

Submitted By: Brian Nickerson, PE Date: 6 / 6 / 18 Recommended: Brian Nickerson, PE Date: 6 / 6 / 18

Engineer of Record

To: Michael Hood, PE

Program / Project Manager

BASIS OF DESIGN EXCEPTION

- Request for Approval of Design Exceptions to AASHTO Guidelines
- Request for Approval of Design Exceptions from Standard SCDOT Procedures

PROJECT CHARACTERISTICS

County: Lex/Rich/Newberry Rd./Route: I-26 Const. Pin: P029208

From: MM 85 To: MM 101

Length: 16.5 miles MPO / COG: Central Midlands

Work Type: Interstate widening and interchange reconstruction

Functional Classification: Rural/Urban Freeways

Group Designation: (1 / 2 / 3 / 4) (if applicable)

Type of Terrain: (Level / Rolling / Mountainous)

Design Speed: 70 mph (mph)

2015 ADT 71,700

2040 ADT 136,230

TRUCKS 23 %

CRASH ANALYSIS

(Attach additional sheets with accident history data)

TOTAL PROJECT ESTIMATE (\$) 532,000,000

CHECK APPROPRIATE BOX(ES) FOR DESIGN EXCEPTION(S)

- | | | |
|---|--|---|
| <input type="checkbox"/> Design Speed | <input type="checkbox"/> Maximum Grade | <input type="checkbox"/> Travel Lane Width |
| <input type="checkbox"/> Horizontal Alignment | <input type="checkbox"/> Vertical Clearance | <input type="checkbox"/> Shoulder Width |
| <input type="checkbox"/> Minimum Radii | <input type="checkbox"/> Bridge Width | <input type="checkbox"/> Horizontal Clearance |
| <input type="checkbox"/> Vertical Alignment | <input type="checkbox"/> Structural Capacity | <input checked="" type="checkbox"/> Stopping Sight Distance |
| <input type="checkbox"/> Level SSD K-Values | <input type="checkbox"/> Superelevation Rate | |
| | <input type="checkbox"/> Cross Slope | |
| | <input type="checkbox"/> Travel Lanes | |
| | <input type="checkbox"/> Shoulders | |

DESCRIBE ELEMENT(S) FOR DESIGN EXCEPTION(S)

(Attach additional sheets as needed) _____

Two locations along the project contain vertical crest curves with SSD values of approximately 570'. These locations are 1) EB 7054+50 & WB 4054+50 (mainline station near 1054+75), and 2) EB 7431+80 & WB 4432+25 (mainline station 1432+00). The required SSD for a 70 MPH design speed is 730'. (see attached)

JUSTIFICATION FOR DESIGN EXCEPTION(S)

(Attach additional sheets as needed) _____

The existing SSD (570') for these vertical curves meets a minimum design speed less than or equal to 60 mph. The I-26 Traffic Safety Analysis Report shows a total of only three crashes within the limits of the substandard SSD; none appear related to SSD. In order to meet SSD of 730', significant amount of fills or cuts will be required. (attached)

DESCRIBE STEPS TO ELEMIMATE DESIGN EXCEPTION(S). INCLUDE COST

(Attach additional sheets as needed) _____

Each location was evaluated to meet 70 mph stopping sight crest vertical curve criteria. The additional depth of cut or fill were developed. Cost to remove, lower and reconstruct the crest vertical curves for both locations is estimated to be \$5,000,000. (see attached)

HOW WILL FUTURE CONSTRUCTION IMPACT DESIGN EXCEPTION(S)?

(Attach additional sheets as needed) _____

(See Attached)

RECORD OF DECISION

For

Against

For

Against

Approved

Denied

W.B. Miller 7/24/18
(Regional Design Manager/
Program Manager / DEA) Date

[Signature] 7/25/18
(Regional Production Engineer) Date

John D. Bright 7/25/18
(Director of Preconstruction) Date

Concur [Signature] 8/20/18

FHWA (NHS > \$50 million & All Interstate)

- cc:
- Director of Preconstruction
- FHWA
- Preconstruction Support Engineer
- Regional Production Group Engineer
- District Engineering Administrator
- Director of Traffic Engineering

Describe Elements for Design Exception

Stopping sight distance (SSD) is defined as the distance for drivers to see an obstacle in the roadway and safely bring their vehicle to stop. This distance is the sum of the distance traveled during a driver's perception/reaction or brake reaction time and the distance traveled while braking to a stop. These distances will vary dependent on travel speed and grade. The criterion for SSD is applied to both horizontal and vertical alignments. For vertical alignments, a minimum length of crest curve is required to provide SSD for any given design speed.

Two locations along the project contain vertical crest curves with SSD values of approximately 570'. The first location is near mainline station 1054+75 (Location 1) and the second is near mainline station 1432+00 (Location 2). Both vertical curve locations are in the eastbound and westbound direction of travel. According to the 2011 AASHTO Policy on Geometric Design of Highways and Streets and the South Carolina Roadway Design Manual, a SSD of 730' is required for a 70 mph design speed. The existing, substandard vertical curves have a SSD which meets a design speed of 60 mph. The proposed crest curves would have a SSD of 645' and meet a design speed of 65 mph. These values were developed based on past practices on interstate projects where significant cuts and fills were required to meet design criteria, but where there was no significant crash history related to SSD. In this instance, cuts and fills were restricted to a maximum of 3'.

Justification for Design Exception(s)

The elimination of the SSD design exceptions would require extensive reconstruction of I-26, would present major traffic control issues, and would add significantly to the cost of the project. Significant excavation also introduces risks to the project associated with unknown subsurface conditions that have not been captured in preliminary cost estimates. Rock was encountered in preliminary borings within 4.5 feet of the surface 100 feet from the Location 1 curve, and within 4 feet of the surface in the Location 2 curve.

At Location 2, the vertical curve is between the exit ramp and entrance ramp in both directions of travel. The additional length of curve required to provide additional stopping sight distance will create longer temporary ramps for longer periods of time in order to complete the additional excavation. The longer vertical curve will require the proposed westbound exit ramp (loop) to be much lower than the existing ramp grade thereby creating potential construction issues while maintaining the existing ramp.

As described below, the crash history at these two locations does not indicate any issues attributable to the available stopping sight distance, and both curves are proposed to be improved from the existing condition.

✓
Re

In the Interstate 26 Traffic Safety Analysis Report prepared by STV, Inc., historical crash data is included for years 2013 thru 2015 (3 years) for the project area from mile marker 81.8 to 102.5. There were 1,037 crashes on the interstate mainline or ramps during this period and 130 crashes on interchange arterials and adjacent roadways. The majority of these accidents (82%) were classified as property damage only. There were seven fatal crashes during this period. These fatal crashes included four hitting a fixed object, sideswipe/head-on, and pedestrian illegally in roadway (one in each direction). The majority of the crashes along I-26 were rear end crashes (441) and no collision with motor vehicle (433) or 84% of the total crashes. Sideswipes same direction crashes accounted for 11% of the crashes. The widening of this section of I-26 is anticipated to reduce congestion and reduce rear-end crashes that could result from slowed or stopped traffic due to traffic queues. The substandard crest vertical curves occur in areas where the horizontal curvature does not cause issues with stopping sight distance.

The attached figures (A-5, A-6, A-13, A-14, B-15, B-16, B-23, B-24) show the location of all crashes in areas where the proposed design exception is located as well as the approximate location of the vertical curves. Location 1 had 4 crashes in the westbound lanes (improper lane usage/change, aggressive operation of vehicle, and two crashes of driving too fast for conditions) and 3 crashes (two were driving too fast for conditions and improper lane change) in the eastbound lanes. Location 2 had crashes (all driving too fast for conditions) in the westbound lanes and 4 crashes (all driving too fast for conditions) in the eastbound lanes. As shown on these figures, these locations are not in "hot spot" areas of this project.

The proposed SSD for the curves at these locations is 645' which meets a design speed of 65 mph, greater than the current design speed but below the 70 mph design speed for the remainder of the project. Since the current length of crest curve does not appear to contribute to the crashes, the proposed length of curve should not contribute to future crashes and would be an improvement.

In addition to increasing the existing available SSD, other safety measures such as cross slope correction, additional clear zone, interchange improvements, and an additional travel lane in each direction, as proposed, will significantly improve the safety of I-26 through the project limits.

Based on the proposed improvements which mitigate crash history, construction cost to correct the vertical curve to meet 70 mph SSD, and minimal crash history related to the geometry, it is recommended to provide the 65 mph SSD.

// ✓ TR

// ✓ TR

// ✓ TR

Describe steps to eliminate Design exception(s)

In order to eliminate the design exceptions, longer crest curves are required to provide the 730' SSD. This will require additional construction cost due to added depth of cut and length of reconstruction. During construction, the additional depth of cut will require temporary shoring in order to maintain the existing elevations of travel lanes in one direction while excavation and construction of the concrete median to the proposed elevations of the other direction can be accomplished. The additional length and depth of reconstruction along with temporary shoring will add approximately 3 weeks per side of each location or 3 months to the contract time.

At location 1, the 65 mph design eastbound requires 1.3' cut verses 5.2' for 70 mph. In the westbound direction the 65 mph design requires 2.2' cut verses 6.1' for 70 mph. At location 2, the 65 mph design eastbound requires 2.7' cut verses 5.7' cut for 70 mph. In the westbound direction the 65 mph design requires 2.5' cut verses 5.9' cut for 70 mph. The additional construction cost for both locations is approximately \$5,000,000 which does not include engineering cost.

How will future construction impact Design Exception(s)

Future construction is not anticipated to be impacted by the design exception. Due to issues with constructability and maintenance of traffic to correct the grades and the fact that the crash analysis does not indicate adverse effects on safety, it is not anticipated these grades will be modified in the future provided an acceptable level of safety remains in the future.

I-26 MM 85 TO 101 - EASTBOUND DIRECTION											
8/28/2017	EXISTING CONDITIONS		70 MPH SSD						RECOMMENDATION		
									CRASH HISTORY		
									[TRAFFIC REPORT FIGURES]		
LOCATION	STATION	LENGTH	DES SPEED	VPI #	STATION	LENGTH	CREST	SAG			
1	C 1054+65.00	1102.01	60	36	C 1054+80.00	1890.00	-5.20		DESIGN EXCEPTION 65 MPH [1.3' CUT]		
2	C 1431+00.00	1200.00	60	63	C 1431+82.00	1650.00	-5.70		DESIGN EXCEPTION 65 MPH [2.7' CUT]		
									Figures A-13 / A-14		
									Figures A-5, A-6		

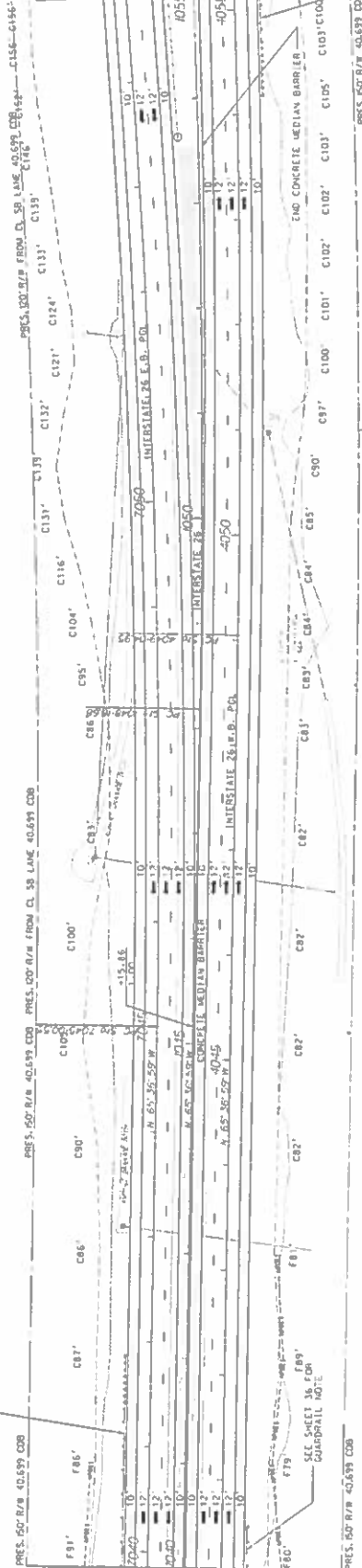
INTERSTATE 26



PROJECT NO.	STATE	COUNTY	SHEET NO.
17-25	3	1	17
POSITION			

MATCH LINE STA. 1040+00.00

MATCH LINE STA. 1055+00.00



SEE SHEET 36 FOR
GARRAILED NOTE

SEE SHEET 36 FOR
GARRAILED NOTE

SEE SHEET 36 FOR
GARRAILED NOTE

ALIGNMENT CONTROL CAN BE FOUND
ON REFERENCE DATA SHEET 30 - 31



CIVIL ENGINEERING
CONSULTING SERVICES, INC.

DESIGNED BY: J. L. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W.
CHECKED BY: J. L. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W.DATE: 08/07/07
SCALE: 1" = 50' HORIZ

NO.	DATE	DESCRIPTION

BY	DATE	DESCRIPTION

BY	DATE	DESCRIPTION

BY	DATE	DESCRIPTION

BY	DATE	DESCRIPTION

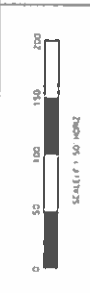
BY	DATE	DESCRIPTION

BY	DATE	DESCRIPTION

SCS

SOUTH CAROLINA DEPARTMENT
OF TRANSPORTATION

PRELIMINARY PLANS
NOT FOR CONSTRUCTION



WILPSSHALE 26 RWS/MWG

PLAN SHEET

STA. 1040+00.00 TO STA. 1055+00.00

08/07/07

J. L. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W.

J. L. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W.

J. L. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W.

J. L. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W.

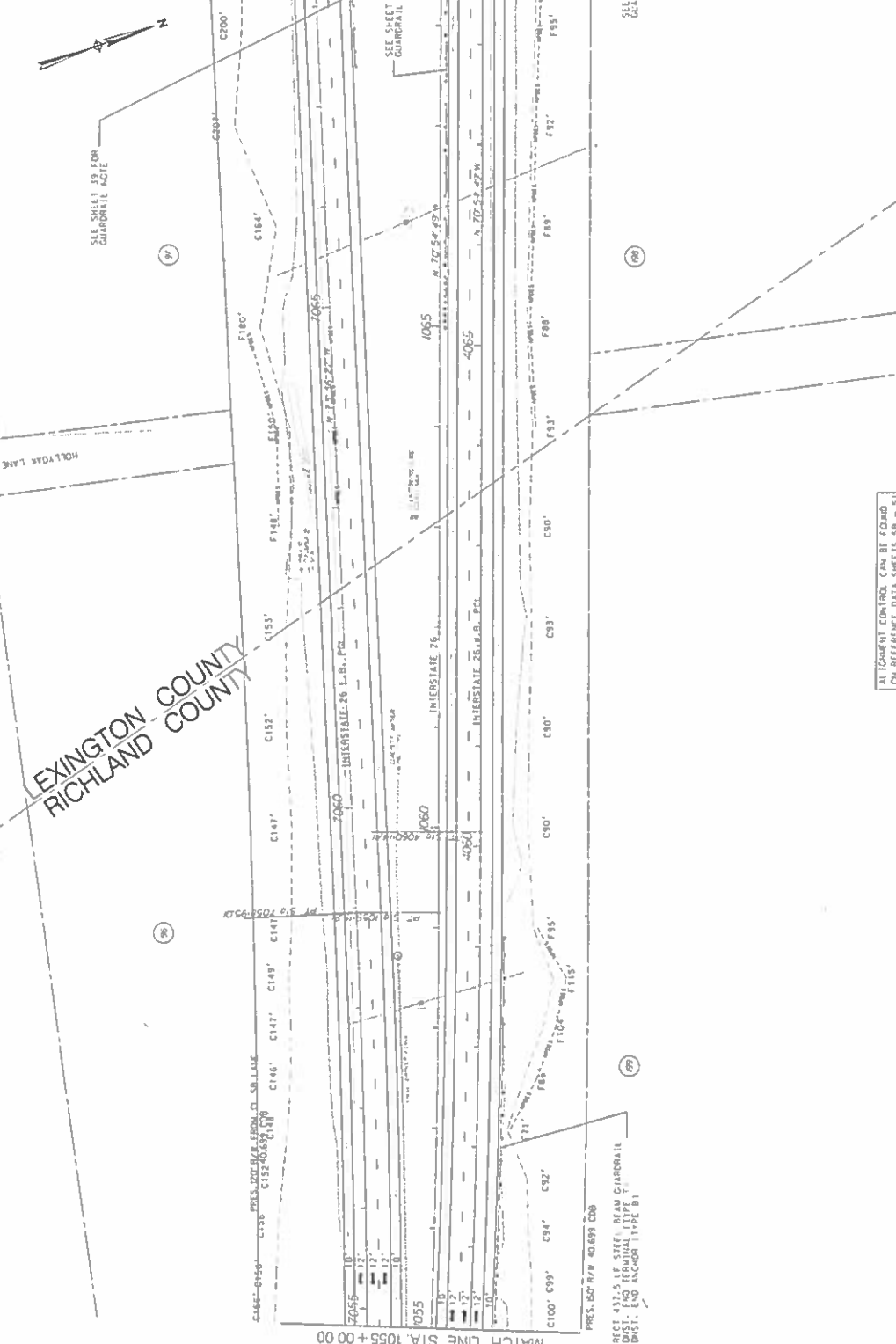
J. L. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W.

J. L. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W. / J. M. W.

08/07/07

PROJECT NO.	STATE	COUNTY	PROJECT	SHEET NO.	TOTAL SHEETS
1000	3	3	1000	1	10

INTERSTATE 26



LEXINGTON COUNTY
RICHLAND COUNTY



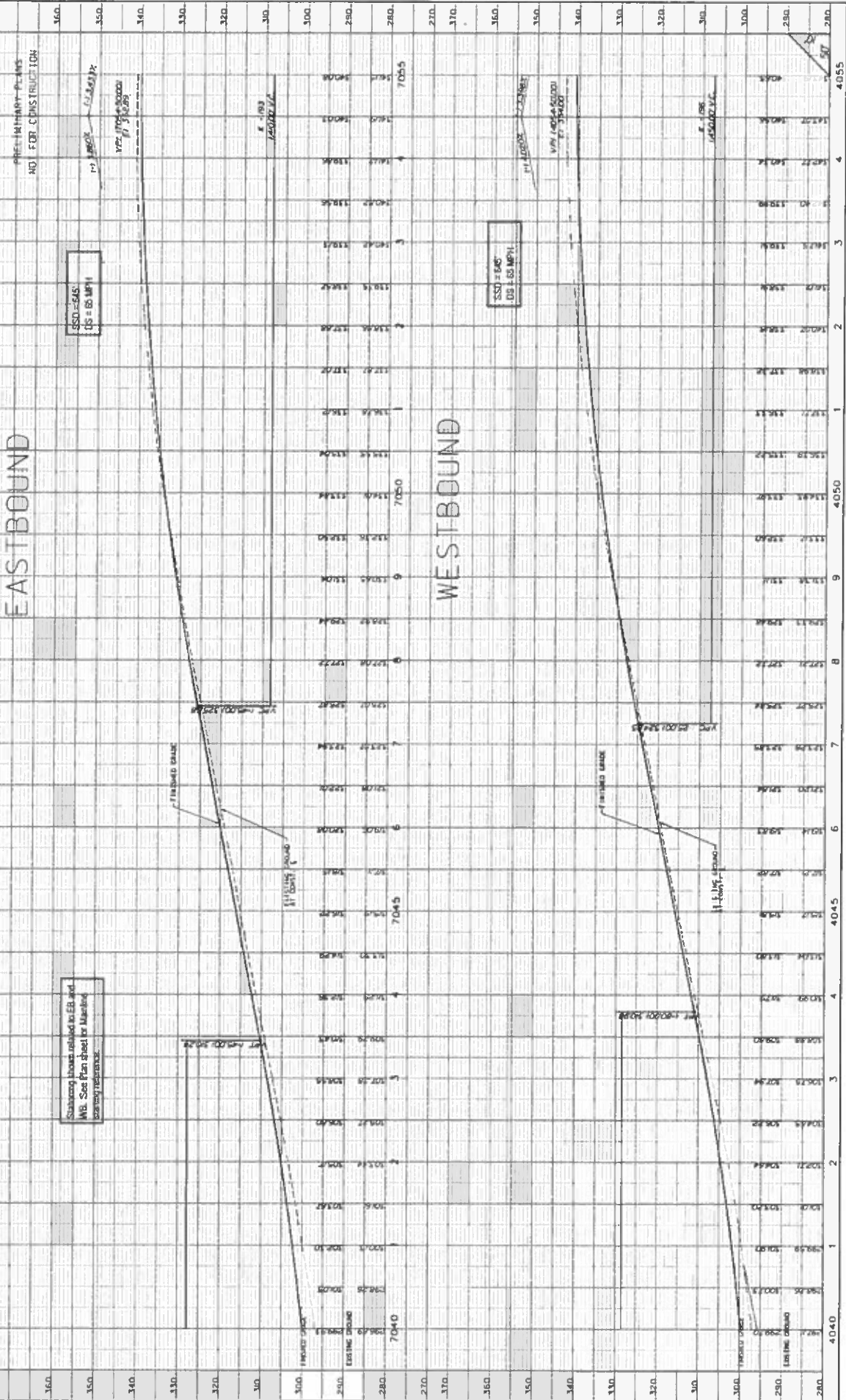
		SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION INTERSTATE 26 HIGHWAY PLAN SHEET STA. 1055+00.00 TO STA. 1070+00.00	
PRELIMINARY PLANS NOT FOR CONSTRUCTION		<p>SCALE: 1" = 50' HORZ.</p>	
ATTENTION: CONTRACTORS CAN BE FOUND ON REFERENCE DATA SHEETS 3B - 5I			
DATE: 07/20/07 DRAWN BY: [Name] CHECKED BY: [Name] APPROVED BY: [Name]	DATE: 07/20/07 DRAWN BY: [Name] CHECKED BY: [Name] APPROVED BY: [Name]	DATE: 07/20/07 DRAWN BY: [Name] CHECKED BY: [Name] APPROVED BY: [Name]	DATE: 07/20/07 DRAWN BY: [Name] CHECKED BY: [Name] APPROVED BY: [Name]

INTERSTATE 26

STATE 26
 COUNTY
 PROJECT
 SHEET NO.
 DATE

EASTBOUND

WESTBOUND



INTERSTATE 26

PROJECT B
SHEET NO. 57
DATE 1/24/95

PLANS
NOT FOR CONSTRUCTION

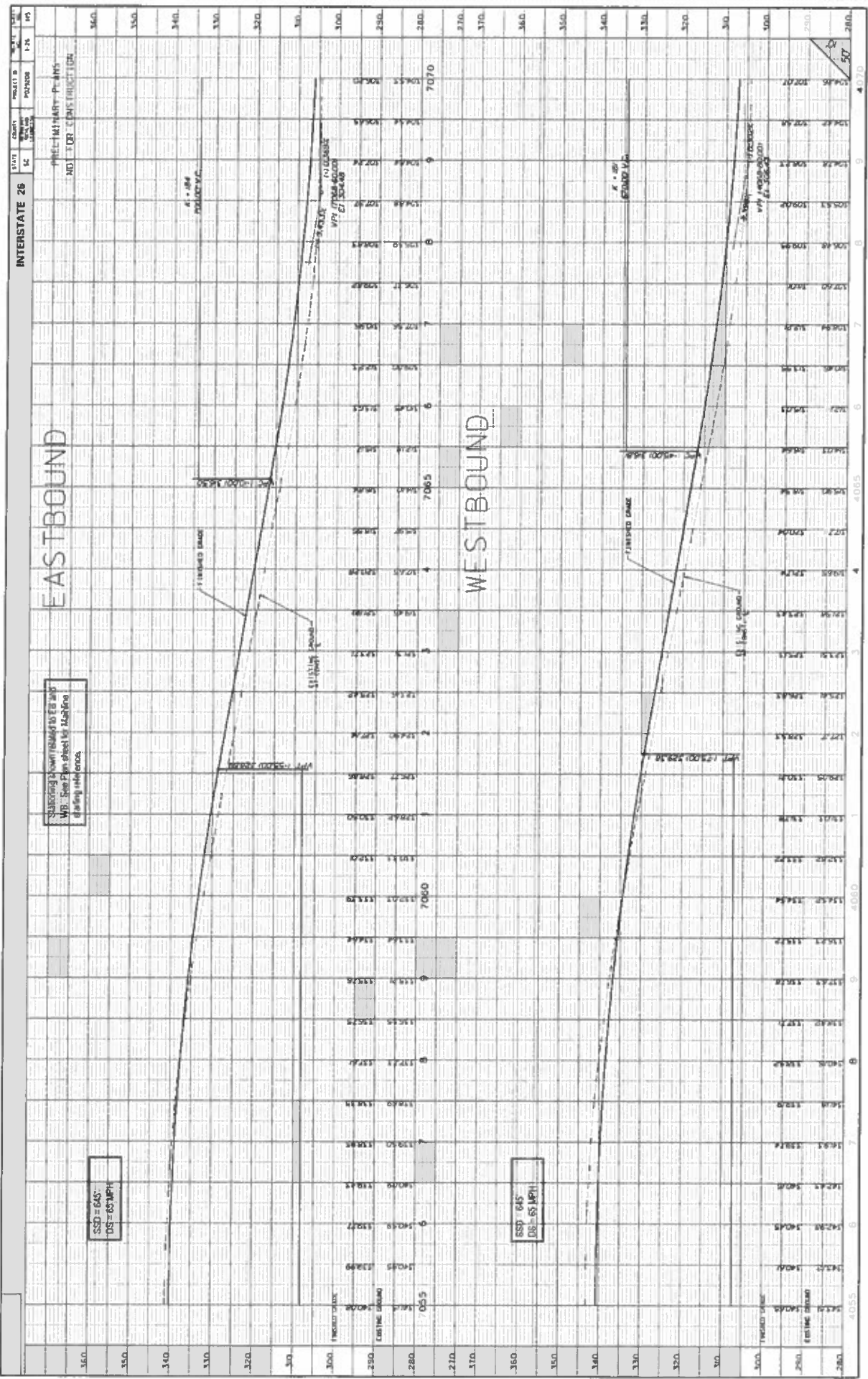
EASTBOUND

WESTBOUND

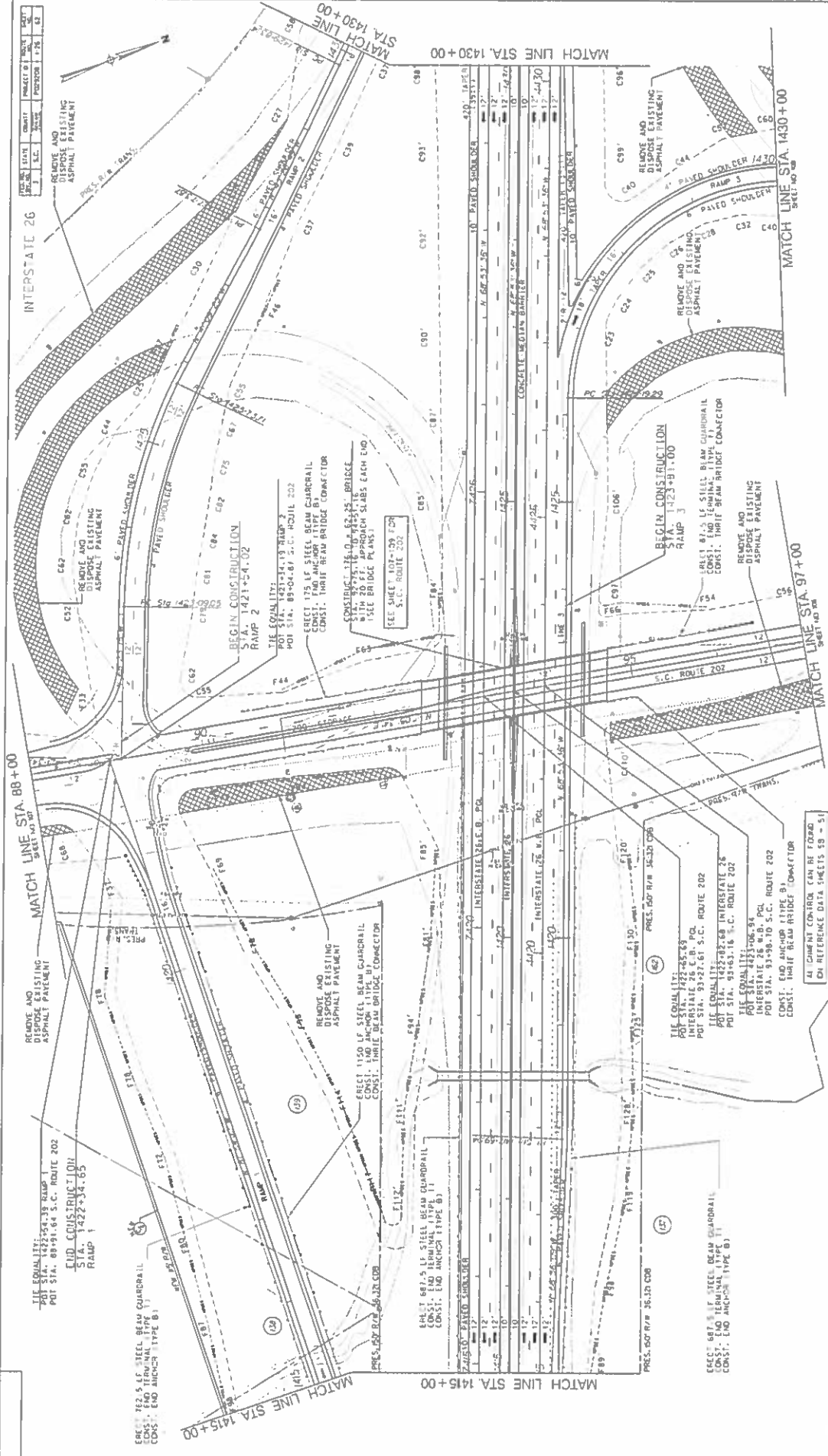
CONSTRUCTION INFORMATION
W.P. See Plan Sheet for Machine
grading tolerance.

SSD = 645'
DS = 0.5 MPH

SSD = 645'
DS = 0.5 MPH



4055 4060 4065 4070
280 290 300 310 320 330 340 350 360



INTERSTATE 26
 REMOVE AND DISPOSE EXISTING ASPHALT PAVEMENT

PRELIMINARY PLANS
 NOT FOR CONSTRUCTION

CIVIL ENGINEERING
 CONSULTING SERVICES, INC



NO.	DATE	DESCRIPTION	BY	SCALE	PROJECT NO.	SHEET NO.

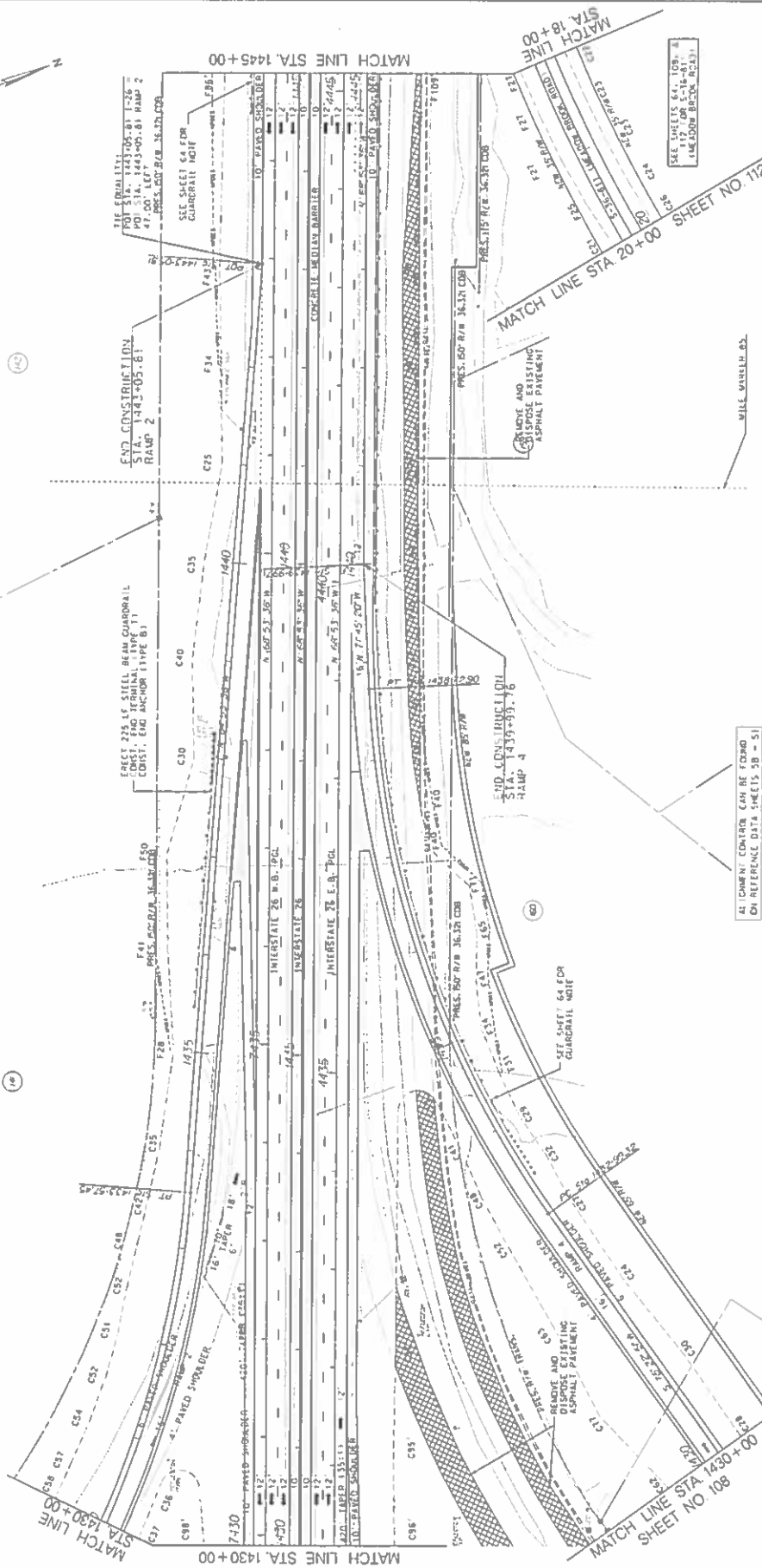
SCALE: 1" = 50' HORIZ
 1" = 20' VERT

STA. 1415+00.00 TO STA. 1430+00.00
 PLAN SHEET

REMOVE AND DISPOSE EXISTING ASPHALT PAVEMENT
 ERECT 175 LF STEEL BEAM GUARDRAIL
 CONST. END ANCHOR (TYPE B)
 CONST. TRIPLE BEAM BRIDGE CONNECTOR
 ERECT 175 LF STEEL BEAM GUARDRAIL
 CONST. END ANCHOR (TYPE B)
 CONST. TRIPLE BEAM BRIDGE CONNECTOR
 ERECT 1150 LF STEEL BEAM GUARDRAIL
 CONST. END ANCHOR (TYPE B)
 CONST. TRIPLE BEAM BRIDGE CONNECTOR

INTERSTATE 26

NO.	DATE	BY	REVISION
1			
2			
3			
4			
5			



SEE SHEETS 25, 26 & 27 FOR S-11-01 (LEADING BRIDGE R.C.I.)

END CONSTRUCTION STA. 1442+05.81 RAMP 2

END CONSTRUCTION STA. 1439+99.76 RAMP 4

SEE SHEET 64 FOR GUARDRAIL NOTE

REMOVE AND DISPOSE EXISTING ASPHALT PAVEMENT

CONCRETE-MEDIUM BARRIER

PRELIMINARY PLANS NOT FOR CONSTRUCTION

SCALE: 1" = 50'-0"

PLAN SHEET STA. 1430+00.00 TO STA. 1445+00.00

NO.	DATE	BY	REVISION
1			
2			
3			
4			
5			

PRELIMINARY PLANS NOT FOR CONSTRUCTION

SCALE: 1" = 50'-0"

PLAN SHEET STA. 1430+00.00 TO STA. 1445+00.00

PRELIMINARY PLANS NOT FOR CONSTRUCTION

SCALE: 1" = 50'-0"

PLAN SHEET STA. 1430+00.00 TO STA. 1445+00.00

NO.	DATE	BY	REVISION
1			
2			
3			
4			
5			

PLAN SHEET STA. 1430+00.00 TO STA. 1445+00.00

PRELIMINARY PLANS NOT FOR CONSTRUCTION

SCALE: 1" = 50'-0"

PLAN SHEET STA. 1430+00.00 TO STA. 1445+00.00

PRELIMINARY PLANS NOT FOR CONSTRUCTION

SCALE: 1" = 50'-0"

PLAN SHEET STA. 1430+00.00 TO STA. 1445+00.00

NO.	DATE	BY	REVISION
1			
2			
3			
4			
5			

PLAN SHEET STA. 1430+00.00 TO STA. 1445+00.00

PRELIMINARY PLANS NOT FOR CONSTRUCTION

INTERSTATE 26

PROJECT B
P02398

DATE
11/15/07

SCALE
1" = 40'

BY
PJS

CHECKED BY
PJS

PROJECT B
P02398

DATE
11/15/07

SCALE
1" = 40'

BY
PJS

CHECKED BY
PJS

PROJECT B
P02398

DATE
11/15/07

SCALE
1" = 40'

BY
PJS

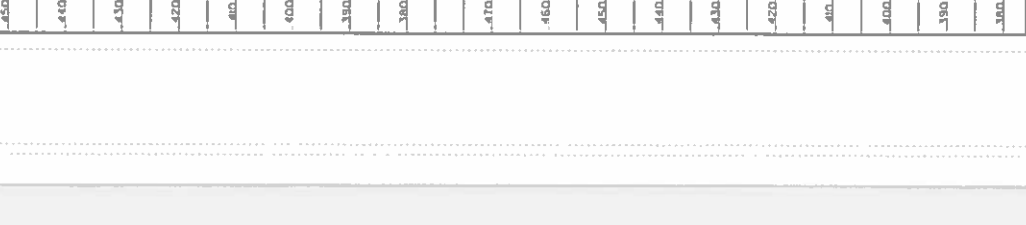
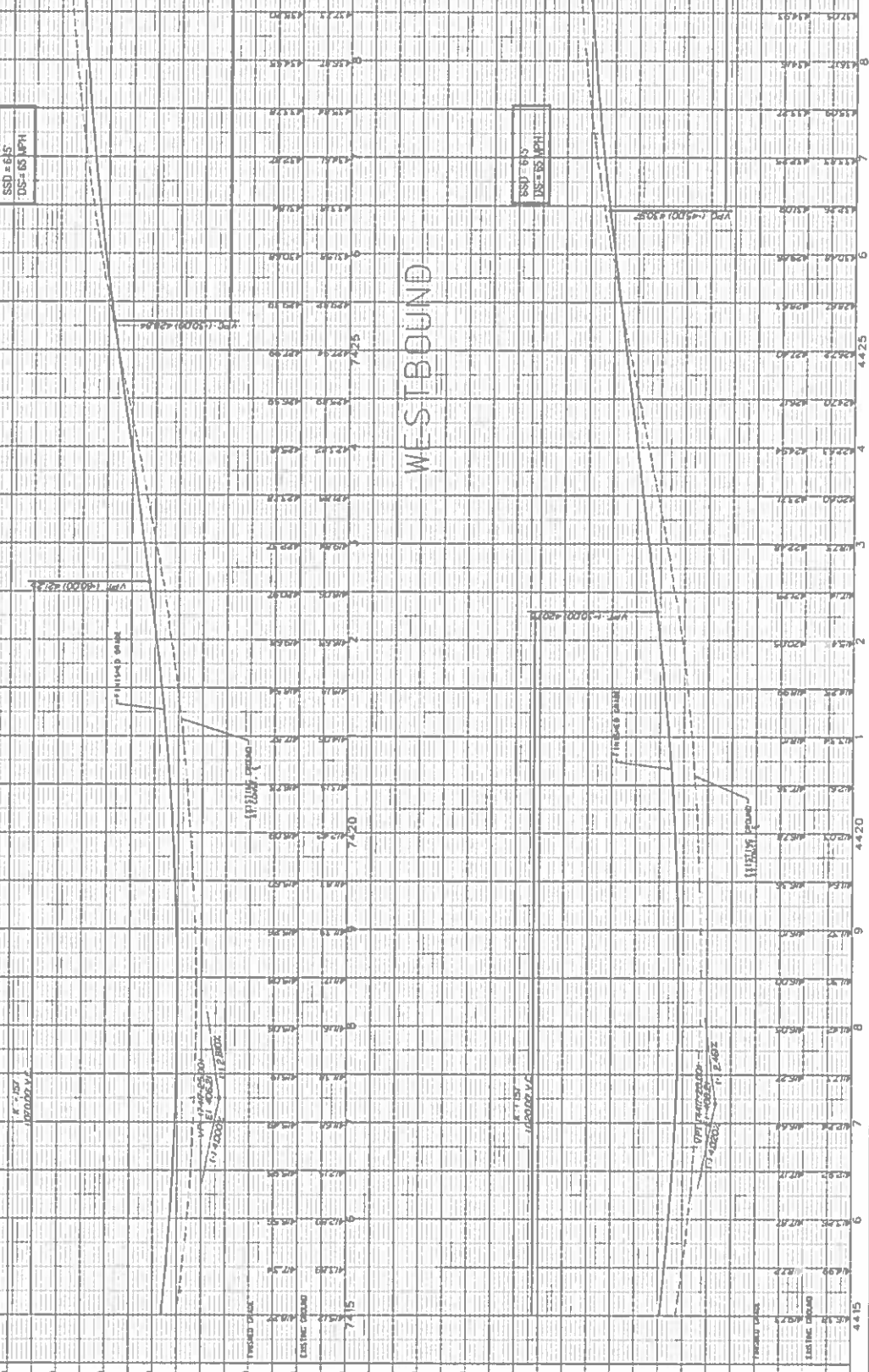
CHECKED BY
PJS

STATIONING shown relative to EB and WB. Set Point sheet for Member starting reference.

PROJECT B
P02398
DATE
11/15/07
SCALE
1" = 40'
BY
PJS
CHECKED BY
PJS

460. 450. 440. 430. 420. 410. 400. 390. 380. 410. 400. 460. 450. 440. 430. 420. 410. 400. 390. 380. 410. 400. 460. 450. 440. 430. 420. 410. 400. 390. 380.

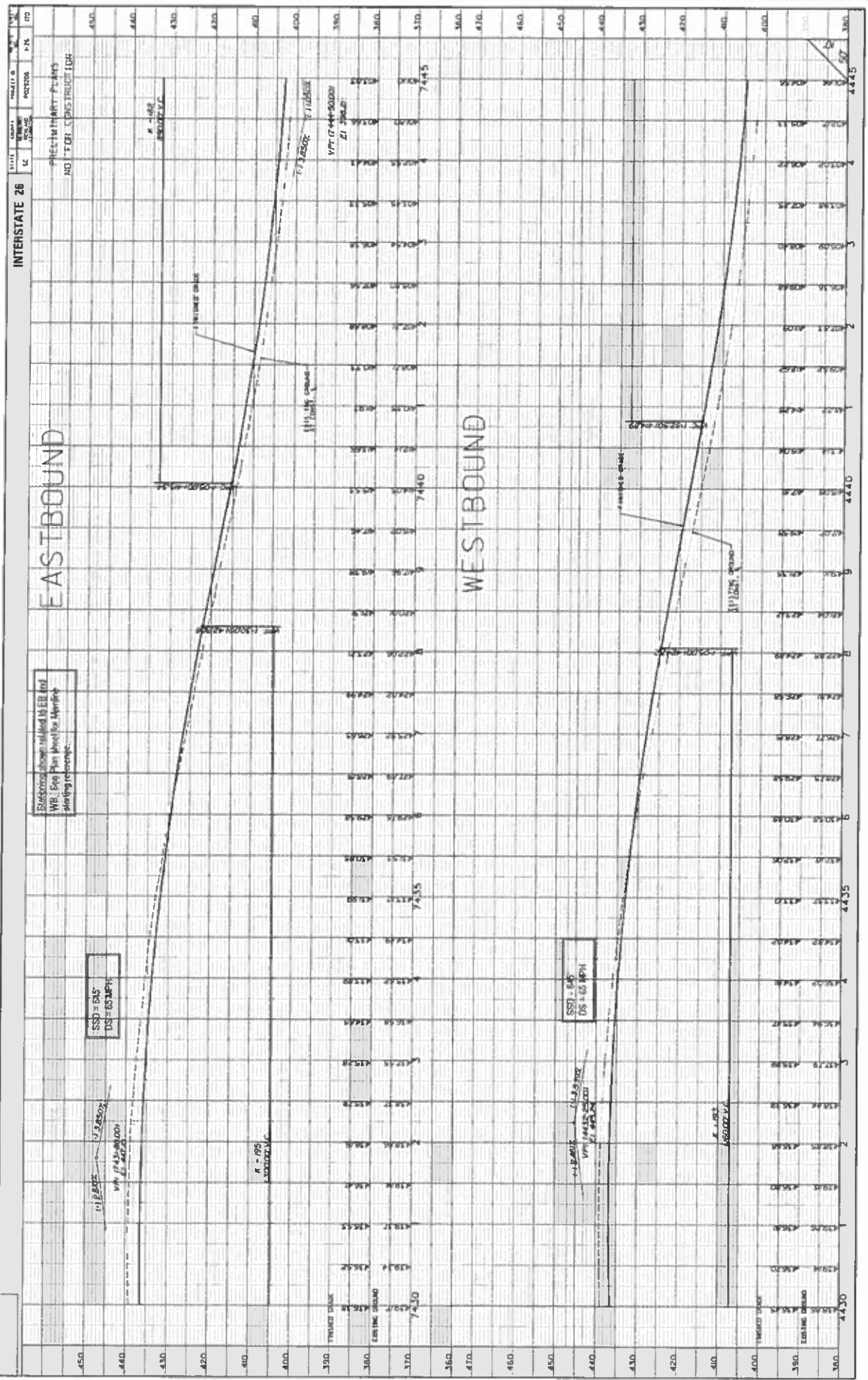
460. 450. 440. 430. 420. 410. 400. 390. 380. 410. 400. 460. 450. 440. 430. 420. 410. 400. 390. 380. 410. 400. 460. 450. 440. 430. 420. 410. 400. 390. 380.



INTERSTATE 26

EASTBOUND

WESTBOUND



Stationing shown relative to EB and WB 1500 Foot Auxiliary Marking starting reference.

SSD = 145
DS = 65 MPH

SSD = 145
DS = 65 MPH



- Manner of Collision**
- ◆ Backed Into EB
 - Sideswipe Collision EB
 - ◆ Head On EB
 - ▲ No Collision With Motor Vehicle EB
 - Angle Collision EB
 - Rear End EB

Figure A-13
I-26 Eastbound
Exit 91 - Mt Vernon
Church Road

03/2017



Source: East Carolina University, Geology & Earth Science Department, Geology & Earth Science Department, University of West Virginia, Morgantown, West Virginia



Figure A-14
 I-26 Eastbound
 Exit 91 - Mt Vernon
 Church Road

03/2017



Source: East Carolina University, Geomatics Engineering Department, College of Architecture, Planning, and Design, 2017. Geomatics Department, 10/1/17. The position and date are subject to change.

- Manner of Collision**
- ◆ Backed Into EB
 - Sideswipe Collision EB
 - ◆ Head On EB
 - ▲ No Collision With Motor Vehicle EB
 - ◆ Angle Collision EB
 - Rear End EB

Figure A-5
I-26 Eastbound
Exit 85

03/2017



Source: East Carolina University, Geomatics Lab. Data for Georgia Tech. Source: Google Earth, 2017. Data for road names, road types, road widths, and other road attributes.



Type of Injury

- Fatality EB
- Incapacitating Injury EB
- Non-incapacitating Injury EB
- Possible Injury EB
- No Injury EB

Figure A-6
I-26 Eastbound
Exit 85

03/2017



- Manner of Collision**
- ◆ Backed Into WB
 - Sideswipe Collision WB
 - ◆ Head On WB
 - ▲ No Collision With Motor Vehicle WB
 - Angle Collision WB
 - Rear End WB

Figure B-15
I-26 Westbound
Mt Vernon Church
Road - Exit 91

03/2017



© 2017 Esri, Inc. All rights reserved. Esri, the Esri logo, ArcGIS, the ArcGIS logo, and the ArcGIS logo are either registered trademarks or trademarks of Esri, Inc. in the United States and/or other countries. Microsoft, the Microsoft Dynamics logo, and the Microsoft Dynamics logo are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries. Other brands and product names are trademarks of their respective owners.



Type of Injury

- Fatality WB
- Incapacitating Injury WB
- Non-incapacitating Injury WB
- Possible Injury WB
- No Injury WB

Figure B-16
I-26 Westbound
Mt Vernon Church
Road - Exit 91

03/2017



Aerial Base: © 2017 Google, Imagery: © 2017 GeoEye, GeoEye, Inc., Imagery: © 2017 GeoEye, GeoEye, Inc., Imagery: © 2017 GeoEye, GeoEye, Inc. Schedules: and for the City of Charlotte



Location 2
MM 85.1
(1432+00)

Manner of Collision

- ◆ Backed Into WB
- Sideswipe Collision WB
- ⊕ Head On WB
- ▲ No Collision With Motor Vehicle WB
- ★ Angle Collision WB
- Rear End WB

Figure B-23
I-26 Westbound
Exit 85

03/2017

Prepared by: The Transportation Consulting, Inc. for the Transportation Planning, Construction, and Maintenance Division, Florida Department of Transportation, Tallahassee, Florida.



Type of Injury

- Fatality WB
- Incapacitating Injury WB
- Non-incapacitating Injury WB
- Possible Injury WB
- No Injury WB



Research Triangle Institute, Inc. (RTI) is a research organization that provides scientific and technical information to the public. RTI is a not-for-profit organization and is not affiliated with any government agency.

Figure B-24
I-26 Westbound
Exit 85

03/2017

