

# Travel Demand Modeling

Planning Certification Review  
November 3-5, 2009





# MAG Travel Demand Modeling and Forecasting



- Four Step Trip Based Model Overview
- Applications
- Inputs and Data Management
- Outputs and Validation
- Recent Improvements and Updates
- Future Directions



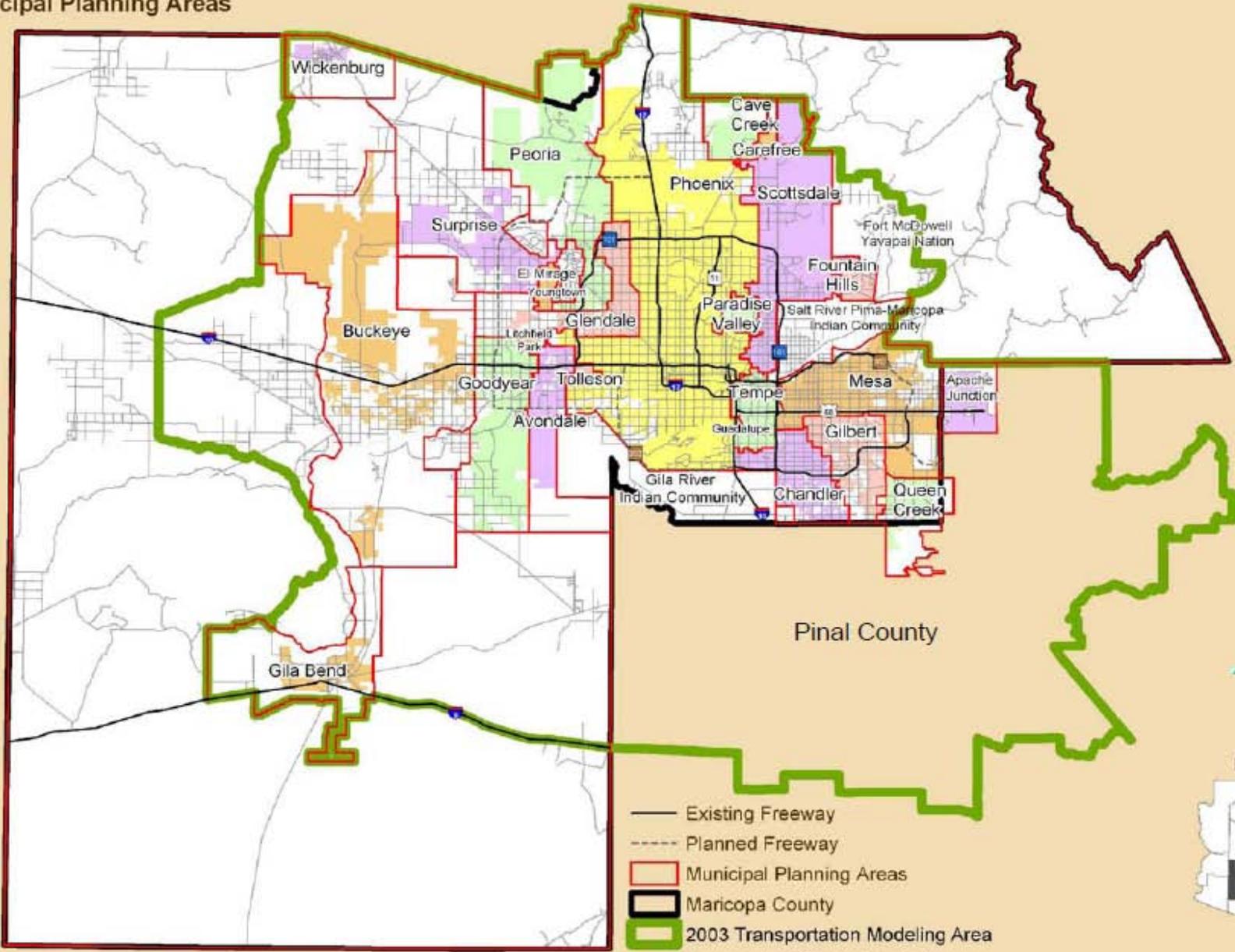
# Current MAG Model

State-of-the-practice travel forecasting tool for a large metropolitan area

## Supply Part:

- 2006 traffic zones
- 12 Modes (2008)
- 18011 two-way links (2008)
- 12053 nodes (2008)
- 171 peak period directional transit lines
- 4525 Sq. Miles Modeling Area

2003 MAG  
 Transportation Modeling Area  
 and  
 Municipal Planning Areas



- Existing Freeway
- - - Planned Freeway
- ▭ Municipal Planning Areas
- ▭ Maricopa County
- ▭ 2003 Transportation Modeling Area
- ▭ Incorporated Areas Shaded





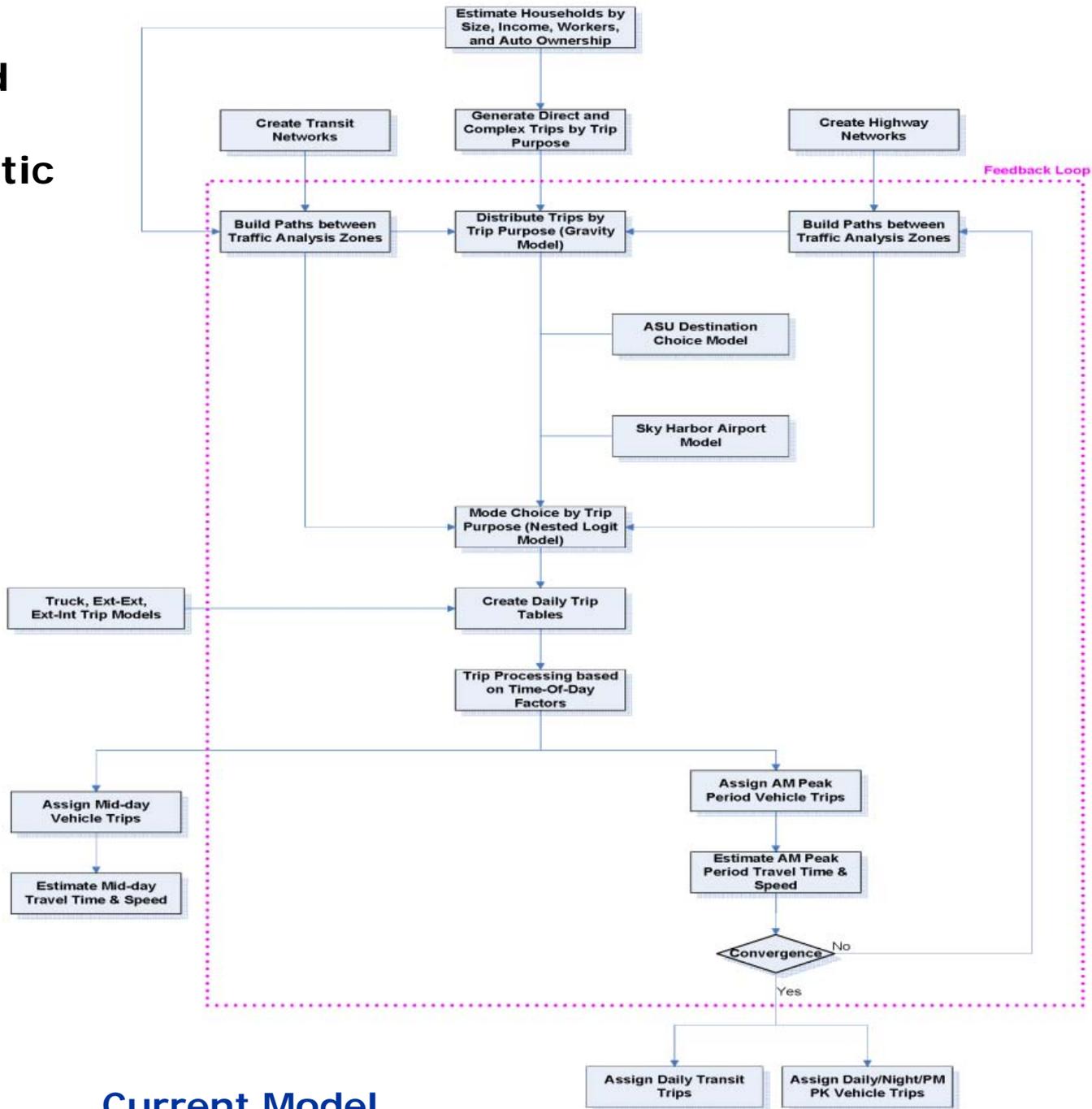
# Current MAG Model

State-of-the-practice travel forecasting tool for a large metropolitan area

## Demand Part:

- 7 Purposes in (2008)
- 5 classes in multiclass assignment
- Nested Logit Mode Choice integrated with Gravity Model, ASU destination choice sub-model, Airport sub-model
- Three step based truck model

# Travel Demand Model Schematic

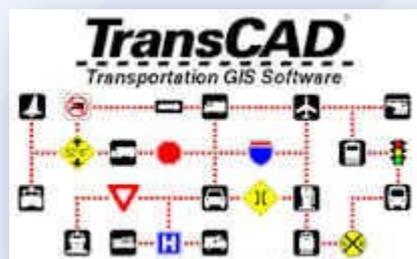


Current Model



# Current MAG Model

Modeling software and hardware: were optimized/upgraded to shorten run times by almost 50%. It is acceptable now but we will be back to this issue with ABM.



## TransCAD Shell Model, JAVA, Fortran, GISDK 7 Purposes in (2008)

- **2008 - 13 hours** (Dell Precision 690, 2X Dual core 3.0GHZ CPU, 4GB 666MHz RAM, made on 12/2006)
- **2028 - 14 hours** (Dell Precision T7400, 2X Quad core 3.2GHZ CPU, 4GB 666MHz RAM, made on 08/2008)



# Current MAG Model: An Active Model

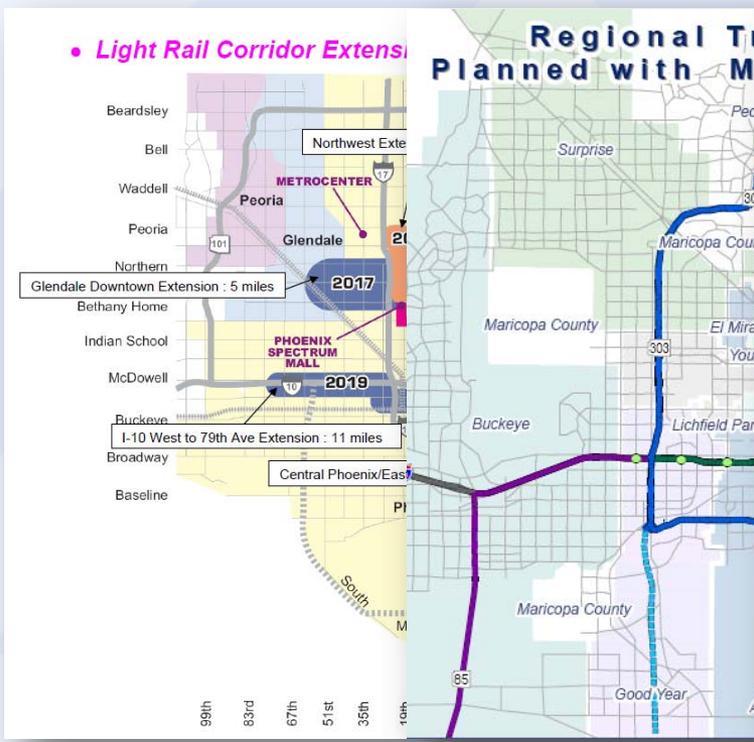
## Number of Requests





# Applications

Applied for All Regionally Significant Freeway and Arterial Projects, RTP/TIP/AQ Conformity Analysis, New Starts/Small Starts



Transportation Management System - Windows Internet Explorer

http://mag.ms2soft.com/tcdfs/search.asp?loc=Mag&mod=PMDS

Project ID: PHX07-738 | Project Type: TIP

RTP ID: | RTP Phase: | Status: Deferred

Agency ID: | Lead Agency: Phoenix | Road Closure:

Description: Design and construct roadway safety improvements

Imprmt. Type: Safety | Mode: Safety

Facility: Collector Street

Est. Start Dt. | Est. End Dt. | Act. Start Dt. | Act. End Dt.

LOCATION			
Type	LINK	Township	
County	Maricopa	Section	
Community	Phoenix	Range	
Latitude	33.571333	Longitude	-112.080098
Located On	Hatcher Rd		
From Road	19th Ave		
To Road	Cave Creek Rd		
Direction		Length (mi) 2	
Limits	Hatcher Rd: 19th Ave to Cave Creek Rd		

	BEFORE	AFTER
Lanes	2	2
SB or WB Lanes	1	1
NB or EB Lanes	1	1
Paved	No	No
Bus Pullouts	No	No
Paved Shoulder	No	No
Curbs	No	No

Map: Project PHX07-738 Hatcher Rd: 19th Ave to Cave Creek Rd



# MAG Model

A model that is being continuously reviewed and improved

- **October 2006 Peer Review:**
  - A state-of-the-practice procedure
  - Suggested improvements, mostly on transit side
  
- **Hundreds of annual applications, forecast continuously reviewed by member agencies, consultants and for the purposes of academic research**
  - Model forecast is utilized in all significant highway improvements and RTP
  - Model forecast is utilized for New/Small Starts FTA processes



# MAG Model

A model that is being continuously reviewed and improved

- Collaboration with leading universities
- Active participation in Federal Research
- Collaboration with professional community at large through different users groups
- Strict versioning system and naming conventions, GIS-T



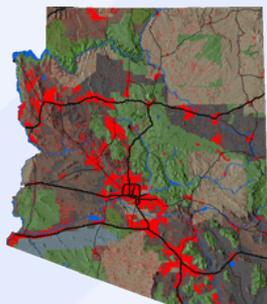
# MAG Model Updates Require Extensive Data Collection Efforts

Main data sets used for the current model	Main data sets for upcoming updates and improvements
2001 Household Survey	2008 Household Survey (NHTS)
2003 or older data for current Traffic Analysis Zone System	2008/9 Data for updated and expanded Traffic Analysis Zones
2007 ASU survey, 2005 Airport Ground Survey	2011/12 ASU and tour-based surveys
2007 On-board Transit Survey	2010 On-board Transit Survey
2007 Travel Time and Speed Survey	Annual purchase (INRIX, NAVTEQ, etc.)
1999/01 Special Events Data and Model	2009 Special Events Survey and Model
2007 Internal Truck Survey	2011-2012 data collection
2007 Socio-economic forecast	2012 Socio-economic forecast
1999 External Travel Survey	2007-2009 External Travel Survey
2006-2008 Traffic Studies (Volume, Classification counts, LOS studies)	2010 – 2011 Traffic Studies (Traffic volumes, LOS, intersection queue length)



# Socioeconomic Projections

- Prepared every five years or as needed
- 40+ Variables projected
- Approved by MAG Regional Council
- Models:
  - 2007 Projections: Metropilus & SAM-IM
    - Land use allocation
    - 1 acre grid
  - 2012 Projections: AZ-SMART based on UrbanSim/OPUS
    - Behavioral
    - Explicit parcel, buildings, agents
    - NAICS sectors
    - Ability to extend model to all Arizona Counties



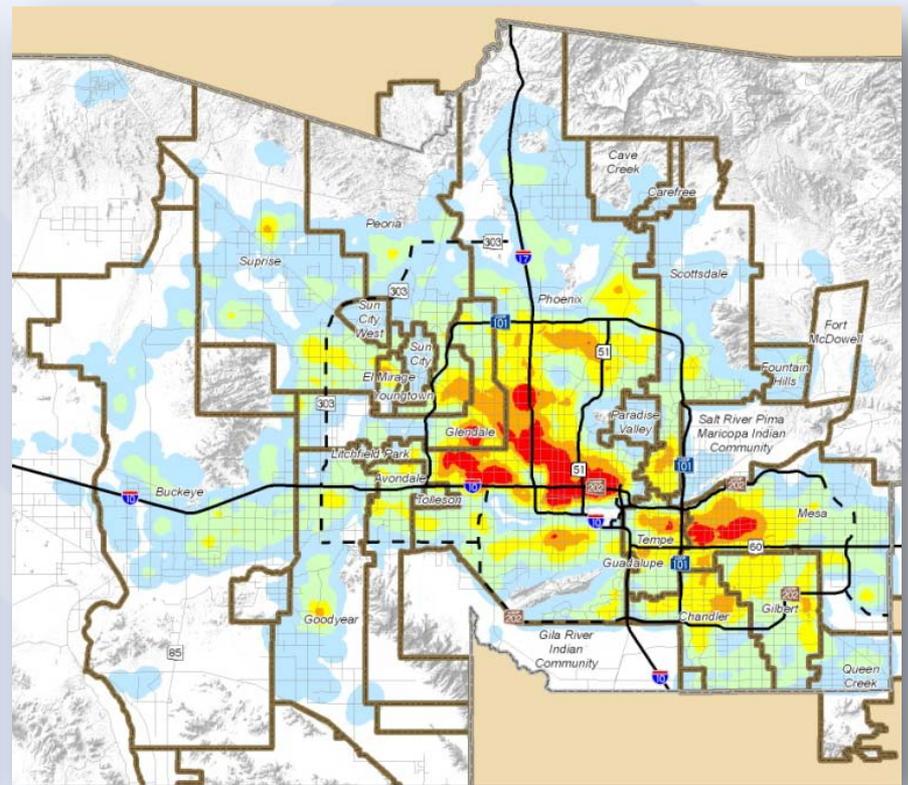
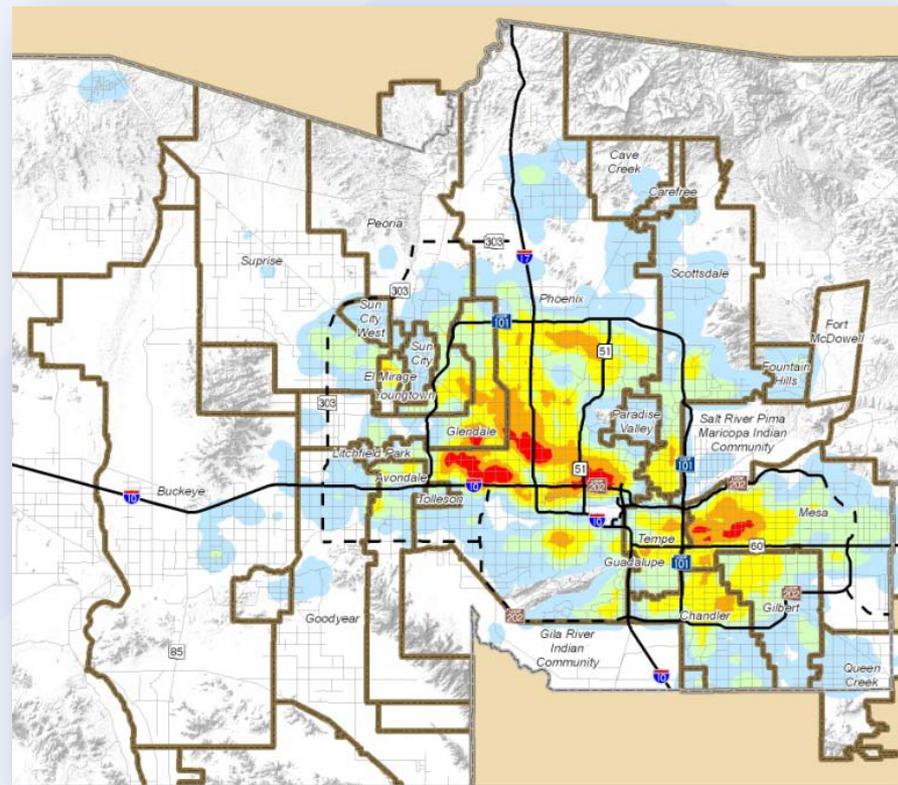


# 2007 Projections

Population

2005

2030



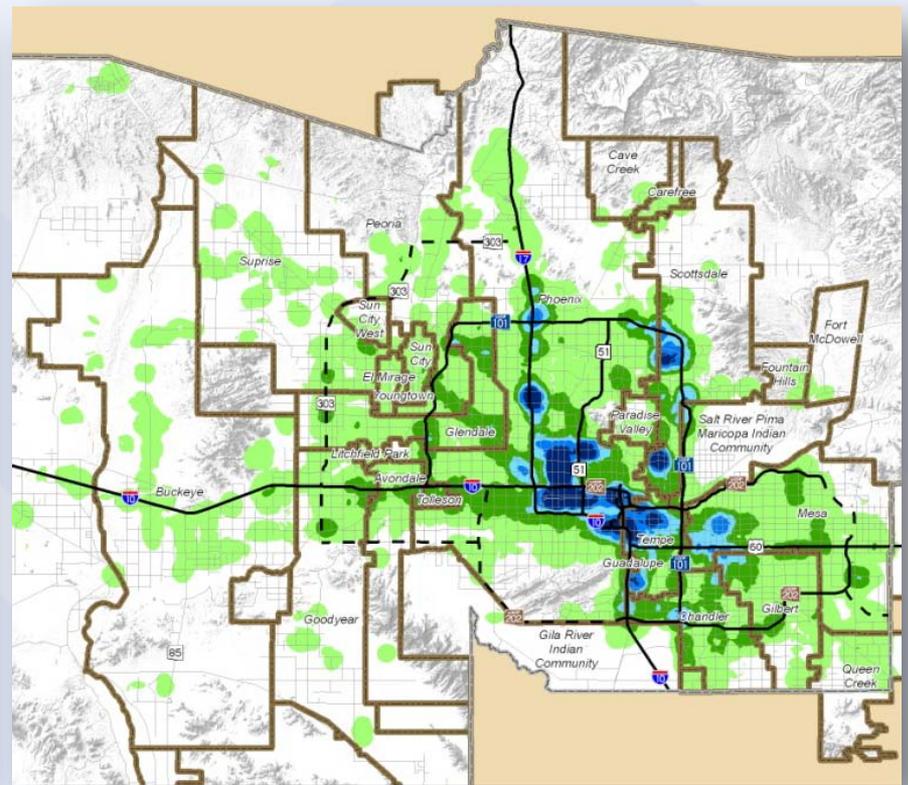
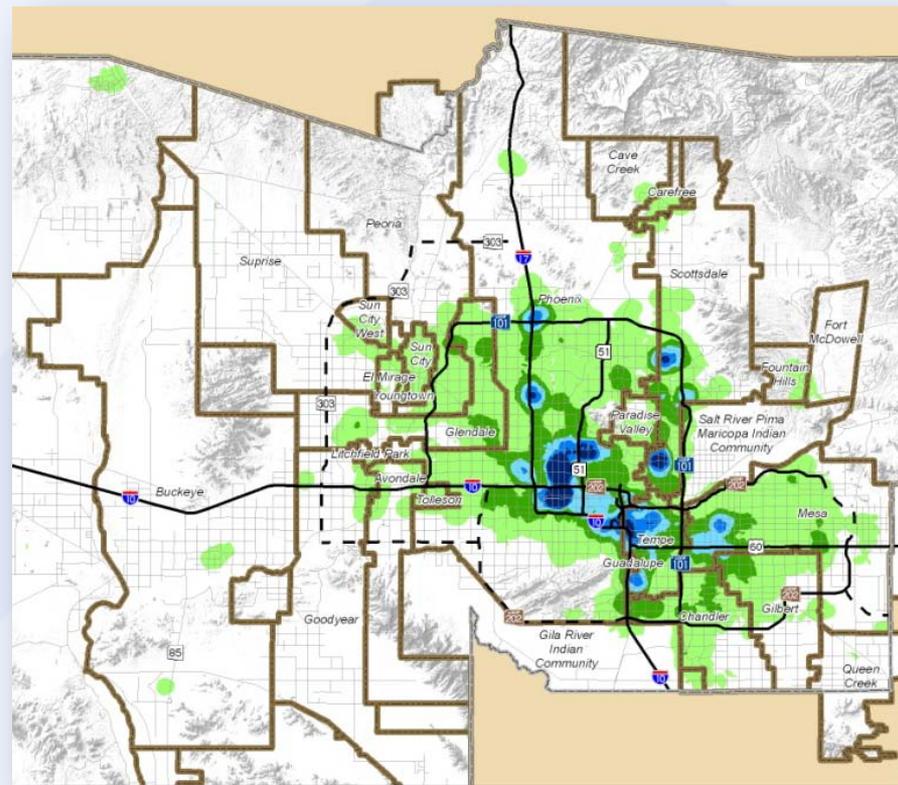


# 2007 Projections

Employment

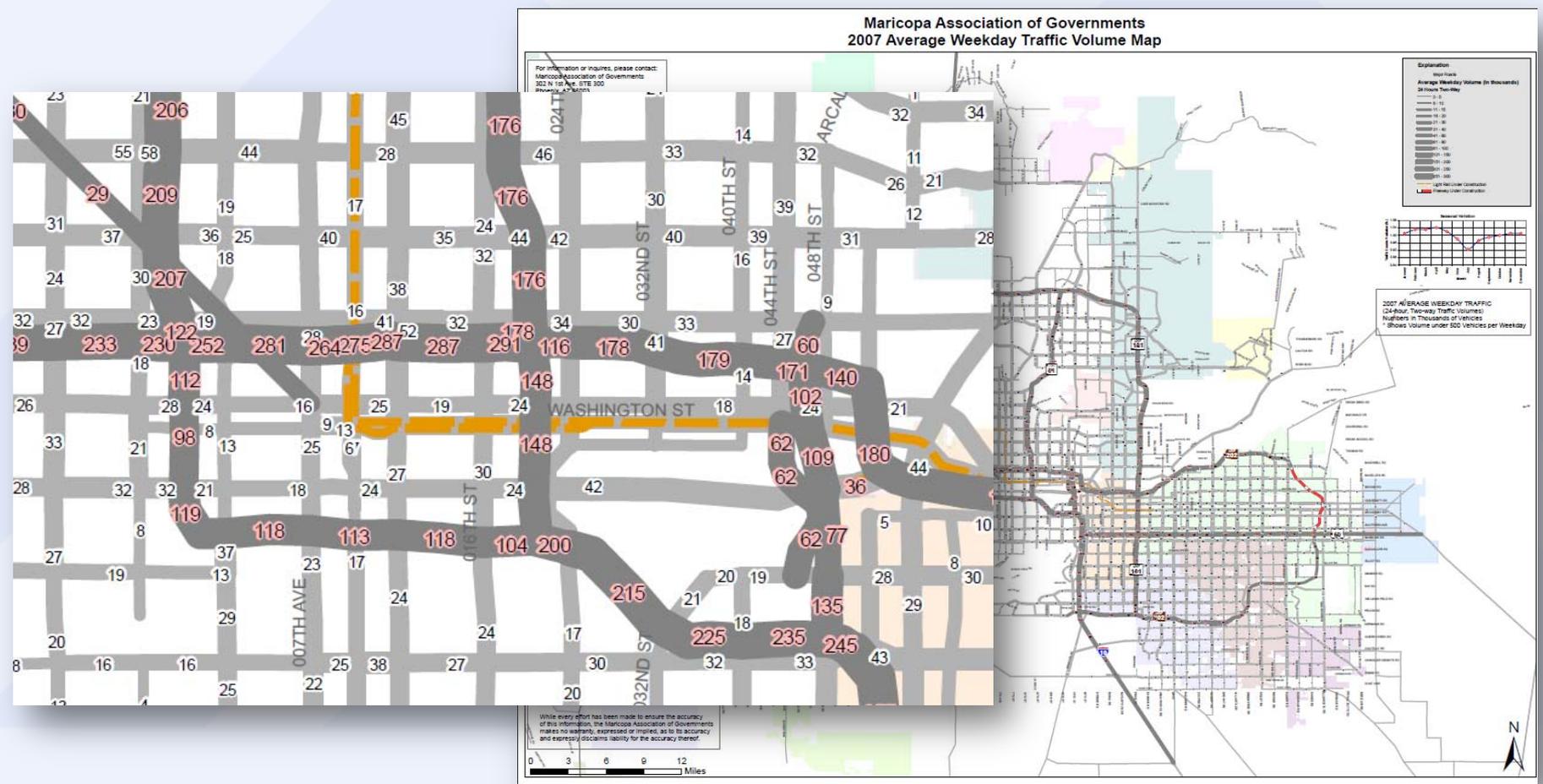
2005

2030



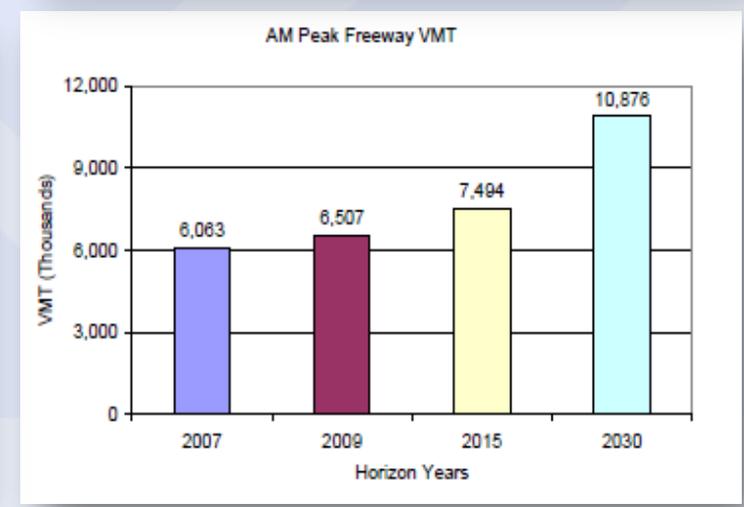
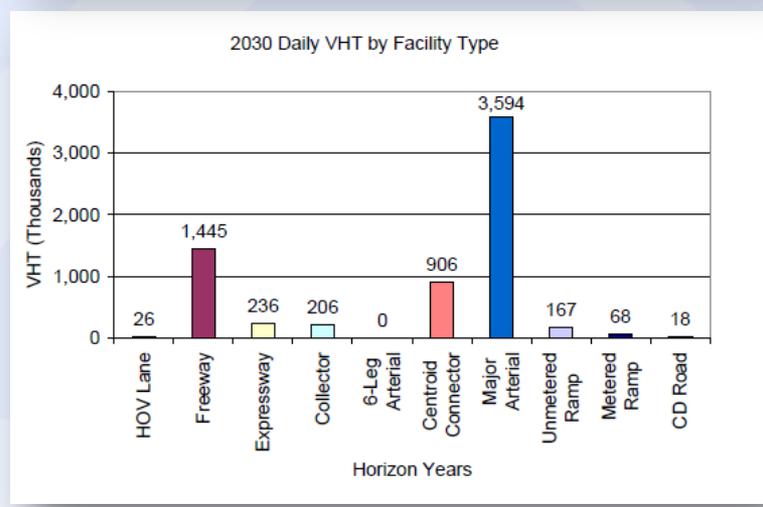
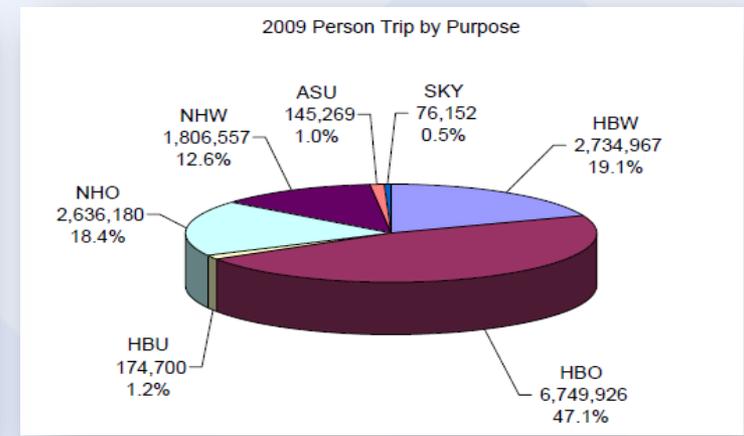
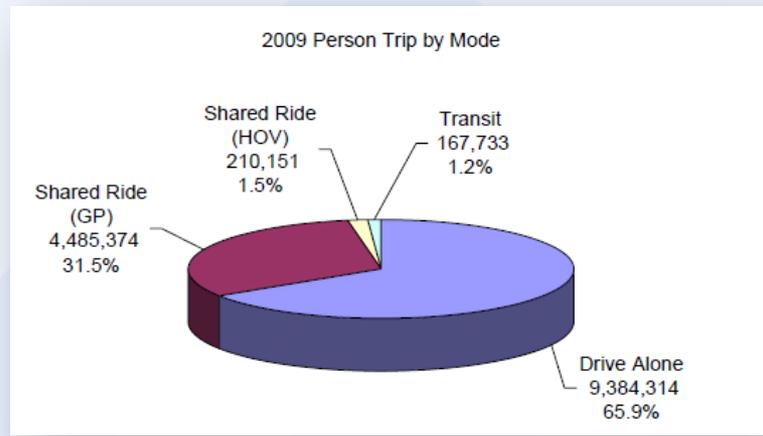


# Traffic Counts – Extensive Region Wide



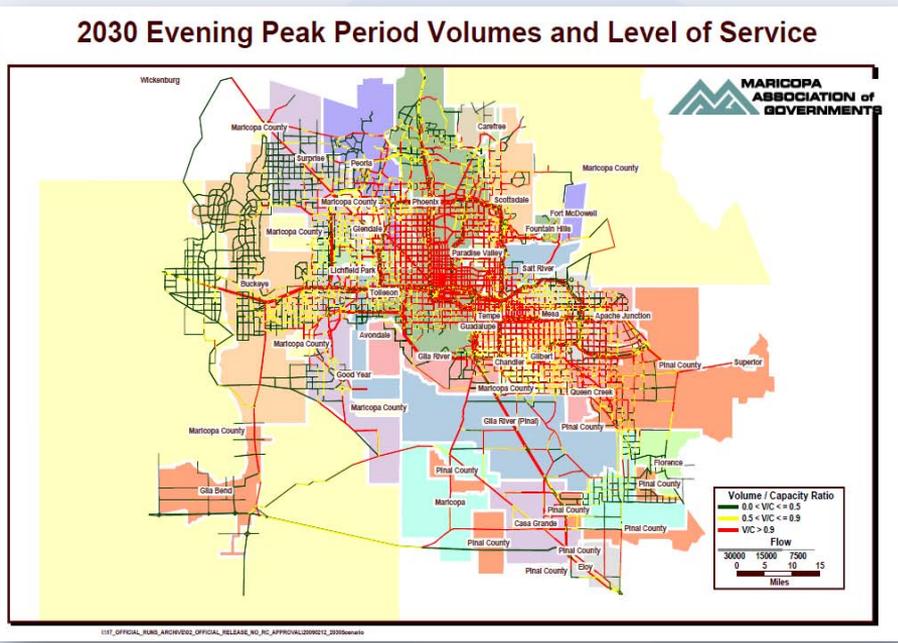
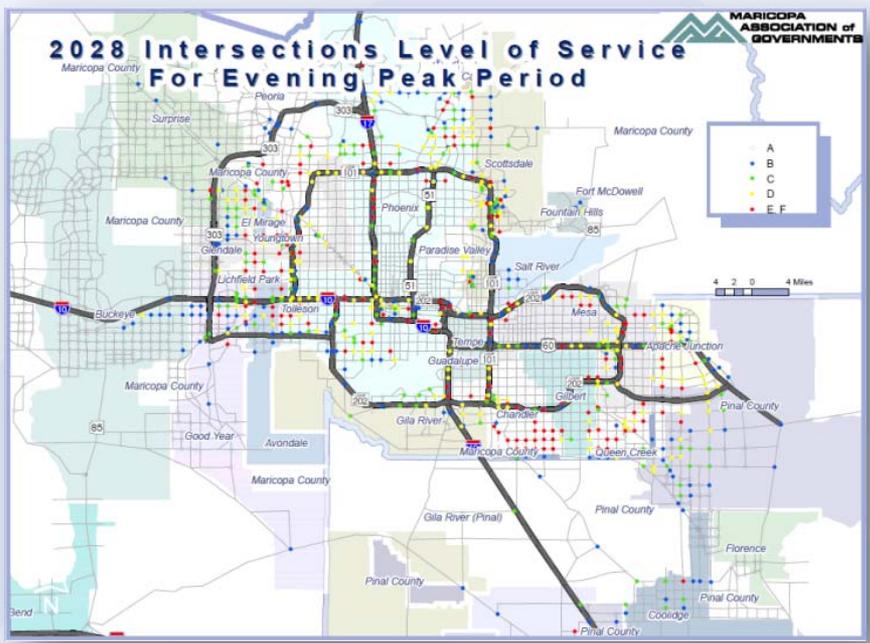


# MAG Model: Outputs Charts and Graphs



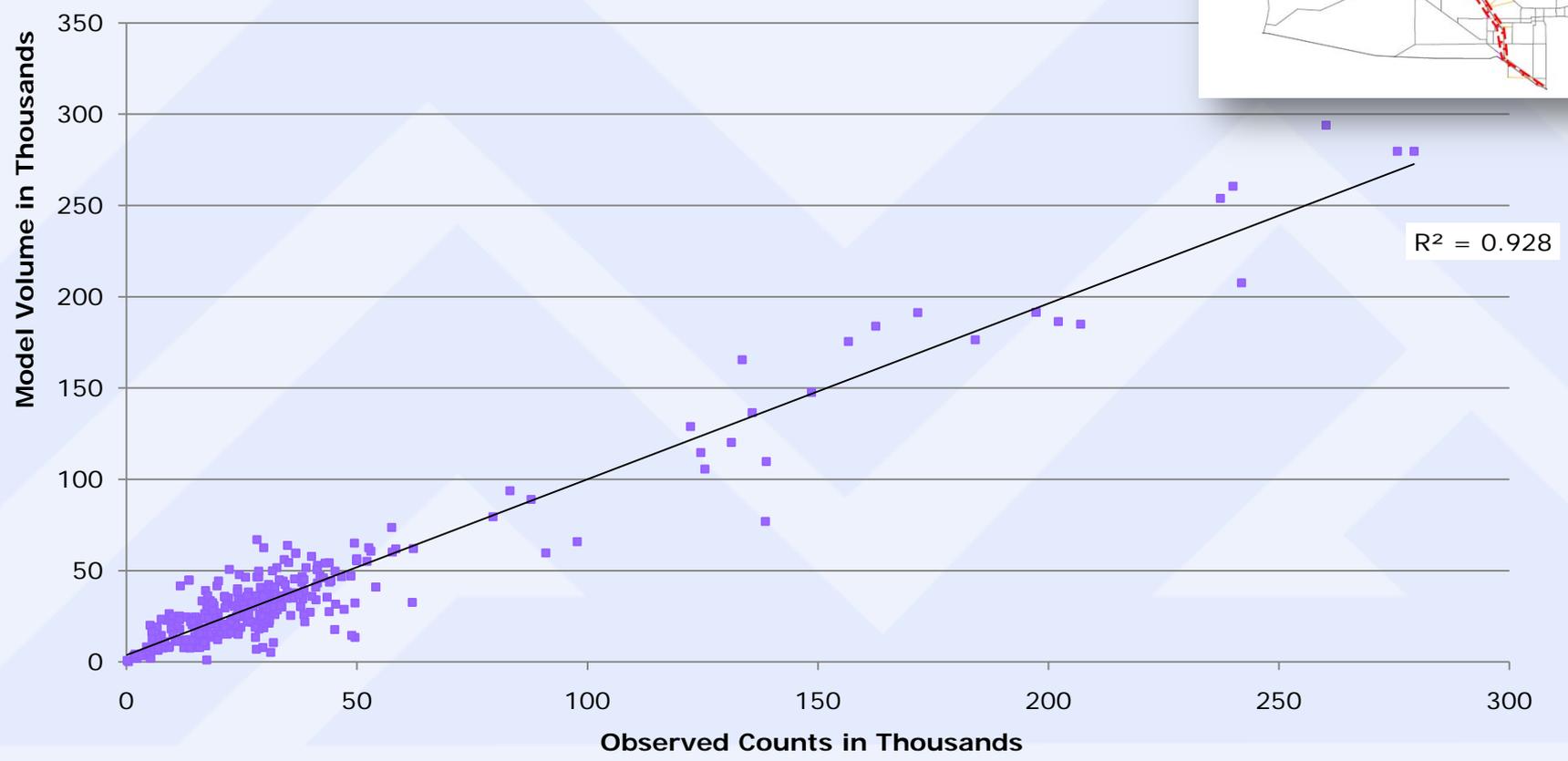
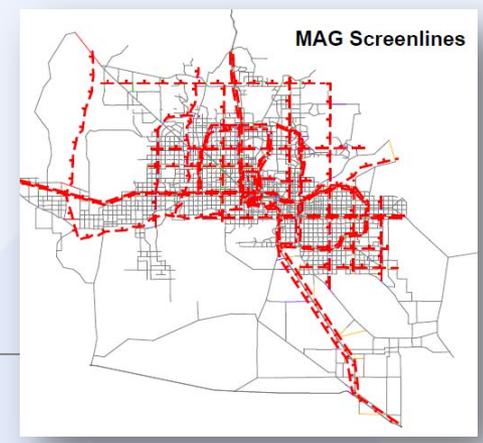


# MAG Model: Outputs Maps





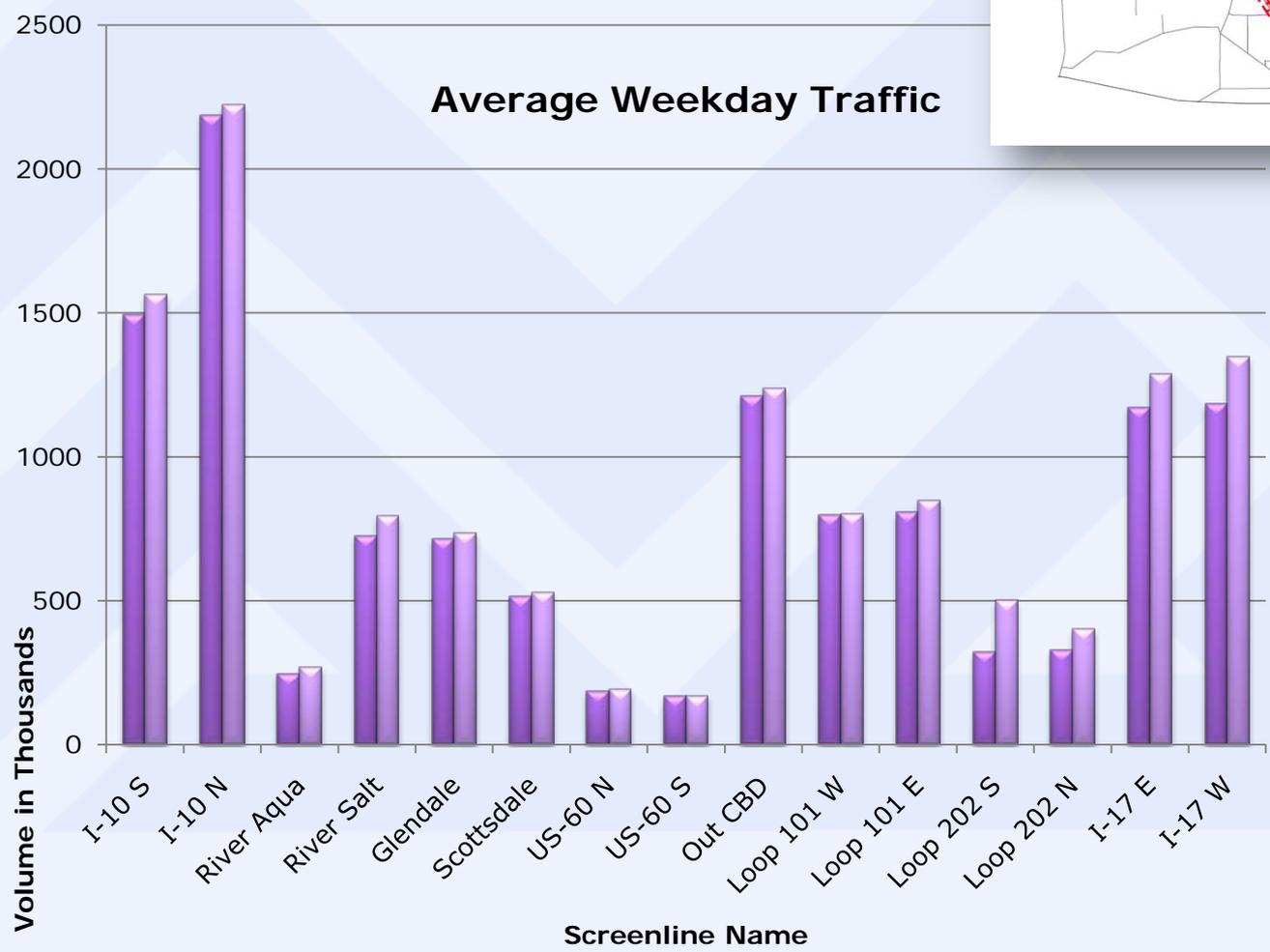
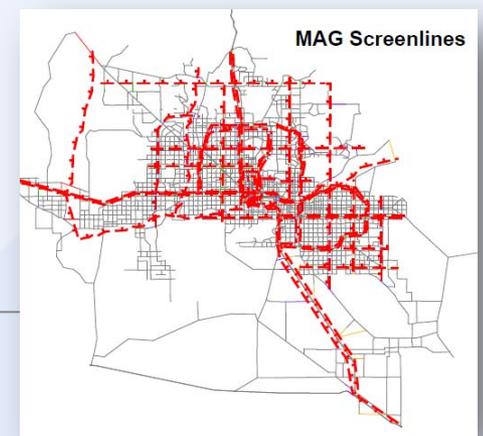
# 2008 Screenline Validation



Each data point represents a screenline count



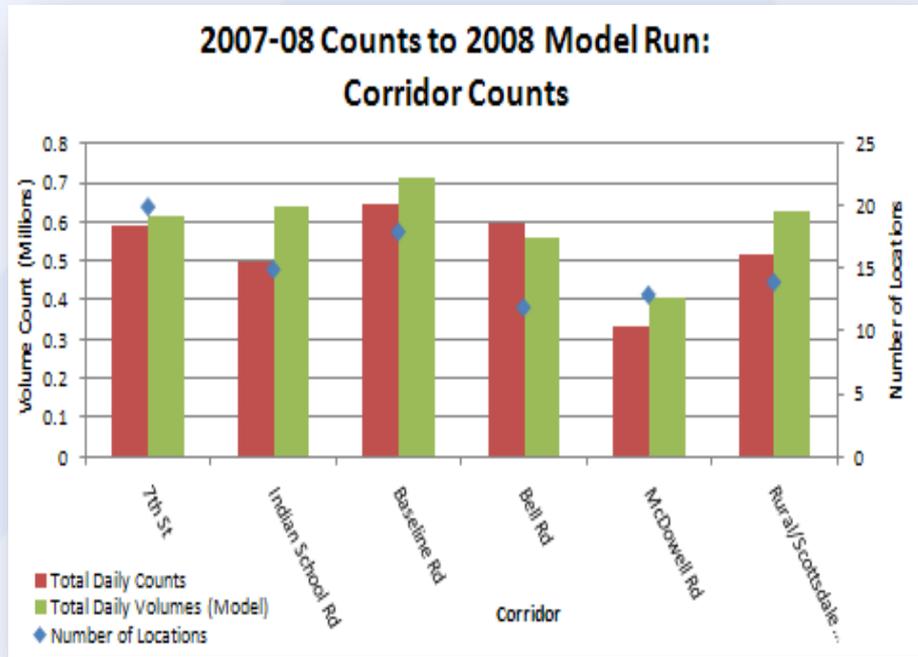
# 2008 Screenline Validation



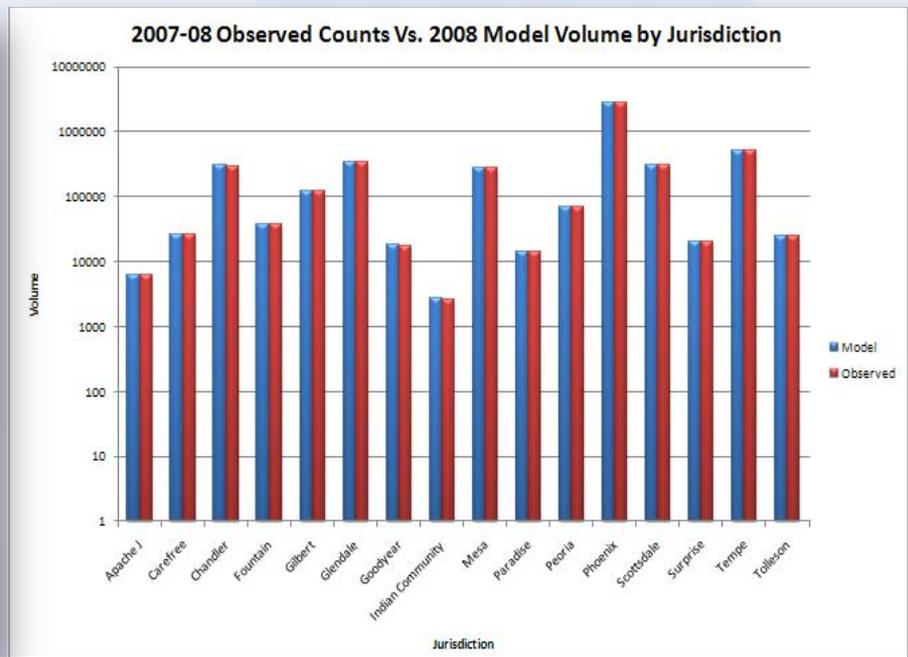


# 2008 Corridor and Area Validation:

## Corridor



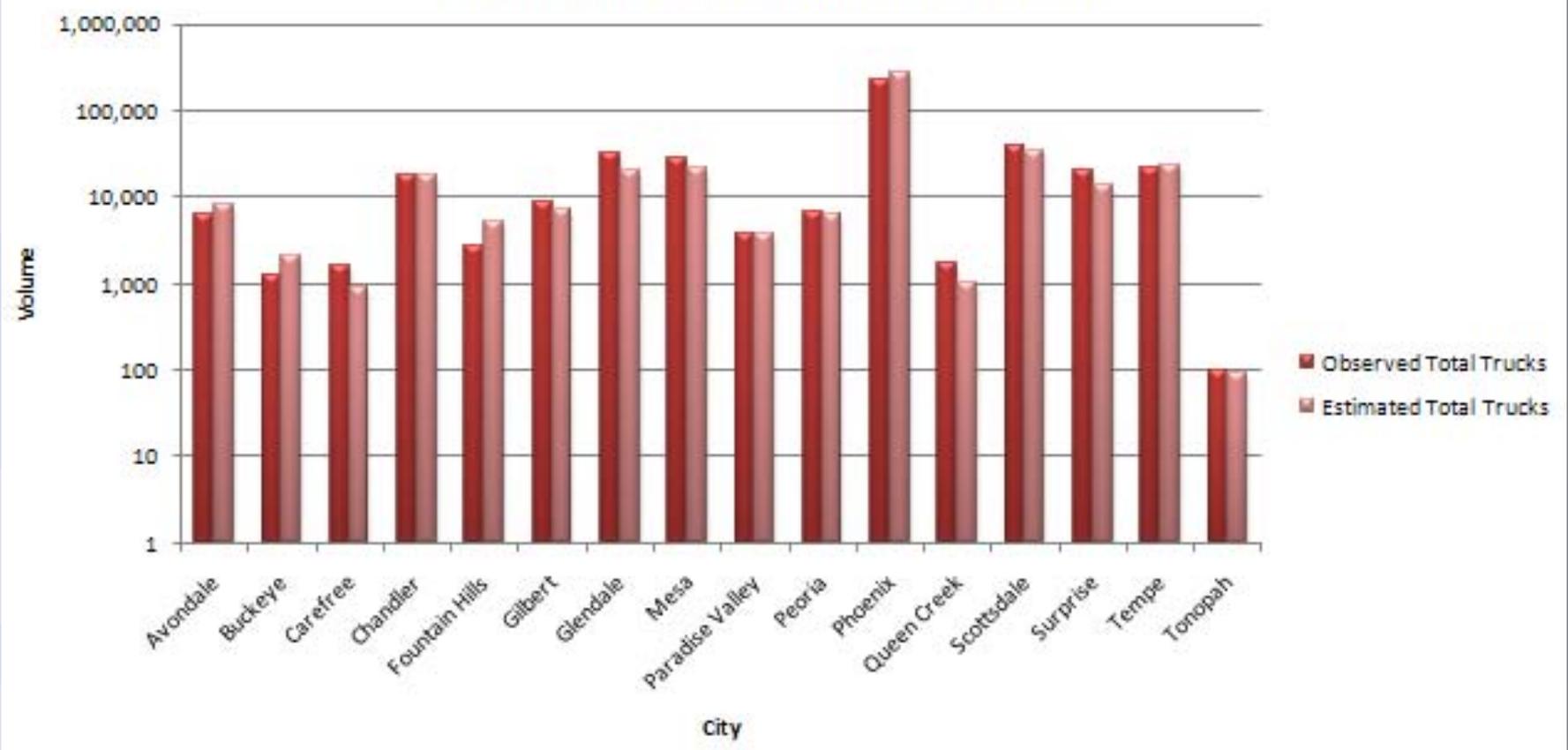
## Area





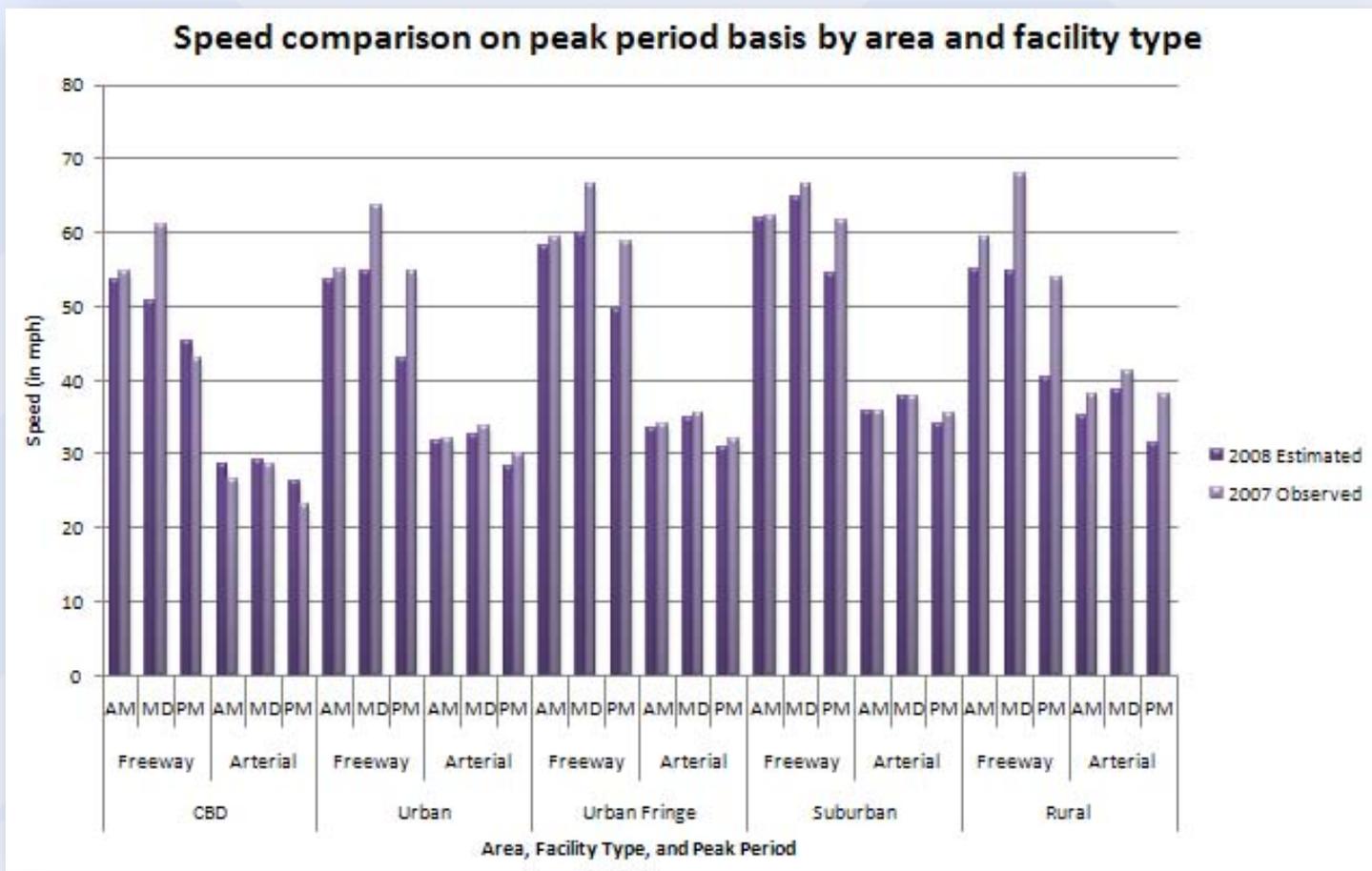
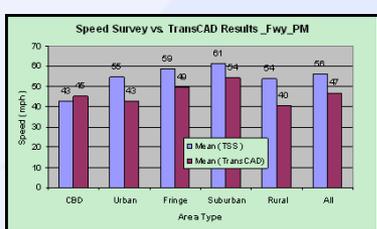
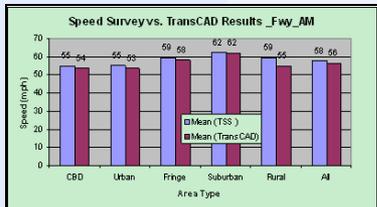
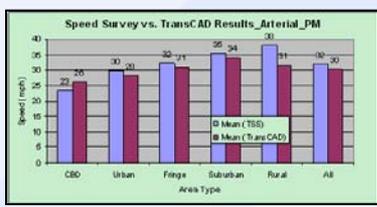
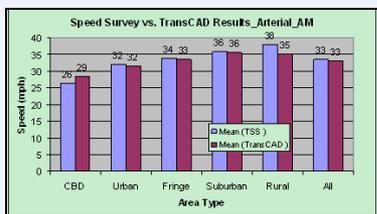
# MAG Truck Model Validation

2007 MAG Truck Model Validation





# MAG Model Speed Validation





# Model Improvements in the Past Couple Years

A yellow starburst graphic with a white border and a drop shadow, containing the word 'NEW' in a bold, white, sans-serif font.

**NEW**

- New Completely Revised Mode Choice Models
- Recalibrated to the 2007 On-board Survey
- New ASU destination choice sub-model based on 2007 ASU survey and on-board survey
- New Internal/External Truck Models based on 2007 Internal Truck Survey and External Travel Survey
- New volume-delay functions based on 2007 Travel Time and Speed Study and counts
- New Sky Harbor sub-model based on 2005 Ground Survey
- New software modeling platform (TransCAD)
- New conflated GIS-based networks (work in progress)
- A variety of added utilities



# Effective management of the large data sets require innovative ways of acquisition, storage, access and retrieval of the transportation data

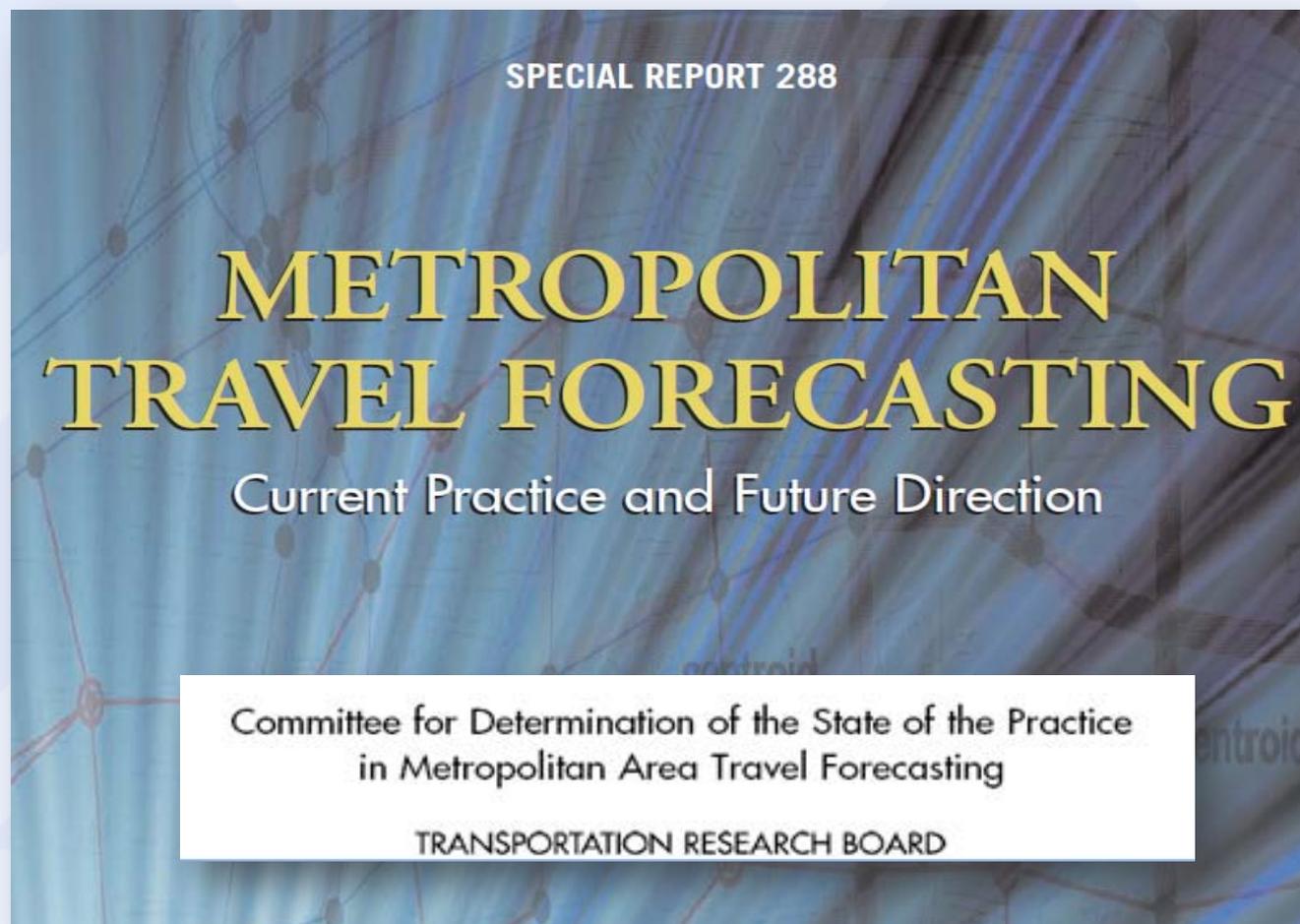
The image displays a composite view of GIS software and a web application. On the left, ArcMap shows a database schema for 'GIS-T: MS2 Programming/Projects DB 9/17/09 Rev 3'. The schema includes tables such as `ISCompos`, `ISSegments`, `ISAgenciesLU`, `ISRoutesLU`, `ISStopsLU`, `ISPermsLU`, `ISFacilityLU`, `ISChangeTypesLU`, `ISChangeTypesLU`, and `ISFacilityLU`. The central browser window shows the 'Transportation Management System' website at <http://mag.ms2soft.com/tcds/tsearch.asp?loc=MAG>. The website header features the URL **WWW.MAGTRANS.ORG** and navigation links like Home, TMC, TCLS, TIDS, PMS, PMDS, RSMS, PCDS, PMMS, WOTS, and RTV. A record viewer shows details for Record 232, including Location ID, Type (LINK), Group, Fractl Class, Located On (Shea Blvd), From Road (24th St), To Road (32nd St), County (Maricopa), Community (Phoenix), Jurisdiction (MAG), Screenline IDs, Perm Station (No), Lanes, Surface Type, Latitude (33.582386), and Longitude (-112.016248). Below the record viewer is an AADT table:

	Year	AAADT	DHV-30	K %	D %	PA	BC	Src
	2007	9,264						
	2002	11,469						

On the right, the browser shows a satellite map of an urban area with a red location pin at coordinates 17.417, 9.264 (07). The map interface includes a 'TOOLS' panel with options like Print Map, Print Area, Clear Located, Markers, Boundaries, TDS, TMS, PMS, and GIS LAYERS (Screenline checked). A 'LEGEND' panel shows various location types like Spot, Perm Stn, Located Spot, Located Perm, Stn, Link Start, Link End, and Data Distribution. A 'Volume Range' legend shows categories from 1-1,000 to 50,000+.



# When good is not good enough...





# Suite of Modeling Tools: Activity Based Model

## ■ Includes:

- Population Synthesis
- Long-term choices
- Coordinated Daily Activity Pattern (intra-household interactions)
- Tour-level choices
- Trip-level choices
- Explicit Modeling of Seasonality
- Sub-models for university-related travel
- Sub-models for non-resident visitor travel
- Integrated Special Events
- Integrated advanced airport sub-model with explicit modeling of airport choices and ground access modes
- DTA



# Suite of Modeling Tools: Four-Step Trip Based Model

- **Major Upcoming Improvements:**
  - New TAZ system
  - Recalibration to 2008 Household Survey as data becomes available
  - Recalibration to the 2010 On-board
  - Comprehensive validation after recalibration (past years, sensitivity, bottlenecks, uncertainties, traditional validations, etc.)

# Travel Demand Modeling

THANK YOU





# Transportation Modeling Innovation Decision Matrix

	Threats	Opportunities
Strengths	<p><b>Urgent Not Important</b> e.g. innovative capitalization on another ongoing project where the need can be addressed with traditional tools as well</p>	<p><b>Not Urgent Not Important</b> e.g. an improvement in the traditional four step based procedure that is not crucial for model applications or future development</p>
Weaknesses	<p><b>Urgent Important</b> e.g. innovative approach to address unmet data needs from a major project or stakeholder</p>	<p><b>Not Urgent Important</b> Best Time to introduce innovations</p>

- **Paradigm Shift** and disaggregation – Data Mining and Knowledge Management - Database Approach, ABM
  - **Enterprise Application Integration and Automation** - PMDS, Geo Database, Master Network
  - **Data Accessibility and Visualization** - Web-based GIS technologies, 3D
- Arrows indicate results of example project level decisions on data management innovations