DRAFT SUPPLEMENTAL REPORT

A National Model for the Evaluation of CMV Selective Enforcement Programs

Supplemental Report

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Executive Summary

The project entitled "A National Model for the Evaluation of CMV Selective Enforcement Programs" had the goal of describing best practices for the evaluation of Ticketing Aggressive Cars and Trucks (TACT) projects. The methodology and examples are typically not restricted to formal TACT projects, and they generally apply to any project involving selective enforcement and Public Information and Education (PI&E) with regard to large trucks. For this reason "TACT" was omitted from the project title, but for purposes of brevity these projects will generally be referenced as TACT projects in this report.

The final report for this project is separated into two documents: (1) a brief Methodology Manual (MM) to provide a step-by-step approach to the evaluation of TACT projects, and (2) a Supplemental Report (SR) that presents detailed examples to provide further guidance in areas where it might be required. Throughout these two documents the word *project* is used to refer to a specific implementation within an overall *program.* The acronym TACT refers not only to the FMCSA sponsored TACT programs, but to all selective enforcement that would involve commercial motor vehicles (CMVs), recognizing that the methodology and examples have general application. Thus, *TACT projects* should generally convey the meaning of *TACT and/or TACT-type projects*.

These two documents have the goal of providing those doing TACT project evaluations with an overall methodology to apply to their evaluations. Specifically, the data collection and analytical techniques to be employed are targeted at law enforcement personnel who have statistical and evaluation interests and the corresponding expected level of expertise in this regard. The evaluations are intended to be ongoing for the purpose of continued improvement as opposed to highly scientific evaluations that might draw undue resources away from the projects themselves. Consultants and university researchers are expected to be employed on these types of evaluations on a minimal "advisory" basis as opposed to turning the entire evaluation process over to them.

The formal Ticketing Aggressive Cars and Trucks (TACT) program is the result of the collaboration of the Federal Motor Carrier Safety Administration (FMCSA) and the National Highway Traffic Safety Administration (NHTSA), both of which have major traffic safety responsibilities. TACT is a high-visibility traffic enforcement program that uses communication, enforcement, and evaluation activities to reduce car-truck crashes, fatalities, and injuries. According to FMCSA, the TACT program "is an evidence-based traffic enforcement model that can help States reduce crashes between large trucks and personal vehicles, by promoting safe driving behavior around commercial motor vehicles (CMVs)." TACT's goal is to deter unsafe driving behaviors by personal vehicle and commercial motor vehicle drivers when they interact to share the road, and thereby to reduce CMV-private vehicle crashes, injuries, and fatalities.

As its name implies, enforcement is at the heart of the TACT effort. In this regard the specific unsafe acts (e.g., primary contributing circumstances) involving both passenger vehicles and

Commercial Motor Vehicles (CMVs) have been identified as those which can be used to identify citations and crashes that would qualify to be considered within a TACT evaluation.

The evaluation model presented requires planning prior to the project. For example, analytical tools are used at this point to determine the best possible locations in which the selective enforcement portion of the program will be performed. Model examples for these pre-project planning steps are illustrated by an interactive Web site whereby officers locate the hotspots throughout the state. This web display is based on the Critical Analysis Reporting Environment (CARE), which provides additional functionality for producing information on the specified hotspots. In particular, locations are to be sought that are especially over-represented in car-truck (CMV) crashes in which one of the vehicles was guilty of one or more of the TACT offenses (as opposed to crashes in general).

The TACT programs under consideration for evaluation generally involve two major components – a Public Information and Education (PI&E) component and a selective enforcement (SE) component. Usually, PI&E involves both industry and media participation, while the SE involves patrol officers working special details in specific locations and time periods. These efforts can involve local agencies, general DPS Highway Patrol officers, and special DPS Motor Carrier Safety Unit (MCSU) officers.

After-the-fact evaluation without sufficient planning may provide some useful information, but it certainly is most desirable to start the evaluation process well before the projects are to be implemented. The report calls for evaluation planning to be integrated into the overall TACT planning process, since the "before" aspects of the evaluation process can provide valuable information toward optimizing the TACT projects. Called *problem identification*, this process involves determining the "who, what, when, where, how and why" of the types of crashes under consideration, in this case CMV-involved crashes. Problem identification and planning are heavily emphasized the two report documents, and several examples are given both before and after the projects are implemented.

The effectiveness evaluation procedure requires that detailed records be kept during the selective enforcement effort, which is also the basis for the administrative evaluation. The examples given involve a secure online enforcement summary form that was developed for participating law enforcement officers. Each TACT officer enters his/her name, department, enforcement location, enforcement time period, and counts for each type of citation issued. Citations that are entered are further categorized by the vehicle type issued to: CMV or Non-CMV. Motor carrier officers can also report CMV inspections using this same form. In order for the evaluation to consider specific areas and locations, officers must submit a form for each separate location and time period they patrolled. Based on these data, daily, weekly, and monthly reports can be automatically generated and made available on the Internet. In the system illustrated, these

reports can be available for the entire state, for each participating agency or DPS troop, or for individual officers.

The first TACT project was quite comprehensive in scope, at times involving almost all patrol officers in Alabama. Several examples are given for this effort in which over 30,000 citations and warnings were issued as part of the TACT program. Of these, the vast majority (94%) of citations were issued to private motorists, and only about 10% of the contacts resulted in warnings as opposed to citations.

Several types of evaluations are exemplified in the Supplemental Report:

- A comparison of crashes before and during the TACT projects,
- A crash comparison of months in which TACT selective enforcement was being applied against months in which there were little or no TACT efforts.
- A comparison of citations issued before and during the TACT projects,
- Two attitude surveys for participating officers and truckers,
- A survey of drivers distributed at driver licensing stations.
- Observational studies that employed existing cameras to determine if PI&E, billboards and selective enforcement was changing driver behavior.

The crash comparison examples considered two types of crashes: all crashes involving CMVs, and two vehicle crashes involving a CMV and a Personal Vehicle (car). The more significant findings were in the overall CMV crashes as opposed to the two vehicle case where a CMV and a car were involved. In all cases significant reductions in crashes were found. The following two tables presents a summary of the crash-reduction results estimated: (1) for CMV-involved crashes during the first TACT project, and (2) a number of follow-on projects that were conducted during the 17-month *interim* period beginning after the completion of the first project and finishing before the most recent TACT effort, which that took place in June 2011. These results are rounded to the nearest crash with the exception of the fatal crash category, and the counts are of crashes, not persons injured or persons killed.

Estimates of Crash Savings per Month for the First TACT Project Months

SEVERITY	CMV-INVOLVED CRASHES
Property Damage Crashes	35
Non-Fatal Injury Crashes	9
Fatal Crashes	0.8

Estimates of Crash Savings per Month for the Interim Project Months

SEVERITY	CMV-INVOLVED CRASHES
Property Damage Crashes	35
Non-Fatal Injury Crashes	17
Fatal Crashes	0.6

These results are surprisingly comparable given the realization that they were obtained through two quite different estimation techniques. The first TACT program was evaluated by comparing crashes before and during the program. The interim projects were evaluated by comparing months in which TACT effort hours exceeded 100 hours against those that had less. All but two of the non-TACT months had zero hours worked. These crash-reduction estimate example results are a by-product of the Model Evaluation project, which had as its goal to illustrate sound evaluation methods, and not necessarily to evaluate any particular project.

The analysis of eCite-issued citations was performed to determine if there was a more concentrated effort during the TACT program times to issue citations for TACT type offenses. The following is an example summary of the results for the first TACT project.

Change in Citations Issued During TACT Period

VIOLATION TYPE	May-Aug 2009*	Sep-Dec 2009	% Inc (+)/Dec (-)
Speeding	60,730	61,928	+2.0%**
Following Too Close	1,847	1,966	+6.4%**
Improper Lane Change	901	1,258	+39.6%**
Failure To Signal	443	628	+41.9%
No Seatbelt	28,941	25,589	-11.6%**
No Insurance	15,401	16,062	+4.3%**
Drivers' License	10,599	11,432	+7.9%**
Improper Passing	262	260	-0.8%

* Adjusted so that the two four-month periods are comparable.
** Statistically significant increases at alpha less than 0.01.

All of the violation type categories showed statistical significant increases or decreases at the alpha level of 0.01 or less with the exception of Failure to Signal and Improper Passing.

The example officer survey indicated that officers' attitudes toward the TACT program are generally positive. The only possible exception is the question with regard to whether TACT was best run as a statewide program or left for individual officers to enforce. Although more Officers responded they could best perform TACT-related activities on their own, over half

indicated that awareness of car and truck interactions led to more citations after conducting the TACT program.

Similarly, there was an overall positive attitude expressed toward the TACT conveyed via the example trucker survey. There were fifteen responses to the online trucker survey, and of these the majority was administrators (i.e., owners and managers). The results indicated industry support for TACT. Specifically, 94% of the respondents indicated the program was positive and 100% indicated they felt the enforcement was fair. Interestingly, the trucker survey indicated more support for large-scale organized programs such as TACT as opposed to more ad hoc, individual officer based enforcement.

A National Model for the Evaluation of CMV Selective Enforcement Programs
Supplemental Report

1.0 Introduction and Background

TACT programs are primarily interested in reducing the conflicts between CMVs and other vehicle types. These other vehicle types are often referenced as "passenger vehicles" or "personal vehicles." This report uses the word "cars" to collectively represent all of these "non-CMV vehicle types." This is done for brevity recognizing that there are many private vehicle types that would qualify, including sedans, vans, mini-vans, pickup trucks, SUVs, etc. A crash between a CMV and a car (or a car and a CMV) is referred to as a CMV-car crash. In using this term (CMV-car), unless otherwise stated there is no implication as to which of the two vehicles (or their drivers) caused the crash. The term CMV-car is used for consistency, but it is undistinguishable from car-CMV; the two should be considered interchangeable in the context of this report.

This section will consist of an introduction to establish the purpose of this document and the ways that it is different from most documents on the subject of TACT evaluation. After a discussion of overall goals and motivation, background material is exemplified for the first TACT evaluation and an update is exemplified by the second evaluation.

1.1 Purpose, Mission and Strategy

In order to understand the purpose, mission and strategy of the TACT model evaluation project, is it important to understand those of TACT. The following is quoted verbatim from the FMCSA TACT web page (http://www.fmcsa.dot.gov/safety-security/tact/abouttact.htm):

"Purpose. TACT provides a research-based safety model that can be replicated by States when conducting a high-visibility traffic enforcement program to promote safe driving behaviors among car and truck drivers.

"Mission. The mission of the TACT program is to reduce CMV-related crashes, injuries, and fatalities. FMCSA is achieving its mission by educating car and truck drivers on how to share the road safely.

"Strategy. The TACT program combines communication and evaluation with targeted enforcement activities to raise awareness among car and truck drivers about safe driving behaviors. Unsafe driving behaviors may include, but are not limited to: unsafe lane changes, tailgating, failing to signal lane changes, failing to yield the right of way, speeding, and aggressive driving (a combination of two or more behaviors). Pre-planning activities for States

include problem identification and goal setting. Outreach and education activities are supported by a communications plan that includes print or Web-based outreach and paid or earned media placement. Evaluation of the reduction in crashes following a TACT enforcement period is followed by post-program activities such as reporting and recognition and rewards programs."

The purpose of TACT evaluations are twofold: (1) to assure that the above purpose, mission and strategy as given above are being accomplished to their maximum extent possible under the resource constraints, and (2) to discover ways in which the purpose, mission and strategy can continue to improve over time as part of a continuous improvement approach.

It is important to differentiate between the goals that this model evaluation project is attempting to accomplish and that of TACT projects in general. Clearly TACT projects have the goal of overall crash reduction between CMVs and private vehicles. The current project (and this document) involved using actual TACT Public Information and Education (PI&E) and Selective Enforcement (SE) for case study examples, but it is not a report on this TACT project per se. The recommendations made in this document are recommendations for ways to evaluate and improve TACT programs in general. It is not our goal to promote any tactic applied in Alabama or any other state – only to provide an effective means for their evaluation. It is intended that the techniques illustrated be applicable to any TACT or TACT-like program regardless of the specifics.

Finally, it is not the intention that this be a stand-alone document. The implementation of the recommended evaluation procedures will be best realized if the companion document entitled "Methodology Manual – A National Model for the Evaluation of CMV Selective Enforcement Programs." That document, henceforth reference as the *Methodology Manual*, should provide the basic guide and the current document should be used to get more details and examples when they are needed. For ease of referencing, the section numbers of the current Supplemental Report are generally consistent with those of the Methodology Manual to facilitate the reference to the examples contained herein.

1.2. Discussion of Motivation

Traffic safety has suffered immeasurably from evaluations that were motivated by very little other than a desire to prove a program to be worthy of continued funding. Clearly, programs are best conceived and implemented when overall funding decisions are not based solely on the evaluation of one component of a total traffic safety program. All components need to be evaluated and their costs and benefits assessed so that the total program can be optimized. The primary motivation for evaluating any given component (e.g., a TACT project) must be that of improving that component's effectiveness in the future. "Improvement" in this context might consider major re-direction of future resources, but generally it will be geared toward minor

modifications that will continue to enhance the project in future implementations. If problem identification and evaluation can be viewed in this context it will lead to greater objectivity and dramatically improved programs.

Given this motivation, the following are some objectives that might be set to be accomplished by the evaluation process:

- To determine the benefits of the specific TACT project, and to establish the best estimate of its effectiveness in terms of reduced crash frequency and severity;
- To find at least one weakness in each of the TACT components;
- To overcome these weaknesses by formulating recommendations for future TACT projects; and
- To seek out and establish, if possible, new and creative strategic approaches toward reducing the frequency and severity of CMV involved crashes.

1.3 Example Background Sections

This section presents examples of the type of introductory information that might be included in a TACT evaluation. Generally the background material should cover enough of the history of the program to enable the evaluation to be placed in its proper context. The following subsections present the introduction to the first TACT evaluation and the added history for the evaluation of the smaller project that was implemented in June 2011. Examples from both of these evaluations will be given in the more detailed planning and evaluation illustrations in subsequent sections of this report. Some of the general statistics have been update to the most recent compete available year (CY2010 for Alabama) in order to make the examples more current.

1.3.1 Background – First TACT Evaluation in Alabama

This example of background information was extracted from the original TACT program evaluation that was completed in September 2010, which was before the 2010 data were available. However, to make some of the introduction paragraphs more useful and current, the numbers have been updated to those obtained after the 2010 crash data closeout, and they are inclusive of 2008-2011 data through the equivalent of about August 15, 2011. However, the rest of the example background material will be from the time span of the original TACT project.

Nationally, since 2008 approximately 4,000 people have died annually in large truck crashes, and over 100,000 were injured (http://www.fmcsa.dot.gov/safety-security/tact/resources.htm). In calendar year 2010, Alabama had 8,914 CMV crashes of which 114 were fatal crashes that resulted in 127 fatalities (one of the crashes caused 4 fatalities). These crashes are quite often very spectacular and severe mainly due to the physics involved. A small passenger car does not

have much of chance up against an 18-wheeler. In the 2008-2011 (most current 3.71 years) data, the total number of crashes, fatalities and injuries is given in the following table:

Severity Indicator	Number (2008-2011)	Number per Year
Total Crashes	29260	109.2
Injuries	17301	4665.4
Fatalities	405	789.3

The driving public tends to blame trucks for most car-truck crashes. This would seem to be a reasonable assumption, given the increased size and reduced maneuverability of most commercial motor vehicles (CMV). Recognize first that if fault is divided evenly between any two types of vehicles that crash, it can be reasonably be expected that each will be causal in 50% of the crashes in which they are involved. Now consider the following percent of car-truck crashes caused by CMVs 2008-2011:

	% Caused by CMV
All Crashes	43.0%
Injury Crashes	39.8%
Fatal Crashes	20.8%

In all cases the trucks were assigned by the reporting officers to be the causal vehicle well under half of their expected value of 50%, which is obviously statistically significant at the highest level of testing.

In two-vehicle fatal crashes, nearly 80% are indicated to be caused by the personal motor vehicle. It is very clear that if fatalities and severe injuries are to be reduced, then there must be a collective effort on the part of both the truckers and the private motorists to work on eliminating these crashes.

Passenger cars can often be observed rushing around 18 wheelers, cut them off getting back into the right lane, and then slow down. Likewise, big trucks can be observed exhibiting aggressive behavior such as tailgating cars. These are the types of behaviors that can easily lead to fatal crashes, especially since the larger vehicles do not have the maneuverability or the breaking capabilities of the smaller vehicle. It is up to those driving the personal vehicles to make themselves visible, stay out of the blind spots, and to the extent possible, just stay as far away from the larger vehicles as possible. At the same time, it is imperative that truckers have respect for their four-wheeled counterparts as they share the road. This must be a cooperative effort.

To help reduce crashes and fatalities, Congress directed the Federal Motor Carrier Safety Administration (FMCSA) and the National Highway Traffic Safety Administration (NHTSA) to work together to educate motorists on how to share the road safely with commercial motor

vehicles (CMVs). The result of this government collaboration was the development of the Ticketing Aggressive Cars and Trucks (TACT) program—a high-visibility traffic enforcement program that uses communication, enforcement, and evaluation activities to reduce car-truck crashes, fatalities, and injuries.

As part of this effort, in the fall of 2004 Washington State was selected as the first pilot State for the Ticketing Aggressive Cars and Trucks (TACT) program. Based on the success of the Washington State TACT program and other traffic enforcement programs, FMCSA encouraged additional States to undertake TACT programs on roadways with injuries and fatalities resulting from crashes between cars and trucks. A second state (North Carolina) was funded for a follow-up effort. This was quickly followed by three additional states – Georgia, Kentucky and Pennsylvania. Currently there are 16 States participating in the TACT program: Alabama, Connecticut, Georgia, Indiana, Kentucky, Maine, Montana, Nevada, New Jersey, North Carolina, Oregon, Pennsylvania, Rhode Island, South Dakota, Texas, and Washington.

According to the TACT State Resource Toolkit (http://www.fmcsa.dot.gov/documents/safety-security/TACT-Toolkit-Users-Guide.pdf), "the *Ticketing Aggressive Cars and Trucks* (**TACT**) Program is an evidence-based traffic enforcement model that can help States reduce crashes between large trucks and personal vehicles, by promoting safe driving behavior around commercial motor vehicles (CMVs)." TACT's goal is to deter unsafe driving behaviors by personal vehicle and commercial motor vehicle drivers when they interact to share the road, and thereby reduce CMV-private vehicle crashes, injuries, and fatalities.

Alabama got involved with the National TACT program with planning efforts for a TACT Readiness grant application. The effort involved the Alabama Department of Public Safety (DPS) Motor Carrier Safety Unit (MCSU), which began conducting high visibility enforcement details in May 2008. This was not the main TACT program; it was implemented to collect data in support of the TACT Readiness grant application. This effort was followed up in May 2008 by two separate enforcement details from which data were collected. The first of these utilized Highway Patrol supervisors and resulted in a total of 832 citations issued over a two-day period. The entire Highway Patrol Division was involved in the second detail, and 16,281 citations were issued to a combination of CMVs and personal vehicles for TACT-emphasis offenses. This led to a pre-TACT meeting in November 2008, where 21 local law enforcement agencies participated. The agenda covered TACT goals and the role that local agencies would play.

Shortly before the Alabama TACT program was fully initiated, a news conference was called by Col. J. Christopher Murphy, Director of DPS, to announce the program. In additional to Col. Murphy, the following individuals took part in the news conference:

- Darrell Ruban, FMCSA Southern Service Division field administrator,
- Judy C. VanLuchene, FMCSA division administrator,
- Joe McInnes, Director of the Alabama Department of Transportation (ALDOT),
- Frank Filgo, president and chief executive officer of the Alabama Trucking Association (ATA), and
- Several local law enforcement agencies that have partnered in commercial vehicle enforcement.

This news conference was followed immediately by a press release. There were also a number of local TV news reports on the TACT program that were initiated by the various DPS posts over this time frame.

This participation showed the cooperation of not only the federal, state and local law enforcement, but also the trucking industry through its recognized trade association. The major reason for this cooperative support for TACT is that all of these agencies and companies have much to gain from increased safety in and around commercial motor vehicles, which is the primary goal of TACT. The accomplishment of this goal depends upon the realization of the various objectives established for the program. These include the following:

- Detect and respond to offenses in the commercial vehicle environment whether they be committed by the truck driver or the private motorist.
- Focus especially on those offenses and driver behaviors that cause severe (fatal or severe injury) crashes as given by information generated from past car-truck crash records; among there are the following contributing circumstances (offenses):
    - Unsafe lane changes (e.g., too close to trucks when passing),
    - Following too closely,
    - Failure to signal lane changes,
    - Failure to yield the right of way,
    - Speeding,
    - Erratic driving (e.g. inconsistent speeds and braking) while around trucks,
    - Remaining in trucks' blind spots for unreasonable time, and
    - Any other unsafe or risky behavior, or any combination of these unsafe acts.
- Concentrate especially on aggressive driving. Since the motivation for multiple offenses usually involves some emotional issues, the combination of two or more offenses by a given driver is defined to be *aggressive driving*; as indicated by the TACT program name, aggressive driving by either car or truck drivers was given special attention, and the maximum citations were given.
- Condition officers to look for and be more aware of violations in the commercial vehicle environment.

- Prevent future unsafe activities through a combination of Public Information and Education and the continued threat of strict enforcement.
- Demonstrate how crash and citation data can be used to guide, not only the design of the program details, but also the evaluation of its effects.

This goal and these objectives established a firm basis for moving ahead with the program.

Prior to the program, the Critical Analysis Reporting Environment (CARE) system was used to run several "hotspot" analyses to determine the best possible locations for the selective enforcement portion of the program. This was done with the aid of the University of Alabama's Center for Advanced Public Safety (CAPS), which also developed an interactive Web site whereby officers could locate the hotspots throughout the state. (See http://caps.ua.edu/ for additional information on CAPS.) In particular, locations were sought that were especially over-represented in car-truck (CMV) crashes in which the causal vehicle was guilty of one or more of the offenses listed above (as opposed to crashes in general). Details of the location selection are given in the project description below.

The first MCSAP funding received from the Federal Motor Carrier Safety Administration (FMCSA) for TACT was in April 2009 for purposes of taking the experience to date and applying it to a full-blown TACT effort, including an evaluation component to assess changes in crashes and citations as well as driver behavior and awareness. The $645,000 grant DPS received from FMCSA, was matched by a major part of the effort that involved all DPS posts and several local agencies.

The program itself involved two major components – a Public Information and Education (PI&E) component and a selective enforcement (SE) component. PI&E involved both industry and media participation. The SE involved the working special details in seven time periods between early September (Labor Day) and the end of the year. These efforts involved local agencies, general DPS Highway Patrol officers, and special DPS Motor Carrier Safety Unit (MCSU) officers. Enforcement details were scheduled for the following periods:

- September 6-12, 2009 (1 week)
- October 4-17, 2009 (2 weeks)
- November 15 – December 12, 2009 (4 weeks).

The first two of these time slots (about three weeks total) were worked by both the DPS and the local city CMV-certified officers. The final period was worked only by DPS. Details of the particular hours worked and the issued citation types are given in the project description below.

The PI&E effort for TACT was a joint effort led by the Department of Public Safety, but also heavily involving the Alabama Department of Transportation (ALDOT), the Alabama Trucking Association (ATA), and the Federal Motor Carrier Safety Administration (FMCSA). This part of the program had the goal of educating motorists about safely sharing the road, and it was implemented through posters, electronic message boards, and displays on commercial motor vehicles.

The Alabama Trucking Association enlisted six of their members to donate one trailer each for the installation of TACT graphics, as shown in Display 2.1.1 of the original evaluation report (24). Generally referenced as trailer "wrappers," these mobile billboards were on the road throughout the TACT program.

The posters that were ordered and distributed as part of the TACT program carried the basic TACT message, as illustrated in Display 2.1.2 of the original evaluation report for Alabama (24). Over 150 posters were produced, and they were distributed to drivers' license offices, rest areas, trooper posts, DPS headquarters, truck stops and trucking companies. The Alabama Department of Transportation also provided two electronic message boards that were illustrated in the first report (24).

In summary, the TACT program combined outreach, education, and evaluation with targeted enforcement activities to raise awareness among car and truck drivers about unsafe driving behaviors, several of which were mentioned above.

1.3.2 Example Background Update from Recent TACT Project and Evaluation

The following is a 2010 update of Alabama large truck crash statistics derived from the Fatality Analysis Reporting System (FARS) & the Motor Carrier Management System (MCMIS) as given on http://ai.volpe.dot.gov/crashprofile/crashprofilemainnew.asp?STATE_ID=AL&dy=2010:

- 2,074 large trucks and 144 buses involved in non-fatal crashes,
- 907 large trucks and 78 buses involved in injury crashes,
- 1,274 injuries in crashes and 161 injuries in crashes involving buses,
- 1,167 large Trucks and 66 buses involved in tow-away crashes,
- 5 Large trucks and 0 buses involved in hazmat (HM) placard crashes.

The above shows the overall scope of the problems of commercial vehicle crashes that are being addressed by TACT programs.

The most recent TACT project that was considered in the model evaluation project was originally planned to consist of a number of waves of TACT selective enforcement accompanied

by a PI&E effort that included two billboards on I-59 near Tuscaloosa, Alabama. The original start date was set for mid-February. However there were delays in getting the billboards designed and contracts negotiated that delayed the project one month. In mid-April a round of tornadoes further delayed the project in that patrol officers were sidetracked to the affected areas and it was determined that the billboards would not be created until the officers were ready to be allocated to the selective enforcement effort. Then, on April 27, 2011 a major tornado disaster in the Tuscaloosa and several other diverse areas of the state further occupied the majority of DPS patrol officers for several weeks. These tornado incidents were well documented in the National news and will not be described further here.

The billboard provider was quite patient and implemented the billboards on or about June 1, 2011. The patrol officers, however, were not available until June 15th when the full project actually started. This did provide two weeks of "billboard only" treatment that could provide information for the evaluation effort. The selective enforcement portion of the project continued through the end of June, and it involved about three TACT-dedicated officers working in the vicinity of the billboards. While this was a microscopic effort compared to the original massive statewide project, it accomplished the purpose of enabling observational and other types of studies to be exercised, and to provide examples of how even the smallest of TACT efforts can be effectively evaluated.

2.0 Literature Review and Guide to Using this Document

2.1 Literature Review

This section will reference (by number) the annotated literature review given in Section 8. As a summary to that, the following is a categorization of the references found:

- Alabama websites/reports referencing TACT and CARE (13, 21, 26, 27);
- Federal websites/reports referencing TACT (2, 3, 4, 8, 14, 17, 20, 23, 28, 29, 30, 31, 32; 33, 34, 35);
- State level evaluation studies (1, 5, 9, 10, 11, 16, 18, 19, 22, 25; 37);
- Published evaluation studies (15);
- TACT alternative approaches and TACT enhancements (6, 7, 12, 36).

Of particular mention is an FMCSA publication called *A Guide for Planning and Managing the Evaluation of a TACT Program* (33), which is a forerunner of the current document. This *Guide* is an excellent description of the TACT program structure and the integration of evaluation into that structure. It contains very useful checklists, especially the administrative and effectiveness evaluation metric checklist in Appendix A. Since it was assumed that all TACT managers and evaluators will avail themselves of this *Guide*, no attempt was made to replicate this material either in the Methodology Manual or the current document. A review of this *Guide* is highly recommended before applying the recommended procedures in the Methodology Manual.

To most impressive state-level evaluations found were from North Carolina, Kentucky, Pennsylvania and Washington State. These all involved external experts (from universities and consulting firms) who were retained specifically for the evaluation of specific TACT projects. This is certainly commendable, and their reports provide impressive targets for the evaluation of future TACT projects.

It was the goal of the current document and the model project, however, to enable relatively skilled in-house analytical individuals to perform the actual evaluations, perhaps with a small number of days of advisory assistance from an outside consultant. The current report is not meant to replace the retaining of experts if resources to that effect are available. However, it would be expected that if this is the course chosen by the state, that the expertise of the consultant group chosen would be such to enable them to go beyond the analytical techniques that recommended in this report (as was the case in these reports). It may be infeasible for states to bear the continued cost of such consultants for all future TACT projects, and an ongoing integrated evaluation presence is necessary for continuous improvement forever. This is not a criticism of these excellent efforts; it is just a statement that their one-time intensive evaluations are different in scope and application from the methodologies documented in this report. The cost and benefit of evaluation has to be balanced against the sacrificed hours of selective enforcement and PI&E.

2.2 Guide to Using this Document

As indicated above, this document is intended to serve as a supplementary resource to the Methodology Manual a checklist for project administrators and evaluators. *The section numbers of this document are generally identical to the corresponding section numbers in the Methodology final report,* thus providing a direct means for referencing additional information on any given subject. Generally the reader will not be reminded that the Methodology Manual is the overall guide to be used first, and that the materials in this Supplemental Report are intended to provide examples and more detailed instructions.

The topics are considered in the same (chronological) order as they are expected to be implemented for any particular *project.* It is expected that the entire TACT *program* that is implemented by a state will consists of several such projects, often referenced as *waves* or *details*. Programs (consisting of a series of projects) are usually defined by an allocation of funds to TACT for a given period of time. The approach toward evaluation given here applies to one project at a time, and not necessarily to the entire program (depending on how large or over what period of time the program is implemented).

The evaluation itself should be viewed as two separate entities:

- Administrative evaluation – a series of ongoing measurements to verify that the projects (and ultimately the program) accomplish the activities that were specified in the project plan (e.g., 1000 hours of TACT-related overtime). For additional administrative purposes, data on the actual activities will be accumulated (e.g., names involved, times, locations, etc.), and this information could be extremely useful in the effectiveness evaluation. For example, the specific times, officers involved and locations might be applied to determine the particular citations that were issued as a result of the program.
- Effectiveness evaluation – measurements to determine the effectiveness of the particular project (or combination of projects) in bringing about the program goals. For example, a goal might be to reduce the proportion of CMV-related multiple vehicle crashes that are caused by young drivers.

For funding and accountability purposes, generally all projects within a program will be given the same administrative evaluation. However, program resources allocated to the effectiveness evaluation will generally not allow all of the projects to be given the same intensive consideration. Thus, considerable up-front planning must go into determining the particular evaluation metrics that will be applied and the set of projects to which they will be applied. The sections below are generally in chronological order starting from the planning process before the project(s) to be evaluated and continuing through to the statistical analysis of the evaluation metrics.

To summarize, these various sections follow the same numbering scheme as in the Methodology Manual that should accompany this document. The Methodology Manual documents the steps necessary to perform the evaluations. This document provides the examples that illustrate these steps. While much of the information contained in this document is quite valuable from the point of view of assessing the value of TACT programs in general, *the purpose of this document is not to present evaluation results per se.* It is to rather to illustrate by giving examples of the documentation that would accompany a sound evaluation.

3.0 Preparation for the Project

3.1 Establishing the Project Plan

In most cases TACT programs supported by federal funds will require a project plan prior to the approval of funding. The project plan does not need to be long and complex – it just needs to specify what is currently known and anticipated about the project. Further, the plans are tentative and dynamic – they should not lock in decisions that may be improved with more current information. For example, as the problem identification is performed for the project it will generally modify the project parameters that were originally assumed. Plans should be considered for:

- The overall selective enforcement project itself;
- The PI&E effort;
- Observational studies;
- Special emphasis areas and their analyses;
- Administrative evaluations

These will be covered in the 3.1 subsections.

Plans often emanate from meetings, and it is quite important that all meetings are followed up with minutes that, in essence, document that plans as they evolve.

3.1.1 Plan for the Selective Enforcement Project Itself

Following the check-list in the Methodology Manual, the following is an example plan for the TACT program implemented in early spring 2011 in Alabama:

- Who will be involved? The DPS Motor Carrier Safety Unit (MCSU) will provide the management and most of the officers for conducting the selective enforcement details. As in past details, local law enforcement who are trained in CMV enforcement will be recruited as part of the effort.
- What specifically will they be instructed to do? In particular, how will the TACT project be different from their normal details? Most of the involved officers are experienced in TACT operations. However there will be training as to the particular TACT-related, and new officers will be given more intensive training. This training will take place about two weeks before the start of the project.
- How much time will each of them be allocated to accomplish their tasks? As part of the training prior to the project, each involved officer will be informed as to the amount of normal and over-time that will be allocated to the project.

- Where will they be required to perform these activities? As determined by the problem identification effort discussed in Section 3.2 below, the sections will include major sections of I-59.
- When will they do it? The general time frame will be March 27 through April 30, 2011. They will put special emphasis on TACT on weekdays immediately after the early rush hours.
- Are there any special support resources that they will need (e.g., training)? Some overtime funding is being reserved for the project.
- What administrative requirements will need to be met (see administrative evaluation recommendations below)? Officers will complete their standard TACT web based time sheets (discussed in Section 3.1.6)

3.1.2 Plan for the Public Information and Education (PI&E) Effort

Plans for the PI&E effort included billboard design and implementation and earned media involvement. The following responds to the planning questions with regard to the PI&E component of the project:

- Who will be involved and in what capacity? A person was assigned the task of working with a university-based art department and establishing a competition among teams to design the billboards. The final selection would be made by the Steering Committee. The selected billboard artistry would also be used in a poster that would be distributed to rest areas and universities first in the area of the SE during the time of the SE, and ultimately to all that could be reached statewide. The DPS publicity director assigned personnel to coordinate the media efforts, which would include some media ride-alongs.
- What resources are available. The resources for the PI&E efforts for this project were quite limited – a total of $16,000 for all costs incurred.
- Where will they be required to perform these activities? The specific locations for the billboards could not be specified at this time since costs and location availability had to be determined. However, generally they would be in the I-59 corridor as close to Tuscaloosa as possible in order to take advantage of the younger drivers in that general area (see Problem Identification, Section 3.2 for the decision to concentrate on younger drivers). Note: while the PI&E concentrated on younger drivers, there was no attempt to profile the SE effort in this regard – involved SE field officers were not aware that the PI&E efforts were targeted at younger drivers.
- When will they do it? – Immediately prior and then concurrently with the SE efforts.
- Are there any special support resources that they will need? In this case some special resources were used for purchasing and for the billboard design.
- What administrative requirements will need to be met (see administrative evaluation recommendations below)? It is essential to document the times and places of each of the

PI&E efforts, especially if they are not timed simultaneously with the SE effort. While the plan is to have them occur simultaneously, events out of the control of the TACT administrators may prevent this from happening.

3.1.3 Plan for the Use of Crash, Citation and Survey Data

This will be considered in terms of the four areas of evaluation that were considered as part of this project:

- Crash and citation data.
- Driver survey
- Law Enforcement Survey
- Trucker Survey

3.1.3.1 Crash and Citation Data

The crash and citation comparative evaluations (before-during-after) did not require any special planning efforts for the Alabama projects, since there are systems in place that both capture all of the data needed (eCrash and eCite) and perform the necessary analysis (CARE) on these data for their accomplishment. This would be true in all states that have electronic crash and citation systems, and in most that have paper entry systems as well. If this is not then case, then some special provision would have to be made before the project to assure that these data would be available for the evaluations. As an example, prior to the eCrash system being installed in Alabama it was impossible to utilize the crash data for any type of comparisons for at least three months after the project was over, since the latency in getting the data into the database required a manual entry that tended to be unpredictable. Similarly, access to citation information was quite difficult. In situations like this it would be essential to obtain permissions from the database administrators prior to the project to make the data available to the project team as soon as practical. In some cases special data collection might be required for the relatively few crashes that involving CMVs. The most important part of the planning is to assure that sufficient data are available for the “before” time period. In most cases these data have been collected continually for a number of years, so it is just a matter of obtaining the data from the appropriate database.

It is important that the filters be defined to include those crashes and citations of interest. This presented somewhat of a problem for Alabama since there was a major change of reporting over the time span of the study. In June 2009 an electronic crash (eCrash) system began to be deployed throughout the state, beginning with the Department of Public Safety, which reports the vast majority of CMV crashes (all on the state and Interstate highway systems). An integrated dataset was formed of both the old paper system and the new eCrash gathered data. The crashes that were identified as involving heavy trucks and/or CMVs had the following characteristics

(note that E indicates that the record was generated with eCrash, while P indicates that it was generated from a paper form):

(D101 = E Single-Unit Truck 3 Axles or More
OR E Truck Tractor with Trailer
OR E Truck Tractor Only - Bobtail
OR E Tractor/Semi-Trailer
OR E Tractor/Doubles
OR E Tractor/Triples
OR E Other Heavy Truck -- Cannot Classify Otherwise
OR E Mobile Home Transport
OR E Maintenance/Construction Vehicle
OR P Truck Tractor
OR P Other Truck
OR P Commercial Bus)
OR
D103: Commercial Motor Vehicle Indicator = Unit is CMV

The rationale for this filter was that the TACT program is not limited to reducing crashes to only CMVs, but on the other hand, all CMV crashes should be included. Thus, both the body style and the CMV crash indicator were used in creating the filter. This filter definition, or slight derivations from it, was used in all of the before and after comparisons.

3.1.3.2 Driver Survey

In the Alabama example, it was determined to perform driver surveys utilizing drivers' license renewal offices (DLRO). This had several advantages over alternatives that were proposed: (1) they were readily available and could be targeted to the test and control areas under consideration; (2) they were under DPS control, and DPS was a fully participating partner, not only in the TACT program but in the evaluation process; and (3) they would by their very nature generate a random sampling of drivers, since there is very little (if any) demographic bias as to who comes in for renewal during any given time period. Display 3.1.3.2 shows the locations of the DL offices (Lee, Macon, Shelby and Tuscaloosa counties) surveyed relative to the hotspot corridors and the State as whole.

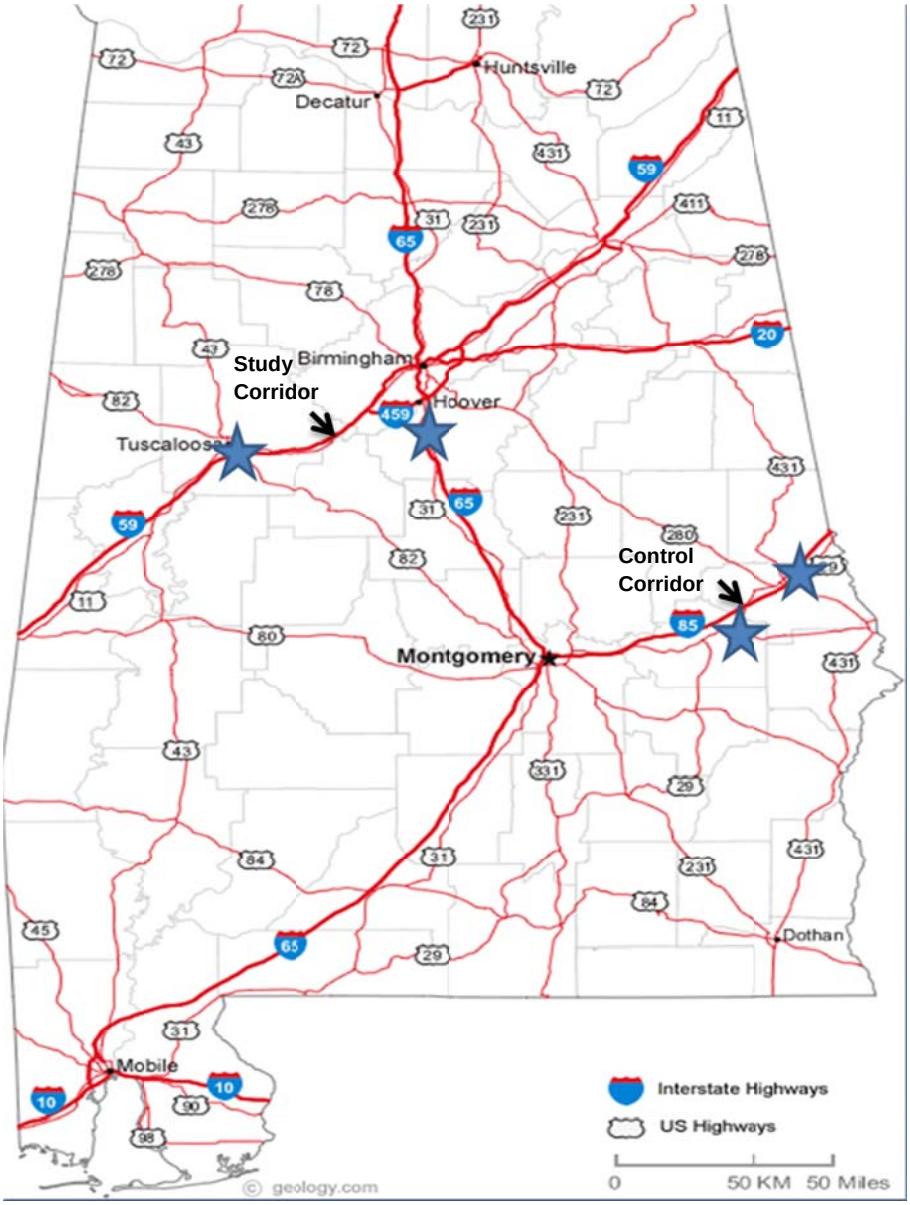
This last point needs some qualification. Certainly there might be a geographical demographic bias. However, this would be beneficial to the study since it would tend to include those drivers who should have been exposed to the project from the test area, and not exposed to it for the control area. The only thing that would create a bias could be the reluctance of some subsets (e.g., an age subset) of the population of drivers having their licenses renewed that might be

reluctant to take the survey. The survey was totally voluntary, so if there were ages, races, gender or other factors that would make one subset more apt to take the survey than another, this could bias the results. However, for the most part this would be automatically adjusted since there was no reason to expect that this bias should be any different in the test area than in the control area. Nevertheless, this potential bias should not be ignored, and demographic information on the survey itself (age, gender, etc.) can be used to determine if this is a significant factor or not, and if the test areas are different in these factors from the control areas.
While using the drivers' license renewal offices (DLROs) seemed simple enough, there were still a number of issues that needed to be resolved:

- General permission and then specific contact of the commanders of each of the DLROs that were to be involved (this was handled by the participating DPS officers);
- An overall information sheet for the DLRO commander and staff (see Display 3.1.3.2a below);
- An instruction sign for the participants (see Display 3.1.3.2b below);
- The design of the survey form itself (see Display 3.1.3.2c below);
- A determination of the number of forms to be printed (in this case 100 per month per DLRO was seen to be a sufficient sample for statistical validity);
- Assurance that the specific DLRO was identified on the form (in this case different color forms were used to keep things from getting confused).

The survey form itself was patterned after that used in Washington State (19). Several data elements were eliminated and refined in order to make the form as simple as possible. One goal was to get it down to one side of one page so that it would be much more acceptable to those who were completing the form and thus obtain a greater sample size. However, no data elements that were necessary to the planned analyses for these data were sacrificed. Another goal was to avoid being unnecessarily intrusive if, in fact, a data element was either not needed for the analysis or could be obtained by other means.

Display 3.1.3.2 Location of DLROs relative to Study and Control Corridors



Display 3.1.3.2a Information Sheet for DLRO Commander and Staff

Date

Subject: TACT Surveys

Driver License Office Chief:

The Alabama Department of Public Safety is working with the University of Alabama on a study to determine the effectiveness of various countermeasures with regard to the Ticketing Aggressive Cars and Trucks (TACT) projects that are currently on-going in the state.

The Federal Motor Carrier Safety Administration (FMCSA) is particularly interested in safety project evaluation, and they have made evaluation an essential part of the TACT projects.

Officers will be bringing a stack of survey forms to your office near the first of each month. There will be a brief sign accompanying the surveys that will provide instructions for the general public. No action will be required on the part of your staff – everything should be self-explanatory. If this is not the case, please let us know.

It is imperative to the study that a continuum of results be obtained on a monthly basis. For this reason you can expect an officer to exchange the completed forms with a fresh batch of new forms at the beginning of each month. This will continue for several months, probably into the summer of 2011.

I know that you want to support this effort and help Alabama and the country in making decisions that will enhance the effectiveness of our TACT projects. Please do all that you can to support the survey and to assure that the results obtained are objective, representative and accurate.

We appreciate your cooperation and support.

Sincerely,

Display 3.1.3.2b Instruction Sign for Participants (Drivers)

PLEASE HELP

WE NEED YOUR INPUT

Please Complete One of These Quick Survey Forms

It Won't Take a Minute and it is Totally Anonymous

PLACE IN BOX WHEN COMPLETED

Thank You for Helping Save Lives in Alabama

Display 3.1.3.2c Drivers Survey

Date:* **Location:***

1. Do you feel comfortable driving around large trucks?

☐ Yes ☐ No

2. Which of the following do you think is important when driving around large trucks? (Check one)

☐ Do not pull in front of a truck and slow down

☐ Do not tailgate trucks

☐ Stay out of the truck driver's blind spots

3. Have you recently read, seen or heard anything about giving large trucks more space (check all that apply)?

☐ Yes, on TV

☐ Yes, on a billboard

☐ Yes, on the radio

☐ Yes, in the newspaper

☐ Yes, in a brochure

☐ None of the above

4. Has this information changed how you drive around trucks?

☐ Yes ☐ No ☐ Have not seen or heard this information

5. Do you know the name of any programs related to safety around trucks in Alabama? (check all that apply):

☐ **Trucks Need Space Too** ☐ Share the Road ☐ *Stay Safe, Give Trucks Space* ☐ Click It or Ticket

6. About how many miles did you drive last year?

☐ I do not drive

☐ Less than 5,000 ☐ 5,000 to 15,000 ☐ 15,001 to 20,000 ☐ More than 20,000

7. What type of vehicle do you drive most often?

☐ Passenger car ☐ Pickup truck ☐ Sport utility vehicle ☐ Mini-van ☐ Full-van

☐ Semi truck ☐ Motorcycle ☐ I do not drive

8. Are you (or have you ever been) a commercial truck driver?

☐ Yes ☐ No

9. Your age:

☐ Under 21 ☐ 21-25 ☐ 26-39 ☐ 40-49 ☐ 50-59 ☐ 60 Plus

10. Your gender:

☐ Male ☐ Female

11. Your Zip Code: _____

* The Date and Location fields were located in the Word margin to prevent them from being altered by the survey participants.

3.1.3.3 Law Enforcement Officer Survey

The law enforcement officer was considerably simplified compared to that of the drivers because it was internet-based. The URL was given to the officers involved in the study and they obtained the involvement of other officers in completing the survey before and after the specific TACT project. The following provides an example survey that was implemented for the Alabama projects.

Display 3.1.3 Law Enforcement Survey

The following survey is part of an evaluation that is required for the Ticketing Aggressive Cars and Trucks (TACT) program. It is very important that we obtain this information and that you provide candid and accurate responses to the best of your ability. The responses are anonymous, and they will be entered into a database without identifying information prior to any processing. With the possible exception of suggestions, all results will be reported in summary form. We appreciate your participation and assistance with this survey.

1. My Participation in the TACT program was as:

☐ A field enforcement officer ☐ An administrator

2. The extent of my participation was:

☐ Less than 5 hours ☐ 21 – 50 hours
☐ 5 – 10 hours ☐ Over 60 hours
☐ 11 – 20 hours

3. To what extent do you see TACT activities to be different from your normal patrol activities?

☐ **Not very much at all** ☐ **Quite a bit different**
☐ **Somewhat different** ☐ **Completely different**

4. I believe that it is best to perform TACT type of enforcement:

☐ **On my own** ☐ **As part of a coordinated statewide TACT program**

5. Since being involved in the TACT effort, I have been more aware of traffic offenses that involve interactions between cars and trucks:

☐ True ☐ False

6. Being more aware of traffic offenses that involve interactions between cars and trucks has led me to issue more citations for these types of offenses even after the TACT program was over:

☐ True ☐ False

7. Feedback that I have received from truckers as to the value of the TACT program has been:

☐ More positive than negative
☐ About the same, positive and negative
☐ More negative than positive

8. Feedback that I have received from the general public as to the value of the TACT program has been:

☐ More positive than negative
☐ About the same, positive and negative
☐ More negative than positive

9. Do you believe that the traffic law enforcement associated with the TACT program accomplished its objectives of changing driving behavior and saving lives?

☐ Yes ☐ No

3.1.3.4 Trucker Survey

Similar to the law enforcement officer survey, the trucker survey was considerably simplified compared to that of the drivers because it was also internet-based. The URL was given to the Alabama Trucking Association (ATA), and it encouraged its members to participate in completing the survey before and after the specific TACT project. The participation in the survey was completely voluntary and totally anonymous. The introductory paragraph was identical to that given for the officer survey above. The following provides an example survey that was implemented for the Alabama projects.

Display 3.1.3 Truck Driver Survey

1. **My Participation in the TACT program was as:**
   - ☐ A truck driver
   - ☐ A trucking company administrator
2. **My participation in the program involved:**
   - ☐ No exposure to TACT program public service announcements
   - ☐ A few observations to these announcements
   - ☐ Several observations of these announcements
   - ☐ Seeing these announcements almost every day during the program
3. **To what extent did the TACT program change the way you view four-wheelers?**
   - ☐ **Not very much at all**
   - ☐ **Quite a bit different**
   - ☐ **Somewhat different**
   - ☐ **Completely different**
4. **I believe that the problem of car drivers not driving properly around trucks can be best addressed by:**
   - ☐ **Methods other than TACT that have been used in the past**
   - ☐ **Implementing a coordinated statewide effort, like the TACT program**
5. **Since being involved in the TACT effort, I have been more aware of traffic offenses that involve interactions between cars and trucks:**
   - ☐ True
   - ☐ False
6. **I believe that the TACT program:**
   - ☐ Was biased towards the private vehicle driver
   - ☐ Was trying to be fair in addressing offenses of both cars and trucks
   - ☐ Was biased toward trucks
7. **My feelings as to the overall value of the TACT program is:**
   - ☐ More positive than negative
   - ☐ More negative than positive
   - ☐ About the same, positive and negative
8. **Feedback that I have from the general public as to the value of the TACT program has been:**
   - ☐ More positive than negative
   - ☐ More negative than positive
   - ☐ About the same, positive and negative
9. **I know of at least one trucker who received a ticket as a result of the TACT program:**
   - ☐ True
   - ☐ False
10. **Do you believe that the traffic law enforcement associated with the TACT program accomplished its objectives of changing driving behavior and saving lives?**
    - ☐ Yes
    - ☐ No

3.1.4 Plans for Conducting Observational Studies

3.1.4.1 Considerations from the North Carolina TACT Evaluation

Cunningham, et al (25) conducted an excellent and intensive study of the North Carolina TACT projects. These results constitute a major contribution to the TACT program, and a discussion of their methods provides a good introduction into the subject for this section. Consider the following quotes from this effort:

- Justification for observational studied: "Documentation of how many speeding tickets from past evaluation efforts are issued during a TACT enforcement phase does not constitute evidence that vehicle speeds and following distances have been affected by enforcement presence. Neither do measures of TACT "media recognition" constitute evidence that TACT efforts have resulted in measurable changes in critical driver behaviors. Instead, data should be defensible and based on the effect of the treatment being employed, in this case public awareness/education campaigns and focused enforcement."
- Limitations in the police officer observation – either stationary or moving: "For maximum enforcement effectiveness, surveillance needs to be continuous and corridor-wide in its coverage, in addition to its ability to produce measurable detection evidence of the behaviors in question."
- Desirability of automated collection of TACT performance measures: "…it has the potential to a) greatly decrease analysis time, b) increase sample size, c) improve reliability across multiple sites, and d) eliminate human observer bias."
- Potential for totally automated data collection: "Alternatively, automated video-image processing software is commercially available that can be used to deliver lane-by-lane volumes, speeds, and classification data, and can further be adopted to identify short gaps … but the results are not necessarily tied to the selected product."
- Type of metrics collected: "It is critical for the adoption of TACT as a model program of effective enforcement that the behaviors in question be *observable* and *quantifiable*, and that a change in their frequency or rate can be shown to be associated with the presence of enforcement."

Clearly, automated data collection has not only the value of providing data for TACT evaluations, but the development of these technologies could lead to major operational data upon which to base selective enforcement tactical decisions. For example, if these monitoring tools were used and the resulting information fed to a central office, it could be then be used to dispatch selective enforcement resources to hot spots on a real-time basis. While exploring this use of the technology is beyond the scope of the model evaluation, it bears mentioning since those involved with TACT and TACT evaluations would certainly be interested in such for future applications.

It should be noted that the automated data collection documented in the North Carolina study was restricted to the following specific applications:

"Consequently, the three primary TACT performance measures are:

- RLV - Restricted Lane Violations: RLV events are strictly defined by a count of CMV vehicles in a restricted lane (if applicable). The performance measure is defined in terms of an absolute count of events, as well as a rate of RLV events over time (e.g. violations per hour).

- VPS - Violation of Posted Speed: VPS events are defined as a count of vehicles (CMV or passenger car) observed to travel more than 9 miles per hour in excess of the posted speed limit. The performance measure is again reported as a count of events (per lane), and a rate of violations over time.

- FTC - Following-Too Close: An FTC event occurs when one vehicle (CMV or car) follows the vehicle in front of it at a specified time gap that does not allow adequate reaction time if the leading vehicle were to unexpectedly apply its brakes. An FTC event is especially critical for a CMV following another vehicle, because large trucks generally cannot decelerate as quickly as passenger cars due to their larger mass. (25)"

The exact definition for what was considered to be "too close" is given in (25) and will not be repeated here. It is defined in following sections for the observations conducted under the current study. It must be noted that that a very precise and consistent definition is required for any such study to produce meaningful results.

RLV are not of concern in Alabama and many other states, so will not be further discussed here, although it should be important to those where this is relevant to explore the relationship of RLV to safety.

There exists an issue with simply judging an occurrence to be unsafe if two vehicles are less than a given distance apart. While this might be a criterion in the extreme case, the NC study indicated that it would not be useful to use the legal definition of tailgating. So many are in violation of this technical definition that it would be impossible to measure any changes in it, and the TACT program is designed to increase safety, not to enforce a rigid legal standard that is rarely reflected in driver behavior. In other words, if the overall following distances are measured and compared, and those during and after the program are significantly higher than before, this is clearly an improvement in safety (i.e., a reduction in the potential for and probability of a crash). While counting the number that fall within a minimum following

distance is certainly one way to measure this, it does not take into account another very important factor: the relative motion between the vehicles. For example, if a car is traveling 10 MPH faster than a CMV and pulls in 30 feet in front of it, that is not nearly the hazard as a car that pulls in 50 feet ahead of the CMV that is going 10 MPH slower than the CMV. While there might come a time when affordable technology is developed to measure this, currently this requires a human observer to make a judgment as to the relative hazard of various events.

Finally, hazards caused by the presence of cars remaining in CMV's blind spots for an excessive amount of time could not be considered by the automated equipment. Here again, it is not the mere presence in the blind spot that should be deemed hazardous. Rather, it is the *lingering* in the blind spot area that creates a significant decrease in safety. This requires trained human observers to detect.

No system of evaluation is perfect, and the purpose of the discussion above was not to detract from the excellent study and methods applied by the North Carolina research team. The highest degree of automated data collection that is effective in measuring unsafe events should be applied, and the North Carolina effort is an excellent step forward in that regard.

3.1.4.2 Approach of the Alabama Example

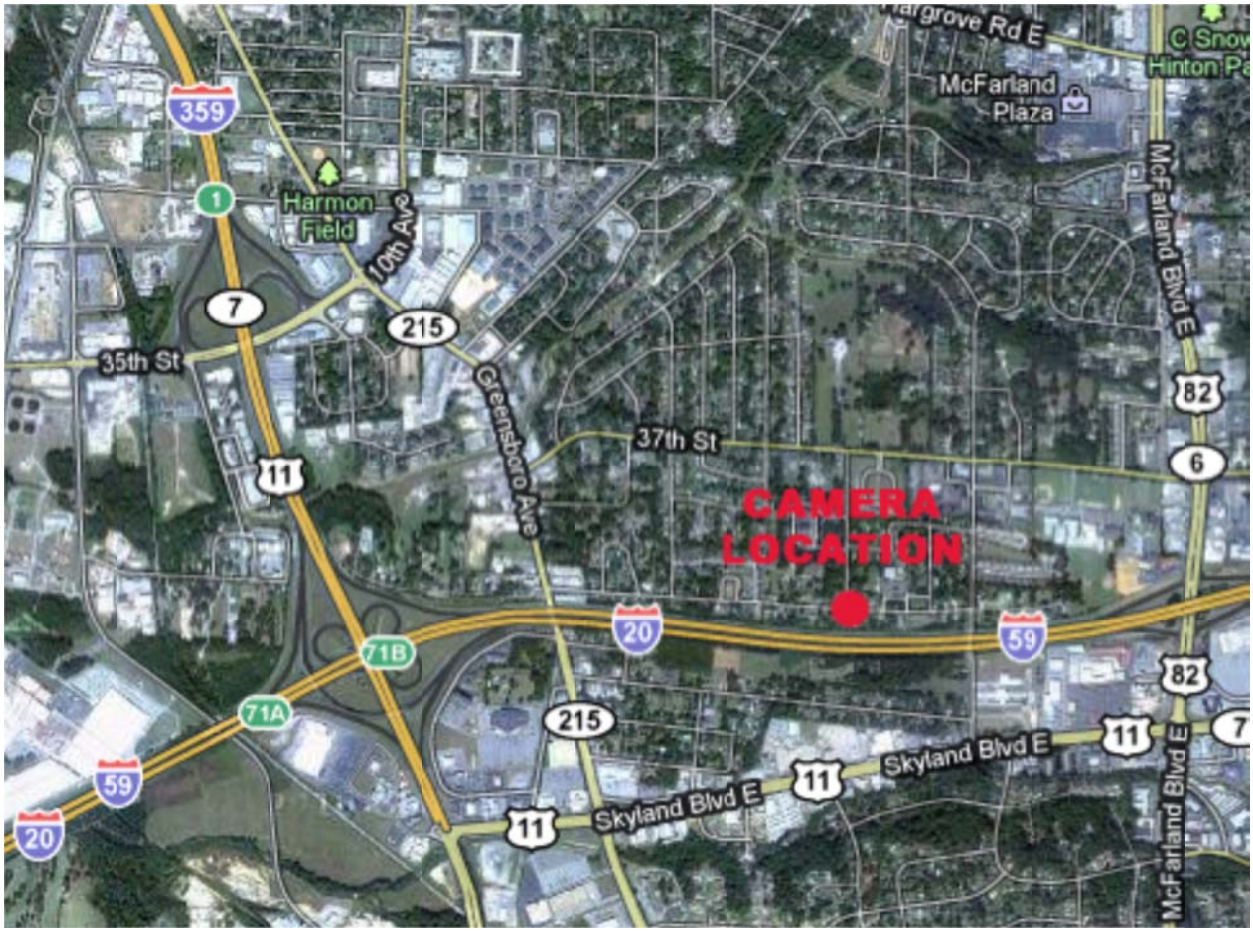
The example that is documented in this section as well as Sections 3.1.4.3 and 3.1.4.4 is motivated by the lack of any special additional equipment resources available for the evaluation, and relatively low personnel resources. The use of existing video cameras was quite efficient in that it required no new equipment purchase. It also added to the efficiency and accuracy of the evaluation in the following ways:

- It is simple and can be implemented by those of reasonable technical skills.
- A dramatically increased number of events could be captured than would ever be possible by direct observation.
- Having the events on video media enabled them to be reviewed by multiple reviewers and, if necessary, multiple times by the same reviewers.
- Markings on the roadway or environment (e.g., the roadway centerlines) can be used to gauge distances.
- Criteria were developed that placed events into very clear categories of safe and unsafe. While some events would be questionable, they could be designated as such, and the analysis could be conducted accordingly (e.g., all questionable cases could be eliminated to make the comparisons based on the clearly unsafe events, and the "middle-ground" events could be compared to see how they varied before and after or between reviewers).

3.1.4.2.1 Video Data Collection Equipment

Video data of driving behavior around trucks were collected using traffic surveillance cameras operated by the Tuscaloosa Department of Transportation (TDOT). The study camera is located on I-20/59 in the City of Tuscaloosa. Display 3.1.4.2.1 shows the location of the camera in relation to the study corridor and its environs. The camera has pan capabilities to allow different views of I-20/59. Display 3.1.4.2.1a shows screen captures of the camera views from the video data collection.

Display 3.1.4.2.1 Location of CCTV Camera for Video Data Collection



Display 3.1.4.2.1a Sample Screenshots from Video Data Collection

3.1.4.2.2 Video Data Collection Methodology

As with the survey data, the video data was collected for four study periods: *Before*, *PIE*, *PIE+Enforcement (E)* and *After*. Video data was recorded on Tuesdays, Wednesdays, and Thursdays between the hours of 7 – 9AM, 11AM – 1PM, and 4 – 6PM. The total video data collected comprised of some 38 hours of *Before*, 42 hours of *PIE*, 54 hours of *PIE+E* and 44 hours of *After* video footage. The video was recorded directly from the TDOT cameras and transferred to portable hard drives for storage, reduction and analysis.

The primary objective of the video analysis was to determine whether a measurable change in driving behavior could be observed among the different study periods. In particular, the video analysis was intended to show whether the TACT program (PI& E and enforcement) resulted in safer driving conditions.

In order to establish whether there had been a change in driving behavior, a baseline event was defined for observation within the video data. An *event* was defined as at least one truck and at least one car in the video frame within three truck lengths (approximately 180 feet) of one another. The evaluation team, in conjunction with Alabama DPS officers, developed the criteria by which unsafe events were defined. Initial video footage of various events were recorded and shown to DPS officers to allow them to identify events they deemed safe versus unsafe. After reviewing numerous events and much discussion, the following definitions of *unsafe event(s)* were used:

- *Blind Spot (BS) event*: A vehicle or truck maintaining a position in a truck's blind spot for an amount of time deemed unsafe (at least 3 seconds) without relative movement out of the blind spot. A sample screenshot showing an unsafe BS event is given in Display 3.1.4.2.2.
- *Tailgating (TG) event*: A vehicle or truck that is following the other vehicle within the average spacing for an amount of time deemed unsafe (at least 3 seconds) without relative movement away from tailgating. A sample screenshot showing an unsafe TG event is provided as Display 3.1.4.2.2a.
- *Lane Changing (LC) event*: A vehicle that pulls in front of another vehicle or truck within one truck length. A sample screenshot showing an unsafe LC event is provided as Display 3.1.4.2.2b.

A set of training videos were set aside to teach the reviewers how to identify safe versus unsafe events. The training was conducted over a one-hour period with the evaluation team and all reviewers watching the videos together. When an event occurred everyone would score it as safe or unsafe. Then all participants would share their evaluations to determine if there were any discrepancies among observers. The video would be rewound and the event would be reviewed repeatedly and discussed with the intention of developing a relatively consistent perspective among reviewers.

Display 3.4.1.2.2 Sample Screenshot Showing Unsafe Blind Spot Event

Display 3.4.1.2.2b Sample Screenshot Showing Unsafe Tailgating

Display 3.4.1.2.2c Sample Screenshot Showing Unsafe Lane Change

3.1.4.2.3 Video Analysis

Originally, a team member would watch the raw footage and clip out footage not containing an event. However, this process was deemed unnecessary because it only reduced each video by a matter of a few minutes. Rather than reducing the video, a new, simpler sampling method was developed. This was based on the concept of developing a *rate of occurrence* of unsafe events to total events. A random sample of events (as defined above) was taken from the video in one-minute intervals. Furthermore, since the camera view allowed collection of data in two directions along the study corridor, the event selected each minute was taken from alternating directions of travel.

Videos containing 6 hours of total footage were selected for each of the study periods. Each of the four sets of videos was given a name unrelated to the study period and assigned to one of the reviewers using a random number. The set of videos contained footage representing morning, midday and afternoon conditions on the study. In order to remove bias, the reviewers examined videos in sets with no knowledge from which study period the video was taken. Data from three videos from each of the four study periods were collected using the methods described in the previous section. Displays 3.1.4.2.3 and 3.14.2.3a show listing of videos for each period and the file name (indicating time-of-day, month and day). The twelve videos randomly selected for analysis are shown in *italics*.

Display 3.1.4.2.3 *Before* and *PIE* Video Files

RANDOM NUMBER	FILE NAME	RANDOM NUMBER	FILE NAME
1	Morning 3 09	20	Morning 5 25
2	*Morning 3 23*	21	Morning 5 26
3	Morning 3 24	22	Morning 5 31
4	Morning 3 30	23	Morning 6 01
5	Morning 4 05	24	Morning 6 02
6	Morning 4 06	25	Morning 6 07
7	Lunch 3 10	26	Morning 6 08
8	Lunch 3 24	*27*	*Morning 6 09*
9	*Lunch 3 29*	28	Lunch 5 25
10	Lunch 3 30	29	Lunch 5 26
11	Lunch 4 05	30	Lunch 5 31
12	Lunch 4 07	*31*	*Lunch 6 01*
13	Lunch 5 24	32	Lunch 6 02
14	Evening 3 09	33	Lunch 6 07
15	Evening 3 10	34	Evening 5 24
16	Evening 3 24	*35*	*Evening 5 25*
17	Evening 3 29	36	Evening 5 26
18	Evening 3 30	37	Evening 5 31
19	*Evening 4 05*	38	Evening 6 01
		39	Evening 6 02
		40	Evening 6 07

Display 3.1.4.2.3a *PIE&E* and *After* Video Files

RANDOM NUMBER	FILE NAME	RANDOM NUMBER	FILE NAME
41	*Morn 6 13**	68	Morn 7 08*
42	Morn 6 17*	*69*	*Even 7 08**
43	Morn 6 20*	70	Even 7 11*
44	Lunch 6 13*	71	Morning 7 05
45	Lunch 6 17*	72	Morning 7 06
46	Lunch 6 20*	*73*	*Morning 7 07*
47	Even 6 13*	74	Morning 7 12
48	Even 6 17*	75	Morning 7 13
49	Even 6 20*	76	Morning 7 14
50	Morning 6 14	77	Morning 7 19
51	Morning 6 15	78	Morning 7 20
52	Morning 6 16	79	Morning 7 21
53	Morning 6 21	*80*	*Lunch 7 05*
54	*Morning 6 22*	81	Lunch 7 06
55	Morning 6 23	82	Lunch 7 12
56	Lunch 6 14	83	Lunch 7 13
57	Lunch 6 15	84	Lunch 7 14
58	Lunch616	85	Lunch 7 19
59	Lunch 6 21	86	Lunch 7 20
60	Lunch 6 22	87	Evening 7 05
61	Lunch 6 23	88	Evening 7 06
62	Evening 6 14	89	Evening 7 07
63	Evening 6 15		
64	Evening 6 16		
65	Evening 6 21		
66	Evening 6 22		
67	Evening 6 23		

* Videos taken on a Monday or Friday during and immediately after the enforcement period

In order to simplify the procedure, it was decided that reviewers would identify 50 events from each video using the random selection method described above. Therefore, 150 events were evaluated for each of the four study periods representing traffic conditions at different times of day. Each reviewer coded the 50 videos as *safe* or *unsafe* (the type of unsafe event was coded in the comment field) in the form presented in Display 3.1.4.2.3b.

Display 3.1.4.2.3b

Event #	Time Truck Appears	Safe	Unsafe	Comment (description of event)

3.1.5 Plans for Special Emphasis Area Analyses

This report does not use the term "special emphasis areas" to refer to CMV or TACT focus violations or high crash locations (this is routine and not special). Rather special emphasis areas are intended to connote a specific driving behavior or subset of the driving population to be specifically targeted. An example of such a focus area for the recent TACT project in Alabama was the concentration on youth-caused CMV-car crashes. This was chosen because general traffic safety problem identifications for selective enforcement had shown younger drivers to be particularly problematic because of their lack of experience and inclinations to take risks. Plans to address this particular emphasis area included the assignment of additional problem identification efforts to be made so that the TACT project could be better targeted by location and time. These are shown in the related problem identification section (3.2.2) below.

3.1.6 Administrative Evaluation Plans

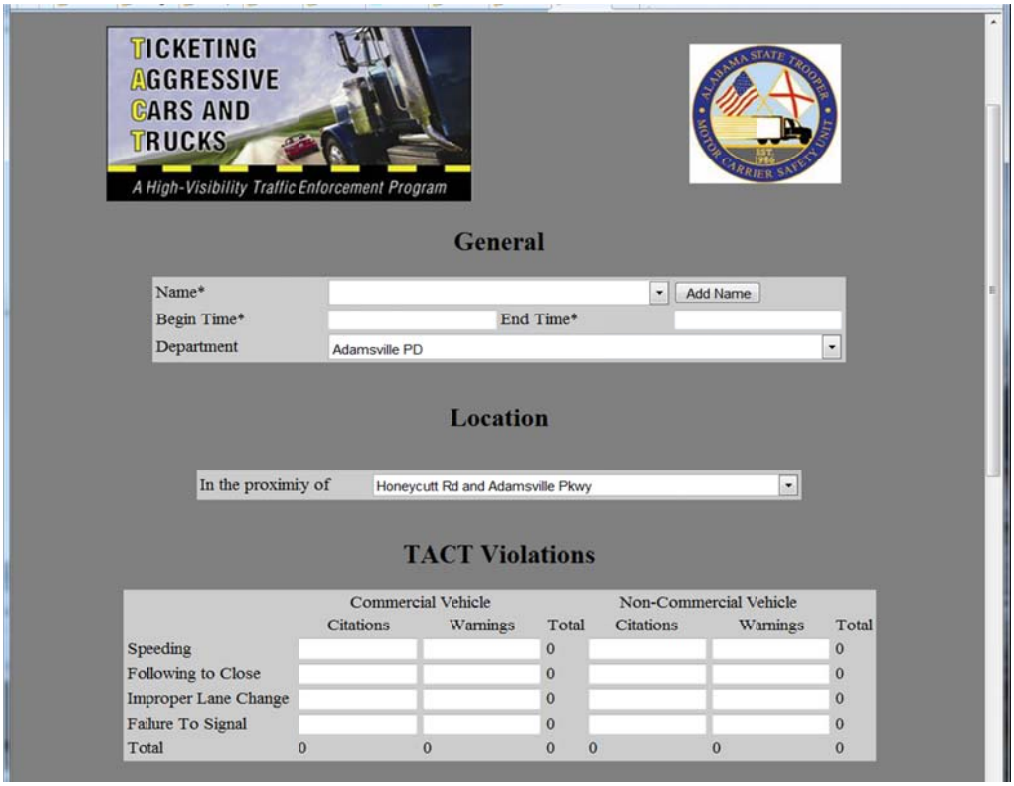
The plans for the administrative evaluation should include the development of the data collection forms and procedures for recording the relevant actions as they progress. One of the most important aspects of the administrative evaluation with respect to the effectiveness evaluation is that the administrative evaluation keep track of the times, places and activities of the project itself so that the parameters for the before-during-after citation and crash studies can be known.

This is one of the most vital (but quite often missing) information when a decision is made after the fact to perform an evaluation. There is no reason for it to be lacking if proper administrative data collection techniques are in place.

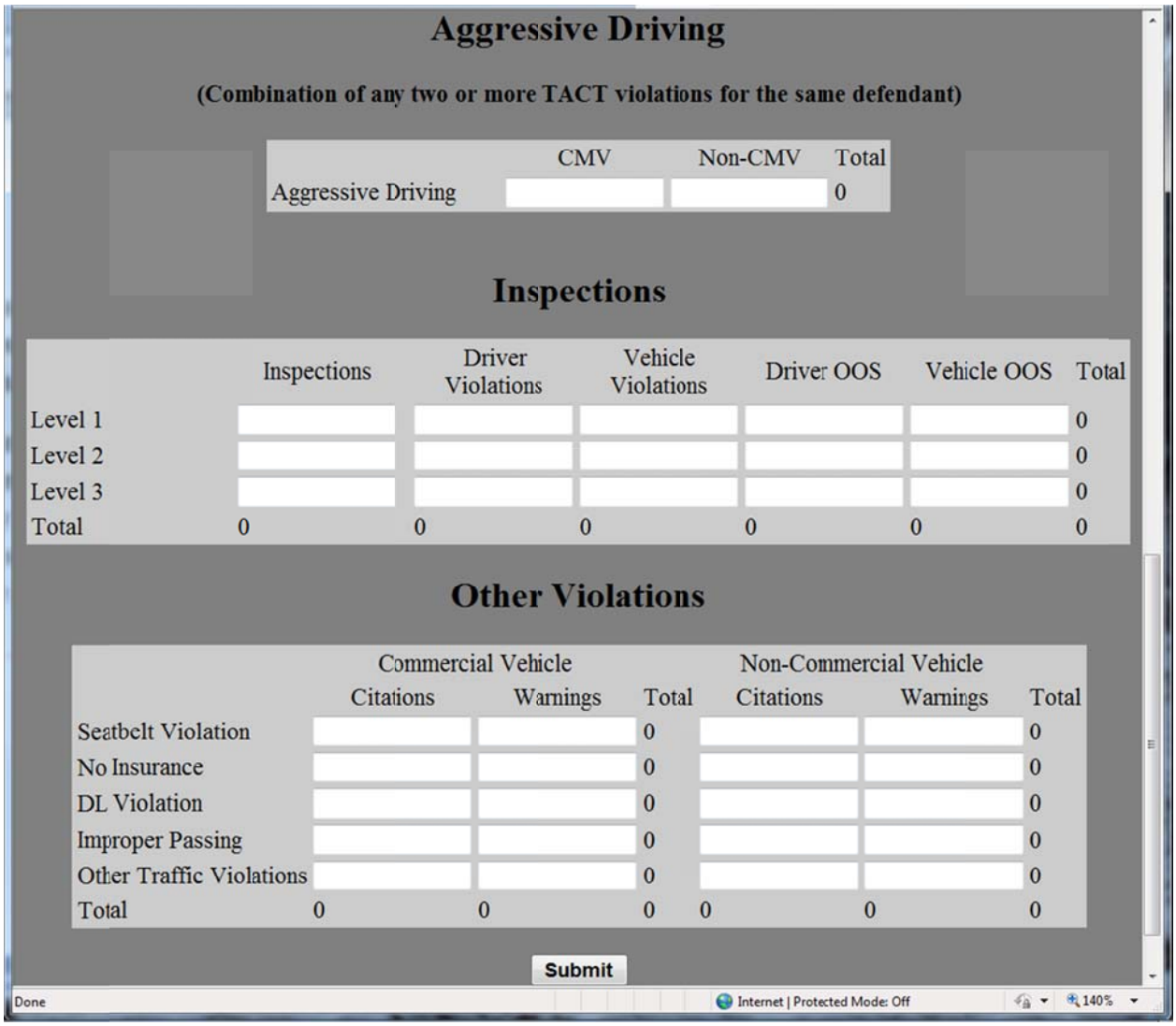
The secure online enforcement summary forms that have been used in Alabama since before their first TACT program serve to illustrate examples of the Internet-based administrative data forms and procedures. This system was developed for the direct use of participating law enforcement officers. Each officer assigned to TACT entered citation and warning summaries at this site. The summary also included the officers' names, departments, enforcement locations, and enforcement time periods. Citations that were entered were further categorized by CMV and Non-CMV. Motor carrier officers also reported CMV inspections using this same form.

Officers were required to submit a form for each separate location and time period they patrolled. Based on these data, daily, weekly, and monthly reports were automatically generated and made available on the Internet. These reports were available for the entire state or for each participating agency or DPS troop. The TACT Web site served as the mechanism for officers throughout the state to report their activities. Displays 3.1.6 and 3.1.6a show the Web-based data entry forms.

Display 3.1.6 Top Half of Officer Activity Report Data Entry



Display 3.1.6a Bottom Half of Officer Activity Report Data Entry



Aggressive Driving

(Combination of any two or more TACT violations for the same defendant)

	CMV	Non-CMV	Total
Aggressive Driving			0

Inspections

	Inspections	Driver Violations	Vehicle Violations	Driver OOS	Vehicle OOS	Total
Level 1						0
Level 2						0
Level 3						0
Total	0	0	0	0	0	0

Other Violations

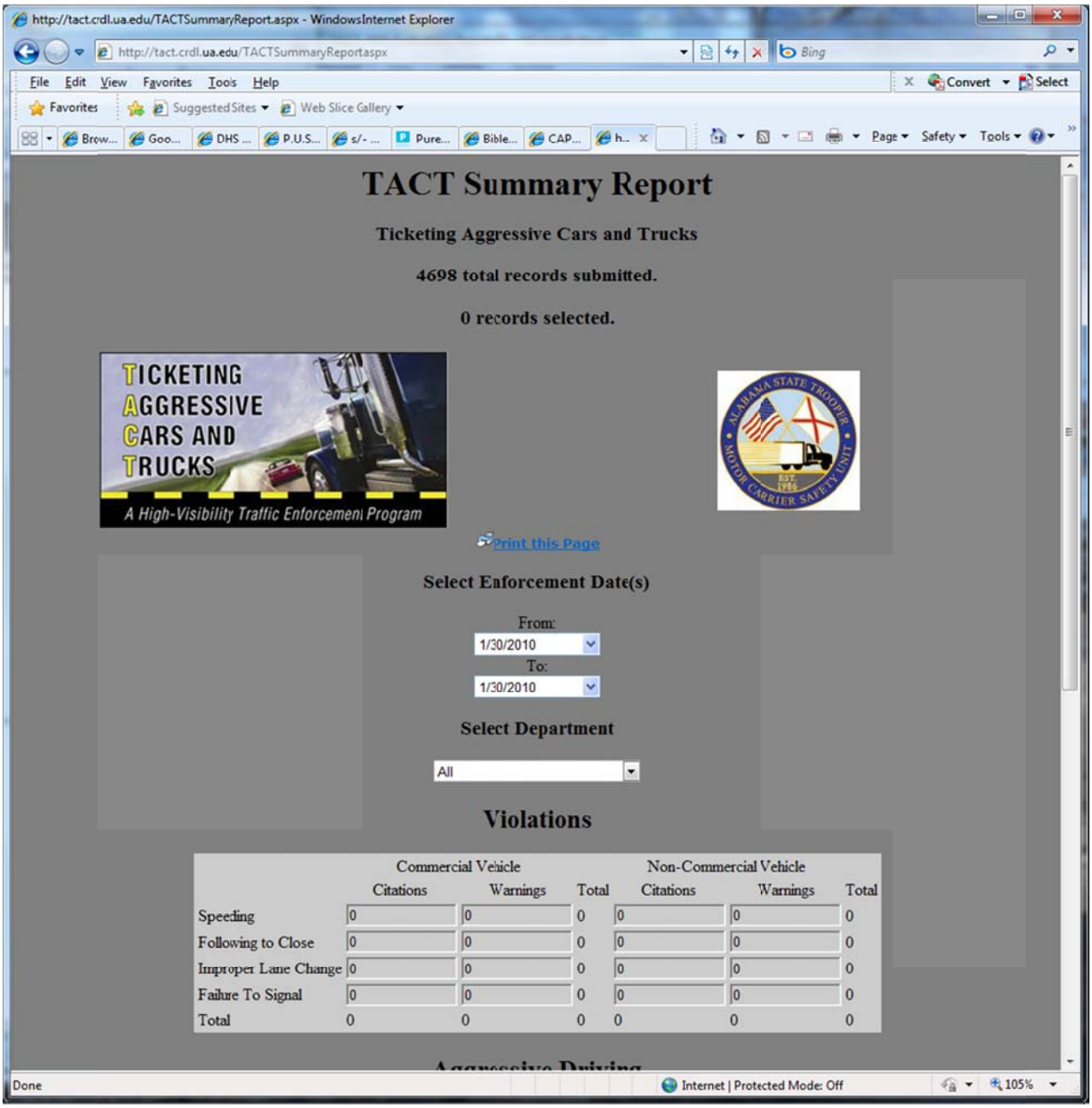
	Commercial Vehicle			Non-Commercial Vehicle		
	Citations	Warnings	Total	Citations	Warnings	Total
Seatbelt Violation			0			0
No Insurance			0			0
DL Violation			0			0
Improper Passing			0			0
Other Traffic Violations			0			0
Total	0	0	0	0	0	0

Submit

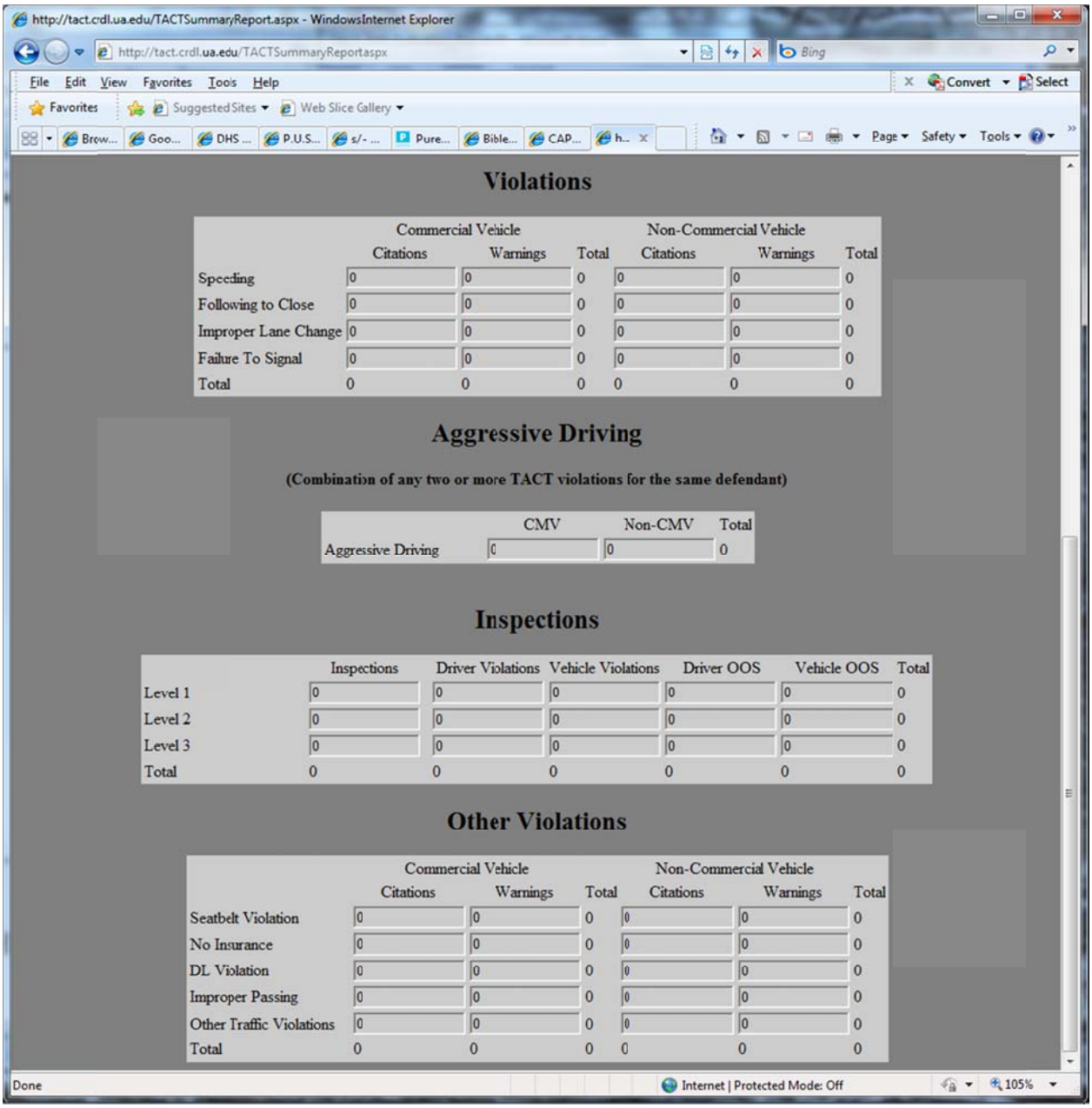
Done Internet | Protected Mode: Off 140%

The TACT Web site also provided a summary report by which individual officers or their supervisors (collectively) could track their progress in writing citations and warnings of various types. The format of these reports is shown in Displays 3.1.6b and 3.1.6c.

Display 3.1.6b Top Half of TACT Summary Report



Display 3.1.6c Bottom Half of TACT Summary Report



http://tact.crdl.ua.edu/TACTSummaryReport.aspx - WindowsInternet Explorer

http://tact.crdl.ua.edu/TACTSummaryReportaspx

File Edit View Favorites Tools Help

Favorites Suggested Sites Web Slice Gallery

Violations

	Commercial Vehicle			Non-Commercial Vehicle		
	Citations	Warnings	Total	Citations	Warnings	Total
Speeding	0	0	0	0	0	0
Following to Close	0	0	0	0	0	0
Improper Lane Change	0	0	0	0	0	0
Failure To Signal	0	0	0	0	0	0
Total	0	0	0	0	0	0

Aggressive Driving

(Combination of any two or more TACT violations for the same defendant)

	CMV	Non-CMV	Total
Aggressive Driving	0	0	0

Inspections

	Inspections	Driver Violations	Vehicle Violations	Driver OOS	Vehicle OOS	Total
Level 1	0	0	0	0	0	0
Level 2	0	0	0	0	0	0
Level 3	0	0	0	0	0	0
Total	0	0	0	0	0	0

Other Violations

	Commercial Vehicle			Non-Commercial Vehicle		
	Citations	Warnings	Total	Citations	Warnings	Total
Seatbelt Violation	0	0	0	0	0	0
No Insurance	0	0	0	0	0	0
DL Violation	0	0	0	0	0	0
Improper Passing	0	0	0	0	0	0
Other Traffic Violations	0	0	0	0	0	0
Total	0	0	0	0	0	0

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3.2 Problem Identification Methods and Examples

Problem identification is a normal extension of the planning process. Once the most strategic decisions are made with regard to a project, then problem identification is used to further refine the countermeasures by this data-driven process.

At the highest level, a comparison of the data subset of those crashes involving CMVs against those that do not over all variables will surface the major factors that are over-represented in CMV crashes in general. The following is an example of the results that can be obtained from the performance of this analysis comparing CMV-involved crashes in general (i.e., independent of causation) against crashes that did not involve CMV crashes in Alabama during the 3.65 year time period of 2008 to 2011 (current through partial August):

- CMVs are involved in about 8,000 crashes per year, which is about 6.5% of all motor vehicle crashes.
- Less than 5% of CMVs carry hazardous cargo.
- The most over-represented primary contributing circumstances with regard to the potential for total crash reductions are ranked as follows (worst first): improper lane change or use, cargo fell or load shift, defective equipment, unseen object/person/vehicle, improper turn, improper backing, improper passing, and crossed the center line.
- The least over-represented primary contributing circumstances with regard to the potential for total crash reductions are ranked as follows (best first, that is, the most under-represented in CMV involved crashes): following too close, misjudge stopping distance, driver not in control, failed to yield right of way, DUI, over the speed limit, driving too fast for conditions, and failure to obey signs/signals.
- The causal driver was male in about 38% more cases CMV involved crashes than crashes that did not involve CMVs.
- The most over-represented causal driver age was 47, and the range of 33-69 years of age was generally over-represented (causal driver her could be of the CMV or a private vehicle if the crash involved two vehicles).
- The most over-represented roadway classification was Interstates, without about 21% of all crashes (as opposed to about 8% for crashes in general). Federal routes were slightly over-represented; state routes were about as expected, and county roads and city streets were under-represented.
- All hours from 5:00 AM through 3:00 PM were over-represented. Although slightly under-represented, the 3:00-3:59 PM hour had the highest frequency of CMV involved crashes, but they dropped off very quickly after that.
- The most over-represented “causal unit maneuvers” were (worst first): changing lanes, turning right, passing and merging.
- The most over-represented “cities” (rural areas of a county are worked int0 the comparison as virtual cities) were: Rural Tuscaloosa, Birmingham, Rural St. Clair, Rural

Jefferson (the county of Birmingham), followed by the rural areas of Cleburne, Sumter, Montgomery, Morgan Escambia, Cullman counties.

- Sideswipe and side impact were over-represented by at least three times their expected proportions.
- The overwhelming first harmful event was "collision with vehicle in traffic, which accounted for over 73% of the crashes. Collisions that involved running off the road were the most under-represented.
- Similarly, 78% of the CMV involved crashes were "On the Roadway" as far as the first harmful event is concerned.
- The most over-represented model years for the causal vehicles were 2005-2007.
- Four and six lane roadways were over-represented by about 18% and 34%, respectively, with all other numbers of lanes being under-represented.
- Multiple-vehicle crashes accounted for about 85% of the crashes, with two vehicle crashes being about 79%.
- About 63% of the CMV crashes did not require a vehicle to be towed as opposed to about 56% for crashes in general.
- Due to the rural nature of many of these crashes, police arrival delay was over-represented in all categories above 21 minutes from the time of the crash.
- A third of the CMV involved crashes were classified as rural, which is about 30% more than what is seen in crashes in general.
- Weather was indicted to play a part in only about 2.0% of the CMV involved crashes as opposed to 2.7% of crashes in general. Only about 9% of the CMV involved crashes occurred in the rain, as opposed to almost 13% for crashes in general.
- Work zones were involved in less than 10% of the CMV involved crashes, although this was about three times that found in the general crash population.
- The roadway junction features that were most over-represented were bridge/overpass and entrance/exit ramps.
- CMV involved crashes were over-represented in virtually all of the vehicle defect categories.
- Citations were issues in only about 10% of CMV involved crashes.
- CMV involved crashes had over twice the fatal injuries as other crashes; however, all of the other injury classifications were significantly under-represented.
- DUI played a factor in only about 2% of CMV involved crashes, which was less than half of what was recorded for other crash types, according to the officers' opinions.
- Fatigue and sleep were not recorded to be significantly different from that found in the general population of crashes.

Note once again, the results above are for all crashes involving CMVs without regard to which vehicle may have caused the crash if the crash involved a CMV and a car.

Examples of other comparisons to provide results as those listed above would be to compare the following: (1) those that involve a car and a truck and compare this subset against all other two-vehicle crashes; (2) those CMV-related two vehicle crashes that are caused by CMVs compared to CMV-related two vehicle crashes that are not caused by CMVs; and (3) those CMV-related two vehicle crashes that are caused by non-CMVs compared to non-CMV-related two vehicle crashes (obviously caused by the car driver since it does not involve a CMV). There are several others, and as they are tried certain patterns will emerge that is fairly common to most of them.

CARE is set up to do these types of analyses using its IMPACT module. See (25) and (26) for information on basic problem identification techniques. These techniques are supported by other statistical processing packages as well. Some specific findings are exemplified in the sections below in which the problem identification examples are divided into: (1) location hotspot analysis, which is mandatory for all TACT projects, and (2) supplementary problem identification, which would only apply to projects that are further targeted on a particular crash type. In addition, the following supplementary problem identification examples will be addressed:

- Causal driver age,
- Point of initial impact,
- Time of day, and
- Day of the week.

These will be covered in Section 3.2.2.

3.2.1 Site Selection – Hotspot Analysis

The word *hotspot* is used to refer to locations that are found from analytical techniques to be most fruitful for TACT intervention. Hotspots are determined from crash analysis techniques to be a segment of roadway that have significantly more than their expected number of the type of crashes that would generally be anticipated for that roadway classification and area. There are many techniques that could be employed to determine hotspots, and it is recommended that the various alternative techniques be explored in the literature. The following presents some of the most-frequently used criteria:

- Crash frequency – by far the simplest and most understood approach, the assumption being that the recent history (generally three years) of high-crash concentrations would predict the immediate future of where these crashes would continue to recur without intervention. It is suggested that unless there is some definitive reason that this assumption is in error, it should be given strong consideration, along with the severity consideration given in the next bullet. The number of locations that can be funded under the program is determined, and then those locations with the largest crash frequencies are chosen for treatment unless there is some mitigating reason to make an exception. A

"location" is a segment (e.g., a five or even ten-mile stretch) covered by the selective enforcement effort. Compromises should be made if there is not an obvious break point, i.e., locations should not be eliminated just because they do not make, for example, the top ten of the list. When it comes to selective enforcement interventions, there is no reason that several locations that fall toward the bottom of the most critical list could not be worked. Adjustments can be made in the "high crash" criteria until a reasonable number of locations are obtained.

- Crash frequency by severity – when a large enough number of crashes occur at the potential candidate locations, consideration can be restricted to a higher severity classification (usually all injury and fatal crashes). This targets the severity of crashes most apt to produce fatalities, and can actually be a better predictor of fatality locations in the future than the relatively few past fatality locations. "All injury crashes" is certainly a much better predictor of fatality crashes that all crashes regardless of severity. For example, it will be noticed immediately that hotspots that are based on all crashes are clustered in the urban areas where the severity of crashes is generally low. On the other hand, it is not recommended that just fatality frequency or number of fatalities be used as a criterion in that the locations of these crashes are highly subject to chance as opposed to the causes that the TACT program is attempting to mitigate. Any of the methods below can be qualified on severity merely by running the corresponding hotspot analyses restricted to subsets of data that only contain crashes of the severity of interest.
- Empirical Bayes – the argument for adding this element to the screening analysis is that frequency alone (regardless of the severity subset) can lead to locations where the large number of crashes is an anomaly that will be mitigated without intervention due to regression to the mean. The projected savings is thus adjusted so that only a portion of the total crashes at a given location are considered as the potential for savings. This method is not recommended under the following circumstances: (1) when the frequency at a given location is obviously stable, perhaps measured by the variance on a quarterly basis; i.e., if there have not any significant variations in the quarterly readings over the past 36 months (or 12 quarters), then the chances of the frequency being an "outlier" is extremely low; or (2) when the computations that include Empirical Bayes adjustments are obviously going to produce the same adjustment effect (proportionately speaking) for all locations considered. Adjusting all estimates by a constant will not change the locations that will ultimately be chosen for treatment, and so the more complex analysis is not justified.
- Pure rate approach. This would identify a hotspot to be where a given threshold of crash rate (as opposed to crash frequency) is high. Since average ADTs are available for most routes with heavy CMV concentrations, a rate can easily be obtained for all five or ten mile segments. A simple selection of those at the top of the rate sort would determine the locations for the enforcement. The reasoning behind this approach is that over time a certain number of crashes are expected of a given ADT just because of the sheer

numbers of vehicles (in this case CMV-car combinations) on the segment. Thus, the "most dangerous" should be surfaced by the rate, and thus performing selective enforcement on these routes would produce the greatest reductions. While the major premise in this reasoning is quite true (generally, most of the variation of crashes between locations can be accounted for by the variation in the ADT), the conclusion reached as far as total TACT impact is generally not valid. In many cases the pure rate approach will move resources from the most heavily traveled roadways to those that have very few crashes. Truism: *It is impossible to reduce more crashes from a given segment than the number of crashes that will occur there without the intervention.* The result of the pure rate approach can be to apply resources to a very few crashes due to a few mishaps that may have nothing to do with what the enforcement program is designed to control. This is not to negate the value of rates in determining potentially hazardous situations. For example, if both the rate and the frequency of crashes are high, then the location would certainly be a primary target for TACT enforcement efforts. Rates, then, provide an additional metric that help to determine if a given segment should receive consideration.

- Frequency/Quality Control. This approach uses frequencies but it takes an average and a standard deviation of them over the applicable portion of the roadway (e.g., rural Interstate roads). It then runs the high-crash software over these roadways and seeks out any that are greater than a certain number of standard deviation units from the average. Since the number of standard deviation units from the mean can be used to quantify the probability, this would seem to be an approach superior to using frequencies alone. For example, a crash count over two standard deviation units from the mean (the average taken over this and similar roadways) will occur no more than 5% of the time. This approach may not return too many locations than were found in the pure frequency method. However, it does enable a quantified approach for comparing locations that are in different category of the roadway system as long as a different mean and standard deviation is determine for each of the categories.
- Rate/Quality Control approaches. This uses the rate as opposed to the frequency in a similar approach to that discussed immediately above.
- Combinations of the above. It is strongly recommended that consideration be given to more than one of the techniques above, and that a comparison of these techniques take place to see if the more complex methods are justified. For example, while rates have the downside give above, they are extremely useful in surfacing potential problem areas. A rule might be derived that a hotspot will consist of all locations above a given rate that have at least a given crash count. As such, the benefit of the different methods can be obtained without incurring any of their deficiencies. Of course, none of these rules or methods can replace good common sense when it comes to the ultimate selection of a location, and it is highly recommended that experienced officers be involved in the selection of locations using the selected quantitative tool as a guide.

Analysts are urged to use the technique that is a combination of most accurate and that which can be understood and accepted within the culture of their organization. They should also realize that some locations might be difficult or infeasible to patrol, and that some might be so costly that they will drain resources from obtaining better crash reductions that what would be expected from a more balanced approach. For the remainder of this document the term "hotspots" will refer to locations determined to be those that have the greatest potential for crash reductions when all of these factors are considered to the extent possible.

3.2.1.1 Example from Alabama's First TACT Project

The first TACT program applied in Alabama involved virtually all of the DPS patrol force as well as several CMV-qualified agencies all implementing the program simultaneously and generally throughout the state. TACT hotspots for this project were identified for all urban and rural mileposted roadways in Alabama using 2006-2008 calendar year data. In this case the analysis was restricted to (1) past CMV crashes, i.e., those involving one or more CMVs, and (2) locations where one or more of the primary contributing circumstances given in Section 1.3.1 occurred with high frequency. This led to two lists being created that were reported out separately. Any locations that were common to both lists would indicate that the area had both a CMV crash problem and crash problems that were caused by the TACT-emphasis primary contributing circumstances. Generally those locations common to both lists were considered to be the hotspots.

Since the program was to be implemented statewide, hotspots were identified per DPS post and per county. A sliding window hotspot identification technique was developed within CARE to locate road segments with crash counts above a given threshold. In order to distribute the effort statewide, the crash count threshold was varied to assure that all trooper posts would be involved in the program. For example, road segments in a given rural county may have qualified if there were 4 crashes on a 3 mile road segment, while a more populated county may have required 7 crashes per 1 mile road segment. Hotspots were also identified for the participating municipalities for roadways in their jurisdiction. If it were, for some reason, impossible to re-allocate resources among the posts, then the method applied above would produce as good a state-wide result as could be expected. However, it is clear that if resources could be re-allocated from one post to another, then it would be best to apply statewide optimization criteria. Each state might have differing constraints in this regard.

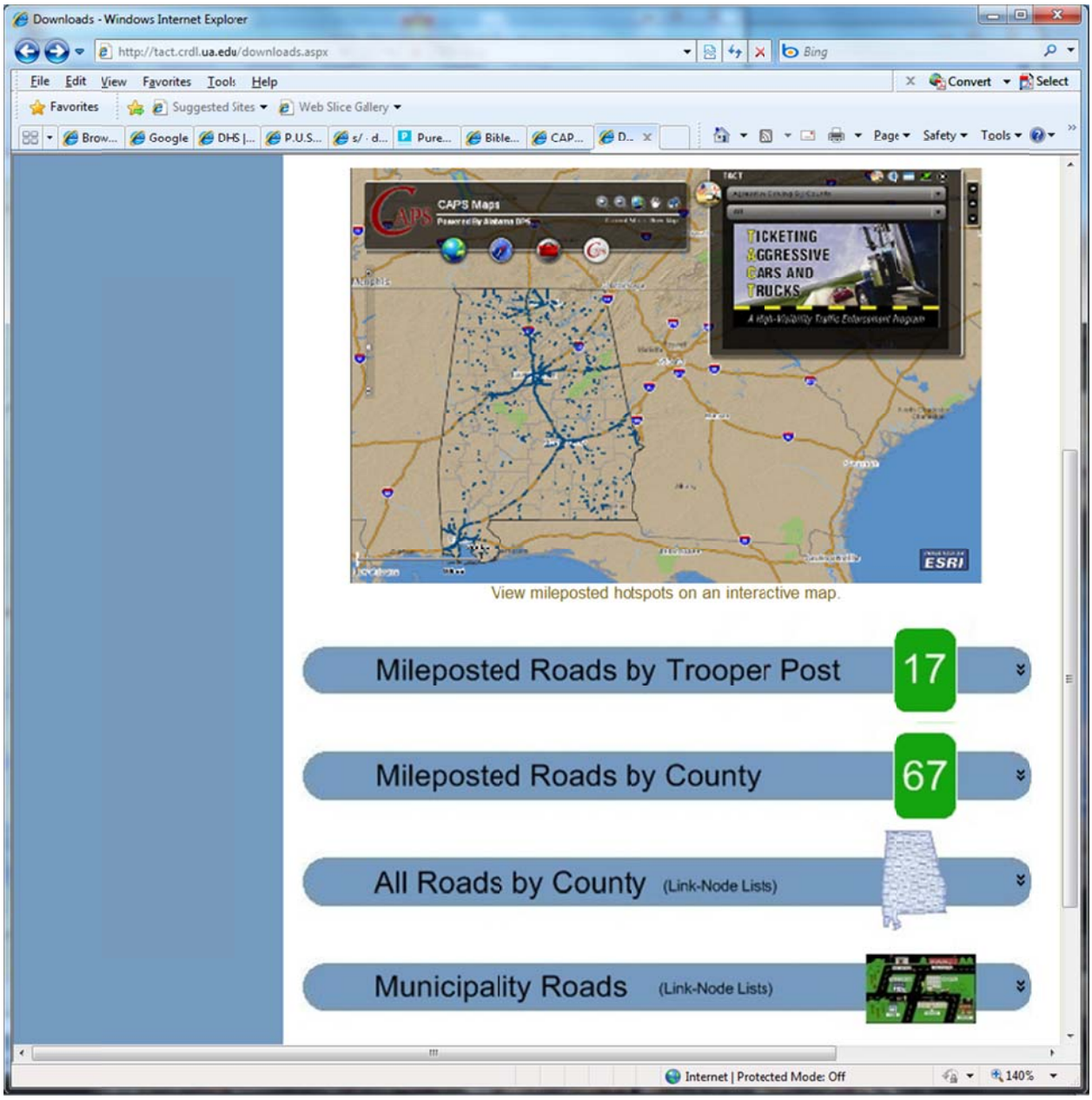
Display 3.2.1 presents the overall categorization for the hotspot results. The button under the map labeled "View mileposted hotspots on an interactive map" leads to a number of tools made available to the officers that will be discussed in Section 3.2.3. Each of the following buttons leads to the drop-down menu that lists hotspot output options:

- Mileposted Roads by Trooper Post – these are Interstate, state and federal roads that have mileposts installed, and to date, this provides the best referencing system in the state.

They are organized by trooper post to assist troopers who will generally operate within the geographical area served by their respective posts.

- Mileposted Roads by County – this lists the output options identically to that given above, but by county rather than trooper post, which are groupings of counties.
- All Roads by County (Link-Node Lists) – this includes the roadways that are not mileposted. Hotspots are determined by a different algorithm. CARE outputs the nodes (mostly intersections) and the links (defined by two nodes) in an ordering of maximum crashes at the top. This enables officers to view those nodes and links that have the greatest crash activity. The traffic record contains link-node information on many crashes that occur on mileposted roads. If so, CARE will process these crashes both by mileposted techniques and by link-node in order to generate the maximum amount of information for the officers.
- Municipal Roads (Link-Node Lists) – this is identical to that described immediately above with the exception that the lists are organized by municipality as opposed to county.

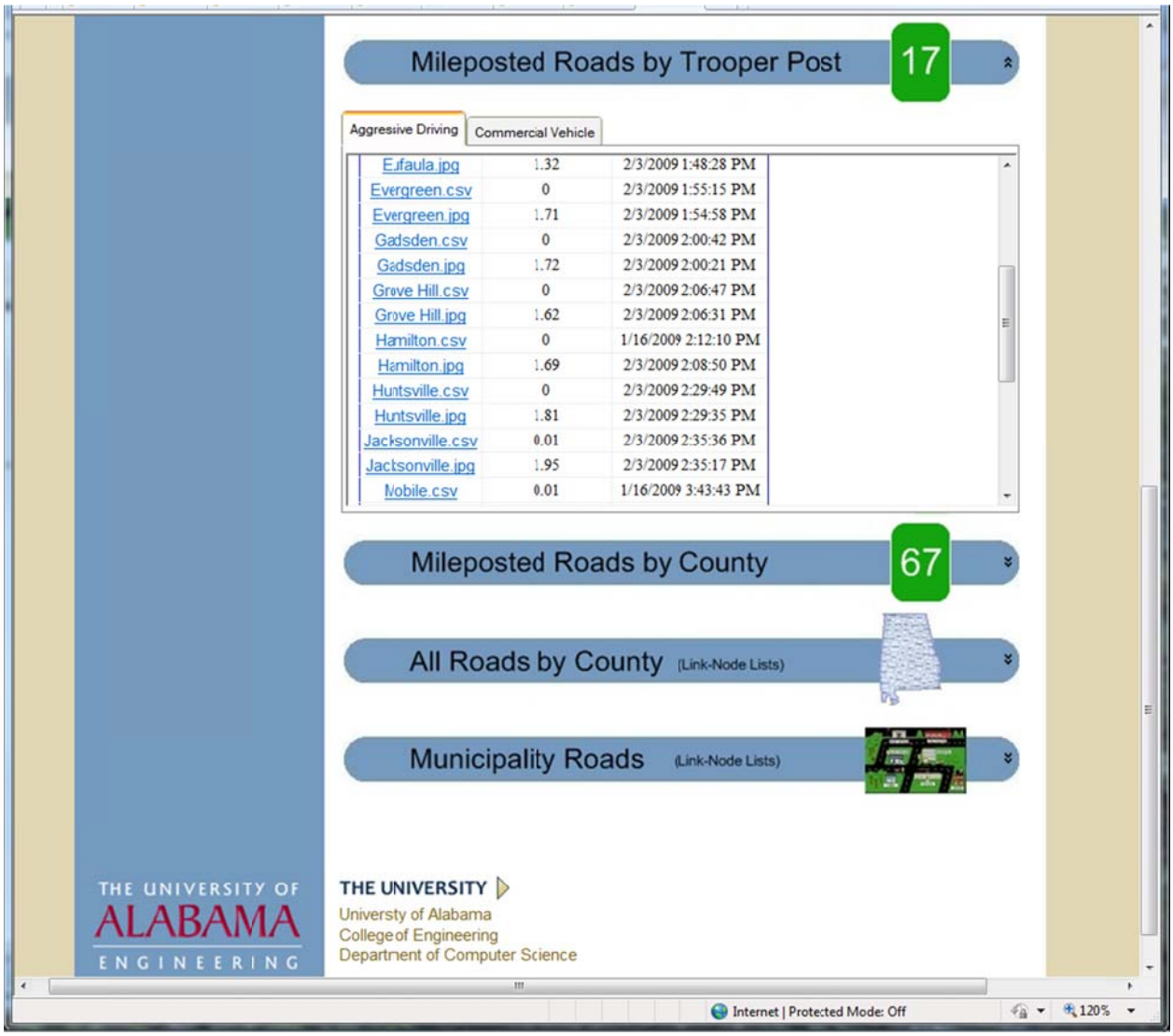
Display 3.2.1 Example Hotspot Report Selection Page



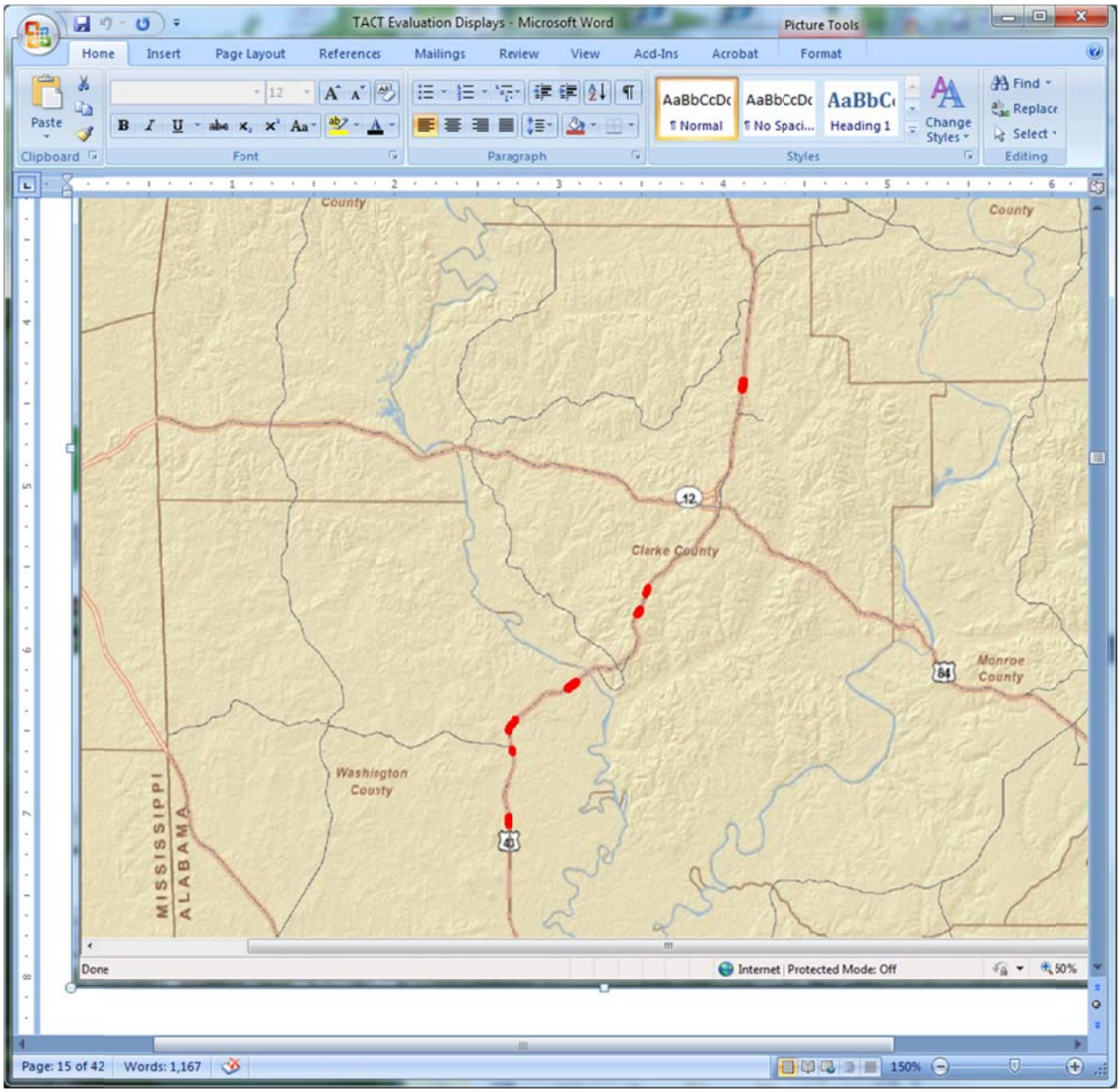
Within each of the dropdowns there are two output types – a map and a listing – both showing the hotspots that were found for the various jurisdictions. Display 3.2.1a illustrates this for the trooper post drop-down. Users can scroll to any of the 17 trooper posts. At that point there are two possible selections. The jpg download is a map of the hotspots, while the csv download is a listing of those same locations. Note also the tabs. The one opened in Display 3.2.1a is for the Aggressive Driving offenses (contributing circumstances), while the Commercial Vehicle tab would provide hotspot information based on the numbers of CMV-involved crashes. The drop-

downs for the other categories operate in the same way. Display 3.2.1b gives a typical example of a map view that is produced by downloading one of the jpg files, while Display 3.2.1c illustrates a tabular output.

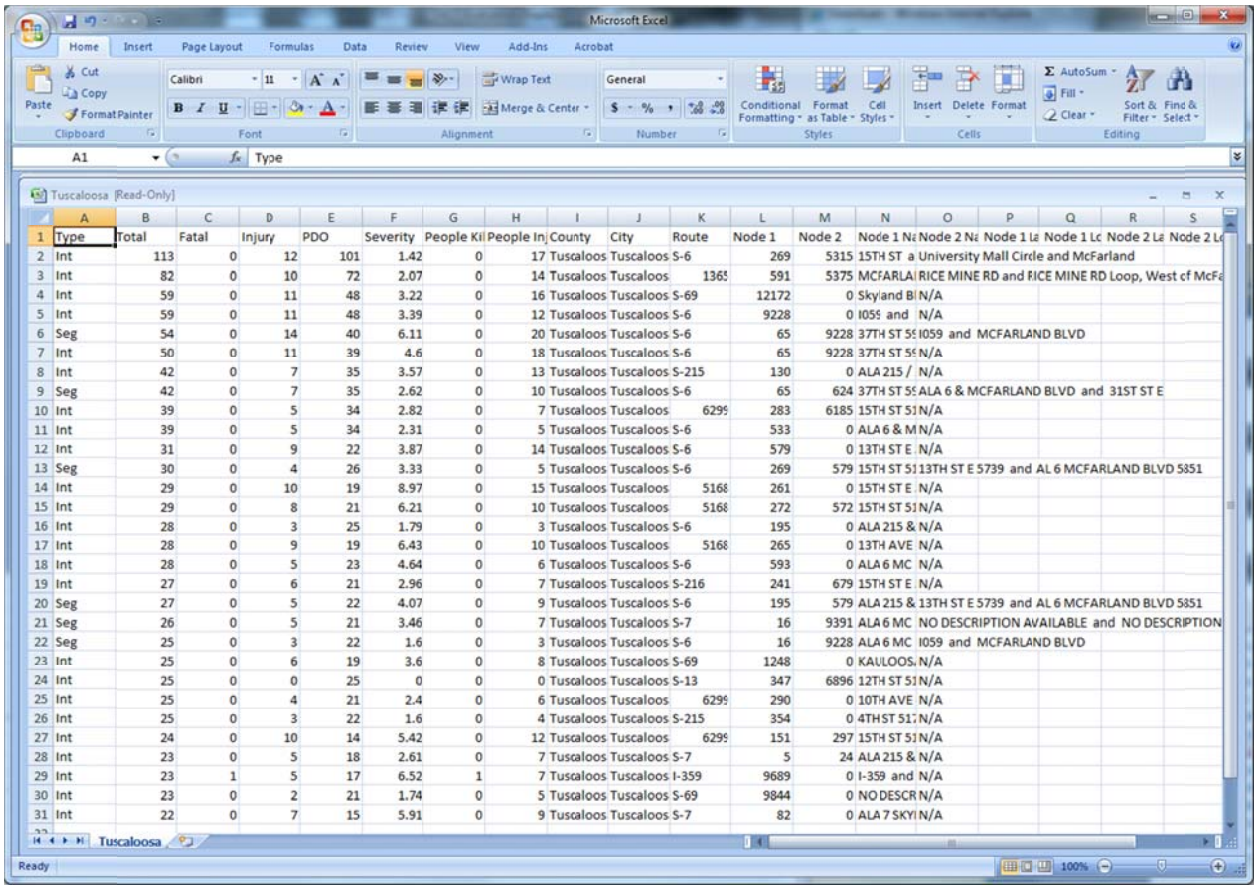
Display 3.2.1a Example Drop-Down for Mileposted Roads by Trooper Post



Display 3.2.1b Example Hotspot Map Output



Display 3.2.1c Example Hotspot Table Listing



Tuscaloosa [Read-Only]

Type	Total	Fatal	Injury	PDO	Severity	People Ki	People In	County	City	Route	Node 1	Node 2	Node 1 Na	Node 2 Na	Node 1 La	Node 1 Lc	Node 2 La	Node 2 Lc
Int	113	0	12	101	1.42	0	17	Tuscaloos	Tuscaloos	S-6	269	5315	15TH ST a	University Mall Circle and McFarland				
Int	82	0	10	72	2.07	0	14	Tuscaloos	Tuscaloos	136	591	5375	MCFARLA	RICE MINE RD and RICE MINE RD Loop, West of McFa				
Int	59	0	11	48	3.22	0	16	Tuscaloos	Tuscaloos	S-69	12172	0	Sky and B	N/A				
Int	59	0	11	48	3.39	0	12	Tuscaloos	Tuscaloos	S-6	9228	0	I059 and	N/A				
Seg	54	0	14	40	6.11	0	20	Tuscaloos	Tuscaloos	S-6	65	9228	37TH ST 59	I059 and MCFARLAND BLVD				
Int	50	0	11	39	4.6	0	18	Tuscaloos	Tuscaloos	S-6	65	9228	37TH ST 59	N/A				
Int	42	0	7	35	3.57	0	13	Tuscaloos	Tuscaloos	S-215	130	0	ALA 215 /	N/A				
Seg	42	0	7	35	2.62	0	10	Tuscaloos	Tuscaloos	S-6	65	624	37TH ST 59	ALA 6 & MCFARLAND BLVD and 31ST ST E				
Int	39	0	5	34	2.82	0	7	Tuscaloos	Tuscaloos	629	283	6185	15TH ST 51	N/A				
Int	39	0	5	34	2.31	0	5	Tuscaloos	Tuscaloos	S-6	533	0	ALA 6 & M	N/A				
Int	31	0	9	22	3.87	0	14	Tuscaloos	Tuscaloos	S-6	579	0	13TH ST E	N/A				
Seg	30	0	4	26	3.33	0	5	Tuscaloos	Tuscaloos	S-6	269	579	15TH ST 51	13TH ST E 5739 and AL 6 MCFARLAND BLVD 5851				
Int	29	0	10	19	8.97	0	15	Tuscaloos	Tuscaloos	516	261	0	15TH ST E	N/A				
Int	29	0	8	21	6.21	0	10	Tuscaloos	Tuscaloos	516	272	572	15TH ST 51	N/A				
Int	28	0	3	25	1.79	0	3	Tuscaloos	Tuscaloos	S-6	195	0	ALA 215 &	N/A				
Int	28	0	9	19	6.43	0	10	Tuscaloos	Tuscaloos	516	265	0	13TH AVE	N/A				
Int	28	0	5	23	4.64	0	6	Tuscaloos	Tuscaloos	S-6	593	0	ALA 6 MC	N/A				
Int	27	0	6	21	2.96	0	7	Tuscaloos	Tuscaloos	S-216	241	679	15TH ST E	N/A				
Seg	27	0	5	22	4.07	0	9	Tuscaloos	Tuscaloos	S-6	195	579	ALA 215 &	13TH ST E 5739 and AL 6 MCFARLAND BLVD 5851				
Seg	26	0	5	21	3.46	0	7	Tuscaloos	Tuscaloos	S-7	16	9391	ALA 6 MC	NO DESCRIPTION AVAILABLE and NO DESCRIPTION				
Seg	25	0	3	22	1.6	0	3	Tuscaloos	Tuscaloos	S-6	16	9228	ALA 6 MC	I059 and MCFARLAND BLVD				
Int	25	0	6	19	3.6	0	8	Tuscaloos	Tuscaloos	S-69	1248	0	KAULOOS.	N/A				
Int	25	0	0	25	0	0	0	Tuscaloos	Tuscaloos	S-13	347	6896	12TH ST 51	N/A				
Int	25	0	4	21	2.4	0	6	Tuscaloos	Tuscaloos	629	290	0	10TH AVE	N/A				
Int	25	0	3	22	1.6	0	4	Tuscaloos	Tuscaloos	S-215	354	0	4TH ST 51	N/A				
Int	24	0	10	14	5.42	0	12	Tuscaloos	Tuscaloos	629	151	297	15TH ST 51	N/A				
Int	23	0	5	18	2.61	0	7	Tuscaloos	Tuscaloos	S-7	5	24	ALA 215 &	N/A				
Int	23	1	5	17	6.52	1	7	Tuscaloos	Tuscaloos	I-359	9689	0	I-359 and	N/A				
Int	23	0	2	21	1.74	0	5	Tuscaloos	Tuscaloos	S-69	9844	0	NO DESCR	N/A				
Int	22	0	7	15	5.91	0	9	Tuscaloos	Tuscaloos	S-7	82	0	ALA 7 SKY	N/A				

3.2.1.2 Example from Alabama's June 2011 TACT Project

The recent TACT implementation in Alabama was one in which resources were quite limited compared to the original TACT program. Because of assignments to areas struck by recent tornados, only a very small force of officers could be made available. This enabled the project to exemplify projects of both the largest possible statewide coverage (illustrated above), to the smallest localized effort. The smaller effort required resources to be much more focused both in location and in the drivers targeted (i.e., in this example, the younger causal driver). Resources that were anticipate to be available over the fiscal year would support two or perhaps three waves of combined selective enforcement and PI&E with a limited number of patrol officers. The planning below reflects this anticipation.

3.2.1.2.1 Hotspot Analysis

Most states have the capability to find high crash locations across their state and Interstate systems, which often coincides with roadway segments with the heaviest truck traffic. As a first rough cut it was decided to run the high crash program using the Alabama CARE program with the segment length set to 20 miles, and to capture locations with three or more CMV crashes caused by young (16-20 year old) drivers from 3+ years of data starting in January of 2007 through most of July 2010 and about a third of August 2010. The sample was further limited to Interstate highways because these had the highest number of these types of crashes, and thus the highest potential for mitigating the problem. The filter applied to create the subset of crashes of interest was as follows: Young Causal Driver AND CMV Involved AND Interstate. A comparable run on all state and Federal highways confirmed that there were no qualified hotspots similar to those found on the Interstate highways.

The resulting list of segments is given in Display 3.2.1d. Note that the route is given in the third column, and the milepost (MP) endpoints on that route are given in the next two columns. The crash counts are given by severity next (Total Crashes, Fatal, and Injury). Finally, to get a feel for the crash rate, the Million Vehicle Miles (MVM) and the crashes per billion vehicles miles (C/BVM) are given for each 20-mile segment. Again, crashes here are those involving CMVs that were caused by 16 to 20 year old drivers over the most recent 3+ year time span of data available in Alabama at the time of the analysis that was done for planning purposes. Only locations with three or more crashes over this time span are listed. Severity did not enter into this comparison since the severity of car-truck crashes on Interstate highways is fairly stable and not location dependent.

SEE PART 2