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Final Report

Assessing the Feasibility of Using TRANSIMS in North Carolina: The Fayetteville—Fort Bragg Case

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16. Abstract

This project assesses the feasibility implementing TRANSIMS to accomplish regional transportation modeling in North Carolina. The report summarizes TRANSIMS technology, its data and resource requirements, and typical output results. To gauge TRANSIMS resource requirements for a case study application, NCSU researchers examine the City of Fayetteville and its neighbor the US Army Fort Bragg military installation. In order to demonstrate and compare TRANSIMS to traditional techniques the NCSU research team develops interesting analogs with CORSIM and Tranplan for corridor and area traffic analysis. An Internet-based assessment tool generalizes the benefits and resource requirements of TRANSIMS for the Fayetteville – Fort Bragg case study, and the Internet site http://www4.ncsu.edu/~dsengup/indextransims.html summarizes the project findings. The research finds that Fayetteville and Fort Bragg offer an excellent technical opportunity to test prototype TRANSIMS methodology. However, personnel availability and other resource obligations at NCDOT necessitate deferring implementation of TRANSIMS to a future time.

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Introduction

Providing mobility while maintaining environmental standards is a significant challenge for metropolitan planning organizations (MPOs). For over two decades transportation agencies have used the traditional "four step" process to model regional transportation networks and test project alternatives. Now TRANSIMS, which is supported by a $24 million federal research program, promises a new approach that will more accurately and equitably compare transportation alternatives while addressing increasingly restrictive environmental regulations. Yet TRANSIMS requires significantly more data, computational resources, and staff training than traditional models like Tranplan, TransCAD, Emme2 and QRSII.

To test and promote TRANSIMS in practical MPO settings, the Congress instituted a $9 million Early Deployment Program (EDP) "…to provide training and technical assistance with respect to the implementation and application of the advanced transportation model…to a diversity of populations and geographic regions…"[1]. The original TEA21 legislation provided the funds for as many as 12 pilot applications of TRANSIMS in fiscal years 2000 through 2003. By June 2000 (the time of this report) the FHWA had reduced the EDP program to six MPOs and approximately $6 million. Also, due to a variety of delays in commercializing the prototype TRANSIMS software, the starting date for the first EDP project slipped from fiscal year 2000 to some unspecified date. However, the Portland MPO, which with Dallas helped develop and test TRANSIMS modules, will be a likely EDP site.

According to federal commentary TRANSIMS is destined to become the institutionalized travel model for state DOTs, MPOs and consultants. Thus, the EDP competition represents an excellent opportunity for early users to receive federal funding "…to convert from the use of (current) travel forecasting procedures…to the use of the advanced transportation model."[1]

Project Scope and Objectives

In spite of the significant functionality of TRANSIMS and its promising results in Dallas and Portland, the data, computational resources, and staff requirements for TRANSIMS appear daunting and must be thoroughly considered by prospective agency users like NCDOT. Thus, the scope of this project addressed the feasibility of using TRANSIMS in North Carolina and, if the timing was right, of developing a TRANSIMS EDP grant application. However, in mid-project NCDOT modified the scope of the project to exclude the preparation of an EDP grant application, citing concerns about the case study Fayetteville Area becoming non-attainment, production modeling schedules, and staff and other resource limitations.

The Advisory Committee recommended that the research team continue to focus on Fayetteville as an example implementation site for TRANSIMS, and carry out the remaining project objectives including:

- assess the state-of-the-art of TRANSIMS development,
- assess the resource requirements necessary to apply TRANSIMS,
- estimate advantages and disadvantages, costs and benefits of doing a TRANSIMS study, and
- facilitate a possible future implementation of TRANSIMS in North Carolina.

In this regard the project team used Fayetteville and Fort Bragg as a case study to carry out the objectives of the research except for writing an EDP proposal. In our approach we explored TRANSIMS concepts and resource requirements and Fayetteville - Fort Bragg "readiness" for TRANSIMS. We used the Fayetteville – Fort Bragg case to develop and test an assessment methodology, which should be helpful to

[1] Transportation Efficiency Act, Section 1210 Advanced Travel Forecasting Procedures Program.

others considering an EDP, and we demonstrated practical modeling alternatives to TRANSIMS for the Fayetteville – Fort Bragg case.

TRANSIMS

The prototype TRANSIMS software uses sophisticated non-linear models to describe the mobility choices, travel behavior and itineraries of individuals to and from their households and other origins and destinations. Incorporating dynamic models for automobiles, buses, and other modes including walking, TRANSIMS simulates minute by minute, hourly and daily travel flows on regional multi-modal and pedestrian networks. It estimates transportation system performance including fuel consumption and emissions, and it produces a variety of summary travel statistics, graphic reports and animated visualizations. Exhibit ES-1 illustrates a high-level flowchart for TRANSIMS.

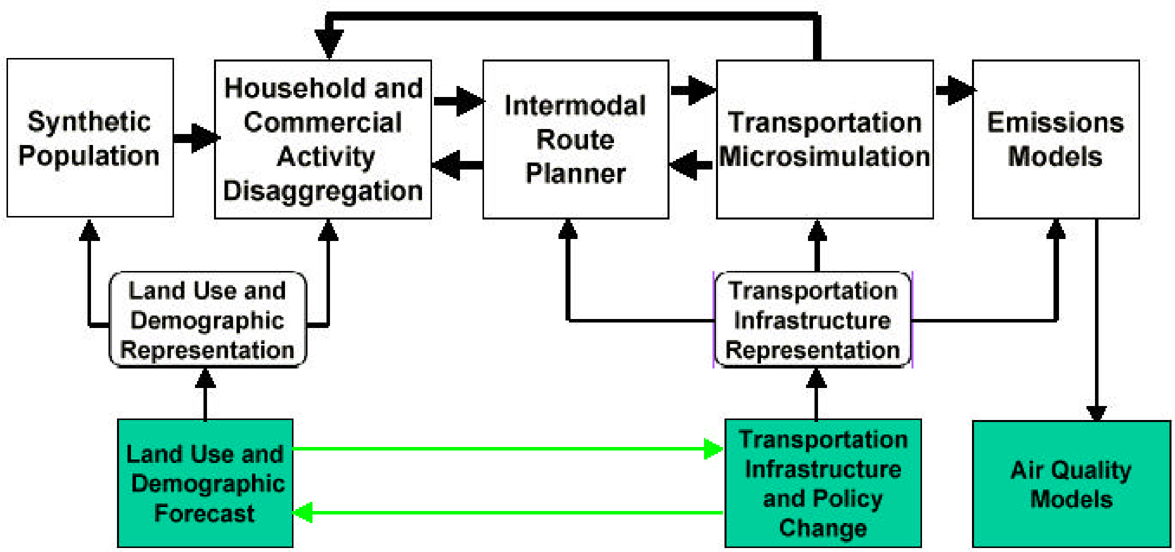

Exhibit ES-1: TRANSIMS High Level Flowchart

To accomplish its sophisticated numerical modeling and results, TRANSIMS requires new and detailed data and computational resources. Furthermore, TRANSIMS requires a new level of training and education compared to traditional approaches. Thus to achieve the promised benefits of TRANSIMS agencies must “pay the price” in terms of new resource investment.

TRANSIMS represents a significant departure from current approaches for regional planning. The findings in this report will be of particular interest to agencies considering the FHWA Early Deployment Program for TRANSIMS. Readers of this report are invited to use the NCSU TRANSIMS “feasibility assessment tool” (TFAT) that implements the findings of this project. The decision support tool, significant TRANSIMS links, summary information, and the entire project report are at the following Internet address: site http://www4.ncsu.edu/~dsengup/indextransims.html

Project Findings

As an assumed eventual user of TRANSIMS NCDOT has two options:

1. Apply to be one of the six EDP agencies and if selected receive technical assistance and federal funds estimated to be approximately $1 million that must be matched 20%, or
2. Forego federal EDP support, wait for the results of the Early Deployment Program in other regions, and implement TRANSIMS as needed.

As discussed above the NCDOT Technical Advisory Committee for this project decided on option (2). While recognizing the incompatibility of the TRANSIMS EDP schedule relative to NCDOT modeling commitments, the research team also determined the following aspects of the Fayetteville – Fort Bragg EDP case:

1. The medium size Fayetteville - Fort Bragg area represents an attractive opportunity to demonstrate selected TRANSIMS capabilities quickly with a high certainty of success. This varies from the FHWA focus on larger metropolitan areas that would test most TRANSIMS functionalities.
2. The Fayetteville – Fort Bragg case meets most all the EDP requirements: geographic diversity, transportation applications, probability of success, team expertise, computer support, data availability, cost and match.
3. The Fayetteville – Fort Bragg case falls short of EDP requirements in terms of commitment and political support because of staffing and other NCDOT regional modeling obligations.
4. Ignoring contributed federal support for training and software the estimated cost for an EDP project for the Fayetteville – Fort Bragg case is about $800,000. This preliminary estimate includes a grant request from FHWA for $625,000 and a local 22% match of $175,000. NCDOT, Fayetteville, Fort Bragg, NCSU and NISS would share the local match.
5. Significant decision factors regarding the feasibility of implementing TRANSIMS in a region can be captured in a simplified "TRANSIMS Feasibility Assessment Tool" that appears valid for the Fayetteville – Fort Bragg case, Portland, and Dallas-Fort Worth.
6. While one significant "selling point" of TRANSIMS is its capability for "micro" traffic modeling at the street level as well as "macro" modeling at the regional level, hybrid approaches combining Corsim with Tranplan or TransCAD are attractive substitutes, at least for the short term until TRANSIMS is fully demonstrated.

Project Recommendations

During the course of this research project the team examined specific traffic problems concerning the Fayetteville – Fort Bragg case, as well as the overall feasibility of using Fayetteville and Fort Bragg in a TRANSIMS Early Deployment Project. Regarding the TRANSIMS EDP we make the following recommendations:

- North Carolina should not develop a TRANSIMS EDP grant application until the NCDOT management approves budget and other resource expectations.
- The Fayetteville Area Metropolitan Planning Organization should have high priority as an EDP candidate.
- NCDOT should make the results of this project available to other North Carolina MPO's so that they can gauge the utility of TRANSIMS.

With respect to the on-going Fayetteville regional study and in anticipation of an eventual TRANSIMS model for the Fayetteville area, we make the following recommendations:

- Apply the 1995 base year TransCAD model that the NCSU/NISS team developed from the original Tranplan model. TransCAD with its GIS functionality represents a precursor step toward a TRANSIMS model.
- Add more network detail to reflect link bearings, intersection coordinates and geometries; and capacities and signalization of major streets especially through Fort Bragg. The Fayetteville traffic response signal plan will be helpful.
- Collect household and employment data at the property level rather than aggregating for traffic analysis zones. The excellent condition of the Fayetteville and Fort Bragg GIS databases will facilitate this task.
- Test CORSIM as a “micro” traffic analysis tool to address link-level project issues like congestion at the Fort Bragg security gates. The results will reflect (and perhaps substitute for) the type of detail available from TRANSIMS. Also, explore and apply as appropriate the micro-level traffic modeling capabilities of TransCAD.

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Section 1: Introduction

This chapter describes the historic and legislative background that led to the development of TRANSIMS. It also addresses the Early Deployment Program funding for which NCDOT can apply given a competitive case study. Identifying and defining such a case study is the purpose of this project.

Background

The **Federal mandates** embodied in the Intermodal Surface Transportation Efficiency Act (ISTEA) and the Clean Air Act and Amendments (CAAA) demand analytical requirements that exceed the capabilities of current regional transportation models and methodologies. Using models like Tranplan, TP2/Viper, EMME2, and TransCAD state departments of transportation and metropolitan planning organizations have struggled to meet ISTEA and CAAA requirements with modest, but incomplete success. For example, accurate air quality modeling requires vehicle fleet information such as percentage heavy and light vehicles. Since engine emissions are proportional to engine load, accurate air quality modeling also requires data such as individual vehicle speed profiles and roadway grade throughout the network. Such vehicle and network details are unavailable in current regional transportation models and their databases.

Furthermore, the CAAA establish conformity standards that require transportation planners to prepare long-range demand forecasts with unusual detail and fidelity. The multimodal transportation forecasts must be disaggregated through activity surveys at the individual household and business level (not zone level), and they must generate people's travel demand, changing travel patterns, and temporal travel characteristics. Given this information air quality models must predict absolute (not relative) levels of pollution and dispersion dynamics throughout a region. Neither current transportation models nor air quality models meet such rigorous, Federally mandated standards [1].

National surveys and assessments support these conclusions. The majority of transportation professionals whether they are in primarily rural, mixed or urban states, believe that "…existing transportation models and procedures are incapable of identifying congestion problems and possible corrective strategies to measure performance of implemented strategies at the micro level…" as required by ISTEA[2]. Furthermore, "…in order to meet CAAA requirements, many MPOs will need to monitor growth rates, track vehicle miles of travel, and forecast the impacts of transportation options in more precise and quantitative terms than have been necessary in the past."[3] Of particular concern to local officials is the threat of litigation if a regional model and the recommended transportation plan do not conform to Federal requirements.

Besides falling short on Federally mandated analytical requirements, conventional regional transportation models cannot accommodate the Intelligent Transportation Infrastructure (ITI) options being actively promoted by USDOT. Without including ITI options many of the nation's transportation systems will be inadequately evaluated for future performance and conformity as prescribed by ISTEA.

Finally the aggregate nature of regional transportation and air quality modeling does not address equity issues inherent in ISTEA and TEA21. Identifying the benefits and impacts from transportation improvements on sub-populations such as mall travelers and low income neighborhoods is not possible with current models.

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[1] TRANSIMS Model Design Criteria as Derived from Federal Legislation, USDOT Technology Sharing Report DOT-T-95-21, June 1995.
[2] Assessment of Transportation and Air Quality Modeling, National Association of Regional Councils, Harvey and Deakin, 1992.
[3] The Federal Register, Vol. 58, No. 39, 23 CFR Part 500, 2 March 1993

Against this backdrop of dissatisfaction with traditional transportation and air quality models, professionals have adopted two **strategies** to address Federal mandates:

- upgrade and patch existing models, and
- use national funding to develop new integrated transportation/air quality model with sophisticated micro-level simulation, analysis and graphical output capabilities.

At **NCDOT** engineers have applied the "upgrade and patch" strategy to several generations of Tranplan to conduct regional transportation modeling. They have also developed a variety of "post processor" implementations to convert Tranplan aggregate, daily average traffic flow and speed results into the more disaggregate speed data required by Mobile models for regional air quality and conformity analysis. As a next step NCDOT is replacing Tranplan with TransCAD in order to facilitate the modeling process with more accessible models, graphical input and output, and graphical user interface program features. Yet, the new TransCAD software essentially facilitates traditional procedures without correcting their shortcomings with regard to ISTEA, TEA21, CAAA, ITI and equity requirements.

At the national level the **Los Alamos National Laboratory** has directed the second strategy to develop a new suite of integrated transportation and air quality models. TRANSIMS (TRansportation ANalysis and SIMulation System) will provide an analytical environment within which state and local planners can meet Federal mandates for transportation and air quality analysis. The research version of this program (TRANSIMS LANL) is complete. By mid-year 2000 a private firm is developing a commercial product called TRANSIMS DOT, which will be licensed to local and state agencies[4]. It will fully meet Federal mandates and be executable locally on high-speed computers or remotely over the Internet through a centralized consultant that receives local data and returns local results.

Problem Definition

Some professionals liken TRANSIMS to a freight train driven by legislative mandate. It is powered by the latest computer technology, multidisciplinary travel theory, and professional pedigree. It seems destined to carry state DOTs, MPOs, and consultants into the 21st century of regional transportation and air quality modeling. And some believe that the time has come for transportation planners and engineers to get on board.

To test the prototype software and facilitate the transition from conventional modeling techniques the Congress has authorized funds for an Early Deployment Program (EDP)[5]. According to TEA21:

> For each of the fiscal years 2000 through 2003 not more than …$3.25 million, $2.5 million, $2 million and $1.25 million, respectively, …will be made available…to a diversity of populations and geographic regions for a pilot program to enable transportation management areas…to convert from the use of travel forecasting procedures…to the use of the advanced transportation model.

Figure 1-1 conceptually describes how the regional MPOs will be supported in the EDP by the Federal legislation and funding, USDOT training, the commercial version or "shell" for TRANSIMS, and a variety of research studies including the original case studies conducted for Dallas-Fort Worth and Portland. The foundation of the entire program is the prototype software developed by the Los Alamos National Laboratory.

[4] Richard Beckman, LANL TRANSIMS project director. Teleconference for LANL, NISS and NCSU, February 22, 1999.

[5] Transportation Efficiency Act, Section 1210 Advanced Travel Forecasting Procedures Program.

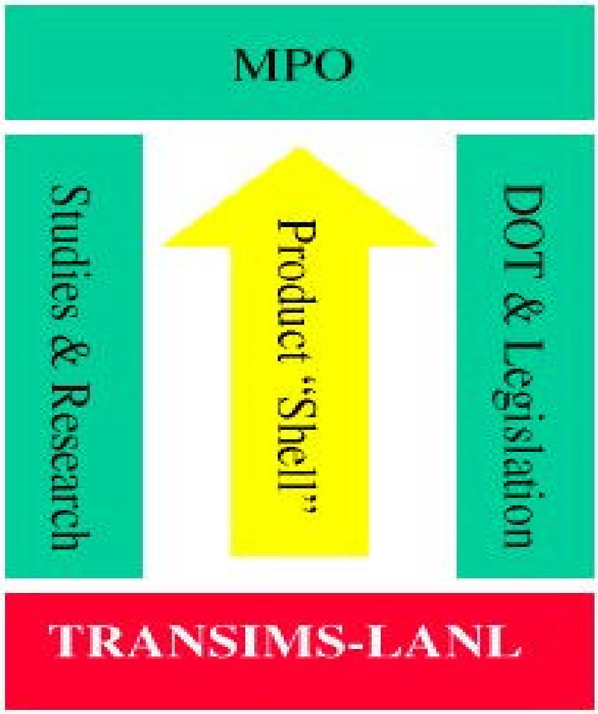

Figure 1-1: Early Deployment Program Support

FHWA discussions indicate that six regions will receive about $1 million each. Each qualifying agency or MPO will provide a 20% match. The original legislation defined a schedule beginning in fiscal year 2000 and lasting through 2003, however, various events including commercializing the "product shell" have delayed the schedule. EDP proposals were originally due in December 1999 with all pilot sites to be selected in March 2000. By mid year 2000 no EDP sites had yet been selected, though Portland is expected to be one of them because of their on going pilot effort.

As a possible user of TRANSIMS NCDOT has two choices:

- apply early to be one of the first six agencies to demonstrate TRANSIMS in the Federally funded Early Deployment Program, or
- wait several years to implement TRANSIMS and forego significant Federal support.

Under option (1) if a North Carolina city becomes a pilot site for TRANSIMS, NCDOT will win a share of the EDP funds authorized "to provide training and technical assistance with respect to the implementation and application of the advanced transportation model. . ."[5]. Under option (2) if NCDOT adopts a "wait and see" attitude, they will not receive early Federal support to implement TRANSIMS, but they will eventually use a more proven software package and profit from the experiences of the pilot states.

This research examined options (1) and (2). Assuming North Carolina has a nationally competitive pilot city or region and could organize a competitive professional team with outstanding technical resources, the team then an EDP proposal for the TRANSIMS pilot program could be developed. If the study proves otherwise, the team will have gathered the information and helped lay the foundation for a future implementation of TRANSIMS in North Carolina.

Scope and Objectives

In spite of the significant functionality of TRANSIMS and its promise to meet federal mandates, the data requirements, computational resources, and staffing for TRANSIMS appear daunting and must be thoroughly considered by prospective agency users like NCDOT. Thus, the scope of this project addressed the feasibility of using TRANSIMS in North Carolina and, if the timing were right, of developing a TRANSIMS EDP grant application. However, in mid-project NCDOT modified the scope of the project to exclude the preparation of an EDP grant application. According to NCDOT[6]:

> "While management is supportive of the project and concept, there (are) concerns expressed about the Fayetteville region possibly becoming non-attainment and the potential impact of involvement as a TRANSIMS early deployment site. Participation in the EDP as a parallel effort to production modeling is not feasible, given limited availability of staff and other resources. Given these issues, it (is) determined that the Department should not proceed with preparation of an EDP grant proposal."

The Advisory Committee recommended that the research team focus on Fayetteville as an example implementation site for TRANSIMS, and therefore carry out the remaining project objectives including:

- assess the state-of-the-art of TRANSIMS development,
- assess the resource requirements necessary to apply TRANSIMS,
- estimate advantages and disadvantages, costs and benefits of doing a TRANSIMS study, and
- facilitate a possible future implementation of TRANSIMS in North Carolina.

In this regard the project team used Fayetteville and Fort Bragg as a case study to carry out the objectives of the research except for writing an EDP grant. The approach was to explore TRANSIMS concepts and resource requirements and Fayetteville - Fort Bragg "readiness" for TRANSIMS. The Fayetteville - Fort Bragg case was used to develop and test an assessment methodology that should be helpful to others considering an EDP, and demonstrated practical modeling alternatives to TRANSIMS.

Furthermore, the research team recognizes that NCDOT is conducting a year 2000 update of the Fayetteville Area transportation model and plan. Thus, the team adopted the philosophy of facilitating that process by collecting relevant data, upgrading the Tranplan model to TransCAD, and addressing pertinent issues. Issues examined include:

- corridor and regional traffic congestion resulting from new gate security measures at Fort Bragg,
- traffic control measures at Fort Bragg gates, and
- project level evaluation methods.

Research Tasks

Within the revised scope of this project The team addressed the state of the art of TRANSIMS development and its potential application to the Fayetteville – Fort Bragg area. Its modeling and data requirements were compared to those available at NCDOT and the case study Fayetteville Area MPO. The team also estimated the level of investment necessary to implement a North Carolina TRANSIMS EDP study. The ultimate goal was to help NCDOT and other agencies "gear up" for TRANSIMS.

The research tasks in this project were to:

1. Organize a NCDOT Advisory Committee and identify local and national contacts for the research team from NCSU and the National Institute of Statistical Sciences.

[6] Memorandum to the File, Project 00-5 Technical Advisory Committee Meeting – 1/19/00. January, 31, 2000.

2. Conduct meetings with the Advisory Committee to examine TRANSIMS technical requirements, discuss the timeline for Federal funding, refine project scope and objectives, and obtain advice regarding the project.
3. Assess the data, computer, personnel, and other resource requirements necessary to apply TRANSIMS to a case study based on the Fayetteville Area MPO including Fort Bragg.
4. Demonstrate the type of results expected from a TRANSIMS implementation.
5. Estimate the advantages and disadvantages, the costs and benefits, and innovations derivable from doing a North Carolina TRANSIMS pilot study.
6. Examine issues of value to the Fayetteville Area Transportation planning process.

Summary

There is little question that TRANSIMS represents a revolution in regional transportation modeling. By integrating activity-based travel models, microscopic traffic flow models and environmental models, TRANSIMS provides capabilities that do not exist today and that could be used directly to satisfy a variety of federal mandates. The USDOT has, and will continue to invest significant resources into TRANSIMS. This study will help North Carolina to implement this new modeling technology when the time is right. This research provides guidance on data preparation, computing needs and personnel training requirements to bring about this profound change in models and philosophy of transportation planning.

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Section 2: TRANSIMS Overview

This section summarizes the functionalities of TRANSIMS and its computer and data requirements. It also discusses the Dallas–Fort Worth and Portland case studies. This information will introduce the reader to TRANSIMS as an evaluation approach for regional planning, and it will prepare a foundation for the development of the Fayetteville – Fort Bragg case study. Besides this information the NCSU project website located at http://www4.ncsu.edu/~dsengup/indextransims.html provides Internet links and additional details on TRANSIMS.

TRANSIMS Functionalities

To address Federal transportation evaluation mandates (Section 1) the prototype TRANSIMS models the following:

- disaggregate land use and demographic characteristics for a region;
- the natural environment for a region;
- a multimodal transportation network with entity-level representations of travelers and freight;
- representative populations and commercial environments;
- unique travel decisions of individuals including choice/utility models;
- detailed vehicle and network representations;
- continuous simulations of traffic, transit, freight, bike, and pedestrian travel patterns over the course of extended time periods including both peak and non-peak travel demand; and
- unique influences of traffic on congestion and air quality.

The major software modules of TRANSIMS are[1]:

- Population Synthesizer
- Household and Commercial Activity Disaggregation generator (HCAD)
- Intermodal Route Planner for individuals' activity patterns (IRP)
- Traffic Micro-simulation
- Environmental Analysis for emissions and fuel consumption estimation
- Output Visualizer

The software modules use sophisticated non-linear models to describe the mobility choices and the travel behavior of individuals, constrained by the transportation system performance including vehicle speed, gap acceptance, capacity, etc. Feedback (Figure 2-1) among modules describing households and activities, routes and travel plans, and multimodal traffic represent improvements in TRANSIMS over traditional models that have no feedback. The feedback is also necessary to stabilize the non-linear activity/transportation system. Numerous iterations permit activities, routes and traffic to reach quasi-equilibrium. Following equilibrium of traffic flows in all modes, TRANSIMS determines fuel consumption, emissions and system performance[1].

TRANSIMS Resource Requirements

Throughout the sophisticated numerical modeling and computational process TRANSIMS requires new data and computational resources. Furthermore, TRANSIMS promises to need a new generation of skilled professionals to develop the data packages and operate TRANSIMS, as well as carry out the traditional community participation and agency review functions of the transportation planning process. This "resource overhead" appears daunting and must be more fully defined through research and

[1] B. W. Bush, The TRANSIMS Framework, Los Alamos National Laboratory, The 78th Annual Meeting of the Transportation Research Board, 12 January 1999 (http://transims.tsasa.lanl.gov/)

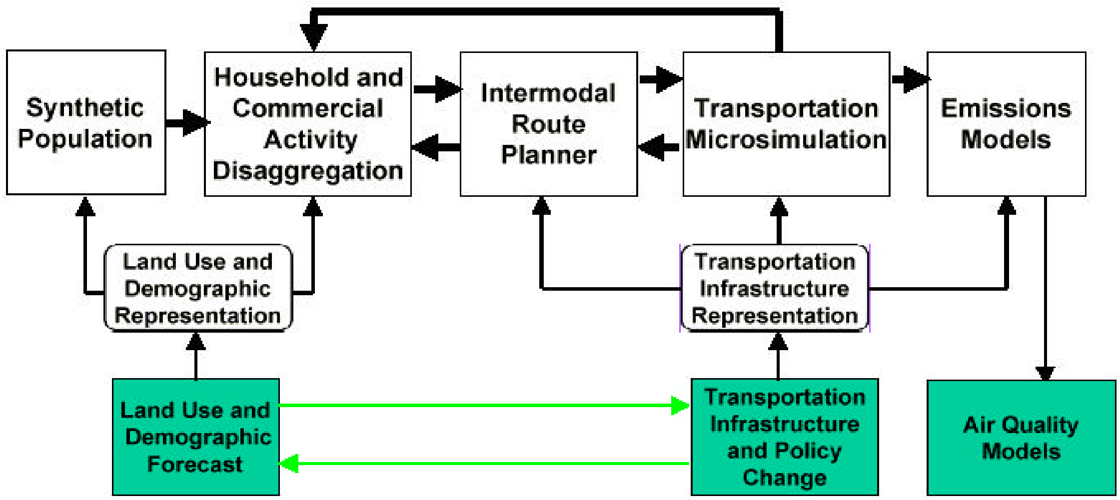

Figure 2-1: TRANSIMS High-Level Flowchart
Source: B. W. Bush, The TRANSIMS Framework, Los Alamos National Laboratory, The 78th Annual Meeting of the Transportation Research Board, 12 January 1999 (http://transims.tsasa.lanl.gov/)

demonstration pilot projects so that state DOTs and MPOs will be able to plan their future levels of investment in TRANSIMS. Here the focus is on having adequately detailed data and sufficient computing resources for applying TRANSIMS successfully in a pilot project. Examples come from the recently available Dallas-Fort Worth case study that applied TRANSIMS on a sub-area representing approximately 2% of the regional model[2]. Implications from the Portland study on proposed EDP projects[3] are also discussed and summarized. Cost information for data collection and processing, computer time, and personnel are not fully available from either study.

Input data that TRANSIMS requires for operation are summarized by Table 2-1. The table also shows the results and type of **output data** for each TRANSIMS module. Following the input/output convention of block diagram algebra, input data are shown in the left column of the table, the module in the center column, and the output data in the right column. The information may be superimposed on the flowchart of Figure 2-1 to see the plethora of feed-forward and feedback information produced by TRANSIMS.

Figures 2-2 through 2-7[4] further illustrate TRANSIMS. Figure 2-2 depicts the block face and street level location of households, employment and other trip generating activities. Synthetic methods based on census data and population models can simplify activity modeling. Figure 2-3 graphically illustrates the intermodal route planner. For each individual trip TRANSIMS can track each modal link segment including walking, bicycling, driving personal vehicles, and taking transit. Clearly detailed activity surveys including traveler and activity locations and daily trips by time of day and mode are necessary for TRANSIMS. By contrast traditional travel forecasting models aggregate such precursors of travel at the

[2] R. J. Beckman, TRANSIMS: The Dallas-Ft. Worth Case Study, LAUR-97-4502, Los Alamos National Laboratory, November 14, 1997 (http://transims.tsasa.lanl.gov/)
[3] L. Smith, TRANSIMS Travelogue, IOC-2 Planning, Los Alamos National Laboratory, July 1998 (http://www.bts.gov/tmip/publ/n18 /n18f2.htm)
[4] http://transims.tsasa.lanl.gov/

Table 2-1: TRANSIMS Modules and Input/Output Data

Input Data	TRANSIMS Module	Output Data
Network data Demographic data Geo-coded census tracts	**Population Synthesizer**	Synthetic households Synthetic persons

Synthetic population
Household activity
  24-hour survey
Network data
  nodes & links
  locations of activities
	Household & Activity Generator	Activity data
		  who & what activity
		  priorities
		  starting & ending times
		  mode preference
		  vehicle preference

Activity data
Transit data
Network data
	Route Planner
	including vehicle, bus, walk, park
		Traveler plans
		  household by household
		  times, O/Ds, paths, modes
		  trip sequence
		Vehicles
		  types, start & end locations

Network data
Vehicles
Transit data
Traveler plans
	Traffic Micro Simulator	Traveler events
		  second by second
		Snapshots & animations
		  links & intersections
		  vehicles & traffic controls
		  vehicle trajectories

Micro simulator output
Vehicles
External data sets for emissions
Network data
	Emissions Estimator	Emissions inventories
		  every 30 meters
		  every 5 minutes
		  CO, NO_X, NMHCs, CO_2
		  particulate matter
		  fuel consumption
		MODELS3 database

Traveler plans
Micro simulation output
	Output Visualizer	2-D & 3-D static views
		2-D & 3-D animated views
		Interactive or batch output
		Individual displays
		  by location
		  by performance data type

Source: B. W. Bush, The TRANSIMS Framework, Los Alamos National Laboratory, The 78th Annual Meeting of the Transportation Research Board, 12 January 1999 (http://transims.tsasa.lanl.gov/)

zone level. Figure 2-4 illustrates the level of detail needed for coding the highway network, though approximate defaults values may simplify data collection and coding. Similarly detailed data are necessary for other modes. Figure 2-5 illustrates the regional traffic micro-simulation that predicts the dynamics of individual vehicles, congestion, delays, and vehicle performance. With such detailed output TRANSIMS can predict more accurate estimates of emissions and emissions distributions as shown in Figure 2-6. Stylistic animations of traffic flow are also possible as shown in Figure 2-7.

Computing resources for TRANSIMS are substantial because of the intensive computations throughout the four major modules of the architecture of Figure 2-1. Computations must manipulate all of the data in Table 2-1 and produce second-by-second simulations of individual travelers every 30 meters through all

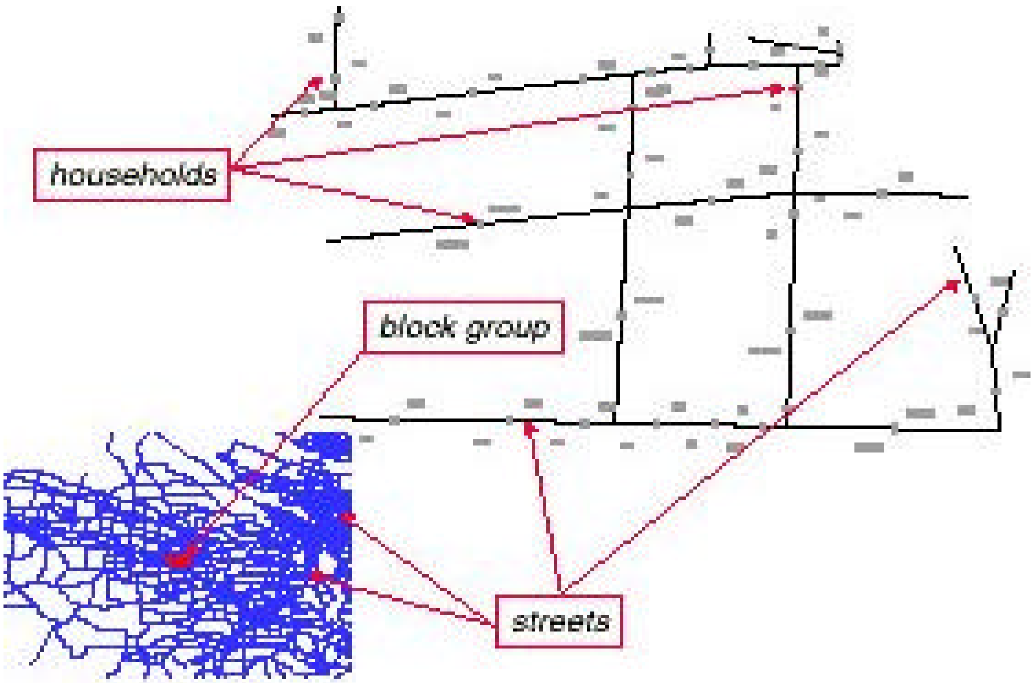

Figure 2-2: Households and Activities

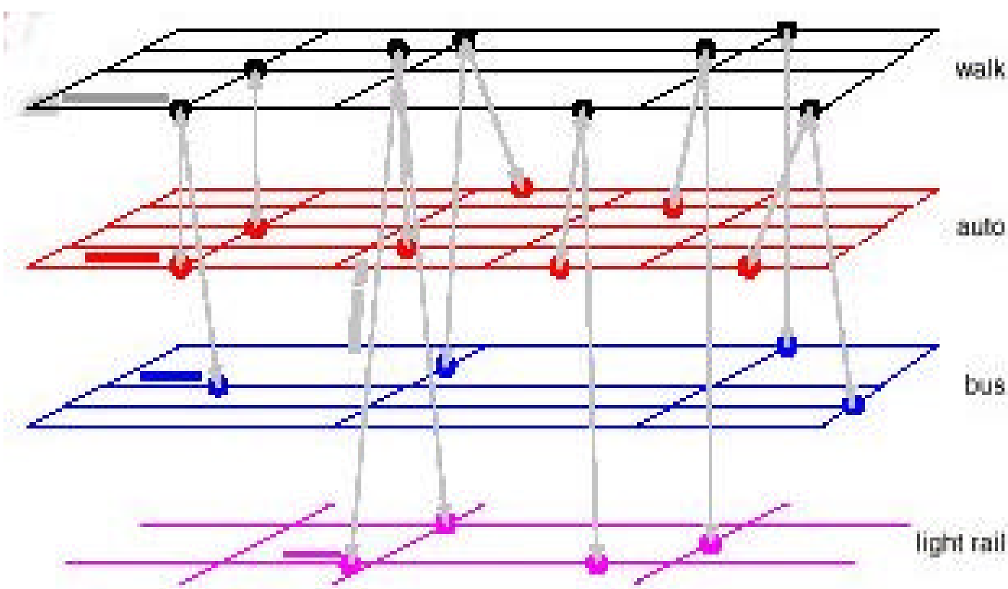

Figure 2-3: Intermodal Routes and Plans

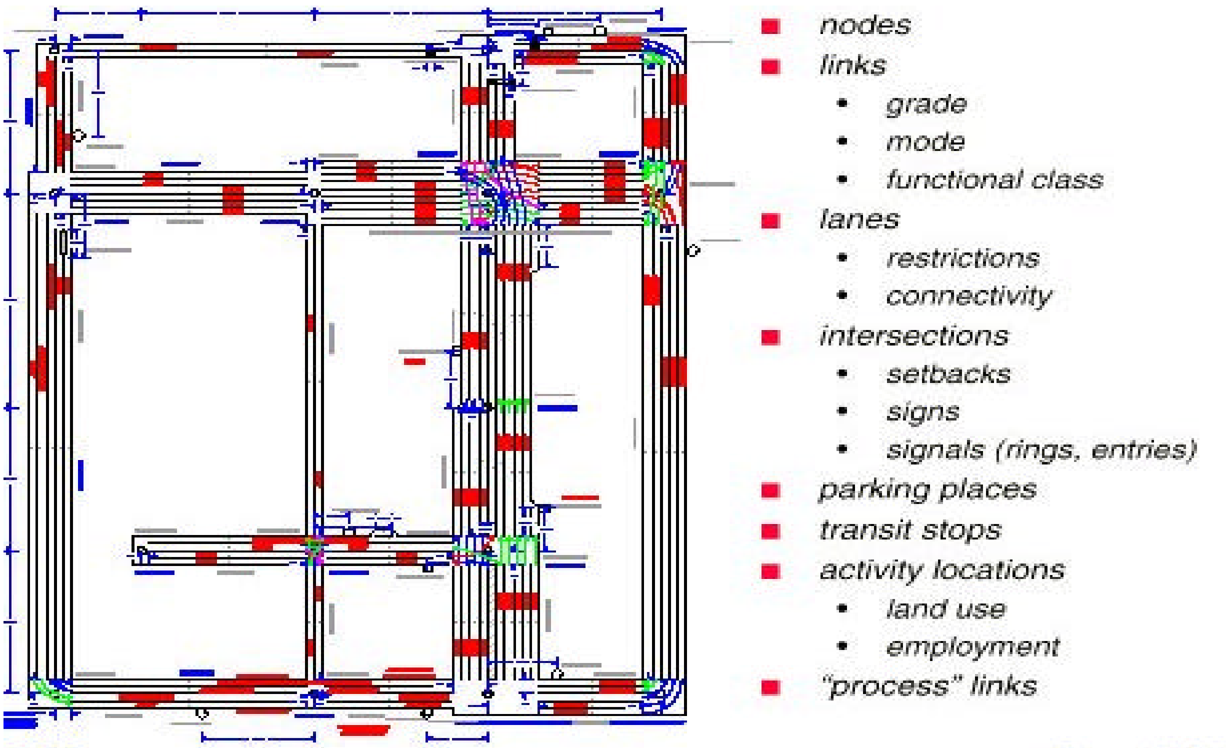

Figure 2-4: Network Data Requiremtns

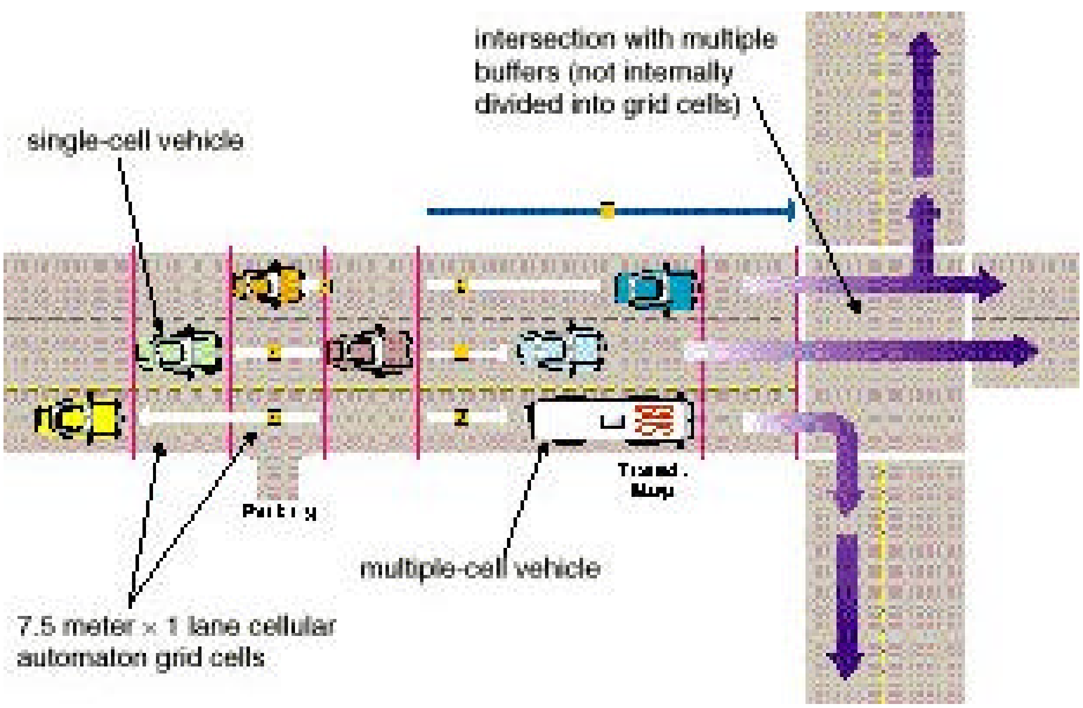

Figure 2-4: Traffic Micro-Simulation

Figure 2-6: Emissions Estimates by Link and Concentration

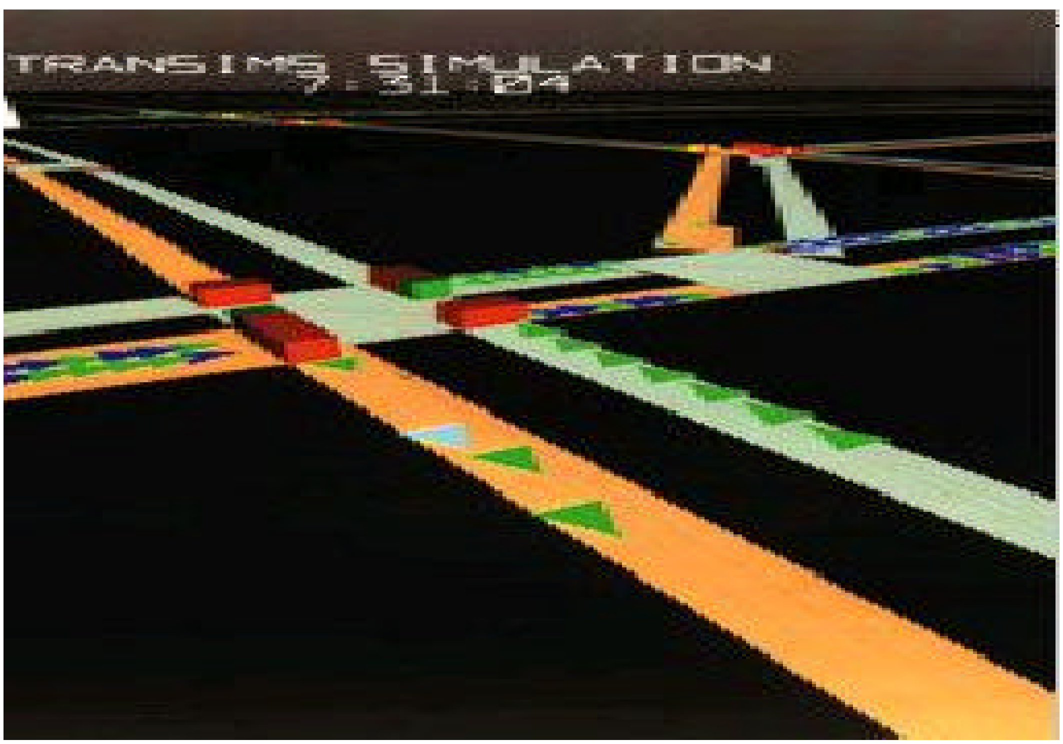

Figure 2-7: TRANSIMS Animation for Dallas-Fort Worth Simulation

Table 2-2: TRANSIMS Computational Resources

Computational Resource	Requirement
Software package	CD #1: TRANSIMS modules CD #2: Micro-simulation file extensions
System requirements	SUN SPARC level hardware Multiprocessor machine, or Single-CPU workstations on a local area network for parallel computing capability
Multiprocessor requirements	Ultra Enterprise
Workstation/LAN requirements	Sparcstation 5 Sparcstation 20 Ultra TCP/IP network connectivity Calibration: 2 single CPU workstations Simulation: 5 single CPU workstations
Operating system requirement	Solaris 2.5 or higher
Memory requirements	250 Mbytes per CPU for multiprocessor configuration 250Mbytes per workstation for LAN configuration
Hard disk requirements	1.2 Gbytes to install TRANSIMS 9.5 Mbytes for plan sets 250 Mbytes for software database 1 – 2 Gbytes for the micro-simulation depending on its size
Software requirements	Parallel Virtual Machine 3.3 (supplied with TRANSIMS) Java 1.1 or higher xgl library (Solaris) HOOPS runtime license ArcView (optional)
Compilation requirements	Rogue Wave Booch Components SunPRO C++ Compiler 4.1

Source: C. L. Barrett, R. J. Beckman et al, TRANSIMS User Notebook, LAUR-97-4502, Los Alamos National Laboratory, April 1998 (http://transims.tsasa.lanl.gov/)

multimodal networks. An Output Visualizer can scan the resulting reams of results for very specific localized impacts during a specified time, or it can compile and display summary global results. Engineers and planners can accomplish all traditional transportation analyses with TRANSIMS using the aggregate, summary data that results from the micro-simulation. To achieve such results TRANSIMS currently runs on multiple CPUs to maximize the computational speed. Updating of vehicle position is done in parallel on the individual CPUs, which is faster than updating on a single CPU. The transportation network is partitioned among the CPUs with each CPU receiving a set of nodes and links. This approach results in some links that are split in the middle between two CPUs. Vehicles are transferred between the CPUs as they traverse split links. Table 2-2 summarizes the computational resources for TRANSIMS.

Dallas-Fort Worth Case Study

The Dallas-Fort Worth case study demonstrates the potential of TRANSIMS and highlights the critical data and computational resources needed by TRANSIMS. The goal of the case study was to apply the traffic micro-simulation module in the 25-square-mile area surrounding the Galleria shopping complex. The study area represented about 1% of the DFW region and between 2% and 4% of the total DFW population and employment depending on the base year 1990 or future year 2010. Using existing DFW production/attraction data for 800 zones, TRANSIMS generated activities and plans for approximately 3.5 million travelers for the hours 5:00 to 10:00 am. Those travelers' plans falling in the Galleria study area became the input to the micro-simulation. Approximately 200,000 vehicle trips were simulated for each of the two Galleria transportation improvements. Figure 2-7 depicts a sample output of the micro-simulation model applied to the Galleria area network.

Transportation improvements included an additional lane in each direction on the nearby I-675 and additional lanes on four major arterials to improve Galleria access. The analysis showed that the arterial improvements were superior to the interstate improvements. The project participants reported surprise when the improvements induced about 10% additional demand, thus offsetting the improvements somewhat. Thus, one of the significant contributions of TRANSIMS is the greater and different insight that it offers about the transportation system under study. The Dallas-Ft. Worth micro-simulation required five networked Sun SPARC workstations running in parallel. This level of computational power generates the five-hour micro-simulation of traffic between 5:00 and 10:00 a.m. in real time. About 1.2 gigabytes of local disk space were needed for raw binary data, and an equal amount of disk space was required for the DFW calibration. An additional 300 Mbytes of disk space were needed for the post-processed simulation data for each micro-simulation run. Many runs were completed, but not all were saved for subsequent analysis. Table 2-2 summarizes general software and hardware requirements for TRANSIMS.

Portland Case Study

The Portland case study is currently in progress at LANL with support from Portland METRO and the National Institute of Statistical Sciences[3]. Portland provided activity and network data, and NISS developed a sampling methodology to adapt METRO activity data to the TRANSIMS framework.

Portland has demonstrated the second interim operational capability (IOC-2) of TRANSIMS and that set the stage for the commercial version of TRANSIMS. While the Dallas-Ft. Worth study emphasizes the TRANSIMS micro-simulation module for a restricted network, the Portland study emphasizes activity demand forecasting and intermodal trip plans, as well as micro-simulation. Furthermore, the TRANSIMS network covers the entire Portland METRO planning region. The study includes multiple travel modes (auto, bus, light rail, walk, and bicycle), high occupancy vehicle analysis, and trucks and freight deliveries. The environmental analysis involves emissions only, not air quality.

As an example of the type of network data a North Carolina city would have to provide to a TRANSMIS pilot analysis, consider what Portland METRO has provided LANL:

- an EMME/2 representation of the Portland transportation network,
- additional network features including pocket lanes, signals, and lane connectivities at intersections,
- Tiger files for transformation into the TRANSIMS format, and
- link characteristics for speed, functional class, capacity, allowed modes, prohibited turns, parking, number of through lanes, street alignments, traffic signal locations, and transit stops.

Future network enhancements will include off-street and on-street parking, transit routes, sign inventories, and timing and phasing plans for signalized intersections.

Data in the Portland activity model include:

- five broad time periods,

- sample enumeration on households,
- probabilities of travel tours (patterns) described by time of day, mode and destination choice, and
- tour purposes - work/school, household maintenance and discretionary.

Future activity model enhancements will include under-16 age group travelers, separation of school and work purpose trips, movement from traffic analysis zones to discrete lots or street arcs.

The basic METRO style model (or that of other cities) must be changed from a probability model to a stochastic model using Monte Carlo simulation. When Monte Carlo simulation is applied to a 100% count of synthetic households, the result is a full set of activity patterns and tours by primary purpose, complexity and time period designation. The result is a synthetic household survey for all households in a region such as Portland or a pilot city in North Carolina.

Cost and Staffing Requirements

Documented costs for the Dallas and Portland TRANSIMS studies are not available. TRANSIMS development costs and contributions by FHWA and LANL would be hard to separate from application costs. Anecdotal comments suggest that the very complete data set for Portland required several person-years to produce.

Summary

TRANSIMS exists as a working prototype. The Los Alamos National Laboratory has demonstrated TRANSIMS on Dallas-Fort Worth and Portland, and Federal EDP funds will sponsor five or six more pilot demonstrations. TRANSIMS data requirements are extensive, especially for the network and activities. TRANSIMS is computationally intense, and the required hardware is not typically available at MPOs or DOTs. Any MPO considering the use of TRANSIMS must be willing to dedicate significant resources. While the TRANSIMS-LANL model is essentially complete, uncertainty exists regarding the computer platform and application of the commercial version.

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Section 3: The Fayetteville-Fort Bragg Case Study

This chapter discusses the potential of using the Fayetteville Area including Fort Bragg as an Early Deployment Program pilot project for TRANSIMS. After establishing the significance and rationale for the Fayetteville-Fort Bragg case, the team examines the compatibility of the Fayetteville-Fort Bragg case with a variety of EDP requirements as defined by FHWA. Such requirements include availability of activity and network data and other resources. This chapter provides the foundation for an EDP pilot project proposal, and it organizes decision factors for the development of the TRANSIMS Feasibility Assessment Tool that a subsequent chapter describes. Additional information regarding the Fayetteville-Fort Bragg case study may be obtained on the project web site http://www4.ncsu.edu/~dsengup/indextransims.html.

The Study Area

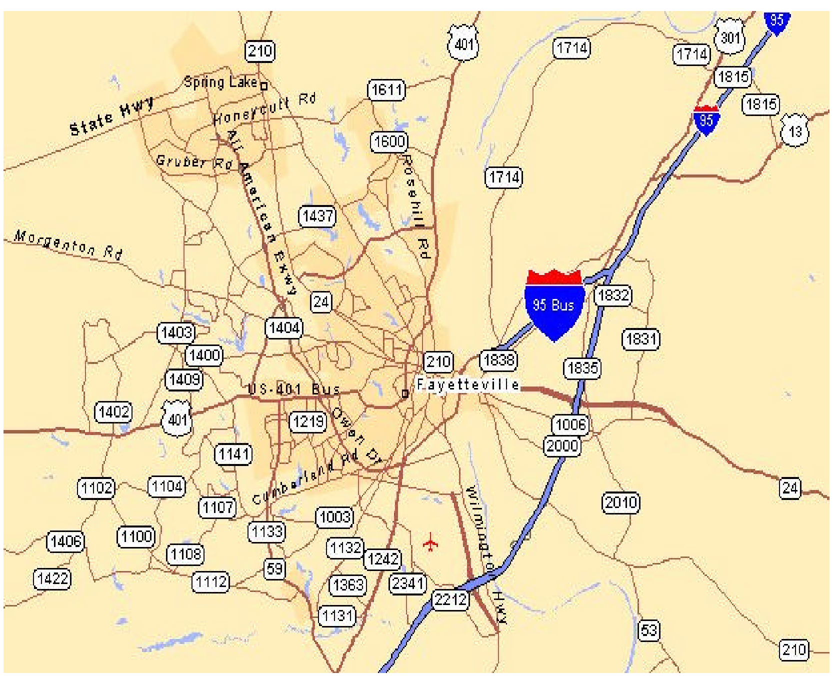
The Fayetteville metropolitan area (Figure 3-1) is located in eastern North Carolina along the Cape Fear River. It includes the following jurisdictions:

- City of Fayetteville
- Town of Hope Mills
- Town of Spring Lake
- Cumberland County
- Harnett County

In addition Fort Bragg Military Reservation and Pope Air Force Base are in the Fayetteville metropolitan area and participate in transportation planning. Based on the 1990 Census of 275,000 persons and 125,000 jobs, the area is the third largest metropolitan area in North Carolina. Regional officials expect year 2025 population to be nearly 400,000 and employment to be 175,000. Approximately 25% of the population are military personnel and dependents, and 36% of the jobs are military.

Fort Bragg and Pope Air Force Base are critical to the international policy of the U.S. Jointly they can deploy airborne contingency troops within 18 hours. Support units and materiel follow by air, land and sea routes. Thus, local roads and highways must be capable of supporting sustained in-bound and out-bound troop and equipment movements through the region to I-95 and eastern seaports. To protect its troop movements and military facility against the threat of terrorism Fort Bragg recently constructed gates

Figure 3-1: Fayetteville Metropolitan Area



at all major entrances. As a result of normal and emergency troop movements and because of continuing security checks along state highways that pass through Fort Bragg, traffic congestion and vehicle emissions may increase beyond acceptable levels. New studies at NCDOT and NCSU are underway to quantify these concerns and to evaluate improvement alternatives.

Focus Problems for an EDP Project

The Fayetteville-Fort Bragg case presents a variety of issues to explore in an EDP project, or in a traditional transportation planning effort. They include

- traffic congestion
- vehicle emissions estimates
- corridor-level, peak hour project analysis
- project prioritization
- ITS vs. conventional traffic options
- civilian-military "good neighbor" issues
- military/civilian equity
- military/civilian emissions budgets
- military access to I-95
- transportation model research

Fayetteville has the usual traffic problems of a small city, but they are compounded by the presence of Fort Bragg, which is a small city itself. With restricted Post access, traffic congestion at Fort Bragg gates spills back to Bragg Boulevard and Murchison Road, which are two state highways that serve the region (Figure 3-2). Not only is regional traffic affected, but also interregional travel from to and from Fayetteville, Raleigh, and other cities to the north and west. Troop deployments during international emergencies, during exercises, or in response to terrorist compound traffic congestion. Likewise, local traffic congestion inhibits military missions. Potential solutions include demand management of military traffic and intelligent transportation systems (ITS) options at military gates. More conventional options include corridor right-of-way widening, traffic signal system improvements, expressway loops around or through Fort Bragg and direct military access to I-95.

Fort Bragg is the economic engine for the region, and Fayetteville residents are generally grateful. Yet, Fort Bragg officials are sensitive to important "good neighbor" issues. One, for example, is maintaining equity of Fort Bragg transportation improvements versus others in the region. Another is the assumed impact of Fort Bragg mobile and point source emissions on regional air quality conformity. And others include the impacts of numerous military retirees on land use development and traffic. TRANSIMS micro level evaluation and tracking capabilities can allow equitable allocation of impacts between military and civilian sectors.

While the Fayetteville metropolitan area has enjoyed good air quality, it is likely to become a non-attainment area in the near future. Of direct concern to NCDOT (and other agencies considering EDP pilot studies) is the impact of a new model like TRANSIMS on the air quality estimates. A new model may force a borderline region toward non-attainment with mandated funding consequences. TRANSIMS, however, has the desirable characteristics of "micro" simulation that can help Fayetteville to prioritize over 40 projects versus constrained air quality budgets – a difficult task with traditional systems-level models. Such tasks include, for example, assessing whether or not a proposed $10 million areawide computerized signal system is more likely to maintain air quality conformity than construction projects. Furthermore, the TRANSIMS project-level evaluation capabilities can test what specific military transportation demand management options are conducive to reduced emissions.

As a potential candidate for a TRANSIMS EDP project the Fayetteville – Fort Bragg case also presents attractive, yet daunting, research issues. They include:

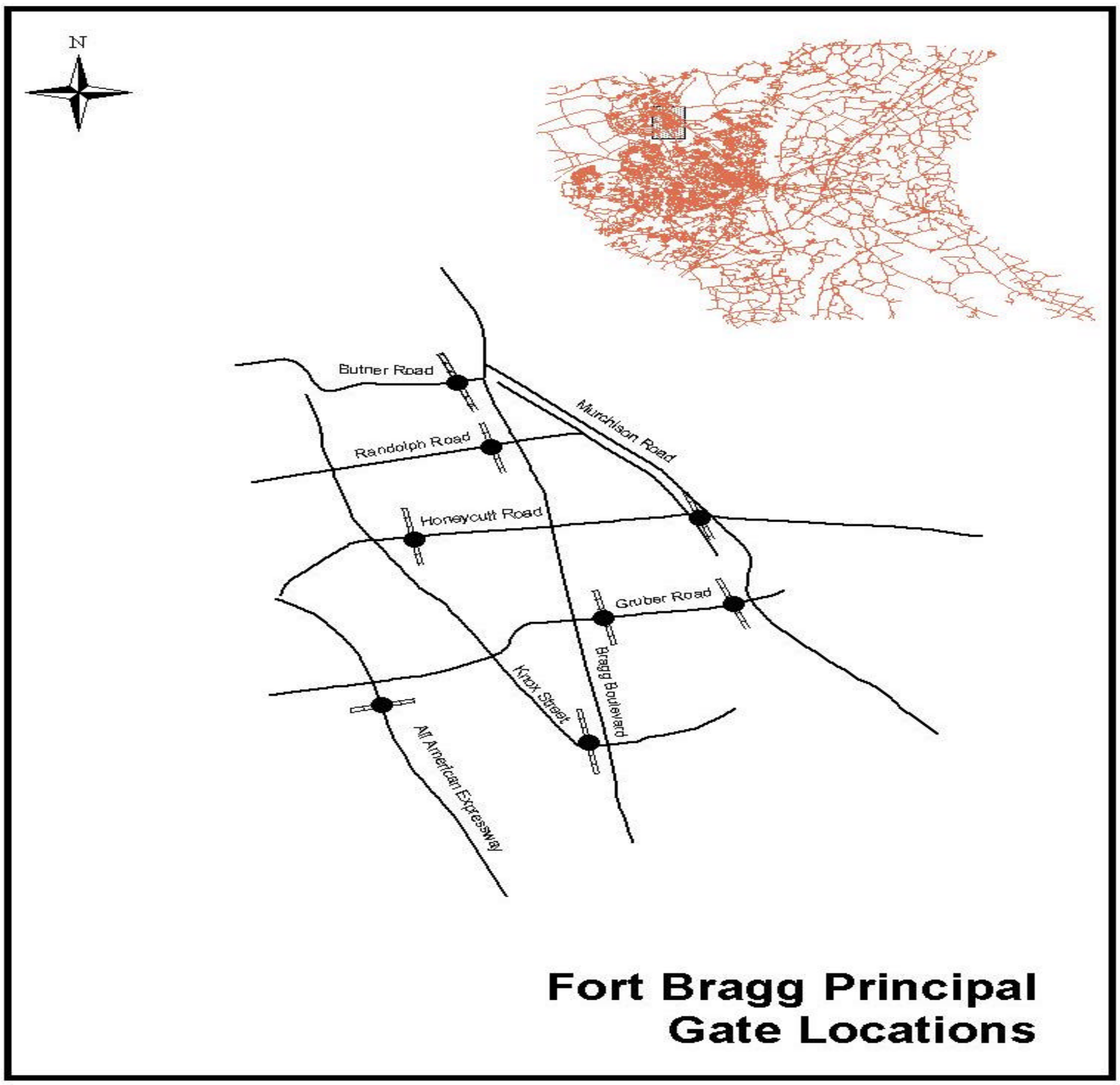
- "bridging the gap" between current and future year data
- TRANSIMS calibration and validation versus traffic counts, Tranplan and TransCAD

- activity-based survey sample sizes for standard and specialized (military) populations
- synthesized activity system data and transportation system data for current or future year
- model feedback to test air quality measures at the link and corridor level
- incorporating the effects of significant external-to-internal trips

Beyond these opportunities for regional transportation planning, the Fayetteville – Fort Bragg case may be useful for other applications. For example, the case presents opportunities to examine the utility of TRANSIMS for military applications including planning troop movements during emergencies and assessing mobility impacts from terrorist attacks.

Clearly, however, if the Fayetteville – Fort Bragg case were to be used in a TRANSIMS EDP pilot study, only priority issues should be addressed. Otherwise, the effort could become overwhelming, especially with respect to data collection, model construction and maintenance. As noted in Section 2 the Portland case study required a multi-year, expensive data collection effort.

Figure 3-2: Fort Bragg Gate Locations



EDP Case Study Requirements

To be competitive in the TRANSIMS EDP selection process a case study must demonstrate "readiness" in several important categories[1 2]:

- diversity in city size, US region and TRANSIMS application
- availability of data, political support, local match and commitment to TRANSIMS
- team expertise and computer support
- probability of success and cost of the EDP project

Furthermore, the proposed EDP pilot study must be completed within a two to three year period at a federal cost of about $1 million.

Relatively few agencies or MPOs are likely to meet the time and cost requirements, especially if the candidates are the larger, more problematical regions for which FHWA and LANL developed TRANSIMS. Thus, it seems likely that a successful candidate agency will focus on one or two transportation problems in a sub-area network like the Dallas-Fort Worth case, or indeed the study area will be a smaller region. Such a case will likely minimize data requirements, cost, and project time while maximizing the probability of a successful project.

The Fayetteville – Fort Bragg case fits the profile for success. It represents a smaller region with minimal risk, acceptable cost, manageable data requirements, interesting traffic problems, minimal air quality benchmarking, local expertise, and appropriate computer resources. Furthermore, the timing is right: the Fayetteville regional model is due for update in 2000, TRANSIMS can provide insight into regional military-civil equity problems, expected activity-system survey costs could be used for the local match, and the NISS/NCSU technical team members are available. However, due to recent NCDOT personnel changes, model platform changes and regional modeling commitments, NCDOT had to rescind its support for the EDP case study (Section 1). Without local support and commitment to TRANSIMS, a pilot study is not feasible in North Carolina.

For the edification of other agencies considering the Early Deployment Program, and for possible future implementation of TRANSIMS in North Carolina, it is worthwhile to discuss in more detail how the Fayetteville – Fort Bragg case meets TRANSIMS data requirements, perhaps the most challenging requirement. This data discussion is also very appropriate as NCDOT begins conversion form Tranplan to TransCAD that can use all or most of the GIS-based data discussed in subsequent pages of this section.

TRANSIMS Data Requirements

Depending on the application of TRANSIMS (or TransCAD) a variety of network and activity system data are available from the Fayetteville Area Metropolitan Planning Organization and from Fort Bragg. TRANSIMS is a very flexible program that can address a variety of problems in differing detail. Thus, data requirements will vary. For a simple case, a standard Tranplan model and data set can be applied with simplifying assumptions to test limited TRANSIMS capabilities. For an extreme test a detailed new data set would have to be developed to more fully test TRANSIMS capabilities. Such network data would include coding every street, every lane group, bus route, signal, intersection, and parking facility. Activity data would come from a new activity-based residential survey and a business travel survey. Like traditional regional modeling, the data collected depend on the problem to be solved, the time and resources available and precision necessary.

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[1] Agency Participation in TRANSIMS Early Deployment Program, Solicitation Plan, Travel Model Improvement Program, FHWA, USDOT, September 20, 1999

[2] Early Deployment of TRANSIMS: Getting Ready for TRANSIMS, FHWA, USDOT, April 11, 2000

LANL and FHWA are exploring ways to reduce the effort required to build TRANSIMS databases and models. They include reducing the necessary data, improving data collection techniques, synthesizing data, and exploring the concept of data providers. Thus, TRANSIMS data requirements are likely to decrease in coming months. However, this study identifies data requirements for the early prototype versions of TRANSIMS. Figure 3-3 displays a summary of those requirements by module. Subsequent figures and material give a more detailed discussion of TRANSIMS data requirements and Fayetteville – Fort Bragg resources for that data.

This research reviewed the literature[3] [4] and examined TRANSIMS files for test networks to identify required information for TRANSIMS including input files, file structures, and program structure. As part of the literature review, the team developed a flowchart that summarizes the TRANSIMS modules as well as their corresponding input and output files. Figure 3-4 shows the four primary modules used in TRANSIMS: Population Synthesizer, Activity Generator, Route Planner, and Micro-simulation. Input files that are available are shown with a ✓ next to them. Input files that are required and are not available are shown with the ❆ symbol. The figure includes a reference for each file and module that identifies a volume and section number from the corresponding TRANSIMS document set. As shown in the flowcharts, the output files created as part of one module are often used as input files for another module. Additionally, some of the network files (node, link, activity location) are utilized in multiple modules.

After identifying the required input files for each module, the team examined each of the individual input data to determine the population, network, and activity attributes needed to run TRANSIMS. Table 3-1 and Table 3-2 provide a list of the required input data for the network and activity files. It should be noted that the TRANSIMS population synthesizer module requires census data that are available from either CD-ROM or the World Wide Web. Thus, Table 3-1 does not provide any reference for required population data.

Fayetteville – Fort Bragg Data Availability

Based on discussions with engineers and planners at NCDOT, the City of Fayetteville, and Cumberland County, the team identified various data sources that include some of the required information needed to run the TRANSIMS model. Table 3-1 identifies the available data source for each of the required TRANSIMS attribute data. A summary of the primary data sources obtained to date is provided below.

911 GIS Database

Cumberland County maintains a GIS-based 911 database which includes street networks, parcel lines, building footprints, and tax assessor's data for each residential and commercial structures. The assessor's data include information such as size of building, parcel evaluation, and owner's name. This information will be helpful in establishing a skeletal transportation network with housing and employment locations. Detailed transportation network information is not provided. Other sources will be needed for transportation network information (see City of Fayetteville Signal System Implementation Plan below).

Land Use Planning Data

The Cumberland County Planning Department maintains GIS files that include the land use plan for the Fayetteville metropolitan area. This database includes a zone-based summary of housing conditions and types for year 1992 and 2010 conditions. The data are compatible with conventional trip generation

[3] TRANSIMS-LANL-1.0 Document Set (May 28, 1999)
[4] http://transims.tsasa.lanl.gov/

Figure 3-3: Summary TRANSIMS Modules and Data Requirements

Input Data	TRANSIMS Module	Output Data
Network data Demographic data Geo-coded census tracts	**Population Synthesizer**	Synthetic households Synthetic persons
Synthetic population Household activity 24-hour survey Network data nodes & links locations of activities	**Household & Activity Generator**	Activity data who & what activity priorities starting & ending times mode preference vehicle preference
Activity data Transit data Network data	**Route Planner** including vehicle, bus, walk, park	Traveler plans household by household times, O/Ds, paths, modes trip sequence Vehicles types, start & end locations
Network data Vehicles Transit data Traveler plans	**Traffic Micro Simulator**	Traveler events second by second Snapshots & animations links & intersections vehicles & traffic controls vehicle trajectories
Micro simulator output Vehicles External data sets for emissions Network data	**Emissions Estimator**	Emissions inventories every 30 meters every 5 minutes CO, NO_X, NMHCs, CO_2 particulate matter fuel consumption MODELS3 database
Traveler plans Micro simulation output	**Output Visualizer**	2-D & 3-D static views 2-D & 3-D animated views Interactive or batch output Individual displays by location by performance data type

Source: B. W. Bush, The TRANSIMS Framework, Los Alamos National Laboratory, The 78th Annual Meeting of the Transportation Research Board, 12 January 1999 (http://transims.tsasa.lanl.gov/)

Figure 3-4: Detailed TRANSIMS Modules and Data Requirements

Legend: ✓ Data available to the NCSU/NISS TRANSIMS team
☸ Data to be collected by the NCSU/NISS team

Sources: TRANSIMS CD Document Volumes

Population Synthesizer

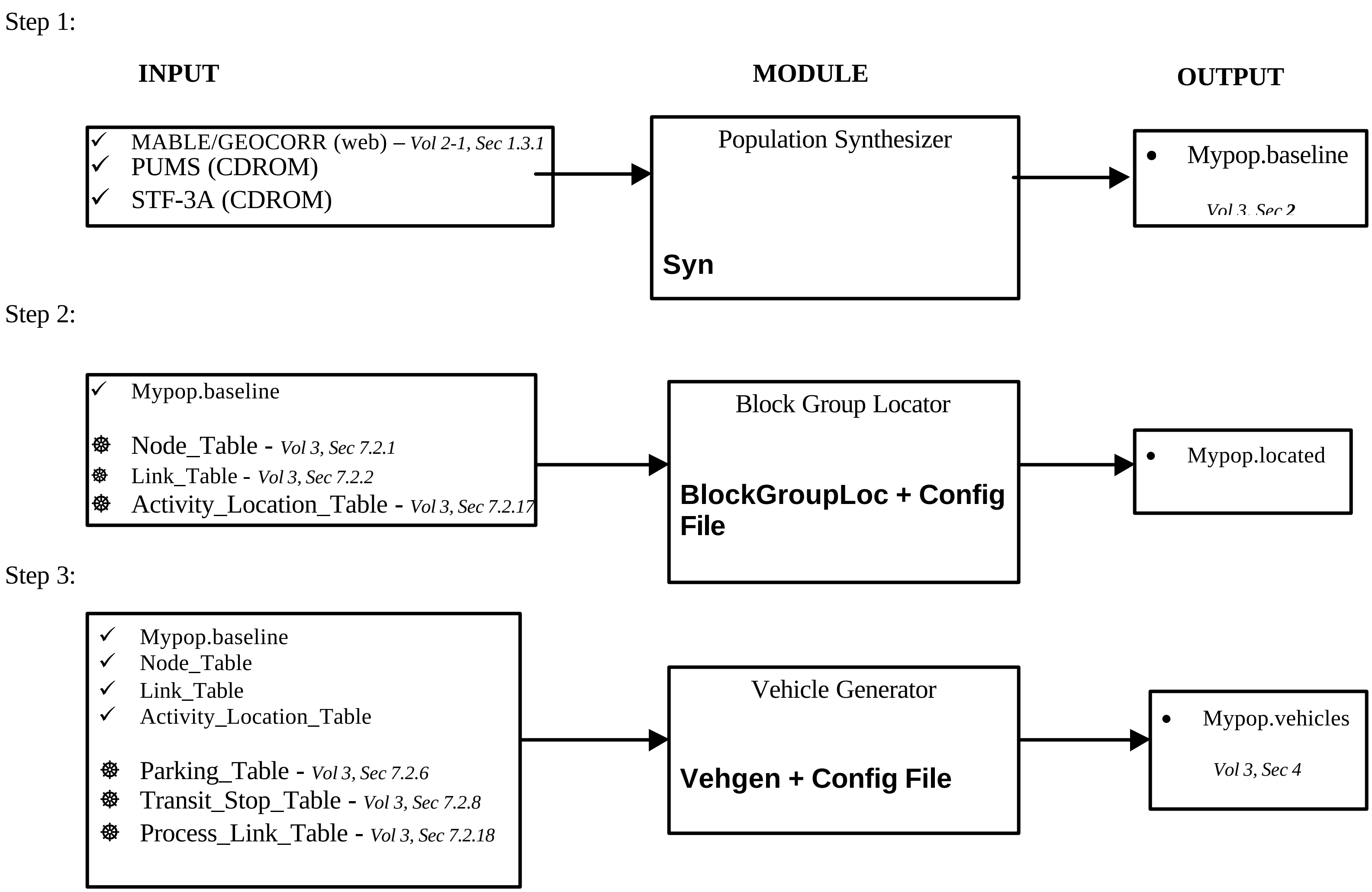
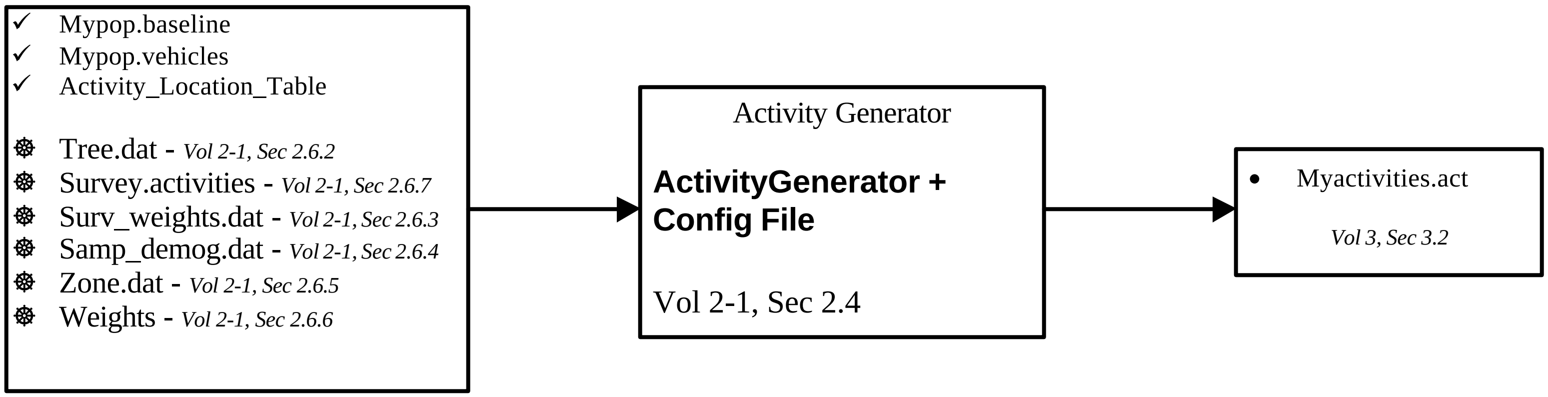
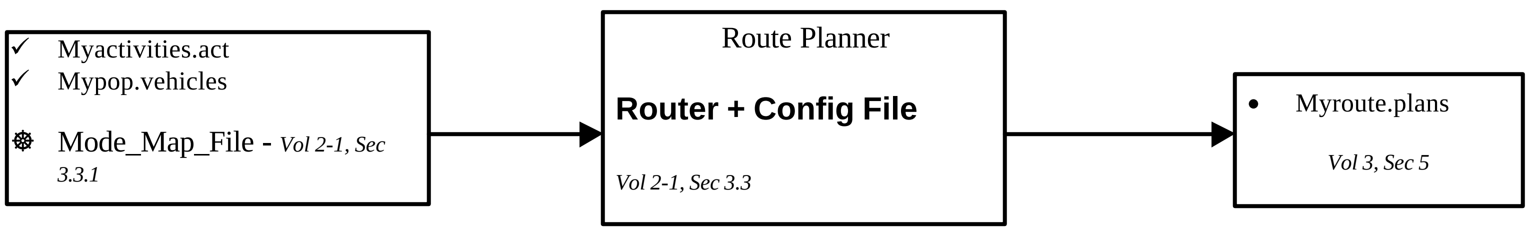


Figure 3-4 (continued)

Activity Generator



Route Planner



Traffic Micro-simulator

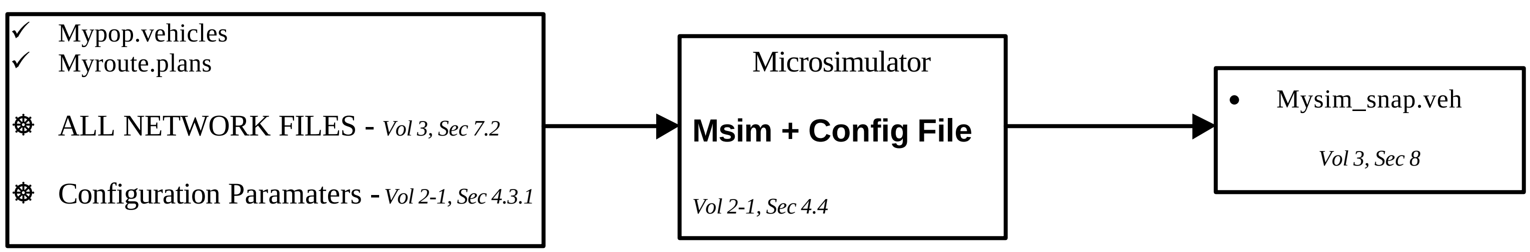


Table 3-1: TRANSIMS Network Data Requirements and Fayetteville Sources

Roadway Attribute	Availability/Acquisition of Data
Location/Elevation of Roadway	911 GIS Database
Number of Lanes	Field Data Collection
Number of Turn Pockets	Field Data Collection
Length/Style of Turn Pockets	Field Data Collection
Grade	Field Data Collection
Setback	Field Data Collection
Capacity	Field Data Collection
Speed Limit	Field Data Collection
Free Flow Speed	Field Data Collection
Functional Classification	Fayetteville Area Transportation Plan
Vehicle Type	Field Data Collection
Lane Use	Field Data Collection
Transit Stops	Fayetteville MPO Transit Authority
Transit Type/Capacity	Fayetteville MPO Transit Authority

Intersection Attribute	Availability/Acquisition of Data
Location/Elevation	911 GIS Database
Intersection Control	Signal Systems Implementation Plan/Field Data
Signal Type and Plan	Signal Systems Implementation Plan/Field Data
Signal Offset, Coord, Ring, and Entry	Signal Systems Implementation Plan/Field Data
Signal Phasing	Signal Systems Implementation Plan/Field Data
Signal Timing (Min, Max, Yellow)	Signal Systems Implementation Plan/Field Data

Activity Location Attribute	Availability/Acquisition of Data
Parking Lot Location	Field Data Collection
Parking Lot Type	Field Data Collection
Parking Lot Capacity	Field Data Collection
Zone Location	Fayetteville Area TRANPLAN Model
Zone Type (work, shop, school, visit, other)	Fayetteville Area TRANPLAN Model
Activity Location and Offset	911 GIS Database
Activity Square-footage by Land Use Type	911 GIS Database
Number of Employees/Employers of Activity	911 GIS Database
Activity TAZ, Block Group and Tract	Fayetteville Area TRANPLAN Model

Table 3-2: Required Data for Travel Activity and Fayetteville Sources

Activity Type Attribute	Availability/Acquisition of Data
Delay/Cost for Modes	Activity Survey
Activity Type per person	Activity Survey
Activity Start Location and Time	Activity Survey
Activity End Location and Time	Activity Survey
Arrival Mode of Activity	Activity Survey
Occupancy Type (Driver/Passenger)	Activity Survey
Number in Vehicle	Activity Survey
Household Income	Activity Survey
Number of Vehicles in Household	Activity Survey
Household Size	Activity Survey
Household Income	Activity Survey
Ages of Household Members	Activity Survey
Number of Workers in Household	Activity Survey
Household Density	Activity Survey
Relationship of Each Person	Activity Survey
Person Work	Activity Survey
Person Gender	Activity Survey
Person Age	Activity Survey

models. The Fayetteville GIS database of residences and employment locations (Figures 3-5, 3-6, and 3-7) provide the information needed to locate, size and value residential and employment activities for the activity survey. Furthermore, 1992 base year GIS measures and 2010 future year estimates of residential and employment locations, size and value are available in Fayetteville (Tables 3-3 and 3-4).

The excellent detail provided by the Fayetteville GIS database is a primary reason that Fayetteville is an excellent candidate for a TRANSIMS EDP project; however, the data require enhancement with an activity-based survey of travel behavior for TRANSIMS activity system modeling.

Fayetteville Area Activity-Based Survey

TRANSIMS requires detailed activity system data on person trips by type, origin, destination, mode, time of day, etc. A detailed activity-based survey involving a travel diary for several days will be needed to provide this data. NCDOT, which supported this type of survey for the Triangle Area Plan, estimated that such a survey would cost about $200,000 and would qualify as the local match for an EDP project. An alternative to conducting a new survey (which can exceed $100 per household) may be re-calibration of similar information acquired from the Triangle and/or Portland. NISS has been actively involved in the development and review of the Portland survey, which included a sample size of 4,000 households. NISS and its associate have examined the feasibility of re-calibrating Portland travel activity for Fayetteville based on a small sample of about 600 households.

Fayetteville Area Transportation Plan

The Transportation Advisory Committee of the Fayetteville Area MPO approved the Long Range Transportation Plan (April 1999) on June 9, 1999. This document contains useful information such as the thoroughfare plan, pedestrian plan, bicycle plan, and transit plan. These plans are in map and narrative format that would need to be converted to a GIS format for TRANSIMS.

Figure 3-5: Sample Fayetteville Area GIS Snapshot

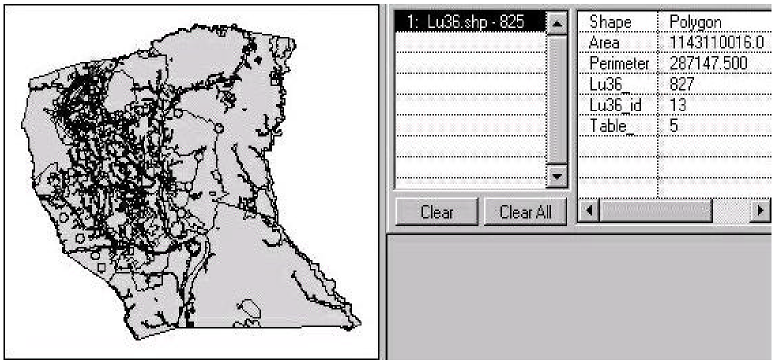


Figure 3-6: Sample Fayetteville Residential Area GIS Snapshot

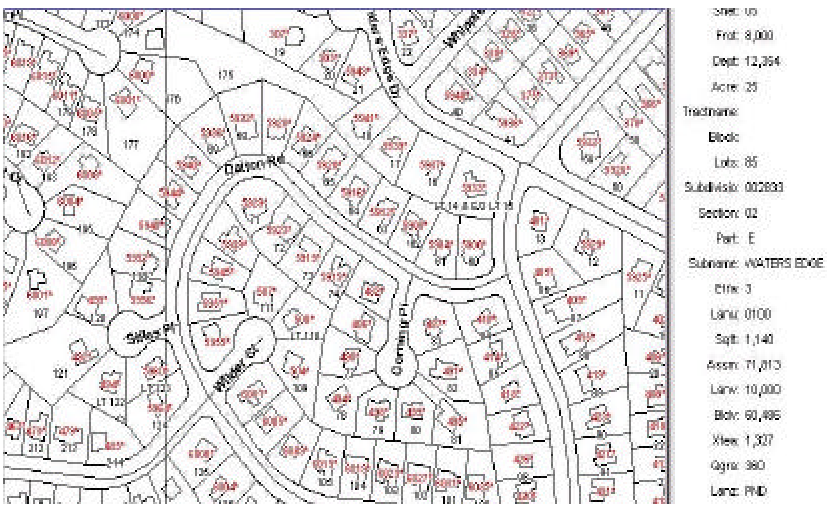


Figure 3-7: Sample Fayetteville Employment GIS Snapshot

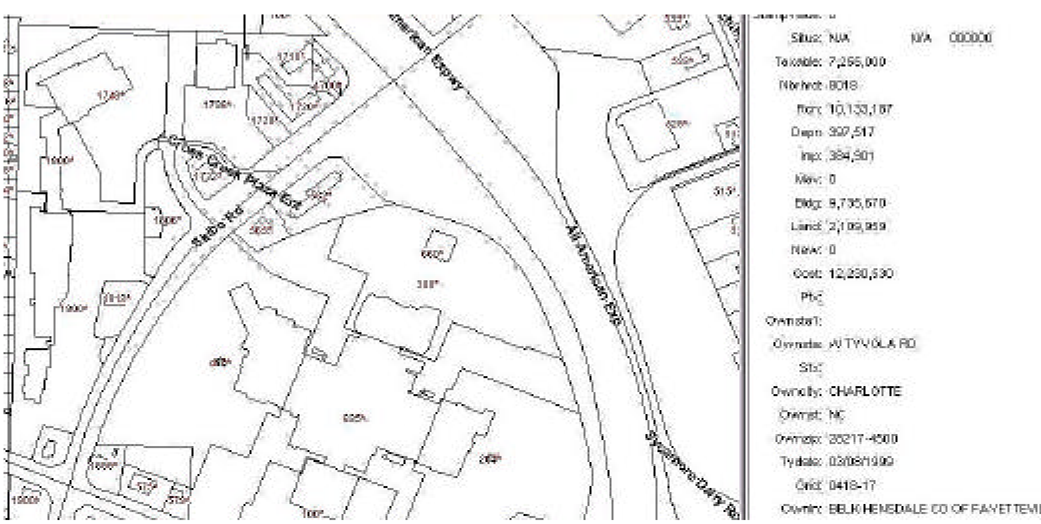


Table 3-3: Sample Fayetteville Residential and Employment Base Year Data

1	ODZ	EXCEL	ABOVE	AVERAGE	BELOW	POOR	X6	SPECIAL	TRUCKS	X1	X2	X3	X4	X5	X7	TOTAL	SFU	MFU	MHU	HHP	GQP	TOP
2	0114.00070	0	7	48	136	30	221	0	81	553	236	7	6	67	0	869	180	17	23	580	0	580
3	0114.00071	0	0	4	10	29	43	0	6	0	0	0	0	10	0	10	27	5	12	113	46	159
4	0114.00072	1	7	32	13	0	53	0	0	1	0	0	0	0	0	1	46	0	8	141	0	141
5	0114.00073	4	13	156	5	0	178	0	0	0	7	0	0	7	0	14	131	0	47	458	0	458
6	0114.00074	0	4	52	15	7	78	0	1	26	0	2	0	19	0	47	47	0	31	197	0	197
7	0114.00075	0	0	18	10	0	28	0	7	14	25	0	5	8	0	52	20	0	8	72	0	72
8	0114.00076	0	0	23	6	1	30	0	1	0	44	50	0	151	0	245	15	4	11	76	0	76
9	0114.00077	1	0	2	2	9	14	0	12	8	0	0	0	0	0	8	8	0	6	35	0	35
10	0114.00078	2	5	74	72	179	332	0	6	21	23	9	1	2	0	56	236	19	76	858	0	858
11	0114.00079	0	0	3	44	83	130	0	0	0	63	0	0	6	0	69	118	0	13	345	0	345
12	0114.00080	1	0	32	92	27	152	0	8	16	0	0	0	0	0	16	113	0	39	392	0	392

Table 3-4: Sample Fayetteville Residential and Employment Future Year Data

1	EX2010	AB2010	AV2010	BE2010	PO2010	X62010	SP2010	XCOORDODZY	X12010	X22010	X32010	X42010	X52010	X72010	TOT2010
2	0	7	51	145	30	233	0	0114.00070	608	260	8	7	74	0	956
3	0	0	4	13	29	46	0	0114.00071	0	0	0	0	11	0	11
4	1	8	36	14	0	59	0	0114.00072	1	0	0	0	0	0	1
5	4	14	166	5	0	189	0	0114.00073	0	8	0	0	8	0	15
6	0	4	54	16	7	81	0	0114.00074	29	0	2	0	21	0	52
7	0	0	21	12	0	33	0	0114.00075	15	28	0	6	9	0	57
8	0	201	224	6	1	431	0	0114.00076	0	44	50	0	151	200	445
9	1	0	2	3	9	15	0	0114.00077	9	0	0	0	0	0	9
10	2	5	80	92	179	358	0	0114.00078	23	25	10	1	2	0	62
11	0	0	3	48	83	134	0	0114.00079	0	69	0	0	7	0	76
12	1	0	34	101	27	163	0	0114.00080	18	0	0	0	0	0	18

Fayetteville Automated Signal System Plan

The City of Fayetteville Traffic Department and Kimley-Horn Associates are developing a new automated signal system for the urban area including Fort Bragg. The Kimley-Horn plan, intersection field data, lane geometry, turn lane storage length, and signal timing data for over 130 signalized intersections are appropriate and necessary for TRANSIMS. Additionally, the City of Fayetteville can provide 1998 intersection turning movement counts for each of the 130 intersections. These intersections represent most of the major intersections in the Fayetteville area. Consequently the majority of the street and intersection data that TRANSIMS requires is available.

Fayetteville Area TRANPLAN Model

NCDOT and NCSU have the TRANPLAN files for the 1995 Fayetteville area transportation model. They include information such as number of lanes per link, link speeds, link capacities, and functional classifications. NCSU has converted these files to TransCAD. By converting the network to TransCAD as an intermediate step toward TRANSIMS the network can be warped over aerial photography or GIS image to obtain a very accurate network representation beyond that normally associated with traditional "stick figure" networks.

Fort Bragg Planning Data

The Master Planning Unit at Fort Bragg maintains data CDs including transportation networks, facility locations, utilities, gate access and other information important for developing a TRANSIMS or other model. The data are in several formats including Microstation and self-opening images. Various military reports document gate access issues, mobilization, security, economic impacts and long range planning.

Other Required Resources[2]

Besides extensive data TRANSIMS requires sophisticated computer resources. Depending on the platform upon which TRANSIMS is delivered after the commercialization process, the local input TRANSIMS data will be delivered by Internet to a remote support agency for processing or the local agency itself will be responsible for its own data processing. At this time FHWA does not know the TRANSIMS platform, and it advised agencies considering an EDP not to invest in computer resources for the EDP. Table 3-5 summarizes current computer requirements for production runs of the research version TRANSIMS-LANL. NISS and NCSU have conducted demonstration runs and other small networks with TRANSIMS-LANL running on a 600 MHz Linux platform. Both organizations have used parallel computer networks to solve problems of similar complexity to TRANSIMS.

GIS is another resource that a potential EDP agency must have. Not only having GIS data, but also being able to program and manipulate GIS data and interfaces will facilitate data collection and modeling. Fayetteville and Fort Bragg planning officials, as well as NCDOT engineers, are well versed in GIS as demonstrated by previous paragraphs on activity system data and network data.

Aerial photography is another resource that will support the TRANSIMS development process. Again, Fayetteville, Fort Bragg and NCDOT use aerial photography throughout their current planning processes and would have the requisite expertise for a TRANSIMS EDP project.

In a large sense training is another requirement for TRANSIMS. The methodology and computer programs are a completely new approach to modeling travel. New concepts include simulation techniques, population synthesis and aging, data collection, manipulation and analysis, and experiment design. Furthermore, EDP staff may need to learn to operate with the Linux computer operating system depending on the TRANSIMS platform. The Texas Transportation Institute, under sponsorship of USDOT, will continue its Transportation Model Improvement Program (TMIP) and broaden it to train EDP participants and future TRANSIMS user agencies. NCDOT engineers have participated in all past TMIP conferences, especially those devoted to TRANSIMS, and they have already developed an in-house appreciation of TRANSIMS regardless of the recent decision not to pursue an EDP project.

While not emphasized by USDOT, forming relationships with local universities can provide an important introduction to TRANSIMS. First, universities can help provide the necessary training. Second, and most important, universities can develop precursor studies in support of a possible EDP project. And third, universities can develop research in support of future TRANSIMS implementation and application. Here, NCDOT has had the foresight to involve NCSU and NISS in its assessment of TRANSIMS. The results of this project will provide a foundation upon which to build future TRANSIMS capability at NCDOT and elsewhere in North Carolina.

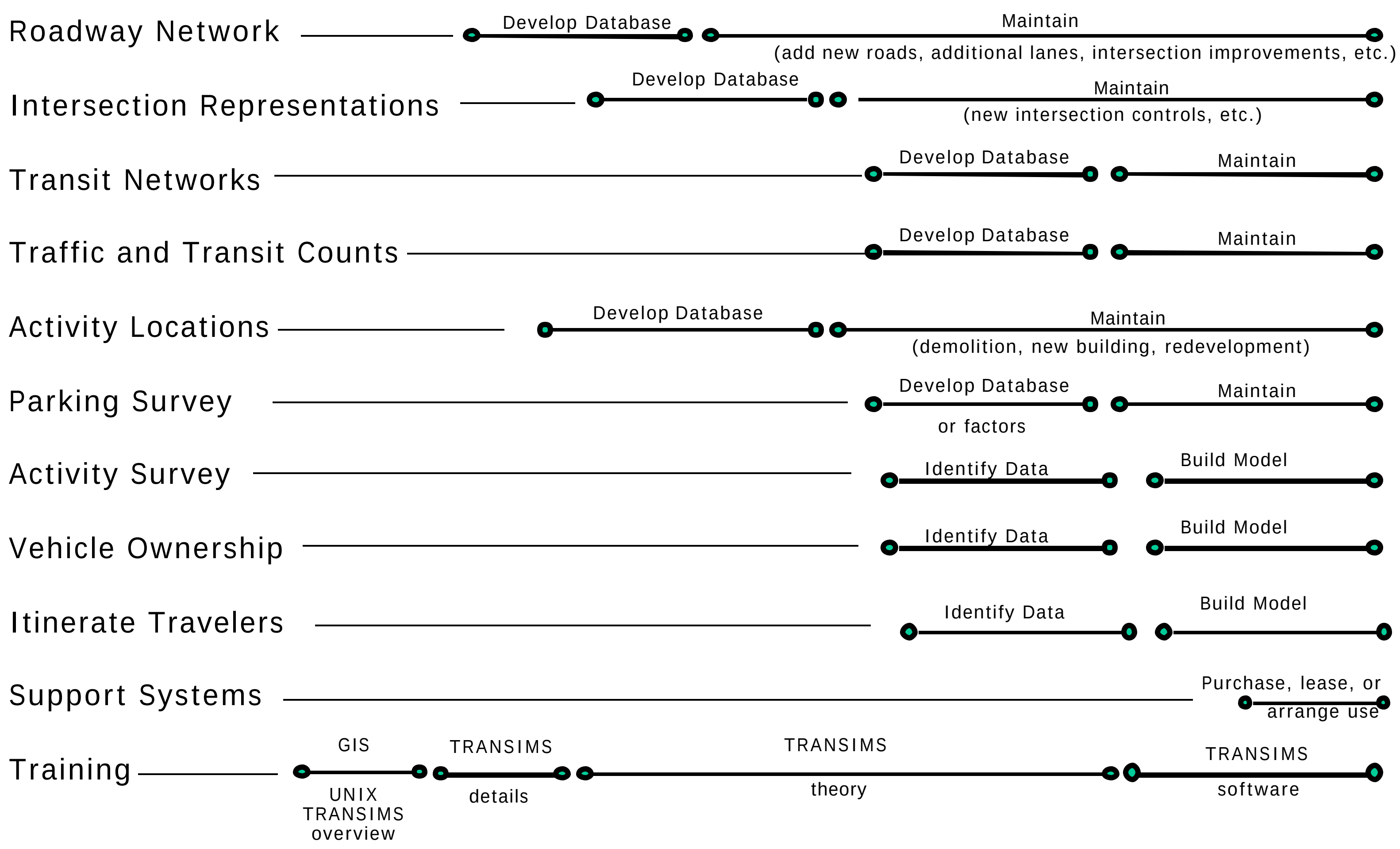
TRANSIMS Data Development Schedule

Data development is the most challenging aspect of implementing TRANSIMS either for an EDP pilot project or for future “production” projects. The actual data to be collected and converted for TRANSIMS will depend on the case study area and on TRANSIMS requirements that are in a state of flux. As previously discussed, FHWA is conducting research to develop default and synthesized data for activity systems and networks that may simplify data development. Figure 3-8 shows data development activities and a generic schedule for accomplishing them. FHWA has not developed time estimates for individual

Table 3-5: TRANSIMS-LANL Computer Requirements

Computational Resource	**Requirement**
Software package	CD #1: TRANSIMS modules CD #2: Micro-simulation file extensions
System requirements	SUN SPARC level hardware Multiprocessor machine, or Single-CPU workstations on a local area network for parallel computing capability
Multiprocessor requirements	Ultra Enterprise
Workstation/LAN requirements	Sparcstation 5 Sparcstation 20 Ultra TCP/IP network connectivity Calibration: 2 single CPU workstations Simulation: 5 single CPU workstations
Operating system requirement	Solaris 2.5 or higher
Memory requirements	250 Mbytes per CPU for multiprocessor configuration 250Mbytes per workstation for LAN configuration
Hard disk requirements	1.2 Gbytes to install TRANSIMS 9.5 Mbytes for plan sets 250 Mbytes for software database 1 – 2 Gbytes for the micro-simulation depending on its size
Software requirements	Parallel Virtual Machine 3.3 (supplied with TRANSIMS) Java 1.1 or higher xgl library (Solaris) HOOPS runtime license ArcView (optional)
Compilation requirements	Rogue Wave Booch Components SunPRO C++ Compiler 4.1

Figure 3-8: Generic Schedule for TRANSIMS Data and Resource Development



tasks because they depend on the study area, availability and format of existing data, size of transportation networks, activity surveys, etc. Before initiating the data and resource development process for TRANSIMS an agency should check for the latest requirements.

Budget Estimate

Estimated costs for a TRANSIMS EDP project are highly speculative. Of primary interest to the local agency in preparing an EDP proposal are the estimates for federal EDP support and local agency match. The local agency does not have to worry about some EDP costs like software, consulting and training that the USDOT will provide during the EDP project. However, the local agency should be concerned about hard-to-determine secondary costs resulting from conducting a pilot program in parallel with normal transportation modeling and planning. Furthermore, some agencies are concerned about the potential financial implications if TRANSIMS should depict the local study area as worse in some issue such as social equity or environmental impacts than the current traditional model.

Ignoring contributed federal support and secondary local costs the NCSU/NISS team developed a Phase 1 budget for a Fayetteville – Fort Bragg EDP project (Table 3-6). The $800,000 budget includes a grant request from FHWA for $625,000. The local 22% match equals $175,000 shared as follows:

- NCDOT 75,000
- NCSU 25,000
- NISS 25,000
- FAMPO 25,000
- Fort Bragg 25,000

Personnel costs for NCDOT, NCSU, and NISS personnel total $470,000, of which $220,000 are paid by the grant. Collecting/coding transportation data is the second largest cost at $100,000. It is paid by the grant. FHWA and NCDOT equally share the $100,000 activity survey. Computing costs are $100,000 and other costs are $30,000, all of which are paid by the grant. All estimates are "first order" subject to revision if the Fayetteville – Fort Bragg case were accepted by FHWA in its Phase 1 preliminary screening of EDP grant requests.

Summary

While recognizing the incompatibility of the TRANSIMS EDP schedule relative to NCDOT modeling commitments and staffing, the NCSU/NISS team determined the following positive aspects of the Fayetteville – Fort Bragg EDP case:

- The relatively small Fayetteville - Fort Bragg area represents an attractive opportunity to demonstrate selected TRANSIMS capabilities quickly with a high probability of success. This contrasts with the FHWA focus on larger metropolitan areas that would test more TRANSIMS functionalities with more difficulty and possibly with a lower probability of success.
- The Fayetteville – Fort Bragg case meets most all the EDP requirements including geographic diversity, transportation applications, probability of success, team expertise, computer support, data availability, cost and match.
- The Fayetteville – Fort Bragg case falls short in terms of current political support because of staffing and other NCDOT regional modeling commitments.
- The estimated EDP budget for the Fayetteville – Fort Bragg case totals approximately $800,000 including a local match of $175,000. This competitive estimate falls within FHWA expectations.

Table 3-6: Draft Phase 1 Budget for the Fayetteville – Fort Bragg EDP

Budget Line Items	FHWA EDP Grant (for 2 years)	Match (for 2 years)	Match Source	Total
1. Personnel				
NCDOT modeler	$ 100,000			
NCDOT staff support		$ 25,000	NCDOT	
NCSU faculty	$ 125,000	$ 25,000	NCSU	
NCSU graduate students	$ 70,000			
NISS researcher	$ 50,000	$ 25,000	NISS	
FAMPO staff support		$ 25,000	FAMPO	
Ft. Bragg staff support		$ 25,000	Ft. Bragg	
TOTAL PERSONNEL	$ 345,000	$ 125,000		$ 470,000
2. Transportation data collection	$ 100,000			$ 100,000
3. Activity data collection	$ 50,000	$ 50,000	NCDOT	$ 100,000
4. Computing	$ 100,000			$ 100,000
Installing TRANSIMS				
Conversion to TRANSIMS				
Hardware				
5. Equipment	tbd			
6. Other				
TRANSIMS programs	No charge		FHWA	
TRANSIMS training	No charge		FHWA	
TRANSIMS tech support	No charge		FHWA	
Travel	$ 15,000			
Supplies	$ 10,000			
Communications	$ 5,000			
TOTAL OTHER	$ 30,000			$ 30,000
7. TOTAL PROJECT	**$ 625,000**	**$ 175,000**		**$ 800,000**

SUMMARY PROJECT	
Total Project	$ 800,000
Federal Share	$ 625,000
NCDOT Share	$ 75,000
NCSU Share	$ 25,000
NISS Share	$ 25,000
FAMPO Share	$ 25,000
Ft. Bragg Share	$ 25,000

Note: This is an estimate for an EDP Phase 1 proposal. FHWA will help write a refined Phase 2 Proposal budget if FHWA accepts the Phase 1 proposal.

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Section 4: TRANSIMS Feasibility Assessment Tool

This section of the report presents an Internet-based utility called the TRANSIMS Feasibility Assessment Tool (TFAT). It is a prototype method for quickly assessing the feasibility of successfully applying TRANSIMS in a metropolitan area. Decision-makers and planners answer a series of questions regarding the expected regional modeling benefits that TRANSIMS will provide relative to the current travel forecasting method. They then estimate the availability of resources required for TRANSIMS. The following paragraphs explain TFAT, and the project Internet site implements the tool at the following address: http://www4.ncsu.edu/~dsengup/indextransims.html.

Introduction

TRANSIMS is a new travel demand forecasting and analysis model that has been developed in part to address policies and regulations recently mandated by federal and state legislation. Traditional planning tools lack the ability to model the impact of federal mandates in relation to vehicle emissions and pedestrian/bicycle facilities, among others. Along with providing increased analytical capabilities and model output, TRANSIMS requires significantly more data input and coding and processing time when compared to traditional planning software. The increased time and data requirements result in increased investments for regional planning agencies.

The utility of using TRANSIMS greatly depends on the needs of the local region and the adequacy of its existing transportation planning software. In order to help transportation planners assess whether they should acquire TRANSIMS, the team has developed the TRANSIMS Feasibility Assessment Tool (TFAT). TFAT is a simple tool that can be used by transportation planning officials to estimate the likelihood of success of implementing TRANSIMS for their region. TFAT, which can be accessed through the project web site, evaluates the relative benefits and resource requirements of implementing TRANSIMS. The evaluation framework and methodology provided in TFAT can also be applied to other feasibility assessment issues.

Overview

TFAT consists of two modules: a benefit utility module and a resource utility module. In each module, the user answers five questions with responses of either 'yes,' 'no,' or 'uncertain.' The modules evaluate the equally weighted benefits gained and the equally weighted resources required for using TRANSIMS. Based on the answers given, a normalized score ranging from 0 to 100 is returned indicating whether TRANSIMS is a suitable transportation planning tool for the region in question.

The logic in TFAT is based on the team's project experience with TRANSIMS, as well as a review of documents and reports produced by LANL. TRANSIMS remains a work-in-progress, and, to date, TRANSIMS has only been applied to a sub-area network in Dallas and to the Portland, Oregon Metropolitan Area. While the Dallas study is complete, the Portland study was still in progress at the time of this report. By June 2000, the software commercialization process was also still underway, and it remained unknown whether TRANSIMS would be operated locally or via the Internet. Because of the modifications that will likely take place in the upcoming months as TRANSIMS is further developed, the content and utility scoring of TFAT are likely to change. However, the general framework and methodology of the assessment tool can remain the same and help agencies structure their consideration of TRANSIMS.

Benefit Utility Module

The benefit utility module assesses a region's need and current ability to model five policy-related modeling issues. These issues, listed below, are representative of the primary issues that transportation planning officials currently face:

- air quality analyses,
- multi-modal assessment,
- equity evaluation,
- project impact analysis, and
- land use planning effects.

The key assumption in the benefit utility module is that TRANSIMS is (or will be upon completion) a superior tool in comparison to traditional planning software for modeling each of the above issues. For each issue, TFAT asks whether there is an overriding need to address the issue and whether the existing methods are adequate for modeling the impacts of the issue. A score ranging between 0 and 100 is given for each modeling issue based on the two questions the user is asked for each issue. The scores for each of the five issues are averaged (assuming equal weighting) to yield the overall benefit utility. A score of 100 represents the maximum benefit of using TRANSIMS, meaning that a region has a need to address a particular issue and their current methods are not adequate. Table 4-1 provides the benefit utility scoring matrix.

Table 4-1: Benefit Utility Scoring Matrix*

		Is Existing Model Adequate?		
		Yes	*Uncertain*	*No*
Is there a need to model the issue?	No	0	0	0
	Uncertain	0	25	50
	Yes	0	50	100

*The same scoring applies to all five issues.

As can be seen from Table 4-1, if a region's existing model is adequate for addressing an issue, or if there is no need to address an issue (e.g., a region is projected to conform to all air quality standards), a benefit score of 0 is returned.

<u>Air Quality Analyses</u>

Federal legislation, including the Clean Air Act and Amendments the Transportation Efficiency Act for the 21st Century (TEA-21), has mandated that regions maintain specific air-quality levels. Regions that fall below this level are designated as non-attainment areas. In order for non-attainment areas to gain federal funding, they must demonstrate that proposed transportation projects will improve emissions levels under a 20-year future scenario. To date, none of the traditional planning models provide vehicle-specific emissions estimates that are critical for achieving *relatively* accurate emissions estimates. Currently, link volume and average speed estimates provide what analysts agree are gross estimates of vehicle emissions.

TRANSIMS evaluates vehicle-by-vehicle emissions every second. The emissions model accounts for atmospheric conditions and the dispersion of emissions across a region. The majority of the emissions estimates come from the microsimulation model. The microsimulation model allows for emissions to be calculated by fleet type (e.g., bus and trucks). TRANSIMS utilizes the MODELS-3 system (developed by EPA) for its emissions estimates.

Multi-Modal Assessment

Many regions desire to assess the performance of non-motorized modes of travel including walking, biking, and transit. To date, none of the traditional planning models provide a means for evaluating the adequacy of non-motorized modes and their impact on regional travel. TRANSIMS simulates individual travel, whether by car, walking, biking, bus, or a combination of each. Thus, TRANSIMS can estimate performance measures such as wait times and travel times for each travel mode.

Equity Evaluation

Equity measures the impacts of transportation projects on different population groups. Traditional planning models lack the ability to "track" users through a system. Because TRANSIMS simulates individual travelers, it is possible to identify the location of travelers that use a particular facility and evaluate whether a proposed set of improvements is equitable to an entire region.

As an example, a state DOT may be interested in evaluating the demographic characteristics of drivers that are expected to use a new freeway facility. The demographic data could be analyzed to determine if a particular group within a region was receiving benefits proportional to the amount of taxes being paid. TRANSIMS allows for this type of analysis since each synthetic person is "tracked" throughout the network and is linked to a household that includes demographic data.

Project Impact Analyses

The prioritization of transportation improvement projects is often based on an estimation of the impact that a project will have, or the regional improvement in traffic conditions that a project will result in. Traditional planning models are often inadequate for evaluating regional impacts due to a specific roadway or corridor improvement (e.g., ITS projects, traffic signal coordination, incident management systems). The microsimulation feature in TRANSIMS provides the user a tool for determining the regional impact of a project by taking into account vehicle re-routing and by capturing individual vehicle travel times on each route.

In addition, the TRANSIMS microsimulation model can be utilized to evaluate hourly or daily traffic conditions related to special events such as sporting events and emergency situations.

Land Use Planning Effects

The population and development growth that many areas throughout the United States have experienced over the past several years has been a driving force for incorporating land use in transportation planning. To date, none of the traditional transportation planning software allows for the modeling of land use "feedback". TRANSIMS, upon its completion, is projected to include the capabilities for modeling various future-year land use scenarios. The land use model within TRANSIMS would be used in the route-choice model and could be evaluated to determine the effect that various land use scenarios have on vehicle-miles traveled, delay, travel time, and fuel consumption.

Resource Utility Module

The purpose of the resource utility module is to estimate the ability of a region to meet TRANSIMS resource requirements. The utility module focuses on five primary resource areas:

- computing,
- staffing,
- data availability,
- survey availability, and
- political feasibility.

In the utility module, the user is asked if the region can meet each of the primary resource requirements of TRANSIMS, which are defined in the module and later in this chapter. Similar to the benefit utility module, the resource utility module assigns a score to each resource item based on an answer of 'yes,' 'no,' or 'uncertain.' Table 4-2 shows the scoring assignment.

Table 4-2: Resource Utility Module Scoring Breakdown

Resource	Can you meet TRANSIMS requirements for this resource?		
	Yes	**Uncertain**	**No**
Computing	100	50	0
Staffing	100	50	0
Network Data Availability	100	50	0
Survey Data	100	50	0
Political Feasibility	100	50	0

The scores for each of the five resources are averaged (assuming equal weighting) to produce an overall resource utility rating. The resource utility rating represents the percentage of resources a region has available to meet TRANSIMS requirements. Thus, a score of 100 indicates that a region has all of the primary resources available to develop a TRANSIMS model for that region. A description of each of the primary resource requirements follows.

Computing

TRANSIMS-LANL (version 1.0) has following minimum hardware and software system requirements:

- 400 MHz Pentium II Processor (or above),
- Graphics Board
- 128 MB of memory
- 4 GB of disk space
- Red Hat Linux, Version 5.2

Although TRANSIMS can be run from a single processor, it is likely that multiple computers would be required to run in parallel in order to reduce the amount of run time. As an example, LANL has 10 computers connected in parallel for running the Portland network.

As mentioned earlier, the software commercialization process is underway and it is unknown if, upon the awarding of the contract, TRANSIMS will be run locally or over the internet. Changes in the hardware and software requirements are inevitable as future versions of the software are released and the commercialization process is finalized.

Staffing

It is difficult to assess the staffing requirements at this early stage of the TRANSIMS development process. TRANSIMS to date has only been applied to a sub-area network in Dallas, Texas and is currently being applied to the Portland, Oregon metropolitan area. TRANSIMS officials have indicated that three man-years were required to collect the necessary data and code the TRANSIMS network for the Portland study. It is expected that as TRANSIMS is further developed and refined, the staffing time required for data collection and coding will decrease. Additionally, the amount of staff time required to develop a TRANSIMS network will likely be proportional to the size and complexity of the region being modeled. For reference purposes, the Portland Metro area has a population of approximately 1.5 million and includes a significant amount of transit (both bus and light rail) services.

Network Data Availability

TRANSIMS requires a significant amount of demographic and network data (Section 3). Much of the demographic data (i.e., population and employment statistics) can be obtained through public records such as census reports or tax assessment records. In either case, a GIS-based system is required to code and edit the data. A GIS system is also needed to create properly-formatted input files, although the method of inputting data into TRANSIMS may change upon completion of the commercialization process.

TRANSIMS requires a significant amount of network data in addition to the data required by traditional planning models which typically include link length, number of lanes, posted speeds, etc. TRANSIMS requires detailed link information for all roadways (including local streets) such as the length and type of turn-lanes and the location of bus stops. In addition, TRANSIMS requires detailed intersection information such as lane geometry and control. For signalized intersections, the phase times and phase sequences are required for each timing plan throughout the day. Los Alamos National Laboratories is currently evaluating algorithms to determine if local street data and/or signalized intersection data can be synthesized within TRANSIMS in order to reduce the amount of input data required. It is unknown at this time if those attempts have been successful.

For a more complete description of the network data requirements, see Section 3 of this report.

Survey Availability

Household survey data are required by TRANSIMS to develop an itinerary of trips throughout the modeling period for each synthetic person. The survey should be representative of the population and must include travel and activity information for all household members for a 24-hour period. Based on results published in *Data Collection in the Portland, Oregon Metropolitan Area Case Study* (FHWA, June 1996), survey data for the Portland study was collected from 4,451 households (approximately 0.8% of the total households in the region). The total cost to collect and reduce the data was approximately $603,000. This equates to a unit cost of $136 per person, which is comparable to the costs for detailed household that have been taken in other regions of the United States as shown in Table 4-3.

As additional household activity data become available for regions across the United States, it may be possible to develop statistical characteristics by specific demographic groups. It is foreseeable that this type of statistically-valid data could be applied in the absence of locally collected survey data, thus significantly reducing the required costs for implementation. The development of synthesized survey data is likely to occur as the TRANSIMS model evolves.

Utility Evaluation

The user can combine scores from the benefit and resource utility modules to estimate the feasibility of implementing TRANSIMS for a particular region. In summary, the benefit utility module predicts the added benefit from TRANSIMS compared to traditional planning methods based on five modeling issues. The resource utility module identifies the ability of a region to meet TRANSIMS requirements.

Table 4-3: Survey Cost Summary

City	Year	Sample Size (Households)	Approximate Cost ($)	Unit Cost per Household ($)
Atlanta	1991	2,400	225,000	94
Baltimore	1993	2,700	400,000	148
Boston	1991	3,800	360,000	94
Detroit	1994	7,500	637,500	85
Houston	1994	2,600	275,000	106
Miami	1993	2,650	150,000	57
Pittsburg	1990	450	15,000	33
San Diego	1995	2,000	180,000	90
St. Louis	1990	1,400	150,000	107
Washington, DC	1994	4,800	585,000	122
Kansas City	1991	1,221	80,000	66
Raleigh-Durham	1994	2,000	270,000	135
Sacramento	1991	4,000	380,000	95
Salt Lake City	1993	3,082	300,000	97
Portland, OR	1994/95	4,451	603,180	136

Source: *Data Collection in the Portland, Oregon Metropolitan Area Case Study* (FHWA, June 1996)

The two utility scores can be used to determine if the benefits provided by TRANSIMS justify the allocation of a region's available resources for acquiring and implementing the model. For instance, if a region meets 100% of the TRANSIMS resource requirements yet only realizes 10% of the benefits, the region's resources would likely be more effectively used elsewhere. Conversely, a high benefit score and a low resource score may indicate that a region should focus on acquiring additional resources to meet the requirements and eventually adopt the model.

To aid the user in determining a course of action after completing the TRANSIMS Feasibility Assessment Tool, a chart has been developed to indicate the feasibility of implementing TRANSIMS for a particular metropolitan area. The chart includes four general categories: highly infeasible, infeasible, feasible, and highly feasible. The limits for each category are somewhat arbitrary reflecting reasonable expectations of benefits versus resources for an application of TRANSIMS to be feasible or not. The chart is not based on any real-world examples.

Sample TFAT Evaluations

As a demonstration of TFAT consider the feasibility of using TRANSIMS for the Fayetteville – Fort Bragg case. The authors of this paper answered the questions in Figures 4-1 and 4-2 concerning TFAT utility on the project Internet site http://www4.ncsu.edu/~dsengup/indextransims.html.

Considering Resources if the EDP were pursued:

- NCSU has parallel platforms if the commercial TRANSIMS requires local computing resources,
- staffing is uncertain at NCDOT,
- much of the GIS data are available but some detailed network data must be collected with uncertain results,
- the activity survey can be conducted,
- political support is uncertain.

Figure 4-1: Benefit Questions

Policy Issue (Click to access help)	Do you need to consider these issues for your area ?	Can your existing program address these issues ?
Air Quality Analysis	No	Yes
Multi-Modal Assessment	No	Yes
Equity Evaluation	No	Yes
Project Impact	No	Yes
Land Use Planning Effects	No	Yes

Click for Total Benefit Score

Figure 4-2: Resource Questions

Resource (Click to access help)	Can you meet TRANSIMS requirements for this resource ?
Computing	Yes
Staffing	Yes
Data Availability	Yes
Survey Availability	Yes
Political Support	Yes

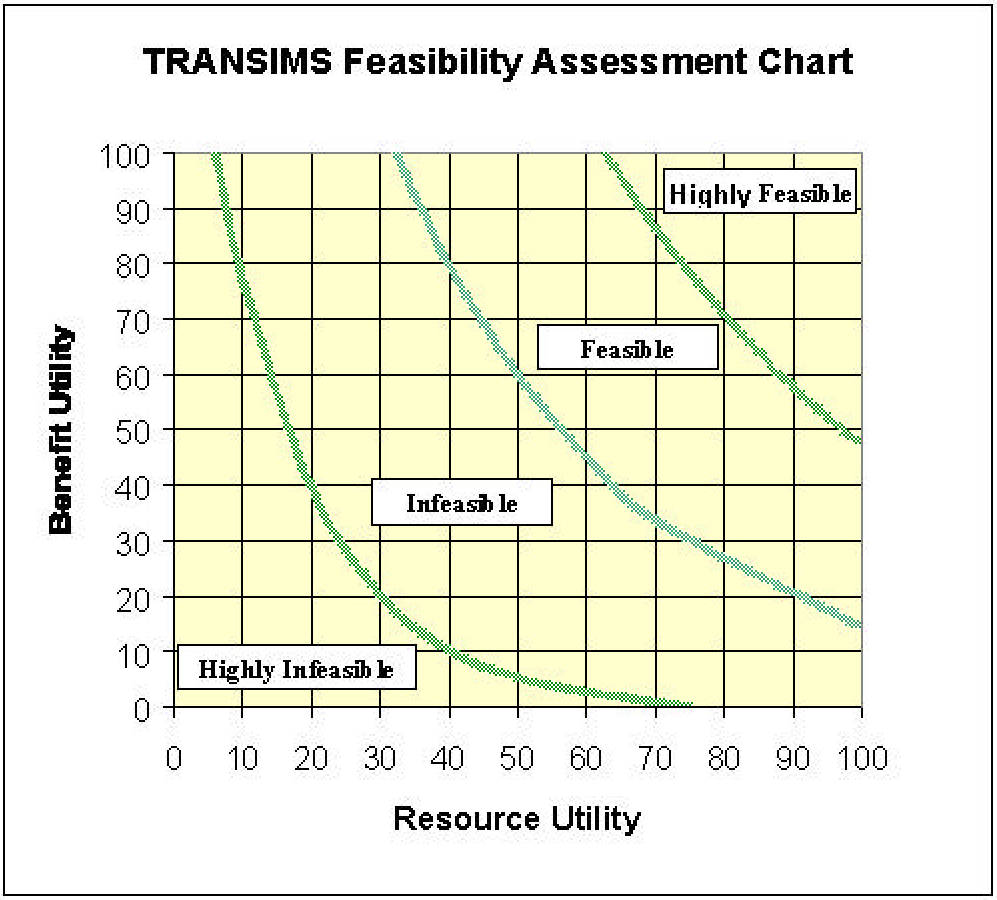
Click for Total Resource Score

Considering Benefits:

- the current model in conjunction with Mobile 5 cannot determine localized emissions,
- the necessity of multi-modal modeling is uncertain,
- the current model cannot develop a military-civilian equity assessment,
- it cannot examine project level impacts,
- it cannot include land use options.

The resulting Fayetteville resource-benefit coordinates for Figure 4-3 are (80, 40) which falls inside the feasible boundary. Thus, TFAT judges the Fayetteville – Fort Bragg EDP case to have most of the resources and that the project would yield modest benefits relative to the needs. Sensitivity tests suggest

Figure 4-3: TRANSIMS Feasibility



that the deciding factors are staffing and political support as in the actual case. If neither are available (as is the case), then the resource-benefit coordinates drop to (60, 40) which lies in the infeasible region.

Similar first-order TRANSIMS feasibility assessments can be developed for the Dallas-Fort Worth and Portland cases. The average results from NCSU team members found both cases to be clustered about the feasible/highly feasible boundary in the neighborhood of the resource-benefit coordinates (90, 60). These results roughly correspond to successful completion of both cases.

Summary

Other agencies considering TRANSIMS, especially those that may be candidates for an EDP pilot study, can use the TRANSIMS Feasibility Assessment Tool to help structure the local decision process. While only five equally weighted benefits and resources are used in the evaluation, the tool can be expanded to include more decision factors and the equal weights can be adjusted if necessary. The prototype TFAT approximately duplicates the relative benefits and resources of the Dallas and Portland studies suggesting that both are feasible to highly feasible applications for TRANSIMS. Application of TFAT to the Fayetteville- Fort Bragg case suggest that most of the TRANSIMS resources are available and the resulting TRANSIMS benefits relative to needs would exceed results obtainable from traditional models. The TRANSIMS EDP for the Fayetteville – Fort Bragg case is feasible with NCDOT staffing and support and infeasible without them.

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Section 5: Simulating Fort Bragg Gates and Traffic Impacts

In this section of the report we discuss the gates that Fort Bragg will build along roads leading into the military reservation. Eight gates are going up to improve security during a terrorist threat or a deployment of Fort Bragg soldiers. Using a traditional micro-simulation model, we explore the resulting traffic impacts on local roads that serve Fort Bragg and Fayetteville. In the following section of this report we discuss how combining traditional regional traffic forecasting with corridor traffic simulation emulates a "poor man's" TRANSIMS analysis.

Introduction

Fort Bragg is one of the nation's largest military installations, and it is the only one of comparable size to allow non-military traffic nearly unrestricted access. However, as the nation's threats from terrorism have increased, so have the security needs of its military bases. Officials at Fort Bragg now wish to improve post security, and limit access to the base during times of terrorist alerts, emergencies and troop deployments. As a result traffic congestion at the gates and on nearby roadways will develop.

The Post attracts a substantial amount of military and civilian automobile and truck traffic every day. Drivers primarily access the Post by using the north-south arterials Bragg Boulevard, Murchison Road, and the All-American Expressway. In addition they enter the Post at perimeter gates that serve rural roads from the west. An increase in security along these corridors entails slowing or stopping traffic at the gates. As security levels increase, vehicle stopping times increase. Depending on gate location and security level, traffic could potentially queue excessively and spill back onto major thoroughfares, even though the gates themselves are on adjacent side roads.

Two of these thoroughfares are also regionally important to through traffic. Bragg Boulevard and Murchison Road carry a substantial amount of through traffic to and from Fayetteville, Spring Lake, and other parts of the region including Southern Pines and Sanford. The volume of traffic on these thoroughfares promotes and supports residential and business development just north and south of the Post. Thus, traffic queues and spillback from the new gated entrances on the Post will likely create localized traffic problems. Furthermore, closing perimeter gates that serve rural roads will inconvenience drivers who have traditionally taken short cuts through the Post.

Past Work

In 1998, a consultant[1] performed a base closure traffic impact analysis of the gate entrances during assumed periods of heightened security. The consultant collected traffic counts and twenty-four hour roadway tube counts in January of 1998 and used the counts to develop a simulation model with Integration to estimate the amount of storage required at the gate entrances under low security restrictions (400 vehicle/hour/lane). The original gate analysis assumed the construction of 17 gates. Based on the results of the consultant's queuing analysis and recommended lane geometries at the gates, Fort Bragg developed design drawings for each gate entrance to show the required roadway improvements (primarily widening) needed to accommodate future queuing. Yet, since the time of the consultant's study, Fort Bragg has pursued a new plan regarding the location of the security gates. Fort Bragg intends to construct the gates and related roadway improvements during 2000 and 2001. Thus, the results from the original study need updating. Also, the traffic impacts and proposed roadway improvements may have implications for the regional transportation plan that NCDOT will update in 2000 and 2001.

[1] *Fort Bragg Force Protection Plan Project Development Brochure,* Greenhorne & O'Mara, Raleigh, NC, July 1998

NCSU Research

Due to increasing security threats, Fort Bragg has implemented a Force Protection Plan[2] that includes the construction of a chain link fence around the base cantonment area. As part of the construction of the fence, access to the base will be limited to 17 gate locations. Each gate will include a guardhouse from which military police monitor and inspect vehicles as they enter the Post. Currently the Force Protection Plan only serves temporary Post closures of less than 24 hours. However, different levels of security measures could be implemented. Under the lightest security level, military police would likely wave vehicles through and would rarely stop them for inspection. Under the tightest level of security military police would individually inspect each vehicle. As security is increased, the available gate capacity, or the number of vehicles that could enter the base during a given time period, would decrease.

The decrease in the capacity at the gate entrances has important ramifications on the surrounding transportation system. Currently the gate entrances are planned to be located approximately 400-1,000 feet from adjacent arterials. Under the lightest of security measures, it is likely that adequate storage will be available to serve the vehicles waiting at the checkpoints since little delay would be incurred to motorists. At high levels of security (which result in low gate traffic rates), vehicle queues will likely build and spill back onto the roads that serve the surrounding area, for example All-American Freeway, Bragg Boulevard, and Yadkin Road (Figure 5-1).

In order to model the effects that a gate closure has on the nearby transportation system, we developed a CORSIM simulation for four gate entrances along Bragg Boulevard. Although these four gate entrances have relatively low volumes compared to others, Bragg Boulevard provides primary access to the base and the network developed as part of this project could be expanded in future work to include the remaining gates along Bragg Boulevard or elsewhere on the Post. The CORSIM model estimated vehicle queues at the gate entrances and nearby intersection delays under three different security levels. These results were then compared to vehicle queues estimated by the consultant.

Initially, the goal of this project was to develop a working TRANSIMS model that could be used in comparison with the CORSIM model. Although significant effort occurred including running demonstration TRANSIMS-LANL networks, when we upgraded to a new version of the Linux operating system, TRANSIMS would no longer run. Thus, we used CORSIM to simulated the effects of reduced gate capacity on Fort Bragg traffic. CORSIM results also serve as a rough analogy to the type of micro-simulation results that TRANSIMS would produce.

Fort Bragg Security Levels

The Fort Bragg Force Protection Plan identifies four security levels (Table 5-1). At Alpha, the lowest level of security, traffic flows unimpeded through the gates. For increasing security levels, military police increasingly restrict traffic into the Post. At Bravo level military police may look for vehicle stickers, at Charlie level they may stop drivers and examine military identification, and at Delta level police may stop and inspect inside and underneath vehicles. As Table 5-1 indicates, each security level has an assumed vehicle flow rate through the gate depending on how long and how many vehicles police stop. During the NCSU study, all security levels and assumed traffic flow rates were examined. It should be noted that for the Charlie and Delta security levels, we used the average expected capacity. However, we assumed the maximum expected capacity for the Bravo scenario in order to reflect the conditions assumed by the consultant using Integration.

[2] *Force Protection Plan*, Fort Bragg, NC, 1998.

Figure 5-1: Principal Gate Locations

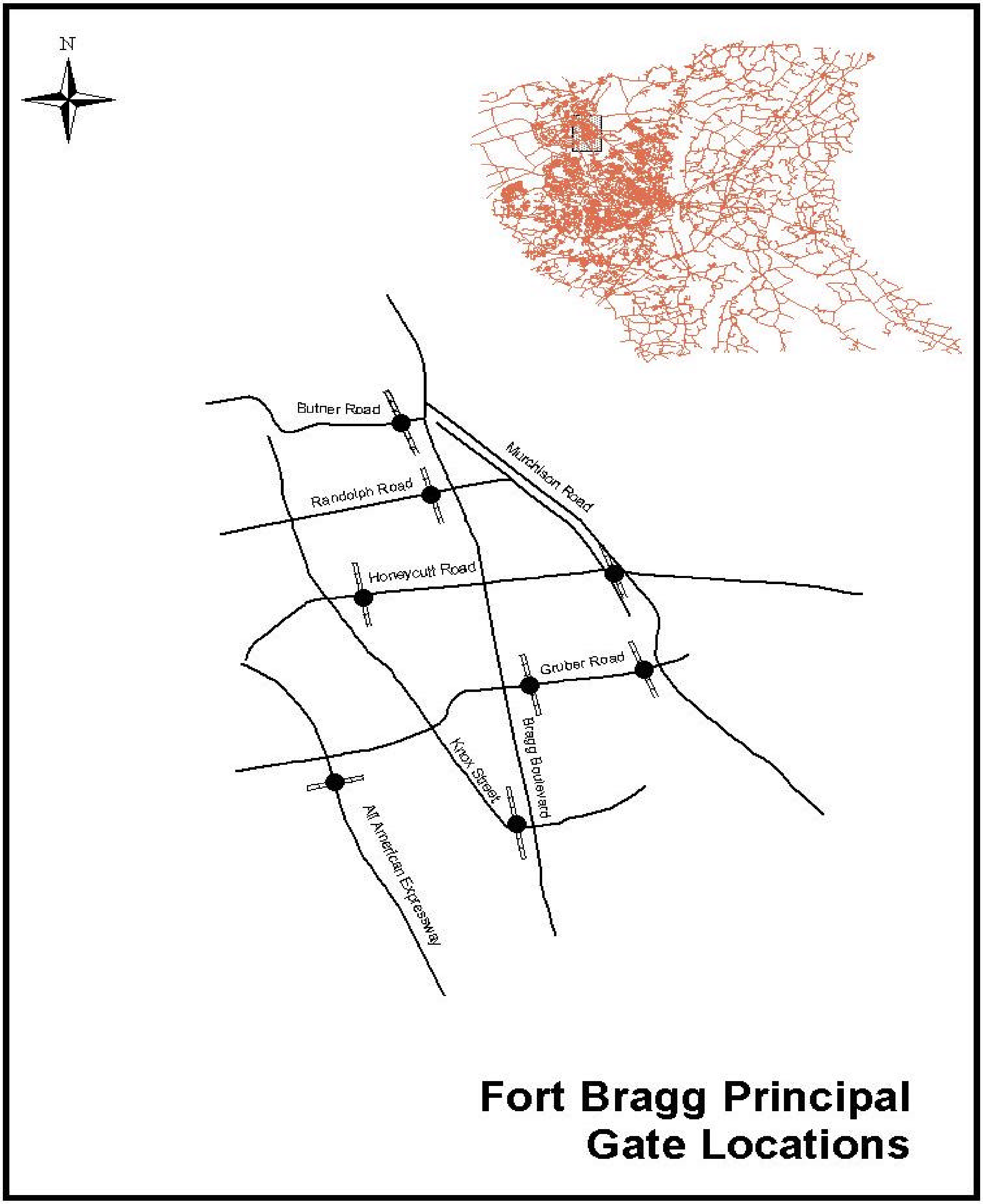


Table 5-1: Gate Security Levels

Security Level	Expected Gate Capacity	Gate Capacity Assumed in CORSIM Analysis
Alpha	Free Flow (Random Checks)	Not Modeled
Bravo	200-400 vphpl	400 vphpl
Charlie	150-280 vphpl	215 vphpl
Delta	90-170 vphpl	130 vphpl

Bragg Boulevard Corridor Network

The study area for this analysis focused on Bragg Boulevard at four gate locations:

- Knox Street east of Bragg Boulevard,
- Gruber Road east of Bragg Boulevard,
- Gruber Road west of Bragg Boulevard, and
- Knox Street west of Bragg Boulevard.

We chose the weekday a.m. peak hour (8:00-9:00 a.m.) time period for this analysis since it represents the maximum one hour volumes from the consultant's traffic counts and Integration input files. It should be noted that the consultant's Integration analysis covered two and a half hours for the morning peak period. This recognizes the habit of some military personnel attending early morning physical training, returning home to shower and eat, and returning to the Post again for normal duty hours.

The following paragraphs provide a brief summary of the transportation facilities within the study area network.

Bragg Boulevard is a four-lane divided arterial that serves as a primary route for Fort Bragg traffic. It also serves as a major connection between downtown Fayetteville and the Spring Lake community north of Fort Bragg. The study network for this project includes two traffic signals: Bragg Boulevard/Knox Street and Bragg Boulevard/Gruber Road. Both signals were coded in CORSIM to operate as pre-timed 8-phase signals with cycle lengths of 90 seconds.

The *Knox Street* gate east of Bragg Boulevard carries light traffic throughout the day. The peak hour of traffic volumes were found to occur at 8:45 a.m. and consist of 84 vehicles per 15 minutes. Traffic volumes throughout the remainder of the day are even lower. Given the low volume of traffic, the consultant proposed one entrance lane to serve the gate that is located approximately 425 feet east of Bragg Boulevard.

The *Gruber Road gate east of Bragg Boulevard* carries much higher traffic volumes than the Knox Street gate. Traffic approaches 700 vehicles during the peak hour. The consultant proposed three lanes to serve this gate. The gate will be located approximately 225 feet east of Bragg Boulevard, thereby, providing little storage for vehicles approaching from Bragg Boulevard.

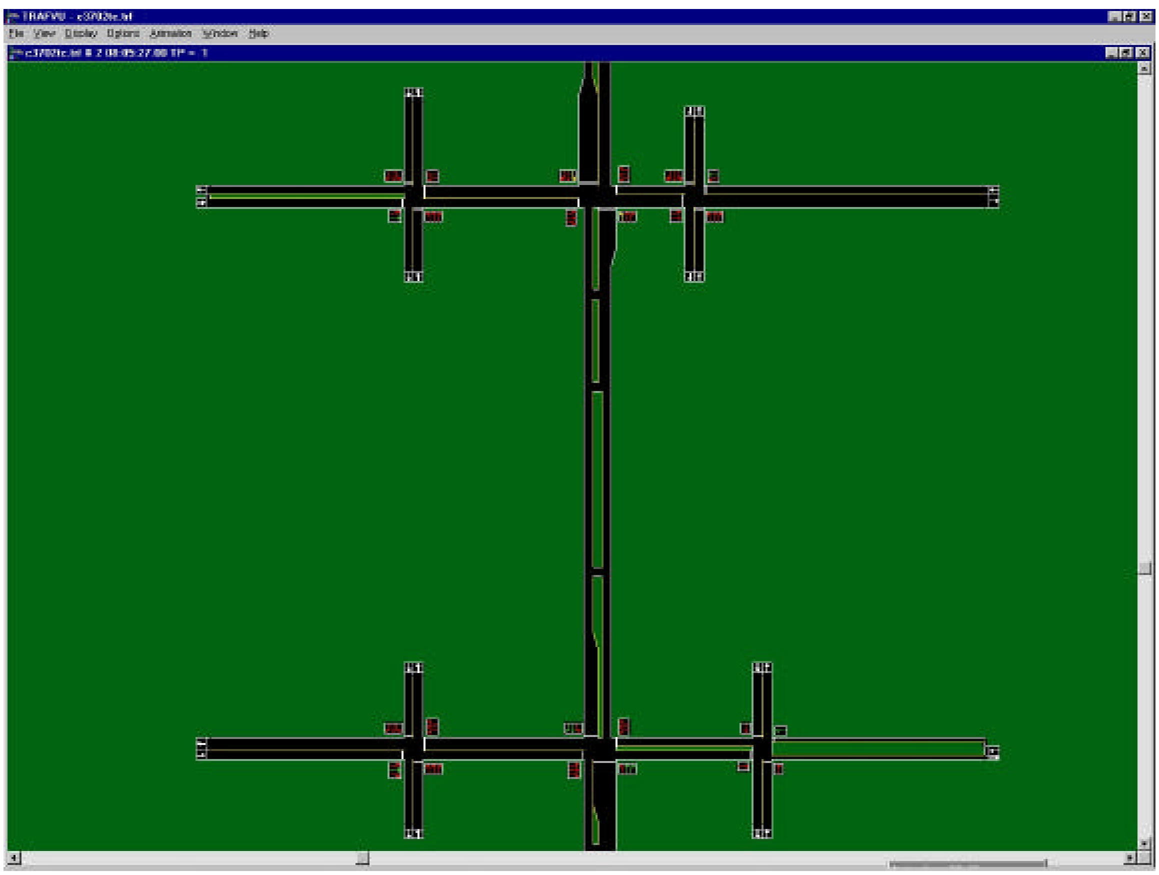
The *Gruber Road gate west of Bragg Boulevard* serves the highest amount of traffic volumes of the four gates. The consultant recommended three entrance lanes for this gate location that is proposed to be located approximately 475 feet west of Bragg Boulevard.

The *Knox Street gate west of Bragg Boulevard* is similar to the one east of Bragg Boulevard. It will likely serve a relatively light volume of traffic (66 vehicles during peak 15-minute periods). The consultant's design drawings show three entrance lanes at this location. However, the text from the study indicates that the existing two entrance lanes will serve the gate. Our CORSIM analysis assumes that three lanes will serve the gate entrance.

Simulation Analysis Results

The study network described in the previous section was modeled in CORSIM and run assuming three different gate capacities which represent the various security-level scenarios that could be implemented by Fort Bragg: Bravo, Charlie, and Delta. Figure 5-2 depicts the CORSIM transportation network. Each of the four gates are modeled as pre-timed traffic signals. Side streets were added to "trick" the network into thinking that the approaches exist, although no volumes are added to these approaches. In order to reflect the condition of 400 vehicles per hour per lane (for the Bravo security scenario), or one vehicle every nine seconds, a cycle length of nine seconds was used. A green time of one second and a yellow time of one second was given for the inbound (vehicles entering Fort Bragg) movement to limit one vehicle to enter the gate per cycle. The remaining green time was assigned to the outbound vehicles. Even though only one second of green was given for the inbound traffic, results from the simulation analysis reveal that during certain cycles, more than one vehicle will enter the gate. CORSIM allows the user to modify this effect of "sneakers;" but only for left-turn movements. The use of a ramp meter will be investigated following this project to determine if it can better represent the desired conditions.

Figure 5-2: CORSIM Study Network



We made 25 CORSIM runs for each security scenario at each gate location. Since the focus of this analysis is vehicle queuing at the four gates, the approaches to the gates were the focus of the output reports. For each of the 25 runs, the queue time, percentage storage, maximum queue, and actual vehicle volume were recorded for each of the four gates. The queue time, percentage storage, and vehicle volumes for each of the 25 runs was averaged and recorded. The 85th percentile value from the 25 maximum queues was determined and also recorded. We used these values as the basis for comparing the three security scenarios.

Bravo Scenario

This initial CORSIM analysis assumes that each of the gates will serve 400 vehicles per hour per lane. Results for this scenario (based on 25 simulation runs) are shown in Table 5-2. Additionally, Table 5-2 includes the consultant's results from the Integration (Intgrn) simulation analysis. Note that all queues for this analysis are reported in vehicles per lane.

Table 5-2: CORSIM Results for Bravo Scenario (400 vphpl)

Location	**Lanes**	**Available Storage**	**Queue Time** (vh-min)	**% Storage**	**85th Percentile Max. Queue**		**Vehicle Trips**	
					CORSIM	Intgrn	CORSIM	Intgrn
Gruber West of Bragg	3	19	25.2	3.5	4	8	435	672
Knox West of Bragg	3	19	12.7	2.0	3	3	225	210
Knox East of Bragg	1	17	13.1	2.9	5	4	190	166
Gruber East of Bragg	3	9	44.6	7.1	4	6	661	620

Note: All queues reported in number of vehicles per lane

As shown in Table 5-2, the maximum vehicle queues found from the CORSIM analysis (based on 85th percentile maximum queue) are very similar to the Integration results, with the exception of the Gruber Road gate located west of Bragg Boulevard. Further review of the simulation results reveal that the amount of traffic entering the Gruber Road gate located west of Bragg Boulevard is approximately 235 vph less than what was intended to be modeled. Due to the time constraints of this project, the volume was not adjusted. However, the close resemblance between the values for the other three gates though gives validity to the model network. Adequate storage is available at all modeled gates under the Bravo scenario.

Charlie Scenario

The Charlie security level was modeled assuming gate capacities equal to 215 vehicles per hour. This reflects the added time required by the security guards to more thoroughly check incoming vehicles and driver id's. All other network conditions were held constant. Table 5-3 provides the results of this analysis. Note that the consultant study did not analyze Charlie or Delta security levels.

Table 5-3: CORSIM Results for Charlie Scenario (215 vphpl)

Location	No. of Lanes	Available Storage	Queue Time (veh-min)	% Storage	85th Percentile Max. Queue	Vehicle Trips
Gruber West of Bragg	3	19	72.2	4.7	5	434
Knox West of Bragg	3	19	28.9	2.4	4	226
Knox East of Bragg	1	17	39.1	4.1	7	190
Gruber East of Bragg	3	9	137.7	11.8	6	659

Note: All queues reported in number of vehicles per lane

As shown in Table 5-3, the queue time is more than twice that for the Bravo scenario. The 85th percentile maximum queues increase by one to two vehicles for each gate location. Adequate storage is available at all modeled gates under this scenario.

Delta Scenario

The Delta security level is the highest. The analysis assumed a gate capacity of 130 vehicles per hour. Under this security level nearly every vehicle would be inspected, which results in an estimated service time of one vehicle every 28 seconds. Table 5-4 provides the results of this CORSIM analysis which is based on an average of 25 runs.

Table 5-4: CORSIM Results for Delta Scenario (130 vphpl)

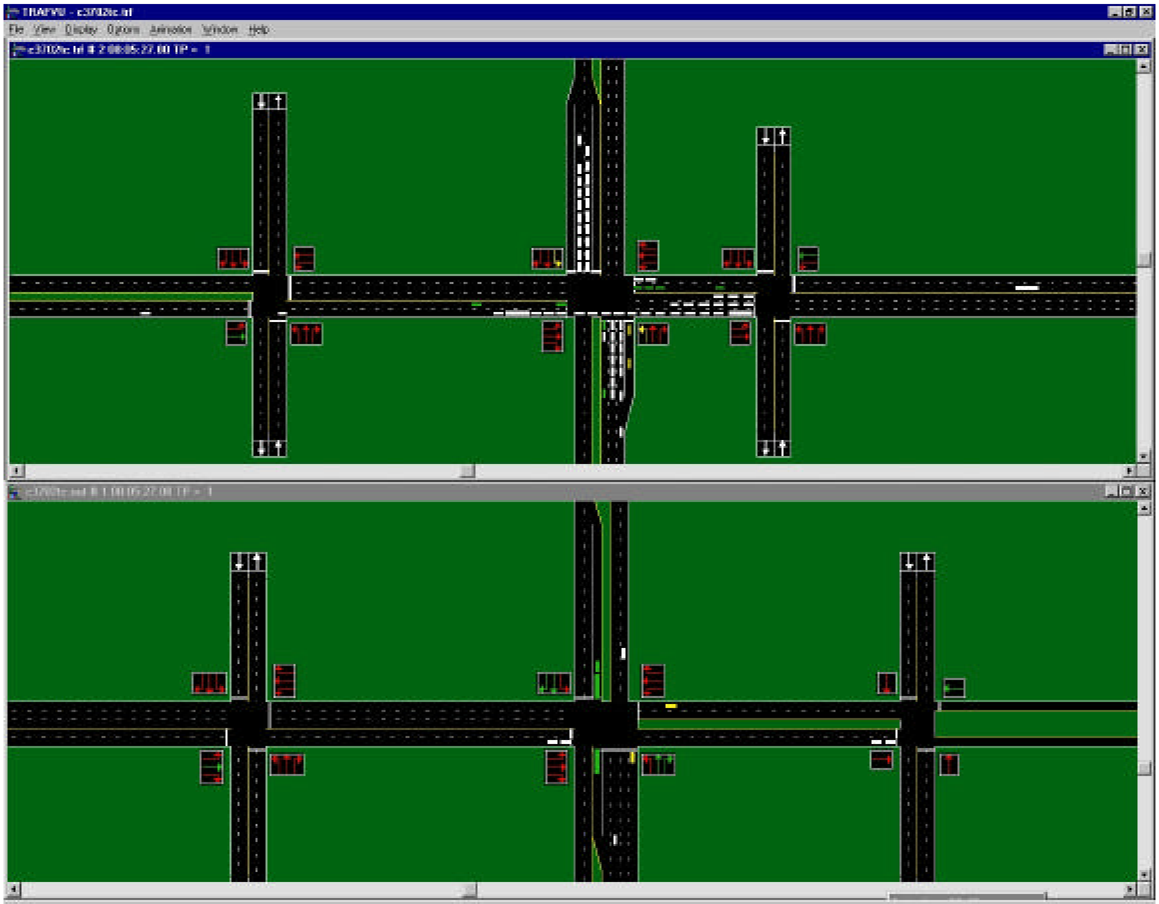
Location	No. of Lanes	Available Storage	Queue Time (vh-min)	% Storage	85th Percentile Max. Queue	Vehicle Trips
Gruber West of Bragg	3	19	252.1	9.1	9	435
Knox West of Bragg	3	19	53.9	3.1	5	227
Knox East of Bragg	1	17	107.4	7.0	10	190
Gruber East of Bragg	3	9	798.7	42.9	15*	631

Note: All queues are reported in number of vehicles per lane
***** Exceeds available storage

As expected, the queue time for this scenario increases dramatically over the previous two scenarios due to the reduction in gate capacity. The 85th percentile maximum queues also increase significantly for the Gruber Road gates. Due to the limited amount of available storage at the Gruber Road gate east of Bragg, vehicle queues are expected to spill back onto Bragg Boulevard.

Figure 5-3 provides a snapshot of queuing conditions at the gates on Gruber Road and Knox street under the Delta scenario. Note that the top portion of the split screen represents the Gruber Road gates and the bottom portion represents the Knox Street gates. As shown in the figure, vehicles from the Gruber Road gate east of Bragg Boulevard spill back to Bragg Boulevard thus blocking through traffic along Bragg Boulevard. Figure 5-3 also shows that the Knox street gates may not experience a significant amount of queuing due to the light volume of traffic on the roadway.

Figure 5-3: CORSIM Snapshot – Delta Scenario



Scenario Comparisons

We compared the results from the three CORSIM scenarios in order to understand the effects that a reduction in gate capacity has on vehicle queuing at the gate entrances, and also on traffic flow along Bragg Boulevard. Figures 5-4 and 5-5 show the queue time and 85th percentile maximum queues, respectively, for the four gates under each of the three scenarios.

Figures 5-4 and 5-5 both show that as the saturation level at the gate entrances is approached, the queue time and 85th percentile maximum queues increase dramatically. Additionally, Figure 5-5 shows that under all three scenarios, adequate storage is available for queuing at the two Knox Street gates and the Gruber Road gate west of Bragg Boulevard. However, as noted previously, the CORSIM volumes entering the Gruber Road gate west of Bragg Boulevard are approximately two-thirds the actual volumes that should be approaching the gate. Thus, it is expected that queue spill back will likely occur under the highest Delta security level at both Gruber Road gates.

Figure 5-4: Queue Time Summary Comparison

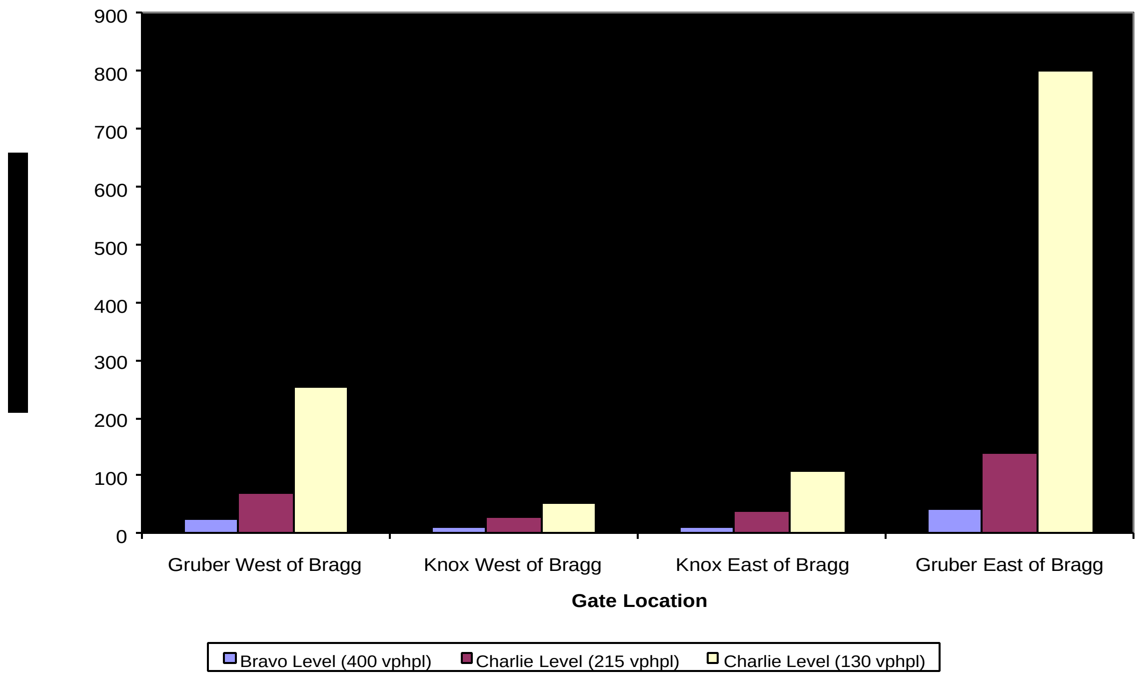
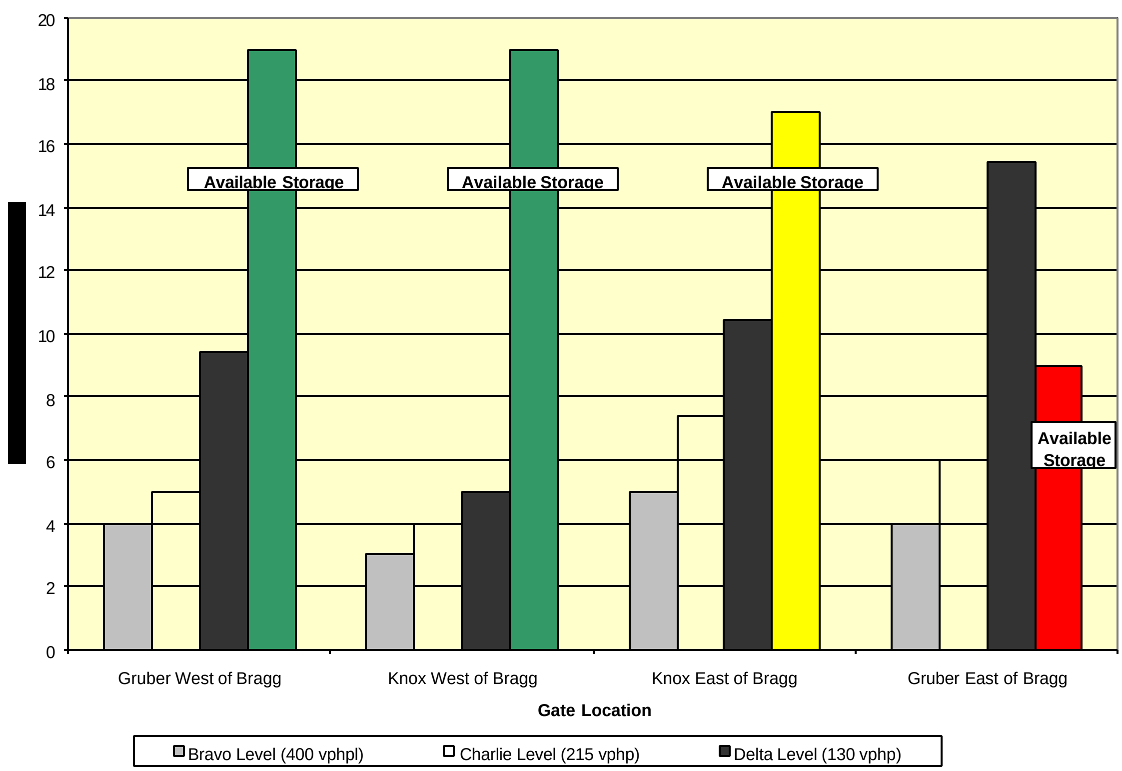


Figure 5-5: 85th Percentile Maximum Queue Summary



Summary

At no cost to Fort Bragg, NCSU faculty and students conducted a preliminary update of the original consultant's gate traffic impact study. We used the consultant's traffic data and the new gate locations as specified by Fort Bragg. Preliminary results using spreadsheet analysis show that little queue spillback occurs under the lowest security condition. However, queue spillback will likely occur at nearly all of the gates for higher security conditions. Simulated traffic flows for streets, intersections and gates show in animation how traffic may react under various levels of security and vehicle delay at the gates. The simulations show that at the lowest security level, queue spillback occurs at the Gruber Road gate located east of Bragg Boulevard. Under an increased security level, vehicle queues may spill back to Bragg Boulevard from the gates located on Butner Road, Honeycutt Road, and Gruber Road.

Through our simulation analysis we have identified various issues that need to be further addressed in order to ensure an accurate representation of the traffic impacts associated with the gate closure of Fort Bragg. These include:

- refine the volumes approaching the Gruber Road gate west of Bragg Boulevard,
- incorporate traffic volumes for the entire two and a half hour period, with peaking characteristics,
- explore the potential for modeling the gates using a ramp meter analogy. This would eliminate the opportunity for multiple vehicles to "enter" a gate during a cycle, and
- field check the actual lane configurations and traffic volumes for the network.

Other follow-up activities include:

- Rerun the spreadsheet and simulation analyses with the current traffic data to predict revised traffic impacts at and near the gates for different security levels.
- Use the simulation analysis to test traffic options for the streets leading to the gates and to test alternative control procedures at the gates.
- Apply the traffic congestion results of the simulation analysis to the regional transportation model to determine how military and civilian personnel are likely to change their travel patterns and behavior during periods of increased security.
- Estimate regional travel and economic impacts using the regional transportation model.
- Test alternative ideas to reduce the congestion such as projects to improve the highway network, traveler demand management, transit and carpooling, and "intelligent" transportation systems technology.

Further effort should be made to develop a running TRANSIMS model for the Bragg Boulevard network. This will allow us to examine first-hand the micro-simulation module of TRANSIMS. It will also provide another tool for examining the traffic impacts caused by closure of the gates at Fort Bragg. Additionally, results developed by NCSU using an Excel spreadsheet program for the various security level scenarios should be compared to the micro-simulation results.

Simulation analysis like that available with CORSIM, Integration and TRANSIMS is useful to predict how traffic will move on the streets. In this case it is likely, however, that traffic congestion and spillback on the major through routes of Bragg Boulevard and Murchison Drive will also affect regional traffic. Of particular concern is to what extent regional traffic will have to detour around the post. In a preliminary attempt to address this issue, we exercised the regional transportation model for Fayetteville. This task is discussed in the next section of the report. The results of the exercise show that the gate traffic will cause significant regional impacts in terms of traffic delay, increased regional travel and traffic diversion.

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Section 6: Regional Impacts of Congestion at Fort Bragg Gates

This chapter shows the regional impacts of Fort Bragg gate traffic. The team's approach combines the micro-simulation analysis of CORSIM, which was discussed in the previous chapter, with the current Tranplan model that NCDOT uses for Fayetteville regional transportation planning. This approach represents a "poor man's" alternative to TRANSIMS. Microscopic and macroscopic traffic is examined separately rather than together as in TRANSIMS. The analysis has implications for the Fayetteville regional transportation plan and the year 2000 update.

Introduction

For many years Fort Bragg has not restricted access to the Post. Military and civilian personnel and military retirees from surrounding communities freely enter the Post to work, shop, go to the doctor, and enjoy recreational activities. Regional travelers use roads across the Post as short cuts to and from Fayetteville.

As a result of changing security needs, Fort Bragg will soon begin active control of its perimeter. However, two public, state-maintained roads pass through this federal property. Bragg Boulevard (NC 24) and Murchison Drive (NC 87 & 210) are important facilities for surrounding communities, as well as Fort Bragg (Figure 6-1). In order to maintain Post security, particularly during periods of heightened alert, Fort Bragg will construct gates on military roads that intersect Bragg Boulevard, Murchison Drive and 15 other arterials and highways (Figure 6-2). These roadways bring a substantial amount of traffic to and through the Post every day. Gated access points will allow only authorized traffic to enter the base while restricting the access of through traffic.

The dual functions of Bragg Boulevard and Murchison Drive as regional thoroughfares and as local access routes to the Post may conflict at times. While gates will improve Post security, the traffic queued at these gates will spill back onto Bragg Boulevard and Murchison Drive. This spillback will create delay for through traffic. Similar concerns exist for All American Freeway and other roads that cross the Post perimeter, provide access to the Post for military and civilian personnel, and serve as shortcuts for regional traffic to Fayetteville from the north and west.

The goal of this analysis is to estimate the regional travel impacts of gate congestion and to suggest roadway improvements on the Post to minimize the impacts. We leave the examination of other options such as military traffic management (ridesharing, perimeter parking, coordinating signals, "intelligent" gate technology, etc.) and building regional roads that by-pass the Post to the regional transportation planning process. The options we consider are the following:

- Do nothing to mitigate gate queues.
- Convert Honeycutt Road and Gruber Road into a one-way pair.
- Convert Honeycutt Road into a reversible facility
- Convert Gruber Road into a reversible facility
- Convert both Honeycutt Road and Gruber Road into reversible facilities.

Such roadway options can be modeled within the Tranplan regional model and regional impacts can be calculated in terms of regional estimates of average vehicle speed, miles traveled and total travel time. Tranplan cannot model and evaluate traffic management options, though they potentially offer attractive solutions to gate congestion. NCDOT commonly uses Tranplan to test by-pass options.

Figure 6-1: Gate Closure Study Area

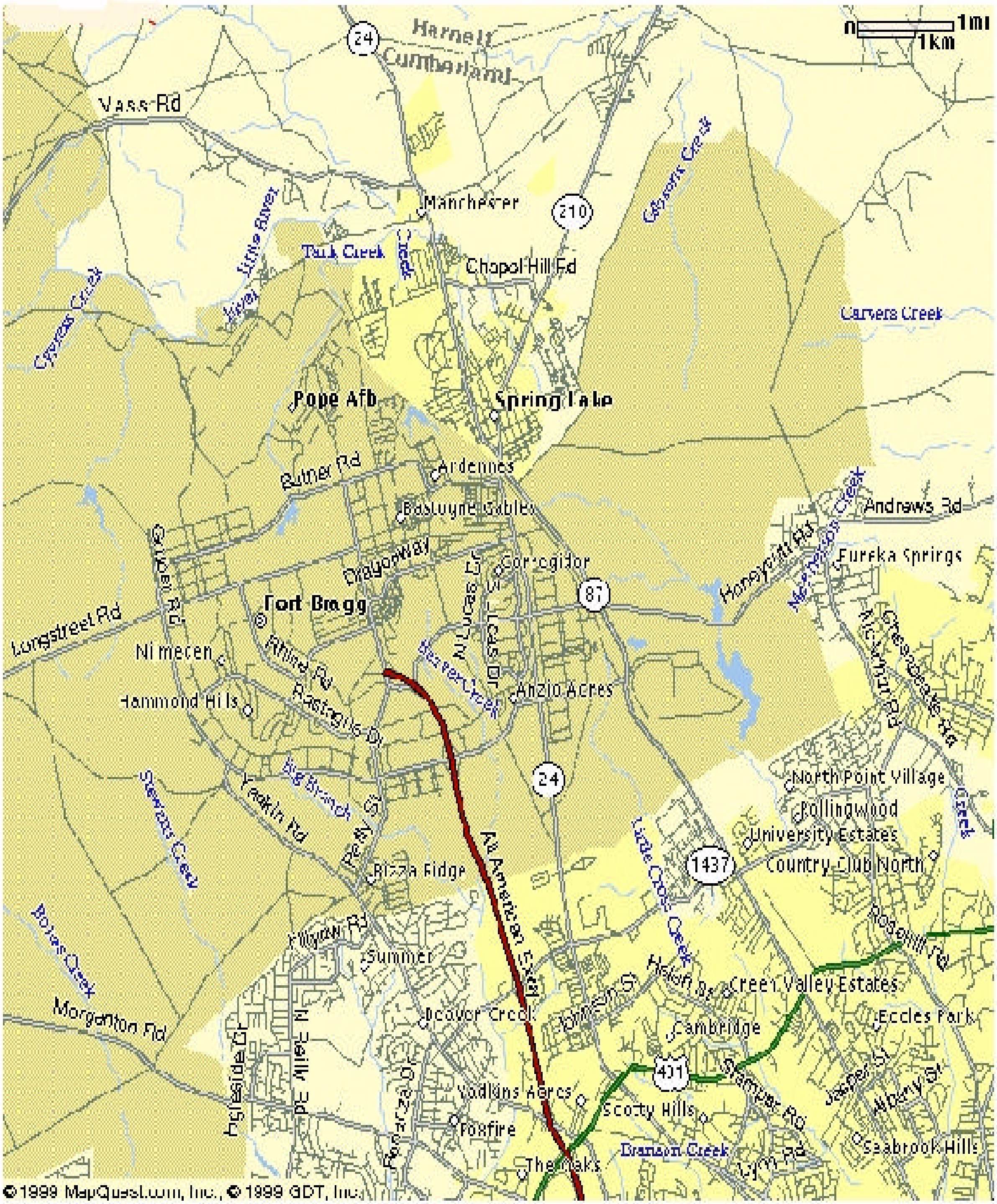
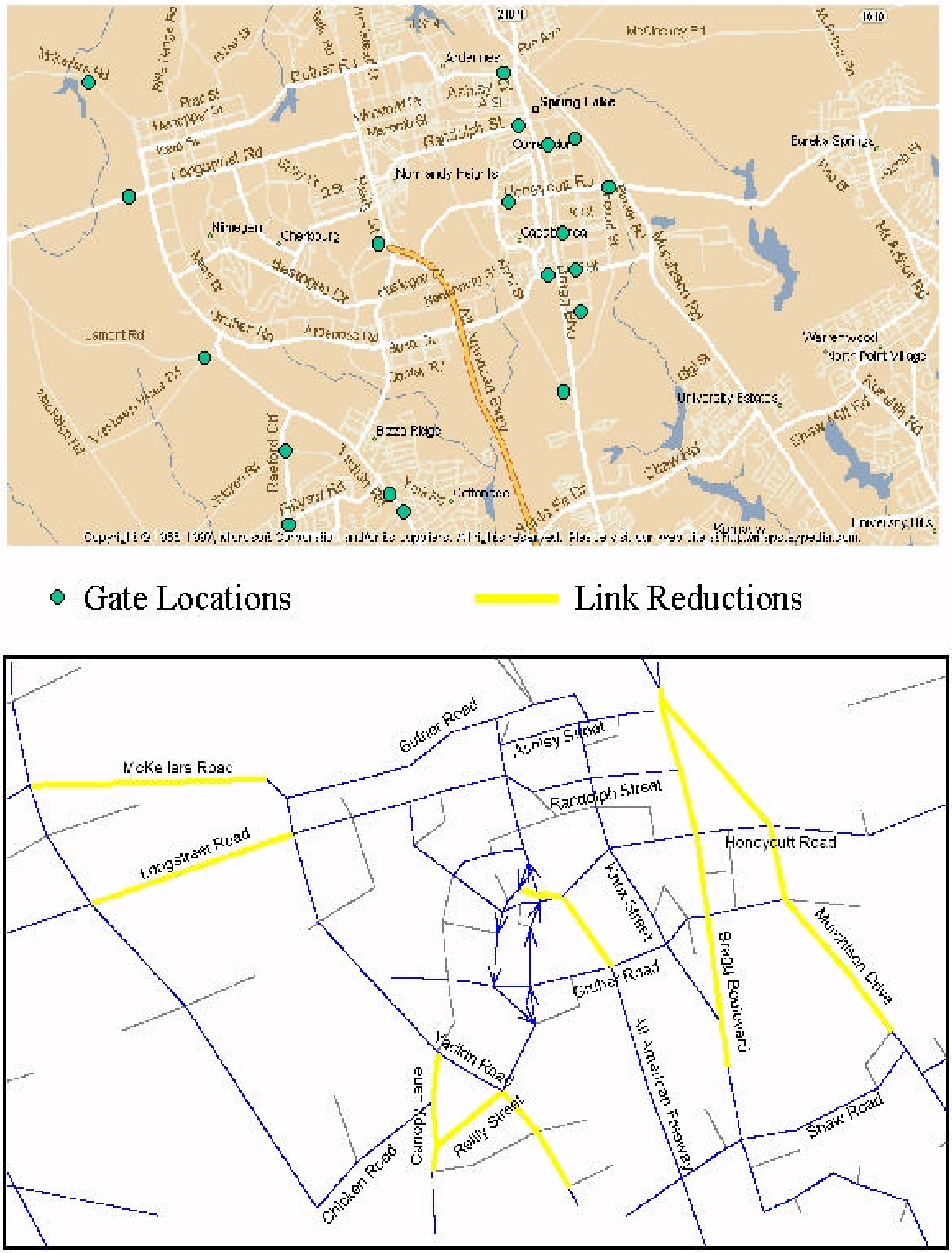


Figure 6-2: Fort Bragg Gate Locations and Model Link Reductions



Approach

Section 5 of this report discussed CORSIM, a corridor simulation program, and how it modeled and evaluated gate queues along Bragg Boulevard and Murchison Drive. However, this approach only provided delay information for that segment of the regional network. To extrapolate the localized effects of gate congestion to the region we used Tranplan, a transportation software program capable of analyzing an entire region.

The Fayetteville Tranplan model estimates travel demand and forecasts traffic volumes on the regional network. It reflects land use and travel patterns for 1995, the base year model. NCDOT calibrated the 1995 base year so that model traffic flows are within 5% of traffic counts taken throughout the region. We used the 1995 base year model to test the year 2000 Fort Bragg gate construction which was modeled using 1998 traffic counts. The time discrepancies are acceptable for this study because we are comparing relative impacts, not trying to predict absolute traffic impacts.

First, we examined the traffic assignment method in the regional model. NCDOT originally programmed the Fayetteville model with an all-or-nothing traffic assignment meaning that all drivers use the shortest route to their destination regardless of congestion. All-or-nothing traffic assignment does not account for network capacity constraints and route diversion. While all-or-nothing assignment is appropriate for a small town with few route choices and little congestion, it is not appropriate for an urban area like Fayetteville. Drivers will avoid certain streets with congestion or delay like that expected on Bragg Boulevard and Murchison Drive as a result of the gates. Thus, to reflect capacity restrictions and driver route choices, we used equilibrium traffic assignment.

Second, we changed the capacities of certain links in the regional network to reflect the gated access points (Figure 6-2). The capacity reductions are guided by the CORSIM analysis under varying security scenarios. To represent the Bravo scenario we reduced the 1995 base year link capacities of each link affected by a gate by 10% (the highlighted links in Figure 6-2). For the Charlie security scenario we kept the perimeter link capacities at 10% capacity reduction, but we reduced Bragg Boulevard and Murchison Drive capacities by 25% to represent degraded traffic movements at the gates and possible spillback onto the two highways. We represented the Delta security scenario by Bragg and Murchison capacity reductions of 50% representing significant spillback and traffic delay again holding the perimeter gates at 10%. The 25% and 50% reductions were not verified by CORSIM and only generally represent the security scenarios. Rather the range from 10% to 50% capacity reductions provides a clue to the sensitivity of regional impacts to heighten security. To limit the scope of this analysis, however, we only examined roadway improvement options for the Bravo 10% scenario.

In the third step in the approach we created separate networks for each of the various improvement options based on the all-around 10% capacity reductions. The options modeled follow with the option name in parenthesis:

- Convert Honeycutt Road and Gruber Road into a one-way pair between Bragg Boulevard and Knox Street with Honeycutt carrying westbound vehicles and Gruber carrying eastbound traffic (one way pair)
- Convert Honeycutt Road and Gruber Road into a one-way pair between Murchison Drive and Knox Street with Honeycutt carrying westbound vehicles and Gruber carrying eastbound traffic (extended one way pair)
- Convert Honeycutt Road into a reversible facility between Bragg Boulevard and Knox Street (Honeycutt reversible)

- Convert Gruber Road into a reversible facility between Bragg Boulevard and Knox Street (Gruber reversible)
- Convert both Honeycutt Road and Gruber Road into reversible facilities between Bragg Boulevard and Knox Street (both reversible)

When we converted a two-way street to a one-way street we assumed that its capacity is approximately the same as the total capacity of a two-way street, however, operational improvements may occur as a result of fewer turning conflicts at intersections near gates. Similarly we assumed that capacity of a reversible facility is approximately 50% greater than that of a two-way facility. Table 6-1 summarizes the different scenarios, capacity reductions, and names of the model improvements. Note that the 25% and 50% capacity reductions were for Bragg Boulevard and Murchison Drive only. The rest of the affected links in those Tranplan models have 10% capacity reductions to reflect the gate delays.

Third, after creating the Tranplan network for each option, we ran the networks to obtain results estimating the impacts of the gates on regional traffic conditions.

Table 6-1: Transportation Options

	Capacity Reductions			
Transportation Options	0% A	10% B	25% C	50% D
No Improvements	Base Net	Base Network	Base Net	Base Net
One way pair between Bragg and Knox	-	One Way Pair	-	-
One way pair between Murchison and Knox	-	Extended One Way	-	-
Gruber becomes a reversible facility	-	Gruber Reversible	-	-
Honeycutt becomes a reversible facility	-	Honeycutt Reversible	-	-
Gruber and Honeycutt become reversible facilities	-	Both Reversible	-	-

Discussion of Regional Traffic Impacts

The results produced by the model runs include network vehicle miles traveled (VMT), vehicle hours traveled (VHT), and average speed (Tables 6-2 and 6-3). We calculated link volumes but only compared them between the original and the do-nothing loaded networks. Figure 6-3 displays the volume comparisons between the two loaded networks, showing the traffic diversion (dark links versus light links) when Fort Bragg has restricted access.

To estimate the sensitivity of regional diversion to capacity changes, we compared the original measures of system-wide travel time (VHT), distance traveled (VMT) and average speed (mph) to the 10% restrictions (Table 6-2). The results of this comparison help to validate the modeling approach. In each case we would expect that the modeled capacity decreases should result in added regional diversion. The results met this expectation. When capacity on Bragg and Murchison was decreased by 10%, the added VMT was 13,000 miles per day. A decrease in capacity of 50% met with a rise in VMT of 85,000 miles per day. Similar system-wide comparisons show the effectiveness of the one-way pair and reversible lane options in mitigating the traffic. Results in Table 6-2 and Table 6-3 show that reversible options are effective and one-way options are not. Figure 6-3 displays diversion in terms of threshold link volume changes throughout the region.

Table 6-2: Scenario Results

Vehicle Miles Traveled (miles)

	Original A	**10% B**	**25% C**	**50% D**
No Improvements	6,585,871	6,599,357	6,616,781	6,671,443
One Way Pair	-	6,615,181	-	-
Extended One Way Pair	-	6,618,665	-	-
Gruber Reversible	-	6,599,763	-	-
Honeycutt Reversible	-	6,598,131	-	-
Both Reversible	-	6,596,689	-	-

Vehicle Hours Traveled (hrs)

	Original A	**10% B**	**25% C**	**50% D**
	Original	10%	25%	50%
No Improvements	224,161	225,127	228,211	230,951
One Way Pair	-	226,520	-	-
Extended One Way Pair	-	227,354	-	-
Gruber Reversible	-	225,203	-	-
Honeycutt Reversible	-	224,993	-	-
Both Reversible	-	225,015	-	-

Average Speed (mph)

	Original A	**10% B**	**25% C**	**50% D**
	Original	10%	25%	50%
No Improvements	29.38	29.31	28.99	28.89
One Way Pair	-	29.20	-	-
Extended One Way Pair	-	29.11	-	-
Gruber Reversible	-	29.31	-	-
Honeycutt Reversible	-	29.33	-	-
Both Reversible	-	29.32	-	-

Table 6-3: Percent Changes of Scenarios

Sensitivity Analysis **Improvement Options**

Daily Vehicle Miles Traveled

Original	6,585,871
10% Reduction	0.20%
25% Reduction	0.47%
50% Reductions	1.30%

Do Nothing	6,599,357
One Way Pair	0.24%
Extended One Way Pair	0.29%
Gruber Reversible	0.01%
Honeycutt Reversible	-0.02%
Both Reversible	-0.04%

Vehicle Hours Traveled

Original	224,161
10% Reduction	0.43%
25% Reduction	1.81%
50% Reductions	3.03%

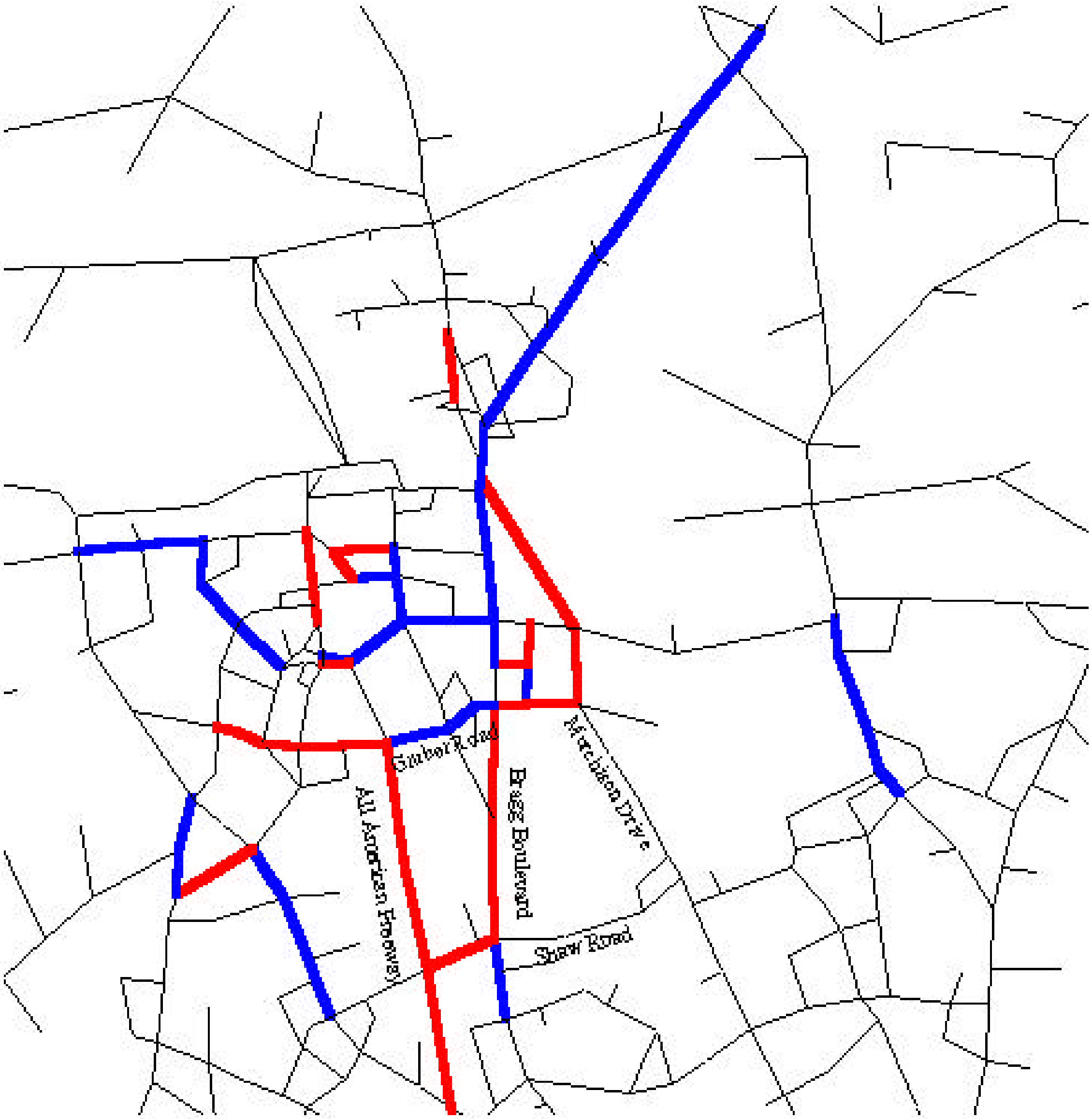
Do Nothing	225,127
One Way Pair	0.62%
Extended One Way Pair	0.99%
Gruber Reversible	0.03%
Honeycutt Reversible	-0.06%
Both Reversible	-0.05%

Average Speed (mph)

Original	29.38
10% Reduction	-0.24%
25% Reduction	-1.33%
50% Reductions	-1.67%

Do Nothing	29.31
One Way Pair	-0.38%
Extended One Way Pair	-0.68%
Gruber Reversible	0.00%
Honeycutt Reversible	0.07%
Both Reversible	0.03%

Figure 6-3: Volume Changes Due to Restricted Base Access



Note: Only increases and decreases of 1,000 or more vehicles per day are shown.

Legend: increase
decrease

Vehicle Miles Traveled

The Tranplan model predicts the effects of restricted access on regional vehicle miles traveled (VMT). A 10% reduction in capacity causes areawide VMT to rise by 0.2%. Tranplan also forecasts the impact of various traffic improvement options. Increasing levels of congestion due to gate queuing correlates to increasing VMT. When the options are examined, certain ones actually increase VMT. Both one-way pair options increase regional VMT more than doing nothing. Converting Gruber alone into a reversible facility also increases VMT. When only Honeycutt is converted to a reversible facility, there is an improvement in VMT. The best results are given when both roads are converted to reversible facilities.

Vehicle Hours Traveled

Regional vehicle hours traveled (VHT) increases by 0.43% with a 10% reduction in capacity. Three of the options provide no benefit and increase VHT more than doing nothing at all. Poorly performing options convert both Gruber and Honeycutt into a one-way pair, the same roads into extended one-way pairs, and Gruber into a reversible facility. By converting both Gruber and Honeycutt into reversible lanes, a decrease of 0.05% in VHT is obtained compared to doing nothing. A slightly larger benefit (0.06%) is obtained by converting only Honeycutt to a reversible facility.

Average Speed

A 10% reduction in capacity decreases regional average speed by 0.24% with no subsequent improvements. Once again, both one-way pair options perform worse than having no improvements. By converting Gruber into a reversible facility, Tranplan predicts no change in average speed when compared to doing nothing. When Honeycutt and Gruber are converted to reversible facilities a 0.03% increase in average speed is obtained. If Honeycutt is converted to a reversible facility by itself, a 0.07% improvement in average speed is achieved.

As the rather small areawide impacts indicate, the effects of changes at Fort Bragg tend to “wash out” compared to areawide averages for VMT, VHT and average speed. However, the capacity decreases used to model the gate effects do cause a noticeable effect in these quantities. Regional VMT increases by roughly fifteen thousand, thirty thousand, and eighty-five thousand miles for 10%, 25%, and 50% reductions in capacity, respectively. Similarly, VHT increases by roughly 1,000, 3,000, and 6,000, respectively. These effects are most noticeable in vicinity of Fort Bragg because that is where the gates are located. This “sphere of influence” should be kept in mind when examining the system-wide data. It might also be determined that the links near the gates are causing traffic impacts out of proportion to the amount of traffic they carry.

The Tranplan results have personal travel implications. If trips were distributed equally among the roughly 30,000 people employed at the base, they would add of least one mile of travel a day per person depending on the resulting traffic queues. On an annual basis, assuming 250 working days per year, this produces more than 3.75 million extra miles traveled in the region. In terms of lost time, the extra travel would amount to 250,000 man-hours per year (250 days X 1,000 VHT per day). The lost time equates to two million dollars per year, assuming an average wage of $8 per hour. In addition to these economic costs, environmental costs rise as well due to the extra mileage, delay and engine idling in queues. The increase in motor travel in the region entails an increase in the emission of greenhouse gases.

Of the options that were modeled using Tranplan, the conversion of Honeycutt Road into a reversible facility had the greatest effect in mitigating diversion. The other options tested actually resulted in greater diversion. The VMT and VHT increases that result from reducing capacity around the gate installations were reduced by about 10% when Honeycutt Road was modeled as a reversible thoroughfare. Similarly, the reductions in average speed were about 30% less when this improvement option was modeled. The Tranplan results indicate that installing reversible lanes on Honeycutt Road will be effective in processing inbound traffic during the Bravo security scenario. Other security scenarios should be examined also.

Regional Diversion

By observing changes in traffic volumes between model runs, Tranplan can be used to predict traffic diversion among specific thoroughfares. Figure 6-3 shows some of the traffic diversion that may occur when gate security measures are implemented. The model indicates that traffic may increase by at least 1000 vehicles per day on sections of Murchison Drive in Fort Bragg, Gruber Road between Bragg Boulevard and Murchison Drive, Bragg Boulevard south of the base, and most of All-American Freeway. To illustrate, a hypothetical trip originating in downtown Fayetteville, bound for the town of Spring Lake, encounters the brunt of the congestion. Delay would result either from traffic on the aforementioned thoroughfares or the driver's detour via McCormick Bridge Road. Conversely, a journey from downtown Fayetteville to the airport would hardly be affected. Additional study is warranted for Charlie and Delta security levels and for options that favor traffic management and by-pass construction.

Summary

Fort Bragg gates will change driver travel patterns due to increased congestion. Tranplan shows increases in traffic volumes of 1000 vehicles or more along certain sections of Bragg Boulevard, Murchison Drive, Gruber Road, and the All-American Freeway. North-south trips through the base will be affected the most.

The traffic impacts can be divided into regional impacts and traffic diversion. Tranplan predicts significant increases in travel distance and travel time at the Bravo security level. Higher security levels will produce greater impacts. VMT throughout the study area is expected to increase 10,000 to 85,000 miles per day, while VHT increases 1,000 to 6,000 hours per day, which will be concentrated in the Fort Bragg vicinity. These increases can be associated with added costs of lost time and environmental impacts. The economic costs alone are foreseen to be at least two million dollars per year.

Two classes of transportation improvements were tested with Tranplan at the Bravo security level. The first involves converting Honeycutt Road and Gruber Road into one-way pairs between Bragg Boulevard and Murchison Drive or Murchison and Knox Street. Neither of these scenarios decrease the diversion caused by the proposed gates. Reversible lanes on these roads did mitigate diversion and congestion.

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Section 7: Findings and Recommendations

Review

This research examined the Fayetteville metropolitan area including Fort Bragg as a candidate implementation site for TRANSIMS under the FHWA Early Deployment Program. The project objectives were to:

- review the state-of-the-art of TRANSIMS development,
- examine the resource requirements necessary to apply TRANSIMS,
- estimate advantages, disadvantages, costs and benefits of conducting a TRANSIMS study in North Carolina, and
- facilitate future implementation of TRANSIMS in North Carolina.

The research explored TRANSIMS concepts and resource requirements and ran test networks in order to determine Fayetteville - Fort Bragg "readiness" for TRANSIMS. It used the Fayetteville – Fort Bragg case to develop and test an assessment methodology, which should be helpful to other agencies considering an EDP, and demonstrated practical modeling alternatives to TRANSIMS for the Fayetteville – Fort Bragg case.

There is little question that TRANSIMS represents a revolution in regional transportation modeling. By integrating activity-based travel models, microscopic traffic flow models and environmental models, TRANSIMS provides capabilities that do not exist and that could be used directly to satisfy a variety of federal mandates. The USDOT has, and will continue to invest significant resources into TRANSIMS. Yet, in spite of the significant functionality of TRANSIMS and its promising results in Dallas and Portland, the data, computational resources, and staff requirements for TRANSIMS appear daunting and must be thoroughly considered by prospective agency users like NCDOT.

This study will help North Carolina to implement this new modeling technology when the time is right. This research provides guidance on data preparation, computing needs and personnel training requirements to bring about a profound change in the models and philosophy of transportation planning.

Findings

<u>TRANSIMS</u>

TRANSIMS exists as a working prototype. The Los Alamos National Laboratory has demonstrated TRANSIMS on Dallas-Fort Worth and Portland, and Federal EDP funds will sponsor five or six more pilot demonstrations. TRANSIMS data requirements are extensive, especially for the network model and the activity system. TRANSIMS is computationally intense, and the required hardware is not typically available at MPOs or DOTs. Any MPO considering the use of TRANSIMS must be willing to dedicate significant resources. While the TRANSIMS-LANL model is essentially complete, uncertainty exists regarding the computer platform and application of the commercial version.

<u>The Fayetteville – Fort Bragg Case for the Early Deployment Program</u>

As an assumed eventual user of TRANSIMS NCDOT has two options:

- Apply to be one of the six EDP agencies and if selected receive technical assistance and federal funds estimated to be approximately $1 million that must be matched 20%, or
- Forego federal EDP support, wait for the results of the Early Deployment Program in other regions, and implement TRANSIMS as needed.

The NCDOT Technical Advisory Committee for this project decided not to pursue an EDP grant, citing the incompatibility of the TRANSIMS EDP schedule relative to NCDOT modeling commitments and staff resources. Recognizing the NCDOT decision the research team determined the following aspects of the Fayetteville – Fort Bragg EDP case:

- The medium size Fayetteville - Fort Bragg area represents an attractive opportunity to demonstrate selected TRANSIMS capabilities quickly with a high certainty of success. This varies from the FHWA focus on larger metropolitan areas that would test most TRANSIMS functionalities.
- The Fayetteville – Fort Bragg case meets most all the EDP requirements: geographic diversity, transportation applications, probability of success, team expertise, computer support, data availability, cost and match.
- The Fayetteville – Fort Bragg case falls short of EDP requirements in terms of commitment and political support because of staffing constraints and NCDOT regional modeling obligations.
- Ignoring contributed federal support for training and software, the estimated cost for an EDP project for the Fayetteville – Fort Bragg case is about $800,000. This preliminary estimate includes a grant request from FHWA for $625,000 and a local 22% match of $175,000. NCDOT, Fayetteville, Fort Bragg, NCSU and NISS would share the local match.
- Significant decision factors regarding the feasibility of implementing TRANSIMS in a region can be captured in a simplified "TRANSIMS Feasibility Assessment Tool" that appears valid for the Fayetteville – Fort Bragg case, Portland, and Dallas-Fort Worth.
- While one significant "selling point" of TRANSIMS is its capability for "micro" traffic modeling at the street level as well as "macro" modeling at the regional level, hybrid approaches combining CORSIM with Tranplan or TransCAD are attractive substitutes, at least for the short term until TRANSIMS is fully demonstrated.

TRANSIMS Feasibility Assessment Tool (TFAT)

Whether or not TRANSIMS is a feasible transportation model for an area depends on the relative benefits that would be gained compared to the current model for the area versus the resources needed to develop the new TRANSIMS model. This research developed a prototype Internet-based utility called the TRANSIMS Feasibility Assessment Tool (TFAT) that will help planning agencies make such comparisons.

- The project Internet site implements the tool at http://www4.ncsu.edu/~dsengup/indextransims.html.
- TFAT gives reasonable results for the Dallas – Fort Worth and Portland applications of TRANSIMS.
- According to TFAT the Fayetteville – Fort Bragg case is feasible with NCDOT staffing and support and infeasible without them.

Corridor and Regional Traffic Impacts of Fort Bragg Gates

Fort Bragg is building gates across roads leading into the military reservation in order to improve security during a terrorist threat or deployment of Fort Bragg soldiers. The gates will change regional travel patterns and create localized congestion. Using CORSIM, which is a micro-simulation model, we modeled gate operations for different security levels, and we estimated the corridor traffic impacts along Bragg Boulevard and Murchison Road that serve Fort Bragg and the region. We also used the corridor impacts in the Tranplan regional model. The approach of combining local and regional traffic forecasting represents a "poor man's" TRANSIMS analysis. Analysis determined the following:

- Simulated traffic flows for streets, intersections and gates show that at the lowest security level, queue spillback occurs at the Gruber Road gate located east of Bragg Boulevard.
- At increased security levels vehicle queues may spill back to Bragg Boulevard from the gates located on Butner Road, Honeycutt Road, and Gruber Road.

- The simulations and resulting computer animations are helpful to illustrate to decision-makers how traffic may react under various levels of security and vehicle delay at the gates.
- Fort Bragg gates will change regional travel patterns when perimeter gates close rural roads and when gates cause congestion on Bragg Boulevard and Murchison Road.
- Depending on the security level and how military police inspect vehicles entering Fort Bragg, regional Vehicle Miles Traveled will increase 10,000 to 85,000 miles per day, while Vehicle Hours Traveled increases 1,000 to 6,000 hours per day.
- Converting Honeycutt Road and Gruber Road into one-way pairs between Bragg Boulevard and Murchison Drive or Murchison and Knox Street do not decrease the regional traffic diversion caused by the gates.
- Reversible lanes on Honeycutt and Gruber Roads did mitigate diversion and congestion.

Recommendations

<u>TRANSIMS Early Deployment</u>

Regarding the TRANSIMS EDP, the research team makes the following recommendations:
1. North Carolina should not develop a TRANSIMS EDP grant application until the NCDOT management approves budget and other resource expectations.
2. Besides obtaining the support of Fayetteville and Fort Bragg officials, other officials in the Fayetteville metropolitan area will have to be brought into the project. Other state officials in resource agencies must also be involved.
3. When resource and scheduling constraints change at NCDOT and when the TRANSIMS methodology is further developed, the Fayetteville Area Metropolitan Planning Organization should have high priority as the first TRANSIMS analysis in North Carolina.

<u>Year 2000 Update of the Fayetteville Metropolitan Area Transportation Plan</u>

With respect to the ongoing Fayetteville regional study and in anticipation of an eventual TRANSIMS model for the Fayetteville area, the team makes the following recommendations:
1. Apply the 1995 base year TransCAD model that the NCSU/NISS team developed from the original Tranplan model. (TransCAD with its GIS functionality represents a precursor step toward a TRANSIMS model.)
2. Add more network detail to reflect link bearings, intersection coordinates and geometries; and capacities and signalization of major streets especially through Fort Bragg. (This information will be helpful for eventual TransCAD or TRANSIMS micro-simulations.)
3. Collect household and employment data at the property level rather than aggregating for traffic analysis zones. (This refined level of aggregation will permit closer examination of land use options and provide important detail for TransCAD and TRANSIMS.)

Test CORSIM as a "micro" traffic analysis tool to address link-level project issues like congestion at the Fort Bragg security gates. (The results will reflect and perhaps substitute for the type of detail available from TRANSIMS.)

<u>Corridor and Regional Traffic Impacts of Fort Bragg Gates</u>

Regarding traffic impacts associated with the gates at Fort Bragg, the team suggests the following:
1. Update traffic counts used in the CORSIM analysis, and use traffic volumes for the entire two and a half hour peak periods
2. Field check lane configurations.
3. Explore the potential for modeling the gates using a ramp meter analogy instead of signals.

4. Rerun the spreadsheet and simulation analyses with the current traffic data to predict revised traffic impacts at and near the gates for different security levels.
5. Estimate regional travel and economic impacts using the regional transportation model.
6. Test alternative ideas to reduce the congestion such as projects to improve the highway network, traveler demand management, transit and carpooling, and "intelligent" transportation systems technology.
7. For research comparisons develop TRANSIMS and TransCAD micro-simulation models of the corridor.

Technology Transfer

NCDOT and NCSU should make the results of this project available to other agencies and MPO's so that officials can gauge the utility of TRANSIMS for their own transportation planning projects. Potential EDP candidates will also find the project results helpful and informative. FHWA and members of the Transportation Model Improvement Program (TMIP) are candidate recipients of the report.

Technology transfer regarding the overall project has begun and will continue in several ways:

- Distributing this final report in traditional paper format.
- Distributing the report on CD.
- Providing access to summary project findings and an electronic version of the entire report on the project website at http://www4.ncsu.edu/~dsengup/indextransims.html
- Presentation of the project at the Transportation Research Board Annual Meeting and other appropriate conferences.
- Publication of the research approach and findings in an appropriate TRB or other journal.

The project also provides important information for NCDOT and the Fayetteville Metropolitan Area Planning Organization as staff members update the regional transportation plan. NCSU can make available the following items developed during the project:

- Digital information for the Fayetteville area and Fort Bragg including socio-economic and land use data, geographic and network data, employment data, etc.
- CORSIM data files for gate traffic impact analyses.
- Tranplan data files for regional traffic impacts from the gates.
- TransCAD data files that correspond to the 1995 base year Tranplan network and traffic assignment.

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Ft. Bragg Long Range Component/ Master Plan, July 1994.

Data on CD's and Disks

911 Mapping Data: Map Info Files

Fayetteville Area Tranplan Models for Base and Future Years (Loaded and Unloaded Traffic)

Ft Bragg networks, utilities, physical infrastructure, gate access

Fayetteville Area Orthophotos (2)

Population and Employment Data: Arc Info Files

TRANSIMS-LANL program (research version), installation and documentation files

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Internet Resources

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Appendix A: TransCAD Model for the Fayetteville Area

TransCAD

Caliper Corporation designed the TransCAD program as a full-featured geographic information system (GIS) for transportation planning and management purposes. Recently NCDOT chose TransCAD as the regional transportation modeling and planning tool. It will eventually replace the Tranplan software package. It can also serve as a precursor model for TRANSIMS that relies heavily on GIS databases. Therefore, the NCSU team converted the Fayetteville Tranplan network into TransCAD format in anticipation of the upcoming year 2000 update of the Fayetteville regional transportation model. The team converted the base year 1995 model originally developed by NCDOT in Tranplan version 8.0 to an equivalent 1995 base year model using TransCAD version 3.6. NCSU has the files and will provide them to NCDOT.

Fayetteville Network Conversion

The NCDOT Statewide Planning Branch developed an internal document[1] to illustrate detailed procedures of network conversion. The basic steps are briefly summarized below.

The 'netcard.exe' program, one of Tranplan utility programs, converts a binary Tranplan network (i.e., *base95.net*) into ASCII formatted link data and x-y coordinates (i.e., *base95.txt*). Since these x-y coordinates are arbitrary, they have to be later on converted to the State Plan Coordinates NAD 83 meters (STP NAD83). Note that the STP NAD83 has relationship to real world projection.

We used a basemap shapefile (*stmap.shp*) from the Fayetteville Planning Department for coordinate transformation. This shapefile was created from ARCVIEW program. An 'import planning networks' procedure under planning menu | planning utilities in TransCAD opens the Tranplan network. This procedure also transforms arbitrary coordinates (Tranplan coordinates) into the STP NAD83. However, the Tranplan network and the shapefile do not usually match very well. Another procedure, "rubbersheeting", in TransCAD matches the Tranplan network layer to the shapefile. A new network (STP NAD83 coordinates) is produced and saved to a new layer (*overlay.dbd*). A new network layer is saved as new base network from Networks/Paths → Create menu in TransCAD. The newly created network is saved as *basecase.net*.

O/D Matrix

The origin-destination table (O/D table) has to be converted to TransCAD format as well in order to conduct network assignment. The TRANPLAN O/D table, which is in a binary format, (*total95.tab*) was converted to a text version file (*total95.od*) using "tpcard1.exe" program. The tpcard1 is a Tranplan utility program. Then this text file was saved as databases file (*total95.dbf*) so that TransCAD program can import it as matrix file (*tij95.mtx*). Note that matrix file is a TransCAD format.

Network Loading

Once the network file and O/D matrix are ready in TransCAD format, traffic assignment can be conducted from traffic assignment option under planning menu. The loaded network maps, one from Tranplan and the other from TransCAD, based on all-or-nothing method are shown in Figure A-1. It appears that assignment results are very similar. As shown in Table A-1 vehicle-kilometers-traveled and vehicle-hours-traveled between Tranplan and TransCAD are very close.

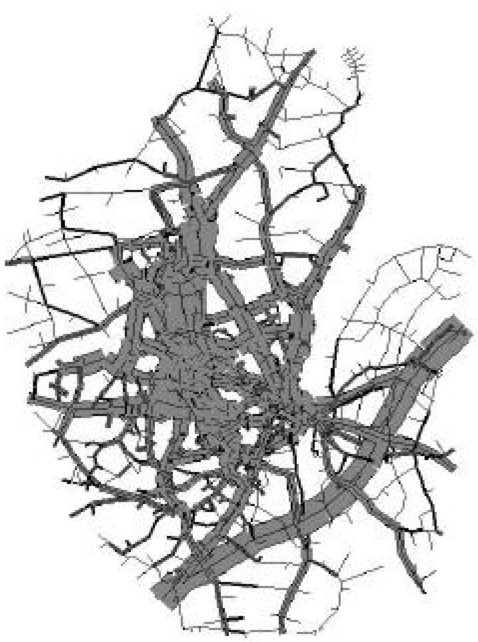
[1] TransCAD 3.5 Users Manual for the Statewide Planning Branch Volume I

Table A-1: Comparison of Assignment Results

	Vehicle-Kilometer-Traveled	Vehicle-Hour-Traveled
Tranplan	6,493,591	177,915
TransCAD	6,488,922	177,660

Figure A-1a: Tranplan All-or-Nothing Results

Figure A-1b: TransCAD All-or-Nothing Assignment Results



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Appendix B: Data Available for the Fayetteville – Fort Bragg Area

Figure B-1: Fayetteville Zoning Map

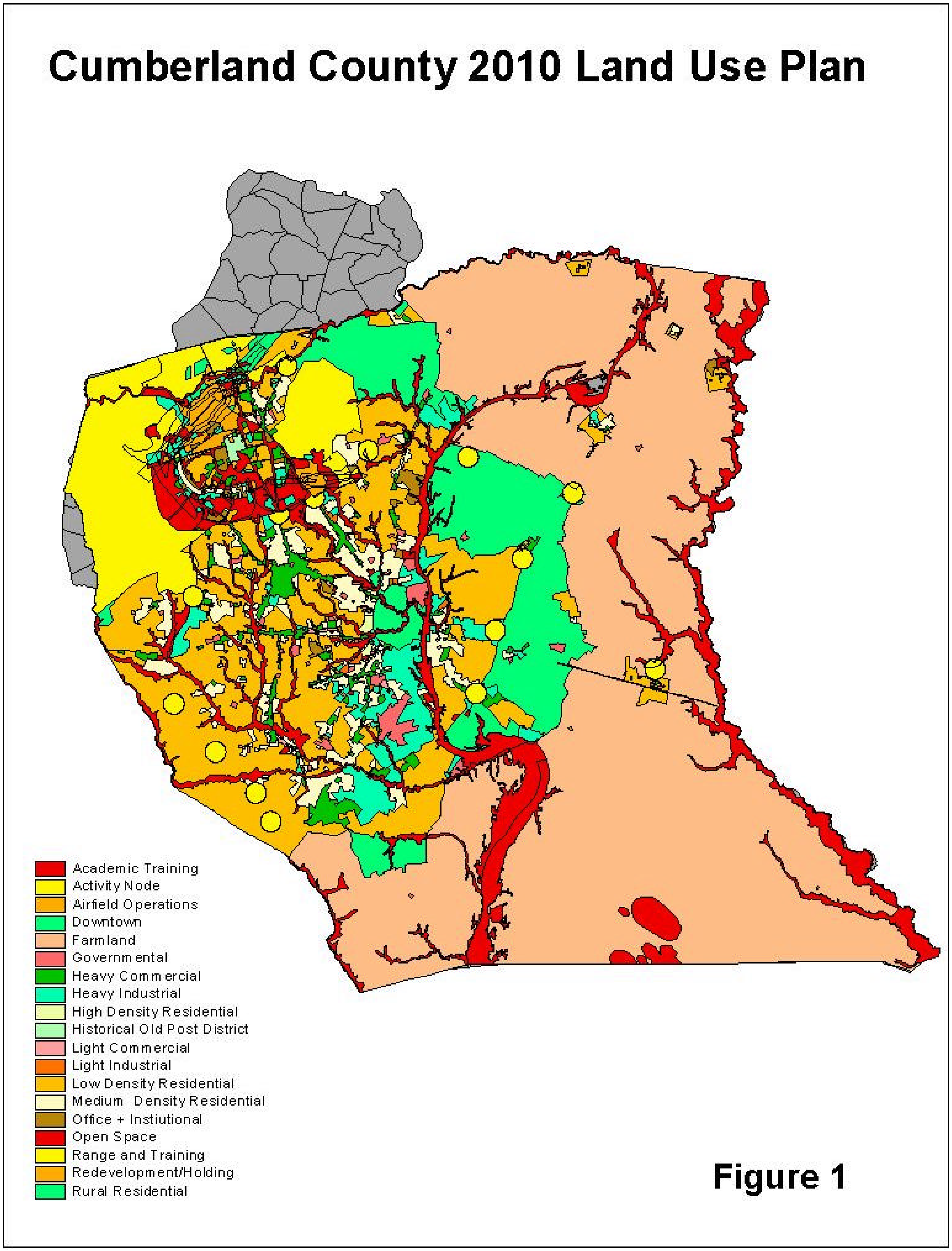


Figure B-2: Fayetteville Street Network

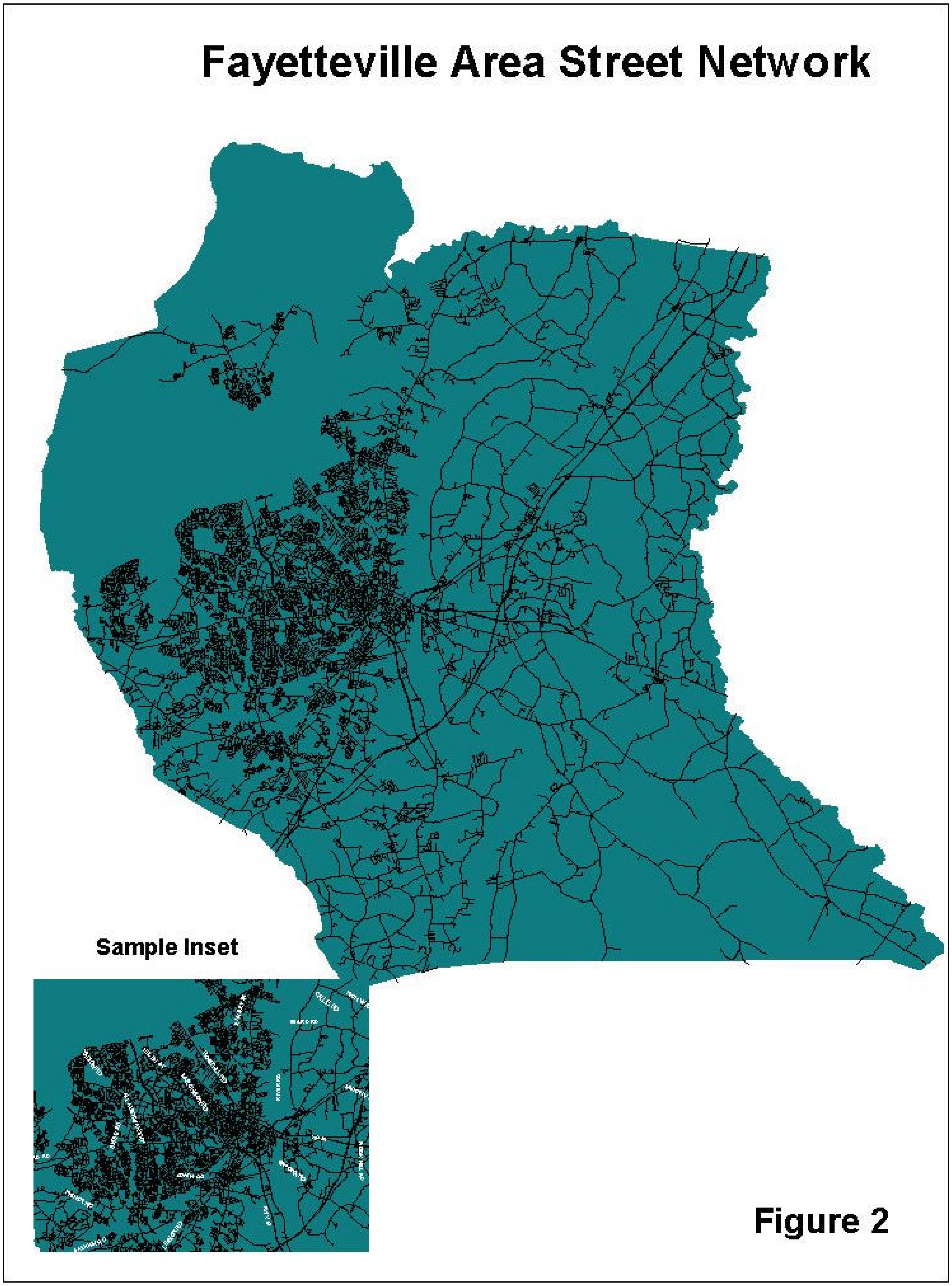


Figure B-3: Activity Location Data

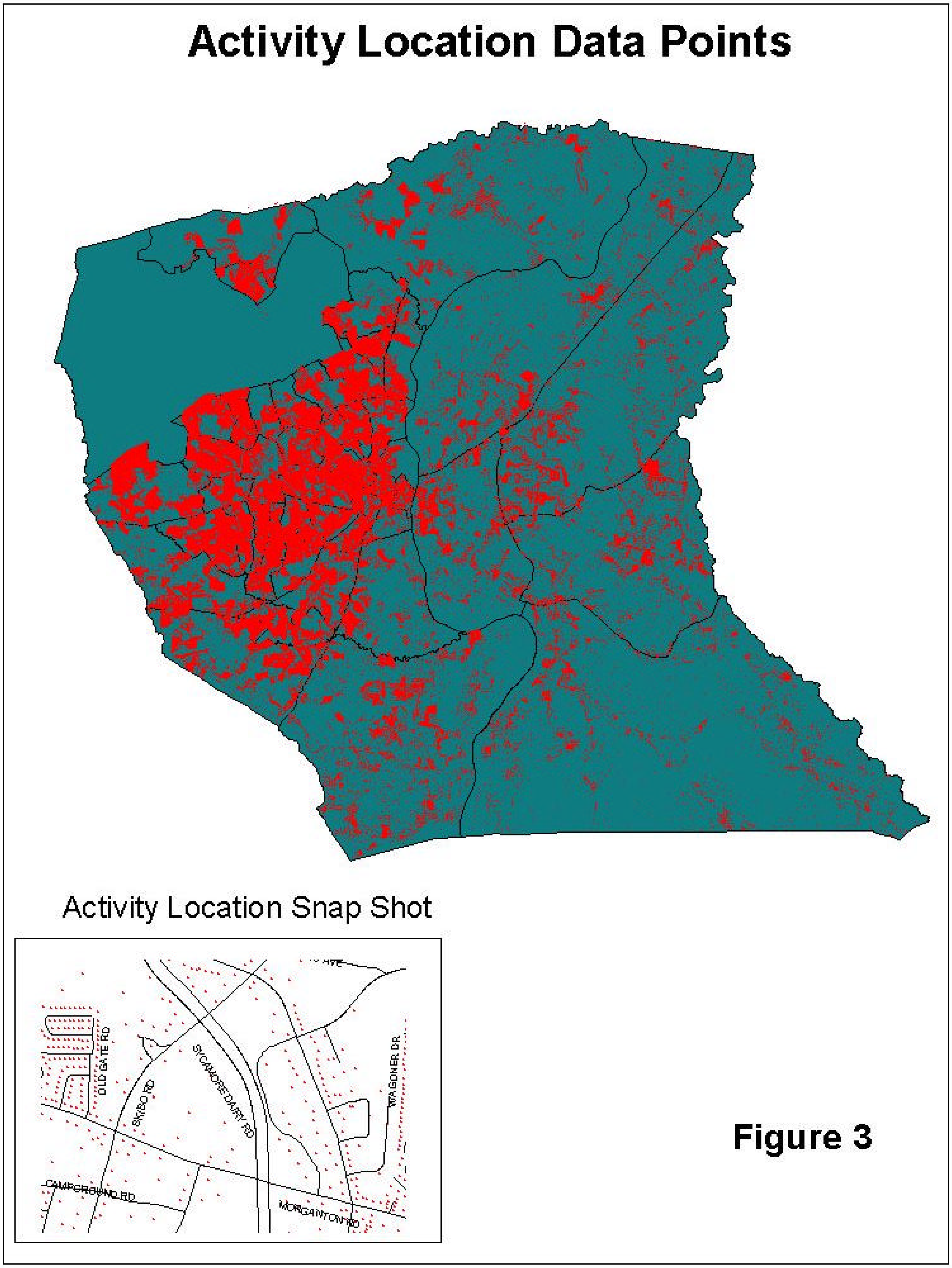


Figure B-4: Fayetteville TAZ Map

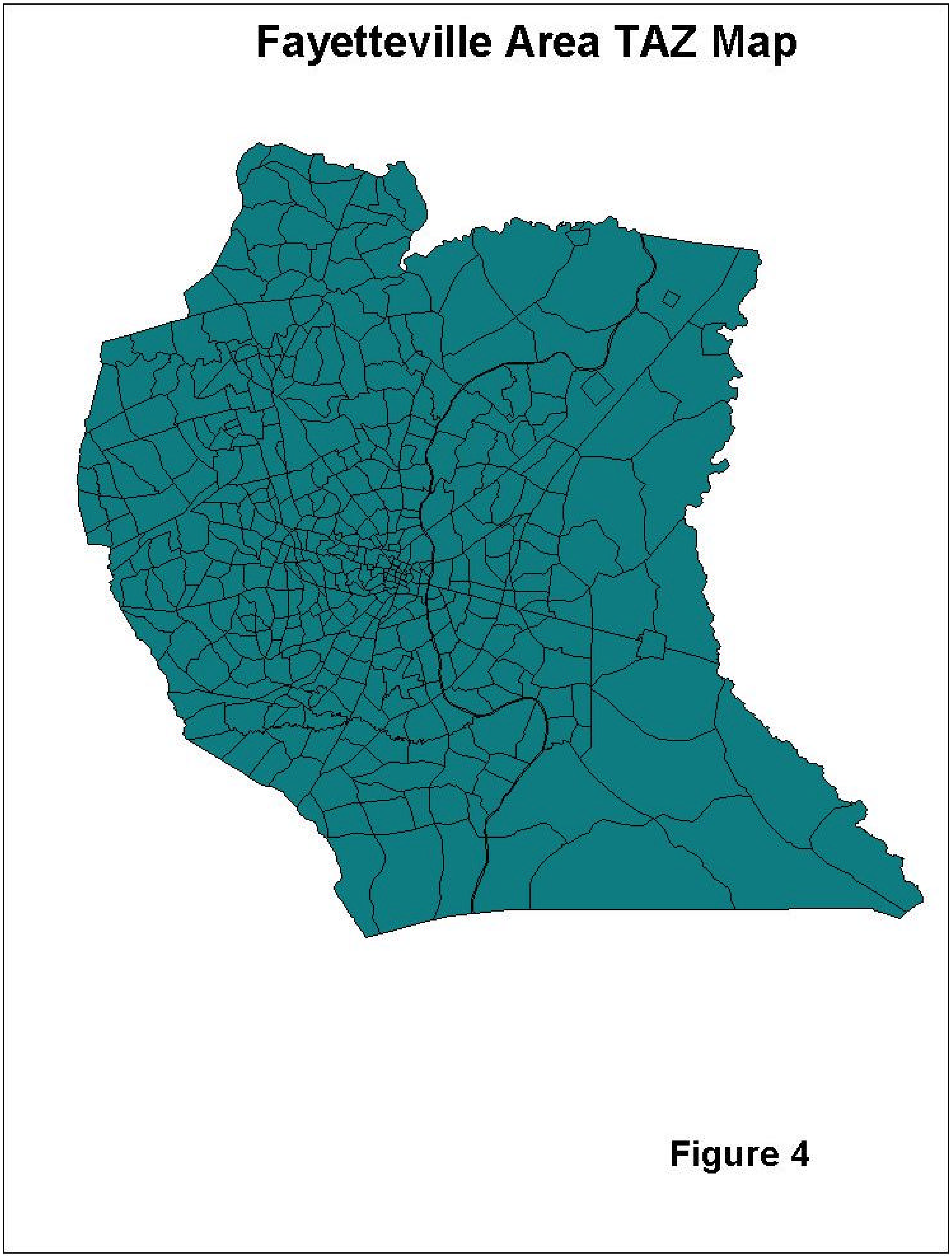
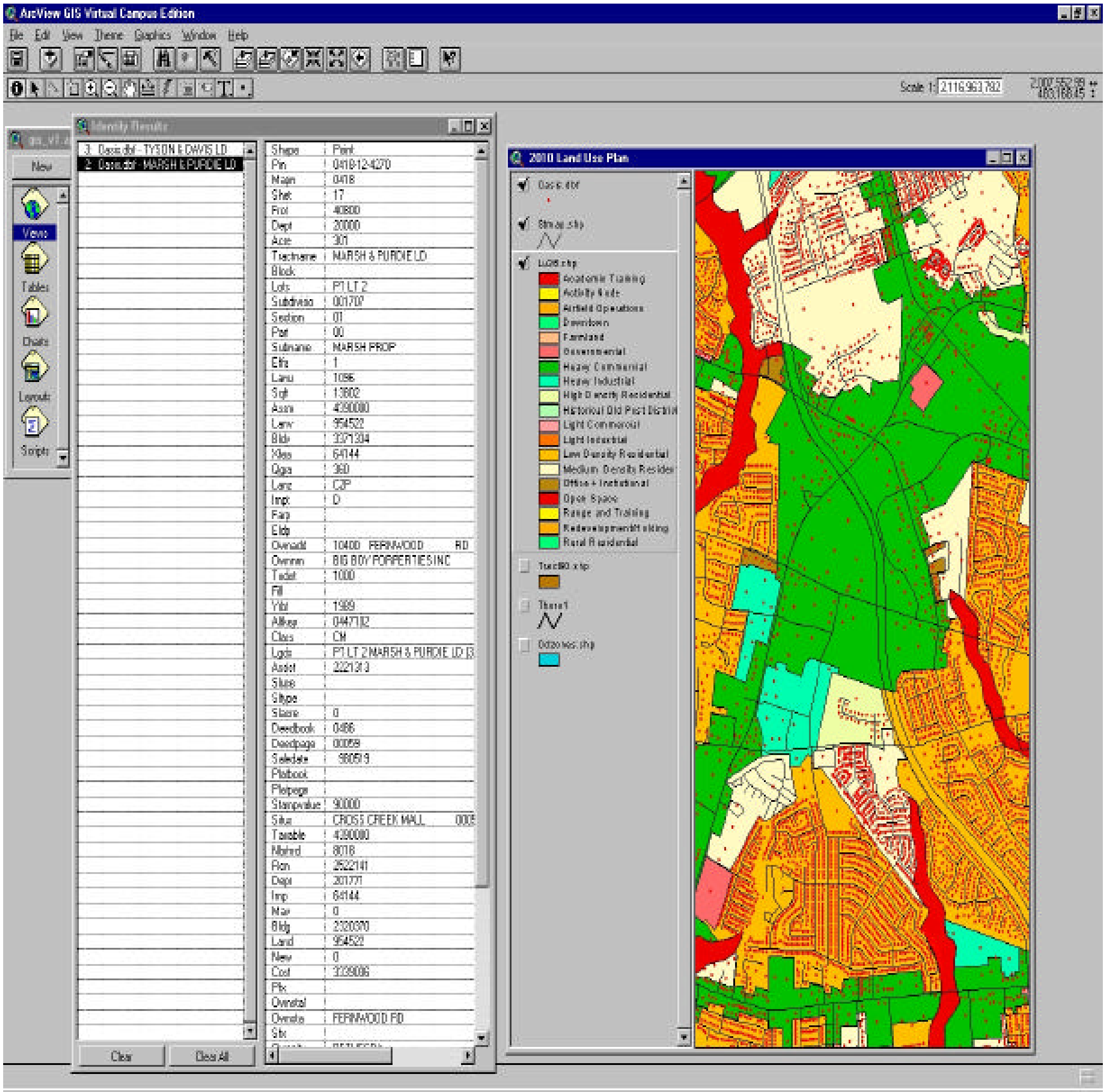


Figure B-5: Sample Fayetteville Tax Assessor Database



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