



# Managing Critical Truck Parking Tech Memo #2: Minnesota Case Study – Utilizing Truck GPS Data to Assess Parking Supply and Demand

**March 2017**

W. Ford Torrey, IV  
Research Associate  
American Transportation Research Institute  
Atlanta, GA

Daniel Murray  
Vice President  
American Transportation Research Institute  
St. Paul, MN



## ATRI BOARD OF DIRECTORS

**Judy McReynolds**  
**Chairman of the ATRI Board**  
Chairman, President and CEO  
ArcBest Corporation  
Fort Smith, AR

**David S. Congdon**  
Vice Chairman and CEO  
Old Dominion Freight Line  
Thomasville, NC

**Michael L. Ducker**  
President and CEO  
FedEx Freight  
Memphis, TN

**Rich Freeland**  
President and COO  
Cummins Inc.  
Columbus, IN

**Hugh H. Fugleberg**  
President and COO  
Great West Casualty Company  
South Sioux City, NE

**Dave Huneryager**  
President and CEO  
Tennessee Trucking Association  
Nashville, TN

**Derek Leathers**  
President and CEO  
Werner Enterprises  
Omaha, NE

**Chris Lofgren**  
President and CEO  
Schneider National, Inc.  
Green Bay, WI

**Robert E. Low**  
President and CEO  
Prime Inc.  
Springfield, MO

**Rich McArdle**  
President  
UPS Freight  
Richmond, VA

**Jeffrey J. McCaig**  
Chairman  
Trimac Transportation, Inc.  
Houston, TX

**Gregory L. Owen**  
Head Coach and CEO  
Ability/ Tri-Modal Transportation  
Services  
Carson, CA

**Annette Sandberg**  
President and CEO  
Transsafe Consulting, LLC  
Davenport, WA

**Rebecca M. Brewster**  
President and COO  
American Transportation  
Research Institute  
Atlanta, GA

**Chris Spear**  
President and CEO  
American Trucking Associations  
Arlington, VA

## ATRI RESEARCH ADVISORY COMMITTEE

**Scott Mugno, RAC Chairman**

Vice President, Safety,  
Sustainability and Vehicle  
Maintenance  
FedEx Ground

**Jon Blackham**

Policy and Government Affairs  
Canadian Trucking Alliance

**Amy Boerger**

Vice President Sales  
Cummins, Inc.

**Randy Boyles**

Senior Vice President, Mobile  
Strategy  
PeopleNet

**Bill Brown**

Manager of Fleet Telematics  
Southeastern Freight Lines

**Michael Conyngham**

Director of Research  
International Brotherhood of  
Teamsters

**Bob Costello**

Senior Vice President and  
Chief Economist  
American Trucking  
Associations

**Tom Cuthbertson**

Vice President, Regulatory  
Compliance  
Omnitracs, LLC

**Dennis Dellinger**

President  
Cargo Transporters

**Chip Duden**

Vice President, Strategic  
Business Analytics  
Werner Enterprises

**Paul J. Enos**

Chief Executive Officer  
Nevada Trucking Association

**Scott George**

Chief Executive Officer  
TCW, Inc.

**Mike Golias**

Director for Research,  
Intermodal Freight  
Transportation Institute  
University of Memphis

**Stan Hampton**

Vice President of Driver  
Personnel  
J.B. Hunt

**Victor Hart**

Director of Safety  
DOT Transportation, Inc.

**Sanford Hodes**

Ryder System, Inc.  
Senior Vice President and  
Deputy General Counsel

**Ken Howden**

Director, 21st Century Truck  
Partnership  
U.S. Department of Energy

**Kelly Killingsworth**

VP of Inbound Transportation  
Wal-mart Stores, Inc.

**Victoria King**

VP Public Affairs  
UPS

**Dustin Koehl**

Vice President, Sales and  
Marketing  
Total Transportation of  
Mississippi

**Caroline Mays**

Director, Freight and  
International  
Trade Section  
Texas DOT

**Chris McLoughlin**

Cargo Risk Manager  
C.H. Robinson Worldwide, Inc.

**Lisa Mullings**

President and CEO  
National Association of Truck  
Stop Operators

**Tom Murtha**

Senior Planner  
Chicago Metropolitan Agency  
for Planning

**Brenda Neville**

President  
Iowa Motor Truck Association

**Dean Newell**

Vice President, Safety  
Maverick, Inc.

**Karen Rasmussen**

President and CEO  
HELP Inc.

**Wellington F. Roemer, III**

President and CEO  
Wellington F. Roemer  
Insurance, Inc.

**Mark Savage**

Deputy Chief  
Colorado State Patrol

**Andrea Sequin**

Director, Regulatory Services  
Schneider National, Inc.

**Carl Stebbins**

Corporate Director of  
Admissions and Marketing  
New England Tractor Trailer  
Training School

**Harold Sumerford, Jr.**

Chief Executive Officer  
J&M Tank Lines

**James E. Ward**

President and CEO  
D.M. Bowman

**Tom Weakley**

Director of Operations  
Owner-Operator Independent  
Drivers Association Foundation

**TABLE OF CONTENTS**

**1.0 INTRODUCTION..... 3**

**2.0 PHASE ONE – GOOSE CREEK REST AREA ANALYSIS..... 3**

**2.1 Methodology ..... 3**

**2.2 Results..... 4**

**3.0 PHASE TWO – ANALYSIS OF DES MOINES RIVER, CLEAR LAKE, AND MINNESOTA VALLEY REST AREAS..... 6**

**3.1 Methodology ..... 6**

**3.2 Results..... 6**

**4.0 CONCLUSION ..... 10**

**TABLE OF FIGURES**

**Figure 1: Goose Creek Rest Area - Overcapacity by Day-of-Week..... 5**

**Figure 2: Goose Creek Rest Area - Overcapacity by Hour-of-Day ..... 5**

**Figure 3: Minnesota Valley Rest Area - Overcapacity by Day-of-Week..... 7**

**Figure 4: Minnesota Valley Rest Area - Overcapacity by Hour-of-Day ..... 7**

**Figure 5: Clear Lake Rest Area - Overcapacity by Day-of-Week..... 8**

**Figure 6: Clear Lake Rest Area - Overcapacity by Hour-of-Day ..... 8**

**Figure 7: Des Moines Rest Area - Overcapacity by Day-of-Week ..... 9**

**Figure 8: Des Moines Rest Area - Overcapacity by Hour-of-Day ..... 9**

## **1.0 INTRODUCTION**

At its annual meeting in 2015, the American Transportation Research Institute (ATRI) Research Advisory Committee (RAC)<sup>1</sup> selected “Managing Critical Truck Parking” as its number one research priority. ATRI’s RAC-directed truck parking research was conducted through a series of discrete tasks, the results of each being documented in separate reports. This Tech Memo details the results of a truck parking analysis case study undertaken for the Minnesota Department of Transportation (MNDOT).

ATRI was contacted by MNDOT to conduct an analysis using truck Global Positioning System (GPS) data for several rest stop locations, based on a customized methodology that utilizes ATRI’s large database of truck GPS points<sup>2</sup>. This first-of-its-kind research is attempting to assess truck parking supply and demand by cross-referencing GPS data (i.e. truck activity) at several Minnesota rest stops.

## **2.0 PHASE ONE – GOOSE CREEK REST AREA ANALYSIS**

### **2.1 Methodology**

ATRI selected October 2015 as the observation period for this study. The first location assessment was the Goose Creek Rest Area, which lies along the I-35 northbound corridor north of the Twin Cities. ATRI used rest area truck counts derived from its GPS database and expanded these counts, using an extrapolation factor associated with MNDOT truck count data, to estimate the total number of trucks at the stop for each hour of the observation month.

#### *Rest Area Counts*

To prepare the October 2015 data, a geographic bounding box was created around truck parking in the rest area, and the needed data was extracted if a point’s latitude and longitude fell inside this bounding box. Next, the point data were joined with spatial polygons resulting in the points receiving a text identifier of where in the study area the truck was positioned. The number of trucks parked by hour-of-day and day-of-week were then found by:

- Removing trucks with a speed greater than zero miles per hour (MPH) to establish that a truck was parked;
- Converting the date/time stamp on a truck’s GPS ping from Greenwich Mean Time (GMT) to Central Standard Time (CST);
- Extracting hour-of-day and day-of-week information from the converted date/time stamp;
- Creating a unique identifier (UID) for each point using the truck identification number, hour-of-day, and day-of-week indicator;

---

<sup>1</sup> ATRI’s RAC is comprised of industry stakeholders representing motor carriers, trucking industry suppliers, labor and driver groups, law enforcement, federal government and academia. The RAC is charged with annually recommending a research agenda for the Institute.

<sup>2</sup> ATRI’s anonymized truck GPS dataset is comprised of a continuous stream of truck position data that is reported from more than six hundred thousand trucks. For each individual truck, a latitude/longitude, date and time stamp, speed and other information is recorded continuously. Rates of position are extremely frequent; anywhere from every 30 seconds to every several minutes.

- Removing duplicate UIDs to account for a truck pinging a location more than once in any given hour on any given day; and
- Aggregating the number of UIDs by the hour-of-day and day-of-week.

### *Truck Count Expansion*

ATRI developed an expansion factor for every hour in the observation period. This factor was used to expand GPS rest area counts in order to estimate the total number of trucks occupying the location. ATRI used truck count data from ATR 191, a MNDOT weigh-in-motion (WIM) traffic counting station 17 miles upstream of the Goose Creek rest area, and ATRI GPS data at the same geographical location to develop the expansion factor.

First, the MNDOT WIM data was analyzed to determine the number of trucks observed by day and hour-of-day on I-35. Next, ATRI GPS data was cross-referenced with the truck count data to determine the proportion of ATRI's sample to the WIM data; this was done for each hour for each day. This expansion factor was then applied to the ATRI GPS data found at the Goose Creek rest stop, providing a reasonable estimation of the number of trucks parked in the rest stop. For example, if the MNDOT WIM data showed 18 trucks on the road at a particular time on a particular day, and the ATRI GPS data showed nine trucks, it can reasonably be assumed that ATRI GPS data is capturing 50 percent of the trucks for that time period, and applying a factor of two to ATRI's Goose Creek GPS units can estimate truck parking usage.

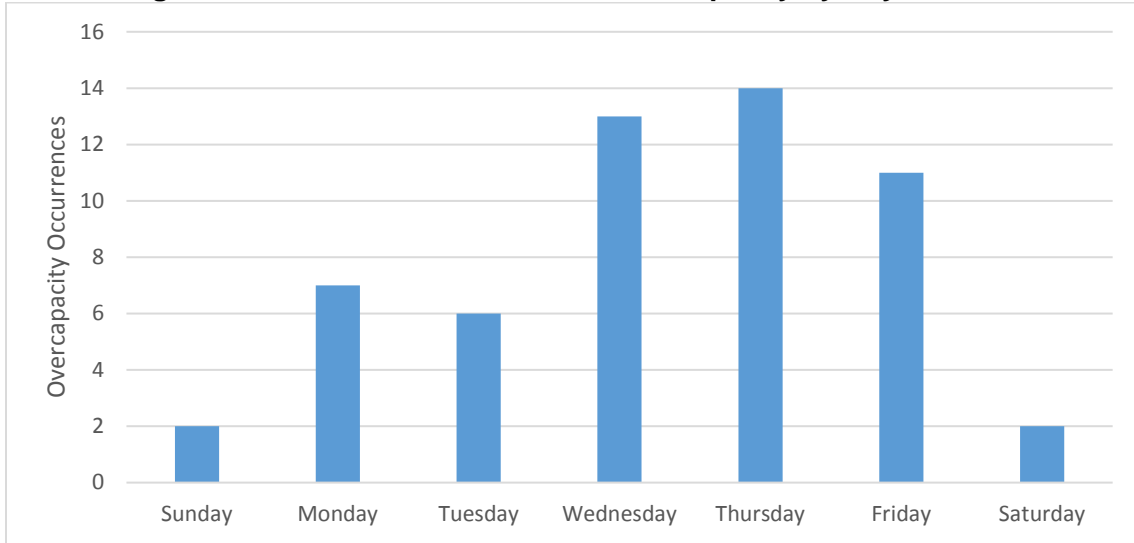
When the expansion factors were applied for all hours of the selected October dates at Goose Creek, a truck parking usage matrix was developed, including occurrences where capacity was exceeded during certain hours of certain days.

## **2.2 Results**

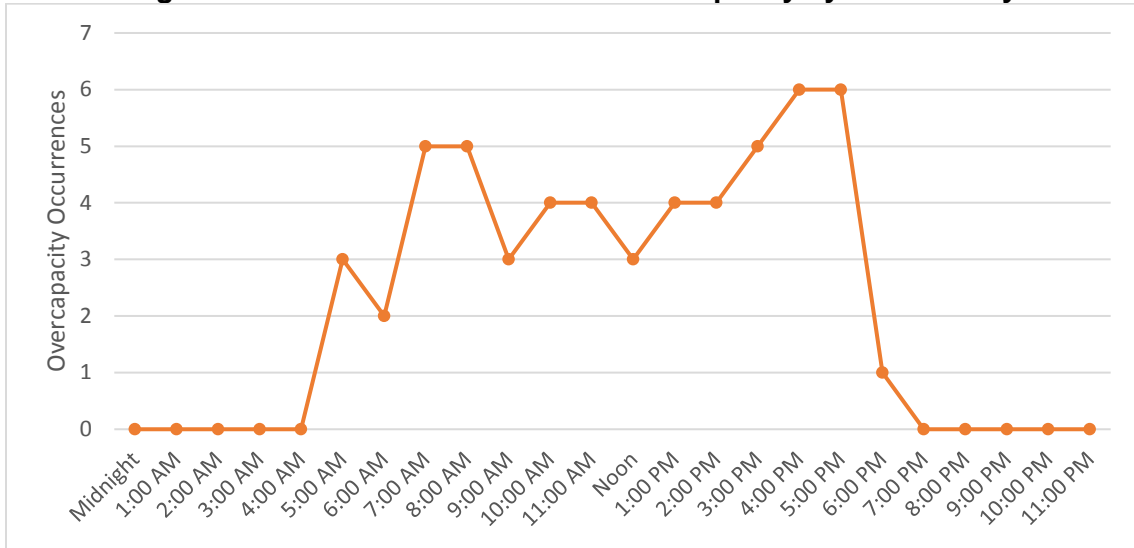
### *Goose Creek Rest Area Overcapacity Counts*

The Goose Creek Rest Area experienced 55 of its hours being overcapacity at some point during October of 2015; this translates to being overcapacity 7.4 percent of the month. The latter part of the week experienced more crowding with Wednesday, Thursday, and Friday seeing the bulk of the overcapacity (Figure 1). Additionally, the issue was concentrated during the daylight hours between 5:00 a.m. and 6:00 p.m. with the other hours of the day seeing no overcapacity issue, suggesting overcapacity being the result of drivers stopping for their hours-of-service (HOS) rest break (Figure 2).

**Figure 1: Goose Creek Rest Area - Overcapacity by Day-of-Week**



**Figure 2: Goose Creek Rest Area - Overcapacity by Hour-of-Day**



### **3.0 PHASE TWO – ANALYSIS OF DES MOINES RIVER, CLEAR LAKE, AND MINNESOTA VALLEY REST AREAS**

#### **3.1 Methodology**

Due to the unavailability of WIM counters in the vicinity of the remaining study areas, the methodology for Phase Two of the analysis was slightly altered from the Phase One analysis in order for it to remain possible to analyze the remaining rest areas. The methodology remained identical in all aspects except for the source of data that went into the calculation of the truck count expansion factor which was performed using average annual daily truck traffic (AADTT) metrics from the Federal Highway Administration (FHWA) Freight Analysis Framework (FAF). This process was performed as follows:

- AADTT for a stretch of roadway along each rest area were retrieved from the full FAF dataset;
- Due to the base year in the FAF being 2007, AADTT was multiplied by an adjustment factor using truck vehicle miles traveled (VMT) figures produced by FHWA to reflect the change in VMT from 2007 to 2014 as a proxy for changes in volume to produce a more current volume figure;
- This figure was then multiplied by a factor of 31 (days) to estimate total volume for the month from the new AADTT figure;
- The figure for the total monthly volume was then allocated across all hours of each day based on the proportion of ATRI GPS trucks found in each hour of each day corresponding to the particular segment of roadway;
- Finally, the number of trucks found in the ATRI GPS data was compared to the number of trucks in the FAF data to calculate the expansion factor.

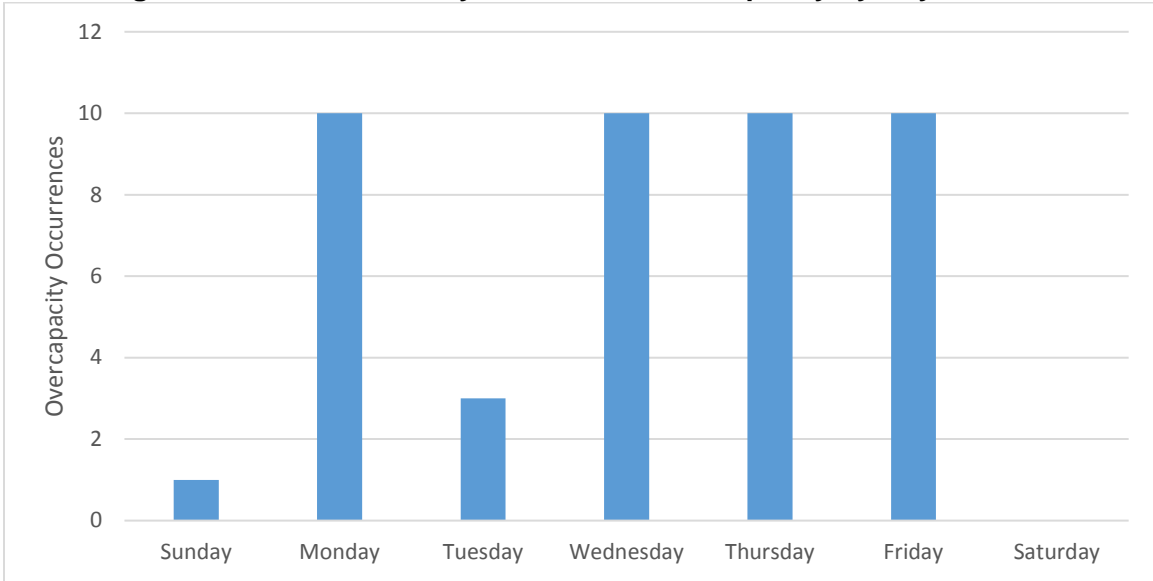
#### **3.2 Results**

##### *Minnesota Valley Rest Area*

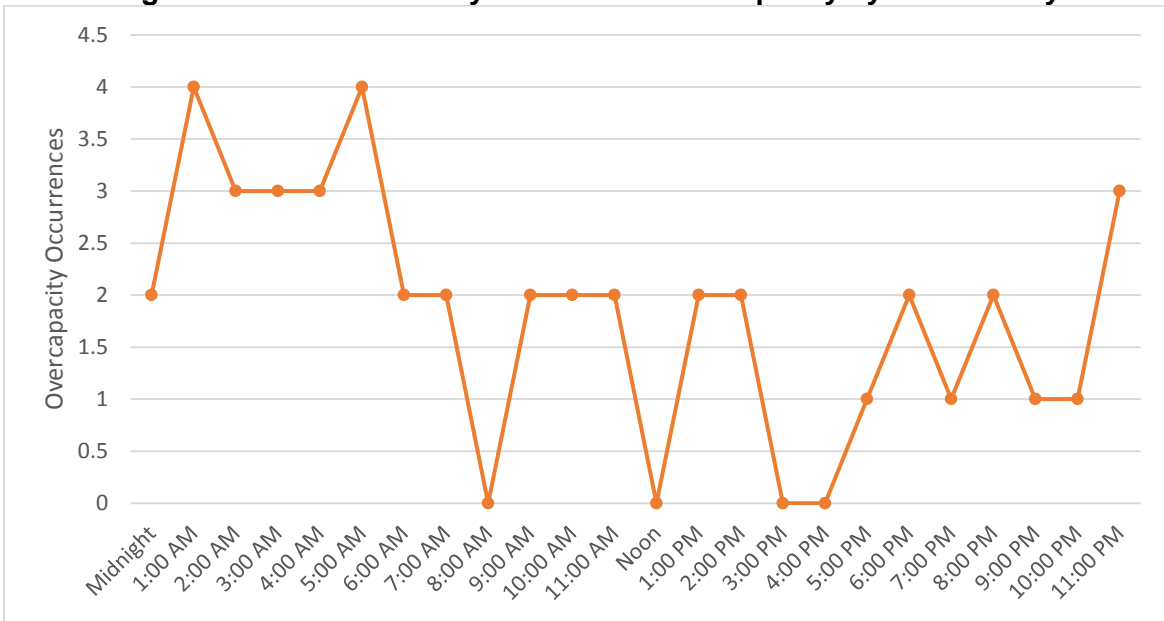
The Minnesota Valley Rest Area on US 169 saw the second highest occurrence of overcapacity among the examined rest areas, with 44 hours of the month being at overcapacity, or a 5.9 percent overcapacity rate. Similar to the Goose Creek Rest area this was concentrated in the latter half of the week; however Monday saw a high overcapacity issue, and no overcapacity was found on Saturday (Figure 3). Additionally, overcapacity occurred during all but four hours of the day during October 2015, peaking between the hours of midnight and 7:00 a.m. suggesting that truck drivers cannot find a parking space when they need to rest overnight (Figure 4).



**Figure 3: Minnesota Valley Rest Area - Overcapacity by Day-of-Week**



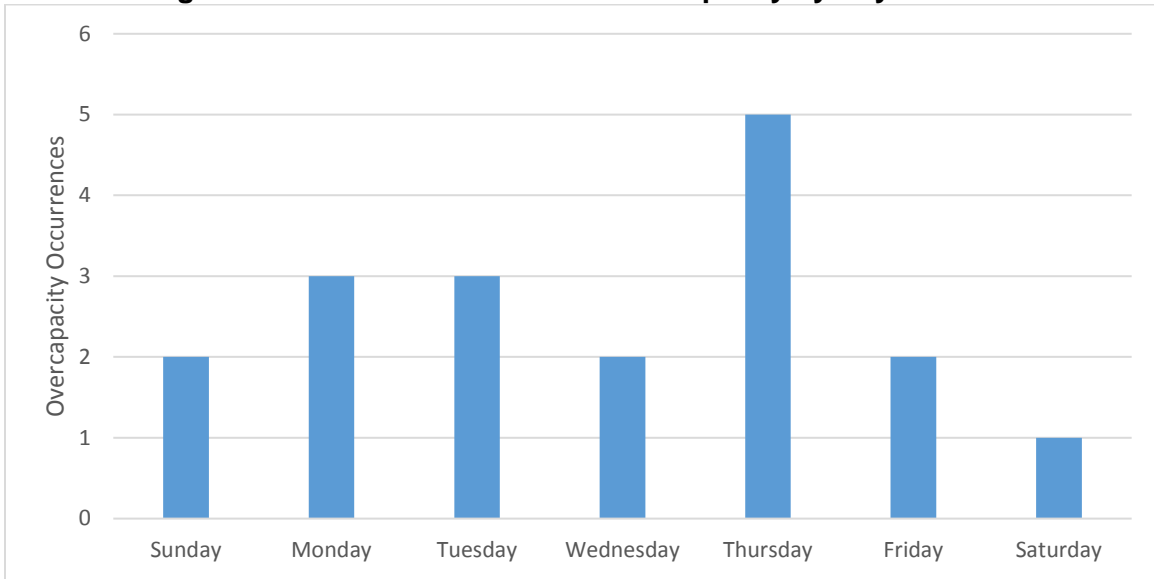
**Figure 4: Minnesota Valley Rest Area - Overcapacity by Hour-of-Day**



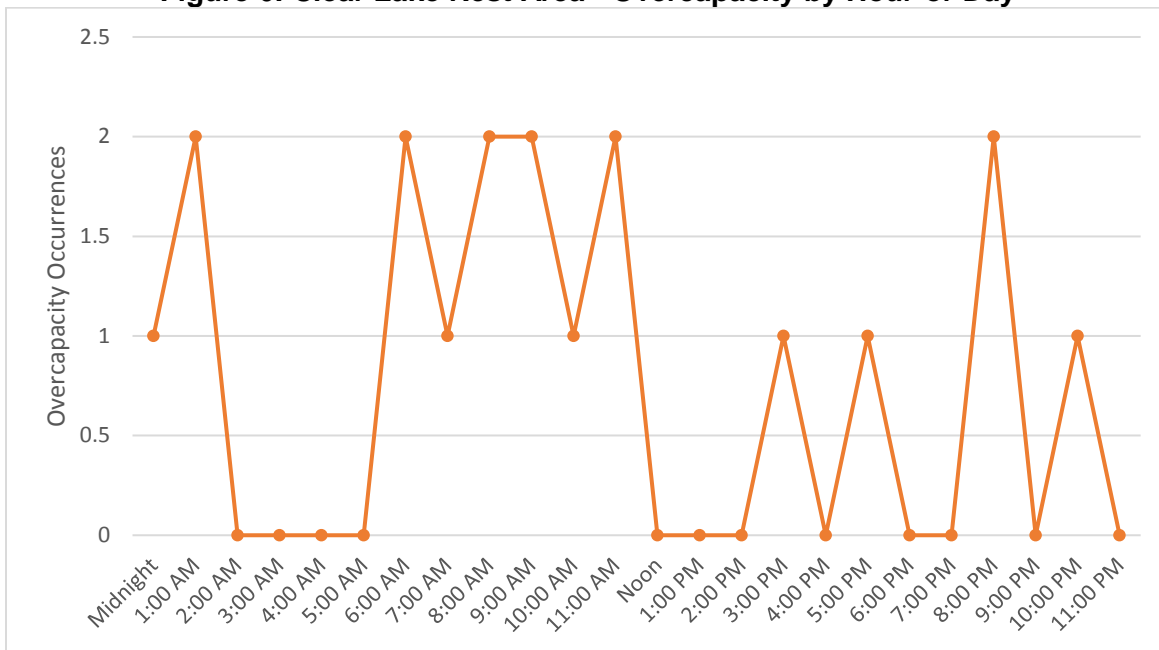
**Clear Lake Rest Area**

Clear Lake Rest Area located on I-90 East experienced an overcapacity rate of 2.4 percent, exceeding capacity during 18 hours of October 2015. With this rest area’s analysis, a trend begins to emerge in that overcapacity tends to be highest in the second half of the week (Figure 5). While somewhat of a peak can be seen between 5:00 a.m. and noon at Clear Lake, the availability of spaces tends to be very sporadic throughout hours of the day suggesting that truck drivers utilize the rest area for both overnight and HOS breaks (Figure 6).

**Figure 5: Clear Lake Rest Area - Overcapacity by Day-of-Week**



**Figure 6: Clear Lake Rest Area - Overcapacity by Hour-of-Day**

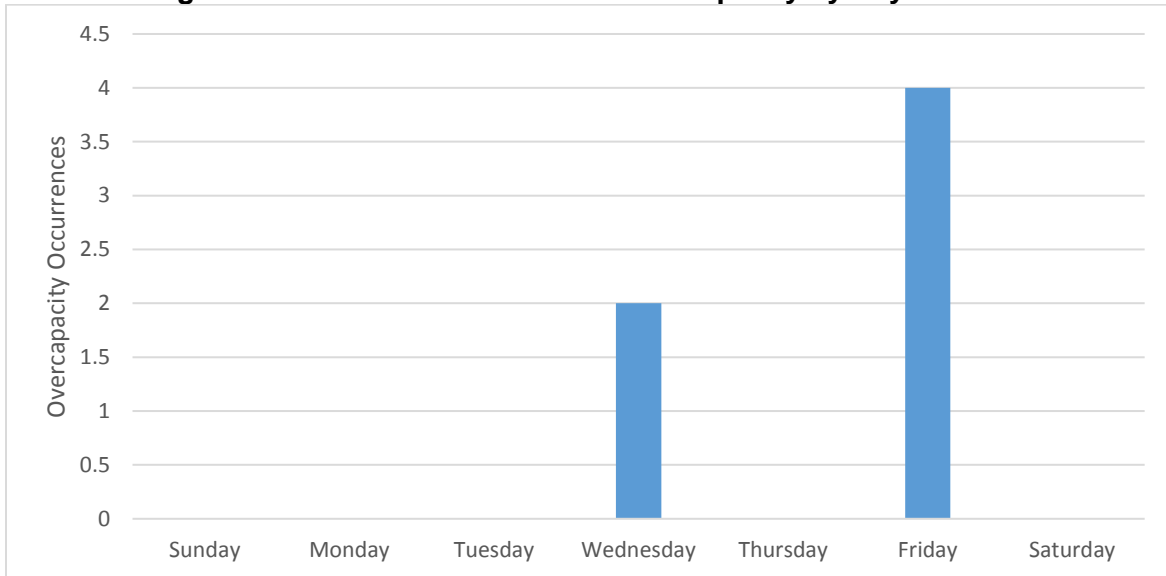


*Des Moines River Rest Area*

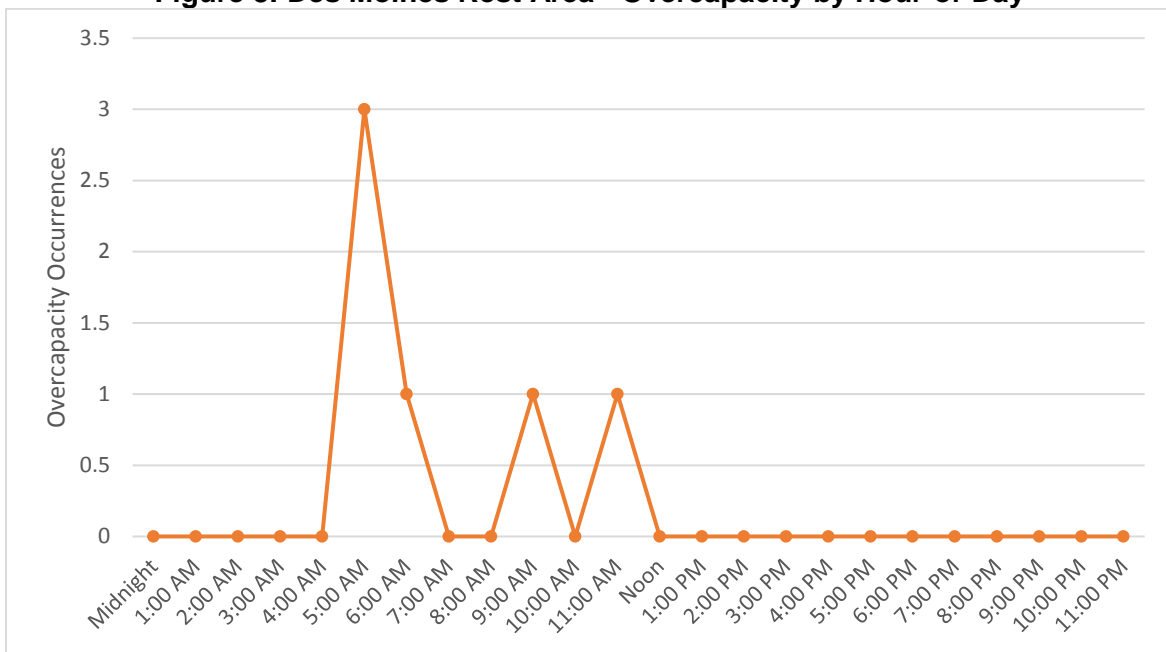
The Des Moines River Rest Area located on I-90 West experienced the fewest occurrences of overcapacity, being overcapacity for only six of the hours in October 2015 (1% overcapacity rate). Consistent with the trend, the overcapacity here was seen solely in the latter part of the week, specifically on Wednesday and Friday (Figure 7). While overcapacity was low overall, it

was essentially concentrated between 5:00 a.m. and 6:00 a.m. with overcapacity occurring at 9:00 a.m. and 11:00 a.m. as well (Figure 8).

**Figure 7: Des Moines Rest Area - Overcapacity by Day-of-Week**



**Figure 8: Des Moines Rest Area - Overcapacity by Hour-of-Day**



#### **4.0 CONCLUSION**

This quantitative analysis corroborates that truck parking capacity assessments can be developed using real world truck GPS data. The analysis showed that while overcapacity occurs at some locations much more frequently than others, all of the locations examined in this analysis experienced overcapacity at some point during October 2015. Additionally, this analysis uncovered a consistent trend whereby truck drivers had the greatest difficulty finding available parking in the latter part the week.