South Dakota
Department of Transportation
Office of Research

U.S. Department
of Transportation
Federal Highway
Administration

SD00-13-F

Assessment of Commercial Driver Rest Area Needs

Study SD00-13
Final Report

Prepared by:
Mike Powell & Gopi Ande
Office of Research, Room 239
700 East Broadway
Pierre, South Dakota 57501-2586

August 2000

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the South Dakota Department of Transportation, the State Transportation Commission, or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

ACKNOWLEDGEMENTS

This work was performed under the supervision of the SD00-13 Technical Panel:

John Adler.....Operations
Lt. James Carpenter ..... SD Highway Patrol
Brian Hines .....Research
Sharon Johnson.....FHWA
Darin Larson ..... LGA
Barb Lindstrom .....SD Trucking Association
Kenneth Marks.....Data Inventory
Craig McIntyre.....Planning & Programs
Daris Ormesher .....Research
Roland Stanger..... FHWA

The work was performed in cooperation with the United States Department of Transportation, Federal Highway Administration.

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. SD00-13	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Assessment of Commercial Driver Rest Area Needs		5. Report Date August 2000
		6. Performing Organization Code
7. Author(s) Mike Powell, Gopi Ande		8. Performing Organization Report No.
9. Performing Organization Name and Address Mike Powell & Gopi Ande South Dakota Department of Transportation Office of Research, Room 229 700 East Broadway Pierre, South Dakota 57501-2586		10. Work Unit No.
		11. Contract or Grant No. SDDOT Contract Number
12. Sponsoring Agency Name and Address South Dakota Department of Transportation Office of Research 700 East Broadway Avenue Pierre, SD 57501-2586		13. Type of Report and Period Covered Final Report May 2000 to August 2000
		14. Sponsoring Agency Code
15. Supplementary Notes A complete final report is published separately as SD00-13X.		

16. Abstract

Federal regulations are currently in place that set hours-of-service limits for commercial drivers. The establishment of these regulations removes the uncertainties surrounding possible breaks-in-service for commercial drivers and thus creates a need to perform better assessments of when and where commercial drivers may want to have stopovers. As a result, the Federal Highway Administration (FHWA) has issued a national mandate under the Transportation Efficiency Act for the 21st Century (TEA21) that requires all states to examine the condition of commercial vehicle rest sites and parking facilities along their major trucking routes. Thereby, the South Dakota Department of Transportation (SDDOT) has an inherent responsibility to evaluate the needs of commercial drivers, especially in regard to the adequacy of rest area and truck stop facilities. The ultimate intent of the evaluation is to develop recommendations for safe, adequate rest area facilities for commercial drivers and other travelers. This research project has been structured to comply with Section 4027 of TEA21.

17. Keywords commercial drivers, rest area, truck stop, truck parking	18. Distribution Statement No restrictions. This document is available to the public from the sponsoring agency.		
19. Security Classification (of this report) Unclassified	20. Security Classification (of this page) Unclassified	21. No. of Pages 87 pages	22. Price

Table of Contents

List of Tables

Executive Summary

Problem Description

Federal regulations are currently in place that set hours-of-service limits for commercial truck drivers. The establishment of these regulations removes the uncertainties where "breaks-in-service" for commercial drivers are concerned and thus creates a need to perform better assessments of when and where commercial drivers may want to have stopovers. From a national perspective, a lack of parking spaces is pushing commercial drivers past the regulated limits for hours-of-service. As a result, Congress passed the Transportation Efficiency Act for the 21st Century (TEA21 – Section 4027), requiring all states to examine the condition of commercial truck parking and available facilities along their major trucking routes. Subsequently, the South Dakota Department of Transportation (SDDOT) was asked to evaluate the needs of commercial drivers and gain perspectives on the adequacy of rest area and truck stop facilities within the state. The results of the evaluation are meant to include recommendations for adequate and safe rest area facilities for commercial truck drivers and other travelers as well. This research project has been structured to comply with Section 4027 of TEA21.

Project Objectives

The technical panel for this project developed one research objective:

1) *Using the guidelines established by the Federal Highway Administration (FHWA), develop recommendations that will provide parking facilities and associated services/amenities that meet the rest area needs of commercial truck drivers in South Dakota.*

Project Tasks

To meet the project objective, the researchers for this study were assigned the following tasks:

Task 1: Meet with the technical panel to review the project scope and work plan.
Task 2: Perform a literature search regarding commercial driver rest area needs.

Task 3: Recommend, for technical panel approval, appropriate highway corridors used by motor carriers in South Dakota for the evaluation purposes of this study.

Task 4: Conduct random surveys of commercial drivers at selected rest areas and truck stops, and within the selected corridors, identify their driving habits, attitudes, and preferences. This survey should be coordinated with the South Dakota Trucking Association.

Task 5: Conduct direct observations of in-service truck parking conditions at a representative number of rest areas, both private and public.

Task 6: Perform an inventory of all highway rest area facilities, both public and private, in the selected highway corridors.

Task 7: Apply a "Truck Parking Demand Model" to determine overall demand for truck parking in the selected trucking corridors.

Task 8: Perform an assessment of parking space supply for commercial trucks, and also assess deficiencies in various service and amenity categories.

Task 9: Analyze and interpret the results to better understand the demand/capacity issues for the parking of trucks in South Dakota. Recommend changes to SD rest area parking facilities, services, and amenities that will meet the present and future rest area needs of commercial truck drivers.

Essential Project Task Efforts

Choose Major Trucking Corridors: The researchers proposed to the project's technical panel an inventory of major trucking corridors in South Dakota that would be used for evaluation purposes in the study. These trucking corridors consisted of segments of roadway with relatively uniform truck traffic throughout the segment, and were also defined as roadway segments with current or projected truck traffic of at least 1,000 trucks per day. Interstate 90 in South Dakota was divided into 3 corridors for analysis purposes and SD Interstate 29 was divided into 2 analysis corridors.

Conduct Random Surveys: The researchers conducted random surveys of professional truck drivers on Interstates 90 and 29 to better assess the specific needs of truck drivers traveling across South Dakota's main truck routes, and also to attain feedback on the truck drivers' perceived needs. During the 72 hour National Safety Awareness Week of June 6-8, 2000, a questionnaire was given to commercial truck drivers and collected concurrently at South Dakota's 4 major ports-of-entry, which are namely: Tilford, Valley Springs, McCook, and Sisseton. Completion of the survey questionnaire was completely

voluntary. The questionnaires were completed on site, collected, and conveyed to the Office of Research for subsequent analysis.

Perform Nighttime Observations: For this study, all public and private rest facilities along Interstates 90 and 29 were investigated to determine adequacy of parking space, as well as to assess the various levels of service provided. Additionally, random facilities were selected along South Dakota Interstate corridors for nighttime observation surveys. At selected public rest areas and private truck stops, researchers observed and recorded the number of trucks parked from 10:00 PM until 6:00 AM over 3 consecutive nights. Most commercial truck drivers travel during daylight hours and sleep at night, thereby increasing the demand for parking at public and private rest facilities during the nighttime and evening hours. Since the researchers wished to observe peak parking conditions, it was logical to monitor truck parking during nighttime and evening hours.

Determine Truck Parking Demand: The research team decided to incorporate a "Truck Parking Demand Model" to perform estimates of the demand for truck parking along the selected trucking corridors. A "Truck Parking Demand Model" is capable of predicting the demand for truck parking along an entire corridor through analysis of several interrelated variables, including:

- Percentage of daily truck traffic for both short-, and long- haul trucks.
- Short-haul parking duration (in minutes) per each hour traveled.
- Ratio of parked time per week to driving time per week.
- Peak parking factor for short-, and long- haul trucks.
- Proportionate share of short-, and long- haul truck demand for parking at both private truck stops, and public rest areas.

To determine the adequacy of available truck parking, the researchers compared the peak demand for parking within a corridor to the actual number of parking spaces provided in the same corridor (the parking supply). The table on the following page contains the computed results, or output, from the *Truck Parking Demand Model* used in this study for each of the selected corridors.

Results Obtained From the *Truck Parking Demand Model*.

Corridor	ADT	TS Supply	RA Supply	Demand					
				Current		10-Year		20-Year	
				TS	RA	TS	RA	TS	RA
1	8437	244	76	246	19	293	22	340	26
2	5988	253	105	94	33	116	41	139	49
3	7870	357	82	213	47	255	56	296	65
4	9809	304	67	209	55	250	66	290	76
5	5656	173	41	143	25	173	31	202	36

*Note: See Appendix B for predicted ADT values.

Table Key:

TS = Truck Stop RA = Rest Area ADT = Average Daily Traffic

The research team reviewed the output from the *Truck Parking Demand Model* to evaluate the sufficiency of currently available parking space in each corridor. The researchers did not find an overall shortage of parking along any given corridor and, in fact, only one instance deficient parking space was found during the comparative examinations across all 5 corridors. The deficiency was found in the private truck stop category along Corridor 1 where the existing supply of parking space was determined to be fairly close to demand.

Assessment of the Results Obtained From the *Truck Parking Demand Model*:

The results from the *Truck Parking Demand Model* were obtained using relative quantities of truck parking space based on the nighttime observations performed by the researchers, and *not* on computed quantities using truck parking allocations based on a generally recommended allocation of 1,500 ft^2 per truck. The above table reflects the results of this "modified" approach, as do the following comments.

Assessment of Current Truck Parking Demand

Corridor I: The total parking demand at private truck stops is 246 trucks and the total parking demand at public rest areas is 19 trucks. There are 244 truck spaces available at private truck stops in this corridor and 76 spaces are available at public facilities. In Corridor I, there is a surplus of public rest area parking. However, the private parking demand is just over capacity.

Corridor II: The total parking demand at private truck stops is 94 trucks and the total parking demand at public rest areas is 33 trucks. There are 253 truck spaces available at private truck stops in this corridor and 105 spaces are available at public parking facilities. Both the public and private facilities' truck parking supplies well exceed the demands.

Corridor III: The total parking demand at private truck stops is 213 trucks and the total parking demand at public rest areas is 47 trucks. Meanwhile, there are 357 truck spaces available at private truck stops in this corridor and 82 space are available at public parking facilities. Corridor III also has public and private parking supplies that are well above the demands.

Corridor IV: The total demand for parking at private truck stops is 209 trucks and the total demand for parking at public rest areas is 55 trucks. The corridor has a supply of 304 private parking spaces, which is more than sufficient to meet the demand. The public supply, 67 spaces, also exceeds the demand.

Corridor V: The total parking demand at private truck stops is 143 trucks and the total parking demand at public rest areas is 25 trucks. There are 173 truck parking spaces available at private truck stops in this corridor and 41 spaces at public parking facilities. Corridor V also has parking surpluses at both truck stops, and public parking areas.

Assessment of Predicted 10-Year Truck Parking Demand

The researchers calculated future demand for truck parking by substituting the present Average Daily Traffic (ADT) truck volumes for the 10-year predictions of truck ADT. Predicted ADT values are produced from a linear traffic growth model used by the Office of Data Inventory at the SDDOT. Initially, default values conceived for nationwide application were used to predict parking demand at truck stops and rest areas. However, the default values yielded results that did not correlate with the researchers' findings from the nighttime surveys along South Dakota trucking corridors. Utilization of the default values tended to produce a fairly even distribution of parking between rest areas and truck stops, whereas nighttime observations in selected corridors revealed parking demands that strongly favored private truck stops. Therefore, the default values for truck stops were adjusted relative to the values used for rest areas, thereby producing a more accurate parking demand model for South Dakota conditions. Revisions to the technical guidelines for this study contain the modified values that are felt to

provide better representation of South Dakota traffic patterns. Following are the comments on the resultant assessments of 10-year truck parking demand:

Corridor I: The total demand for parking at private truck stops is 293 trucks and the total demand for parking at public rest areas is 22 trucks. Currently, there are 244 truck spaces available at private truck stops in this corridor and 76 available spaces at public parking facilities. In Corridor I, there will be a surplus of public rest area parking. However, there will be a deficiency in private parking spaces.

Corridor II: The total demand for parking at private truck stops is 116 trucks and the total demand for parking at public rest areas is 41 trucks. Currently, there are 253 parking spaces available at private truck stops in this corridor and 105 parking spaces at public facilities. Both the public and private facilities' truck parking supplies exceed the 10-year predicted demand for parking.

Corridor III: The total demand for parking at private truck stops is 255 trucks and the total demand for parking at public rest areas is 56 trucks. There are 357 truck spaces available at private truck stops in this corridor and 82 parking spaces at public facilities. Both the public and private facilities' truck parking supplies exceed the 10-year predicted demand for parking in Corridor III.

Corridor IV: In Corridor IV, the ten-year predicted total demand for parking at private truck stops is 250 trucks and the total demand for parking at public rest areas is 66 trucks. Corridor IV has a supply of 304 private parking spaces, giving it more than adequate spaces to meet future parking demands. However, the predicted demand for parking at public rest areas has already been reached at public parking areas where 67 truck parking spaces are currently available.

Corridor V: The total demand for parking at private truck stops is 173 trucks and the total demand for parking at public rest areas is 31 trucks. There are currently 173 parking spaces available at private truck stops in this corridor and 41 spaces are available at public parking facilities. In Corridor V, the supply of public parking will be sufficient to meet 10-year predictions. However, the private demand for parking will reach maximum capacity by that time.

Research Findings and Conclusions

The research team for this project was pleased that the *Assessment of Commercial Driver Rest Area Needs Study Survey Questionnaire* provided highly relevant insights for assessing the rest area/truck stop facilities for commercial vehicle drivers operating in South Dakota. The original project work plan called for the research team to perform a series of 24-hour observations to assess SD truck parking conditions, but there was not adequate time and/or resources to fully meet this criterion. Therefore, the researchers were primarily limited to nighttime observations, and also part of one day. In spite of this, the researchers feel that peak parking conditions were indeed observed since the density of truck parking normally achieves the highest levels during nighttime hours.

An important aspect of the study centered on the researchers' need to determine the best way to apply the *Truck Parking Demand Model*. As stated previously, the validity of the model output was questionable because original default values for the model were taken from national data that did not appear to accurately depict traffic patterns/statistics representative of South Dakota conditions. Upon careful review, the model was revised whereby default input values were replaced with values more representative of a rural state like South Dakota. The original default values for short-haul truck and long-haul truck percentages were of particular concern and a decision was made to revise them accordingly. The values were reset to 0.60 for long-haul trucks, and 0.40 for short-haul trucks. Resetting these values significantly increased parking demand at private truck stops while decreasing demand at public facilities, thus providing a much better correlation to the researchers' on-site observations of truck parking conditions during nighttime surveys.

Also of particular interest during the nighttime surveys, the researchers observed trucks parked along on/off ramps in spite of obvious available parking at nearby rest areas. Even though the survey questionnaire was aimed at gaining insights to these occurrences, the responses did not provide any concise clarification. Thirty-three percent of the survey respondents claimed to have parked along on/off ramps at highway interchanges and public rest areas. When asked the reasons for parking along on/off ramps, the responding truck drivers listed the following: "No parking available in rest areas" – 21%, "Short breaks and naps" – 19%, "Equipment inspection" – 15%, and, "Long breaks and long-term sleep" – 4%. Even though a majority claimed there was no parking available in rest areas, the researchers' nighttime observations produced conflicting evidence when trucks were seen parked along on/off ramps at the same time that parking was definitely available at nearby rest areas. The researchers can only attempt to rationalize these situations through two possible explanations: 1) Some truck drivers simply prefer to park along on/off ramps, 2) The rest areas may be full just prior to the need to find truck parking, but parking then becomes available shortly thereafter. In essence, the factors contributing to on/off ramp

parking remain unclear and the issue should probably be deferred to more of a nationwide perspective since the anomaly is not unique to South Dakota.

Finally, the research team concluded that the optimal distance between consecutive rest sites for truck drivers in SD is 34.625 miles. The optimal distance was calculated by taking the cumulative average of all truck drivers' answers to the survey questionnaire whereby drivers specified their viewpoints of an ideal distance between rest sites. In actuality, the average distance between rest areas/truck stops along I-29 is 21.2 miles, while on I-90 the average distance is 17.75 miles. Therefore, the researchers concluded that the distribution of rest sites along trucking corridors in South Dakota is sufficient.

Recommendations

1) *Truck parking at rest areas should be segregated from other vehicles and, in particular, truck parking should be maintained in separate areas removed from recreational vehicle (RV) and camper parking.* The SDDDOT needs to consider separate truck-parking areas that are removed and segregated from other vehicle parking. During the nighttime observations, the researchers noted several occasions where truck parking areas were approaching, or else beyond parking space capacities. At these times, however, the truck parking areas contained vehicle types other than trucks, including campers, RVs, etc. These situations may be forcing trucks to seek less desirable parking alternatives such as on/off ramps, thereby creating potentially dangerous conditions. Therefore, the research team recommends that the SDDOT keenly consider the re-allocation of parking space at rest area facilities whereby trucks could have dedicated parking areas.

2) *When upgrading existing rest area facilities, or else building new ones, the research team recommends incorporating "diagonal pull-through" spaces in the design of truck-parking areas.* During the course of nighttime observations, the research team ascertained that diagonal pull-through parking spaces allow for the most efficient use of parking lot space, and are the most "user-friendly" design. Trucks can simply pull in and drive out of the spaces, thus avoiding parallel-parking situations that are often awkward for large commercial vehicles.

3) *The SDDOT needs to consider additional public telephones at public rest areas, and also needs to consider the addition of separate facilities for short-term bathroom breaks.* When questioned about the top three reasons for choosing to stop at public rest areas in South Dakota, truck drivers

prioritized the following: use of restrooms, telephone calls, long-term sleep. During the inventory of public rest area facilities, it was found that most public rest areas in South Dakota only have one pay phone. Therefore, the research team recommends the addition of additional public telephones at rest areas.

Also, the apparent high priority placed on short-term bathroom breaks may be an indication that existing facilities may be too widely spaced to completely fulfill the needs. Therefore, the addition of separate facilities that are significantly downsized to provide restroom services only, and that are strategically placed along certain corridor sections only, is an alternative that deserves consideration.

4) *Parking lot expansions that provide better facilitation for the parking of triple/double trailers at private truck stops in Corridor I should be considered in order to meet rising parking demand.* As a result of the study, it was found that available parking at private truck stops is just barely keeping up with parking demand in Corridor I. Predictions of ten- and twenty-year demand for truck parking in Corridor I indicate that available parking space may soon become deficient. Keeping these predictions in mind, private truck stops in Corridor I may want to consider parking lot expansions in the very near future. At the same time, private truck stops in Corridor I may also want to address the needs of vehicles pulling double/triple trailers when planning the parking lot expansions. Although only thirty-one percent of respondents to the survey questionnaire pulled double/triple trailers, those respondents indicate that available parking space for double/triple trailers at private truck stops is insufficient. Finally, public rest areas in Corridor I may also need to consider expansions that facilitate more double/triple trailer parking because of the increasing demands for this type of parking..

The current and future parking supply versus parking demand appears to be sufficient along all other corridors in South Dakota. This holds true for both public rest area and private truck stop facilities. However, the research team recommends the continuous monitoring of all rest area and truck stop parking conditions around the state. Estimates of current and future demand for parking based on corridor analyses do not necessarily reflect the rapidly changing conditions that can often occur at individual sites.

5) *The State of South Dakota may wish to further investigate illegal/dangerous activities at public rest areas, determine if there are specific public rest areas that tend to attract such activities on a regular basis, and also consider providing security personnel if investigative results so dictate.* In reviewing responses to the survey questionnaire, most drivers feel safest while parked at private truck stops (77%) while, at the same time, 19% claim to feel safest at public rest areas and the remaining 3%

chose on/off ramps as the safest for parking purposes. Perhaps the most intriguing aspect of these survey results is the fact that public rest area facilities scored much lower when perceptions of having a safe environment were similarly compared to private truck stops. The primary illegal activities that respondents claimed to witness included prostitution (19%), use/distribution of illegal drugs (11%), and robbery (4%). If these activities truly occur with such frequency, the State of South Dakota may want to consider providing security personnel at certain public rest areas. However, the research team recommends more thorough and detailed investigations in a more focused study conducted by security specialists and/or law enforcement consultants prior to taking such action.

1.0 Problem Description

Federal regulations are currently in place that set hours-of-service limits for commercial truck drivers. The establishment of these regulations removes the uncertainties where "breaks-in-service" for commercial drivers are concerned and thus creates a need to perform better assessments of when and where commercial drivers may want to have stopovers. From a national perspective, a lack of parking spaces is pushing commercial drivers past the regulated limits for hours-of-service. As a result, Congress passed the Transportation Efficiency Act for the 21st Century (TEA21 – Section 4027), requiring all states to examine the condition of commercial truck parking and available facilities along their major trucking routes. Subsequently, the South Dakota Department of Transportation (SDDOT) was asked to evaluate the needs of commercial drivers and gain perspectives on the adequacy of rest area and truck stop facilities within the state. The results of the evaluation are meant to include recommendations for adequate and safe rest area facilities for commercial truck drivers and other travelers as well. This research project has been structured to comply with Section 4027 of TEA21.

2.0 Background

Prior to this study, no comparative analysis of commercial vehicle parking capacity versus commercial vehicle parking demand had ever been performed at South Dakota rest areas and truck stops. Additionally, commercial drivers now have permissible hours-of-service limits and may have problems finding a suitable place to park. If commercial drivers are unable to receive necessary rest breaks during long periods of service, they may present a safety hazard to both themselves and the general public. Other states have recently been compelled to conduct similar studies and are reporting commercial vehicles parked on the shoulders of entrance and exit ramps along interstate routes. Trucks parked on ramp shoulders create traffic safety hazards, can cause potential damage to shoulders, and may also damage adjacent highway appurtenances. The reports from other states maintain that entrance/exit ramp parking situations coexist with empty parking spaces that are readily available at private truck stops and/or public rest areas. From a national perspective, there may well be a variety of factors contributing to such troublesome parking patterns. Since the sufficiency of commercial vehicle parking space at public rest areas and private truck stops in South Dakota has never been fully examined, this study will need to determine if similar problems exist in South Dakota. The research effort includes procedures to inventory the rest area/truck stop facilities along South Dakota trucking corridors, assess truck parking conditions in those corridors, and identify any deficiencies that may need corrective action. SDDOT's management of a practical program would assure that parking facilities, related services, and corresponding amenities are indeed fulfilling the needs of commercial truck drivers at rest area facilities. The program guidelines would need to be structured in conformance with the requirements of Section 4027 of TEA21.

3.0 Project Objectives

The technical panel for this study developed one research objective:

1) *Using the guidelines established by the Federal Highway Administration (FHWA), develop recommendations that will provide parking facilities and associated services/amenities that meet the rest area needs of commercial truck drivers in South Dakota.*

To identify any problems or deficiencies, parking facilities and associated services at South Dakota's rest areas and truck stops would need to be evaluated. The discovery of any problems or deficiencies would point to any improvements that might be necessary. Recommendations could then be formulated based on any improvements identified as a result of the assessments on current conditions.

The efforts to discover possible deficiencies at South Dakota public rest areas and private truck stops were conducted in accordance with the guidelines as set forth by the FHWA, and through guidelines developed for the project's "Request for Research Proposal." To begin the study, the researchers developed a database inventory of the major trucking corridors in the State of South Dakota. The next task was to inventory all rest areas and private truck stops along these corridors, again developing a database of the information. During this task the researchers paid special attention to site-specific matters, such as: available amenities, services provided, and any significant restrictions applied to particular classes of commercial vehicles. Correspondingly, the conditions surrounding commercial vehicle parking areas were assessed along each of the previously defined trucking corridors. The researchers focused primarily on the number of available parking spaces, but also considered parking space orientation and any provisional parking for oversized vehicles (e.g., extra long/wide vehicles, etc.) among other considerations.

The next phase in the research process required the application of a series of mathematical models collectively known as a corridor-based *Truck Parking Demand Model*. The application of the *Truck Parking Demand Model* allowed the researchers to predict the total hours of demand for commercial vehicle parking during nighttime hours (otherwise assumed to be the peak time of parking demand for commercial trucks).

Once the demand for truck parking was ascertained, the researchers were tasked with assessing the corridor-based truck parking supply. The assessment of parking supply along the major trucking corridors included analyses of available user services, appreciable vehicle restrictions at the facilities, and the spatial distribution of commercial vehicle parking.

A summary effort of the research project called for the performance of random surveys at each of South Dakota's four major ports of entry whereby short-, and long- haul commercial drivers were queried in regard to their driving habits, attitudes, preferences, and characteristics. Thus, by comparing the requirements expressed by commercial truck drivers to the analyses performed on public/private rest area facilities, the researchers were able to identify possible deficiencies and formulate recommendations.

4.0 Project Task Descriptions

Task 1---*Meet with the technical panel to review the project scope and work plan, and develop a list of SDDOT personnel to contact.*

The research team met with the technical panel to review the proposed research methodology and work plan for the project. The meeting provided the technical panel an opportunity to question the researchers about the intended project approach, and also provide input. Although some revisions to the research methodology were incorporated, most of the meeting efforts were focused on revisions to the project's work plan. Primary discussion points centered on gaining mutual assurances that the most relevant information would be obtained from the nighttime studies, refining the proposed survey techniques, and defining acceptable limits for the major research activities. A primary decision at the meeting required the research team to merely record the number of parked trucks during nighttime observations and not to attempt to determine the lengths of time that trucks were parked. It was also decided that the researchers needed to attend a safety briefing before embarking on the nighttime surveys.

The revisions discussed during the meeting were approved by the technical panel and adopted into the final work plan.

Task 2---*Perform a literature search regarding commercial driver rest area needs.*

The researchers examined relevant information and materials that were obtained by the SDDOT Office of Research from other state departments of transportation and transportation research centers. The information provided sufficient background for the proposed research efforts. Of particular interest during the literature reviews were publications entitled "Commercial Driver Rest and Parking Requirements: Making Space for Safety" **[Trucking Research Institute; Apogee Research, Inc.; and Wilbur Smith Associates, 1996]** and "Rest Area Forum: Summary of Proceedings" **[FHWA, 1999]**.

Although more location-specific information related to commercial driver rest area needs was desired for the study, data representative of rural states similar to South Dakota was difficult to find. Therefore, most of the site analyses performed for this study involved the use of commonly accepted factors to produce results. Also, a revision of the "Technical Guidance Document – TEA-21 Section 4027 Study for the Adequacy of Commercial Truck Parking Facilities Serving the National Highway System" was released by the FHWA late in the study and did contain information defining location-

specific values for South Dakota in a better way. Finally, current and predicted values of ADT (Average Daily Traffic) for South Dakota were obtained from the SDDOT Office of Data Inventory.

Task* 3---*Recommend, for technical panel approval, appropriate highway corridors that will be evaluated in this study and that are used by motor carriers in South Dakota.

The researchers presented the technical panel with an inventory of major trucking corridors in South Dakota, as proposed for evaluation purposes. The corridors consisted of segments of roadway with relatively uniform demand for truck parking throughout the segment, and were also defined as roadways with current or projected truck traffic of at least 1,000 vehicles per day. Interstate 90 in South Dakota was divided into 3 corridors for analysis purposes and SD Interstate 29 was divided into 2 analysis corridors. A map showing the layout of the analysis corridors can be found in Appendix F of this report.

Along Interstate 90, 3 corridors were defined with approximately lengths. Corridor 1 starts at the western border of the state and ends at Cactus Flat, SD (MRM 131); Corridor 2 begins at Cactus Flat and ends at the Pukwana, SD exit (MRM 272); Corridor 3 extends from Pukwana to the eastern border of the state. Interstate 29 was divided into 2 corridors as follows: Corridor 4 starts at North Sioux City, SD, and extends to Exit 109. Corridor 5 starts at Exit 109 and ends at the northern border of the state.

All survey results, study analyses, and other project task efforts were conducted and maintained relative to the pre-selected corridors (Corridors 1-5). Keeping research processes focused within the specified corridors provided an effective means to manage the study efforts by allowing ambiguities, problems, and deficiencies to be isolated and treated more effectively. Thereby, the findings, conclusions, and recommendations were more easily attained.

Task 4*--*Conduct random surveys of commercial drivers at selected rest areas and truck stops within the specified corridors to identify their driving habits, attitudes and preferences. This survey should be coordinated with the South Dakota Trucking Association.

The researchers conducted random surveys of professional truck drivers on Interstates 90 and 29 to gain feedback on the specific needs of truck drivers traveling across South Dakota's main truck routes. The survey information was deemed essential for subsequent reviews and analysis by the research team. During the 72 hour National Safety Awareness Week of June 6-8, 2000, a questionnaire was given to

commercial truck drivers and then collected concurrently at South Dakota's 4 major ports-of-entry. The ports-of-entry are, namely: Tilford, Valley Springs, McCook, and Sisseton. Completion of the survey questionnaires was completely voluntary.

In conducting the random survey, employees from the SDDOT Office of Research literally handed the survey forms to in-service truck drivers, gave a brief explanation of the project, and stressed the importance of their input. The questionnaires were completed on site, collected, and conveyed to the Office of Research for subsequent analysis. Upon completion of the on-site efforts, additional survey forms were left at the ports-of-entry in the hope of supplementing the number of responses collected in the field. However, the bulk of the survey responses were collected at the ports-of-entry and 228 forms were collected altogether. Also, the vast majority of the survey respondents were able to complete the form in its entirety. A copy of the survey questionnaire can be found in Appendix A of this report.

All data collected from the survey was entered into an Excel spreadsheet for the ensuing analysis needs of this study. Each survey questionnaire was assigned a row on the spreadsheet, and each question of the survey form was assigned a column. Appropriate cells were marked for each of the responses selected on the survey questionnaires. The accumulated responses were then represented as percentages for clarity during the reviews.

The following table contains the tabulated results from *the Assessment of Commercial Driver Rest Area Needs Study Survey Questionnaire*. Since a number of questions in the survey allowed respondents to select more than one answer, or else stop answering after completing an initial section of a question, the cumulative percentage may not always equal 100%. Also, not all survey questionnaires were completed in their entirety. For these reasons, the table depicts 2 separate columns of percentage data whereby the "A" column contains the response rates relative to all 228 forms collected and the "Q" column contains the response rates relative to the number of respondents for that question only.

Table 4 – 1. Results of the Survey Questionnaire for the Assessment of Commercial Driver Rest Area Needs

#	Survey Question	A	Q
1	In your opinion, what purpose should public rest areas serve?		
	Short breaks & naps	34%	34%
	Long breaks & long term sleep (4 hours or more)	66%	66%
2	In general, have you found that there are enough parking spaces provided in SD at:		
	Public rest areas?		
	Yes	53%	59%
	No	37%	41%
	Private truck stops?		
	Yes	39%	51%
	No	38%	49%

#	Survey Question	A	Q
3	Do you haul wide loads or pull double/triple trailers?		
	Yes	31%	32%
	No	67%	68%
	If yes, is adequate parking provided for loads such as wide loads, or double/triple trailers?		
	At public rest areas:		
	Yes	21%	42%
	No	30%	58%
	At privately owned truck stops:		
	Yes	26%	48%
	No	28%	52%
4	Do you think that additional public rest area parking spaces are needed in the State of South Dakota?		
	Yes	57%	62%
	No	35%	38%
5	Do you think that the distance between public rest areas in South Dakota is too great?		
	Yes	26%	29%
	No	64%	71%
	If yes, what, in your opinion, is the ideal distance between rest areas?		
	30 miles	7%	13%
	40 miles	12%	22%
	50 miles	34%	60%
	other	3%	5%
6	Where do you stop for short-term bathroom breaks in the State of South Dakota?		
	Public rest areas	74%	63%
	Truck stops	43%	43%
7	Do you park along on/off ramps to public rest areas and/or highway interchanges?		
	Yes	33%	35%
	No	63%	65%
	If yes, for what reasons do you park along on/off ramps?		
	Equipment inspection	15%	25%
	Short breaks & naps	19%	60%
	Long breaks & long term sleep	4%	7%
	No parking space available in rest areas	21%	36%
	If yes, how long do you usually park along on/off ramps?		
	30 minutes or less	17%	40%
	1 hour	4%	10%
	2 hours	5%	13%
	4 hours	9%	22%
	8 hours	6%	15%
	Other	—	—

#	Survey Question	A	Q
8	What are the top 3 reasons you choose to stop at truck stops, besides refueling?		
	Availability of adequate parking space (at night)	26%	7%
	Restaurants	61%	16%
	Safety	18%	5%
	Snacks/beverages	31%	18%
	Showers	50%	13%
	Telephone use	44%	12%
	Short breaks & naps	16%	4%
	Long-term sleep/long breaks	36%	9%
	Equipment checks	31%	8%
	Maintenance work	11%	3%
	Leisure time	14%	4%
	Exercise/stretching	11%	3%
	Use of restrooms	32%	8%
	Others	—	—
9	What are the top 3 reasons you choose to stop at public rest areas?		
	Availability of adequate parking space (at night)	19%	6%
	Telephone calls	43%	14%
	Safety	11%	4%
	Short breaks & naps	31%	10%
	Long-term sleep	35%	11%
	Equipment checks	21%	7%
	Use of restrooms	68%	21%
	Exercise/stretching	22%	7%
	Vending machines (candy/pop)	13%	4%
	Leisure time	5%	2%
	Maintenance work	3%	1%
	Others	—	—
10	Has the lack of parking spaces at your projected rest location ever caused you to drive beyond current permissible hours-of-service limits, while driving in the State of South Dakota?		
	Yes	36%	40%
	No	56%	56%
11	Where do you feel the safest, while parking your vehicle at night?		
	Public rest areas	19%	19%
	Truck stops	78%	78%
	On/Off Ramps	3%	4%
12	What illegal activities have you witnessed at public rest areas in SD?		
	Robbery	4%	11%
	Prostitution	19%	57%
	Use/distribution of illegal drugs	11%	33%
	Others	—	—

#	Survey Question	A	Q
13	Please select three existing features of SD public rest areas that need to be improved and/or what features you would like to see added?		
	Build more/bigger rest areas	38%	18%
	Rest area security personnel	22%	10%
	Improved lighting in parking lots	18%	9%
	Showers	21%	10%
	Telephone	20%	9%
	Plug-in Internet terminals for portable PC's	4%	2%
	Designated "trucks only" rest areas	37%	17%
	Short-term bathroom parking	18%	9%
	Stop closing existing rest areas	35%	16%
	Others	—	—
14	When making a short-haul trip (not requiring overnight parking), how much time do you spend parked for every hour of driving (fueling, resting, etc.)?		
	5 – 10 min	38%	38%
	10 – 15 min	16%	20%
	15 – 20 min	14%	18%
	20 – 25 min	11%	14%
15	When making a long-haul trip, how long do you spend driving each day?		
	6 – 7 hours	2%	2%
	7 – 8 hours	5%	6%
	8 – 9 hours	12%	13%
	9 – 10 hours	64%	70%
	More than 10	8%	9%
16	What is the minimum distance you feel should be between consecutive rest sites (either private truck stops and/or public rest areas)?		
	100 miles	18%	20%
	80 miles	14%	15%
	60 miles	32%	35%
	40 miles	26%	30%
	Other (specify)	—	—
17	Please, briefly mention any trouble you have experienced finding parking space along other SD highway segments (other than interstate). Include when and where this took place:		
	(Please see comments that follow)		

Comments that were noted during tabulation of the responses to the *Assessment of Commercial Driver Rest Area Needs Study Survey Questionnaire* can also be found in Appendix A.

Results Analysis of the Survey Questionnaire:

Once the results of *the Assessment of Commercial Driver Rest Area Needs Study Survey Questionnaire* were tabulated, the researchers were able to perform analyses that led to the formulation of conclusions. Information gathered from the survey forms was cross-referenced in various ways and subsequent reviews did not necessarily proceed in the order of the questions as presented on the questionnaire. The following sections present the survey questions categorically instead of

chronologically, thereby allowing the corresponding narratives on the analyses and conclusions to be presented more according to subject area.

Question 2: Are there enough truck parking spaces at a) public rest areas and, b) private truck stops in SD?

In regard to South Dakota public rest areas, the majority of truck drivers felt that parking was currently adequate. However, this seemed to contradict survey responses to a later question concerning the need to add space for more truck parking at public rest areas. To clarify, the same sampling of survey respondents declaring that public rest area parking was currently adequate also responded later in the series of questions that additional parking spaces were *needed* at public rest areas. Perhaps these respondents feel that truck parking at rest areas is currently available, yet anticipate growth in traffic and an increase in the demand for truck parking. Since the researchers would need a more detailed follow-up survey to verify this assumption, no definitive conclusion can be drawn. However, in view of the ever-increasing growth trends of truck traffic and the likely impacts to available parking space at public rest area facilities in South Dakota, the SDDOT should carefully examine the output from *the Truck Parking Demand Model* for decision-making support.

The research team arrived at a very weak conclusion that adequate parking space is available at private truck stops in South Dakota. Thirty-nine percent of respondents said that enough parking spaces are available and 38% said that there is not enough available parking. Again, considering the growth trends of truck traffic in South Dakota, parking conditions at private truck stops may need to be monitored carefully.

Question 3: Do you haul wide loads or pull double/triple trailers? and, Is adequate parking for such loads available at public and private truck facilities?

Although only 31 percent of truck drivers from the survey pulled double/triple trailers, the majority of these respondents (58% vs. 42%) claim that SD public rest areas do not provide sufficient parking for wide-, or long-load vehicles. The SDDOT may need to consider additional parking spaces for such vehicles, make better utilization of available space through reconfigurations of existing parking areas, and/or expand parking areas for oversized vehicles by some other means.

The respondents pulling oversized loads also found parking availability at private truck stops to be inadequate for double/triple trailers. However, the apparent need at private truck stops may not be as great, according to respondents. Fifty-two percent felt that parking for oversized vehicles was inadequate at private truck stops while 48% felt that there was adequate parking available.

Question 5: Is the distance between public rest areas in SD too great? and if it is, What is the ideal distance between rest areas?

Sixty-four percent of survey respondents felt that the typical distance between SD public rest areas is not too great. This speaks well for rest area distribution in South Dakota. Also, the "ideal distance" between rest areas is 48 miles according to the computed average of all responses to that question.

Question 16: What is the ideal minimum distance between consecutive rest sites (either private truck stops or public rest areas)?

The majority of survey respondents selected 60 miles as the ideal distance between consecutive rest sites. However, the ideal distance averaged from all responses was computed to be 34.625 miles. This number was related to the average distance that actually occurs between consecutive rest sites (either private truck stops or public rest areas) on both the I-29, and I-90 trucking corridors. On I-29, the average distance between consecutive sites is 21.2 miles, and on I-90, the average distance is 17.75 miles.

Reviews of the distribution along I-90 were initially confusing so further analysis was performed for this corridor. It was soon evidenced that "clusters" of 3-4 rest sites are often found within a 5-mile radius of each other and it is often quite a stretch of distance along I-90 until the next cluster is encountered. These clusters are normally centered at, or near larger towns along the interstate corridor. To compensate, the researchers calculated the average distance between consecutive clusters along I-90. The results produced an average distance of approximately 24 miles, which was still well under the average ideal distance of 34.625 miles. The final conclusion drawn by the researchers is that the overall distribution of rest sites in South Dakota is sufficient.

Question 1: What purpose should public rest areas serve: short breaks & naps, or long breaks & long-term sleep?

Question 6: Where do you stop for short-term bathroom breaks in South Dakota: public rest areas, or truck stops?

Sixty-six percent of professional drivers traveling in South Dakota feel that public rest areas should serve the primary purposes of long breaks and long-term sleep. At the same time, the majority of truck drivers (74%) said that they stopped at public rest areas, as opposed to private truck stops, for short-term bathroom breaks.

There are a wide range of amenities, conveniences, and services offered by public rest areas and private truck stops in South Dakota. A single difference, or any combination of differences may lure drivers to stop at one facility as opposed to another depending on the timing and needs of the driver.

Question 8: What are the top 3 reasons you choose to stop at truck stops, besides refueling?
Question 9: What are the top 3 reasons you choose to stop at public rest areas?

Responses to the survey questionnaire indicated that restaurants, showers, and telephone use were the three primary reasons that truck drivers choose to stop at private truck stops. The top three reasons for drivers to stop at public rest areas were use of restrooms, telephone calls, and long-term sleep.

In relating the responses to Questions 1 and 6, drivers apparently tend to stop at public rest areas (more so than truck stops) to use restroom facilities, probably for the sake of convenience and timeliness. Since public rest areas do not offer services for fueling, food, repairs, showers, etc, drivers will naturally use available truck stop facilities to meet those needs.

Question 7: Do you park along on/off ramps to public rest areas and/or highway interchanges?, if so, For what reasons?, and, For how long?

Thirty-three percent of survey respondents claimed to park along on/off ramps to public rest areas and highway interchanges. The lack of available parking space was listed as the main reason for this practice. Other reasons cited (in descending order of priority) included equipment inspection, long breaks, and long-term sleep. Further reviews of survey responses revealed that the majority of these trucks park along on/off ramps for 4 hours, while the average time spent in a parked condition along on/off ramps is approximately 2½ hours. The average on/off ramp parking time of 2½ hours probably reflects the high percentage of respondents claiming the need for "short breaks and naps."

Question 10: Has the lack of parking spaces at your projected rest location ever caused you to drive beyond current permissible hours-of-service limits in South Dakota?

According to the survey results, the combined lack, and uneven spatial distribution of parking spaces in South Dakota has pushed 40 percent of drivers past the permissible hours-of-service limits. Even though this figure does not represent a majority of truck drivers, the discovery does bear attention. In essence, though, there appear to be contradictory findings when the results of the *Truck Parking Demand Model* are compared with the responses to related questions in the survey. Application of the *Truck Parking Demand Model* did not reveal any deficiencies in the parking available for trucks at public rest areas along any of the trucking corridors. In addition, truck drivers' responses to Question 16 indicate that approximately 60 miles between rest sites is an ideal distance, suggesting that drivers are generally satisfied with rest site distribution along the state's trucking corridors. Again, the actual average distance between rest sites was found to be even less, and therefore better. Considering that this evidence tends to contradict the outcome of Question 10, the researchers can only conclude the following: 1) truckers may need to plan trips and destinations better, and/or 2) the SDDOT may need to gain better

control of the influences that affect parking distribution along the interstates. To clarify further, during the nighttime observations the researchers noted that certain rest facilities were nearly empty while other areas were overcrowded. This tends to suggest an uneven spatial distribution of rest areas and truck stops along the trucking corridors. However, these findings can only be supported by a more detailed investigation that is defined to carry well outside the scope of this study.

Question 11: Where do you feel safest when parking your vehicle at night?
Question 12: What illegal activities have you witnessed at public rest areas in SD?

According to the survey, most drivers feel safest while parked at private truck stops (77 percent). Meanwhile, 19 percent chose public rest areas as safest, thus leaving the remaining 3 percent choosing "On/Off ramps." Upon reviewing these results, the researchers questioned the low percentage of responses acknowledging public facilities as the safest place to park. In a comparative analysis, the results of Question 12 were reviewed whereby drivers were asked to report the witnessing of any illegal activities public rest areas in South Dakota. Prostitution was selected on 19 percent of the surveys while 11 percent marked the use/distribution of illegal drugs and another four percent claimed to have witnessed robbery at SD public rest areas. These findings were rather surprising, particularly since no illegal activities were ever witnessed by the researchers during their nighttime observations of public rest areas and private truck stops. Again, without a more thorough investigation involving a law enforcement perspective that would tend to overextend the scope of this study, the findings cannot be considered conclusive.

Question 13: Please select three existing features of SD public rest areas that need to be improved and/or what features you would like to see added. (List of features then provided)

The following were selected as the top three features to be added, or else improved upon at public rest areas in South Dakota, according to truckers: 1) Build more and bigger rest areas, 2) Designate "trucks only" rest areas, and 3) Stop closing existing rest areas. To alleviate the collective concerns, the SDDOT may need to consider introducing future rest area facilities that are categorized as "trucks only."

Question 14: When making a short haul trip, how much time do you spend parked for every hour of driving?
Question 15: When making a long-haul trip, how long do you spend driving each day?

The researchers found it unnecessary to incorporate the responses from Questions 14 and 15 into the study. These questions were originally included in the questionnaire to facilitate the process of defining input values for the *Truck Parking Demand Model*. However, ensuing revisions to the model

negated the input requirements and, thereby, eliminated the need for the requisite information to define those inputs.

Task 5--*Conduct direct observations of actual truck parking conditions at a representative number of rest areas, both private and public.*

Under the guise of this study, all public rest area and private truck stop facilities along Interstates 90 and 29 were investigated to determine the sufficiency of available parking space, and to assess the various levels of services provided as well. Additionally, random rest area and truck stop facilities were selected along South Dakota Interstate corridors for nighttime observation surveys. At selected rest areas and truck stops, researchers observed and recorded the number of trucks parked from 10:00 PM until 6:00 AM over 3 consecutive nights. Most commercial truck drivers travel during daylight hours and sleep at night, thereby increasing the demand for truck parking space at public and private rest facilities during the nighttime and evening hours. Since the researchers wished to observe peak parking conditions, it was logical to monitor the demand for truck parking over nighttime and evening hours.

To facilitate the research efforts, a public rest area was paired with the nearest private truck stop. The researchers performed ongoing counts of parked trucks by cycling back and forth between each site and duly recording their observations. The data collection process was conducted over 3 consecutive nights for each pair of facilities represented by 1 public rest area and 1 private truck stop. The primary purposes for the collection of parking data along major trucking corridors were the subsequent processes to quantify the use of parking facilities and to determine whether the supply of truck parking spaces was adequately meeting the demands. Throughout the nighttime observations the researchers also checked the number of trucks parked along the interstate on/off ramps. The number of trucks parked along on/off ramps was then compared to the density of trucks parked within the nearby rest area and/or truck stop. By performing these checks, the researchers hoped to gain a better understanding of the causes for trucks to park along ramps by comparing the levels of parking availability at nearby truck stops and rest area facilities.

The table on following page, Table 4 – 2, provides a listing of the private truck stops and public rest areas that were selected for nighttime observations along Interstates I-90 and I-29.

Table 4 – 2. Listing of Facilities Selected for Nighttime Observations, by Location

Route	Type of Facility	MRM	Name/Title of Facility	Location/neighboring Community
I-90	Public Rest Areas	42		Tilford
I-90	Private Truck Stop	51	The Windmill	Rapid City
I-90	Private Truck Stop	55	Flying J. Travel Plaza	Rapid City
I-90	Private Truck Stop	150	Discount Fuel	Kadoka
I-90	Private Truck Stop	151	Badlands Travel Stop	Kadoka
I-90	Public Rest Areas	167		Belividere
I-90	Public – Pull Offs	188		Murdo
I-90	Private Truck Stop	192	Triple H Auto Shop	Murdo
I-90	Public – Pull Offs	194		Murdo
I-90	Public Rest Areas	363		Salem
I-90	Private Truck Stop	399	Frontier Village	Sioux Falls
I-90	Private Truck Stop	399	Pilot	Sioux Falls
I-29	Private Truck Stop	18	Philips 66	Elk Point
I-29	Public Rest Area	26		Vermillion
I-29	Private Truck Stop	26	Coffee Cup Fuel Stop	Vermillion
I-29	Private Truck Stop	47	Jet	Beresford
I-29	Private Truck Stop	47	Truck Town Plaza	Beresford
I-29	Public Rest Areas	161		Watertown
I-29	Private Truck Stop	178	Stone's Truck Stop	Watertown

MRM = Mile Reference Marker

As seen in the table, the comparative number of nighttime observations was not entirely consistent across each of the corridors. The essential limiting factors were the amounts of travel and time required for performing observations among widely dispersed rest area/truck stop facilities. Facilities were selected primarily on the basis of locations that were well suited to the schedule and itinerary imposed by the nighttime observations. Basically, the nighttime observations were arranged to allow the researchers to gather as much data as possible given the travel and time constraints. Tables that detail all findings of the nighttime observations can be found in Appendix C.

Safety Measures Undertaken During the Performance of the Nighttime Observations:

Prior consideration was given to safety issues that could possibly arise for the research team during the performance of nighttime study efforts at public rest areas and truck stops. Safety precautions were developed in an effort to reduce risks and a safety briefing was conducted before any on-site work activities were initiated. Above all else, researchers were instructed to avoid potentially dangerous situations by immediately seeking safety if ever threatened. A list of precautionary measures developed for the project's field exercises, along with brief explanations, are outlined as follows.

1. *The researchers are to be equipped with a cellular phone and/or radio, and to check in with the highway patrol or State Radio every hour.*

   The researchers were equipped with a cellular phone whereby power was to be maintained for the duration of survey. Although hourly call-ins were performed regularly during the initial work efforts, the need to perform check-ins so often diminished over time. The research team supervisor, Brian Hines, traveled with the researchers during the first week of the field research to assess the project startup activities, and to assess the need for hourly check-ins. It was ultimately decided that hourly call-ins would not be mandatory during the field efforts. However, the research team was instructed to seek a safe area and/or contact the Highway Patrol through the State Radio System and the if emergency situations arose. Throughout the nighttime observations, the researchers did contact Mr. Hines before and after each work shift (at approximately 10 PM and 6 AM) to report and give progress updates.

2. *The researchers shall wear "official-looking" clothing that is highly visible (i.e., brightly colored t-shirts and reflective safety vests). The clothing should allow the researchers to be readily seen, discourage unwanted intrusions, and make the general public aware that the research team is serving in a state government capacity.*

   Although safety apparel was distributed to the researchers, it was seldom needed. The research team performed nighttime observations almost entirely from a requisitioned state vehicle. The vehicle bore markings very similar to law enforcement and the effect tended to discourage interruptions to the work efforts.

3. *The researchers shall drive a state-owned vehicle with a light bar on it.*

   The light bar was necessary to change directions on Interstates 29 and 90 when maintenance/service roads were utilized.

4. *The researchers shall be attentive to the activities and surroundings of work sites, and should contact the local police and/or State Radio Service in the event of any disturbance.*

   Two minor incidents were encountered during field work whereby the cell phone was used to contact appropriate authorities. Neither incident directly involved the research team. In both cases, the recommended procedures were followed and authorities were able to take corrective measures. There were no injuries during these incidents.

5. *A staff member from the Office of Research shall travel with the research team for the first week of rest area data collection.*

   Mr. Brian Hines traveled with the research team during the first week of nighttime observations. No special circumstances or problems arose so the researchers were able to conduct the remaining nighttime study efforts without additional monitoring.

6. *The SD Highway Patrol shall brief the researchers on safety measures.*

   Lieutenant James Carpenter of the SD Highway Patrol conducted a meeting with the research team prior to the start of nighttime observations. Discussion topics included: 1) Be aware of your surroundings, 2) Do not feel obligated to play hero, 3) In any event where it might become necessary, contact State Radio and/or the Highway Patrol and, 4) Move to safety in the event of a potentially dangerous situation. If possible, however, remain to witness events.

7. *The researchers will be made fully aware that their safety is more important than this study. If they do not feel safe at any time, they are to leave the area.*

   These points were presented quite clearly to the research team from the very outset of the research efforts.

8. *Random surveys of the truck drivers will not take place at night.*

   The researchers and other staff members of the SDDOT Office of Research conducted field surveys of commercial truck drivers at South Dakota's major ports-of-entry during the 72-hour National Safety Awareness Week from June 6-8, 2000. The survey forms were completed on site and returned to the SDDOT Office of Research in Pierre for analysis. The surveys were conducted during daylight hours in the presence of SD Carrier Enforcement personnel at state ports-of-entry weigh stations.

Task 6--*Perform an inventory of all highway rest area facilities, both public and private, in the selected highway corridors.*

The research team performed an inventory of all rest areas (public) and truck stops (private) along the major trucking corridors of South Dakota interstate routes. In conducting the inventory, the researchers recorded the various spatial aspects of truck parking, such as size (or surface area), arrangement, and orientation. The primary tasks were to obtain a count of the available parking spaces for commercial trucks and to calculate the surface area comprising those spaces.

In the "Technical Guidance Document – TEA-21 Section 4027…", 1,500 square feet is the space recommended for parking a single truck in unmarked parking areas and 1,200 square feet per truck is recommended for marked parking spaces. These figures were initially used to determine the supply of parking for the five study corridors in South Dakota, as found in Appendix E of this report "Corridor Parking Supply vs. Demand: Present and Future Analysis." When the researchers compared truck parking supply estimates based on the above to actual truck parking conditions recorded during nighttime observations, the estimates based on recommended parking space per truck appeared to be low. For example, the total parking supply for all private truck stops in Corridor 1 was estimated to be 194 spaces when using the recommended allowance of 1,500 ft^2 per truck. At the Windmill and Flying J truck stops alone, the researchers observed a total of 201 trucks parked. In addition, parking space availability at the Windmill was calculated to be 60 trucks when using 1,500 ft^2 of space allowance per truck, but the researchers actually observed 113 trucks parked at this truck stop. Also, in spite of the difference between calculated supply and direct observations, these 2 truck stops did not seem overcrowded. If anything, the parking areas appeared to be at, or near capacity.

As a result of the apparent inconsistencies between calculated and observed parking availability, the researchers concluded that simply measuring the area available for truck parking did not provide the full means to determine parking capacity. The layout of a parking lot, parking lot design, and parking patterns are other variables that need to be considered when assessing the efficient use of space within a parking lot. In considering marked and unmarked parking spaces only, the technical guidelines provided by the FHWA seemed to lack specificity in describing the methods for parking lot measurement. The research team felt that the lack of detail had the potential to create inconsistency when performing measurements and, thereby, contributed to the disparity between observed and calculated parking capacities.

In the final estimation of the research team, the recommendation to designate 1,500 ft^2 per truck in unmarked parking areas appeared to be a liberal designation. Based on this, the researchers decided to recalculate parking supply in all of the trucking corridors whereby nighttime observations essentially

guided the spatial allocations. At truck stops where observations revealed the number of parked trucks actually exceeded the recommended parking capacity, the researchers decided that the actual number of parked trucks would represent the available supply of parking space.

Tables showing the estimates of parking supply versus parking demand for SD trucking corridors can be found in Appendix D. Sections D1 and D2 give the supply versus demand breakdown using an allowance of 1,500 ft^2 per truck in unmarked parking spaces. Sections D3 and D4 provide truck parking supply estimates that are based on the nighttime observations performed by the researchers.

During the process of quantifying available truck parking, the researchers also classified parking spaces by arrangement and orientation, such as pull-through areas and spaces available for parallel parking. The classifications enabled the research team to determine the levels of efficiency of parking areas, and provided background to later suggest possible improvements. Additionally, the researchers considered whether any segregation existed between recreational vehicle/car parking areas and commercial trucks parking areas. Having separate parking areas normally increases the likelihood that other vehicles will not park in spaces dedicated to trucks. At most South Dakota rest areas, however, campers and RVs are directed to park in the same parking area as trucks, thereby decreasing available truck parking. The researchers took special note of the different types of vehicles in truck parking areas during the nighttime observations in an effort to obtain additional, relevant background information.

Finally during the nighttime observations, the researchers verified the availability of, or else the restrictions to services and amenities at truck stops and rest areas. There are often restrictions in place at certain discerning public rest areas and private truck stops, particularly for commercial drivers pulling triple trailers, wide loads, etc. Other sites make efforts to cater to a broader audience where the aim is to attract higher truck traffic and/or more passing motorists. Included as primary interests to the researchers were food services (vending machines/diners), restrooms (temperature controlled?), showers, telephones, parking fees, fuel, and vehicle service centers. Also, various lighting conditions were observed at parking lots, restrooms, on/off ramps, fuel pump islands, and other areas. The original intent was to facilitate categorization of rest areas and truck stops, thus allowing the researchers to establish co-relationships with other research findings. However, since services and amenities tended to be nearly identical for all rest areas, and very similar between various truck stops, categorical analysis was minimized. Most of the correlative study efforts were focused on simple comparisons of the services and amenities offered at truck stop facilities in general, as opposed to the services and amenities offered at rest areas controlled by the State of South Dakota.

Task 7--*Apply the "Truck Parking Demand Model" to determine overall demand for truck parking in the selected trucking corridors.*

Prior to January 2000, there were apparent shortcomings in the efforts of state and federal agencies to develop a model that would project truck-parking demand estimates for public and private rest facilities within a transportation corridor. The "Technical Guidance Study for the Adequacy of Commercial Truck Parking Facilities" **[Science Applications International Corporation; George Mason University; Turner Fairbank Highway Research Center, 2000]** included a *Truck Parking Demand Model* that took a different approach that incorporated site analyses of private truck stops. In the approach, existing parking, available amenities, and spatial distribution of parking spaces provided a basic framework to predict parking demand. The model was designed to satisfy the guidelines set forth in Section 4027 of TEA21. Thereby, the research team for this study effort decided to incorporate the *Truck Parking Demand Model* to perform estimates of truck parking demand along selected trucking corridors.

The *Truck Parking Demand Model* is capable of predicting truck-parking demand along an entire corridor through analysis of several interrelated variables, including:

- Percentage of daily truck traffic for both short-, and long- haul trucks.
- Short-haul parking duration (in minutes) per each hour traveled.
- Ratio of parked time per week to driving time per week.
- Peak parking factor for short-, and long- haul trucks.
- Proportionate share of short-, and long- haul truck parking demand at both private truck stops, and public rest areas.

Demand for parking space was computed in terms of truck spaces per hour and distributed into long-, and short-haul parking demands. The long and short-haul parking space demands were then distributed according to their proportionate shares to the rest areas and truck stops. (e.g., Long-haul parking space demands were calculated for each public rest area whereby demands represented the maximum number of truck spaces needed at each location, otherwise refereed to as peak parking demand.) The researchers then accumulated the total demand for parking space at all rest areas within a corridor and compared this total to the actual number of parking spaces provided within the corridor (the parking supply) to determine the adequacy of parking there. If the number of available parking spaces for trucks was found to be less than the demand, the corridor was considered insufficient. The adequacy of parking space supply versus parking space demand for trucks was computed for current, as well as projected future demands. Current parking space demands for trucks were computed using current ADT figures. Ten-

year and 20-year projected demands were arrived at through substitution of 10-year and 20-year predicted ADT values into the model equation.

The following table describes the data input, or "Model Variables", as well as the default values (as applicable) for the variables used in the *Truck Parking Demand Model*:

Table 4 – 3. Descriptions of Variables Used in the *Truck Parking Demand Model*

Model Variable	Variable Description	Default Value (If Applicable)
L	Length of Highway Segment (miles)	
ADT	Average Daily Traffic (vehicles per day)	
P_t	Percent of Daily Traffic Consisting of Commercial Trucks	
S	Speed Limit of Highway, or average truck speed (mph)	
Fs	Seasonal Peaking Factor	1.15
P_{SH}	Percent of Daily Truck Traffic Consisting of Short-Haul Trucks	40%
P_{LH}	Percent of Daily Truck Traffic Consisting of Long-Haul Trucks	60%
D_{SH}	Short-Haul Parking Duration Per Hour Traveled (minutes)	5 min
R*	Ratio of parked time per week to driving time per week	70/60
PPF_{SH}	Peak parking factor for short-haul trucks	0.02
PPF_{LH}	Peak parking factor for long-haul trucks	0.07
$P_{(SH,TS)}$	Portion of Short-Haul Demand for Truck Stop Spaces	0.60
$P_{(SH,RA)}$	Portion of Short-Haul Demand for Rest Area Spaces	0.40
$P_{(LH, RA)}$	Portion of Long-Haul Demand for Truck Stop Spaces	0.40
$P_{(LH, TS)}$	Portion of Long-Haul Demand for Rest Area Spaces	0.60
PS_{TS}	Private Truck Stop Parking Space Supply in the Corridor	
PS_{RA}	Public Rest Area Parking Space Supply in the Corridor	

*Note: Nationally accepted default values were used for certain variables, particularly when more recent/location specific information could not be acquired.

Data and Formulas Used in the *Truck Parking Demand Model*:

The framework of the *Truck Parking Demand Model* consists of a series of models that make use of available data on traffic, roadway type, and parking behavior to predict parking demand within a corridor. The following list describes the data that was collected and the formulas that were used in the series of mathematical models that make up the *Truck Parking Demand Model*.

Compute Seasonal Peak Daily Truck Volume (V_t) in trucks per day:

(1) $V_t = ADT \times P_t \times F_s$

Compute Average Truck Travel Time (TT) for the roadway segment, in hours per truck:

(2) $TT = L / S$

Estimate Total Vehicle Hours of Travel (VHT) for both short-, and long- haul trucks:

(3) $VHT_{SH} = P_{SH} \times V_t \times TT$

(4) $VHT_{LH} = P_{LH} \times V_t \times TT$

Compute Vehicle Hours of Short-Haul Parking Demand (VHP_{SH}):

(5) $VHP_{SH} = D_{SH} \times VHT_{SH} / 60$

Compute Vehicle Hours of Long-Haul Parking Demand (VHP_{LH}):

(6) $VHP_{LH} = R^* \times VHT_{LH} + (VHT_{LH} / 12)$

Compute Peak-Hour Parking Demand (PHP) for both short-, and long- haul trucks in spaces per hour occupied:

(7) $PHP_{SH} = PPF_{SH} \times VHP_{SH}$

(8) $PHP_{LH} = PPF_{LH} \times VHP_{LH}$

Estimate the Peak-Hours of Parking Demand for both short-, and long- haul trucks at private Truck Stops (TS) and public Rest Areas (RA) in spaces per hour occupied:

(9) $PHP_{(SH\text{-}TS)} = P_{(SH, TS)} \times PHP_{SH}$

(10) $PHP_{(SH\text{-}RA)} = P_{(SH, RA)} \times PHP_{SH}$

(11) $PHP_{(LH\text{-}TS)} = P_{(LH, TS)} \times PHP_{LH}$

(12) $PHP_{(LH\text{-}RA)} = P_{(LH, RA)} \times PHP_{LH}$

By comparing the results obtained from Equations 9 through 12, the researchers were able to determine the demand for commercial truck parking at specific locations within a corridor. Subsequently, the researchers were able to assess the adequacy of truck parking within a corridor by comparing the computed parking demand to the available parking supply within a corridor. Recommendations to address inadequate truck parking could then be formulated as necessary. Appendix B contains sample calculations performed by means of the above sequence for a Corridor I analysis.

The following table contains the computed results, or output, from *the Truck Parking Demand Model* for each of the corridors selected for the study.

Table 4 – 4. Results Obtained From the *Truck Parking Demand Model*.

Corridor	ADT	TS Supply	RA Supply	Demand					
				Current		10-Year		20-Year	
				TS	RA	TS	RA	TS	RA
1	8437	244	76	***246***	19	***293***	22	***340***	26
2	5988	253	105	94	33	116	41	139	49
3	7870	357	82	213	47	255	56	296	65
4	9809	304	67	209	55	250	***66***	290	***76***
5	5656	173	41	143	25	***173***	31	202	36

*Note: See Appendix B for predicted ADT values.

Table Key:

TS = Truck Stop RA = Rest Area ADT = Average Daily Traffic

When defining the corridors, the researchers ensured that no large city was the starting point or ending point of a corridor. Interstate 90 (I-90) was divided into three sections. Interstate 29 (I-29) was divided into two sections. Each corridor was approximately 135 miles in length with bounds described as follows:

Corridor 1: From the western border to Cactus Flats (exit 131).
Corridor 2: From Cactus Flats (exit 131) to Pukwana (exit 272).
Corridor 3: From Pukwana (exit 272) to the eastern border.
Corridor 4: From the southern border to Colman (exit 109).
Corridor 5: From Colman (exit 109) to the northern border.

Assessment of the Results Obtained From the *Truck Parking Demand Model*:

The results from the *Truck Parking Demand Model* were obtained using the actual quantities of parked trucks recorded during the nighttime observations, and *not* on computed quantities using truck parking allocations based on 1,500 ft^2 of space per truck. The above table reflects the results of this "modified" approach, as do the following comments.

Assessment of Current Truck Parking Demand

Corridor I: The total parking demand at private truck stops is 246 trucks and the total parking demand at public rest areas is 19 trucks. There are 244 truck spaces available at private truck stops in this corridor and 76 available spaces at public parking facilities. In Corridor I, there is a surplus of public rest area parking for trucks. However, the private parking demand for trucks is just over capacity.

Corridor II: The total parking demand at private truck stops is 94 trucks and the total parking demand at public rest areas is 33 trucks. There are 253 truck spaces available at private truck stops in this corridor and 105 available spaces at public parking facilities. Both the public and private facilities' truck parking supplies well exceed the parking demands.

Corridor III: The total parking demand at private truck stops is 213 trucks and the total parking demand at public rest areas is 47 trucks. Meanwhile, there are 357 truck spaces available at private truck stops in this corridor and 82 available spaces at public parking facilities. Corridor III also has public and private parking supplies that are well above the parking demands.

Corridor IV: The total parking demand at private truck stops is 209 trucks and the total parking demand at public rest areas is 55 trucks. The corridor has a supply of private parking at 304 spaces, which is more than sufficient to meet the parking demand. The public parking supply, 67 spaces, also exceeds the public parking demand.

Corridor V: The total parking demand at private truck stops is 143 trucks and the total parking demand at public rest areas is 25 trucks. There are 173 truck spaces available at private truck stops in this corridor and 41 available spaces at public parking facilities. Corridor V also has surpluses of truck parking at private truck stops and public parking areas.

Assessment of Predicted 10-Year Truck Parking Demand

The researchers calculated future truck parking demand by substituting 10-year predictions of ADT for the present ADT values. Predicted ADT values are produced from a linear growth model used by the Office of Data Inventory at the SDDOT. Initially, generally accepted default values were used to predict parking demand at truck stops and rest areas. Again, however, default values yielded results that were not representative of the researchers' findings from the nighttime observations. Utilization of the

default values produced a fairly even distribution of parking between rest areas and truck stops, whereas nighttime observations in selected corridors revealed parking demands that strongly favored private truck stops. Therefore, the default values for truck stops were adjusted relative to the values used for rest areas, thus producing a more accurate model for South Dakota conditions. Revisions to the technical guidelines for this study contain the modified values, which were felt to better represent South Dakota traffic patterns. Following are the comments on the results obtained:

Corridor I: The total parking demand at private truck stops is 293 trucks and the total parking demand at public rest areas is 22 trucks. Currently, there are 244 truck spaces available at private truck stops in this corridor and 76 available spaces at public parking facilities. In Corridor I, there will be a surplus of public rest area parking for trucks. However, there will be a deficiency in the private parking supply for trucks.

Corridor II: The total parking demand at private truck stops is 116 trucks and the total parking demand at public rest areas is 41 trucks. Currently, there are 253 truck spaces available at private truck stops in this corridor and 105 available spaces at public parking facilities. Both the public and private facilities' truck parking supplies exceed the 10-year predicted truck parking demand.

Corridor III: The total parking demand at private truck stops is 255 trucks and the total parking demand at public rest areas is 56 trucks. There are 357 truck spaces available at private truck stops in this corridor and 82 available spaces at public parking facilities. Both the public and private facilities' truck parking supplies exceed the 10-year predicted truck parking demand in Corridor III.

Corridor IV: In Corridor IV, the ten-year predicted total parking demand at private truck stops is 250 trucks and the total parking demand at public rest areas is 66 trucks. Corridor IV has a supply of 304 private parking spaces for trucks, making it more than adequate to meet future truck parking demands. However, the predicted truck parking demand at public rest areas has already been reached at public parking areas where 67 truck spaces are currently provided.

Corridor V: The total parking demand at private truck stops is 173 trucks and the total parking demand at public rest areas is 31 trucks. There are currently 173 truck spaces available at private truck stops in this corridor and 41 available spaces at public parking facilities. In Corridor V, the supply of public truck parking will be sufficient to meet the 10-year predictions. However, the private parking demand for trucks will reach maximum capacity.

Task 8--*Perform an assessment of parking space supply, and also assess deficiencies in various service and amenity categories.*

The major trucking corridors selected from within the state were studied to gain a better understanding of: 1) spatial distributions of existing truck parking, 2) availability of truck stop/rest area amenities and, 3) availability of truck stop/rest area services. A preferred research methodology was originally conceived to perform the study analysis, but the researchers eventually found this methodology to be too far-reaching in scope. The methodology had to be simplified to a mere comparison of the truck parking supply to the truck parking demand within each corridor so that parking sufficiency could be determined. Parking sufficiency was also analyzed relative to public and private parking facilities in the corridors. The analysis was performed using ADT for trucks as the input values to produce current truck parking demands, 10-year predicted demands, and 20-year predicted demands. The results of the analysis can be seen in the Supply vs. Demand tables in Appendix E.

Analysis of User Services and Restrictions: A categorized inventory of parking facilities along consecutive highway interchanges within each corridor was conceived so that the researchers could compare parking space distribution and adequacy to the available amenities/services in close proximity. The analysis was meant to provide insights to the need for expanded parking, added amenities, modified restrictions, or provisional signing to more evenly balance parking within a corridor that has adequate parking supply overall, but where the spatial distribution is often inadequately addressed. The analysis of user services, facilities restrictions, and parking concentrations was primarily intended to identify locations where truck parking and/or services were deemed to be deficient. The identified deficiencies were then meant to be combined with the output from the *Truck Parking Demand Model* to give a better perspective of truck parking conditions in South Dakota and eventually lead to the formulation of location-specific facilities assessments. (e.g. If truck parking was found to be sufficient at a specific location, it would not preclude recommendations to upgrade and/or enhance certain services and amenities that could potentially be lacking at the same location.)

The facilities surveys focusing on the services/amenities at various parking facilities within each corridor produced very consistent findings. That is, most all truck stops in SD offer nearly the same services/amenities, and the distribution is also fairly consistent throughout. The same is true for public rest areas where the similarities are even more profound. Therefore, a service-, or amenity- categorized analysis of parking facilities was not continued because further study was deemed to bear little relevance.

Spatial Distribution of Parking: The original work plan for this research effort called for an examination of the spatial uniformity of parking spaces within each corridor. To analyze the spatial distribution of parking within corridors, the following procedure was developed:

- Corridors were to be divided into 20-mile sections.
- The average number of available parking spaces for trucks was to be tabulated along each contiguous, sixty-mile stretch (three sections) of the corridor.
- The average parking demand for trucks was to be computed for each 60-mile corridor segment.
- The average demand would then be divided by the average supply for each sixty-mile stretch, thus producing an index.
- The index would indicate whether parking was deficient along any given 60-mile stretch of corridor.

In spite of original intents, the researchers were unable to complete parking analyses centered on the spatial distribution of truck parking. Recommendations in the technical guide for TEA21 – Section 4027, specifically state: " For segments with demand to supply ratios greater than 0.85, but less than one, an analysis of the spatial distribution of parking is recommended, to ensure that the supply of parking is adequately distributed along the corridor." When the ratio of parking demand to parking supply was generated for each SD corridor, all of the ratios were found to be less than 0.85. Therefore, since each corridor in SD had a ratio that was below the recommended range, the procedure was foregone.

Task 9—*Analyze and interpret the results to better understand the demand/capacity issues for truck parking in South Dakota. Recommend changes to SD rest area parking facilities, services, and amenities to meet the rest area needs of commercial truck drivers.*

The research work plan called for the researchers to analyze and interpret results from three points of view, described as follows:

1) Shortfall Analysis: a) If the *Truck Parking Demand Model* predicts truck parking demand that is well below available supply, no further analysis will be necessary (unless there is further evidence of necessary analysis arising from the random survey results.) b) If the *Truck Parking Demand Model* predicts parking demand that is near capacity, a spatial distribution analysis will need to be performed to ensure that

parking supply is adequate all along the corridor, and also to ensure that there is not a significant highway segment that approaches minimum service levels. c) If parking demand is well beyond capacity, a spatial distribution analysis will be necessary to determine where additional truck parking should be planned.

After inventorying all five corridors and determining available parking supply, the survey team used the output from the *Truck Parking Demand Model* to compare the results along each corridor. The comparisons can be seen in Appendix E2. However, since the researchers did not find an overall shortage of truck parking along any given corridor, it was deemed unnecessary to evaluate the spatial distribution of parking. In fact, there was only one instance where a truck parking shortage was exhibited during the comparative examinations across all 5 corridors. The instance occurred in the private truck stop category along Corridor 1 and the existing parking supply was determined to be fairly close to parking demand.

Amenity and Service Supply Analysis: To determine whether an equitable distribution of services exists along each of the selected corridors, appropriate data (as found in Appendix D) would need to be reviewed.

Reviews of available services at rest stop facilities in SD revealed that public rest areas are all very similar in the levels of service provided, and so too are services provided at private truck stops. The essential task became a determination of the optimal spacing between rest stop facilities.

It was concluded that the survey questionnaire collected from truck drivers contained the primary information to define the optimum distance between rest sites. Upon review, a question included with the survey asked commercial drivers to cite a distance between consecutive rest sites that would be a typical distance relative to their perceived rest area needs. All responses were taken into consideration and an average minimum distance was acquired. The average minimum distance between consecutive sites was found to be 65 miles. It should be noted in some cases, however, a service deficiency often resulted in a truck drivers' perceived need for a simple improvement at a public rest area and such perceptions often tended to increase the optimal distance between sites. In other cases, it was felt that private truck stop operators or franchised facilities could be encouraged to provide improvements, upgrades, or even new facilities at locations along a supposedly deficient stretch of corridor to, again optimizing stopping distances.

Special Needs Analysis: Under the auspices of this study, the distribution of rest area facilities needs to be assessed in regard to the levels of service provided for trucks with special needs. This would include long-haul trucks without sleepers, oversize loads, and triple trailer trucks. If it is determined that parking and access restrictions significantly affect access to services at rest areas for these special needs truck categories, rest area improvements may be warranted to accommodate these types of trucks.

At private truck stops in South Dakota, most of the parking areas consist of unmarked gravel lots. Therefore, there are few restrictions on the parking of oversize vehicles or triple trailer trucks. During the nighttime observations, the researchers did not identify any problems for special needs trucks and thereby determined that special needs analyses were not necessary.

Task 10—*Make an executive presentation to the SDDOT Research Review Board at the conclusion of the project.*

Upon completion of the project, Michael R. Powell made an executive presentation to the Research Review Board at their August 2000 meeting. Mr. Powell summarized the findings and conclusions of the study efforts, and also forwarded recommendations.

5.0 Research Analysis and Findings

The researchers for this project feel that the *Assessment of Commercial Driver Rest Area Needs Study Survey Questionnaire* provided highly relevant insights into conditions of rest area/truck stop facilities for commercial vehicle drivers operating in South Dakota. It should be noted that there were a few minor errors on the original survey form that that needed resolutions. In question 9, for example, selections A through E were repeated. However, the problems were addressed during ensuing analyses so that the results would not be compromised.

The research team also adjusted the procedures somewhat for the study of truck parking at public rest areas and private truck stops during the course of the study. The original project work plan called for a series of 24-hour observations to assess SD truck parking conditions. However, since the research team did not have adequate time and/or resources to satisfy this criterion in the most suitable fashion, the researchers were mainly limited to nighttime observations and also part of one day. In spite of this, the researchers feel that peak parking conditions were indeed observed since truck-parking density is normally at the highest levels during nighttime hours. The researchers were able to observe parking patterns along South Dakota's major trucking corridors over 3 consecutive nights, from 10 PM until 6 AM.

Finally, the researchers needed to make determinations on how to apply the *Truck Parking Demand Model*. The validity of the model output was initially questionable because original default values for the model were taken from national statistics that did not appear to accurately depict traffic patterns/records that were representative of South Dakota conditions. Upon careful review, the truck model default values were revised for South Dakota and replaced with values more representative of a rural state. The original default values for short-haul truck and long-haul truck percentages were of particular concern and a decision was made to revise these defaults. The values were reset to 0.60 for long-haul trucks, and 0.40 for short-haul trucks. Resetting these values significantly increased parking demand at private truck stops while decreasing demand at public facilities, thus providing a much better correlation to the researchers' on-site observations of truck parking conditions during nighttime surveys.

Of particular interest during the nighttime surveys, the researchers observed trucks parked along on/off ramps in spite of obvious available parking at nearby rest areas. Even though the survey questionnaire was aimed at gaining insights into these occurrences, the responses did not provide any definitive information that helped clarify the matter. Upon review of the responses to the survey questionnaire, it was found that 33% of survey respondents claimed to have parked along on/off ramps at highway interchanges and public rest areas. When asked the reasons for parking along on/off ramps, the responding truck drivers listed the following: No parking available in rest areas – 21%, Short breaks and

naps – 19%, Equipment inspection – 15%, and, Long breaks and long-term sleep – 4%. Even though a majority claimed there was no parking available in rest areas, the researchers' nighttime observations produced conflicting evidence, especially since trucks were seen parked along on/off ramps at the same time there was obvious parking available at nearby rest areas. The researchers can only attempt to rationalize these parking behavioral patterns with two possible explanations: 1) Some truck drivers simply prefer to park along on/off ramps, 2) The rest areas may be full just prior to the need to find truck parking, but parking then becomes available shortly thereafter. In essence, the factors contributing to on/off ramp parking remain unclear and the issue probably deserves more of a nationwide perspective since the idiosyncrasy is not unique to South Dakota.

Finally, the research team concluded that the optimal distance between consecutive rest sites for truck drivers in SD is 34.625 miles. The conclusion was drawn by computing the cumulative average of all distances along SD corridors that were specified to be the ideal distances by truck drivers responding to the survey questionnaire. In actuality, the average distance between rest area/truck stop along I-29 is 21.2 miles, while on I-90 the average distance is 17.75 miles. Therefore, the researchers concluded that the distribution of rest sites in South Dakota is sufficient.

6.0 Recommendations

1) *Truck parking at rest areas should be segregated from other vehicles and, in particular, parking areas for trucks should be in separate areas that are entirely removed from recreational vehicle (RV) and camper parking.* The SDDDOT needs to consider schemes whereby truck parking is removed to a separate area and trucks are segregated from other vehicle parking. During the nighttime observations, the researchers noted several occasions where truck parking areas were approaching, or else beyond parking space capacities. At these times, however, the truck parking areas contained vehicle types other than trucks, including campers, RVs, etc. These conditions may be forcing trucks to seek less desirable parking alternatives such as on/off ramps thereby creating potentially dangerous situations. Therefore, the research team recommends the SDDOT keenly consider re-allocations of parking space at rest area facilities whereby trucks would be afforded fully dedicated parking areas.

2) *When upgrading existing rest area facilities, or else building new ones, the research team recommends incorporating "diagonal pull-through" spaces in the design of truck-parking areas.* During the course of nighttime observations the research team ascertained that diagonal pull-through parking spaces allow for the most efficient use of parking lot space, and are the most "user-friendly" design. Trucks can simply pull in and drive out of these types of parking spaces, thus avoiding parallel-parking situations that are often awkward for large commercial vehicles.

3) *The SDDOT should consider additional public telephones at public rest areas, and also consider the addition of separate facilities for short-term bathroom breaks.* When questioned about the top three reasons for choosing to stop at public rest areas in South Dakota, truck drivers chose the following: use of restrooms, telephone calls, long-term sleep. During the inventory of public rest area facilities, it was found that most public rest areas in South Dakota only have one pay phone. Therefore, the research team recommends the addition of additional public telephones at rest areas.

   Also, the apparent high priority placed on short-term bathroom breaks may be an indication that existing facilities may be too widely spaced to completely fulfill the needs. Therefore, the addition of separate facilities that are significantly downsized by providing restroom services only may be an alternative deserving consideration along certain deficient trucking corridors.

4) *Parking lot expansions that facilitate triple/double trailers more readily at private truck stops in Corridor I should be considered in order to meet the rising demand for the parking of oversize vehicles.* Evidence gathered during this study indicates that available parking at private truck stops is

barely keeping up with truck parking demand in Corridor I. Predictions of ten- and twenty-year parking demand for trucks in Corridor I indicate that parking deficiencies may soon be realized. Keeping these predictions in mind, private truck stops in Corridor I may need to consider expanded truck parking in the very near future. At any time parking lot expansions are planned at private truck stops in Corridor I, additional parking for vehicles pulling double/triple trailers may also need to be considered. Although only 31% of respondents to the survey questionnaire pulled double/triple trailers, those respondents indicate that available parking space for double/triple trailers at private truck stops is currently insufficient. Also, public rest areas in Corridor I may need to consider parking lot expansions that facilitate more double/triple trailer parking as the parking demands for oversize vehicles continues to increase.

The current and future truck parking supply versus parking demand appears to be sufficient along all other corridors in South Dakota. This holds true for both public rest area and private truck stop facilities. However, the research team recommends the continuous monitoring of parking conditions at all rest area and truck stop facilities around the state. Current and predicted parking demands that are corridor-based do not necessarily reflect the rapidly changing conditions that can often impact facilities on a more localized basis.

5) *The State of South Dakota may wish to pursue further investigations of illegal/dangerous activities at public rest areas, determine if there are specific public rest areas that tend to attract such activities on a regular basis, and consider providing security personnel if investigative results so dictate.* In reviewing responses to the survey questionnaire, most drivers feel safest while parked at private truck stops (77%). Meanwhile, 19% claim to feel safest at public rest areas and the remaining 3% chose on/off ramps as the safest for parking purposes. Perhaps the most intriguing aspect of these survey findings is the fact that public rest area facilities scored so much lower in the perception of providing a safe environment compared to private truck stops. The primary illegal activities that respondents claimed to witness included prostitution (19%), use/distribution of illegal drugs (11%), and robbery (4%). If these activities truly occur with such frequency then the State of South Dakota may want to consider security provisions at certain public rest areas. However, the research team recommends a more thorough and detailed investigation by security specialists and/or law enforcement consultants prior to taking such action.

References

1) **Commercial Driver Rest and Parking Requirements: Making Space For Safety, Report No. FHWA-MC-96-0010**, prepared by Trucking Research Institute; Apogee Research, Inc.; and Wilbur Smith Associates for the Federal Highway Administration, U.S. Department of Transportation, Washington, D.C., May 1996.

2) **Rest Area Forum: Summary of Proceedings, December 1999, Publication No. FHWA-RD-00-034,** Federal Highway Administration, U.S. Dept. of Transportation, Washington, D.C., December 1999.

3) **Technical Guidance Study for the Adequacy of Commercial Truck Parking Facilities, Report No. FHWA**, prepared by Science Applications International Corporation; George Mason University; and Turner Fairbank Highway Research Center for the Federal Highway Administration, U.S. Department of Transportation, Washington, D.C., April 2000.

Appendix A

Commercial Driver Rest Area Needs Study

Survey Questionnaire

Commercial Driver Rest Area Needs Study
Survey Questionnaire

1. In your opinion, what purpose should public rest areas serve?
   O Short breaks & naps O Long breaks & long term sleep (4 hours or more)

2. In general, have you found that there are enough parking spaces provided, in SD, at…
   A) Public rest areas? B) Private truck stops
   O Yes O No O Yes O No

3. Do you haul wide loads or pull double/triple trailers?
   O Yes O No

   If yes, is adequate parking provided for loads such as wide loads, or double/triple trailers?
   At public rest areas:
   O Yes O No
   At privately owned truck stops:
   OYes O No

4. Do you think that additional public rest area parking spaces are needed in the State of South Dakota?
   O Yes O No

5. Do you think that the distance between public rest areas in South Dakota is too great?
   O Yes O No

   If yes, what, in your opinion, is the ideal distance between rest areas?
   O 30 miles O 40 miles O 50 miles O other

6. Where do you stop for short-term bathroom breaks in the State of South Dakota?
   O Public rest areas O Truck stops

7. Do you park along on/off ramps to public rest areas and/or highway interchanges?
   O Yes O No

   If yes, for what reasons do you park along on/off ramps?
   O Equipment inspection O Short breaks & naps
   O Long breaks & long term sleep O No parking space available in rest areas

   If yes, how long do you usually park along on/off ramps?
   O 30 minutes or less O 1 hour O 2 hours
   O 4 hours O 8 hours O other _____

8. What are the top 3 reasons you choose to stop at truck stops, besides refueling?
   O Availability of adequate parking space (at night) O Restaurants O Safety
   O Telephone use O Snacks/beverages O Showers
   O Equipment checks O Short breaks & naps O Long-term sleep/long breaks
   O Exercise/stretching O Maintenance work O Leisure time
   O Use of restrooms O Others _____

9. What are the top 3 reasons you choose to stop at public rest areas?

O Availability of adequate parking space (at night)	O Telephone calls	O Safety
	O Long-term sleep	O Equipment checks
O Use of restrooms	O Short breaks & naps	O Long-term sleep
O Exercise/stretching	O Vending machines (candy/pop)	O Leisure time
O Availability of adequate parking space (at night)	O Telephone calls	O Safety
	O Long-term sleep	O Equipment checks
O Maintenance work	O Others _____	

10. Has the lack of parking spaces at your projected rest location ever caused you to drive beyond current permissible hours-of-service limits, while driving in the State of South Dakota?
    O Yes O No

11. Where do you feel the safest, while parking your vehicle at night?
    O Public rest areas O Truck stops O On/Off Ramps

12. What illegal activities have you witnessed at public rest areas in SD?
    O Robbery O Prostitution O Use/distribution of Illegal Drugs O Others_____

13. Please select three existing features of SD public rest areas that need to be improved and/or what features you would like to see added?

O Build more/bigger rest areas	O Rest area security personnel
O Improved lighting in parking lots	O Showers
O Telephone	O Plug-in Internet terminals for portable PC's
O Designated "trucks only" rest areas	O Short-term bathroom parking
O Stop closing existing rest areas	O Others

14. When making a short-haul trip (not requiring overnight parking), how much time do you spend parked for every hour of driving (fueling, resting, etc.)?
    O 5 - 10 min O 10 - 15 min O 15 - 20 min O 20-25 min

15. When making a long-haul trip, how long do you spend driving each day?
    O 6 - 7 hours O 7 - 8 hours O 8 - 9 hours O 9 - 10 hours O More than 10

16. What is the minimum distance you feel should be between consecutive rest sites (either private truck stops and/or public rest areas)?
    O 100 miles O 80 miles O 60 miles O 40 miles O other (specify

17. Please, briefly mention any trouble you have experienced finding parking space along other SD highway segments (other than interstate). Include when and where this took place:

Comments From Truck Drivers Responding to the Survey Questionnaire:

#2 - In general, have you found that there are enough parking spaces provided, in SD, at…
A) Public rest areas?

Valley Springs:
"I prefer small truck stops."
"Ok on I-90, not on I-29."

B) Private truck stops?

Tilford:
Marked "No" – "In the last couple of years."

#5 - Do you think that the distance between public rest areas in South Dakota is too great?

Valley Springs:
"I-90 OK. I-29 not O.K."

#7 - Do you park along on/off ramps to public rest areas and/or highway interchanges? If yes, for what reasons?…If yes, how long do you park along on/off ramps?

Tilford:
"Anytime"

Valley Springs:
"Depends on weather, too…"

Sisseton:
"Try not to"

#8 - What are the top 3 reasons you choose to stop at truck stops, besides refueling?

McCook County:
"[N]o one beating on door."

#9 - What are the top 3 reasons you choose to stop at public rest areas?

Sisseton:
"Ease of entry and exit."
"Convenience."
"Quick on and off."
"Quiet."

#12 - What illegal activities have you witnessed at public rest areas in SD?

McCook County:
"I haven't ever seen any."

Tilford:
Marked "Yes" – "Not very often."
"None"

Valley Springs:
"None"
Marked "Robbery" – "Heard not only in South Dakota, but most other states."
"None"
"None of the above"

Sisseton:
"None."
"None"
"None"
"none."
"None."
"Vandalism."

#13 - Please select three existing features of SD public rest areas that need to be improved and/or what features you would like to see added.

Tilford:
"More phones" "Need Spaces for trucks separate from capers and u hauls."

McCook County:
"Good Idea" = Short-term bathroom parking

#17 - Please, briefly mention any trouble you have experienced finding parking space along other highway segments (other than interstate). Include when and where this took place:

McCook County:
"Around Sioux Falls all the time."
"[On] some stretches of highway, it is far between towns. Some don't want trucks to stop at night, so make pull-offs more like [the ones] Texas has."
Has trouble "finding room for long loads"
"No place to park if I run out of hours or need to take a break."

Tilford:
"I think more states should do as South Dakota does. I really enjoy driving truck in this state. I feel everything is just fine."
"41 rest area – motor vehicles congesting up truck parking areas – need truck only."

Valley Springs:
"I live here, so rest areas aren't really a problem." "Note: Actually, rest areas and parking at truck stops, in general, in South Dakota, are good. Truck stop facilities could be better: better

showers, TV rooms, etc. Overall, S.D. is pretty good. A lot of states need to do better, as in supplying pull off areas, etc. My biggest complaint in most states is not enough parking at night."
"Few rest stops on skinny roads."
"I haven't experienced any problems."
"I can't think of any. More states should have these surveys. Thank you."
"Haven't had much to complain about, except during Sturgis. Things get kind of cramped." (#17)
"On 2 lane Highways, in South Dakota, there is no place to park, especially when it rains."
"Too many RVs park in rest areas taking up valuable truck parking spaces."
"Would like more info. on next rest area of truck stop, in winter time."

Sisseton:
"I don't have much trouble. I've lived here all my life and can always find an elevator or someplace to pull over. Over, east, in Ohio, etc…population is heavy…[this] is where the trouble is."
"There is none unless to find a small town."
"Not enough parking on secondary routes in SD."
"Truck checks in rest area."
"I've had no problems in SD."
"No places to pull off in case of a flat tire."
"I'm a truck driver and plan ahead. Thank you."
"Summertime: Lots of Campers."
"We could use more pull-offs on state highways."
"Anywhere: No place to pull over."
"not suitable to get into, in wet/bad weather, and just wasn't any. 281 – 81."
"No available parking on two-lane roads for oversize loads."

Additional Comments:

Tilford:
"Daris-not enough rest stops comments from driver"

Valley Springs:
"Regarding the twelve hour law: If it a choicer between getting home or sitting for 12 hours, home wins! And parking is going to be an impossibility."

Appendix B

Table of Values for Truck Parking Model

Appendix B1-1 (Truck model with $P_{(SH)}$, $P_{(LH)}$, $P_{(LH,TS)}$, and $P_{(LH,RA)}$ values changed to reflect nighttime observations)

Corridor	ADT	Fs	Pt	Vt	Ssl	L	TT	P_{SH}	P_{LH}	VHT_{SH}	VHT_{LH}	VHP_{SH}	VHP_{LH}	PPF_{SH}	PHP_{SH}	PPF_{LH}	PHP_{LH}	$P_{(SH,TS)}$	$P_{(SH,RA)}$	PHP (SH,TS)	PHP (SH,RA)	P (LH,TS)	P (LH,RA)	VHP (LH,TS)	VHP (LH,RA)	Peak TS	Peak RA
Present Model Results																											
1	8437	1.15	0.1833	1778.372	75	131	1.747	0.03	0.97	93.187	3013.036	7.766	3776.339	0.020	0.155	0.070	264.344	0.930	0.070	0.144	0.011	0.930	0.070	245.840	18.504	246	19
2	5988	1.15	0.1833	1262.240	75	141	1.880	0.40	0.60	949.205	1423.807	79.100	1784.505	0.020	1.582	0.070	124.915	0.741	0.259	1.172	0.410	0.741	0.259	92.562	32.353	94	33
3	7870	1.15	0.1833	1658.957	75	138	1.840	0.03	0.97	91.574	2960.906	7.631	3711.002	0.020	0.153	0.070	259.770	0.820	0.180	0.125	0.027	0.820	0.180	213.012	46.759	213	47
4	9809	1.15	0.1833	2067.688	75	121	1.613	0.10	0.90	333.587	3002.283	27.799	3762.862	0.020	0.556	0.070	263.400	0.792	0.208	0.440	0.116	0.792	0.208	208.613	54.787	209	55
5	5656	1.15	0.1833	1192.257	75	134	1.787	0.10	0.90	213.016	1917.148	17.751	2402.826	0.020	0.355	0.070	168.198	0.850	0.150	0.302	0.053	0.850	0.150	142.968	25.230	143	25
10 Year Predicted Truck Model Results																											
1	10057	1.15	0.1833	2119.965	75	131	1.747	0.03	0.97	111.086	3591.787	9.257	4501.706	0.020	0.185	0.070	315.119	0.930	0.070	0.172	0.013	0.930	0.070	293.061	22.058	293	22
2	7440	1.15	0.1833	1568.315	75	141	1.880	0.40	0.60	1179.373	1769.059	98.281	2217.221	0.020	1.966	0.070	155.205	0.749	0.251	1.472	0.493	0.741	0.259	115.007	40.198	116	41
3	9412	1.15	0.1833	1984.003	75	138	1.840	0.03	0.97	109.517	3541.048	9.126	4438.113	0.020	0.183	0.070	310.668	0.800	0.200	0.146	0.037	0.820	0.180	254.748	55.920	255	56
4	11715	1.15	0.1833	2469.463	75	121	1.613	0.10	0.90	398.407	3585.661	33.201	4494.028	0.020	0.664	0.070	314.582	0.800	0.200	0.531	0.133	0.792	0.208	249.149	65.433	250	66
5	6825	1.15	0.1833	1438.676	75	134	1.787	0.10	0.90	257.043	2313.391	21.420	2899.450	0.020	0.428	0.070	202.961	0.850	0.150	0.364	0.064	0.850	0.150	172.517	30.444	173	31
20 Year Predicted Truck Model Results																											
1	11678	1.15	0.1833	2461.664	75	131	1.747	0.03	0.97	128.991	4170.715	10.749	5227.296	0.020	0.215	0.070	365.911	0.930	0.070	0.200	0.015	0.930	0.070	340.297	25.614	340	26
2	8892	1.15	0.1833	1874.389	75	141	1.880	0.40	0.60	1409.541	2114.311	117.462	2649.936	0.020	2.349	0.070	185.496	0.749	0.251	1.760	0.590	0.741	0.259	137.452	48.043	139	49
3	10944	1.15	0.1833	2306.940	75	138	1.840	0.03	0.97	127.343	4117.427	10.612	5160.509	0.020	0.212	0.070	361.236	0.800	0.200	0.170	0.042	0.820	0.180	296.213	65.022	296	65
4	13621	1.15	0.1833	2871.239	75	121	1.613	0.10	0.90	463.227	4169.039	38.602	5225.195	0.020	0.772	0.070	365.764	0.800	0.200	0.618	0.154	0.792	0.208	289.685	76.079	290	76
5	7994	1.15	0.1833	1685.095	75	134	1.787	0.10	0.90	301.070	2709.633	25.089	3396.074	0.020	0.502	0.070	237.725	0.850	0.150	0.427	0.075	0.850	0.150	202.066	35.659	202	36

Appendix B1-2 (Truck model using default values)

Corridor	ADT	Fs	Pt	Vt	Ssl	L	TT	P_{SH}	P_{LH}	VHT_{SH}	VHT_{LH}	VHP_{SH}	VHP_{LH}	PPF_{SH}	PHP_{SH}	PPF_{LH}	PHP_{LH}	$P_{(SH,TS)}$	$P_{(SH,RA)}$	PHP (SH,TS)	PHP (SH,RA)	P (LH,TS)	P (LH,RA)	VHP (LH,TS)	VHP (LH,RA)	Peak TS	Peak RA
Present Truck Model Results																											
1	8437	1.15	0.1833	1778.372	75	131	1.747	0.4	0.6	1242.489	1863.734	103.541	2335.880	0.02	2.071	0.07	163.512	0.972	0.028	2.013	0.058	0.972	0.028	158.933	4.578	161	5
2	5988	1.15	0.1833	1262.240	75	141	1.880	0.4	0.6	949.205	1423.807	79.100	1784.505	0.02	1.582	0.07	124.915	0.741	0.259	1.172	0.410	0.741	0.259	92.562	32.353	94	33
3	7870	1.15	0.1833	1658.957	75	138	1.840	0.4	0.6	1220.992	1831.488	101.749	2295.465	0.02	2.035	0.07	160.683	0.820	0.180	1.669	0.366	0.820	0.180	131.760	28.923	133	29
4	9809	1.15	0.1833	2067.688	75	121	1.613	0.4	0.6	1334.348	2001.522	111.196	2508.574	0.02	2.224	0.07	175.600	0.792	0.208	1.761	0.463	0.792	0.208	139.075	36.525	141	37
5	5656	1.15	0.1833	1192.257	75	134	1.787	0.4	0.6	852.066	1278.099	71.005	1601.884	0.02	1.420	0.07	112.132	0.906	0.094	1.286	0.134	0.906	0.094	101.558	10.574	103	11
10 Year Predicted Truck Model Results																											
1	10057	1.15	0.1833	2119.965	75	131	1.747	0.4	0.6	1481.149	2221.724	123.429	2784.560	0.02	2.469	0.07	194.919	0.800	0.200	1.975	0.494	0.972	0.028	189.461	5.458	191	6
2	7440	1.15	0.1833	1568.315	75	141	1.880	0.4	0.6	1179.373	1769.059	98.281	2217.221	0.02	1.966	0.07	155.205	0.749	0.251	1.472	0.493	0.741	0.259	115.007	40.198	116	41
3	9412	1.15	0.1833	1984.003	75	138	1.840	0.4	0.6	1460.226	2190.339	121.685	2745.225	0.02	2.434	0.07	192.166	0.800	0.200	1.947	0.487	0.820	0.180	157.576	34.590	160	35
4	11715	1.15	0.1833	2469.463	75	121	1.613	0.4	0.6	1593.627	2390.441	132.802	2996.019	0.02	2.656	0.07	209.721	0.800	0.200	2.125	0.531	0.792	0.208	166.099	43.622	168	44
5	6825	1.15	0.1833	1438.676	75	134	1.787	0.4	0.6	1028.174	1542.261	85.681	1932.967	0.02	1.714	0.07	135.308	0.800	0.200	1.371	0.343	0.906	0.094	122.548	12.760	124	13
20 Year Predicted Truck Model Results																											
1	11678	1.15	0.1833	2461.664	75	131	1.747	0.4	0.6	1719.883	2579.824	143.324	3233.379	0.02	2.866	0.07	226.337	0.800	0.200	2.293	0.573	0.972	0.028	219.999	6.337	222	7
2	8892	1.15	0.1833	1874.389	75	141	1.880	0.4	0.6	1409.541	2114.311	117.462	2649.936	0.02	2.349	0.07	185.496	0.749	0.251	1.760	0.590	0.741	0.259	137.452	48.043	139	49
3	10944	1.15	0.1833	2306.940	75	138	1.840	0.4	0.6	1697.908	2546.862	141.492	3192.067	0.02	2.830	0.07	223.445	0.800	0.200	2.264	0.566	0.820	0.180	183.225	40.220	185	41
4	13621	1.15	0.1833	2871.239	75	121	1.613	0.4	0.6	1852.906	2779.359	154.409	3483.463	0.02	3.088	0.07	243.842	0.800	0.200	2.471	0.618	0.792	0.208	193.123	50.719	196	51
5	7994	1.15	0.1833	1685.095	75	134	1.787	0.4	0.6	1204.281	1806.422	100.357	2264.049	0.02	2.007	0.07	158.483	0.800	0.200	1.606	0.401	0.906	0.094	143.538	14.945	145	15

Appendix B2

Sample Calculations for Corridor I:

Compute Season Peak Daily Truck Volume (V_t in trucks per day):

(1) $V_t = ADT \times P_t \times F_s$

$V_t = 8.437 \times 0.1833 \times 1.15$

V_t = 1,778.372

Compute average truck travel time, TT , for the segment (TT in hours per truck):

(2) $TT = L / S$

$TT = 131 / 75$

TT = 1.75

Estimate Total Vehicle Hours of Travel (VHT) for Short-Haul and Long-Haul Trucks:

(3) $VHT_{SH} = P_{SH} \times V_t \times TT$

$VHT_{SH} = 0.03 \times 1,778.372 \times 1.75$

VHT_{SH} = 93.187

(4) $VHT_{LH} = P_{LH} \times V_t \times TT$

$VHT_{LH} = 0.97 \times 1,778.372 \times 1.75$

VHT_{LH} = 3,013.036

Compute Vehicle Hours of Short-Haul Parking Demand (VHP_{SH}):

(5) $VHP_{SH} = D_{SH} \times VHT_{SH} / 60$

$VHP_{SH} = 5 \times 93.18669 / 60$

$VHP_{SH} = 7.766$

Compute Vehicle Hours of Long-Haul Parking Demand (VHP_{LH}):

(6) $VHP_{LH} = R^* \times VHT_{LH} + (VHT_{LH} / 12)$

$VHP_{LH} = (70/60) \times 3{,}013.0364 + (3{,}013.0364 / 12)$

$VHP_{LH} = 3{,}776.339$

Compute Peak-Hour Parking Demand (PHP) for Short-Haul and Long-Haul Trucks (Spaces per hour):

(7) $PHP_{SH} = PPF_{SH} \times VHP_{SH}$

$PHP_{SH} = 0.02 \times 7.7656$

$PHP_{SH} = 0.155$

(9) $PHP_{LH} = PPF_{LH} \times VHP_{LH}$

$PHP_{LH} = 0.07 \times 3{,}776.339$

$PHP_{LH} = 264.344$

Estimate the Peak-Hours of Parking Demand for Short-haul and Long-haul Trucks at Private Truck Stops and Public Rest Areas (Spaces per Hour):

(12) $PHP_{(SH\text{-}TS)} = P_{(SH, TS)} \times PHP_{SH}$

$PHP_{(SH\text{-}TS)} = 0.93 \times 0.1553$

$PHP_{(SH\text{-}TS)} = 0.144$

(13) $PHP_{(SH\text{-}RA)} = P_{(SH,\ RA)} \times PHP_{SH}$

$PHP_{(SH\text{-}RA)} = P_{(SH,\ RA)} \times 0.1553$

$PHP_{(SH\text{-}RA)} = 0.011$

(14) $PHP_{(LH\text{-}TS)} = P_{(LH,\ TS)} \times PHP_{LH}$

$PHP_{(LH\text{-}TS)} = 0.93 \times 264.3437$

$PHP_{(LH\text{-}TS)} = 245.8$

(15) $PHP_{(LH\text{-}RA)} = P_{(LH,\ RA)} \times PHP_{LH}$

$PHP_{(LH\text{-}RA)} = 0.07 \times 264.3437$

$PHP_{(LH\text{-}RA)} = 18.5$

Appendix C

Nighttime Observation Tables: Corridors 1-5

CORRIDOR 1 (I-90 MRM 1-131)

Private

	Flying J MRM 61			Sinclair MRM 51			TOTAL
	TIME	# of Trucks	# of RV's	TIME	# of Trucks	# of RV's	
20-Jun	1.07am	87	3	11.40pm	64	2	156
	2.00am	90	3	2.05am	56	1	150
	3.05am	92		2.40am	68	1	161
	4.04am	91		3.40am	66	1	158
	4.56am	85		4.40am	65	1	151
	5.46am	82		5.35am	62	1	145
	6.30am	72	3	6.20am	61		136
	11.30pm	82	2	11.15pm	71		155
21-Jun	12.44am	100	2	12.30am	79	1	182
	1.41am	91	1	1.28am	82	1	175
	2.47am	102		2.38am	81		183
	3.57pm	103	1	3.45 am	76		180
	4.53am	97	3	4.40am	83		183
	6.02am	92	3	5.47am	83	1	179
	11.50pm	104	1				105
22-Jun	1.04am	113		12.50am	80		193
	2.18am	108		1.47am	86		194
	3.11am	108		2.58am	87		195
	4.05am	111		3.50am	88		199
	5.32am	106	2	5.12am	86		194
	6.28am	90	3	6.14am	76		169

Public

	East Bound MRM 41			West Bound MRM 42			TOTAL
	TIME	# of Trucks	# of RV's	TIME	# of Trucks	# of RV's	
20-Jun	11.35pm	1		11.30pm	0	1	2
	12.04am	0		12.04am	0	1	1
	1.31am	2		1.29am	1	1	4
	2.23am	2		2.21am	1	1	4
	3.33am	2		3.31am	2	1	5
	4.26am	2		4.24am	3	1	6
	5.18am	3		5.16am	4	1	8
	6.15am	3		6.13am	3	1	7
	11.00pm	1		10.57pm	3	2	6
21-Jun	12.13am	1		12.11am	3	2	6
	1.11am	1	1	1.09am	4	2	8
	2.20am	1	1	2.19am	3	3	8
	3.30am	1	2	3.26am	3	3	9
	4.24am	0	2	4.21am	3	3	8
	5.32am	0	2	5.27am	4	3	9
	6.26am	1	2	6.24am	3	0	6

22-Jun	12.20am	1		12.15am	1	2	4
	1.30am	3		1.28am	0	2	5
	2.43am	3		2.41am	1	2	6
	3.36am	3	1	3.33am	1	2	7
	4.57am	2	1	4.55am	2	2	7
	6.00am	2	1	5.58am	2	2	7
	6.50am	2	1	6.48am	2	1	6

CORRIDOR 2 (I-90 MRM 131-272)

		Triple H MRM 192		TOTAL	Totals from MRM 150 &151	Grand Total
Private	TIME	# of Trucks	# of RV's			
10-Jul	9:58	19	1	20	27	47
	11:50	21	1	22	38	60
11-Jul	12:07	22	1	23	38	61
	1:44	26	2	28	46	74
	3:38	28	1	29	46	75
	5:37	27	1	28	42	70
	10:17	20	2	22	31	53
12-Jul	12:32	28	2	30	42	72
	2:28	27	2	29	48	77
	4:18	26	3	29	49	78
	5:52	23	3	26	49	75
	10:30	12	1	13	31	44
13-Jul	12:17	18	3	21	42	63
	12:30	23	3	26	42	68
	2:34	24	3	27	39	66
	4:11	21	3	24	41	65
	6:10	19	4	23	41	64

		Badlands Travel Stop MRM 151			Discount Fuel MRM 150		TOTAL
	TIME	# of Trucks	# of RV's	TIME	# of Trucks	# of RV's	
10-Jul	10:57	16		11:10	9	2	27
11-Jul	12:48	20		12:52	16	2	38
	2:33	26		2:57	18	2	46
	4:52	22		5:00	18	2	42
	10:57	9	3	11:03	17	2	31
12-Jul	1:12	21	3	1:41	16	2	42
	3:09	23	3	3:31	21	1	48
	5:08	22	5	5:12	20	2	49

13-Jul	11:10	20	2	11:17	6	3	31
	1:13	26	4	1:23	9	3	42
	3:14	24	4	3:19	8	3	39
	5:20	26	4	5:27	8	3	41

Public

	East Bound MRM 166			West Bound MRM 167			TOTAL
	TIME	# of Trucks	# of RV's	TIME	# of Trucks	# of RV's	
10-Jul	11:23	2	2	10:36	3		7
11-Jul	1:15	4	2	12:30	4		10
	3:11	4	3	2:17	9		16
	5:10	4	2	4:36	8		14
	11:34	3	1	10:43	4		8
12-Jul	1:55	8	1	12:57	8		17
	3:45	7	1	2:53	11	1	20
	5:26	7	1	4:53	11	1	20
	11:45	5	1	10:55	2	1	9
13-Jul	1:51	4	2	12:55	5	2	13
	3:44	8	3	2:58	5	2	18
	5:43	6	3	4:48	6	2	17

TOTAL from MRM 166/167	Total from MRM 188	Total from MRM 194	Grand Total
7	0	1	8
10	0	4	14
16	2	6	24
14	2	7	23
			0
8	2	0	10
17	5	2	24
20	3	1	24
20	5	1	26
			0
9	1	0	10
13	2	3	18
18	2	5	25
17	2	5	24

Pull Off	East Bound MRM 188 TIME	# of Trucks	# of RV's	West Bound MRM 188 TIME	# of Trucks	# of RV's	TOTAL
10-Jul	11:44	0		10:18	0		0
11-Jul	1:35	0		12:11	0		0
	3:31	1		1:58	1		2
	5:30	0		4:12	2		2
	10:23	2		10:23	0		2
	11:55	2	1	12:02	2		5
12-Jul	2:15	2	1	2:33	3		3
	4:06	1	1	4:32	3		5
	10:36	1	0	10:36	0		1
13-Jul	12:03	1	1	12:35	0		2
	2:12	1	1	2:38	0		2
	4:04	1	1	4:29	0		2
	6:06	2	1	6:06	0		3

Pull Off	East Bound MRM 194 TIME	# of Trucks	# of RV's	West Bound MRM 194 TIME	# of Trucks	# of RV's	TOTAL
10-Jul	9:56	0		9:56	1		1
11-Jul	12:03	0		12:03	4		4
	1:52	0		1:52	5	1	6
	3:47	0		3:47	5	1	6
	5:41	0		5:41	6	1	7
	10:14	0		10:14	0		0
12-Jul	12:02	0		12:02	2		2
	2:25	1		2:25	0		1
	5:55	1		4:32	0		1
	10:25	0		10:25	0		0
13-Jul	12:09	1		12:11	2		3
	2:25	4		2:23	1		5
	4:10	4		4:11	1		5
	6:23	1		6:23	4		5

CORRIDOR 3 (I-90 MRM 272-410)

Private	Pilot MRM 399			Frontier Village MRM 399			TOTAL
	TIME	# of Trucks	# of RV's	TIME	# of Trucks	# of RV's	
17-Jul	10:50	103	1	10:55	45		149
18-Jul	12:03	106	1	12:07	47	1	155
	1:33	111	1	1:37	53		165
	2:57	113	1	3:02	53		167
	4:23	114		4:30	53		167
	5:39	106	1	5:45	56		163
	10:36	124	1	10:39	58		183
	11:46	122		11:48	54		176
19-Jul	1:38	129	2	1:41	49		180
	2:48	115	4	2:51	48		167
	4:17	125	5	4:19	47		177
	5:31	123	5	5:34	48		176
	5:52	117	5	5:55	47		169
	6:01	116	5	6:03	45		166
	10:24	120	1	10:27	48		169
	11:45	128	3	11:48	44		175
20-Jul	1:05	135	4	1:11	49		188
	2:28	135	2	2:31	49		186
	3:55	129	2	3:57	48		179
	5:14	122	2	5:17	49		173

Public	East Bound MRM 363			West Bound MRM 363			TOTAL
	TIME	# of Trucks	# of RV's	TIME	# of Trucks	# of RV's	
17-Jul	11:29	3	1	11:27	7	5	16
18-Jul	12:43	5	3	12:40	13	5	26
	2:25	6	2	2:23	18	6	32
	3:50	5	3	3:38	17	6	31
	5:03	5	3	5:01	13	6	27
	6:17	3	3	6:15	15		21
	11:12	3	3	11:11	5		11
19-Jul	12:54	4	3	12:52	11		18
	2:14	4	5	2:12	16		25
	3:42	5	6	3:40	20		31
	4:57	5	6	4:55	20		31
	11:11	3	1	11:01	2	1	7
20-Jul	12:32	8	2	12:29	8	2	20
	1:49	16	1	1:47	10	4	31
	3:05	14	1	3:03	12	4	31
	4:40	13	1	4:38	12	3	29
	5:50	11	1	5:49	11	3	26

CORRIDOR 4 (I-29 MRM 1-109)

Private	TIME	Phillips 66 MRM 18 # of Trucks	# of RV's	TOTAL
12-Jun	11:02	2		2
	11:50	2		2
13-Jun	2:15	2		2
	3:48	2		2
	4:57	2		2
	11:20	1		1
14-Jun	12:44	1		1
	1:50	1		1
	3:59	1		1
	5:11	1		1
	11:19	2		2
15-Jun	12:58	2		2
	2:45	2		2
	3:57	2		2
	5:23	2		2

	TIME	Coffee Cup Fuel MRM 26 # of Trucks	# of RV's	TOTAL	Total from MRM 18	Total from MRM 47	Grand Total
12-Jun	10:48	26		26	2	20	48
13-Jun	12:20	32		32	2	20	54
	1:13	40		40	2	22	64
	2:02	44		44	2	22	68
	2:30	47	1	48	2	20	70
	3:35	51	1	52	2	22	76
	4:39	49	1	50	2	22	74
	5:10	45		45	2	20	67
	10:20	22		22	1	17	40
	11:10	36		36	1	17	54
	11:33	36		36	1	24	61
14-Jun	12:30	39		39	1	25	65
	12:57	40		40	1	25	66
	1:39	41		41	1	25	67
	2:39	40		40	1	25	66
	3:46	41		41	1	25	67
	4:49	41		41	1	25	67
	5:53	39		39	1	23	63

	10:20	25		25	2	19	46
	11:06	35		35	2	19	56
	11:39	35		35	2	25	62
15-Jun	12:28	51		51	2	25	78
	1:32	55		55	2	25	82
	2:22	56		56	2	25	83
	2:48	61		61	2	26	89
	3:47	58		58	2	26	86
	4:10	59		59	2	26	87
	5:02	55		55	2	26	83
	5:36	54		54	2	26	82

	Truck Town Plaza MRM 47			Jett MRM 47			TOTAL
	TIME	# of Trucks	# of RV's	TIME	# of Trucks	# of RV's	
12-Jun	12:50	8		12:48	12		20
13-Jun	1:40	10		1:46	12		22
	3:08	9		3:06	11		20
	4:14	11		4:11	11		22
	5:41	9		5:38	11		20
	10:45	8		10:47	9		17
14-Jun	12:02	13		12:07	11		24
	1:15	15		1:16	10		25
	3:21	16		3:14	9		25
	4:39	16		4:25	9		25
	5:30	12		5:27	11		23
	10:50	8		10:43	11		19
15-Jun	12:10	14		11:58	11		25
	1:19	11		1:52	14		25
	3:18	13		3:19	13		26
	4:28	13		4:36	13		26

Public

	Both Direction MRM 26			TOTAL
	TIME	# of Trucks	# of RV's	
12-Jun	10:29	5	2	7
	10:31	5	1	6
13-Jun	12:00	7	2	9
	12:27	9	2	11
	1:15	11	2	13
	2:05	10	2	12
	2:25	9	2	11
	3:29	10	2	12
	4:35	10	2	12
	5:07	9	2	11

	10:25	5	2	7
	11:30	6	1	7
14-Jun	12:34	6	3	9
	12:54	8	3	11
	2:35	12	1	13
	3:49	15	1	16
	4:51	14	1	15
	5:50	14	1	15

	10:23	8	2	10
	11:09	6	2	8
	11:35	6	2	8
15-Jun	12:23	5	2	7
	1:12	6	2	8
	2:18	11	2	13
	2:54	11	2	13
	3:43	11	3	14
	4:06	9	3	12
	4:59	9	2	11

CORRIDOR 5 (I-29 MRM 109-251)

		Stone's MRM 178		TOTAL
Private	TIME	# of Trucks	# of RV's	
26-Jun	10:38	50	9	59
	11:32	58	7	65
27-Jun	12:08	61	8	69
	12:45	61	8	69
	1:21	61	8	69
	2:10	64	8	72
	2:53	69	8	77
	3:30	67	8	75
	4:06	64	8	72
	5:05	61	8	69
	5:47	53	8	61

	11:00	67	5	72
	11:37	77	6	83
28-Jun	12:14	78	6	84
	1:08	72	6	78
	1:45	82	5	87
	2:23	86	5	91
	3:20	85	5	90
	3:57	91	5	96
	4:35	83	5	88
	5:36	83	4	87

	10:14	61	5		66
	10:50	56	5		61
	11:26	59	5		64
29-Jun	12:15	71	6		77
	12:59	70	6		76
	1:37	70	6		76
	2:14	72	6		78
	2:51	73	6		79
	3:54	74	6		80
	4:32	76	6		82
	5:28	65	6		71

Public

	TIME	North Bound MRM 160 # of Trucks	# of RV's	TIME	South Bound MRM 160 # of Trucks	# of RV's	TOTAL
26-Jun	11:07	1		11:00	3		4
	11:50	4		11:48	3		7
27-Jun	12:27	4		12:24	4		8
	1:04	3		1:01	5		8
	1:53	4		1:50	4		8
	2:35	3		2:32	5		8
	3:13	3		3:10	5	1	9
	3:49	3		3:46	6	1	10
	4:47	3		4:45	6		9
	5:31	5		5:28	5		10
	6:04	5		6:02	5		10
							0
	10:40	3		10:37	6	1	10
	11:18	4		11:16	5		9
	11:56	4		11:54	5	1	10
28-Jun	12:49	7		12:46	6	1	14
	1:27	8		1:24	6	1	15
	2:04	8		2:02	6	1	15
	3:02	9		3:00	5	1	15
	3:39	9		3:36	5	1	15
	4:16	9		4:14	4	1	14
	5:17	9		5:15	4	2	15
	5:52	8	1	5:51	3	1	13
							0
	10:32	3	1	10:30	5		9
	11:08	3	1	11:06	6		10
	11:57	4	1	11:55	7		12
29-Jun	12:41	7	1	12:30	8		16
	1:19	7	1	1:16	8		16
	1:56	7	1	1:53	8		16
	2:32	7	1	2:30	7		15
	3:36	7	1	3:34	7		15
	4:12	7	1	4:10	7		15
	5:10	7	1	5:08	7		15
	5:42	6	1	5:44	5		12

Appendix D

Parking Supply and Amenities Table:

I-90 and I-29

Appendix D-1

Parking Supply and Amenities Survey for I-90 – using truck parking allocation of 1500 sq. ft per truck:

Rest Area Name	MRM	Direction Served	Truckstop or Rest Area	Spaces for Trucks	Type of Truck Parking	Are Camper/Rec Vehicles separate from Truck Parking	Does it allow Triples	Does it allow Oversized	Lighting at Night	Welcome Center	Attendant	Snack Machine	Drink Machine	Picnic Tables	Restrooms	Showers	Gas	Diesel	Water	Repair Facilities	Restaurant	Pay Phones	Security Personnel	ATM
CORRIDOR 1 (MRM 1 - 131)																								
Public	2	EB	Rest Area	25	DPT	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	18	WB	Pull off	2	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Public	40	WB	Rest Area	3	P	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	42	EB	Rest Area	3	P	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Windmill	51	Both	TS	60	BB/NM	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Flying J	61	Both	TS	91	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Conoco	66	Both	TS	40	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public	68	WB	Pull off	1	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Public	68	EB	Pull off	1	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Amoco Food shop	94	Both	TS	3	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public	100	WB	Rest Area	7	DPT	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	100	EB	Rest Area	6	DPT	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
CORRIDOR 2 (MRM 131 - 272)																								
Discount Fuel	147	Both	TS	27	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Badlands Travel stop	153	Both	TS	49	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Belvidere	163	Both	TS	10	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public	164	EB	Rest Area	4	P	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	167	WB	Rest Area	4	P	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
1880 Town	170	Both	TS	22	NM	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Murdo	190	EB	Pull off	12	P	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Murdo	190	WB	Pull off	12	P	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Triple H	192	Both	TS	30	NM	N	Y	Y	Y	N	Y													
Murdo	192	EB	Pull off	7	NM																			
Murdo	192	WB	Pull off	7	NM																			
Public	224	WB	Rest Area	8	M, NM	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	224	EB	Rest Area	*19	DPT	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	N	N	Y	N	N

Als' Oacoma	260	Both	TS	29	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Amoco - Oacoma	260	Both	Ts	58	NM	N	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	Y	N	Y
Public	263	Both	Rest Area	*16	DPT	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Whoa n go	269	Both	TS	28	M, NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
CORRIDOR 3 (MRM 272 - 411)																								
In Kimball	290	Both	TS	38	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public	292	WB	Pull off	3	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Public	292	EB	Pull off	3	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Public-White Lake	296	EB	Rest Area	9	DPT	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public-White Lake	296	WB	Rest Area	9	DPT	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Coffee cup	310	Both	TS	44	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Travel Center	325	Both	TS	66	NM	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public	336	EB	Pull off	3	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Public	336	WB	Pull off	3	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
TA Travel center	355	Both	TS	9	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public - Salem	360	EB	Rest Area	16	DPT	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public - Salem	360	WB	Rest Area	17	DPT	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Pilot Travel Center	399	Both	TS	135	M	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Frontier Village	399	Both	TS	55	NM	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Amoco Food shop	406	Both	TS	10	NM	N	Y	Y	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y
Valley Springs	411	EB	Rest Area	7	M	N	Y	Y	Y	N	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N

Total Parking Supply Per Corridor:		
Corridor 1:	48	Public
	194	Private
Corridor 2:	90	Public
	253	Private
Corridor 3:	70	Public
	357	Private

Explaining Abbreviations	
TS	Truck Stop
EB	East Bound
WB	West Bound
DPT	Diagonal Pull Through
P	Parallel
BB	Back to Back
M	Marked
NM	Not Marked

Appendix D-2

Parking Supply and Amenities Survey for I-29 – using truck parking allocation of 1500 sq. ft per truck:

Rest Area Name	MRM	Direction Served	Truckstop or Rest Area	Spaces for Trucks	Type of Truck Parking	Are Camper/Rec Vehicles separate from Truck Parking	Does it allow Triples	Does it allow Oversized	Lighting at Night	Welcome Center	Attendant	Snack Machine	Drink Machine	Picnic Tables	Restrooms	Showers	Gas	Diesel	Water	Repair Facilities	Restaurant	Pay Phones	Security Personnel	ATM
CORRIDOR 4 (1 - 109)																								
Phillips66	18	Both	TS	11	NM	N	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y
Coffee Cup Fuel Stop	26	Both	TS	95	NM	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y
Public	26	Both	Rest Area	27	DPT	N	N	N	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	41	SB	Pull Off	11	NM																			
Jet Truck Plaza (Sinclair)	47	Both	TS	25	NM	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	FF NB	Y	N	Y
Super 8 (Parking by Cenex)	47	Both	TS	10	BB	N	N	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y
Cenex/Truck Town	47	Both	TS	81	NM	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Pump n Pack	62	Both	TS	29	NM	N	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Larry's Truck Stop (Texaco)	74	Both	TS	36	NM	N	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Texaco-Crossroads	94	Both	TS	17	NM	N	N	N	N	N	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	N	Y
Public	102	NB	Pull Off	13	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Public	102	SB	Pull Off	16	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
CORRIDOR 5 (109 - 251)																								
Public	121	Both	Rest Area	3	NM	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	160	SB	Rest Area	7	DPT	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	160	NB	Rest Area	8	DPT	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Sinclair	177	Both	TS	147	NM	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Conoco	207	Both	TS	59	NM	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public	213	NB	Rest Area	8	DPT	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Phillips66	232	Both	TS	14	NM	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public	251	SB	Rest Area	10	DPT	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
																								Y

Total Parking Supply Per Corridor:		
Corridor 4:	67	Public
	304	Private
Corridor 5:	36	Public
	220	Private

Appendix D-3

Parking Supply and Amenities Survey for I-90 – parking supply guided by nighttime observations

Rest Area Name	MRM	Direction Served	Truckstop or Rest Area	Spaces for Trucks	Type of Truck Parking	Are Camper/Rec. Vehicles separate from Truck Parking	Does it allow Triples	Does it allow Oversized	Lighting at Night	Welcome Center	Attendant	Snack Machine	Drink Machine	Picnic Tables	Restrooms	Showers	Gas	Diesel	Water	Repair Facilities	Restaurant	Pay Phones	Security Personnel	ATM
CORRIDOR 1 (MRM 1 - 131)																								
Public	2	EB	Rest Area	25	DPT	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	18	WB	Pull off	2	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Public	40	WB	Rest Area	10	P	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	42	EB	Rest Area	10	P	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Windmill	51	Both	TS	110	BB/NM	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Flying J	61	Both	TS	91	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Conoco	66	Both	TS	40	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public	68	WB	Pull off	8	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Public	68	EB	Pull off	8	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Amoco Food shop	94	Both	TS	3	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public	100	WB	Rest Area	7	DPT	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	100	EB	Rest Area	6	DPT	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
CORRIDOR 2 (MRM 131 - 272)																								
Discount Fuel	147	Both	TS	27	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Badlands Travel stop	153	Both	TS	49	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Belvidere	163	Both	TS	10	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public	164	EB	Rest Area	12	P	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	167	WB	Rest Area	12	P	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
1880 Town	170	Both	TS	22	NM	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Murdo	190	EB	Pull off	12	P	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Murdo	190	WB	Pull off	12	P	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Triple H	192	Both	TS	30	NM	N	Y	Y	Y	N	Y													
Murdo	192	EB	Pull off	7	NM																			
Murdo	192	WB	Pull off	7	NM																			
Public	224	WB	Rest Area	8	M, NM	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	224	EB	Rest Area	19	DPT	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	N	N	Y	N	N

Als' Oacoma	260	Both	TS	29	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Amoco - Oacoma	260	Both	Ts	58	NM	N	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	N	Y	Y	N	Y
Public	263	Both	Rest Area	16	DPT	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Whoa n go	269	Both	TS	28	M, NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
CORRIDOR 3 (MRM 272 - 411)																									
In Kimball	290	Both	TS	38	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public	292	WB	Pull off	3	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Public	292	EB	Pull off	3	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Public-White Lake	296	EB	Rest Area	9	DPT	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public-White Lake	296	WB	Rest Area	9	DPT	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Coffee cup	310	Both	TS	44	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Travel Center	325	Both	TS	66	NM	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public	336	EB	Pull off	9	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Public	336	WB	Pull off	9	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
TA Travel center	355	Both	TS	9	NM	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public - Salem	360	EB	Rest Area	16	DPT	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public - Salem	360	WB	Rest Area	17	DPT	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Pilot Travel Center	399	Both	TS	135	M	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Frontier Village	399	Both	TS	55	NM	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Amoco Food shop	406	Both	TS	10	NM	N	Y	Y	N	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y
Valley Springs	411	EB	Rest Area	7	M	N	Y	Y	Y	N	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N

Total Parking Supply Per Corridor:		
Corridor 1:	76	Public
	244	Private
Corridor 2:	105	Public
	253	Private
Corridor 3:	82	Public
	357	Private

Appendix D-4

Parking Supply and Amenities Survey for I-29 – parking supply guided by nighttime observations

Rest Area Name	MRM	Direction Served	Truckstop or Rest Area	Spaces for Trucks	Type of Truck Parking	Are Camper/Rec Vehicles separate from Truck Parking	Does it allow Triples	Does it allow Oversized	Lighting at Night	Welcome Center	Attendant	Snack Machine	Drink Machine	Picnic Tables	Restrooms	Showers	Gas	Diesel	Water	Repair Facilities	Restaurant	Pay Phones	Security Personnel	ATM
CORRIDOR 4 (1 - 109)																								
Phillips66	18	Both	TS	11	NM	N	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y
Coffee Cup Fuel Stop	26	Both	TS	95	NM	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y
Public	26	Both	Rest Area	27	DPT	N	N	N	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	41	SB	Pull Off	11																				
Jet Truck Plaza (Sinclair)	47	Both	TS	25	NM	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Super 8 (Parking by Cenex)	47	Both	TS	10	BB	N	N	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y
Cenex/Truck Town	47	Both	TS	81	NM	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Pump n Pack	62	Both	TS	29	NM	N	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
Larry's Truck Stop (Texaco)	74	Both	TS	36	NM	N	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Texaco-Crossroads	94	Both	TS	17	NM	N	N	N	N	N	Y	Y	Y	N	Y	N	Y	Y	Y	N	Y	Y	N	Y
Public	102	NB	Pull Off	13	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Public	102	SB	Pull Off	16	NM	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
CORRIDOR 5 (109 - 251)																								
Public	121	Both	Rest Area	8	NM	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	160	SB	Rest Area	7	DPT	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Public	160	NB	Rest Area	8	DPT	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Sinclair	177	Both	TS	100	NM	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Conoco	207	Both	TS	59	NM	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public	213	NB	Rest Area	8	DPT	N	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
Phillips66	232	Both	TS	14	NM	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y
Public	251	SB	Rest Area	10	DPT	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y	N	N	Y	N	N
																								Y

Total Parking Supply Per Corridor:		
Corridor 4:	67	Public
	304	Private
Corridor 5:	41	Public
	173	Private

Appendix E

Corridor Parking Supply vs. Demand:
Present and Future Analysis

Appendix E-1

Parking Supply vs. Demand: Using 1,500 square ft per truck

A

Corridor:		Supply:	Demand: Now:	Demand: 10 Year Predictions:	Demand: 20 Year Predictions:
1	Pub.	48	19	22	26
	Priv.	194	246	292	341
2	Pub.	90	33	41	49
	Priv.	253	94	117	139
3	Pub.	70	47	56	65
	Priv.	357	213	255	296
4	Pub.	67	55	66	76
	Priv.	304	209	250	290
5	Pub.	26	25	31	36
	Priv.	220	143	173	203

Over capacity

At/Near Capacity

Appendix E-2

Parking Supply vs. Demand: Supply Based on Nighttime Observations

B

Corridor:		Supply:	Demand:	Demand:	Demand:
			Now:	10 Year Predictions:	20 Year Predictions:
1	Pub.	76	19	22	26
	Priv.	244	246	293	340
2	Pub.	105	33	41	49
	Priv.	253	94	116	139
3	Pub.	82	47	56	65
	Priv.	357	213	255	296
4	Pub.	67	55	66	76
	Priv.	304	209	250	290
5	Pub.	41	25	31	36
	Priv.	173	143	173	202

Over capacity

At/Near Capacity

Appendix F

Map of Survey Corridors

Corridor Map