

# Modeling Truck Traffic Volume Growth Congestion

By

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University Transportation Center for Alabama  
The University of Alabama, The University of Alabama at Birmingham, and  
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<b>16.Abstract</b>  Modeling of the statewide transportation system is an important element in understanding issues and programming of funds to thwart potential congestion. As Alabama grows its manufacturing economy, the number of heavy vehicles traversing its highways will continue to rise, straining its already limited infrastructure. This project looks to improve existing modeling tools and develop future forecasts of roadway demand as a means to glimpse the future highway demand and identify locations where the existing level of roadway infrastructure in Alabama would be unable to handle the future demand. This involves modeling future growth scenarios and analyzing the traffic congestion arising from the scenarios. The results from this project include the identification of key congestion chokepoint locations in the existing infrastructure when facing the future demand and the creation of a modeling tool that can be used effectively to examine alternative scenarios in the future.			
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## **Executive Summary**

Correct infrastructure investment decisions results from accurate information identifying the congestion choke points and capacity shortfalls. Additionally, the U.S. economy is dependent on the timely movement of freight. With freight projected to double in the next decade, the strain on the existing infrastructure will only worsen. Therefore, a detailed understanding of the impact of the projected increase in truck traffic on the existing highway system is needed to examine in the potential outcomes and develop a focused plan to accommodate the anticipated increase.

This work develops a linkage between two existing models used to identify choke points and capacity shortfall on the existing roadway infrastructure. The linkage between the two models provides insight into the potential congestion that is not evident using either model independently. The distribution model is vital to allocate freight movements and identify locations where daily volume to capacity ratios exceed existing thresholds and the simulation model is vital to identify locations where hourly travel times drop to an unacceptable level for freight operations and economic viability.

This effort identifies trouble locations and is intended to assist in decision-makers struggling to improve the highway system and respond to traveler and freight needs, in an environment of limited resources.

## **Section 1.0 Introduction**

The ability to make reasonable decisions regarding transportation investment is limited by the quality and quantity of information available on the transportation infrastructure. The ability to accurately model transportation infrastructure, identify congestion choke points, and define needed capacity shortfalls is vital to the planning decision-making needs on transportation systems for both people and goods. The movement of freight in a timely and efficient manner is quickly becoming one of the critical components of the U.S. economy. Heavy vehicles, 18-wheel trucks, are the backbone of the logistics and economic success of industry in the United States. National projections are that freight shipments will double in the next ten years. The increase in freight will have a significant impact on the level of congestion along the national transportation infrastructure and will require innovative congestion mitigation solutions. A detailed understanding of the impact of the projected increase in truck traffic on the existing highway system is needed to examine in the potential outcomes and develop a focused plan to accommodate the anticipated increase.

This project will build upon existing transportation analysis and planning tools developed at The University of Alabama in Huntsville (UAH) under a grant from the U. S. Department of Transportation (USDOT) to develop a model to examine statewide freight transportation. The first of these tools is the Alabama Transportation Infrastructure Model (ATIM). The ATIM is an analytical tool that utilizes discrete-event simulation to model traffic flows over multiple 24-hour periods. The ATIM is able to incorporate the random variation inherent in transportation systems with the raw traffic data collected by government, industry, and academic entities. This random variation is visible in the complex interactions of freight movement across the transportation infrastructure network and through intermodal transfer points. Freight traffic and passenger automobile traffic are independently calculated, and combined, to simulate overall traffic flows on the roadways. Railway and waterway transportation systems are also modeled to show the dynamics between the multiple shipping modes. The second tool is a statewide highway, rail, and waterway network developed in TRANPLAN, a generally accepted travel demand model, which has been enhanced to support a statewide freight analysis. The research effort conducted in this project will develop a seamless interface between the two models to allow for easy sharing of volume, route and origin/destination data. The integration of these models will produce a tool capable of quickly analyzing scenarios and events on the transportation infrastructure that can be used to evaluate alternative solutions.

Included in this project will be an analysis of the increase in truck traffic to ensure that the growth model is realistic, not just increasing the number of trucks in each county evenly or simply based on historical trends. The analysis performed will include a focus on the impact of increasing trucks on pavement infrastructure, congestion, mobility, and safety.

Specific tasks in this project are listed as follows:

1. Update the TRANPLAN and ATIM models to the current traffic data and infrastructure networks.
2. Use Alabama Department of Transportation (ALDOT) traffic counts for validation of the model to current conditions.
3. Develop a list of feasible economic scenarios to run as projections through the ATIM.
4. Design and implement a seamless interface between TRANPLAN and ATIM.
5. Run the ATIM to generate the impact of increasing truck traffic.
6. Analyze the output and develop conclusions.

There are significant project benefits to be obtained from the successful completion of this work. First, a comprehension of the congestion expected to occur on the highways in Alabama is important to understanding the steps necessary to implement to mitigate future issues. Second, the improvement and continued work on the transportation analysis and planning tools themselves will establish the modeling approach and system knowledge developed as a major contributor in forecasting congestion and highway bottlenecks in the future, not just in Alabama but with the ability to extend the knowledge to other states facing similar problems and issues. The more accurate planning data from new freight planning methods will significantly improve the ability to plan for transportation infrastructure solutions. This access to better data will be fully realized through the application of simulation and modeling tools to evaluate how the transportation flows react over time. The integrated TRANPLAN and Alabama Transportation Infrastructure Model (ATIM) will add significant capability in the analysis of proposed transportation solutions.



## Section 2.0 Background

### Updating the TRANPLAN and ATIM Networks

To start the process of modeling the future truck growth using the two software packages in unison, the two highway networks needed to be amended to be reflective of each other. The differences in the networks was based on the fact that they were developed at different times and, with the varied operations of the software packages, there were discrepancies that were initially entered to benefit each package.

The TRANPLAN model was the network that required updating as it was used for distributing the freight flow while the ATIM network was used to routing purposes. The original ATIM network included almost 4,000 miles of roadway in Alabama (3,960 miles). The original TRANPLAN network was only 3,114 miles, as shown in Figure 2-1.

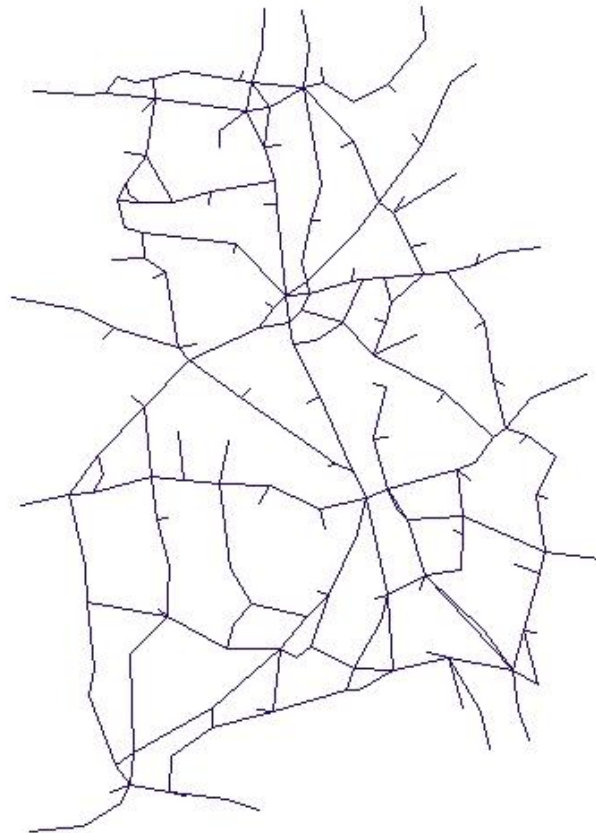
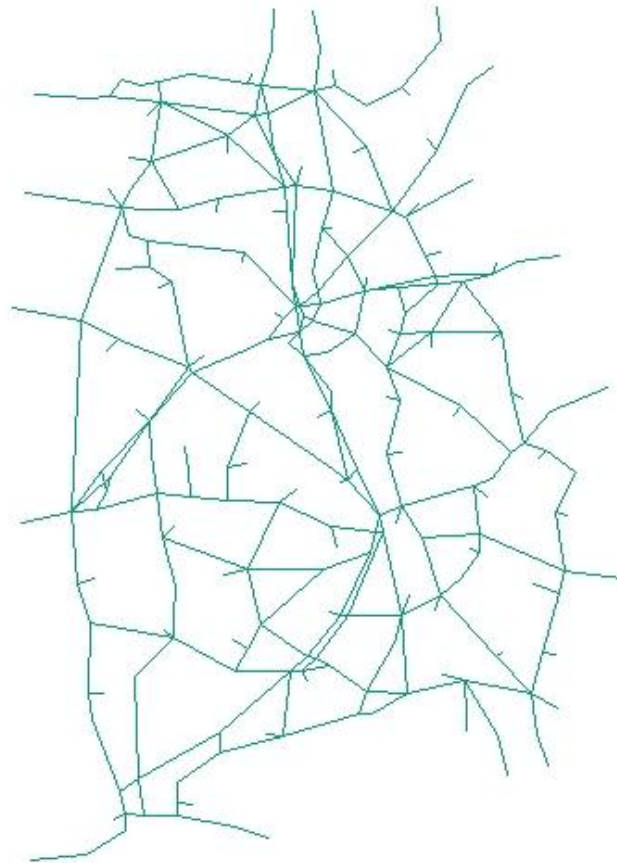


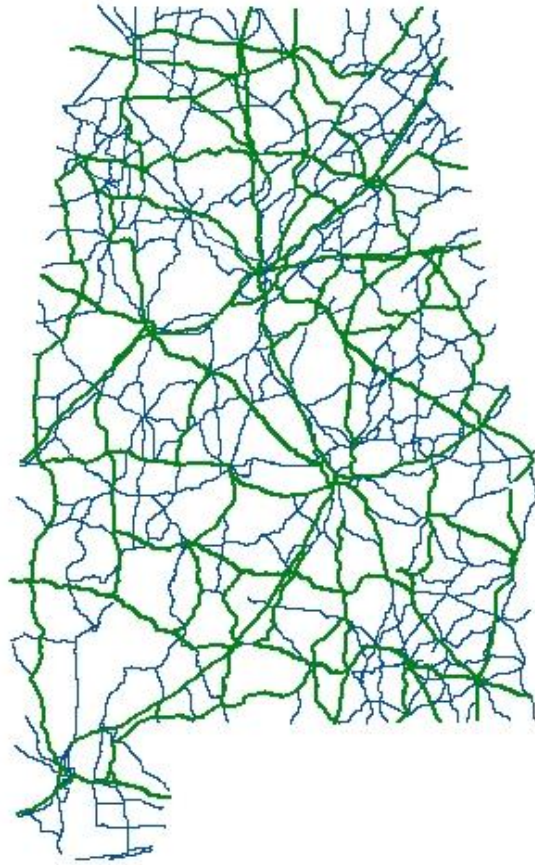
Figure 2-1. Original TRANPLAN network.

A careful process was undertaken to match roadways from the ATIM network to roadways in the original TRANPLAN network to ensure that the two networks were similar. This step was done manually with each roadway being correctly coded in the TRANPLAN environment. Upon completion, the TRANPLAN network contained the roughly 4,000 miles that the ATIM model contained, as shown in Figure 2-2. The actual roadway distances were not exact as the ATIM model allows links to follow the specific curvature of the roadway, while TRANPLAN is easier to work with when using straight line segments for the roadways, but the matching of the two networks was paramount to the process.



**Figure 2-2. Modified TRANPLAN network.**

After updating the TRANPLAN network, a process was developed to link the TRANPLAN network roadways to the roadways contained in data provided by the Alabama Department of Transportation (ALDOT). By completing this step, the roadways could be easily identified and the official data values such as capacity, lane miles, traffic volume and growth rates could be used for further analysis. Figure 2-3 shown the network overlaid with the entire ALDOT roadway file.



**Figure 2-3. Modified TRANPLAN linked to ALDOT roadways.**

## Section 3.0 Methodology

### Model Validation

The use of freight data in transportation modeling requires confidence in the data being used for decision making. The method in transportation planning activities to gain confidence in the data is through a verification process, essentially, determining how well the freight data developed from the model matches the freight data observed through actual traffic counts. To perform this validation, a complete model for freight data was needed to generate freight at the county level, distribute freight between counties and assign freight to expected roadways in Alabama to determine if the assignment met closely with the actual volumes. Only after this preliminary validation of the freight volume, could the model be trusted to provide accurate future volumes when the various scenarios were developed.

The procedure developed that resulted in a model assignment of trucks on the roadway has been named the Freight Planning Framework. This procedure, shown in Figure 3-1, takes the Freight Analysis Framework, Version 2 database and follows a systematic process of converting the raw freight data into roadway volumes. As can be seen from the figure, the key components to the process are the freight data used and the factors for disaggregation.

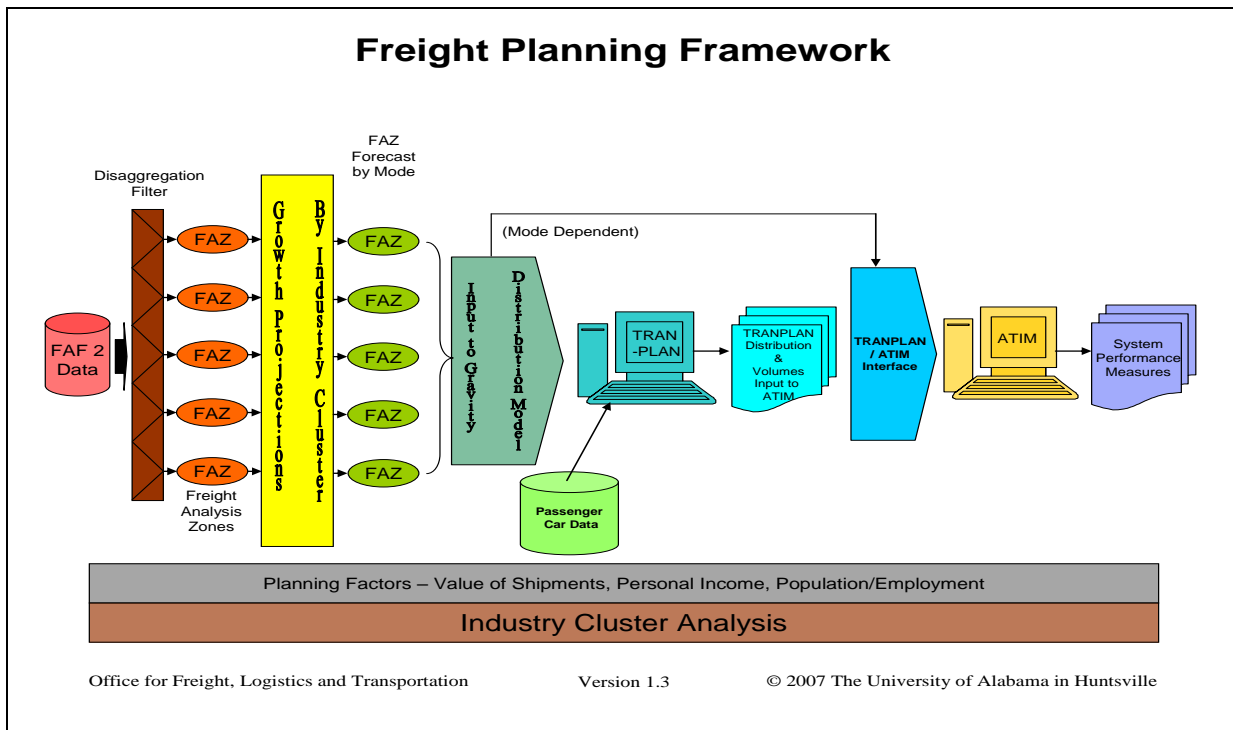
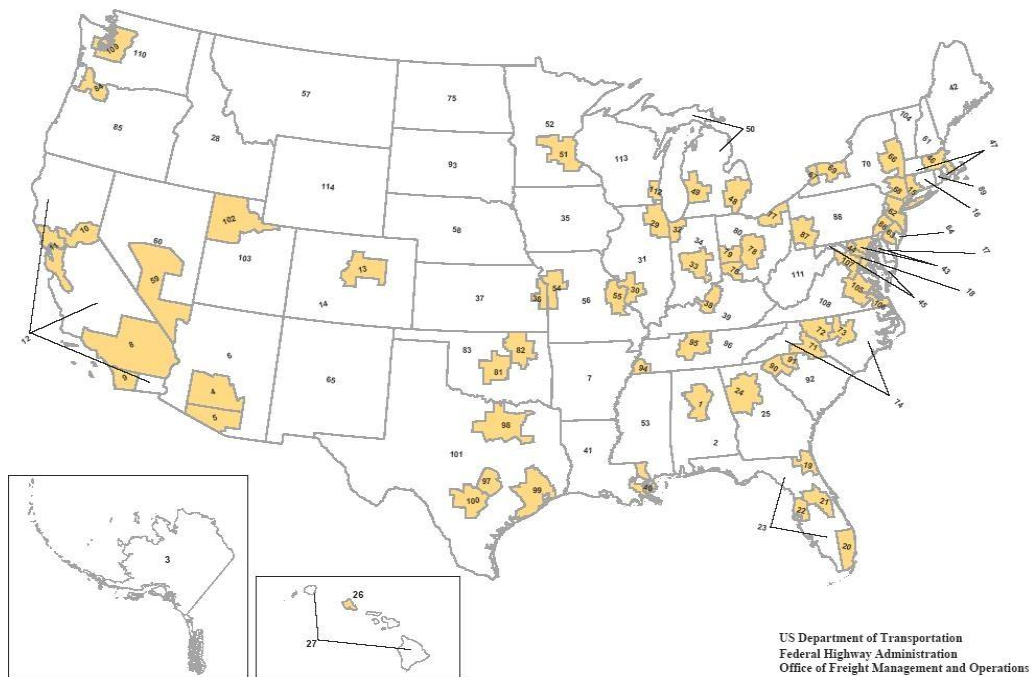


Figure 3-1. Freight Planning Framework.

The freight data were obtained from the second generation of the Freight Analysis Framework (FAF2). The FAF2 is a continuation of the original Freight Analysis Framework developed by the Federal Highway Administration (FHWA) of the U. S. Department of Transportation. Whereas the original FAF provided the public with generalized freight movement and highway congestion maps without disclosing the underlying data, FAF2 provides commodity flow origin-destination (O-D) data and freight movement data on all highways within the FAF2 highway network. The O-D data covers both the base year (2002) and future years between 2010 and 2035 in five-year intervals (FAF2). The Freight Analysis Framework is designed to enable the FHWA to conduct investment and policy analysis and to support legislative activities.

The factors used for the disaggregation of the data were the value of shipments, personal income, population and employment; all based on the ratio of contribution of the county to the total state. Initially, Alabama is included in the FAF2 database as two zones, the Birmingham area, and the rest of Alabama. (See Figure 3-2.) The disaggregation involved examining the statewide contribution of freight (Originating, Terminating, or Passing Through Alabama), then taking the internal to the state and disaggregating to the county level.



**Figure 3-2. Geographic locations for FAF2 data.**  
([http://www.ops.fhwa.dot.gov/freight/freight\\_analysis/faf/cfs\\_faf\\_areas.htm](http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/cfs_faf_areas.htm))

The actual validation was only possible after completing the collection of freight data from the FAF2, disaggregating to the county level, and assigning the freight trips between the 67 counties in Alabama, as well as freight originating, terminating and passing through. The flow of freight

on the Alabama roadways can be displayed graphically, as shown in Figures 3-3 and 3-4, and statistics can be utilized to gauge the level of validation. To statistically measure the difference between the model assignments using the Freight Planning Framework methodology and the actual truck counts, the Nash Sutcliffe (NS) coefficient was employed. The Nash-Sutcliffe value can range from  $-\infty$  to 1. An efficiency of 1 ( $E=1$ ) corresponds to a perfect match of forecasted counts to the ground counts. An efficiency of 0 ( $E=0$ ) indicates that the forecasted values are as accurate as the mean of the ground counts, whereas an efficiency coefficient less than zero ( $-\infty < E < 0$ ) occurs when the forecasted mean is less than the ground values. In other words, this coefficient gives us a measure of scatter variation from the 1:1 slope line of modeled truck counts vs. the ground counts. The more deviation of points from the 1:1 slope line, the lower the coefficient. The greater the NS-value is the better the forecast. It can be calculated using the formula:

$$\text{NS-Coefficient} = 1 - \frac{\sum_1^n (\text{ModeledCounts} - \text{GroundCounts})^2}{\sum_1^n (\text{GroundCounts} - \text{MeanGoundCounts})^2}$$

From the data, the NS-Coefficient was computed to be 0.85. This value indicated that the use of the FAF2 database and the disaggregation parameters outlined in the Freight Planning Framework were able to provide a quality freight forecast, and therefore should provide quality results in future scenarios.

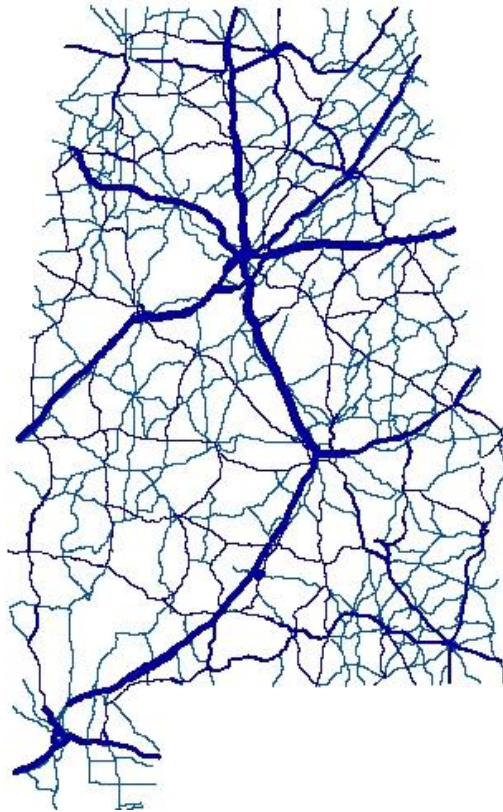


Figure 3-3. Flow of freight from the FAF2 data.

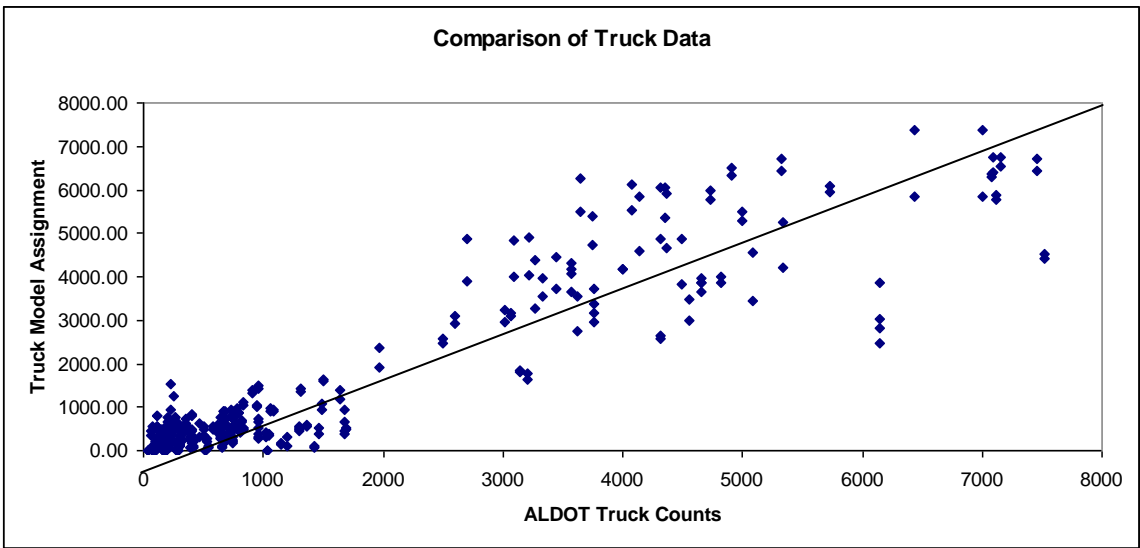


Figure 3-4. Validation of actual truck counts to model truck counts.

## Section 4.0 Project Findings

### Developing a Seamless Interface between TRANPLAN and ATIM

It was desirable to develop a seamless interface to provide a mechanism to pass data from the TRANPLAN into the Alabama Transportation Infrastructure Model (ATIM model). The ATIM model is an analytical tool that utilizes discrete-event simulation to model traffic flows over multiple 24-hour periods. By using discrete-event simulation, the ATIM is able to incorporate the random variation inherent in transportation systems with the raw traffic data. The benefits of having the discrete-event simulation model are the ability to include variation, time of day data and generate performance measures for the transportation infrastructure that are dynamic, including:

- Average speed for road segments in each Alabama DOT traffic zone
- Average congestion level for road segments in ALDOT traffic zones

The ATIM is programmed using ProModel software, interfacing with Excel spreadsheets, which are read into the ATIM as arrays. These arrays supply the simulation with user input data, which includes model settings for establishing batch sizes, vehicle speeds and capacities, passenger car equivalents, and speeds at which the visual graphics change to indicate flow conditions. The list of input options is shown in Table 4-1.

**Table 4-1. General Inputs to ATIM**

<ul style="list-style-type: none"> <li>• graphic batch sizes</li> </ul>	<ul style="list-style-type: none"> <li>• peak time ratio</li> </ul>
<ul style="list-style-type: none"> <li>• vehicle settings               <ul style="list-style-type: none"> <li>○ train, barge, and ship speeds</li> <li>○ barge, ship, train, and truck capacities</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• <math>\alpha</math> and <math>\beta</math> values for the Bureau of Public Roads (BPR) equation</li> </ul>
<ul style="list-style-type: none"> <li>• truck speed calculation intervals</li> </ul>	<ul style="list-style-type: none"> <li>• passenger car equivalence conversion factor</li> </ul>
<ul style="list-style-type: none"> <li>• peak time interval</li> </ul>	<ul style="list-style-type: none"> <li>• threshold speeds for graphics changes</li> </ul>

Additional inputs to the model include the physical characteristics of the transportation system defining the framework of the model, such as road characteristics, the number of lanes, speed limits and the distances between locations. Additionally, the user defines the capacity of road types in passenger car per hour per lane (PCPHPL), the average annual daily traffic volumes (AADT) for road segments, and the nominal travel time between two locations.

Finally, an origin-destination (OD) table must be specified to identify the locations where the freight trips begin and end. This file is developed in Excel and includes the freight volumes for each OD pair, the frequency of arrivals at origin locations, and the routing directions for freight to travel between the origin location and destination location. It is this OD data that is generated from the Gravity Model distribution function in TRANPLAN that provide the freight flow data necessary for the ATIM to function.



The program developed in this research is used to take the OD data output from TRANPLAN as a text file, and update the Excel file, which ATIM used as its input file. Figure 4-1 presents a flowchart of the process. The process involves developing a program capable of editing existing Excel files and a file matching search routine, as the two networks are similar in terms of roadways and capacities. They were not attributed with the same classification schemes due to the differences in TRANPLAN and ProModel programming capabilities.

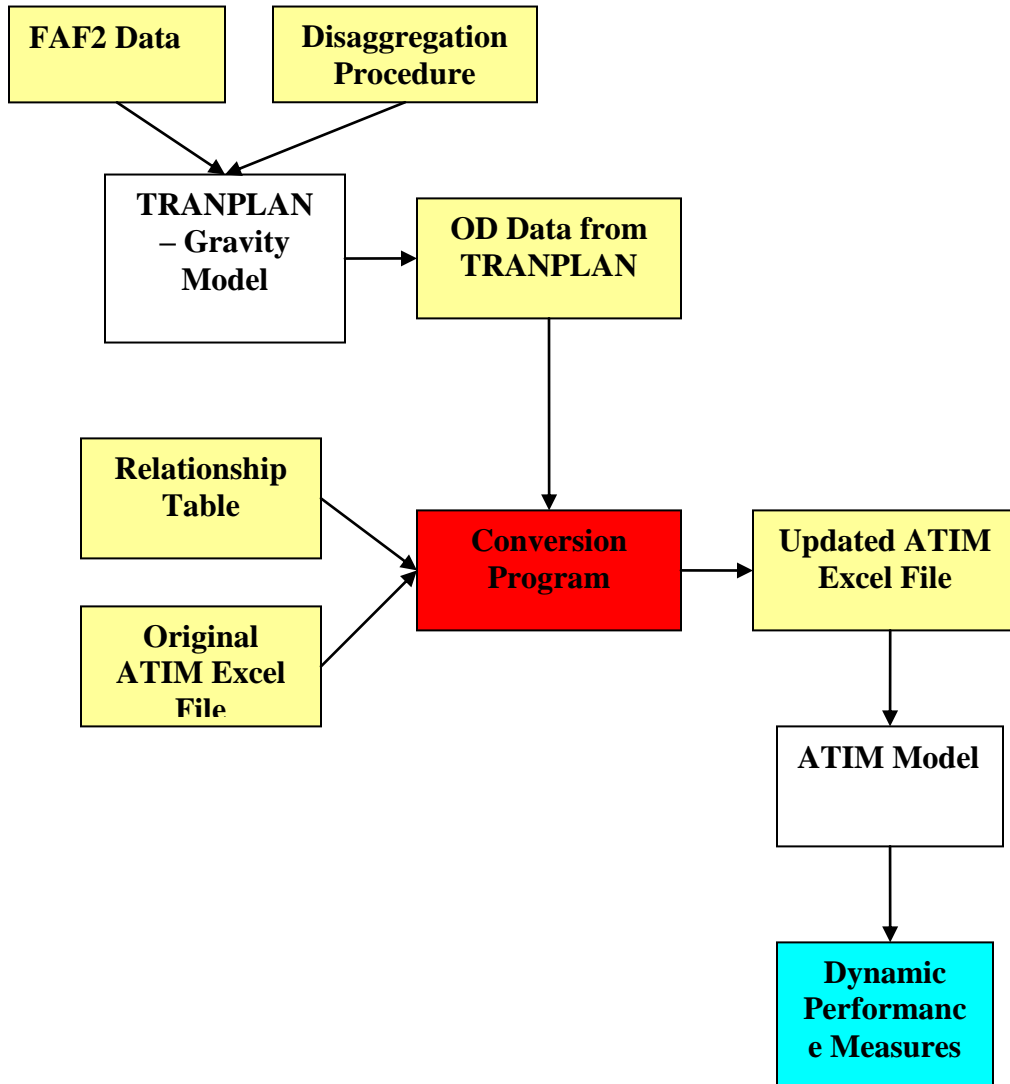


Figure 4-1. Flowchart for seamless interface.

Before the interface developed in this research, the OD data output from TRANPLAN would require a manual entry into the Excel file for ATIM. This process involved the updating of 6,724 individual OD entries contained on multiple workbook pages and with different referencing schemes. The process would take several days and was fraught with the possibility for error. The program developed here was written in Visual Basic and operates as an executable file. The program reduces the time to update the ATIM data to a few hours and removes the possibility of human error.

## **Section 5.0 Project Findings**

### **Feasible Economic Scenarios**

The scenarios developed to explore the impact of increasing the number of trucks on the state's highway infrastructure were intended to provide a snap-shot of "what-ifs" for the current available capacity. It is important to note that the Alabama Department of Transportation is constantly adding capacity and enhancing the roadway infrastructure. The analysis performed here assumes that the state's infrastructure is held constant, as a mechanism to identify potential choke-points and assist in focusing the scarce resources of the state.

Using the original ALDOT volumes and network capacities, provided and the freight data provided from the Freight Analysis Framework, Version 2, and five growth scenarios were examined in this work. The first scenario was a trend line projecting growth to the year 2015 using the existing traffic count and a growth percentage obtained from historical traffic counts. This scenario was the anticipation of what would happen if traffic volumes grew in the future as traffic volumes had grown in the past.

The next four scenarios all utilized different approaches to forecast the amount of freight expected on the Alabama roadway infrastructure. However, the constant in the scenarios was that the number of passenger cars expected on the roadways was all based on the trend line projection of current passenger car level forecasted to 2015 using the historical growth factors.

The second scenario involved forecasting freight using the projection for 2015 that was developed within the FAF2 database. The procedure for disaggregating the freight data to the county level described earlier was followed. Passenger car volumes were added afterwards.

The third scenario involved a doubling of the 2002 FAF2 freight flow data. This scenario represents the prediction that freight will double by the year 2020. This doubling was performed such that each county's contribution of freight to the entire state was doubled. Passenger car volumes were added afterwards.

The fourth scenario involved doubling selected counties in Alabama, not the state as a whole. The top sixteen counties, representing 25% of the state and more than 80% of the gross state product, were modeled with a doubling of freight volumes. Passenger car volumes were added afterwards.

The fifth scenario involved using the FAF2 database's forecast of 2035 freight volumes and making the assertion that the state would reach this level of freight activity by 2015, due to the tremendous growth in industry and freight movements. As with the second scenario, the

procedure for disaggregating freight data to the county level described earlier was followed. Passenger car volumes were added afterwards.

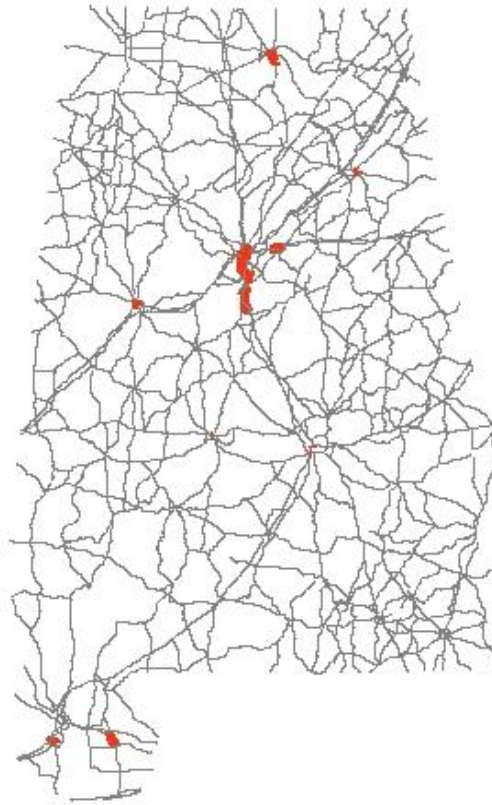
The five scenarios developed for this effort represent possible growth options developed to test to the development of the software packages and the interface.

## Section 6.0 Project Results

### Run ATIM Scenarios and Identify Congestion Chokepoints

The data developed were forecasted in TRANPLAN and ATIM to identify congestion chokepoints. The advantage of operating the two models together is the ability to identify two different measures of congestion. TRANPLAN, which runs a static daily assignment, is used to determine the locations where the forecasted daily volumes are approaching the available daily capacities. ATIM, which runs a discrete event simulation will provide travel times for vehicles on specific roadways segments during all times, including peak periods of the day. For the analysis, locations are defined as congested if the volume to capacity ratio exceeds 0.9 on a daily basis in TRANPLAN, and the travel time during the peak congested hour of the day exceeds 25% of the travel time that would be achievable if a vehicle could travel at the posted speed limit in ATIM. Again, it is important to note that these identified chokepoints are based in existing capacity levels, and changes in capacity to alleviate congestion would improve travel time at these locations. Additionally, varying the definition of congestion would identify different locations and amounts of congestion.

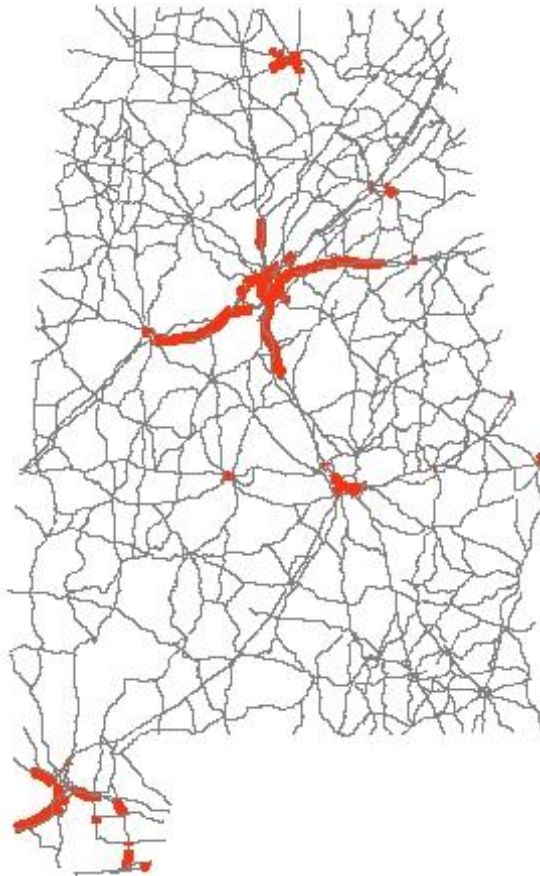
Initially, it is important to know what level of congestion is currently being experienced in Alabama. Using the definition of congestion mentioned above for the volume to capacity ratio of 0.9, the TRANPLAN model indicates that there are 329 miles *total lane miles* of congestion, shown in Figure 6-1. Using the increased travel time method of calculating congestion, there are 159 *center line miles* of roadway in ATIM where actual travel time is 25% greater than travel time at free flow speeds. Based upon this starting point, several scenario based analyses were performed utilizing both the TRANPLAN model and ATIM.



**Figure 6-1. Current congestion locations.**

***First Scenario - ALDOT 2015 Forecast***

The first scenario employed the ALDOT 2015 forecast using trend line analysis. In this scenario the growth rate used to project traffic counts into the future is based upon the historical growth rate determined from past traffic counts. From the data, the total lane miles of congestion was determined to be 1,421 miles and the congested locations are shown in Figure 6-2. Based upon the current state of 329 congested lane miles, congestion is projected to grow by 332%.



**Figure 6-2. Congested locations using trend line analysis.**

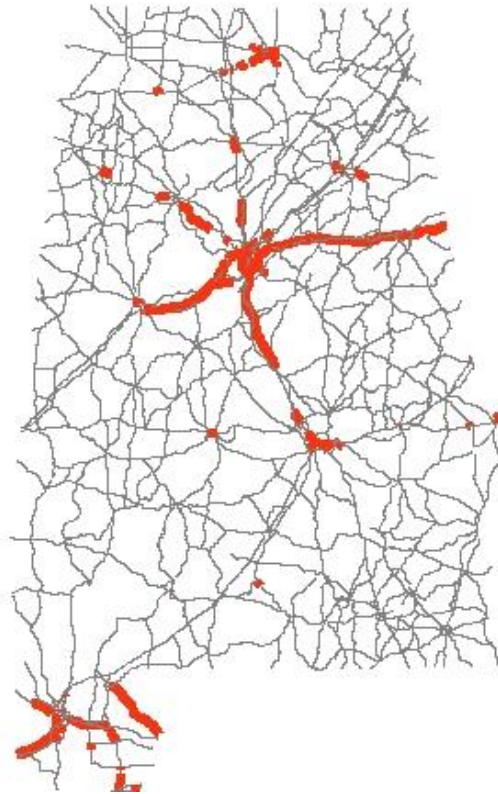
***Second Scenario - FAF2 2015 Forecast***

The second scenario used the 2015 projection included in the FAF2 database. The origin/destination table for the trucks was obtained using the data disaggregating procedure identified previously in this report. The truck data was added to the passenger car projection for 2015 provided by ALDOT. Using the TRANPLAN model, this scenario resulted in 1,813 total lane miles of congestion and the locations are identified in Figure 6-3. ATIM was used to determine the maximum departure from free-flow travel speed to the travel speed the vehicle actual encounters during the worst period of the day. Figure 6-4 shows the locations where the actual travel time is 25% greater than the free-flow travel time.

These two figures clearly show the value in using the gravity distribution model (TRANPLAN) and a discrete event simulation (ATIM) concurrently to communicate transportation system issues. First, the TRANPLAN model communicates that the projected increase in congestion, based upon volume to capacity ratio is 451%. Next, the ATIM model communicates that it will take at least 25% longer to travel than expected on 292 miles of roadways, an 84% increase. For

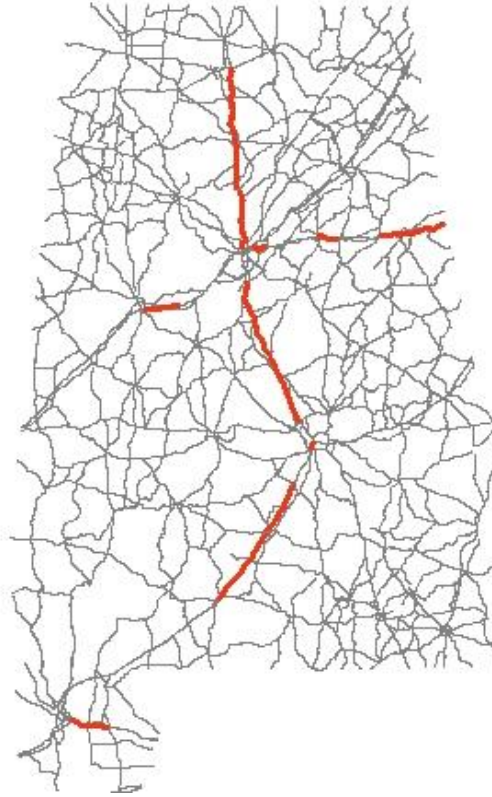
industry interested in moving freight, the expected travel time is probably the more important metric.

It would appear that there is discrepancy between the congestion calculations. In reality, the models are indicating that there are locations of congestion, defined by the volume to capacity ratio, where vehicles travel at times greater than free flow speed but less than the 25% threshold.



**Figure 6-3. Congested locations using the FAF2 2015 projection.**

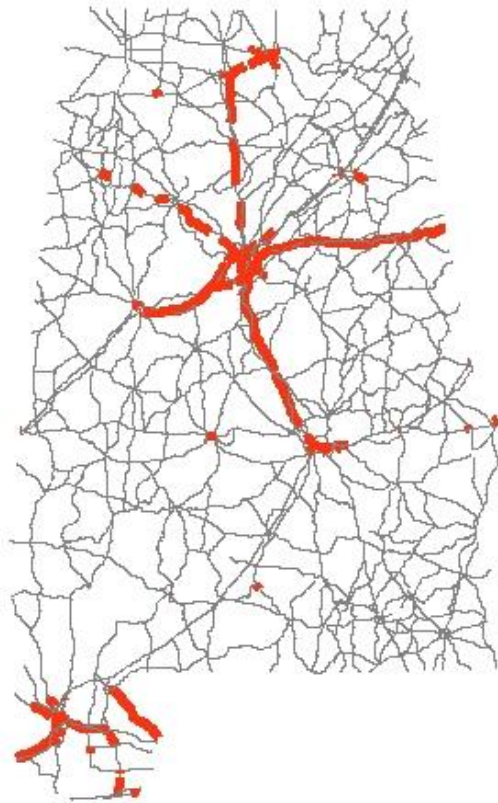




**Figure 6-4. Locations where travel time exceeds 25% using the FAF2 2015 projection.**

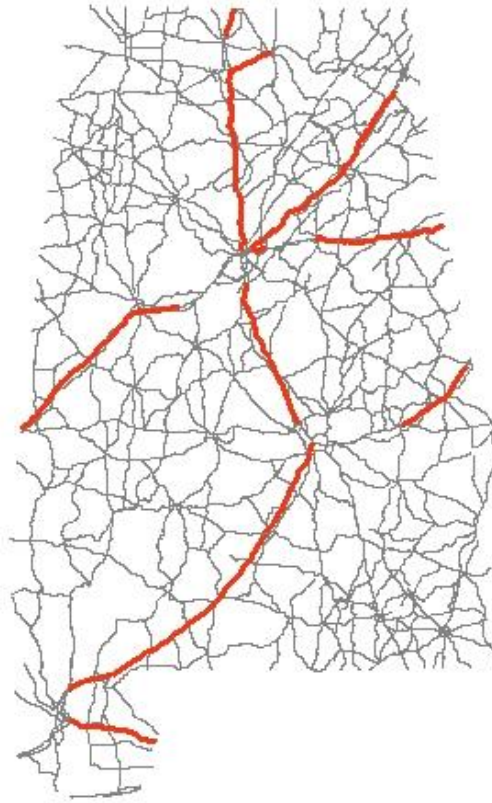
### ***Third Scenario – Forecast Doubling the FAF2 2002 Truck Traffic Values***

Projections of truck traffic are that the volume will double in the U. S. by 2020. The third scenario used the 2002 truck data from the FAF2 database and simulates the projection that freight traffic will double by doubling the 2002 volume in each county. The truck origin/destination table for the trucks was obtained using the data disaggregating procedure identified previously in this report. The truck data was added to the passenger car projection for 2015 provided by ALDOT. This scenario resulted in 2,191 total lane miles of congestion and the congested locations are identified in Figure 6-5. The resulting growth in congestion, based upon the volume to capacity ration and the TRANPLAN model, is 566%. It is important to note that this congestion metric assumes that capacity remains constant.



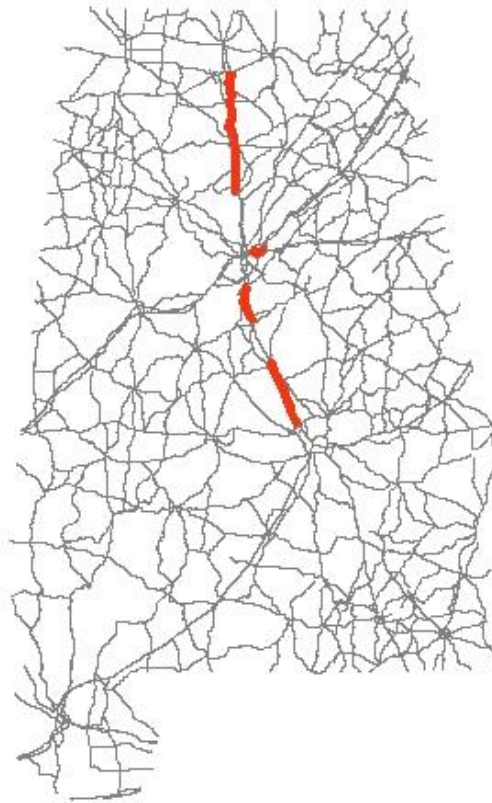
**Figure 6-5. Congested locations doubling the FAF2 2002 volumes.**

ATIM was used to determine the maximum departure from free-flow travel speed to the travel speed the vehicle actual encounters during the worst period of the day. Figure 6-6 shows the locations where the actual travel time is 25% greater than the free-flow travel time. The resulting growth in congestion based upon travel time is 692 miles, or 335%.



**Figure 6-6. Locations where travel time exceeds 25% when truck traffic is doubled from FAF2 2002 volumes.**

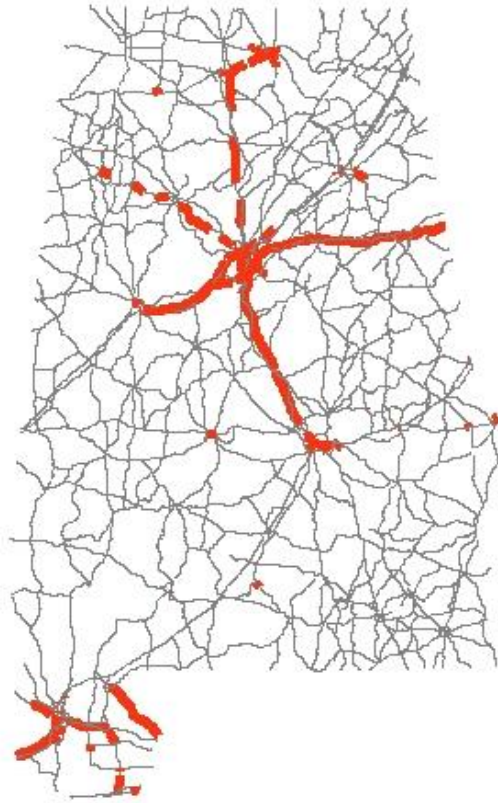
Figure 6-7 shows the locations where the actual travel time is greater than 100% of the free-flow travel time. This scenario describes a situation where it will take twice as long as to travel I-65 as one would expect at free flow speeds. The resulting impact of freight flow would be significant.



**Figure 6-7. Locations where travel time exceeds 100% when FAF2 2002 volumes are doubled.**

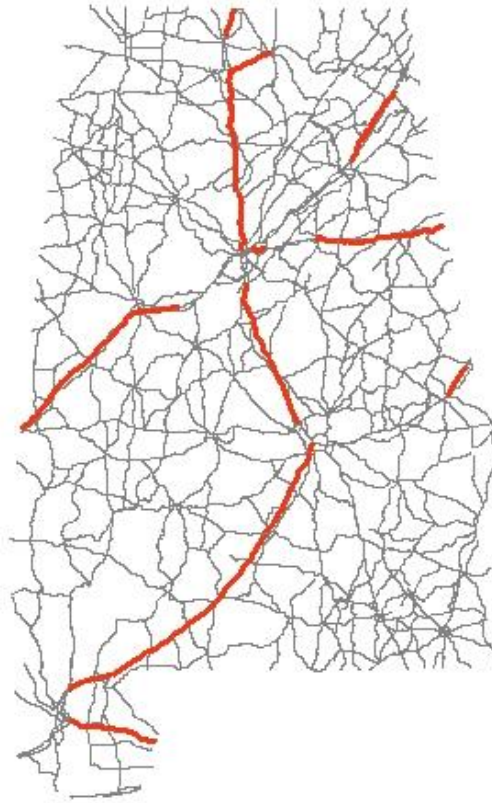
***Fourth Scenario - FAF2 2002 Forecast Doubling Truck Traffic in Selected Counties***

The fourth scenario used the 2002 truck data from the FAF2 database, but only the truck volumes for the 16 counties compiling most of the economic activity in the state, as measured by employment and value of shipments, were doubled. The origin/destination table for trucks was obtained using the data disaggregating procedure identified previously in this report. The truck data was added to the passenger car projection for 2015 provided by ALDOT. This scenario resulted in 2,101 total lane miles of congestion. The congested locations are identified in Figure 6-8. The resulting growth in congestion, measured by volume to capacity ratio, is 538%. Note that this is not significantly different than scenario three where truck traffic in all counties was doubled, indicating that there are at least 51 counties where the capacity is available to absorb significant levels of growth before infrastructure improvements are required.



**Figure 6-8. Congested locations when truck traffic is doubled in selected counties.**

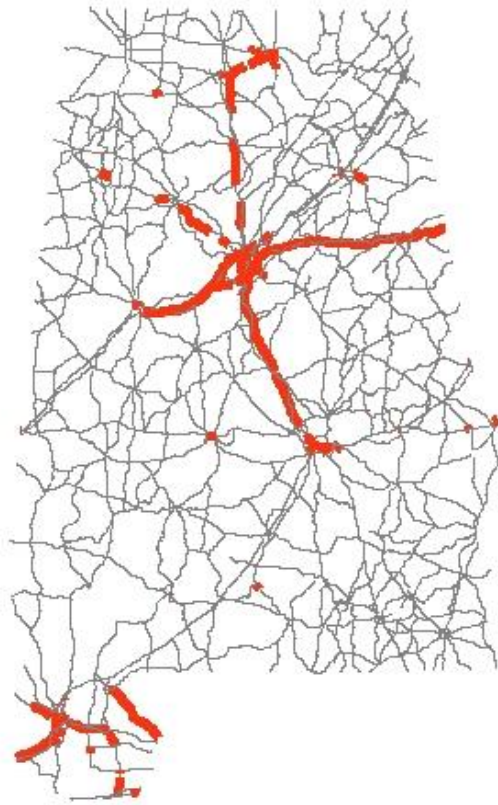
ATIM was used to determine the maximum departure from the free-flow travel speed to the travel speed the vehicle actual encounters during the worst period of the day. Figure 6-9 shows the locations where the actual travel time is greater than 25% of the free-flow travel time. The resulting growth in congestion, measured by travel time exceeding the free flow time by more than 25% is 614 centerline miles or 286%.



**Figure 6-9. Locations where travel time exceeds 25% when truck traffic is doubled for selected counties.**

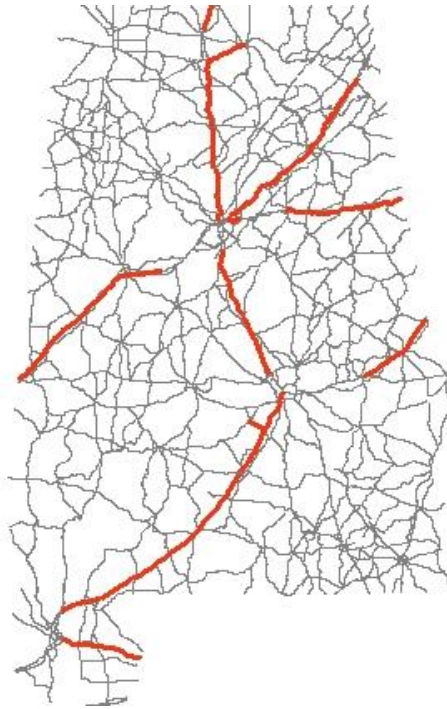
***Fifth Scenario - FAF2 2035 Forecast***

The fifth, and final, scenario tested used the 2035 truck data from the FAF2 database. The origin/destination table for trucks was obtained using the data disaggregating procedure identified previously in this report. The truck data was added to the passenger car projection for 2015 provided by ALDOT. This scenario resulted in 2,105 total lane miles of congestion and the congested locations are identified in Figure 6-10. The resulting growth in congestion, measured by volume to capacity ratio, is 539%.

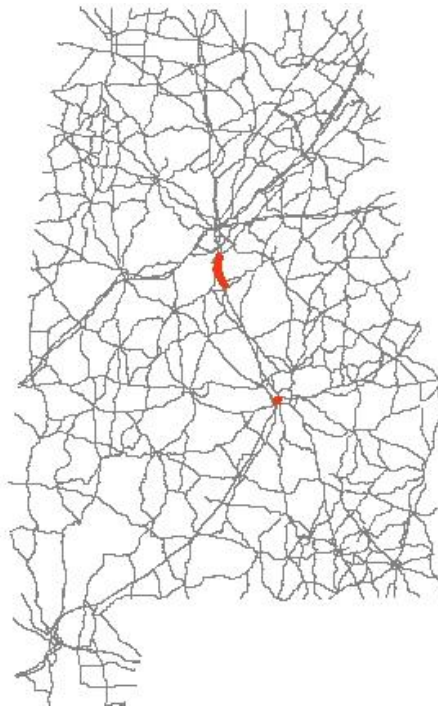


**Figure 6-10. Congested locations using the 2035 FAF2 projection.**

ATIM was used to determine the maximum departure from free flow travel speed to the travel speed the vehicle actual encounters during the worst period of the day. Figure 6-11 shows the locations where the actual travel time is 25% greater than the free flow travel time. The resulting growth in congestion, measured by travel time exceeding the free flow time by more than 25% is 694 centerline miles or 336%. Figure 6-12 shows the locations where the actual travel time is greater than 100% of the free-flow travel time.



**Figure 6-11. Locations where travel time exceeds 25% using the 2035 FAF2 projection.**



**Figure 6-12. Locations where travel time exceeds 100% using the 2035 FAF2 projection.**



## Section 7.0 Conclusions

This project demonstrated the ability to improve a statewide freight forecasting model and link a gravity distribution freight flow model to a discrete event simulation in such a way that the two programs can pass data and work jointly.

The improvements to the existing TRANPLAN model were conducted to better mirror the two model networks and involved the inclusion of nearly 1,000 miles of roadway in the model. Additionally, the report documents a Freight Planning Framework developed at The University of Alabama in Huntsville (UA) that can be used to develop disaggregate federal freight flow data and utilize at the state level.

The program developed in this research provided for the successful interface of two common software packages being used for transportation planning in Alabama, and with the capability to target specific freight movements. The function of the program was successful in that it allowed the transfer of data to occur in a matter of minutes, versus several weeks to months when using the program without the interface. The ability to quickly develop and test scenarios in the two modeling packages represents a significant improvement, without reducing the accuracy of the models.

The identification of congestion chokepoints/bottlenecks is important when considering that scarce resources are available for highway improvements and the cost for improvements continues to rise. This situation implies that the best available modeling tools be employed to ensure resources and appropriately invested to benefit the state as a whole. The results of the case study show that significant congestion is likely to occur if capacity building projects are not undertaken, or are undertaken in the wrong locations.

Finally, the Alabama Department of Transportation is under tremendous pressure to improve the highway system and respond to traveler and freight needs. The chokepoints/bottlenecks identified in this work are only suggested to occur if the department discontinues all improvement projects, which is not likely. However, the case studies are important to illustrate what conditions might occur due to funding limitations and other unforeseen situations. All projections suggest significant increase in all freight traffic. The development of modeling capabilities that will improve analysis and decision tools will be desperately needed.

## 8.0 References

*Freight Analysis Framework, Version 2 (FAF2)*. [http://ops.fhwa.dot.gov/freight/freight\\_analysis/faf/index.htm](http://ops.fhwa.dot.gov/freight/freight_analysis/faf/index.htm). Accessed June 1, 2008.