

Low Cost Strategies to Increase Truck Parking in Wisconsin

Teresa Adams, University of Wisconsin – Madison
Praveen Srivastava, University of Wisconsin – Madison
Bruce Wang, Texas A&M University
Libby Ogard, Prime Focus LLC

WisDOT 0092-08-28, CFIRE 01-04
September 2009



WISCONSIN DOT

Wisconsin Department of Transportation Research & Library Unit

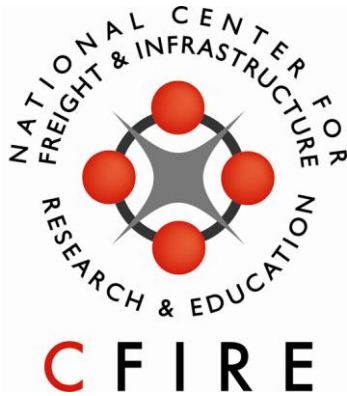


CFIRE

National Center for Freight & Infrastructure Research & Education
Wisconsin Transportation Center
University of Wisconsin, Madison

Wisconsin Department of Transportation
Research & Library Unit
4802 Sheboygan Avenue, Room 104
P.O. Box 7915
Madison, WI 53707

CFIRE
National Center for Freight & Infrastructure Research & Education
Wisconsin Transportation Center
2205 Engineering Hall
1415 Engineering Drive
Madison, WI 53706



Low Cost Strategies to Increase Truck Parking in Wisconsin

Project 01-04

September 2009

National Center for Freight & Infrastructure Research & Education
College of Engineering
Department of Civil and Environmental Engineering
University of Wisconsin -Madison

Authors: Teresa Adams¹, Praveen Srivastava¹, Bruce Wang², and Libby Ogard³

¹ University of Wisconsin-Madison, Madison, WI 53706

² Texas A&M University, College Station, TX

³ Prime Focus LLC, DePere, WI 54115

Principal Investigator: Teresa M. Adams; PhD

Professor, Department of Civil and Environmental Engineering, University of Wisconsin-Madison

Disclaimer

This research was funded by the Wisconsin Department of Transportation through the National Center for Freight and Infrastructure Research and Education at the University of Wisconsin-Madison. The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. This document is disseminated under the sponsorship of the Wisconsin Department of Transportation, University Transportation Centers Program, in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof. The contents do not necessarily reflect the official views of the National Center for Freight and Infrastructure Research and Education, the University of Wisconsin, the Wisconsin Department of Transportation, or the USDOT's RITA at the time of publication.

The United States Government assumes no liability for its contents or use thereof. This report does not constitute a standard, specification, or regulation.

The United States Government does not endorse products or manufacturers. Trade and manufacturers names appear in this report only because they are considered essential to the object of the document.

Technical Report Documentation Page

1. Report No. CFIRE 01-04	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Low Cost Strategies to Increase Truck Parking in Wisconsin		5. Report Date May 2009	
		6. Performing Organization Code	
7. Teresa M. Adams, Praveen Srivastava, Bruce X. Wang and Libby Ogard		8. Performing Organization Report No.	
9. Performing Organization Name and Address National Center for Freight and Infrastructure Research and Education (CFIRE) College of Engineering, University of Wisconsin-Madison 1415 Engineering Drive, Madison, WI 53706		10. Work Unit No. (TRAIS)	
		11. Contract or Grant No. 0092-08-28	
12. Sponsoring Organization Name and Address Wisconsin Department of Transportation Research and Library Section Rm 104, 4802 Sheboygan Avenue Madison, WI 53705		13. Type of Report and Period Covered Final Report (11/01/07 – 05/31/2009)	
		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract This report documents a study of truck parking issues along the major state highways in Wisconsin. The effort builds upon another project at CFIRE funded by the Mississippi Valley Freight Coalition to study the truck parking issues on Interstate highways in the ten-state AASHTO Mississippi Valley Region. This study also inventories both public and private parking facilities along a select number of state highways. A web GIS tool was developed for continuous survey and public participation. The study surveyed highway patrol officers, public freight planners, and truckers to identify parking facilities incommensurate with truck parking needs. It proposes a method for ranking parking facilities identified as having the most need of additional truck parking capacity. Building on a review of previous studies and face-to-face interviews with carriers, the report contains a discussion of why existing parking facilities do not meet needs and describes a set of low cost strategies for addressing truckers' parking needs.			
17. Key Words Truck Parking, Web-GIS Survey		18. Distribution Statement No restrictions.	
19. Security Classification (of this report) Unclassified	20. Security Classification (of this page) Unclassified	21. No. Of Pages 54	22. Price -0-

Acknowledgements

This research project was sponsored by the Wisconsin Department of Transportation (WisDOT). The authors acknowledge and appreciate the assistance from WisDOT members, who provided oversight, information and assistance in our data collection effort, as well as from the Wisconsin Motor Carriers Association, which helped with outreach to the drivers and carriers.

The team also wishes to thank the staff of the I-80 Truck Stop in Wolcott, Iowa, the Waupun Truck-N-Show in Waupun, Wisconsin and the Highway 41 Truck Stop in Oshkosh, Wisconsin - along with the Mid-west Truckers Association, Inc. of Peoria, Illinois - for providing opportunities to meet truckers and conduct the survey.

Table of Contents

Disclaimer	ii
Technical Report Documentation Page	iii
Acknowledgements	iv
Table of Contents	v
List of Figures	vii
List of Tables	viii
Executive Summary	1
Chapter 1. Introduction.....	5
1.1 Background	5
1.2 Study Objective and Scope	6
1.3 Study Methodology	7
1.4 Organization of the Report.....	10
Chapter 2. Related Studies.....	12
2.1 Parking Issues faced by Daytime Trip Truckers and during Short Stops	12
2.2 Case Studies	13
2.3 Findings from the MVFC Truck Parking Study.....	17
Chapter 3. Truck Parking Issues in Wisconsin.....	21
Chapter 4. Spatial Analysis of Survey Data	25
4.1 Inventory of Parking on State Highway and Interstate Routes in Wisconsin	25
4.2 Geo-spatial Analysis Results.....	27
Chapter 5. Summary of Findings and Recommendations	35
5.1 Summary of Findings	35
5.2 Private Truck Stops and the Privatization of Rest Areas	36
5.3 Parking Management Systems	38
5.4 Real Time Counts of Available Parking Spaces	39
5.5 Signs and Message Boards to Communicate Parking Availability.....	39
5.6 Web-based Information Systems	40
5.7 Radio Broadcast Solutions	40
5.8 Cellular Phone Based Solutions	41

5.9	Selected Suggestions from Survey Participants	44
5.10	Other Possible Solutions.....	44
	Appendix A: Online Survey to State Patrol Officers, Freight Planners and Truckers	47
	Appendix B: Paper Survey to Truckers	52
	References.....	55

List of Figures

Figure 1: Wisconsin Highways in Study Scope.....	6
Figure 2: Distribution of Survey Responses	8
Figure 3: Public Rest Areas in Wisconsin	25
Figure 4: Screenshot of Private Truck Parking Facilities Visualization Tool	27
Figure 5: Distribution of Locations with Parking Issues in Wisconsin	28
Figure 6: Highways of Wisconsin with Parking Issues	29
Figure 7: Priority Facilities with Capacity Issues	32
Figure 8: Close-up of Incommensurate Parking Locations in Southeast Wisconsin.....	33
Figure 9: 511 Deployment Status as of Feb 21, 2009.....	42
Figure 10: Locations of Wisconsin DOT Traffic Cameras.....	43
Figure 11: Low Cost Solutions Suggested by Survey Respondents	44

List of Tables

Table 1: Distribution of Survey Responses in Wisconsin	8
Table 2: Number of Drivers Reporting Preferences for Rest Areas or Truck Stops by Activity	16
Table 3: Truck-hours of Parking at Rest Areas and Truck Stops by Activity (# of drivers reporting preference multiplied by average time for activity)	16
Table 4: Proportion of Parking Demand for Rest Areas and Truck Stops	17
Table 5: Locations and Interstates with Truck Parking Issues in the 10-state Region	18
Table 6: Inventory of Truck Parking Facilities in Wisconsin	26
Table 7: Ranking of Parking Facilities with Capacity Issues	31

Executive Summary

Truck parking has been an issue of great concern for many years as it relates to freight mobility and highway safety. Highways in the state of Wisconsin connect two major metro areas, Chicago and the Twin Cities, along I-90 and I-94. In addition, the state highways in Wisconsin carry freight traffic, mostly by truck, from and within Wisconsin to support the state's agricultural, manufacturing and other industries. Intensive trucking operations can be seen in and around major metro areas in Wisconsin, such as Milwaukee and Madison. An examination of truck parking problems in terms of capacity adequacy, safety and convenience to truckers will allow state freight transportation planners to better plan parking infrastructure and thereby better serve the trucking industry and the overall economy in both the state of Wisconsin and the Mississippi Valley region.

This project is funded by the Wisconsin Department of Transportation (WisDOT). Its objectives are to systematically examine truck parking issues, to identify locations where truck parking problems exist along specific U.S. and state trunk highway corridors in Wisconsin, and to recommend low cost solutions for these locations. The study specifically reviewed truck parking issues along several Wisconsin highways, including Interstate 43, U.S. Highways 8, 10, 41, 51, 53 and 151, and State Trunk Highway 29. The project complements a parallel study sponsored by the Mississippi Valley Freight Coalition (MVFC) through a pooled fund from the ten-state Midwest region of American Association of State Highway and Transportation Officials (AASHTO). The MVFC study examines similar issues, but for locations along the major freight corridors on Interstate highways throughout the Mississippi Valley region. The MVFC study enabled the team to provide additional information regarding truck parking issues along Wisconsin's Interstate corridors. For convenience to the reader, Wisconsin specific results from the MVFC study are included in this report where applicable.

The National Center for Freight and Infrastructure Research and Education (CFIRE) at the University of Wisconsin-Madison performed this project along with Prime Focus Consulting. Dr. Teresa Adams was the Principal Investigator (PI) leading this research, with Dr. Bruce Wang as the Co-PI.

The project began on November 1, 2007 and was completed on May 30, 2009. The methodology for this research is identifying problems and solutions directly from stakeholders by means of a survey and in-person interviews. The project team developed a geographic information system-(GIS)-supported online survey instrument to collect information from remote participants (see Appendix A for the questionnaire). This made it possible for the survey on truck parking issues to be conducted continuously throughout the study period via the Internet. Truckers – who were identified with help from the Wisconsin Motor Carriers Association – actively assisted in the early development of the online GIS survey tool by participating in the pilot tests. This helped both this Wisconsin truck parking project and the MVFC parking project.

This GIS tool is designed to accommodate three groups of participants: truckers/carriers, highway patrol officers and public freight planners. In total, three highway patrol officers identified 23 locations that are experiencing parking issues. One public freight planner identified two such locations, and 42 truckers/carriers identified 46 locations with parking concerns in the state of Wisconsin.

The research team also went to four truck shows –located in Walcott, IA (July 2008), Waupun, WI (August 2008), Oshkosh, WI (August 2008) and Peoria, IL (February 2009) - to talk with truckers and to conduct surveys. The participants at the truck shows, many of whom were long haul drivers, came from states across the region. The survey, a paper version of the one available online, primarily dealt with locations with truck parking issues and the frequency with which truckers observed those conditions at each location (see Appendix B for the questionnaire). In addition, the survey included questions about the types of commodities that were being shipped and their origins and destinations, drivers’ preferred times of day and durations for driving, their reasons for parking (staging, food, break, etc.), the availability of truck parking near their stopping points, and their recommended solutions for truck parking issues. In total, about 300 surveys were collected in addition to a number of surveys from online participants. These surveys and interviews provided critical information for both the MVFC and Wisconsin truck parking studies.

The research team believes truckers who have experienced problems in finding parking spots along the highway have valuable information for identifying truck parking problems and for suggesting strategies for developing new parking capacity where needed. An observation of the researchers in conducting this study is that truckers who experience problems finding parking in an area often come from outside that area. It is therefore difficult for public freight planners to identify truck parking problems in an area from truckers based within that area. A survey covering a larger geographic area is therefore needed. Important information about truck parking problems in Wisconsin is obtained from truckers in other regions. In this sense, the MVFC Truck Parking project helped enhance this study of truck parking in Wisconsin.

The in-person interviews conducted by Prime Focus identify the causes of parking problems from a broader perspective, covering issues such as the logistical operations of carriers and municipal ordinances regarding local delivery. In the MVFC project, a set of low cost strategies for addressing truck parking problems are reviewed and examined, many of which also apply to the Wisconsin truck parking project. These include approaches that involve 1) in-vehicle radio, such as CB (citizens’ band), low-power FM radio or Dedicated Short Range Communication, 2) electronic visual displays in vehicles and 3) the Internet. Seventy-three percent, 40 percent and 12 percent of participants expressed their preferences for the above strategies respectively. In terms of recommendations, truckers showed strong inclination to variable road signs. The most desirable information about parking in order of importance - as identified by the trucker interviews - includes the locations of parking areas, available amenities, space availability and time limits on use.

Major findings from this study include following:

- Many truck parking problems take place at the outskirts of large metro areas, such as Milwaukee, where truckers park primarily for staging for customer appointment times.
- The most common parking problem is related to capacity and ramp parking. There are not enough parking spaces to meet the peak demand during popular hours of use and the overflow trucks park at the ramps.
- Parking capacity shortages occur in the early evening or late at night.
- Truckers experiencing problems finding available parking in an area tend to know little about available parking in the vicinity and either do not have or are not aware of means to obtain the needed information.
- Truckers also identified design problems in public truck parking areas. For example, poor design at some locations make entry and exit movements difficult, passenger cars park in some truck spots, and some vehicles take up more than one spot due to poor lane markings and thereby waste available parking spaces.

This study produced the following recommendations:

- The locations along specified U.S. and state trunk highway routes and Interstates in Wisconsin that have the most serious shortages of parking capacity, grouped by priority ranking, are:
 - Top Priority: I-94 - exit 333, I-94 - exit 295, and I-94 - exit 4,
 - High Priority: the interchange at I-94/I-39/I-90 & US-51 - exit 132, I-43 - exit 107, I-90/I-94 - exit 108A (close to WI78 S), Intersection of WI-26/US-41 - exit 41, Intersection of US-41/WI-145, Intersection of I-90/I-43 and WI-81 - exit 185A, I-90 - exit 3, US-41 - exit 101, I-94 - exit 116, I-90/I-94 - exit 106, I-39/I-90 - exit 183, I-94 - exit 345,
 - Medium Priority: I-90/I-94 - exit 61.
- Advance parking information posted in real time, upstream of each parking area, would be useful for truckers searching for available spots. Variable road signs are recommended, as many drivers have described them as a valuable resource.
- Other recommendations include improving communication with truckers so that they understand policies regarding allowable parking in public rest areas and other locations.

Chapter 1. Introduction

1.1 Background

Truck parking has been a national issue for policy makers, regulators, planners and truckers starting in the 1990s. The demand for trucking services has grown rapidly during the past two decades. In 1990, freight movements by truck, measured in ton-miles, comprised 23 percent of total national goods movement. By 1998, truck ton-miles increased to 28 percent and by 2002, truck ton-miles accounted for 34 percent of total goods movement nationally (1). Wisconsin's economy depends on trucks for freight movement. Trucks carry 83 percent of all manufactured freight transported in Wisconsin, and over 77 percent of Wisconsin communities are served exclusively by trucks (2). The trucking industry in Wisconsin provides over 195,000 jobs, or one out of 14 of all jobs in the state. Total trucking wages paid in Wisconsin in 2005 exceeded \$7.5 billion, with an average annual trucking industry salary of \$37,383 (2). As trucking freight grows, especially along major freight corridors in the Upper Midwest region, truck parking problems have become increasingly significant to freight mobility in the state of Wisconsin. An examination of current truck parking in Wisconsin is therefore needed.

The urgency of this issue is a result of the increasing volume of commercial traffic on the Interstate Highway system, new Hours of Service (HOS) regulations implemented by the FHWA in 2005, growing incidents of truck parking on ramps, and increasing awareness of the connection between driver fatigue and traffic accidents. Federal Hour of Service (HOS) regulations (3) specify that truckers can be on duty for a maximum of 14 hours, during which a maximum of 11 driving hours are allowed. This rule implies that typically truckers are mandated to make an overnight stay while being en route for longer than a day. Complicating the matter is the fact that drivers are often under pressure to cover the greatest possible distance during each shift—causing them to drive until they have reached their legal limit and, in some cases, to park illegally on ramps or shoulders when legal parking in their immediate vicinity is unavailable. When truckers are fatigued or have reached their allowable driving time and have nowhere to park, they are forced to choose between continuing to drive and parking illegally, both of which raise serious safety concerns. The Federal Motor Carrier Safety Administration has estimated that driver fatigue is either a primary or secondary factor in 15 percent of crashes involving large trucks (4).

The adequacy of the supply of truck parking spaces is unknown both at the national level and in Wisconsin. According to a study by the Federal Highway Administration, there are regions in which available truck parking spaces are exceedingly scarce (5). This is probably due to the uneven distribution of truck parking demand over both space and time. Also, truck parking needs may be a direct result of the logistics and operational strategies that dictate delivery schedules. The growing use of “just-in-time” delivery and designated delivery times is contributing to the need for truck parking in and around urban areas.

Another study found that while a great deal of illegal truck parking in public right-of-way is a result of insufficient parking space at public rest areas and private truck stops (due to high demand and/or poor design), a significant percentage of truck drivers park in such areas in order to get away from disturbances. When describing these disturbances, truckers mentioned solicitations from drug dealers and prostitutes at private truck stops and enforcement of time limits at rest areas. These findings were consistent across a number of recent truck parking studies. In Wisconsin, truckers are allowed to park overnight in all rest areas. However, truckers may anticipate that time limits exist based on their general experiences traveling throughout the country, and they may factor this into their decisions about where to park.

Trucking represents the largest component of our nation's freight transportation system, and truck parking demand will only increase in the coming years (6). The nation's freight tonnage is projected to increase nearly 70 percent between 1998 and 2020, which necessitates planning for ways to accommodate the additional trucks that will be on the nation's highways (7). The freight corridors in Wisconsin will carry a significant amount of this freight and must be ready to accommodate a large increase in truck traffic in the coming years.

1.2 Study Objective and Scope

The objectives of this study are to understand and analyze trends in truck parking, and to identify 1) the parking issues for day trip drivers (related to short stops for meals and bathroom breaks), 2) operational issues causing the need for parking, 3) where new or expanded facilities are needed in Wisconsin, and 4) low-cost solutions to address truck parking shortfalls. Furthermore, this research spatially portrays the locations of existing truck parking facilities in Wisconsin and makes this information available to transportation stakeholders. By doing so, this study provides information necessary for the state of Wisconsin to consider increasing short term truck parking availability in the locations where it is needed most and also identifies the most important characteristics for new facilities.

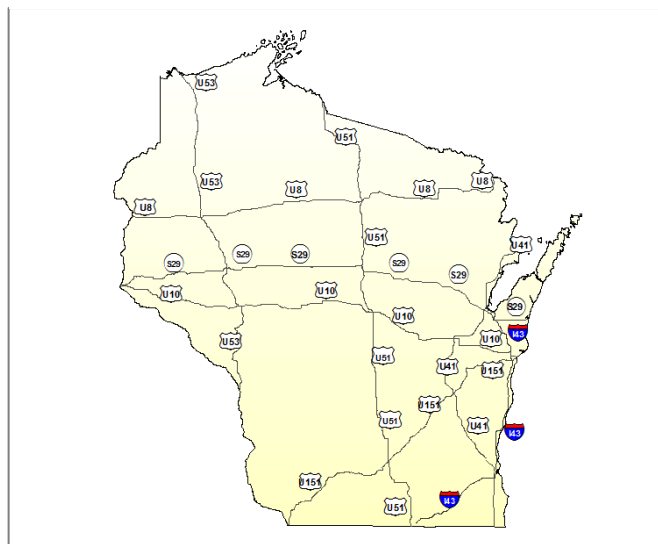


Figure 1: Wisconsin Highways in Study Scope

This study specifically covers major freight corridors in Wisconsin, which include Interstate 43, U.S. Highways 8, 10, 41, 51, 53 and 151, and State Trunk Highway 29 (shown in Figure 1). It also draws information from the Mississippi Valley Freight Coalition (MVFC) study *Low Cost*

Strategies for Short Term Parking on Interstate Highways of the MVFC (8), and therefore provides information about additional Interstate corridors in Wisconsin. Meanwhile, the present study complements the MVFC truck parking study by discussing truck parking along the aforementioned Wisconsin highways. The MVFC truck parking study builds upon the Federal Highway Administration's (FHWA) *Study of Adequacy of Parking Facilities (5)*, completed in 2002, which outlines the lack of adequate parking facilities for truckers and the mismatch between available facilities and trucker needs with regard to location, amenities, and functional characteristics. A potential benefit of both the present study and the MVFC truck parking study is that they identify ways to increase the efficiency of trucking operations while making it easier for drivers to comply with hours of service regulations.

1.3 Study Methodology

For both this study and the MVFC Truck Parking study, information about truck parking issues was collected from several stakeholder groups: freight carriers, truck drivers, metropolitan planning organization (MPO) representatives, state freight planners and state patrol officers. Our methods for data collection combine various techniques, which include online and paper-based surveys and in-person and telephone interviews. The research team used e-mail, telephone, and in-person contacts to solicit responses to the web-based survey and surveys and interviews were conducted between June 2008 and February 2009. The approaches used for both the surveys and the interviews are described in further detail below.

Survey Methodology

State and Metropolitan planning Organizations (MPOs) freight planners and highway patrol officers were contacted through e-mail and by telephone about the web-survey and its online link (see Appendix A for the questionnaire). It was easier to get responses from freight planners and highway patrol than from truck drivers. A few local freight carrier agencies were contacted using similar methods. However, these approaches were not effective for collecting data from truck drivers; therefore the research team gathered data from truckers in person at trucking conventions (see Appendix B for the questionnaire). More details on the survey methodology and challenges faced in data collection are described in the MVFC truck parking study (8).

The research team went to four trucking conventions - one in Iowa, two in Wisconsin, and one in Illinois - and surveyed the participants. When possible, the research team's booth at the event was equipped with Internet access and laptop computers, which enabled participants to take the surveys online. Otherwise, general and location-specific questionnaires were printed out and given to truckers to fill out at the events. In order to pinpoint the locations of parking facilities, truckers were asked to mark locations on a paper travel atlas. Data from each participant was later entered into the web-based survey system. Additional details on the surveys, including the response rate, the number of survey participants and the dates of data collection, are discussed in the MVFC truck parking study (8).

In total, 46 respondents from all three groups identified parking issues at 61 locations in Wisconsin. During the data cleaning process, some survey responses were found to be incomplete and a few respondents marked locations clearly not designated or suitable for truck parking, which had to be discarded. The distribution of responses is listed in Table 1.

It is evident that most of the voided entries are from truck drivers. This may be due in part to their level of proficiency with interactive maps and computers.

Table 1: Distribution of Survey Responses in Wisconsin

Respondents Group	No. of Participants	No. of Validated Samples
State Patrol	3	22
Freight Planners	1	2
Truck Drivers	42	37
Total	46	61

In the general population, there are more truck drivers than freight planners and state patrol officers. As such, the team expected to have more responses from truck drivers than from the other groups. Figure 2 shows the distribution of survey respondents based on the data samples collected from each group.

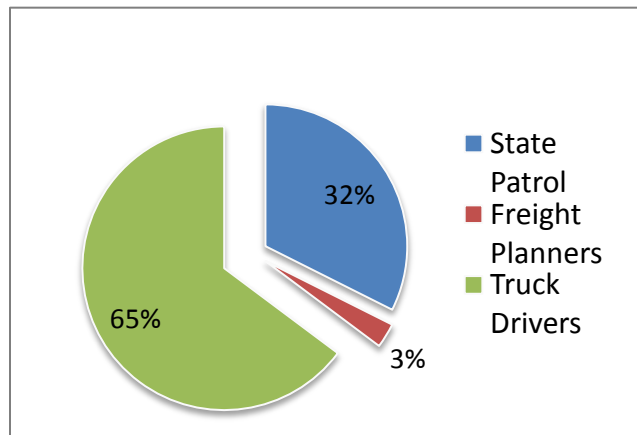


Figure 2: Distribution of Survey Responses

Interview Strategies

Representatives from both public and private sector organizations were contacted and interviewed to better understand their perspectives on truck parking issues and solutions for the state of Wisconsin. Of public sector organizations, staff at the Wisconsin Department of Transportation (WisDOT) were interviewed, along with several weigh station operators with the Wisconsin State Patrol, who confirmed that parked trucks would not be required to move out of weigh stations. The research team also spoke with representatives of the Wisconsin Department of Tourism, who discussed methods, locations, and program delivery strategies used for communicating with tourists, and the Wisconsin Department of Commerce, who suggested contacting business development agencies and suggested the Petroleum Environmental Cleanup Fund as a means of rehabilitating closed and unoccupied fueling stations. The team also contacted staff at Wisconsin Public Radio to determine if there were broadcasts or Wisconsin local delivery systems to communicate parking information. The research team also interviewed staff of the Ohio DOT, Indiana DOT, Michigan DOT and Minnesota DOT as part of the MVFC study, which supplies supplementary material to this study.

Motor carriers in the State of Wisconsin and the MVFC region and representatives of state trucking associations were interviewed to identify what role dispatchers and associations could play in communicating information about parking availability. The trucking companies interviewed includes Schneider National, JB Hunt, C.H. Robinson, Celadon Trucking, Heartland Express, Knight Transportation Midwest, McLeod Express LLC, H.O. Wolding, Birchwood Transport Corp, Boxer Trucking, LLC, and Skinner Transfer Corp. Several trucking associations around the Midwest were also contacted; these include the Wisconsin Trucking Association, the Illinois Trucking Association, the Indiana Trucking Association and the Mid-West Truckers Northern Illinois Advisory Group.

Interviews with carriers were confidential. Ten large irregular route trucking companies and brokerage firms were contacted, many with headquarters in MVFC states, to identify parking opportunities and issues for their drivers. Some large companies in this region have operating centers for their trucks, while others have fueling agreements with truck stop companies, which allow drivers to purchase fuel with a credit card. Some cards provide discounts on fuel, some are billed back to the trucking company on a direct basis, and others offer other frequent fueling program discounts and benefits. Many truck stop vendors have truck parking available for fuel purchasers, but there are no guarantees of parking availability.

The responses from the motor carrier executives provided insight on drivers' parking location preferences. Safety is one factor, as many truck accidents happen at rest areas and truck stops. This is primarily driven by the fact that many of these locations are crowded; when the number of spaces is maximized, there is little room to maneuver. Moreover, some tractor trailer combinations are particularly difficult to maneuver, making precision parking hazardous.

Drivers also prefer level locations where they won't be disturbed. In Wisconsin, trucks are allowed to park overnight at weigh stations. However, truckers have reported that they are concerned that they will be asked to move when station personnel arrive for duty, though representatives from WisDOT commented that drivers would not be asked to move in that situation. It is possible that other factors may play a role in truckers' decisions to park at weigh stations, though these were not mentioned by truckers participating in this study. Many at WisDOT feel that truckers do not park at weigh stations because they are concerned about being inspected, which might result in delays or a ticket. Other types of potential disturbances influence truckers' parking decisions. In some highly populated areas and at popular truck stops, vandalism and prostitution are problems. To minimize intrusion, many carriers move to ramp or roadside parking areas.

Truckers who travel regular routes are often able to predict choke points or congestion delays. For these drivers, many plan their trip with a stop after they have cleared the anticipated bottleneck location. This leads to bunching of truck parking demand on the outbound edge of many urban areas. Trucking associations indicate that many drivers who travel familiar regions have less difficulty predicting where to stop for rest or breaks. They also reported that carriers

with special load restrictions – such as those carrying high, wide or dimensional loads, hazardous waste or placarded loads - can run into problems finding suitable locations to rest.

The research team also conducted interviews with representatives from several other private organizations. Representatives from ParkingCarma, a high tech parking services company that patented the ParkingCarma SmartParking Information Network (SPIN), were contacted to identify available technology and plans for Internet access to parking information. The team also interviewed technical and marketing staff at Garmin, a navigation and communication devices company, who suggested using the ability to “program favorites” in navigation systems as a mechanism for creating a user “frequently accessed location” file and noted how the creation of intercept points could be used to alert drivers as they approach defined parking locations. Finally, commercial real estate brokers in Oak Creek, Wisconsin were contacted to determine the price of several parcels of land around the Ryan Road exit off of I-94. These brokers also discussed zoning and property tax issues with the research team and enabled them to access online property tax assessments and ownership information.

Geospatial Analysis

This study aims to determine specific locations in Wisconsin with parking issues and prioritize them based on specific criteria. All of the location-specific data collected through the survey was first cleaned for spatial errors (see the MVFC Truck Parking Study, Sec 4.2 [8]) and then exported to ArcGIS Desktop 9.3’ for spatial analysis. Other data required for analysis, including shape files of Interstate and state highways networks and related attribute information, was taken from the National Transportation Atlas Database (NTAD) 2006 and the Freight Analysis Framework (FAF) (9, 10).

The research team’s data analyses include 1) a cluster analysis of problematic truck parking facilities, 2) a correlation analysis of existing truck parking facilities and incommensurate parking facilities and 3) a determination of priority interstate and state corridors and cities in the region suffering from truck parking issues. The locations of parking facilities were clustered using the Nearest Neighbor Hierarchical (NNH) clustering algorithm in the software tool ‘CrimeStat 3.1’. These analyses generated results pertaining to the characteristics of services currently available at truck parking facilities, the possibility of expanding existing facilities and whether any new facilities are needed. Responses from the three participant groups differ according to their part in the transportation industry and the precision of their marked locations.

1.4 Organization of the Report

Chapter 2 reviews related studies on truck parking and findings from the MVFC Truck Parking Study. Chapter 3 describes the truck parking issues pertaining to Wisconsin as determined through surveys and in-person interviews. Chapter 4 presents results of the truck parking survey and the geo-spatial analyses, and discusses priority locations in the state for investment in truck parking facilities. It also describes the developed inventory of current truck parking facilities

along major Interstate and state corridors in Wisconsin. Chapter 5 presents a summary of findings and recommended low cost strategies to improve truck parking in the state. Additional recommendations, which are more applicable to the whole Mississippi Valley region, are explained in the MVFC Truck Parking Study (8).

Chapter 2. Related Studies

This chapter briefly summarizes other truck parking studies and projects, including the MVFC Truck Parking Study, that are most relevant to the present study. Several of these studies are also summarized in the MVFC truck parking study.

2.1 Parking Issues faced by Daytime Trip Truckers and during Short Stops

The Federal Highway Administration (FHWA) report *Commercial Driver Rest & Parking Requirements: Making Space for Safety* of 1996 (11) evaluates rest area parking facilities serving truck drivers using the Interstate highway system. This comprehensive assessment projected a shortfall of 28,400 truck parking spaces in public rest areas nationwide. The study's results showed some important distinctions between public rest areas and private truck stops. The majority of truck drivers surveyed expressed a preference for public rest areas for short-term parking, while two-thirds indicated a preference for private truck stops for long-term rest needs, which suggests a distinction between the facility types in terms of the needs that they serve. The original intent of rest areas along the nation's highways was to allow drivers to make brief stops to break up their journey (12). Providing a place for drivers to make longer stops or sleep is a more recent role for rest areas, although they generally do not accommodate these longer rest breaks, particularly for truckers. The study showed that while public rest areas lack adequate parking spaces for trucks, privately owned truck stops would not necessarily compensate for this because they serve different functions and meet different needs (11). This means that truckers find other places for long-term stops, often in unsafe areas, such as on highway shoulders or on the entrance and exit ramps of freeways.

FHWA developed a public rest area parking inventory by surveying DOTs of the 48 contiguous states, and nine toll road/throughway agencies responsible for a combined total of 1,487 public rest areas with facilities on the Interstate highway system (11). The key findings mentioned in this report are summarized below:

- For short-term parking (less than 2 hours), truck drivers prefer public rest areas (49%) to private truck stops (43%). For those who prefer rest areas, accessibility is usually the most important factor in choosing a short-term parking space.
- During the day, nearly half of all rest areas are full or overflowing.
- Nearly eight in ten rest areas report truck parking utilization as either full or overflowing onto the ramps at night.
- At least 42 percent of the 1,487 rest areas reviewed in the FHWA study have some type of limit on truck parking; e.g. 2 or 4 hour parking, or no overnight parking. (There are no time limits on truck parking at rest areas in Wisconsin.) At a majority of the facilities in the contiguous United States, however, these limits are “rarely” or “never” enforced. Only one in ten reports that time limits are always “enforced”.

- Parking areas for cars are underutilized. Six in ten rest areas have excess car parking capacity during the day, and eight in ten rest areas have excess parking capacity at night.
- A majority (54%) of truck drivers rate public rest areas as “fair” or “poor” (for meeting drivers’ rest needs). The reasons given for this less than favorable rating include: overcrowding, safety concerns, campers and recreational vehicles parked in truck parking spaces, time restrictions, not enough public rest areas, dirty or poorly kept facilities, and poor parking area/space design.
- Most rest areas provide restrooms. Nine in ten rest areas offer picnic tables. The majority of rest area facilities provide drinking water and telephones, but only half of these facilities offer snack or beverage machines.
- Trucks often park on the shoulders and ramps to avoid parallel parking spaces because they are difficult to use.

States have undertaken actions to improve the amenities and functionality of rest areas, including developing Welcome Centers that are designed to expand some services to travelers (13). Although states consider the needs of truckers as part of the planning and design process, they do not develop or expand rest areas for the exclusive use by truckers. According to the 2006 National Safety Rest Area Conference Open Forum Notes (14), Minnesota has been sizing rest areas based on daytime volumes and not addressing nighttime truck parking needs. Texas identifies that the problem is twofold; there is a need for short-term parking to address driver fatigue and a need for long-term parking to address required sleep requirements.

2.2 Case Studies

California Roadside Rest Area System

Caltrans convened the Caltrans Safety Roadside Rest Area System Team in January 1999 to develop a vision and recommendations for improving California’s Safety Roadside Rest Area System. The team - which included organizations representing the traveling public, commercial drivers, senior citizens, Caltrans staff responsible for safety rest areas, and several other state agencies - was charged with addressing the following issues:

- Significant increases in the safety of roadside rest area usage,
- Lack of a comprehensive master plan update since 1985,
- Perceived low level of priority and staffing for rest areas, and
- Issues related to truck usage of the safety rest areas.

The team developed recommendations for consideration by Caltrans management and the California Transportation Commission (15). In response to these recommendations, Caltrans established an In-Route Truck Issues Task Force. This task force was chaired by the Traffic Operations Program and included participation by the California Highway Patrol, the California Trucking Association, the California Chapter of the National Association of Truck Stops

Operators, the Automobile Association of Southern California, and the California State Automobile Association.

The task force identified a privatization–partnership concept that entails the construction of fenced, lighted parking lots built adjacent to commercial developments in the vicinity of overcrowded rest areas or where the master plan indicates unmet stopping needs. The auxiliary lots would be free to all motorists and there would be signs directing motorists to these lots from the highway and from nearby rest areas. It was envisioned that the private sector would provide restrooms, clean up litter, and provide security at these auxiliary lots through competitive, negotiated, long-term agreements. Land for these lots may be leased or purchased by the state. If implemented, this concept could alleviate the overcrowding experienced at current rest area locations.

Michigan Rest Area Utilization Study

The Michigan Department of Transportation and Michigan State University conducted a study of 82 rest areas in the state of Michigan (16). The study measured truck parking space utilization as a function of time by using modeling techniques, including regression and discriminant analyses. Observations for the parking utilization study were made at most of the rest areas along Interstates and U.S. routes in Michigan during peak overnight hours. The results of this study showed that although a majority of the rest areas (42%) were not full, some rest areas were overcrowded (19 %). Regression analyses were run for four time periods (12:00 a.m. to 2:00 a.m., 12:00 a.m. to 4:00 a.m., 4:00 a.m. to 8:00 a.m., and 6:00 a.m. to 8:00 a.m.) using a measure of truck parking space utilization as the response variable and factors including truck average daily traffic, number of truck parking spaces, parking space layout, and distance to the nearest city as the independent variables. The results of the regression analyses showed the following:

- From 12:00 a.m. to 2:00 a.m., truck average daily traffic was a significant factor in explaining parking space utilization.
- From 4:00 a.m. to 8:00 a.m., distance to the nearest city was a significant factor in explaining parking space utilization.
- From 6:00 a.m. to 8:00 a.m., parking space layout was a significant factor in explaining parking space utilization.

The results of the discriminant analysis showed that the same three factors that were found to be significant in the regression analyses were significant contributors to truck parking space utilization.

Minnesota Truck Parking Study

The Minnesota Interstate Truck Parking Study was completed in January 2008 in order to help the Minnesota Department of Transportation (Mn/DOT) develop the information necessary to support decisions regarding future responses to truck parking issues in Minnesota (1). The issues examined by the study include 1) determining what the state’s role should be in providing truck

parking; 2) which provisions of long term truck parking will provide the greatest support to the state's economy, and 3) what actions will provide the greatest impact on traffic safety while taking maximum advantage of effective technology and available federal programs.

The Minnesota Interstate Truck Parking Study examined the supply and demand of public and private commercial vehicle parking along Minnesota's three primary interstate corridors: I-90, I-35, and I-94. The study involved the three primary tasks listed below:

- An inventory of Minnesota's Interstate truck parking supply was established as a basis for collecting data regarding truck parking demand by time of day. Areas within one mile of interstate exits were examined with regard to parking facilities, rest areas, truck stops, vacant lots, or large parking lots at retail centers.
- Data compiled on parking facilities was then given to a field data collection team for use during facility site visits in order to carry out a truck parking demand analysis. Field researchers recorded truck parking supply information, including facility layout descriptions and total parking spaces, the number of available spaces, parking duration and limits, and facility ownership (public/private). Once this data was summarized, the team worked with the Mn/DOT Rest Area Program Manager to develop a measure that would effectively identify facilities that had reached or were over capacity during the busiest hours of the day. Overall, 20 facilities were identified as having significant capacity issues during the busiest time of day. Using all the available information, the project team produced maps showing the supply and demand for parking at public rest area facilities, with indications of how often public rest area parking facilities for commercial vehicles are filled to capacity during weeknight hours.
- The study also included a survey of trucking company practices. Vehicle information was turned over to researchers, who contacted the motor carrier companies responsible for the trucks observed to find out more about why their drivers were parked in a particular location and the nature of their stop. An attempt was made to contact the operating motor carrier within 48 hours of vehicle observation. The interview consisted of nine survey questions sent to 433 motor carriers throughout the Midwest and Canada. Of the 433 carriers identified, 178 (41 %) responded to the survey by telephone, fax, U.S. mail or email. In general, the purpose of the interviews was to determine reasons for parking selection.

Currently, the project team is developing a framework for future discussions regarding the impacts of various options, including 1) financial impacts; 2) safety impacts; 3) impacts to the motor carrier industry nationally, regionally, and locally; and 4) impacts to Minnesota shippers. This parking study essentially set the stage for future research on solutions for the state's truck parking issues.

Several statewide solutions have been identified that will form the framework for future studies. Upcoming phases of this study will evaluate the effectiveness of several options including, but

not limited to, public-private partnerships, parking capacity additions, parking policy revisions, and information technology (IT) systems.

FHWA Model Development for Commercial Vehicle Parking

According to the 2002 FHWA report *Model Development for National Assessment of Commercial Vehicle Parking (17)*, the proportions of total parking demand for rest area spaces and for truck stop spaces were derived based on survey responses from truck drivers regarding where they prefer to stop for different activities (e.g., long-term rest, restroom, meal, etc.). Tables 2 through 4 illustrate how the data from the survey was used to derive the levels of demand for rest areas and truck stop spaces. This process resulted in values for the proportion of parking demand for rest area and truck stop spaces to be 0.23 and 0.77, respectively (Table 4).

The study highlights that drivers prefer to use rest areas when making a short stop (to make a phone call, get a snack, or use the restroom) because they are more convenient to the highway than from truck stops. On the other hand, survey responses indicated that most long-haul drivers prefer to make their long-term rest stops in truck stops, because they provide more services (fuel, meal, showers) than rest areas.

Table 2: Number of Drivers Reporting Preferences for Rest Areas or Truck Stops by Activity

Activity	Average Time for Activity (hours)	Preference for Rest Area (# of drivers)	No Preference (# of drivers)	Preference for Truck Stop (# of drivers)
Restroom	0.25	208	334	222
Eat a meal	1.00	8	63	668
Quick nap	1.00	328	287	143
Extended rest	5.00	47	108	593
Vending machines	0.25	227	400	111
Phones	0.25	138	340	276
Travel information	0.25	85	370	278

Source: FHWA report “Model Development for National Assessment of Commercial Vehicle Parking, 2002

Table 3: Truck-hours of Parking at Rest Areas and Truck Stops by Activity (# of drivers reporting preference multiplied by average time for activity)

Activity	Preference for Rest Area (truck-hours)	No Preference (truck-hours)	Preference for Truck Stop (truck-hours)
Restroom	52.00	83.5	55.50
Eat a meal	8.00	63.0	668.00
Quick nap	328.00	287.0	143.00
Extended rest	235.00	540.0	2965.00
Vending machines	56.75	100.0	27.75
Phones	34.50	85.0	69.00
Travel information	21.25	92.5	69.50
Total truck-hours of parking	735.50	1251.0	3997.75

Source: FHWA report “Model Development for National Assessment of Commercial Vehicle Parking, 2002

Table 4: Proportion of Parking Demand for Rest Areas and Truck Stops

Facility	Demand (truck-hours)	Proportion of Total Demand
Rest Areas	$735.5 + 0.5 * 1251 = 1361$	$1361 / 5984.25 = \mathbf{0.23}$
Truck Stops	$3997.75 + 0.5 * 1251 = 4623.25$	$4623.25 / 5984.25 = \mathbf{0.77}$
Total	5,984.25	1.00

Source: FHWA report “Model Development for National Assessment of Commercial Vehicle Parking, 2002”

2.3 Findings from the MVFC Truck Parking Study

As the companion project to this study, the Mississippi Valley Freight coalition study *Low Cost Strategies for Short Term Parking on Interstate Highways of the MVFC* (8), focuses on truck parking facilities along Interstate highways in the ten-state Mississippi Valley (MV) region in the Midwestern United States, which includes Illinois, Iowa, Indiana, Kansas, Kentucky, Michigan, Minnesota, Missouri, Ohio and Wisconsin. This region is home to about 20 percent of the nation’s metro regions and metro-area population. Of these areas, Chicago, Illinois and Detroit, Michigan are larger than the average size of the nation’s 50 largest metro areas, and they serve as freight hubs that connect this region to the rest of the country and global markets. In addition, they are located at the crossroads of the continental United States and bridge cross country freight routes. Freight mobility has been a critical issue in the region because of freight bottlenecks and truck parking problems.

To help address MV freight transportation issues, the MVFC worked with the National Center for Freight and Infrastructure Research and Education (CFIRE) at the University of Wisconsin-Madison to address the lack of adequate truck parking facilities in the region and the mismatch between available facilities and truckers’ needs with regard to location, amenities, and functional characteristics. The goals of the study are to apply web-based GIS to 1) identify the problem truck parking areas in the MV region, 2) to carry out spatial cluster analysis and ranking to determine the areas where new or expanded truck parking facilities are needed, and 3) to disseminate truck parking spatial information over the Internet. This research is designed to provide information necessary for the states to consider increasing short term truck parking availability in the areas where it is most needed along the region’s Interstate highways.

In the MVFC truck parking study, the research team developed a web-based GIS tool to collect survey data from truck parking stakeholders and to support the visualization and analysis of truck parking hot spots. In total, 317 respondents from truck driver, state patrol, and freight planner groups identified parking issues at 360 locations across the 10-state region. For a more detailed description of the methodologies used to survey stakeholders, develop the web-based GIS tool, and analyze survey responses, please see the MVFC truck parking study (8).

Ultimately, the study reported the following findings regarding locations with truck parking issues:

- Interstate corridors to Chicago, Illinois, such as I-90, I-94, I-55, I-57 and I-80, have the highest density of incommensurate parking facilities. The I-94 corridor connecting

Minneapolis/St Paul, Minnesota, to other cities; I-39, I-90 and I-43 near Rockford, Illinois; and I-94 to Milwaukee also have truck parking problems.

- Locations with truck parking problems are usually in and around major urban areas, such as Milwaukee. It was observed in the survey that 58 percent of truckers like to park at locations on the outskirts of large cities. Milwaukee is considered to have relatively serious truck parking needs, while Madison and Janesville experience moderate parking shortages. Beloit and Racine were also noted as having parking shortages.

Table 5 gives a summary of locations and highways in the ten-state region Mississippi Valley region that have truck parking issues.

Table 5: Locations and Interstates with Truck Parking Issues in the 10-state Region

State	Cities with truck parking issues	Interstate corridors	Sections of Interstate
Illinois	Chicago, St. Louis, Rockford, Decatur	I-90, I-94, I-55, I-57, I-80, I-72, I-74 and I-55	Corridors near Chicago, Corridors connecting Decatur with Peoria and Springfield
Indiana	Indianapolis	I-65, I-69, I-70, I-80, I-94 and I-74	I-65, I-69, I-70 and I-74 near Indianapolis and I-80, I-94 between Chicago and Indianapolis
Iowa	Davenport, Des Moines	I-80	I-80 corridors near Davenport and Des Moines
Kansas	Kansas City and Topeka	I-35, I-70	Corridors connecting Kansas City and Topeka
Kentucky	Louisville, Bowling Green and Paducah	I-64, I-65, I-71 and I-24	I-64, I-65 and I-71 corridors near Louisville and I-24 near Bowling Green
Michigan	Detroit and Toledo	I-75, I-94, I-96	I-75 corridor connecting Toledo and Detroit, and I-94 and I-96 in outskirts of Detroit
Minnesota	Minneapolis – St. Paul and Albert Lea	I-94, I-35	I-94 east and west of Minneapolis –St. Paul and I-35 South of Minnesota
Missouri	St. Louis, Springfield and Eureka	I-44, I-70	I-44 between Springfield and St. Louis and I-70 between Columbia and St. Louis
Ohio	Columbus and Cincinnati	I-71	I-71 between and close to Columbus and Cleveland
Wisconsin	Milwaukee, Madison, Beloit, Racine	I-43, I-90, I-94	I-43 corridor connecting Chicago and Milwaukee, I-90 and I-94 connecting Chicago, Madison and Minneapolis

The MVFC study also revealed a number of other truck parking issues:

- Most of the locations with truck parking issues are facing capacity problems, with truck parking facilities being the most crowded between 9:00 PM and 5:00 AM. After capacity problems, ramp parking issues occur most frequently. Other parking issues that were reported include: “security concerns”, “unable to handle traffic”, “bad maintenance” and “bad stripes design.”

- Fifty three percent of truck drivers experience truck parking problems in more than 70 percent of their visits to locations identified as having truck parking issues.
- Major truck parking problems are caused by parking areas being used for staging purposes and for the breaks truckers take to conform to hours of service regulations. As a result, there are not enough parking spaces to meet peak demand during popular hours of use.
- Truckers use CB radio, Sirius, XM, and satellite radios and past experiences to get information about traffic congestion. On average, truckers check these sources about 2.86 hours in advance to plan their parking.
- The most important factor for truckers in planning their truck parking is the availability of gas, restrooms, and/or food, followed by security and proximity to their destination.
- Based on results of survey of state patrol officers across the region, the researchers estimate that approximately 14 percent of highway patrol officers across the Mississippi Valley region issue tickets if they see ramp parking or illegal parking, whereas the remaining 86 percent either issue a warning or ignore illegally-parked truckers because they do not want them to drive. (Wisconsin State Patrol reports that citations could be issued to truckers that park on ramps if the following conditions exist: the tractor/trailer is an imminent hazard, a sign is posted banning parking and other locations are available, or if the trucker is engaging in disorderly conduct or other illegal activities. However, most troopers in Wisconsin will choose not to wake drivers because they do not want to see a fatigued driver on the highway.)
- A majority of DOTs mention having a lack of funds to address truck parking demand in their states. WisDOT staff report that while federal funds are available for building new rest areas in Wisconsin, there is no funding available for maintaining them.
- Across the Mississippi Valley region, there is a lack of communication systems to inform truckers about available parking spaces. The study results show that most truckers either do not know about nearby truck stops or that nearby truck stops have a shortage of parking spaces. About 74 percent of DOTs in the region indicate that having no communication mechanism to inform truckers about available spaces is a serious issue, but truckers' responses to questions about this are significantly different from those of the highway patrol and freight planner groups.

Among the many suggested remedies for the truck parking shortage in the Mississippi Valley region, there are several that may hold particular promise. The first of these is the privatization of rest areas and public support of private truck stops in the form of tax credits or incentives. This solution is more cost-effective for the public sector than constructing or expanding rest areas and is supported by private truck stops as well.

A second solution is the use of ITS technologies to inform drivers on the road of available truck parking locations on a real-time basis. Though ITS-related strategies may generally be more complex and expensive, even simple signage indicating nearby parking areas can help truckers

find suitable rest areas, which will help reduce illegal parking and driver fatigue. Variable message boards can be used to deploy advanced parking information to help en route truckers make early and informed decisions. Upstream truck parking lots can display capacity availability for downstream lots. Additional solutions proposed for improving communication regarding available truck parking include web, radio, and cellular phone- based systems.

Solutions that involve modifying and renovating existing rest areas to accommodate more trucks have the advantage of being relatively low-cost if the state already owns the needed land, as there would be no need to purchase additional commercial real estate. In some cases, however, there may be opposition from neighboring landowners. Another solution that has been proposed is the use of inspection and to encourage increased use of weigh stations and park-and-ride facilities as truck parking locations during off hours. Wisconsin currently allows parking in the lots at weigh stations both day and night, and 23 percent of the state's weigh stations are 24/7 rest areas for trucks which offer restroom facilities and parking. However, their use has not been widely adopted. (It is important to note that drivers parking at weigh stations are required to weigh when the facility is open and may not "dolly down" and leave their trailers to pursue other interests, as they are able to do at private truck stops. They also may not park on entrance and exit ramps for safety reasons.)

Solutions to truck parking problems should be considered in the context of freight logistics and operations. For example, within urban areas, large distribution centers should consider providing truck parking spaces that are most convenient to truckers. The outskirts of large urban areas - such as Chicago, Illinois, Minneapolis/St. Paul, Minnesota, and Louisville, Kentucky - need to add truck parking capacity for the trucks staging for next day delivery. One of the major reasons that trucks stage for early next day delivery is due to an inability to deliver at night or during peak hour traffic. City ordinances may need to be changed to make the delivery window wider for truckers.

Chapter 3. Truck Parking Issues in Wisconsin

A basic background on the type of business and the nature of the commodities shipped in Wisconsin is needed to understand the state's truck parking needs.

Wisconsin has a pivotal location in the Upper Midwest and is important to large consumer and retail companies for low cost, high quality labor, and low cost land to support the development of distribution centers. Many retailers - including Wal-Mart, Target, and Walgreens - have established world class distribution centers in the southern region of the state. These facilities are primarily accessible by I-94, I-43 and US 41. Many interstate truckers that drive on Interstate highways pick up and deliver products to these busy facilities daily. Products moving inbound to these facilities often have international origins or come from diverse locations across North America.

Manufacturing is still strong in Wisconsin, with many industrial manufacturers located in the eastern portion of the state along I-43 and US 41. Shipments to these facilities tend to be more local or regional in nature. Truckers serving these locations tend to make more frequent but shorter-haul trips. The pulp and paper industry has an average inbound length of haul which is less than 200 miles. Meanwhile, Wisconsin's dairy and agriculture (i.e. processed foods) businesses rely on carriers who make multiple trips per day between farms and processing facilities.

Parking issues vary by highway corridor based on truck volume and the types of businesses located along the corridor. Regional or "day" truckers are often home at night and therefore have less need for overnight parking. Wisconsin also manufactures boats and industrial and commercial machinery, which is often moved as "over size" or dimensional cargo. These truckers have special needs when it comes to parking and route selection due to the fact that many of these loads take up more than one parking space and have turning or other maneuverability limitations.

Observations made for major Wisconsin highway corridors include the following:

- I-94 has the largest truckload volume in Wisconsin and connects busy, densely populated corridors. Many private truck stops have been developed along this corridor, but most if not all run out of overnight truck parking spots early in the evening. These shortages can be partly attributed to the limited footprint most private truck stops have, due to expensive land prices next to interstate interchanges, but also to the fact that truckers are not accustomed to having to pay for parking.
- I-43 carries a substantial volume of trucks in the state. Weigh stations are often an underutilized truck parking alternative. While actual practices vary among states, some drivers fear that they will be asked to move if they park in a weigh station, some feel that they will be subject to an inspection if they park at the station. Actual State DOT

practices vary by state, yet one experience tends to color a driver's perception of what is allowable.

- I-43 has much more parking demand in the southern portion of the state, specifically in Kenosha and Racine. This situation results in many trucks parking on access ramps, even when weigh station and rest area vacancy exists. In Newton, WI few trucks are observed to be parking overnight. Parking on access ramps is seen less frequently in the northern portion of the I-43. This is due to in part to the nature and number of businesses located in northern Wisconsin.
- US-41 is one of the most densely traveled state highways in Wisconsin, as it connects pulp and paper producers in the far northern portion of the state to production facilities- This corridor also connects two of Wisconsin's three largest population centers and supports substantial manufacturing and food processing activities. This corridor is also one that allows trucks carrying oversize and overweight loads to operate on it. While there are fewer national franchise truck stops along this corridor, local services seem to support the large population of regional carriers.
- US-51/Interstate 39 is a primary corridor for agriculture and forest products. Carriers in this business, due to the nature of logging and weather uncertainties, often load and stage shipments based on mill hours and highway conditions. Many of these movements are short haul in nature and most drivers are home every night, which reduces the need for overnight parking or rest areas. Because locations of logging operations and sales change based on timber availability, fewer truck stop services are available in the northern portion of this network. The portion of this corridor between the Illinois state line and Madison has private truck stops available.
- Expansions of Wisconsin State Trunk Highway 29 have recently been completed across the state. Because of the relative "newness" of this corridor, truck stops and services are beginning to develop along the eastern portion of this route. This highway is a connector primarily for finished products moving east-west between Green Bay and Minneapolis/St. Paul, Minnesota. This corridor also supports commerce in central Wisconsin and is a feeder route for the Wausau area.

The Waupun Truck-n-Show and the Wisconsin FLY IN truck stop appreciation event were the primary locations at which the study team interviewed truck drivers. These drivers represented a diverse group of carriers, including some owner-operators, some large fleet drivers and some company private fleet drivers. The truck parking issues these drivers identified include the following:

- More parking needs to be made available, but drivers are not willing to pay for parking. Drivers feel that they pay for infrastructure through truck license fees, which have

recently been increased, and through gas taxes. In their opinions, the money to fund truck parking “has already been collected.”

- Many drivers do not rely on any form of advance reservation system for finding truck parking. Most drivers felt that they were familiar enough with the areas that they traveled that they had “secret spots” they went to when the truck stops were full.
- Navigation systems were of some interest to truck drivers. Use of these systems is increasing and a data base from Wisconsin DOT is something they would consider using if it was easy to use.
- Most drivers reported that they would prefer not to park in closed weigh stations because they perceive that they will have to move when the station opens, which would interrupt their rest. In Wisconsin, law enforcement has been directed not to disturb drivers at rest unless they pose a hazard.
- Many fleet operators have engine monitoring systems and must conform to hours of service (HOS) regulations and certain speed limits. These systems are read by company managers as input for determining bonuses or incentive pay. When drivers cannot find parking at rest stops and have to keep moving, they are penalized if they operate outside standard hours of service.
- Truck parking needs to be close to the on or off ramps due to delay times getting to and from highways and also to poor turning radii and turn-around points, especially in small towns and rural areas.

Chapter 4. Spatial Analysis of Survey Data

4.1 Inventory of Parking on State Highway and Interstate Routes in Wisconsin

As mentioned previously, one of the goals of this research is to identify parking locations where new or expanded facilities are needed and the operational issues causing the need for additional parking at those locations. This required developing an inventory of existing truck parking facilities in Wisconsin, which was done in conjunction with similar research for the whole ten-state Mississippi Valley region. This inventory data was also used in efforts to clean survey data (see MVFC Truck Parking Study, Sec 4.2) (8). The inventory includes the following data elements:

- Major private parking and public rest areas located along Wisconsin's Interstate, U.S., and state trunk highways, along with other Interstates in the ten-state region.
- Site location data, including city, state, zip code, route number, travel direction and milepost number
- Physical characteristics of the site, including the number of truck parking spaces
- Site amenities and facilities, including food service, showers, restrooms, scales, and/or repair facilities

Development of the inventory also required information about public rest areas, commercial truck stops, and travel plazas with overnight parking. The primary data sources used include:

- The Wisconsin DOT web page showing public rest areas (<http://www.dot.wisconsin.gov/travel/restareas/locations.htm>) [also see Figure 3]
- The online Dieselboss Truck Stop Locator Directory (18) and the TruckerGuide 2007 (19), which were used to get information about commercial truck stops and travel plazas,
- Google Maps satellite images (20), and

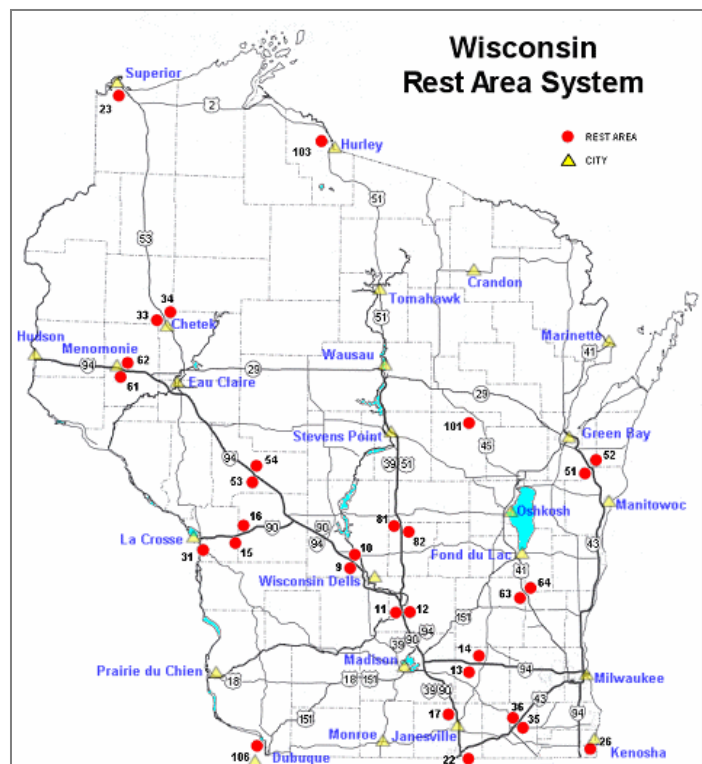


Figure 3: Public Rest Areas in Wisconsin

- Microsoft (MS) Live Search Maps satellite and “bird’s eye view” images (21).

Truck drivers value public rest areas primarily for ease of access and convenience. Wisconsin has 16 public rest areas on the routes reviewed in this study and 31 throughout the state. All public rest areas in Wisconsin provide truck parking spaces (See Figure 3). The contents of the inventory for Wisconsin are summarized in Table 6. These numbers do not match the values reported in FHWA’s *Commercial Driver Rest & Parking Requirements: Making Space for Safety* report (11), which was completed in 2002. A number of new rest areas were opened in the 1990’s. Other public rest areas were closed since 2002, those include Genoa City (closed in 2008) and Hudson (closed in 2009).

Table 6: Inventory of Truck Parking Facilities in Wisconsin

Facility Type	FHWA 2002		CFIRE 2008	
	Facilities	Total Parking Spaces	Facilities	Total Parking Spaces
Public Rest Areas (on study routes)			16	296
Public Rest Areas (statewide)	23	652	31	658
Private Truck Stops	80	2,863-5,971	43	3,983

The inventory includes public rest areas with at least 15 parking spaces and private truck stops with at least parking 12 spaces. The highest number of spaces noted at a single facility is 83 at a public rest area and 300 at a private facility. This study’s inventory database can be seen at the project website or at (<http://mvfcpraveen.cae.wisc.edu/visualizer/>) which covers most of the known commercial parking facilities in the ten-state region, contains information describing the number of commercial vehicle parking spaces available as well as information about amenities at each facility. Unfortunately, the number of parking spaces available at truck stops is not always expressed as an exact number in existing data sources. For example, the number may be given as a range (i.e. “more than 200”). Nor is this information available in the popular on line Trucker Guide (TruckerGuide, Inc. www.truckerguide.com) that lists a range of parking spaces at locations (i.e. small equals 0-10 spaces, medium equals 20-50 spaces, and large equals 50 or more spaces). In an effort to spatially portray the locations of private parking facilities, a Google Maps tool was developed. Figure 4 shows a sample screenshot from this tool.

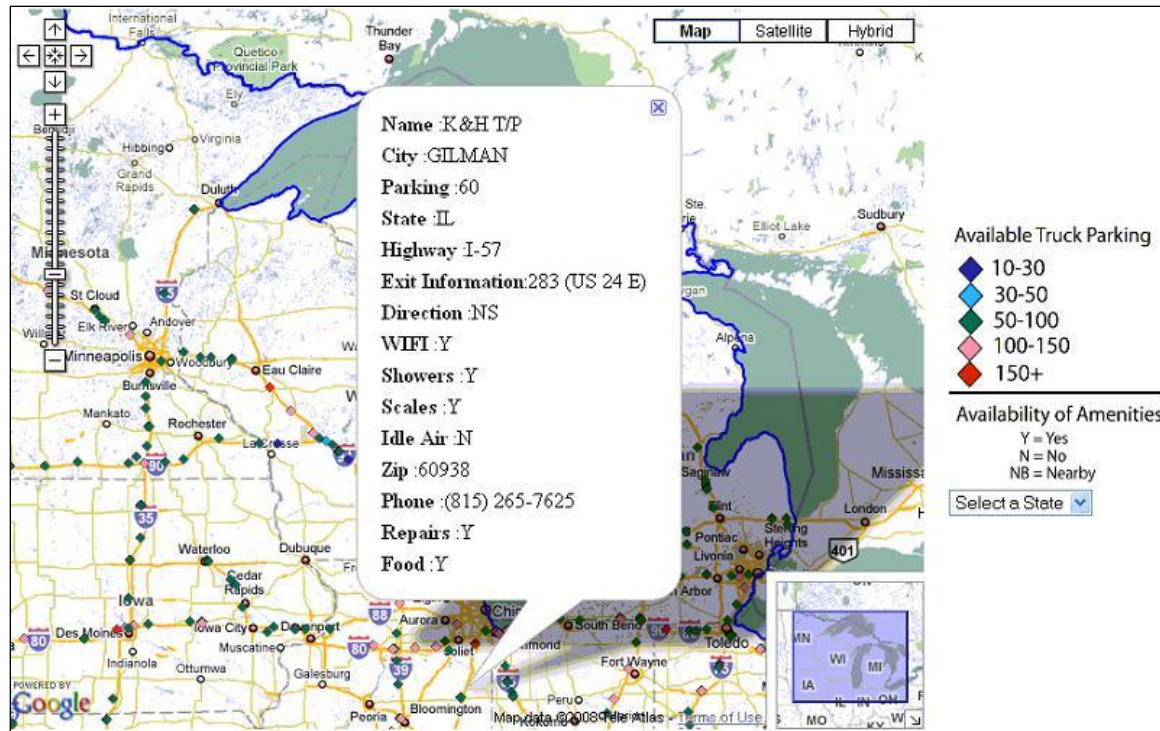


Figure 4: Screenshot of Private Truck Parking Facilities Visualization Tool

4.2 Geo-spatial Analysis Results

Distribution of Parking Problems

The research team classified the truck parking issues taken from the survey responses into the following categories:

- Capacity issues (i.e. parking facilities are always too full to meet the demand for truck parking)
- No Parking Around Site (i.e. the area in the vicinity of specified locations does not have enough parking facilities to meet the overflow demand for truck parking)
- Ramp parking (i.e. locations where survey respondents indicated trucks park on ramps)
- Design issues (i.e. parking spaces at a given facility are too small for long trucks and are not designed for trucks to effectively exit and enter)

The map in Figure 5 shows the distribution and concentration of locations experiencing the above-mentioned parking issues throughout Wisconsin. As shown on the map, many of these incommensurate locations are clustered around Interstate highway corridors, though several are located along U.S. Highway 41 and Wisconsin State Trunk Highway 29. Insufficient capacity for truck parking has been observed at most locations. However, locations with this problem are

more concentrated in southeast Wisconsin, where most of the freight operations in the state take place.

Ramp parking issues are the second-most frequently observed after capacity issues. Locations experiencing ramp parking problems are mostly found close to incommensurate truck parking facilities and rest areas. Truckers tend to avoid congested parking facilities and park their trucks on ramps. It has been observed in a few cases, however, that truckers park on ramps as a matter of convenience rather than necessity. For example, this occurs at I-94/exit 333 near Racine, at I-94 exit 4 near the Minnesota state line, and at I-90/exit 171A near Janesville. One of the

survey respondents from the state patrol group remarked

that some drivers stop at the ramps near the intersection of I-39/90 and I-43 for bathroom breaks instead of going to a nearby truck stop, even though “it would just add five to ten minutes to their trip.” In other cases, however, truckers park on ramps because they are unable to find an available parking space and cannot continue to drive under Hours of Service (HOS) regulations. For example, this occurs on U.S. 51 near US-51/exit 225 and near I-90/exit 28 near La Crosse.

There were far fewer parking facilities characterized as having design problems. One design issue reported in the surveys is primarily related to the need for parking space stripes to be angled so that trucks can pull in and out of spaces more easily.

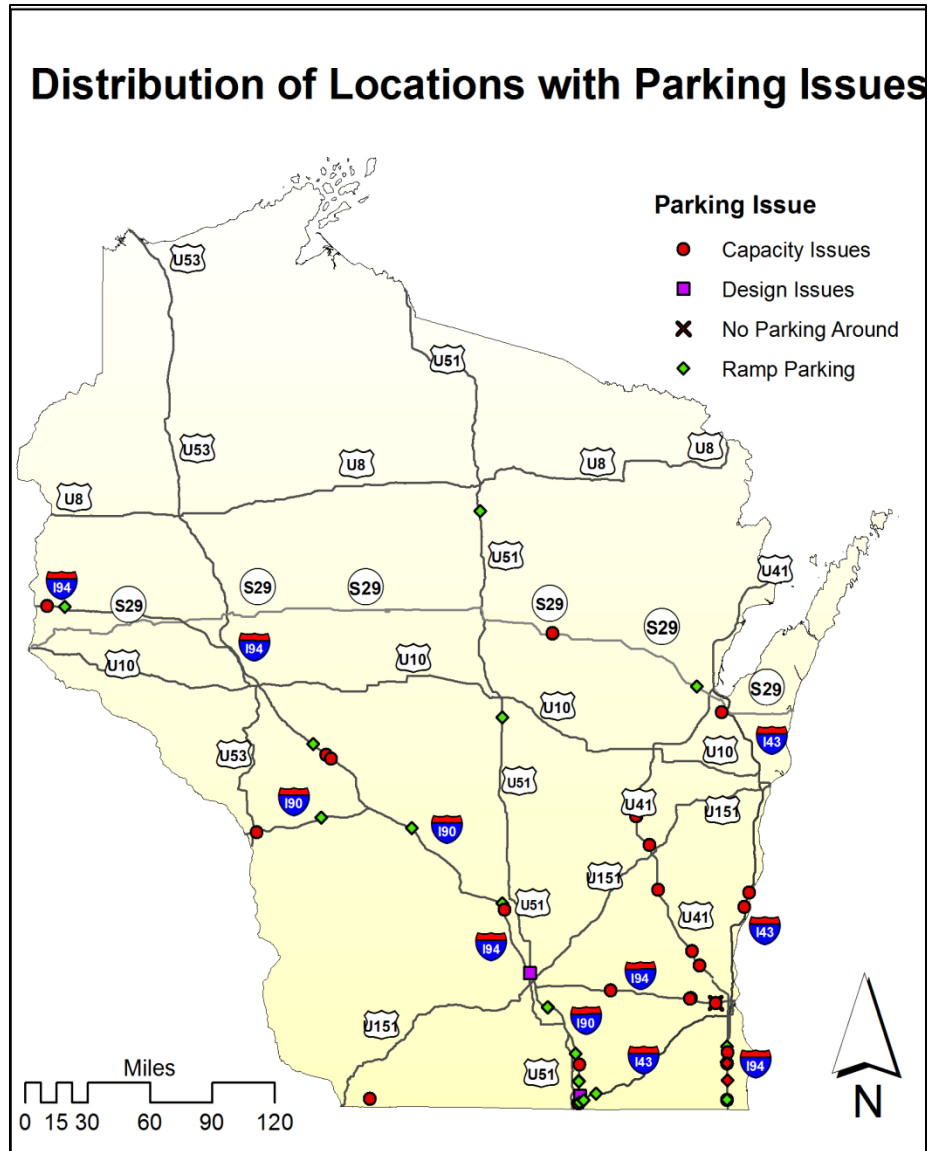
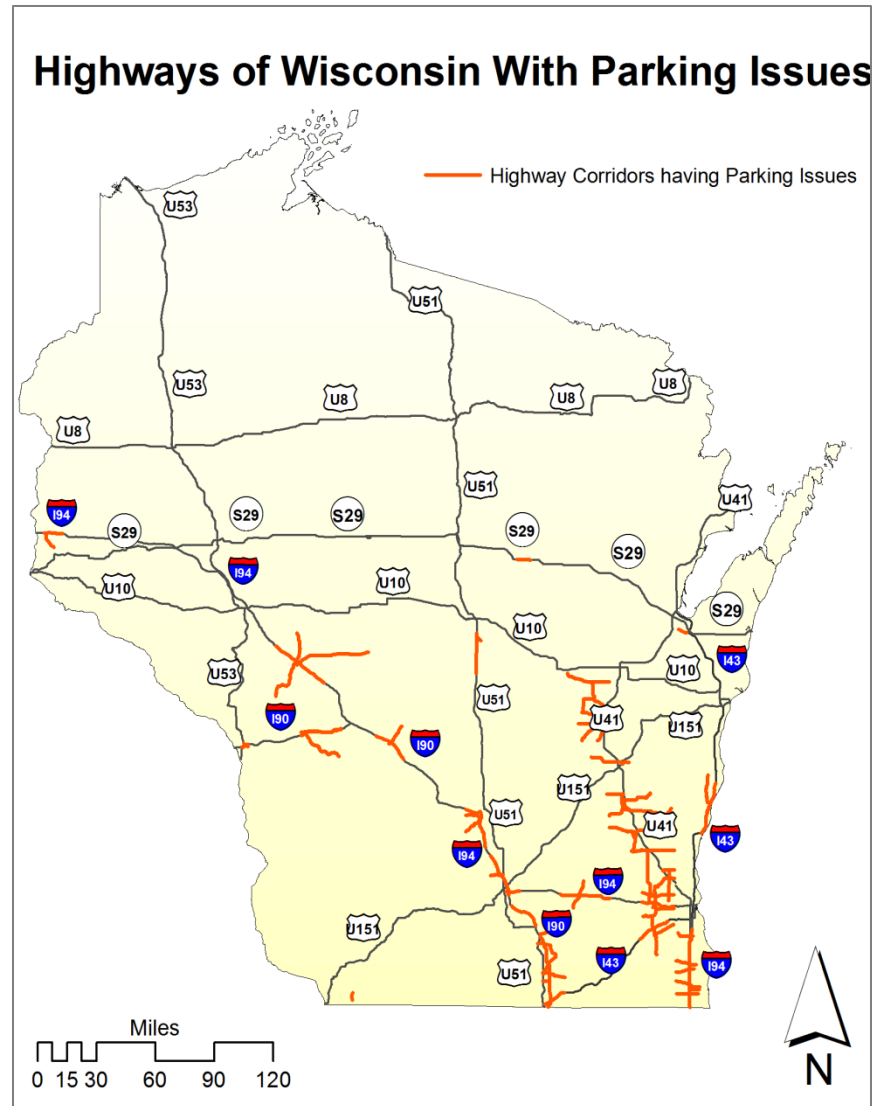


Figure 5: Distribution of Locations with Parking Issues in Wisconsin

Highway Corridors with Parking Issues

This analysis identifies the Interstate, U.S. and state trunk highway corridors in Wisconsin that are experiencing truck parking issues. The map in Figure 6 shows highlighted sections of Interstates and other highways in Wisconsin identified as having various truck parking problems.

The map shows that the I-94 corridor connecting Minneapolis/St. Paul and Madison, the intersection of I-94 and State Trunk Highway (STH) 54 near Black River Falls, and I-94 to Milwaukee each have several problematic parking locations. This is intuitive, as I-94 carries heavy truck flows between Minneapolis/St.



Paul, Minnesota and Chicago, Illinois, via Madison and Milwaukee to accommodate interstate trade in manufacturing and agricultural goods. Additional problem locations exist on STH 16 and STH 71 near La Crosse, I-39 near Stevens Point, STH 110 near Appleton, and STH 172 near Green Bay. Besides these, many other state, US and Interstate highway corridors in Wisconsin that have incommensurate parking facilities or are experiencing ramp parking issues. For example, many instances of ramp parking have been observed along the I-94 corridor to Milwaukee, especially at night. According to one trucker, “More trucks are noted just outside of the Milwaukee congestion area, where carriers have gotten through the choke points and are now staged to move reliably when they wake up.”

Priority Facilities Facing Capacity Issues

One purpose of this analysis is to determine priority truck parking facilities in Wisconsin which require immediate attention in order to resolve truck parking problems. The research team conducted this analysis by matching the locations mentioned in the surveys to existing facilities

and then represented capacity issues at these truck parking facilities. Facilities that matched multiple “marker” data points from the surveys were assigned an average value based on all the data points related to that facility. Through this process, a total of 32 such facilities were identified. In order to rank the facilities, the research team used the following criteria:

- The total number of markers matching a given truck parking facility (N), which range between 1 and 6.
- The responses to Question 2 in Appendix A- Questionnaire for truckers (F), which asks how frequently truckers experience parking issues at the marked parking facility. Possible values range between 0.1 and 0.9; with 0.1 equaling “once out of ten trips” and 0.9 equaling “almost every trip.”
- The responses to question 4 in Appendix A- Questionnaire for truckers (S), which asks truckers how severely they would characterize the parking issues they experience at the marked facility. Possible values range between 0.25 and 1, with 1 representing the most severe parking issues.

The ranking score was determined using the following formula:

$$\text{Ranking Score} = W_N * N + W_F * F + W_S * S,$$

where W_N , W_F and W_S are weights assigned to variables.

The frequency and severity of parking issues for a given marker are assigned by the same survey participant; however a facility is denoted by many markers which have been identified independently by different survey participants. Thus, the number of markers assigned to a facility was weighed more heavily than the frequency or severity scores. The research team chose to assign weights as W_N (number of markers) = 0.5, W_F (frequency) 0.25, and W_S (severity) = 0.25.

Table 7 shows the values this methodology requires to prioritize different parking facilities for truck parking improvements, while Figure 7 shows the locations of these facilities geographically. These facilities were then classified as Top, High, Medium and Low priority depending on their ranking scores. Table 7 also specifically highlights locations along I-43, U.S. 8, 10, 41, 51, 53 and 151, and STH 29, which include a mix of high, medium and low-priority facilities.

Table 7: Ranking of Parking Facilities with Capacity Issues

Location of Parking Facility	Markers	Average Frequency	Average Severity	Ranking Score	Priority
I-94 - Exit 333	6	0.9	0.625	0.881	Top
I-94 - Exit 295	3	0.9	0.667	0.642	Top
I-94 - Exit 4	2	0.9	0.875	0.610	Top
Interchange of I-94/I-39/I-90 & US-51 - Exit 132	1	0.9	1	0.558	High
I-43 - Exit 107	1	0.9	1	0.558	High
I-90/I-94 - Exit 108A (Close to WI78 S)	1	0.9	1	0.558	High
Intersection of WI-26/US-41 - Exit 41	3	0.57	0.58	0.538	High
Intersection of US-41/WI-145 (near Richfield)	1	0.9	0.75	0.496	High
Intersection of I-90/I-43 and WI-81 - Exit 185A	2	0.575	0.625	0.467	High
I-90 - Exit 3	1	0.9	0.5	0.433	High
US-41 - Exit 101	1	0.55	0.75	0.408	High
I-94 - Exit 116	2	0.45	0.50	0.404	High
I-90/I-94 - Exit 106	1	0.25	1	0.396	High
I-39/I-90 - Exit 183	1	0.25	1	0.396	High
I-94 - Exit 345	2	0.4	0.5	0.392	High
I-90/I-94 - Exit 61	1	0.45	0.75	0.383	Medium
Intersection of WI-11/WI-80N	1	0.9	0.25	0.371	Medium
Intersection of I-94/US-41 and WI-142 - Exit 339	1	0.45	0.625	0.352	Medium
I-94 - Exit 267	1	0.55	0.5	0.346	Medium
WI-26 - Exit 171A on I-90	1	0.55	0.5	0.346	Medium
I-90/I-39 - Exit 147	2	0.45	0.25	0.342	Medium
I-94 - Exit 329	2	0.45	0.25	0.342	Medium
Intersection of WI-29 and US-45S - Exit 195	2	0.4	0.25	0.329	Medium
Intersection of W-67 US-41 - Exit 85 on US-41	1	0.55	0.25	0.283	Low
Intersection of US-41 and US-45 - Exit 54	1	0.55	0.25	0.283	Low
I-39/I-90 - Between exit 163 and 171C	1	0.45	0.25	0.258	Low
I-39/US-51 - Exit 151	1	0.45	0.25	0.258	Low
I-94 - Exit 116	1	0.45	0.25	0.258	Low
I-94 - Exit 345	1	0.45	0.25	0.258	Low
I-90 -Exit 28	1	0.45	0.25	0.258	Low
I-43 - Exit 180	1	0.25	0.25	0.208	Low
I-43 - Exit 113	1	0.25	0.25	0.208	Low

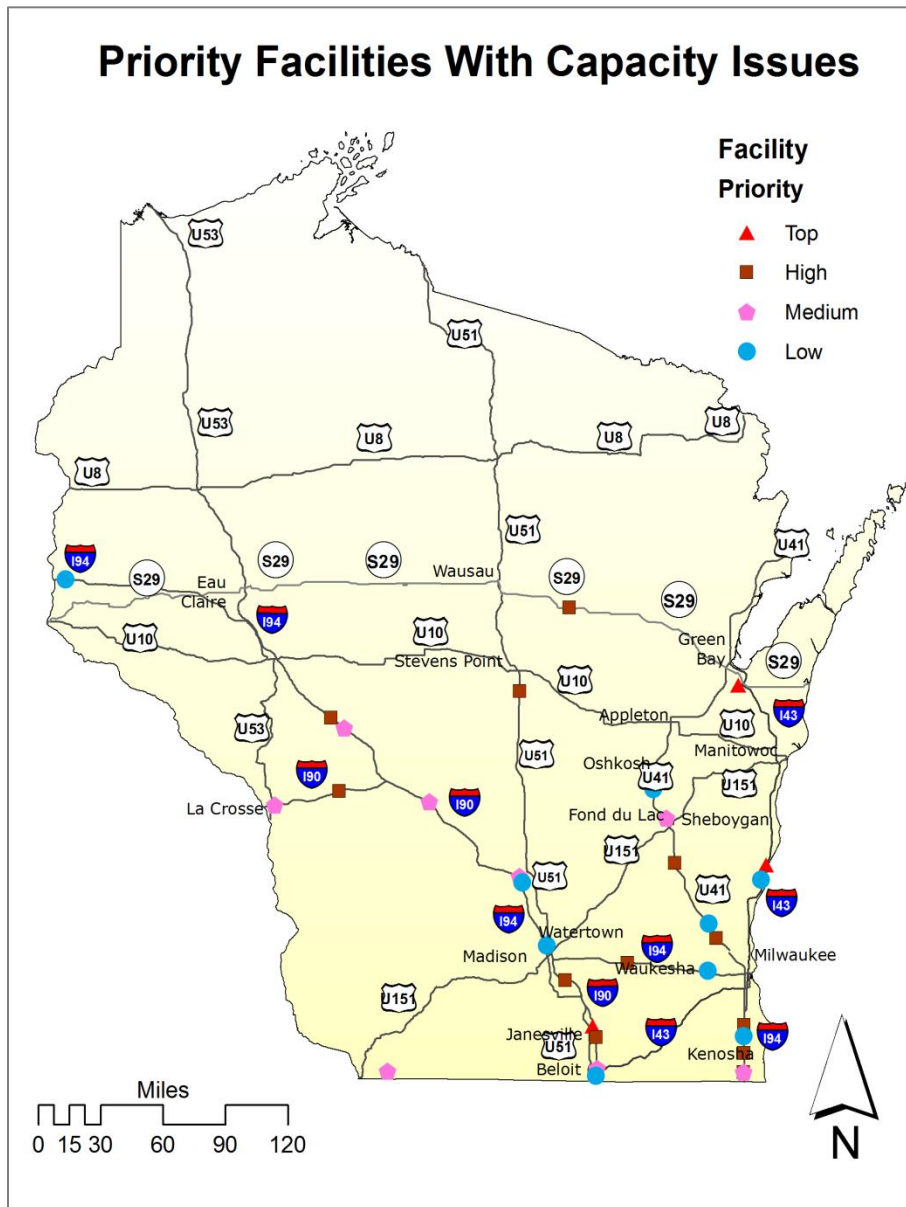


Figure 7: Priority Facilities with Capacity Issues

Parking Locations in Southeastern Wisconsin

Figure 8 provides a more detailed picture of the geographic distribution of locations with parking issues in the southeastern Wisconsin, which is where most of these locations are found in the state. This information regarding truck parking facilities in southeastern Wisconsin can be used by WisDOT and should be studied further to resolve existing parking issues and plan for additional facilities.



Figure 8: Close-up of Incommensurate Parking Locations in Southeast Wisconsin

The map in Figure 8 focuses on the proximity between locations with ramp parking issues and locations with capacity issues. Overnight ramp parking issues are seen at rest areas as well as near private truck stops, because overflow trucks park at the ramps at night when these lots become full. The majority of instances of ramp parking are caused by truckers being unable to find facilities with available parking spaces while driving in Wisconsin. For example, several ramps close to Clinton on I-43/exit 6 are used for truck parking. According to a participant from the state patrol group, “The rest area north of Janesville along I-39/I-90 seems to have a lot of ramp parking at night between 11 PM and 6 AM. Lack of parking facilities at the truck stops in Janesville is the cause. Troopers do not like to enforce the ramp parking here.” South of

Janesville, ramps are used for short breaks during the day or are used by drivers while working on log books. Additionally, ramp parking issues have been observed in Beloit and South Beloit due to the shortage of parking facilities there. A participant from the freight planner group mentioned another cause for ramp parking in southeast Wisconsin: “State Trunk Highway 140 is the port of entry for oversized loads. There is [a] place for truckers to park when they enter the state, however so many times they are forced to park on the ramps.”

Chapter 5. Summary of Findings and Recommendations

This section summarizes this study’s findings and details several low-cost recommendations for addressing truck parking issues in Wisconsin. As described previously, the state of Wisconsin has historically provided truck parking at rest areas along highway corridors. Additionally, many truck stop operators provide truck parking as a means to attract potential customers. In spite of this capacity, providing truck parking at sites experiencing high demand has been difficult, a situation which can be partially attributed to growth of freight traffic within and through Wisconsin and implementation of Hours of Service (HOS) legislation. Other factors play a role; for example, many truckers want to get past congested urban areas or to a point where there is a highly reliable and predictable transit time between where they stop and their final destination. However, these locations are often in areas where real estate costs are high and little remaining open land exists to develop truck parking facilities, and thus shortages occur. Collectively, these have led to considerable truck parking challenges in the state of Wisconsin.

5.1 Summary of Findings

Major findings from this research, which are consistent with the MVFC Truck Parking Study (8), include the following:

- Many truck parking problems take place at the outskirts of large metro areas, such as Milwaukee, where truckers park primarily for staging for customer appointment times.
- The most common parking problem is related to capacity and ramp parking. There are not enough parking spaces to meet the peak demand during popular hours of use and the overflow trucks park at nearby ramps.
- In most places, parking capacity shortages occur in the early evening or late at night.
- Bad weather during Wisconsin winters can also create parking shortages at rest areas and private truck stops.
- Truckers experiencing problems finding available parking spots in a given area tend to know little about parking availability in the vicinity and either do not have or are not aware of means to find needed information.
- Truckers also identified design problems in public truck parking areas. For example, poor design at some locations make entry and exit movements difficult, passenger cars park in some truck spaces, and some vehicles take up more than one spot due to poor lane markings and thereby waste available parking spaces.

The locations in Wisconsin experiencing the greatest shortages of parking capacity – included those on Interstate, U.S., and State Trunk Highway corridors - are listed below according to priority category.

- Top Priority: I-94 - exit 333, I-94 - exit 295, and I-94 - exit 4,

- High Priority: the interchange at I-94/I-39/I-90 & US-51 - exit 132, I-43 - exit 107, I-90/I-94 - exit 108A (close to WI78 S), Intersection of WI-26/US-41 - exit 41, Intersection of US-41/WI-145, Intersection of I-90/I-43 and WI-81 - exit 185A, I-90 - exit 3, US-41 - exit 101, I-94 - exit 116, I-90/I-94 - exit 106, I-39/I-90 - exit 183, I-94 - exit 345,
- Medium Priority: I-90/I-94 - exit 61.

These results indicate that many locations with serious truck parking issues are concentrated in southeastern Wisconsin. Other locations experiencing parking shortages include areas close to the Minnesota border, such as Hudson, and cities close to Illinois, such as Beloit and Janesville.

The research team explored several low cost solutions for truck parking problems in Wisconsin using information gathered from discussions with public and private parking providers, software experts and drivers. These recommendations are briefly discussed in the following subsection. This study defines low-cost solutions as those which do not depend on additional purchases of right-of-way or expansion of rest areas. The research team did not assign dollar amounts or ranges to the recommendations in this study, but such cost estimations should be the subject of future research.

5.2 Private Truck Stops and the Privatization of Rest Areas

Some of the most commonly cited truck parking problems are the shortage of parking capacity at public rest areas and, in some cases, closures of public rest areas. Privatizing these facilities is one potential solution. Because of longstanding federal regulations, this option has not been implemented on the Interstate network. Toll roads that receive no federal aid have promoted privately-financed rest areas, which do not exist on the Interstate system unless they were in operation prior to 1960. During the last 20 years, there has been interest in public-private partnerships with businesses to fund the maintenance and operations of rest areas so that state departments of transportation could cut costs. One of the survey respondents indicated an interest in public private partnerships with private truck stops which already have restaurant, diesel, and shower facilities, saying, “Maine DOT has partnered with Irving Oil Company on just such a project near I-95 in Kittery, Maine.”

However, there are many challenges involved in implementing this option. US Code Title 23, Chapter 1, Section 111, prohibits privatization of rest areas on federally funded highways. Also, because, of stiff opposition from the National Association of Truck Stop Operators (NATSO), the McDonald’s Corporation, and local businesses, no public rest areas have been privatized. NATSO, which represents over 900 private truck stops nationwide, and McDonald’s are worried that an increase in the size and services at current public rest areas would lead to reduced demand at restaurants and truck stops located at highway exits (22).

While the National Transportation Safety Board (NTSB) recommended in 2000 that the Congressional ban on privatization of rest areas be repealed, NATSO argues that lifting the ban

would damage existing businesses located near commercialized rest areas and would result in a decrease in available parking spaces because nearby truck stops would go out of business. A NATSO funded study conducted by the University of Maryland in 2003 (23) found that truck stops located at interchange exits near commercialized rest areas built before 1960 experienced sales significantly lower than the average truck stop. Specifically, these stops sold 56 percent less food, 51 percent less gasoline, and had 46 percent lower sales at truck service facilities.

One example from Indiana demonstrates how these reduced sales can translate into problems for truck parking. Indiana DOT contacted a private truck stop owner about their plans to expand an area of an interstate highway in Indianapolis. There was available land next to the existing truck stop. Representatives of the truck stop said that the cost of the land, pavement, lighting, maintenance and increased property taxes could not be justified since these anticipated costs would be far greater than any incremental increase in fuel or grocery purchases at the existing location. A similar analysis was reviewed in Milwaukee and the price of land in proximity to the Interstate was prohibitively expensive and not feasible for most truck stop operators to purchase.

With over 90 percent of truck stop parking free, NATSO has maintained in the past that if demand grows large enough, truck stop owners will begin charging parking fees to truckers to cover the costs of providing additional parking. Because it may be politically difficult to privatize rest areas, one possible alternative is to create incentives for truck stops to maintain free parking and provide the services of public rest areas. For example, Vermont DOT closed a small run-down rest area and designated a nearby truck stop a “Vermont Interstate Center.” In exchange for this designation, the truck stop agreed to meet certain criteria, such as providing prominent tourist information and 24-hour access to pay phones, parking and restrooms. Utah has tried a similar program. NATSO supports directing motorists to private facilities as a substitute for public rest areas but believes that the federal government should set standards to increase openness and transparency in the process of designating such facilities to ensure fairness. It also supports standardizing the name and signage of these facilities across the country as well; it suggests the name “Interstate Oasis” (24).

DOTs can also work with other private entities to increase the supply of truck parking. For example, in Northern Illinois IDOT is working with a private land owner adjacent to the interstate to provide access to a large employer. The large employer owns the property adjacent to an existing oasis and was willing to swap employee access to their facility for key property needed for truck parking expansion. In sum, there is precedent among state transportation agencies such that WisDOT could examine privatizing rest areas or developing agreements with private entities as a way to increase the state’s supply of truck parking.

5.3 Parking Management Systems

The next series of recommendations involve the use of real-time information, the first among these being parking management systems. While real-time tools that inform drivers about current space availability are useful to drivers considering an immediate stop, these systems can also be useful for drivers who have preplanned stops, especially for confirming that anticipated spaces exist prior to the driver exiting the highway. Many drivers indicate that many of their usual stopping points are becoming unavailable as the number of trucks and the volume of freight increases. Real-time information systems are particularly useful when drivers find themselves in a situation at the end of their hours-of-service limit with no legal place to stop and rest.

Smith, et al. (25) performed a comprehensive evaluation of ITS technologies related to truck parking for the Federal Motor Carrier Safety Administration. The report mentions two possible methods of providing information about space availability. The first method was to use historical data to calculate daily and seasonal patterns of parking space usage and provide drivers an estimate of when all spaces are likely to be filled. Another method is to allow drivers to reserve a parking space with a parking management system, which would then include these reservations when providing parking availability information to drivers. However, the information and communications needs required to process reservation requests and update parking availability might make this approach impractical. Implementing reservation processes can be further complicated by rest areas, where parking spot designation is unclear and where passenger and recreation vehicles may park in designated truck areas. Many drivers complain about others who park on the lines or take up two spaces because of others who are trying to fit into non-designated areas.

Based in part on the findings of the above-mentioned study, there are two potential approaches for using information technology to enhance drivers' ability to plan their stops more effectively. First, historical occupancy data (for a time period of at least one year) could be provided online so that drivers can better estimate their likelihood of finding a space at a given time and date. Second, parking availability could be integrated into the decision support software sometimes used by drivers and carriers to select refueling stops. Planning where to refuel is important to carriers because the cost of fuel is the carriers second largest cost item. Many truck stops publish how many spaces are available at their location but have not implemented a reservation system. Rest locations are often at or near refueling areas, so integrating information about them into a single online format would make the trip planning process more efficient.

All ITS deployments made with highway trust funds for highways or transit must conform to the National ITS Architecture and Standards. Parking management functions, as defined in the National ITS Architecture, include space availability monitoring, provision of information about parking availability and cost, electronic fee collection, and violation enforcement. Parking availability information is to be provided to: drivers in the immediate vicinity of parking areas through the use of variable message signs, information service providers through fixed-point to

fixed-point communication, and other parking facilities. Parking information service providers could include large trucking firms performing this function for their fleet or industry groups or truck stop operators or public highway agencies performing the function for specific parking locations or geographical areas. Work continues in this area to determine the best way to inform drivers of parking availability.

5.4 Real Time Counts of Available Parking Spaces

The effectiveness of real-time tools to aid drivers in planning where to stop while they are on the road is dependent on having 1) a sufficient number of total parking spaces on the road segment, 2) the ability to accurately detect the number of trucks parked in an area, and 3) being able to translate this information into a usable format for approaching drivers. ITS solutions can aid in matching supply and demand to better utilize spaces.

Measuring the number of available spaces can be done using either vehicle detection at each parking space or a “count in, count out” method that would keep a running total of available spaces by detecting trucks entering and leaving the parking area. Vehicle detection at each space tends to be more accurate but much more costly to implement. At some parking facilities there is a single entryway for both automobiles and commercial motor vehicles, which necessitates that any “count in, count out” system be able to distinguish between cars and trucks. Effective “count in, count out” technologies include pole-mounted break beams and weight-in-motion (WIM) technologies. Although the cost of WIM equipment tends to be much higher than pole-mounted break beams, parking areas co-located with weigh stations might save costs by making existing WIM equipment dual-use. The “count in, count out” approach also requires that entries and exits from parking areas be well organized to ensure that all vehicles are detected as they enter and exit the facility and that the system allows an operator to manually adjust the count on a daily or weekly basis so that counting errors do not accumulate and reduce the accuracy. This often requires on-site reconciliation or the means to monitor these areas via remote cameras for visual verification.

5.5 Signs and Message Boards to Communicate Parking Availability

Communicating parking availability information to drivers can help effectively use available parking by matching drivers with available parking spaces. Solutions such as smart signs - which display real-time information on available parking spaces at truck stops before truckers reach them - can help truckers planning parking beforehand. Also, signs showing the distance to the next truck stop from a prior one can enhance planning on the driver’s part, as they can make parking decisions based on how far and where they are going. A potential low-cost solution would be putting signs at truck stops to give information about nearby locations. Variable message signs are the simplest, most effective method of delivering information to drivers. The signs located near parking areas could be hard-wired, while those located further away could be

equipped with a radio-frequency or cellular telephone interface. Different truck parking stakeholders may perceive ITS solutions to be low cost depending on who pays for data collection and the technology to transmit information. However, improvements of this sort do not result in resistance from local residents and are far less capital intensive than increasing the supply of spaces.

5.6 Web-based Information Systems

There are currently several available online resources available to aid truckers in planning for their next night's stopping place. NATSO operates an online guide with very basic information about 1,100 truck stops in the United States (26). *Trucker's Friend* is a paid website sponsored by TR Information Publishers, which includes information on the facilities and number of parking spaces at several thousand truck stops (27). The state of Maryland also publishes a truck map and motor carrier handbook (28) which is available online and lists private truck stops, park and ride lots, and weigh stations with overnight parking within the state. However, none of these sites provides a nationwide all-inclusive list of legal parking areas for trucks. One of the future potential extensions of the survey data visualization tool and online inventory of truck parking for the Midwest region could be a comprehensive GIS based truck parking information system.

The study team contacted several navigation systems providers to explore ways of communicating truck parking locations via satellite navigation systems. In much the same way that passenger cars can program favorite destinations in their navigation systems, truckers could program a truck parking directory into their navigation systems. After several interviews a process was suggested whereby all the truck parking locations in a given state could be compiled into a universal file format. As trucks enter the state, the first truck weigh station or welcome site could provide a WIFI hot spot with information about how to download this location file to their navigation system. An enhanced mechanism to provide the actual number of truck parking spaces could also exist in areas with ITS systems.

There are some limitations to using web applications to transmit parking information to truckers. From a practical standpoint, the driver wants to know if there is a parking spot at the desired location before they pull off the highway. Many drivers report that they find searching the web for a parking spot to be a waste of time, particularly on applications without real-time features. It is also impractical for drivers to access a computerized screen while driving.

5.7 Radio Broadcast Solutions

Radio broadcasts may also be a viable means of getting parking information to drivers. Many drivers listen to satellite radio broadcast. Many of the "Trucker Buddy" programs are prerecorded but a mechanism could be designed to incorporate truck parking information on weather and travel channels, provided that there is a way to make sure the information is up to date and accurate. This solution may be helpful in larger urban areas, though there are many

areas where queuing and parking issues exist that are not covered by these satellite stations. Broadcasting regular parking space availability messages using a synthesized voice on traveler information radio (on AM frequencies set aside by the Federal Communications Commission) would be an economical option as well. However, converting raw data into a suitable format for broadcast would require some effort. CB radio, which is very popular with truck drivers, is another possible medium for transmitting information on parking space availability, although it is not typically used to broadcast information. For any of these mechanisms to be effective, a real-time inventory of spaces left or alerts signifying areas where no space is available must be first established.

5.8 Cellular Phone Based Solutions

The majority of truckers carry cellular telephones with them, and those that do not can use phones at stopping places. Therefore, it is feasible to communicate information to drivers through either a dedicated parking availability information system or an additional truck-specific menu on Wisconsin's existing 511 traveler information system. On-board computers, which are widely used by carriers to communicate with drivers, could also be used to transmit parking information.



The 511 system was designed by the Federal Communications Commission (FCC) as a nationwide three-digit telephone number for traveler information. This system was established in 1999 to support information on traffic delay, weather, transit and tourism information. Actual functionality varies by the telecom provider, the state DOTs or the local transportation and transit agencies that support the system.

The deployment status map in Figure 9 illustrates that nearly 70 percent of the U.S. population has access to the system. The dark green states have operational systems and the light green states began implementation in 2008 (29). Seven of the 10 states of the MVFC are deploying 511 systems. As of 2008, more than 53 million 511 calls nationwide have been received since 511 inception (30).

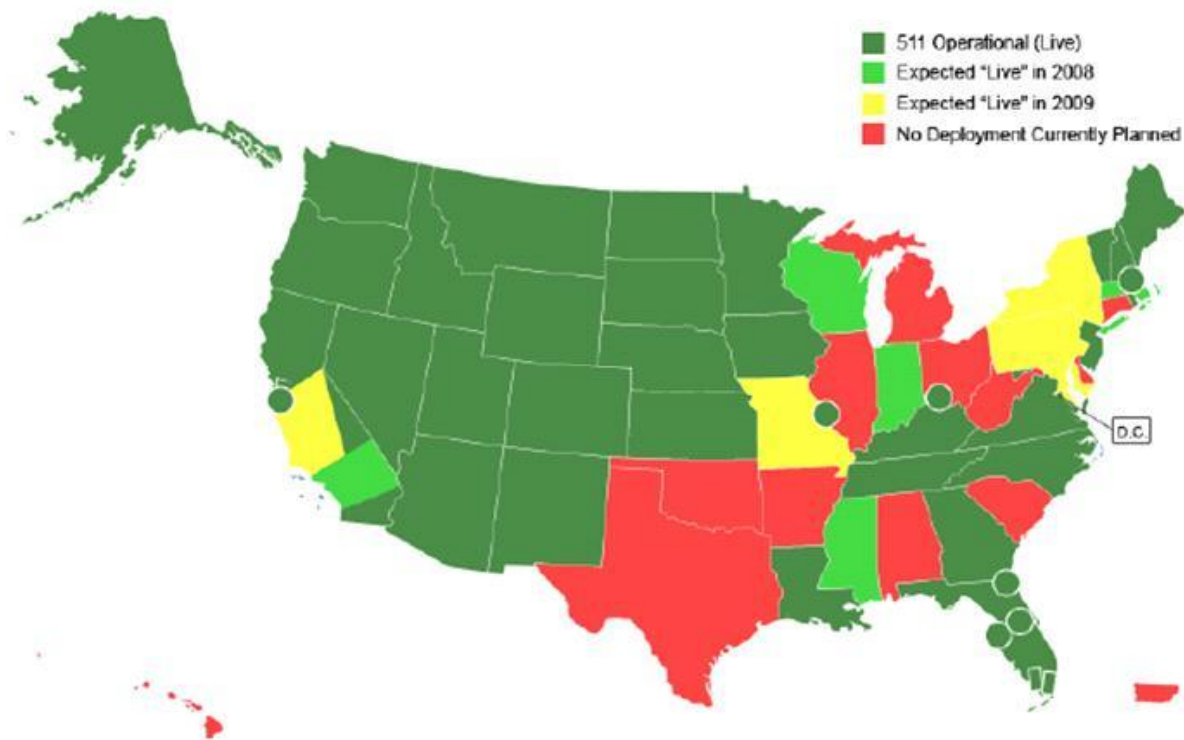
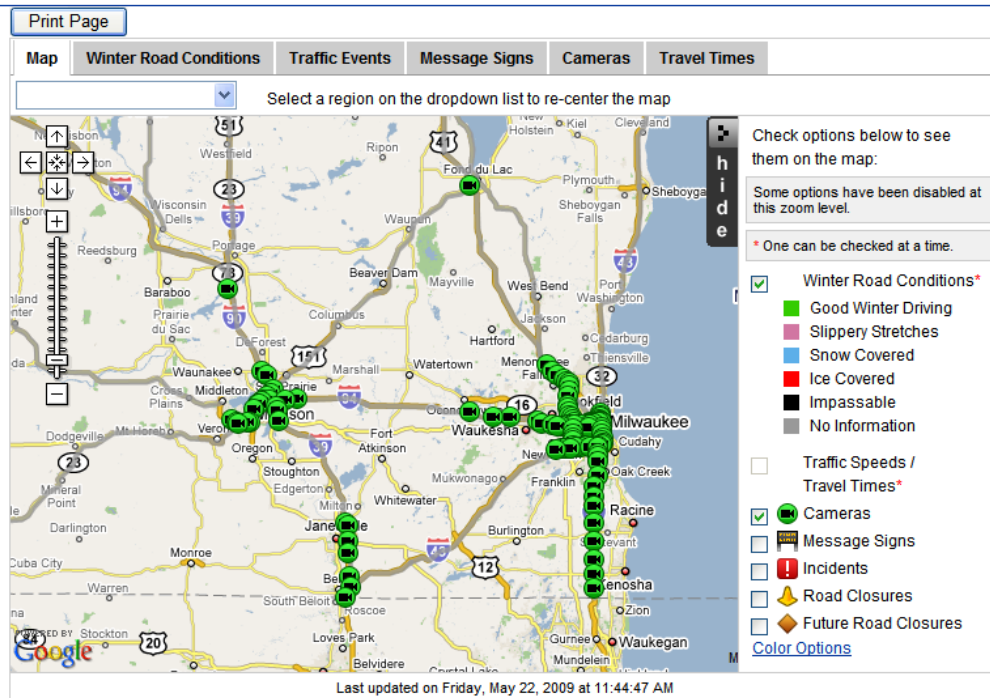


Figure 9: 511 Deployment Status as of Feb 21, 2009

The Wisconsin 511 system (31) includes information on many topics, including: modes of travel, travel assistance, construction, safety and emergency information, major events and tourism. Statewide and urban public transportation systems in Milwaukee, Madison, Wausau, and Eau Claire, along with Valley Transport, can link to the system. The Wisconsin system dispatches lane/ramp closures with detour information, current driving conditions, and construction updates for key state projects, such as the I-94 North-South Freeway project. Cameras showing real-time traffic and weather are located in Brown, Columbia, Dane, Fond du Lac, Kenosha, Marathon, Milwaukee, Racine, Rock and Waukesha counties, with specific camera surveillance of the following highways: East Johnson Street (Madison), East Washington Avenue (Madison), I 39/I 90, I43, I 43/I894, I 43/I 94, I 794, I 894/ 45, I 94, Miller Parkway (Milwaukee), STH 172, US 12, US 41, US 51, US 41/45, US 45 and WIS 30. The following map (Figure 10) shows a snapshot of locations with Wisconsin DOT traffic cameras.



© Copyright 2008 Wisconsin Department of Transportation. All Rights Reserved. [Privacy Policy](#)

[Home](#) | [Traffic](#) | [Transit](#) | [Travel Services](#) | [Help/FAQ](#) | [My 511wi](#) | [Sitemap](#) | [Contact Us](#) | [Disclaimer](#)

Figure 10: Locations of Wisconsin DOT Traffic Cameras

Many of these highways were noted as having truck parking shortages. The Wisconsin 511 system has personalization features which might be valuable to the trucking community in addressing this problem. The deployment of the MY 511 program, which is scheduled for 2009, will require users to register their cell phones with the system. Truckers could register their cell phones with the Wisconsin 511 system and set up the program to alert them to truck parking availability at given times of day or on given routes they are traveling.

Setting up a truck specific menu on the 511 programs across a multi-state region would improve adoption of the system. Interoperability issues in the MVFC area are being addressed by the MVFC Clearinghouse Project. Data on actual truck parking availability is the missing element of the current system. A possible solution to this would include placing vehicle counting devices at truck stops and rest areas. These counters may not always be accurate if users park using more than one spot. Cameras could be mounted at popular parking locations and instant visuals of parking areas could be transmitted via cell phone displays.

As cell phone technology improves and the use of personal navigation systems expands, there is an opportunity for state DOTs to compile and collect truck parking data for their state. At “Welcome Portals” located near state boundaries, many states have WIFI hot spots that could be used by carriers and/or the public to download parking locations. (States currently sponsoring or

planning to sponsor WIFI hotspots should be aware of potential safety and security issues related to making these hotspots non-restricted.) These locations could be coded with intercept data, so that as the motor carrier or the passenger vehicle approaches a rest area or parking facility, the driver could be alerted to the resource. DOTs could collect and format the location data for all parking resources in the state and make them available this data could be downloaded into csv (comma separated value) files for use in any personal navigation system.

5.9 Selected Suggestions from Survey Participants

The survey completed for this project sought suggestions from stakeholders for solving truck parking issues. Participants were able to choose more than one option, and their responses are shown in Figure 11.

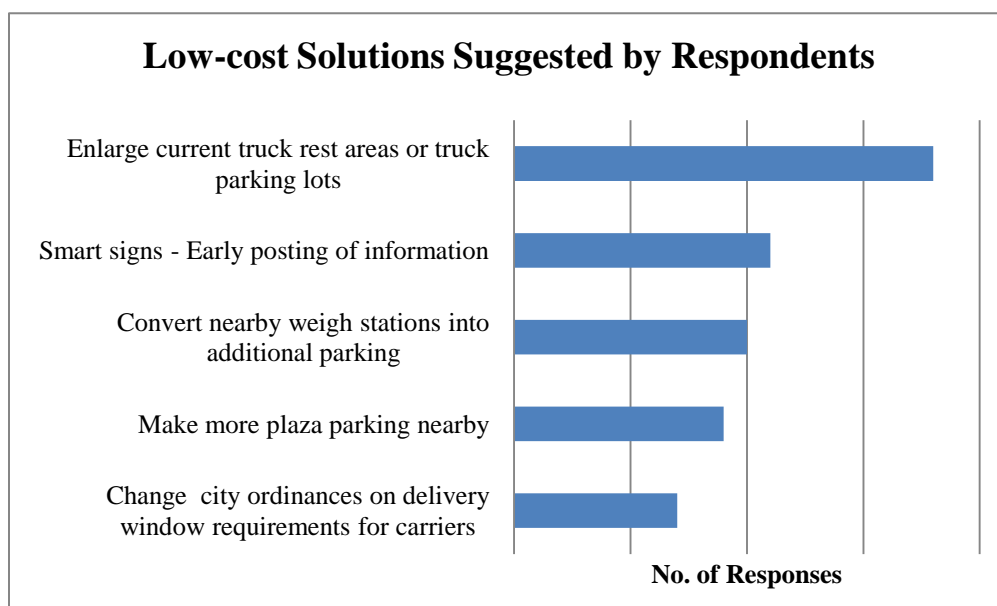


Figure 11: Low Cost Solutions Suggested by Survey Respondents

Suggestions include enlarging current truck parking facilities, adding upstream signs to inform drivers about parking available nearby, converting nearby weigh stations into additional parking, making more plaza parking nearby, and changing city ordinances on delivery windows for carriers.

5.10 Other Possible Solutions

Other possible solutions recommended by survey participants - as found in the comments sections of the survey - are listed below:

- Installation of portable bathrooms near highway exits in areas experiencing high truck traffic and suffering ramp parking issues, such as along the I-94 corridor to Milwaukee,

- Allowing parking at discount stores such as Wal-Mart but cracking down on truckers who litter,
- Providing radio broadcasts about parking, and
- Using auto parking areas at rest areas or truck stops for overflow, allowing for less auto parking at truck stops.

These suggestions from truckers may address truck parking issues, but there are limitations involved. Because most truckers prefer to park near delivery places or at the outskirts of cities where they have to deliver the next day, incenting local businesses, retail malls and large retail chains such as Wal-Mart to allow parking for trucks is a potential option. Yet in some areas, truckers who have not disposed of trash in appropriate ways have created ill will, and some retailers have banned parking. Also, mall parking lots have not been designed or built to support the weight of large loaded trucks. Some retail establishments have expressed concern about the potential maintenance costs they will incur if overnight parking is allowed. On this issue, one of the respondents commented, “Compensate shopping centers or big box retailers to allow large trucks to use their lots. And ask shippers and receivers to allow more overnight parking.” Arrangements such as these may best be formed through partnerships between the trucking industry and other private entities.

Many carriers have contacted their shippers and freight receivers to see if truck parking can be accommodated. While there have been some success stories, others have objected due to a lack of physical space available to accommodate a parked truck; others have had concerns about insurance and security. It is often difficult to expand existing parking facilities in manufacturing areas where no open land surrounds the facility.

Truckers also suggested that reopening abandoned truck stops and converting nearby weigh stations and commuter lots into additional parking places can also reduce congestion at incommensurate truck parking locations. From a driver’s perspective, if they park at a weigh station, they may be asked to move within a few hours of arrival to accommodate the needs of the weigh station. This can be an explicit violation of the Hours of Service rules and regulations. One survey respondent commented, “Open abandoned lots for truck parking, charge a small fee to use lots (make truckers take some ownership in keeping them clean.” It is important to note that Wisconsin currently offers truck parking at weigh stations and uses signs to encourage truck parking at three sites (Madison, Beloit, and Kenosha). Also, the conversion of weigh stations to additional parking could result in negative impacts on overall highway safety. Truck parking overnight in commuter lots may be viable but poses different challenges, as one tractor/trailer unit can take up as many as 8-10 automobile stalls, and one strategically placed car can inhibit the driver’s ability to move his truck safely when he or she wants to leave.

Finally, improved communication between states and truckers with clear information about each state’s truck parking policies would be beneficial. For example, some truckers seeking to park in public facilities in Wisconsin operate under the assumption that overnight parking at public rest

areas and weigh stations is unlawful. However, WisDOT staff, including officers in the Wisconsin state patrol, say that overnight parking is allowed. New or improved efforts to disseminate parking policy information, particularly regarding the variations across states, can be implemented by both public and private stakeholders may be a low cost way to help truckers to find safe parking alternatives. Furthermore, overnight truck parking at park-and-ride facilities may be an option during off hours.

Appendix A: Online Survey to State Patrol Officers, Freight Planners and Truckers

1. Please rate the following truck parking problems in your state.* [1 = not an issue; 5 = very serious issue]

	1	2	3	4	5
Truck parking space shortage overall					
Truck parking space sufficient overall, but in shortage at critical points					
No Communication mechanism to inform drivers of available spaces					
Parking on ramp or in not designated wayside when spaces are available at the nearby parking lot					

Other truck parking problems _____

2. Please rate the following factors to alleviate truck parking problems in your state.* [1 = not recommended; 5 = highly recommended]

	1	2	3	4	5
Parking reservation system at critical parking spots					
Advances truck parking signs					
Cell phone notification system					
Reduced delivery curfews					
Adjunct to 511 system					
Incent businesses to accept deliveries 24/7					

3. What are the constraints/major obstacles (in ranking order) to solve the truck parking problems in your state?*(Check all that apply)

- Current regulations
- Lack of parking available
- Lack of funds to meet parking demand
- A breakdown in private sector which is not providing truck parking spaces to meet demand
- Lack of available land to build parking spaces
- Lack of public acceptance to allow parking in their neighborhoods
- Other _____

4. What solutions have you found to be successful?*(You are welcome to convey any general comments here.)

QUESTIONS ABOUT SPECIFIC TROUBLE LOCATIONS (To Highway Patrol)

(* indicates mandatory questions/fields)

1. What is the truck parking problem at this location?*

 - Ramp parking
 - Always too full
 - Other _____

2. How would you rank this parking location in terms of space shortage in your state?
 - Among the top 3 in most shortage of space
 - Among the top 5 in most shortage of space
 - Among the top 10 in most shortage of space
 - Somewhat serious, but not in the top of listGeneral comments on ranking _____
3. How do you address this parking problem?*

 - Issuing tickets (___tickets per day on average)
 - Warning/reminding the drivers
 - Letting it go
 - Other _____

4. Are there nearby truck stops or other rest areas available?*

 - Yes
 - Those additional spaces are under utilized
 - Those additional spaces are in serious shortage
 - No idea
 - Not that I know of

5. What causes the truck parking problem at this location?* (Check all that apply)

 - Peak demand occurs and there is not enough space during popular hours of use
 - Parking area is constantly full – no overflow available
 - Parking areas are being used for staging purposes for nearby customers
 - Parking spaces are used for a break, to conform to the hours of service regulation
 - Availability of truck parking along nearby highway is too limited
 - Other _____

6. What low cost solution(s) do you suggest to solve the parking problem at this location?* (Check all that apply)

 - Convert nearby weigh station into additional parking
 - Enlarge the current truck rest areas and truck parking lot
 - Make more plaza parking nearby
 - Change the city ordinance on delivery window requirement for carriers
 - Smart signs - Early posting of parking information before reaching this location
 - Allow overnight parking at malls or large retail chains such as Wal-Mart and Target
 - Increase number of public truck stops like Pilot or Flying J
 - Other _____

7. General comments about this location. You are welcome to recommend any contact (name/tel/email) to know more about the problems.
-

QUESTIONS ABOUT SPECIFIC TROUBLE LOCATIONS (To Freight Planners)

(* indicates mandatory questions/fields)

1. What is the truck parking problem at this location?*

 - Ramp parking because of the parking lot always too full
 - Ramp parking when the parking is still available
 - Other _____

2. How was this truck parking problem brought to your attention?

 - Meeting with carriers
 - State highway patrol reports
 - Personal observations
 - Public complaints
 - Other _____

3. How would you rank space availability at this parking location?* (1= space always available; 5 = always in shortage)

1 2 3 4 5

Time period of the day when this location has parking problems _____ (Ex: 8 am – 10 am)

4. Are there nearby truck stops or other rest areas available?*

 - Yes
 - Those additional spaces are under utilized
 - Those additional spaces are in serious shortage
 - No idea
 - Not that I know of

5. What causes the truck parking problem at this location?* (Check all that apply)

 - Peak demand occurs and there is not enough space during popular hours of use
 - Parking area is constantly full – no overflow available
 - Parking areas are being used for staging purposes for nearby customers
 - Parking spaces are used for a break, to conform to the hours of service regulation
 - Availability of truck parking along nearby highway is too limited
 - Other _____

6. What low cost solution(s) do you suggest to solve the parking problem at this location?* (Check all that apply)

 - Convert nearby weigh station into additional parking
 - Enlarge the current truck parking lot
 - Increase number of public truck stops like Pilot or Flying J
 - Allow overnight parking at malls or large retail chains such as Wal-Mart and Target
 - Change the city ordinance on delivery window for carriers
 - Smart signs - Early posting of parking information before reaching this location

Other _____

7. General comments about this location. You are welcome to recommend any contact (name/tel/email) to know more about the problems.

QUESTIONS ABOUT SPECIFIC TROUBLE LOCATIONS (To Truck Drivers)

(* indicates mandatory questions/fields)

1. What is the truck parking problem at this location?*

- Ramp parking
- Always too full
- Other _____

2. How frequently do you observe/experience parking problem at this location?*

- Once or less out of ten trips
- Three times out of ten trips
- Seven times out of ten trips
- Almost every trip

Time period of the day when this location has parking problems _____ (Ex: 8 am – 10 am)

3. What is your route when you observe the problem at this location?*

(state)	(state)	(commodity type)
from _____	to _____	_____
from _____	to _____	_____
from _____	to _____	_____

4. How would you rank this parking problem?* This location is among the top 10/20/30/somewhat serious locations.*

5. If you are a driver, why do you park at this location?

- For a break after long hours of driving
- Overnight stay waiting for next day delivery
- Daytime stay waiting for delivery window
- Other occasional needs (e.g. restroom, food etc.) _____
- I am not a driver

6. Are there nearby truck stops or other rest areas available?*

- Yes
 - Those additional spaces are under utilized
 - Those additional spaces are in serious shortage
 - No idea
- Not that I know of

7. What low cost solution(s) do you suggest to solve the parking problem at this location?* (Check all that apply)

- Convert nearby weigh station into additional parking
- Enlarge the current truck rest areas and truck parking lot
- Make more plaza parking nearby
- Encourage private investment and expansion of truck stops
- Incent local business to allow truck parking at their sites
- Change the city ordinance on delivery window requirement for carriers
- Smart signs - Early posting of parking information before reaching this location
- Other _____

8. General comments about this location.

Appendix B: Paper Survey to Truckers



PERSONAL INFORMATION

Name _____

Phone Number _____

E-Mail _____

Affiliation/Organization _____

State of Registration _____

GENERAL QUESTIONS

1. Please choose your criteria for parking: (Check all that apply)

- I need to park every ___ hours.
- I like to park at locations at the outskirts of large cities.

2. Please rank the following factors in your planning for parking places.

Factor	Priority
availability of gas/restroom/food	
level space/lights/noise	
security	
proximity to destination	

3. In general, where do you get information for:
- Truck Parking? _____
 - Traffic Congestion? _____

I check these parking information sources ____ hours in advance.

SPECIFIC TROUBLE SPOTS

The following questions involve your input of parking trouble spots. Using the atlas, please give us a detailed location (city, exit number, state, etc) that has poor parking and answer the following questions.

Location:

What is the truck parking problem at this location? (Ex. Ramp parking, Lot too full)

How frequently do you observe/experience this problem?

_____ times out of every ten trips

Time of day when the problem is observed _____ (Ex: 8:00 A.M- 10:00 A.M)

What is your route when you observe the problem?

From (state) _____ to (state) _____ Commodity Type _____

This location is among the top (10 20 30 100) most serious locations. (Circle One)

Why do you park at this location? Circle one or fill in the blank

For a break after long hours of driving	Overnight stay waiting for next day delivery	Daytime stay waiting for delivery window	
---	--	--	--

What causes the truck parking problem at this location? (Check all that apply)

- Peak demand occurs and there is not enough space during popular hours of use
- Parking area is constantly full – no overflow available
- Parking areas are being used for staging purposed for nearby customers
- Parking spaces are used for a break, to conform to the hours of service regulation
- Availability of truck parking along nearby highway is too limited
- Other: _____

What do you suggest to solve the parking problem at this location? (Check all that apply)

- Convert nearby weigh station into additional parking
- Enlarge the current truck parking lot
- Make more plaza parking nearby
- Encourage private investment and expansion of truck stops
- Incent local businesses to allow truck parking at there sites

- Change the city ordinance on delivery window for carriers
- Smart signs - Early posting of parking information before reaching this location
- Other: _____

Please name three low cost solutions to truck parking problems?

1. _____
2. _____
3. _____

Are there nearby truck stops or other rest areas available nearby? If yes, how far away are they and why don't you park there?

General comments about this location:

References

- (1) MnDOT Minnesota Department of Transportation (MnDOT). *The Minnesota Interstate Truck Parking Study*. (2009). Retrieved from <http://www.intrans.iastate.edu/reports/truck-parking.pdf> on June 17, 2009
- (2) Wisconsin Motor Carrier Association. *The Wisconsin Trucking Industry Perspective*. (2008) Retrieved www.witruck.org/2008DCpaper.pdf on June 17, 2009.
- (3) Federal Motor Carrier Safety Administration, U.S. Department of Transportation. *Hours of Service Regulations*. Retrieved from <http://www.fmcsa.dot.gov/rules-regulations/topics/hos/index.htm> on June 17, 2009.
- (4) Federal Motor Carrier Safety Administration, US Department of Transportation, *Report to Congress on the Large Truck Crash Causation Study*. (2006). Retrieved from <http://www.fmcsa.dot.gov/facts-research/research-technology/report/lccs-2006.pdf>. on June 17, 2009.
- (5) Federal Highway Administration, U.S. Department of Transportation. *Study of Adequacy of Commercial Truck Parking Facilities – Technical Report*. (2002). Retrieved from <http://www.tfhrc.gov/safety/pubs/01158/01158.pdf> on June 18, 2009.
- (6) Bureau of Transportation Statistics. *2002 Commodity Flow Survey United States*, (2004) Retrieved from http://www.bts.gov/publications/commodity_flow_survey/2002/united_states/ on May 5, 2009.
- (7) Federal Highway Administration and Federal Transit Administration, U.S. Department of Transportation. *2006 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance*. (2007). Retrieved from <http://www.fhwa.dot.gov/policy/2006cpr/pdfs.htm> on June 26, 2009.
- (8) Center for Freight and Infrastructure, Research and Education. *Low-cost Strategies for Short Term Parking On Interstate Highways of the MVFC*. (2009).
- (9) Research and Innovative Technology Administration/Bureau of Transportation Statistics, Bureau of Transportation Statistics. *National Transportation Atlas Database (NTAD) 2006 CD*. (2006) Retrieved from <https://www.bts.gov/pdc/user/products/src/products.xml?p=2408> on May 5, 2009.
- (10) Federal Highway Administration, U.S. Department of Transportation. Federal Highway Administration. *Freight Analysis Framework (FAF)*, Retrieved from http://ops.fhwa.dot.gov/freight/freight_analysis/faf/#faf2trk on Dec. 4, 2008.
- (11) Federal Highway Administration, U.S. Department of Transportation, *Commercial Driver Rest & Parking Requirements: Making Space for Safety*. (1996). Publication No. FHWA-MC-96-0010, Washington, D.C. Retrieved from <http://www.tfhrc.gov/safety/pubs/commercial.pdf> on June 18, 2009.

- (12) TranSafety Inc. "Public Rest Areas Do Not Provide Enough Spaces for Commercial Vehicles." (August 1998). *Auto Road and Road User Journal*. Retrieved from <http://www.usroads.com/journals/aruj/9808/ru980802.htm> on May 5, 2009.
- (13) National Cooperative Highway Research Program. NCHRP Synthesis 317. *Dealing with Truck Parking Demands*. (2003). NCHRP Synthesis 317. Retrieved from http://onlinepubs.trb.org/Onlinepubs/nchrp/nchrp_syn_317fm.pdf on May 5, 2009.
- (14) American Association of State Highway and Transportation Officials (AASHTO) 2006 National Safety Rest Area Conference. *Conference Open Forum Notes*. (2006) Retrieved from <http://maintenance.transportation.org/?siteid=76&pageid=2591> on May 5, 2009.
- (15) Caltrans Safety Roadside Rest Area System Improvement Team. *Enhancing Highway Safety and Serving the Public: A Recommendation for Improving California's Safety Roadside Rest Area Improvement System*. (1999). Retrieved from: http://www.dot.ca.gov/hq/LandArch/srra/docs/09_Rest_Area_System_Improvement_Team%20Report.pdf on June 18, 2009.
- (16) Taylor, W.C., Sung, N., Kolody, K.A. and Jawad, A. *A Study of Highway Rest Area Characteristics and Fatigue Related Truck Crashes*. (1999). Michigan Department of Transportation, Lansing, MI.
- (17) Federal Highway Administration, U.S. Department of Transportation, *Model Development for National Assessment of Commercial Vehicle Parking*. (2002). McLean, VA . Retrieved from <http://www.tfhr.gov/safety/pubs/01159/3.htm> on May 5, 2009.
- (18) DieselBoss Inc. DieselBoss TruckStop Locator Directory. Retrieved from <http://www.dieselboss.com/truckstops.asp> on May 5, 2009.
- (19) Trucker Guide, Inc. TruckerGuide. Retrieved from truckerguide.com on June 25, 2009.
- (20) Google. Google Maps. <http://maps.google.com/maps>
- (21) Microsoft Corporation. Live Search Maps. Retrieved from <http://maps.live.com> on May 19, 2009.
- (22) Maze, Tom, Beth A. Taylor, and Mark Nelson. *Commercial Vehicle Parking*. (1999). Management Project 99-56. Center for Transportation Research and Education – Iowa State University. Retrieved from <http://www.intrans.iastate.edu/reports/truckpar.pdf> on June 18, 2009
- (23) University of Maryland. *Fueling American Prosperity: How Rest Area Commercialization will Devastate the Economic Contributions of Interstate Business*. (2003) *NATSO Foundation*.
- (24) Trucking Research Institute (TRI), Apogee Research Inc., and Wilbur Smith Associates *Commercial Driver Rest Area Requirements: No Room at the Inn*. (1996). American Trucking Associations Foundation.
- (25) Smith, S.B., W. Baron, K. Gay, and G. Ritter. *Intelligent Transportation Systems and Truck Parking*. (2005). Federal Motor Carrier Safety Administration. Retrieved from <http://www.fmcsa.dot.gov/facts-research/briefs/intelligent-transportation-truckparking.pdf> on June 18, 2009.

- (26) National Association of Truck Stop Operators. *NATSO TruckStops Directory*. Retrieved from http://www.natso.com/AM/Template.cfm?Section=TruckStop_Directory1&Template=/CustomSearches/TruckStop_Directoryd.cfm on May 15, 2009.
- (27) TR Information Publishers. (2007) *2007 Truck Stop Directory: Trucker's Friend*.
- (28) State Highway Administration, Maryland Department of Transportation. *Maryland Motor Carrier Handbook*. (2009). Retrieved from <http://www.marylandroads.com/businesswithsha/trucking/oost/motorcarrierhandbook.pdf> on June 18, 2009.
- (29) Federal Highway Administration, U.S. Department of Transportation. *511 Deployment Status*. (2009). FHWA 511 Travel Information Telephone Services. Retrieved from <http://www.deploy511.org/deployment-stats.html> on June 18, 2009.
- (30) SunGuide: Florida's Intelligent Transportation System. "SunGuide 511." (2008). Retrieved from <http://www.sunguide.org/sunguide511.jsp> on June 26, 2009.
- (31) Wisconsin Department of Transportation (WisDOT). *511 Wisconsin Travel Info*. Retrieved from <http://www.511wi.gov/Web> on June 18, 2009.