looking Upstream

Looking at Downstream Face of 66" SPP with Headwall under I-26

Looking Downstream at Scour Hole from 66" SPP

APPENDIX M

SITE 10



QUAD MAP - SITE 10

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/15/2014

Project: I-4400 / I-4700

Site #: 10

Stream Name: UT to Devils Fork

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	0	0.0	0.000
Low - Medium Density Residential	2 - 5	20%	15	3.0	0.016
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	53	18.6	0.100
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	0	0.0	0.000
Cities	-	55%	117	64.4	0.348
Industrial	-	70%	0	0.0	0.000
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	0	0.0	0.000
Totals			**185**	**85.9**	**46.4%**

Drainage Area = 185 acres

Project: I-4400 / I-4700

Site #: 10

Stream Name: UT to Devils Fork

Drainage Area (sq mi): 0.29

Impervious Area (%): 46.4%

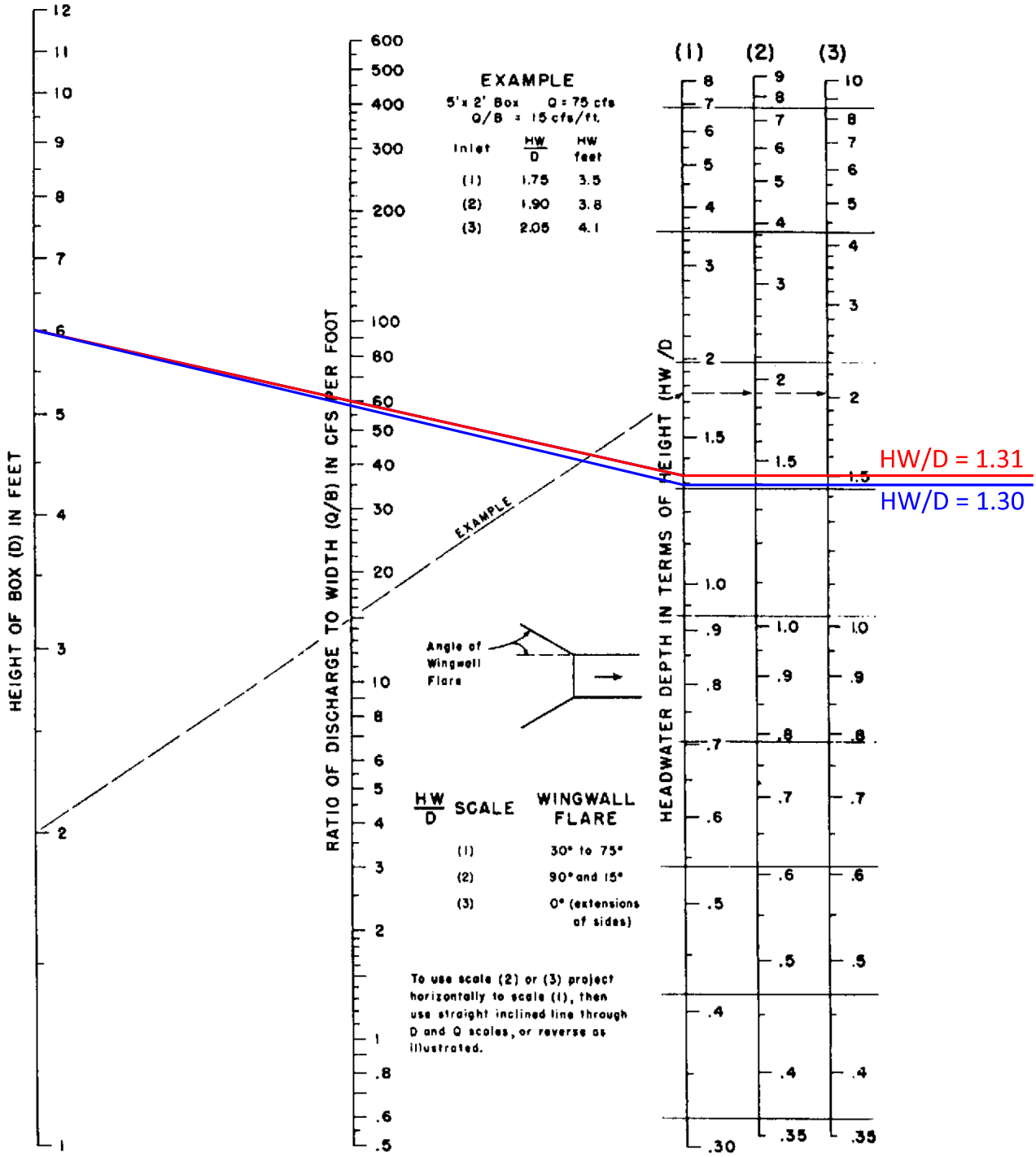
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	DISCHARGE (cfs)		
	PIEDMONT - RIDGE AND VALLEY	SAND HILLS	COASTAL PLAIN
2	280	-	-
5	318	-	-
10	337	-	-
25	349	-	-
50	352	-	-
100	359	-	-
200	360	-	-
500	380	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	DISCHARGE (cfs)
10	-
50	-
100	-
500	-

SITE 10

50 Year	100 Year
1 @ 6' x 6' RCBC	1 @ 6' x 6' RCBC
Q = 350 CFS	Q = 360 CFS
Q/NB = 58 CFS/FT.	Q/NB = 60 CFS/FT.

CHART 8B



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/4/14

SITE NUMBER 10 STREAM UT TO DEVILS FORK ROUTE I-26/EAST PRINCE RD.

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 1 @ 6' x 6' RCBC. CRACKING THROUGHOUT THE STRUCTURE.

UPSTREAM CHANNEL: TOP WIDTH 15 FT BOTTOM WIDTH 5 FT BANKFULL DEPTH 3 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL

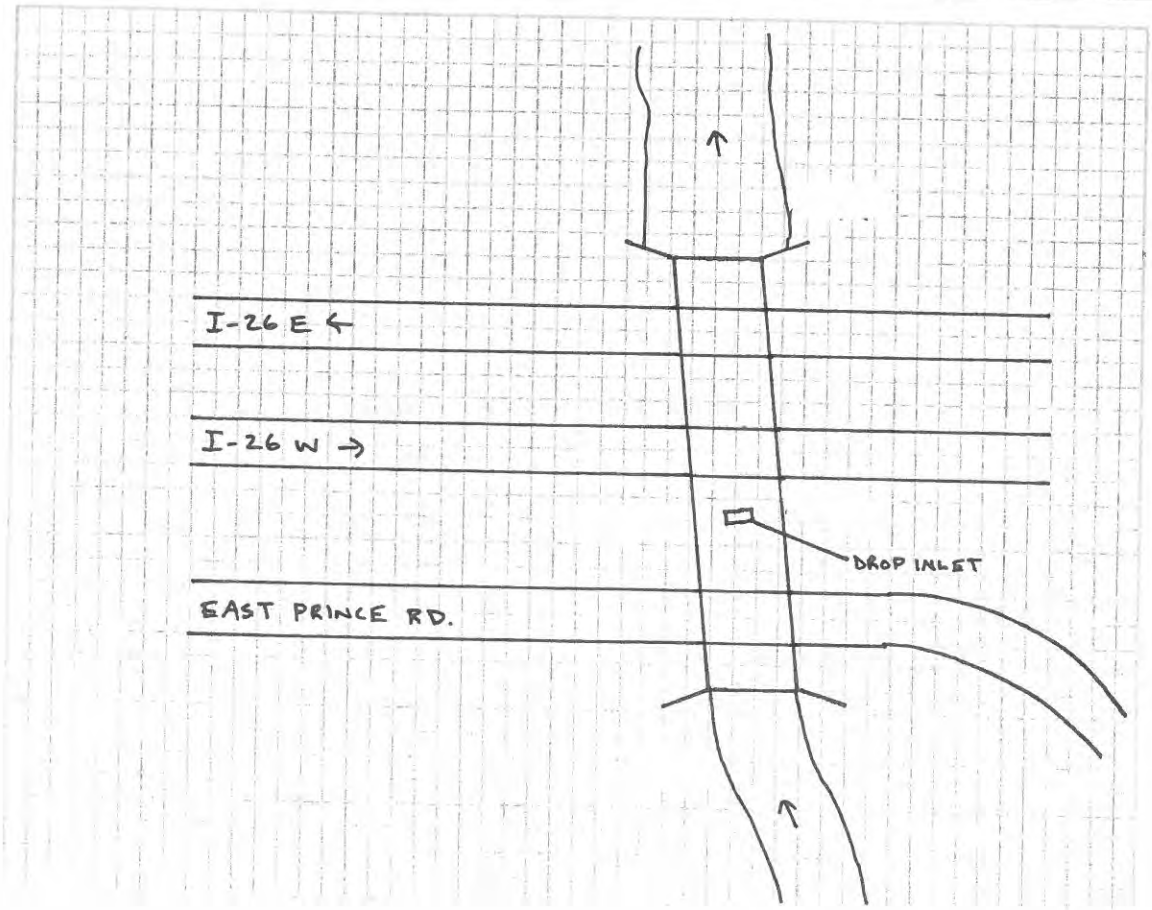
BANK/ CHANNEL CONDITIONS BANKS ARE STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 30 FT BOTTOM WIDTH 18 FT BANKFULL DEPTH 2 FT

DEPTH OF FLOW (AT TIME OF VISIT) 1 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS THE OUTLET IS PERCHED 4'. THERE IS RIP RAP AT THE OUTLET. BANKS ARE STABLE AND VEGETATED

COMMENTS



Looking at Upstream Face of 1 @ 6' x 6' RCBC under I-26

Looking Upstream from 1 @ 6' x 6' RCBC Inlet

Looking Upstream Inside of the Barrel

Looking Downstream Inside of the Barrel

Cracks on Downstream Side and Top Slab of the Barrel

Pipe Outlet on Right Side of the Barrel

Looking at Downstream Face of 1 @ 6' x 6' RCBC under I-26

Looking at Downstream Face of 1 @ 6' x 6' RCBC under I-26

Looking at Downstream Right Ditch

Looking Downstream from 1 @ 6′ x 6′ RCBC Outlet

APPENDIX N

SITE 11

5/8/2014

Project: I-4400 / I-4700

Site #: 11

Stream Name: Clear Creek

Drainage Area (sq mi): 44.30

Impervious Area (%): 1.9%

USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	1820	-	-
5	3104	-	-
10	4057	-	-
25	5332	-	-
50	6317	-	-
100	7339	-	-
200	8410	-	-
500	9903	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	3430
50	5790
100	7000
500	10340

Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 9670

FEMA

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
HENDERSON COUNTY	370125	9670	J
HENDERSONVILLE, CITY OF	370128	9670	J

Site 11

MAP NUMBER
3700967000J

MAP REVISED
10/2/2008

Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet **1:6,000**

0 250 500 1,000 Feet

0 75 150 300 Meters

FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 9579

FEMA

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
HENDERSON COUNTY	370125	9579	J
HENDERSONVILLE, CITY OF	370128	9579	J

Site 11

MAP NUMBER
3700957900J

MAP REVISED
10/2/2008

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

A Report of Flood Hazards in

HENDERSON COUNTY, NORTH CAROLINA AND INCORPORATED AREAS

Community Name	Community Number
CITY OF HENDERSONVILLE	370128
HENDERSON COUNTY	370125
TOWN OF FLETCHER	370568
TOWN OF LAUREL PARK	370384
VILLAGE OF FLAT ROCK	370565

NORTH CAROLINA
Cooperating Technical State
FEMA'S COOPERATING TECHNICAL PARTNER

EFFECTIVE: 10/2/2008
REVISED: 1/6/2010
Federal Emergency Management Agency
State of North Carolina
Flood Insurance Study Number
37089CV000
www.fema.gov and www.ncfloodmaps.com

Table 8 - Flooding Sources Studied by Detailed Methods: Revised or Newly Studied

Source	Riverine Sources		Affected Communties
	From	To	
Bat Fork Creek	The confluence with Mud Creek	Approximately 1,500 feet upstream of New Hope Road (SR 1757)	City Of Hendersonville Henderson County
Boylston Creek	Approximately 500 feet downstream of Banner Farm Road	Approximately 100 feet upstream of Gonce Drive	Town Of Mills River
Boylston Creek Tributary 7	The confluence with Boylston Creek	Approximately 1,100 feet upstream of Cross Creek Court	Henderson County Town Of Mills River
Broad River	Approximately 500 feet upstream of US HWY 64 / 74 A	The Henderson / Rutherford County boundary	Henderson County
Cane Creek	The confluence with French Broad River	Approximately 600 feet upstream of Cross Creek Farm Road	City Of Asheville Henderson County Town Of Fletcher
Clear Creek	The confluence with Mud Creek	Approximately 600 feet upstream of Howard Gap Road (SR 1006)	City Of Hendersonville Henderson County
Devils Fork	The confluence with Bat Fork Creek	Approximately 500 feet upstream of Old Dana Road (SR 1738)	City Of Hendersonville Henderson County
Green River	Approximately 0.7 mile downstream of NC Route 225	Approximately 400 feet upstream of Bear Paw Ridge Road	Henderson County
Higgins Branch	The confluence with Kimsey Creek	Approximately 50 feet downstream of the Henderson/Buncombe County boundary	Town Of Fletcher
Hoopers Creek	The confluence with Cane Creek	Approximately 120 feet upstream of Lindsey Loop Road (SR 1571)	Henderson County Town Of Fletcher
Kimsey Creek	The confluence with Cane Creek	Approximately 50 feet downstream of the Henderson/Buncombe County boundary	Henderson County Town Of Fletcher
Mill Pond Creek	At Hysong Lane	Approximately 40 feet downstream of North Hills Drive	Henderson County
Mills River	The confluence with French Broad River	The confluence with South Fork Mills River and North Fork Mills River	Henderson County Town Of Mills River
Mud Creek	The confluence with French Broad River	Approximately 500 feet upstream of Walnut Cove Road (SR 1125)	City Of Hendersonville Henderson County Town Of Fletcher Village Of Flat Rock
South Wash Creek	The confluence with Wash Creek	Approximately 50 feet downstream of Lake Drive	Town Of Laurel Park
Wash Creek	The confluence with Mud Creek	Approximately 1,400 feet upstream of Glasgow Lane (SR 1185)	City Of Hendersonville Henderson County Town Of Laurel Park

Table 9, “Flooding Sources Studied by Detailed Methods: Redelineated”, lists all flooding sources that were studied by detailed methods for the pre-statewide FIS and redelineated for previous FISs. These flooding sources were not part of this revision and their effective analyses remain valid.

Table 9 - Flooding Sources Studied by Detailed Methods: Redelineated

Source	Riverine Sources		Affected Communties
	From	To	
Boylston Creek	The confluence with French Broad River	Approximately 500 feet downstream of Banner Farm Road	Henderson County Town Of Mills River
Britton Creek	The confluence with Mud Creek	New Village Drive	City Of Hendersonville
Clear Creek	Approximately 600 feet upstream of Howard Gap Road (SR 1006)	Approximately 150 feet downstream of the confluence of Kyles Creek	City Of Hendersonville Henderson County
Crab Creek	The confluence with Little River	The Henderson/Transylvania County boundary Transylvania County boundary	Henderson County
French Broad River	Approximately 1.1 miles downstream of the Buncombe/Madison County boundary	Approximately 3 miles upstream of the Buncombe/Henderson County boundary	City Of Asheville Henderson County Town Of Fletcher Town Of Mills River
French Broad River	Approximately 3 miles upstream of the Buncombe/Henderson County boundary	The confluence of North Fork French Broad River and West Fork French Broad River	Henderson County Town Of Mills River
McDowell Creek	The confluence with French Broad River	Pennsylvania Road (SR 1348)	Henderson County Town Of Mills River
Mill Pond Creek	The confluence with French Broad River	At Hysong Lane	Henderson County
Shepherd Creek	The confluence with Mud Creek	Approximately 50 feet downstream of S. Lakeside Drive (SR 1148) (SR 1148)	City Of Hendersonville

Table 10, “Flooding Sources Studied by Detailed Methods: Limited Detailed”, lists all flooding sources within the county that were studied by limited detailed methods for either this FIS or previous FISs.

Table 13 - Summary of Discharges

Flooding Source		Discharges (cfs)			
Location	Drainage Area (square miles)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Approximately 300 feet downstream of Howard Gap Road (SR 1006)	79.77	*	*	11,340	*
Approximately 50 feet upstream of confluence of Hoopers Creek	63.63	*	*	10,690	*
Approximately 100 feet upstream of Mills Gap Road (SR 1551)	63.14	*	*	10,670	*
Approximately 1,200 feet upstream of Mills Gap Road (SR 1551)	60.64	*	*	8,160	*
At the Henderson/Buncombe County boundary	60.31	*	*	8,150	*
Clear Creek					
At the confluence with Mud Creek	44.44	3,550	5,970	7,200	10,620
Approximately 50 feet upstream of Allen Branch	42.98	3,430	5,790	7,000	10,340
Approximately 200 feet upstream of Nix Road (SR 1513)	42.57	3,400	5,740	6,940	10,260
Approximately 900 feet downstream of Howard Gap Road (SR 1006)	42.32	3,380	5,710	6,900	10,220
Approximately 100 feet downstream of Howard Gap Road (SR 1006)	39.23	3,290	5,540	6,690	9,880
Approximately 0.6 mile upstream of the confluence with Wolfpen Creek	37.10	3,100	5,300	6,500	9,700
Approximately 0.4 mile upstream of Lancaster Road (SR 1582)	34.10	2,950	5,000	6,200	9,200
Approximately 1,500 feet upstream of Fruitland Road (SR 1574)	28.00	2,600	4,500	5,500	8,100
Approximately 50 feet upstream of confluence of Kyles Creek	23.70	*	*	5,320	*
At the confluence of Puncheon Camp Creek	10.67	*	*	3,270	*
Devils Fork					
At the confluence with Bat Fork Creek	8.53	1,380	2,350	2,840	4,240
Approximately 100 feet upstream of Tracy Grove Road (SR 1793)	8.23	1,350	2,300	2,780	4,150
Approximately 1,500 feet upstream of Tracy Grove Road (SR 1793)	7.80	1,300	2,220	2,690	4,020
Approximately 0.5 mile upstream of Tracy Grove Road (SR 1793)	7.42	1,260	2,150	2,610	3,900
Approximately 0.4 mile downstream of Interstate 26	6.83	1,190	2,040	2,480	3,710
Approximately 200 feet upstream of Interstate 26	6.27	1,130	1,930	2,350	3,520
Approximately 0.4 mile upstream of Interstate 26	5.80	1,080	1,850	2,250	3,390
Approximately 0.7 mile upstream of Interstate 26	4.95	960	1,660	2,020	3,050
Approximately 300 feet upstream of Howard Gap Road (SR 1006)	4.55	910	1,570	1,920	2,900
Approximately 0.5 mile upstream of Howard Gap Road (SR 1006)	4.00	840	1,450	1,770	2,680
Approximately 0.5 mile downstream of Dana Road (SR 1525)	2.44	600	1,060	1,300	1,990
Approximately 1,500 feet downstream of Dana Road (SR 1525)	1.86	500	890	1,100	1,690
Dunn Creek					
At the confluence with Bat Fork Creek	3.07	*	*	1,500	*
Approximately 600 feet downstream of Howard Gap Road (SR 1006)	1.01	*	*	750	*
Featherstone Creek					
At the confluence with Mud Creek	4.12	*	*	1,810	*
Approximately 1,100 feet downstream of Locust Grove Road (SR 1528)	1.37	*	*	910	*
Finley Creek					
At the confluence with Shepherd Creek	2.22	*	*	1,230	*
French Broad River					
Approximately 0.4 mile downstream of the confluence of Bent Creek	676.00	*	*	50,000	*
At the confluence of Cane Creek	633.00	*	*	48,500	*
Mile 166.9 above Cane Creek	546.00	*	*	46,000	*
Mile 168.5 above Mud Creek	432.00	*	*	41,500	*
Mile 169.2 above Mill River	357.00	17,000	30,600	38,000	58,500
Gash Creek					

5.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the flood elevations for the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles and/or Water-surface elevation rasters. For stream segments for which BFEs were computed, selected cross-section locations are also shown on the FIRM. Flood Profiles and/or Water-surface elevation rasters were developed showing computed water-surface elevations for floods of the selected recurrence intervals.

Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles and/or Water-surface elevation rasters or in the Floodway Data tables in the FIS Report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in the FIS in conjunction with the data shown on the FIRM.

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the Flood Profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For details on the county's hydraulic analyses, the hydraulic report is available by request.

For the streams studied by detailed methods, water surface elevations of floods of the selected recurrence intervals were computed through use of the Army Corps of Engineers' HEC RAS step backwater computer program . The hydraulic analyses were based on unobstructed flow. The flood elevations shown on the Profiles and/or Water-surface elevation rasters are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail. The computer models were calibrated using historic high water data collected during field investigations.

The cross section geometries were obtained from a combination of digital elevation data obtained by Light Detection and Ranging (LIDAR) and field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Natural floodplain cross sections were surveyed approximately every 4000 feet along the detail study reaches to obtain the channel geometry between bridges and culverts. Overbank cross section data for the backwater analyses were obtained from recently flown LIDAR data.

Channel roughness factors (Manning's "n") used in the hydraulic computations were made in the field by an engineer where stream access was possible, with orthophotos used to supplement areas that could not be accessed. The channel and overbank "n" values for all of the streams studied by detailed methods are shown in Table 16, "Roughness Coefficients".

Table 16 - Roughness Coefficients

Stream	Channel "n"	Overbank "n"
Allen Branch	0.045 to 0.050	0.030 to 0.090
Bat Fork Creek	0.040 to 0.060	0.022 to 0.150
Battle Creek	0.035 to 0.040	0.040 to 0.090
Big Willow Creek	0.040	0.050 to 0.090
Big Willow Creek Tributary 1	0.025 to 0.050	0.050 to 0.090
Boylston Creek	0.035 to 0.090	0.040 to 0.120
Boylston Creek Tributary 7	0.040 to 0.090	0.050 to 0.090
Britton Creek	0.035 to 0.060	0.030 to 0.160
Britton Creek Tributary 2	0.040 to 0.050	0.030 to 0.090
Broad River	0.028 to 0.100	0.010 to 0.130
Cane Creek	0.040 to 0.050	0.025 to 0.250
Clear Creek	0.035 to 0.060	0.030 to 0.140
Crab Creek	0.055 to 0.061	0.080 to 0.660
Devils Fork	0.040 to 0.070	0.010 to 0.150
Dunn Creek	0.035 to 0.050	0.030 to 0.090
Featherstone Creek	0.045 to 0.090	0.030 to 0.090
Finley Creek	0.040 to 0.050	0.040 to 0.090
French Broad River	0.024 to 0.064	0.030 to 0.200
Gash Creek	0.037 to 0.057	0.030 to 0.125
Green River	0.032 to 0.090	0.025 to 0.100
Hickory Creek (near Gerton)	0.060 to 0.100	0.060 to 0.100
Higgins Branch	0.050 to 0.065	0.025 to 0.100
Hoopers Creek	0.045 to 0.070	0.025 to 0.150
Kimsey Creek	0.040 to 0.045	0.025 to 0.100
King Creek	0.045 to 0.050	0.030 to 0.090
King Creek Tributary 3	0.045 to 0.050	0.030 to 0.090
Kyles Creek	0.045 to 0.050	0.006 to 0.090
Lanning Mill Creek	0.050	0.050 to 0.090
Lewis Creek	0.045 to 0.050	0.030 to 0.090

PRELIMINARY DESIGN AND ASSESSMENT OF
STREAM CROSSINGS AND ENCROACHMENTS

COUNTY Henderson PROJECT NUMBER I-4400/I-4700

STREAM Clear Creek ROUTE I-26

ASSESSMENT PREPARED BY HNTB Corporation DATE _____

HYDROLOGIC EVALUATION

NEAREST GAGING STATION ON THIS STREAM _____ (NONE X) _____

ARE FLOOD STUDIES AVAILABLE ON THIS STREAM: Yes

FLOOD DATA:
Q10 4057 CFS EST BKWTR. - FT. Q25 5332 CFS EST BKWTR. - FT.
Q50 6317 CFS EST BKWTR. - FT. Q100 7339 CFS EST BKWTR. - FT.
Q500 9903 CFS OR OVERTOPPING CFS EST BKWTR. - FT.

DRAINAGE AREA 44.3 Sq. Miles

METHOD USED TO COMPUTE Q USGS Urban Regression

PROPERTY RELATED EVALUATIONS

DAMAGE POTENTIAL: LOW X MODERATE _____ HIGH _____

COULD THIS BE SIGNIFICANTLY INCREASED BY PROPOSED

ENCROACHMENT: YES _____ NO X

EXPLANATION: Bridge widening should not significantly

affect WSE._____

LIST BUILDINGS IN FLOOD PLAIN Approximately 15 homes

located in the floodway LOCATION 0.5 Miles upstream of I-26

FLOOR ELEVATION Unknown

UPSTREAM LAND USE Residential/ Agricultural

ANTICIPATE ANY CHANGE? Yes, Residential/ Industrial Zoning

ANY FLOOD ZONING? (FIS STUDIES, ETC.) YES X NO _____

TYPE OF STUDY FEMA_Detailed

BASE FLOOD ELEVATION 2081.1 ft (100 YEAR)

REGULATORY FLOODWAY WIDTH 80 (AS NOTED IN FIS STUDIES)

COMMENTS: Cross Section 036

TRAFFIC RELATED EVALUATIONS

PRESENT YEAR 2011 TRAFFIC COUNT 57100 VPD % TRUCKS 15

DESIGN YEAR 2040 TRAFFIC COUNT 70600 VPD % TRUCKS 15

EMERGENCY ROUTE _____ SCHOOL BUS ROUTE _____ MAIL ROUTE _____

DETOUR AVAILABLE? _____ LENGTH OF DETOUR _____ MILES

DOES THE LEVEL OF TRAFFIC SERVICE OF AN EXISTING CROSSING VARY GREATLY FROM STANDARD DESIGN LEVELS? _____

_____

IS THE TRAFFIC VOLUME, TYPE, USAGE SUCH TO WARRANT CONSIDERATION FOR VARIANCE FROM STANDARDS OR EXISTING LEVEL OF INTERRUPTION?

_____

COMMENTS: _____

_____

HIGHWAY AND BRIDGE (CULVERT) RELATED EVALUATIONS

NOTE ANY OUTSIDE FEATURES WHICH MIGHT AFFECT STAGE, DISCHARGE OR FREQUENCY.

LEVEES _____ AGGRADATION/DEGRADATION _____ RESERVOIRS _____

DIVERSIONS _____ DRAINAGE DISTRICT _____ NAVIGATION _____

BACKWATER FROM ANOTHER SOURCE _____

EXPLANATION: _____

_____

ROADWAY OVERFLOW SECTION (NONE __) LENGTH _____ ELEVATION _____

EMBANKMENT: SOIL TYPE Codorus Loam TYPE SLOPE COVER Vegetated

COMMENTS: USDS Soil Map NC089

ENVIRONMENTAL CONSIDERATIONS

LIST SPECIAL CONDITIONS OR CONSIDERATIONS WHICH AFFECT HYDRAULIC DESIGN (NONE _____)

_____

_____

MISCELLANEOUS COMMENTS

IS THERE UNUSUAL SCOUR POTENTIAL? YES _ NO X PROTECTION NEEDED _

ARE BANKS STABLE? Yes PROTECTION NEEDED X

DOES STREAM CARRY APPRECIABLE AMOUNT OF LARGE DEBRIS? No

COMMENTS:

_____

_____

_____

ALTERNATIVES

RECOMMENDED DESIGN Widen Existing Structure

DETOUR STRUCTURE N/A

WERE OTHER HYDRAULIC ALTERNATES CONSIDERED? YES _____ NO X

THIS SITE ASSESSMENT INDICATES THE DESIGN SHOULD FOLLOW:

(1) X NORMAL PROCESS

(2) _____ NORMAL PROCESS WITH SPECIAL SPECIFIC CONSIDERATION FOR

_____

(3) _____ SPECIFIC DESIGN PROCESS WITH APPROPRIATE RISK/ECONOMIC EVALUATION ADDRESSING: _____

NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
BRIDGE MANAGEMENT UNIT

ATTENTION

BRIDGE INSPECTION REPORT

INSPECTION TYPE: Routine Inspection

COUNTY HENDERSON | BRIDGE NUMBER 440211 | INSPECTION CYCLE 2 YRS 48.4

ROUTE I26,US74 WBL | ACROSS CLEAR CREEK | M.P. 48.40

LOCATION 1.0 MI.N.JCT.US64

SUPERSTRUCTURE REINFORCED CONCRETE FLOOR ON I-BEAMS

SUBSTRUCTURE E.BTS:RC CAPS/H-PILES;INT.BTS:RC POST&BEAM

SPANS 1 @ 73.64';1 @ 72.86';1 @ 73.64'

LONGITUDE 82° 27' 95.70" | LATITUDE 35° 20' 57.77"

INSPECTION DATE 03/11/2013 | PRESENT CONDITION FAIR

PRESENT POSTING N NOT POSTED | PROPOSED POSTING

OTHER SIGNS PRESENT DELINEATORS (1)

EAST

Fracture Critical	No
Temporary Shoring	No
Scour Critical	No
Scour POA	No

SIGN NOTICE ISSUED FOR		NUMBERED REQUIRED
No	WEIGHT LIMIT	
No	DELINEATORS	
No	NARROW BRIDGE	
No	ONE LANE BRIDGE	
No	LOW CLEARANCE	

NATIONAL BRIDGE INVENTORY-------- STRUCTURE INVENTORY AND APPRAISAL Run Date: 05/08/2013

IDENTIFICATION

(1) STATE NAME -NORTH CAROLINA BRIDGE 440211
(8) STRUCTURE NUMBER(FEDERAL) 000000000890211
(5) INVENTORY ROUTE (ON/UNDER) - ON 11000260
(2) STATE HIGHWAY DEPARTMENT DISTRICT 1
(3) COUNTY CODE 89 (4) PLACE CODE 0
(6) FEATURE INTERSECTED - CLEAR CREEK
(7) FACILITY CARRIED I26,US74 WBL
(9) LOCATION 1.0 MI.N.JCT.US64
(11)MILEPOINT 48.4
(16)LAT 35° 20' 57.77" (17)LONG 82° 27' 95.70"
(98)BORDER BRIDGE STATE CODE PCT SHARE
(99)BORDER BRIDGE STRUCTURE NO

STRUCTURE TYPE AND MATERIAL

(43) STRUCTURE TYPE MAIN: Steel
TYPE - Stringer Mutlibeam or Girder CODE 302
(44) STRUCTURE TYPE APPR :
TYPE - CODE 000
(45) NUMBER OF SPANS IN MAIN UNIT 3
(46) NUMBER OF APPROACH SPANS
(107)DECK STRUCTURE TYPE - 1 CODE
(108)WEARING SURFACE / PROTECTIVE SYSTEM :
(A) TYPE OF WEARING SURFACE - CODE
(B) TYPE OF MEMBRANE - CODE
(C) TYPE OF DECK PROTECTION - CODE

AGE AND SERVICE

(27) YEAR BUILT 1963
(106)YEAR RECONSTRUCTED 1989
(42) TYPE OF SERVICE : ON - Highway
UNDER - Waterway CODE 15
(28) LANES: ON STRUCTURE 2 UNDER STRUCTURE 0
(29) AVERAGE DAILY TRAFFIC 27000
(30) YEAR OF ADT 2011 (109) TRUCK ADT PCT 16%
(19) BYPASS OR DETOUR LENGTH 1 MI

GEOMETRIC DATA

(48) LENGTH OF MAXIMUM SPAN 70 FT
(49) STRUCTURE LENGTH 220 FT
(50)CURB OR SIDEWALK: LEFT 1.6 FT RIGHT 1.6 FT
(51) BRIDGE ROADWAY WIDTH CURB TO CURB 28 FT
(52) DECK WIDTH OUT TO OUT 33.417 FT
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS) 28 FT
(33) BRIDGE MEDIAN - No Median CODE 1
(34) SKEW 0° (35) STRUCTURE FLARED 0
(10) INVENTORY ROUTE MIN VERT CLEAR 999.9 FT
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR 28 FT
(53) MIN VERT CLEAR OVER BRIDGE RDWY 999.9 FT
(54) MIN VERT UNDERCLEAR REF Not a Highway or Railroad 0 FT
(55) MIN LAT UNDERCLEAR RT REF Not a Highway or Railroad 000 FT
(56) MIN LAT UNDERCLEAR LT REF - 000 FT

NAVIGATION DATA

(38) NAVIGATION CONTROL - No Navigational Control CODE 0
(111)PIER PROTECTION - CODE
(39) NAVIGATION VERTICAL CLEARANCE 0
(116)VERT - LIFT BRIDGE NAV MIN VERT CLEAR FT
(40) NAVIGATION HORIZONTAL CLEARANCE 0 FT

SUFFICIENCY RATING = 76.39
STATUS = Functionally Obsolete

CLASSIFICATION — CODE

(112)NBIS BRIDGE SYSTEM - YES
(104)HIGHWAY SYSTEM Is on the NHS 1
(26) FUNCTIONAL CLASS - Arterial - Interstate 11
(100)STRAHNET HIGHWAY - Interstate STRAHNET Route 1
(101)PARALLEL STRUCTURE - Left Parallel Structure L
(102)DIRECTION OF TRAFFIC - 1-way Traffic 1
(103)TEMPORARY STRUCTURE -
(110)DESIGNATED NATIONAL NETWORK - On the National Network 1
(20) TOLL On Free Road 3
(31) MAINTAIN - State Highway Agency 01
(22) OWNER - State Highway Agency 01
(37) HISTORICAL SIGNIFICANCE - Not Eligible 5

CONDITION — CODE

(58) DECK 6
(59) SUPERSTRUCTURE 7
(60) SUBSTRUCTURE 6
(61) CHANNEL & CHANNEL PROTECTION 8
(62) CULVERTS N

LOAD RATING AND POSTING — CODE

(31) DESIGN LOAD HS 20 + MOD 6
(63) OPERATING RATING METHOD - Load Factor 1
(64) OPERATING RATING - HS-51 91
(65) INVENTORY RATING METHOD - Load Factor 1
(66) INVENTORY RATING - HS-30 54
(70) BRIDGE POSTING - No Posting Required 5
(41) STRUCTURE OPEN, POSTED ,OR CLOSED A
DESCRIPTION - Open, No Restriction

APPRAISAL — CODE

(67) STRUCTURAL EVALUATION 6
(68) DECK GEOMETRY 3
(69) UNDERCLEARANCES,VERTI & HORIZ N
(71) WATERWAY ADEQUACY 7
(72) APPROACH ROADWAY ALIGNMENT 8
(36) TRAFFIC SAFETY FEATURES 0111
(113)SCOUR CRITICAL BRIDGES 8

PROPOSED IMPROVEMENTS

(75) TYPE OF WORK - CODE
(76) LENGTH OF STRUCTURE IMPROVEMENT
(94) BRIDGE IMPROVEMENT COST
(95) ROADWAY IMPROVEMENT COST
(96) TOTAL PROJECT COST
(97) YEAR OF IMPROVEMENT COST ESTIMATE
(114)FUTURE ADT 54000 (115) YEAR FUTURE ADT 2025

INSPECTIONS

(90) INSPECTION DATE 03/11/2013
(92) CRITICAL FEATURE INSPECTION : (93) CFI DATE
A) FRACTURE CRIT DETAIL - NO A)
B) UNDERWATER INSP - NO B)
C) OTHER SPECIAL INSP NO C)
SCOUR

BRIDGE MANAGEMENT UNIT

DATA ON EXISTING STRUCTURE Run Date: 05/08/2013

COUNTY :	DIVISION :	DISTRICT:	STRUCTURE NUMBER :	LENGTH :
HENDERSON	14	1	440211	220 FEET

ROUTE CARRIED : I26,US74 WBL

FEATURE INTERSECTED : CLEAR CREEK

LOCATED : 1.0 MI.N.JCT.US64

BRIDGE NAME :

CITY :

FUNC. CLASS :	SYST.ON :	SYST.UNDER :	ADT & YR :	RAIL TYPE :
11	FA	NFA	27000 2011	LT 713 RT 713

BUILT :	BY :	PROJ :	FED.AID PROJ :	DESIGN LOAD :
1963	SHC	8.18293	I-26-1(5)12	HS 20 + MOD

REHAB :	BY :	PROJ :	ALIGNMENT :	SKEW :	LANES :
1989	DOH	5.9531008	LT.	90	ON 2 UNDER 0

NAVIGATION :	HT. CRN. TO BED :	WATER DEPTH :
VC 0 FT HC 0 FT	56 FT	2 FT

SUPERSTRUCTURE : REINFORCED CONCRETE FLOOR ON I-BEAMS

SUBSTRUCTURE : E.BTS:RC CAPS/H-PILES;INT.BTS:RC POST&BEAM

SPANS : 1 @ 73.64';1 @ 72.86';1 @ 73.64'

BEAMS OR GIRDERS : 4 LINES 36 I-BEAMS @ 8' CENTERS

FLOOR :	ENCROACHMENT :	DECK (OUT TO OUT) :
9 RC/NO AWS		33.417 FT

CLEAR ROADWAY :	BETWEEN RAILS :	SIDEWALK OR CURB :
28 FT	31.25 FT	LT 1.6 FT RT 1.6 FT

VERT.CL.OVER : 999.9 FT

INV.RTG. :	OPE.RTG. :	CONTR.MEMBER :	POSTED :		
HS-30	HS-51	int bm	SV	TTST	DATE

SYSTEM :	GREEN LINE ROUTE :
Primary Interstate	Y

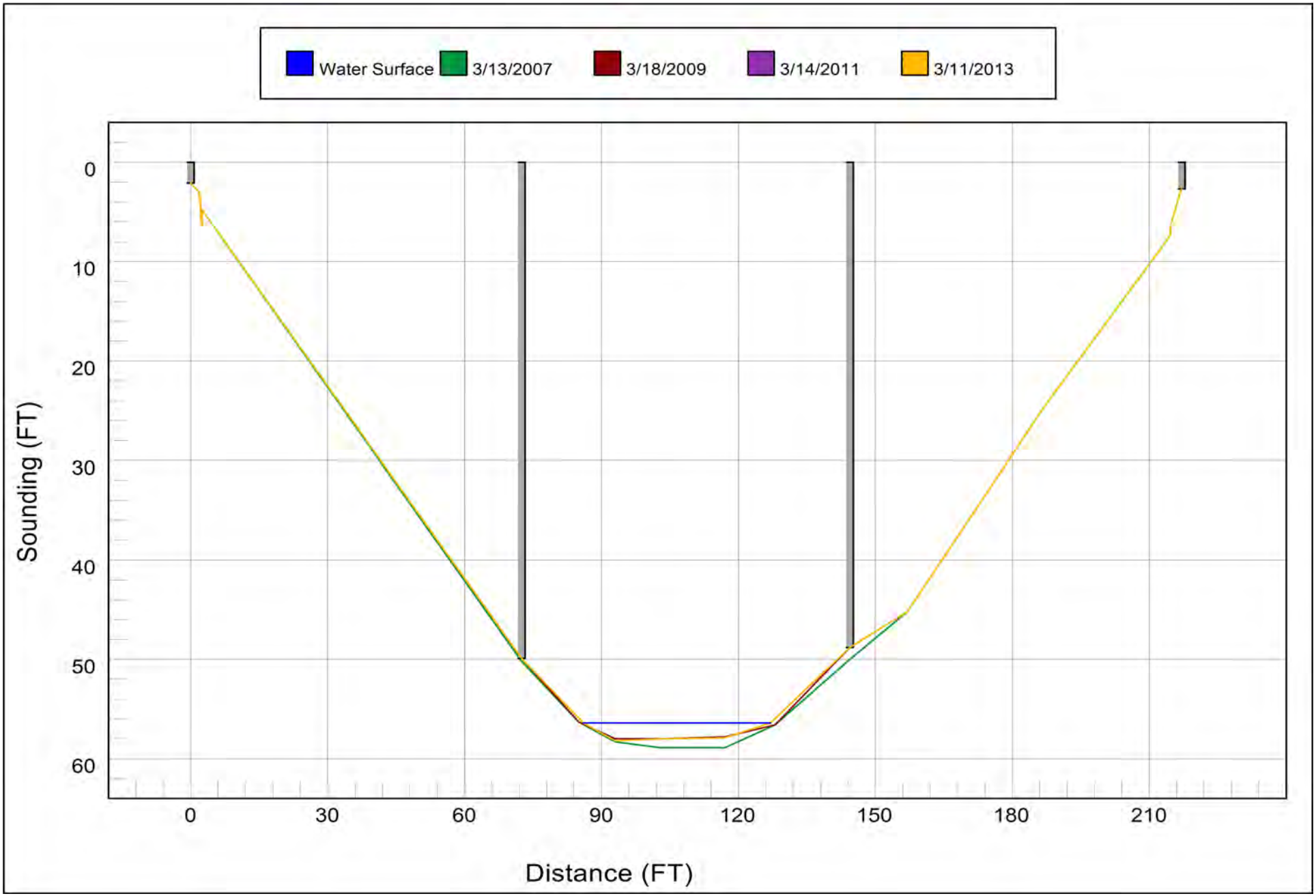
UNDER ROUTES AND CLEARANCES

REMARKS :

Bridge: 440211 County HENDERSON Date: 03/11/2013

STREAMBED PROFILE (Downstream)

Top of Rail = 0 FT (Sounding)



WEST

DOWNSTREAM SOUTH

REP OF END BENT (END BENT 2)

REP OF INTERIOR BENT (INTERIOR BENT 2/EAST FACE)

UPSTREAM NORTH

DOWNSTREAM SOUTH

NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
BRIDGE MANAGEMENT UNIT

ATTENTION

BRIDGE INSPECTION REPORT

INSPECTION TYPE: Routine Inspection

COUNTY HENDERSON BRIDGE NUMBER 440212 INSPECTION CYCLE 2 YRS

ROUTE I-26 EBL ACROSS CLEAR CREEK M.P. 48.40

LOCATION 1 MI.N.JCT.US64

SUPERSTRUCTURE REINFORCED CONC.FLOOR ON I-BEAMS

SUBSTRUCTURE E.BTS:RC CAPS/H-PILES;INT.BTS:RC POST&BEAM

SPANS 1 @ 73.64';1 @ 72.86';1 @ 73.64'

LONGITUDE 82° 27' 10.23" LATITUDE 35° 20' 57.36"

INSPECTION DATE 03/11/2013 PRESENT CONDITION FAIR

PRESENT POSTING N NOT POSTED PROPOSED POSTING

OTHER SIGNS PRESENT DELINEATORS (2)

EAST

Fracture Critical	No
Temporary Shoring	Yes
Scour Critical	No
Scour POA	No

SIGN NOTICE ISSUED FOR		NUMBERED REQUIRED
No	WEIGHT LIMIT	
No	DELINEATORS	
No	NARROW BRIDGE	
No	ONE LANE BRIDGE	
No	LOW CLEARANCE	

NATIONAL BRIDGE INVENTORY-------- STRUCTURE INVENTORY AND APPRAISAL Run Date: 05/08/2013

IDENTIFICATION

(1) STATE NAME -NORTH CAROLINA BRIDGE 440212
(8) STRUCTURE NUMBER(FEDERAL) 000000000890212
(5) INVENTORY ROUTE (ON/UNDER) - ON 11000260
(2) STATE HIGHWAY DEPARTMENT DISTRICT 1
(3) COUNTY CODE 89 (4) PLACE CODE 0
(6) FEATURE INTERSECTED - CLEAR CREEK
(7) FACILITY CARRIED I-26 EBL
(9) LOCATION 1 MI.N.JCT.US64
(11)MILEPOINT 48.4
(16)LAT 35° 20' 57.36" (17)LONG 82° 27' 10.23"
(98)BORDER BRIDGE STATE CODE PCT SHARE
(99)BORDER BRIDGE STRUCTURE NO

STRUCTURE TYPE AND MATERIAL

(43) STRUCTURE TYPE MAIN: Steel
TYPE - Stringer Mutlibeam or Girder CODE 302
(44) STRUCTURE TYPE APPR :
TYPE - CODE 000
(45) NUMBER OF SPANS IN MAIN UNIT 3
(46) NUMBER OF APPROACH SPANS
(107)DECK STRUCTURE TYPE - 1 CODE
(108)WEARING SURFACE / PROTECTIVE SYSTEM :
(A) TYPE OF WEARING SURFACE - CODE
(B) TYPE OF MEMBRANE - CODE
(C) TYPE OF DECK PROTECTION - CODE

AGE AND SERVICE

(27) YEAR BUILT 1963
(106)YEAR RECONSTRUCTED 1989
(42) TYPE OF SERVICE : ON - Highway
UNDER - Waterway CODE 15
(28) LANES: ON STRUCTURE 2 UNDER STRUCTURE 0
(29) AVERAGE DAILY TRAFFIC 27000
(30) YEAR OF ADT 2011 (109) TRUCK ADT PCT 16%
(19) BYPASS OR DETOUR LENGTH 1 MI

GEOMETRIC DATA

(48) LENGTH OF MAXIMUM SPAN 72 FT
(49) STRUCTURE LENGTH 220 FT
(50)CURB OR SIDEWALK: LEFT .1 FT RIGHT .1 FT
(51) BRIDGE ROADWAY WIDTH CURB TO CURB 28 FT
(52) DECK WIDTH OUT TO OUT 33.417 FT
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS) 28 FT
(33) BRIDGE MEDIAN - No Median CODE 1
(34) SKEW 0° (35) STRUCTURE FLARED 0
(10) INVENTORY ROUTE MIN VERT CLEAR 999.9 FT
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR 28 FT
(53) MIN VERT CLEAR OVER BRIDGE RDWY 999.9 FT
(54) MIN VERT UNDERCLEAR REF Not a Highway or Railroad 0 FT
(55) MIN LAT UNDERCLEAR RT REF Not a Highway or Railroad 000 FT
(56) MIN LAT UNDERCLEAR LT REF - 000 FT

NAVIGATION DATA

(38) NAVIGATION CONTROL - No Navigational Control CODE 0
(111)PIER PROTECTION - CODE
(39) NAVIGATION VERTICAL CLEARANCE 0
(116)VERT - LIFT BRIDGE NAV MIN VERT CLEAR FT
(40) NAVIGATION HORIZONTAL CLEARANCE 0 FT

SUFFICIENCY RATING = 6
STATUS = Structurally Deficient

CLASSIFICATION — CODE

(112)NBIS BRIDGE SYSTEM - YES
(104)HIGHWAY SYSTEM Is on the NHS 1
(26) FUNCTIONAL CLASS - Arterial - Interstate 11
(100)STRAHNET HIGHWAY - Interstate STRAHNET Route 1
(101)PARALLEL STRUCTURE - Right Parallel Structure R
(102)DIRECTION OF TRAFFIC - 1-way Traffic 1
(103)TEMPORARY STRUCTURE - Temporary Structure/Conditions T
(110)DESIGNATED NATIONAL NETWORK - On the National Network 1
(20) TOLL On Free Road 3
(31) MAINTAIN - State Highway Agency 01
(22) OWNER - State Highway Agency 01
(37) HISTORICAL SIGNIFICANCE - Not Eligible 5

CONDITION — CODE

(58) DECK 5
(59) SUPERSTRUCTURE 6
(60) SUBSTRUCTURE 4
(61) CHANNEL & CHANNEL PROTECTION 8
(62) CULVERTS N

LOAD RATING AND POSTING — CODE

(31) DESIGN LOAD HS 20 + MOD 6
(63) OPERATING RATING METHOD - Load Factor 1
(64) OPERATING RATING - HS-1 1
(65) INVENTORY RATING METHOD - Load Factor 1
(66) INVENTORY RATING - HS-1 1
(70) BRIDGE POSTING - No Posting Required 5
(41) STRUCTURE OPEN, POSTED ,OR CLOSED D
DESCRIPTION - Open Temporary Shoring

APPRAISAL — CODE

(67) STRUCTURAL EVALUATION 3
(68) DECK GEOMETRY 3
(69) UNDERCLEARANCES,VERTI & HORIZ N
(71) WATERWAY ADEQUACY 7
(72) APPROACH ROADWAY ALIGNMENT 8
(36) TRAFFIC SAFETY FEATURES 1111
(113)SCOUR CRITICAL BRIDGES 8

PROPOSED IMPROVEMENTS

(75) TYPE OF WORK - CODE
(76) LENGTH OF STRUCTURE IMPROVEMENT
(94) BRIDGE IMPROVEMENT COST
(95) ROADWAY IMPROVEMENT COST
(96) TOTAL PROJECT COST
(97) YEAR OF IMPROVEMENT COST ESTIMATE
(114)FUTURE ADT 54000 (115) YEAR FUTURE ADT 2025

INSPECTIONS

(90) INSPECTION DATE 03/11/2013
(92) CRITICAL FEATURE INSPECTION : (93) CFI DATE
A) FRACTURE CRIT DETAIL - NO A)
B) UNDERWATER INSP - NO B)
C) OTHER SPECIAL INSP NO C)
SCOUR

BRIDGE MANAGEMENT UNIT

DATA ON EXISTING STRUCTURE Run Date: 05/08/2013

COUNTY :	DIVISION :	DISTRICT:	STRUCTURE NUMBER :	LENGTH :
HENDERSON	14	1	440212	220 FEET

ROUTE CARRIED : I-26 EBL

FEATURE INTERSECTED : CLEAR CREEK

LOCATED : 1 MI.N.JCT.US64

BRIDGE NAME :

CITY :

FUNC. CLASS :	SYST.ON :	SYST.UNDER :	ADT & YR :	RAIL TYPE :
11	FA	NFA	27000 2011	LT 523 RT 523

BUILT :	BY :	PROJ :	FED.AID PROJ :	DESIGN LOAD :
1963	SHC	8.18293	I-26-1(5)12	HS 20 + MOD

REHAB :	BY :	PROJ :	ALIGNMENT :	SKEW :	LANES :
1989	DOH	5.9531008	LT.	90	ON 2 UNDER 0

NAVIGATION :	HT. CRN. TO BED :	WATER DEPTH :
VC 0 FT HC 0 FT	57 FT	2 FT

SUPERSTRUCTURE : REINFORCED CONC.FLOOR ON I-BEAMS

SUBSTRUCTURE : E.BTS:RC CAPS/H-PILES;INT.BTS:RC POST&BEAM

SPANS : 1 @ 73.64';1 @ 72.86';1 @ 73.64'

BEAMS OR GIRDERS : 4 LINES 36 I-BEAMS @ 8' CENTERS

FLOOR :	ENCROACHMENT :	DECK (OUT TO OUT) :
9 RC/NO AWS		33.417 FT

CLEAR ROADWAY :	BETWEEN RAILS :	SIDEWALK OR CURB :
28 FT	28.167 FT	LT .1 FT RT .1 FT

VERT.CL.OVER : 999.9 FT

INV.RTG. :	OPE.RTG. :	CONTR.MEMBER :	POSTED :		
HS-1	HS-1	int bm	SV	TTST	DATE

SYSTEM : Primary Interstate

GREEN LINE ROUTE : Y

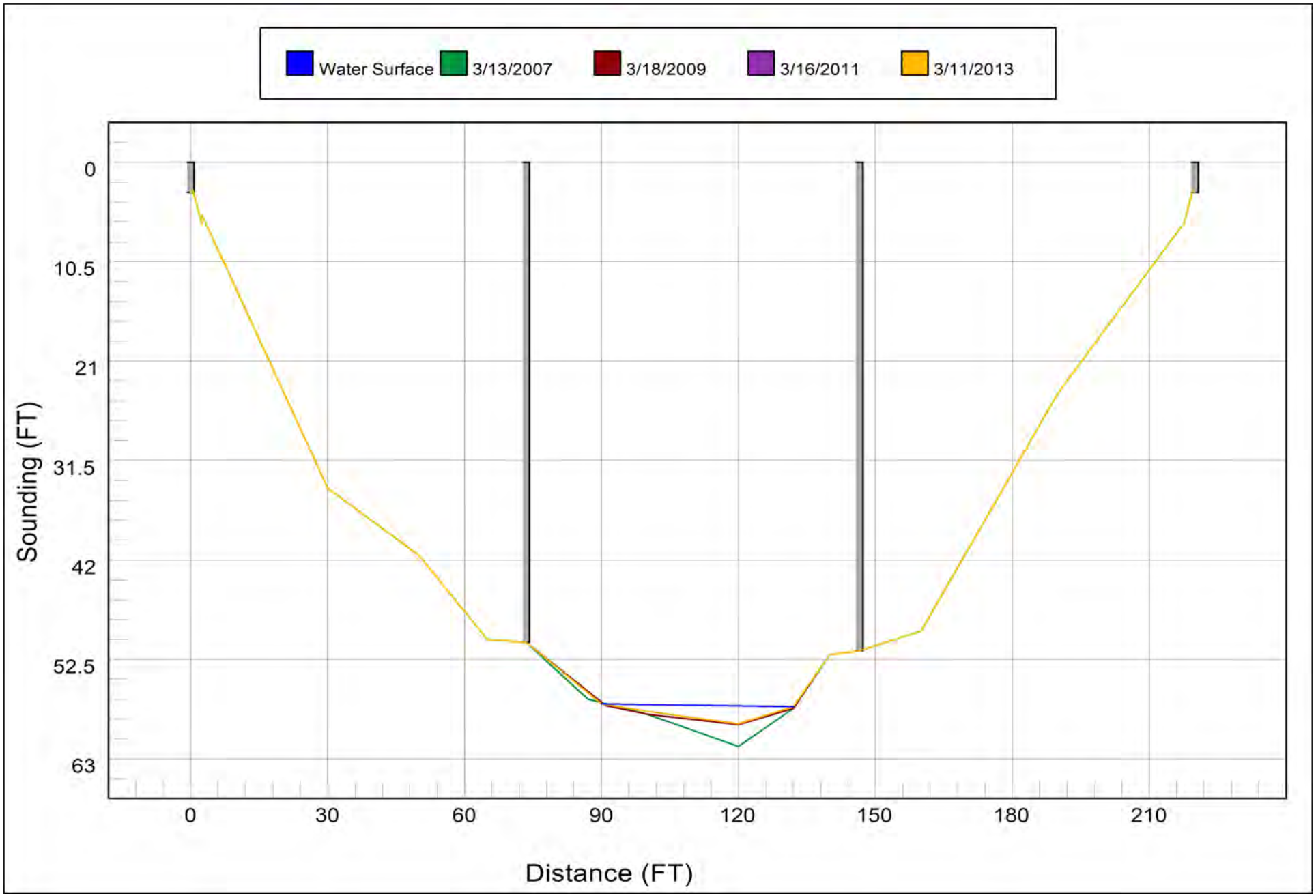
UNDER ROUTES AND CLEARANCES

REMARKS :

Bridge: 440212 County HENDERSON Date: 03/11/2013

STREAMBED PROFILE (Downstream)

Top of Rail = 0 FT (Sounding)



DOWNSTREAM SOUTH

REP OF END BENT (END BENT 1)

REP OF INTERIOR BENT (INTERIOR BENT 2/WEST FACE)

UPSTREAM NORTH

EAST

WEST AT APPROACH GUARDRAIL

EAST AT APPROACH GUARDRAIL

WEST

REP OF APPROACH GUARDRAIL POST SPACING AT BRIDGE (SOUTH EAST)

DOWNSTREAM SOUTH

UPSTREAM NORTH

Looking at Upstream Face

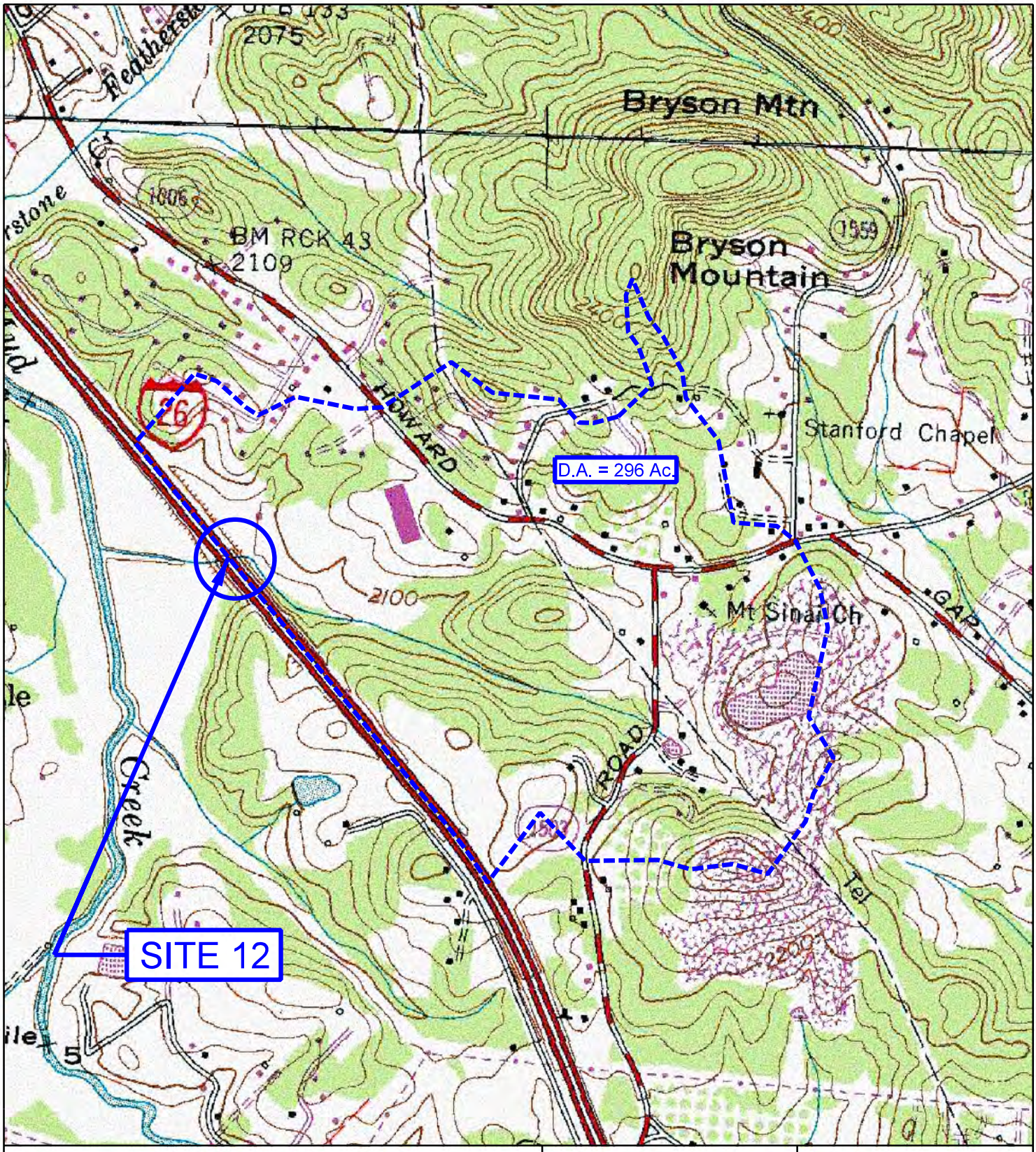
Looking at Downstream Face

Looking Downstream

Looking Upstream

APPENDIX O

SITE 12



QUAD MAP - SITE 12

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 12

Stream Name: UT to Mud Creek

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	0	0.0	0.000
Rock Quary	-	10%	50	5.0	0.017
Low - Medium Density Residential	2 - 5	20%	86	17.2	0.058
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	10	3.5	0.012
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	0	0.0	0.000
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	150	105.1	0.356
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	0	0.0	0.000
Totals			**296**	**130.8**	**44.2%**

Drainage Area = **296** **acres**

Project: I-4400 / I-4700

Site #: 12

Stream Name: UT to Mud Creek

Drainage Area (sq mi): 0.46

Impervious Area (%): 44.2%

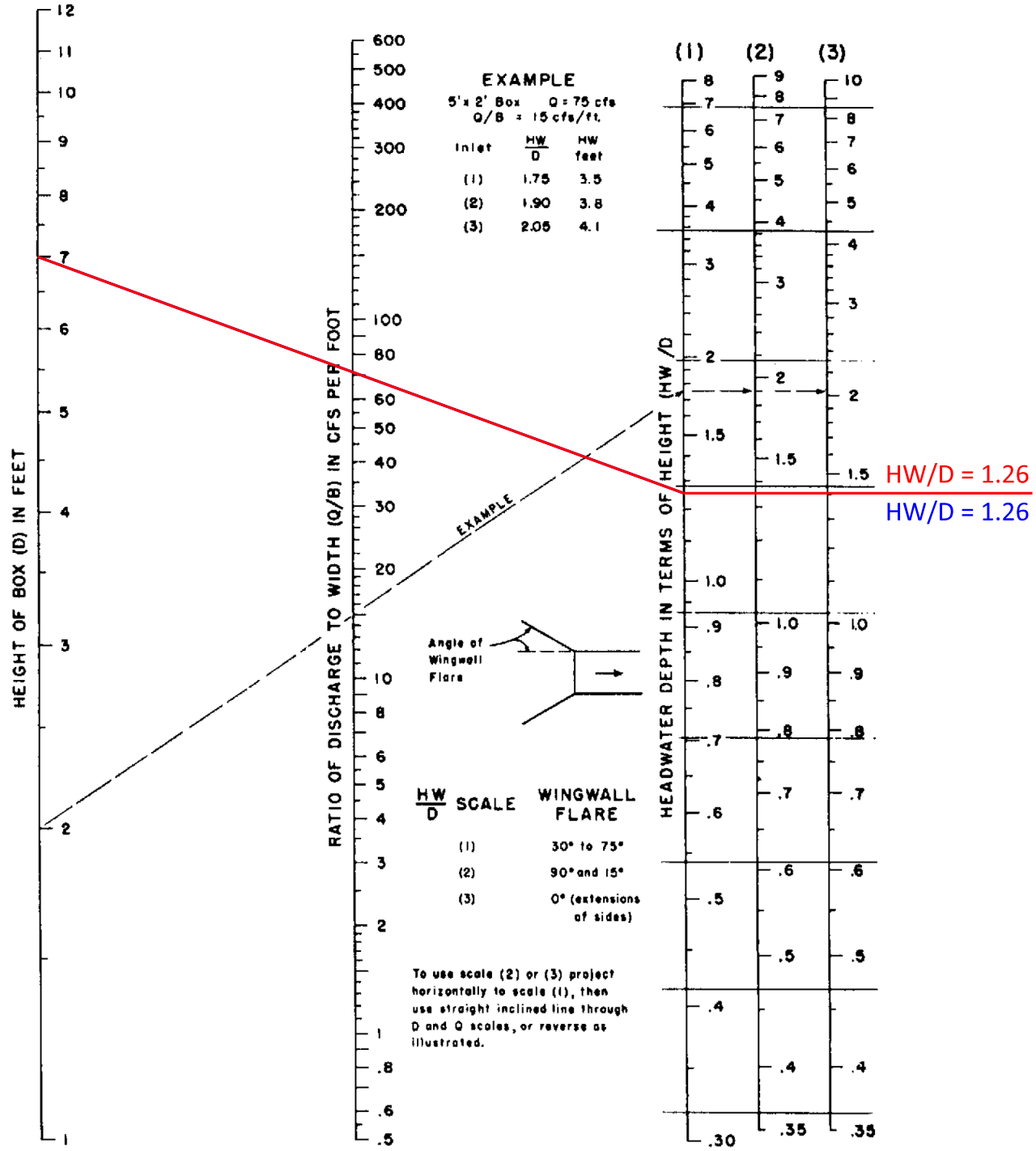
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	365	-	-
5	428	-	-
10	462	-	-
25	488	-	-
50	500	-	-
100	517	-	-
200	526	-	-
500	557	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	-
50	-
100	-
500	-

SITE 12

50 Year	100 Year
1 @ 7' x 7' RCBC	1 @ 7' x 7' RCBC
Q = 500 CFS	Q = 500 CFS
Q/NB = 71 CFS/FT.	Q/NB = 71 CFS/FT.

CHART 8B



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/4/14

SITE NUMBER 12 STREAM UT TO MUD CREEK ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 1@ 7' x 7' RCBC. GOOD CONDITION. MINOR CRACKS AND HOLE THROUGHOUT THE STRUCTURE.

UPSTREAM CHANNEL: TOP WIDTH 14 FT BOTTOM WIDTH 7 FT BANKFULL DEPTH 3 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL

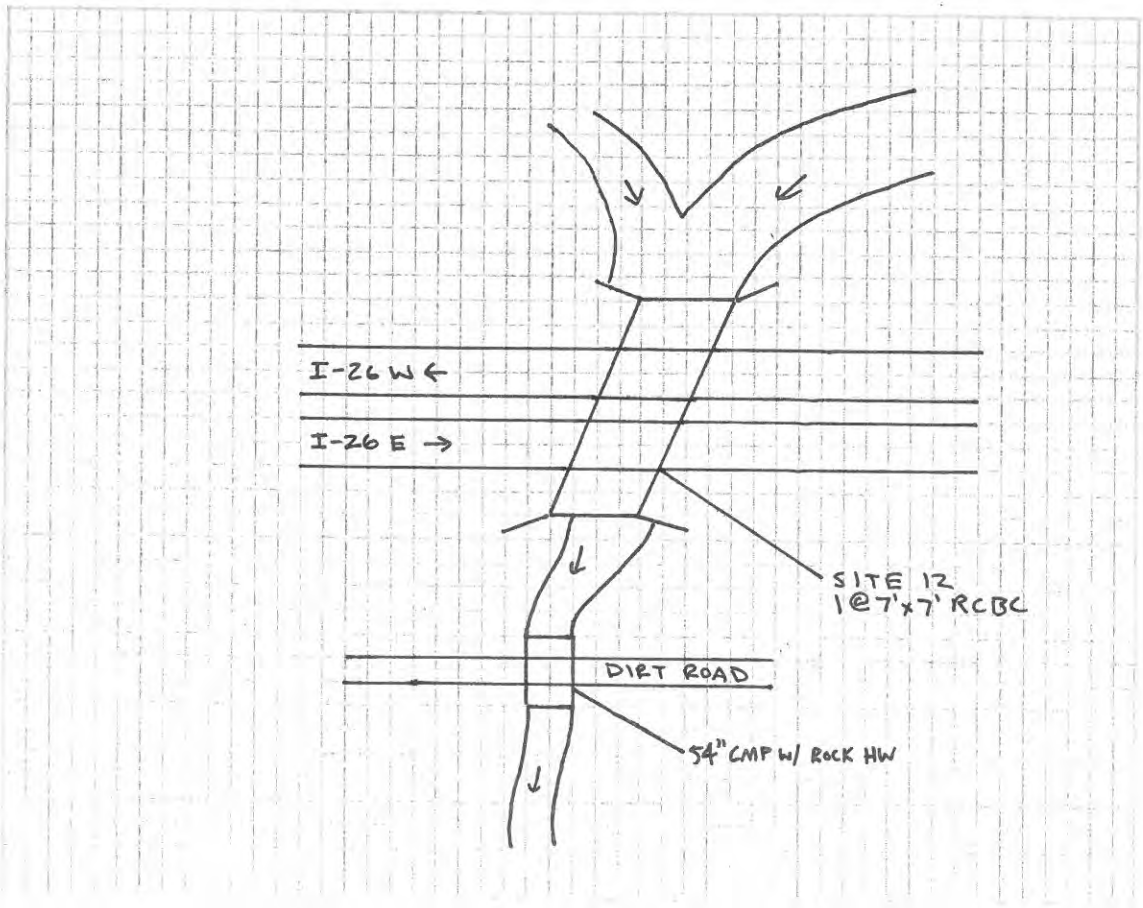
BANK/ CHANNEL CONDITIONS TWO CHANNELS COMING INTO THE STRUCTURE. BANKS ARE STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 16 FT BOTTOM WIDTH 4 FT BANKFULL DEPTH 6 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS MINOR SILT AT OUTLET. BANKS ARE STABLE AND VEGETATED.

COMMENTS A 54" CMP WITH ROCK HEADWALL IS LOCATED DOWNSTREAM OF THE STRUCTURE.



Looking at Upstream Face of 1 @ 7' x 7' RCBC under I-26

Looking Upstream from 1 @ 7' x 7' RCBC Inlet

Looking at Upstream Channel coming from the right

Looking at Upstream Channel coming from the right

Looking at Upstream Channel coming from the left

Looking Downstream inside of the Barrel

Cracks on the Side of the Wall Inside of the Barrel

Cracks on the Top Slab Inside of the Barrel

Looking Downstream inside of the Barrel

Looking at Downstream Face of 1 @ 7' x 7' RCBC under I-26

Looking Downstream from 1 @ 7′ x 7′ RCBC Outlet

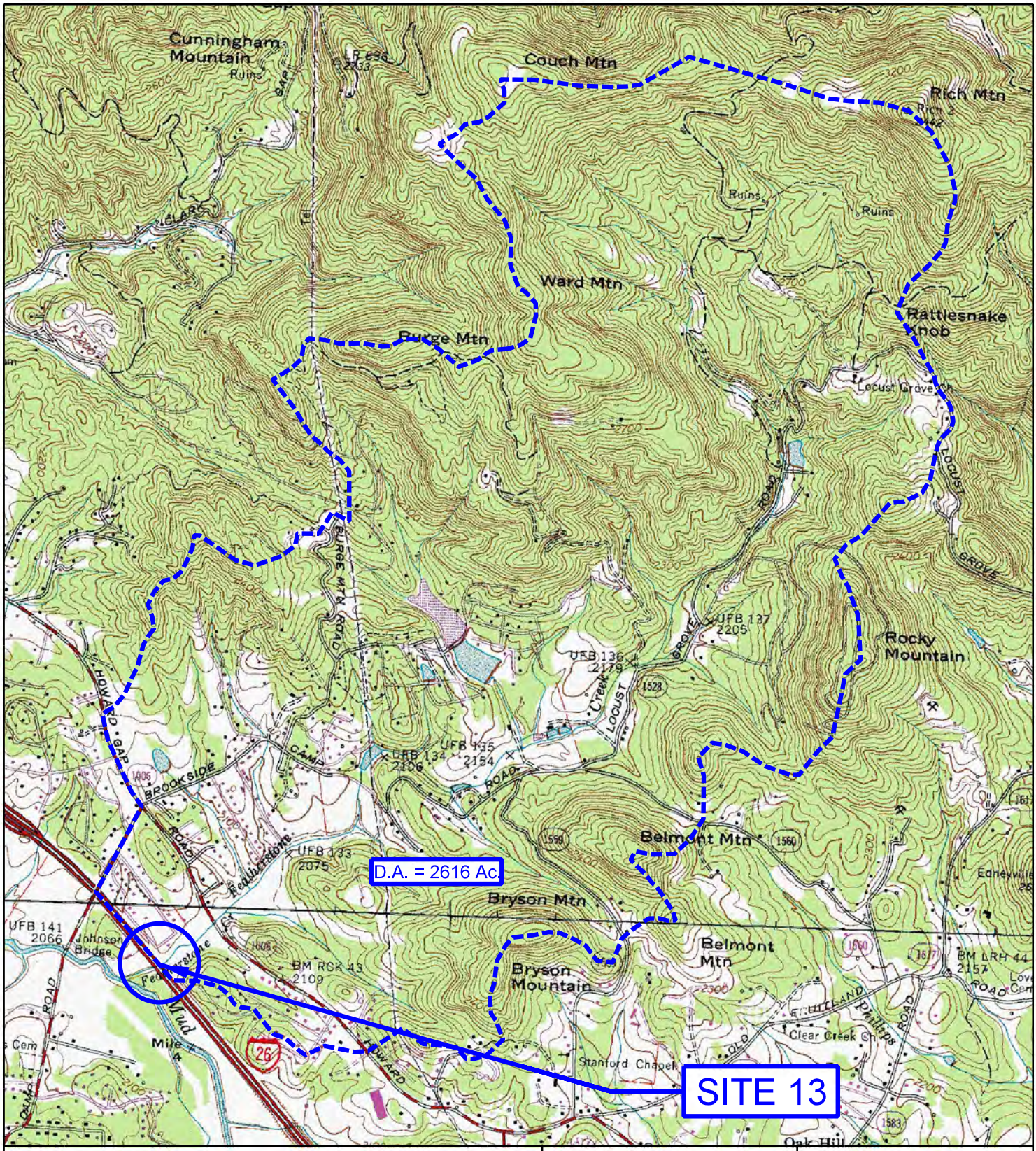
Upstream Face of Downstream 54″ CMP with Rock Headwall

Downstream Face of Downstream 54" CMP with Rock Headwall

Downstream of 54" CMP with Rock Headwall

APPENDIX P

SITE 13



QUAD MAP - SITE 13

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

1,000 0 1,000 2,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 13

Stream Name: Featherstone Creek

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	1226	122.6	0.047
Low - Medium Density Residential	2 - 5	20%	1383	276.5	0.106
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	0	0.0	0.000
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	0	0.0	0.000
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	0	0.0	0.000
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	7	6.1	0.002
Totals			**2616**	**405.2**	**15.5%**

Drainage Area = **2616** **acres**

Project: I-4400 / I-4700

Site #: 13

Stream Name: Featherstone Creek

Drainage Area (sq mi): 4.09

Impervious Area (%): 15.5%

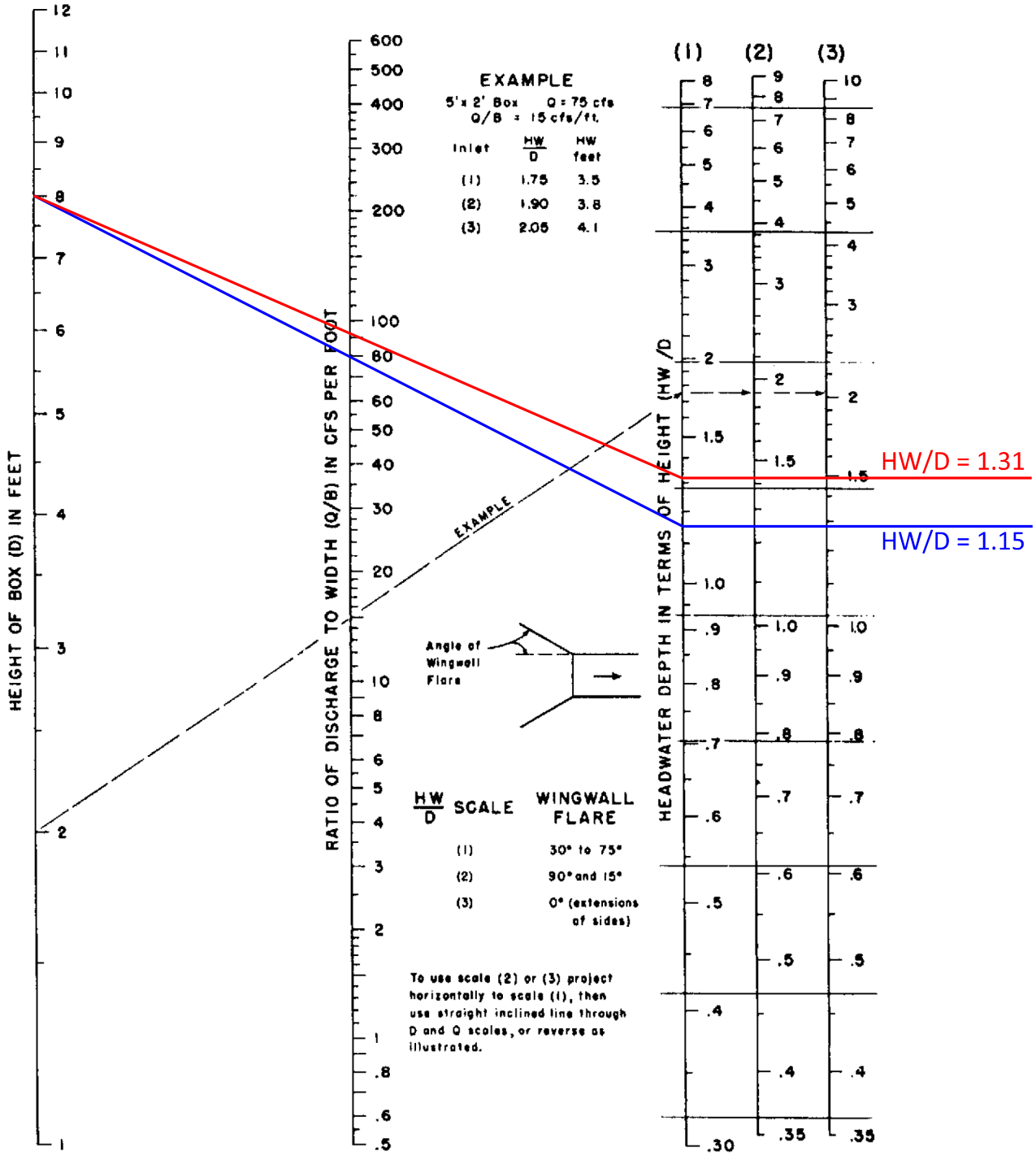
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	DISCHARGE (cfs)		
	PIEDMONT - RIDGE AND VALLEY	SAND HILLS	COASTAL PLAIN
2	636	-	-
5	1029	-	-
10	1308	-	-
25	1672	-	-
50	1945	-	-
100	2220	-	-
200	2509	-	-
500	2895	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	DISCHARGE (cfs)
10	-
50	-
100	1810
500	-

SITE 13

50 Year	100 Year
3 @ 8' x 8' RCBC	3 @ 8' x 8' RCBC
Q = 1900 CFS	Q = 2200 CFS
Q/NB = 79 CFS/FT.	Q/NB = 92 CFS/FT.

CHART 8B



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

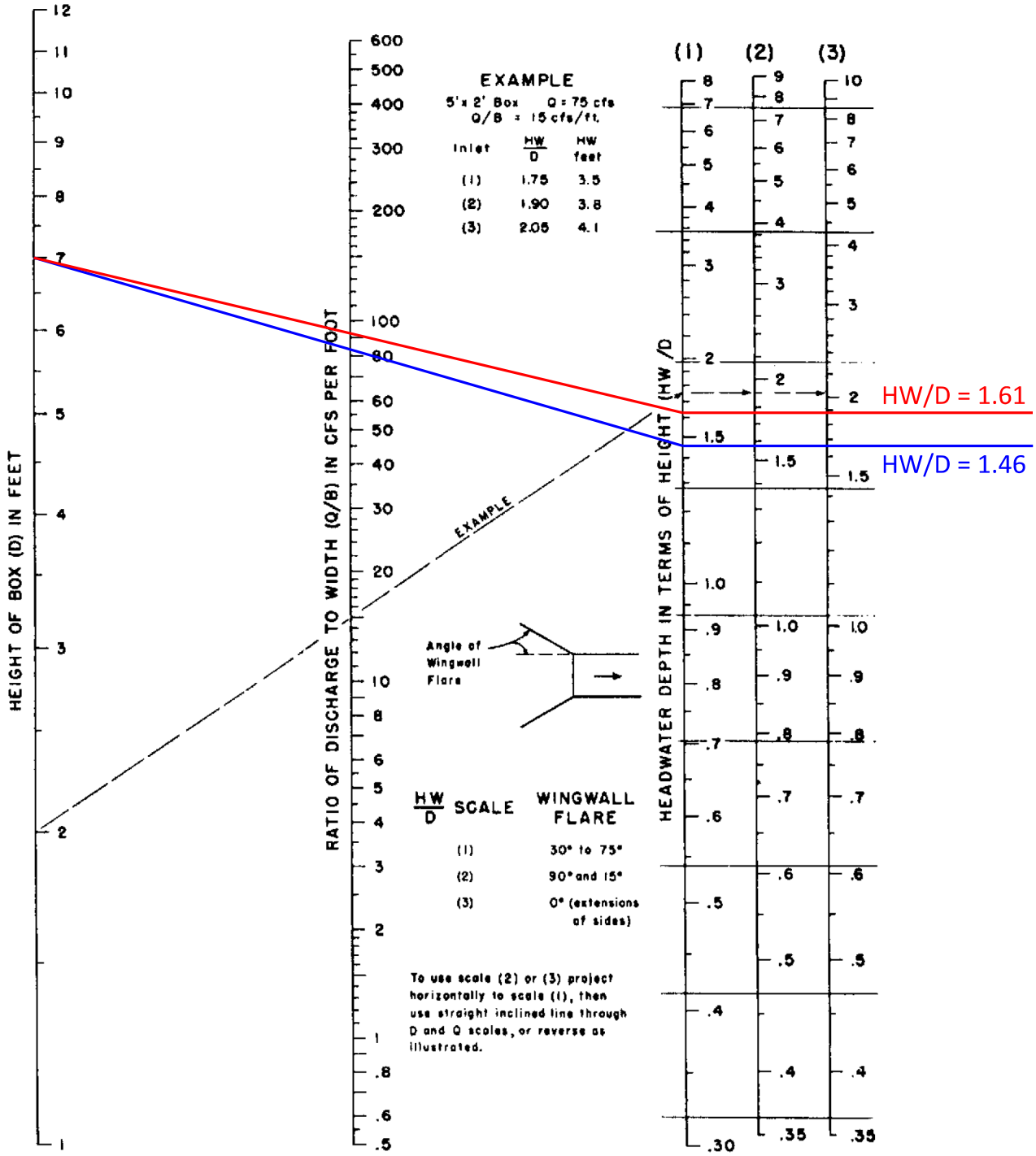
BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

SITE 13

50 Year (1 Ft. of Silt)	100 Year (1 Ft. of Silt)
3 @ 8' x 8' RCBC	3 @ 8' x 8' RCBC
Q = 1900 CFS	Q = 2200 CFS
Q/NB = 79 CFS/FT.	Q/NB = 92 CFS/FT.

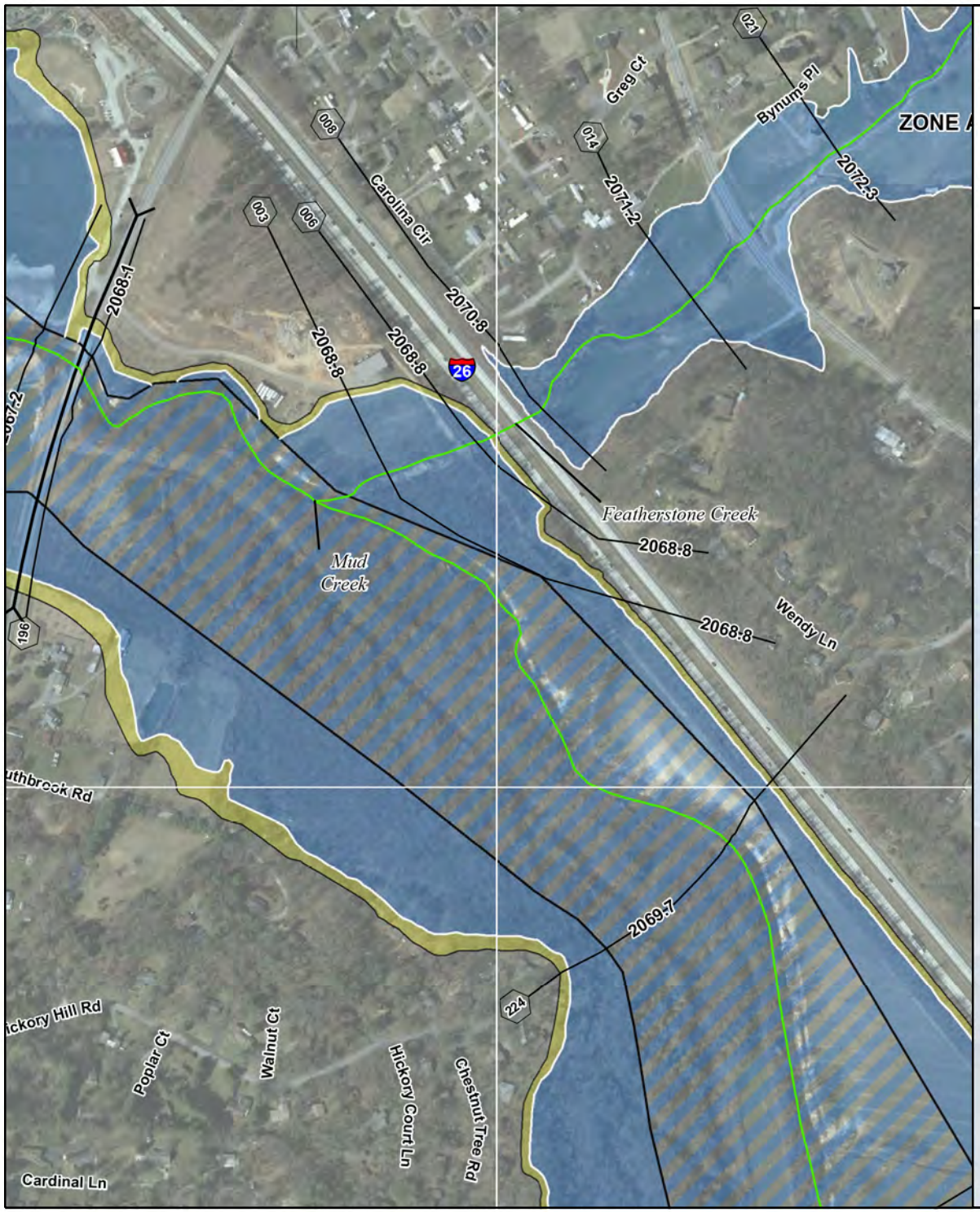
CHART 8B



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING



Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 9660

FEMA

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
HENDERSON COUNTY	370125	9660	J
HENDERSONVILLE, CITY OF	370128	9660	J

Site 13

MAP NUMBER
3700966000J

MAP REVISED
10/2/2008

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

A Report of Flood Hazards in

HENDERSON COUNTY, NORTH CAROLINA AND INCORPORATED AREAS

Community Name	Community Number
CITY OF HENDERSONVILLE	370128
HENDERSON COUNTY	370125
TOWN OF FLETCHER	370568
TOWN OF LAUREL PARK	370384
VILLAGE OF FLAT ROCK	370565

NORTH CAROLINA
Cooperating Technical State
FEMA'S COOPERATING TECHNICAL PARTNER

EFFECTIVE: 10/2/2008
REVISED: 1/6/2010
Federal Emergency Management Agency
State of North Carolina
Flood Insurance Study Number
37089CV000
www.fema.gov and www.ncfloodmaps.com

Table 10 - Flooding Sources Studied by Detailed Methods: Limited Detailed

Source	Riverine Sources		Affected Communties
	From	To	
Allen Branch	The confluence with Clear Creek	Approximately 200 feet upstream of the Luther Capell Lane	City Of Hendersonville Henderson County
Bat Fork Creek	Approximately 1,500 feet upstream of New Hope Road (SR 1757)	Approximately 200 feet upstream of US Route 176	City Of Hendersonville Henderson County
Battle Creek	The confluence with Shaw Creek	Approximately 0.5 mile upstream US Route 64	Henderson County
Big Willow Creek	The confluence with French Broad River	The confluence of South Fork Big Willow Creek and North Fork Big Willow Creek	Henderson County
Big Willow Creek Tributary 1	The confluence with Big Willow Creek	Approximately 50 feet upstream of Lakeshore Drive	Henderson County
Boylston Creek	Approximately 100 feet upstream of Gonce Drive	Approximately 280 feet upstream of King Road (SR 1502) (SR 1502)	Town Of Mills River
Britton Creek	New Village Drive	Approximately 90 feet upstream of Mistletoe Trail	City Of Hendersonville Henderson County
Britton Creek Tributary 2	The confluence with Britton Creek	Approximately 150 feet upstream of Stonebrook Drive	City Of Hendersonville
Broad River	The Henderson/Rutherford County boundary	Approximately 120 feet upstream of the Henderson/Buncombe County boundary	Henderson County
Clear Creek	Approximately 150 feet downstream of the confluence of Kyles Creek	Approximately 1.0 mile upstream of Apple Valley Road (SR 1572)	Henderson County
Dunn Creek	The confluence with Bat Fork Creek	Approximately 700 feet upstream of Howard Gap Road (SR 1006)	City Of Hendersonville Henderson County
Featherstone Creek	The confluence with Mud Creek	Approximately 250 feet upstream of Locust Grove Road (SR 1528)	Henderson County
Finley Creek	The confluence with Shepherd Creek and Perry Creek	Approximatley 0.4 mile upstream of Old Kanuga Road (SR 1138)	City Of Hendersonville Henderson County
Gash Creek	The confluence with French Broad River	Approximately 1,300 feet upstream of US Route 64	Henderson County
Green River	Approximately 90 feet downstream of the confluence of Wheat Creek	Approximately 0.7 mile downstream of NC Route 225	Henderson County
Henderson Creek	The confluence with Clear Creek	Approximately 1,300 feet upstream of Pace Rd (SR 1726)	Henderson County
Hickory Creek (near Gerton)	The confluence with Broad River	Approximately 0.6 mile upstream of Bearwallow Mountain Road (SR 1693)	Henderson County
King Creek	The confluence with Bat Fork Creek	Approximately 2,400 feet upstream of W. Blue Ridge Road	City Of Hendersonville Henderson County Village Of Flat Rock
King Creek Tributary 3	The confluence with King Creek	Approximately 200 feet upstream of Rutledge Drive (SR 1166)	City Of Hendersonville Henderson County Village Of Flat Rock
Kyles Creek	The confluence with Clear Creek	Approximately 150 feet downstream of Terrys Gap Road (SR 1565)	Henderson County
Lanning Mill Creek	The confluence with Kyles Creek	Approximately 800 feet upstream of the confluence with Kyles Creek	Henderson County
Lewis Creek	The confluence with Clear Creek	Approximately 140 feet downstream of Pilot Mountain Road (SR 1783)	Henderson County
Little Willow Creek	The confluence with French Broad River	Approximately 1.0 mile upstream of Pleasant Grove Church (SR 1191)	Henderson County
Mill Pond Creek	Approximately 40 feet downstream of North Hills Drive	Approximately 400 feet upstream of Stoney Mountain Road (SR 1383)	Henderson County
North Fork Big Willow Creek	The confluence with Big Willow Creek	Approximately 0.6 mile upstream of the confluence with Big Willow Creek	Henderson County
North Fork Mills River	The confluence with Mills River	Approximately 1.3 miles upstream of Rush Branch Road	Henderson County Town Of Mills River
Perry Creek	The confluence with Finley Creek and Shepherd Creek	Approximately 1,500 feet upstream of Price Road (SR 1137)	Henderson County
Piney Branch	The confluence with South Fork Big Willow Creek	Approximately 0.8 mile upstream of Big Willow Road (SR 1191)	Henderson County
Reedypatch Creek	The confluence with Broad River	Approximately 600 feet upstream of Bald Rock Road (SR 1710)	Henderson County
Rock Creek (into Green River)	The confluence with Green River	Approximately 0.4 mile upstream of Green River Road (SR 1106)	Henderson County
Shaw Creek	The confluence with French Broad River	Approximately 1,400 feet upstream of Turley Falls Road (SR 1215)	Henderson County
Shepherd Creek	Approximately 50 feet downstream of S. Lakeside Drive (SR 1148)	The confluence of Finley Creek and Perry Creek	City Of Hendersonville Henderson County
South Fork Big Willow Creek	The confluence with Big Willow Creek	Approximately 0.4 mile upstream of Patterson Road (SR 1194)	Henderson County
South Fork Mills River	The confluence with Mills River	Approximately 3.2 miles upstream of Dalton Road (SR 1340)	Henderson County Town Of Mills River
Tonys Creek	The confluence with Shepherd Creek	Approximately 0.5 mile upstream of Willow Road (SR 1171)	City Of Hendersonville Henderson County Town Of Laurel Park

Table 13 - Summary of Discharges

Flooding Source		Discharges (cfs)			
Location	Drainage Area (square miles)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Approximately 300 feet downstream of Howard Gap Road (SR 1006)	79.77	*	*	11,340	*
Approximately 50 feet upstream of confluence of Hoopers Creek	63.63	*	*	10,690	*
Approximately 100 feet upstream of Mills Gap Road (SR 1551)	63.14	*	*	10,670	*
Approximately 1,200 feet upstream of Mills Gap Road (SR 1551)	60.64	*	*	8,160	*
At the Henderson/Buncombe County boundary	60.31	*	*	8,150	*
Clear Creek					
At the confluence with Mud Creek	44.44	3,550	5,970	7,200	10,620
Approximately 50 feet upstream of Allen Branch	42.98	3,430	5,790	7,000	10,340
Approximately 200 feet upstream of Nix Road (SR 1513)	42.57	3,400	5,740	6,940	10,260
Approximately 900 feet downstream of Howard Gap Road (SR 1006)	42.32	3,380	5,710	6,900	10,220
Approximately 100 feet downstream of Howard Gap Road (SR 1006)	39.23	3,290	5,540	6,690	9,880
Approximately 0.6 mile upstream of the confluence with Wolfpen Creek	37.10	3,100	5,300	6,500	9,700
Approximately 0.4 mile upstream of Lancaster Road (SR 1582)	34.10	2,950	5,000	6,200	9,200
Approximately 1,500 feet upstream of Fruitland Road (SR 1574)	28.00	2,600	4,500	5,500	8,100
Approximately 50 feet upstream of confluence of Kyles Creek	23.70	*	*	5,320	*
At the confluence of Puncheon Camp Creek	10.67	*	*	3,270	*
Devils Fork					
At the confluence with Bat Fork Creek	8.53	1,380	2,350	2,840	4,240
Approximately 100 feet upstream of Tracy Grove Road (SR 1793)	8.23	1,350	2,300	2,780	4,150
Approximately 1,500 feet upstream of Tracy Grove Road (SR 1793)	7.80	1,300	2,220	2,690	4,020
Approximately 0.5 mile upstream of Tracy Grove Road (SR 1793)	7.42	1,260	2,150	2,610	3,900
Approximately 0.4 mile downstream of Interstate 26	6.83	1,190	2,040	2,480	3,710
Approximately 200 feet upstream of Interstate 26	6.27	1,130	1,930	2,350	3,520
Approximately 0.4 mile upstream of Interstate 26	5.80	1,080	1,850	2,250	3,390
Approximately 0.7 mile upstream of Interstate 26	4.95	960	1,660	2,020	3,050
Approximately 300 feet upstream of Howard Gap Road (SR 1006)	4.55	910	1,570	1,920	2,900
Approximately 0.5 mile upstream of Howard Gap Road (SR 1006)	4.00	840	1,450	1,770	2,680
Approximately 0.5 mile downstream of Dana Road (SR 1525)	2.44	600	1,060	1,300	1,990
Approximately 1,500 feet downstream of Dana Road (SR 1525)	1.86	500	890	1,100	1,690
Dunn Creek					
At the confluence with Bat Fork Creek	3.07	*	*	1,500	*
Approximately 600 feet downstream of Howard Gap Road (SR 1006)	1.01	*	*	750	*
Featherstone Creek					
At the confluence with Mud Creek	4.12	*	*	1,810	*
Approximately 1,100 feet downstream of Locust Grove Road (SR 1528)	1.37	*	*	910	*
Finley Creek					
At the confluence with Shepherd Creek	2.22	*	*	1,230	*
French Broad River					
Approximately 0.4 mile downstream of the confluence of Bent Creek	676.00	*	*	50,000	*
At the confluence of Cane Creek	633.00	*	*	48,500	*
Mile 166.9 above Cane Creek	546.00	*	*	46,000	*
Mile 168.5 above Mud Creek	432.00	*	*	41,500	*
Mile 169.2 above Mill River	357.00	17,000	30,600	38,000	58,500
Gash Creek					

5.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the flood elevations for the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles and/or Water-surface elevation rasters. For stream segments for which BFEs were computed, selected cross-section locations are also shown on the FIRM. Flood Profiles and/or Water-surface elevation rasters were developed showing computed water-surface elevations for floods of the selected recurrence intervals.

Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles and/or Water-surface elevation rasters or in the Floodway Data tables in the FIS Report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in the FIS in conjunction with the data shown on the FIRM.

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the Flood Profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For details on the county's hydraulic analyses, the hydraulic report is available by request.

For the streams studied by detailed methods, water surface elevations of floods of the selected recurrence intervals were computed through use of the Army Corps of Engineers' HEC RAS step backwater computer program . The hydraulic analyses were based on unobstructed flow. The flood elevations shown on the Profiles and/or Water-surface elevation rasters are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail. The computer models were calibrated using historic high water data collected during field investigations.

The cross section geometries were obtained from a combination of digital elevation data obtained by Light Detection and Ranging (LIDAR) and field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Natural floodplain cross sections were surveyed approximately every 4000 feet along the detail study reaches to obtain the channel geometry between bridges and culverts. Overbank cross section data for the backwater analyses were obtained from recently flown LIDAR data.

Channel roughness factors (Manning's "n") used in the hydraulic computations were made in the field by an engineer where stream access was possible, with orthophotos used to supplement areas that could not be accessed. The channel and overbank "n" values for all of the streams studied by detailed methods are shown in Table 16, "Roughness Coefficients".

Table 16 - Roughness Coefficients

Stream	Channel "n"	Overbank "n"
Allen Branch	0.045 to 0.050	0.030 to 0.090
Bat Fork Creek	0.040 to 0.060	0.022 to 0.150
Battle Creek	0.035 to 0.040	0.040 to 0.090
Big Willow Creek	0.040	0.050 to 0.090
Big Willow Creek Tributary 1	0.025 to 0.050	0.050 to 0.090
Boylston Creek	0.035 to 0.090	0.040 to 0.120
Boylston Creek Tributary 7	0.040 to 0.090	0.050 to 0.090
Britton Creek	0.035 to 0.060	0.030 to 0.160
Britton Creek Tributary 2	0.040 to 0.050	0.030 to 0.090
Broad River	0.028 to 0.100	0.010 to 0.130
Cane Creek	0.040 to 0.050	0.025 to 0.250
Clear Creek	0.035 to 0.060	0.030 to 0.140
Crab Creek	0.055 to 0.061	0.080 to 0.660
Devils Fork	0.040 to 0.070	0.010 to 0.150
Dunn Creek	0.035 to 0.050	0.030 to 0.090
Featherstone Creek	0.045 to 0.090	0.030 to 0.090
Finley Creek	0.040 to 0.050	0.040 to 0.090
French Broad River	0.024 to 0.064	0.030 to 0.200
Gash Creek	0.037 to 0.057	0.030 to 0.125
Green River	0.032 to 0.090	0.025 to 0.100
Hickory Creek (near Gerton)	0.060 to 0.100	0.060 to 0.100
Higgins Branch	0.050 to 0.065	0.025 to 0.100
Hoopers Creek	0.045 to 0.070	0.025 to 0.150
Kimsey Creek	0.040 to 0.045	0.025 to 0.100
King Creek	0.045 to 0.050	0.030 to 0.090
King Creek Tributary 3	0.045 to 0.050	0.030 to 0.090
Kyles Creek	0.045 to 0.050	0.006 to 0.090
Lanning Mill Creek	0.050	0.050 to 0.090
Lewis Creek	0.045 to 0.050	0.030 to 0.090

PRELIMINARY DESIGN AND ASSESSMENT OF
STREAM CROSSINGS AND ENCROACHMENTS

COUNTY Henderson PROJECT NUMBER I-4400/I-4700

STREAM Featherstone Creek ROUTE I-26

ASSESSMENT PREPARED BY HNTB Corporation DATE _____

HYDROLOGIC EVALUATION

NEAREST GAGING STATION ON THIS STREAM _____ (NONE X) _____

ARE FLOOD STUDIES AVAILABLE ON THIS STREAM: Yes

FLOOD DATA:
Q10 1308 CFS EST BKWTR. - FT. Q25 1672 CFS EST BKWTR. - FT.
Q50 1945 CFS EST BKWTR. - FT. Q100 2220 CFS EST BKWTR. - FT.
Q500 2895 CFS OR OVERTOPPING CFS EST BKWTR. - FT.

DRAINAGE AREA 4.09 Sq. Miles

METHOD USED TO COMPUTE Q USGS Urban Regression

PROPERTY RELATED EVALUATIONS

DAMAGE POTENTIAL: LOW _____ MODERATE X HIGH _____

COULD THIS BE SIGNIFICANTLY INCREASED BY PROPOSED

ENCROACHMENT: YES _____ NO X

EXPLANATION: Limited changes will be made to this site.

_____

LIST BUILDINGS IN FLOOD PLAIN 1 House

LOCATION 0.25 miles upstream of I-26

FLOOR ELEVATION Unknown

UPSTREAM LAND USE Residential

ANTICIPATE ANY CHANGE? No

ANY FLOOD ZONING? (FIS STUDIES, ETC.) YES X NO _____

TYPE OF STUDY FEMA Limited_Detailed

BASE FLOOD ELEVATION 2070.8 ft (100 YEAR)

REGULATORY FLOODWAY WIDTH 69 (AS NOTED IN FIS STUDIES)

COMMENTS: Cross Section 008

TRAFFIC RELATED EVALUATIONS

PRESENT YEAR 2011 TRAFFIC COUNT 57100 VPD % TRUCKS 15

DESIGN YEAR 2040 TRAFFIC COUNT 71800 VPD % TRUCKS 15

EMERGENCY ROUTE _____ SCHOOL BUS ROUTE _____ MAIL ROUTE _____

DETOUR AVAILABLE? _____ LENGTH OF DETOUR _____ MILES

DOES THE LEVEL OF TRAFFIC SERVICE OF AN EXISTING CROSSING VARY GREATLY FROM STANDARD DESIGN LEVELS? _____

_____

IS THE TRAFFIC VOLUME, TYPE, USAGE SUCH TO WARRANT CONSIDERATION FOR VARIANCE FROM STANDARDS OR EXISTING LEVEL OF INTERRUPTION?

_____

COMMENTS: _____

_____

HIGHWAY AND BRIDGE (CULVERT) RELATED EVALUATIONS

NOTE ANY OUTSIDE FEATURES WHICH MIGHT AFFECT STAGE, DISCHARGE OR FREQUENCY.

LEVEES _____ AGGRADATION/DEGRADATION _____ RESERVOIRS _____

DIVERSIONS _____ DRAINAGE DISTRICT _____ NAVIGATION _____

BACKWATER FROM ANOTHER SOURCE 78” CMP 80 ft downstream

EXPLANATION: Private drive downstream that overtops during large events.

ROADWAY OVERFLOW SECTION (NONE __) LENGTH _____ ELEVATION _____

EMBANKMENT: SOIL TYPE Comus Fine Sandy Loam

TYPE SLOPE COVER Vegetated

COMMENTS: USDS Soil Map NC089

ENVIRONMENTAL CONSIDERATIONS

LIST SPECIAL CONDITIONS OR CONSIDERATIONS WHICH AFFECT HYDRAULIC DESIGN (NONE _____)

_____

MISCELLANEOUS COMMENTS

IS THERE UNUSUAL SCOUR POTENTIAL? YES _ NO X PROTECTION NEEDED _

ARE BANKS STABLE? Yes PROTECTION NEEDED Yes

DOES STREAM CARRY APPRECIABLE AMOUNT OF LARGE DEBRIS? Yes

COMMENTS:

_____

_____

_____

ALTERNATIVES

RECOMMENDED DESIGN Retain Existing Structure

DETOUR STRUCTURE N/A

WERE OTHER HYDRAULIC ALTERNATES CONSIDERED? YES _____ NO X

THIS SITE ASSESSMENT INDICATES THE DESIGN SHOULD FOLLOW:

(1) X NORMAL PROCESS

(2) _____ NORMAL PROCESS WITH SPECIAL SPECIFIC CONSIDERATION FOR

_____

(3) _____ SPECIFIC DESIGN PROCESS WITH APPROPRIATE RISK/ECONOMIC EVALUATION ADDRESSING: _____

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/4/14

SITE NUMBER 13 STREAM FEATHERSTONE CREEK ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 3 @ 8' x 8' RCBC. MINOR CRACK THROUGHOUT THE STRUCTURE. THERE IS A DROP INLET IN THE MIDDLE BARREL. THE LEFT AND RIGHT BARRELS ACT AS OVERFLOW BARRELS. THERE WASN'T ANY FLOW THROUGH THESE BARRELS AT THE TIME OF THE FIELD VISIT.

UPSTREAM CHANNEL: TOP WIDTH 22 FT BOTTOM WIDTH 11 FT BANKFULL DEPTH 3 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.4 FT BED MATERIAL

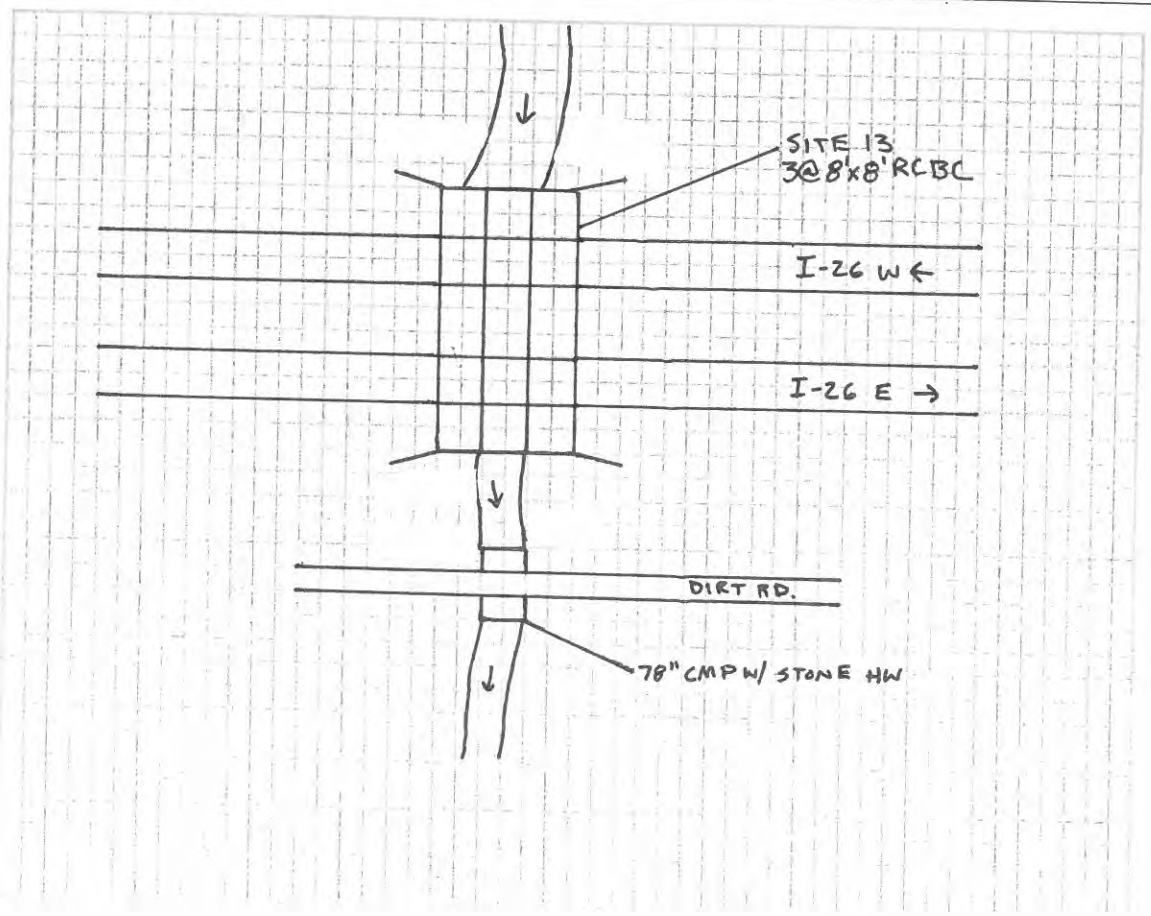
BANK/ CHANNEL CONDITIONS SILT IN LEFT AND RIGHT BARRELS. BANKS ARE STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 25 FT BOTTOM WIDTH 9 FT BANKFULL DEPTH 3 FT

DEPTH OF FLOW (AT TIME OF VISIT) 1 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS BANKS ARE STABLE AND VEGETATED.

COMMENTS THERE IS A 78" CMP W/ STONE HW ABOUT 80' DOWNSTREAM OF THE STRUCTURE. THERE IS EROSION BEHIND THE HW AND A SCOUR HOLE ON THE DOWNSTREAM SIDE.



NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
BRIDGE MANAGEMENT UNIT

ATTENTION

BRIDGE INSPECTION REPORT

INSPECTION TYPE: Routine Inspection

COUNTY HENDERSON | BRIDGE NUMBER 440218 | INSPECTION CYCLE 2 YRS 46.5

ROUTE I26,US74 | ACROSS BRANCH OF MUD CREEK | M.P. 46.60

LOCATION .3 MI.S.JCT.SR1528

SUPERSTRUCTURE TRIPLE 8'X8'RC BOX CULVERT;152'-8 ALONG CENTERLINE CULVERT

SUBSTRUCTURE

SPANS

LONGITUDE 82° 28' 21.56" | LATITUDE 35° 22' 21.30"

INSPECTION DATE 03/11/2013 | PRESENT CONDITION FAIR

PRESENT POSTING N NOT POSTED | PROPOSED POSTING

OTHER SIGNS PRESENT NOT POSTED

EAST

Fracture Critical	No
Temporary Shoring	No
Scour Critical	No
Scour POA	No

SIGN NOTICE ISSUED FOR		NUMBERED REQUIRED
No	WEIGHT LIMIT	
No	DELINEATORS	
No	NARROW BRIDGE	
No	ONE LANE BRIDGE	
No	LOW CLEARANCE	

NATIONAL BRIDGE INVENTORY-------- STRUCTURE INVENTORY AND APPRAISAL Run Date: 04/18/2013

IDENTIFICATION

(1) STATE NAME -NORTH CAROLINA BRIDGE 440218
(8) STRUCTURE NUMBER(FEDERAL) 000000000890218
(5) INVENTORY ROUTE (ON/UNDER) - ON 11000260
(2) STATE HIGHWAY DEPARTMENT DISTRICT 1
(3) COUNTY CODE 89 (4) PLACE CODE 0
(6) FEATURE INTERSECTED - BRANCH OF MUD CREEK
(7) FACILITY CARRIED I-26,US74
(9) LOCATION .3 MI.S.JCT.SR1528
(11)MILEPOINT 46.5
(16)LAT 35° 22' 21.30" (17)LONG 82° 28' 21.56"
(98)BORDER BRIDGE STATE CODE PCT SHARE
(99)BORDER BRIDGE STRUCTURE NO

STRUCTURE TYPE AND MATERIAL

(43) STRUCTURE TYPE MAIN: Concrete continuous
TYPE - Culverts (includes frame culverts) CODE 219
(44) STRUCTURE TYPE APPR :
TYPE - CODE 000
(45) NUMBER OF SPANS IN MAIN UNIT 3
(46) NUMBER OF APPROACH SPANS
(107)DECK STRUCTURE TYPE - N CODE
(108)WEARING SURFACE / PROTECTIVE SYSTEM :
(A) TYPE OF WEARING SURFACE - CODE
(B) TYPE OF MEMBRANE - CODE
(C) TYPE OF DECK PROTECTION - CODE

AGE AND SERVICE

(27) YEAR BUILT 1965
(106)YEAR RECONSTRUCTED
(42) TYPE OF SERVICE : ON - Highway
UNDER - Waterway CODE 15
(28) LANES: ON STRUCTURE 4 UNDER STRUCTURE 0
(29) AVERAGE DAILY TRAFFIC 54000
(30) YEAR OF ADT 2011 (109) TRUCK ADT PCT 23%
(19) BYPASS OR DETOUR LENGTH 1 MI

GEOMETRIC DATA

(48) LENGTH OF MAXIMUM SPAN 8 FT
(49) STRUCTURE LENGTH 25 FT
(50)CURB OR SIDEWALK: LEFT 0 FT RIGHT 0 FT
(51) BRIDGE ROADWAY WIDTH CURB TO CURB 0 FT
(52) DECK WIDTH OUT TO OUT 0 FT
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS) 76 FT
(33) BRIDGE MEDIAN - No Median CODE 2
(34) SKEW 5° (35) STRUCTURE FLARED 0
(10) INVENTORY ROUTE MIN VERT CLEAR 999.9 FT
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR 76 FT
(53) MIN VERT CLEAR OVER BRIDGE RDWY 999.9 FT
(54) MIN VERT UNDERCLEAR REF Not a Highway or Railroad 0 FT
(55) MIN LAT UNDERCLEAR RT REF Not a Highway or Railroad 000 FT
(56) MIN LAT UNDERCLEAR LT REF - 000 FT

NAVIGATION DATA

(38) NAVIGATION CONTROL - No Navigational Control CODE 0
(111)PIER PROTECTION - CODE
(39) NAVIGATION VERTICAL CLEARANCE 0
(116)VERT - LIFT BRIDGE NAV MIN VERT CLEAR FT
(40) NAVIGATION HORIZONTAL CLEARANCE 0 FT

SUFFICIENCY RATING = 82.35
STATUS = Not Deficient

CLASSIFICATION — CODE

(112)NBIS BRIDGE SYSTEM - YES
(104)HIGHWAY SYSTEM Is on the NHS 1
(26) FUNCTIONAL CLASS - Arterial - Interstate 01
(100)STRAHNET HIGHWAY - Interstate STRAHNET Route 1
(101)PARALLEL STRUCTURE - No Parallel Structure N
(102)DIRECTION OF TRAFFIC - 2-way Traffic 2
(103)TEMPORARY STRUCTURE -
(110)DESIGNATED NATIONAL NETWORK - On the National Network 1
(20) TOLL On Free Road 3
(31) MAINTAIN - State Highway Agency 01
(22) OWNER - State Highway Agency 01
(37) HISTORICAL SIGNIFICANCE - Not Eligible 5

CONDITION — CODE

(58) DECK N
(59) SUPERSTRUCTURE N
(60) SUBSTRUCTURE N
(61) CHANNEL & CHANNEL PROTECTION 5
(62) CULVERTS 5

LOAD RATING AND POSTING — CODE

(31) DESIGN LOAD HS 20 + MOD 6
(63) OPERATING RATING METHOD - Load Factor 1
(64) OPERATING RATING - HS-26 46
(65) INVENTORY RATING METHOD - Load Factor 1
(66) INVENTORY RATING - HS-20 36
(70) BRIDGE POSTING - No Posting Required 5
(41) STRUCTURE OPEN, POSTED ,OR CLOSED A
DESCRIPTION - Open, No Restriction

APPRAISAL — CODE

(67) STRUCTURAL EVALUATION 5
(68) DECK GEOMETRY N
(69) UNDERCLEARANCES,VERTI & HORIZ N
(71) WATERWAY ADEQUACY 7
(72) APPROACH ROADWAY ALIGNMENT 8
(36) TRAFFIC SAFETY FEATURES NNNN
(113)SCOUR CRITICAL BRIDGES 8

PROPOSED IMPROVEMENTS

(75) TYPE OF WORK - CODE
(76) LENGTH OF STRUCTURE IMPROVEMENT
(94) BRIDGE IMPROVEMENT COST
(95) ROADWAY IMPROVEMENT COST
(96) TOTAL PROJECT COST
(97) YEAR OF IMPROVEMENT COST ESTIMATE
(114)FUTURE ADT 108000 (115) YEAR FUTURE ADT 2025

INSPECTIONS

(90) INSPECTION DATE 03/11/2013
(92) CRITICAL FEATURE INSPECTION : (93) CFI DATE
A) FRACTURE CRIT DETAIL - NO A)
B) UNDERWATER INSP - NO B)
C) OTHER SPECIAL INSP NO C)
SCOUR

BRIDGE MANAGEMENT UNIT

DATA ON EXISTING STRUCTURE Run Date: 04/18/2013

COUNTY : HENDERSON
DIVISION : 14
DISTRICT: 1
STRUCTURE NUMBER : 440218
LENGTH : 25 FEET

ROUTE CARRIED : I-26,US74
FEATURE INTERSECTED : BRANCH OF MUD CREEK

LOCATED : .3 MI.S.JCT.SR1528
BRIDGE NAME :
CITY :

FUNC. CLASS : 01
SYST.ON : FA
SYST.UNDER : NFA
ADT & YR : 54000 2011
RAIL TYPE : LT 0 RT 0

BUILT : 1965
BY : SHC
PROJ :
FED.AID PROJ :
DESIGN LOAD : HS 20 + MOD

REHAB :
BY :
PROJ :
ALIGNMENT : TAN
SKEW : 95
LANES : ON 4 UNDER 0

NAVIGATION : VC 0 FT HC 0 FT
HT. CRN. TO BED : 18 FT
WATER DEPTH : 1 FT

SUPERSTRUCTURE : TRIPLE 8'X8'RC BOX CULVERT;152'-8 ALONG CENTERLINE CULVERT

SUBSTRUCTURE :

SPANS :

BEAMS OR GIRDERS :

FLOOR :
ENCROACHMENT :
DECK (OUT TO OUT) : 0 FT

CLEAR ROADWAY : 0 FT
BETWEEN RAILS : 0 FT
SIDEWALK OR CURB : LT 0 FT RT 0 FT

VERT.CL.OVER : 999.9 FT

INV.RTG. : HS-20
OPE.RTG. : HS-26
CONTR.MEMBER :
POSTED : SV TTST DATE

SYSTEM : Primary Interstate
GREEN LINE ROUTE : Y

UNDER ROUTES AND CLEARANCES

REMARKS :

Structure 440218 County HENDERSON Date: 03/11/2013 Condition Photos

SAND IN BARREL 1

REP OF EARTH MOUND AND VEGETATION AT INLET OF BARREL 1 AND DRIFT AND DEBRIS AT INLET

EAST

WEST

Structure 440218 County HENDERSON Date: 03/11/2013 Structure Photos

UPSTREAM NORTH

DOWNSTREAM SOUTH

2' DRAIN PIPE TOP SLAB/BARREL 2

UPSTREAM NORTH

DOWNSTREAM SOUTH

Looking at Upstream Face of 3 @ 8′ x 8′ RCBC under I-26

Looking Upstream from 3 @ 8′ x 8′ RCBC Inlet

Looking Downstream in Left Barrel

Crack in the Top Slab of Left Barrel

Looking Upstream in Center Barrel

Looking Upstream in Right Barrel

Drop Inlet in Center Barrel

Looking at Downstream Face of 3 @ 8' x 8' RCBC under I-26

Looking Downstream from 3 @ 8'x 8' RCBC Outlet

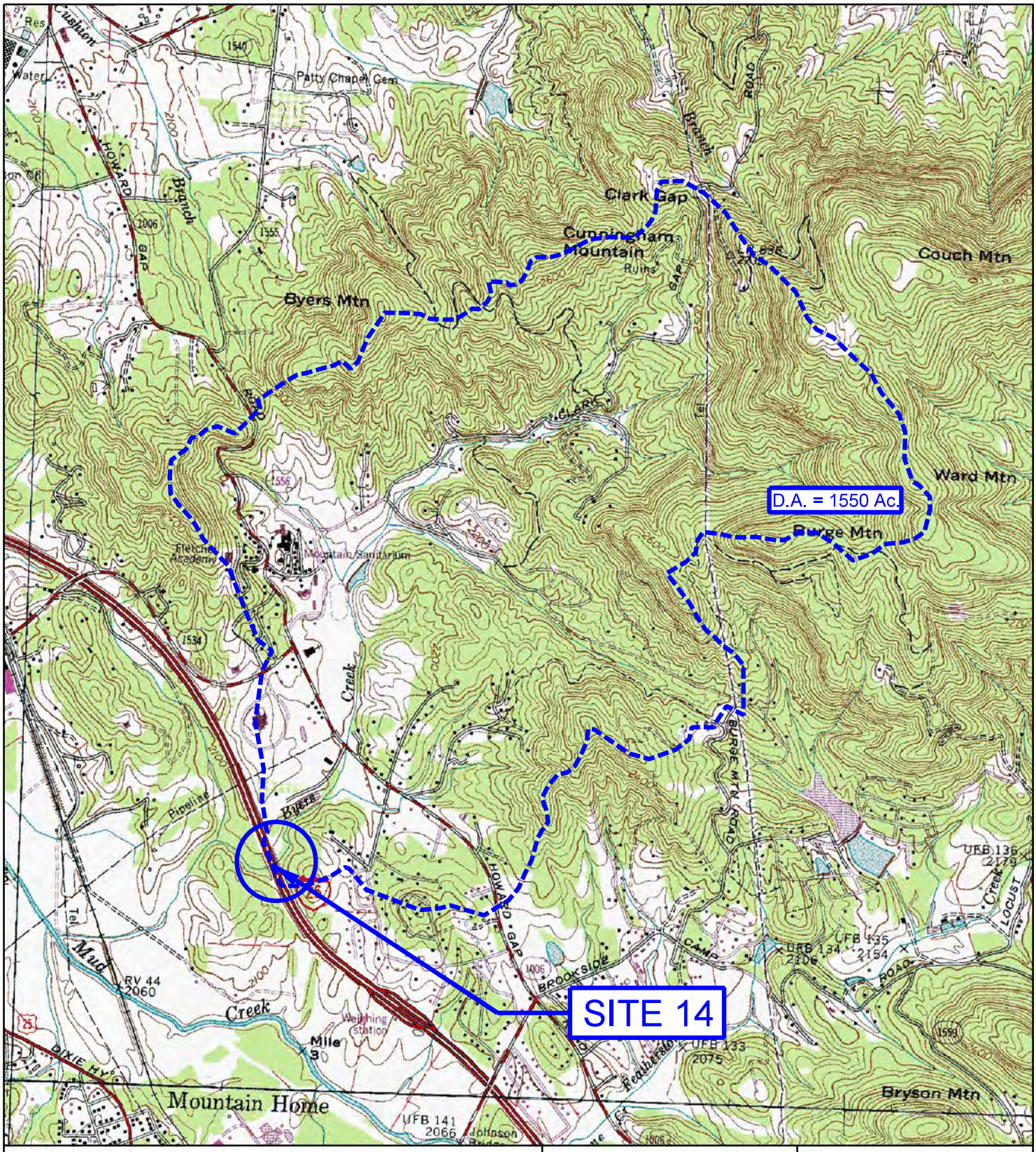
Looking at Upstream Face of 78" CMP

Looking at Downstream Face of 78" CMP

Erosion on top of 78" CMP

APPENDIX Q

SITE 14



QUAD MAP - SITE 14

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

1,000 0 1,000 2,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 14

Stream Name: Byers Creek

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	1007	100.7	0.065
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	3	1.0	0.001
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	540	297.1	0.192
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	0	0.0	0.000
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	0	0.0	0.000
Totals			**1550**	**398.8**	**25.7%**

Drainage Area = 1550 acres

Project: I-4400 / I-4700

Site #: 14

Stream Name: Byers Creek

Drainage Area (sq mi): 2.42

Impervious Area (%): 25.7%

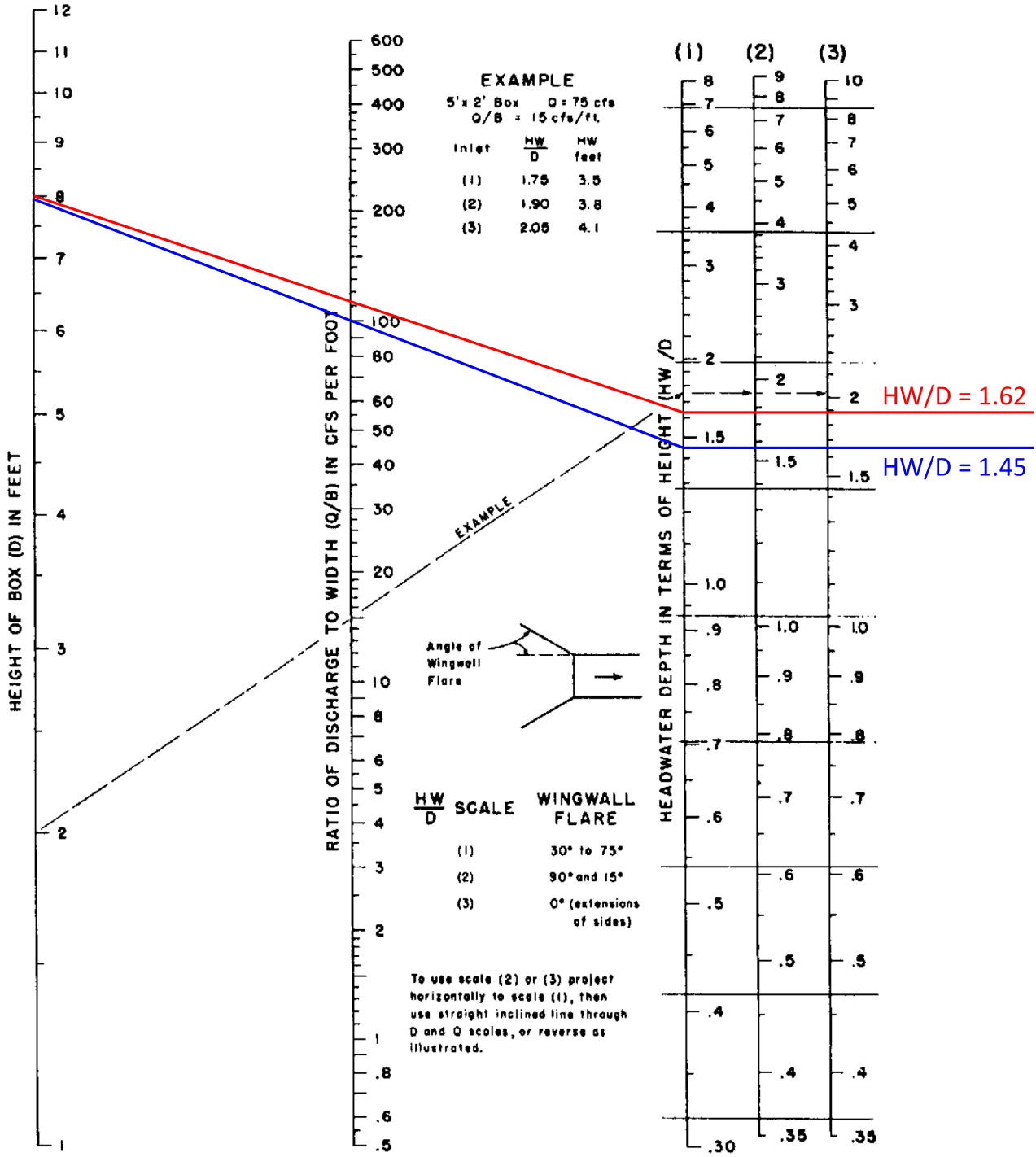
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	DISCHARGE (cfs)		
	PIEDMONT - RIDGE AND VALLEY	SAND HILLS	COASTAL PLAIN
2	671	-	-
5	961	-	-
10	1164	-	-
25	1408	-	-
50	1583	-	-
100	1767	-	-
200	1946	-	-
500	2151	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	DISCHARGE (cfs)
10	-
50	-
100	-
500	-

SITE 14

50 Year	100 Year
2 @ 8' x 8' RCBC	1 @ 8' x 8' RCBC
Q = 1600 CFS	Q = 1800 CFS
Q/NB = 100 CFS/FT.	Q/NB = 113 CFS/FT.

CHART 8B



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/4/14

SITE NUMBER 14 STREAM BYERS CREEK ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 2@8'x8' RCBC. GOOD CONDITION. MINOR CRACKS THROUGHOUT THE STRUCTURE.

UPSTREAM CHANNEL: TOP WIDTH 30 FT BOTTOM WIDTH 13 FT BANKFULL DEPTH 2 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL

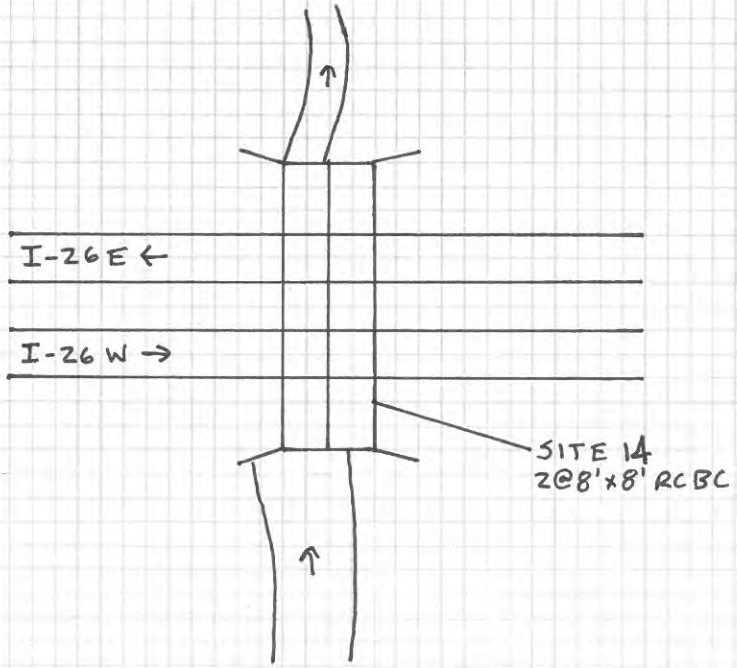
BANK/ CHANNEL CONDITIONS BANKS ARE STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 22 FT BOTTOM WIDTH 9 FT BANKFULL DEPTH 3 FT

DEPTH OF FLOW (AT TIME OF VISIT) 1 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS DEBRIS IN CHANNEL. 3' OF SILT IN LEFT BARREL. 3.5' OF SILT IN RIGHT BARREL. BANKS ARE STABLE AND VEGETATED

COMMENTS



Looking at Upstream Face of 2 @ 8′ x 8′ RCBC under I-26

Looking Upstream from 2 @ 8′ x 8′ RCBC

Looking Downstream in Left Barrel

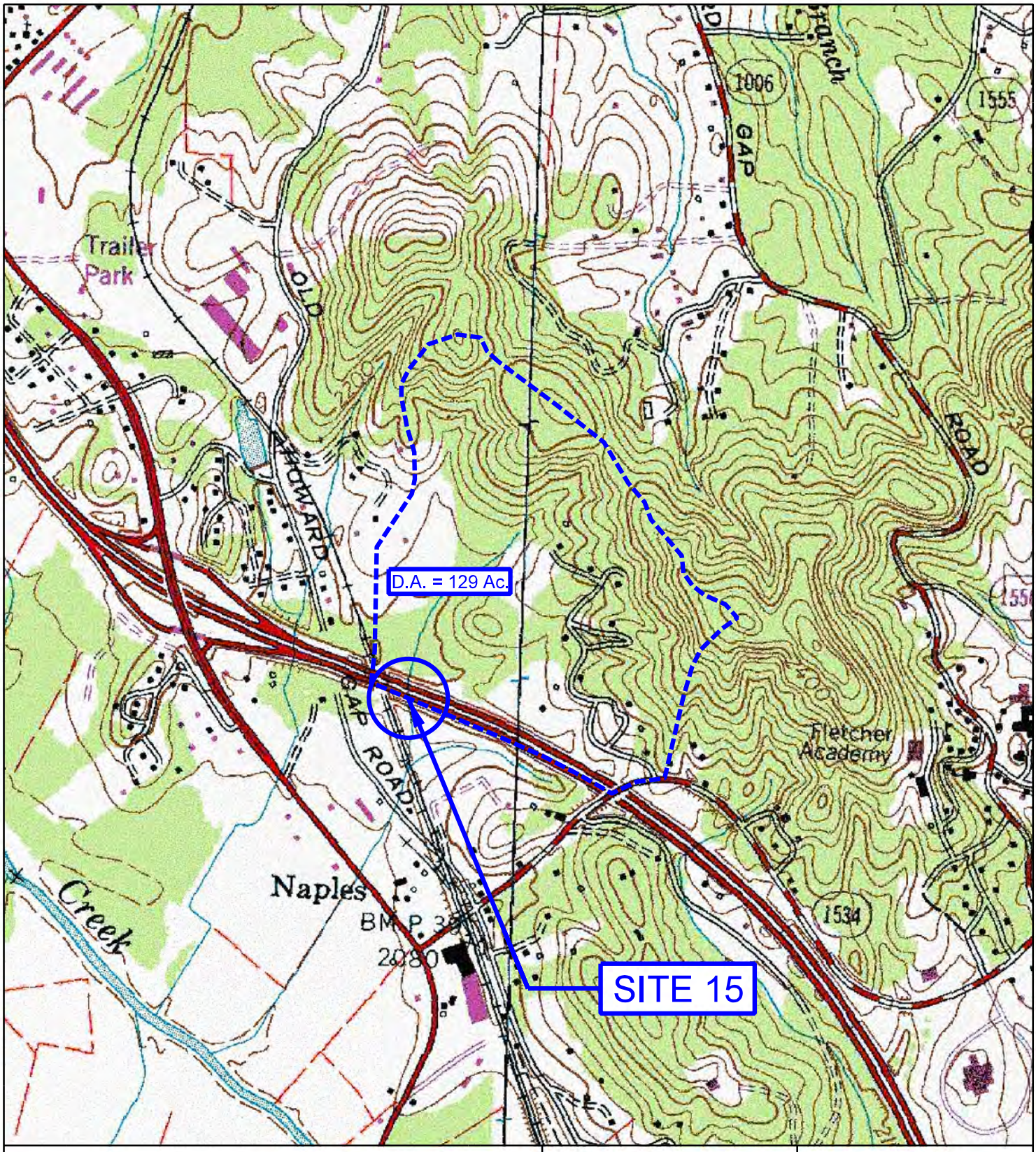
Looking Downstream in Right Barrel

Looking at Downstream Face of 2 @ 8' x 8' RCBC under I-26

Looking Downstream from 2 @ 8' x 8' RCBC

APPENDIX R

SITE 15



QUAD MAP - SITE 15

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 15

Stream Name: UT to Mud Creek

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	0	0.0	0.000
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	88	30.8	0.240
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	0	0.0	0.000
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	41	28.4	0.220
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	0	0.1	0.001
Totals			**129**	**59.3**	**46.1%**

Drainage Area = 129 acres

5/7/2014

Project: I-4400 / I-4700

Site #: 15

Stream Name: UT to Mud Creek

Drainage Area (sq mi): 0.20

Impervious Area (%): 46.1%

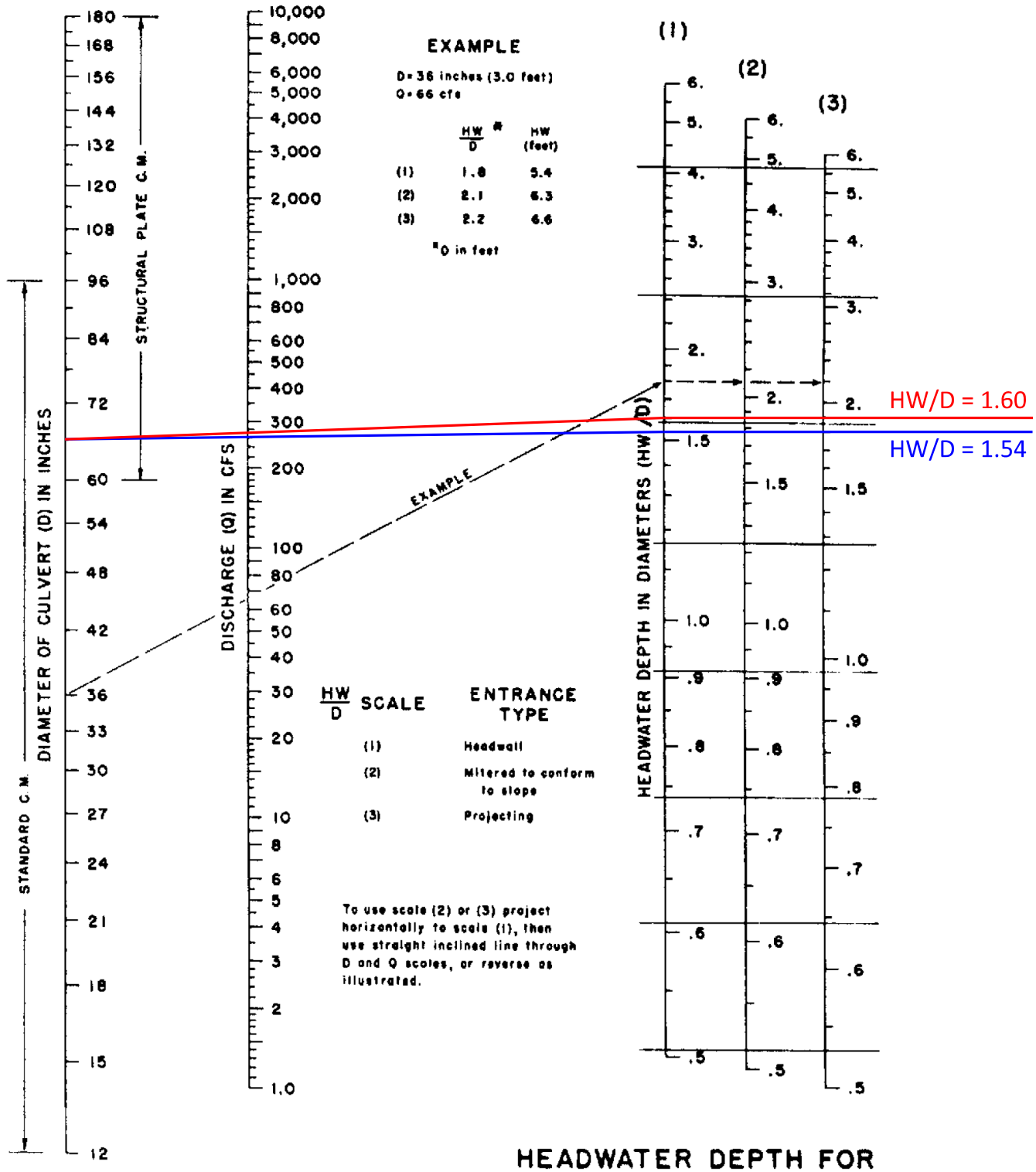
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	214	-	-
5	242	-	-
10	255	-	-
25	262	-	-
50	263	-	-
100	268	-	-
200	267	-	-
500	282	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	-
50	-
100	-
500	-

SITE 15

50 Year	100 Year
1 @ 66" CMP W/ HW	1 @ 66" CMP W/ HW
Q = 260 CFS	Q = 270 CFS

CHART 2B



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT _____

SITE NUMBER 15 STREAM UT TO MUD CREEK ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE _____

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 66" STRUCTURAL PLATE PIPE WITH A HEADWALL. GOOD CONDITION

UPSTREAM CHANNEL: TOP WIDTH 15 FT BOTTOM WIDTH 4 FT BANKFULL DEPTH 8 FT

DEPTH OF FLOW (AT TIME OF VISIT) 1 FT BED MATERIAL _____

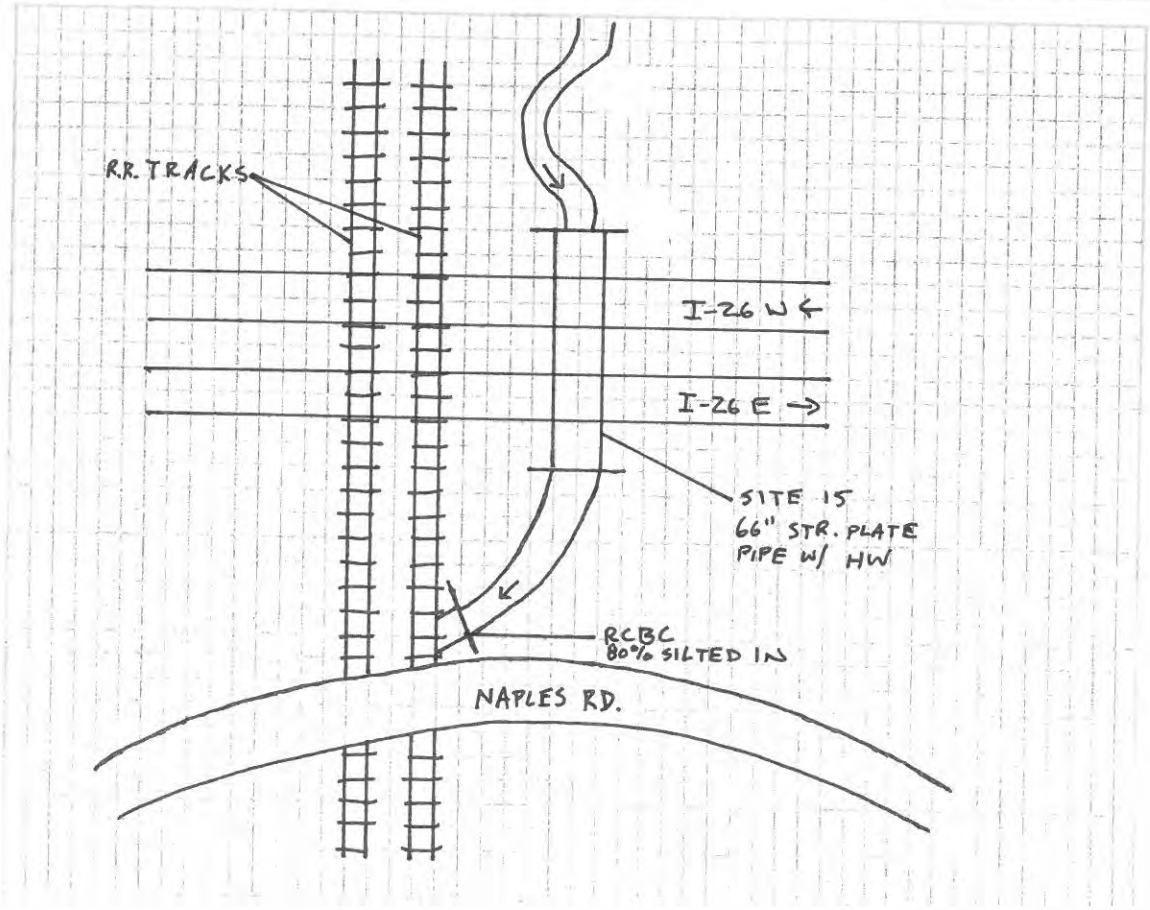
BANK/ CHANNEL CONDITIONS BANKS ARE STEEP AND UNSTABLE. EVIDENCE OF EROSION. HIGH DEBRIS. HIGH SCOUR.

DOWNSTREAM CHANNEL: TOP WIDTH 15 FT BOTTOM WIDTH 6 FT BANKFULL DEPTH 4 FT

DEPTH OF FLOW (AT TIME OF VISIT) 1 FT BED MATERIAL _____

BANK/ CHANNEL CONDITIONS HIGH DEBRIS. SILT AT OUTLET. RIP RAP AT OUTLET. BANKS ARE STEEP AND VEGETATED.

COMMENTS THERE IS A RCBC DOWNSTREAM THAT IS 80% SILTED IN.



Looking at Upstream Face of 66" SPP with Headwall under I-26

Looking Upstream of 66" SPP

Looking Downstream Inside 66" SPP

Looking Upstream Inside 66" SPP

Looking at Downstream Face of 66" SPP with Headwall under I-26

Looking at Downstream of 66" SPP

APPENDIX S

SITE 16

5/8/2014

Project: I-4400 / I-4700

Site #: 16

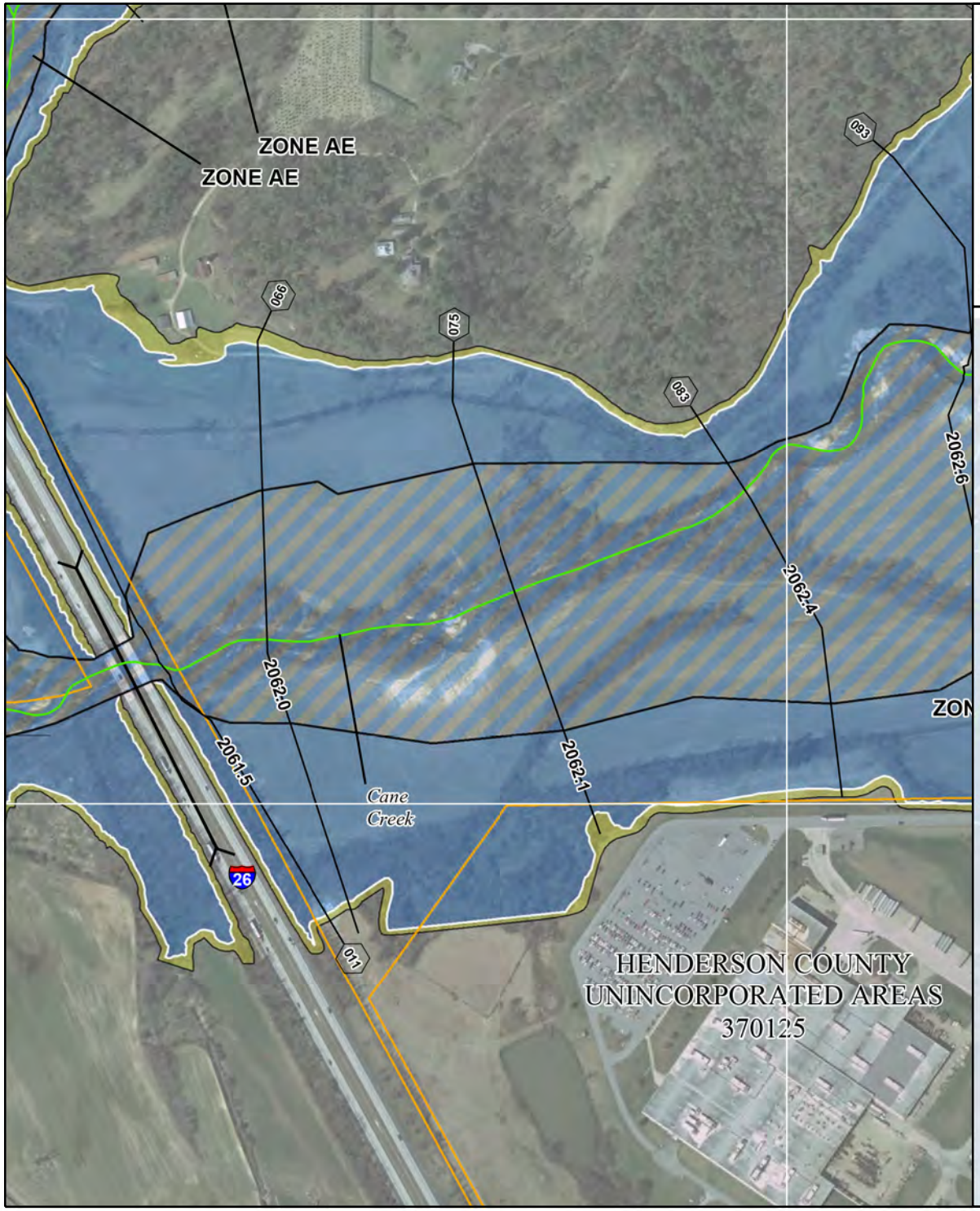
Stream Name: Cane Creek

Drainage Area (sq mi): 83.80

Impervious Area (%): 1.9%

USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	DISCHARGE (cfs)		
	PIEDMONT - RIDGE AND VALLEY	SAND HILLS	COASTAL PLAIN
2	2623	-	-
5	4437	-	-
10	5775	-	-
25	7556	-	-
50	8929	-	-
100	10346	-	-
200	11828	-	-
500	13887	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	DISCHARGE (cfs)
10	7030
50	10330
100	11480
500	14610



Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 9652

FEMA

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
FLETCHER, TOWN OF	370568	9652	J
HENDERSON COUNTY	370125	9652	J

Site 16

MAP NUMBER
3700965200J

MAP REVISED
10/2/2008

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

A Report of Flood Hazards in

HENDERSON COUNTY, NORTH CAROLINA AND INCORPORATED AREAS

Community Name	Community Number
CITY OF HENDERSONVILLE	370128
HENDERSON COUNTY	370125
TOWN OF FLETCHER	370568
TOWN OF LAUREL PARK	370384
VILLAGE OF FLAT ROCK	370565

NORTH CAROLINA
Cooperating Technical State
FEMA'S COOPERATING TECHNICAL PARTNER

EFFECTIVE: 10/2/2008
REVISED: 1/6/2010
Federal Emergency Management Agency
State of North Carolina
Flood Insurance Study Number
37089CV000
www.fema.gov and www.ncfloodmaps.com

Table 8 - Flooding Sources Studied by Detailed Methods: Revised or Newly Studied

Source	Riverine Sources		Affected Communties
	From	To	
Bat Fork Creek	The confluence with Mud Creek	Approximately 1,500 feet upstream of New Hope Road (SR 1757)	City Of Hendersonville Henderson County
Boylston Creek	Approximately 500 feet downstream of Banner Farm Road	Approximately 100 feet upstream of Gonce Drive	Town Of Mills River
Boylston Creek Tributary 7	The confluence with Boylston Creek	Approximately 1,100 feet upstream of Cross Creek Court	Henderson County Town Of Mills River
Broad River	Approximately 500 feet upstream of US HWY 64 / 74 A	The Henderson / Rutherford County boundary	Henderson County
Cane Creek	The confluence with French Broad River	Approximately 600 feet upstream of Cross Creek Farm Road	City Of Asheville Henderson County Town Of Fletcher
Clear Creek	The confluence with Mud Creek	Approximately 600 feet upstream of Howard Gap Road (SR 1006)	City Of Hendersonville Henderson County
Devils Fork	The confluence with Bat Fork Creek	Approximately 500 feet upstream of Old Dana Road (SR 1738)	City Of Hendersonville Henderson County
Green River	Approximately 0.7 mile downstream of NC Route 225	Approximately 400 feet upstream of Bear Paw Ridge Road	Henderson County
Higgins Branch	The confluence with Kimsey Creek	Approximately 50 feet downstream of the Henderson/Buncombe County boundary	Town Of Fletcher
Hoopers Creek	The confluence with Cane Creek	Approximately 120 feet upstream of Lindsey Loop Road (SR 1571)	Henderson County Town Of Fletcher
Kimsey Creek	The confluence with Cane Creek	Approximately 50 feet downstream of the Henderson/Buncombe County boundary	Henderson County Town Of Fletcher
Mill Pond Creek	At Hysong Lane	Approximately 40 feet downstream of North Hills Drive	Henderson County
Mills River	The confluence with French Broad River	The confluence with South Fork Mills River and North Fork Mills River	Henderson County Town Of Mills River
Mud Creek	The confluence with French Broad River	Approximately 500 feet upstream of Walnut Cove Road (SR 1125)	City Of Hendersonville Henderson County Town Of Fletcher Village Of Flat Rock
South Wash Creek	The confluence with Wash Creek	Approximately 50 feet downstream of Lake Drive	Town Of Laurel Park
Wash Creek	The confluence with Mud Creek	Approximately 1,400 feet upstream of Glasgow Lane (SR 1185)	City Of Hendersonville Henderson County Town Of Laurel Park

Table 9, “Flooding Sources Studied by Detailed Methods: Redelineated”, lists all flooding sources that were studied by detailed methods for the pre-statewide FIS and redelineated for previous FISs. These flooding sources were not part of this revision and their effective analyses remain valid.

Table 9 - Flooding Sources Studied by Detailed Methods: Redelineated

Source	Riverine Sources		Affected Communties
	From	To	
Boylston Creek	The confluence with French Broad River	Approximately 500 feet downstream of Banner Farm Road	Henderson County Town Of Mills River
Britton Creek	The confluence with Mud Creek	New Village Drive	City Of Hendersonville
Clear Creek	Approximately 600 feet upstream of Howard Gap Road (SR 1006)	Approximately 150 feet downstream of the confluence of Kyles Creek	City Of Hendersonville Henderson County
Crab Creek	The confluence with Little River	The Henderson/Transylvania County boundary Transylvania County boundary	Henderson County
French Broad River	Approximately 1.1 miles downstream of the Buncombe/Madison County boundary	Approximately 3 miles upstream of the Buncombe/Henderson County boundary	City Of Asheville Henderson County Town Of Fletcher Town Of Mills River
French Broad River	Approximately 3 miles upstream of the Buncombe/Henderson County boundary	The confluence of North Fork French Broad River and West Fork French Broad River	Henderson County Town Of Mills River
McDowell Creek	The confluence with French Broad River	Pennsylvania Road (SR 1348)	Henderson County Town Of Mills River
Mill Pond Creek	The confluence with French Broad River	At Hysong Lane	Henderson County
Shepherd Creek	The confluence with Mud Creek	Approximately 50 feet downstream of S. Lakeside Drive (SR 1148) (SR 1148)	City Of Hendersonville

Table 10, “Flooding Sources Studied by Detailed Methods: Limited Detailed”, lists all flooding sources within the county that were studied by limited detailed methods for either this FIS or previous FISs.

Table 13 - Summary of Discharges

Flooding Source		Discharges (cfs)			
Location	Drainage Area (square miles)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Approximately 0.5 mile downstream of US 176	1.00	*	*	930	*
Battle Creek					
At the confluence with Shaw Creek	1.89	*	*	1,110	*
Big Willow Creek					
At the confluence with French Broad River	9.64	*	*	3,070	*
Approximately 100 feet upstream of confluence with Big Willow Creek Tributary 1	8.88	*	*	2,920	*
Big Willow Creek Tributary 1					
At the confluence with Big Willow Creek	0.56	*	*	520	*
Boylston Creek					
At the confluence with French Broad River	15.50	2,000	3,300	4,000	5,400
Approximately 1,100 feet downstream of Banner Farm Road	14.80	1,900	3,200	3,850	5,200
Approximately 300 feet upstream of Banner Farm Road	14.63	1,090	1,870	2,270	3,400
Approximately 1,400 feet downstream of Warlick Road	13.77	1,080	1,850	2,250	3,380
Approximately 900 feet downstream of confluence of Boylston Creek Tributary 7	12.31	1,060	1,830	2,220	3,330
Approximately 1,500 feet downstream of Ray Hill Road	11.98	1,060	1,820	2,210	3,320
Approximately 100 feet upstream of Ray Hill Road	10.57	1,050	1,800	2,190	3,280
Approximately 1.0 mile downstream of Gash Road	9.59	1,040	1,780	2,170	3,260
Approximately 300 feet downstream of Gash Road	8.61	1,030	1,770	2,150	3,230
Approximately 400 feet downstream of Quellette Road	7.77	*	*	2,130	*
Approximately 0.6 mile of Brickyard Road	6.96	*	*	2,120	*
At the Transylvania/Henderson County boundary	5.96	*	*	2,100	*
Boylston Creek Tributary 7					
At Ray Hill Road	0.59	230	430	530	840
Britton Creek					
At the confluence with Mud Creek	3.50	720	1,250	1,530	2,000
Below tributary, Mile 0.29	3.20	685	1,180	1,475	1,900
Above tributary, mile 0.29	2.30	540	960	1,185	1,520
Below tributary, mile 0.96	2.10	500	900	1,100	1,420
Above tributary, mile 0.96	1.60	430	760	945	1,200
Approximately 100 feet downstream of Essex Path	0.48	*	*	470	*
Britton Creek Tributary 2					
At the confluence with Britton Creek	0.91	*	*	700	*
Approximately 300 feet upstream of Browning Avenue	0.52	*	*	500	*
Broad River					
At the Henderson/Rutherford County boundary	64.90	*	*	16,180	*
Approximately 300 feet downstream of US Route 64	51.48	*	*	9,710	*
Approximately 0.5 mile upstream of US Route 74A	40.83	*	*	7,570	*
Approximately 1.8 miles upstream of US Route 74A	36.50	*	*	7,060	*
Cane Creek					
At the confluence with French Broad River	87.06	*	*	11,940	*
Approximately 50 feet upstream of confluence of Kimsey Creek	83.99	*	*	11,600	*
Approximately 0.4 mile upstream of Interstate 26	82.47	*	*	11,480	*
Approximately 200 feet upstream of US Route 25	81.51	*	*	11,400	*
Approximately 900 feet downstream of Howard Gap Road (SR 1006)	80.60	*	*	11,360	*

Table 13 - Summary of Discharges

Flooding Source		Discharges (cfs)			
Location	Drainage Area (square miles)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Approximately 300 feet downstream of Howard Gap Road (SR 1006)	79.77	*	*	11,340	*
Approximately 50 feet upstream of confluence of Hoopers Creek	63.63	*	*	10,690	*
Approximately 100 feet upstream of Mills Gap Road (SR 1551)	63.14	*	*	10,670	*
Approximately 1,200 feet upstream of Mills Gap Road (SR 1551)	60.64	*	*	8,160	*
At the Henderson/Buncombe County boundary	60.31	*	*	8,150	*
Clear Creek					
At the confluence with Mud Creek	44.44	3,550	5,970	7,200	10,620
Approximately 50 feet upstream of Allen Branch	42.98	3,430	5,790	7,000	10,340
Approximately 200 feet upstream of Nix Road (SR 1513)	42.57	3,400	5,740	6,940	10,260
Approximately 900 feet downstream of Howard Gap Road (SR 1006)	42.32	3,380	5,710	6,900	10,220
Approximately 100 feet downstream of Howard Gap Road (SR 1006)	39.23	3,290	5,540	6,690	9,880
Approximately 0.6 mile upstream of the confluence with Wolfpen Creek	37.10	3,100	5,300	6,500	9,700
Approximately 0.4 mile upstream of Lancaster Road (SR 1582)	34.10	2,950	5,000	6,200	9,200
Approximately 1,500 feet upstream of Fruitland Road (SR 1574)	28.00	2,600	4,500	5,500	8,100
Approximately 50 feet upstream of confluence of Kyles Creek	23.70	*	*	5,320	*
At the confluence of Puncheon Camp Creek	10.67	*	*	3,270	*
Devils Fork					
At the confluence with Bat Fork Creek	8.53	1,380	2,350	2,840	4,240
Approximately 100 feet upstream of Tracy Grove Road (SR 1793)	8.23	1,350	2,300	2,780	4,150
Approximately 1,500 feet upstream of Tracy Grove Road (SR 1793)	7.80	1,300	2,220	2,690	4,020
Approximately 0.5 mile upstream of Tracy Grove Road (SR 1793)	7.42	1,260	2,150	2,610	3,900
Approximately 0.4 mile downstream of Interstate 26	6.83	1,190	2,040	2,480	3,710
Approximately 200 feet upstream of Interstate 26	6.27	1,130	1,930	2,350	3,520
Approximately 0.4 mile upstream of Interstate 26	5.80	1,080	1,850	2,250	3,390
Approximately 0.7 mile upstream of Interstate 26	4.95	960	1,660	2,020	3,050
Approximately 300 feet upstream of Howard Gap Road (SR 1006)	4.55	910	1,570	1,920	2,900
Approximately 0.5 mile upstream of Howard Gap Road (SR 1006)	4.00	840	1,450	1,770	2,680
Approximately 0.5 mile downstream of Dana Road (SR 1525)	2.44	600	1,060	1,300	1,990
Approximately 1,500 feet downstream of Dana Road (SR 1525)	1.86	500	890	1,100	1,690
Dunn Creek					
At the confluence with Bat Fork Creek	3.07	*	*	1,500	*
Approximately 600 feet downstream of Howard Gap Road (SR 1006)	1.01	*	*	750	*
Featherstone Creek					
At the confluence with Mud Creek	4.12	*	*	1,810	*
Approximately 1,100 feet downstream of Locust Grove Road (SR 1528)	1.37	*	*	910	*
Finley Creek					
At the confluence with Shepherd Creek	2.22	*	*	1,230	*
French Broad River					
Approximately 0.4 mile downstream of the confluence of Bent Creek	676.00	*	*	50,000	*
At the confluence of Cane Creek	633.00	*	*	48,500	*
Mile 166.9 above Cane Creek	546.00	*	*	46,000	*
Mile 168.5 above Mud Creek	432.00	*	*	41,500	*
Mile 169.2 above Mill River	357.00	17,000	30,600	38,000	58,500
Gash Creek					

5.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the flood elevations for the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles and/or Water-surface elevation rasters. For stream segments for which BFEs were computed, selected cross-section locations are also shown on the FIRM. Flood Profiles and/or Water-surface elevation rasters were developed showing computed water-surface elevations for floods of the selected recurrence intervals.

Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles and/or Water-surface elevation rasters or in the Floodway Data tables in the FIS Report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in the FIS in conjunction with the data shown on the FIRM.

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the Flood Profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For details on the county's hydraulic analyses, the hydraulic report is available by request.

For the streams studied by detailed methods, water surface elevations of floods of the selected recurrence intervals were computed through use of the Army Corps of Engineers' HEC RAS step backwater computer program . The hydraulic analyses were based on unobstructed flow. The flood elevations shown on the Profiles and/or Water-surface elevation rasters are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail. The computer models were calibrated using historic high water data collected during field investigations.

The cross section geometries were obtained from a combination of digital elevation data obtained by Light Detection and Ranging (LIDAR) and field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Natural floodplain cross sections were surveyed approximately every 4000 feet along the detail study reaches to obtain the channel geometry between bridges and culverts. Overbank cross section data for the backwater analyses were obtained from recently flown LIDAR data.

Channel roughness factors (Manning's "n") used in the hydraulic computations were made in the field by an engineer where stream access was possible, with orthophotos used to supplement areas that could not be accessed. The channel and overbank "n" values for all of the streams studied by detailed methods are shown in Table 16, "Roughness Coefficients".

Table 16 - Roughness Coefficients

Stream	Channel "n"	Overbank "n"
Allen Branch	0.045 to 0.050	0.030 to 0.090
Bat Fork Creek	0.040 to 0.060	0.022 to 0.150
Battle Creek	0.035 to 0.040	0.040 to 0.090
Big Willow Creek	0.040	0.050 to 0.090
Big Willow Creek Tributary 1	0.025 to 0.050	0.050 to 0.090
Boylston Creek	0.035 to 0.090	0.040 to 0.120
Boylston Creek Tributary 7	0.040 to 0.090	0.050 to 0.090
Britton Creek	0.035 to 0.060	0.030 to 0.160
Britton Creek Tributary 2	0.040 to 0.050	0.030 to 0.090
Broad River	0.028 to 0.100	0.010 to 0.130
Cane Creek	0.040 to 0.050	0.025 to 0.250
Clear Creek	0.035 to 0.060	0.030 to 0.140
Crab Creek	0.055 to 0.061	0.080 to 0.660
Devils Fork	0.040 to 0.070	0.010 to 0.150
Dunn Creek	0.035 to 0.050	0.030 to 0.090
Featherstone Creek	0.045 to 0.090	0.030 to 0.090
Finley Creek	0.040 to 0.050	0.040 to 0.090
French Broad River	0.024 to 0.064	0.030 to 0.200
Gash Creek	0.037 to 0.057	0.030 to 0.125
Green River	0.032 to 0.090	0.025 to 0.100
Hickory Creek (near Gerton)	0.060 to 0.100	0.060 to 0.100
Higgins Branch	0.050 to 0.065	0.025 to 0.100
Hoopers Creek	0.045 to 0.070	0.025 to 0.150
Kimsey Creek	0.040 to 0.045	0.025 to 0.100
King Creek	0.045 to 0.050	0.030 to 0.090
King Creek Tributary 3	0.045 to 0.050	0.030 to 0.090
Kyles Creek	0.045 to 0.050	0.006 to 0.090
Lanning Mill Creek	0.050	0.050 to 0.090
Lewis Creek	0.045 to 0.050	0.030 to 0.090

PRELIMINARY DESIGN AND ASSESSMENT OF
STREAM CROSSINGS AND ENCROACHMENTS

COUNTY Henderson PROJECT NUMBER I-4400/I-4700

STREAM Cane Creek ROUTE I-26

ASSESSMENT PREPARED BY HNTB Corporation DATE _____

HYDROLOGIC EVALUATION

NEAREST GAGING STATION ON THIS STREAM _____ (NONE X) _____

ARE FLOOD STUDIES AVAILABLE ON THIS STREAM: Yes

FLOOD DATA:
Q10 5775 CFS EST BKWTR. - FT. Q25 7556 CFS EST BKWTR. - FT.
Q50 8929 CFS EST BKWTR. - FT. Q100 10346 CFS EST BKWTR. -FT.
Q500 13887 CFS OR OVERTOPPING CFS EST BKWTR. - FT.

DRAINAGE AREA 83.8 Sq. Miles

METHOD USED TO COMPUTE Q USGS Urban Regression

PROPERTY RELATED EVALUATIONS

DAMAGE POTENTIAL: LOW X MODERATE _____ HIGH _____

COULD THIS BE SIGNIFICANTLY INCREASED BY PROPOSED

ENCROACHMENT: YES _____ NO X

EXPLANATION: Limited changes will be made to this site.

_____

LIST BUILDINGS IN FLOOD PLAIN 2 Athletic Park Buildings

LOCATION 0.5 miles upstream of I-26

FLOOR ELEVATION Unknown

UPSTREAM LAND USE Residential/ Commercial

ANTICIPATE ANY CHANGE? No

ANY FLOOD ZONING? (FIS STUDIES, ETC.) YES X NO _____

TYPE OF STUDY FEMA_Detailed

BASE FLOOD ELEVATION 2062.0 ft (100 YEAR)

REGULATORY FLOODWAY WIDTH 840 (AS NOTED IN FIS STUDIES)

COMMENTS: Cross Section 066

TRAFFIC RELATED EVALUATIONS

PRESENT YEAR 2011 TRAFFIC COUNT 63500 VPD % TRUCKS 15

DESIGN YEAR 2040 TRAFFIC COUNT 79300 VPD % TRUCKS 15

EMERGENCY ROUTE _____ SCHOOL BUS ROUTE _____ MAIL ROUTE _____

DETOUR AVAILABLE? _____ LENGTH OF DETOUR _____ MILES

DOES THE LEVEL OF TRAFFIC SERVICE OF AN EXISTING CROSSING VARY GREATLY FROM STANDARD DESIGN LEVELS? _____

_____

IS THE TRAFFIC VOLUME, TYPE, USAGE SUCH TO WARRANT CONSIDERATION FOR VARIANCE FROM STANDARDS OR EXISTING LEVEL OF INTERRUPTION?

_____

COMMENTS: _____

_____

HIGHWAY AND BRIDGE (CULVERT) RELATED EVALUATIONS

NOTE ANY OUTSIDE FEATURES WHICH MIGHT AFFECT STAGE, DISCHARGE OR FREQUENCY.

LEVEES _____ AGGRADATION/DEGRADATION _____ RESERVOIRS _____

DIVERSIONS _____ DRAINAGE DISTRICT _____ NAVIGATION _____

BACKWATER FROM ANOTHER SOURCE _____

EXPLANATION: _____

_____

ROADWAY OVERFLOW SECTION (NONE __) LENGTH _____ ELEVATION _____

EMBANKMENT: SOIL TYPE Comus Fine Sandy Loam

TYPE SLOPE COVER Vegetated

COMMENTS: USDS Soil Map NC089

ENVIRONMENTAL CONSIDERATIONS

LIST SPECIAL CONDITIONS OR CONSIDERATIONS WHICH AFFECT HYDRAULIC DESIGN (NONE _____)

_____

MISCELLANEOUS COMMENTS

IS THERE UNUSUAL SCOUR POTENTIAL? YES _ NO X PROTECTION NEEDED _

ARE BANKS STABLE? Yes PROTECTION NEEDED _

DOES STREAM CARRY APPRECIABLE AMOUNT OF LARGE DEBRIS? No

COMMENTS:

_____

_____

_____

ALTERNATIVES

RECOMMENDED DESIGN Widen Existing Bridge

DETOUR STRUCTURE N/A

WERE OTHER HYDRAULIC ALTERNATES CONSIDERED? YES _____ NO X

THIS SITE ASSESSMENT INDICATES THE DESIGN SHOULD FOLLOW:

(1) X NORMAL PROCESS

(2) _____ NORMAL PROCESS WITH SPECIAL SPECIFIC CONSIDERATION FOR

_____

(3) _____ SPECIFIC DESIGN PROCESS WITH APPROPRIATE RISK/ECONOMIC EVALUATION ADDRESSING: _____

NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
BRIDGE MANAGEMENT UNIT

ATTENTION

BRIDGE INSPECTION REPORT

INSPECTION TYPE: Routine Inspection

COUNTY HENDERSON BRIDGE NUMBER 440233 INSPECTION CYCLE 2 YRS

ROUTE I-26,US74 WBL ACROSS CANE CREEK M.P. 42.10

LOCATION 1.6 MI.N.JCT.US25

SUPERSTRUCTURE REINFORCED CONCRETE FLOOR ON I-BEAMS

SUBSTRUCTURE E.BTS:RC CAPS/H-PILES;INT.BT:RC POST&BEAM

SPANS 1 @ 66'-6;1 @ 65'-3;1 @ 66'-6

LONGITUDE 82° 31' 24.89" LATITUDE 35° 25' 24.35"

INSPECTION DATE 03/12/2013 PRESENT CONDITION FAIR

PRESENT POSTING N NOT POSTED PROPOSED POSTING

OTHER SIGNS PRESENT DELINEATORS (2)

EAST

Fracture Critical	No
Temporary Shoring	No
Scour Critical	No
Scour POA	No

SIGN NOTICE ISSUED FOR		NUMBERED REQUIRED
No	WEIGHT LIMIT	
No	DELINEATORS	
No	NARROW BRIDGE	
No	ONE LANE BRIDGE	
No	LOW CLEARANCE	

NATIONAL BRIDGE INVENTORY-------- STRUCTURE INVENTORY AND APPRAISAL Run Date: 06/04/2013

IDENTIFICATION

(1) STATE NAME -NORTH CAROLINA BRIDGE 440233
(8) STRUCTURE NUMBER(FEDERAL) 000000000890233
(5) INVENTORY ROUTE (ON/UNDER) - ON 11000260
(2) STATE HIGHWAY DEPARTMENT DISTRICT 1
(3) COUNTY CODE 89 (4) PLACE CODE 90108
(6) FEATURE INTERSECTED - CANE CREEK
(7) FACILITY CARRIED I-26,US74 WBL
(9) LOCATION 1.6 MI.N.JCT.US25
(11)MILEPOINT 42.1
(16)LAT 35° 25' 24.35" (17)LONG 82° 31' 24.89"
(98)BORDER BRIDGE STATE CODE PCT SHARE
(99)BORDER BRIDGE STRUCTURE NO

STRUCTURE TYPE AND MATERIAL

(43) STRUCTURE TYPE MAIN: Steel
TYPE - Stringer Mutlibeam or Girder CODE 302
(44) STRUCTURE TYPE APPR :
TYPE - CODE 000
(45) NUMBER OF SPANS IN MAIN UNIT 3
(46) NUMBER OF APPROACH SPANS
(107)DECK STRUCTURE TYPE - 1 CODE
(108)WEARING SURFACE / PROTECTIVE SYSTEM :
(A) TYPE OF WEARING SURFACE - CODE
(B) TYPE OF MEMBRANE - CODE
(C) TYPE OF DECK PROTECTION - CODE

AGE AND SERVICE

(27) YEAR BUILT 1964
(106)YEAR RECONSTRUCTED
(42) TYPE OF SERVICE : ON - Highway
UNDER - Waterway CODE 15
(28) LANES: ON STRUCTURE 2 UNDER STRUCTURE 0
(29) AVERAGE DAILY TRAFFIC 27000
(30) YEAR OF ADT 2011 (109) TRUCK ADT PCT 23%
(19) BYPASS OR DETOUR LENGTH 1 MI

GEOMETRIC DATA

(48) LENGTH OF MAXIMUM SPAN 65 FT
(49) STRUCTURE LENGTH 198 FT
(50)CURB OR SIDEWALK: LEFT 1.6 FT RIGHT 1.6 FT
(51) BRIDGE ROADWAY WIDTH CURB TO CURB 28 FT
(52) DECK WIDTH OUT TO OUT 33.417 FT
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS) 28 FT
(33) BRIDGE MEDIAN - No Median CODE 1
(34) SKEW 0° (35) STRUCTURE FLARED 0
(10) INVENTORY ROUTE MIN VERT CLEAR 999.9 FT
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR 28 FT
(53) MIN VERT CLEAR OVER BRIDGE RDWY 999.9 FT
(54) MIN VERT UNDERCLEAR REF Not a Highway or Railroad 0 FT
(55) MIN LAT UNDERCLEAR RT REF Not a Highway or Railroad 000 FT
(56) MIN LAT UNDERCLEAR LT REF - 000 FT

NAVIGATION DATA

(38) NAVIGATION CONTROL - No Navigational Control CODE 0
(111)PIER PROTECTION - CODE
(39) NAVIGATION VERTICAL CLEARANCE 0
(116)VERT - LIFT BRIDGE NAV MIN VERT CLEAR FT
(40) NAVIGATION HORIZONTAL CLEARANCE 0 FT

SUFFICIENCY RATING = 63.87
STATUS = Functionally Obsolete

CLASSIFICATION — CODE

(112)NBIS BRIDGE SYSTEM - YES
(104)HIGHWAY SYSTEM Is on the NHS 1
(26) FUNCTIONAL CLASS - Arterial - Interstate 01
(100)STRAHNET HIGHWAY - Interstate STRAHNET Route 1
(101)PARALLEL STRUCTURE - Left Parallel Structure L
(102)DIRECTION OF TRAFFIC - 1-way Traffic 1
(103)TEMPORARY STRUCTURE -
(110)DESIGNATED NATIONAL NETWORK - On the National Network 1
(20) TOLL On Free Road 3
(31) MAINTAIN - State Highway Agency 01
(22) OWNER - State Highway Agency 01
(37) HISTORICAL SIGNIFICANCE - Not Eligible 5

CONDITION — CODE

(58) DECK 7
(59) SUPERSTRUCTURE 5
(60) SUBSTRUCTURE 7
(61) CHANNEL & CHANNEL PROTECTION 5
(62) CULVERTS N

LOAD RATING AND POSTING — CODE

(31) DESIGN LOAD HS 20 + MOD 6
(63) OPERATING RATING METHOD - Load Factor 1
(64) OPERATING RATING - HS-43 78
(65) INVENTORY RATING METHOD - Load Factor 1
(66) INVENTORY RATING - HS-26 47
(70) BRIDGE POSTING - No Posting Required 5
(41) STRUCTURE OPEN, POSTED ,OR CLOSED A
DESCRIPTION - Open, No Restriction

APPRAISAL — CODE

(67) STRUCTURAL EVALUATION 5
(68) DECK GEOMETRY 3
(69) UNDERCLEARANCES,VERTI & HORIZ N
(71) WATERWAY ADEQUACY 7
(72) APPROACH ROADWAY ALIGNMENT 8
(36) TRAFFIC SAFETY FEATURES 0011
(113)SCOUR CRITICAL BRIDGES 8

PROPOSED IMPROVEMENTS

(75) TYPE OF WORK - CODE
(76) LENGTH OF STRUCTURE IMPROVEMENT
(94) BRIDGE IMPROVEMENT COST
(95) ROADWAY IMPROVEMENT COST
(96) TOTAL PROJECT COST
(97) YEAR OF IMPROVEMENT COST ESTIMATE
(114)FUTURE ADT 54000 (115) YEAR FUTURE ADT 2025

INSPECTIONS

(90) INSPECTION DATE 03/12/2013

(92) CRITICAL FEATURE INSPECTION :		(93) CFI DATE	
A) FRACTURE CRIT DETAIL -	NO	A)	
B) UNDERWATER INSP -	YES 48Mo	B)	04/21/2010
C) OTHER SPECIAL INSP	NO	C)	
SCOUR			

BRIDGE MANAGEMENT UNIT

DATA ON EXISTING STRUCTURE Run Date: 06/04/2013

COUNTY :	DIVISION :	DISTRICT:	STRUCTURE NUMBER :	LENGTH :
HENDERSON	14	1	440233	198 FEET

ROUTE CARRIED :	FEATURE INTERSECTED :
I-26,US74 WBL	CANE CREEK

LOCATED :	BRIDGE NAME :	CITY :
1.6 MI.N.JCT.US25		

FUNC. CLASS :	SYST.ON :	SYST.UNDER :	ADT & YR :	RAIL TYPE :
01	FA	NFA	27000 2011	LT 99 RT 99

BUILT :	BY :	PROJ :	FED.AID PROJ :	DESIGN LOAD :
1964	SHC	8.19002	I-26-1(10)6	HS 20 + MOD

REHAB :	BY :	PROJ :	ALIGNMENT :	SKEW :	LANES :
			TAN	90	ON 2 UNDER 0

NAVIGATION :	HT. CRN. TO BED :	WATER DEPTH :
VC 0 FT HC 0 FT	29 FT	5 FT

SUPERSTRUCTURE : REINFORCED CONCRETE FLOOR ON I-BEAMS

SUBSTRUCTURE : E.BTS:RC CAPS/H-PILES;INT.BT:RC POST&BEAM

SPANS : 1 @ 66'-6;1 @ 65'-3;1 @ 66'-6

BEAMS OR GIRDERS : 4 LINES 36 I-BEAMS @ 8' CENTERS

FLOOR :	ENCROACHMENT :	DECK (OUT TO OUT) :
7.75 RC/NO AWS		33.417 FT

CLEAR ROADWAY :	BETWEEN RAILS :	SIDEWALK OR CURB :
28 FT	31.25 FT	LT 1.6 FT RT 1.6 FT

VERT.CL.OVER :
999.9 FT

INV.RTG. :	OPE.RTG. :	CONTR.MEMBER :	POSTED :		
HS-26	HS-43	Ext bms	SV	TTST	DATE

SYSTEM :	GREEN LINE ROUTE :
Primary Interstate	Y

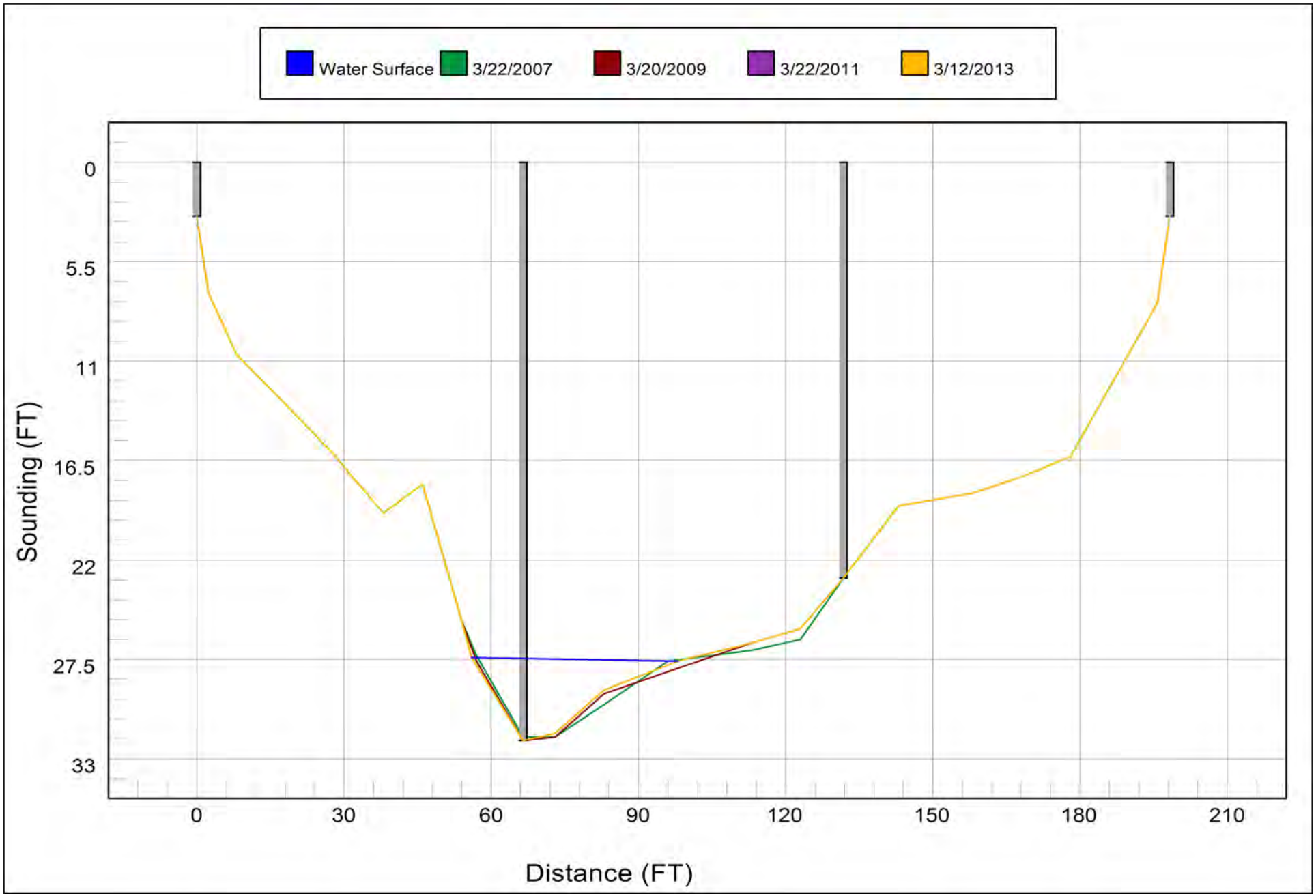
UNDER ROUTES AND CLEARANCES

REMARKS :

Bridge: 440233 County HENDERSON Date: 03/12/2013

STREAMBED PROFILE (Downstream)

Top of Rail = 0 FT (Sounding)



DOWNSTREAM SOUTH

EAST AT APPROACH GUARDRAIL

WEST AT APPROACH GUARDRAIL

WEST

NAME PLATE

REP OF END BENT (END BENT 2)

REP OF INTERIOR BENT (INTERIOR BENT 1 EAST FACE)

UPSTREAM NORTH

DOWNSTREAM SOUTH

UPSTREAM NORTH

APPROACH GUARDRAIL TERMINAL END SOUTH WEST CORNER

NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
BRIDGE MANAGEMENT UNIT

ATTENTION

BRIDGE INSPECTION REPORT

INSPECTION TYPE: Routine Inspection

COUNTY HENDERSON | BRIDGE NUMBER 440234 | INSPECTION CYCLE 2 YRS | 42.1

ROUTE I-26,US74 | ACROSS CANE CREEK | M.P. 42.10

LOCATION 1.6 MI.N.JCT.US25

SUPERSTRUCTURE REINFORCED CONCRETE FLOOR ON I-BEAMS

SUBSTRUCTURE E.BTS:RC CAPS/H-PILES;INT.BTS:RC POST&BEAM

SPANS 1 @ 66'-6;1 @ 65'3;1 @ 66'-6

LONGITUDE 82° 31' 25.57" | LATITUDE 35° 25' 21.07"

INSPECTION DATE 03/12/2013 | PRESENT CONDITION FAIR

PRESENT POSTING N NOT POSTED | PROPOSED POSTING

OTHER SIGNS PRESENT NIONE

EAST

Fracture Critical	No
Temporary Shoring	No
Scour Critical	No
Scour POA	No

SIGN NOTICE ISSUED FOR		NUMBERED REQUIRED
No	WEIGHT LIMIT	
No	DELINEATORS	
No	NARROW BRIDGE	
No	ONE LANE BRIDGE	
No	LOW CLEARANCE	

NATIONAL BRIDGE INVENTORY-------- STRUCTURE INVENTORY AND APPRAISAL Run Date: 05/31/2013

IDENTIFICATION

(1) STATE NAME -NORTH CAROLINA BRIDGE 440234
(8) STRUCTURE NUMBER(FEDERAL) 000000000890234
(5) INVENTORY ROUTE (ON/UNDER) - ON 11000260
(2) STATE HIGHWAY DEPARTMENT DISTRICT 1
(3) COUNTY CODE 89 (4) PLACE CODE 90108
(6) FEATURE INTERSECTED - CANE CREEK
(7) FACILITY CARRIED I-26,US74
(9) LOCATION 1.6 MI.N.JCT.US25
(11)MILEPOINT 42.1
(16)LAT 35° 25' 21.07" (17)LONG 82° 31' 25.57"
(98)BORDER BRIDGE STATE CODE PCT SHARE
(99)BORDER BRIDGE STRUCTURE NO

STRUCTURE TYPE AND MATERIAL

(43) STRUCTURE TYPE MAIN: Steel
TYPE - Stringer Mutlibeam or Girder CODE 302
(44) STRUCTURE TYPE APPR :
TYPE - CODE 000
(45) NUMBER OF SPANS IN MAIN UNIT 3
(46) NUMBER OF APPROACH SPANS
(107)DECK STRUCTURE TYPE - 1 CODE
(108)WEARING SURFACE / PROTECTIVE SYSTEM :
(A) TYPE OF WEARING SURFACE - CODE
(B) TYPE OF MEMBRANE - CODE
(C) TYPE OF DECK PROTECTION - CODE

AGE AND SERVICE

(27) YEAR BUILT 1964
(106)YEAR RECONSTRUCTED
(42) TYPE OF SERVICE : ON - Highway
UNDER - Waterway CODE 15
(28) LANES: ON STRUCTURE 2 UNDER STRUCTURE 0
(29) AVERAGE DAILY TRAFFIC 28500
(30) YEAR OF ADT 2011 (109) TRUCK ADT PCT 23%
(19) BYPASS OR DETOUR LENGTH 1 MI

GEOMETRIC DATA

(48) LENGTH OF MAXIMUM SPAN 65 FT
(49) STRUCTURE LENGTH 198 FT
(50)CURB OR SIDEWALK: LEFT 1.6 FT RIGHT 1.6 FT
(51) BRIDGE ROADWAY WIDTH CURB TO CURB 28 FT
(52) DECK WIDTH OUT TO OUT 33.417 FT
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS) 28 FT
(33) BRIDGE MEDIAN - No Median CODE 1
(34) SKEW 0° (35) STRUCTURE FLARED 0
(10) INVENTORY ROUTE MIN VERT CLEAR 999.9 FT
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR 28 FT
(53) MIN VERT CLEAR OVER BRIDGE RDWY 999.9 FT
(54) MIN VERT UNDERCLEAR REF Not a Highway or Railroad 0 FT
(55) MIN LAT UNDERCLEAR RT REF Not a Highway or Railroad 000 FT
(56) MIN LAT UNDERCLEAR LT REF - 000 FT

NAVIGATION DATA

(38) NAVIGATION CONTROL - No Navigational Control CODE 0
(111)PIER PROTECTION - CODE
(39) NAVIGATION VERTICAL CLEARANCE 0
(116)VERT - LIFT BRIDGE NAV MIN VERT CLEAR FT
(40) NAVIGATION HORIZONTAL CLEARANCE 0 FT

SUFFICIENCY RATING = 64.7
STATUS = Functionally Obsolete

CLASSIFICATION — CODE

(112)NBIS BRIDGE SYSTEM - YES
(104)HIGHWAY SYSTEM Is on the NHS 1
(26) FUNCTIONAL CLASS - Arterial - Interstate 01
(100)STRAHNET HIGHWAY - Interstate STRAHNET Route 1
(101)PARALLEL STRUCTURE - Right Parallel Structure R
(102)DIRECTION OF TRAFFIC - 1-way Traffic 1
(103)TEMPORARY STRUCTURE -
(110)DESIGNATED NATIONAL NETWORK - On the National Network 1
(20) TOLL On Free Road 3
(31) MAINTAIN - State Highway Agency 01
(22) OWNER - State Highway Agency 01
(37) HISTORICAL SIGNIFICANCE - Not Eligible 5

CONDITION — CODE

(58) DECK 7
(59) SUPERSTRUCTURE 5
(60) SUBSTRUCTURE 5
(61) CHANNEL & CHANNEL PROTECTION 7
(62) CULVERTS N

LOAD RATING AND POSTING — CODE

(31) DESIGN LOAD HS 20 + MOD 6
(63) OPERATING RATING METHOD - Load Factor 1
(64) OPERATING RATING - HS-44 80
(65) INVENTORY RATING METHOD - Load Factor 1
(66) INVENTORY RATING - HS-27 48
(70) BRIDGE POSTING - No Posting Required 5
(41) STRUCTURE OPEN, POSTED ,OR CLOSED A
DESCRIPTION - Open, No Restriction

APPRAISAL — CODE

(67) STRUCTURAL EVALUATION 5
(68) DECK GEOMETRY 3
(69) UNDERCLEARANCES,VERTI & HORIZ N
(71) WATERWAY ADEQUACY 7
(72) APPROACH ROADWAY ALIGNMENT 8
(36) TRAFFIC SAFETY FEATURES 0111
(113)SCOUR CRITICAL BRIDGES 8

PROPOSED IMPROVEMENTS

(75) TYPE OF WORK - CODE
(76) LENGTH OF STRUCTURE IMPROVEMENT
(94) BRIDGE IMPROVEMENT COST
(95) ROADWAY IMPROVEMENT COST
(96) TOTAL PROJECT COST
(97) YEAR OF IMPROVEMENT COST ESTIMATE
(114)FUTURE ADT 57000 (115) YEAR FUTURE ADT 2025

INSPECTIONS

(90) INSPECTION DATE 03/12/2013
(92) CRITICAL FEATURE INSPECTION : (93) CFI DATE
A) FRACTURE CRIT DETAIL - NO A)
B) UNDERWATER INSP - NO B)
C) OTHER SPECIAL INSP NO C)
SCOUR

BRIDGE MANAGEMENT UNIT

DATA ON EXISTING STRUCTURE Run Date: 05/31/2013

COUNTY :	DIVISION :	DISTRICT:	STRUCTURE NUMBER :	LENGTH :
HENDERSON	14	1	440234	198 FEET

ROUTE CARRIED : I-26,US74

FEATURE INTERSECTED : CANE CREEK

LOCATED : 1.6 MI.N.JCT.US25

BRIDGE NAME :

CITY : *AVERY CREEK

FUNC. CLASS :	SYST.ON :	SYST.UNDER :	ADT & YR :	RAIL TYPE :
01	FA	NFA	28500 2011	LT 99 RT 99

BUILT :	BY :	PROJ :	FED.AID PROJ :	DESIGN LOAD :
1964	SHC	8.19002	I-26-1(10)6	HS 20 + MOD

REHAB :	BY :	PROJ :	ALIGNMENT :	SKEW :	LANES :
			TAN	90	ON 2 UNDER 0

NAVIGATION :	HT. CRN. TO BED :	WATER DEPTH :
VC 0 FT HC 0 FT	27 FT	3 FT

SUPERSTRUCTURE : REINFORCED CONCRETE FLOOR ON I-BEAMS

SUBSTRUCTURE : E.BTS:RC CAPS/H-PILES;INT.BTS:RC POST&BEAM

SPANS : 1 @ 66'-6;1 @ 65'3;1 @ 66'-6

BEAMS OR GIRDERS : 4 LINES 36 I-BEAMS @ 8'CENTERS

FLOOR :	ENCROACHMENT :	DECK (OUT TO OUT) :
7.75 RC/NO AWS		33.417 FT

CLEAR ROADWAY :	BETWEEN RAILS :	SIDEWALK OR CURB :
28 FT	31.25 FT	LT 1.6 FT RT 1.6 FT

VERT.CL.OVER : 999.9 FT

INV.RTG. :	OPE.RTG. :	CONTR.MEMBER :	POSTED :
HS-27	HS-44	int bm	SV TTST DATE

SYSTEM : Primary Interstate

GREEN LINE ROUTE : Y

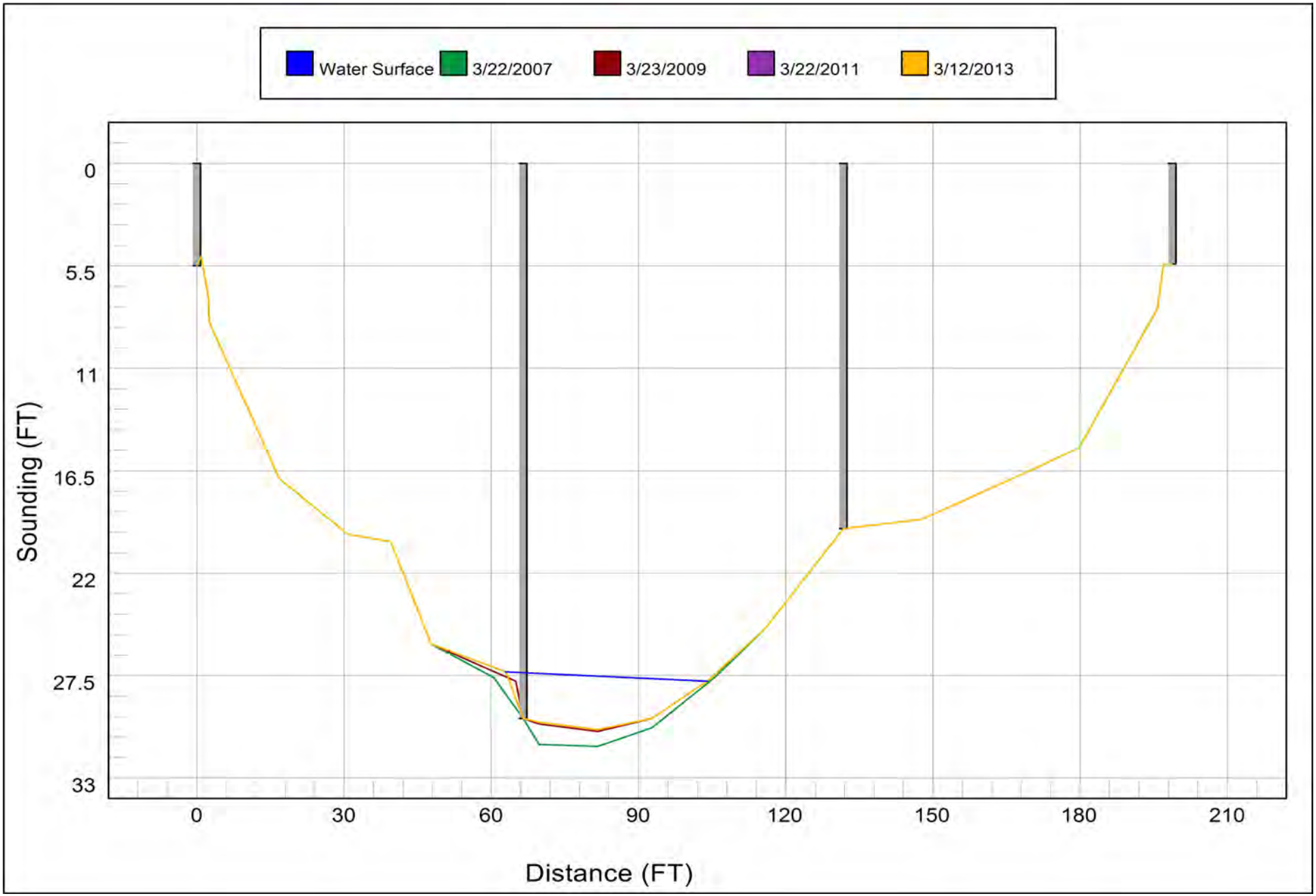
UNDER ROUTES AND CLEARANCES

REMARKS :

Bridge: 440234 County HENDERSON Date: 03/12/2013

STREAMBED PROFILE (Downstream)

Top of Rail = 0 FT (Sounding)



NAME PLATE

WEST AT APPROACH GUARDRAIL

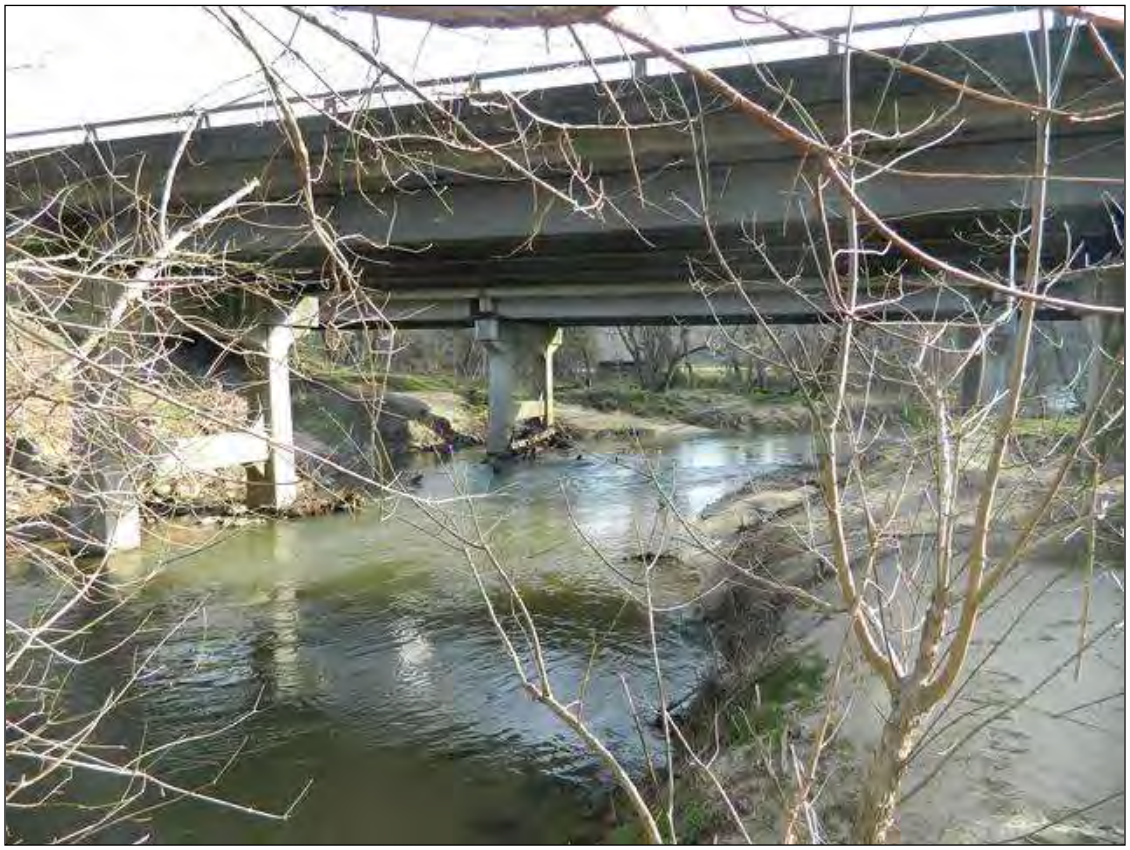
EAST AT APPROACH GUARDRAIL

APPROACH GUARDRAIL TERMINAL END (NORTH EAST)

REP OF END BENTS (END BENT 1)

REP OF INTERIOR BENTS (INTERIOR BENT 1, WEST FACE)

UTILITY LINE AT END BENT 1



UPSTREAM NORTH

DOWNSTREAM SOUTH

WEST

Looking at Upstream Face

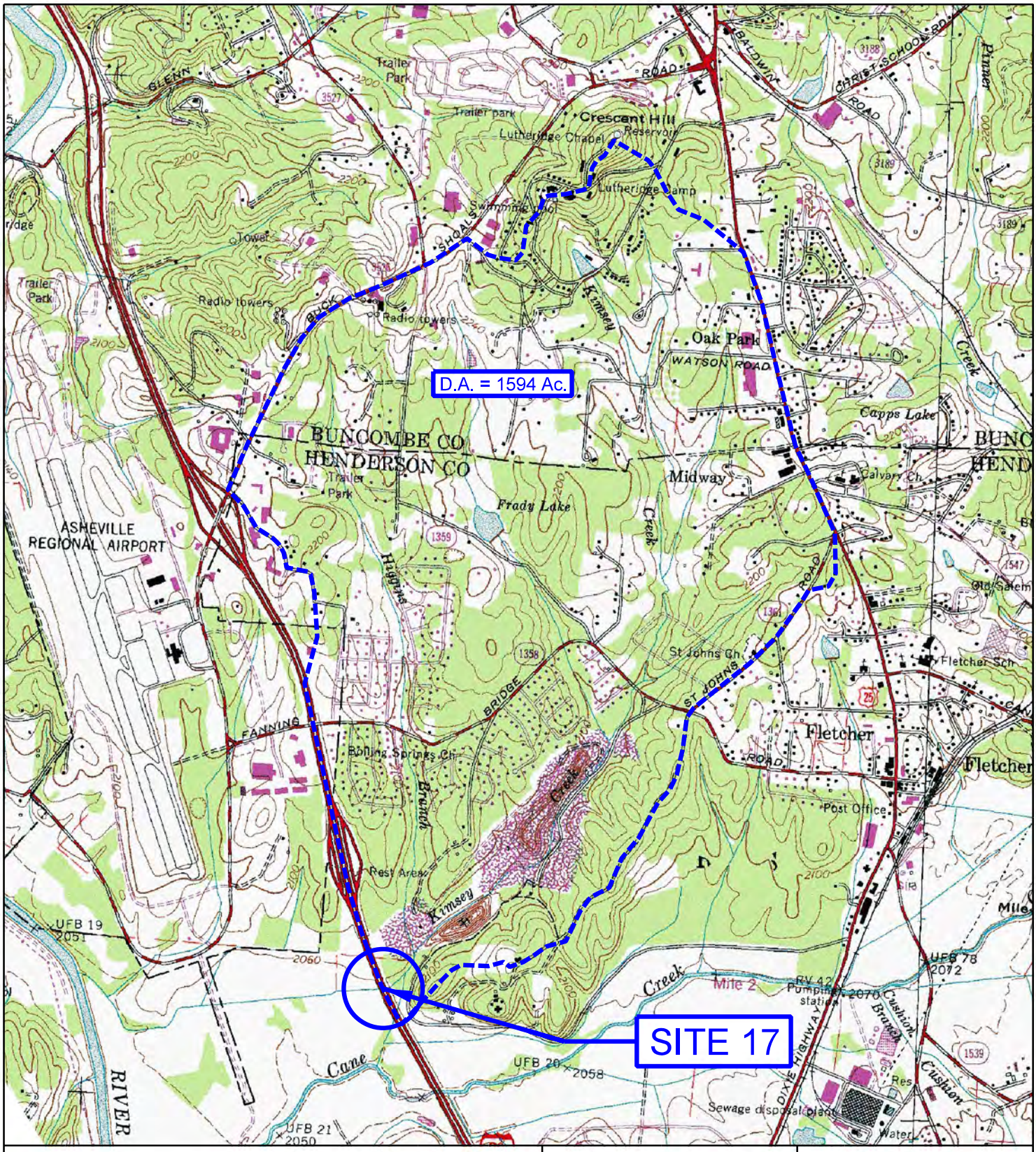
Looking Upstream

Looking at Downstream Face

Looking Downstream

APPENDIX T

SITE 17



QUAD MAP - SITE 17

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

1,000 0 1,000 2,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 17

Stream Name: Kimsey Creek

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	101	10.1	0.006
Rock Quary	-	10%	210	21.0	0.013
Low - Medium Density Residential	2 - 5	20%	171	34.3	0.022
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	897	313.9	0.197
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	135	74.1	0.047
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	38	26.7	0.017
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	41	35.2	0.022
Totals			**1594**	**515.4**	**32.3%**

Drainage Area = **1594** **acres**

Project: I-4400 / I-4700

Site #: 17

Stream Name: Kimsey Creek

Drainage Area (sq mi): 2.49

Impervious Area (%): 32.3%

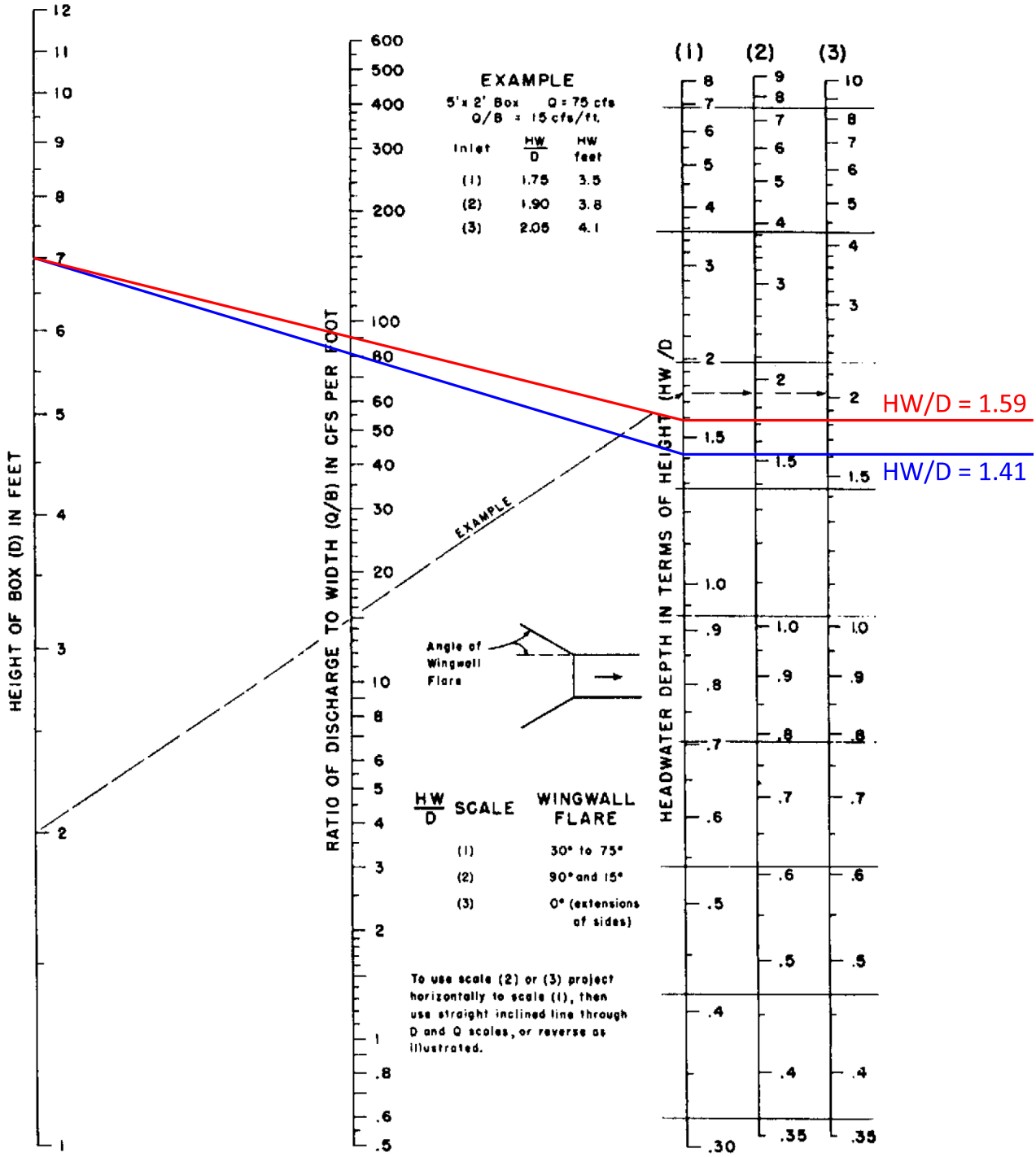
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	DISCHARGE (cfs)		
	PIEDMONT - RIDGE AND VALLEY	SAND HILLS	COASTAL PLAIN
2	838	-	-
5	1135	-	-
10	1334	-	-
25	1559	-	-
50	1712	-	-
100	1875	-	-
200	2024	-	-
500	2200	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	DISCHARGE (cfs)
10	-
50	-
100	1426
500	-

SITE 17

50 Year	100 Year
3 @ 7' x 7' RCBC	3 @ 7' x 7' RCBC
Q = 1700 CFS	Q = 1900 CFS
Q/NB = 81 CFS/FT.	Q/NB = 90 CFS/FT.

CHART 8B



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 1,000 Feet

0 75 150 300 Meters

FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 9642

FEMA

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
ASHEVILLE, CITY OF	370032	9642	K
FLETCHER, TOWN OF	370568	9642	K
HENDERSON COUNTY	370125	9642	K
MILLS RIVER, TOWN OF	370025	9642	K

Site 17

MAP NUMBER
3700964200K

MAP REVISED
01/06/10

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

A Report of Flood Hazards in

HENDERSON COUNTY, NORTH CAROLINA AND INCORPORATED AREAS

Community Name	Community Number
CITY OF HENDERSONVILLE	370128
HENDERSON COUNTY	370125
TOWN OF FLETCHER	370568
TOWN OF LAUREL PARK	370384
VILLAGE OF FLAT ROCK	370565

NORTH CAROLINA
Cooperating Technical State
FEMA'S COOPERATING TECHNICAL PARTNER

EFFECTIVE: 10/2/2008
REVISED: 1/6/2010
Federal Emergency Management Agency
State of North Carolina
Flood Insurance Study Number
37089CV000
www.fema.gov and www.ncfloodmaps.com

Table 8 - Flooding Sources Studied by Detailed Methods: Revised or Newly Studied

Source	Riverine Sources		Affected Communties
	From	To	
Bat Fork Creek	The confluence with Mud Creek	Approximately 1,500 feet upstream of New Hope Road (SR 1757)	City Of Hendersonville Henderson County
Boylston Creek	Approximately 500 feet downstream of Banner Farm Road	Approximately 100 feet upstream of Gonce Drive	Town Of Mills River
Boylston Creek Tributary 7	The confluence with Boylston Creek	Approximately 1,100 feet upstream of Cross Creek Court	Henderson County Town Of Mills River
Broad River	Approximately 500 feet upstream of US HWY 64 / 74 A	The Henderson / Rutherford County boundary	Henderson County
Cane Creek	The confluence with French Broad River	Approximately 600 feet upstream of Cross Creek Farm Road	City Of Asheville Henderson County Town Of Fletcher
Clear Creek	The confluence with Mud Creek	Approximately 600 feet upstream of Howard Gap Road (SR 1006)	City Of Hendersonville Henderson County
Devils Fork	The confluence with Bat Fork Creek	Approximately 500 feet upstream of Old Dana Road (SR 1738)	City Of Hendersonville Henderson County
Green River	Approximately 0.7 mile downstream of NC Route 225	Approximately 400 feet upstream of Bear Paw Ridge Road	Henderson County
Higgins Branch	The confluence with Kimsey Creek	Approximately 50 feet downstream of the Henderson/Buncombe County boundary	Town Of Fletcher
Hoopers Creek	The confluence with Cane Creek	Approximately 120 feet upstream of Lindsey Loop Road (SR 1571)	Henderson County Town Of Fletcher
Kimsey Creek	The confluence with Cane Creek	Approximately 50 feet downstream of the Henderson/Buncombe County boundary	Henderson County Town Of Fletcher
Mill Pond Creek	At Hysong Lane	Approximately 40 feet downstream of North Hills Drive	Henderson County
Mills River	The confluence with French Broad River	The confluence with South Fork Mills River and North Fork Mills River	Henderson County Town Of Mills River
Mud Creek	The confluence with French Broad River	Approximately 500 feet upstream of Walnut Cove Road (SR 1125)	City Of Hendersonville Henderson County Town Of Fletcher Village Of Flat Rock
South Wash Creek	The confluence with Wash Creek	Approximately 50 feet downstream of Lake Drive	Town Of Laurel Park
Wash Creek	The confluence with Mud Creek	Approximately 1,400 feet upstream of Glasgow Lane (SR 1185)	City Of Hendersonville Henderson County Town Of Laurel Park

Table 9, “Flooding Sources Studied by Detailed Methods: Redelineated”, lists all flooding sources that were studied by detailed methods for the pre-statewide FIS and redelineated for previous FISs. These flooding sources were not part of this revision and their effective analyses remain valid.

Table 9 - Flooding Sources Studied by Detailed Methods: Redelineated

Source	Riverine Sources		Affected Communties
	From	To	
Boylston Creek	The confluence with French Broad River	Approximately 500 feet downstream of Banner Farm Road	Henderson County Town Of Mills River
Britton Creek	The confluence with Mud Creek	New Village Drive	City Of Hendersonville
Clear Creek	Approximately 600 feet upstream of Howard Gap Road (SR 1006)	Approximately 150 feet downstream of the confluence of Kyles Creek	City Of Hendersonville Henderson County
Crab Creek	The confluence with Little River	The Henderson/Transylvania County boundary Transylvania County boundary	Henderson County
French Broad River	Approximately 1.1 miles downstream of the Buncombe/Madison County boundary	Approximately 3 miles upstream of the Buncombe/Henderson County boundary	City Of Asheville Henderson County Town Of Fletcher Town Of Mills River
French Broad River	Approximately 3 miles upstream of the Buncombe/Henderson County boundary	The confluence of North Fork French Broad River and West Fork French Broad River	Henderson County Town Of Mills River
McDowell Creek	The confluence with French Broad River	Pennsylvania Road (SR 1348)	Henderson County Town Of Mills River
Mill Pond Creek	The confluence with French Broad River	At Hysong Lane	Henderson County
Shepherd Creek	The confluence with Mud Creek	Approximately 50 feet downstream of S. Lakeside Drive (SR 1148) (SR 1148)	City Of Hendersonville

Table 10, “Flooding Sources Studied by Detailed Methods: Limited Detailed”, lists all flooding sources within the county that were studied by limited detailed methods for either this FIS or previous FISs.

Table 13 - Summary of Discharges

Flooding Source		Discharges (cfs)			
Location	Drainage Area (square miles)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Approximately 1,200 feet downstream of Lindsey Loop Road (SR 1571)	6.30	*	*	2,350	*
Kimsey Creek					
At the confluence with Cane Creek	2.80	*	*	1,860	*
Approximately 1,000 feet upstream of Interstate 26	1.74	*	*	1,420	*
Approximately 900 feet downstream of Fanning Bridge Road (SR 1358)	1.37	*	*	1,300	*
Approximately 0.4 mile upstream of Fanning Bridge Road (SR 1358)	0.67	*	*	880	*
King Creek					
At the confluence with Bat Fork Creek	7.57	*	*	2,640	*
Approximately 50 feet upstream of confluence of King Creek Tributary 3	5.85	*	*	2,250	*
Approximately 500 feet downstream of Highland Lake Road (SR 1783)	5.17	*	*	2,080	*
King Creek Tributary 3					
At the confluence with King Creek	0.75	*	*	720	*
Approximately 0.4 mile upstream of confluence with King Creek	0.40	*	*	420	*
Kyles Creek					
At the confluence with Clear Creek	4.41	*	*	1,880	*
At the confluence of Lanning Mill Creek	2.05	*	*	1,170	*
Lanning Mill Creek					
At the confluence with Kyles Creek	1.11	*	*	800	*
Lewis Creek					
At the confluence with Clear Creek	6.56	*	*	2,410	*
Approximately 1,900 feet downstream of N Ridge Road (SR 1861)	4.08	*	*	1,790	*
Little Willow Creek					
At the confluence with French Broad River	4.39	*	*	1,880	*
Approximately 0.8 mile upstream of Pleasant Grove Road (SR 1191)	3.55	*	*	1,640	*
McDowell Creek					
At the confluence with French Broad River	4.90	*	*	1,900	*
Mile 3.5	1.00	*	*	1,000	*
Mill Pond Creek					
At the confluence with French Broad River	3.60	750	1,300	1,600	2,060
Mile 0.65	2.52	590	1,020	1,270	1,630
Mile 1.4	2.02	500	880	1,100	1,400
At Triple Creek Drive	1.02	*	*	750	*
Mills River					
At the confluence with French Broad River	72.92	5,470	8,850	10,540	15,160
Approximately 500 feet downstream of Hooper Lane (SR 1353)	72.16	5,430	8,780	10,460	15,060
Approximately 0.9 miles downstream of Boylston Highway (NC 191)	71.30	5,380	8,700	10,370	14,940
Approximately 1,100 feet upstream of Boylston Highway (NC 191)	70.30	5,320	8,620	10,270	14,800
Approximately 1.3 miles upstream of Boylston Highway (NC 191)	69.37	5,270	8,530	10,170	14,670
Approximately 1.6 miles upstream of Boylston Highway (NC 191)	67.20	5,140	8,340	9,950	14,360
Approximately 2.4 miles upstream of Boylston Highway (NC 191)	66.48	5,100	8,280	9,880	14,260
Approximately 2,100 feet downstream of confluence of South Fork Mills River	65.90	5,070	8,240	9,830	14,190
Mud Creek					
At the confluence with French Broad River	112.56	7,620	12,080	14,260	20,210
Approximately 0.5 mile upstream of Rugby Road (SR 1365)	111.35	7,560	12,000	14,170	20,080

5.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the flood elevations for the selected recurrence intervals. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles and/or Water-surface elevation rasters. For stream segments for which BFEs were computed, selected cross-section locations are also shown on the FIRM. Flood Profiles and/or Water-surface elevation rasters were developed showing computed water-surface elevations for floods of the selected recurrence intervals.

Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles and/or Water-surface elevation rasters or in the Floodway Data tables in the FIS Report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in the FIS in conjunction with the data shown on the FIRM.

The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the Flood Profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For details on the county's hydraulic analyses, the hydraulic report is available by request.

For the streams studied by detailed methods, water surface elevations of floods of the selected recurrence intervals were computed through use of the Army Corps of Engineers' HEC RAS step backwater computer program . The hydraulic analyses were based on unobstructed flow. The flood elevations shown on the Profiles and/or Water-surface elevation rasters are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail. The computer models were calibrated using historic high water data collected during field investigations.

The cross section geometries were obtained from a combination of digital elevation data obtained by Light Detection and Ranging (LIDAR) and field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. Natural floodplain cross sections were surveyed approximately every 4000 feet along the detail study reaches to obtain the channel geometry between bridges and culverts. Overbank cross section data for the backwater analyses were obtained from recently flown LIDAR data.

Channel roughness factors (Manning's "n") used in the hydraulic computations were made in the field by an engineer where stream access was possible, with orthophotos used to supplement areas that could not be accessed. The channel and overbank "n" values for all of the streams studied by detailed methods are shown in Table 16, "Roughness Coefficients".

Table 16 - Roughness Coefficients

Stream	Channel "n"	Overbank "n"
Allen Branch	0.045 to 0.050	0.030 to 0.090
Bat Fork Creek	0.040 to 0.060	0.022 to 0.150
Battle Creek	0.035 to 0.040	0.040 to 0.090
Big Willow Creek	0.040	0.050 to 0.090
Big Willow Creek Tributary 1	0.025 to 0.050	0.050 to 0.090
Boylston Creek	0.035 to 0.090	0.040 to 0.120
Boylston Creek Tributary 7	0.040 to 0.090	0.050 to 0.090
Britton Creek	0.035 to 0.060	0.030 to 0.160
Britton Creek Tributary 2	0.040 to 0.050	0.030 to 0.090
Broad River	0.028 to 0.100	0.010 to 0.130
Cane Creek	0.040 to 0.050	0.025 to 0.250
Clear Creek	0.035 to 0.060	0.030 to 0.140
Crab Creek	0.055 to 0.061	0.080 to 0.660
Devils Fork	0.040 to 0.070	0.010 to 0.150
Dunn Creek	0.035 to 0.050	0.030 to 0.090
Featherstone Creek	0.045 to 0.090	0.030 to 0.090
Finley Creek	0.040 to 0.050	0.040 to 0.090
French Broad River	0.024 to 0.064	0.030 to 0.200
Gash Creek	0.037 to 0.057	0.030 to 0.125
Green River	0.032 to 0.090	0.025 to 0.100
Hickory Creek (near Gerton)	0.060 to 0.100	0.060 to 0.100
Higgins Branch	0.050 to 0.065	0.025 to 0.100
Hoopers Creek	0.045 to 0.070	0.025 to 0.150
Kimsey Creek	0.040 to 0.045	0.025 to 0.100
King Creek	0.045 to 0.050	0.030 to 0.090
King Creek Tributary 3	0.045 to 0.050	0.030 to 0.090
Kyles Creek	0.045 to 0.050	0.006 to 0.090
Lanning Mill Creek	0.050	0.050 to 0.090
Lewis Creek	0.045 to 0.050	0.030 to 0.090

PRELIMINARY DESIGN AND ASSESSMENT OF
STREAM CROSSINGS AND ENCROACHMENTS

COUNTY Henderson PROJECT NUMBER I-4400/I-4700

STREAM Kimsey Creek ROUTE I-26

ASSESSMENT PREPARED BY HNTB Corporation DATE _____

HYDROLOGIC EVALUATION

NEAREST GAGING STATION ON THIS STREAM _____ (NONE X) _____

ARE FLOOD STUDIES AVAILABLE ON THIS STREAM: Yes

FLOOD DATA:
Q10 1334 CFS EST BKWTR. - FT. Q25 1559 CFS EST BKWTR. - FT.
Q50 1712 CFS EST BKWTR. - FT. Q100 1875 CFS EST BKWTR. - FT.
Q500 2200 CFS OR OVERTOPPING CFS EST BKWTR. - FT.

DRAINAGE AREA 2.49 Sq. Miles

METHOD USED TO COMPUTE Q USGS Urban Regression

PROPERTY RELATED EVALUATIONS

DAMAGE POTENTIAL: LOW X MODERATE _____ HIGH _____

COULD THIS BE SIGNIFICANTLY INCREASED BY PROPOSED

ENCROACHMENT: YES _____ NO X

EXPLANATION: Limited changes will be made to this site.

_____

LIST BUILDINGS IN FLOOD PLAIN None LOCATION N/A

FLOOR ELEVATION Unknown

UPSTREAM LAND USE Residential/ Industrial

ANTICIPATE ANY CHANGE? No

ANY FLOOD ZONING? (FIS STUDIES, ETC.) YES X NO _____

TYPE OF STUDY FEMA_Detailed

BASE FLOOD ELEVATION 2061.0 ft (100 YEAR)

REGULATORY FLOODWAY WIDTH 162 (AS NOTED IN FIS STUDIES)

COMMENTS: Cross Section 011

TRAFFIC RELATED EVALUATIONS

PRESENT YEAR 2011 TRAFFIC COUNT 63500 VPD % TRUCKS 15

DESIGN YEAR 2040 TRAFFIC COUNT 79300 VPD % TRUCKS 15

EMERGENCY ROUTE _____ SCHOOL BUS ROUTE _____ MAIL ROUTE _____

DETOUR AVAILABLE? _____ LENGTH OF DETOUR _____ MILES

DOES THE LEVEL OF TRAFFIC SERVICE OF AN EXISTING CROSSING VARY GREATLY FROM STANDARD DESIGN LEVELS? _____

_____

IS THE TRAFFIC VOLUME, TYPE, USAGE SUCH TO WARRANT CONSIDERATION FOR VARIANCE FROM STANDARDS OR EXISTING LEVEL OF INTERRUPTION?

_____

COMMENTS: _____

_____

HIGHWAY AND BRIDGE (CULVERT) RELATED EVALUATIONS

NOTE ANY OUTSIDE FEATURES WHICH MIGHT AFFECT STAGE, DISCHARGE OR FREQUENCY.

LEVEES _____ AGGRADATION/DEGRADATION _____ RESERVOIRS _____

DIVERSIONS _____ DRAINAGE DISTRICT _____ NAVIGATION _____

BACKWATER FROM ANOTHER SOURCE _____

EXPLANATION: _____

_____

ROADWAY OVERFLOW SECTION (NONE __) LENGTH _____ ELEVATION _____

EMBANKMENT: SOIL TYPE Delanco Loam

TYPE SLOPE COVER Vegetated

COMMENTS: USDS Soil Map NC089

_____

ENVIRONMENTAL CONSIDERATIONS

LIST SPECIAL CONDITIONS OR CONSIDERATIONS WHICH AFFECT HYDRAULIC DESIGN (NONE _____)

_____

_____

MISCELLANEOUS COMMENTS

IS THERE UNUSUAL SCOUR POTENTIAL? YES _ NO X PROTECTION NEEDED _

ARE BANKS STABLE? Yes PROTECTION NEEDED Yes

DOES STREAM CARRY APPRECIABLE AMOUNT OF LARGE DEBRIS? No

COMMENTS:

_____

_____

_____

ALTERNATIVES

RECOMMENDED DESIGN Retain Existing Structure

DETOUR STRUCTURE N/A

WERE OTHER HYDRAULIC ALTERNATES CONSIDERED? YES _____ NO X

THIS SITE ASSESSMENT INDICATES THE DESIGN SHOULD FOLLOW:

(1) X NORMAL PROCESS

(2) _____ NORMAL PROCESS WITH SPECIAL SPECIFIC CONSIDERATION FOR

_____

(3) _____ SPECIFIC DESIGN PROCESS WITH APPROPRIATE RISK/ECONOMIC EVALUATION ADDRESSING: _____

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/4/14

SITE NUMBER 17 STREAM KIMSEY CREEK ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 3 @ 7'x7' RCBC GOOD CONDITION. MINOR CRACKS THROUGHOUT THE STRUCTURE.

UPSTREAM CHANNEL: TOP WIDTH 22 FT BOTTOM WIDTH 18 FT BANKFULL DEPTH 4 FT

DEPTH OF FLOW (AT TIME OF VISIT) 2 FT BED MATERIAL

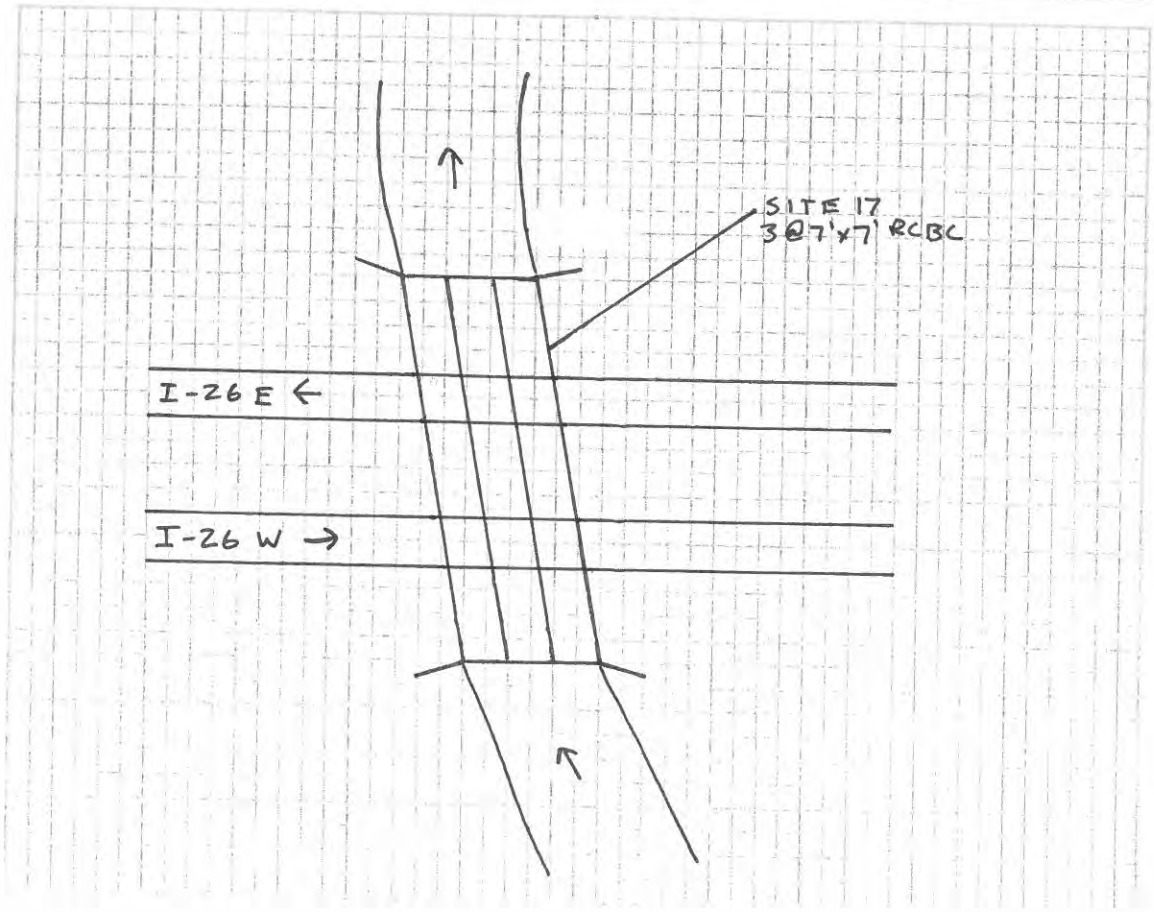
BANK/ CHANNEL CONDITIONS SCOUR HOLE NEAR LEFT WINGWALL. BANKS ARE STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 16 FT BOTTOM WIDTH 12 FT BANKFULL DEPTH 4 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS MIDDLE AND RIGHT BARRELS HAVE 1.5' OF SILT AND THE LEFT BARREL HAS 2.5' OF SILT. BANKS ARE STABLE AND VEGETATED.

COMMENTS



NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
BRIDGE MANAGEMENT UNIT

ATTENTION

BRIDGE INSPECTION REPORT

INSPECTION TYPE: Routine Inspection

COUNTY HENDERSON BRIDGE NUMBER 440236 INSPECTION CYCLE 2 YRS 41.9

ROUTE I26,US74 ACROSS BRANCH OF CANE CREEK M.P. 41900

LOCATION 1.8 MI.N.JCT.US25

SUPERSTRUCTURE TRIPLE 7'X7'RCBC;231'ALONG CENTERLINE CULVERT

SUBSTRUCTURE

SPANS

LONGITUDE 82° 31' 33.56" LATITUDE 35° 25' 13.15"

INSPECTION DATE 03/13/2013 PRESENT CONDITION GOOD

PRESENT POSTING Not Posted PROPOSED POSTING

OTHER SIGNS PRESENT NONE

EAST

Fracture Critical	No
Temporary Shoring	No
Scour Critical	No
Scour POA	No

SIGN NOTICE ISSUED FOR		NUMBERED REQUIRED
No	WEIGHT LIMIT	
No	DELINEATORS	
No	NARROW BRIDGE	
No	ONE LANE BRIDGE	
No	LOW CLEARANCE	

NATIONAL BRIDGE INVENTORY-------- STRUCTURE INVENTORY AND APPRAISAL Run Date: 04/18/2013

IDENTIFICATION

(1) STATE NAME -NORTH CAROLINA BRIDGE 440236
(8) STRUCTURE NUMBER(FEDERAL) 000000000890236
(5) INVENTORY ROUTE (ON/UNDER) - ON 11000260
(2) STATE HIGHWAY DEPARTMENT DISTRICT 1
(3) COUNTY CODE 89 (4) PLACE CODE 0
(6) FEATURE INTERSECTED - BRANCH OF CANE CREEK
(7) FACILITY CARRIED I26,US74
(9) LOCATION 1.8 MI.N.JCT.US25
(11)MILEPOINT 41.9
(16)LAT 35° 25' 13.15" (17)LONG 82° 31' 33.56"
(98)BORDER BRIDGE STATE CODE PCT SHARE
(99)BORDER BRIDGE STRUCTURE NO

STRUCTURE TYPE AND MATERIAL

(43) STRUCTURE TYPE MAIN: Concrete continuous
TYPE - Culverts (includes frame culverts) CODE 219
(44) STRUCTURE TYPE APPR :
TYPE - CODE 000
(45) NUMBER OF SPANS IN MAIN UNIT 3
(46) NUMBER OF APPROACH SPANS
(107)DECK STRUCTURE TYPE - N CODE
(108)WEARING SURFACE / PROTECTIVE SYSTEM :
(A) TYPE OF WEARING SURFACE - CODE
(B) TYPE OF MEMBRANE - CODE
(C) TYPE OF DECK PROTECTION - CODE

AGE AND SERVICE

(27) YEAR BUILT 1963
(106)YEAR RECONSTRUCTED
(42) TYPE OF SERVICE : ON - Highway
UNDER - Waterway CODE 15
(28) LANES: ON STRUCTURE 4 UNDER STRUCTURE 0
(29) AVERAGE DAILY TRAFFIC 57000
(30) YEAR OF ADT 2011 (109) TRUCK ADT PCT 23%
(19) BYPASS OR DETOUR LENGTH 1 MI

GEOMETRIC DATA

(48) LENGTH OF MAXIMUM SPAN 7 FT
(49) STRUCTURE LENGTH 33 FT
(50)CURB OR SIDEWALK: LEFT 0 FT RIGHT 0 FT
(51) BRIDGE ROADWAY WIDTH CURB TO CURB 0 FT
(52) DECK WIDTH OUT TO OUT 0 FT
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS) 76 FT
(33) BRIDGE MEDIAN - No Median CODE 2
(34) SKEW 45° (35) STRUCTURE FLARED 0
(10) INVENTORY ROUTE MIN VERT CLEAR 999.9 FT
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR 76 FT
(53) MIN VERT CLEAR OVER BRIDGE RDWY 999.9 FT
(54) MIN VERT UNDERCLEAR REF Not a Highway or Railroad 0 FT
(55) MIN LAT UNDERCLEAR RT REF Not a Highway or Railroad 000 FT
(56) MIN LAT UNDERCLEAR LT REF - 000 FT

NAVIGATION DATA

(38) NAVIGATION CONTROL - No Navigational Control CODE 0
(111)PIER PROTECTION - CODE
(39) NAVIGATION VERTICAL CLEARANCE 0
(116)VERT - LIFT BRIDGE NAV MIN VERT CLEAR FT
(40) NAVIGATION HORIZONTAL CLEARANCE 0 FT

SUFFICIENCY RATING = 93.73
STATUS = Not Deficient

CLASSIFICATION — CODE

(112)NBIS BRIDGE SYSTEM - YES
(104)HIGHWAY SYSTEM Is on the NHS 1
(26) FUNCTIONAL CLASS - Arterial - Interstate 01
(100)STRAHNET HIGHWAY - Interstate STRAHNET Route 1
(101)PARALLEL STRUCTURE - No Parallel Structure N
(102)DIRECTION OF TRAFFIC - 2-way Traffic 2
(103)TEMPORARY STRUCTURE -
(110)DESIGNATED NATIONAL NETWORK - On the National Network 1
(20) TOLL On Free Road 3
(31) MAINTAIN - State Highway Agency 01
(22) OWNER - State Highway Agency 01
(37) HISTORICAL SIGNIFICANCE - Not Eligible 5

CONDITION — CODE

(58) DECK N
(59) SUPERSTRUCTURE N
(60) SUBSTRUCTURE N
(61) CHANNEL & CHANNEL PROTECTION 7
(62) CULVERTS 7

LOAD RATING AND POSTING — CODE

(31) DESIGN LOAD HS 20 + MOD 6
(63) OPERATING RATING METHOD - Load Factor 1
(64) OPERATING RATING - HS-26 46
(65) INVENTORY RATING METHOD - Load Factor 1
(66) INVENTORY RATING - HS-20 36
(70) BRIDGE POSTING - No Posting Required 5
(41) STRUCTURE OPEN, POSTED ,OR CLOSED A
DESCRIPTION - Open, No Restriction

APPRAISAL — CODE

(67) STRUCTURAL EVALUATION 7
(68) DECK GEOMETRY N
(69) UNDERCLEARANCES,VERTI & HORIZ N
(71) WATERWAY ADEQUACY 7
(72) APPROACH ROADWAY ALIGNMENT 8
(36) TRAFFIC SAFETY FEATURES NNNN
(113)SCOUR CRITICAL BRIDGES 8

PROPOSED IMPROVEMENTS

(75) TYPE OF WORK - CODE
(76) LENGTH OF STRUCTURE IMPROVEMENT
(94) BRIDGE IMPROVEMENT COST
(95) ROADWAY IMPROVEMENT COST
(96) TOTAL PROJECT COST
(97) YEAR OF IMPROVEMENT COST ESTIMATE
(114)FUTURE ADT 114000 (115) YEAR FUTURE ADT 2025

INSPECTIONS

(90) INSPECTION DATE 03/13/2013
(92) CRITICAL FEATURE INSPECTION : (93) CFI DATE
A) FRACTURE CRIT DETAIL - NO A)
B) UNDERWATER INSP - NO B)
C) OTHER SPECIAL INSP NO C)
SCOUR

BRIDGE MANAGEMENT UNIT

DATA ON EXISTING STRUCTURE Run Date: 04/18/2013

COUNTY : HENDERSON
DIVISION : 14
DISTRICT: 1
STRUCTURE NUMBER : 440236
LENGTH : 33 FEET

ROUTE CARRIED : I26,US74
FEATURE INTERSECTED : BRANCH OF CANE CREEK

LOCATED : 1.8 MI.N.JCT.US25
BRIDGE NAME :
CITY :

FUNC. CLASS : 01
SYST.ON : FA
SYST.UNDER : NFA
ADT & YR : 57000 2011
RAIL TYPE : LT 0 RT 0

BUILT : 1963
BY : SHC
PROJ : 8.19002
FED.AID PROJ :
DESIGN LOAD : HS 20 + MOD

REHAB :
BY :
PROJ :
ALIGNMENT : TAN
SKEW : 45
LANES : ON 4 UNDER 0

NAVIGATION : VC 0 FT HC 0 FT
HT. CRN. TO BED : 24 FT
WATER DEPTH : 1 FT

SUPERSTRUCTURE : TRIPLE 7'X7'RCBC;231'ALONG CENTERLINE CULVERT

SUBSTRUCTURE :

SPANS :

BEAMS OR GIRDERS :

FLOOR :
ENCROACHMENT :
DECK (OUT TO OUT) : 0 FT

CLEAR ROADWAY : 0 FT
BETWEEN RAILS : 0 FT
SIDEWALK OR CURB : LT 0 FT RT 0 FT

VERT.CL.OVER : 999.9 FT

INV.RTG. : HS-20
OPE.RTG. : HS-26
CONTR.MEMBER :
POSTED : SV TTST DATE

SYSTEM : Primary Interstate
GREEN LINE ROUTE : Y

UNDER ROUTES AND CLEARANCES

REMARKS :

Structure 440236 County HENDERSON Date: 03/13/2013 Structure Photos

UPSTREAM NORTH

DOWNSTREAM SOUTH

Structure 440236 County HENDERSON Date: 03/13/2013 Structure Photos

DOWNSTREAM SOUTH

UPSTREAM NORTH

Looking at Upstream Face of 3 @ 7' x 7' RCBC under I-26

Looking Upstream of 3 @ 7' x 7' RCBC

Looking Downstream in Left Barrel

Looking Downstream in Center Barrel

Looking Upstream in Right Barrel

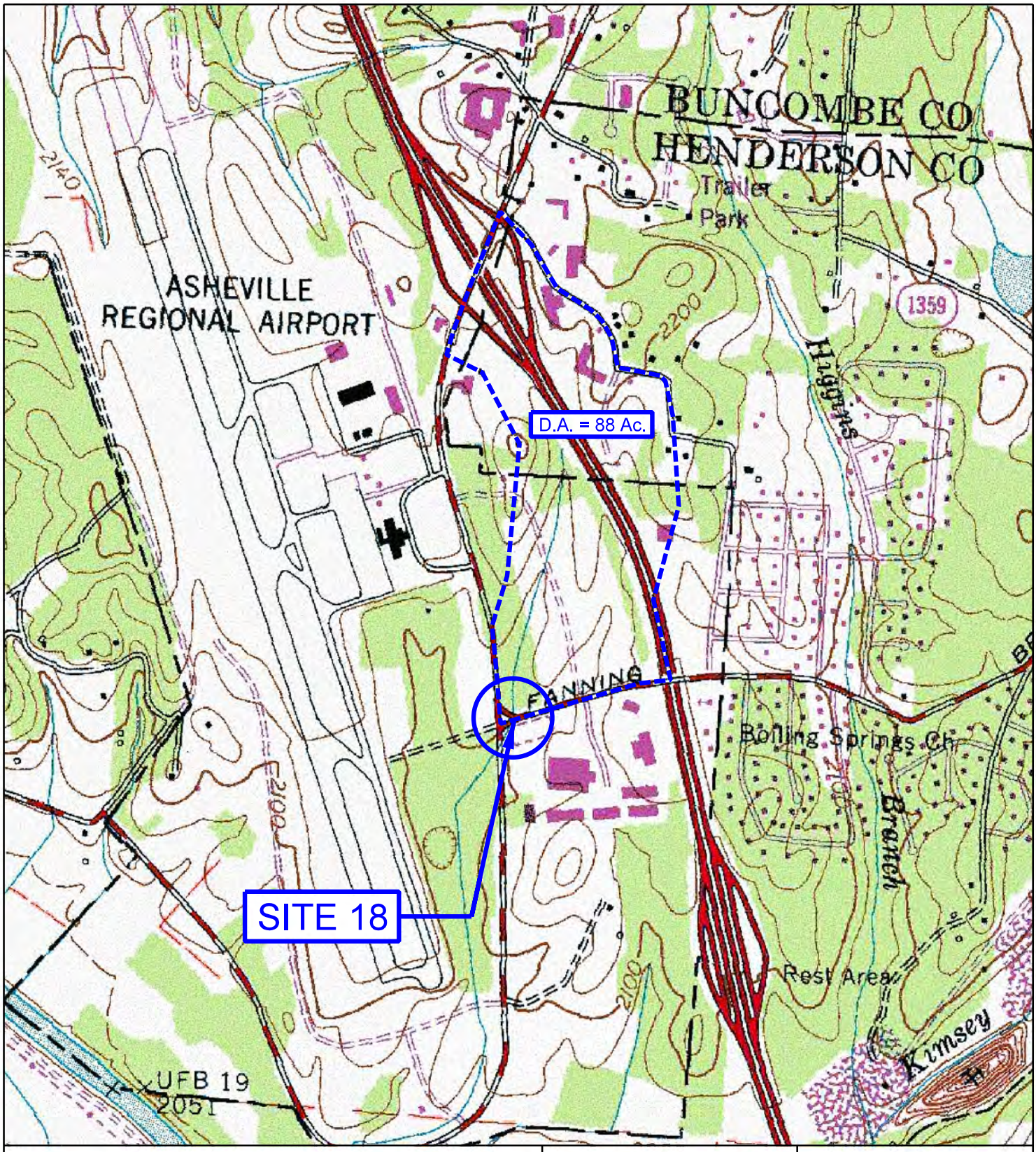
Looking at Downstream Face of 3 @ 7' x 7' RCBC

Looking at Downstream Face of 3 @ 7' x 7' RCBC under I-26

Looking Downstream of 3 @ 7' x 7' RCBC

APPENDIX U

SITE 18



QUAD MAP - SITE 18

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/16/2014

Project: I-4400 / I-4700

Site #: 18

Stream Name: UT to French Broad River

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	0	0.0	0.000
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	0	0.0	0.000
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	14	7.7	0.088
Cities	-	55%	34	18.7	0.213
Industrial	-	70%	40	28.0	0.318
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	0	0.0	0.000
Totals			**88**	**54.4**	**61.8%**

Drainage Area = 88 acres

PROJECT NAME: I-4400 / I-4700
Site #: 18
STREAM NAME: UT to French Broad River
DRAINAGE AREA (acres): 88
Hydrologic Contour: 8

Q10 (cfs): 123

URBAN CHART C 200.3				
FREQUENCY (YR)	DISCHARGE (cfs)			
	SMALL AREA FULL BUSINESS	LARGE AREA FULL BUSINESS	AVERAGE DEVELOPMENT	RESIDENTIAL HIGH TYPE
5	129.2	**115.3**	92.3	80.7
10	172.2	**153.8**	123.0	107.6
25	232.5	**207.6**	166.1	145.3
50	318.6	**284.4**	227.6	199.1
100	370.2	**330.6**	264.5	231.4
200	495.9	**442.8**	354.2	310.0
500	630.3	**562.7**	450.2	393.9

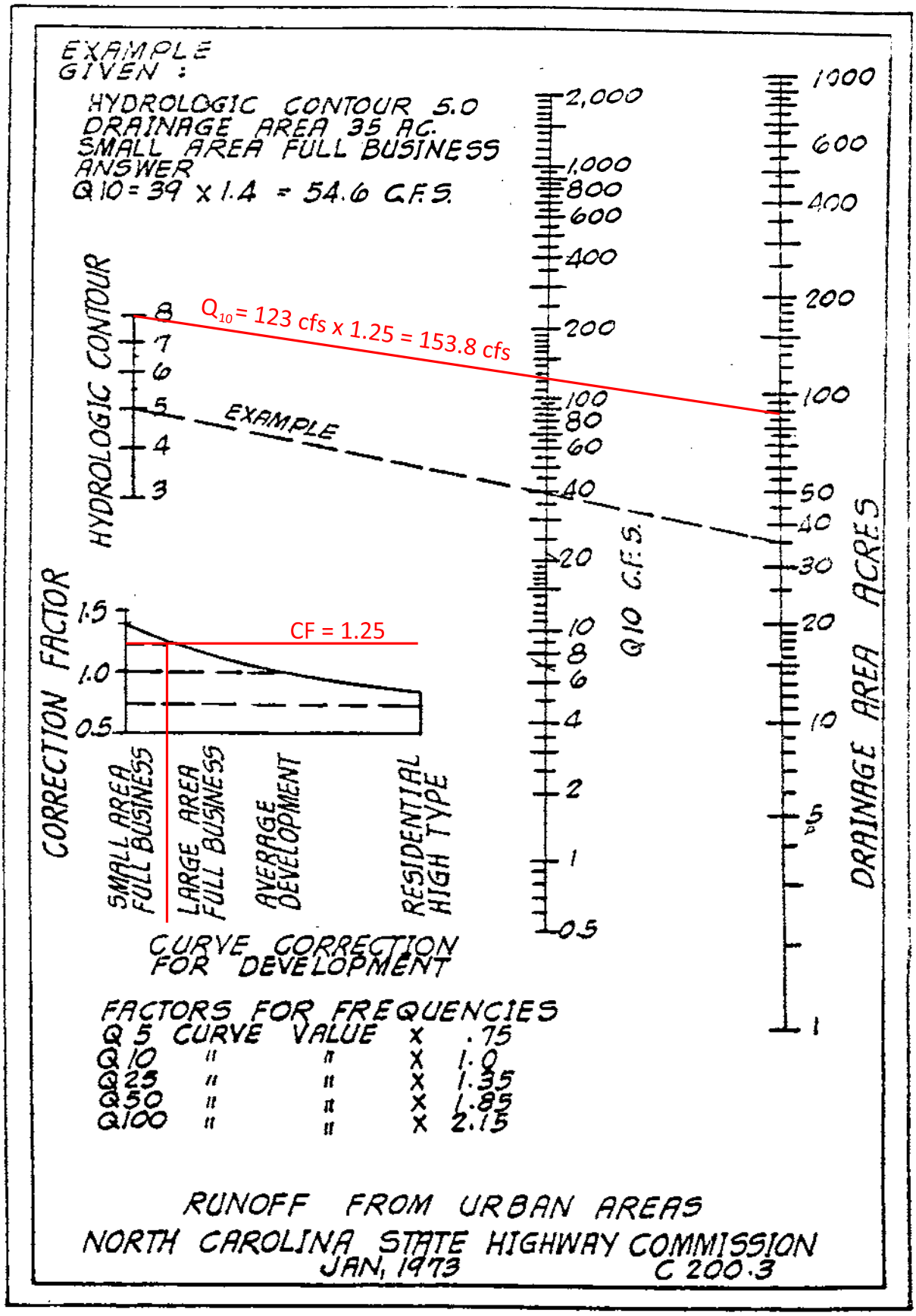
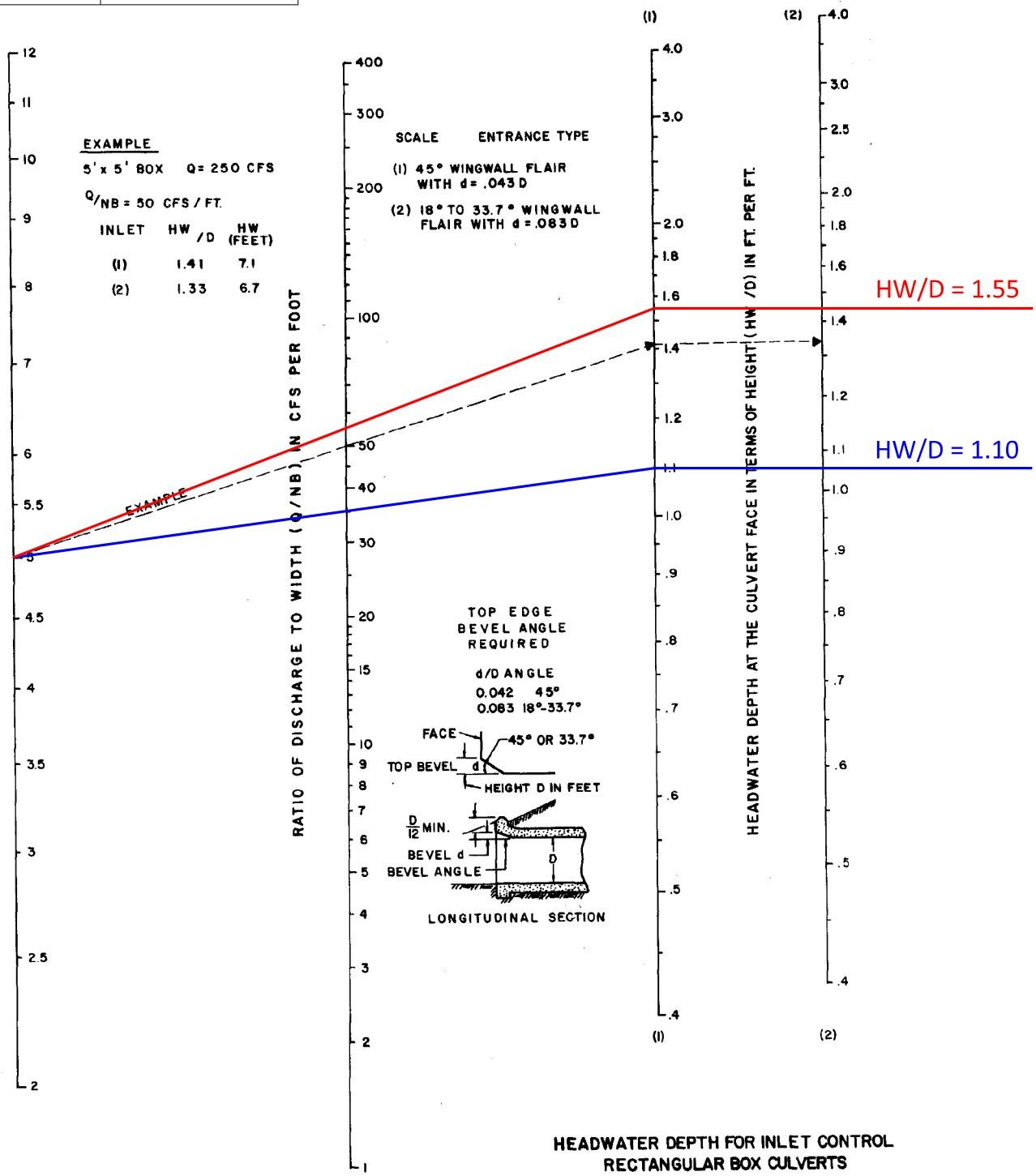

EXAMPLE
GIVEN :
HYDROLOGIC CONTOUR 5.0
DRAINAGE AREA 35 AC.
SMALL AREA FULL BUSINESS
ANSWER
Q10 = 39 x 1.4 = 54.6 C.F.S.
HYDROLOGIC CONTOUR
8
7
6
5
4
3
Q10 = 123 cfs x 1.25 = 153.8 cfs
EXAMPLE
CORRECTION FACTOR
1.5
1.0
0.5
CF = 1.25
SMALL AREA FULL BUSINESS
LARGE AREA FULL BUSINESS
AVERAGE DEVELOPMENT
RESIDENTIAL HIGH TYPE
CURVE CORRECTION FOR DEVELOPMENT
Q10 C.F.S.
2,000
1,000
800
600
400
200
100
80
60
40
20
10
8
6
4
2
1
0.5
DRAINAGE AREA ACRES
1000
600
400
200
100
50
40
30
20
10
5
1
FACTORS FOR FREQUENCIES
Q 5 CURVE VALUE x .75
Q10 " " x 1.0
Q25 " " x 1.35
Q50 " " x 1.85
Q100 " " x 2.15
RUNOFF FROM URBAN AREAS
NORTH CAROLINA STATE HIGHWAY COMMISSION
JAN, 1973
C 200.3

CHART C 200.3

SITE 18

25 Year	100 Year
1 @ 6' x 5' RCBC	1 @ 6' x 5' RCBC
Q = 210 CFS	Q = 330 CFS
Q/NB = 35 CFS/FT.	Q/NB = 55 CFS/FT.

CHART 9B



HEADWATER DEPTH FOR INLET CONTROL
RECTANGULAR BOX CULVERTS
FLARED WINGWALLS 18° TO 33.7° & 45°
WITH BEVELED EDGE AT TOP OF INLET

EXISTING

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/6/14

SITE NUMBER 18 STREAM UT TO FRENCH BROAD RIVER ROUTE FANNING BRIDGE RD./AIRPORT RD.

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 1@6'x5' RCBC. THE CULVERT MEETS AT A JUNCTION BOX AND TRANSITIONS TO A 66" RCP. THE RCBC AND THE RCP ARE BOTH IN GOOD CONDITION. SLOPE AT INLET.

UPSTREAM CHANNEL: TOP WIDTH 9 FT BOTTOM WIDTH 4 FT BANKFULL DEPTH 2 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.2 FT BED MATERIAL

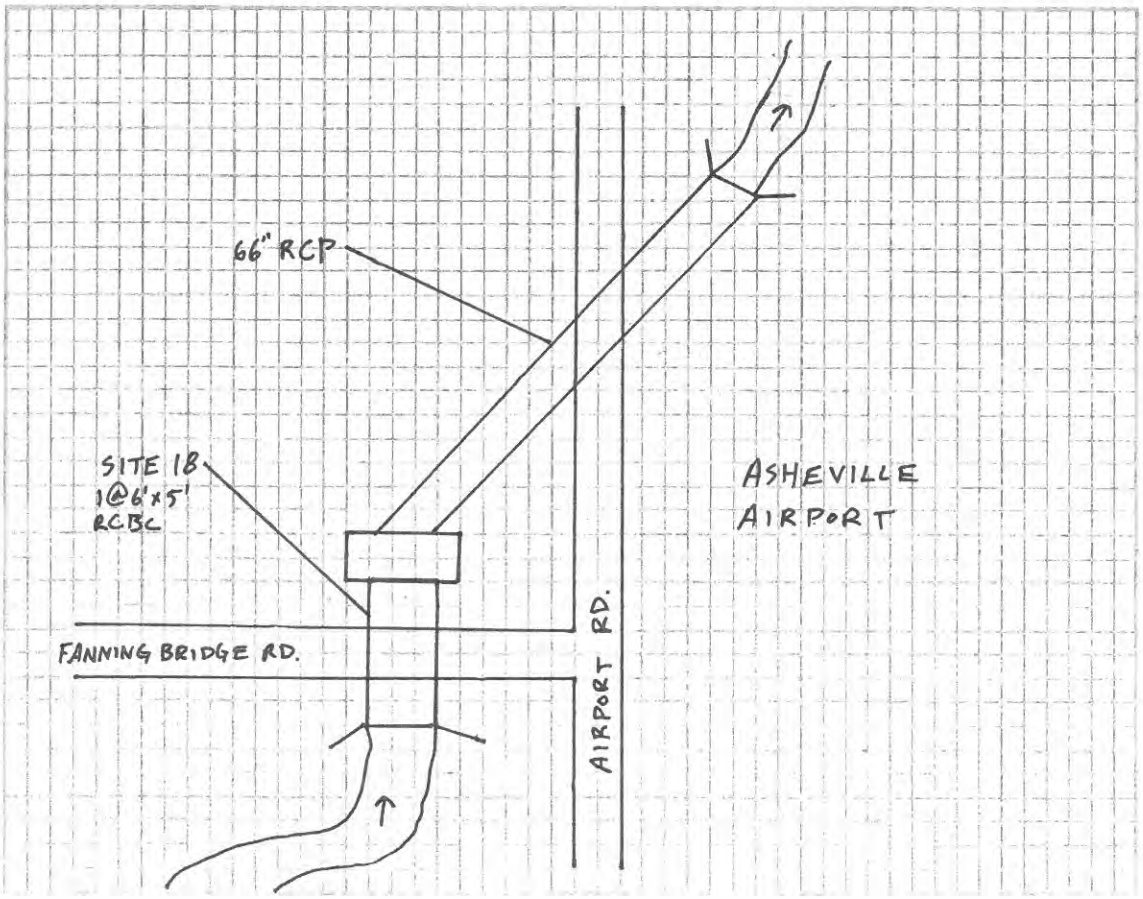
BANK/ CHANNEL CONDITIONS RIP RAP LINED CHANNEL. BANKS ARE STABLE AND VEGETATED

DOWNSTREAM CHANNEL: TOP WIDTH 10 FT BOTTOM WIDTH 4 FT BANKFULL DEPTH 2 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.3 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS MILD SILT AT OUTLET. RIP RAP LINED CHANNEL. BANKS ARE STABLE AND VEGETATED.

COMMENTS THE ASHEVILLE AIRPORT IS LOCATED ABOUT 100' RIGHT OF THE STRUCTURE.



Looking at Upstream Face of 1 @ 6' x 5' RCBC under Airport Rd.

Looking Upstream from 1 @ 6' x 5' RCBC Inlet

Pipe located Upstream of 1 @ 6' x 5' RCBC

Looking Downstream Inside 1 @ 6' x 5' RCBC

Looking Downstream Inside of 66" RCP

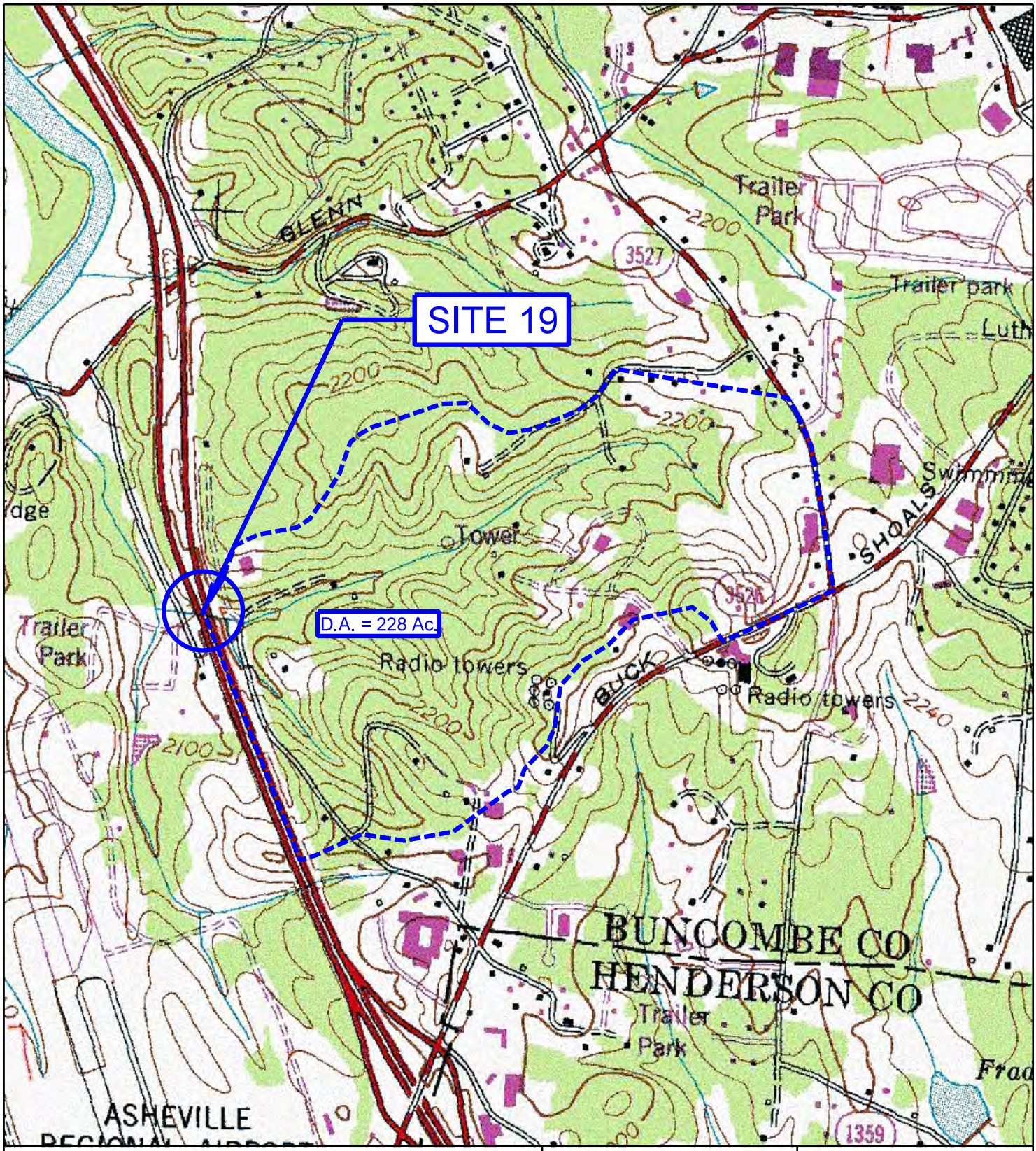
Looking at Downstream Face of 66" RCP with Headwall under Airport Rd.

Looking Downstream from 66" RCP

Looking Downstream 66" RCP

APPENDIX V

SITE 19



QUAD MAP - SITE 19

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 19

Stream Name: UT to French Broad River

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	0	0.0	0.000
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	0	0.0	0.000
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	99	54.5	0.239
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	8	5.8	0.025
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	121	102.9	0.450
Totals			**228**	**163.2**	**71.4%**

Drainage Area = 228 acres

Project: I-4400 / I-4700

Site #: 19

Stream Name: UT to French Broad River

Drainage Area (sq mi): 0.36

Impervious Area (%): 47.9%

The computed impervious area exceeds the applicable range for SIR 2014-5030 Equations of 47.9%, therefore 47.9% is used to compute site discharge values.

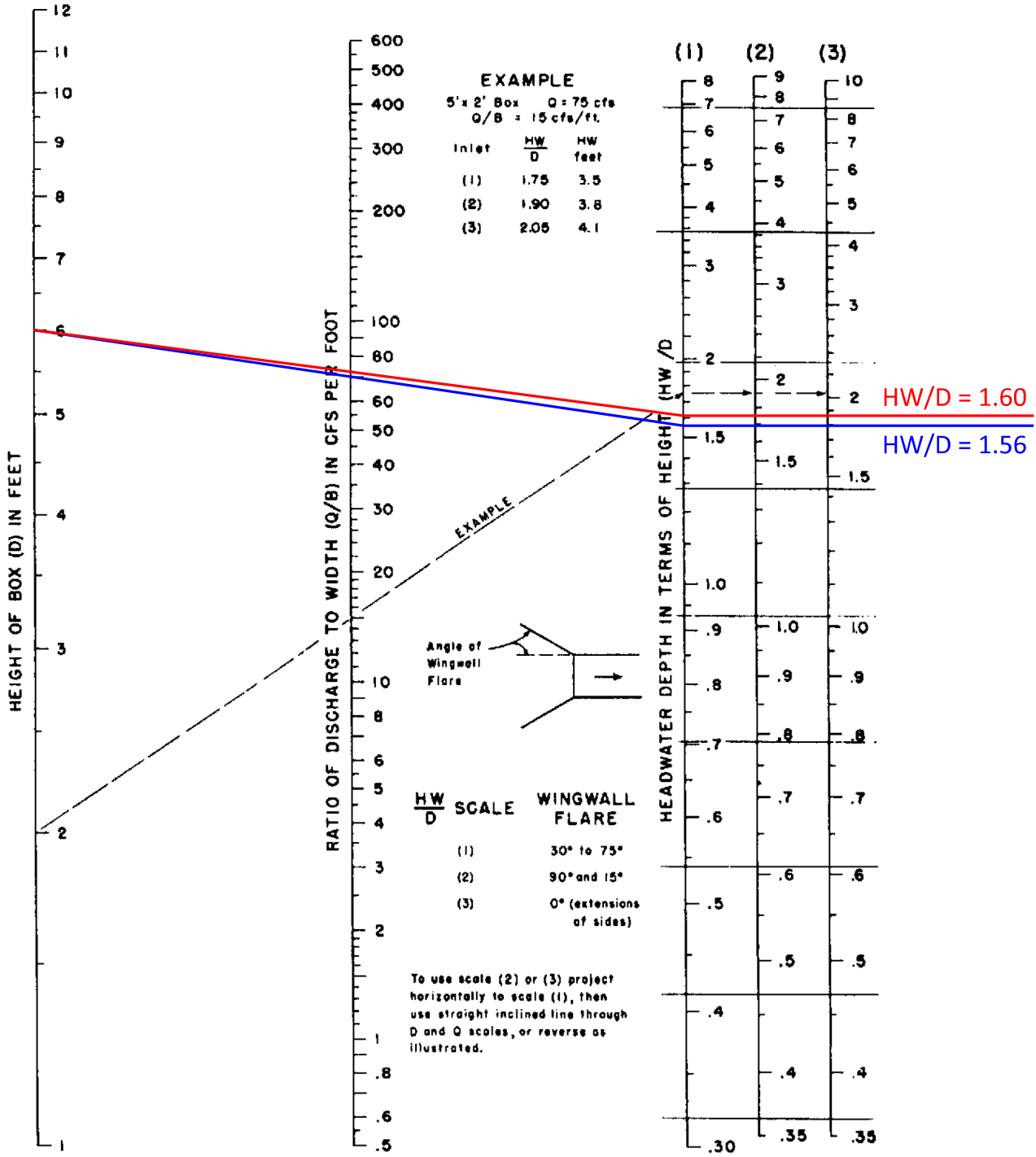
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	DISCHARGE (cfs)		
	PIEDMONT - RIDGE AND VALLEY	SAND HILLS	COASTAL PLAIN
2	340	-	-
5	384	-	-
10	405	-	-
25	418	-	-
50	421	-	-
100	429	-	-
200	430	-	-
500	451	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	DISCHARGE (cfs)
10	-
50	-
100	-
500	-

SITE 19

50 Year	100 Year
1 @ 6' x 6' RCBC	1 @ 6' x 6' RCBC
Q = 420 CFS	Q = 430 CFS
Q/NB = 70 CFS/FT.	Q/NB = 72 CFS/FT.

CHART 8B



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/4/14

SITE NUMBER 19 STREAM UT TO FRENCH BROAD RIVER ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 1@ 6' x 6' RCBC. MINOR CRACKING THROUGHOUT THE STRUCTURE.

UPSTREAM CHANNEL: TOP WIDTH 12 FT BOTTOM WIDTH 5 FT BANKFULL DEPTH 5 FT

DEPTH OF FLOW (AT TIME OF VISIT) 1 FT BED MATERIAL

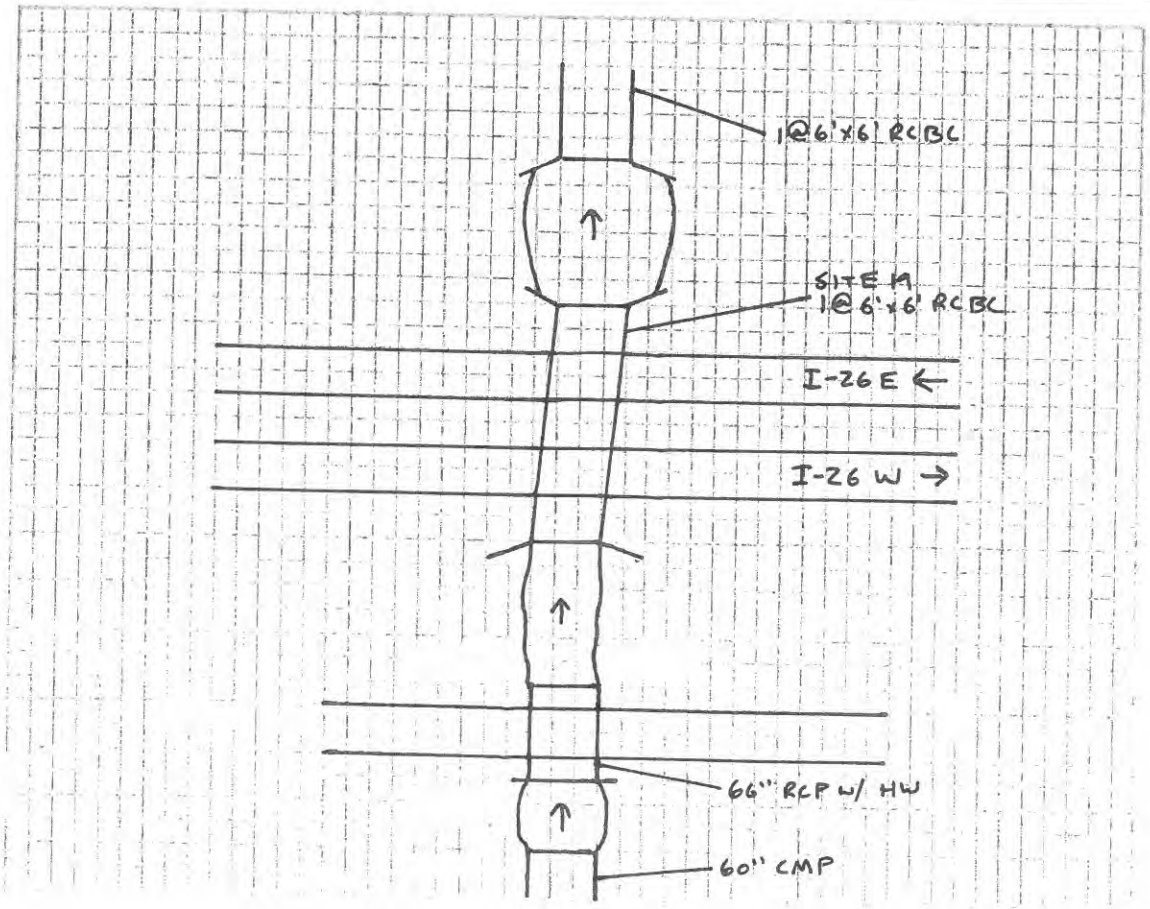
BANK/ CHANNEL CONDITIONS RIP RAP LINED CHANNEL FOR STABILITY. BANKS ARE VEGETATED

DOWNSTREAM CHANNEL: TOP WIDTH 16 FT BOTTOM WIDTH 4 FT BANKFULL DEPTH 4 FT

DEPTH OF FLOW (AT TIME OF VISIT) 2 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS RIP RAP AND GEOTEXTILE FABRIC FOR STABILITY. BANKS ARE VEGETATED. SCOUR HOLE.

COMMENTS 25' DOWNSTREAM OF THE STRUCTURE IS A 1@6'x6' RCBC. UPSTREAM OF THE STRUCTURE ARE A 66" RCP WITH A HEADWALL AND A 60" CMP.



Looking at Upstream Face of 1 @ 6' x 6' RCBC under I-26

Looking Upstream from 1 @ 6' x 6' RCBC Inlet

Looking Downstream Inside of 1 @ 6' x 6' RCBC

Looking Upstream of 1 @ 6' x 6' RCBC

Looking at Downstream Face of 1 @ 6' x 6' RCBC under I-26

Looking at Downstream Face of 1 @ 6' x 6' RCBC under I-26

Looking at Upstream Face of 1 @ 6' x 6' RCBC under Hidden Creek Rd

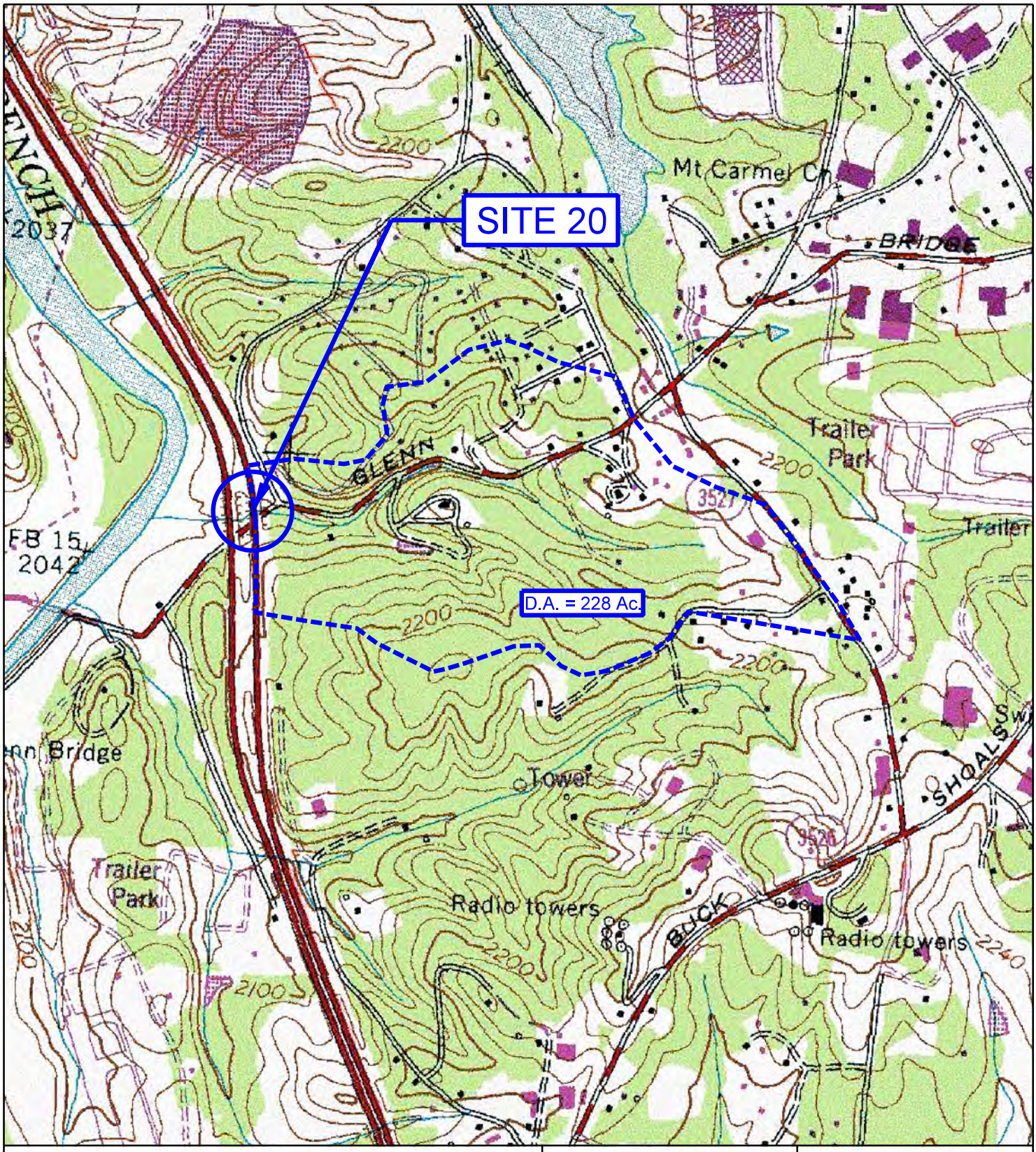
Looking at Downstream Face of 1 @ 6' x 6' RCBC under Hidden Creek Rd

Looking Downstream from Hidden Creek Rd

Home Downstream of Hidden Creek Rd

APPENDIX W

SITE 20



QUAD MAP - SITE 20

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 20

Stream Name: French Broad River Tributary 149

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	106	10.6	0.069
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	0	0.0	0.000
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	45	24.9	0.161
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	1	1.0	0.006
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	1	1.2	0.008
Totals			**154**	**37.7**	**24.4%**

Drainage Area = 154 acres

Project: I-4400 / I-4700

Site #: 20

Stream Name: French Broad River Tributary 149

Drainage Area (sq mi): 0.24

Impervious Area (%): 24.4%

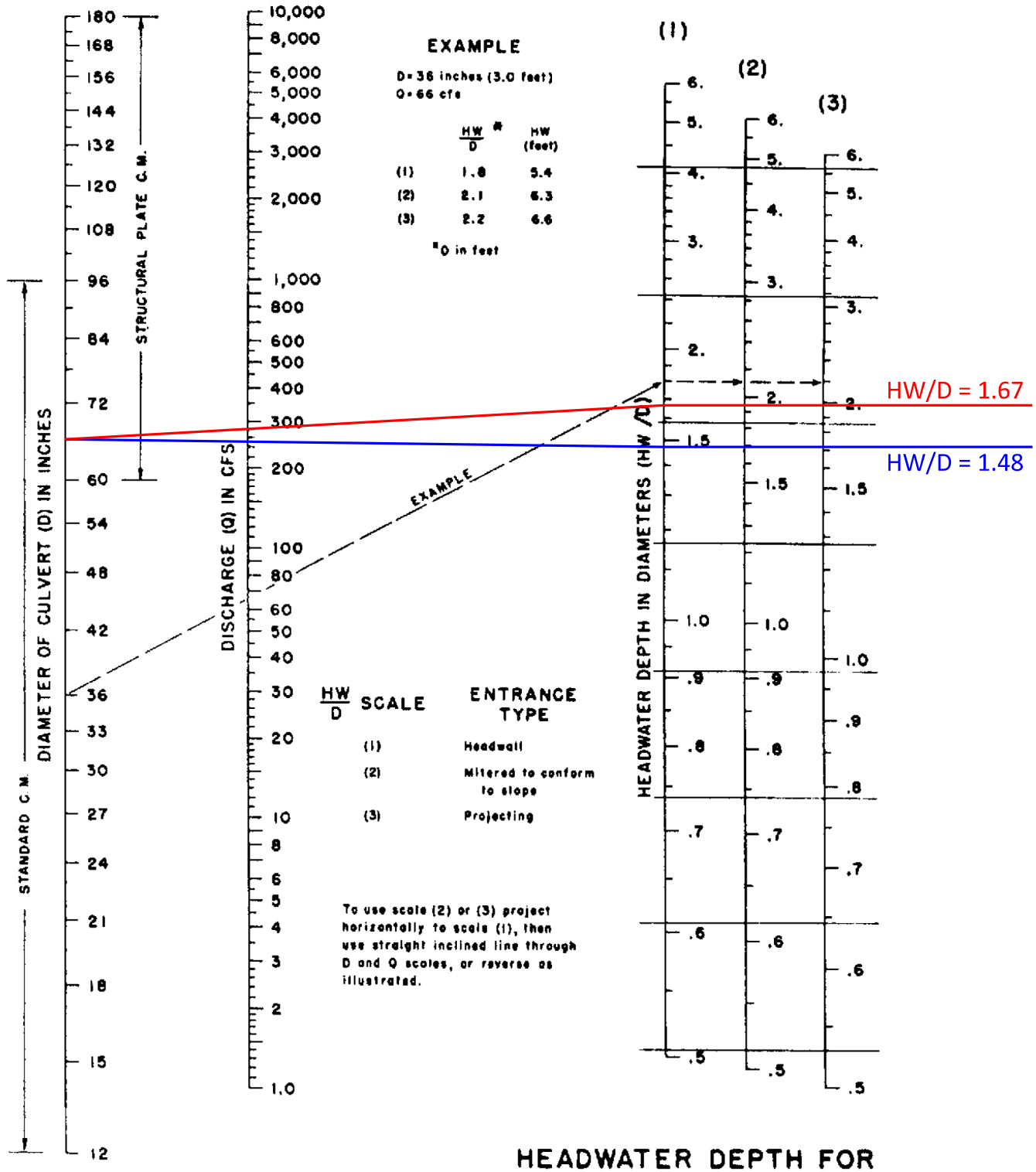
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	126	-	-
5	171	-	-
10	200	-	-
25	232	-	-
50	253	-	-
100	275	-	-
200	294	-	-
500	327	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	-
50	-
100	490
500	-

SITE 20

50 Year	100 Year
1 @ 66" CMP W/ HW	1 @ 66" CMP W/ HW
Q = 250 CFS	Q = 280 CFS

CHART 2B



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 750 1,500 Feet

0 100 200 400 Meters

FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

BUNCOMBE COUNTY, NC
and Incorporated Areas

PANEL 9644

FEMA

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
ASHEVILLE, CITY OF	370032	9644	J
BUNCOMBE COUNTY	370031	9644	J

Site 20

MAP NUMBER
3700964400J

EFFECTIVE DATE
1/6/2010

Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 750 1,500 Feet

0 100 200 400 Meters

FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

BUNCOMBE COUNTY, NC
and Incorporated Areas

PANEL 9643

FEMA

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
ASHEVILLE, CITY OF	370032	9643	K
BUNCOMBE COUNTY	370031	9643	K
FLETCHER, TOWN OF	370568	9643	K
HENDERSON COUNTY	370125	9643	K
MILLS RIVER, TOWN OF	370025	9643	K

Site 20

MAP NUMBER
3700964300K

EFFECTIVE DATE
1/6/2010

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

A Report of Flood Hazards in

BUNCOMBE COUNTY, NORTH CAROLINA AND INCORPORATED AREAS

Community Name	Community Number
BUNCOMBE COUNTY	370031
CITY OF ASHEVILLE	370032
TOWN OF BILTMORE FOREST	370475
TOWN OF BLACK MOUNTAIN	370033
TOWN OF MONTREAT	370476
TOWN OF WEAVERVILLE	370269
TOWN OF WOODFIN	370380

NORTH CAROLINA
Cooperating Technical State
FEMA'S COOPERATING TECHNICAL PARTNER

EFFECTIVE: 1/6/2010
REVISED: 4/3/2012
Federal Emergency Management Agency
State of North Carolina
Flood Insurance Study Number
37021CV000
www.fema.gov and www.ncfloodmaps.com

Table 9 - Flooding Sources Studied by Detailed Methods: Redelineated

Source	Riverine Sources		Affected Communties
	From	To	
Reems Creek	Approximately 1.1 miles downstream of New Stock Road (SR 1882)	Just upstream of Twin Hills Drive	Buncombe County Town Of Weaverville
Robinson Creek	Approximately 250 feet upstream of the confluence with Cane Creek	Approximately 3,790 feet downstream of Mills gap Road (SR 3118)	Buncombe County
Sweeten Creek Tributary 3	The confluence with Sweeten Creek	Just downstream of Taft Street	City Of Asheville
Tomahawk Branch	The confluence with Swannanoa River	Approximately 200 feet upstream of Cragmont Road	Town Of Black Mountain
Tributary to Camp Branch	The confluence with Camp Branch	Approximately 200 feet upstream of the confluence with Camp Branch	Town Of Black Mountain

Table 10, “Flooding Sources Studied by Detailed Methods: Limited Detailed”, lists all flooding sources within the county that were studied by limited detailed methods for either this FIS or previous FISs.

Table 10 - Flooding Sources Studied by Detailed Methods: Limited Detailed

Source	Riverine Sources		Affected Communties
	From	To	
Avery Creek	The confluence with French Broad River	Approximately 0.7 mile upstream of NC Highway 191	Buncombe County
Beaverdam Creek (into French Broad River) Tributary 1	Approximately 500 feet downstream of US Highway 19	Approximately 400 feet upstream of Baird Cove Road (SR 2088)	Buncombe County Town Of Woodfin
Beaverdam Creek (into South Hominy Creek)	The confluence with South Hominy Creek	Approximately 0.5 mile upstream of the confluence of Beaverdam Creek (into South Hominy Creek) Tributary	Buncombe County
Beaverdam Creek (into South Hominy Creek) Tributary	The confluence with Beaverdam Creek (into South Hominy Creek)	Approximately 0.6 mile upstream of the confluence with Beaverdam Creek (into South Hominy Creek)	Buncombe County
Bee Branch	The confluence with Willow Creek	Approximately 1,200 feet upstream of Bee Branch Road	Buncombe County
Beetree Creek	Approximately 350 feet upstream of Summer Haven Road (SR 2427)	Approximately 0.9 mile upstream of Beetree Road (SR 2428)	Buncombe County
Bent Creek	The confluence with French Broad River	The confluence with Wesley Creek	Buncombe County City Of Asheville
Bill Moore Creek	The confluence with Hominy Creek	Approximately 100 feet upstream of Reeves Cove Road (SR 3439)	Buncombe County City Of Asheville
Broad River	The Buncombe/Henderson County boundary	Approximately 1,600 feet upstream of NC Highway 9	Buncombe County
Brush Creek	The confluence with Cane Creek	Approximately 300 feet upstream of Doston Cove Road	Buncombe County
Camp Branch	NC Highway 9	Approximately 700 feet upstream of Camp Branch Road	Town Of Black Mountain
Cane Creek	Approximately 600 feet upstream of Cross Creek Farm Road	Approximately 1,600 upstream of the confluence of Garren Creek	Buncombe County
Cane Creek (into Hominy Creek)	The confluence with Hominy Creek	Approximately 1,600 feet upstream of Sand Hill Road	City Of Asheville
Curtis Creek	The confluence with South Hominy Creek	At Old Curtis Cove Road	Buncombe County
Dick Branch	The confluence with Flat Creek (into French Broad River)	Approximately 300 feet upstream of Flat Creek Church Road (SR 1764)	Buncombe County
Dillingham Creek	Just downstream of Dillingham Road (SR 2173)	Approximately 1,100 feet upstream of Northside Drive	Buncombe County
Dingle Creek	The confluence with French Broad River	Approximately 1,800 feet upstream of Ballantree Drive	Buncombe County City Of Asheville
Dix Creek	The confluence with Newfound Creek	Approximately 900 feet upstream of Old Leicester Hwy (SR 1002)	Buncombe County
Eller Cove	The confluence with Reems Creek	Just upstream of Eller Hollow Road	Town Of Weaverville
Emma Branch	The confluence with Smith Mill Creek	Approximately 0.8 mile upstream of Eliada Home Road	Buncombe County City Of Asheville
Emma Branch Tributary 2	The confluence with Emma Branch	Approximately 0.5 mile upstream of Brickyard Road	City Of Asheville
Flat Creek	The confluence with the Broad River	Approximately 1.1 miles upstream of the confluence with the Broad River	Buncombe County
Flat Creek (into French Broad River)	The confluence with the French Broad River	Approximately 0.5 mile upstream of Chambers Road	Buncombe County Town Of Weaverville
Flat Creek (into Swannanoa River) Tributary 1	The confluence with Flat Creek (into Swannanoa River)	Approximately 800 feet upstream of NC 9	Town Of Black Mountain
Fourmile Branch	The confluence with French Broad River	Just downstream of US Highway 25	Buncombe County City Of Asheville Town Of Biltmore Forest
French Broad River Tributary 149	The confluence with French Broad River	Approximately 2,000 feet upstream of River Glen Drive	Buncombe County

Table 13 - Summary of Discharges

Flooding Source		Discharges (cfs)			
Location	Drainage Area (square miles)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Eller Cove					
At the confluence with Reems Creek	2.00	*	*	1,150	*
Emma Branch					
At the confluence with Smith Mill Creek	1.67	*	*	1,030	*
Approximately 1,000 feet upstream of Hazel Mill Road	0.52	*	*	500	*
Emma Branch Tributary 2					
At the confluence with Emma Branch	0.31	*	*	360	*
Flat Creek					
At the confluence with Broad River	10.45	*	*	3,750	*
Approximately 0.9 mile upstream of the confluence with Broad River	9.99	*	*	3,640	*
Flat Creek (into French Broad River)					
At the confluence with French Broad River	24.71	*	*	5,530	*
Approximately 1.6 miles downstream of US Highway 25/70	19.64	*	*	4,790	*
Approximately 0.4 mile upstream of the confluence of Dick Branch	12.28	*	*	2,960	*
Approximately 300 feet downstream of I-26	7.05	*	*	2,520	*
Approximately 1,100 feet upstream of Chambers Road	4.34	*	*	1,860	*
Flat Creek (into Swannanoa River)					
At the confluence with Swannanoa River	6.03	*	*	3,570	*
At the confluence of Flat Creek (into Swannanoa River) Tributary 1	5.50	*	*	3,370	*
Just upstream of Padgettown Road	5.24	*	*	3,270	*
Just upstream of Flat Creek Road	4.74	*	*	3,070	*
Just upstream of Shenandoah Terrace	4.32	*	*	2,910	*
Approximately 300 feet downstream of the confluence of Little Piney Branch	3.75	*	*	2,660	*
At the confluence of Puncheon Branch	2.83	*	*	1,650	*
Flat Creek (into Swannanoa River) Tributary 1					
At the confluence with Flat Creek (into Swannanoa River)	0.36	*	*	520	*
Fourmile Branch					
At the confluence with French Broad River	3.37	*	*	1,590	*
Approximately 300 feet downstream of Brooklawn Chase	1.06	*	*	770	*
French Broad River					
Approximately 0.6 mile downstream of Fletcher Martin Road (SR 1620)	1052.00	*	*	67,000	*
Upstream of Craggy Dam	966.00	*	*	63,600	*
Approximately 600 feet upstream of Craggy Dam	954.00	*	*	63,200	*[2]
At Pearson Bridge Road	945.00	*	*	63,000	*
Approximately 500 feet upstream of Amboy Road	801.00	*	*	56,200	*
Approximately 2.4 miles downstream of the confluence of Fourmile Branch	695.00	*	*	51,000	*
Approximately 0.4 mile downstream of the confluence of Bent Creek	676.00	*	*	50,000	*
At the confluence of Cane Creek	633.00	*	*	48,500	*
French Broad River Tributary 149					
At the confluence with French Broad River	0.30	*	*	490	*
Gap Creek					
At the confluence with Cane Creek	7.83	*	*	2,700	*
Approximately 800 feet upstream of Gap Creek Road (SR 3129)	3.58	*	*	1,650	*
Approximately 100 feet upstream of Roseanne Lane (SR 2888)	1.42	*	*	930	*

surveyed approximately every 4000 feet along the detail study reaches to obtain the channel geometry between bridges and culverts. Overbank cross section data for the backwater analyses were obtained from recently flown LIDAR data.

Channel roughness factors (Manning's "n") used in the hydraulic computations were made in the field by an engineer where stream access was possible, with orthophotos used to supplement areas that could not be accessed. The channel and overbank "n" values for all of the streams studied by detailed methods are shown in Table 16, "Roughness Coefficients".

Table 16 - Roughness Coefficients

Stream	Channel "n"	Overbank "n"
Avery Creek	0.050 to 0.090	0.030 to 0.090
Beaverdam Creek (into French Broad River)	0.035 to 0.065	0.030 to 0.150
Beaverdam Creek (into French Broad River) Tributary 1	0.025 to 0.065	0.030 to 0.150
Beaverdam Creek (into South Hominy Creek)	0.030 to 0.090	0.030 to 0.100
Beaverdam Creek (into South Hominy Creek) Tributary	0.045 to 0.050	0.055 to 0.085
Bee Branch	0.040 to 0.050	0.050 to 0.100
Beetree Creek	0.035 to 0.060	0.025 to 0.200
Bent Creek	0.042 to 0.052	0.030 to 0.100
Bill Moore Creek	0.030 to 0.090	0.030 to 0.200
Broad River	0.040 to 0.100	0.050 to 0.100
Brush Creek	0.035 to 0.090	0.030 to 0.090
Bull Creek	0.045 to 0.060	0.013 to 0.150
Camp Branch	0.045 to 0.050	0.030 to 0.140
Cane Creek	0.040 to 0.050	0.025 to 0.250
Cane Creek (into Hominy Creek)	0.050	0.050 to 0.090
Curtis Creek	0.048 to 0.090	0.030 to 0.090
Dick Branch	0.050	0.050 to 0.090
Dillingham Creek	0.040 to 0.060	0.030 to 0.150
Dingle Creek	0.035 to 0.090	0.030 to 0.090
Dix Creek	0.050	0.030 to 0.090
Eller Cove	0.035 to 0.055	0.040 to 0.090
Emma Branch	0.035 to 0.050	0.030 to 0.090
Emma Branch Tributary 2	0.050 to 0.059	0.045 to 0.090
Flat Creek	0.040 to 0.060	0.050 to 0.100
Flat Creek (into French Broad River)	0.040 to 0.055	0.030 to 0.150
Flat Creek (into Swannanoa River)	0.035 to 0.090	0.035 to 0.090
Flat Creek (into Swannanoa River) Tributary 1	0.050	0.050 to 0.090
Fourmile Branch	0.030 to 0.090	0.030 to 0.100
French Broad River	0.024 to 0.064	0.030 to 0.200
French Broad River Tributary 149	0.040 to 0.090	0.030 to 0.090
Gap Creek	0.045 to 0.050	0.030 to 0.090
Garren Creek	0.045 to 0.050	0.030 to 0.090
Gashes Creek	0.018 to 0.060	0.025 to 0.200
George Branch	0.050 to 0.090	0.030 to 0.090
Gill Branch	0.050	0.150
Glady Fork	0.050	0.050 to 0.090
Gouches Branch	0.045	0.012 to 0.085
Grassy Branch	0.040 to 0.055	0.035 to 0.090
Gregg Branch	0.045 to 0.050	0.090
Haw Creek	0.020 to 0.060	0.040 to 0.120
Herron Cove Branch	0.050	0.050 to 0.090
Hogeye Branch	0.040 to 0.050	0.050 to 0.090
Hominy Creek	0.035 to 0.060	0.020 to 0.150
Hominy Creek Tributary 21	0.040	0.070
Hominy Creek Tributary 25	0.050	0.070
Indian Camp Branch	-8888.000	-8888.000
Ivy Creek	0.040 to 0.060	0.025 to 0.160
Killian Branch	0.040 to 0.060	0.050 to 0.090
Lee Creek	0.040 to 0.055	0.030 to 0.015
Little Ivy Creek	0.040 to 0.100	0.030 to 0.100
Little Piney Branch	0.050	0.035 to 0.090
Little Sandymush Creek	0.045 to 0.060	0.030 to 0.900
Long Branch (into Beetree Creek)	0.050	0.050 to 0.090

FIELD REVIEW FORM

COUNTY HENDERSON PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/4/14

SITE NUMBER 20 STREAM FRENCH BROAD RIVER TRIB 149 ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: TWO 66" STRUCTURAL PLATE PIPES. ONE UNDER EACH LANE OF I-26. BOTH HAVE HEADWALLS. BOTH ARE IN POOR CONDITION. THE INVERTS OF BOTH ARE RUSTED THROUGH. RUST THROUGHOUT BOTH PIPES. MINOR SILT IN THE ONE UNDER I-26 W.

UPSTREAM CHANNEL: TOP WIDTH 25 FT BOTTOM WIDTH 8 FT BANKFULL DEPTH 7 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL

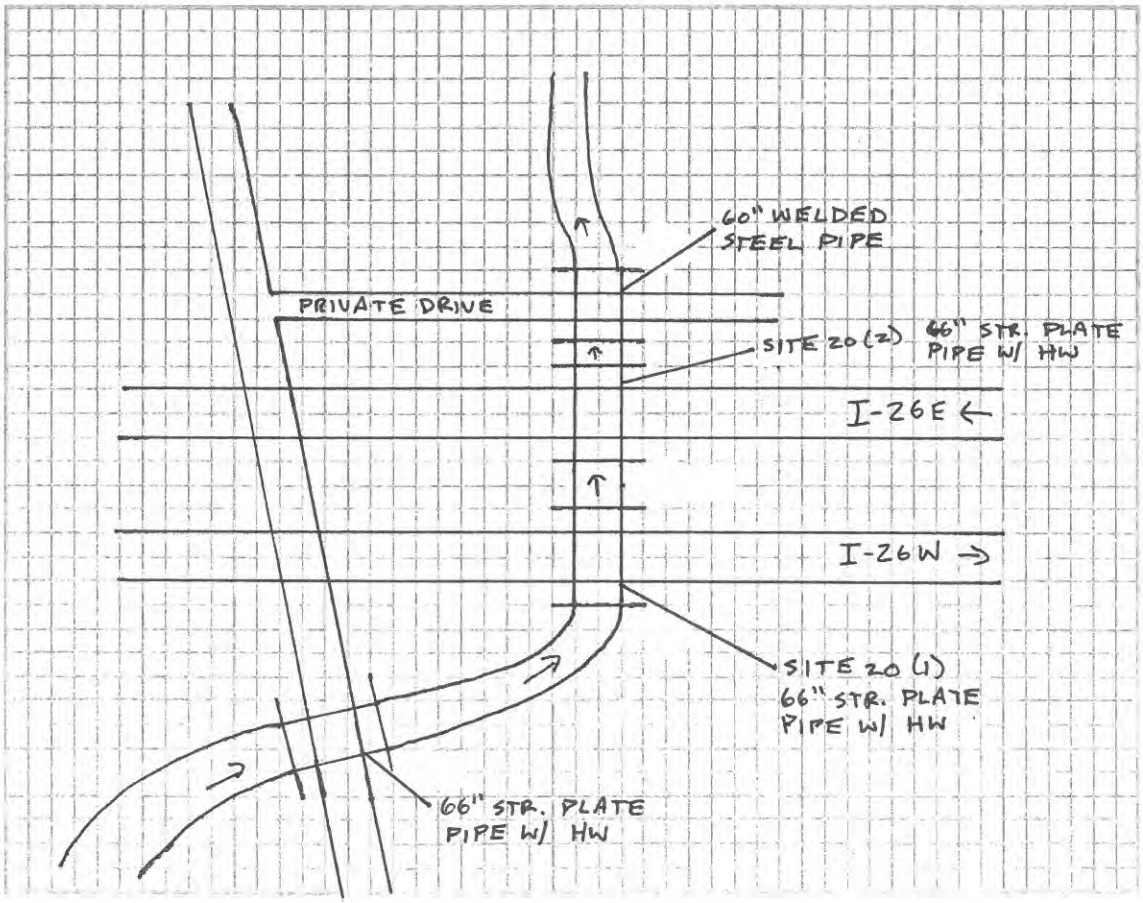
BANK/ CHANNEL CONDITIONS BANKS ARE STEEP. BANKS ARE STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 12 FT BOTTOM WIDTH 5 FT BANKFULL DEPTH 4 FT

DEPTH OF FLOW (AT TIME OF VISIT) VARIES FT BED MATERIAL

BANK/ CHANNEL CONDITIONS BANKS ARE STABLE AND VEGETATED.

COMMENTS 66" STR. PLATE PIPE UPSTREAM. 60" WELDED STEEL PIPE DOWNSTREAM. IN BETWEEN THE TWO PIPES THE TOP WIDTH IS 17', THE BOTTOM WIDTH IS 5'. THE BANKFULL DEPTH IS 3' AND THE DEPTH OF FLOW WAS 0.3'.



Looking at Upstream Face of 66" SPP with Headwall under I-26 W

Looking Downstream in 66" SPP

Bottom of Pipe under I-26 W

Looking at Downstream Face of 66" SPP with Headwall under I-26 W

Looking at Upstream Face of 66" SPP with Headwall under I-26 E

Looking Downstream in 66" SPP under I-26 E

Bottom of Pipe under I-26 E

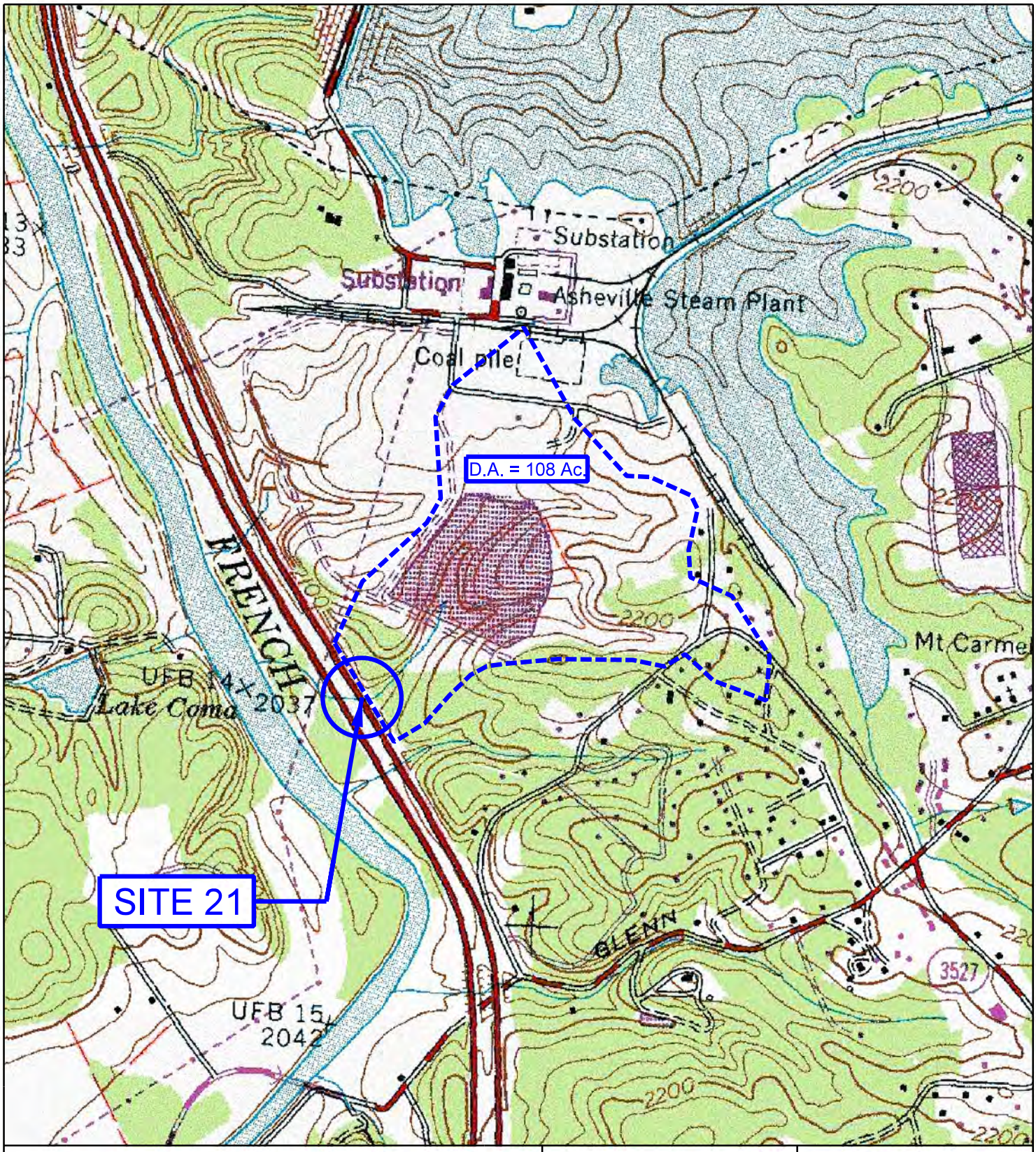
Looking at Downstream Face of 66" SPP with Headwall under I-26 E

Looking at Downstream Face of 60" WSP under Private Drive

Looking Downstream from Private Drive

APPENDIX X

SITE 21



QUAD MAP - SITE 21

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 21

Stream Name: UT to French Broad River

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	20	2.0	0.019
Coal Ash/Power Plant	-	10%	88	8.8	0.081
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	0	0.0	0.000
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	0	0.0	0.000
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	0	0.0	0.000
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	0	0.0	0.000
Totals			**108**	**10.8**	**10.0%**

Drainage Area = 108 acres

Project: I-4400 / I-4700

Site #: 21

Stream Name: UT to French Broad River

Drainage Area (sq mi): 0.17

Impervious Area (%): 10.0%

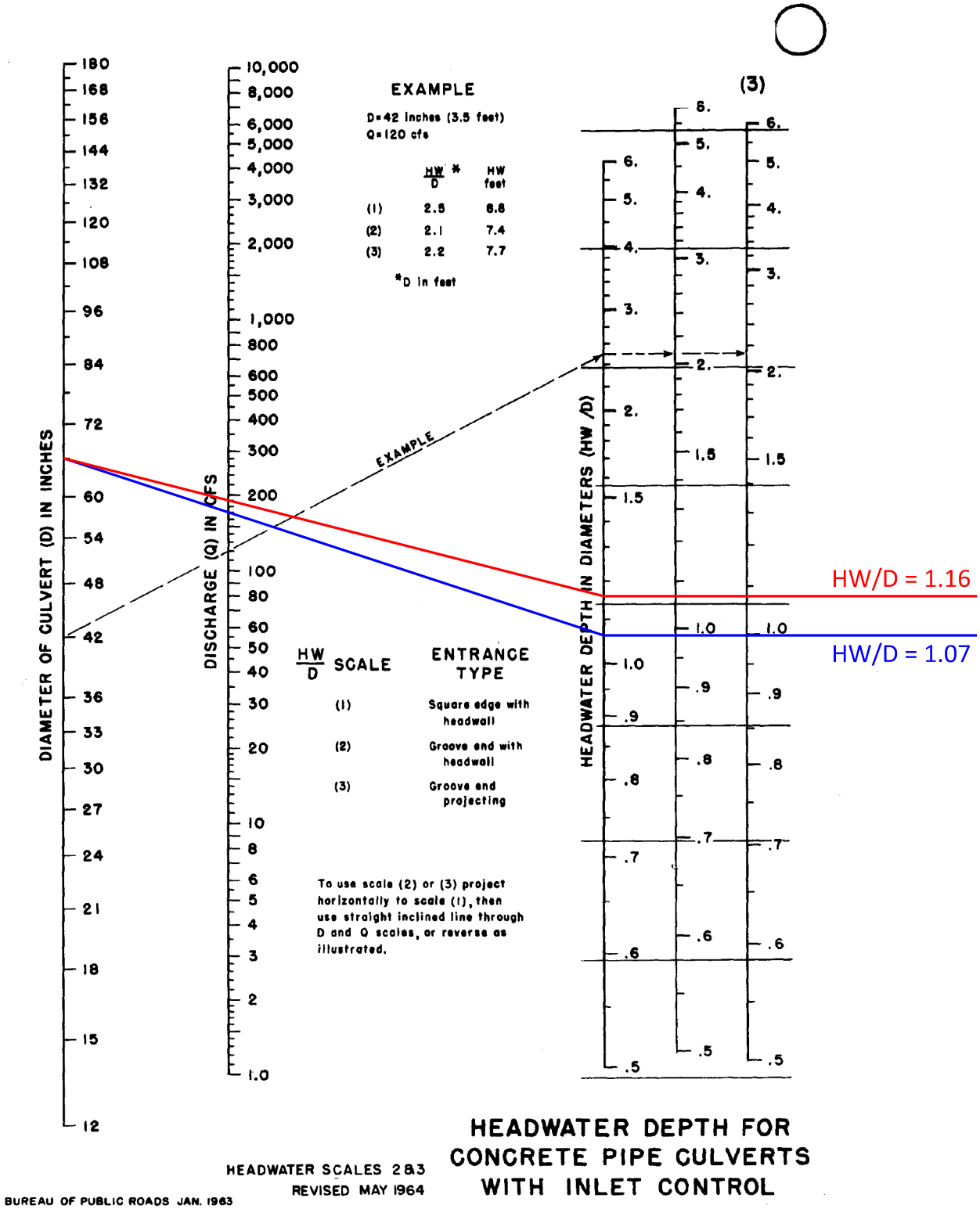
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	63	-	-
5	96	-	-
10	119	-	-
25	148	-	-
50	169	-	-
100	191	-	-
200	212	-	-
500	245	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	-
50	-
100	-
500	-

SITE 21

50 Year	100 Year
1 @ 66" RCP W/ HW	1 @ 66" RCP W/ HW
Q = 170 CFS	Q = 190 CFS

CHART 1B



EXISTING

FIELD REVIEW FORM

COUNTY BUNCOMBE PROJECT NUMBER I-4400/I-4700 DATE OF VISIT _____

SITE NUMBER 21 STREAM UT TO FRENCH BROAD RIVER ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE _____

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 66" RCP WITH HEADWALL. GOOD CONDITION.

UPSTREAM CHANNEL: TOP WIDTH 3.5 FT BOTTOM WIDTH 3.5 FT BANKFULL DEPTH 2 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.8 FT BED MATERIAL _____

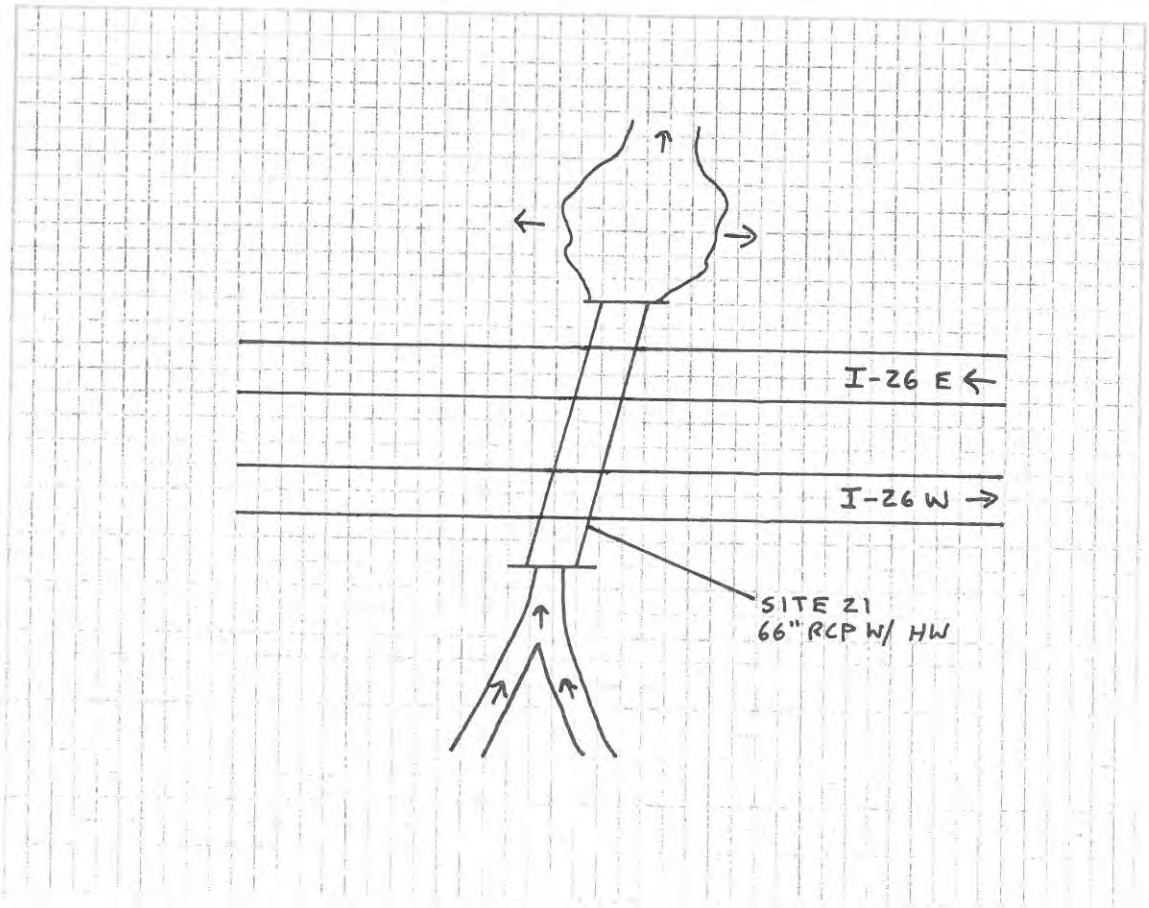
BANK/ CHANNEL CONDITIONS BANKS ARE STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 20 FT BOTTOM WIDTH 20 FT BANKFULL DEPTH 3 FT

DEPTH OF FLOW (AT TIME OF VISIT) 2 FT BED MATERIAL _____

BANK/ CHANNEL CONDITIONS NO DEFINED DOWNSTREAM CHANNEL. WATER HAS POOLED AT THE OUTLET. BANKS ARE VEGETATED.

COMMENTS _____



Looking at Upstream Face of 66" RCP with Headwall under I-26

Looking Upstream of 66" RCP

Looking Downstream Inside 66" RCP

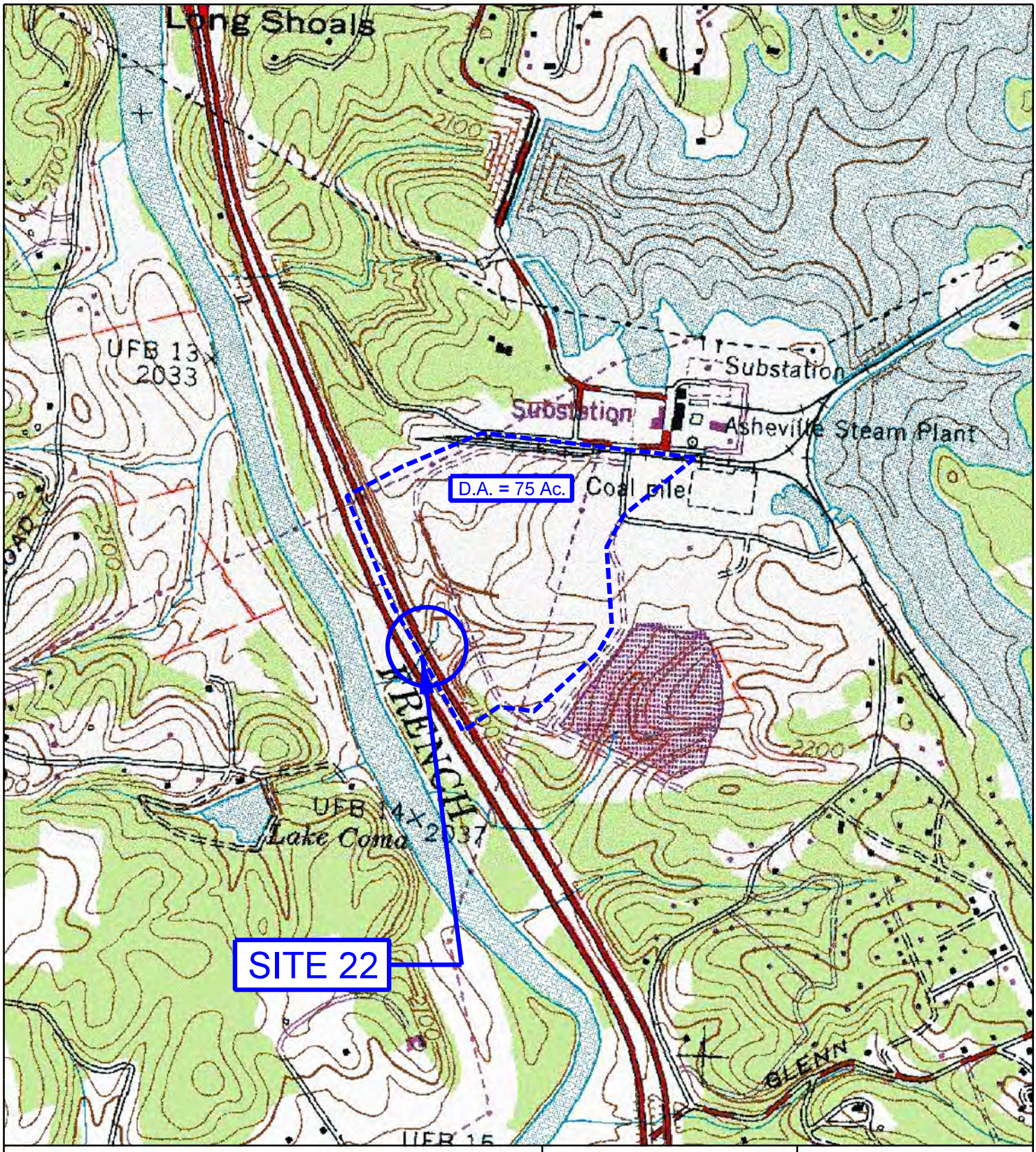
Looking at Downstream Face of 66" RCP with Headwall under I-26

Looking Downstream of 66" RCP

Looking Upstream Inside 66" RCP

APPENDIX Y

SITE 22



QUAD MAP - SITE 22

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 22

Stream Name: UT to French Broad River

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	0	0.0	0.000
Power Plant	-	10%	75	7.5	0.100
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	0	0.0	0.000
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	0	0.0	0.000
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	0	0.0	0.000
Business	-	85%	0	0.0	0.000
Commercial / Shopping Center	-	85%	0	0.0	0.000
Totals			**75**	**7.5**	**10.0%**

Drainage Area = **75** **acres**

Project: I-4400 / I-4700

Site #: 22

Stream Name: UT to French Broad River

Drainage Area (sq mi): 0.12

Impervious Area (%): 10.0%

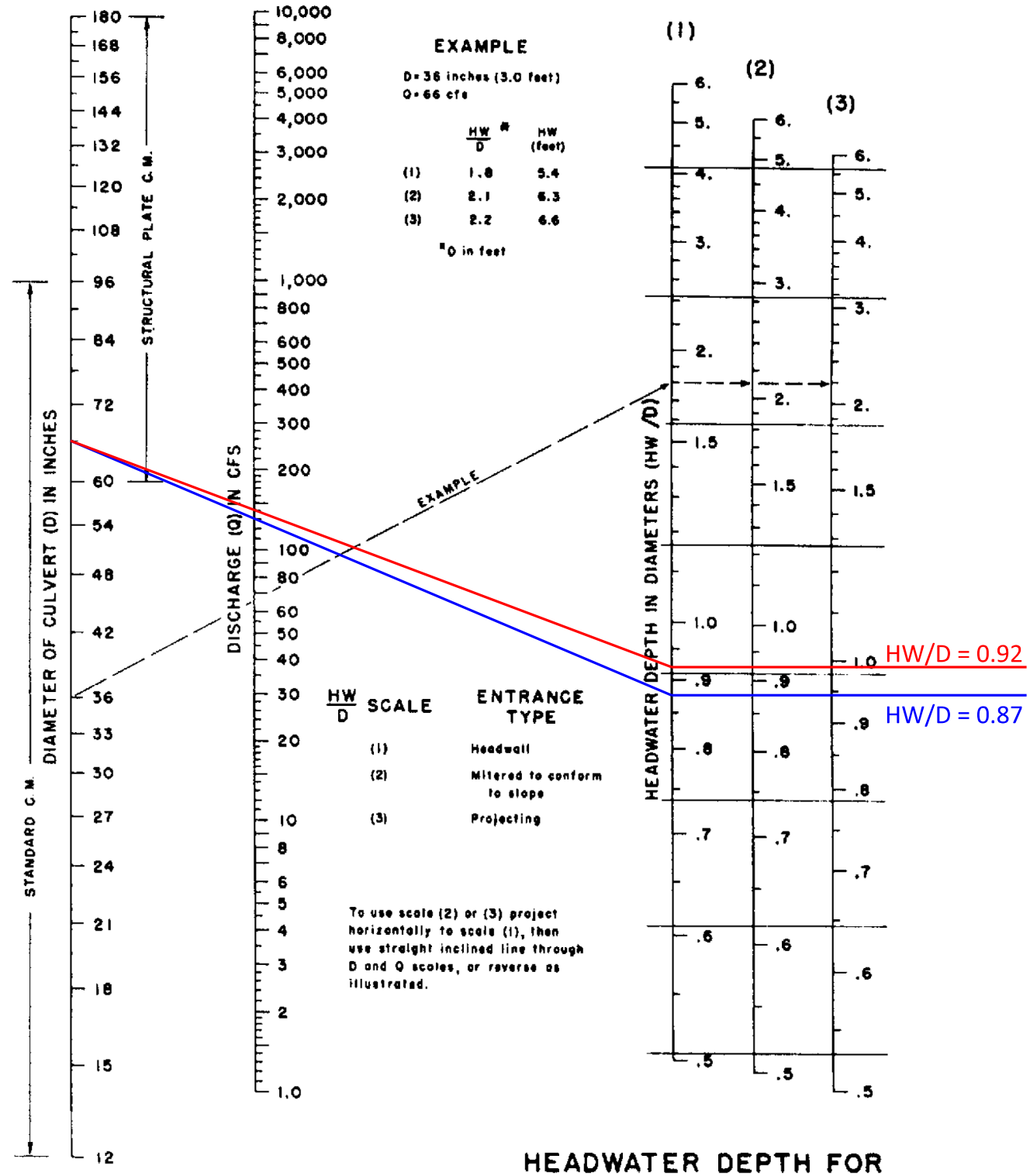
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	DISCHARGE (cfs)		
	PIEDMONT - RIDGE AND VALLEY	SAND HILLS	COASTAL PLAIN
2	48	-	-
5	73	-	-
10	90	-	-
25	111	-	-
50	126	-	-
100	142	-	-
200	157	-	-
500	181	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	DISCHARGE (cfs)
10	-
50	-
100	-
500	-

SITE 22

50 Year	100 Year
1 @ 66" CMP W/ HW	1 @ 66" CMP W/ HW
Q = 130 CFS	Q = 140 CFS

CHART 2B



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY BUNCOMBE PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/6/14

SITE NUMBER 22 STREAM UT TO FRENCH BROAD RIVER ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 66" STRUCTURAL PLATE PIPE WITH A HEADWALL. POOR CONDITION. BOTH INVERTS ARE RUSTED THROUGH.

UPSTREAM CHANNEL: TOP WIDTH 20 FT BOTTOM WIDTH 3 FT BANKFULL DEPTH 3 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL

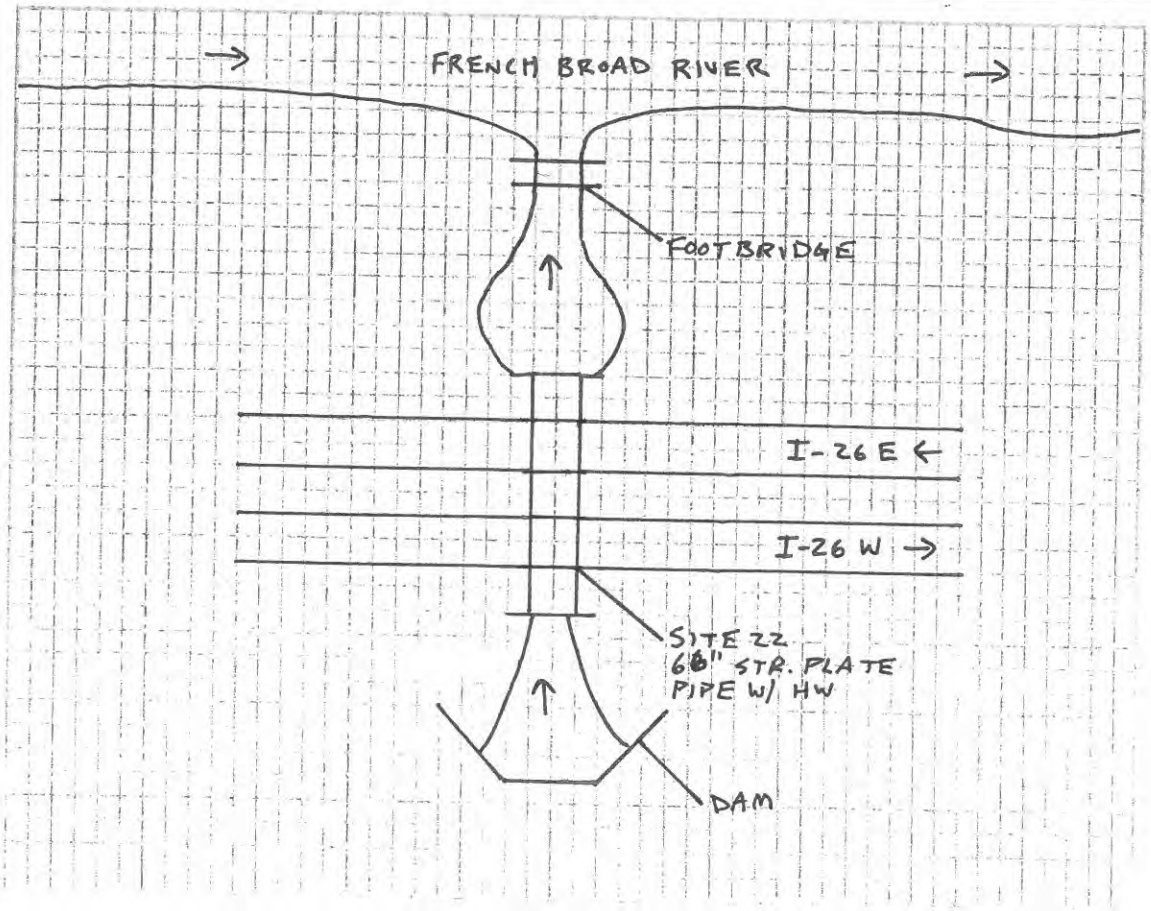
BANK/ CHANNEL CONDITIONS BANKS ARE STABLE AND VEGETATED. THE BANKS AND CHANNEL ARE BLACK DUE TO THE DUKE POWER PLANT.

DOWNSTREAM CHANNEL: TOP WIDTH 15 FT BOTTOM WIDTH 4 FT BANKFULL DEPTH ___ FT

DEPTH OF FLOW (AT TIME OF VISIT) 1 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS DOWNSTREAM INVERT IS PERCHED 5'. BANKS ARE STEEP AND ERODED. BANK ARE VEGETATED.

COMMENTS A DUKE POWER PLANT DAM IS LOCATED UPSTREAM OF THE STRUCTURE.



Looking at Upstream Face of 66" SPP with Headwall under I-26

Looking Upstream from 66" SPP

Inside of 66" SPP

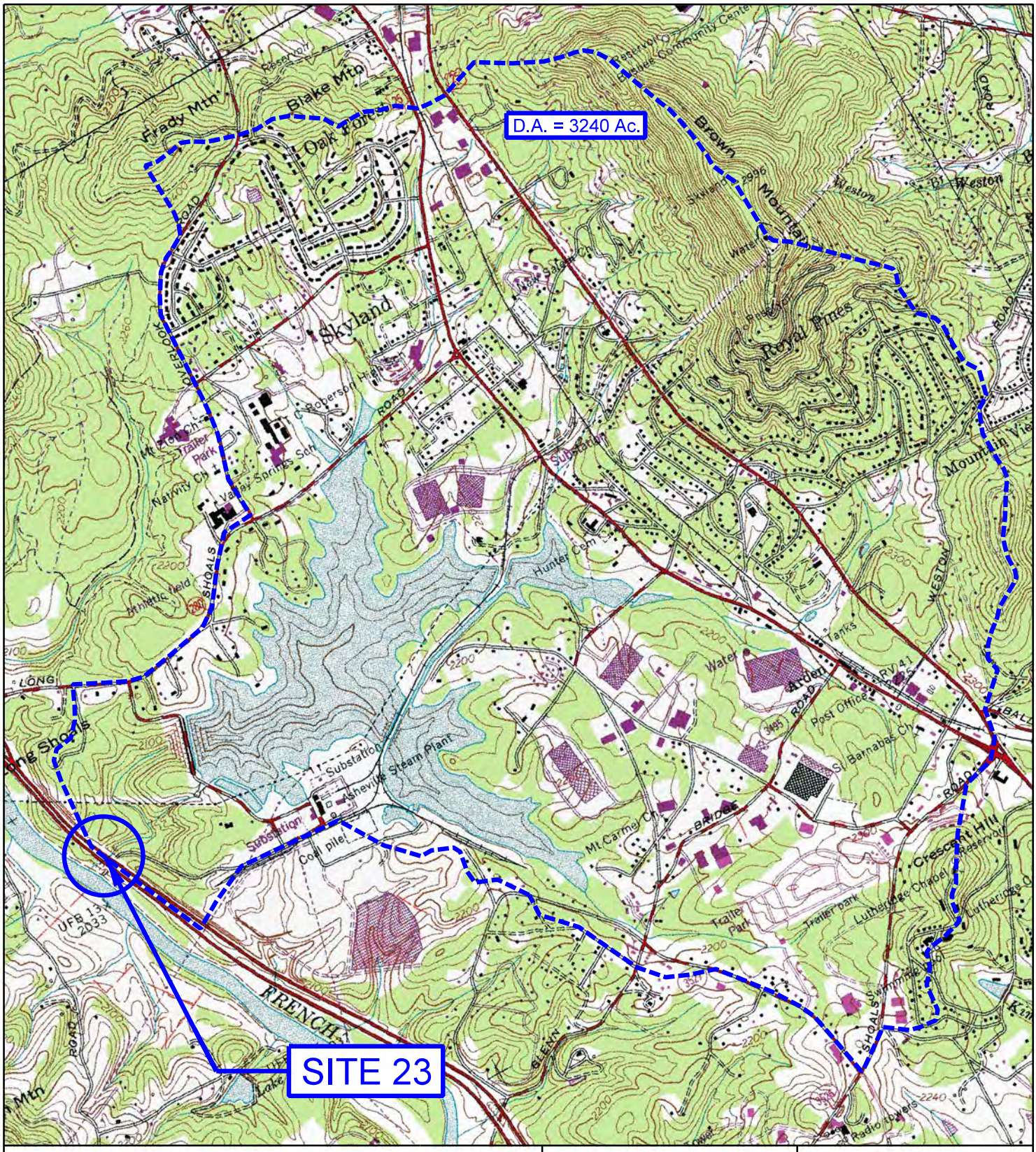
Looking at Downstream Face of 66" SPP with Headwall under I-26

Looking Downstream from 66" SPP

5' Perched on Downstream Side

APPENDIX Z

SITE 23



QUAD MAP - SITE 23

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

1,000 0 1,000 2,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 23

Stream Name: Powell Creek

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	217	21.7	0.007
Lake	-	10%	327	32.7	0.010
Low - Medium Density Residential	2 - 5	20%	169	33.9	0.010
Medium Density Residential	4 - 6	30%	319	95.6	0.030
Medium - High Density Residential	5 - 9	35%	446	156.1	0.048
High Density Residential	7 - 11	40%	294	117.6	0.036
Office / Institutional	-	55%	758	416.8	0.129
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	241	168.6	0.052
Business	-	85%	302	257.0	0.079
Commercial / Shopping Center	-	85%	168	142.4	0.044
Totals			**3240**	**1442.3**	**44.5%**

Drainage Area = 3240 acres

Project: I-4400 / I-4700

Site #: 23

Stream Name: Powell Creek

Drainage Area (sq mi): 5.06

Impervious Area (%): 44.5%

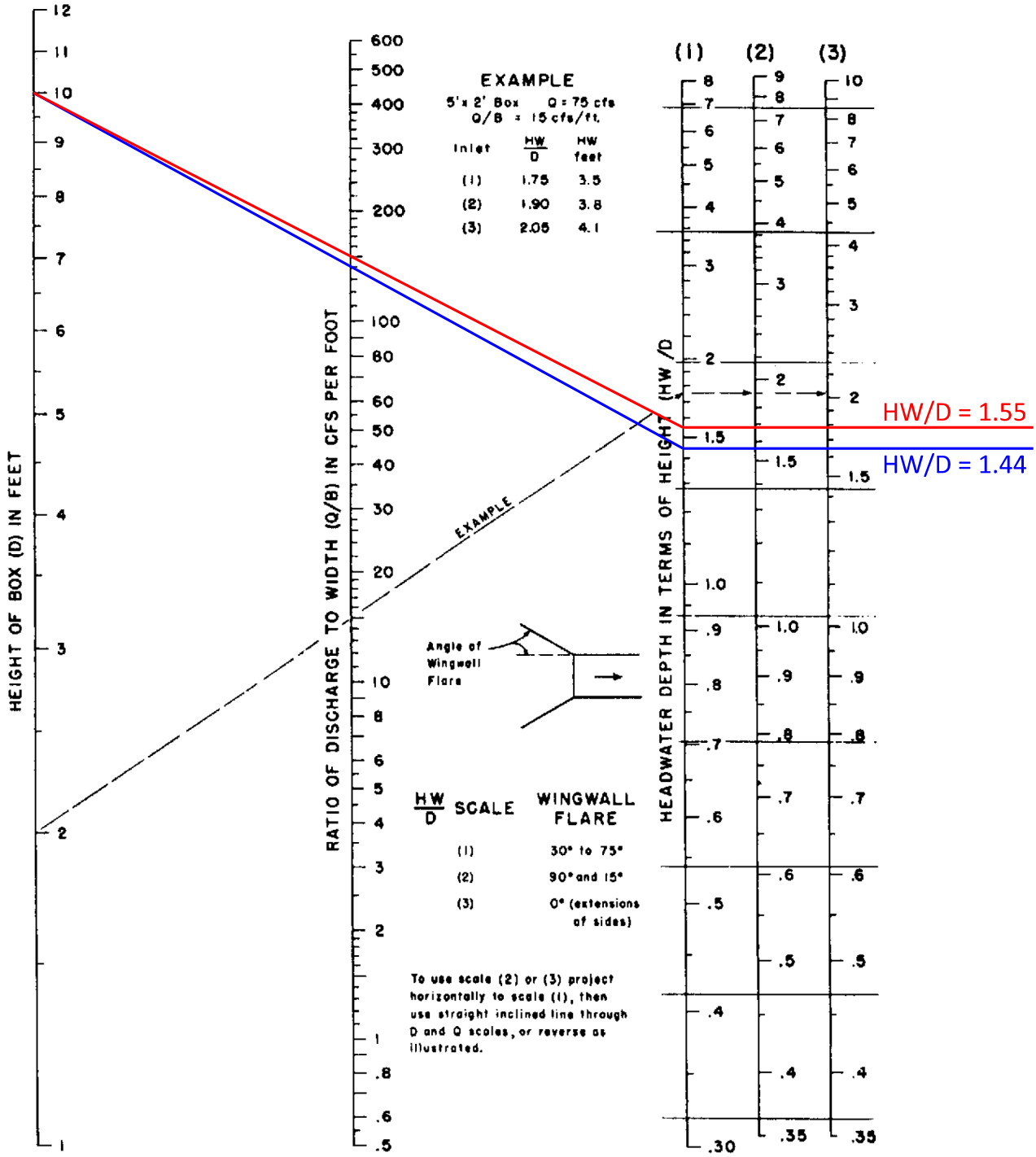
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	DISCHARGE (cfs)		
	PIEDMONT - RIDGE AND VALLEY	SAND HILLS	COASTAL PLAIN
2	1413	-	-
5	1902	-	-
10	2198	-	-
25	2556	-	-
50	2798	-	-
100	3003	-	-
200	3237	-	-
500	3491	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	DISCHARGE (cfs)
10	-
50	-
100	-
500	-

SITE 23

50 Year	100 Year
2 @ 10' x 10' RCBC	2 @ 10' x 10' RCBC
Q = 2800 CFS	Q = 3000 CFS
Q/NB = 140 CFS/FT.	Q/NB = 150 CFS/FT.

CHART 8B



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

PRELIMINARY DESIGN AND ASSESSMENT OF
STREAM CROSSINGS AND ENCROACHMENTS

COUNTY Buncombe PROJECT NUMBER I-4400/I-4700

STREAM Powell Creek ROUTE I-26

ASSESSMENT PREPARED BY HNTB Corporation DATE _____

HYDROLOGIC EVALUATION

NEAREST GAGING STATION ON THIS STREAM _____ (NONE X) _____

ARE FLOOD STUDIES AVAILABLE ON THIS STREAM: No

FLOOD DATA:
Q10 2198 CFS EST BKWTR. - FT. Q25 2556 CFS EST BKWTR. - FT.
Q50 2798 CFS EST BKWTR. - FT. Q100 3003 CFS EST BKWTR. - FT.
Q500 3491 CFS OR OVERTOPPING CFS EST BKWTR. - FT.

DRAINAGE AREA 5.06 Sq. Miles

METHOD USED TO COMPUTE Q USGS Urban Regression

PROPERTY RELATED EVALUATIONS

DAMAGE POTENTIAL: LOW X MODERATE _____ HIGH _____

COULD THIS BE SIGNIFICANTLY INCREASED BY PROPOSED

ENCROACHMENT: YES _____ NO X

EXPLANATION: Limited changes will be made to this site.

_____

LIST BUILDINGS IN FLOOD PLAIN None LOCATION N/A

FLOOR ELEVATION Unknown

UPSTREAM LAND USE Industrial

ANTICIPATE ANY CHANGE? No

ANY FLOOD ZONING? (FIS STUDIES, ETC.) YES ____ NO X

TYPE OF STUDY N/A

BASE FLOOD ELEVATION _____ (100 YEAR)

REGULATORY FLOODWAY WIDTH _____ (AS NOTED IN FIS STUDIES)

COMMENTS: _____

TRAFFIC RELATED EVALUATIONS

PRESENT YEAR 2011 TRAFFIC COUNT 83600 VPD % TRUCKS 14

DESIGN YEAR 2040 TRAFFIC COUNT 81700 VPD % TRUCKS 14

EMERGENCY ROUTE _____ SCHOOL BUS ROUTE _____ MAIL ROUTE _____

DETOUR AVAILABLE? _____ LENGTH OF DETOUR _____ MILES

DOES THE LEVEL OF TRAFFIC SERVICE OF AN EXISTING CROSSING VARY GREATLY FROM STANDARD DESIGN LEVELS? _____

IS THE TRAFFIC VOLUME, TYPE, USAGE SUCH TO WARRANT CONSIDERATION FOR VARIANCE FROM STANDARDS OR EXISTING LEVEL OF INTERRUPTION?

COMMENTS: _____

HIGHWAY AND BRIDGE (CULVERT) RELATED EVALUATIONS

NOTE ANY OUTSIDE FEATURES WHICH MIGHT AFFECT STAGE, DISCHARGE OR FREQUENCY.

LEVEES _____ AGGRADATION/DEGRADATION _____ RESERVOIRS X

DIVERSIONS _____ DRAINAGE DISTRICT _____ NAVIGATION _____

BACKWATER FROM ANOTHER SOURCE French Broad River

EXPLANATION: Lake Julian is upstream and the French Broad River is directly downstream.

ROADWAY OVERFLOW SECTION (NONE __) LENGTH _____ ELEVATION _____

EMBANKMENT: SOIL TYPE Udorthents-Urban Land Complex

TYPE SLOPE COVER Vegetated

COMMENTS: USDS Soil Map NC021

ENVIRONMENTAL CONSIDERATIONS

LIST SPECIAL CONDITIONS OR CONSIDERATIONS WHICH AFFECT HYDRAULIC DESIGN (NONE _____)

MISCELLANEOUS COMMENTS

IS THERE UNUSUAL SCOUR POTENTIAL? YES X NO _ PROTECTION NEEDED X

ARE BANKS STABLE? Yes PROTECTION NEEDED Yes

DOES STREAM CARRY APPRECIABLE AMOUNT OF LARGE DEBRIS? No

COMMENTS:

_____

_____

_____

ALTERNATIVES

RECOMMENDED DESIGN Retain Existing Structure

DETOUR STRUCTURE N/A

WERE OTHER HYDRAULIC ALTERNATES CONSIDERED? YES _____ NO X

THIS SITE ASSESSMENT INDICATES THE DESIGN SHOULD FOLLOW:

(1) X NORMAL PROCESS

(2) _____ NORMAL PROCESS WITH SPECIAL SPECIFIC CONSIDERATION FOR

_____

(3) _____ SPECIFIC DESIGN PROCESS WITH APPROPRIATE RISK/ECONOMIC EVALUATION ADDRESSING: _____

FIELD REVIEW FORM

COUNTY BUNCOMBE PROJECT NUMBER I-4400/I-4700 DATE OF VISIT _____

SITE NUMBER 23 STREAM POWELL CREEK ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE _____

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 2 @ 10' x 10' RCBC

MINOR HOLE AT BASE OF THE STRUCTURE MIDWAY THROUGH.

MINOR CRACKS IN LEFT BARREL. MINOR CRACKS IN RIGHT BARREL.

RIGHT BARREL HAS 1' OF SILT ON THE DOWNSTREAM SIDE.

UPSTREAM CHANNEL: TOP WIDTH 10 FT BOTTOM WIDTH 7 FT BANKFULL DEPTH 5 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL _____

BANK/ CHANNEL CONDITIONS RIP RAP LINED. BANKS ARE STABLE AND VEGETATED

UPSTREAM OF THE STRUCTURE IS A 90° TURN IN THE CHANNEL.

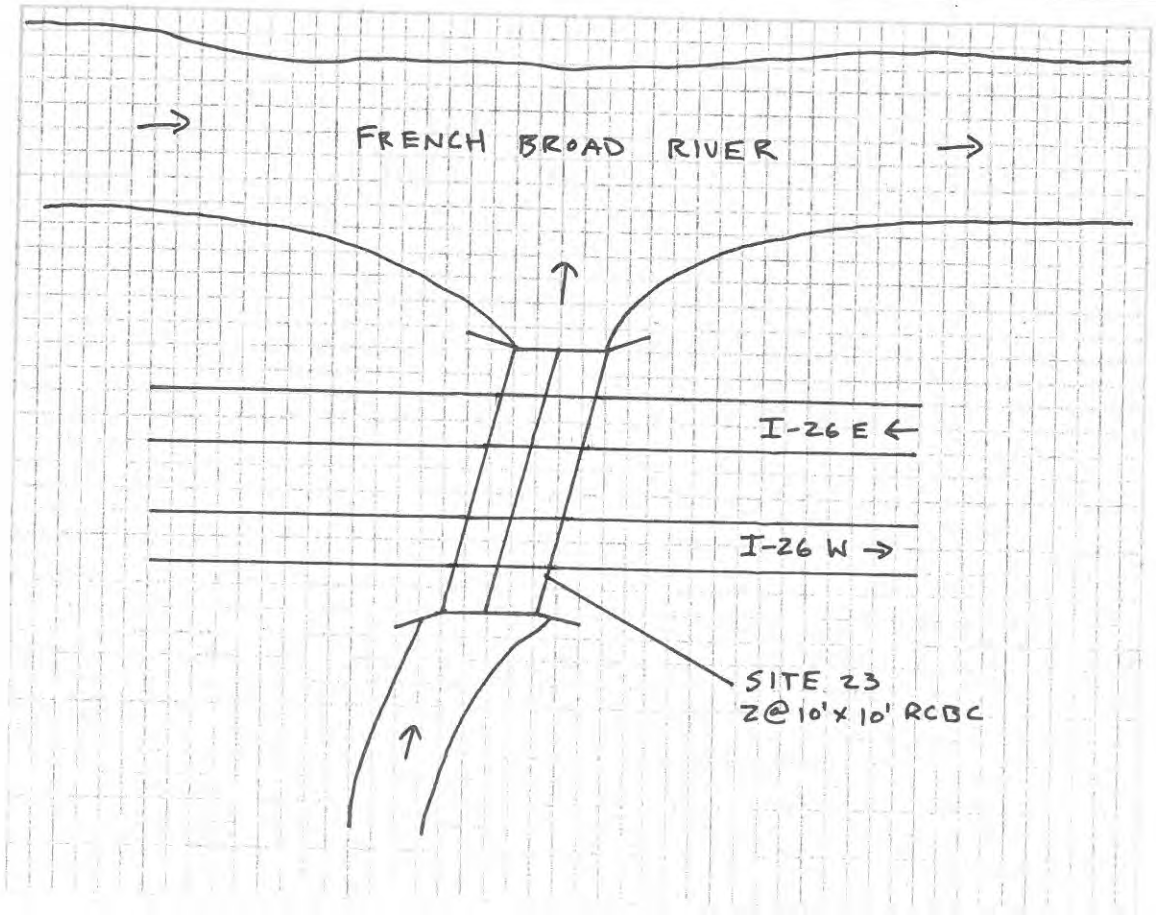
DOWNSTREAM CHANNEL: TOP WIDTH 25 FT BOTTOM WIDTH 15 FT BANKFULL DEPTH 4 FT

DEPTH OF FLOW (AT TIME OF VISIT) 1 FT BED MATERIAL _____

BANK/ CHANNEL CONDITIONS DEBRIS IN CHANNEL. BANKS ARE STABLE AND VEGETATED.

COMMENTS LAKE JULIAN IS UPSTREAM OF THE STRUCTURE.

2 UTILITY PIPES RUN PERPENDICULAR TO THE CHANNEL ON THE DOWNSTREAM SIDE.



NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
BRIDGE MANAGEMENT UNIT

ATTENTION

BRIDGE INSPECTION REPORT

INSPECTION TYPE: Routine Inspection

COUNTY BUNCOMBE BRIDGE NUMBER 100101 INSPECTION CYCLE 2 YRS

ROUTE I-26 ACROSS POWELL CREEK M.P. 37.85

LOCATION .6 MI.S.JCT.NC146

SUPERSTRUCTURE DBL. 10'X10' RCBC;260' ALONG CENTERLINE CULVERT

SUBSTRUCTURE

SPANS

LONGITUDE 82° 33' 12.93" LATITUDE 35° 28' 27.36"

INSPECTION DATE 12/02/2013 PRESENT CONDITION FAIR

PRESENT POSTING N NOT POSTED PROPOSED POSTING

OTHER SIGNS PRESENT NONE

EAST

Fracture Critical	No
Temporary Shoring	No
Scour Critical	No
Scour POA	No

SIGN NOTICE ISSUED FOR		NUMBERED REQUIRED
No	WEIGHT LIMIT	
No	DELINEATORS	
No	NARROW BRIDGE	
No	ONE LANE BRIDGE	
No	LOW CLEARANCE	

NATIONAL BRIDGE INVENTORY-------- STRUCTURE INVENTORY AND APPRAISAL Run Date: 02/05/2014

IDENTIFICATION

(1) STATE NAME -NORTH CAROLINA BRIDGE 100101
(8) STRUCTURE NUMBER(FEDERAL) 000000000210101
(5) INVENTORY ROUTE (ON/UNDER) - ON 11000260
(2) STATE HIGHWAY DEPARTMENT DISTRICT 2
(3) COUNTY CODE 21 (4) PLACE CODE 5880
(6) FEATURE INTERSECTED - POWELL CREEK
(7) FACILITY CARRIED I-26
(9) LOCATION .6 MI.S.JCT.NC146
(11)MILEPOINT 37.85
(16)LAT 35° 28' 27.36" (17)LONG 82° 33' 12.93"
(98)BORDER BRIDGE STATE CODE PCT SHARE
(99)BORDER BRIDGE STRUCTURE NO

STRUCTURE TYPE AND MATERIAL

(43) STRUCTURE TYPE MAIN: Concrete continuous
TYPE - Culverts (includes frame culverts) CODE 219
(44) STRUCTURE TYPE APPR :
TYPE - CODE 000
(45) NUMBER OF SPANS IN MAIN UNIT 2
(46) NUMBER OF APPROACH SPANS
(107)DECK STRUCTURE TYPE - N CODE
(108)WEARING SURFACE / PROTECTIVE SYSTEM :
(A) TYPE OF WEARING SURFACE - CODE
(B) TYPE OF MEMBRANE - CODE
(C) TYPE OF DECK PROTECTION - CODE

AGE AND SERVICE

(27) YEAR BUILT 1965
(106)YEAR RECONSTRUCTED
(42) TYPE OF SERVICE : ON - Highway
UNDER - Waterway CODE 15
(28) LANES: ON STRUCTURE 4 UNDER STRUCTURE 0
(29) AVERAGE DAILY TRAFFIC 72000
(30) YEAR OF ADT 2012 (109) TRUCK ADT PCT 16%
(19) BYPASS OR DETOUR LENGTH 1 MI

GEOMETRIC DATA

(48) LENGTH OF MAXIMUM SPAN 10 FT
(49) STRUCTURE LENGTH 24 FT
(50)CURB OR SIDEWALK: LEFT 0 FT RIGHT 0 FT
(51) BRIDGE ROADWAY WIDTH CURB TO CURB 0 FT
(52) DECK WIDTH OUT TO OUT 0 FT
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS) 76 FT
(33) BRIDGE MEDIAN - No Median CODE 2
(34) SKEW 20° (35) STRUCTURE FLARED 0
(10) INVENTORY ROUTE MIN VERT CLEAR 999.9 FT
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR 76 FT
(53) MIN VERT CLEAR OVER BRIDGE RDWY 999.9 FT
(54) MIN VERT UNDERCLEAR REF Not a Highway or Railroad 0 FT
(55) MIN LAT UNDERCLEAR RT REF Not a Highway or Railroad 000 FT
(56) MIN LAT UNDERCLEAR LT REF - 000 FT

NAVIGATION DATA

(38) NAVIGATION CONTROL - No Navigational Control CODE 0
(111)PIER PROTECTION - CODE
(39) NAVIGATION VERTICAL CLEARANCE 0
(116)VERT - LIFT BRIDGE NAV MIN VERT CLEAR FT
(40) NAVIGATION HORIZONTAL CLEARANCE 0 FT

SUFFICIENCY RATING = 79.71
STATUS = Not Deficient

CLASSIFICATION — CODE

(112)NBIS BRIDGE SYSTEM - YES
(104)HIGHWAY SYSTEM Is on the NHS 1
(26) FUNCTIONAL CLASS - Arterial - Interstate 11
(100)STRAHNET HIGHWAY - Interstate STRAHNET Route 1
(101)PARALLEL STRUCTURE - No Parallel Structure N
(102)DIRECTION OF TRAFFIC - 2-way Traffic 2
(103)TEMPORARY STRUCTURE -
(110)DESIGNATED NATIONAL NETWORK - On the National Network 1
(20) TOLL On Free Road 3
(31) MAINTAIN - State Highway Agency 01
(22) OWNER - State Highway Agency 01
(37) HISTORICAL SIGNIFICANCE - Not Eligible 5

CONDITION — CODE

(58) DECK N
(59) SUPERSTRUCTURE N
(60) SUBSTRUCTURE N
(61) CHANNEL & CHANNEL PROTECTION 5
(62) CULVERTS 5

LOAD RATING AND POSTING — CODE

(31) DESIGN LOAD HS 20 + MOD 6
(63) OPERATING RATING METHOD - No Rating Analysis or Evaluatic 5
(64) OPERATING RATING - HS-26 46
(65) INVENTORY RATING METHOD - No Rating Analysis or Evaluatic 5
(66) INVENTORY RATING - HS-20 36
(70) BRIDGE POSTING - No Posting Required 5
(41) STRUCTURE OPEN, POSTED ,OR CLOSED A
DESCRIPTION - Open, No Restriction

APPRAISAL — CODE

(67) STRUCTURAL EVALUATION 5
(68) DECK GEOMETRY N
(69) UNDERCLEARANCES,VERTI & HORIZ N
(71) WATERWAY ADEQUACY 5
(72) APPROACH ROADWAY ALIGNMENT 8
(36) TRAFFIC SAFETY FEATURES NNNN
(113)SCOUR CRITICAL BRIDGES 8

PROPOSED IMPROVEMENTS

(75) TYPE OF WORK - CODE
(76) LENGTH OF STRUCTURE IMPROVEMENT
(94) BRIDGE IMPROVEMENT COST
(95) ROADWAY IMPROVEMENT COST
(96) TOTAL PROJECT COST
(97) YEAR OF IMPROVEMENT COST ESTIMATE
(114)FUTURE ADT 144000 (115) YEAR FUTURE ADT 2025

INSPECTIONS

(90) INSPECTION DATE 12/02/2013
(92) CRITICAL FEATURE INSPECTION : (93) CFI DATE
A) FRACTURE CRIT DETAIL - NO A)
B) UNDERWATER INSP - NO B)
C) OTHER SPECIAL INSP NO C)
SCOUR

BRIDGE MANAGEMENT UNIT

DATA ON EXISTING STRUCTURE Run Date: 02/05/2014

COUNTY :	DIVISION :	DISTRICT:	STRUCTURE NUMBER :	LENGTH :
BUNCOMBE	13	2	100101	24 FEET

ROUTE CARRIED : I-26

FEATURE INTERSECTED : POWELL CREEK

LOCATED : .6 MI.S.JCT.NC146

BRIDGE NAME :

CITY : *BILTMORE FO

FUNC. CLASS :	SYST.ON :	SYST.UNDER :	ADT & YR :	RAIL TYPE :
11	FA	NFA	72000 2012	LT 0 RT 0

BUILT :	BY :	PROJ :	FED.AID PROJ :	DESIGN LOAD :
1965	SHC	8.19002	I-26-1(10)6	HS 20 + MOD

REHAB :	BY :	PROJ :	ALIGNMENT :	SKEW :	LANES :
			TAN	110	ON 4 UNDER 0

NAVIGATION :	HT. CRN. TO BED :	WATER DEPTH :
VC 0 FT HC 0 FT	40 FT	1 FT

SUPERSTRUCTURE : DBL. 10'X10' RCBC;260' ALONG CENTERLINE CULVERT

SUBSTRUCTURE :

SPANS :

BEAMS OR GIRDERS :

FLOOR :	ENCROACHMENT :	DECK (OUT TO OUT) :
		0 FT

CLEAR ROADWAY :	BETWEEN RAILS :	SIDEWALK OR CURB :
0 FT	0 FT	LT 0 FT RT 0 FT

VERT.CL.OVER : 999.9 FT

INV.RTG. :	OPE.RTG. :	CONTR.MEMBER :	POSTED :
HS-20	HS-26		SV TTST DATE

SYSTEM :	GREEN LINE ROUTE :
Primary Interstate	Y

UNDER ROUTES AND CLEARANCES

REMARKS :

TREE ACROSS STREAM AT OUTLET

TREES AND DEBIS AT OUTLET

Structure 100101 County BUNCOMBE Date: 12/02/2013 Structure Photos

WEST

EAST

Structure 100101 County BUNCOMBE Date: 12/02/2013 Structure Photos

DOWNSTREAM SOUTH

UPSTREAM NORTH

DOWNSTREAM SOUTH

UPSTREAM NORTH

Looking at Upstream Face of 2 @ 10' x 10' RCBC under I-26

Looking Upstream from 2 @ 10' x 10' RCBC Inlet

Looking Downstream in Left Box

Looking Upstream in Left Box

Looking Downstream in Right Box

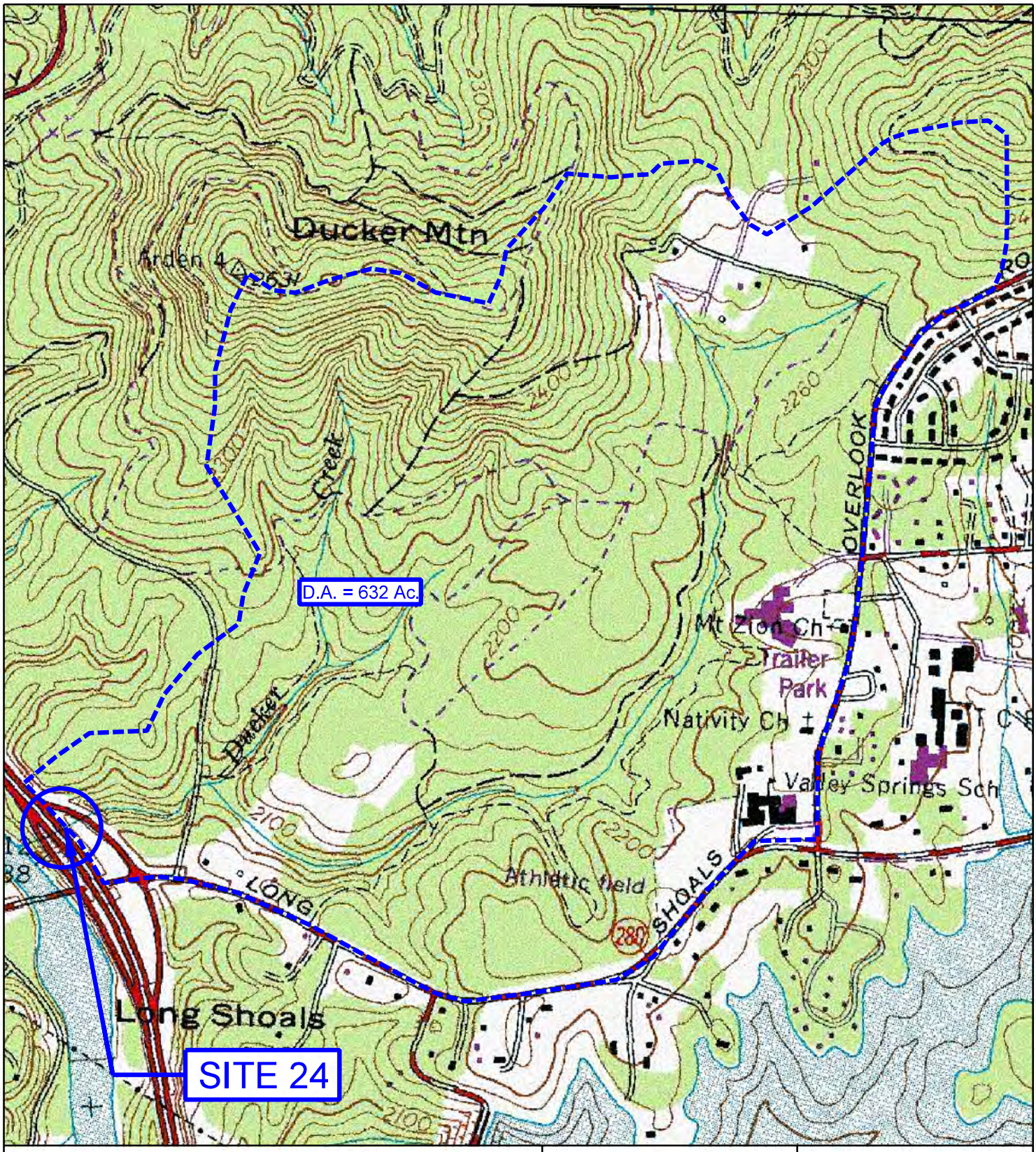
Looking Upstream in Right Box

Looking at Downstream Face of 2 @ 10' x 10' RCBC under I-26

Looking Downstream from 2 @ 10' x 10' RCBC Outlet

APPENDIX AA

SITE 24



QUAD MAP - SITE 24

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 24

Stream Name: Ducker Creek

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	137	13.7	0.022
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	106	31.7	0.050
Medium - High Density Residential	5 - 9	35%	119	41.6	0.066
High Density Residential	7 - 11	40%	175	69.8	0.111
Office / Institutional	-	55%	66	36.2	0.057
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	2	1.2	0.002
Business	-	85%	26	22.3	0.035
Commercial / Shopping Center	-	85%	2	1.4	0.002
Totals			**632**	**217.9**	**34.5%**

Drainage Area = 632 acres

Project: I-4400 / I-4700

Site #: 24

Stream Name: Ducker Creek

Drainage Area (sq mi): 0.99

Impervious Area (%): 34.5%

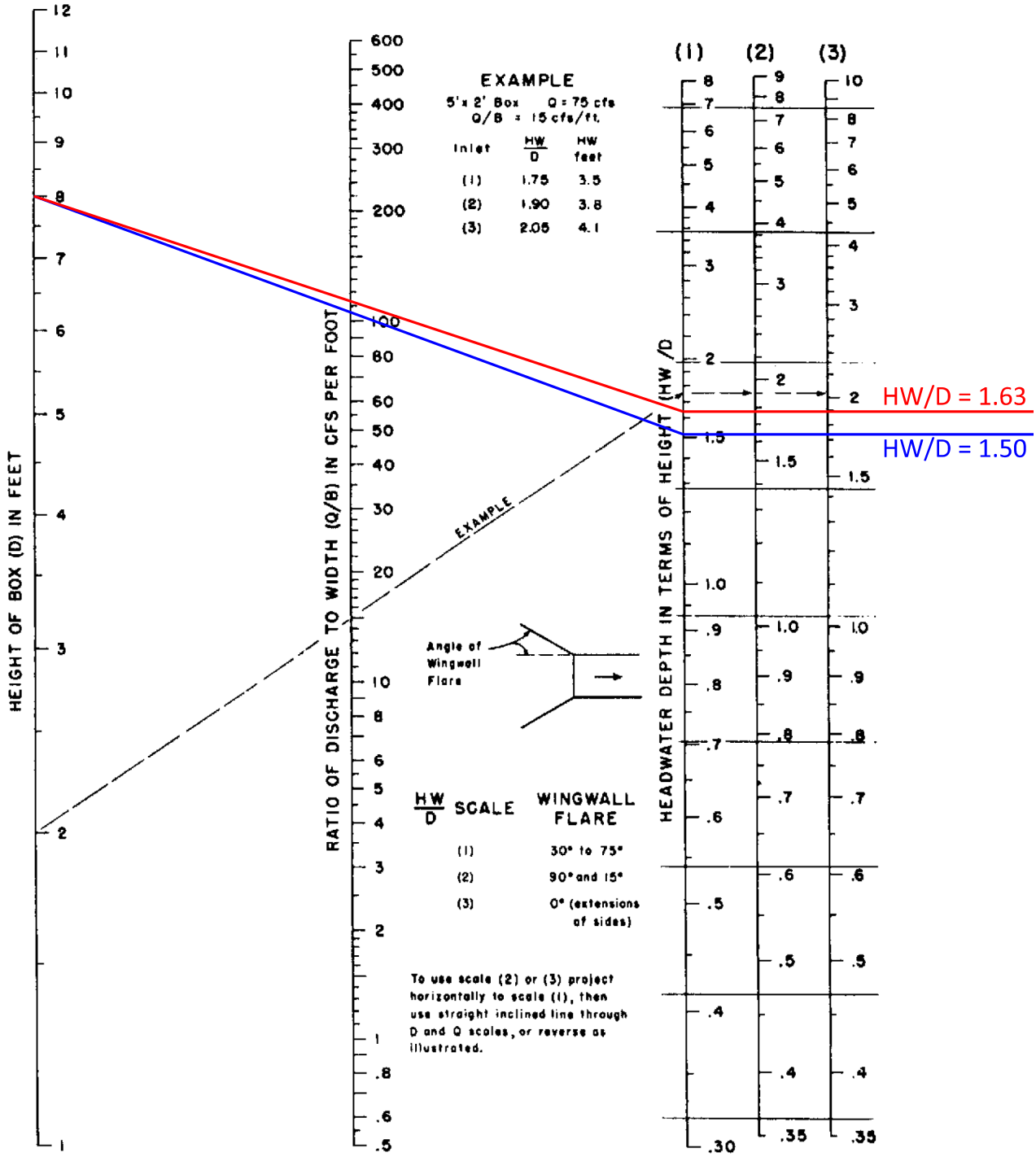
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	464	-	-
5	603	-	-
10	690	-	-
25	781	-	-
50	839	-	-
100	902	-	-
200	954	-	-
500	1034	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	-
50	-
100	-
500	-

SITE 24

50 Year	100 Year
1 @ 8' x 8' RCBC	1 @ 8' x 8' RCBC
Q = 850 CFS	Q = 900 CFS
Q/NB = 106 CFS/FT.	Q/NB = 113 CFS/FT.

CHART 8B



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY BUNCOMBE PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/3/14
SITE NUMBER 24 STREAM DUCKER CREEK ROUTE I-26
ASSESSMENT PREPARED BY HNTB DATE

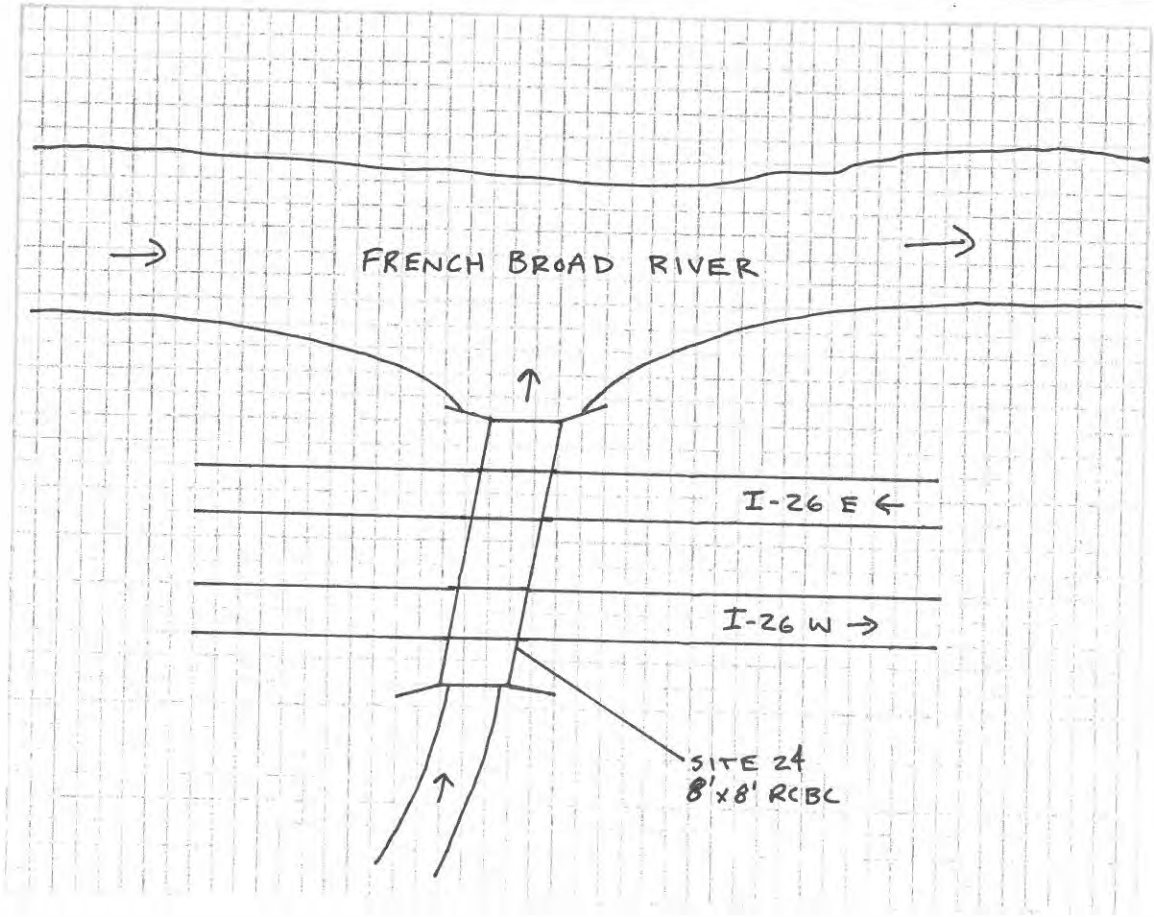
EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 1@8'x8' RCBC. FAIR CONDITION. MINOR CRACKING THROUGHOUT THE STRUCTURE. A UTILITY LINE RUNS THROUGH THE STRUCTURE.

UPSTREAM CHANNEL: TOP WIDTH 9 FT BOTTOM WIDTH 4 FT BANKFULL DEPTH 5 FT
DEPTH OF FLOW (AT TIME OF VISIT) 1.5 FT BED MATERIAL
BANK/ CHANNEL CONDITIONS RIP RAP IN CHANNEL AND AT INLET. BANKS ARE STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 15 FT BOTTOM WIDTH 9 FT BANKFULL DEPTH 4 FT
DEPTH OF FLOW (AT TIME OF VISIT) 1.5 FT BED MATERIAL
BANK/ CHANNEL CONDITIONS CONCRETE RUBBLE AT OUTLET. BANKS ARE VEGETATED. SEPARATION OF THE WINGWALL. SEVERE EROSION.

COMMENTS THE OUTLET OF THE STRUCTURE IS 50' FROM THE FRENCH BROAD RIVER.



Looking at Upstream Face of 1 @ 8′ x 8′ RCBC under I-26

Looking Upstream from 1 @ 8′ x 8′ RCBC Inlet

Looking Downstream

Looking Upstream

Pipe Outlet in the Middle of the Box

Crack in the Top Slab

Cracks in the Box

Right Headwall Separation on the Downstream Side

Looking at Downstream Face of 1 @ 8′ x 8′ RCBC under I-26

Looking Downstream from 1 @ 8′ x 8′ RCBC Outlet

APPENDIX BB

SITE 25

Project: I-4400 / I-4700

Site #: 25

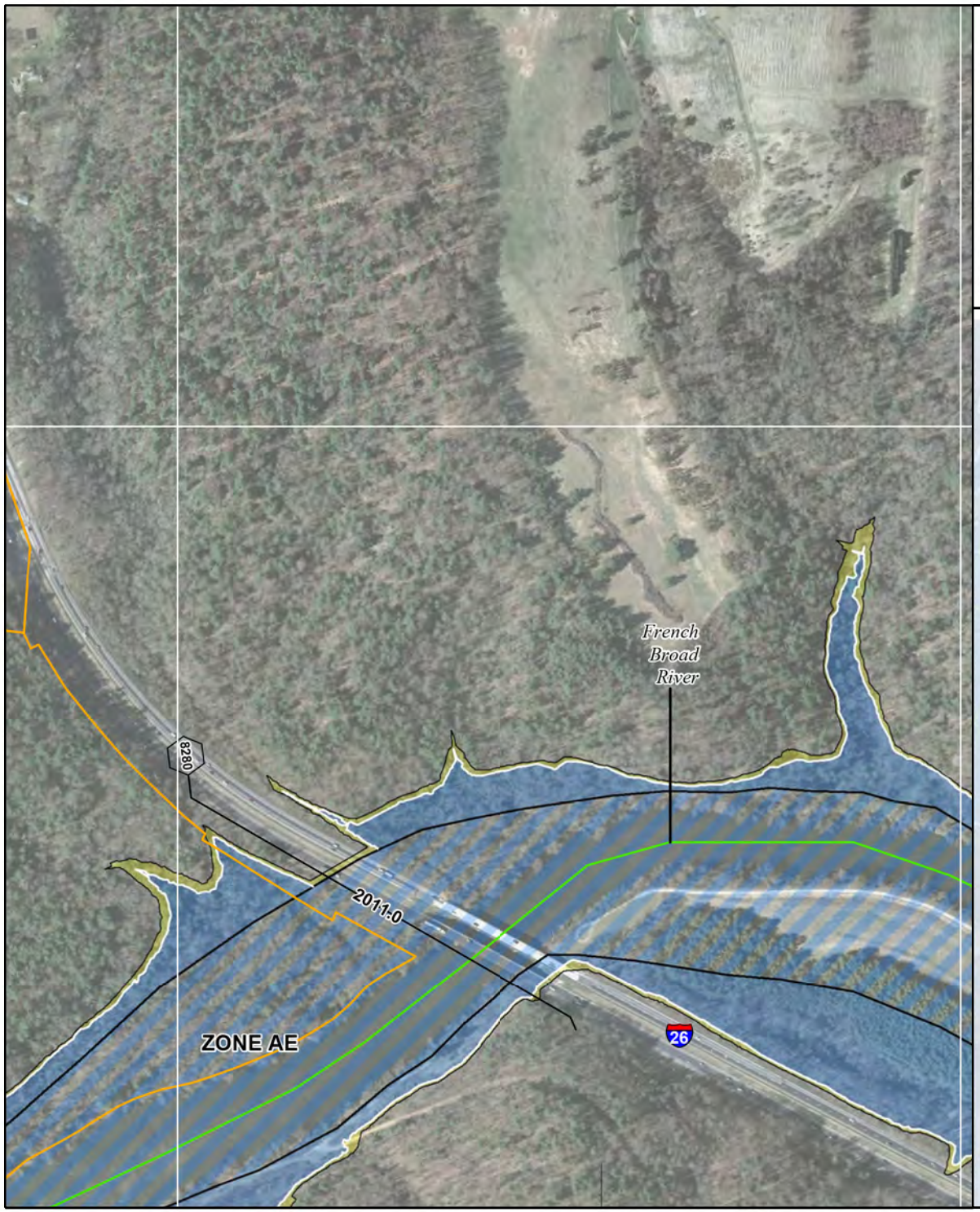
Stream Name: French Broad River

Drainage Area (sq mi): 678.00

Impervious Area (%): 2.1%

USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	8741	-	-
5	14373	-	-
10	18436	-	-
25	23763	-	-
50	27822	-	-
100	31943	-	-
200	36242	-	-
500	42123	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	23000
50	41000
100	50000
500	76000



Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 750 1,500 Feet

0 100 200 400 Meters

FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

BUNCOMBE COUNTY, NC
and Incorporated Areas

PANEL 9636

FEMA

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
ASHEVILLE, CITY OF	370032	9636	J
BUNCOMBE COUNTY	370031	9636	J

Site 25

MAP NUMBER
3700963600J

EFFECTIVE DATE
1/6/2010

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

A Report of Flood Hazards in

BUNCOMBE COUNTY, NORTH CAROLINA AND INCORPORATED AREAS

Community Name	Community Number
BUNCOMBE COUNTY	370031
CITY OF ASHEVILLE	370032
TOWN OF BILTMORE FOREST	370475
TOWN OF BLACK MOUNTAIN	370033
TOWN OF MONTREAT	370476
TOWN OF WEAVERVILLE	370269
TOWN OF WOODFIN	370380

NORTH CAROLINA
Cooperating Technical State
FEMA'S COOPERATING TECHNICAL PARTNER

EFFECTIVE: 1/6/2010
REVISED: 4/3/2012
Federal Emergency Management Agency
State of North Carolina
Flood Insurance Study Number
37021CV000
www.fema.gov and www.ncfloodmaps.com

Table 8 - Flooding Sources Studied by Detailed Methods: Revised or Newly Studied

Source	Riverine Sources		Affected Communties
	From	To	
Gashes Creek	Just upstream of Charland Forest Road	Just downstream of Charles A. Lytle Lane (SR 3279)	Buncombe County
Grassy Branch	The confluence with Swannanoa River	Approximately 150 feet downstream of Upper Grassy Branch Extension	Buncombe County City Of Asheville
Hominy Creek	Just downstream of Morgan Cove Road (SR 1141)	Approximately 80 feet upstream of US Highway 19 / Asheville Road	Buncombe County
Ivy Creek	Approximately 60 feet downstream of the confluence with Gabriel Creek	Approximately 600 feet upstream of NC Highway 197	Buncombe County
Little Ivy Creek	The confluence with Ivy Creek	The confluence of Paint Fork and California Creek	Buncombe County
North Fork Swannanoa River	The confluence with Swannanoa River	Approximately 700 feet upstream of Tom Brown Road	Buncombe County Town Of Black Mountain
Reems Creek	Just upstream of Twin Hills Drive	Approximately 100 feet upstream of the confluence with Ox Creek	Buncombe County Town Of Weaverville
Reems Creek	The confluence with French Broad River	Approximately 1.1 miles downstream of New Stock Road (SR 1882)	Buncombe County
Ross Creek	The confluence with Swannanoa River	Just downstream of Vance Gap Road	City Of Asheville
Smith Mill Creek	The confluence with French Broad River	Approximately 0.4 mile upstream of Johnston School Road (SR 1319)	Buncombe County City Of Asheville
Swannanoa River	The confluence with French Broad River	Approximately 0.3 mile upstream of Dunsmore Avenue (SR 2531)	Buncombe County City Of Asheville Town Of Biltmore Forest Town Of Black Mountain
Sweeten Creek	At Railroad	Approximately 950 feet upstream of Rock Hill Road	City Of Asheville
Sweeten Creek	The confluence with Swannanoa River	At Railroad	City Of Asheville
Sweeten Creek Tributary 4	The confluence with Sweeten Creek	Approximately 1,100 feet upstream of West Chapel Road	City Of Asheville

Table 9, “Flooding Sources Studied by Detailed Methods: Redelineated”, lists all flooding sources that were studied by detailed methods for the pre-statewide FIS and redelineated for previous FISs. These flooding sources were not part of this revision and their effective analyses remain valid.

Table 9 - Flooding Sources Studied by Detailed Methods: Redelineated

Source	Riverine Sources		Affected Communties
	From	To	
Beaverdam Creek (into French Broad River)	The confluence with French Broad River	Just upstream of Governors Drive	City Of Asheville Town Of Woodfin
Beaverdam Creek (into French Broad River) Tributary 1	The confluence with Beaverdam Creek (into French Broad River)	Approximately 500 feet downstream of US Highway 19	Town Of Woodfin
Beetree Creek	Approximately 0.7 mile upstream of the confluence with Swannanoa River	Just upstream of Old Beetree Road (SR 2418)	Buncombe County
Bull Creek	The confluence with Swannanoa River	Just downstream of Bull Creek Road (SR 2424)	Buncombe County
Camp Branch	The confluence with Swannanoa River	NC Highway 9	Town Of Black Mountain
Dillingham Creek	The confluence with Ivy Creek and North Fork Ivy Creek	Just downstream of Dillingham Road (SR 2173)	Buncombe County
French Broad River	Approximately 1.1 miles downstream of the Buncombe/Madison County boundary	Approximately 3 miles upstream of the Buncombe/Henderson County boundary	Buncombe County City Of Asheville Town Of Woodfin
Gashes Creek	The confluence with Swannanoa River	Just downstream of Charland Forest Road	Buncombe County City Of Asheville
Haw Creek	The confluence with Swannanoa River	Just upstream of Mann Drive	City Of Asheville
Hominy Creek	The confluence with French Broad River	Just downstream of Morgan Cove Road (SR 1141)	Buncombe County City Of Asheville
Ivy Creek	Approximately 600 feet upstream of NC Highway 197	The confluence of Dillingham Creek and North Fork Ivy Creek	Buncombe County
Mckinnish Branch	Approximately 100 feet upstream of the confluence with Smith Mill Creek	Approximately 380 feet upstream of Johnston School Road (SR 1319)	Buncombe County City Of Asheville
Moore Creek	The confluence with Hominy Creek	Just upstream of Monte Vista Road (SR 1224)	Buncombe County City Of Asheville
Newfound Creek	Approximately 850 feet upstream of the confluence of Sluder Branch	Just downstream of Morgan Branch Road (SR 1220)	Buncombe County
Pole Creek	The confluence with Hominy Creek	Just downstream of Dogwood Road (SR 1220)	Buncombe County City Of Asheville
Ragsdale Creek	The confluence with Hominy Creek	Just downstream of Sand Hill Road (SR 3412)	City Of Asheville
Reed Creek	The confluence with French Broad River	Just upstream of Murdock Avenue	Buncombe County City Of Asheville Town Of Woodfin

Table 13 - Summary of Discharges

Flooding Source		Discharges (cfs)			
Location	Drainage Area (square miles)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Eller Cove					
At the confluence with Reems Creek	2.00	*	*	1,150	*
Emma Branch					
At the confluence with Smith Mill Creek	1.67	*	*	1,030	*
Approximately 1,000 feet upstream of Hazel Mill Road	0.52	*	*	500	*
Emma Branch Tributary 2					
At the confluence with Emma Branch	0.31	*	*	360	*
Flat Creek					
At the confluence with Broad River	10.45	*	*	3,750	*
Approximately 0.9 mile upstream of the confluence with Broad River	9.99	*	*	3,640	*
Flat Creek (into French Broad River)					
At the confluence with French Broad River	24.71	*	*	5,530	*
Approximately 1.6 miles downstream of US Highway 25/70	19.64	*	*	4,790	*
Approximately 0.4 mile upstream of the confluence of Dick Branch	12.28	*	*	2,960	*
Approximately 300 feet downstream of I-26	7.05	*	*	2,520	*
Approximately 1,100 feet upstream of Chambers Road	4.34	*	*	1,860	*
Flat Creek (into Swannanoa River)					
At the confluence with Swannanoa River	6.03	*	*	3,570	*
At the confluence of Flat Creek (into Swannanoa River) Tributary 1	5.50	*	*	3,370	*
Just upstream of Padgettown Road	5.24	*	*	3,270	*
Just upstream of Flat Creek Road	4.74	*	*	3,070	*
Just upstream of Shenandoah Terrace	4.32	*	*	2,910	*
Approximately 300 feet downstream of the confluence of Little Piney Branch	3.75	*	*	2,660	*
At the confluence of Puncheon Branch	2.83	*	*	1,650	*
Flat Creek (into Swannanoa River) Tributary 1					
At the confluence with Flat Creek (into Swannanoa River)	0.36	*	*	520	*
Fourmile Branch					
At the confluence with French Broad River	3.37	*	*	1,590	*
Approximately 300 feet downstream of Brooklawn Chase	1.06	*	*	770	*
French Broad River					
Approximately 0.6 mile downstream of Fletcher Martin Road (SR 1620)	1052.00	*	*	67,000	*
Upstream of Craggy Dam	966.00	*	*	63,600	*
Approximately 600 feet upstream of Craggy Dam	954.00	*	*	63,200	*[2]
At Pearson Bridge Road	945.00	*	*	63,000	*
Approximately 500 feet upstream of Amboy Road	801.00	*	*	56,200	*
Approximately 2.4 miles downstream of the confluence of Fourmile Branch	695.00	*	*	51,000	*
Approximately 0.4 mile downstream of the confluence of Bent Creek	676.00	*	*	50,000	*
At the confluence of Cane Creek	633.00	*	*	48,500	*
French Broad River Tributary 149					
At the confluence with French Broad River	0.30	*	*	490	*
Gap Creek					
At the confluence with Cane Creek	7.83	*	*	2,700	*
Approximately 800 feet upstream of Gap Creek Road (SR 3129)	3.58	*	*	1,650	*
Approximately 100 feet upstream of Roseanne Lane (SR 2888)	1.42	*	*	930	*

surveyed approximately every 4000 feet along the detail study reaches to obtain the channel geometry between bridges and culverts. Overbank cross section data for the backwater analyses were obtained from recently flown LIDAR data.

Channel roughness factors (Manning's "n") used in the hydraulic computations were made in the field by an engineer where stream access was possible, with orthophotos used to supplement areas that could not be accessed. The channel and overbank "n" values for all of the streams studied by detailed methods are shown in Table 16, "Roughness Coefficients".

Table 16 - Roughness Coefficients

Stream	Channel "n"	Overbank "n"
Avery Creek	0.050 to 0.090	0.030 to 0.090
Beaverdam Creek (into French Broad River)	0.035 to 0.065	0.030 to 0.150
Beaverdam Creek (into French Broad River) Tributary 1	0.025 to 0.065	0.030 to 0.150
Beaverdam Creek (into South Hominy Creek)	0.030 to 0.090	0.030 to 0.100
Beaverdam Creek (into South Hominy Creek) Tributary	0.045 to 0.050	0.055 to 0.085
Bee Branch	0.040 to 0.050	0.050 to 0.100
Beetree Creek	0.035 to 0.060	0.025 to 0.200
Bent Creek	0.042 to 0.052	0.030 to 0.100
Bill Moore Creek	0.030 to 0.090	0.030 to 0.200
Broad River	0.040 to 0.100	0.050 to 0.100
Brush Creek	0.035 to 0.090	0.030 to 0.090
Bull Creek	0.045 to 0.060	0.013 to 0.150
Camp Branch	0.045 to 0.050	0.030 to 0.140
Cane Creek	0.040 to 0.050	0.025 to 0.250
Cane Creek (into Hominy Creek)	0.050	0.050 to 0.090
Curtis Creek	0.048 to 0.090	0.030 to 0.090
Dick Branch	0.050	0.050 to 0.090
Dillingham Creek	0.040 to 0.060	0.030 to 0.150
Dingle Creek	0.035 to 0.090	0.030 to 0.090
Dix Creek	0.050	0.030 to 0.090
Eller Cove	0.035 to 0.055	0.040 to 0.090
Emma Branch	0.035 to 0.050	0.030 to 0.090
Emma Branch Tributary 2	0.050 to 0.059	0.045 to 0.090
Flat Creek	0.040 to 0.060	0.050 to 0.100
Flat Creek (into French Broad River)	0.040 to 0.055	0.030 to 0.150
Flat Creek (into Swannanoa River)	0.035 to 0.090	0.035 to 0.090
Flat Creek (into Swannanoa River) Tributary 1	0.050	0.050 to 0.090
Fourmile Branch	0.030 to 0.090	0.030 to 0.100
French Broad River	0.024 to 0.064	0.030 to 0.200
French Broad River Tributary 149	0.040 to 0.090	0.030 to 0.090
Gap Creek	0.045 to 0.050	0.030 to 0.090
Garren Creek	0.045 to 0.050	0.030 to 0.090
Gashes Creek	0.018 to 0.060	0.025 to 0.200
George Branch	0.050 to 0.090	0.030 to 0.090
Gill Branch	0.050	0.150
Glady Fork	0.050	0.050 to 0.090
Gouches Branch	0.045	0.012 to 0.085
Grassy Branch	0.040 to 0.055	0.035 to 0.090
Gregg Branch	0.045 to 0.050	0.090
Haw Creek	0.020 to 0.060	0.040 to 0.120
Herron Cove Branch	0.050	0.050 to 0.090
Hogeye Branch	0.040 to 0.050	0.050 to 0.090
Hominy Creek	0.035 to 0.060	0.020 to 0.150
Hominy Creek Tributary 21	0.040	0.070
Hominy Creek Tributary 25	0.050	0.070
Indian Camp Branch	-8888.000	-8888.000
Ivy Creek	0.040 to 0.060	0.025 to 0.160
Killian Branch	0.040 to 0.060	0.050 to 0.090
Lee Creek	0.040 to 0.055	0.030 to 0.015
Little Ivy Creek	0.040 to 0.100	0.030 to 0.100
Little Piney Branch	0.050	0.035 to 0.090
Little Sandymush Creek	0.045 to 0.060	0.030 to 0.900
Long Branch (into Beetree Creek)	0.050	0.050 to 0.090

PRELIMINARY DESIGN AND ASSESSMENT OF
STREAM CROSSINGS AND ENCROACHMENTS

COUNTY Buncombe PROJECT NUMBER I-4400/I-4700

STREAM French Broad River ROUTE I-26

ASSESSMENT PREPARED BY HNTB Corporation DATE _____

HYDROLOGIC EVALUATION

NEAREST GAGING STATION ON THIS STREAM Yes- USGS 03447687

ARE FLOOD STUDIES AVAILABLE ON THIS STREAM: Yes

FLOOD DATA:
Q10 18000 CFS EST BKWTR. -FT. Q25 24000 CFS EST BKWTR. -FT.
Q50 28000 CFS EST BKWTR. -FT. Q100 32000 CFS EST BKWTR. -FT.
Q500 42000 CFS OR OVERTOPPING CFS EST BKWTR. -FT.

DRAINAGE AREA 678 Sq. Miles

METHOD USED TO COMPUTE Q USGS Urban Regression

PROPERTY RELATED EVALUATIONS

DAMAGE POTENTIAL: LOW X MODERATE _____ HIGH _____

COULD THIS BE SIGNIFICANTLY INCREASED BY PROPOSED

ENCROACHMENT: YES _____ NO X

EXPLANATION: Limited changes will be made to this site.

_____

LIST BUILDINGS IN FLOOD PLAIN None LOCATION N/A

FLOOR ELEVATION Unknown

UPSTREAM LAND USE Urban

ANTICIPATE ANY CHANGE? No

ANY FLOOD ZONING? (FIS STUDIES, ETC.) YES X NO ____

TYPE OF STUDY FEMA Detailed

BASE FLOOD ELEVATION 2011 ft(100 YEAR)

REGULATORY FLOODWAY WIDTH 640 (AS NOTED IN FIS STUDIES)

COMMENTS: Cross Section 8280

TRAFFIC RELATED EVALUATIONS

PRESENT YEAR 2011 TRAFFIC COUNT 91200 VPD % TRUCKS 14

DESIGN YEAR 2040 TRAFFIC COUNT 90500 VPD % TRUCKS 14

EMERGENCY ROUTE _____ SCHOOL BUS ROUTE _____ MAIL ROUTE _____

DETOUR AVAILABLE? _____ LENGTH OF DETOUR _____ MILES

DOES THE LEVEL OF TRAFFIC SERVICE OF AN EXISTING CROSSING VARY GREATLY FROM STANDARD DESIGN LEVELS? _____

_____

IS THE TRAFFIC VOLUME, TYPE, USAGE SUCH TO WARRANT CONSIDERATION FOR VARIANCE FROM STANDARDS OR EXISTING LEVEL OF INTERRUPTION?

_____

COMMENTS: _____

_____

HIGHWAY AND BRIDGE (CULVERT) RELATED EVALUATIONS

NOTE ANY OUTSIDE FEATURES WHICH MIGHT AFFECT STAGE, DISCHARGE OR FREQUENCY.

LEVEES _____ AGGRADATION/DEGRADATION _____ RESERVOIRS ____

DIVERSIONS _____ DRAINAGE DISTRICT _____ NAVIGATION _____

BACKWATER FROM ANOTHER SOURCE French Broad River

EXPLANATION: _____

_____

_____

ROADWAY OVERFLOW SECTION (NONE __) LENGTH _____ ELEVATION _____

EMBANKMENT: SOIL TYPE Udorthents-Urban Land Complex

TYPE SLOPE COVER Vegetated

COMMENTS: USDS Soil Map NC021

ENVIRONMENTAL CONSIDERATIONS

LIST SPECIAL CONDITIONS OR CONSIDERATIONS WHICH AFFECT HYDRAULIC DESIGN (NONE _____)

_____

_____

MISCELLANEOUS COMMENTS

IS THERE UNUSUAL SCOUR POTENTIAL? YES _ NO X PROTECTION NEEDED _

ARE BANKS STABLE? Yes PROTECTION NEEDED _

DOES STREAM CARRY APPRECIABLE AMOUNT OF LARGE DEBRIS? No

COMMENTS:

_____

_____

_____

ALTERNATIVES

RECOMMENDED DESIGN Retain Existing Structure

DETOUR STRUCTURE N/A

WERE OTHER HYDRAULIC ALTERNATES CONSIDERED? YES _____ NO X

THIS SITE ASSESSMENT INDICATES THE DESIGN SHOULD FOLLOW:

(1) X NORMAL PROCESS

(2) _____ NORMAL PROCESS WITH SPECIAL SPECIFIC CONSIDERATION FOR

_____

(3) _____ SPECIFIC DESIGN PROCESS WITH APPROPRIATE RISK/ECONOMIC EVALUATION ADDRESSING: _____

NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
BRIDGE MANAGEMENT UNIT

ATTENTION

BRIDGE INSPECTION REPORT

INSPECTION TYPE: Routine Inspection

COUNTY BUNCOMBE BRIDGE NUMBER 100211 INSPECTION CYCLE 2 YRS 34.4

ROUTE I-26 WBL ACROSS FRENCH BRD.RV,PRIVATE RD M.P. 34400

LOCATION .6 MI.E.JCT.SR3482

SUPERSTRUCTURE REINFORCED CONCRETE FLOOR ON I-BEAMS

SUBSTRUCTURE E.BTS:RC CAPS/H-PILES;INT.BTS:RC POST&BEAM @ 5'-10 CENTERS

SPANS 1 @ 74'-5.25,4 @ 73',1 @ 74'-5.25

LONGITUDE 82° 35' 3.8" LATITUDE 35° 30' 46.6"

PRESENT CONDITION FAIR INVENTORY RATING

INSPECTION DATE 04/24/2012 OPERATING RATING

PRESENT POSTING Not Posted PROPOSED POSTING

COMPUTER UPDATE ANALYSIS DATE

POSTING LETTER DATE SUFFICIENCY RATING

OTHER SIGNS PRESENT NONE

EAST

SIGN NOTICE ISSUED FOR		NUMBERED REQUIRED
No	WEIGHT LIMIT	
No	DELINEATORS	
No	NARROW BRIDGE	
No	ONE LANE BRIDGE	
No	LOW CLEARANCE	

NATIONAL BRIDGE INVENTORY-------- STRUCTURE INVENTORY AND APPRAISAL Run Date: 05/22/2012

IDENTIFICATION

(1) STATE NAME -NORTH CAROLINA BRIDGE 100211
(8) STRUCTURE NUMBER(FEDERAL) 000000000210211
(5) INVENTORY ROUTE (ON/UNDER) - ON 11000260
(2) STATE HIGHWAY DEPARTMENT DISTRICT 2
(3) COUNTY CODE 21 (4) PLACE CODE 0
(6) FEATURE INTERSECTED - FRENCH BRD.RV,PRIVATE RD
(7) FACILITY CARRIED I-26 WBL
(9) LOCATION .6 MI.E.JCT.SR3482
(11)MILEPOINT 34400
(16)LAT 35° 30' 46.7" (17)LONG 82° 35' 4.0"
(98)BORDER BRIDGE STATE CODE PCT SHARE
(99)BORDER BRIDGE STRUCTURE NO

STRUCTURE TYPE AND MATERIAL

(43) STRUCTURE TYPE MAIN: Steel
TYPE - Stringer Mutlibeam or Girder CODE 302
(44) STRUCTURE TYPE APPR :
TYPE - CODE 000
(45) NUMBER OF SPANS IN MAIN UNIT 6
(46) NUMBER OF APPROACH SPANS
(107)DECK STRUCTURE TYPE - 1 CODE
(108)WEARING SURFACE / PROTECTIVE SYSTEM :
(A) TYPE OF WEARING SURFACE - CODE
(B) TYPE OF MEMBRANE - CODE
(C) TYPE OF DECK PROTECTION - CODE

AGE AND SERVICE

(27) YEAR BUILT 1967
(106)YEAR RECONSTRUCTED
(42) TYPE OF SERVICE : ON - Highway
UNDER - Highway - Waterway CODE 16
(28) LANES: ON STRUCTURE 2 UNDER STRUCTURE 1
(29) AVERAGE DAILY TRAFFIC 37000
(30) YEAR OF ADT 2010 (109) TRUCK ADT PCT 16%
(19) BYPASS OR DETOUR LENGTH 1 MI

GEOMETRIC DATA

(48) LENGTH OF MAXIMUM SPAN 74 FT
(49) STRUCTURE LENGTH 441 FT
(50)CURB OR SIDEWALK: LEFT 0 FT RIGHT 0 FT
(51) BRIDGE ROADWAY WIDTH CURB TO CURB 28 FT
(52) DECK WIDTH OUT TO OUT 33.4 FT
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS) 38 FT
(33) BRIDGE MEDIAN - No Median CODE 1
(34) SKEW 30° (35) STRUCTURE FLARED 0
(10) INVENTORY ROUTE MIN VERT CLEAR 999.9 FT
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR 28 FT
(53) MIN VERT CLEAR OVER BRIDGE RDWY 999.9 FT
(54) MIN VERT UNDERCLEAR REF Not a Highway or Railroad 0 FT
(55) MIN LAT UNDERCLEAR RT REF Not a Highway or Railroad 000 FT
(56) MIN LAT UNDERCLEAR LT REF - 000 FT

NAVIGATION DATA

(38) NAVIGATION CONTROL - No Navigational Control CODE 0
(111)PIER PROTECTION - CODE
(39) NAVIGATION VERTICAL CLEARANCE 0
(116)VERT - LIFT BRIDGE NAV MIN VERT CLEAR FT
(40) NAVIGATION HORIZONTAL CLEARANCE 0 FT

SUFFICIENCY RATING = 58.28
STATUS = Functionally Oboselete

CLASSIFICATION — CODE

(112)NBIS BRIDGE SYSTEM - YES
(104)HIGHWAY SYSTEM Is on the NHS 1
(26) FUNCTIONAL CLASS - Arterial - Interstate 11
(100)STRAHNET HIGHWAY - Interstate STRAHNET Route 1
(101)PARALLEL STRUCTURE - Left Parallel Structure L
(102)DIRECTION OF TRAFFIC - 1-way Traffic 1
(103)TEMPORARY STRUCTURE -
(110)DESIGNATED NATIONAL NETWORK - On the National Network 1
(20) TOLL On Free Road 3
(31) MAINTAIN - State Highway Agency 01
(22) OWNER - State Highway Agency 01
(37) HISTORICAL SIGNIFICANCE - Not Eligible 5

CONDITION — CODE

(58) DECK 7
(59) SUPERSTRUCTURE 5
(60) SUBSTRUCTURE 5
(61) CHANNEL & CHANNEL PROTECTION 7
(62) CULVERTS N

LOAD RATING AND POSTING — CODE

(31) DESIGN LOAD HS 20+MOD 6
(63) OPERATING RATING METHOD - Load Factor
(64) OPERATING RATING - HS-44 180
(65) INVENTORY RATING METHOD - Load Factor
(66) INVENTORY RATING - HS-27 148
(70) BRIDGE POSTING - No Posting Required 5
(41) STRUCTURE OPEN, POSTED ,OR CLOSED A
DESCRIPTION - Open, No Restriction

APPRAISAL — CODE

(67) STRUCTURAL EVALUATION 5
(68) DECK GEOMETRY 3
(69) UNDERCLEARANCES,VERTI & HORIZ 3
(71) WATERWAY ADEQUACY 7
(72) APPROACH ROADWAY ALIGNMENT 7
(36) TRAFFIC SAFETY FEATURES 1111
(113)SCOUR CRITICAL BRIDGES 8

PROPOSED IMPROVEMENTS

(75) TYPE OF WORK - CODE
(76) LENGTH OF STRUCTURE IMPROVEMENT
(94) BRIDGE IMPROVEMENT COST
(95) ROADWAY IMPROVEMENT COST
(96) TOTAL PROJECT COST
(97) YEAR OF IMPROVEMENT COST ESTIMATE
(114)FUTURE ADT 74000 (115) YEAR FUTURE ADT 2025

INSPECTIONS

(90) INSPECTION DATE 04/24/2012
(92) CRITICAL FEATURE INSPECTION : (93) CFI DATE
A) FRACTURE CRIT DETAIL - NO A)
B) UNDERWATER INSP - YES 48Mo B) 08/01/2010
C) OTHER SPECIAL INSP NO C)
SCOUR

Structure No: 100211 County: BUNCOMBE Run Date:

Span Number	Feature Intersected	Inventory Route	Minimum Maximum Vertical Clearance	Milepoint	Base Highway Network	LRS Inventory Route	Toll	Functional Classification	Numer of Lanes	Average Daily Traffic	Year of Average Daily Traffic	Total Horizontal Clearance	See Note 1					STRAHNET Highway Designator	Direction of Traffic	Highway System of Route
													Reference Feature	Minimum Vertical Underclearance	Right Lateral Underclearance	Left Lateral Underclearance	Underclearance Appraisal Grade			
	6	5	10	11	12	13	20	26	28	29	30	47	54A	54	55	56	69	100	102	104
6	PRIVATE RD	80000000	15.3330	0	0			9	2			38.70	H	15.3330	3.3330		9	0	2	

Note 1: Items 54, 55, and 56 are not reported FHWA under route data points but are collected for each under route to determine the minimum value for Underclearance Appraisal Item 69. The under route that generates the lowest Underclearance Appraisal value will be reported on the Facility Carried record.

BRIDGE MANAGEMENT UNIT

DATA ON EXISTING STRUCTURE Run Date: 05/22/2012

COUNTY : BUNCOMBE
DIVISION : 13
DISTRICT: 2
STRUCTURE NUMBER : 100211
LENGTH : 441 FEET

ROUTE CARRIED : I-26 WBL
FEATURE INTERSECTED : FRENCH BRD.RV,PRIVATE RD

LOCATED : .6 MI.E.JCT.SR3482
BRIDGE NAME :
CITY :

FUNC. CLASS : 11
SYST.ON : FA
SYST.UNDER : NFA
ADT & YR : 37000 2010
RAIL TYPE : LT 713 RT 713

BUILT : 1967
BY : SHC
PROJ : 8.1900301
FED.AID PROJ : I-2500
DESIGN LOAD : HS 20+MOD

REHAB :
BY :
PROJ :
ALIGNMENT : TAN
SKEW : 120
LANES : ON 2 UNDER 1

NAVIGATION : VC 0 FT HC 0 FT
HT. CRN. TO BED : 33 FT
WATER DEPTH : 6 FT

SUPERSTRUCTURE : REINFORCED CONCRETE FLOOR ON I-BEAMS

SUBSTRUCTURE : E.BTS:RC CAPS/H-PILES;INT.BTS:RC POST&BEAM @ 5'-10 CENTERS

SPANS : 1 @ 74'-5.25,4 @ 73',1 @ 74'-5.25

BEAMS OR GIRDERS : 4 LINES 36 I-BEAMS @ 8' CENTERS

FLOOR : 7.75 RC/3.5 AWS
ENCROACHMENT :
DECK (OUT TO OUT) : 33.4 FT

CLEAR ROADWAY : 28 FT
BETWEEN RAILS : 28 FT
SIDEWALK OR CURB : LT 0 FT RT 0 FT

VERT.CL.OVER : 999.9 FT

INV.RTG. : HS-27
OPE.RTG. : HS-44
CONTR.MEMBER : Int.bmsSpA
POSTED : SV TTST DATE

SYSTEM : Primary Interstate
GREEN LINE ROUTE : Y

UNDER ROUTES AND CLEARANCES

Span	Route Description	Vertical Clearances		Horizontal Clearances		
		MMVC	MVC	Total	Left	Right
6	PRIVATE RD	15.3330	15.3330	38.70		3.3330

Note: All measurements are in feet.

REMARKS :

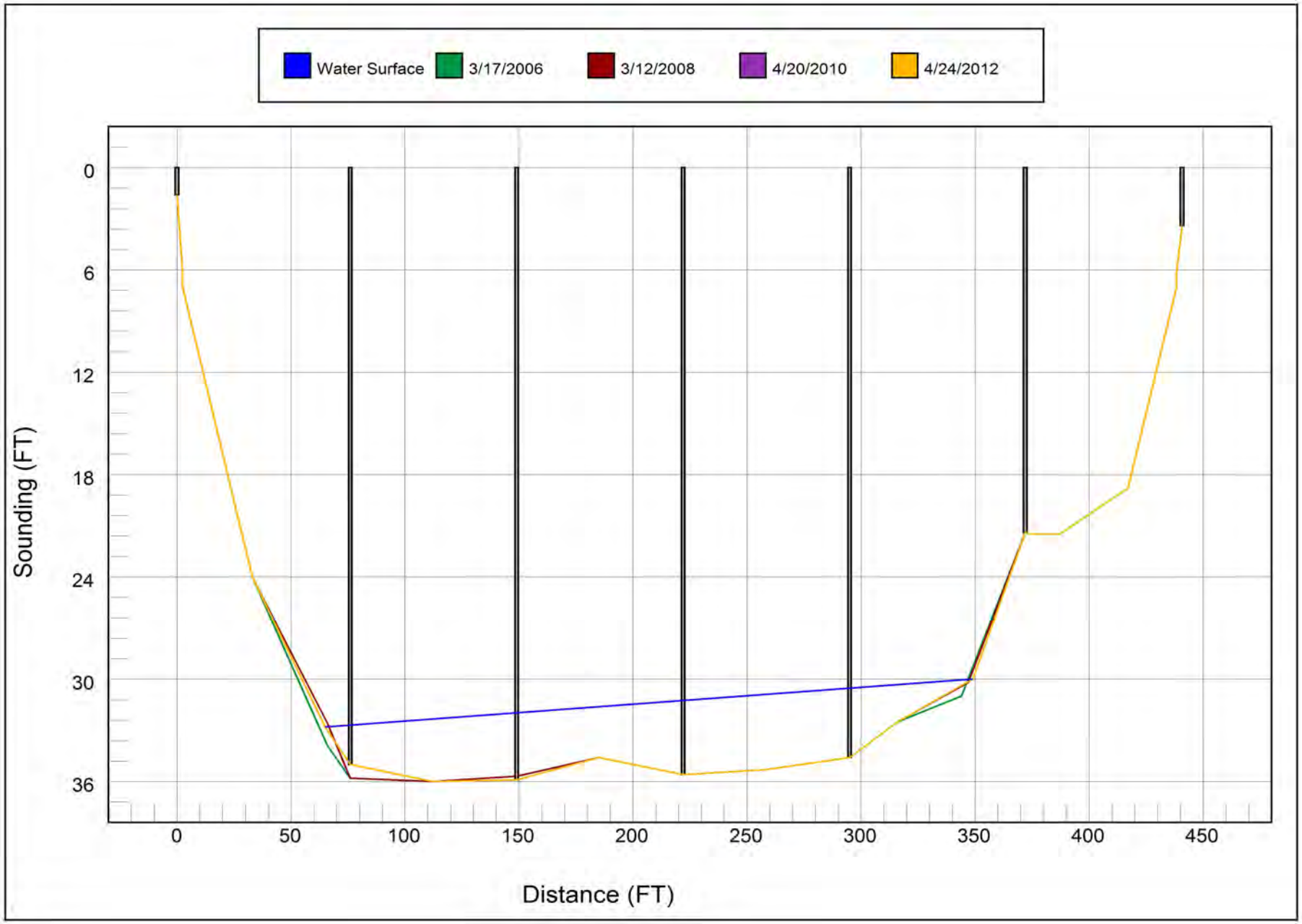
TREE @ THE UP STREAM SIDE @ INTERIOR BENT #4

DAMAGE TO BOTH RAILS (LEFT RAIL)

Bridge: 100211 County BUNCOMBE Date: 04/24/2012

STREAMBED PROFILE (Downstream)

Top of Rail = 0 FT (Sounding)



WEST

NAME PLATE

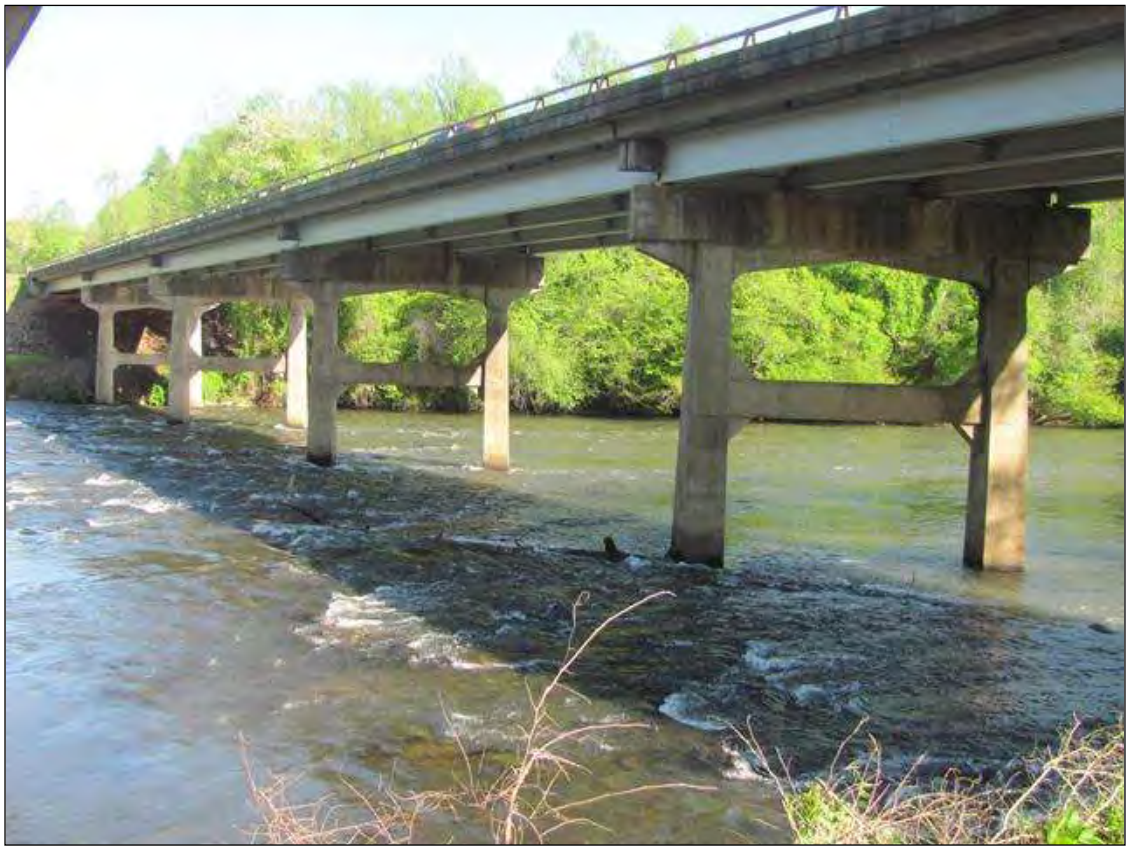
REP OF ABUTMENT (ABUTMENT #2)

REP OF INTERIOR BENT (INTERIOR BENT #4 / EAST FACE)

LOOKING SOUTH ON PRIVATE ROAD IN SPAN #6

LOOKING NORTH ON PRIVATE ROAD IN SPAN #6

Structure 100211 County BUNCOMBE Date: 04/24/2012 Structure Photos



DOWN STREAM NORTH

UP STREAM SOUTH

APPROACH GUARDRAIL LOOKING EAST

UP STREAM SOUTH

DOWN STREAM NORTH

APPROACH GUARDRAIL LOOKING WEST

REP OF CONTINOUS APPROACH GUARDRAIL

EAST

REP OF APPROACH GUARDRAIL POST SPACING @ BRIDGE (SOUTH WEST)

REP OF APPROACH GUARDRAIL POST SPACING OUT FROM BRIDGE (SOUTH WEST)

NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
BRIDGE MANAGEMENT UNIT

ATTENTION PRIORITY MAINTENANCE X 2 (LEFT BRIDGE RAIL, SPALLING CENTER DIAPHRAGM INT. BENT 2)

BRIDGE INSPECTION REPORT

INSPECTION TYPE: Routine Inspection

COUNTY BUNCOMBE BRIDGE NUMBER 100214 INSPECTION CYCLE 2 YRS 34.4

ROUTE I-26 EBL ACROSS FRENCH BROAD RVR,PVT.RD. M.P. 34400

LOCATION .6 MI.S.JCT.SR3482

SUPERSTRUCTURE REINFORCED CONCRETE FLOOR ON I-BEAMS

SUBSTRUCTURE E.BTS:RC CAPS/H-PILES;INT.BTS:RC POST&BEAM

SPANS 1 @ 87',4 @ 73', 1 @ 74'-5.25

LONGITUDE 82° 35' 6.2" LATITUDE 35° 30' 46.8"

PRESENT CONDITION FAIR INVENTORY RATING

INSPECTION DATE 04/23/2012 OPERATING RATING

PRESENT POSTING Not Posted PROPOSED POSTING

COMPUTER UPDATE ANALYSIS DATE

POSTING LETTER DATE SUFFICIENCY RATING

OTHER SIGNS PRESENT NONE

EAST

SIGN NOTICE ISSUED FOR		NUMBERED REQUIRED
No	WEIGHT LIMIT	
No	DELINEATORS	
No	NARROW BRIDGE	
No	ONE LANE BRIDGE	
No	LOW CLEARANCE	

NATIONAL BRIDGE INVENTORY-------- STRUCTURE INVENTORY AND APPRAISAL Update Date: 07/02/2012

IDENTIFICATION

(1) STATE NAME -NORTH CAROLINA BRIDGE **100214**
(8) STRUCTURE NUMBER(FEDERAL) 000000000210214
(5) INVENTORY ROUTE (ON/UNDER) - ON 11000260
(2) STATE HIGHWAY DEPARTMENT DISTRICT 2
(3) COUNTY CODE 21 (4) PLACE CODE 0
(6) FEATURE INTERSECTED - FRENCH BROAD RVR,PVT.RD.
(7) FACILITY CARRIED I-26 EBL
(9) LOCATION .6 MI.S.JCT.SR3482
(11)MILEPOINT 34.4
(16)LAT 35° 30' 46.2" (17)LONG 82° 35' 4.6"
(98)BORDER BRIDGE STATE CODE PCT SHARE
(99)BORDER BRIDGE STRUCTURE NO

STRUCTURE TYPE AND MATERIAL

(43) STRUCTURE TYPE MAIN: Steel
TYPE - Stringer Mutlibeam or Girder CODE 302
(44) STRUCTURE TYPE APPR :
TYPE - CODE 000
(45) NUMBER OF SPANS IN MAIN UNIT 6
(46) NUMBER OF APPROACH SPANS
(107)DECK STRUCTURE TYPE - 1 CODE
(108)WEARING SURFACE / PROTECTIVE SYSTEM :
(A) TYPE OF WEARING SURFACE - CODE
(B) TYPE OF MEMBRANE - CODE
(C) TYPE OF DECK PROTECTION - CODE

AGE AND SERVICE

(27) YEAR BUILT 1967
(106)YEAR RECONSTRUCTED
(42) TYPE OF SERVICE : ON - Highway
UNDER - Highway - Waterway CODE 16
(28) LANES: ON STRUCTURE 2 UNDER STRUCTURE 1
(29) AVERAGE DAILY TRAFFIC 37000
(30) YEAR OF ADT 2010 (109) TRUCK ADT PCT 16%
(19) BYPASS OR DETOUR LENGTH 1 MI

GEOMETRIC DATA

(48) LENGTH OF MAXIMUM SPAN 86 FT
(49) STRUCTURE LENGTH 453 FT
(50)CURB OR SIDEWALK: LEFT 0 FT RIGHT 0 FT
(51) BRIDGE ROADWAY WIDTH CURB TO CURB 28 FT
(52) DECK WIDTH OUT TO OUT 33.4 FT
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS) 38 FT
(33) BRIDGE MEDIAN - No Median CODE 1
(34) SKEW 30° (35) STRUCTURE FLARED 0
(10) INVENTORY ROUTE MIN VERT CLEAR 999.9 FT
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR 28 FT
(53) MIN VERT CLEAR OVER BRIDGE RDWY 999.9 FT
(54) MIN VERT UNDERCLEAR REF Not a Highway or Railroad 0 FT
(55) MIN LAT UNDERCLEAR RT REF Not a Highway or Railroad 000 FT
(56) MIN LAT UNDERCLEAR LT REF - 000 FT

NAVIGATION DATA

(38) NAVIGATION CONTROL - No Navigational Control CODE 0
(111)PIER PROTECTION - CODE
(39) NAVIGATION VERTICAL CLEARANCE 0
(116)VERT - LIFT BRIDGE NAV MIN VERT CLEAR FT
(40) NAVIGATION HORIZONTAL CLEARANCE 0 FT

SUFFICIENCY RATING = 62.63
STATUS = Functionally Obsolete

CLASSIFICATION — CODE

(112)NBIS BRIDGE SYSTEM - YES
(104)HIGHWAY SYSTEM Is on the NHS 1
(26) FUNCTIONAL CLASS - Arterial - Interstate 11
(100)STRAHNET HIGHWAY - Interstate STRAHNET Route 1
(101)PARALLEL STRUCTURE - Right Parallel Structure R
(102)DIRECTION OF TRAFFIC - 1-way Traffic 1
(103)TEMPORARY STRUCTURE -
(110)DESIGNATED NATIONAL NETWORK - On the National Network 1
(20) TOLL On Free Road 3
(31) MAINTAIN - State Highway Agency 01
(22) OWNER - State Highway Agency 01
(37) HISTORICAL SIGNIFICANCE - Not Eligible 5

CONDITION — CODE *

(58) DECK 5
(59) SUPERSTRUCTURE 5
(60) SUBSTRUCTURE 5
(61) CHANNEL & CHANNEL PROTECTION 5
(62) CULVERTS N

LOAD RATING AND POSTING — CODE *

(31) DESIGN LOAD HS 20 + MOD 6
(63) OPERATING RATING METHOD - Load Factor
(64) OPERATING RATING - HS-44 180
(65) INVENTORY RATING METHOD - Load Factor
(66) INVENTORY RATING - HS-27 148
(70) BRIDGE POSTING - No Posting Required 5
(41) STRUCTURE OPEN, POSTED ,OR CLOSED A
DESCRIPTION - Open, No Restriction

APPRAISAL — CODE

(67) STRUCTURAL EVALUATION 5
(68) DECK GEOMETRY 3
(69) UNDERCLEARANCES,VERTI & HORIZ 9
(71) WATERWAY ADEQUACY 7
(72) APPROACH ROADWAY ALIGNMENT 7
(36) TRAFFIC SAFETY FEATURES 1111
(113)SCOUR CRITICAL BRIDGES 8

PROPOSED IMPROVEMENTS

(75) TYPE OF WORK - CODE
(76) LENGTH OF STRUCTURE IMPROVEMENT
(94) BRIDGE IMPROVEMENT COST
(95) ROADWAY IMPROVEMENT COST
(96) TOTAL PROJECT COST
(97) YEAR OF IMPROVEMENT COST ESTIMATE
(114)FUTURE ADT 74000 (115) YEAR FUTURE ADT 2025

INSPECTIONS

(90) INSPECTION DATE 04/23/2012
(92) CRITICAL FEATURE INSPECTION : (93) CFI DATE
A) FRACTURE CRIT DETAIL - NO A)
B) UNDERWATER INSP - YES 48Mo B) 08/01/2010
C) OTHER SPECIAL INSP NO C)
SCOUR

Structure No: 100214 County: BUNCOMBE Run Date:

Span Number	Feature Intersected	Inventory Route	Minimum Maximum Vertical Clearance	Milepoint	Base Highway Network	LRS Inventory Route	Toll	Functional Classification	Numer of Lanes	Average Daily Traffic	Year of Average Daily Traffic	Total Horizontal Clearance	See Note 1					STRAHNET Highway	Direction of Traffic	Highway System of Route
													Reference Feature	Minimum Vertical Underclearance	Right Lateral Underclearance	Left Lateral Underclearance	Underclearance Appraisal Grade			
	6	5	10	11	12	13	20	26	28	29	30	47	54A	54	55	56	69	100	102	104
6	PRIVATE RD	80000000	16.50	0	0			9	2	5	2010	54.8330	H	16.50	14.5830	0	9	0	2	0

Note 1: Items 54, 55, and 56 are not reported FHWA under route data points but are collected for each under route to determine the minimum value for Underclearance Appraisal Item 69. The under route that generates the lowest Underclearance Appraisal value will be reported on the Facility Carried record.

BRIDGE MANAGEMENT UNIT

DATA ON EXISTING STRUCTURE Update Date: 07/02/2012

COUNTY : BUNCOMBE
DIVISION : 13
DISTRICT: 2
STRUCTURE NUMBER : 100214
LENGTH : 453 FEET

ROUTE CARRIED : I-26 EBL
FEATURE INTERSECTED : FRENCH BROAD RVR,PVT.RD.

LOCATED : .6 MI.S.JCT.SR3482
BRIDGE NAME :
CITY :

FUNC. CLASS : 11
SYST.ON : FA
SYST.UNDER : NFA
ADT & YR : 37000 2010
RAIL TYPE : LT 713 RT 713

BUILT : 1967
BY : SHC
PROJ : 8.1900301
FED.AID PROJ : I-2500
DESIGN LOAD : HS 20 + MOD

REHAB :
BY :
PROJ :
ALIGNMENT : TAN
SKEW : 120
LANES : ON 2 UNDER 1

NAVIGATION : VC 0 FT HC 0 FT
HT. CRN. TO BED : 32 FT
WATER DEPTH : 5 FT

SUPERSTRUCTURE : REINFORCED CONCRETE FLOOR ON I-BEAMS

SUBSTRUCTURE : E.BTS:RC CAPS/H-PILES;INT.BTS:RC POST&BEAM

SPANS : 1 @ 87',4 @ 73', 1 @ 74'-5.25

BEAMS OR GIRDERS : 4 LINES 36 I-BEAMS @ 8' CENTERS

FLOOR : 7.75 RC/3.5 AWS
ENCROACHMENT :
DECK (OUT TO OUT) : 33.4 FT

CLEAR ROADWAY : 28 FT
BETWEEN RAILS : 28 FT
SIDEWALK OR CURB : LT 0 FT RT 0 FT

VERT.CL.OVER : 999.9 FT

INV.RTG. : HS-27
OPE.RTG. : HS-44
CONTR.MEMBER : int gd b
POSTED : SV TTST DATE

SYSTEM : Primary Interstate
GREEN LINE ROUTE : Y

UNDER ROUTES AND CLEARANCES

Span	Route Description	Vertical Clearances		Horizontal Clearances		
		MMVC	MVC	Total	Left	Right
6	PRIVATE RD	16.50	16.50	54.8330	0	14.5830

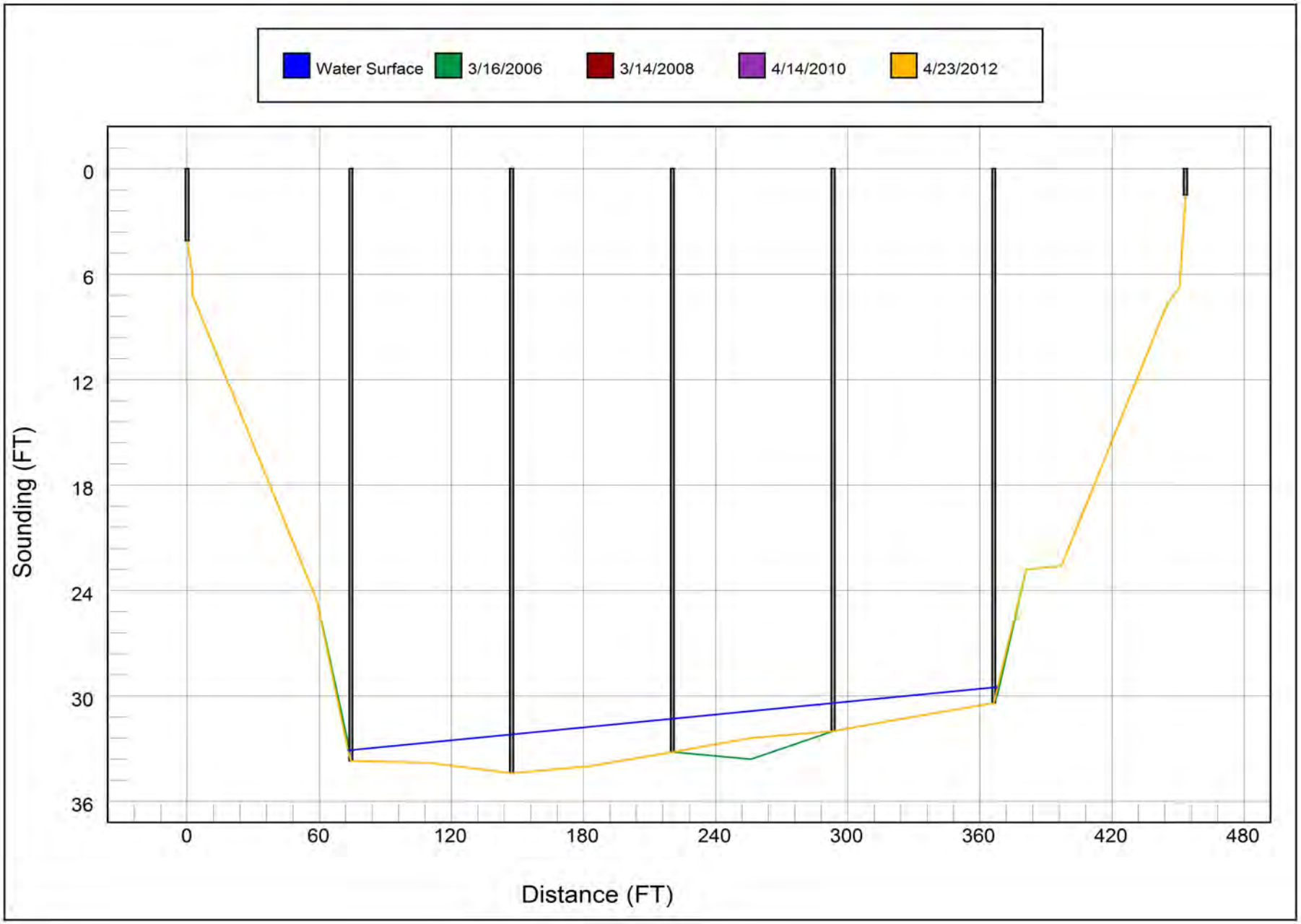
Note: All measurements are in feet.

REMARKS :

Bridge: 100214 County BUNCOMBE Date: 04/23/2012

STREAMBED PROFILE (Downstream)

Top of Rail = 0 FT (Sounding)



WEST

UP STREAM SOUTH

APPROACH GUARDRAIL LOOKING EAST

DOWN STREAM NORTH

APPROACH GUARDRAIL LOOKING WEST

EAST

NAME PLATE

REP OF APPROACH GUARDRAIL POST SPACING @ BRIDGE (SOUTH WEST)

REP OF APPROACH GUARDRAIL POST SPACING OUT FROM BRIDGE (SOUTH WEST)

REP OF CONTINOUS APPROACH GUARDRAIL (NORTH WEST)

DOWN STREAM NORTH

REP OF INTERIOR BENT (INTERIOR BENT #3 / WEST FACE)

UP STREAM SOUTH

REP OF ABUTMENT (ABUTMENT #2)

LOOKING SOUTH ON PRIVATE ROAD IN SPAN #6

LOOKING NORTH ON PRIVATE ROAD IN SPAN #6

Looking Upstream

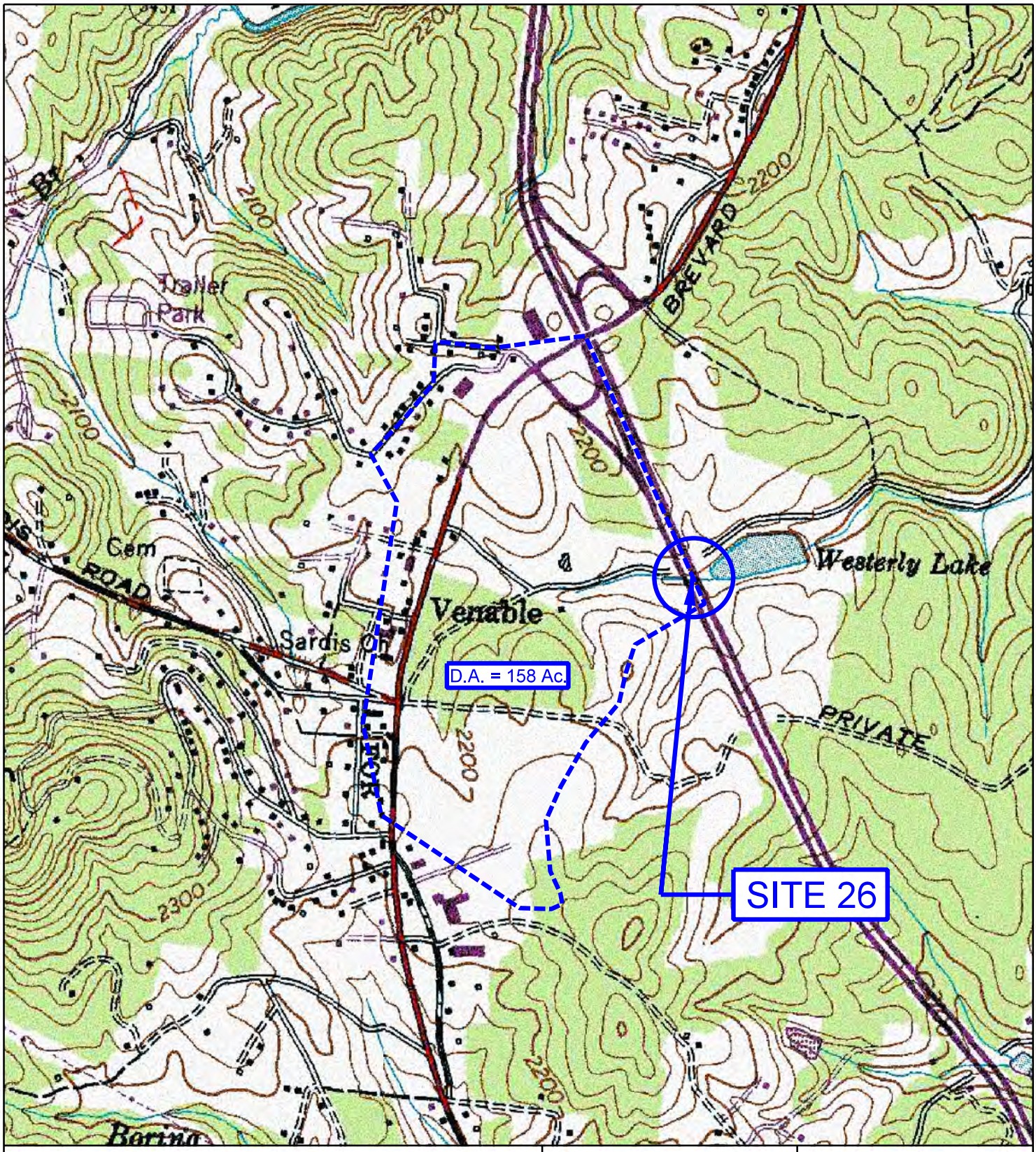
Looking Upstream

Looking at Downstream Face

Looking Downstream

APPENDIX CC

SITE 26



QUAD MAP - SITE 26

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 26

Stream Name: Long Valley Branch

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	0	0.0	0.000
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	0	0.0	0.000
High Density Residential	7 - 11	40%	0	0.0	0.000
Office / Institutional	-	55%	0	0.0	0.000
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	9	6.3	0.040
Business	-	85%	141	119.4	0.754
Commercial / Shopping Center	-	85%	9	7.6	0.048
Totals			**158**	**133.3**	**84.2%**

Drainage Area = 158 acres

Project: I-4400 / I-4700

Site #: 26

Stream Name: Long Valley Branch

Drainage Area (sq mi): 0.25

Impervious Area (%): 47.9%

The computed impervious area exceeds the applicable range for SIR 2014-5030 Equations of 47.9%, therefore 47.9% is used to compute site discharge values.

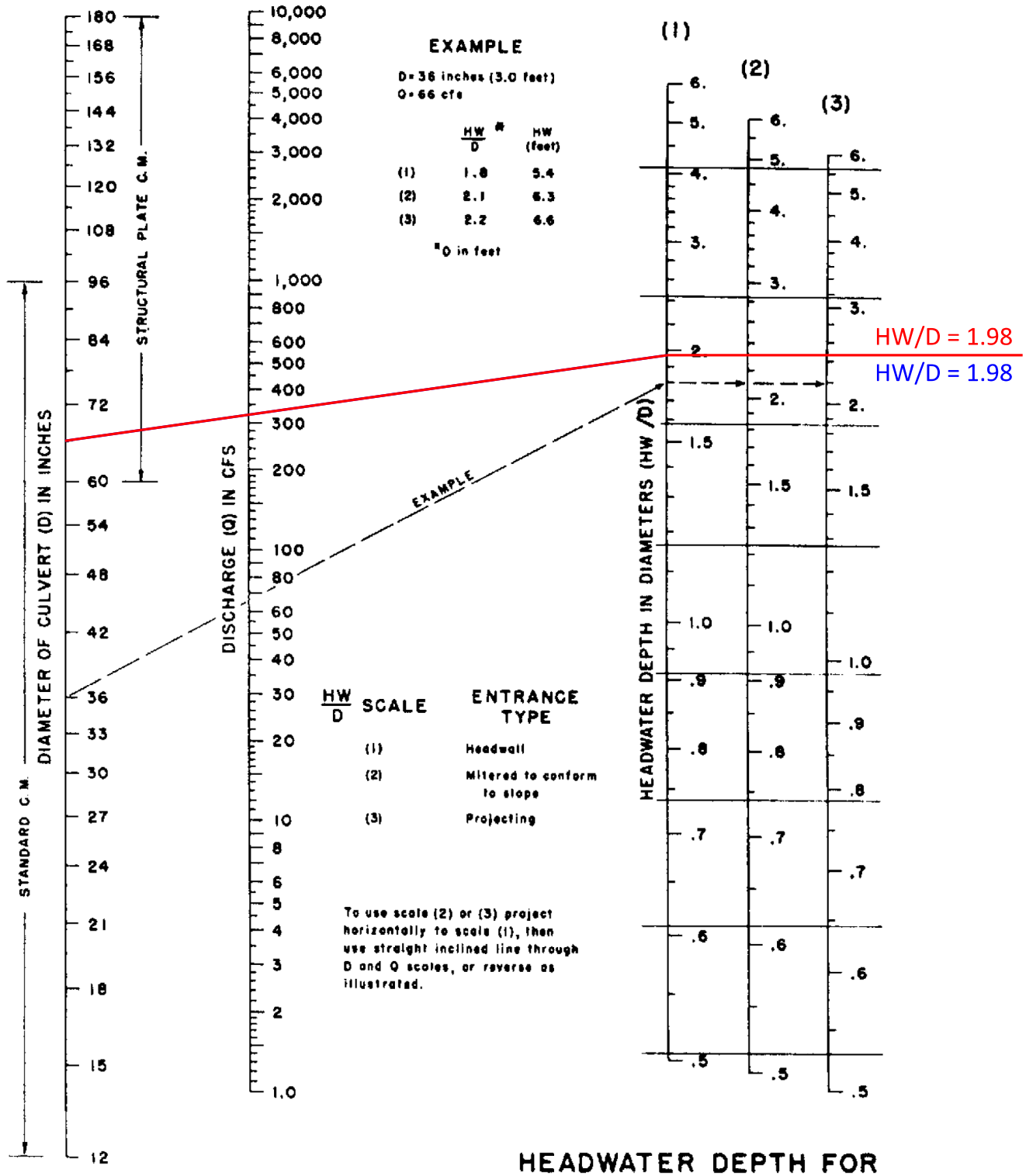
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	DISCHARGE (cfs)		
	PIEDMONT - RIDGE AND VALLEY	SAND HILLS	COASTAL PLAIN
2	263	-	-
5	293	-	-
10	308	-	-
25	315	-	-
50	315	-	-
100	319	-	-
200	318	-	-
500	334	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	DISCHARGE (cfs)
10	-
50	-
100	-
500	-

SITE 26

50 Year	100 Year
1 @ 66" STR. STEEL PIPE W/ HW	1 @ 66" STR. STEEL PIPE W/ HW
Q = 320 CFS	Q = 320 CFS

CHART 2B



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY BUNCOMBE PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/3/14

SITE NUMBER 26 STREAM LONG VALLEY BRANCH ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 66" STRUCTURAL PLATE PIPE WITH HEADWALL. SURFACE RUST BUT PIPE IS INTACT. DOWNSTREAM FACE IS PERCHED 4".

UPSTREAM CHANNEL: TOP WIDTH 15 FT BOTTOM WIDTH 5 FT BANKFULL DEPTH 4 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL

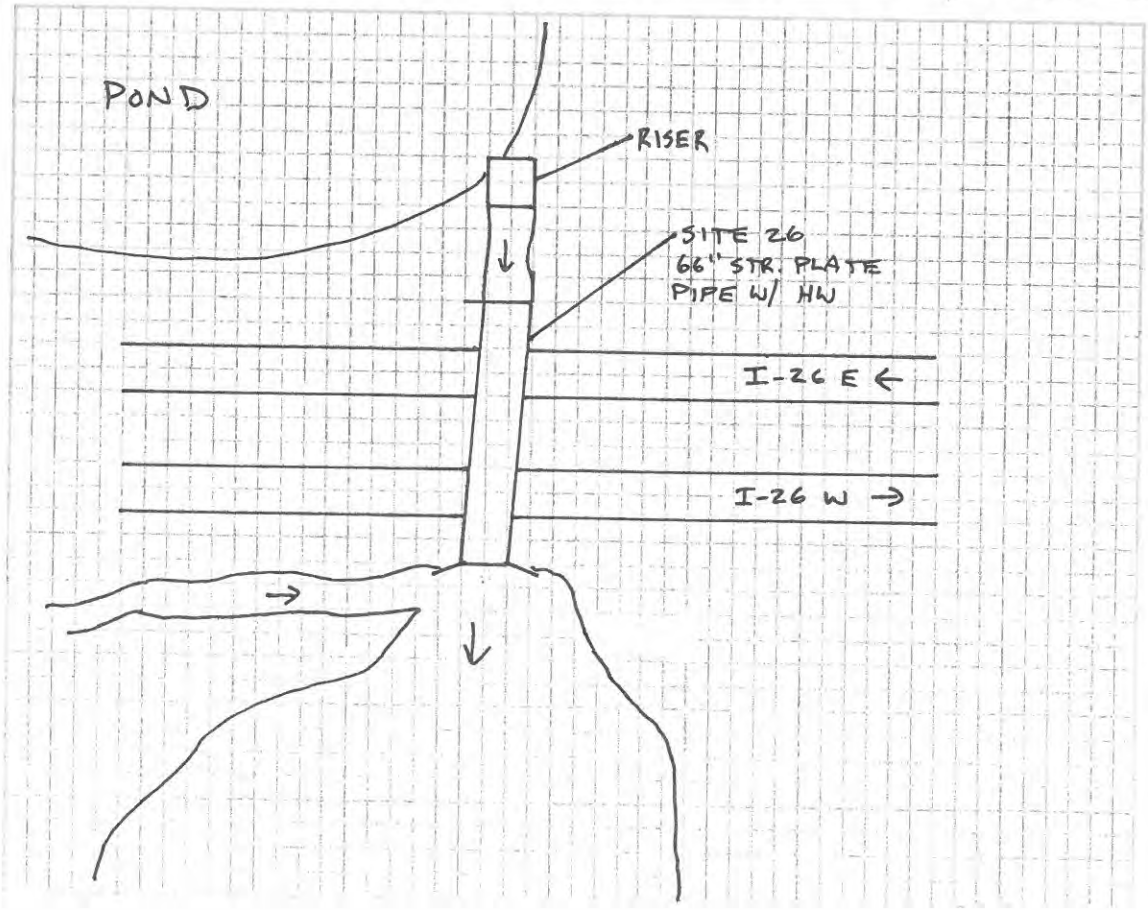
BANK/ CHANNEL CONDITIONS RIP RAP LINED CHANNEL. BANKS ARE STABLE AND VEGETATED

DOWNSTREAM CHANNEL: TOP WIDTH ____FT BOTTOM WIDTH ____FT BANKFULL DEPTH ____FT

DEPTH OF FLOW (AT TIME OF VISIT)_____FT BED MATERIAL

BANK/ CHANNEL CONDITIONS OVERFLOWED. FLOWS INTO WESTERLY LAKE.

COMMENTS APPROXIMATELY 350' LEFT OF THE STRUCTURE IS AN ABANDONED ROADWAY DRIVE ACTING AS AN OVERFLOW STRUCTURE (SIZE: 14'x14'). APPROXIMATELY 50' UPSTREAM OF THE STRUCTURE IS A 60" CMP WITH 90° WINGWALLS.



Looking at Upstream Face of 66" SPP with Headwall under I-26

Upstream Stormwater Pond

Looking Downstream Inside of 66" SPP

Looking at Downstream Face of 66" SPP with Headwall under I-26

Looking Downstream of 66" SPP

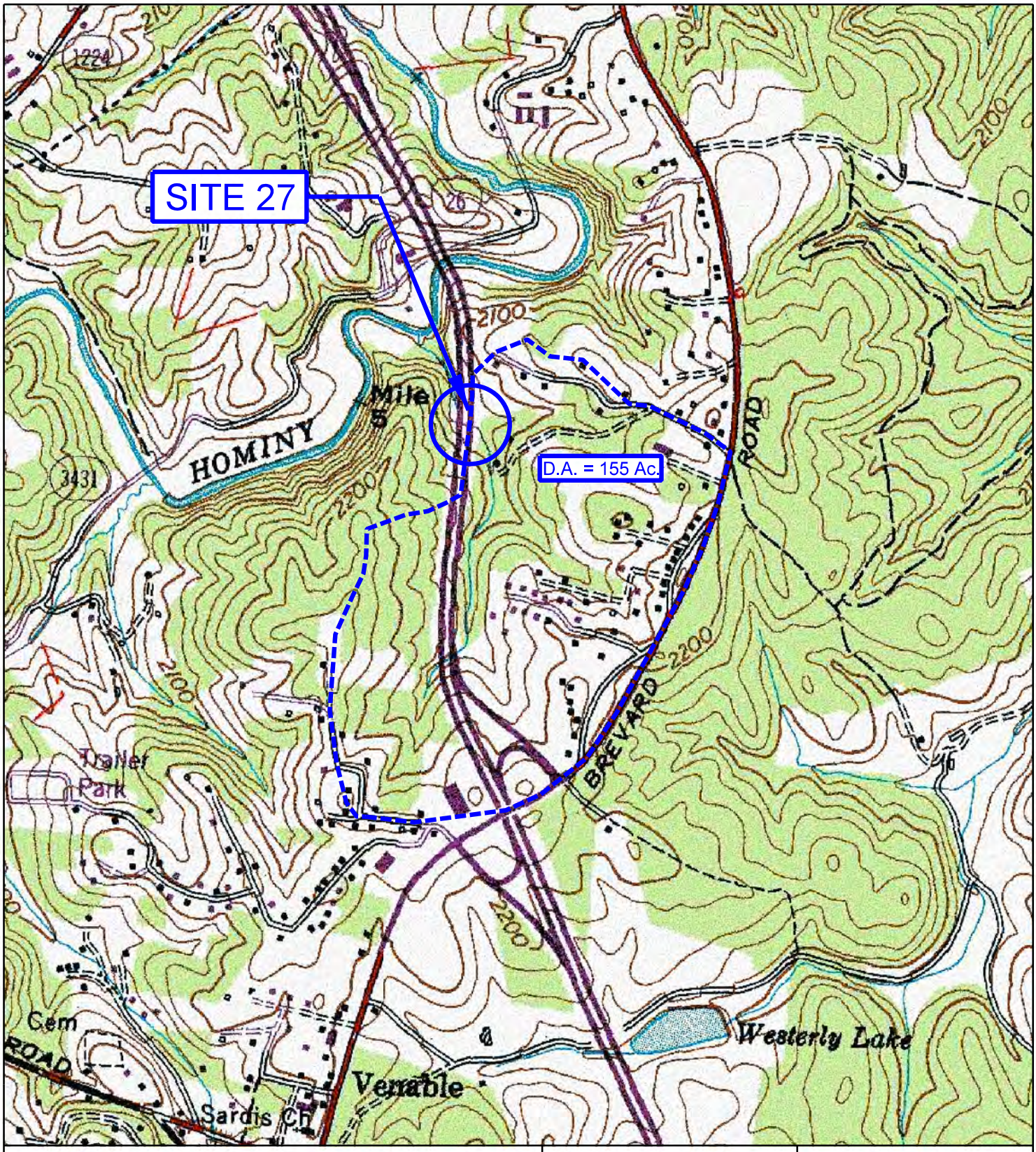
Upstream Side of Vehicular Underpass

Downstream Side of Vehicular Underpass

Looking Downstream from Vehicular Underpass

APPENDIX DD

SITE 27



QUAD MAP - SITE 27

T.I.P. No. I-4400/ I-4700
I-26 Improvements From US 25
in Hendersonville in Henderson County to
I-40/I-240 in Buncombe County
STIP Project I-4400/I-4700

500 0 500 1,000
SCALE:

5/7/2014

Project: I-4400 / I-4700

Site #: 27

Stream Name: UT to Hominy Creek

Zoning Classification	Dwelling Unit / Acre	% Impervious	Area (Ac)	%I * A	%IA / At
Open Space	-	0%	0	0.0	0.000
Low Density Residential	1 - 3	10%	2	0.2	0.001
Low - Medium Density Residential	2 - 5	20%	0	0.0	0.000
Medium Density Residential	4 - 6	30%	0	0.0	0.000
Medium - High Density Residential	5 - 9	35%	0	0.0	0.000
High Density Residential	7 - 11	40%	30	12.0	0.078
Office / Institutional	-	55%	22	12.0	0.078
Cities	-	55%	0	0.0	0.000
Industrial	-	70%	21	15.0	0.097
Business	-	85%	48	40.5	0.262
Commercial / Shopping Center	-	85%	32	27.0	0.175
Totals			**154**	**106.6**	**69.1%**

Drainage Area = 154 acres

Project: I-4400 / I-4700

Site #: 27

Stream Name: UT to Hominy Creek

Drainage Area (sq mi): 0.24

Impervious Area (%): 47.9%

The computed impervious area exceeds the applicable range for SIR 2014-5030 Equations of 47.9%, therefore 47.9% is used to compute site discharge values.

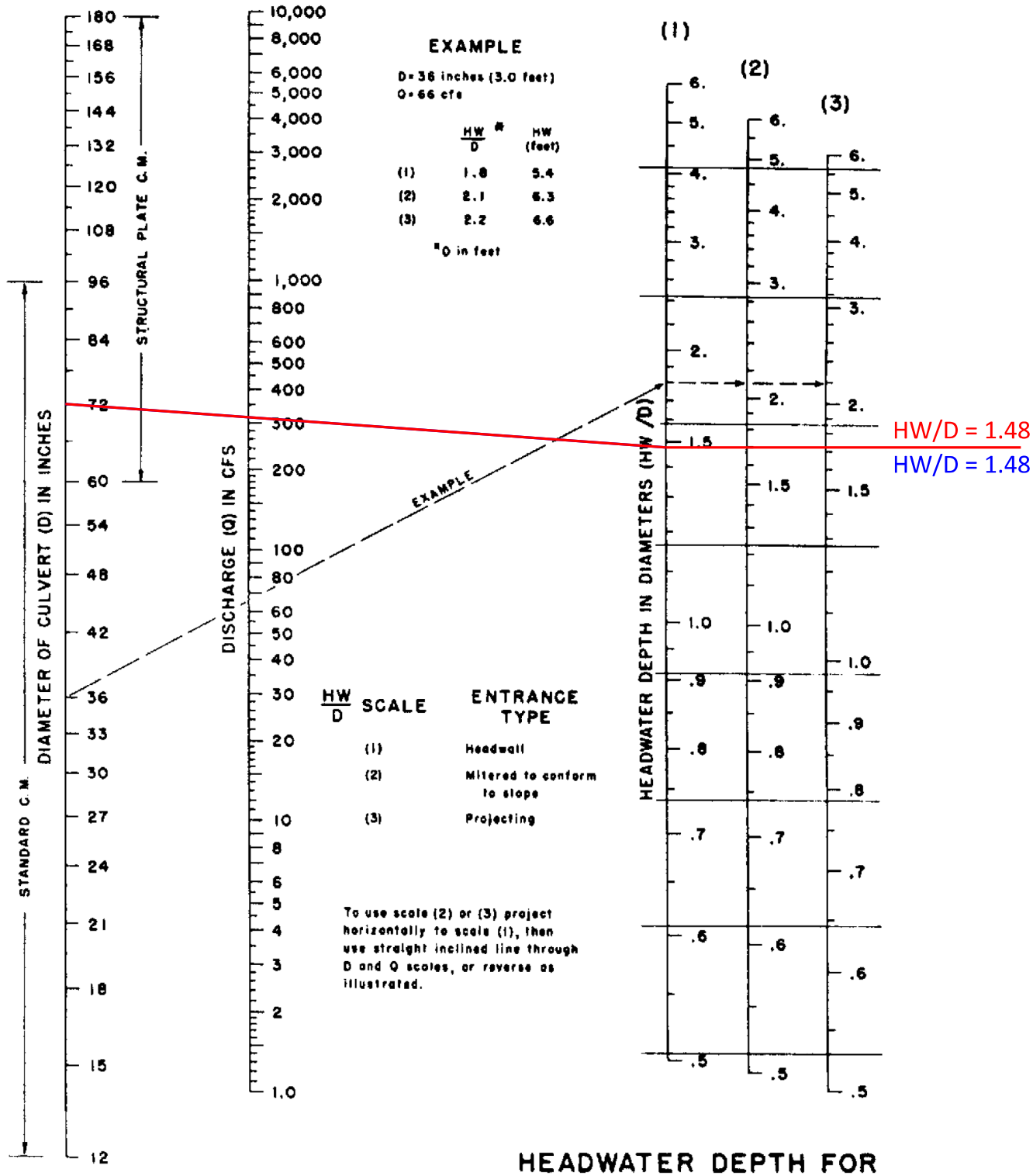
USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	DISCHARGE (cfs)		
	PIEDMONT - RIDGE AND VALLEY	SAND HILLS	COASTAL PLAIN
2	258	-	-
5	288	-	-
10	302	-	-
25	309	-	-
50	309	-	-
100	313	-	-
200	312	-	-
500	327	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	DISCHARGE (cfs)
10	-
50	-
100	-
500	-

SITE 27

50 Year	100 Year
1 @ 72" STR. STEEL PIPE W/ HW	1 @ 72" STR. STEEL PIPE W/ HW
Q = 310 CFS	Q = 310 CFS

CHART 2B



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

EXISTING

FIELD REVIEW FORM

COUNTY BUNCOMBE PROJECT NUMBER I-4400/I-4700 DATE OF VISIT 3/6/14

SITE NUMBER 27 STREAM UT TO HOMINY CREEK ROUTE I-26

ASSESSMENT PREPARED BY HNTB DATE

EXISTING SITE SUMMARY

BREIFLY DESCRIBE THE STRUCTURE: 72" STRUCTURAL PLATE PIPE WITH A HEADWALL. POOR CONDITION. RUSTED THROUGH IN SEVERAL PLACES THROUGHOUT THE PIPE

UPSTREAM CHANNEL: TOP WIDTH 14 FT BOTTOM WIDTH 7 FT BANKFULL DEPTH 4 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.2 FT BED MATERIAL

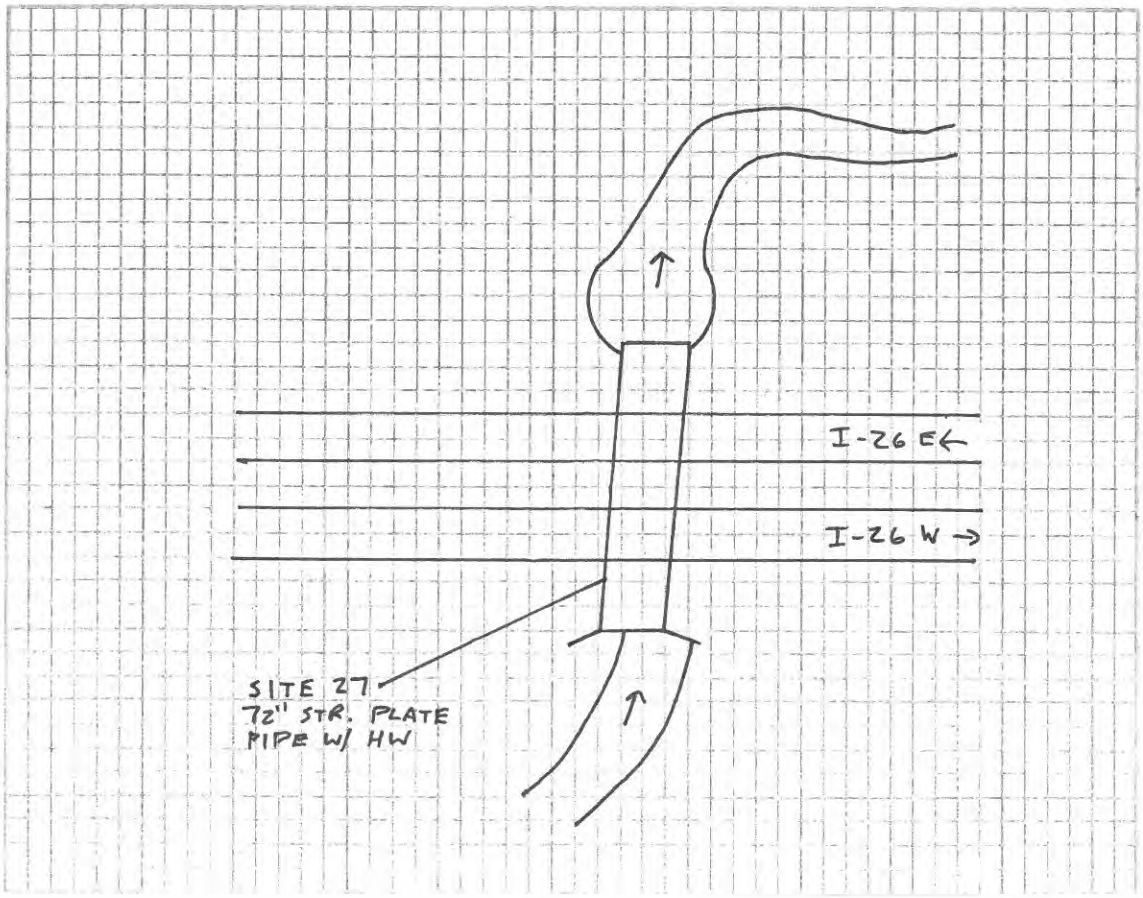
BANK/ CHANNEL CONDITIONS RIGHT BANK NEAR THE HEADWALL HAS UNDERMINED. THE REST OF THE BANKS ARE STABLE AND VEGETATED.

DOWNSTREAM CHANNEL: TOP WIDTH 13 FT BOTTOM WIDTH 5 FT BANKFULL DEPTH 3 FT

DEPTH OF FLOW (AT TIME OF VISIT) 0.5 FT BED MATERIAL

BANK/ CHANNEL CONDITIONS OUTLET IS PERCHED 2'. A SCOUR HOLE IS AT THE OUTLET AND IS 1.5' DEEP. LEFT SIDE OF THE CHANNEL IS ERODED. BANKS ARE VEGETATED.

COMMENTS THE UPSTREAM RIGHT CONCRETE DITCH HAS FAILED.



Looking at Upstream Face of 72" SPP with Headwall under I-26

Looking Upstream of 72" SPP

Looking at Upstream Right Concrete Ditch

Looking Downstream

Looking at the Bottom of the Pipe

Looking at Downstream Face of 72" SPP under I-26

Looking Downstream of 72" SPP

Looking Downstream of 72" SPP

APPENDIX EE

SITE 28

5/8/2014

Project: I-4400 / I-4700

Site #: 28

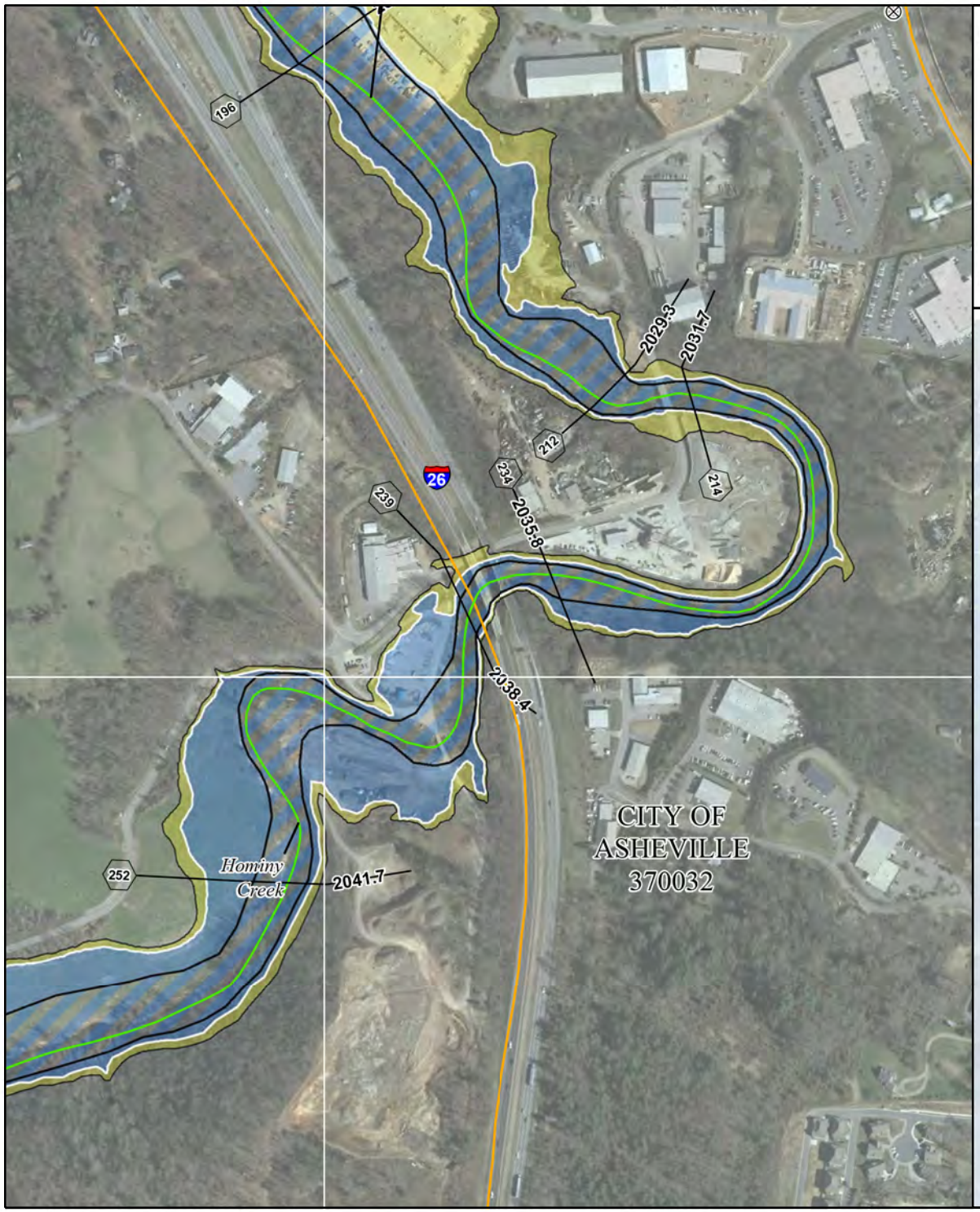
Stream Name: Hominy Creek

Drainage Area (sq mi): 94.60

Impervious Area (%): 1.9%

USGS URBAN REGRESSION EQUATIONS - USGS SIR 2014-5030			
FREQUENCY (YR)	**DISCHARGE (cfs)**		
	PIEDMONT - RIDGE AND VALLEY	**SAND HILLS**	**COASTAL PLAIN**
2	2812	-	-
5	4749	-	-
10	6176	-	-
25	8075	-	-
50	9536	-	-
100	11044	-	-
200	12621	-	-
500	14810	-	-

PUBLISHED FEMA DATA	
FREQUENCY (YR)	**DISCHARGE (cfs)**
10	5700
50	10900
100	14700
500	26000



Map Projection:
North Carolina State Plane Projection Feet (Zone 3200)
Datum: NAD 1983 (Horizontal), NAVD 1988 (Vertical)

1 inch = 500 feet 1:6,000

0 250 500 750 1,500 Feet

0 100 200 400 Meters

FEMA

National Flood Insurance Program

NORTH CAROLINA FLOODPLAIN MAPPING PROGRAM
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

BUNCOMBE COUNTY, NC
and Incorporated Areas

PANEL 9627

FEMA

Panel Contains:

COMMUNITY	CID	PANEL	SUFFIX
ASHEVILLE, CITY OF	370032	9627	J
BUNCOMBE COUNTY	370031	9627	J

Site 28

MAP NUMBER
3700962700J

EFFECTIVE DATE
1/6/2010

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

A Report of Flood Hazards in

BUNCOMBE COUNTY, NORTH CAROLINA AND INCORPORATED AREAS

Community Name	Community Number
BUNCOMBE COUNTY	370031
CITY OF ASHEVILLE	370032
TOWN OF BILTMORE FOREST	370475
TOWN OF BLACK MOUNTAIN	370033
TOWN OF MONTREAT	370476
TOWN OF WEAVERVILLE	370269
TOWN OF WOODFIN	370380

NORTH CAROLINA
Cooperating Technical State
FEMA'S COOPERATING TECHNICAL PARTNER

EFFECTIVE: 1/6/2010
REVISED: 4/3/2012
Federal Emergency Management Agency
State of North Carolina
Flood Insurance Study Number
37021CV000
www.fema.gov and www.ncfloodmaps.com

Table 8 - Flooding Sources Studied by Detailed Methods: Revised or Newly Studied

Source	Riverine Sources		Affected Communties
	From	To	
Gashes Creek	Just upstream of Charland Forest Road	Just downstream of Charles A. Lytle Lane (SR 3279)	Buncombe County
Grassy Branch	The confluence with Swannanoa River	Approximately 150 feet downstream of Upper Grassy Branch Extension	Buncombe County City Of Asheville
Hominy Creek	Just downstream of Morgan Cove Road (SR 1141)	Approximately 80 feet upstream of US Highway 19 / Asheville Road	Buncombe County
Ivy Creek	Approximately 60 feet downstream of the confluence with Gabriel Creek	Approximately 600 feet upstream of NC Highway 197	Buncombe County
Little Ivy Creek	The confluence with Ivy Creek	The confluence of Paint Fork and California Creek	Buncombe County
North Fork Swannanoa River	The confluence with Swannanoa River	Approximately 700 feet upstream of Tom Brown Road	Buncombe County Town Of Black Mountain
Reems Creek	Just upstream of Twin Hills Drive	Approximately 100 feet upstream of the confluence with Ox Creek	Buncombe County Town Of Weaverville
Reems Creek	The confluence with French Broad River	Approximately 1.1 miles downstream of New Stock Road (SR 1882)	Buncombe County
Ross Creek	The confluence with Swannanoa River	Just downstream of Vance Gap Road	City Of Asheville
Smith Mill Creek	The confluence with French Broad River	Approximately 0.4 mile upstream of Johnston School Road (SR 1319)	Buncombe County City Of Asheville
Swannanoa River	The confluence with French Broad River	Approximately 0.3 mile upstream of Dunsmore Avenue (SR 2531)	Buncombe County City Of Asheville Town Of Biltmore Forest Town Of Black Mountain
Sweeten Creek	At Railroad	Approximately 950 feet upstream of Rock Hill Road	City Of Asheville
Sweeten Creek	The confluence with Swannanoa River	At Railroad	City Of Asheville
Sweeten Creek Tributary 4	The confluence with Sweeten Creek	Approximately 1,100 feet upstream of West Chapel Road	City Of Asheville

Table 9, “Flooding Sources Studied by Detailed Methods: Redelineated”, lists all flooding sources that were studied by detailed methods for the pre-statewide FIS and redelineated for previous FISs. These flooding sources were not part of this revision and their effective analyses remain valid.

Table 9 - Flooding Sources Studied by Detailed Methods: Redelineated

Source	Riverine Sources		Affected Communties
	From	To	
Beaverdam Creek (into French Broad River)	The confluence with French Broad River	Just upstream of Governors Drive	City Of Asheville Town Of Woodfin
Beaverdam Creek (into French Broad River) Tributary 1	The confluence with Beaverdam Creek (into French Broad River)	Approximately 500 feet downstream of US Highway 19	Town Of Woodfin
Beetree Creek	Approximately 0.7 mile upstream of the confluence with Swannanoa River	Just upstream of Old Beetree Road (SR 2418)	Buncombe County
Bull Creek	The confluence with Swannanoa River	Just downstream of Bull Creek Road (SR 2424)	Buncombe County
Camp Branch	The confluence with Swannanoa River	NC Highway 9	Town Of Black Mountain
Dillingham Creek	The confluence with Ivy Creek and North Fork Ivy Creek	Just downstream of Dillingham Road (SR 2173)	Buncombe County
French Broad River	Approximately 1.1 miles downstream of the Buncombe/Madison County boundary	Approximately 3 miles upstream of the Buncombe/Henderson County boundary	Buncombe County City Of Asheville Town Of Woodfin
Gashes Creek	The confluence with Swannanoa River	Just downstream of Charland Forest Road	Buncombe County City Of Asheville
Haw Creek	The confluence with Swannanoa River	Just upstream of Mann Drive	City Of Asheville
Hominy Creek	The confluence with French Broad River	Just downstream of Morgan Cove Road (SR 1141)	Buncombe County City Of Asheville
Ivy Creek	Approximately 600 feet upstream of NC Highway 197	The confluence of Dillingham Creek and North Fork Ivy Creek	Buncombe County
Mckinnish Branch	Approximately 100 feet upstream of the confluence with Smith Mill Creek	Approximately 380 feet upstream of Johnston School Road (SR 1319)	Buncombe County City Of Asheville
Moore Creek	The confluence with Hominy Creek	Just upstream of Monte Vista Road (SR 1224)	Buncombe County City Of Asheville
Newfound Creek	Approximately 850 feet upstream of the confluence of Sluder Branch	Just downstream of Morgan Branch Road (SR 1220)	Buncombe County
Pole Creek	The confluence with Hominy Creek	Just downstream of Dogwood Road (SR 1220)	Buncombe County City Of Asheville
Ragsdale Creek	The confluence with Hominy Creek	Just downstream of Sand Hill Road (SR 3412)	City Of Asheville
Reed Creek	The confluence with French Broad River	Just upstream of Murdock Avenue	Buncombe County City Of Asheville Town Of Woodfin

Table 13 - Summary of Discharges

Flooding Source		Discharges (cfs)			
Location	Drainage Area (square miles)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Garren Creek					
At the confluence with Cane Creek	4.18	*	*	1,820	*
At Owenby Ridge Road	3.08	*	*	1,500	*
Gashes Creek					
At the confluence with Swannanoa River	6.20	*	*	2,200	*
Upstream of Culvert Entrance to Interstate 240	5.10	*	*	2,000	*
Approximately 1,200 feet downstream of Rose Hill Road	2.20	*	*	1,150	*
NP	2.20	*	*	1,150	*
Approximately 400 feet downstream of Charles A. Lytle Lane (SR 3279)	1.91	*	*	1,050	*
Approximately 300 feet downstream of Old Charlotte Highway (SR 2771)	1.40	*	*	690	*
George Branch					
At the confluence with Hominy Creek	2.18	*	*	1,210	*
Gill Branch					
At the confluence with Reems Creek	1.62	*	*	1,270	*
Approximately 0.4 mile downstream of I-26	1.10	*	*	1,140	*
Just upstream of Weaver Boulevard (SR 1725)	0.51	*	*	670	*
Glady Fork					
At the confluence with South Hominy Creek	3.92	*	*	1,750	*
Gouches Branch					
At the confluence with Newfound Creek	2.78	*	*	1,410	*
Approximately 1,900 feet upstream of NC Highway 63	2.26	*	*	1,240	*
Grassy Branch					
At the confluence with Swannanoa River	3.38	*	*	1,850	*
Approximately 500 feet upstream of US Highway 70	3.01	*	*	1,720	*
Just upstream of Cherry Grove Road (SR 2404)	2.39	*	*	1,490	*
Approximately 550 feet downstream of McFalls Road	2.01	*	*	1,330	*
At Upper Grassy Branch Road (SR 2400)	1.41	*	*	1,070	*
Approximately 0.4 mile upstream of Upper Grassy Branch Road (SR 2400)	1.01	*	*	870	*
Gregg Branch					
At the confluence with Beetree Creek	1.07	*	*	1,030	*
Haw Creek					
At the confluence with Swannanoa River	4.70	*	*	2,240	*
Below Cask Cove	4.20	*	*	2,050	*
Above Cask Cove	3.70	*	*	1,930	*
Just upstream of Dogwood Drive	2.60	*	*	1,380	*
Near Mann Drive at mile 3.83	0.90	*	*	680	*
Herron Cove Branch					
At the confluence with Reems Creek	2.86	*	*	1,440	*
Approximately 0.8 mile upstream of confluence with Reems Creek	2.11	*	*	1,190	*
Hogeye Branch					
At the confluence with Sandymush Creek	0.54	*	*	510	*
Hominy Creek					
Just downstream of Pound Road	94.70	*	*	14,700	*
Just downstream of Sand Hill Road	91.10	*	*	14,300	*

Table 13 - Summary of Discharges

Flooding Source		Discharges (cfs)			
Location	Drainage Area (square miles)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Approximately 1,900 feet downstream of NC Highway 151	69.90	*	*	12,000	*
Just upstream of confluence of South Hominy Creek	30.30	*	*	6,450	*
Below the confluence of Webb Branch	29.20	*	*	6,290	*
At the confluence of Webb Branch	26.00	*	*	5,840	*
Approximately 530 feet downstream of Morgan Cove Road (SR 1141)	23.30	*	*	5,440	*
At the confluence of George Branch	21.11	*	*	5,010	*
Approximately 600 feet downstream of Walking Horse Trail	20.20	*	*	4,990	*
At Ridgeway Road	19.66	*	*	4,980	*
Approximately 0.4 mile downstream of Haywood/Buncombe County boundary	19.02	*	*	4,970	*
Hominy Creek Tributary 21					
At the confluence with Hominy Creek	0.71	*	*	820	*
Hominy Creek Tributary 25					
At the confluence with Hominy Creek	0.84	*	*	670	*
Ivy Creek					
At confluence of Little Ivy Creek	60.61	*	*	9,690	*
Approximately 1,700 feet upstream of the Madison/Buncombe County boundary	59.96	*	*	9,620	*
Approximately 1.1 miles downstream of Ivy Hill Road (SR 2153)	59.36	*	*	9,560	*
At Ivy Hill Road (SR 2153)	58.86	*	*	9,510	*
At the confluence of Morgan Branch (into Ivy Creek)	56.31	*	*	9,250	*
Approximately 0.8 mile upstream of the confluence of Morgan Branch (into Ivy Creek)	55.70	*	*	9,190	*
Approximately 0.6 mile downstream of NC Highway 197	54.70	*	*	9,090	*
Approximately 1,270 feet downstream of Buckner Branch Road	51.90	*	*3	8,200	*
Killian Branch					
At the confluence with Beaverdam Creek (into French Broad River)	0.87	*	*	680	*
Lee Creek					
At the confluence with French Broad River	4.86	*	*	2,000	*
Approximately 800 feet downstream of Powell Street (SR 1790)	2.88	*	*	1,750	*
Approximately 0.6 mile downstream of NC Highway 63	1.30	*	*	710	*
Approximately 700 feet upstream of NC Highway 63	0.52	*	*	490	*
Little Piney Branch					
At the confluence with Flat Creek (into Swannanoa River)	0.27	*	*	430	*
Little Sandymush Creek					
At the confluence with Sandymush Creek	9.84	*	*	3,110	*
Long Branch (into Beetree Creek)					
At the confluence with Beetree Creek	1.12	*	*	1,050	*
Approximately 900 feet downstream of Sparkill Drive	1.02	*	*	1,000	*
Approximately 0.4 mile downstream of Glory Land Lane	0.55	*	*	680	*
Long Branch (into Sandymush Creek)					
At the confluence with Sandymush Creek	1.04	*	*	760	*
Maney Branch					
At the confluence with Reems Creek	1.13	*	*	800	*
Approximately 1,600 feet upstream of confluence with Reems Creek	1.01	*	*	750	*
Martin Branch					
At the confluence with Turkey Creek	2.80	*	*	1,410	*

surveyed approximately every 4000 feet along the detail study reaches to obtain the channel geometry between bridges and culverts. Overbank cross section data for the backwater analyses were obtained from recently flown LIDAR data.

Channel roughness factors (Manning's "n") used in the hydraulic computations were made in the field by an engineer where stream access was possible, with orthophotos used to supplement areas that could not be accessed. The channel and overbank "n" values for all of the streams studied by detailed methods are shown in Table 16, "Roughness Coefficients".

Table 16 - Roughness Coefficients

Stream	Channel "n"	Overbank "n"
Avery Creek	0.050 to 0.090	0.030 to 0.090
Beaverdam Creek (into French Broad River)	0.035 to 0.065	0.030 to 0.150
Beaverdam Creek (into French Broad River) Tributary 1	0.025 to 0.065	0.030 to 0.150
Beaverdam Creek (into South Hominy Creek)	0.030 to 0.090	0.030 to 0.100
Beaverdam Creek (into South Hominy Creek) Tributary	0.045 to 0.050	0.055 to 0.085
Bee Branch	0.040 to 0.050	0.050 to 0.100
Beetree Creek	0.035 to 0.060	0.025 to 0.200
Bent Creek	0.042 to 0.052	0.030 to 0.100
Bill Moore Creek	0.030 to 0.090	0.030 to 0.200
Broad River	0.040 to 0.100	0.050 to 0.100
Brush Creek	0.035 to 0.090	0.030 to 0.090
Bull Creek	0.045 to 0.060	0.013 to 0.150
Camp Branch	0.045 to 0.050	0.030 to 0.140
Cane Creek	0.040 to 0.050	0.025 to 0.250
Cane Creek (into Hominy Creek)	0.050	0.050 to 0.090
Curtis Creek	0.048 to 0.090	0.030 to 0.090
Dick Branch	0.050	0.050 to 0.090
Dillingham Creek	0.040 to 0.060	0.030 to 0.150
Dingle Creek	0.035 to 0.090	0.030 to 0.090
Dix Creek	0.050	0.030 to 0.090
Eller Cove	0.035 to 0.055	0.040 to 0.090
Emma Branch	0.035 to 0.050	0.030 to 0.090
Emma Branch Tributary 2	0.050 to 0.059	0.045 to 0.090
Flat Creek	0.040 to 0.060	0.050 to 0.100
Flat Creek (into French Broad River)	0.040 to 0.055	0.030 to 0.150
Flat Creek (into Swannanoa River)	0.035 to 0.090	0.035 to 0.090
Flat Creek (into Swannanoa River) Tributary 1	0.050	0.050 to 0.090
Fourmile Branch	0.030 to 0.090	0.030 to 0.100
French Broad River	0.024 to 0.064	0.030 to 0.200
French Broad River Tributary 149	0.040 to 0.090	0.030 to 0.090
Gap Creek	0.045 to 0.050	0.030 to 0.090
Garren Creek	0.045 to 0.050	0.030 to 0.090
Gashes Creek	0.018 to 0.060	0.025 to 0.200
George Branch	0.050 to 0.090	0.030 to 0.090
Gill Branch	0.050	0.150
Glady Fork	0.050	0.050 to 0.090
Gouches Branch	0.045	0.012 to 0.085
Grassy Branch	0.040 to 0.055	0.035 to 0.090
Gregg Branch	0.045 to 0.050	0.090
Haw Creek	0.020 to 0.060	0.040 to 0.120
Herron Cove Branch	0.050	0.050 to 0.090
Hogeye Branch	0.040 to 0.050	0.050 to 0.090
Hominy Creek	0.035 to 0.060	0.020 to 0.150
Hominy Creek Tributary 21	0.040	0.070
Hominy Creek Tributary 25	0.050	0.070
Indian Camp Branch	-8888.000	-8888.000
Ivy Creek	0.040 to 0.060	0.025 to 0.160
Killian Branch	0.040 to 0.060	0.050 to 0.090
Lee Creek	0.040 to 0.055	0.030 to 0.015
Little Ivy Creek	0.040 to 0.100	0.030 to 0.100
Little Piney Branch	0.050	0.035 to 0.090
Little Sandymush Creek	0.045 to 0.060	0.030 to 0.900
Long Branch (into Beetree Creek)	0.050	0.050 to 0.090

PRELIMINARY DESIGN AND ASSESSMENT OF
STREAM CROSSINGS AND ENCROACHMENTS

COUNTY Buncombe PROJECT NUMBER I-4400/I-4700

STREAM Hominy Creek ROUTE I-26

ASSESSMENT PREPARED BY HNTB Corporation DATE _____

HYDROLOGIC EVALUATION

NEAREST GAGING STATION ON THIS STREAM None

ARE FLOOD STUDIES AVAILABLE ON THIS STREAM: Yes

FLOOD DATA:
Q10 6200 CFS EST BKWTR. -FT. Q25 8100 CFS EST BKWTR. -FT.
Q50 9500 CFS EST BKWTR. -FT. Q100 11000 CFS EST BKWTR. -FT.
Q500 15000 CFS OR OVERTOPPING CFS EST BKWTR. -FT.

DRAINAGE AREA 94.6 Sq. Miles

METHOD USED TO COMPUTE Q USGS Urban Regression

PROPERTY RELATED EVALUATIONS

DAMAGE POTENTIAL: LOW X MODERATE _____ HIGH _____

COULD THIS BE SIGNIFICANTLY INCREASED BY PROPOSED

ENCROACHMENT: YES _____ NO X

EXPLANATION: Limited changes will be made to this site.

_____

LIST BUILDINGS IN FLOOD PLAIN None LOCATION N/A

FLOOR ELEVATION Unknown

UPSTREAM LAND USE Urban

ANTICIPATE ANY CHANGE? No

ANY FLOOD ZONING? (FIS STUDIES, ETC.) YES X NO ____

TYPE OF STUDY FEMA Detailed

BASE FLOOD ELEVATION 2035.8 ft (100 YEAR)

REGULATORY FLOODWAY WIDTH 125 (AS NOTED IN FIS STUDIES)

COMMENTS: Cross Section 234

TRAFFIC RELATED EVALUATIONS

PRESENT YEAR 2011 TRAFFIC COUNT 93400 VPD % TRUCKS 12

DESIGN YEAR 2040 TRAFFIC COUNT 89200 VPD % TRUCKS 12

EMERGENCY ROUTE _____ SCHOOL BUS ROUTE _____ MAIL ROUTE _____

DETOUR AVAILABLE? _____ LENGTH OF DETOUR _____ MILES

DOES THE LEVEL OF TRAFFIC SERVICE OF AN EXISTING CROSSING VARY GREATLY FROM STANDARD DESIGN LEVELS? _____

_____

IS THE TRAFFIC VOLUME, TYPE, USAGE SUCH TO WARRANT CONSIDERATION FOR VARIANCE FROM STANDARDS OR EXISTING LEVEL OF INTERRUPTION?

_____

COMMENTS: _____

_____

HIGHWAY AND BRIDGE (CULVERT) RELATED EVALUATIONS

NOTE ANY OUTSIDE FEATURES WHICH MIGHT AFFECT STAGE, DISCHARGE OR FREQUENCY.

LEVEES _____ AGGRADATION/DEGRADATION _____ RESERVOIRS ____

DIVERSIONS _____ DRAINAGE DISTRICT _____ NAVIGATION _____

BACKWATER FROM ANOTHER SOURCE _____

EXPLANATION: _____

_____

_____

ROADWAY OVERFLOW SECTION (NONE __) LENGTH _____ ELEVATION _____

EMBANKMENT: SOIL TYPE Udorthents-Urban Land Complex

TYPE SLOPE COVER Vegetated

COMMENTS: USDS Soil Map NC021

ENVIRONMENTAL CONSIDERATIONS

LIST SPECIAL CONDITIONS OR CONSIDERATIONS WHICH AFFECT HYDRAULIC DESIGN (NONE _____)

_____

_____

MISCELLANEOUS COMMENTS

IS THERE UNUSUAL SCOUR POTENTIAL? YES _ NO X PROTECTION NEEDED _

ARE BANKS STABLE? Yes PROTECTION NEEDED _

DOES STREAM CARRY APPRECIABLE AMOUNT OF LARGE DEBRIS? No

COMMENTS:

_____

_____

_____

ALTERNATIVES

RECOMMENDED DESIGN Retain Existing Structure

DETOUR STRUCTURE N/A

WERE OTHER HYDRAULIC ALTERNATES CONSIDERED? YES _____ NO X

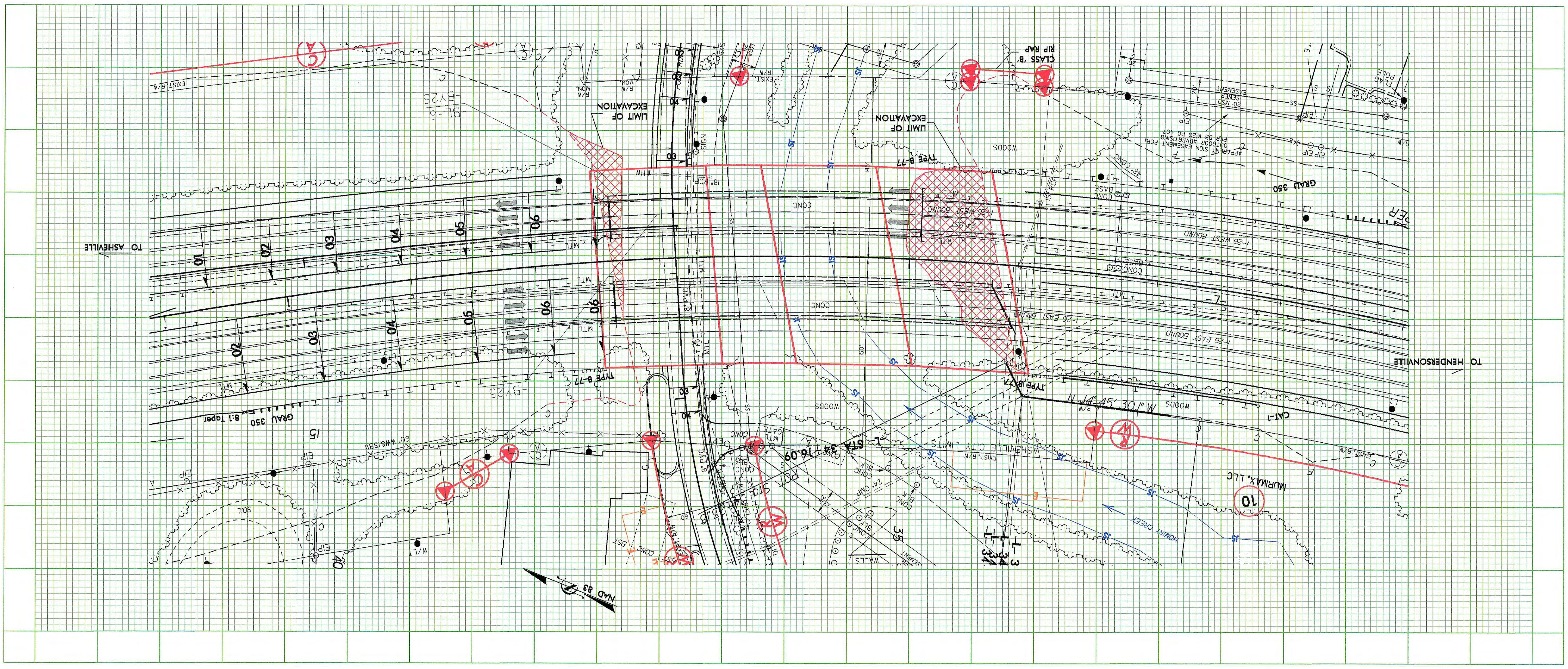
THIS SITE ASSESSMENT INDICATES THE DESIGN SHOULD FOLLOW:

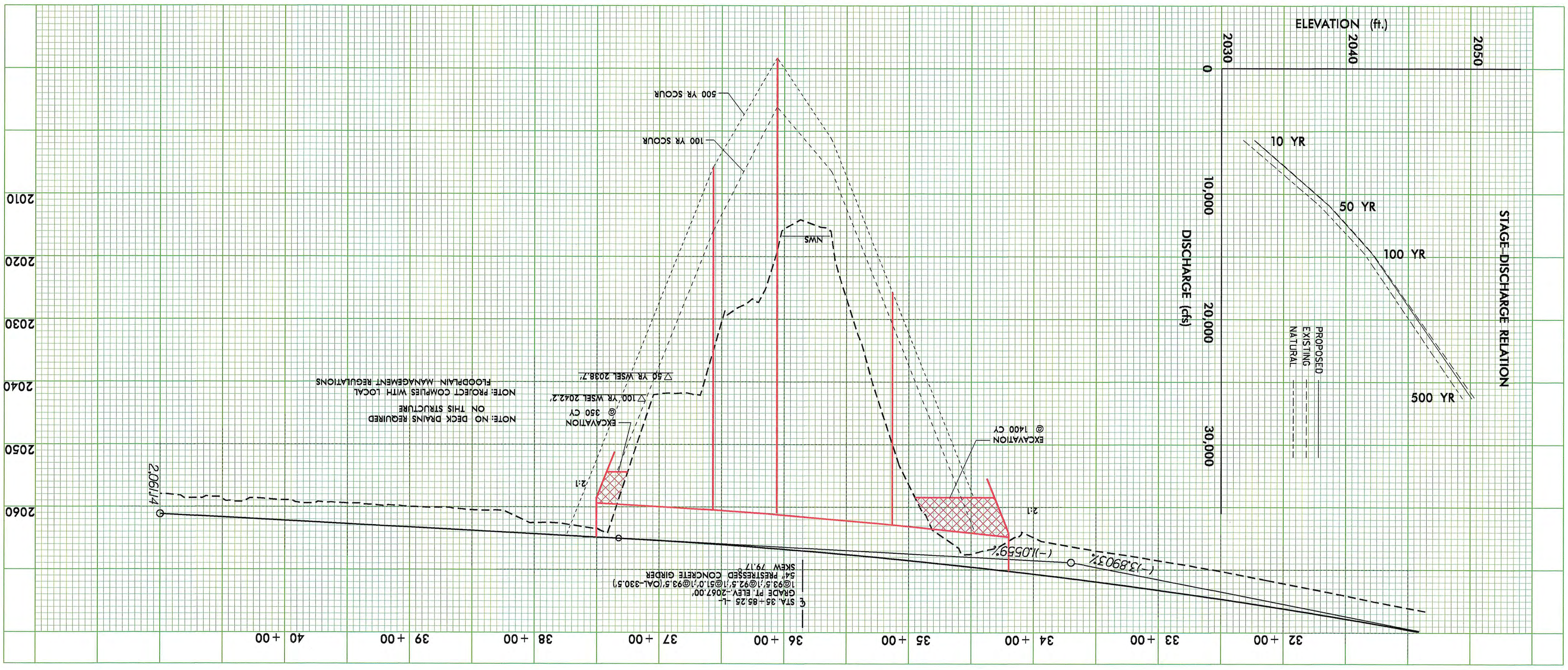
(1) X NORMAL PROCESS

(2) _____ NORMAL PROCESS WITH SPECIAL SPECIFIC CONSIDERATION FOR

_____

(3) _____ SPECIFIC DESIGN PROCESS WITH APPROPRIATE RISK/ECONOMIC EVALUATION ADDRESSING: _____





INFORMATION TO BE SHOWN ON PLANS

Design:	Discharge 10900 c.f.s.	Frequency 50 YR	Elev. 2038.7'
Base Flood:	Discharge 14700 c.f.s.	Frequency 100 yr.	Elev. 2042.2'
Overtopping:	Discharge N/A c.f.s.	Frequency 500 YR+	Elev. N/A

ELEVATIONS TAKEN AT HEC-RAS STA. 24026 (APPROACH)

ADDITIONAL INFORMATION AND COMPUTATIONS

DRAINAGE AREA: 94.5 Sq. Mi. FRENCH BROAD RIVER BASIN

SIR 2009-5158 HYDRAULIC REGION 2 — FEMA DISCHARGES

ADJUSTED TO GAGE NO. 3448500 (D.A.-79.8 Sq.Mi.) — Q10 = 5700 cfs

Q10 = 6700 cfs — Q50 = 10900 cfs

Q50 = 11400 cfs — Q100 = 14700 cfs

Q100 = 14000 cfs — Q500 = 26300 cfs

Q500 = 16700 cfs

SCOUR COMPUTATIONS:

CONTRACTION SCOUR: $Y2=Y1(Q2/Q1)^{0.857}(W1/W2)^{k1}$; Ys= Y2-Y0

100 YR: $Y2=26.12(11640/10288)^{0.857}(59/46)^{0.59}$ — 500 YR: $Y2=34.16(16951/13993)^{0.857}(59/46)^{0.59}$

Y2=26.12 X 1.11 X 1.16 =33.63 Ft. — Y2=34.16 X 1.18 X 1.16 =46.76 Ft.

Ys=33.63 - 25.95 = 7.68 Ft. — Ys=46.76 - 33.97 = 12.79 Ft.

LOCAL SCOUR: $Ys=2.0 \times K1 \times K2 \times K3 \times K4\ (a)^{0.65}(Y1)^{0.35}(Fr1)^{0.43}$; $Fr1= V1/(g \times Y1)^{0.5}$

100 YR: $Ys=2.0 \times 1.1 \times 1.0 \times 1.1 \times 1.0\ (4)^{0.65}(21.54)^{0.35}(0.39)^{0.43}$; $Fr1=10.4/(32.2 \times 21.54)^{0.5}$

Ys= 2.42 X 2.46 X 2.93 X 0.67

Ys=10.3 Ft.

500 YR: $Ys=2.0 \times 1.1 \times 1.0 \times 1.1 \times 1.0\ (4)^{0.65}(29.31)^{0.35}(0.39)^{0.43}$; $Fr1=12.1/(32.2 \times 29.31)^{0.5}$

Ys= 2.42 X 2.46 X 3.26 X 0.67

Ys=13.0 Ft.

SITE DATA

Drainage Area 94.5 Sq.Mi. Source USGS SELECTED SITES AND QUAD MAPS

River Basin FRENCH BROAD RIVER Character RURAL-MOUNTAINOUS

Stream Classification (Such as Trout, High Quality Water, etc.) C

Data on Existing Structure BRIDGE No. 235(SBL) 1@70';1@40';2@70' (OAL-250') CONCRETE BRIDGE WITH STEEL GIRDERS
BRIDGE No. 238(NBL) 1@70';1@57';2@70';1@52'(OAL-319') CONCRETE BRIDGE WITH STEEL GIRDERS — Waterway Opening 1745 Sq.Ft. BELOW 100 YR WSEL

Debris Potential: Low X Moderate ____ High ____

Data on Structures Up and Down Stream UPSTREAM: BRIDGE No. 50 on SR 3431 3@50'CORED SLAB
DOWNSTREAM: BRIDGE No. 51 on SR 3431 3@44' CONCRETE BRIDGE WITH STEEL PILES

Design Control Elev. 2042.19' EXISTING 100 YR WSEL AT APPROACH (RAS STA. 24026)

Gage Station No. 3448500 (WRI 01-4207) Period of Records 35 YRS

Max. Discharge 24000 c.f.s. Date 11/06/77 Frequency 500 yr+

Historical Flood Information:
HURRICANE IVAN
Date 2004 Elev. 2038.5 Est. Freq. ____ Source LOCAL BUSINESS OWNER Period of Knowledge 20 YRS
NEVER SEEN WATER UP TO SR 3431 (POND RD.)
Date ____ Elev. ____ Est. Freq. ____ Source LOCAL BUSINESS OWNER Period of Knowledge 20 YRS
Date ____ Elev. ____ Est. Freq. ____ Source ____ Period of Knowledge ____

Historical Scour Info. : General N/A Contraction N/A Local N/A

Channel Slope 0.001 FT/FT Source USGS QUAD MAP Ordinary High Water Elev. 2019.9'

Manning's n : Left O.B. 0.07 Channel 0.06 Right O.B. 0.08 Source FEMA STUDY

Flood Study / Status DETAILED STUDY (January 6, 2010) Floodway Established? YES

Flood Study 100 yr. Discharge 14700 c.f.s.; W.S. Elev. : With Floodway 2042.6 Without Floodway 2041.7
TAKEN AT SECTION 25186(252)

DESIGN DATA

Hydrological Method FEMA DISCHARGES USED

Hydraulic Design Method HEC-RAS 4.1.0

Floods Evaluated:

Freq.	Q	Elev.	Backwater	Bridge Opening Velocity
10 YR	5700 cfs	2032.6'	0.9'	6.5 fps
50 YR	10900 cfs	2038.7'	0.9'	8.1 fps
100 YR	14700 cfs	2042.2'	0.7'	8.9 fps
500 YR	26300 cfs	2050.3'	0.9'	9.7 fps

ELEVATIONS TAKEN AT HEC-RAS STA. 24026 (APPROACH)

Waterway Opening Provided Below: Design W.S. Elev. 1482 Sq.Ft., 100yr W.S. Elev. 1819 Sq.Ft.

Average Channel Velocity (Design) 9.2 FPS Average Overbank Velocity (Design) 5.1 FPS

Computed Scour : General N/A Contraction 7.68 Ft. Local 10.3 Ft.

Is a Floodway Revision Required? MOA(2a) -0.20 FT. @ RAS SECTION 23585 BR D

DSC

BRIDGE SURVEY & HYDRAULIC DESIGN REPORT

N. C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
HYDRAULICS UNIT
RALEIGH, N. C.

I.D. No. B-5178 Project No. 42549.1.1 Proj. Station 35+85.25 -L-

County BUNCOMBE Bridge Over HOMINY CREEK Bridge Inv. No. 235, 238

On Highway I-26 Between I-40 and NC-191

Recommended Structure 1@93.5';1@92.5';1@51.0';1@93.5' (OAL-330.5') 54" PRESTRESSED CONCRETE GIRDER

Recommended Width of Roadway 155 FT FACE TO FACE Skew 79.17 °

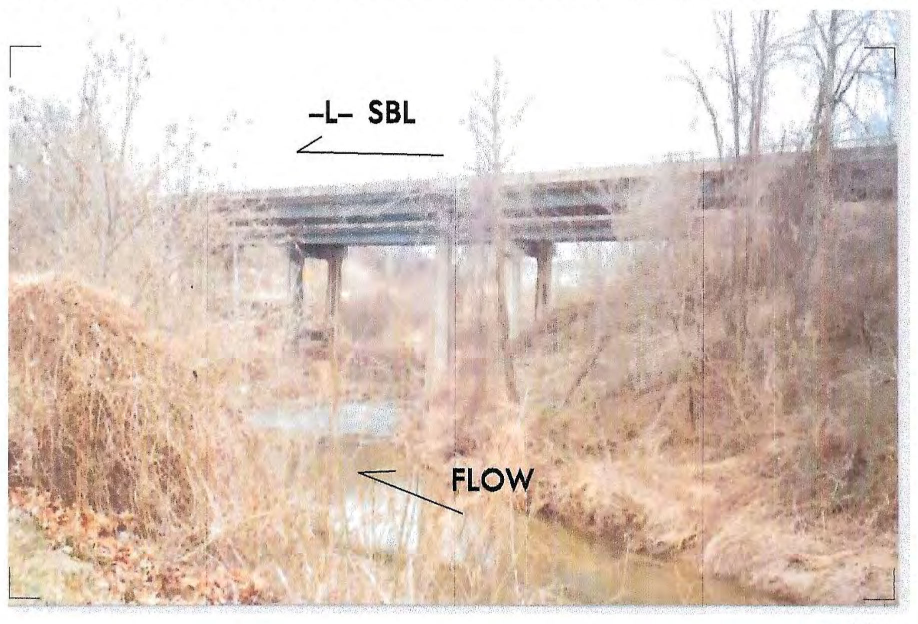
Recommended Location is (Up, (At), Down) Stream from Existing Crossing.

Nearest Shipping Point ASHEVILLE On SOUTHERN R.R., 7 Miles From Bridge

Bench Mark is BM-16 RR SPIKE IN 24" POPLAR -BY25- 6+29; 18 FT RT

Elev. 2045.88' Datum: NAVD 88

Temporary Crossing NONE REQUIRED



Designed by: M.T. SHOWN PE — Date 4/30/12

Assisted by: R.E. LASSITER, J.L. MOORE

Project Engineer: R.C. HENEGAR PE

Reviewed by:

NORTH CAROLINA PROFESSIONAL SEAL 20870 ENGINEER MARC T. SHOWN

Stream HOMINY CRK Struc. Inv. No. 238 235 I.D. No. B-5178 Project No. 42549.1.1 PDF File 10_0235_2011_B-5178_HOMINY_CR_I-26.PDF

NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
BRIDGE MANAGEMENT UNIT

ATTENTION PRIORITY MAINTENANCE X 4 (SPALLING)

BRIDGE INSPECTION REPORT

INSPECTION TYPE: Routine Inspection

COUNTY BUNCOMBE BRIDGE NUMBER 100235 INSPECTION CYCLE 2 YRS 31.8

ROUTE I-26 WBL ACROSS SR3431,HOMINY CREEK M.P. 31800

LOCATION .8 MI.N.JCT.NC191

SUPERSTRUCTURE REINFORCED CONCRETE FLOOR ON I-BEAMS

SUBSTRUCTURE E.BT1:RC CAP/H-PILES;INT.BTS:RCP&BEAM;E.BT2:RC SPILL THRU

SPANS 1 @ 70'-11;1 @ 70';1 @ 40';1 @ 70'-11

LONGITUDE 82° 36' 16.0" LATITUDE 35° 32' 43.7"

PRESENT CONDITION FAIR INVENTORY RATING

INSPECTION DATE 04/25/2012 OPERATING RATING

PRESENT POSTING Not Posted PROPOSED POSTING

COMPUTER UPDATE ANALYSIS DATE

POSTING LETTER DATE SUFFICIENCY RATING

OTHER SIGNS PRESENT DELINS (2)

EAST

SIGN NOTICE ISSUED FOR		NUMBERED REQUIRED
No	WEIGHT LIMIT	
No	DELINEATORS	
No	NARROW BRIDGE	
No	ONE LANE BRIDGE	
No	LOW CLEARANCE	

NATIONAL BRIDGE INVENTORY-------- STRUCTURE INVENTORY AND APPRAISAL Run Date: 05/21/2012

IDENTIFICATION

(1) STATE NAME -NORTH CAROLINA BRIDGE 100235
(8) STRUCTURE NUMBER(FEDERAL) 000000000210235
(5) INVENTORY ROUTE (ON/UNDER) - ON 11000260
(2) STATE HIGHWAY DEPARTMENT DISTRICT 2
(3) COUNTY CODE 21 (4) PLACE CODE 0
(6) FEATURE INTERSECTED - SR3431,HOMINY CREEK
(7) FACILITY CARRIED I-26 WBL
(9) LOCATION .8 MI.N.JCT.NC191
(11)MILEPOINT 31.8
(16)LAT 35° 32' 43.7" (17)LONG 82° 36' 16.0"
(98)BORDER BRIDGE STATE CODE PCT SHARE
(99)BORDER BRIDGE STRUCTURE NO

STRUCTURE TYPE AND MATERIAL

(43) STRUCTURE TYPE MAIN: Steel
TYPE - Stringer Mutlibeam or Girder CODE 302
(44) STRUCTURE TYPE APPR :
TYPE - CODE 000
(45) NUMBER OF SPANS IN MAIN UNIT 4
(46) NUMBER OF APPROACH SPANS
(107)DECK STRUCTURE TYPE - 1 CODE
(108)WEARING SURFACE / PROTECTIVE SYSTEM :
(A) TYPE OF WEARING SURFACE - CODE
(B) TYPE OF MEMBRANE - CODE
(C) TYPE OF DECK PROTECTION - CODE

AGE AND SERVICE

(27) YEAR BUILT 1966
(106)YEAR RECONSTRUCTED
(42) TYPE OF SERVICE : ON - Highway
UNDER - Highway - Waterway CODE 16
(28) LANES: ON STRUCTURE 2 UNDER STRUCTURE 2
(29) AVERAGE DAILY TRAFFIC 40000
(30) YEAR OF ADT 2010 (109) TRUCK ADT PCT 16%
(19) BYPASS OR DETOUR LENGTH 1 MI

GEOMETRIC DATA

(48) LENGTH OF MAXIMUM SPAN 70 FT
(49) STRUCTURE LENGTH 252 FT
(50)CURB OR SIDEWALK: LEFT 0 FT RIGHT 0 FT
(51) BRIDGE ROADWAY WIDTH CURB TO CURB 28 FT
(52) DECK WIDTH OUT TO OUT 33.6 FT
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS) 39 FT
(33) BRIDGE MEDIAN - No Median CODE 1
(34) SKEW 0° (35) STRUCTURE FLARED 0
(10) INVENTORY ROUTE MIN VERT CLEAR 999.9 FT
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR 28 FT
(53) MIN VERT CLEAR OVER BRIDGE RDWY 999.9 FT
(54) MIN VERT UNDERCLEAR REF Not a Highway or Railroad 0 FT
(55) MIN LAT UNDERCLEAR RT REF Not a Highway or Railroad 000 FT
(56) MIN LAT UNDERCLEAR LT REF - 000 FT

NAVIGATION DATA

(38) NAVIGATION CONTROL - No Navigational Control CODE 0
(111)PIER PROTECTION - CODE
(39) NAVIGATION VERTICAL CLEARANCE 0
(116)VERT - LIFT BRIDGE NAV MIN VERT CLEAR FT
(40) NAVIGATION HORIZONTAL CLEARANCE 0 FT

SUFFICIENCY RATING = 60.1
STATUS = Functionally Oboselete

CLASSIFICATION — CODE

(112)NBIS BRIDGE SYSTEM - YES
(104)HIGHWAY SYSTEM Is on the NHS 1
(26) FUNCTIONAL CLASS - Arterial - Interstate 11
(100)STRAHNET HIGHWAY - Interstate STRAHNET Route 1
(101)PARALLEL STRUCTURE - Left Parallel Structure L
(102)DIRECTION OF TRAFFIC - 1-way Traffic 1
(103)TEMPORARY STRUCTURE -
(110)DESIGNATED NATIONAL NETWORK - On the National Network 1
(20) TOLL On Free Road 3
(31) MAINTAIN - State Highway Agency 01
(22) OWNER - State Highway Agency 01
(37) HISTORICAL SIGNIFICANCE - Not Eligible 5

CONDITION — CODE

(58) DECK 5
(59) SUPERSTRUCTURE 5
(60) SUBSTRUCTURE 5
(61) CHANNEL & CHANNEL PROTECTION 7
(62) CULVERTS N

LOAD RATING AND POSTING — CODE

(31) DESIGN LOAD HS 20+MOD 6
(63) OPERATING RATING METHOD - Load Factor
(64) OPERATING RATING - HS-37 166
(65) INVENTORY RATING METHOD - Load Factor
(66) INVENTORY RATING - HS-22 140
(70) BRIDGE POSTING - No Posting Required 5
(41) STRUCTURE OPEN, POSTED ,OR CLOSED A
DESCRIPTION - Open, No Restriction

APPRAISAL — CODE

(67) STRUCTURAL EVALUATION 5
(68) DECK GEOMETRY 3
(69) UNDERCLEARANCES,VERTI & HORIZ 4
(71) WATERWAY ADEQUACY 7
(72) APPROACH ROADWAY ALIGNMENT 7
(36) TRAFFIC SAFETY FEATURES 1110
(113)SCOUR CRITICAL BRIDGES 8

PROPOSED IMPROVEMENTS

(75) TYPE OF WORK - CODE
(76) LENGTH OF STRUCTURE IMPROVEMENT
(94) BRIDGE IMPROVEMENT COST
(95) ROADWAY IMPROVEMENT COST
(96) TOTAL PROJECT COST
(97) YEAR OF IMPROVEMENT COST ESTIMATE
(114)FUTURE ADT 80000 (115) YEAR FUTURE ADT 2025

INSPECTIONS

(90) INSPECTION DATE 04/25/2012
(92) CRITICAL FEATURE INSPECTION : (93) CFI DATE
A) FRACTURE CRIT DETAIL - NO A)
B) UNDERWATER INSP - NO B)
C) OTHER SPECIAL INSP NO C)
SCOUR

Structure No: 100235 County: BUNCOMBE Run Date:

Span Number	Feature Intersected	Inventory Route	Minimum Maximum Vertical Clearance	Milepoint	Base Highway Network	LRS Inventory Route	Toll	Functional Classification	Numer of Lanes	Average Daily Traffic	Year of Average Daily Traffic	Total Horizontal Clearance	See Note 1					STRAHNET Highway Designator	Direction of Traffic	Highway System of Route
													Reference Feature	Minimum Vertical Underclearance	Right Lateral Underclearance	Left Lateral Underclearance	Underclearance Appraisal Grade			
	6	5	10	11	12	13	20	26	28	29	30	47	54A	54	55	56	69	100	102	104
1	SR 3431	31034310	19.9170		0			19	2	200	1995	33.1670	H	16.9170	7		9	0	2	0

Note 1: Items 54, 55, and 56 are not reported FHWA under route data points but are collected for each under route to determine the minimum value for Underclearance Appraisal Item 69. The under route that generates the lowest Underclearance Appraisal value will be reported on the Facility Carried record.

BRIDGE MANAGEMENT UNIT

DATA ON EXISTING STRUCTURE Run Date: 05/21/2012

COUNTY : BUNCOMBE
DIVISION : 13
DISTRICT: 2
STRUCTURE NUMBER : 100235
LENGTH : 252 FEET

ROUTE CARRIED : I-26 WBL
FEATURE INTERSECTED : SR3431,HOMINY CREEK

LOCATED : .8 MI.N.JCT.NC191
BRIDGE NAME :
CITY :

FUNC. CLASS : 11
SYST.ON : FA
SYST.UNDER : NFA
ADT & YR : 40000 2010
RAIL TYPE : LT 713 RT 713

BUILT : 1966
BY : SHC
PROJ : 8.19095
FED.AID PROJ : B-5178
DESIGN LOAD : HS 20+MOD

REHAB :
BY :
PROJ :
ALIGNMENT : RT
SKEW : 90
LANES : ON 2 UNDER 2

NAVIGATION : VC 0 FT HC 0 FT
HT. CRN. TO BED : 52 FT
WATER DEPTH : 3 FT

SUPERSTRUCTURE : REINFORCED CONCRETE FLOOR ON I-BEAMS

SUBSTRUCTURE : E.BT1:RC CAP/H-PILES;INT.BTS:RC P&BEAM;E.BT2:RC SPILL THRU

SPANS : 1 @ 70'-11;1 @ 70';1 @ 40';1 @ 70'-11

BEAMS OR GIRDERS : 4 LINES 36 I-BEAMS @ 8' CENTERS

FLOOR : 7 RC/3 AWS
ENCROACHMENT :
DECK (OUT TO OUT) : 33.6 FT

CLEAR ROADWAY : 28 FT
BETWEEN RAILS : 28 FT
SIDEWALK OR CURB : LT 0 FT RT 0 FT

VERT.CL.OVER : 999.9 FT

INV.RTG. : HS-22
OPE.RTG. : HS-37
CONTR.MEMBER : Int Bm SpC
POSTED : SV TTST DATE

SYSTEM : Primary Interstate
GREEN LINE ROUTE : Y

UNDER ROUTES AND CLEARANCES

Span	Route Description	Vertical Clearances		Horizontal Clearances		
		MMVC	MVC	Total	Left	Right
1	SR 3431	19.9170	16.9170	33.1670		7

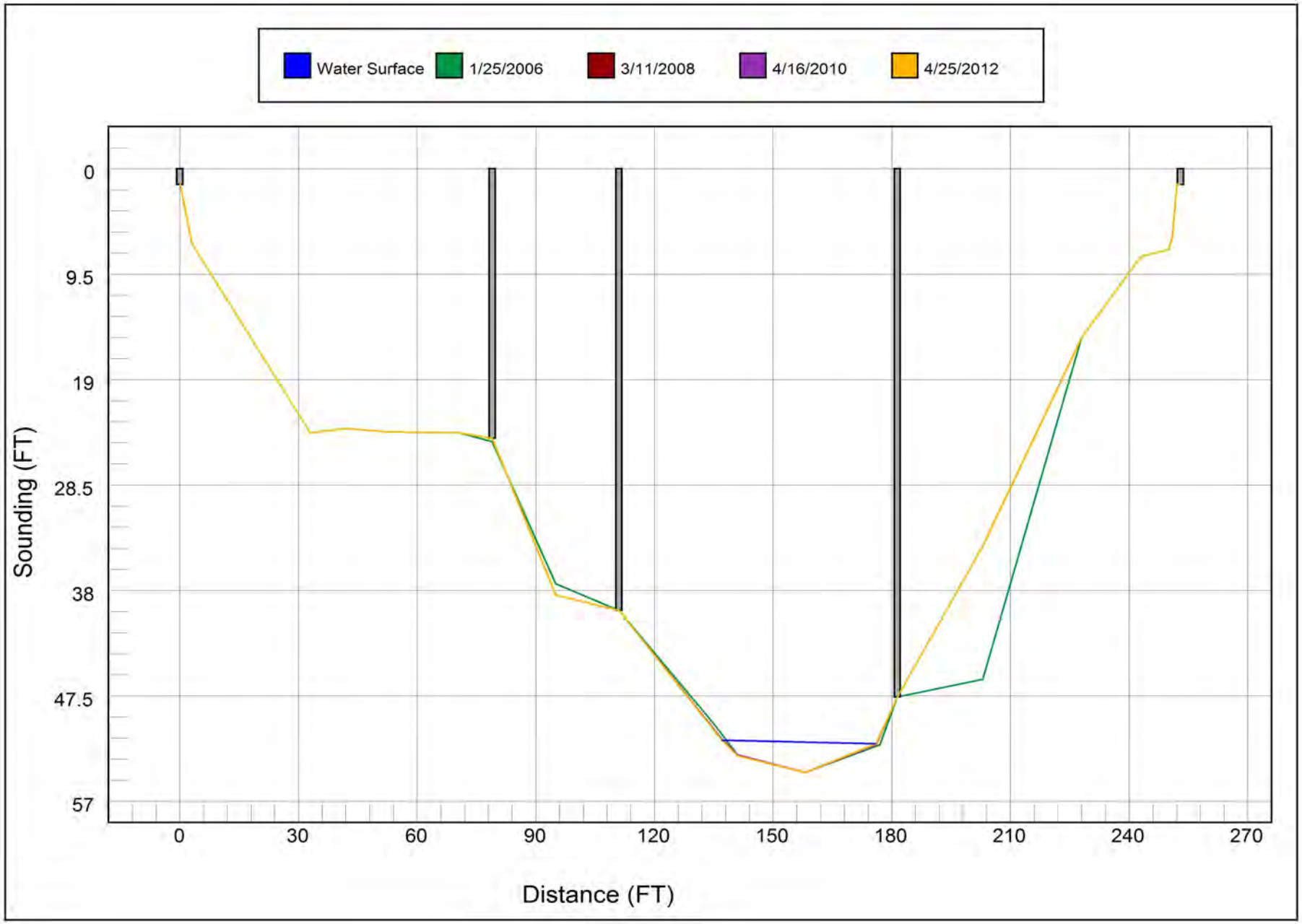
Note: All measurements are in feet.

REMARKS :

Bridge: 100235 County BUNCOMBE Date: 04/25/2012

STREAMBED PROFILE (Downstream)

Top of Rail = 0 FT (Sounding)



REP OF ABUTMENT (ABUTMENT #1)

LOOKING NORTH ON SR:3431

REP OF INTERIOR BENT (INTERIOR BENT #2 / WEST FACE)

LOOKING SOUTH ON SR:3431

UP STREAM SOUTH

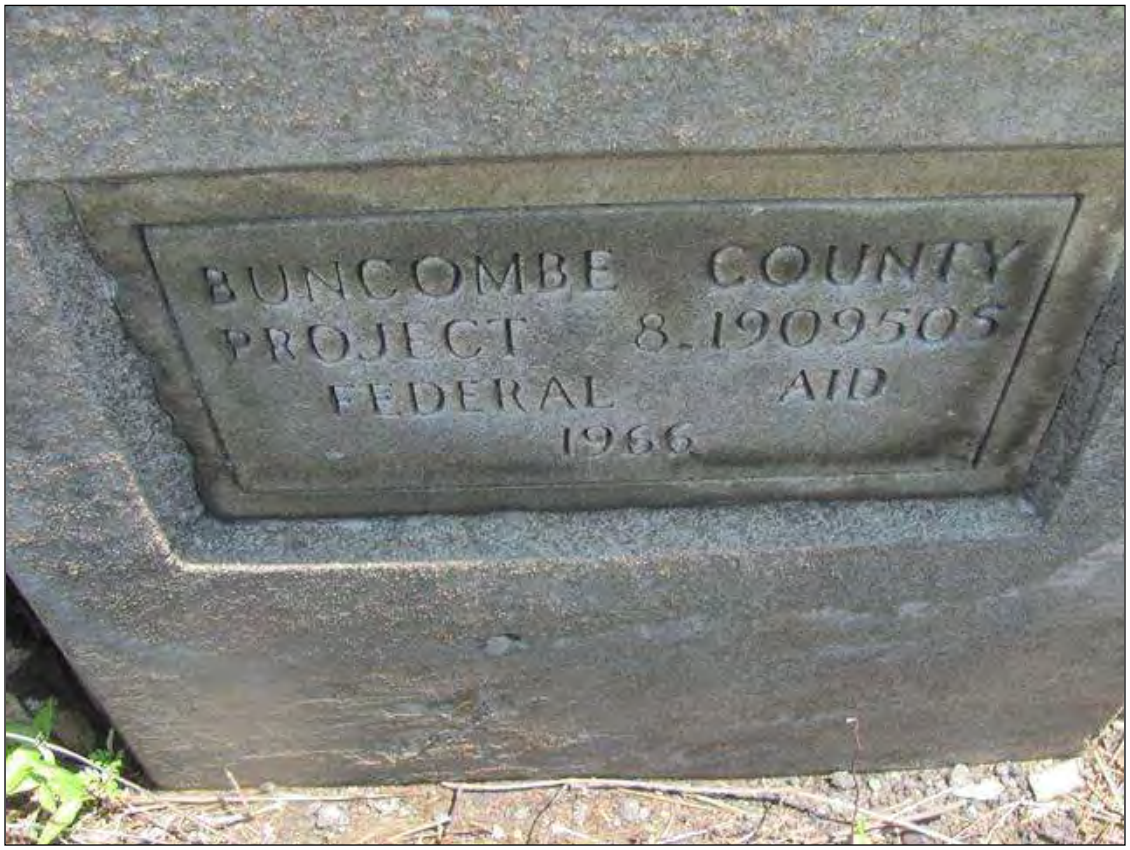
DOWN STREAM NORTH

APPROACH GUARDRAIL LOOKING WEST

UP STREAM SOUTH

DOWN STREAM NORTH

APPROACH GUARDRAIL LOOKING EAST



NAME PLATE

WEST

NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
BRIDGE MANAGEMENT UNIT

ATTENTION

BRIDGE INSPECTION REPORT

INSPECTION TYPE: Routine Inspection

COUNTY BUNCOMBE BRIDGE NUMBER 100238 INSPECTION CYCLE 2 YRS 31.8

ROUTE I-26 EBL ACROSS SR3431,HOMINY CREEK M.P. 31800

LOCATION .8 MI.N.JCT.NC191

SUPERSTRUCTURE REINFORCED CONCRETE FLOOR ON I-BEAMS

SUBSTRUCTURE E.BTS:RC SPILL THRU;BTS:RC POST&BEAM

SPANS 1 @ 51'-.75,2 @ 70',1 @ 50',1 @ 70'-11

LONGITUDE 82° 36' 16.6" LATITUDE 35° 32' 43.1"

PRESENT CONDITION FAIR INVENTORY RATING

INSPECTION DATE 04/19/2012 OPERATING RATING

PRESENT POSTING Not Posted PROPOSED POSTING

COMPUTER UPDATE ANALYSIS DATE

POSTING LETTER DATE SUFFICIENCY RATING

OTHER SIGNS PRESENT DELINEATORS (2)

EAST

SIGN NOTICE ISSUED FOR		NUMBERED REQUIRED
No	WEIGHT LIMIT	
No	DELINEATORS	
No	NARROW BRIDGE	
No	ONE LANE BRIDGE	
No	LOW CLEARANCE	

NATIONAL BRIDGE INVENTORY-------- STRUCTURE INVENTORY AND APPRAISAL Run Date: 06/13/2012

IDENTIFICATION

(1) STATE NAME -NORTH CAROLINA BRIDGE 100238
(8) STRUCTURE NUMBER(FEDERAL) 000000000210238
(5) INVENTORY ROUTE (ON/UNDER) - ON 11000260
(2) STATE HIGHWAY DEPARTMENT DISTRICT 2
(3) COUNTY CODE 21 (4) PLACE CODE 0
(6) FEATURE INTERSECTED - SR3431,HOMINY CREEK
(7) FACILITY CARRIED I-26 EBL
(9) LOCATION .8 MI.N.JCT.NC191
(11)MILEPOINT 31800
(16)LAT 35° 32' 43.4" (17)LONG 82° 36' 16.8"
(98)BORDER BRIDGE STATE CODE PCT SHARE
(99)BORDER BRIDGE STRUCTURE NO

STRUCTURE TYPE AND MATERIAL

(43) STRUCTURE TYPE MAIN: Steel
TYPE - Stringer Mutlibeam or Girder CODE 302
(44) STRUCTURE TYPE APPR :
TYPE - CODE 000
(45) NUMBER OF SPANS IN MAIN UNIT 5
(46) NUMBER OF APPROACH SPANS
(107)DECK STRUCTURE TYPE - 1 CODE
(108)WEARING SURFACE / PROTECTIVE SYSTEM :
(A) TYPE OF WEARING SURFACE - CODE
(B) TYPE OF MEMBRANE - CODE
(C) TYPE OF DECK PROTECTION - CODE

AGE AND SERVICE

(27) YEAR BUILT 1966
(106)YEAR RECONSTRUCTED
(42) TYPE OF SERVICE : ON - Highway
UNDER - Highway - Waterway CODE 16
(28) LANES: ON STRUCTURE 2 UNDER STRUCTURE 2
(29) AVERAGE DAILY TRAFFIC 40000
(30) YEAR OF ADT 2010 (109) TRUCK ADT PCT 16%
(19) BYPASS OR DETOUR LENGTH 1 MI

GEOMETRIC DATA

(48) LENGTH OF MAXIMUM SPAN 70 FT
(49) STRUCTURE LENGTH 312 FT
(50)CURB OR SIDEWALK: LEFT 0 FT RIGHT 0 FT
(51) BRIDGE ROADWAY WIDTH CURB TO CURB 28 FT
(52) DECK WIDTH OUT TO OUT 33.6 FT
(32) APPROACH ROADWAY WIDTH (W/SHOULDERS) 38 FT
(33) BRIDGE MEDIAN - No Median CODE 1
(34) SKEW 0° (35) STRUCTURE FLARED 0
(10) INVENTORY ROUTE MIN VERT CLEAR 999.9 FT
(47) INVENTORY ROUTE TOTAL HORIZ CLEAR 28 FT
(53) MIN VERT CLEAR OVER BRIDGE RDWY 999.9 FT
(54) MIN VERT UNDERCLEAR REF Not a Highway or Railroad 0 FT
(55) MIN LAT UNDERCLEAR RT REF Not a Highway or Railroad 000 FT
(56) MIN LAT UNDERCLEAR LT REF - 000 FT

NAVIGATION DATA

(38) NAVIGATION CONTROL - No Navigational Control CODE 0
(111)PIER PROTECTION - CODE
(39) NAVIGATION VERTICAL CLEARANCE 0
(116)VERT - LIFT BRIDGE NAV MIN VERT CLEAR FT
(40) NAVIGATION HORIZONTAL CLEARANCE 0 FT

SUFFICIENCY RATING = 3
STATUS = Structurally Deficient

CLASSIFICATION — CODE

(112)NBIS BRIDGE SYSTEM - YES
(104)HIGHWAY SYSTEM Is on the NHS 1
(26) FUNCTIONAL CLASS - Arterial - Interstate 11
(100)STRAHNET HIGHWAY - Interstate STRAHNET Route 1
(101)PARALLEL STRUCTURE - Right Parallel Structure R
(102)DIRECTION OF TRAFFIC - 1-way Traffic 1
(103)TEMPORARY STRUCTURE - Temporary Structure/Conditions T
(110)DESIGNATED NATIONAL NETWORK - On the National Network 1
(20) TOLL On Free Road 3
(31) MAINTAIN - State Highway Agency 01
(22) OWNER - State Highway Agency 01
(37) HISTORICAL SIGNIFICANCE - Not Eligible 5

CONDITION — CODE

(58) DECK 5
(59) SUPERSTRUCTURE 4
(60) SUBSTRUCTURE 5
(61) CHANNEL & CHANNEL PROTECTION 7
(62) CULVERTS N

LOAD RATING AND POSTING — CODE

(31) DESIGN LOAD HS 20+MOD 6
(63) OPERATING RATING METHOD - Load Factor
(64) OPERATING RATING - HS-1 101
(65) INVENTORY RATING METHOD - Load Factor
(66) INVENTORY RATING - HS-1 101
(70) BRIDGE POSTING - No Posting Required 5
(41) STRUCTURE OPEN, POSTED ,OR CLOSED D
DESCRIPTION - Open Temporary Shoring

APPRAISAL — CODE

(67) STRUCTURAL EVALUATION 2
(68) DECK GEOMETRY 3
(69) UNDERCLEARANCES,VERTI & HORIZ 5
(71) WATERWAY ADEQUACY 7
(72) APPROACH ROADWAY ALIGNMENT 7
(36) TRAFFIC SAFETY FEATURES 1110
(113)SCOUR CRITICAL BRIDGES 8

PROPOSED IMPROVEMENTS

(75) TYPE OF WORK - CODE
(76) LENGTH OF STRUCTURE IMPROVEMENT
(94) BRIDGE IMPROVEMENT COST
(95) ROADWAY IMPROVEMENT COST
(96) TOTAL PROJECT COST
(97) YEAR OF IMPROVEMENT COST ESTIMATE
(114)FUTURE ADT 80000 (115) YEAR FUTURE ADT 2025

INSPECTIONS

(90) INSPECTION DATE 04/19/2012
(92) CRITICAL FEATURE INSPECTION : (93) CFI DATE
A) FRACTURE CRIT DETAIL - NO A)
B) UNDERWATER INSP - NO B)
C) OTHER SPECIAL INSP NO C)
SCOUR

Structure No: 100238 County: BUNCOMBE Run Date:

Span Number	Feature Intersected	Inventory Route	Minimum Maximum Vertical Clearance	Milepoint	Base Highway Network	LRS Inventory Route	Toll	Functional Classification	Numer of Lanes	Average Daily Traffic	Year of Average Daily Traffic	Total Horizontal Clearance	See Note 1					STRAHNET Highway Designator	Direction of Traffic	Highway System of Route
													Reference Feature	Minimum Vertical Underclearance	Right Lateral Underclearance	Left Lateral Underclearance	Underclearance Appraisal Grade			
	6	5	10	11	12	13	20	26	28	29	30	47	54A	54	55	56	69	100	102	104
5	SR3431	31034310	16.25		0			19	2	200	1995	34.25	H	16.1670	7.9170		9	0	2	0

Note 1: Items 54, 55, and 56 are not reported FHWA under route data points but are collected for each under route to determine the minimum value for Underclearance Appraisal Item 69. The under route that generates the lowest Underclearance Appraisal value will be reported on the Facility Carried record.

BRIDGE MANAGEMENT UNIT

DATA ON EXISTING STRUCTURE Run Date: 06/13/2012

COUNTY : BUNCOMBE
DIVISION : 13
DISTRICT: 2
STRUCTURE NUMBER : 100238
LENGTH : 312 FEET

ROUTE CARRIED : I-26 EBL
FEATURE INTERSECTED : SR3431,HOMINY CREEK

LOCATED : .8 MI.N.JCT.NC191
BRIDGE NAME :
CITY :

FUNC. CLASS : 11
SYST.ON : FA
SYST.UNDER : NFA
ADT & YR : 40000 2010
RAIL TYPE : LT 713 RT 713

BUILT : 1966
BY : SHC
PROJ : 8.19095
FED.AID PROJ : B-5178
DESIGN LOAD : HS 20+MOD

REHAB :
BY :
PROJ :
ALIGNMENT : RT
SKEW : 90
LANES : ON 2 UNDER 2

NAVIGATION : VC 0 FT HC 0 FT
HT. CRN. TO BED : 49 FT
WATER DEPTH : 2 FT

SUPERSTRUCTURE : REINFORCED CONCRETE FLOOR ON I-BEAMS

SUBSTRUCTURE : E.BTS:RC SPILL THRU;BTS:RC POST&BEAM

SPANS : 1 @ 51'-.75,2 @ 70',1 @ 50',1 @ 70'-11

BEAMS OR GIRDERS : 4 LINES 36 I-BEAMS @ 8' CENTERS

FLOOR : 7 RC/3.5 AWS
ENCROACHMENT :
DECK (OUT TO OUT) : 33.6 FT

CLEAR ROADWAY : 28 FT
BETWEEN RAILS : 28 FT
SIDEWALK OR CURB : LT 0 FT RT 0 FT

VERT.CL.OVER : 999.9 FT

INV.RTG. : HS-1
OPE.RTG. : HS-1
CONTR.MEMBER : Int Bm SpA
POSTED : SV TTST DATE

SYSTEM : Primary Interstate
GREEN LINE ROUTE : Y

UNDER ROUTES AND CLEARANCES

Span	Route Description	Vertical Clearances		Horizontal Clearances		
		MMVC	MVC	Total	Left	Right
5	SR3431	16.25	16.1670	34.25		7.9170

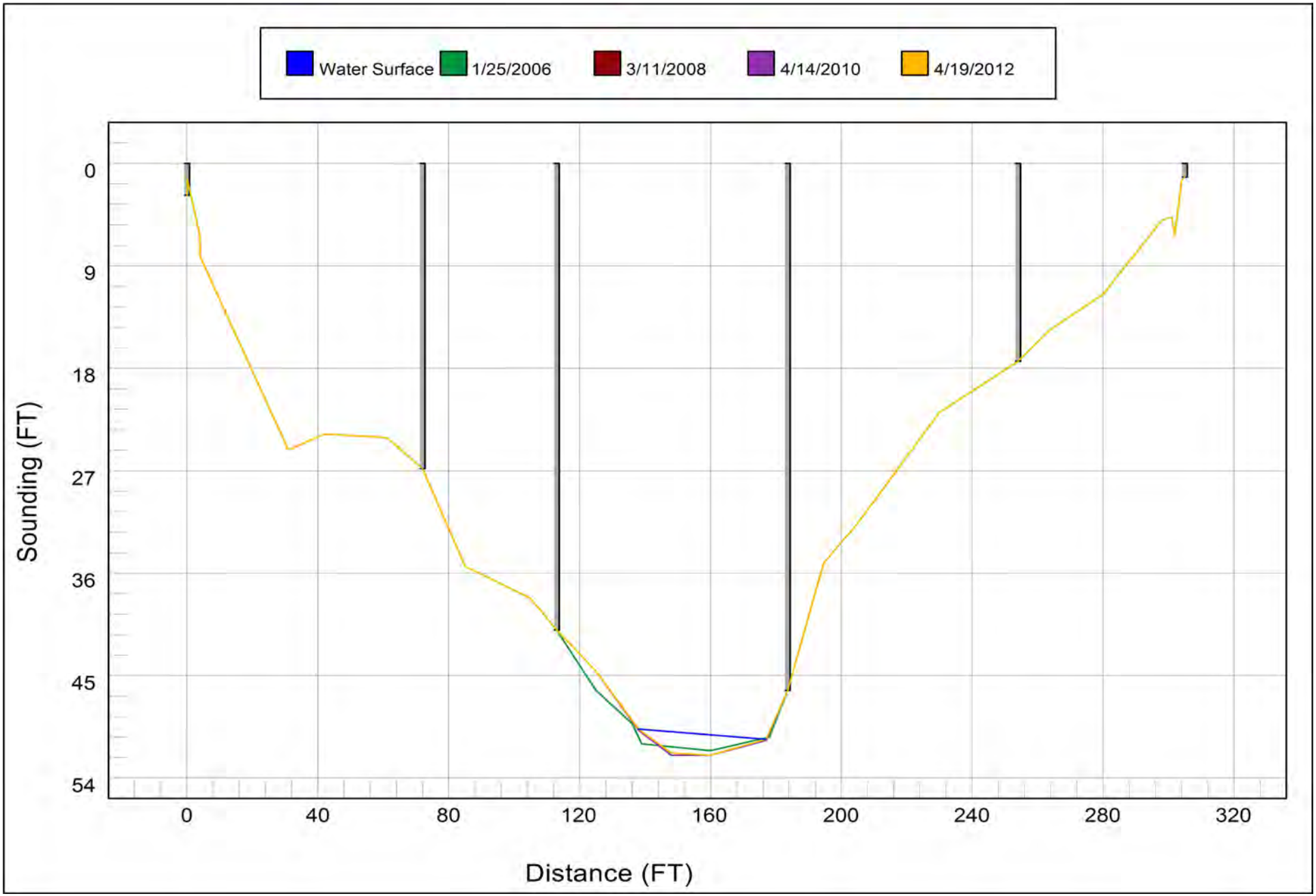
Note: All measurements are in feet.

REMARKS :

Bridge: 100238 County BUNCOMBE Date: 04/19/2012

STREAMBED PROFILE (Downstream)

Top of Rail = 0 FT (Sounding)



REP OF ABUTMENT (ABUTMENT #2)

REP OF INTERIOR BENT (INTERIOR BENT #3 / EAST FACE)

Structure 100238 County BUNCOMBE Date: 04/19/2012 Structure Photos

DOWN STREAM NORTH

UP STREAM SOUTH

APPROACH GUARDRAIL LOOKING EAST

DOWN STREAM NORTH

UP STREAM SOUTH

APPROACH GUARDRAIL LOOKING WEST

NAME PLATE

REP OF APPROACH GUARDRAIL POST SPACING @ BRIDGE (SOUTH WEST)

REP OF APPROACH GUARDRAIL POST SPACING OUT FROM BRIDGE (SOUTH WEST)

EAST

APPROACH GUARDRAIL TERMINAL END @ SOUTH WEST CORNER

LOOKING NORTH ON SR:3431

LOOKING SOUTH ON SR:3431

Looking at Upstream Face

Looking Upstream

Looking Upstream

Looking at Downstream Face

Looking Downstream

Looking Downstream

APPENDIX FF
PRELIMINARY HYDRAULIC RECOMMENDATIONS FOR MAJOR CROSSINGS

PRELIMINARY HYDRAULIC RECOMMENDATIONS FOR MAJOR[1] CROSSINGS
(MERGER CP2A)
6-Lane Widening

DATE: 5/28/14
PROJECT NUMBER: I-4400 / I-4700
WBS ELEMENT #:
PROJECT DESCRIPTION: I-26 Widening
NAME:

SITE NUMBER	ALT ID [2]	ROUTE	STATION	LAT	LONG	STREAM ID	STREAM NAME	FEMA STUDY TYPE	DRAINAGE AREA (Mi^2)	STREAM CLASS	EXISTING STRUCTURE	MINIMUM RECOMMENDED STRUCTURE	Notes
											Number, Size, Structure Type, (Additional Length)	Number, Size, Structure Type, (Additional Length)	
1	-	I-26	-L- 21+61	986723.26530	573804.8333	9-29-27	Beck Creek	None	0.30	C; Tr	2 @ 5' x 6' RCBC	2 @ 5' x 6' RCBC	
2	-	I-26	-L- 23+89	986474.84820	573873.5395	-	UT to Beck Creek	None	0.33	C; Tr	1 @ 72" CMP w/ HW	1 @ 84" SPP w/ HW	
3	-	I-26	-L- 79+09	984574.34510	579028.0539	-	UT to Dunn Creek	None	0.28	C	1 @ 6' x 6' RCBC	1 @ 6' x 6' RCBC	
4	-	I-26	-L- 90+32	984001.24990	579994.0926	6-55-8-1-1	Dunn Creek	Limited	2.58	C	2 @ 8' x 8' RCBC	2 @ 8' x 8' RCBC w/ Supplemental Pipe	Minimum Supplemental Pipe Size = 48".
5	-	SR 1793	-Y4- 16+71	980188.87840	587365.9132	-	UT to Devils Fork	None	0.31	C	1 @ 66" SPP w/ HW	1 @ 66" SPP w/ HW & Supplemental Pipe	Recommend Lining existing 66" SPP. Minimum Supplemental Pipe Size = 48".
6	-	SR 1893	-Y4-2- 13+58	980033.40540	587723.4148	-	UT to Devils Fork	None	0.32	C	1 @ 66" SPP w/ HW	1 @ 66" SPP w/ HW & Supplemental Pipe	Minimum Supplemental Pipe Size = 48".
7	-	I-26	-L- 208+70	978323.86870	590312.0764	6-55-8-2	Devils Fork	Detailed	6.80	C	3 @ 9' X 10' RCBC	3 @ 9' X 10' RCBC	
8	-	SR 1525	-Y4- 34+44	977073.27020	592092.6632	-	UT to Devils Fork	None	0.22	C	1 @ 66" SPP w/ HW	1 @ 66" SPP w/ HW	Recommend Lining existing 66" SPP.
9	-	I-26	-L- 231+67	977275.16950	592615.6113	-	UT to Devils Fork	None	0.21	C	1 @ 66" CMP w/ HW	1 @ 66" SPP w/ HW	Recommend Lining existing 66" SPP.
10	-	I-26	-L- 248+18	976275.36270	593669.2852	-	UT to Devils Fork	None	0.29	C	1 @ 6' x 6' RCBC	1 @ 6' x 6' RCBC	
11	-	I-26	-L- 334+69	970626.40530	599985.8440	6-55-11-(5)	Clear Creek	Detailed	44.30	C	Dual 3 - Span RC Deck Bridges; L = 220.14'	Dual 3 - Span Bridges; L (Min) = 230'	
12	-	I-26	-L- 407+69	966992.48630	606248.2122	-	UT to Mud Creek	None	0.46	C	1 @ 7' x 7' RCBC	1 @ 7' x 7' RCBC	
13	-	I-26	-L- 438+81	965030.75690	608652.8397	6-55-12	Featherstone Creek	Limited	4.09	C	3 @ 8' x 8' RCBC	3 @ 8' x 8' RCBC	
14	-	I-26	-L- 500+94	960792.04680	613087.0524	6-55-13	Byers Creek	None	2.42	C	2 @ 8' x 8' RCBC	2 @ 8' x 8' RCBC	
15	-	I-26	-L- 570+03	956396.25940	618010.6296	-	UT to Mud Creek	None	0.20	C	1 @ 66" SPP w/ HW	1 @ 66" SPP w/ HW	
16	-	I-26	-L- 669+02	950419.18090	625430.4666	6-57-(9)	Cane Creek	Detailed	83.80	C	Dual 3 - Span RC Deck Bridges; L = 198.25'	Dual 3 - Span Bridges; L (Min) = 210'	
17	-	I-26	-L- 682+68	949732.07990	626629.4280	6-57-22	Kimsey Creek	Detailed	2.49	C	3 @ 7' x 7' RCBC	3 @ 7' x 7' RCBC	
18	-	SR 1358	-Y12- 11+44	947362.16240	630621.5065	-	UT to French Broad River	None	0.14	B	1 @ 6' x 5' RCBC - 66" RCP w/ HW	1 @ 6' x 5' RCBC - 66" RCP w/ HW	
19	-	I-26	-L- 800+81	945500.79650	637588.0430	-	UT to French Broad River	None	0.36	B	1 @ 6' x 6' RCBC	1 @ 6' x 6' RCBC w/ Supplemental Pipe	Minimum Supplemental Pipe Size = 48".
20	-	I-26	-LBNB47001-826+95	945249.89830	640150.2926	-	French Broad River Tributary 149	Limited	0.24	B	1 @ 66" CMP w/ HW	1 @ 66" CMP w/ HW	Recommend Lining existing 66" CMP.
21	-	I-26	-LBNB47001-850+25	944247.32610	642286.3579	-	UT to French Broad River	None	0.17	B	1 @ 66" RCP w/ HW	1 @ 66" RCP w/ HW	
22	-	I-26	-LBNB47001-866+58	943457.42560	643633.1138	-	UT to French Broad River	None	0.12	B	1 @ 66" CMP w/ HW	1 @ 66" CMP w/ HW	Recommend Lining existing 66" CMP.
23	-	I-26	-L47001-897+06	942265.08380	646460.8652	6-62	Powell Creek	None	5.06	C	2 @ 10' x 10' RCBC	2 @ 10' x 10' RCBC	
24	-	I-26	-L47001-931+91	941154.43190	649702.5342	6-63	Ducker Creek	None	0.99	C	1 @ 8' x 8' RCBC	1 @ 8' x 8' RCBC	
25	-	I-26	-L47002-1076+40	933445.26330	660880.8725	6-54.5	French Broad River	Detailed	678.00	B	Dual 6 - Span RC Deck Bridges; L_1 = 440.9' L_2 = 453.4'	Dual 6 - Span Bridges; L (Min) = 460'	
26	-	I-26	-L47002-1151+85	929263.58010	666921.5241	6-75	Long Valley Branch	None	0.25	C	1 @ 66" SPP w/ HW	1 @ 66" SPP w/ HW	Recommend Lining existing 66" SPP. This crossing has a RCBC vehicle underpass in the left overbank that should also
27	-	I-26	-L47002-1201+84	928178.14930	671667.8710	-	UT to Hominy Creek	None	0.24	C	1 @ 72" SPP w/ HW	1 @ 72" SPP w/ HW w/ Supplemental Pipe	Recommend Lining existing 72" SPP. Minimum Supplemental Pipe Size = 48".
28	-	I-26	-L47002-1213+77	927981.20080	672819.0849	6-76	Hominy Creek	Detailed	94.60	C	Dual 4 - Span RC Deck Bridges; L_1 = 251.8' L_2 = 312.0'	Dual 4 - Span Bridges; L (Min) = 330'	

NOTES:
(1) Major Crossing are conveyance greater than 72" pipe.
(2) Provided in NRTR or other NES documents

PRELIMINARY HYDRAULIC RECOMMENDATIONS FOR MAJOR[1] CROSSINGS
(MERGER CP2A)
8-Lane Widening

DATE: 5/28/14
PROJECT NUMBER: I-4400 / I-4700
WBS ELEMENT #:
PROJECT DESCRIPTION: I-26 Widening
NAME:

SITE NUMBER	ALT ID [2]	ROUTE	STATION	LAT	LONG	STREAM ID	STREAM NAME	FEMA STUDY TYPE	DRAINAGE AREA (Mi^2)	STREAM CLASS	EXISTING STRUCTURE	MINIMUM RECOMMENDED STRUCTURE	Notes
											Number, Size, Structure Type, (Additional Length)	Number, Size, Structure Type, (Additional Length)	
1	-	I-26	-L- 21+61	986723.26530	573804.8333	9-29-27	Beck Creek	None	0.30	C; Tr	2 @ 5' x 6' RCBC	2 @ 5' x 6' RCBC	
2	-	I-26	-L- 23+89	986474.84820	573873.5395	-	UT to Beck Creek	None	0.33	C; Tr	1 @ 72" CMP w/ HW	1 @ 84" SPP w/ HW	
3	-	I-26	-L- 79+09	984574.34510	579028.0539	-	UT to Dunn Creek	None	0.28	C	1 @ 6' x 6' RCBC	1 @ 6' x 6' RCBC	
4	-	I-26	-L- 90+32	984001.24990	579994.0926	6-55-8-1-1	Dunn Creek	Limited	2.58	C	2 @ 8' x 8' RCBC	2 @ 8' x 8' RCBC w/ Supplemental Pipe	Minimum Supplemental Pipe Size = 48".
5	-	SR 1793	-Y4- 16+71	980188.87840	587365.9132	-	UT to Devils Fork	None	0.31	C	1 @ 66" SPP w/ HW	1 @ 66" SPP w/ HW & Supplemental Pipe	Recommend Lining existing 66" SPP. Minimum Supplemental Pipe Size = 48".
6	-	SR 1893	-Y4-2- 13+58	980033.40540	587723.4148	-	UT to Devils Fork	None	0.32	C	1 @ 66" SPP w/ HW	1 @ 66" SPP w/ HW & Supplemental Pipe	Minimum Supplemental Pipe Size = 48".
7	-	I-26	-L- 208+70	978323.86870	590312.0764	6-55-8-2	Devils Fork	Detailed	6.80	C	3 @ 9' X 10' RCBC	3 @ 9' X 10' RCBC	
8	-	SR 1525	-Y4- 34+44	977073.27020	592092.6632	-	UT to Devils Fork	None	0.22	C	1 @ 66" SPP w/ HW	1 @ 66" SPP w/ HW	Recommend Lining existing 66" SPP.
9	-	I-26	-L- 231+67	977275.16950	592615.6113	-	UT to Devils Fork	None	0.21	C	1 @ 66" CMP w/ HW	1 @ 66" SPP w/ HW	Recommend Lining existing 66" SPP.
10	-	I-26	-L- 248+18	976275.36270	593669.2852	-	UT to Devils Fork	None	0.29	C	1 @ 6' x 6' RCBC	1 @ 6' x 6' RCBC	
11	-	I-26	-L- 334+69	970626.40530	599985.8440	6-55-11-(5)	Clear Creek	Detailed	44.30	C	Dual 3 - Span RC Deck Bridges; L = 220.14'	Dual 3 - Span Bridges; L (Min) = 230'	
12	-	I-26	-L- 407+69	966992.48630	606248.2122	-	UT to Mud Creek	None	0.46	C	1 @ 7' x 7' RCBC	1 @ 7' x 7' RCBC	
13	-	I-26	-L- 438+81	965030.75690	608652.8397	6-55-12	Featherstone Creek	Limited	4.09	C	3 @ 8' x 8' RCBC	3 @ 8' x 8' RCBC w/ Supplemental Pipe	Minimum Supplemental Pipe Size = 48".
14	-	I-26	-L- 500+94	960792.04680	613087.0524	6-55-13	Byers Creek	None	2.42	C	2 @ 8' x 8' RCBC	2 @ 8' x 8' RCBC w/ Supplemental Pipe	Minimum Supplemental Pipe Size = 48".
15	-	I-26	-L- 570+03	956396.25940	618010.6296	-	UT to Mud Creek	None	0.20	C	1 @ 66" SPP w/ HW	1 @ 66" SPP w/ HW & Supplemental Pipe	Minimum Supplemental Pipe Size = 48".
16	-	I-26	-L- 669+02	950419.18090	625430.4666	6-57-(9)	Cane Creek	Detailed	83.80	C	Dual 3 - Span RC Deck Bridges; L = 198.25'	Dual 3 - Span Bridges; L (Min) = 210'	
17	-	I-26	-L- 682+68	949732.07990	626629.4280	6-57-22	Kimsey Creek	Detailed	2.49	C	3 @ 7' x 7' RCBC	3 @ 7' x 7' RCBC w/ Supplemental Pipe	Minimum Supplemental Pipe Size = 48".
18	-	SR 1358	-Y12- 11+44	947362.16240	630621.5065	-	UT to French Broad River	None	0.14	B	1 @ 6' x 5' RCBC - 66" RCP w/ HW	1 @ 6' x 5' RCBC - 66" RCP w/ HW	
19	-	I-26	-L- 800+81	945500.79650	637588.0430	-	UT to French Broad River	None	0.36	B	1 @ 6' x 6' RCBC	1 @ 6' x 6' RCBC w/ Supplemental Pipe	Minimum Supplemental Pipe Size = 48".
20	-	I-26	-LBNB47001-826+95	945249.89830	640150.2926	-	French Broad River Tributary 149	Limited	0.24	B	1 @ 66" CMP w/ HW	1 @ 66" CMP w/ HW & Supplemental Pipe	Recommend Lining existing 66" CMP. Minimum Supplemental Pipe Size = 48".
21	-	I-26	-LBNB47001-850+25	944247.32610	642286.3579	-	UT to French Broad River	None	0.17	B	1 @ 66" RCP w/ HW	1 @ 66" RCP w/ HW	
22	-	I-26	-LBNB47001-866+58	943457.42560	643633.1138	-	UT to French Broad River	None	0.12	B	1 @ 66" CMP w/ HW	1 @ 66" CMP w/ HW	Recommend Lining existing 66" CMP.
23	-	I-26	-L47001-897+06	942265.08380	646460.8652	6-62	Powell Creek	None	5.06	C	2 @ 10' x 10' RCBC	2 @ 10' x 10' RCBC	
24	-	I-26	-L47001-931+91	941154.43190	649702.5342	6-63	Ducker Creek	None	0.99	C	1 @ 8' x 8' RCBC	1 @ 8' x 8' RCBC	
25	-	I-26	-L47002-1076+40	933445.26330	660880.8725	6-54.5	French Broad River	Detailed	678.00	B	Dual 6 - Span RC Deck Bridges; L_1 = 440.9' L_2 = 453.4'	Dual 6 - Span Bridges; L (Min) = 460'	
26	-	I-26	-L47002-1151+85	929263.58010	666921.5241	6-75	Long Valley Branch	None	0.25	C	1 @ 66" SPP w/ HW	1 @ 66" SPP w/ HW	Recommend Lining existing 66" SPP. This crossing has a RCBC vehicle underpass in the left overbank that should also be retained.
27	-	I-26	-L47002-1201+84	928178.14930	671667.8710	-	UT to Hominy Creek	None	0.24	C	1 @ 72" SPP w/ HW	1 @ 72" SPP w/ HW w/ Supplemental Pipe	Recommend Lining existing 72" SPP. Minimum Supplemental Pipe Size = 48".
28	-	I-26	-L47002-1213+77	927981.20080	672819.0849	6-76	Hominy Creek	Detailed	94.60	C	Dual 4 - Span RC Deck Bridges; L_1 = 251.8' L_2 = 312.0'	Dual 4 - Span Bridges; L (Min) = 330'	

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