EXHIBIT 'A'

Scope of Service

for

Development of Speed Models for Improving Travel Forecasting and Highway Performance Evaluation

submitted to:

Florida Department of Transportation
Research Center
605 Suwannee Street, MS 30
Tallahassee FL 32399

c/o Frank Tabatabaee
Project Manager
Systems Planning Office
Florida Department of Transportation

Principal Investigator:

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1. BACKGROUND

Speed and distance are the two variables that determine network travel times and are used in the trip distribution, mode choice, and traffic assignment steps of the four-step modeling process. Currently, most highway networks in Florida travel demand models derive an initial, or free-flow speed from a speed/capacity look-up table based on facility type and area type combinations. Transportation networks should ideally reflect true speeds and travel times based on observed speed data. Accurate speed data are necessary for reliable calculation of vehicle hours traveled (VHT), time-of-day traffic assignments, development of Congestion Management Plans (CMPs), highway and transit corridor analyses, and air quality emissions analysis.

As of March 2011, it is expected that approximately seven Metropolitan Planning Organizations (MPOs) in Florida will soon be designated as ozone non-attainment areas. Non-attainment areas will have one year to demonstrate air quality conformity on their Long Range Transportation Plans (LRTPs) and Transportation Improvement Programs (TIPs). Ozone emissions must be calculated to demonstrate conformity. Emission factors by speed and facility type are applied to each link-level VMT estimate in the travel demand model. Currently, MOBILE6, EPA's currently approved emissions factor program, outputs emissions factors in 1 mile per hour (mph) increments. The MOVES program will soon succeed MOBILE6, but emission rates will still rely on speeds. If the model speed is significantly different than the observed speed, the ozone emissions can be grossly over- or under-estimated. Therefore, reliable and accurate speed estimation is crucial to MPO's responses to the EPA's air quality regulations.

In addition to air quality estimation, planning, design, operations, and maintenance of highways require abundant and accurate data on parameters that characterize traffic flow on these highways. The major traffic parameters that describe traffic flow are speed, volume, and density. Unfortunately, all these three variables vary temporally and spatially thus posing challenges to the modeling and forecasting of traffic at highway locations. For example, speed is a major component of the Florida Standard Urban Transportation Model Structure (FSUTMS) modeling software since the validation of the BPR traffic assignment model requires collection of accurate data on travel time, which is the reciprocal of travel speed.

The Systems Planning Office – as the state's premier office that provides support for transportation modeling – needs accurate, reliable, and consistent sources of data necessary for determining the level of service on roadways, travel forecasting, and traffic assignment on networks. The two potential sources of data for these purposes include telemetered traffic monitoring sites (TTMS) operated by FDOT Statistics Office and Statewide Transportation Engineering Warehouse for Archived Regional Data (STEWARD) database. Although data collected by these sources depict a clear overview of the level of usage of Florida highways, the level of coverage is insufficient particularly when modeling roadway sections that are too far from point of acquisition or have geometric, traffic, and other characteristics not captured by the data source. This is particularly true for speed data that often does not include hourly variation, speed distribution by lane, and other pertinent information critical to modelers. The study proposed herein is aimed at filling the data needs gap, particularly on speed, for use by

transportation modelers, planners, and safety and operational engineers. The desire to conduct accurate speed modeling on Florida highways is consistent with the consensus of the FSUTMS Task Force which found that speed data used for traffic projection and model validation need to be improved.

2. OBJECTIVES

The overall goal of this project is to strengthen the mission of Systems Planning Office of providing support related to traffic modeling for statewide planning, complementing models developed by MPOs and local governments. Consistent with this goal, the objective of this project is to develop a statewide speed model that predicts speed at forecasted link volume levels and estimated speed validated against existing data collected from TTMS sites and other sites. Work not included in this scope of service is not to be performed and will not be subject to compensation by the Department.

3. TASKS

To accomplish this objective the following tasks will be completed:

Task 1: Conduct Literature Review on Speed Modeling

This review will identify past published research on methods and approaches to estimating speeds on roadways within a model context. This includes both volume-delay functions, approaches to estimating these functions, and post-processing techniques to improve estimates of link speeds. We will also investigate published research on optimum data collection methods for developing a speed database.

Task 2: Collect Speed Data on Homogenous Segments

This task includes the development of a speed data survey sampling plan for autos and transit, collection of the speed data on freeway and highway systems at a minimum, and post-processing of the speed data to include in Florida's travel demand models.

Prior to actual data collection, we will define what is meant by homogenous segments, which form the unit of observation for the database. It is important to identify these segments carefully so that the speed data from them can be associated with specific roadway, area and temporal characteristics. The sampling plan should evaluate appropriate methodologies and consider the collection of speeds during different time periods, days of the week, and along different facility types and area type combinations. Spatially-averaged speed data is especially important for application to static travel demand models, and strategies for collecting spatially-averaged speeds will be identified and tested. Travel times and distances will be calculated at multiple points in automobiles and buses. This will assist with comparing automobile to transit travel speeds within the travel demand model and will improve the reliability of transit ridership estimates. Since collecting travel speeds will be limited to a subset of the entire state highway system, auto speeds and transit speed relationships will be summarized by area type, facility type, and lanes to allow for transferability to models throughout Florida.

In addition, this task will look at feasibility of implementing recent research (Hu, Peeta, Chu TRB2009) regarding the optimal placement of sensors in a network that enables the accurate estimation of traffic flows on all links of the network under steady-state conditions (i.e., link capacities, link flows, and the origin-destination demand rates are time invariant).
Finally, other sources of speed data will be investigated. ITS technologies including point traffic sensors and probe surveillance based on license plate readers and/or electronic toll collection tags have been installed on freeways and at some locations on arterial streets. Also, transit agencies have installed automatic vehicle location technologies (AVL) on their buses. Furthermore, private sector information providers have been collecting fleet (e.g., truck fleet) AVL data and use the data for real-time travel time estimation. This research will explore the use of these emerging sources of data combined with the other sources of data mentioned above to provide a cost-effective approach to speed/travel time data collections and estimations. The project anticipates that part of the funding will be used to purchase speed and demand data from private-sector vendors.

Task 3: Develop Speed Distribution Curves for Established Links
Where the data is sufficiently robust, speed distribution curves will be developed. These curves will depict changes in speed and distributions of speed over time and as a function of season, and most importantly demand. Other independent variables, such as truck mix, will also be considered and tested. The goal will be to create a reliable, easy-to-access speed database. This would be useful for model calibration, both at the daily, period and hourly levels. The statistical level of confidence for these speed profiles should also be computed and provided in a geodatabase.

Task 4: Develop Space Mean Speed, Volume and Density Relationships
In this task, the observed speed data, collected with corresponding observed demand data along with information on the facility capacity, facility type and area type will be used to develop observed volume-delay curves that may be used in regional and statewide models. First, different functional forms for the volume-delay curves will be fitted to the observed data. Then a comparison will be made between different formulations to determine how well they perform to capture the observed speed/demand behavior. Confidence limits related to selected curves will be identified. Other factors, such as vehicle mix (e.g., truck share) will be investigated to determine their influence, and how these factors might be reflected in more sophisticated volume delay functions, without an excessive data burden on travel demand models.

Task 5: Develop Methodology and Models to Predict Speed at Various Locations
This task will focus on more empirical models that depend on observed data. Link speeds will vary depending upon a variety of factors, including demand, capacity, roadway geometrics, vehicle mix, facility type and area type. A model that reliably predicts speeds from know volume counts would be very useful in establishing a validation database for metropolitan areas, or state-wide models that have an abundance of count data but lack speed information.

Work not included in this scope of service is not to be performed and will not be subject to completion by the Department.

4. USE OF GRADUATE STUDENTS AND OTHER RESEARCH ASSISTANTS

The research team will be led by Dr. Ren Moses as the principal investigator. Dr. Moses will work on the project throughout the project period but will be compensated only during summer months for a total of 260 hours. In addition, two students will be employed to travel to various Florida localities for traffic monitoring, data collection, and data analysis. The students will devote a total of 1240 hour each in the project.

5. EQUIPMENT

No equipment will be purchased in this project.

6. TRAVEL

Ten in-state travels are planned to visit and collect data from various locations in the state.

All travel shall be in accordance with Section 112.061 Florida Statutes. FDOT employees may not travel on research contracts.

7. DELIVERABLES

Deliverables include progress reports at times tied to specific task completions. A draft final report and a final report will be prepared as a compilation of individual task reports. Task reports include:

1. Literature review on speed modeling
2. Speed Data collection strategies, and discussion of sources of data used in the project, and their particular methodologies.
3. Report showing speed distribution curves, including a discussion of useful and significant independent variables.
4. Report discussing the development of volume delay functions, including preferred functional forms, level of confidence and applicability to travel demand forecast models.
5. Report on empirical models to predict roadway speeds on Florida roadway facilities, functional forms, specifications, applications and limitations of the models.

Kickoff Meeting

A kickoff meeting will be held with FDOT, FSU research faculty and consultant staff to confirm the scope, schedule and roles of each party for this project. Communications and contact information will be shared, and a strategy for sharing data and working files will be discussed.

A kick-off meeting shall be scheduled to occur within the first 30 days of execution by the university. The preferred method for the kick-off meeting is via teleconference or video conference. As a minimum, the project manager and the principal investigator will attend. The Research Center staff must be advised of the meeting and given the option to attend. Other

parties may be invited, as appropriate. The subject of the meeting will be to review and discuss the project's tasks, schedule, milestones, deliverables, reporting requirements, and deployment plan. A summary of the kick-off meeting shall be included in the first progress report.

Progress Reports

Quarterly reports will be submitted to the Research Center within 30 days of the end of the reporting period. Progress reports will be sent to Sandra Bell (Sandra.bell@dot.state.fl.us)

The progress reports will include:
1. Contract number, task work order number, and title
2. Work performed during the period being reported
3. Work to be performed in the following period
4. Anticipated modifications (i.e., to funding, schedule, or scope). This section is for reporting/informational purposes, not for officially requesting an amendment.

The university will submit quarterly progress reports to the Research Center. The first report will cover the activity that occurred in the 90 days following the issuance of the task work order.

Failure to submit progress reports in a timely manner may result in termination of the work order.

Draft Final Reports

The draft final report is due within 90 days prior to the end date of the project. It will be submitted to Sandra Bell (Sandra.bell@dot.state.fl.us) and comply with the requirements of the Research Center.

Final Reports

Once approved, a final report will be prepared. The university will deliver a minimum eight (8) copies on CD or DVD – seven (7) CDs should contain the final repot in PDF format, one (1) CD should contain the final report in PDF format, MS Word format and a Summary of the Final Report. The CD/DVDs should be labeled in a professional manner and include at a minimum the contract number, task work order number, project title and date. The final report is due no later than the end date of the task work order and should be delivered to the Research Center, MS 30, 605 Suwannee Street, Tallahassee, FL 32399-0450.

Project Closeout Meeting

We will conduct a project closeout meeting, in which we will discuss the application path and next steps to implement the findings of this research.

A closeout meeting shall be conducted to review project performance, the deployment plan, and next steps. Attendees shall include, as a minimum, the project manager, the principal investigator, and the Research Center performance coordinator. This meeting is to occur prior to

the expiration of the contract and subsequent to the approval of the draft final report (i.e., it should be scheduled for sometime during the final 30 days of the project).

Project Schedule

FLORIDA DEPARTMENT OF TRANSPORTATION
RESEARCH CENTER

PROJECT SCHEDULE

Project Title	**DEVELOPMENT OF SPEED MODELS FOR IMPROVING TRAVEL FORECASTING**																				
FDOT Financial Project I.D.:														FY	2011-2012		Month	April			
Research Agency	Florida State University																				
Principal Investigator	Dr. Ren Moses																				
RESEARCH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	ESTIMATED %
TASK																					COMPLETION
Kick Off Meeting																					
	100																				
Task I - Conduct literature review on speed modeling																					
		20		40		80			90			100									
Task II - Collect speed data on homogenous segments																					
	10		30		50		70		90						100						
Task III - Develop speed distribution curves for established links																					
				10		30		50		70		90				100					
Task IV - Develop space mean speed, volume, and density models																					
					10		30		50		70		90			100					
Task V - Develop methodology and models for observed data																					
				10		30		50		70			90			100					
Produce Final Products																					
															50		100				
Present Results																					
																				100	
Overall % Complete																					
Projected	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	80%	90%	95%			100%	
Overall % Complete																					
Actual																					

Budget Spreadsheet

<<See budget spreadsheet>>

Subcontract with Parsons Brinckerhoff

<<See attached proposes scope and services and preliminary budget by Parsons Brinckerhoff>>

Contact Information

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