



STATE OF TENNESSEE
DEPARTMENT OF TRANSPORTATION

CORRIDOR INCIDENT MANAGEMENT (CIM)

FINAL REPORT

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16. Abstract The objective of the Corridor Incident Management (CIM) research project was to develop and demonstrate a set of multi-purpose methods, tools and databases to improve corridor incident management in Tennessee, relying primarily on resources already available within the Tennessee Department of Transportation. The department has extensive information about the highway infrastructure, traffic characteristics, and services for highway users as well as an array of tools and procedures for transportation planning and project development. The project explored ways to effectively use those existing resources for new purposes—to improve incident management and emergency transportation operations. The end product was a set of CDs, one for each of five pilot counties. Each CD has multiple folders and files with point-and-click access to facilitate use by TDOT and other state and local agencies that share responsibilities for incident management and emergency operations. This report explains the objectives of the project, provides an overview of the end products, and describes the procedures used to develop those products.			
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Corridor Incident Management (CIM) Research Project

Introduction

This report has three interrelated purposes: (1) summarize the objectives of the Corridor Incident Management (CIM) research project, (2) provide an overview of the end products, and (3) describe the procedures used to develop the end products. The report concludes with a summary of findings and recommendations.

The end products of the Corridor Incident Management (CIM) research project are contained on five compact disks (CDs), one for each of the following Tennessee counties:

- Madison
- Wilson
- Putnam
- Roane
- Jefferson

Research Objectives and Scope

The primary objective of the CIM project was to develop and demonstrate a set of multi-purpose methods, tools and databases to improve corridor incident management in Tennessee. The stakeholders that were identified as potential users of the CIM tools, in addition to TDOT, included state and local law enforcement, emergency management agencies, fire and rescue services, emergency medical services, local highway and public works agencies, emergency communications agencies, and other emergency service and public safety organizations.

The project began with an emphasis on alternate routes for emergency freeway closures, but the scope included other important aspects of incident management and emergency transportation operations. Figure 1 is an illustration used in the early stages of the project to help describe the scope.

The scope of the project was further defined by the following guidelines established at the beginning of the research:

- The project should focus on freeway corridors outside the core areas of the four largest cities (Chattanooga, Knoxville, Memphis and Nashville). Within those heavily-developed core areas, many more resources are available for incident management and emergency operations than in the more outlying and rural areas; and the institutional and operational arrangements for incident management are very different.

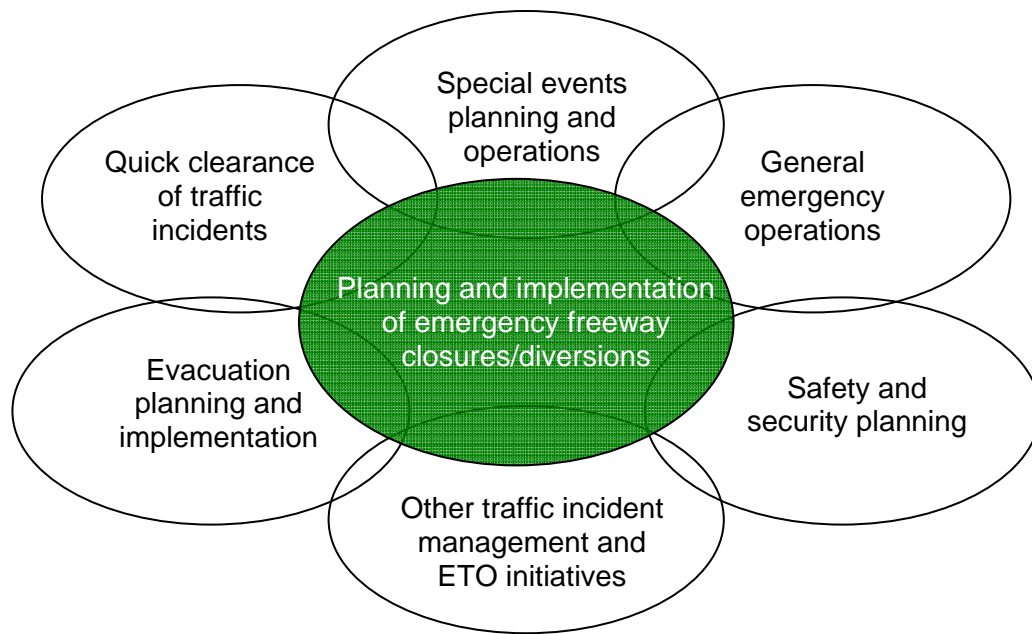


Figure 1. Potential Uses for the Corridor Incident Management (CIM) Tools

- Relative to closures and alternate routes, the focus should be on events that require short term (less than 24-hour) emergency alternate routes (e.g., not long-term detours). CIM products might have applications for those other situations, but the focus should be on incidents, special events, and emergencies that must be handled without the time or resources to plan and implement long-term closures or permanent detour routes.
- In developing tools and procedures, the emphasis should be on gaining the most effective use of existing resources already available within TDOT. The department has extensive information about the highway infrastructure, traffic characteristics, and services for highway users. The department also has an array of tools and procedures for transportation planning and project development. A major objective of this project was to find ways to effectively use those existing resources for new purposes—to improve incident management and emergency transportation operations.
- The department should be able to use the tools and procedures developed as part of the CIM project to produce identical or similar products for other counties in Tennessee, or combination of counties, with the expertise, technology, and other resources readily available to the Office of Incident Management and the Region Incident Management Coordinators.

The final two guidelines had probably the most impact on the results. The five CDs demonstrate methods of using TDOT’s existing resources—maps, aerial photography, data, databases, and planning tools—to improve corridor incident management in Tennessee and to provide useful information for the organizations that share responsibilities for incident management and emergency operations. All of the technology used to produce the CDs is readily available, and the processes are can be replicated without special expertise.

Methodology

The CIM project began in early 2005 with a series of meetings that had the dual purpose of (1) assessing the needs for tools and information to improve CIM and (2) assessing existing TDOT resources that might be used or adapted to help meet the needs for improved CIM. Meetings were held with the TDOT Office of Incident Management (OIM), the four Region Incident Management Coordinators, other units within TDOT (e.g. Aerial Surveys, Long Range Planning, Maintenance, Structures, and Central Services), the Tennessee Highway Patrol, and the Tennessee Emergency Management Agency.

Also, a comprehensive literature review was conducted to identify national best practices and to generate ideas for the CIM project. Many of the documents identified through the literature review are included on the five CDs or hyperlinks are provided for easy access.

Another important source of information and ideas was a survey of the eight states adjacent to Tennessee and selected other states to gather information about alternate route planning and other aspects of incident management in those states. The survey results were summarized in *Corridor Incident Management: Survey of Practices in Selected State Departments of Transportation*, which is attached as Appendix A.

The CIM research was carried out as an iterative process, The researchers (1) identified and obtained access to resources that might be useful for CIM purposes, (2) developed techniques and formats to make that information useful for CIM purposes, (3) obtained feedback from TDOT's Office of Incident Management, the four Region Incident Management Coordinators, and other stakeholders, and (4) refined the techniques and formats based on stakeholder suggestions. The same approach was used to develop the layout of the CDs (referred to as the CIM_CDs). Several versions were proposed, reviewed, and revised based on feedback from TDOT and other stakeholders.

Frequent meetings were held with the OIM and Region Incident Management Coordinators throughout the project, and the TDOT representatives shared information and obtained feedback from other state and local agencies. Two additional meetings were held with representatives of the Tennessee Highway Patrol. Also, draft material was presented at TDOT's Annual Highway Safety and Incident Management Conference, and valuable feedback was received.

The initial scope of work called for four "pilot" counties, one in each of TDOT's four Regions, to test and demonstrate the CIM tools and procedures. A fifth county was added to ensure a fully representative group of counties relative to traffic volumes and patterns, numbers and types of interchanges, typography, adjacent land uses, and the presence of multiple routes (e.g., I-40 and SR 840 in Wilson County, and I-40 and I-81 in Jefferson County). The following counties were selected:

- Madison (Region 4)
- Wilson (Region 3)
- Putnam (Region 2)
- Roane (Region 1)
- Jefferson (Region 1)

The CIM project focused on individual counties because so many of the incident response capabilities in Tennessee are organized on a county-by-county basis (e.g., 911 and dispatch operations, sheriffs, emergency medical services, rescue squads, and emergency management agencies). Of course, adjacent counties need to coordinate their plans and processes, and state agencies, especially TDOT, THP, and TEMA, should view “corridors” from a regional and statewide perspective.

No precise definition or criteria were developed for a “corridor,” recognizing that circumstances call for different criteria. For the most serious incidents, the entire length of I-40 from Memphis to Cocke County may be affected. In other cases, the issues may be concentrated on just the counties between, for instance, Nashville and Knoxville. An incident on the I-40 bridge over the Tennessee River in West Tennessee may impact a relatively short but “wide” corridor since routes to alternate bridges traverse counties that are relatively far distant from the Interstate.

Software and Formats Used

Most of the information on the five CDs is displayed in PDF format, including maps, photographs, and text documents. The few exceptions that are not PDF files include: (a) two interactive Microsoft Excel spreadsheets, (b) a set of TDOT photolog snapshots in JPG format, (c) one KMZ file (link to Google Earth), and (d) one WMV file (video presentation).

Many of the files that are presented in PDF format were created using other software—primarily Microsoft Word and Powerpoint—and then converted to PDF. For some of the converted documents, navigation links and buttons were added after the document was converted to PDF.

In addition to the standard Microsoft software available on virtually all TDOT computers, three other software tools were used for this project:

- Adobe Photoshop was used to manage the very large (approximately 100,000 KB) TIF files that contain the “County Wide” aerial photographs for each interchange. The photographs were opened and cropped using Photoshop, and features were then added using MS Word and Powerpoint.
- Adobe Professional was used to manage the TDOT county and city maps and to add text, links, and navigation buttons to those maps and to the aerial photographs.
- For three counties (Madison, Putnam, and Roane) topographic “segment maps” were developed to illustrate how such maps could complement the TDOT-produced maps. National Geographic’s TOPO!® software was used as the source of the topographic base maps.

(Some of the initial CIM research was carried out using Maptitude®, a relatively inexpensive and easy-to-use GIS software package from the Caliper Corporation. However, the advantages of using GIS did not seem to offset the potential problems for TDOT in training

OIM and Region personnel, maintaining databases, and ensuring that the OIM and each Region could remain proficient in using a GIS-based system.)

Maps and Aerial Photographs Used

Most of the maps and map segments used on the CDs are from city and county maps produced by TDOT. Those “General Highway Maps” are readily available in digital form (PDF), and can be downloaded from TDOT’s public website. A sample county map is shown in Figure 2.

The Adobe “Snapshot Tool” was used extensively to capture map segments. The snapshots were then pasted into Powerpoint slides so that text and other features could be added. The “Index Map” for each county is a strip, copied from the county map, 15-20 miles wide centered on the freeway (i.e., 7-10 miles on each side of the freeway).

For each freeway segment (between interchanges), segment maps, are included. Figure 3 shows examples of segment maps.

The only other maps on the CDs are topographic maps for Madison, Roane, and Putnam Counties. As noted above, the topographic base maps were obtained from National Geographic’s TOPO!®. Text and other features were added in Powerpoint.

Aerial photographs of the freeway interchanges are used on all of the CDs. The Aerial Surveys Section in TDOT’s Design Division provided digital copies of “County Wide” aerial photographs for the selected counties, as illustrated in Figures 4 and 5. These photos were then cropped to zoom on the interchanges. Examples of interchange photographs are shown in Figures 6-8. (The alphanumeric designations on the ramps are to give each ramp a unique identification. The designation process is explained later in this report.)

The “County Wide” photographs are taken from a relatively high altitude and are intended for relatively small-scale mapping purposes. Thus, the resolution is not ideal when focused on a particular interchange or a ramp within an interchange. However, the review by incident responders, especially law enforcement and emergency management agencies, indicated that the interchange and ramp images will be very useful, and that the quality of those images is adequate. (The lowest quality images came from the Roane County photos, perhaps due to a combination of sun angle and the presence of light-colored concrete pavements.) TDOT will soon be using a digital camera for aerial photography, and the County Wide photographs should be even more useful for CIM purposes in the future.

(A more significant issue for CIM purposes is that new County Wide photographs are shot for only one Region each year. This means that the photographs may be four or more years old and may not show more recent interchanges, modified ramp configurations, or changes in surface streets or intersections, land uses, or other important features near the interchange.)

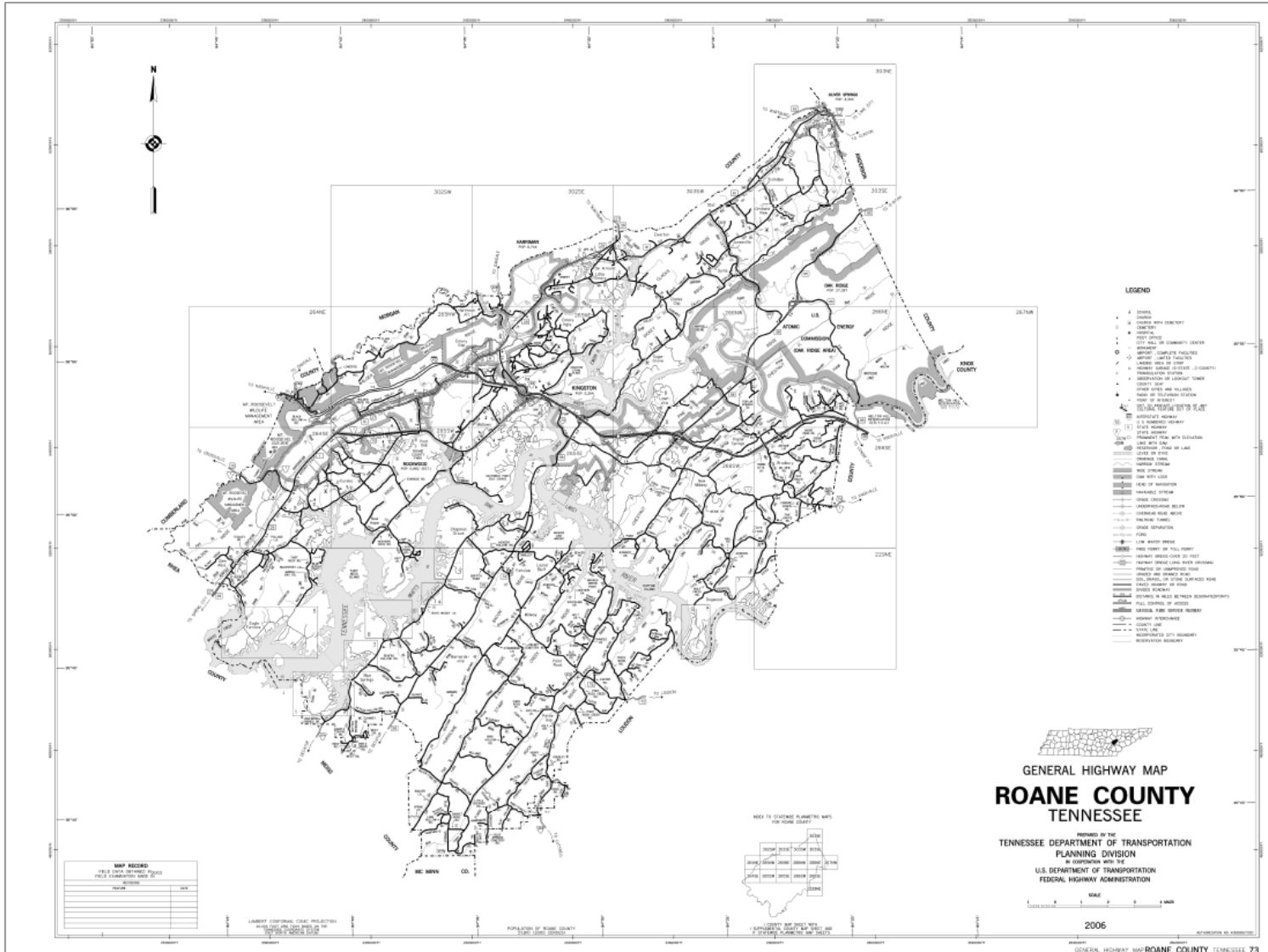


Figure 2. TDOT County Map, Roane County

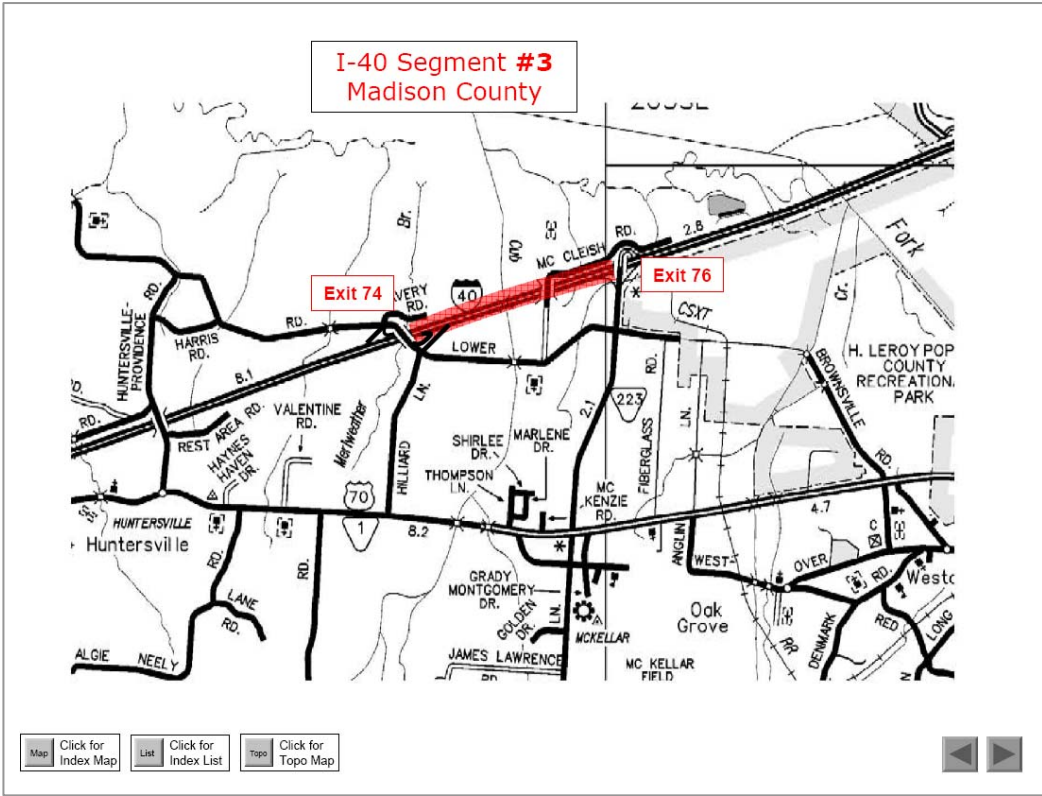
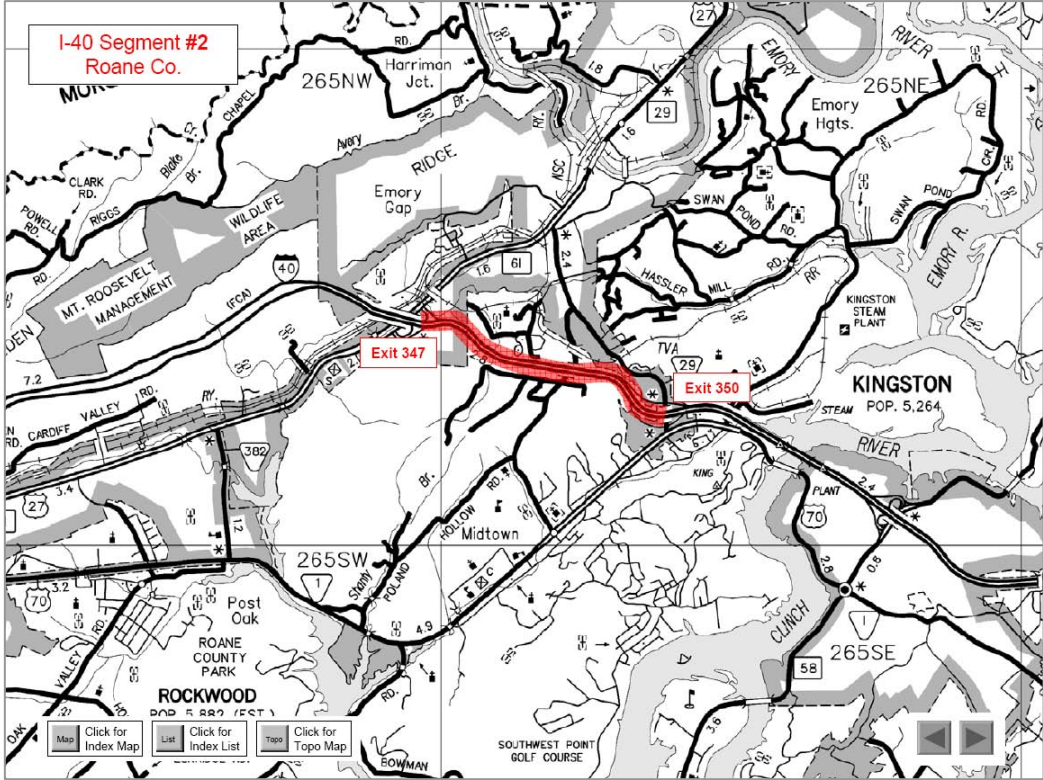


Figure 3. Segment Maps, Roane and Madison Counties



Figure 4. County Wide Aerial Photograph for Predominantly Rural Area



Figure 5. County Wide Aerial Photograph for Predominantly Urban Area



Figure 6. Example Interchange Photograph, Madison County



Figure 7. Example Interchange Photograph, Jefferson County



Figure 8. Examples of “Zoom” Photos of Interchange Ramps (Same Interchange as Figure 7)

Contents of the Corridor Incident Management Compact Disks (CIM_CDs)

The CIM_CD for each county contains multiple folders, and most of the folders have multiple files. Figure 9 shows the organization of each CD (three PDF files and 21 folders). The content of the folders is explained in the following sections.

Name	Size	Type
1. Interchange & Ramp Aerial Photos		File Folder
2. Maps and Segments		File Folder
3. Snapshots		File Folder
4. I40 Traffic and Features		File Folder
5. Traffic Backups		File Folder
6. Other Routes in the Corridor		File Folder
7. Laws, Regulations, Guidelines, and Procedures		File Folder
8. Contact Numbers and E-Mail		File Folder
9. Emergency Alternate Routes		File Folder
10. Signs, Equip. and Personnel		File Folder
11. Public Information Plans		File Folder
12. Radio Frequencies		File Folder
13. Links to Online Maps		File Folder
14. Current Traffic Conditions		File Folder
15. Current Weather and Forecasts		File Folder
16. Special Events		File Folder
17. Community Info and Links		File Folder
18. Inc Mngt Information and Links		File Folder
19. Haz Mat Info and Links		File Folder
20. Training and Self Assessment		File Folder
County, City, and State Maps		File Folder
HOME PAGE.pdf	534 KB	Adobe Acrobat 7.0 Document
Index List Putnam Co.pdf	203 KB	Adobe Acrobat 7.0 Document
Index Map Putnam County.pdf	5,758 KB	Adobe Acrobat 7.0 Document

Figure 9. Organization of Files on CIM_CD

Home Page

The Home Page for each county provides point-and-click access to the maps, photos, tools, and resources to assist with incident management and emergency transportation operations. See Figure 10 for an example. Each box on the page corresponds to a folder on the CD. Clicking on the box opens an introductory page, and many of those pages provide point-and-click access to files within the respective folders.

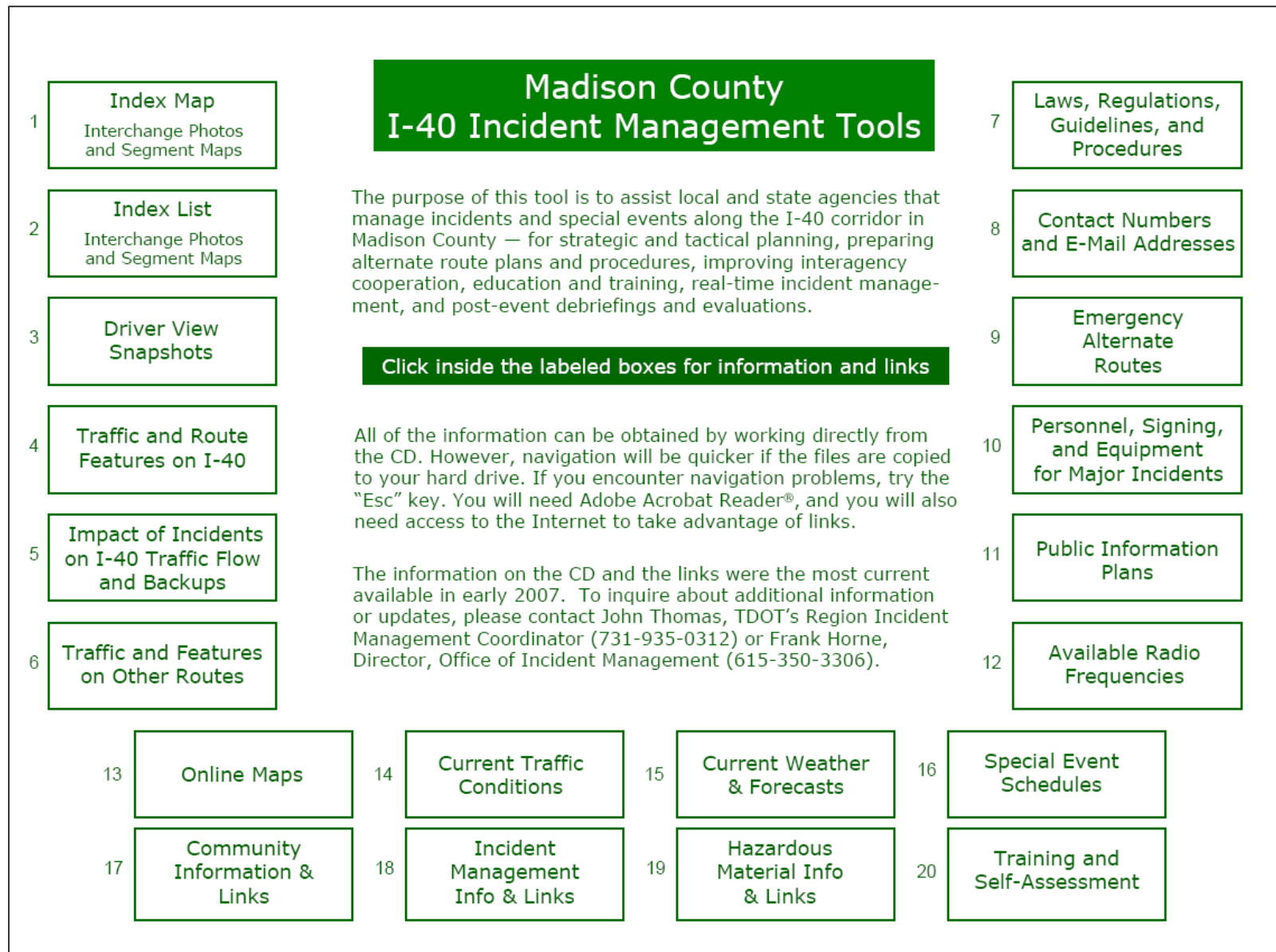


Figure 10. CIM_CD Home Page, Madison County

1. Index Map

Figure 11 is a sample of an “Index Map” which displays the assigned segment and interchange numbers. Users can click on a segment or interchange number to open a file that contains a map of the selected segment or the aerial photograph of the selected interchange. Users can also click on navigation boxes to view maps of cities within the county or maps of adjacent counties.

(The photos are stored in the files named “1. Interchange and Ramp Aerial Photos.” The segment maps are stored in the folder named “2. Maps and Segments.”)

2. Index List

Figure 12 is an example of an “Index List” which provides most of the same information and navigation choices as the Index Map, but in tabular rather than map form. In addition, the Index List has a “Comments” column for special information regarding incident management. Another column identifies the local governments that have jurisdiction over each segment of the freeway.

(The photos are stored in the files named “1. Interchange and Ramp Aerial Photos.” The maps are stored in the folder named “2. Maps and Segments.”)

3. Driver-View Snapshots

This section contains snapshots extracted from the TRIMS Photolog so that users can see roadway locations that might have special significance for incident management and emergency transportation operations. Such locations include the county lines, median crossovers, ramps, and locations where parallel routes are immediately adjacent to the freeway and the topography might allow “over the fence” responses during major emergencies.

Figure 13 shows a typical opening page, and users simply point-and-click to view selected photographs. Typical photographs are shown in Figure 14. Three different views are available in the Photolog: Front, Side, and combined Front and Side. Figure 15 is an example of a combined Front and Side view.

The snapshots were captured by manually viewing the TRIMS Photolog (in both directions) from county line to county line and downloading each selected images. The selected images were downloaded and saved as JPG files.

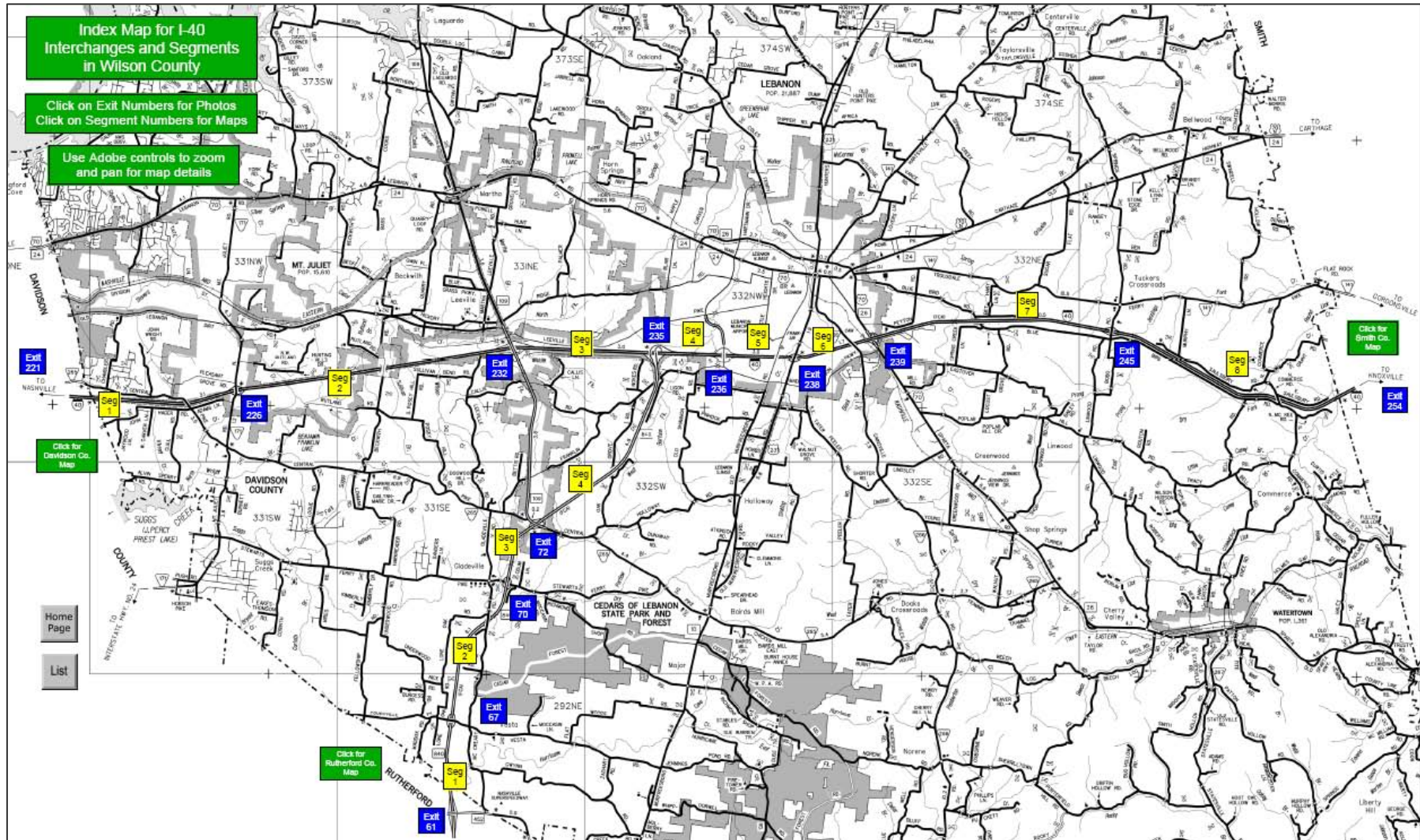


Figure 11. Example of CIM_CD Index Map, Wilson County

Home
Page

Index List for Segments and Interchanges I-40 in Putnam County

Madison Co. I-40 Segment No.	Exit Number	Exit Number <i>Click for Photo</i>	<i>Click for County/City Map Segment</i>	<i>Click for Topo Map Segment</i>	Distance between Exits (Miles)	Comments
1	258 in Smith Co.	268	X	X	9.8 (.8 miles in Putnam Co.)	Link to Smith Co. map ; Welcome Center just west of Smith-Putnam county line (Caney Fork R.)
2	268	273	X	X	5.3	Nashville and Eastern RR, Buffalo Valley Rd. and Buffalo Branch adjacent and parallel to I-40
3	273	276	X	X	2.7	Nashville & Eastern RR overpass just west of Exit 276
4	276	280	X	X	4.0	Exit 280 inside Baxter city limits; Link to Baxter map
5	280	286	X	X	5.6	Exit 280 inside Baxter; part of segment in Putnam Co.; Exit 286 in Cookeville; Link to Cookeville map
6	286	287	X	X	1.5	Congested urban area; inside Cookeville city limits; access to THP and TDOT district offices at Exit 287
7	287	288	X	X	1.3	Congested urban area; inside Cookeville city limits; access to THP and TDOT district offices at Exit 287
8	288	290	X	X	1.7	Inside Cookeville city limits; Link to Cookeville map
9	290	300	X	X	10.6	Exit 290 inside Cookeville city limits; Exit 300 inside Monterey city limits; remainder of Segment 9 rural
10	300	301	X	X	0.7	Exits 300 and 301 and all of Segment 10 inside Monterey city limits; Link to Monterey map
11	301	311 in Cumberland Co.	X	X	9.4 (3.0 miles in Putnam Co.)	Link to Cumberland Co. map

Smith
Co. Line



Cumberland
Co. Line

Click [Map](#) for Putnam County Index Map (with Interchange and Segment numbers marked)

Figure 12. Example of CIM_CD Index List, Putnam County

Driver-View Snapshots Jefferson County

This section contains snapshots of selected locations along I-40 & I-81 in Jefferson County

I-40

County Log Mile	Mile Marker	EB	WB	Description
		Click to View	Click to View	
0.0	409.8	x		Sevier-Jefferson County Line
2.2	412.0	x		Ramp E1 to Exit 412
2.7	412.5		x	Ramp W1 to Exit 412
2.9	412.7		x	End median guardrail
3.1	412.9	x		Begin median guardrail
4.6	414.4	x		Blackberry Ln. parallel to R.O.W.
5.4	415.2	x		Ramp E1 to Exit 415
5.5	415.3		x	Ramp W1 to Exit 415
7.6	417.4	x		Ramp E1 to Exit 417
8.2	418.0		x	Ramp W1 to Exit 417
9.6	419.4	x		Rest Area EB
11.2	421.0		x	Add lane WB (two to three)
11.3	421.1	x	x	End/Begin median barrier
11.4	421.2	x		Ramp to Exit 421, Lane drop (three to two) Split #1
11.9	421.7		x	Ramp to Exit 421 (I-81) Split #2
14.2	424.0	x		Ramp to E1 Exit 424
14.3	424.1	x	x	Begin/End median barrier
14.4	424.2		x	Ramp W1 to Exit 424
15.7	425.5	x	x	End/Begin median barrier
15.9	425.7		x	Rest Area WB and paved median crossover, signed
15.9	425.7	x		Median crossover, paved and signed
17.3	427.1		x	Deerwood Dr. parallel to R.O.W.
19.3	429.1	x	x	Median crossover, paved and signed
20.1	429.9	x	x	Jefferson-Cocke County line

I-81

County Log Mile	Mile Marker	NB	SB	Description
		Click to View	Click to View	
0.0	0.0	x		I-81/I-40 Junction-Split #1
0.0	0.0		x	Valley Home Rd. parallel to R.O.W
0.1	0.1		x	SB I-81 merge with I-40 - Merge #1
0.6	0.6	x		Median crossover, paved and signed
0.7	0.7		x	Split #3
0.9	0.9		x	Median crossover, paved and signed
2.8	2.8	x		Phillips Rd. parallel to R.O.W.
3.0	3.0		x	Rest Area WB
4.0	4.0	x		Ramp N1 to Exit 4
4.4	4.4		x	Ramp S1 to Exit 4
7.5	7.5	x	x	Unpaved median crossover

Figure 13. Driver-View Snapshots Opening Page, Jefferson County



Figure 14. Examples of TRIMS Photolog Snapshots

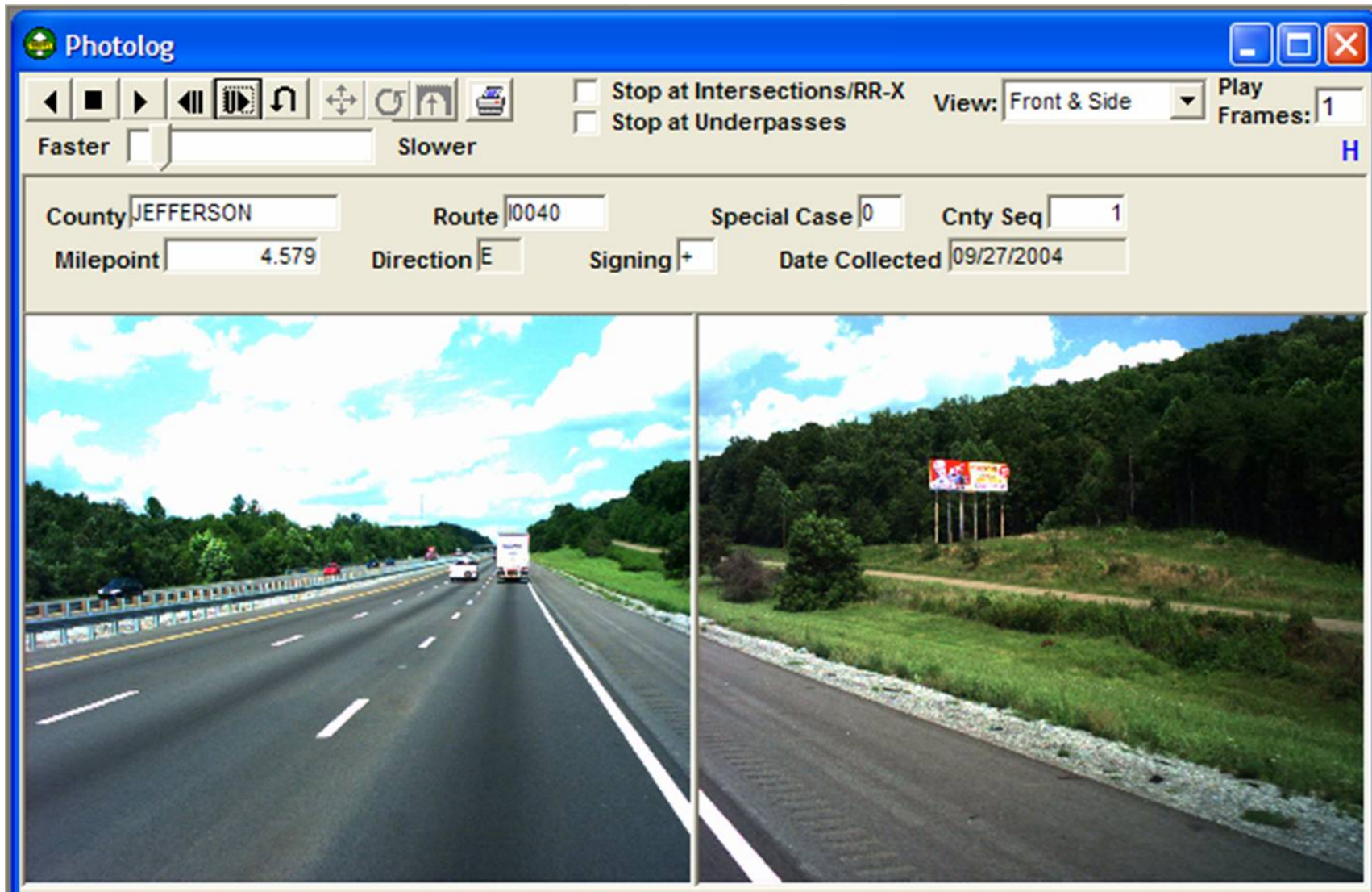
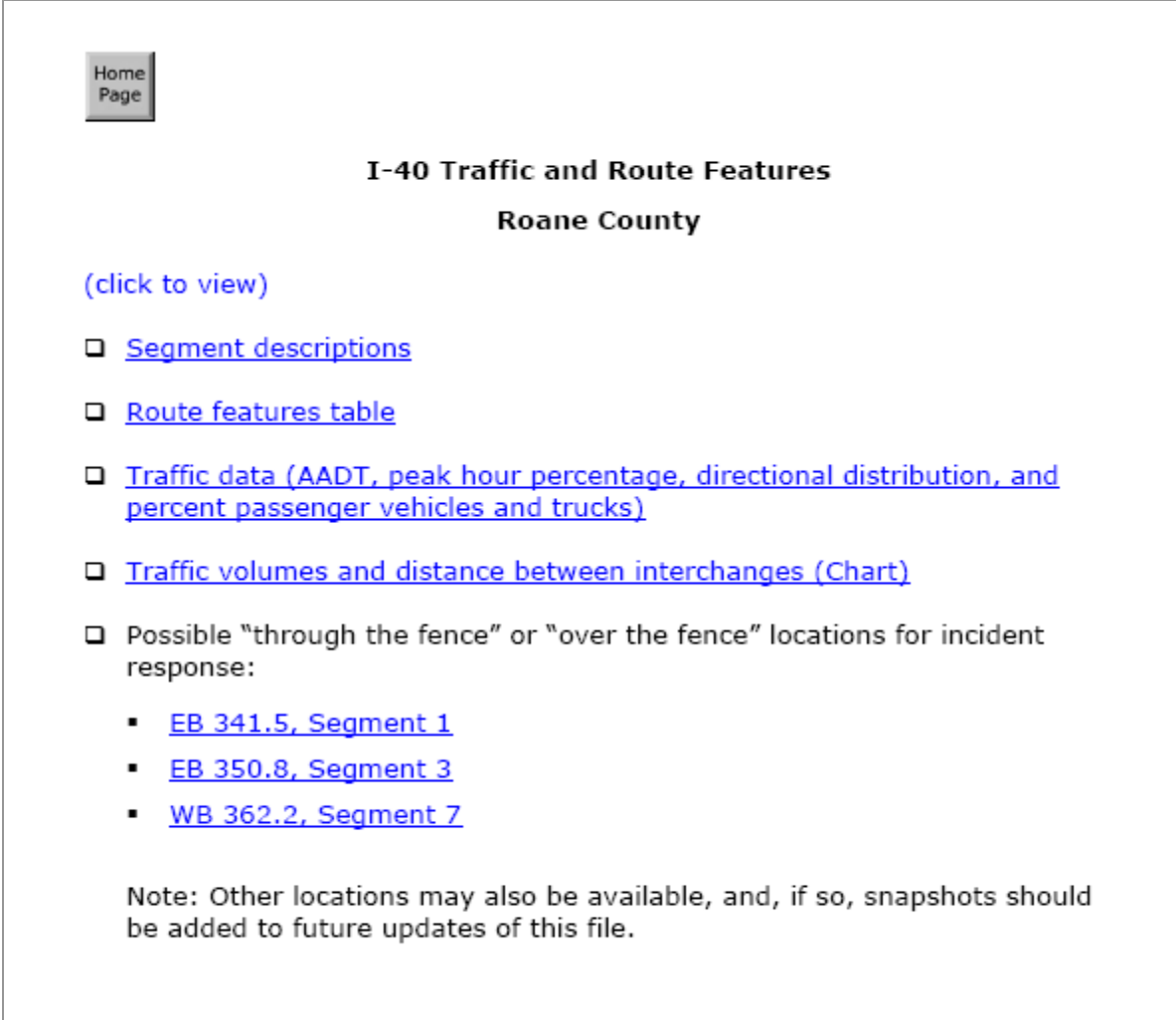


Figure 15. Photolog Snapshot View with “Front & Side” Option Selected

4. Traffic and Route Features on I-XX

This section presents descriptive information about the physical characteristics of each freeway segment and the respective traffic features. An example of the opening page is shown as Figure 16. The information in this section is from the Tennessee Roadway Information Management System (TRIMS) databases and is compiled in tabular and graphic form, as shown in Figures 17-20. Also included are snapshots of location where “over the fence” operations from parallel roadways might be possible during freeway emergencies. An example is shown in Figure 21.



[Home Page](#)

**I-40 Traffic and Route Features
Roane County**

(click to view)

- [Segment descriptions](#)
- [Route features table](#)
- [Traffic data \(AADT, peak hour percentage, directional distribution, and percent passenger vehicles and trucks\)](#)
- [Traffic volumes and distance between interchanges \(Chart\)](#)
- Possible "through the fence" or "over the fence" locations for incident response:
 - [EB 341.5, Segment 1](#)
 - [EB 350.8, Segment 3](#)
 - [WB 362.2, Segment 7](#)

Note: Other locations may also be available, and, if so, snapshots should be added to future updates of this file.

Figure 16. Opening Page for Traffic and Route Features Selections, Roane County

Segment Descriptions I-40 in Putnam County						
	Putnam Co. I-40 Segment No.	Exit Number	Exit Number	Distance between Exits (Miles)	Notes	Local Jurisdictions
Smith Co. Line ↑ WB ↓ EB Cumberland Co. Line	1	258 in Smith Co.	268	9.8 (0.8 miles in Madison Co.)	Link to Smith Co. map ; Welcome Center just west of Smith-Putnam county line (Caney Fork R.)	Smith Co. / Putnam Co.
	2	268	273	5.3	Nashville and Eastern RR, Buffalo Valley Rd. and Buffalo Branch adjacent and parallel to I-40	Putnam County
	3	273	276	2.7	Nashville & Eastern RR overpass just west of Exit 276	Putnam County
	4	276	280	4.0	Exit 280 inside Baxter city limits	Putnam County
	5	280	286	5.6	Inside Cookeville city limits; Link to Cookeville map	Inside Cookeville city limits
	6	286	287	1.5	Congested urban area; inside Cookeville city limits; access to THP and TDOT district offices at Exit 287	Inside Cookeville city limits
	7	287	288	1.3	Congested urban area; inside Cookeville city limits; access to THP and TDOT offices at Exit 287	Inside Cookeville city limits
	8	288	290	1.7	Inside Cookeville limits; Link to Cookeville map	Inside Cookeville city limits
	9	290	300	10.6	Exit 290 inside Cookeville city limits; Exit 300 inside Monterey city limits; remainder of Segment 9 rural	City of Cookeville / Putnam Co. / City of Monterey
	10	300	301	0.7	Exits 300 and 301 and all of Segment 10 inside Monterey city limits; Link to Monterey map	Putnam County
	11	301	311 in Cumberland Co.	9.4 (3.0 miles in Madison Co.)	Link to Cumberland Co. map	Putnam Co. / Cumberland Co.

Figure 17. Freeway Segment Descriptions, Putnam County

**I-40 in Putnam County
Selected Route Features**

Read Down for Eastbound travel -- Read Up for Westbound travel
LT. (left) and RT. (right) is Eastbound reference

County Log Mile	Mile Post	Feature Description
0.00	267.3	SMITH-PUTNAM COUNTY LINE
0.67	268.0	BRIDGE [71100400003]: INDIAN CREEK
0.73	268.0	RAMP TO SR-96 (MEDLEY-AMMONETT RD) RT.
0.84	268.1	SR-96 (MEDLEY-AMMONETT RD.) / {CENTER OF OVERHEAD}
	268.1	EXIT 268: SR-96 / BUFFALO VALLEY RD. / CENTER HILL DAM
0.99	268.3	RAMP FROM SR-96 (MEDLEY-AMMONETT RD) RT.
1.00	268.3	RAMP TO SR-96 (MEDLEY-AMMONETT RD) LT.
2.03	269.3	CULVERT [71CULV01013]: BRANCH
2.72	270.0	MILE POST # 270
2.98	270.3	CULVERT [71CULV01017]: BRANCH
3.73	271.0	MILE POST # 271
4.73	272.0	MILE POST # 272
5.74	273.0	MILE POST # 273
5.95	273.3	RAMP FROM A605 (TUCKER RIDGE RD.) LT.
6.00	273.3	EXIT 273: SR-56 SOUTH / SMITHVILLE-MCMINNVILLE
6.00	273.3	RAMP TO SR-141 RT.
6.12	273.4	UNDERPASS [71100400007]: SR-56 (SR56) RT. & A605 (TUCKER RIDGE RD) LT.
6.12	273.4	PICK-UP SR-56 RT. / CENTER OF UNDERPASS
6.24	273.5	RAMP FROM SR-56 RT.
6.31	273.6	RAMP TO A605 (TUCKER RIDGE RD.) LT.
6.76	274.1	MILE POST # 274
8.53	275.8	UNDERPASS [71100400011]: NASHVILLE & EASTERN RAILROAD [348985K]
8.63	275.9	RAMP FROM FCR-1144 (OLD BAXTER RD.) LT.
8.64	275.9	EXIT 276: OLD BAXTER RD.
8.77	276.1	MILE POST # 276
8.77	276.1	UNDERPASS [71100400013]: FCR-2224 (OLD BAXTER RD.) RT. & FCR-1144 (OLD BAXTER RD.) LT.
8.77	276.1	2224 (OLD BAXTER RD.) RT. & FCR-1144 (OLD BAXTER RD.) LT. / {CENTER OF UNDERPASS}
8.92	276.2	RAMP FROM FCR-2224 (OLD BAXTER RD.) RT.
8.98	276.3	RAMP TO FCR-1144 (OLD BAXTER RD.) LT.
10.77	278.1	MILE POST # 278
11.8	278.9	PARALLEL OVERHEADS [71100400015] [71100400016]: A122 (ELMORE TOWN RD.)
12.58	279.9	RAMP FROM SR-56 LT.
12.58	279.9	RAMP TO 1165 (BAXTER RD) RT.
	279.9	EXIT 280: SR-56 NORTH / BAXTER-GAINESBORO
12.7	280.0	ENTER BAXTER CITY LIMITS
12.75	280.1	PARALLEL OVERHEADS [71100400017] [71100400018]: 1165 (BAXTER RD) RT. & SR-56 (GAINESBORO HWY) LT.
12.75	280.1	LEAVE SR-56 (GAINESBORO HWY) LT. / CENTER OF OVERHEAD
12.75	280.1	1165 GAINESBORO HWY RT. / CENTER OF OVERHEAD
12.82	280.1	MILE POST # 280
12.85	280.2	BRIDGE [71100400019]: MAXWELL BRANCH
12.94	280.2	RAMP FROM 1165 (BAXTER RD) RT. & RAMP TO SR-56 (GAINESBORO HWY) LT.

Figure 18. Route Features Table, Putnam County

**Traffic Characteristics by Segment (2006)
I-40 in Putnam County**

Putnam Co. I-40 Segment No.	Exit Number	Exit Number	Distance between Exits (Miles)	Average Annual Daily Traffic (1)	Peak Hour Percent (2)	Peak Directional Distribution (3)	Percent Passenger Cars	Percent Single Unit Trucks	Percent Multi-Unit Trucks
1	258 in Smith Co.	268	9.8 (0.8 miles in Madison Co.)	35,720	6%	58%	69%	5%	26%
2	268	273	5.3	35,550	6%	50%	70%	5%	25%
3	273	276	2.7	38,190	6%	51%	70%	5%	25%
4	276	280	4.0	40,600	7%	53%	69%	5%	26%
5	280	286	5.6	39,970	6%	51%	71%	5%	24%
6	286	287	1.5	39,720	7%	51%	68%	5%	27%
7	287	288	1.3	38,400	7%	50%	68%	5%	27%
8	288	290	1.7	38,620	7%	52%	68%	5%	27%
9	290	300	10.6	40,430	7%	52%	73%	5%	22%
10	300	301	0.7	38,570	7%	58%	71%	5%	24%
11	301	311 in Cumberland Co.	9.4 (3.0 miles in Madison Co.)	34,960	6%	56%	70%	6%	24%

Smith Co. Line
 ↑
 WB
 ↓
 EB
 Cumberland Co. Line

(1) Total vehicles (both directions combined) on an average day. (Volumes vary by day of the week and season of the year.)
 (2) Percentage of total daily traffic that occurs during the peak hour of travel on an average day. (Also varies by day of the week and season.)
 (3) Percentage of traffic in the "heavy" direction of travel during peak hours.

Figure 19. Traffic Characteristics by Segment, Putnam County

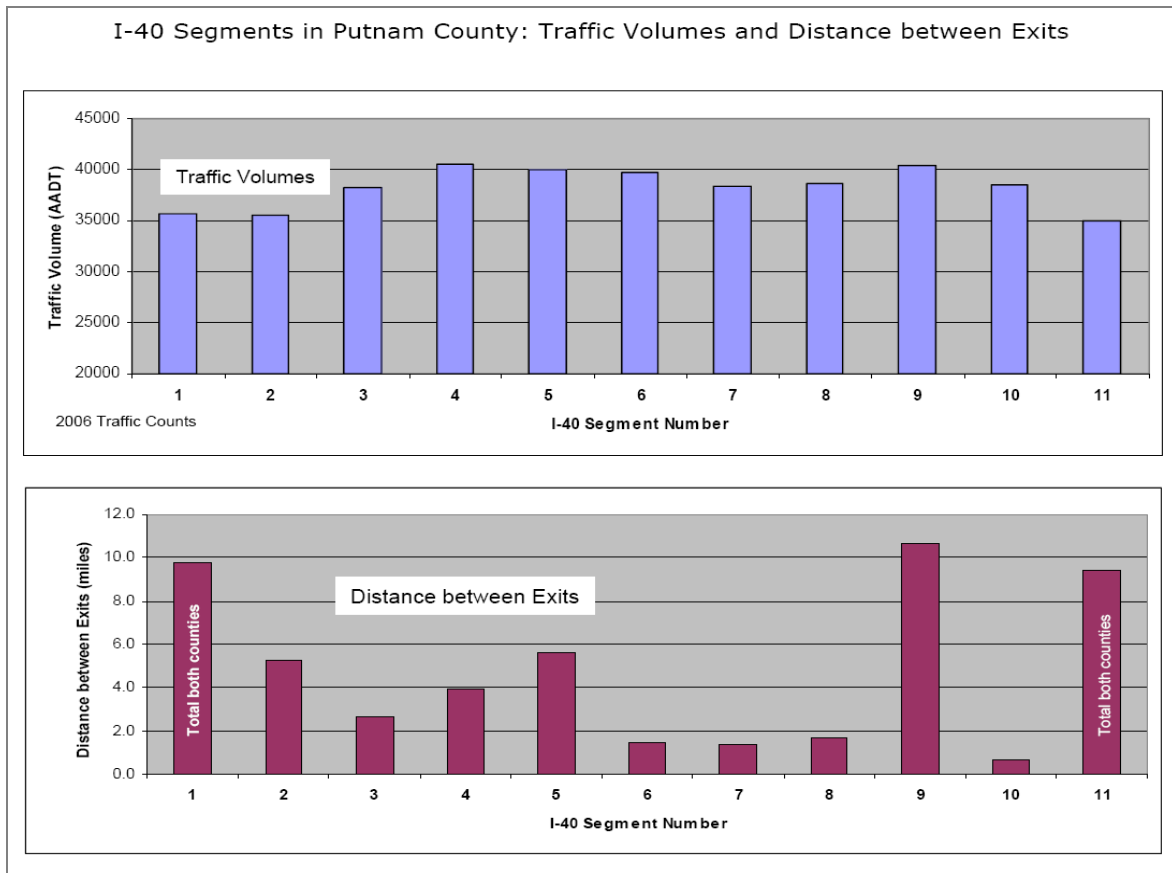


Figure 20. Graphs: Traffic Volumes and Segment Lengths, Putnam County

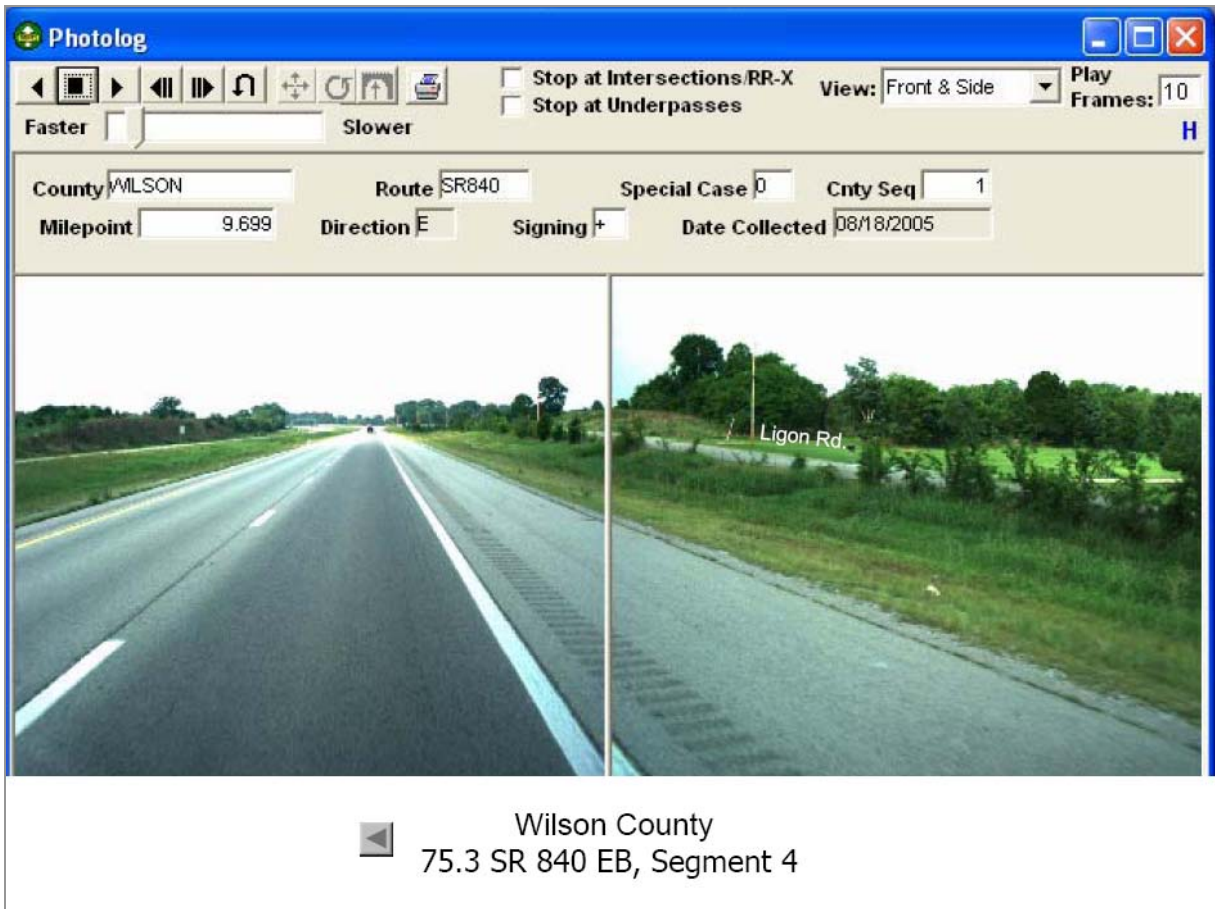


Figure 21. Opportunity for Over-the-Fence Response (SR 840, Wilson County)

5. Impact of Closures on Freeway Traffic Flow and Backups

This section contains the Corridor Incident Management Queue (CIMQ) spreadsheet which was developed as part of the CIM project to estimate the impacts of incidents and incident management practices on freeway traffic flow and the associated delay costs for motorists and truckers. The content and format were heavily influenced by requests from law enforcement and other public safety officials to describe traffic and the impacts of incidents in terms other than technical measures used by traffic engineers (e.g., AADT, peak hour percentages, directional distribution, and “queue lengths” based on “passenger car equivalents.”).

The spreadsheet calculations are supplemented by graphs that illustrate the time delays, the length of the backup (queue), and the delay costs for highway users. The spreadsheet uses data from TDOT’s annual traffic counts coupled with assumptions about travel patterns, roadway capacities, and unit costs.

Methodologies for predicting traffic queues and delays often use “passenger car equivalents” as the measure of queue lengths. CIMQ, however, distinguishes between passenger vehicles,

single unit trucks, and multi-unit trucks, recognizing the exceptional importance of trucks in dealing with traffic backups and possible diversion of freeway traffic to alternate routes. In many cases, alternate routes that are suitable for passenger vehicles are not suitable for trucks. If, for instance, freeway capacity is reduced to only one lane and a high number of trucks are present, the best way to take advantage of overall corridor capacity may be to allow only trucks to use the available lane and divert passenger vehicles.

The CIMQ spreadsheet includes seven different worksheets. The first three are interactive worksheets that quantify the adverse impacts of incidents on traffic flow, including the economic costs for highway users. The other worksheets contain supporting data for calculations.

Figure 22 is an example of CIMQ-generated estimates of the impacts of incidents and incident management practices on traffic backups, delays, and costs for highway users. Appendix B includes the CIMQ instructions and examples of all of three of the interactive worksheets included in CIMQ.

6. Traffic and Features on Other Routes

This section presents information from a TDOT planning tool, known as “**E**valuation of Roadway **E**fficiency” (EVE). TDOT’s Long Range Planning Division used some of the features of EVE, and the companion EVE Viewer, for the CIM project to generate simplified corridor-level views of information that is critical in selecting alternate routes for emergency diversions—roadway characteristics (lane widths, curves, and grades) and normal traffic demands compared with roadway capacity. Figures 23 and 24 are examples of the EVE maps.

The CIM_CDs include the following explanations of the information on the EVE maps:

- “Lane <11 Feet” indicates that lane widths are less than 11 feet. On-site inspection should be made before this route is designated as an alternate for freeway traffic.
- “Curves and Grades Exceeded” indicates that curves and/or grades are less than desirable, especially for large vehicles. On-site inspection should be made before this route is designated as an alternate for freeway traffic.
- “Level of Service” is a measure of traffic demand compared to the capacity of the facility. A route operating at LOS A has more excess capacity than a route operating at LOS B, and so forth. A route operating at Level of Service F is already very congested. (The term “Current” is used in the legend to emphasize that this map is based on the most recent data available on actual traffic demands and on the current capacity of the roadway.)

The EVE maps illustrate very effectively that very few “good” alternatives are available to divert freeway traffic to parallel roadways. In most cases, state and local officials must select a route (or routes) that will minimize the adverse impacts, and the EVE maps are intended to facilitate that planning process.

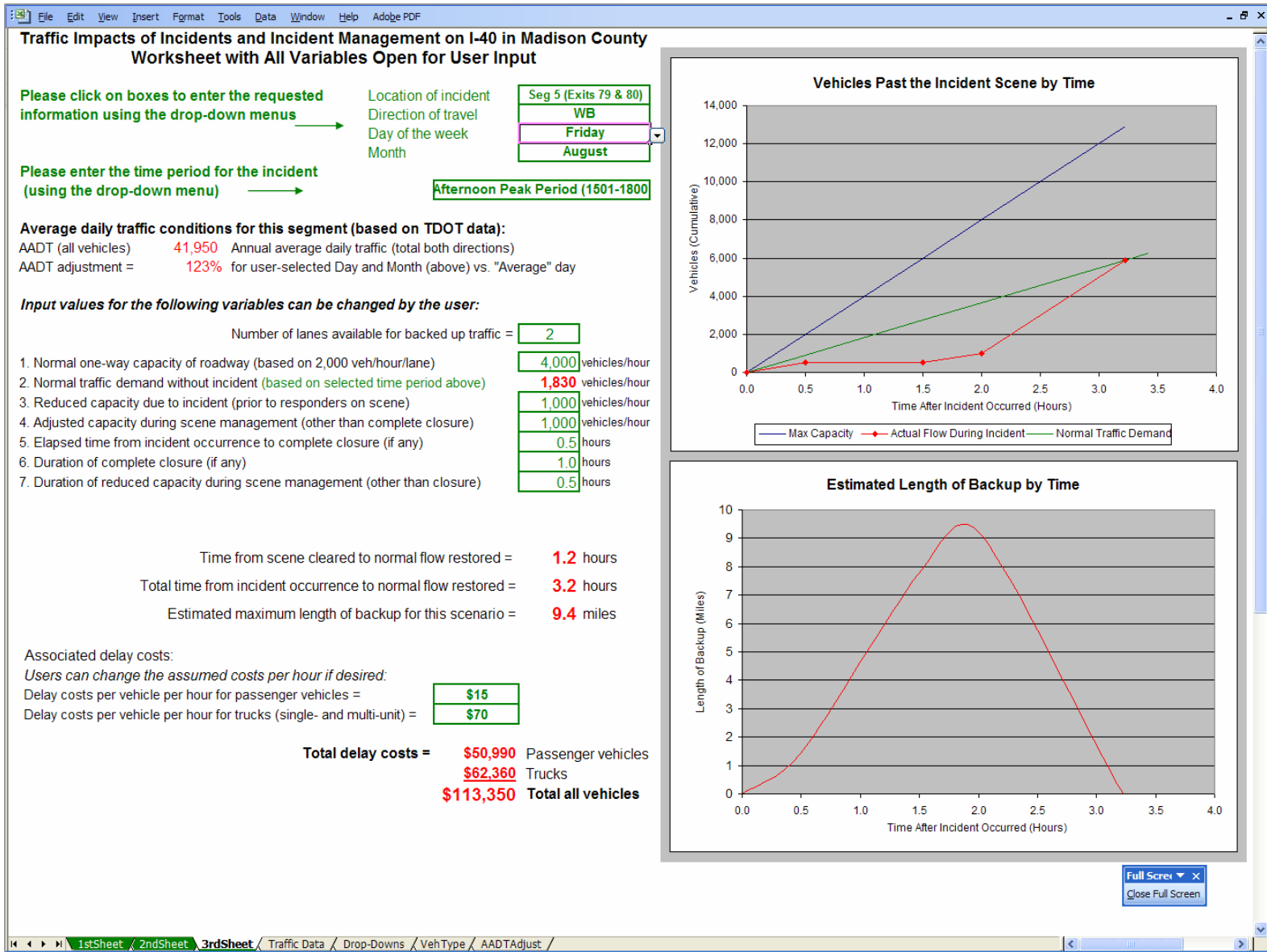


Figure 22. Example of CIMQ Spreadsheet (3rdSheet)

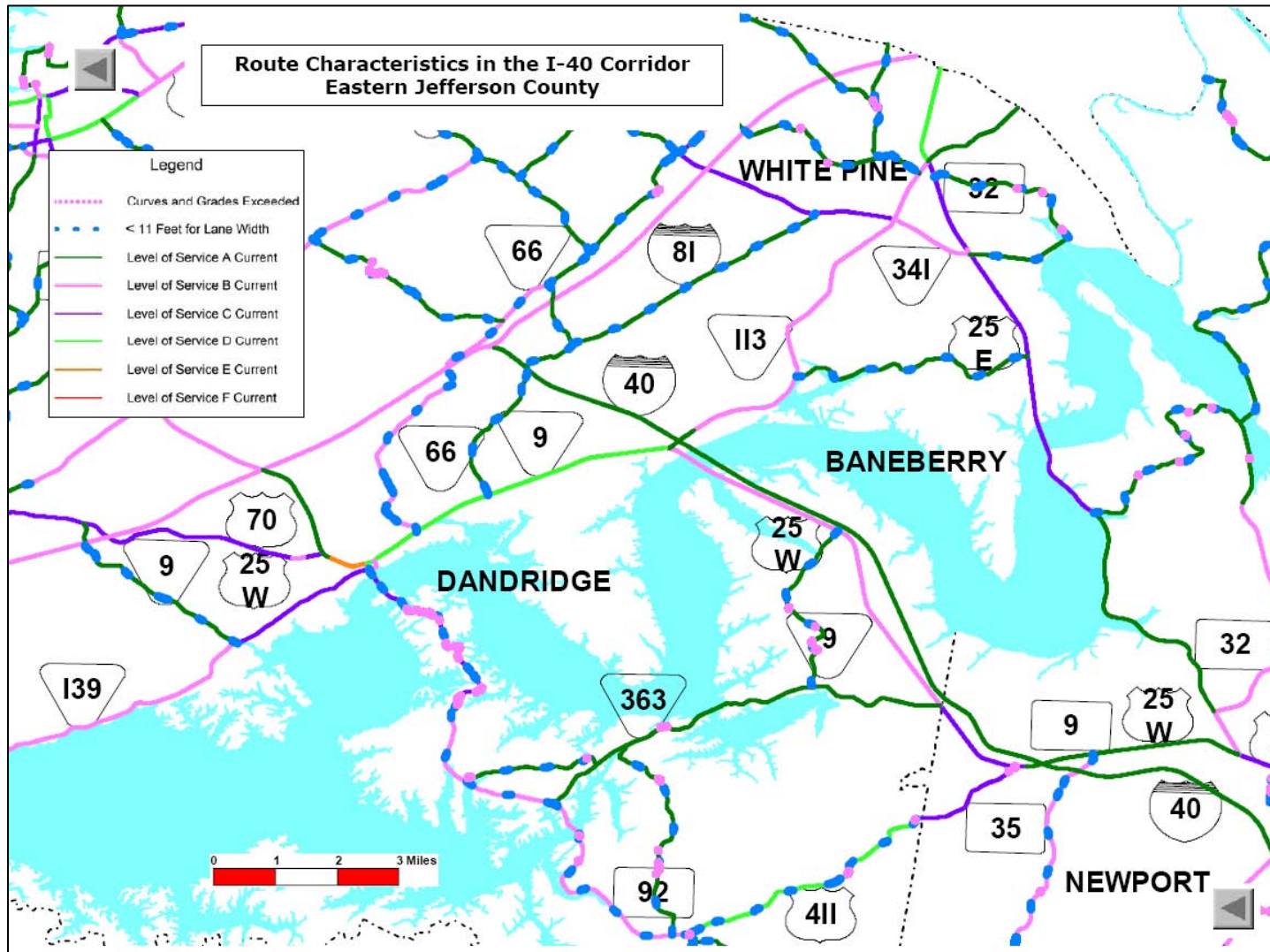


Figure 23. Route Characteristics, Eastern Jefferson County (EVE Map)

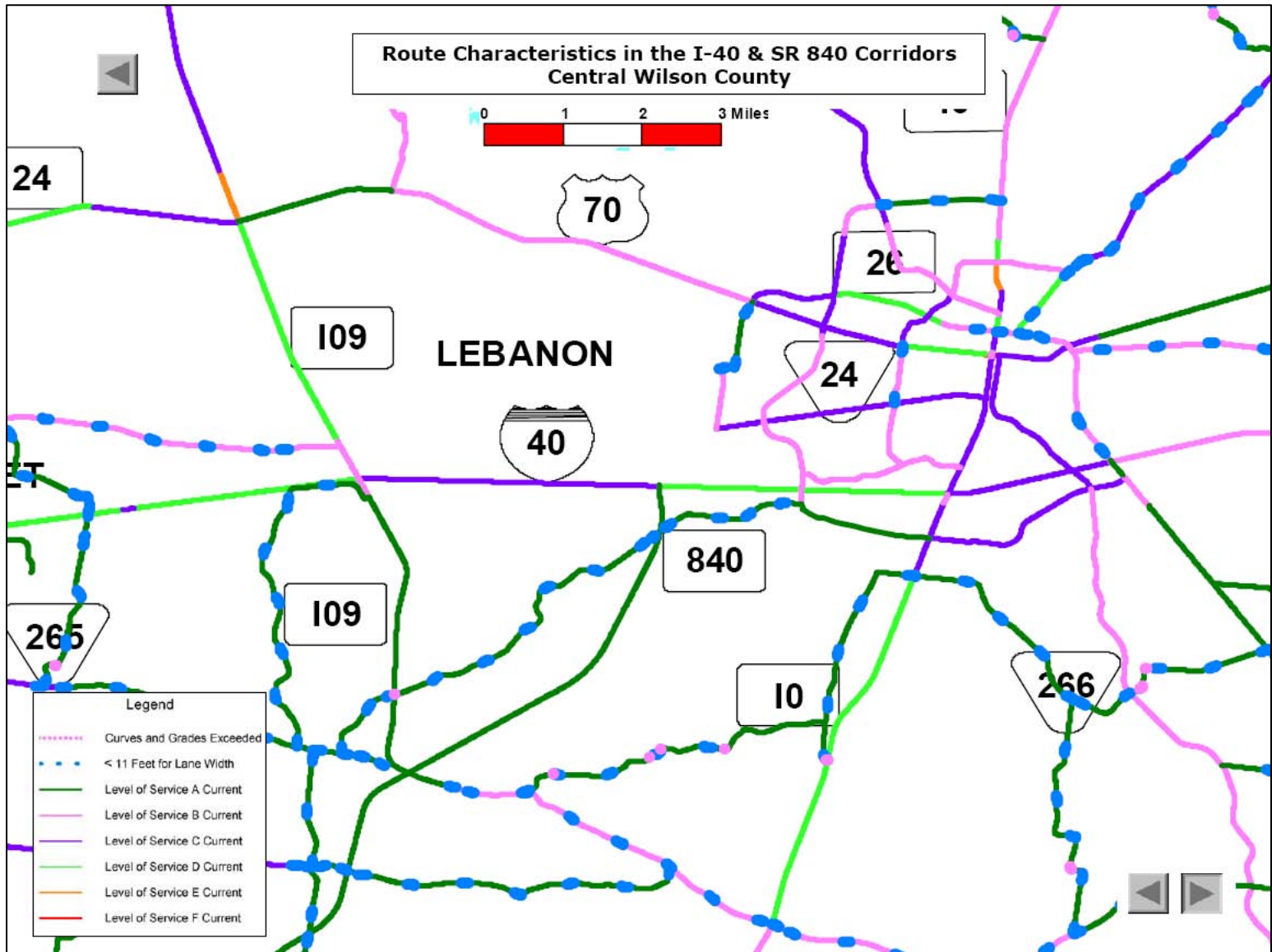


Figure 24. Route Characteristics, Central Wilson County (EVE Map)

7. Laws, Regulations, Guidelines, and Procedures

This section contains an assortment of documents that guide, authorize, and/or restrict traffic incident management and emergency transportation operations. Examples include excerpts from the *Tennessee Code Annotated (TCA)* and Chapter 6I (Control of Traffic through Incident Management Areas) of the national *Manual on Uniform Traffic Control Devices (MUTCD)*.

Also included is a copy of the *Memorandum of Understanding between the Tennessee Department of Safety (DOS) and the Tennessee Department of Transportation (TDOT) Relative to Urgent Clearance of Highway Incidents and Safety at Incident Scenes*. This agreement was executed in late 2004. (The Madison County version of the CIM_CD also includes a copy of a similar agreement between state and local agencies. The agreement between Jackson, Madison County, and state agencies was executed in late 2005. No formal agreements exist in the other four counties.)

For all of the five counties, a *proposed* document is included, entitled *Guidelines for Diversion of Freeway Traffic for Incident Management and Emergency Transportation Operations*. A sample copy is attached as Appendix C. This draft document offers suggested wording on a total 25 key aspects of incident management and diversion of freeway traffic to alternate routes. These potential points of agreement among partner agencies are identified as either “Key Factors” (11) or “Best Practices” (14). The 25 points include strategic and tactical considerations for effective incident management and emergency operations. The purpose is to focus the attention of state and local stakeholders on important issues and to encourage consensus. Once that is accomplished, each agency would be asked to adopt and sign the document.

Another document on the CD is the *TDOT Procedure for Designation of Freeway Ramps*. This was also developed as part of the CIM project, and is attached as Appendix D. The purpose of this procedure is to assign a unique identifier to each freeway ramp. These ramp designations will make it easier for incident responders to communicate and reduce confusion during planning and “after action” meetings. The unique designations could also be used during emergency operations to save valuable time in incident response and verification. In the future, corresponding signs could be erected on the ramps to help improve incident reporting and response. Once tested and refined, the ramp designations could facilitate all phases of incident management and emergency operations, including planning, detection, response, scene management, investigation, clearance, motorist information, and evaluation.

(Initially, the CIM project adopted a ramp designation procedure used for the TDOT’s “Photolog” system. However, other agencies suggested that the designation procedure should be precise enough that assignments made by agencies acting independently would result in the exact same designations being assigned to each ramp within a given interchange. Other agencies also suggested that the designation be as intuitive as possible so that just knowing the alphanumeric designation would help identify the specific ramp without the need for a map or photograph.)

Other documents within this CIM_CD folder include:

Tennessee Incident Management Checklist (TDOT publication)

State of Tennessee Strategic Highway Safety Plan

Strategic Plan for Highway Incident Management in Tennessee

Tennessee Drivers License Manual (2005)

Tennessee Commercial Drivers License Manual (2005)

Best Practices and Guidelines from other sources:

- *Alternate Route Handbook* (Federal Highway Administration)
- *Transportation Emergency Response Checklist* (Institute of Transportation Engineers)
- *Ohio Quick Clear Best Practices Guide*
- *Traffic Incident Management Recommended Operational Guidelines* (Minnesota)
- *New Jersey I-295/I-76/NJ 42 Incident Management Task Force Policy and Procedures Manual*
- *Felony Traffic Investigation Checklist*

8. Contact Numbers and E-Mail Addresses

This section contains a partially-completed contact list for public and private agencies that have responsibilities for incident management or that may need to be advised of possible adverse impacts. An important part of the suggested format is to include 24/7 emergency contact information. An example, the first page from the Madison County roster, is shown as Figure 25.

Confidential

Home Page

**Key Contacts for I-40 Incident Management
Madison County**
Date of Last Update: March 1, 2007

Agency	Person/ Title	E-mail	Administrative Phone Number	Emergency Phone Number	Other 24/7 Emergency Instructions/Numbers
Madison County EMA					
Madison Co. 911 Center					
Madison County Sheriff					
Madison County Fire Dept.					
Madison County Road Department					
Jackson Police Dept.					
Jackson Fire Department					
Jackson Street Department					
Jackson Engineering Dept.					
Jackson Energy Authority					
Southwest TN Electric Membership Cooperative					
Jackson Transit Authority					
West Tennessee Railroad					
Jackson-Madison County Airport Authority					
Haywood County Sheriff					
Haywood Co. 911					
Henderson County Sheriff					
Henderson Co. 911					

Page 1 of 4

Figure 25. Key Contacts Roster, Madison County

9. Emergency Alternate Routes

This section contains segment-by-segment information regarding emergency alternate routes. Figure 26 is an excerpt from the opening page for Roane County. This page provides point-and-click access to segment maps and to interchange photographs.

The segment maps show either “proposed” or “possible” emergency alternate routes for each segment of I-40. “*Proposed* Emergency Alternate Routes” are suggested for those freeway segments where the alternate route choices seem relatively straightforward, subject to review by the agencies responsible for incident management and for those specific alternate roadways. Figures 27 and 28 are examples of “proposed” alternate routes.

For other segments, however, alternate routes are not so obvious. In many cases, no “good” choices are available, and only “*Possible* Emergency Alternate Routes” are identified. For some segments, multiple alternate routes may be designated, depending on such variables as the incident time of day, day of week, season of the year, expected length of closure, and whether or not passenger vehicles can be routed separately from trucks, or perhaps trucks can

be kept on the freeway and only passenger vehicles diverted to alternate routes. Figures 29 and 30 are examples of “possible” alternate routes.

The goal is for state and local agencies to review the routes identified as “possible” alternate routes and narrow the selection to one or perhaps two (e.g., primary and secondary) alternates. Hopefully, the maps, photos, and other information on the CIM_CD will supplement local knowledge of those roadways and intersections and adjacent land uses. The decisions can then be shown on future updates as “proposed” emergency alternate routes.

A form developed for the CIM project is shown as Figure 30. When state and local agencies begin reviewing the proposed and possible alternate routes suggested on the CIM_CDs, needed improvements on those alternate routes will be highlighted. Experienced officers, TDOT field personnel, and local officials will know that certain sections and intersections along the alternate roadways are “problem areas” when freeway traffic is diverted. In many cases those same locations are bottlenecks even under normal traffic conditions, but the normal delays may not have reached a level that warrants corrective expenditures. In other cases, the needed improvements may be relatively inexpensive, but the need has not been well identified or communicated. Figure 30 is to help ensure that needed improvements to minimize the adverse impacts of traffic incidents and emergency diversions (and improve corridor-level capacity) are identified in a systematic manner and that those needs are considered when priorities are established for highway improvements.

This section also includes a table entitled *Normal Threshold Criteria for Diverting Traffic to Alternate Routes*. See Figure 32 for an example. The purpose of this table is to encourage local and state agencies to discuss and agree on the tradeoffs between allowing traffic to back up on the freeway versus diverting traffic to alternate routes. Long backups on the freeway are not desirable, but neither are the problems that occur when freeway traffic is diverted to alternate routes. (Even with a “good” alternate route with significant capacity, quick clearance is always preferable to diverting traffic off the freeway.)

The question to be answered in this table is: What are the normal time limits for expected closures that would warrant diverting traffic from the freeway onto to alternate routes? If we think the incident can be cleared in 30 minutes, should we just allow traffic to back up without establishing a detour?

The answer would almost always be “yes” for an expected 30 minute clearance. But the answer might also be “yes” for an expected two (2) hour closure if the choices of alternate routes are severely limited or the expected adverse impacts are extensive.

The *Normal Threshold Criteria for Diverting Traffic to Alternate Routes* table calls for a specific time for each freeway segment. Of course, incidents and emergencies are seldom “normal,” and it is often difficult to predict clearance times with confidence. The times selected for each segment should be used as a point of reference and adjusted in response to the circumstances.

Emergency Alternate Routes I-40 in Roane County

This section contains maps of "proposed" and "possible" emergency alternate routes for each segment of I-40 in Roane County. Other sections on the CD contain the associated plans for signing, equipment, and personnel and for public information about segment closures.

For this version of the CD (Version 1.1), "*Proposed* Emergency Alternate Routes" are shown for some segments of I-40. In these cases, selection of alternate routes seems relatively straightforward, subject to review by the agencies responsible for incident management along those roadways.

For other segments, however, alternate routes are not so obvious. In many cases, no "good" choices are available, and only "*Possible* Emergency Alternate Routes" are identified. For some of these segments, multiple alternate routes may need to be designated, depending on such variables as time of day, day of week, season of the year, expected length of closure, and whether or not passenger vehicles can be routed separate from trucks, or perhaps trucks should be kept on the freeway and only passenger vehicle diverted to alternate routes.

To view the maps of proposed or possible alternate routes, click on the segment number below. To view aerials photos of interchanges, click on the exit number.

Segment No.	Between Exits	
	#338 in Cumberland Co. SR 299 S. / Westel Rd.	#340 SR 299 / Airport Road
1	#340 SR 299 / Airport Road	#347 US 27 / Harriman-Rockwood
2	#347 US 27 / Harriman-Rockwood	#350 SR 29
3	#350 SR 29	#352 SR 58 South / Kingston
4	#352 SR 58 South / Kingston	#355 Lawville Rd.
5	#355 Lawville Rd.	#356 SR 326/ Gallaher Rd. / SR 58
6	#356 SR 326/ Gallaher Rd. / SR 58	#360 Buttermilk Rd.
7	#360 Buttermilk Rd.	#364 US 321 SR 95 / Lenoir City-Oak Ridge

Figure 26. Emergency Alternate Routes, Roane County

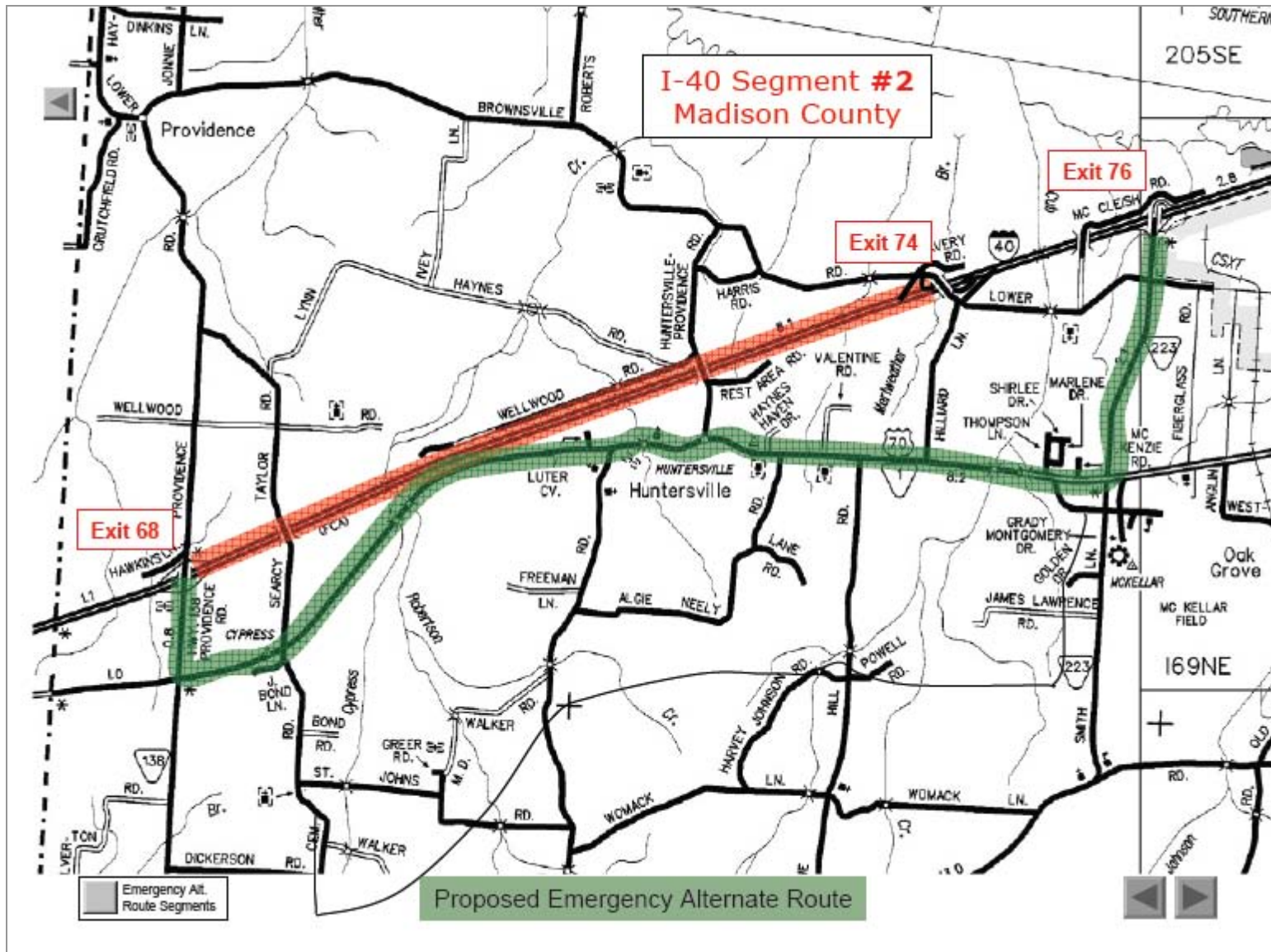


Figure 27. Proposed Emergency Alternate Route, Madison County

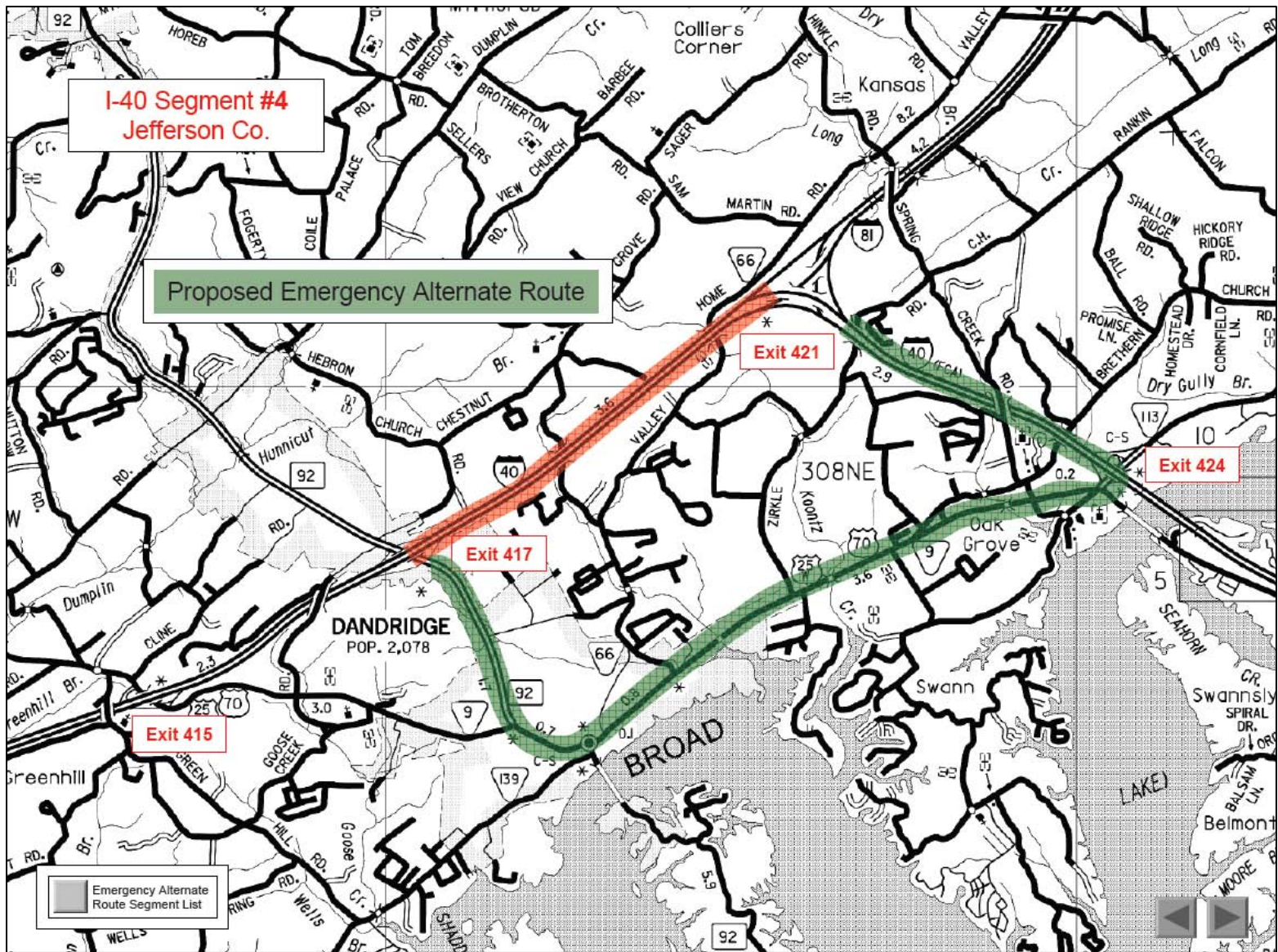


Figure 28. Proposed Emergency Alternate Route, Jefferson County

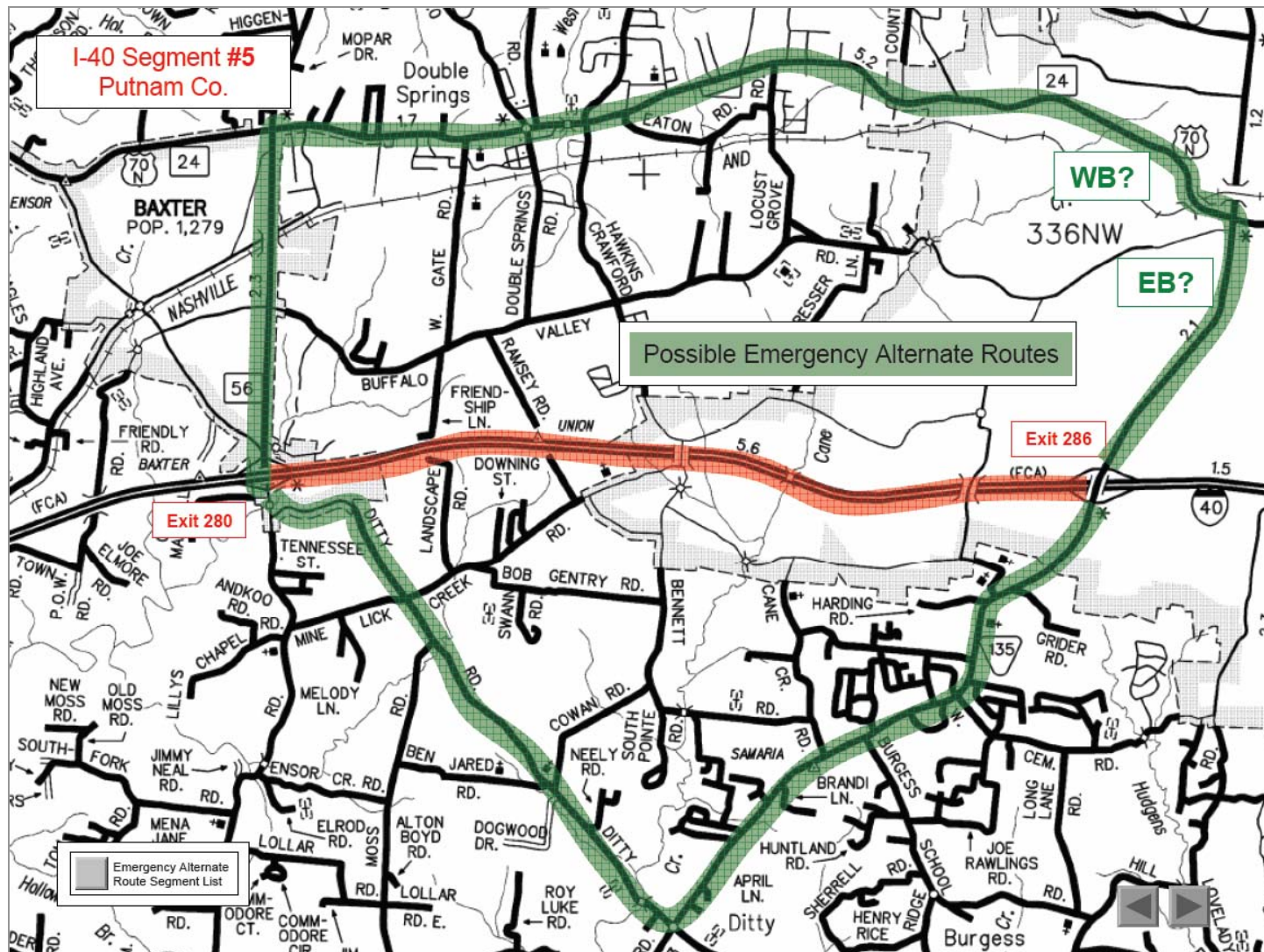


Figure 29. Possible Emergency Alternate Routes, Putnam County

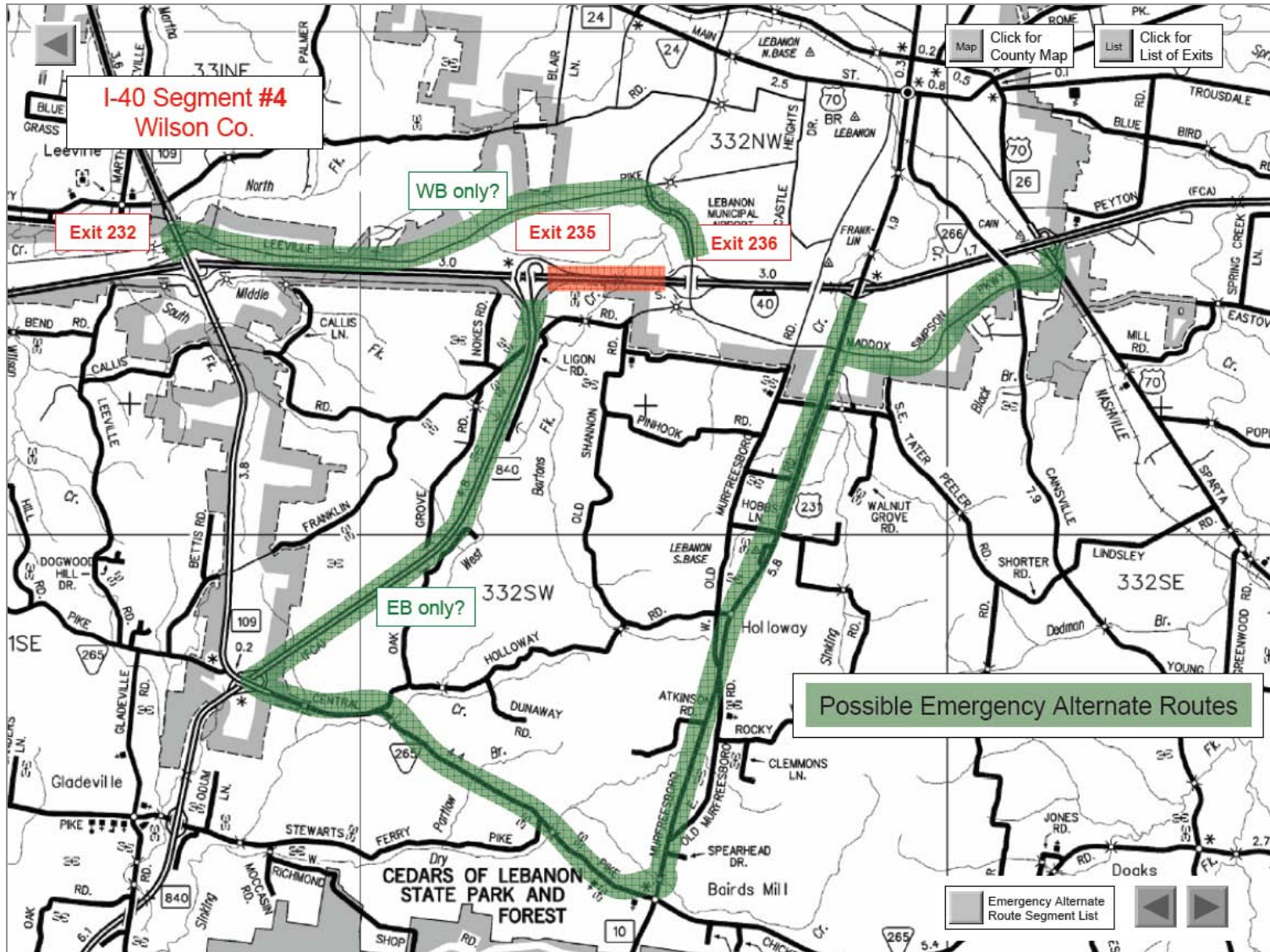


Figure 30. Proposed Emergency Alternate Routes, Wilson County

Proposed Improvement for Emergency Alternate Route

1. Route from which traffic is sometimes diverted: (I or SR) No. _____ Direction ____ (e.g. EB, WB, Both)

2. Proposed improvement is on SR No. _____ at (location) _____

3. County: _____ 4. City (if applicable) _____ 5. TDOT Region No. _____

6. Type of improvement proposed (check all that apply):

<input type="checkbox"/> Signing	<input type="checkbox"/> Additional turn lanes	<input type="checkbox"/> Other roadway changes
<input type="checkbox"/> Pavement marking	<input type="checkbox"/> Other intersection changes	<input type="checkbox"/> Stockpiled signs or other traffic control devices
<input type="checkbox"/> New signalization	<input type="checkbox"/> Additional travel lanes	<input type="checkbox"/> Other
<input type="checkbox"/> Improved signalization	<input type="checkbox"/> Shoulder widening/paving	

7. Describe proposed improvement:

8. Describe existing problem during emergency diversion of freeway traffic and expected benefit if the improvement is implemented:

9. Describe expected benefits (if any) during normal traffic conditions (no emergency diversion):

Attach additional sheets if needed

10. Cost estimate \$ _____
Please itemize below or attach the basis for cost estimate:

11. Suggested means of implementation (e.g., state forces, existing contract, bid, other):

12. Any other information that should be considered:

Proposed by: _____ Date: _____

Reviewed and recommended: _____ Date: _____

Reviewed and recommended: _____ Date: _____

Action:

Attach additional sheets if needed

2

Figure 31. Form to Propose Improvements for Emergency Alternate Route

Normal Threshold Criteria for Diverting Traffic to Alternate Routes* I-40 in Roane County						
Segment No.	Between Exits		Minimum Expected Duration (Hours/Minutes) of Closure Before Diverting Traffic to Alternate Routes*			Comments
			Closure in EB lanes Only	Closure in WB lanes Only	Closure in Both Directions	
	338	340				Exit 338 is in Cumberland Co.; Exit 340 is on the Cumberland-Roane Co. line
1	340	347				
2	347	350				
3	350	352				
4	352	355				
5	355	356				
6	356	360				
7	360	364				Exit 364 is in Loudon Co.

Adopted by (agencies): _____
Date: _____

* For specific incidents, time may need to vary depending on exact circumstances and level of confidence in how soon the incident can be cleared.

Figure 32. Threshold Criteria for I-40 Traffic Diversions, Roane County

10. Personnel, Signing, and Equipment Plans for Major Incidents

This section is primarily for segment-by-segment information on personnel assignments and the signing and equipment necessary for implementation of freeway diversions and alternate routes. Suggested formats are provided (Figure 33), and detailed examples are offered for Madison County. Developing the information for this section will require close, detailed coordination between units within DOT and between TDOT and other partner agencies.

Draft proposals are included for a standard set of signs and equipment for a freeway closure and a second standard set for closures with separate diversion routes for trucks and passenger vehicles (or trucks remain on the freeway).

Also included in this section are suggested formats for information about special equipment (such as TDOT’s “Ready Response Trailers”) that might be available to help manage major incidents, as well as potential staging areas for equipment and personnel that might need to be close to but not necessarily at the immediate scene of major incidents. Figure 34 shows the suggested format.

Personnel, Signing, and Equipment Plan
 I-40, Wilson County, **Segment** __
 Between Exit __ and Exit __



Segment __
EASTBOUND Diversion

Summary description of alternate route

Traffic Control Point	Personnel*	Signs	Equipment

Totals for Eastbound Diversion			
---------------------------------------	--	--	--

*The numbers shown here are for officers and flaggers on post. Additional personnel will be needed for relief.

NOTES:

Uniformed officers should be assigned to traffic control points where detoured traffic needs to (or is likely to) disregard normal traffic control devices or rules of the road.

Signing, Equipment, and Personnel Plan
 I-40, Wilson County, **Segment** __
 Between Exit __ and Exit __

Segment __
WESTBOUND Diversion

Summary description

Traffic Control Point	Personnel*	Signs	Equipment

Totals for Westbound Diversion			
---------------------------------------	--	--	--

*The numbers shown here are for officers and flaggers on post. Additional personnel will be needed for relief.

NOTES:

Uniformed officers should be assigned to traffic control points where detoured traffic needs to (or is likely to) disregard normal traffic control devices or rules of the road.

Figure 33. Format for Segment Personnel, Sign, and Equipment Plan

Potential Sources of Special Equipment for Highway Incident Management and Emergency Operations

Description	Equipment/Capacity	Owner/Base Location	Contact Information
Ready Response Truck (refurbished box truck)	Traffic cones, barrels, barricades and roll-up signs	TDOT Region 4 Headquarters, Benchmark Place	Regular Hours: After Hours:
Ready Response Trailer (pre-stocked and ready to be pulled to scene)	Traffic cones, barrels, barricades and roll-up signs	TDOT County Office, Brownsville (Windrow Rd.)	Regular Hours: After Hours:
Ready Response Trailer (pre-stocked and ready to be pulled to scene)	Traffic cones, barrels, barricades and roll-up signs	TDOT Salt Bin near Exit 101 in Henderson County	Regular Hours: After Hours:
Backhoes, loaders, and other construction/maintenance equip.		TDOT Region, District and County offices	Regular Hours: After Hours:
			Regular Hours: After Hours:

Potential Staging Areas for Highway Incident Management and Emergency Operations

Description/Location	Comments	Contact Information
TDOT Region 4 Headquarters near Exit 76 (Benchmark Place)		Regular Hours: After Hours:
THP District 8 and JFD Station #5 near Exit 82		Regular Hours: After Hours:
Parking lot for Pringles Park near Exit 85		Regular Hours: After Hours:
		Regular Hours: After Hours:

Figure 34. Potential Sources of Special Equipment and Potential Staging Areas

11. Public Information Plans

This section recognizes the importance of accurate public information regarding traffic incidents and emergency operations, and tools are suggested to facilitate public information plans.

As an example, the following responsibilities are suggested as the starting point for discussions among the partner agencies to predetermine “who will do what” during a major incident, event, or emergency in Madison County:

- Determine the key “message points”—where, extent, expected length of closure, detour (if any), and any advice for motorists
- Notify and update all responding and affected agencies
- Notify and update on-scene personnel
- Notify and update local radio and TV
- Notify and update other radio and TV

- Input information to TDOT's SmartWay system
- Advise TDOT TMCs (Memphis and Nashville)
- Notify and update TEMA
- Staff the Joint Information Center if Incident Command is established
- Speak to on-scene news media
- Notify and update major truck stops
- Notify and update rest areas
- Notify and update weigh stations
- Notify and update adjacent county(ies)
- Deploy portable Dynamic Message Signs (DMSs) and Highway Advisory Radio
- Deploy directional signs, barricades, other traffic control devices, and DMSs

Also included on the CIM_CDs are suggested scripts (Message Guidelines) to help advise the news media of freeway closures and diversions routes. The same scripts, designed to ensure concise and accurate information, could be used for recorded messages on Highway Advisory Radio or other audio outlets. Figure 35 is an example for Putnam County.

This section also contains a suggested roster of key agencies and contact persons to facilitate the collection and dissemination of accurate information. In addition to public agencies and news media, the suggested lists include major truck stops, special event sponsors, and other major traffic generators.

12. Available Radio Frequencies

This section is primarily a placeholder for future version of the CIM_CD to allow quick identification of shared or mutually-available radio frequencies to facilitate incident management and emergency transportation operations. A quick reference tabular format is suggested. See Figure 36. This section could also be used in future versions to document interagency policies and procedures to improve interoperability during incidents and emergency situations.

**Message Guidelines for Interstate Closures
Putnam County**

Closure in One Direction Only

Due to an emergency (or traffic incident), Interstate 40 is closed in Putnam County (or in the City of _____), (east- or west-) bound between Exit # ___ and Exit # ___. That is between (name of cross street/highway) _____ and _____ (name of cross street/highway) _____.

The closure is expected to last at least until _____ a.m./p.m. Central Time.

Emergency detour routes are being established. (IF TRUE)

Again, all ___ bound lanes of the Interstate are closed between Exit # ___ and Exit # _____. The closure is expected to last until at least _____ a.m./ p.m. Central Time.

The (opposite direction) _____ bound lanes are open, but rubbernecking delays are expected.

Motorists should be prepared for delays on all routes in the I-40 corridor.

(Closed direction) _____ traffic can still reach the Interstate at Exit # ___ and other Exits to the (east or west).

xxx

Figure 35. Message Guidelines for Interstate Closures, Putnam County

Available Radio Frequencies for Incident Management Roane County												
Channel Name	Agency 1			Agency 2			Agency 3			Agency 4		
	Mobile	Portable	Mobile	Portable	Dispatch	Dispatch	Portable	Dispatch	Dispatch	Portable	Dispatch	Dispatch
	TX/RX	TX/RX	TX/RX	TX/RX	TX/RX	TX/RX	TX/RX	TX/RX	TX/RX	TX/RX	TX/RX	TX/RX
VCALL												
VTAC 1												
VTAC 2												
VTAC 3												
VTAC 4												
VTNTAC												
UCALL												
UCALLA												
UTAC1												
UTAC1A												
UTAC2												
UTAC2A												
UTAC3												
UTAC3A												
ICALL												
ITAC1												
UTNMA												
UTNMALD												
UTNMAHD												
NLEEC												
EMS												

Figure 36. Available Radio Frequencies for Incident Management

13. Online Maps

As a convenience for users, hyperlinks are provided for access to online map services, with the respective county specified as the startup location. For users with Google Earth already loaded, a KMZ file is included.

Users are also given point-and-click access to the respective County Map (and maps of the cities within the respective county) and maps of all the adjacent counties. These maps are stored on the CD, and separate hyperlinks are provided to download new copies from the TDOT web site.

14. Current Traffic Conditions

This section contains hyperlinks to the TDOT SmartWay system—real-time information about traffic conditions throughout the state. Hyperlinks are also provided for real-time traffic information sources in nearby states.

15. Current Weather and Forecasts

Also as a convenience for users, localized hyperlinks are provided for the National Weather Service (NWS), several commercial sources of weather information (e.g. AccuWeather, The Weather Channel), and for detailed current weather condition at nearby airports.

16. Special Event Schedules

If future versions of the CIM_CD are available online (24/7) this section could be used to post up-to-date information about special events that might affect traffic demand or capacity. In the meantime, hyperlinks are provided for users to check for special events information. Figure 37 shows an example from the Jefferson County CIM_CD.

Special Events
Jefferson County

If future versions of the Corridor Incident Management tools are available online, this section can be used to post up-to-date information about special events that might affect traffic demand or capacity.

In the meantime, users should check these links for special events information:

Jefferson County Chamber of Commerce
<http://www.jefferson-tn-chamber.org/Visitor/SpecialEvents.htm>

Tennessee Tourism
<http://www.tnvacation.com/> (click on the calendar)

UT Athletic Events
<http://utsports.cstv.com/calendar/events/>

Virginia Tourism
<http://www.virginia.org/>
<http://www.virginia.org/site/content.asp?MGrp=3&MCat=11&Rgn=10000&ESM=12&ESD=1&ESY=2004&EEM=12&EED=31&EEY=2004>

North Carolina Tourism
<http://www.visitnc.com/>

EastTnVacations.com
<http://www.easttnvacations.com/Events.aspx>

Tennessee Smokies
<http://www.smokiesbaseball.com/images/pdf/2007Schedule.pdf>

Figure 37. Special Events, Jefferson County

17. Community Information & Links

Basic statistics about the community are provided along with hyperlinks to local web sites (city and county governments, public safety agencies, schools, public utilities, and other stakeholder organizations).

18. Incident Management Information & Links

This section provides access to a comprehensive library of information sources on incident management and emergency transportation operations. The listing covers six pages with more than 100 hyperlinks. Five documents are stored on the CD, including the *Traffic Incident Management Handbook* and four “white papers” published by the National Traffic Incident Management Coalition on key topics:

- Benefits of Traffic Incident Management
- Responder Safety
- Prompt, Reliable Incident Communications
- Safe, Quick Clearance

19. Hazardous Material Info & Links

This section includes PDF copies of several documents related to the transportation of hazardous materials, including the *2004 Emergency Response Guidebook* and the *DOT Chart 12: Hazardous Materials Marking, Labeling and Placarding Guide*. Also included are phone numbers for emergency contacts and links to documents and websites with information related to hazardous materials and the management of hazardous material incidents.

20. Training and Self-Assessment

This section begins with an invitation for other agencies to participate in TDOT-sponsored workshops and an offer for TDOT personnel to serve as guest instructors/presenters for training provided by partner agencies.

Also included on each CD are copies of more than a dozen documents, presentations, and other training aides, as follows:

- *Simplified Guide to the Incident Command System for Transportation Professionals* (U.S. DOT, Federal Highway Administration)
- *Highway Safety Training for Emergency Responders* (Minnesota)
- *Model Procedures Guide for Highway Incidents* (National Fire Service Incident Management System)
- *Traffic Incident and Special Event Management: A Police Perspective* (Broken Arrow, OK)
- *Tulsa Traffic Incident Management Guide* (Tulsa)
- *Traffic Incident Management: What It Is and Why It Matters* (Atlanta)
- *Emergency Management, I-74 Reconstruction Project*, Peoria, Illinois (Illinois DOT)
- *International “Scan Trip” on Traffic Incident Response* (England, Germany, Netherlands, Sweden)

- *Unveiling Kentucky's Highway Incident Management Program*
- *Freeway Incident Management* (Texas)
- *Tennessee Incident Management Checklist* (TDOT)
- *Components and Context for Highway Incident Management* (Tennessee)
- *Importance of Highway Incident Management* (Tennessee)
- *Impact of Incidents on Highway Operations* (Tennessee)
- *Highway Incident Management Training Slides* (Tennessee)

Also, the Federal Highway Administration (FHWA) has developed a “self-assessment” procedure to help communities and regions identify the strengths and weaknesses of their respective incident management programs. Copies of the FHWA self-assessment manual and the “rating” spreadsheet are included on the CD.

Another document on the CD, entitled “Guide for Emergency Transportation Operations,” includes self-assessment guidance for state DOTs.

Finally, CIM_CD users are invited to “spend just 18 minutes” and view a presentation (WMV file) by a Virginia State Trooper. The presentation, entitled “Hats of Highway Incident Management,” addresses the importance of interagency cooperation for incident management and the obstacles created when the focus is on “who’s in charge.”

Findings and Recommendations

The objective of the CIM research project has been accomplished consistent with the project guidelines and the feedback received from TDOT and other stakeholders throughout the project. A set of methods, tools, and databases have been developed, using resources already available within TDOT, and the CIM_CDs demonstrate how those results can be applied to five Tennessee counties. Not all of the components (i.e., the 20 “boxes” on the Home Page) will be equally useful for all of the target functions and activities (e.g., alternate route planning, special events planning and management, routine incident management, post-event debriefings), but a menu of choices is now available along with templates and forms that can be easily adapted.

Identical or similar CIM_CDs could be prepared for other counties using TDOT’s own maps, photographs, data sources, planning tools, and off-the-shelf software that does not require exceptional expertise or training. No special computer code, or even macros, are involved. The primary obstacle to preparing CIM_CDs for other counties is that some of the procedures for presenting the information and adding navigation features are tedious and time consuming.

Some of the tools developed as part of the CIM project could also be used independently regardless of whether additional CIM_CDs are created. Examples include the CIMQ spreadsheets, the draft Guidelines for Diversion of Freeway Traffic for Incident Management and Emergency Transportation Operations, the interchange photographs (with ramp designations), the public information plans and templates, the training and self-assessment documents and guidelines, and the library of reference materials and links to other sources.

The most significant weakness of the CIM-CDs is probably that the information will have limited usefulness for real-time incident management and for some other purposes because it is not universally available to all users on a 24/7 basis. For effective real-time use, all responders need to have the same information. How can responders have the information available in real time if they don't have a copy of the CD? If responders are relying on CDs, how can they be sure that all of their partners have the same version of the CD? How can they be sure that all of the information is the most current available?

The most direct solution would be for the CIM_CD information to be available over the Internet on a 24/7 basis. Eventually most of the CIM_CD components should be converted to web pages anyway. For the immediate future, TDOT or another state or local agency could provide access to a server for that purpose, but issues of costs, security, and support would have to be considered.

Even for other than real-time use, having up to date information is important. If the CIM_CDs are used in their present format, new versions will be needed periodically to ensure that the information is current. Figure 38 summarizes the needs and opportunities to update each component of the CIM_CDs.

The following specific recommendations are offered for TDOT's consideration regardless of any decisions about future versions of the CIM_CDs:

Aerial Photographs

TDOT should consider lower-altitude aerial photographs of the entire freeway system (outside of the core metropolitan areas) on an annual basis. The department could then add the ramp designations and make the images available to partner agencies. This would ensure that the photographs were current and would provide a useful, high-quality, and common source of information for all of the agencies that share responsibilities for incident response and emergency operations.

(Since these photographs would not be used for mapping purposes, the flights could be made at times of the year that would not conflict with most of the department's other priorities for aerial photography, i.e. regardless of whether vegetation allows a clear view of the ground.)

Direct Access to Photolog and Other TRIMS Features

Several potential users have indicated that the Photolog images on the CIM_CDs could be very helpful for a wide range of purposes, e.g., confirming the location of median crossovers, identifying overhead wires that might restrict helicopter operations, knowing the exact message on directional signs or the exact location of the signs relative to ramps. However, the CIM_CD process of manually selecting the exact image to "capture" is very subjective. Any one of the features listed above is likely to be visible in several Photolog frames. The most distant frame will capture more of the surrounding features. The closest frame will provide more detail.

Information (Home Page Box)	Need/Opportunity for Updates
1. Index Map and Index List	New “segment numbers” will be required if new interchanges are built (e.g., Beckwith Road in Wilson County). Experience with incidents may call for special notes in the “Comments” column of the Index List
Maps	TDOT is working on a system that will allow updates to City and County maps on a three to five year cycle.
Interchange Photographs	New “County Wide” aerial photos are usually available for one of the four Regions each year. The current schedule is for Regions 1 and 4 in 2008, Region 3 in 2009, and Region 2 in 2010. Ramp designations may change if interchanges are improved
3. Driver-View Snapshots	Photolog images are updated every two years (i.e., two regions are photographed each year).
4. Traffic and Route Features on I-40	Updated traffic data (TRIMS) is available annually. TRIMS route feature information is updated continuously.
5. Impact of Closures on I-40 Traffic Flow and Backups	Updated traffic data (TRIMS) is available annually. Obtaining more county-specific data for vehicle type by time of day (VehType spreadsheet) would be desirable.
6. Traffic and Features on Other Routes	Updated traffic data (TRIMS) is available annually. Roadway geometrics change when improvements are made. EVE maps should be “redrawn” at least annually to reflect new traffic data and any changes in geometrics.
7. Laws, Regulations, Guidelines, and Procedures	State laws are subject to annual change. New laws can be effective on any specified date, but July 1 is the most common. Regulations, guidelines, and procedures are subject to change at any time and should be reviewed annually.
8. Contact Numbers and E-Mail Addresses	Names, numbers, and addresses are subject to change at any time; should be updated at least annually.
9. Emergency Alternate Routes	Details should be added, revised, or deleted based on interagency planning and after-action reviews.
10. Alternate Route Personnel, Signing, and Equipment Plans	Details should be added, revised, or deleted based on local information, interagency planning and after-action reviews.
11. Public Information Plans	Names, numbers, and addresses subject to change at any time; should be revisited at least annually.
12. Available Radio Frequencies	Depends on local circumstances and priorities; should be revisited at least annually.
13. Online Maps	Hyperlinks should be checked at least annually.
14. Current Traffic Conditions	Hyperlinks should be checked at least annually and more often during holiday and summer peak travel periods.
15. Current Weather and Forecasts	Hyperlinks should be checked at least annually and prior to expected adverse weather conditions.
16. Special Event Schedules	Hyperlinks should be checked at least annually and prior to major scheduled events.
17. Community Information and Links	Hyperlinks should be checked at least annually and new resources added when available. FHWA highway statistics are updated annually.
18. Incident Management Information and Links	Hyperlinks should be checked at least annually and new resources added to the CD when available.
19. Hazardous Material Info & Links	Hyperlinks should be checked at least annually and new resources added to the CD when available.
20. Training and Self-Assessment	Hyperlinks should be checked at least annually and new resources added to the CD when available. Tennessee-specific material should be revised based on experience with use.

Figure 38. Needs and Opportunities for CIM Updates

Once the image is captured, it must be stored on the CD and added to the reference list along with the appropriate hyperlink. That process is tedious and time consuming.

A more effective use of the TRIMS Photolog resource may be to allow and encourage other agencies to have direct access to the Photolog system. Many of those agencies could also benefit from access to other TRIMS features and reports.

“Over the Fence” Access to Emergency Scenes

The CIM_CDs identify a number of possible sites for “over the fence” access to emergency scenes from parallel routes. Those site identifications were based on reviews of Photolog images, scans of various maps, and “drive by” assessments. TDOT should consider a more systematic process of identifying and evaluating such sites and possibly enhancing the potential for emergency use. On-site reviews should be conducted with local responders. For sites that have significant potential benefits (in terms of reduced response time or the ability to facilitate quick clearance), TDOT should consider physical improvements for emergency use without compromising safety or security during normal operations and maintenance. .

Interchange Numbers on County Maps

The TDOT county maps are a valuable tool for incident management and emergency operations, but one very important item of information for those purposes is missing on the county maps, the interchange number. Adding those numbers would eliminate the need for users to manually modify the maps and/or to refer back and forth with other maps that include the interchange numbers.

Improved CIMQ

The CIMQ spreadsheet was especially well received by users, and additional refinements could make CIMQ more user-friendly, accurate, and convincing. A web page format would be more user-friendly than the current Excel version, and images and maps could be added to enhance the results. One weakness in that spreadsheet is that it relies on national averages and subjective judgment to build the input data for the distribution of passenger and truck traffic by time of day. Tennessee-specific data from TDOT permanent traffic count stations, Department of Safety Weigh Stations, and perhaps supplemental traffic counts to provide more segment-specific data would make the results more sensitive to specific circumstances.

Ramp Designation Procedure

Before the CIM project began, TDOT had adopted a new procedure to assign unique identities to each freeway ramp. The purpose was to facilitate “photo logging” of the ramps.

Initially the CIM project used that same procedure. However, law enforcement and emergency management officials suggested that a more rigid procedure be developed for incident management purposes to help ensure standardization and so that information about

the ramp could be known based solely on the alphanumeric designation (i.e., without having a map or diagram in hand).

The procedure developed for the CIM project has been proven workable for incident management purposes, but an equivalency table needs to be developed to match the ramps designations used in the TRIMS system. An even better alternative would be for TDOT to adopt the system described in Appendix D for all photologging and all other purposes.

Closing

In closing, three overarching suggestions are offered for TDOT's consideration:

First, future versions of the CIM_CDs should be enhanced by adding information from sources other than TDOT and by using GIS, web pages, and other software to make the tools more functional. Additional information from other sources could included, for instance, locations and types of intersection traffic controls and other ITS resources, the locations of schools and other public facilities and major traffic generators, water sources for fire fighters, pre-designated landing sites for helicopters, and the base locations for response equipment (e.g., fire and rescue, EMS, towing and recovery). With GIS capability, such information could be very useful for planning and for real-time incident and emergency management. Use of web page formats would make the CIM tools more user-friendly and more easily adapted for web-based application and for integration with other systems.

Second, while the CIM_CDs are organized on a county-by-county basis for the valid reasons described above, state agencies should have a regional, statewide, and multi-state perspective. TDOT, TDOS, and TEMA and other state agencies should be engaged in coordinating the efforts of adjacent counties and working directly with the eight states that share common borders with Tennessee.

Finally, the CIM project has highlighted that the best response to freeway incidents is almost always "quick clearance." Planning and preparing for diversions to alternate routes is very important, but Tennessee's freeway corridors are operating so close to capacity that any diversion of freeway traffic to alternate routes is going to have serious adverse impacts. If a freeway has to be closed, planning and preparation will minimize the problems and associated costs, but the freeway needs to be reopened as soon as possible.

Appendix A

Corridor Incident Management: Survey of Practices in Selected State Departments of Transportation

**Corridor Incident Management:
Survey of Practices in Selected State Departments of Transportation**

Prepared for the
Office of Incident Management
Tennessee Department of Transportation
by the
Vanderbilt Center for Transportation Research

February 2007

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APPENDICES *(Not included with this copy)*

- Appendix A – Survey Instrument
- Appendix B – Survey Responses
- Appendix C – Contacts for Additional Information
- Appendix D – Copies of Plans and Other Documents

Introduction

The purpose of this report is to summarize the results of a survey of selected state departments of transportation (DOTs) relative to emergency alternate routes and other aspects of highway incident management. The survey was part of a research project, entitled Corridor Incident Management (CIM), to develop multi-purpose methods, tools, and databases to support the following activities in Tennessee:

- Planning and implementation of emergency freeway closures and diversions
- General emergency operations
- Safety and security planning
- Special events planning and operations
- Evacuation planning and implementation
- Quick clearance of traffic incidents

The report begins with a brief explanation of how the states were selected for the survey and a description of the survey process. The survey results are then summarized for each category of questions that were addressed in the survey, as follows:

- Alternate Route Plan Documents
- Alternate Route Planning Process
- Execution of Emergency Diversions
- Signing; Laws, Regulations, and Procedures; Roadway Features; Interagency Coordination; and Other
- Final Questions

An additional section is included near the end of the report relative to organizational responsibilities for incident management.

The report has four appendices (not included with this copy):

- Appendix A: Survey Instrument
- Appendix B: Survey Responses
- Appendix C: Contact Lists
- Appendix D: Electronic Copies of Plans and Other Documents (CD format)

Appendix B (Survey Responses) include completed survey forms, notes from telephone conversations, and copies of certain emails. Appendix C (Contact Lists) includes names and numbers of individual to contact for various types of information related to emergency alternate routes and incident management. The documents in Appendix D are presented in electronic form (on a CD), and a printed copy of each documents in Appendix D has been provided to TDOT's Office of Incident Management.

States Surveyed

A total of 13 states were contacted, and information was obtained from eleven of those states:

- Alabama
- Arkansas
- Georgia
- Iowa
- Kentucky
- Mississippi
- Missouri
- North Carolina
- South Carolina
- Virginia
- Washington

Also, information and documents from Florida and Wisconsin had been provided to TDOT previously, including interactive CDs containing alternate route information developed for the Wisconsin DOT. Other potentially useful documents from Florida and Wisconsin are included in Appendix D.

The focus of the survey was on the eight states that have common borders with Tennessee. These adjacent states were included because TDOT might learn from the experiences in those states but also because interstate coordination is especially important for TDOT. Tennessee is one of only two states that have common borders with eight other states, and Tennessee is the only state that has Interstate highway connection across eight common borders.

As shown in Table 1, Interstate highways enter and leave Tennessee at a total of 15 locations. Several questions were included in the survey to learn about specific plans and procedures for coordination of incident management at those 15 locations.

Survey Procedures

A list of questions for the other states was developed in consultation with the TDOT Office of Incident Management and the department's Region Incident Management Coordinators. The list of 65 questions was then organized into categories. A survey instrument was developed, and the final version is shown as Appendix A. Also, many of the questions included requests for related documents.

Initial contact was made via an email addressed to the respective states' members of the AASHTO Subcommittee on Systems Operations and Management. The email explained TDOT's need for information from other states and asked if a copy of the 65-question survey could be sent for consideration. All of the contacted states responded favorably.

The survey questions were then emailed to the state contacts, several of whom forwarded the survey to others in their department. Seven of the states responded by filling out the survey form. The most complete responses were from Kentucky, Mississippi, Missouri, South Carolina, Virginia, and Washington State. The states adjacent to Tennessee that did not fill out the survey form were then contacted via phone and email to obtain information on at least key questions. All of the states were also asked to identify contacts for additional or more detailed information, and all of the eleven states responded.

#	State	Route	TDOT Region	Urban or Rural?	TN County	Other State County
1	Kentucky	I-24	3	Clarksville city limits	Montgomery	Christian
2	Kentucky	I-65	3	Rural	Sumner	Simpson
3	Kentucky	I-75	1	Rural	Campbell	Whitley
4	Virginia	I-81	1	Bristol area	Sullivan	Washington
5	Virginia	I-181	1	Kingsport city limits	Sullivan	Scott
6	North Carolina	I-26	1	Rural	Unicoi	Madison
7	North Carolina	I-40	1	Rural	Cocke	Haywood
8	Georgia	I-75	2	Chattanooga city limits	Hamilton	Catoosa
9	Georgia	I-24	2	Chattanooga area	Hamilton	Dade
10	Georgia	I-24	2	Chattanooga area	Hamilton	Dade
11	Alabama	I-65	3	Rural	Giles	Limestone
12	Mississippi	I-55	4	Memphis city limits	Shelby	DeSoto
13	Arkansas	I-55	4	Memphis (Miss. R. bridge)	Shelby	Crittenden
14	Arkansas	I-40	4	Memphis (Miss. R. bridge)	Shelby	Crittenden
15	Missouri	I-155	4	Rural (Miss. R. bridge)	Dyer	Pemiscot

Table 1. Tennessee’s Interstate Highway Border Crossings

The results of the survey are summarized below, using the same categories of questions and order used in the survey. The results highlighted are those judged to be of the most interest to Tennessee DOT for the Corridor Incident Management project. The complete response from each state is in Appendix B, and Appendix C contains names and contact information for individuals in each DOT that can provide more information.

Alternate Route Plan Documents

The first question in the survey asks whether the DOT has emergency alternate route plans for their freeways, followed by a set of questions about the content and format of the alternate route plan documents. Only three states (Arkansas, Mississippi, and Washington) responded “no” to the first question. Most of the other states indicated that alternate route plans had been prepared for at least some of their freeway segments. However, only three states (Kentucky, Missouri, and Virginia) provided copies of plan documents.

The remaining states indicated that their “district” or “division” offices (generally comparable to TDOT’s “regions”) have primary responsibility for alternate route plans. Copies of example plans were requested from district/division officials in Alabama, Georgia, and North Carolina, but none were received.

The NCDOT reported that alternate route plans have been prepared for a number of freeway segments. However, the department is reluctant to post the plans on the web or otherwise make them public because the plans include sensitive information, such as cell and home phone numbers. NCDOT has had internal discussion about developing a GIS system combined with VPN software to make alternate route information available only to emergency responders. NCDOT reported that their plans were prepared by interagency (state and local) task forces.

Of the three states that provided documents, only the Kentucky Transportation Cabinet (KYTC) has alternate route plans for their entire freeway system. The Missouri and Virginia DOTs have alternate routes plans for some of their freeway segments. The KYTC plans are available online, and examples from Missouri and Virginia are included in Appendix D.

(Appendix D also includes several documents other than alternate route plans that may provide useful information for TDOT’s incident management program. For instance, Kentucky and Florida provided copies of their recent strategic plans for incident management. Both of these documents are similar to TDOT’s strategic plan for incident management.)

Kentucky

Kentucky’s segment-by-segment detour maps are available on-line at the following address: <http://128.163.152.205/Detour/WebPage/detourfront.pdf> . From the home page (Figure 1) users can select any route and then a particular route segment. The suggested detour route for that segment is then shown, as illustrated in Figure 2. The page for each segment also includes emergency response contact numbers.

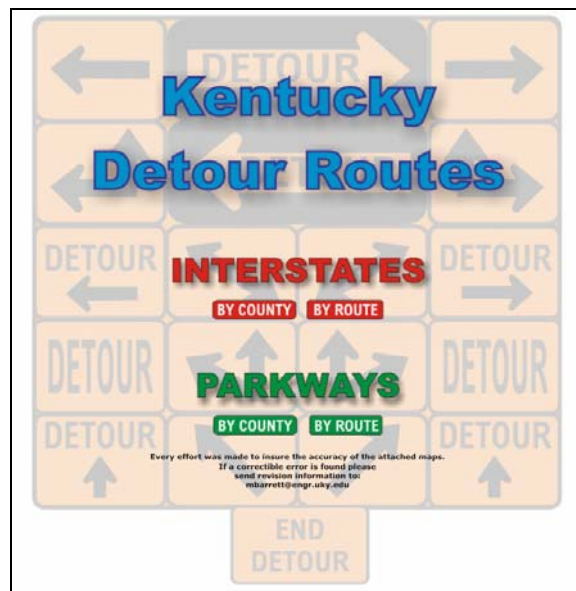


Figure 1. Home Page for Kentucky’s Alternate Route Maps

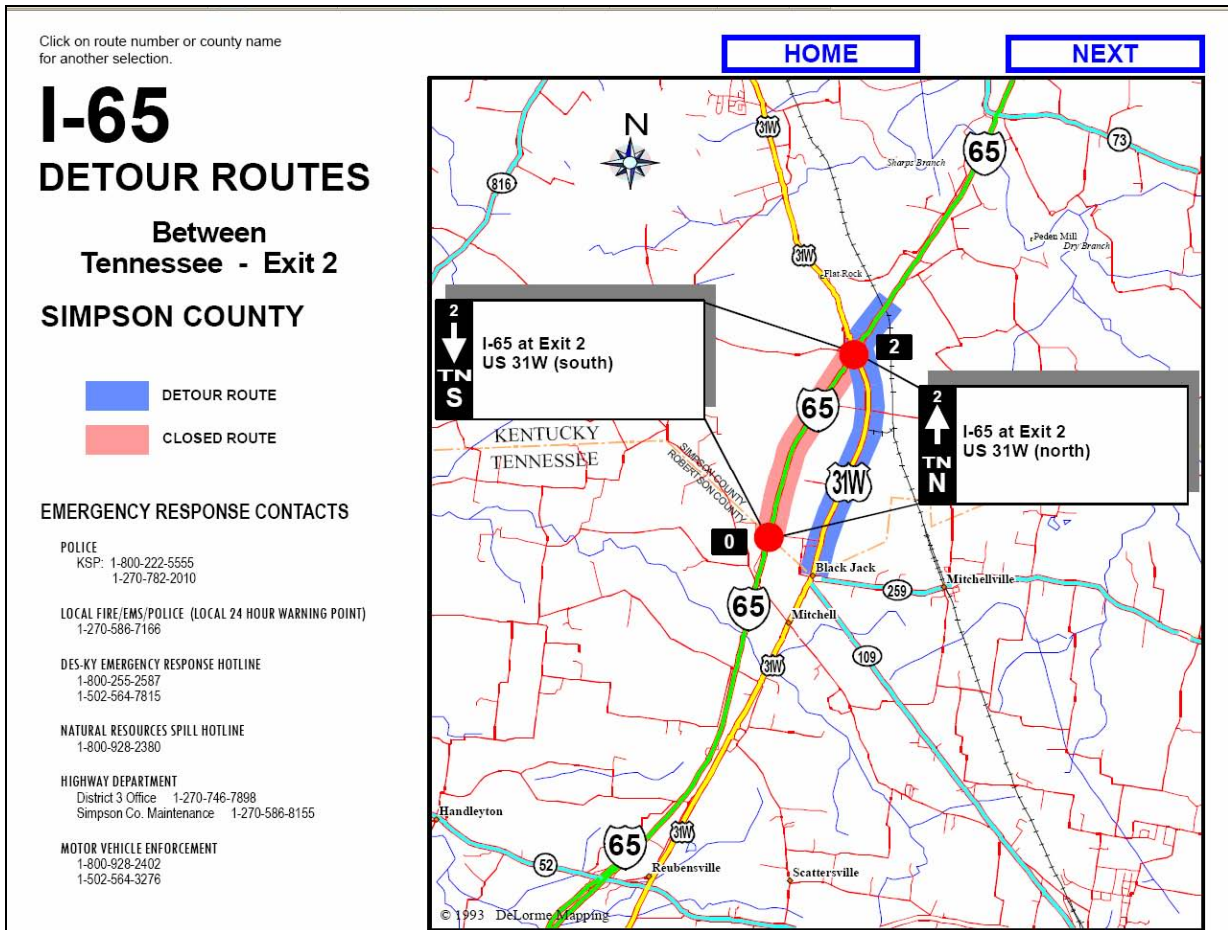


Figure 2. Sample Detour Map—I-65 from the TN State Line to Exit 2

Kentucky’s online system was developed by the Kentucky Transportation Center. The routes were suggested by the Center and then reviewed and revised as needed by the respective Department of Highways District Office.

Missouri

The Missouri DOT is working toward corridor-wide alternate route plans for the entire state, and alternate routes have already been designated for all of the I-70 corridor and for part of the I-44 corridor. Each District office is responsible for preparing plans through their district, and each District produces its own document.

The most extensive document provided by MoDOT is for 22 segments of I-44, covering 85 miles through four counties in MoDOT’s South Central District (District 9). Figure 3 illustrates the “Decision Matrix” for one segment of I-44, from Exit 140 to Exit 145. Figure 4 is the diversion plan for that same segment, and Figure 5 is the alternate route map.

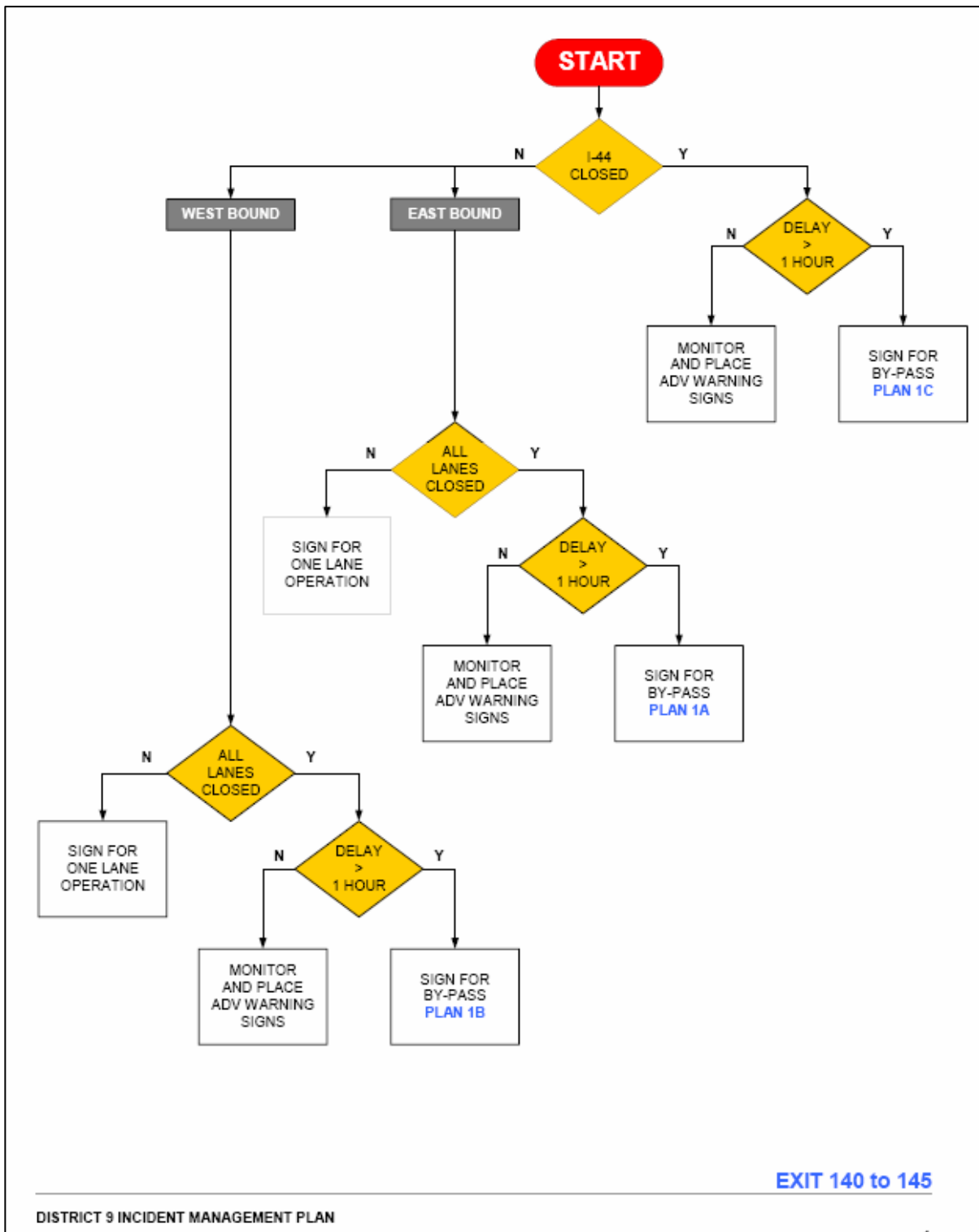
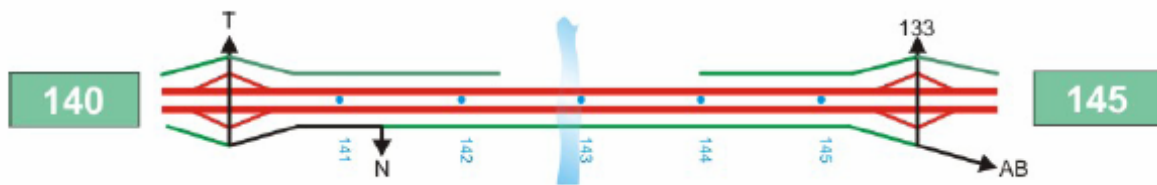


Figure 3. Example of “Decision Tree” for Freeway Segment (Exit 140 to Exit 145) from Missouri DOT



SITUATION

- All eastbound lanes of I-44 are closed between Route T & N (Exit 140) and Route 133 & AB (Exit 145)
- Traffic delays are expected to exceed one hour. (See note below)
- All westbound lanes are open to traffic.

ALTERNATE ROUTE

- ALT-1E Eastbound traffic exit at Route T & N (Exit 140), turn right and go east on South Outer Road for approximately 6 miles to I-44 (Exit 145.) (See Alternate Route Map, Figure 1)
 - Total bypass length 6 miles.

CAUTION: 14'-9" CLEARANCE ON OUTER ROAD BRIDGE

SIGNING

- MAINLINE
 - ALT-1E
 - Place road closed signs, barrels and barricade on I-44 at Exit 140
 - Close Exit 140 eastbound on-ramp
 - Place incident management signs (*Accident Ahead*) and/or (*Be Prepared To Stop*) at mile markers 136,137,138,139.
- ALTERNATE ROUTE
 - ALT-1E
 - Place (*ALT 44*) sign at top of exit ramp 140 with directional arrow pointing right.
 - Place (*ALT 44*) sign at Route N & South Outer Road (west) junction with directional arrow pointing left.
 - Place (*ALT 44*) sign at Route N & South Outer Road junction with directional arrow pointing up.
 - Place (*ALT 44*) sign at Route AB & South Outer Road junction with directional arrow pointing left.

CHANGEABLE MESSAGE BOARDS

- ALT-1E
 - LOCATION – Eastbound at Mile Marker 127
 - ACCIDENT / 13 MILES / AHEAD
 - X HOUR / DELAY / EXPECTED
 - LOCATION – Eastbound at Mile Marker 134
 - ACCIDENT / 6 MILES / AHEAD
 - X HOUR / DELAY / EXPECTED
 - LOCATION – Eastbound at Mile Marker 139
 - I-44 / CLOSED / AHEAD
 - USE / ALT I-44 / EXIT 140

Note: Delay time is estimated at 15 minutes per mile (duel lanes) of vehicles backed up.

EXIT 140 to 145

Figure 4. Example of Alternate Route Sketch and Diversion Plans form Missouri DOT

ALTERNATE ROUTE MAP

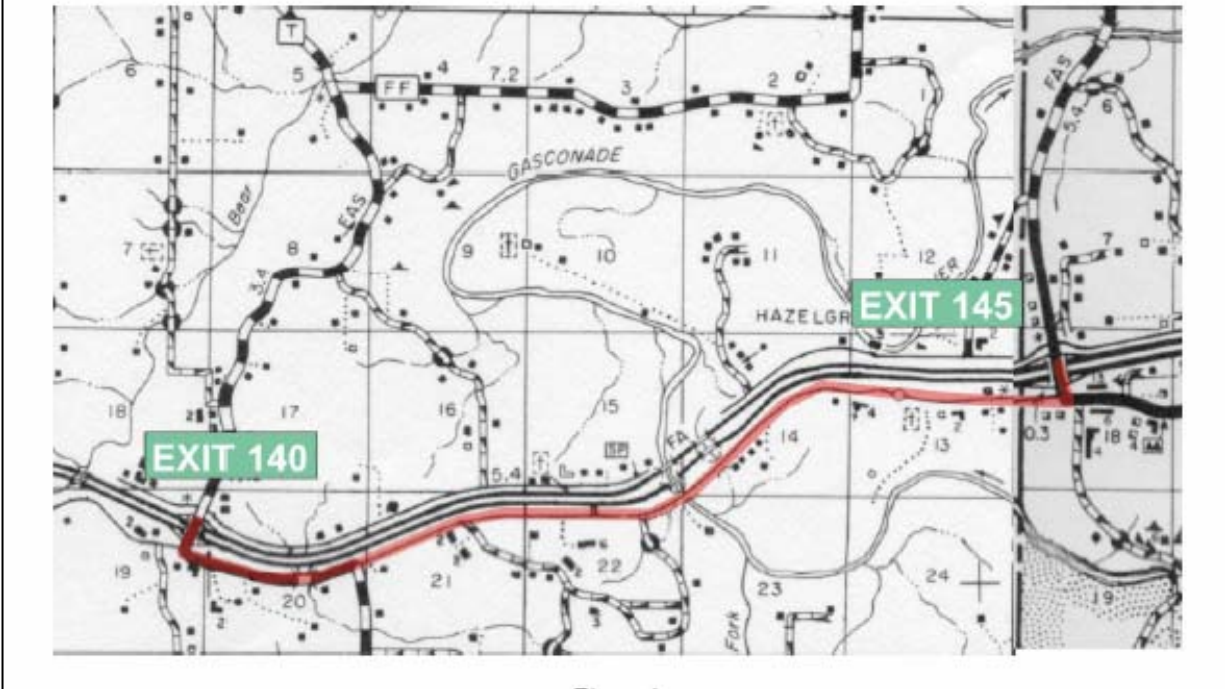


Figure 5. Example of Alternate Route Map from Missouri DOT's Alternate Route Plan for I-44 in District 9

The I-44 plan is not just for incident management. The I-44 document in Appendix D includes information on traffic volumes and predicted queue lengths under different scenarios. The information can be useful for incident management, but the primary use is to decide whether to allow lane closures for construction /maintenance projects.

MoDOT also provided for TDOT a copy of their alternate route plans for the complete I-70 corridor. While this plan covers the entire corridor (from Exit 1 in Kansas City to Exit 249 in St. Louis), it does not provide the same level of detail as the I-44 plan for District 9. The I-70 plan contains only written descriptions of the "detour" routes for each Interstate segment without the "decision matrix," maps, or extensive traffic and accident data. In some cases "Primary" and "Secondary" routes are identified in the I-70 plan. Also, opportunities to use Changeable Message Signs (CMS) are identified.

Figure 6 is an excerpt from the I-70 plan for one county in one district. This excerpt illustrates the CMS notation and the identification of a situation where the "Primary" detour routes is different for cars and trucks.

I-70 Corridor Alternate Route Plan - WESTBOUND

District 5 - Callaway County

Incident between Exit 161 (Rt. YY) and Exit 155 (Rt. A/Z)

Primary Detour Route: Exit Rt. A North to Old 40 to Rt. YY

Incident between Exit 155 (Rt. A/Z) and Exit 148 (Rt. 54)

Primary Detour Route: Exit 155 (Rt. Z) South to Old 40 West to Rt. 54

150WBD5 - CMS Before Rte 54 (Exit 148) (Ver-Mac)

Incident between Exit 148 (Rt. 54) and Exit 144 (Rt. M)

Primary Detour Route **for Cars ONLY (due to Low Clearance)**: Exit 144 (Rt. M), to Old 40 to Rt. 54

Primary Detour Route **for Trucks**: Exit 148 (Rt. 54), South to Rt. 63, North to I-70

Incident between Exit 144 (Rt. M) and Exit 137 (Rt. J/DD)

No direct connection.

Primary Detour Route: Exit 128 (Rt. 63), South to Rt. 54 North

Figure 6. Excerpt from MoDOT's I-70 Corridor Alternate Route Plan

Virginia

The Virginia DOT provided for TDOT a copy of the Interstate Diversion Plan (IDP) for the Hampton Roads area. The introduction to the IDP explains its purpose this way:

Interstate Division Plan is needed in order to:

1. Minimize congestion and delay
2. Reduce the risk of secondary crashes
3. Provide the best delivery of customer service and overall quality of life

The VDOT plan also provides information for each freeway segment (referred to in the VDOT Plan as "sections"). Figure 7 is an excerpt from the VDOT plan. Figure 8 is the map associated with the same section. The example shown here (Section 2, Southside I-264) is a relatively simple situation. Many of the sections in the Hampton Roads area are more complex, and the VDOT document in Appendix D includes several sections with two or more alternate routes.

INTERSTATE DIVERSION PLAN (SOUTHSIDE I-264)

SECTION 2

I-264 between exit 2 (Greenwood Dr.) & exit 3 (Rte. 239, Victory Blvd.)

RESOURCES TO BE DEPLOYED TO ASSIST IN TRAFFIC CONTROL

Deployment:

- Portsmouth City local police
- Portsmouth City public works
- Portsmouth City traffic engineers
- Crash Cushion Vehicles (VDOT)
- Freeway Incident Response Team (VDOT)
- Va. State Police

MESSAGE SIGN AVAILABLE

VMS:

There are a few VMS (I-664 SB MMBT, I-664 SB, Rte. 58 Suffolk, & I-64 WB Shell Rd) in the area to warn motorists of the incident.

Message (I-664 SB MMBT, I-664 SB, Rte. 58 Suffolk & I-64 WB Shell Rd VMS):

"I-264 EB I BLOCKED AT I GREENWOOD DR" (1st Frame)

"EXPECT I DELAYS" OR "FOLLOW I DETOUR I AHEAD" (2nd Frame)

LOCAL POLICE NEEDED

Suggested location:

Portsmouth City police should be stationed along Rte. 58/460 (Airline Blvd), Rte. 239 (Victory Blvd), & Greenwood Dr.

ANALYSIS

WB:

VDOT along with the Portsmouth City police can re-route traffic off WB I-264 by using exit 3, which is Rte. 239 (Victory Blvd). Motorists will continue on Rte. 239 for about 1/2 mile and make a left onto Rte. 58/460 (Airline Blvd). Motorists will travel along Rte. 58/460 for 1 1/2 miles and make a left onto Greenwood Dr. Motorists will travel along Greenwood Dr. for 1/2 mile and take the 1st exit before crossing I-264, which leads onto WB I-264.

EB:

VDOT along with the Portsmouth City police can re-route traffic off EB I-264 by using exit 2A, which is Greenwood Dr. Motorists will continue on Greenwood Dr. for 1/2 mile and make a right onto Rte. 58/460 (Airline Blvd). Motorists will continue on Rte. 58/460 for approximately 1 1/2 miles and make a right onto Rte. 239 (Victory Blvd). Motorists will travel on Rte. 239 for less than 1/2 mile and make a left at the 1st exit after crossing I-264, which leads onto EB I-264.

Figure 7. Text Excerpt from VDOT's Interstate Diversion Plan (IDP), Hampton Roads

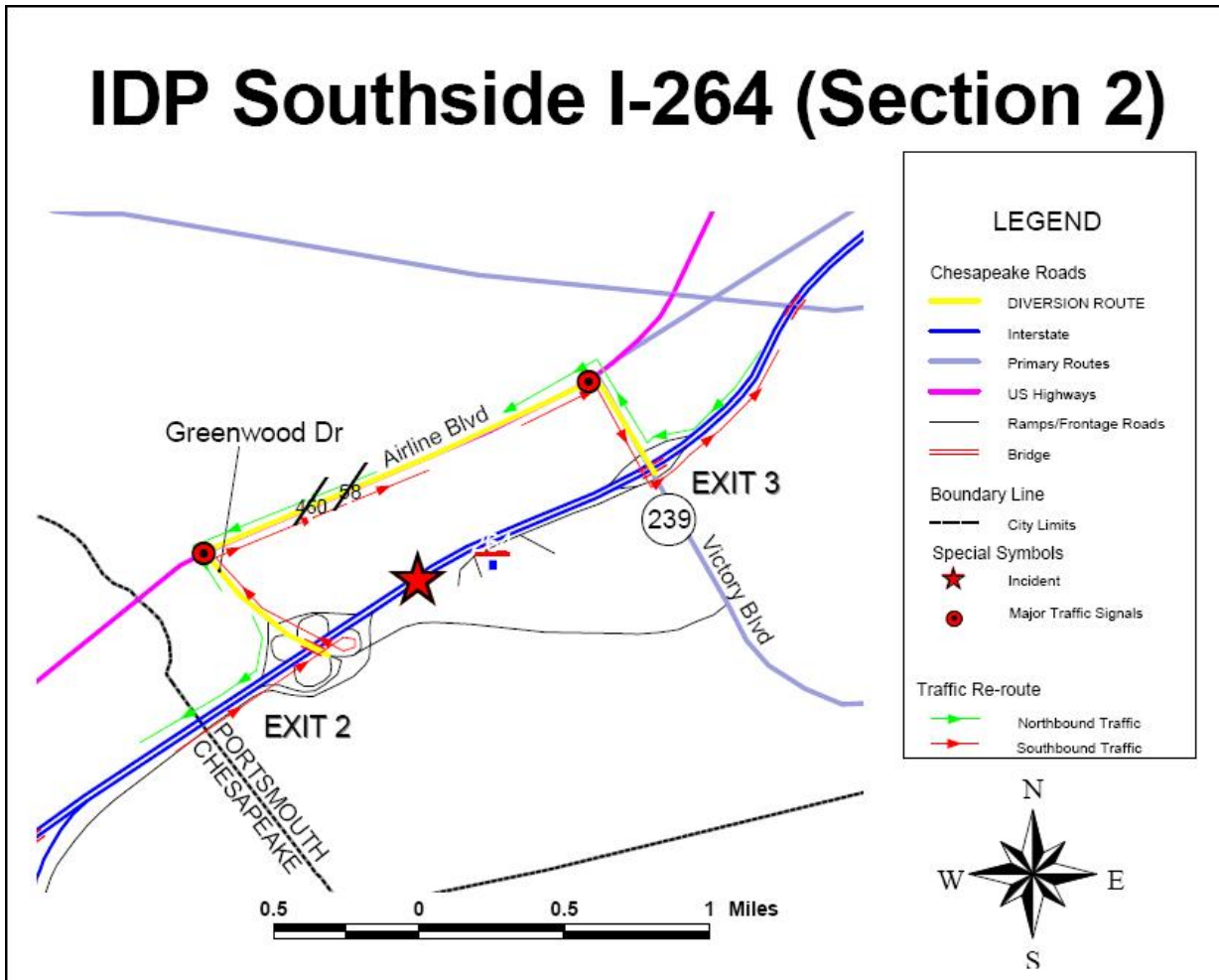


Figure 8. Map Excerpt from VDOT's Interstate Diversion Plan (IDP), Hampton Roads

Self-Assessment of Strengths and Weaknesses

All of the states were asked the following questions regarding their alternate route plans:

Relative to the format and content of your plan documents, what do you see as the best/most useful features?

Relative to the format and content of your plan documents, what do you see as the major weaknesses (i.e., what would you like to add, delete, or change)?

The responses to these questions from the Kentucky, Missouri, and Virginia DOTs are compared in Table 2.

DOT	Best/Most Useful Features	Weaknesses
Kentucky	Clear detour route maps and emergency contact numbers for the specific area	Lack of operational planning and implementation plans in the case of detour route activation
Missouri	Decision matrix	No plan for widespread closure that would impact the main line as well as the alternate routes (primarily outer roadways)
Virginia	The fact it is preplanned	Incident management should be higher on the priority list and noted as a major element in traffic management

Table 2. Self-Evaluation of Alternate Route Plan Format and Content

Alternate Route Planning Process

The second set of questions in the survey addressed the “Alternate Route Planning Process.” However, none of responding DOTs indicated that their department had anything in writing to describe their alternate route planning process, and no formal planning processes were identified regardless of whether documentation was available.

In the states other than Kentucky, the lead responsibility for planning was with the district/division offices, and most of the responses mentioned coordination with law enforcement and local agencies. In Kentucky, the Kentucky Transportation Center (University of Kentucky) seems to be the lead agency for alternate route planning.

None of the states have processes in place to update their alternate route plans. Several of the DOTs, however, expressed a need for such processes. South Carolina’s planning process for alternate routes, is “under development,” and, in response to the question about procedures for “routine updates,” SCDOT stated that “...we will have these procedures.”

Another process-related question asked whether planning for alternate routes was linked to other state, local, or regional planning processes (e.g., long-range planning, safety planning, all-hazards emergency management planning)? The only clear “yes” was from the Virginia DOT (VDOT).

Another process question asked about criteria for selecting or rejecting an emergency alternate route. Several of the DOTs listed roadway features (e.g., route capacity, turning radius, bridge restrictions), but none offered any specific, quantified criteria. None mentioned compatibility with adjacent land uses or other community impacts, although MoDOT

responded simply “local decision.” Two of the states (Virginia and South Carolina) mentioned the ability of the route to accommodate truck traffic.

The final question in this section asked for perceived strengths and weaknesses of the planning processes for emergency alternate routes. Four of the DOTs responded:

Kentucky: Need to develop ongoing, comprehensive planning process.

Missouri: Lack of experience with alternate routing. Strengths/weaknesses not identifiable.

Virginia: Strength: Dedication of those involved and the cooperation from other agencies. Weakness: Time and manpower to accomplish task.

South Carolina: Time and personnel assets to prepare the plan.

Execution of Emergency Diversions

The next set of questions in the survey related to the execution of emergency diversions. Overall, the responding DOTs seem to view their roles as secondary to other agencies, except for using DOT traffic management/operations center to gather and disseminate information to motorists. Several of the DOTs refer to their roles in executing diversions with terms such “supporting law enforcement,” “traffic control,” and “signing.” According to the response, none of the DOTs have written procedures for implementing diversions or for deciding to suspend or discontinue a diversion.

Several questions were included to search for innovative practices, with limited success. None of the DOTs reported any special provisions to deal with secondary crashes during diversions (#33). None are using freeway “fence cuts” or other creative measures to expedite emergency response (other than special gates for bridges/tunnels) (#34). No special measures were identified to expedite clearance when a freeway diversion is required (#35)

Perhaps the most direct question in this section was the following:

How useful have your alternate route plans been during actual emergency diversions?
What lessons have you learned that might be helpful in Tennessee? (#37)

Five DOTs responded, as follows:

Kentucky: Our detour routes quickly become overburdened because we have no comprehensive plan involving local resources to maximize the movement of traffic.

Mississippi: Contra-flow for hurricane evacuation has worked very well

Missouri: Not much experience

South Carolina: They are very useful in communication. Everyone responding is “on the same page” as far as traffic management of the event. Plan ahead. Developing an

alternate route during an event is not as effective due to the communication with other agencies and the public.

Virginia: Very useful in the fact that the preparation made you think of what all the possibilities are. The actual incident never follows a script.

The eight DOTs in adjacent states were asked several questions about operational coordination with Tennessee during events that impact both states. Most of the responses were very general, perhaps because the individuals responding to the survey are not usually involved in the hands-on management of such incidents. In a few cases, the responding DOT seemed not to have current information about TDOT.

Several of the DOTs indicated that “after action” meetings were held following major closures, but an equal number stated that such meetings were not held or were very infrequent. Only a few responded that the results of such meetings are documented. None were aware of any reports being distributed. None were able to provide copies of meeting agendas or findings. However, VDOT indicated that they have a standard Powerpoint format to guide such meetings, and a copy is included in Appendix D.

In three states (Georgia, Kentucky, and Virginia), the responses imply that operational coordination within the DOT is carried out in two parallel paths, one focused on the statewide or regional traffic management/operations centers and the other focused on the local district/division personnel that provide on-scene support. The implication for those three states is that TDOT needs to communicate with both the TMC/TOC and the district/division offices.

Only two DOTs (VDOT and MoDOT) offered specific suggestions to improve coordination with Tennessee. VDOT suggested more frequent meetings and table top exercises involving the two states. MoDOT suggested joint planning with TN, IL, KY and AR.

In retrospect, additional questions should have been considered for this section to probe the actual use of alternate route plans during emergency diversions. Except for the direct question (#37), only one of the state DOTs even mentioned alternate route plans in response to the questions in this section. In response to the question about “usual responsibilities in executing emergency diversions,” South Carolina answered “preparing the plan and implementing through ITS elements.” Otherwise, the responses to this set of questions do not offer much insight on the effectiveness of alternate route plans or of specific features of the plans.

Signing
Laws, Regulations, and Procedures
Roadway Features
Interagency Coordination
Other

Another 21 questions were asked, under the five headings shown above. Most of these questions were to search for innovative practices that might have application in Tennessee or to determine if other states have experience with practices being considered by TDOT. Unfortunately, only a few innovates were discovered. Overall, the responses indicate that TDOT's current practices are state-of-the-art among the surveyed states.

Two of the other DOTs provided examples of alternate route signing. Figure 9 is an example of permanently-installed evacuation signs used by the Arkansas Highway and Transportation Department (AHTD) for the Chemical Stockpile Emergency Preparedness Program (CSEPP). The sign is consistent with the Manual on Uniform Traffic Control Devices (MUTCD) (sign code EM-1). (Similar signs are used in Tennessee for nuclear plan evacuation routes.)



Figure 9. AHTD Sign

The NCDOT indicated that alternate route trailblazing signs had become a problem. Permanent signs were put up for detours, but people complained because the trailblazing signs looked like regular directional signs, and motorists were following the long detours needlessly when exiting gas stations and other service locations to get back to the interstate.

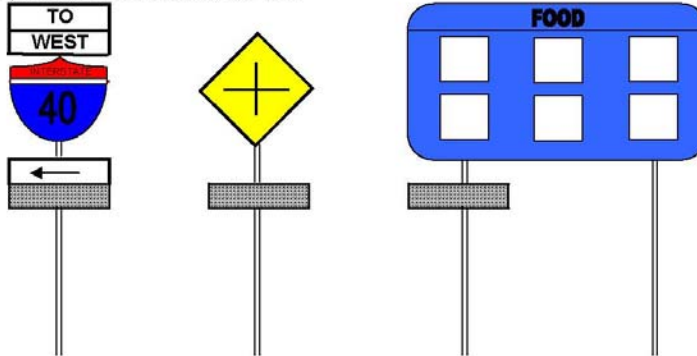
NCDOT plans are for future trailblazing signs to use flip-down directional arrows incorporating the “florescent pink” color designated in the MUTCD for incident management purposes. (For MUTCD examples: http://mutcd.fhwa.dot.gov/HTM/2003r1/part6/fig6i-01_longdesc.htm) Figures 10 and 11 are from NCDOT, showing how trailblazing and other signs will be used to support a freeway diversion as part of incident management.

Several of the states seem to be more aggressive than TDOT in the use of DMSs to support incident management. Kentucky and Virginia have installed DMSs just inside their respective state borders (or in Tennessee) to provide travel information for motorists entering their respective states. (TDOT has installed cameras and signs in Arkansas.) Also, Kentucky reported having approximately 150 portable DMSs to support incident management statewide.

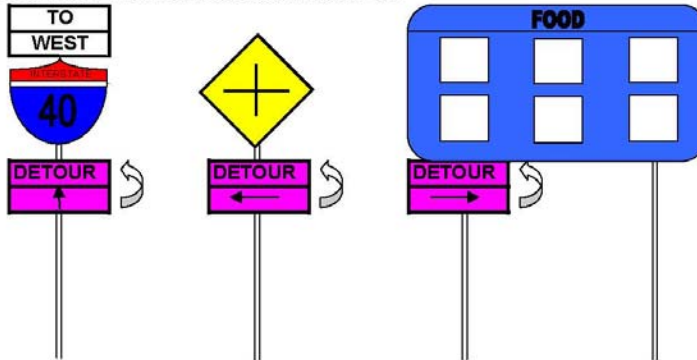
Several of the DOTs noted that some local of their local governments have installed detour signs. Metro Lexington (KY), for instance, has installed flip-down signs. Several of the DOTs also reported the use of permanent signs for hurricane and nuclear plant evacuations and bridge emergencies. Washington State also has evacuation signs for tsunamis.

DETOUR ROUTE TEMPORARY TRAFFIC CONTROL DURING INCIDENTS

ORIGINAL, UNFLIPPED SIGN EXAMPLES



SIGNS IN FLIPPED POSITION DURING AN INCIDENT



PORTABLE SIGNS IN ADVANCE OF THE INCIDENT

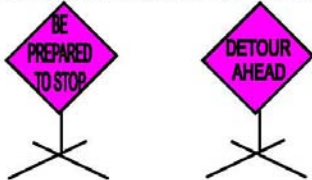


Figure 10. NCDOT Signs for Detour Route Temporary Traffic Control During Incidents

EXAMPLE OF DETOUR ROUTE SIGNING

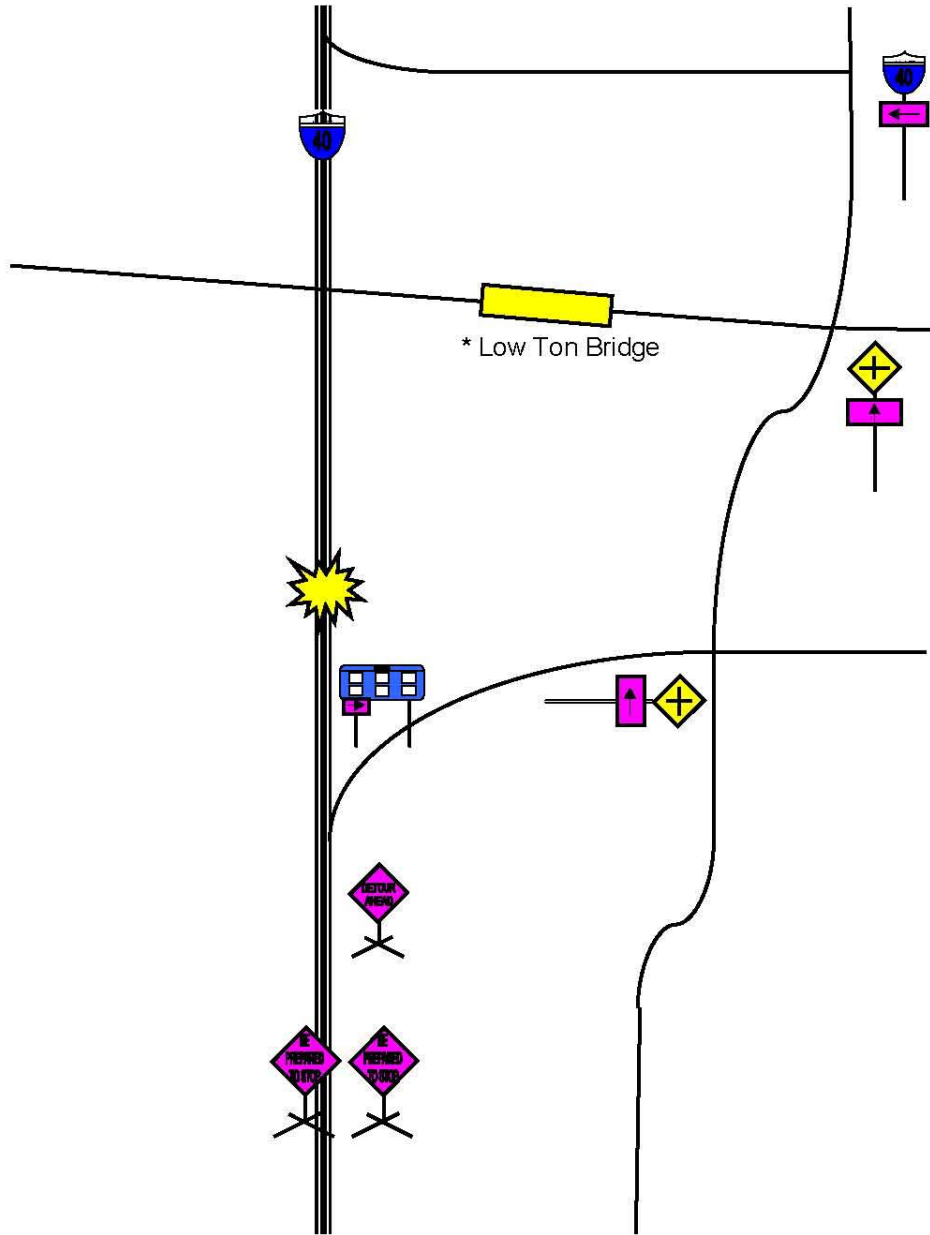


Figure 11. NCDOT Example of Detour Route Signing

The survey did not discover any unique legislation or regulations related to incident management or emergency alternate routes (#47 and #48). However, MoDOT provided a summary of Missouri state laws, entitled “Missouri State Laws Related to Traffic Incident Management, Clearance, and Hazardous Substance Cleanup. (See Appendix D).

All of the states that responded to the question about towing and recovery (#49) seem to use a “rotation list.” Several of the respondents referred to the need for the selected company to be nearby and to have the capability to deal with the situation. Virginia has a new “Tow Board” with statewide jurisdiction, and TDOT may want to investigate further.

Most of the responses to the question about spills from fuel tanks (#50) were incomplete. The Mississippi DOT reported that spills less than 50 gallons are cleaned up by the DOT. Washington State IR trucks are equipped with pumps and holding tanks for spilled fuel. The SC DOT reported that anything over 15 gallons is considered a hazard.

The only special roadway features for incident management identified by the survey were contra-flow lanes, gates for access to tunnels and bridges, and emergency pullovers. South Carolina reported that some routes parallel to freeways have signal systems where signal timing can be adjusted to help with diverted traffic.

None of the DOTs reported any standard procedures to fund (or advance the priority of) needed improvements on alternate routes to better accommodate emergency diversion of freeway traffic. Several indicated that such considerations are introduced in the planning and programming processes as part of local input.

The interagency coordination questions did not yield any significant findings or suggestions. No state-to-state MOUs were identified. (#54) Several states mentioned initiatives to improve radio communication.

Responses to the “other” group of questions also failed to uncover any practices that are much different from Tennessee’s. No unique training aids, case studies, drills or exercises were identified. Also, none of the respondents were able to provide records or data on the frequency of freeway closures, durations, or any related information (#61).

Final Questions

The final group of four questions asked the DOTs to:

- Identify any perceived “best practices” in their department relative to “incident management, emergency operations, and alternate routes”
- Describe any of their department’s planned enhancements or changes
- Identify any “best practices” in other states that might be helpful to Tennessee
- Describe any successes their department may have experienced relative to interstate coordination

The responses are shown below:

Alabama

We have developed and applied a reverse lane operation along I-65 from Montgomery to Mobile during hurricane evacuation events. We can provide more information if needed.

Georgia

Georgia's Traffic Incident Management Enhancement (TIME) Task Force and our Highway Emergency Response Operations (HERO) Program are definitely "best practices". For more info on TIME, please visit our website at:

<http://www.timetaskforce.com/>

Iowa

Best practice: Arrange for the local city and county public works department representatives, applicable law enforcement personnel for the area and Iowa DOT personnel to meet and discuss the need for pre-planned detours. It will happen if all of the stakeholders see how it helps them.

Kentucky

The Kentucky Transportation Center at the University of Kentucky developed several years ago a highway incident management crash site training program and checklist. They have conducted numerous classes with local first responders and have issued many checklists which are formatted to be used on-site. The response from the participants has been very positive.

The Kentucky Transportation Operations Center recently was co-located with Kentucky's Homeland Security Fusion Center. The center allows for the sharing of transportation operational and intelligence operational and criminal intelligence information.

We are considering improving the capabilities of our District Offices as they relate to incident management. We need to be in a better position to provide highway condition and activity information and to better respond to incidents.

(In response to a previous question (#45), Kentucky reported the following: We have initiated a freeway service patrol on portions of our Interstate system. We have plans to cover all our Interstate mileage with this service in the next two years. Part of the service patrol vehicle operators' duties are to report incidents to the Transportation Operations Center and to provide support with traffic control.)

We have had relatively good success with Indiana and Ohio as they are our partners with the freeway management systems operating in the Louisville and Northern Kentucky/Cincinnati metro areas, respectively. We have also had success in working with Tennessee in our efforts to handle events on I-65 and I-75.

Mississippi

MDOT did not respond to these questions. However, lessons learned from MDOT's experiences with Hurricane Katrina could be useful for TDOT. (See the presentation by Todd Jordan, Assistant District Engineer, District 6 (Hattiesburg), MDOT at the 2006 Tennessee Highway Safety and Incident Management Conference.).

Missouri

Corridor wide incident management programming (I-70 and I-44 Corridors)

South Carolina

Cooperation and training between SCDOT and the SC Highway Patrol.

You may want to consult with North Carolina and Florida Turnpike.

Good cooperative effort in the (interstate) planning activities we have engaged in to date.

Virginia

Best practice: Traveler information through VOIS and 511. (VOIS is the Virginia Operations Information System which distributes transportation information to all emergency and operation agencies within the commonwealth.)

Best practice: 24/7 Emergency Operations Center and traveler information. Our smart traffic centers provide excellent support for our traffic incidents. Variable message signs provide a great tool for notifying the public of incidents. Our cameras and safety service patrols provide for excellent quick detection and response which leads to quick clearance.

Enhancements: VOIS II. Enhancements to 511. Will be providing in depth training course on highway incident management. Attempting to build more area committees for incident management. Exploring further CAD integration for VOIS and 511 from localities.

Coordination with other states: 24/7 Emergency Operations Center and traveler information. Our smart traffic centers provide excellent support for our traffic incidents. Variable message signs provide a great tool for notifying the public of incidents. Our cameras and safety service patrols provide for excellent quick detection and response which leads to quick clearance.

We have established communications with Tennessee's agencies through our incident management team in Bristol and our preparations for traffic control during NASCAR events that occur twice a year in Bristol Tennessee.

Washington

Nothing related to alternative routes. However, we have some innovative practices for our IR program

We are working on alternative route planning for the interstate routes in the Tacoma and Spokane areas.

Our State Emergency Management Division may be better able to address interstate coordination and cooperation <http://emd.wa.gov/>

Organizational Arrangements

The survey results also offer some insight on a topic that was addressed only indirectly by the survey questions—the assignment of organizational responsibilities for incident management within state DOTs. Each of the DOTs was asked to identify the appropriate contact person for each of the following purposes:

1. General follow-up on the survey
2. Information about statewide incident management policies, procedures, and practices
3. Information about statewide alternate route planning
4. Information about alternate route planning in the county(ies) adjacent to Tennessee
5. Operational planning and coordination of highway incident management activities in the county(ies) adjacent to Tennessee
6. Emergency contact in your state for incidents (e.g., backups, closures, detours) in Tennessee that are about to impact your roadways

The results are shown in Appendix A. Many different factors could account for the apparent differences among the DOTs. However, the variations are at least noteworthy and are consistent with the idea that many DOTs are searching for the most effective ways of assigning responsibility for incident management, emergency operations, ITS, and other “new” operational responsibilities.

The responses from each of the eight adjacent states are summarized in Table 3, showing the title of the individual or unit designated for each category of information. The designated “general follow up” contacts were almost all the same as the person/unit that responded to the survey. That person was, or was designated by, the person who is the respective DOT’s representative on the AASHTO Subcommittee on Systems Operations and Management.

Of these eight designated contacts for general information, two are located in “Maintenance” units, two in “ITS” or “Traffic Operations” units, and two in “Incident Management” units. Kentucky identified two units that share the responsibility. The breakdown by state:

- Maintenance (Alabama, Arkansas)
- ITS/Traffic Operations (Georgia, North Carolina)
- Incident Management (Missouri, Virginia)
- Other (Kentucky)

Table 3. Titles/Units Identified as Contacts for Additional Information Regarding Corridor Incident Management

	AL	AR	GA	KY	MS	MO	NC	VA
1. General follow-up on the survey	Asst. State Maintenance Engineer (Headquarters)	Staff Maintenance Engineer (Headquarters)	State Traffic Operations Engineer	Commissioner of Transportation Safety and Deputy State Highway Engineer	Maintenance Division (Headquarters)	Statewide Incident Response Coordinator, Traffic Division	State ITS Operations Engineer	Incident Management Program Mngr., Operations & Security Division
2. Information about statewide incident management policies, procedures, and practices	Location Engineer, Design Bureau	Staff Maintenance Engineer (Headquarters)	State Traffic Operations Engineer	Commissioner of Transportation Safety and Deputy State Highway Engineer	Maintenance Division (Headquarters)	Statewide Incident Response Coordinator, Traffic Division	Statewide Incident Management Engineer	Incident Management Program, Operations and Security Division
3. Information about statewide alternate route planning	Location Engineer, Design Bureau	Staff Maintenance Engineer (Headquarters)	Separately by each District Maintenance Engineer	Kentucky Transportation Center, ITS Research Engineer	Asst. State Traffic Engineer	District Maintenance Engineers	Statewide Incident Management Engineer	District Traffic Engineer, Bristol District
4. Information about alternate route planning in the county(ies) adjacent to Tennessee	Location Engineer, Design Bureau	District 1 Maintenance Engineer	District 6 Maintenance Engineer	Kentucky Transportation Center, ITS Research Engineer	Asst.State Traffic Engineer	District Maintenance Engineers	Deputy Division Traffic Engineers (Divisions 11, 13, & 14)	District Traffic Engineer, Bristol District
5. Operational planning and coordination of highway incident management activities in the county(ies) adjacent to Tennessee	Division 1 & 2 Maintenance Engineers	District 1 Maintenance Engineer	TMC Operations Manager and HERO Coordinator	District Branch Manager-Traffic (Districts 2, 3, & 11)	District 1 & 2 Maintenance Engineers	District Maintenance Engineers	Deputy Division Traffic Engineers (Divisions 11, 13, & 14)	Regional Operations Director, Salem District
6. Emergency contact in your state for incidents (e.g., backups, closures, detours) in Tennessee that are about to impact your roadways	Division 1 & 2 Maintenance Engineers	Staff Maintenance Engineer, District Maintenance Engineer, and District Engineer	TMC or TMC Operations Manager	Same as above plus District Maintenance and the Kentucky Transportation Operations Center	District 1 & 2 Maintenance Engineers	District Maintenance Engineer, Southeast District	Deputy Division Traffic Engineers (Divisions 11, 13, & 14)	Traffic Center Operations Manager, Salem District

The Kentucky response identified both the Deputy State Highway Engineer and the Commissioner of Transportation Safety. In response to follow up questions, Kentucky explained that the Transportation Cabinet includes a new Department of Transportation Safety, and that unit now has the lead role for highway incident management. Relative responsibilities and new lines of communication are being developed.

For information about “statewide incident management policies, procedures and practices” (category #2), six of the eight states identified the same contact as for “general follow up on the survey.” The two exceptions were Alabama (ADOT) and North Carolina (NCDOT). ADOT identified the Location Engineer in the Design Bureau, rather than the Assistant State Maintenance Engineer. NCDOT identified the State Incident Management Engineer rather than the State ITS Operations Engineer, but both of those individuals are located in the same unit.

For information about “statewide alternate route planning” (category #3), five of the DOTs (in Alabama, Arkansas, Kentucky, Mississippi, and North Carolina) identified contacts at the headquarters level. Two others (in Missouri and Virginia) indicated that responsibility is so decentralized that each district would have to be contacted. In Kentucky, the identified contact was the Kentucky Transportation Center.

For information about “alternate route planning in the counties adjacent to Tennessee” (category #4) five of the DOTs identified a district/division maintenance or traffic engineer. ADOT and MDOT identified headquarters-level personnel (Location Engineer and Assistant State Traffic Engineer, respectively). Kentucky designated the Kentucky Transportation Center.

Most of the eight states identified their district/division offices as having operational responsibilities for incident management and immediate response in the counties adjacent to Tennessee (categories # 5 and #6). In four cases, the district/division maintenance engineer is the recommended contact person. In North Carolina, the Deputy Division Traffic Engineer is the designated contact.

In Georgia, Kentucky, and Virginia, the respective traffic management/operations center was identified as the contact. In all three of those cases, however, the DOTs indicated that others in their departments (maintenance and/or traffic engineering) would also have responsibilities for operational matters and immediate response in the counties adjacent to Tennessee.

Closing

For the purposes of the Corridor Incident Management (CIM) project, the most immediately useful results of the survey are probably the route maps and documents obtained from other states to provide ideas and examples for TDOT. The maps and plans from Kentucky, Missouri, Virginia (and the previously provided CDs from Wisconsin) illustrate different content and format (and different requirements for resources, e.g., software, skills, time) that TDOT would need to produce similar products. The other documents in Appendix D may generate ideas for information systems, analyses and display of traffic data, operating procedures, guidelines, and other operational considerations.

Another benefit of the survey results is to confirm some key assumptions of the CIM project, including:

- Involving other state and local stakeholders in the planning process is crucial to success
- The process of planning and coordination is as important as the end product
- Producing alternate route maps without giving at least equal attention to operational aspects will be of limited benefit
- The CIM tools and procedures need to be flexible. Each freeway segment has different physical characteristics and a different set of responders with different resources and procedures; and, as stated by VDOT, “actual incidents never follow a script”
- Detouring freeway traffic to other routes should be a last resort. The priority should be on quick clearance rather than diverting freeway traffic to alternate routes

Overall, the survey results indicate that TDOT’s incident management program is at least as comprehensive and progressive as the other DOTs, and TDOT seems to be on a similar course as the other departments in planning for emergency alternate routes.

The survey results also point to two factors that may need more attention in the CIM project than has been given to date. First, procedures for routine updates should be an integral part of the CIM system. Decisions about what to include in the system should weigh the costs and difficulties of updating. The CIM tools and procedures should allow simple and straightforward updating. Expectations and responsibilities for routine updates should be clearly defined.

Second, the long-term CIM goals should include plans for entire corridors, and those plans should address the statewide needs and responsibilities of state agencies such as TDOT, THP, and TEMA. The CIM project is focused on the county level, which still seems appropriate because so many of the response capabilities (e.g., 911, sheriff, EMS, rescue squad, EMA) are organized on a county basis. Of course, adjacent counties need to coordinate their plans and processes. But, over the long term, plans need to cover entire corridors.

The survey revealed some specific initiatives in other states that may warrant TDOT’s further consideration, including:

- Virginia’s new statewide “Tow Board”
- Use of permanent DMSs at the state “gateways” (Kentucky and Virginia) and more extensive use of portable DMSs to support incident management (several states)
- The NCDOT’s use of flip-down “florescent pink” signs to trailblaze alternate routes

Also, the experiences of the other states with contra-flow crossovers and special crossovers for bridges and tunnels could be examined for possible application at critical locations such as major bridges (e.g., Mississippi River in Memphis, Tennessee River in West Tennessee) and locations with a history of slides, crashes, or other events that could be better managed using crossovers.

The survey results seem to rule out the selected states as benchmarks for several innovative practices being considered by TDOT, including possible “fence cuts” (or “over the fence” operations) for incident management, tracking the number and duration of freeway closures, more structured “after action” meetings, and state-to-state MOUs for incident management and emergency operations.

Finally, the survey results highlight the need for more interaction with the adjacent states to ensure effective incident management and emergency operations at the 15 Interstate highway border crossings identified in Table 1. No conflicts or disagreements with the adjacent states were identified, and most of the responses reflected willingness, in some cases eagerness, to work together.

However, none of the responses pointed to any specific actions, agreements, procedures or commitments to overcome the inherent difficulties of operating across state borders. Many of the responses reflected uncertainty about how communication and coordination occurs (or should occur) during an actual event. Some of the responses were vague about who TDOT should contact or indicated that TDOT might need to contact more than one unit within their DOT. Several of the responses seemed unsure of who should be contacted in Tennessee.

As noted in a previous section, some of the uncertainty may be because the person responding to the survey is not directly involved in operational response. Another likely reason is that some of the other DOTs have only a supporting role for incident management within their own state, and rely on other agencies to coordinate across the state line.

Regardless, TDOT seems to have opportunities to improve communication and coordination at these Interstate border crossings. In response to the survey, MoDOT and VDOT offered specific suggestions. While traffic volumes at Tennessee’s common borders with these two states are not as high as at other border crossings, these other two DOTs seem proactive in their approaches to incident management.

Finally, the contact lists in Appendix C includes detailed contact information (name, title, phone number, email address) for several people in each of the adjacent states. Hopefully this will prove to be a valuable source of information for TDOT’s ongoing efforts to improve incident management.

Appendix B

CIMQ Spreadsheet Instructions and Example Printouts

(Wilson County)

Corridor Incident Management Queue (CIMQ) Spreadsheet for I-40 and State Route 840 in Wilson County

The purpose of the CIMQ spreadsheet is to estimate the impacts of incidents and incident management practices on the traffic flow on I-40 and SR 840 and the associated delay costs for motorists and truckers. The spreadsheet uses data from TDOT's annual traffic counts coupled with assumptions about travel patterns, roadway capacities, and unit costs. The calculations to determine queue (backup) lengths, times required for traffic flows to return to normal, and vehicle hours of delay are based on a "deterministic queuing diagram" (Figure 1).

The spreadsheet includes seven different worksheets. The first three are interactive worksheets that quantify the adverse impacts of incidents on traffic flow, including the economic costs for highway users. The other worksheets contain supporting data for calculations.

The first three worksheets require user input to help calculate the traffic impacts and delay costs. The locations for user input (i.e., select from drop-down menus, enter numbers, or accept defaults) are highlighted in **green**. The calculated results are highlighted in **red**. Graphs are used to illustrate the calculated results. The three interactive worksheets are described below.

1stSheet (One Hour Closure)

The 1stSheet uses drop-down menus for the user to select (1) the freeway segment (between Exit # and Exit #), (2) direction of travel, (3) day of the week, and (4) month of the year. The worksheet then displays traffic data, calculates information about the numbers and types of vehicles, and displays the results by time period:

- Night-early morning (Midnight - 6 a.m.)
- Morning peak period (6 a.m. - 9 a.m.)
- Mid day (9 a.m. - 3 p.m.)
- Afternoon peak period (3 p.m. - 6 p.m.)
- Late afternoon-evening (6 p.m. - Midnight)

The 1stSheet also estimates the queue (backup) length for each time period for the first hour of total closure, assuming that no traffic backup existed at the beginning of the closure.

The locations for user input (select from drop-downs, enter numbers, or accept defaults) are highlighted in **green**. The calculated results are highlighted in **red**. Graphs are included to illustrate the calculated results.

2ndSheet (One Hour Closure, Peak Period, Variable Response Characteristics)

The 2ndSheet uses the same segment, direction of travel, day, and month as selected for the 1stSheet but focuses exclusively on the peak travel period (either morning or afternoon, whichever is greater). The first part of the 2ndSheet assumes the following incident scenario:

- Responders need 30 minutes to reach the scene, and the freeway is then closed completely for an hour. Then another 30 minutes are required before both lanes and the shoulders are fully open and all emergency vehicles have cleared the scene.

- The normal capacity of the roadway is 4,000 vehicles per hour (2,000 per lane). During the 30 minutes prior to the responders reaching the scene and during the 30 minutes of “cleanup” after the total closure, the reduced capacity is 1,000 vehicles per hour.

The worksheet then calculates and displays the times required for traffic flow to return to normal and the total time from incident occurrence to normal traffic flow. The worksheet also provides an estimate of the delays experienced by highway users and the costs of those delays. The costs are based on estimates of costs per vehicle per hour of delay. CIMQ users have the option of substituting different unit costs if the default values seem too high or too low.

The second part of the worksheet displays the results of different assumptions about response time, closure time, and cleanup time and different capacities that might result from better (or worse) scene management. For “Alternate 4,” CMIQ users can substitute their own assumptions and view the resulting changes in adverse impacts. Graphs are presented to illustrate key aspects of elapsed time, vehicles hours of delay, and user costs.

The locations for user input are highlighted in **green**. Calculated results are highlighted in **red**.

3rdSheet (User Selects All Variables)

The 3rdSheet allows worksheet users to change any or all of the variables and view the results, including estimated queue (backup) length over the entire period from incident occurrence to the return to normal traffic flow. Users can input values for the three time variables (i.e, time for responders to reach the scene, total closure time (if any), and “cleanup” time with responders still on scene).

The traffic volumes used in the equations are for the specific time period selected (night-early morning, morning peak, mid-day, etc.). For incidents that extend over longer time periods, users should examine the differences in estimated lengths for the overlapping time periods.

For the lowest traffic periods (e.g., night and early morning), the traffic demand may be so low that backups do not occur except during total closures. For those low-volume scenarios, the spreadsheet graphs and calculations are invalid, and an error message will appear.

The locations for user input are highlighted in **green**. Calculated results are highlighted in **red**.

Other Notes for Users

On most computer monitors, all of the “1stSheet” and the “3rdSheet” can be viewed on one screen with minimum scrolling, but users may have to adjust the “Zoom” and/or convert to “Full Screen” view. On the “2ndSheet,” users will have to scroll down to view all of the information.

For all three sheets, users should be able to print without adjusting the print area. Simply select “print” for each spreadsheet. The result will be two printed pages for each of the three spreadsheets. (A one-page option is also available. Select “Page Setup” and then “Fit to 1 page.” The 1st and 3rd spreadsheets should then be converted to “Landscape” before printing.)

Users who want to view the calculation formulas can “unprotect” the worksheets and then “unhide” all of the rows and columns. (Some of the calculations are behind the graphs.)

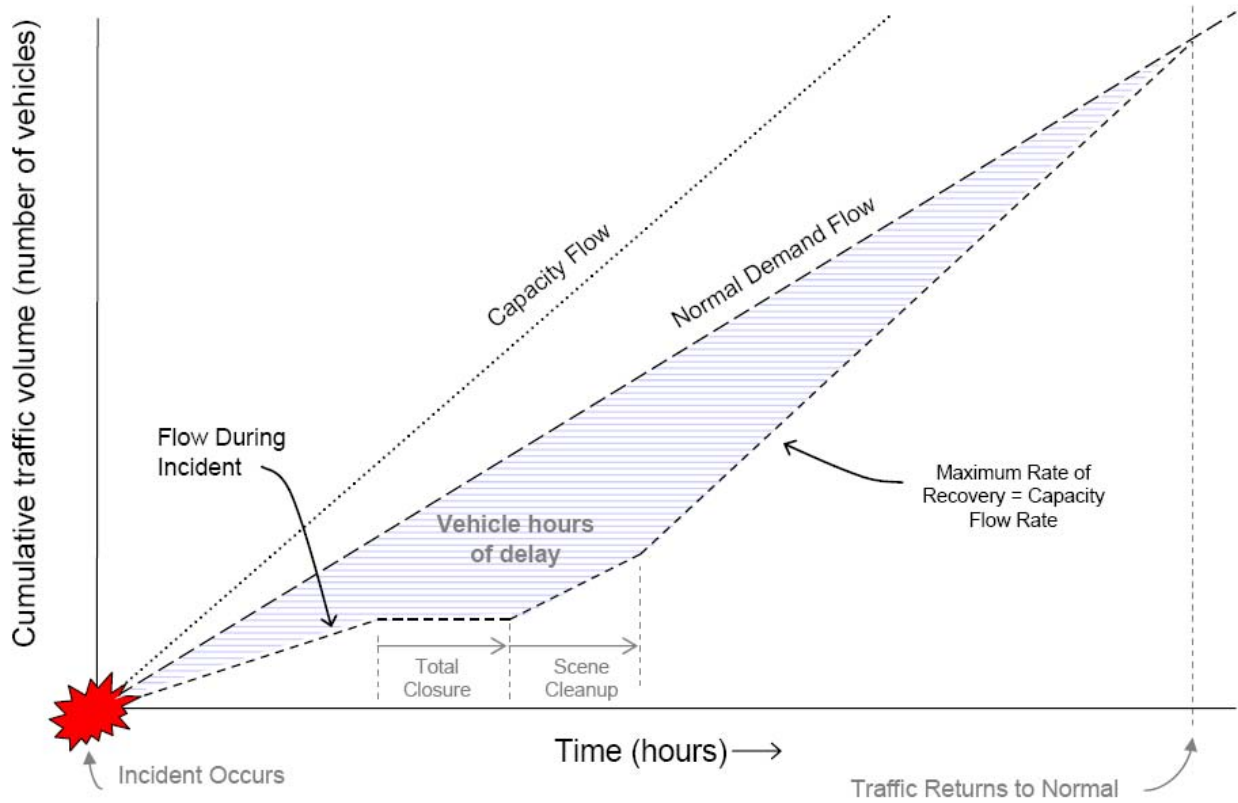


Figure 1. Deterministic Queuing Diagram

Assumptions and Limitations

CIMQ provides an objective and consistent method to quantify the adverse impacts of traffic incidents and to illustrate the results of different approaches to incident management. However, the spreadsheet relies on some simplifying assumptions, and the CIMQ estimates have not been tested or “calibrated” against actual incidents. Users should be cautious in relying solely on CIMQ to predict the results of a particular incident. Users should be aware of the assumptions described below.

Steady Flow

CIMQ assumes that the traffic demand does not change during the incident, i.e. that the number of vehicles attempting to use the freeway is steady from the time the incident occurs until traffic has returned to normal. However, during an actual incident some motorists, especially local motorists, may alter their travel depending on the availability of alternate routes and the dissemination of information about the incident (such as through “511”). Especially for longer incidents, the number of vehicles arriving at the back of the queue may be less than normal. Of course, delays and associated costs may then be transferred to the alternate routes, but CIMQ does not estimate delay costs or other adverse impacts on alternate routes.

Also, the CIMQ calculations take into account only three possible variations in traffic flow (measured in vehicles per hour) past the incident scene—before responders arrive, during complete closure, and during the “cleanup” period. The actual flow rates past the incident scene may change at other times during the various stages of incident management, and CIMQ users have to make simplifying assumptions if multiple flow rates are anticipated.

Time Periods and Vehicle Types

Five distinct time periods are used in CIMQ to address the differences in travel patterns throughout the day. (See the worksheet labeled “VehType.”) Obviously, a particular incident may overlap more than one of the distinct periods, e.g. an incident might begin during the “morning peak period” and extend into the “mid day” period. Further, a steady level of traffic flow is assumed throughout each period, even though traffic volumes actually vary from hour to hour. (During peak periods, volumes often change significantly over 15 minute periods.)

Further, the assumptions about the distribution of passenger vehicles, single unit trucks, and multi-unit trucks by time period are based primarily on typical freeways rather than data specifically for Wilson County. The estimated numbers for Wilson County in the VehType worksheet were selected by the CIMQ authors after considering the typical numbers for urban and rural freeways nationally.

Thus, users should rely on their knowledge of local travel patterns to interpret the volume estimates by time of day and the estimates of vehicle types by time of day. Future versions of the CIMQ spreadsheet could be improved by using more local data.

Vehicle Lengths

For the purpose of calculating queue (backup) lengths, the assumed lengths per vehicle (for the vehicle and the gap between vehicles in the backup) were assumed to be as follows:

Passenger vehicles (autos, vans, pickups, etc.)	27 feet
Single-unit trucks	45 feet
Multi-unit trucks	82 feet

Roadway Capacity

The *Highway Capacity Manual* suggests that an incident that blocks one lane of a two-lane freeway will reduce the capacity (vehicles per hour) by 65%, not by 50% as might be expected. That means that a two-lane freeway with a capacity of 4,000 vehicles per hour (2,000 per lane) would be reduced to a capacity of 1,400 vehicles per hour. However, the actual capacity can be lower (or higher) depending on numerous factors. The default assumptions in CIMQ are only 1,000 vehicles per hour prior to responders reaching the scene and while emergency vehicles are still on the scene.

Some of the factors that determine actual capacity are beyond the control of incident responders. Such factors include weather conditions, visibility, lighting, grades (steepness), number of heavy vehicles, shoulder and lane widths, other roadway characteristics, and the severity of the incident.

Incident responders can also increase (or decrease) the capacity (and safety) of available lanes by:

- **Minimizing the numbers of emergency vehicles at the scene by staging at other locations and by releasing unneeded equipment,**
- **Keeping emergency vehicles (and personnel) as far from travel lanes as possible**
- **Minimizing the use of emergency lighting (especially strobes) on parked vehicles**
- **Using active traffic control (emergency officials or flaggers using hand signals and eye contact to encourage efficient movement passed the incident scene)**
- **Using dynamic message signs, cones, flares and other traffic control devices to reduce confusion and channel traffic into smooth flow**

CIMQ users can substitute different capacity assumptions based on the factors described above.

Economic Costs

CIMQ calculates the total “delay costs” for an incident by multiplying the calculated vehicle hours of delay by an assumed unit cost per vehicle. Two separate numbers are used for the unit costs, one for passenger vehicles and another for trucks (assuming that the costs for single-unit and multi-unit trucks are about the same). These unit costs are intended to include the value of lost time for passenger vehicles and the total vehicle operating costs for trucks.

The suggested unit costs used in CIMQ for delays (\$15 per hour for passenger vehicles and \$70 per hour for trucks) are based primarily on studies by the Texas Transportation Institute (TTI). CIMQ users have the option of substituting different assumptions for the unit costs.

Several costs items are *not* included in these estimates. Examples of adverse impacts *not* built into the cost estimates include secondary crashes, road rage, wasted fuel, and other societal costs such as increased air pollution, increased response time for other emergencies, and interference with normal business and community activities. All of these other costs are significant, and CIMQ users can add whatever premium they deem appropriate to the assumed unit cost per vehicle per hour of delay to account for the other costs.

Other Limitations

Although the equations used in the CIMQ spreadsheets are mathematically sound and the assumptions are conservative, many variables are not considered; and the actual times, delays, and costs associated with a particular incident may be different than the CIMQ estimates. Special events may result in much higher traffic volumes than normal. As noted previously, rubbernecking delays in the opposite direction of travel are not included in the estimated costs. Driver behavior is another unmeasured variable. If truckers, for instance, choose to create “platoons” rather than inching forward, the queue length may be much longer (although vehicles hour of delay will be about the same as the estimate). The CIMQ estimates are meant to supplement, but not replace, the good judgment of experienced incident responders.

Traffic Impact of Incidents and Incident Management on I-40 & SR 840 in Wilson County

Please click on boxes to enter the requested information using drop-down menus →

To view Wilson Co. Index Map: [Click Here](#)

Location I-40 Seg 5 (Exits 236 & 238)

Direction of travel WB

Day of the week Thursday

Month August

Average daily traffic conditions for this segment (TDOT data):

AADT (all vehicles) **58,580** Annual average daily traffic (total both directions)

Passenger vehicles **76%** Percent of daily vehicles that are autos and other passenger vehicles

Single-unit trucks **3%** Percent of daily vehicles that are single-unit trucks

Multi-unit trucks **21%** Percent of daily vehicles that are multi-unit trucks

AADT adjustment = **110%** for user-selected Day and Month (above) vs. "Average" day

Hourly traffic for this specific location, time, and day (vehicles that would normally pass this location in the first hour following an incident):

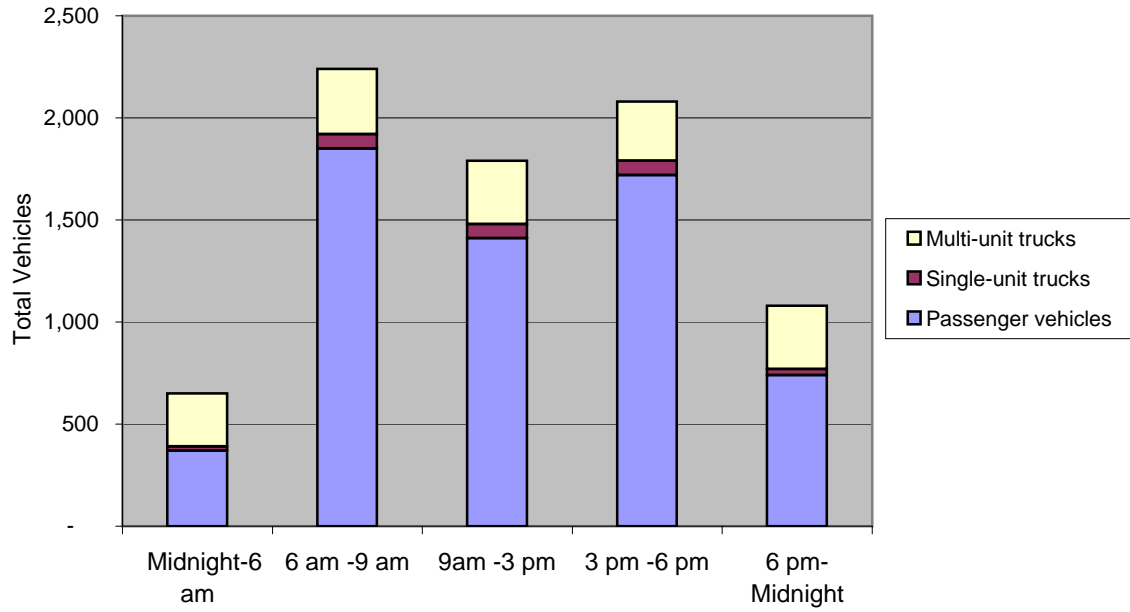
	Approximate number of vehicles				
	Night- Early Morning	Morning Peak Period	Mid Day	Afternoon Peak Period	Late Afternoon- Evening
	Midnight-6 am	6 am -9 am	9am -3 pm	3 pm -6 pm	6 pm- Midnight
Passenger vehicles	370	1,850	1,410	1,720	740
Single-unit trucks	20	70	70	70	30
Multi-unit trucks	260	320	310	290	310
Total vehicles	650	2,240	1,790	2,080	1,080

Approximate backup distances (in miles) after one hour of total closure in the indicated direction of travel (assuming no backup prior to the closure)

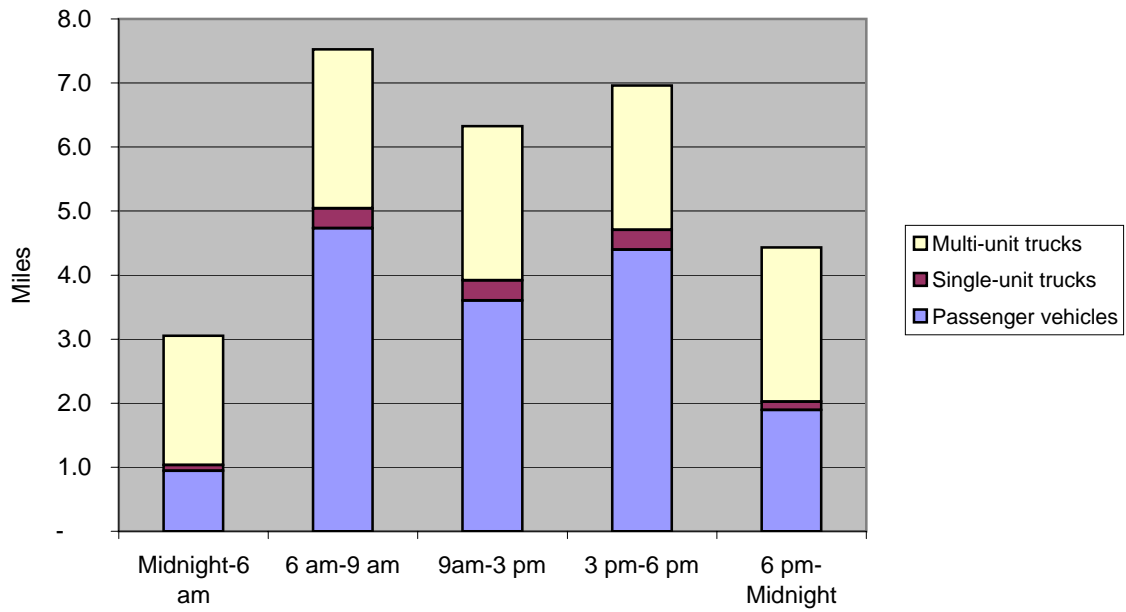
Number of lanes available for backed up traffic = 2

	Approximate backup distance (miles) after one hour				
	Night- Early Morning	Morning Peak Period	Mid Day	Afternoon Peak Period	Late Afternoon- Evening
	Midnight-6 am	6 am-9 am	9am-3 pm	3 pm-6 pm	6 pm- Midnight
Passenger vehicles	0.9	4.7	3.6	4.4	1.9
Single-unit trucks	0.1	0.3	0.3	0.3	0.1
Multi-unit trucks	2.0	2.5	2.4	2.3	2.4
Total backup (miles)	3.1	7.5	6.3	7.0	4.4

Estimated Number of Vehicles in Backup After One Hour



Estimated Backup (Miles) after One Hour (No Prior Backup)



Estimates for: WB I-40 Seg 5 (Exits 236 & 238) Thursday in August

Traffic Impact of Incidents and Incident Management on I-40 & SR 840 in Wilson County

Please click on boxes to enter the requested information using drop-down menus →

Location

Direction of travel

Day of the week

Month

To view Wilson Co. Index Map: [Click Here](#)

Average daily traffic conditions for this segment (TDOT data):

AA DT (all vehicles) **58,580** Annual average daily traffic (total both directions)
 Passenger vehicles **76%** Percent of daily vehicles that are autos and other passenger vehicles
 Single-unit trucks **3%** Percent of daily vehicles that are single-unit trucks
 Multi-unit trucks **21%** Percent of daily vehicles that are multi-unit trucks

AA DT adjustment = **110%** for user-selected Day and Month (above) vs. "Average" day

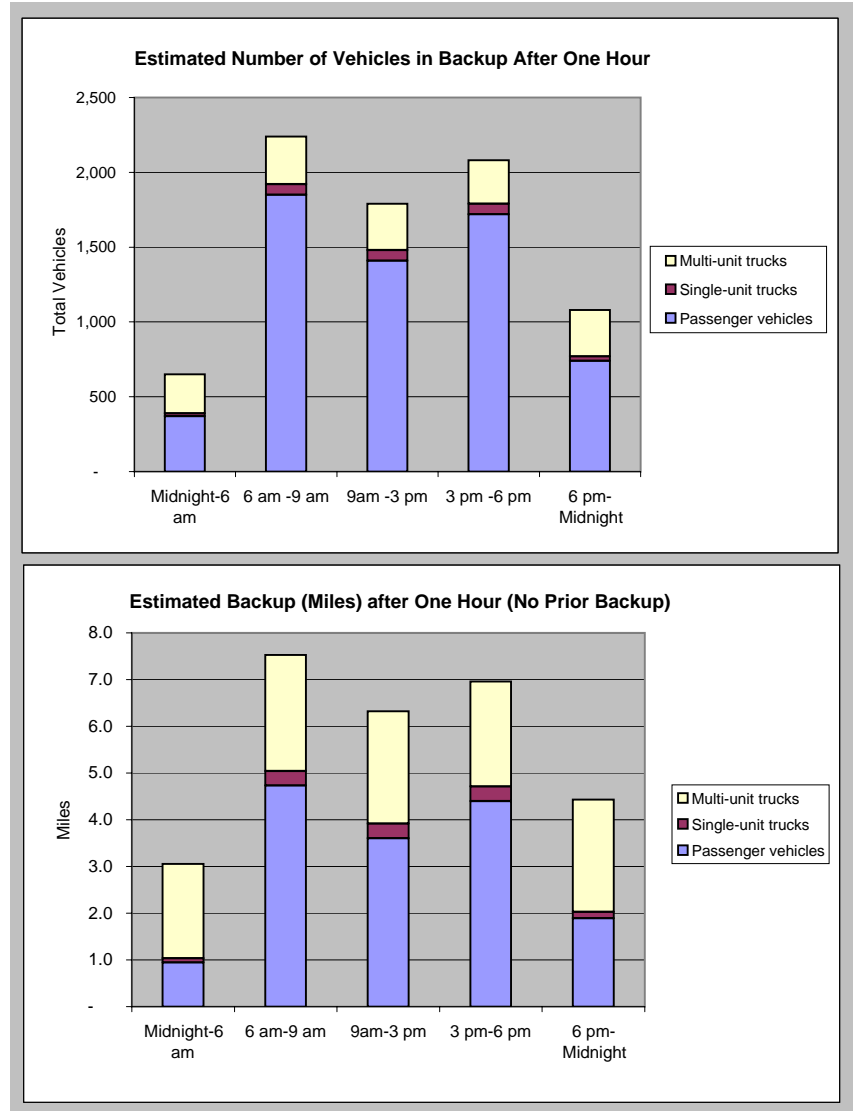
Hourly traffic for this specific location, time, and day (vehicles that would normally pass this location in the first hour following an incident):

	Approximate number of vehicles				
	Night- Early Morning	Morning Peak Period	Mid Day	Afternoon Peak Period	Late Afternoon- Evening
	Midnight-6 am	6 am -9 am	9am -3 pm	3 pm -6 pm	6 pm- Midnight
Passenger vehicles	370	1,850	1,410	1,720	740
Single-unit trucks	20	70	70	70	30
Multi-unit trucks	260	320	310	290	310
Total vehicles	650	2,240	1,790	2,080	1,080

Approximate backup distances (in miles) after one hour of total closure in the indicated direction of travel (assuming no backup prior to the closure)

Number of lanes available for backed up traffic =

	Approximate backup distance (miles) after one hour				
	Night- Early Morning	Morning Peak Period	Mid Day	Afternoon Peak Period	Late Afternoon- Evening
	Midnight-6 am	6 am -9 am	9am -3 pm	3 pm -6 pm	6 pm- Midnight
Passenger vehicles	0.9	4.7	3.6	4.4	1.9
Single-unit trucks	0.1	0.3	0.3	0.3	0.1
Multi-unit trucks	2.0	2.5	2.4	2.3	2.4
Total backup (miles)	3.1	7.5	6.3	7.0	4.4



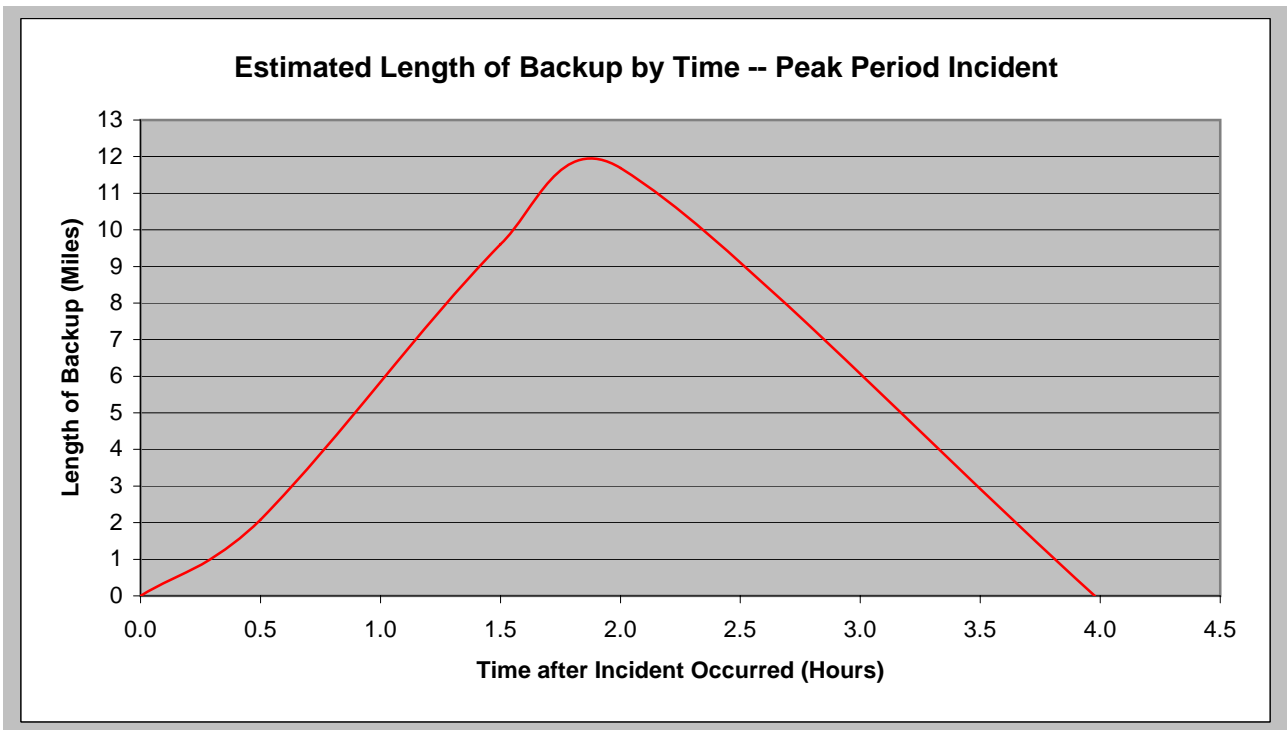
Estimates for: WB I-40 Seg 5 (Exits 236 & 238) Thursday in August

Vehicle Hours of Delay and Associated Delay Costs (Peak Period Incident)

NOTE: The figures on this page are for the "peak period" on the same segment, direction of travel, day, and month as on the 1stSheet.
To change segment, direction, day, or month, return to the 1stSheet.

Wilson County
I-40 Seg 5 (Exits 236 & 238)
WB
Thursday
August

Scenario: {
 Response time (from time incident occurs to responders on scene) = **30 minutes**
 Total closure time after responders reach the scene = **1 hour**
 Cleanup time (lanes reopened but emergency vehicles still on scene) = **30 minutes**
 Peak period = **Morning**



Time from scene cleared to normal flow restored = **2.0** hours

Total time from incident occurrence to normal flow restored = **4.0** hours

Associated delay costs:

Users can change the costs per hour if desired

Delay costs per vehicle per hour for passenger vehicles =

\$15

Delay costs per vehicle per hour for trucks =

\$70

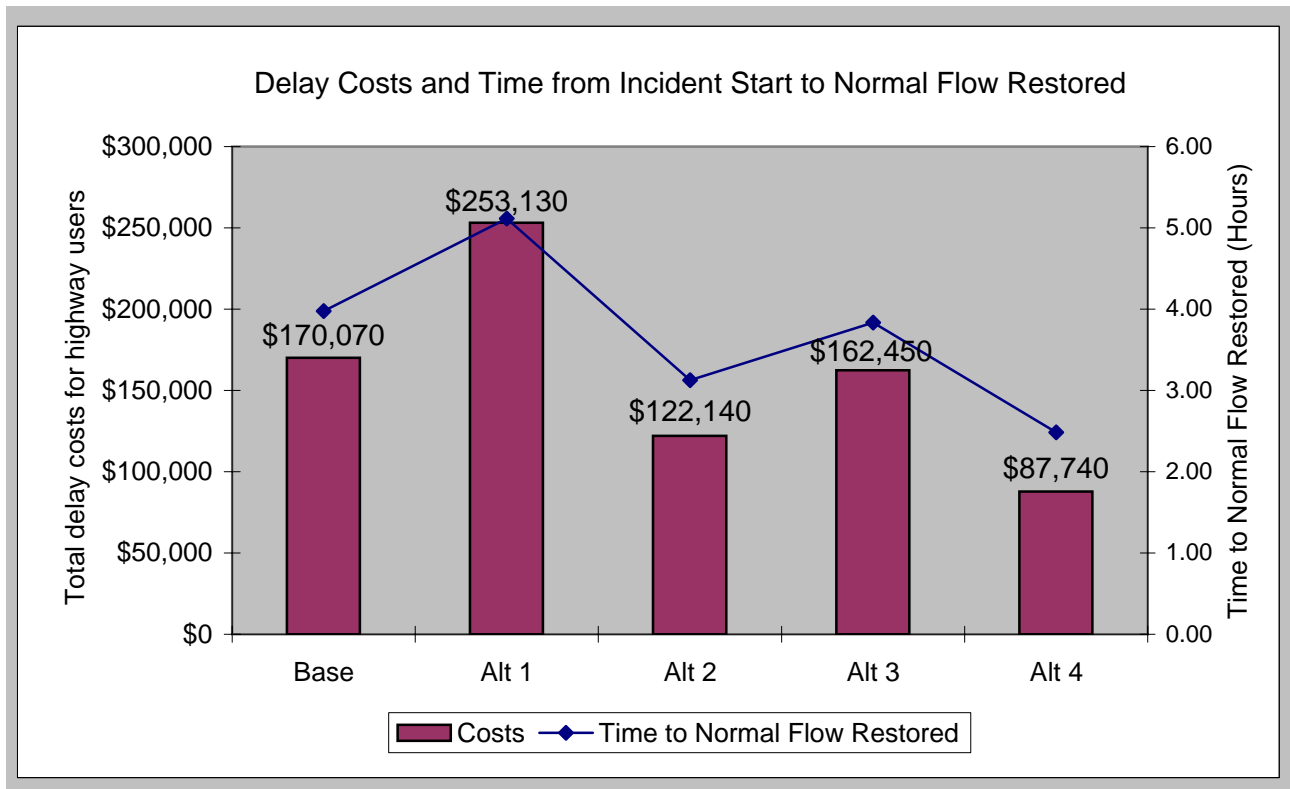
Total delay costs = \$85,730 (Passenger vehicles)

\$84,340 (Trucks)

\$170,070 Total all vehicles

This page illustrates how changes in incident management will affect traffic and the costs of delays. **Users can change any of the variables under Alternate 4 and view the results.**

Input variables	Base Case	Alternate 1 Increase Closure Time	Alternate 2 Reduce Response and Cleanup Times	Alternate 3 Improve Capacity Thru Incident Scene	Alternate 4 Change Times and/or Capacities
1. Elapsed time (in hours) from incident occurrence to responder arrival	0.50	0.50	0.25	0.50	0.25
2. Complete closure time (if any) in hours	1.00	1.50	1.00	1.00	0.75
3. Time during incident management (other than closure) with reduced capacity (in hours)	0.50	0.50	0.25	0.50	0.25
4. Capacity of roadway (vehicles per hour) during incident management (other than complete closure)	1,000	1,000	1,000	1,500	1,500
Results					
Time from scene cleared to normal flow restored (hours)	2.0	2.6	1.6	1.8	1.2
Total time from incident start to normal flow restored (hours)	4.0	5.1	3.1	3.8	2.5
Total vehicle hours of delay	6,920	10,300	4,970	6,610	3,570



Traffic Impact of Incidents and Incident Management on I-40 & SR 840 in Wilson County Worksheet with All Variables Open for User Input

Please click on boxes to enter the requested information using drop-down menus →

Location : I-40 Seg 5 (Exits 236 & 238)

Direction of travel: WB

Day of the week: Thursday

Month: August

Please enter the time period for the incident (using the drop-down menu) →

Morning Peak Period (0601-0900)

Average daily traffic conditions for this segment (based on TDOT data):

AADT (all vehicles) 58,580 Average daily traffic--total both directions
 AADT adjustment = 110% for user-selected Day and Month (above) vs. "Average" Day

The following variables can be changed by the user:

- | | | |
|---|---|---------------|
| Number of lanes available for backed up traffic = | 2 | |
| 1. Normal one-way capacity of roadway (based on 2,000 veh/hour/lane) | 4,000 | vehicles/hour |
| 2. Normal traffic demand without incident (based on selected time period above) | 2,240 | vehicles/hour |
| 3. Reduced capacity due to incident (prior to responders on scene) | 1,000 | vehicles/hour |
| 4. Adjusted capacity during scene management (other than complete closure) | 1,000 | vehicles/hour |
| 5. Elapsed time from incident occurrence to complete closure (if any) | 0.5 | hours |
| 6. Duration of complete closure (if any) | 1.0 | hours |
| 7. Duration of reduced capacity during scene management (other than closure) | 0.5 | hours |

Time from scene cleared to normal flow restored = 2.0 hours
 Total time from incident occurrence to normal flow restored = 4.0 hours
 Estimated maximum length of backup for this scenario = 11.9 miles

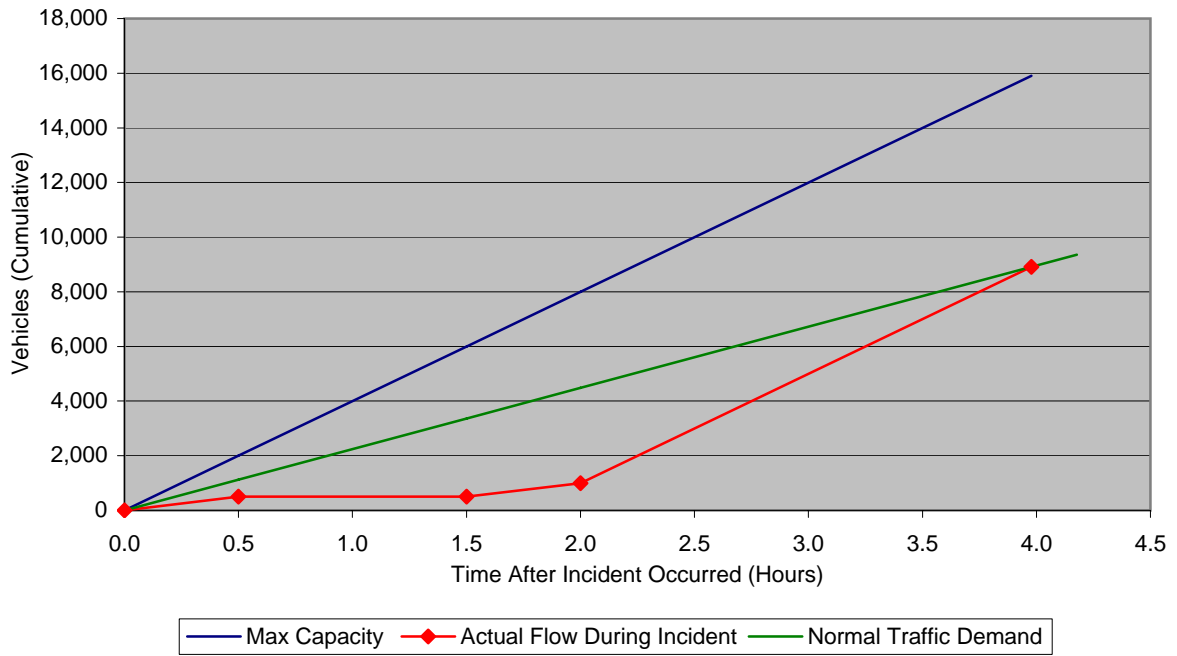
Associated delay costs:

Users can change the assumed costs per hour if desired

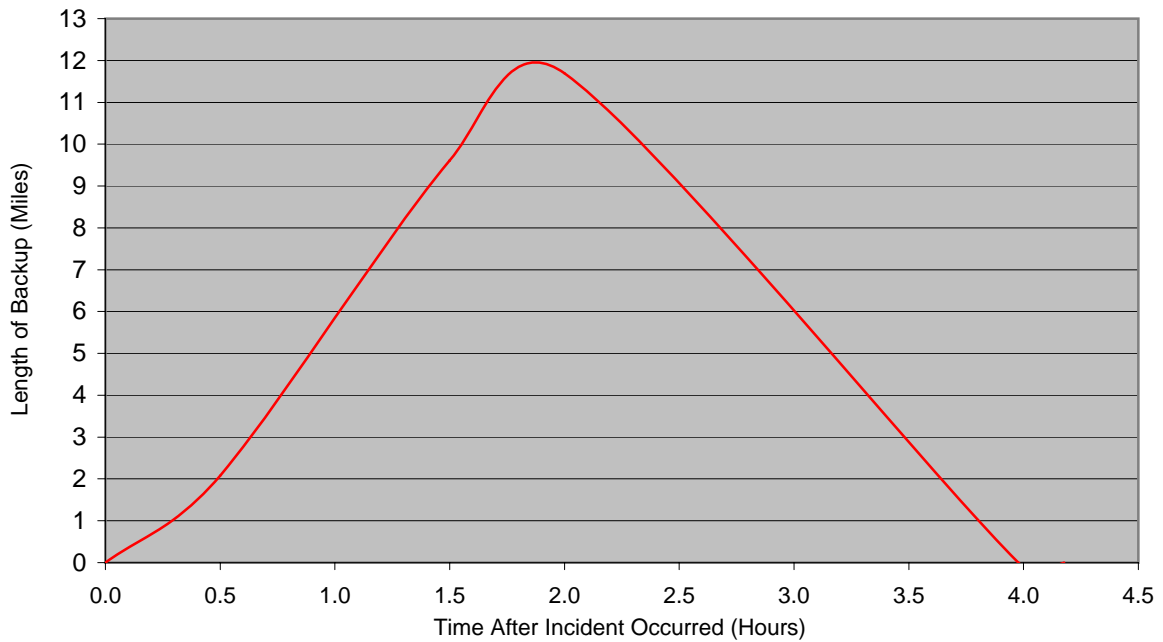
Delay costs per vehicle per hour for passenger vehicles = \$15
 Delay costs per vehicle per hour for trucks (single- and multi-unit) = \$70

Total delay costs = \$85,730 Passenger vehicles
\$84,340 Trucks
\$170,070 **Total all vehicles**

Vehicles Past the Incident Scene by Time



Estimated Length of Backup by Time



**Traffic Impact of Incidents and Incident Management on I-40 & SR 840 in Wilson County
Worksheet with All Variables Open for User Input**

Please click on boxes to enter the requested information using drop-down menus

Location :

Direction of travel:

Day of the week:

Month:

Please enter the time period for the incident (using the drop-down menu)

Average daily traffic conditions for this segment (based on TDOT data):

AADT (all vehicles) **58,580** Average daily traffic--total both directions
 AADT adjustment = **110%** for user-selected Day and Month (above) vs. "Average" Day

The following variables can be changed by the user:

- Number of lanes available for backed up traffic =
- 1. Normal one-way capacity of roadway (based on 2,000 veh/hour/lane) vehicles/hour
- 2. Normal traffic demand without incident (based on selected time period above) vehicles/hour
- 3. Reduced capacity due to incident (prior to responders on scene) vehicles/hour
- 4. Adjusted capacity during scene management (other than complete closure) vehicles/hour
- 5. Elapsed time from incident occurrence to complete closure (if any) hours
- 6. Duration of complete closure (if any) hours
- 7. Duration of reduced capacity during scene management (other than closure) hours

Time from scene cleared to normal flow restored = **2.0** hours
 Total time from incident occurrence to normal flow restored = **4.0** hours
 Estimated maximum length of backup for this scenario = **11.9** miles

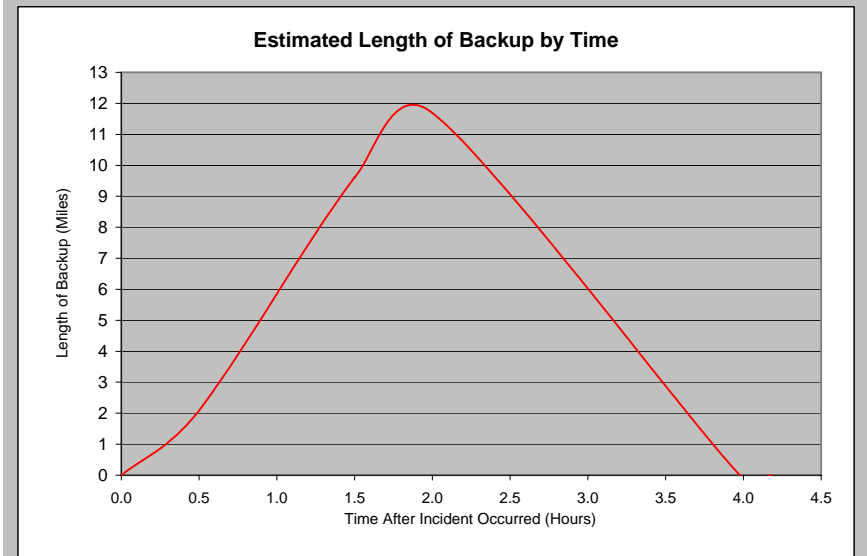
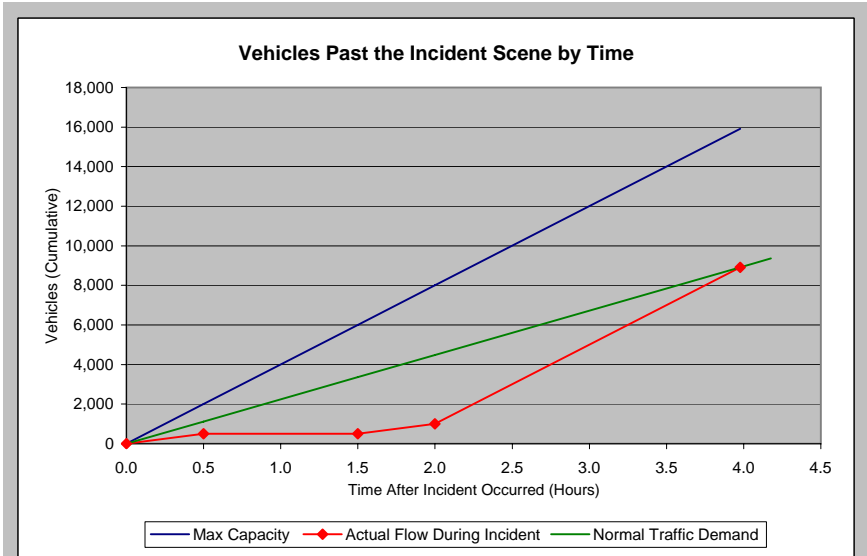
Associated delay costs:

Users can change the assumed costs per hour if desired

Delay costs per vehicle per hour for passenger vehicles =

Delay costs per vehicle per hour for trucks (single- and multi-unit) =

Total delay costs = **\$85,730** Passenger vehicles
\$84,340 Trucks
\$170,070 Total all vehicles



Appendix C

**Guidelines for Diversion of Freeway Traffic for
Incident Management and Emergency Transportation Operations
in
Jefferson County**

**Guidelines for Diversion of Freeway Traffic
for
Incident Management and Emergency Transportation Operations
in
Jefferson County**

The best solution to freeway incident management is quick clearance. None of the alternate routes in Jefferson County have the capacity to handle freeway traffic volumes without congestion and other adverse impacts.

However, diversion of freeway traffic is sometimes necessary. The following information will guide state and local agencies in planning and executing freeway closures in Jefferson County.

Key Factors

Factors to consider before deciding to close the freeway and diverting traffic to alternate routes include the following:

1. Traffic capacity and other features on alternates routes (e.g., lane and shoulder widths, curves and grades, turn lanes, traffic control devices, adjacent land uses)
2. Traffic conditions (including time of day, day of the week, and month of the year)
3. Weather conditions
4. Construction/maintenance activities on the primary alternate route and on other routes in the diversion corridor
5. Personnel and other resources available to implement the closure and detours
6. Location of the incident relative to interchanges, access ramps, and median crossovers
7. Access routes for emergency vehicles
8. Possible evacuation requirements
9. Ability to monitor and suspend or modify the diversion if severe conditions develop on alternate routes
10. Extent and impact of route changes likely to be made by individual motorists regardless of official directions
11. Anticipated duration of closure (in some cases, the alternate route choices are so limited that even long-term backups on the freeway may be unavoidable)
- 12.
- 13.

Best Practices

The following are considered best practices. These may not always be possible, but are specified here as goals for the responsible agencies.

14. Safety for motorists and incident responders should be the first priority in planning and executing freeway diversions.
15. The second priority should be communication. All incident responders and those assisting with the closure and detours should have current information about the expected duration of the closure and conditions on the diversion route(s). Signs and traffic control devices should be deployed to provide clear directions for diverted motorists. Current information should be distributed through the news media and TDOT's SmartWay and 511 systems.
16. Normally, closures should be made at the closest interchange upstream from the incident. However, closing additional segments (i.e., diverting traffic prior to the closest interchange) may be preferable to take advantage of better detour routes. Also, circumstances may call for diverting large trucks at a different interchange from the one used for automobiles, directing trucks to different detour routes than passenger vehicles, or even diverting only cars to alternate routes.
17. If only one lane of the freeway is open, and a suitable alternate route is available for passenger vehicles only (i.e., not suitable for trucks), trucks may be allowed to stay on the freeway and passenger vehicles diverted to the alternate route.
18. Provisions should be made to turn-around any vehicles "trapped" between the incident and the upstream diversion point.
19. Vehicles operating with special permits (over-weight or over-dimensional) should not be allowed to divert from the freeway. A staging location should be designated for such vehicles for the duration of the closure.
20. Active traffic control by uniformed officers should be provided at the location(s) where motorists must exit the freeway, along with warning and directional signs and other traffic control devices (e.g., cones, barricades, barrels).
21. Active traffic control by uniformed officers or other trained personnel should be provided at all key decision points along the diversions route(s), along with warning and directional signs and other traffic control devices (e.g., cones, barricades, barrels). State and local agencies should work together to designate the agency responsible for posting officers or flaggers at specific locations.
22. Uniformed officers should be assigned to traffic control points where detoured traffic needs to (or is likely to) disregard normal traffic control devices or rules of the road.
23. Provisions should be made to ensure that adequate relief will be available for all personnel involved in traffic control and incident management for the duration of the freeway closure and until the exceptional traffic demands end on alternate routes.

DRAFT

- 24. Local and state law enforcement, transportation, and public works officials should be advised of freeway closures as far in advance as possible, and, if alternatives exist, should be consulted about those alternatives.
- 25. Plans should be developed in advance for response to crashes or other incidents that occur on the detour route(s) and to assist any motorists in distress along those routes.
- 26. Plans should be developed in advance for the use of mutual aid and shared frequencies for radio communication among the agencies and on-scene representatives involved in management of the incident, the closure, and the detour route(s)
- 27. After-action meetings should be held following diversions that last significantly longer than projected, generate more congestion than expected, or cause other unexpected problems on the alternate routes. In addition to addressing the specific problems encountered, the review should search for ways to reduce bottlenecks on the diversion routes; reduce impacts on local land uses; secure additional personnel, signing, or equipment for future diversions; and resolve any site-specific safety concerns.
- 28.
- 29.

This list of best practices is not exhaustive and does not replace agency standards or requirements that apply under the conditions encountered during specific incidents or emergency conditions.

Adopted jointly by:

Agency	Signature of Agency Representative	Date
Tennessee Department of Safety		
Tennessee Department of Transportation		

Appendix D

Freeway Ramp Designations for Incident Management and Emergency Transportation Operations

Freeway Ramp Designations for Incident Management
and Emergency Transportation Operations

Prepared for the
Office of Incident Management
Tennessee Department of Transportation

by the
Vanderbilt Center for Transportation Research

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Freeway Ramp Designations for Incident Management and Emergency Transportation Operations

The purpose of the procedures described below is to assign a unique designation to each freeway ramp to facilitate incident management and emergency operations. The designations can be used by transportation, law enforcement, fire services, emergency management, emergency communications (911), towing and recovery, and other emergency services to improve communication about the exact location of incidents and the assignment of personnel and equipment for emergency management. In the future, signs could be installed on selected ramps using these same designations to improve incident reporting by motorists.

Each ramp designation will begin with a letter (E, W, N, or S) indicating the direction of freeway travel *served* by the ramp, regardless of whether the ramp is an off-ramp or an on-ramp. The direction of travel will be the direction served by the *route* and will not necessarily be the “compass heading” of traffic in the immediate location. (In other words, all ramps serving I-40 would begin with either E or W, since I-40 is an east-west route, although the “compass heading” for traffic on discrete sections of I-40 may be more N or S than E or W. All ramps on I-65 would begin with either N or S, since I-65 is a north-south route.)

Following the letter (E, W, N, or S) will be a number that indicates the order in which the ramps intersects the travel lanes of the freeway in the indicated direction of travel. To distinguish “on” and “off” ramps, all on-ramps will be assigned an *even* number and all off-ramps will be assigned an *odd* number. Ramp numbers will be assigned as follows:

- The first ramp that intersects the freeway in the route direction of travel will be assigned the first number, either “1” for off-ramp or “2” for on-ramp.
- If the first ramp has merges or splits between the freeway and the cross street, then the next numbers in sequence will be assigned as follows:
 - ❖ Where off-ramps split before intersecting with the cross street, the number assigned to the right-most split (in the direction of vehicle travel) will be the same as the number at the main ramp’s divergence from the freeway (i.e., will be treated as a continuation from the freeway to the cross street.). The next odd number in sequence will be assigned to the left-most split.
 - ❖ Where on-ramps merge before entering the main freeway lanes, the number assigned to the right-most merging ramp (in the direction of vehicle travel on the ramp) will be assigned the same number as the ramp at the intersection with the freeway (i.e., will be treated as a continuation from the cross street to the freeway). The other section of on-ramp (left-most merging ramp in the direction of travel) will be assigned the next even number in sequence.
 - ❖ Where wide paved areas are available to accommodate left- and right-hand turns at the end of an off-ramp (or beginning of an on-ramp) and the pavement is marked (painted) to separate the turning movements, unique ramp designations will be assigned only if

the separate ramp segments are so far apart or complicated that more than one officer or flagger and/or more extensive than usual traffic control devices would be needed during an emergency. Otherwise, separate ramp designations will be used only if the ramp ends (or beginnings) are separated by curbs or other physical barriers.

- Once numbers are assigned to ramp splits or merges, the next numbers in sequence will be assigned to the next ramps that intersect with the main travel lanes of the freeway, and the process will be continued until all ramps have been assigned a designation.

Exhibit 1 illustrates the results of following the procedures described above to assign ramp designations at a diamond-type interchange.

Exhibit 2 illustrates the results of following the procedures described above to assign ramp designations at a more complicated interchange.

For freeway-to-freeway interchanges, the ramps will be designated “from” and “to” (route and direction of travel), as shown in Exhibit 3. Also, for incident management communication purposes, the split and merge locations will be identified using the word “Split” or “Merge” followed by a number, as shown in Exhibit 3.

The split and merge numbers will be assigned beginning with the lower numbered route and moving in the same direction as the route exit numbers (and mile markers). Since I-40 is the lower numbered route in Exhibit 3, “Split 1” is the first split encountered when moving eastward (direction of increasing exit numbers and mile markers) on I-40. Moving further eastward on I-40 (the lower numbered route), “Split 2” and “Merge 2” are identified. “Split 3” and “Merge 3” are then identified on I-81 (the higher numbered route).

Exhibit 4 illustrates the assignment of unique ramp designations at a location where wide paved and marked areas at the beginning and end of ramps warrants unique ramp designations. In these instances, more than one officer or flagger and/or more extensive than usual traffic control devices would be needed for adequate traffic control during an emergency.

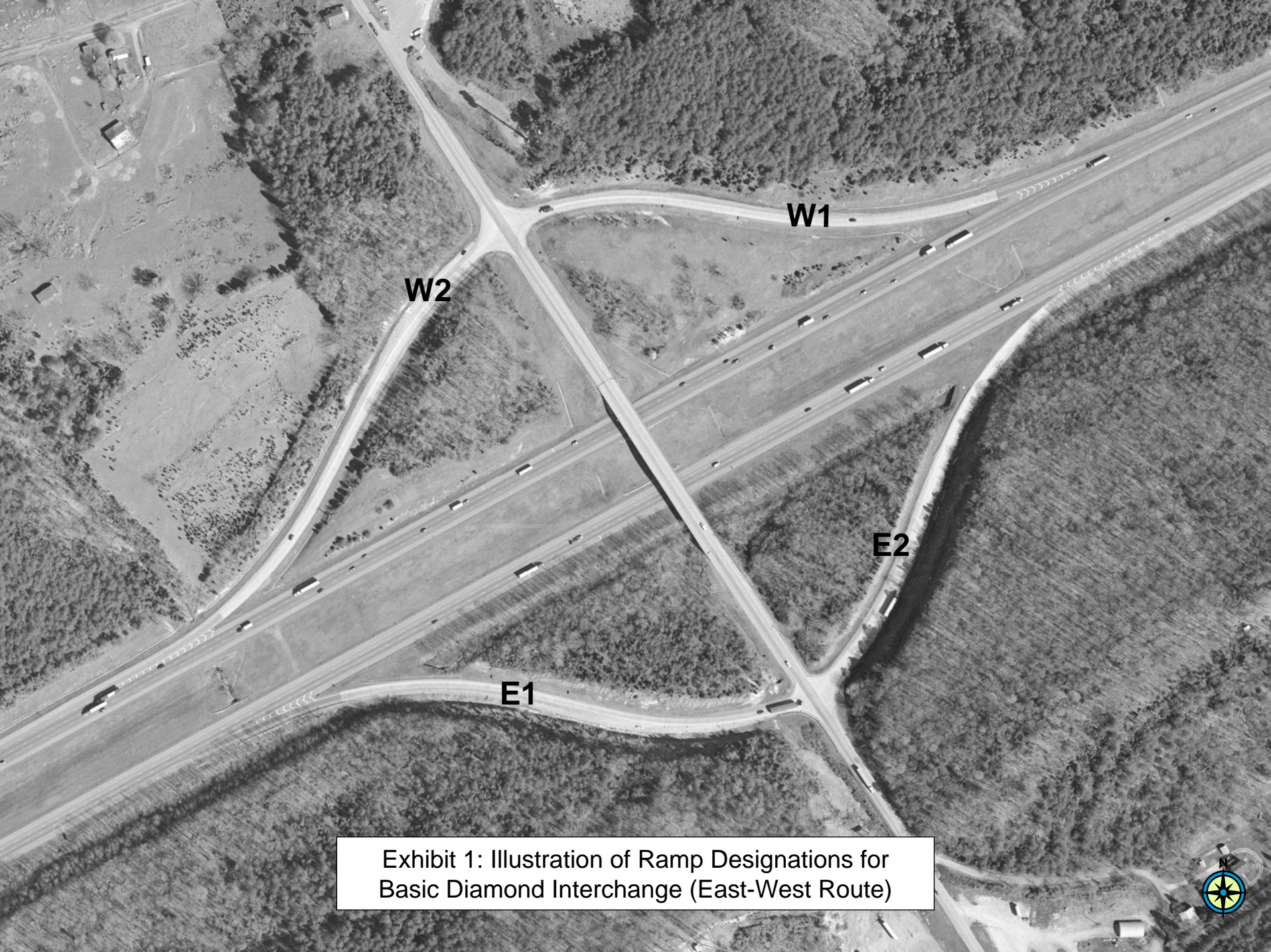
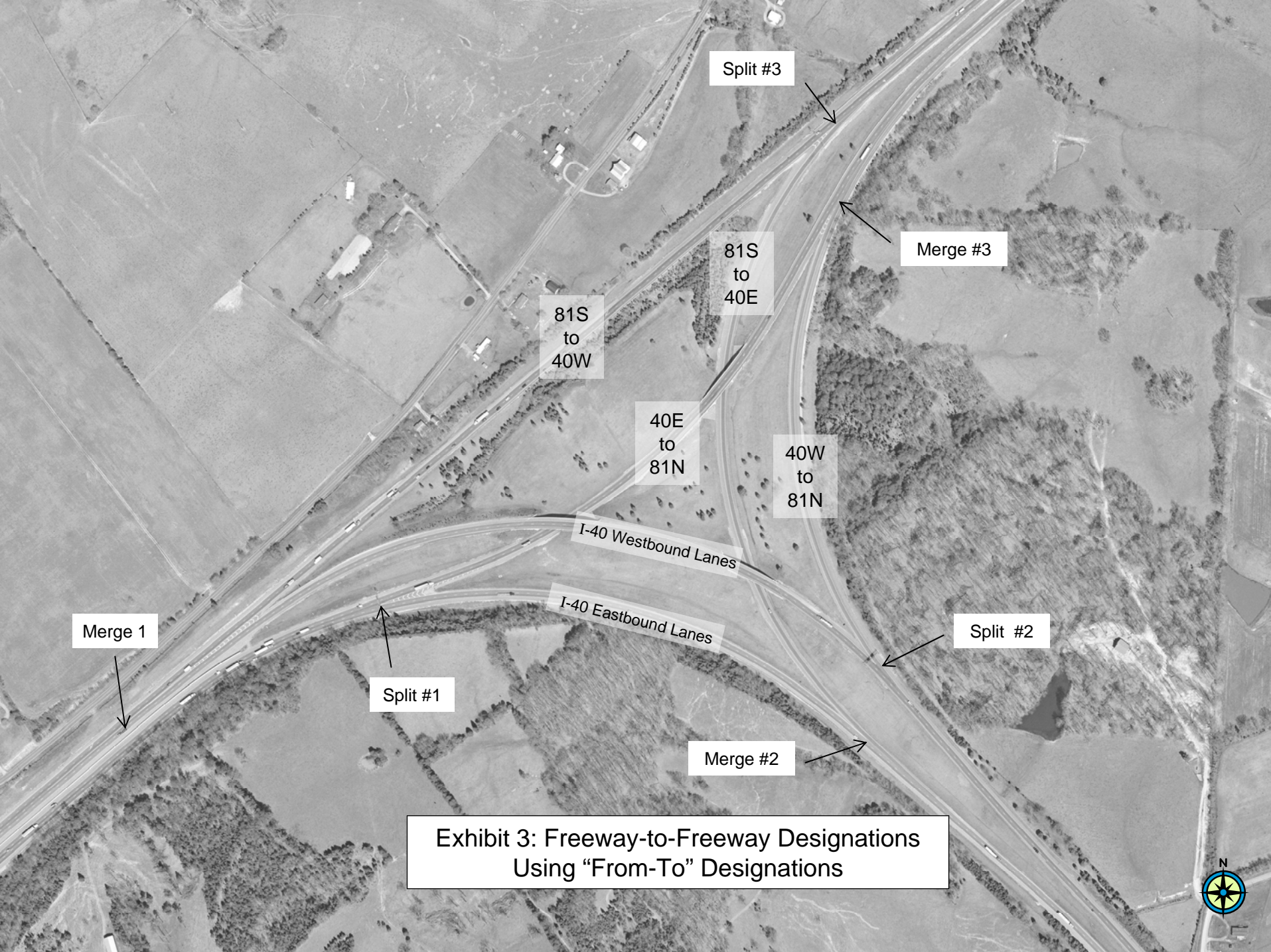


Exhibit 1: Illustration of Ramp Designations for Basic Diamond Interchange (East-West Route)



Exhibit 2: Illustration of Ramp Designations for More Complicated Interchange (East-West Route)





Split #3

Merge #3

81S
to
40E

81S
to
40W

40E
to
81N

40W
to
81N

I-40 Westbound Lanes

I-40 Eastbound Lanes

Merge 1

Split #1

Split #2

Merge #2

Exhibit 3: Freeway-to-Freeway Designations
Using "From-To" Designations





Note: Closing Ramp W4 would require closing this left-turn lane and prohibiting left turns at the traffic signal

Note: Double left turn at end of Ramp W3

W4

W2

W3

W1

W1

Exhibit 4: Designation of End-of-Ramp and Beginning-of-Ramp Splits Created by Pavement Markings

