CAMBRIDGE SYSTEMATICS

Think Forward

District Modeling Support

TransCAD and Travel Model Training

presented to

District 1 and Community Staff

presented by

Cambridge Systematics, Inc.

Caliper Corporation

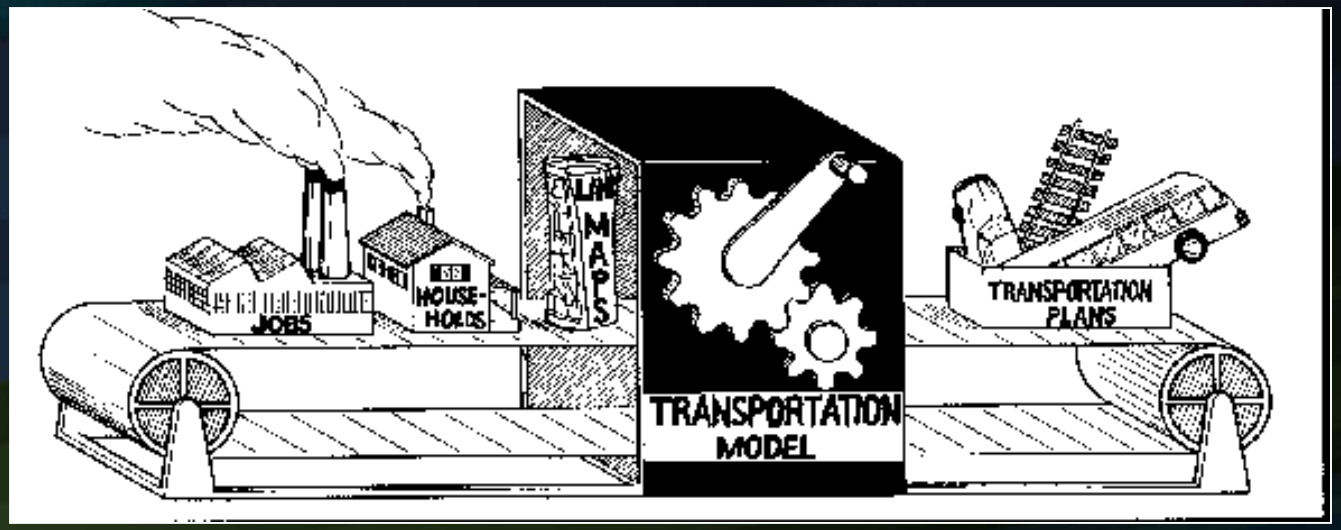
February 1, 2016

Agenda

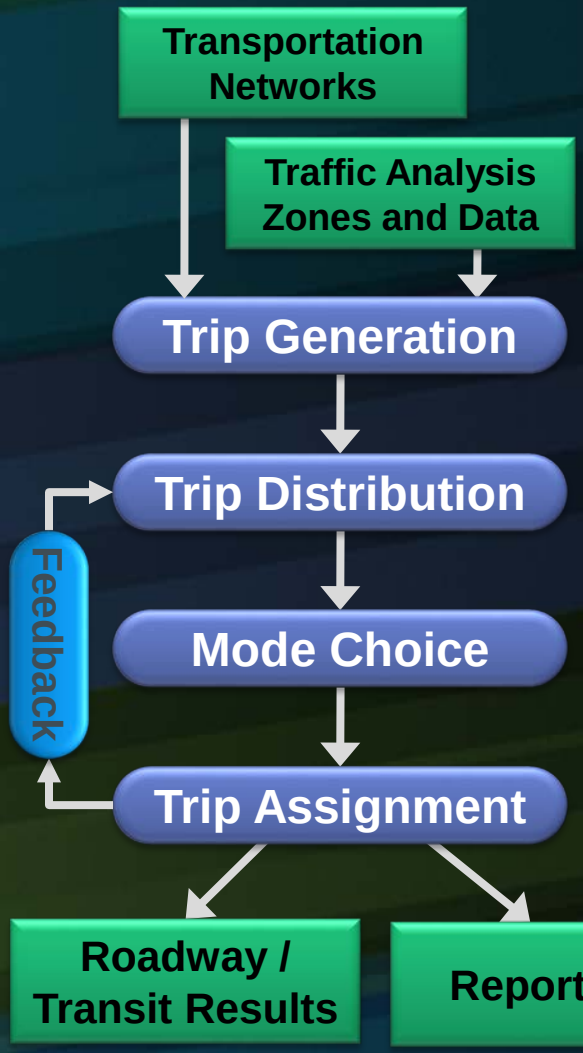
- Modeling basics
  - » Opening the black box
  - » Example applications
- Model Steps
- Model Validation and Post Processing
- TransCAD Basics
- Interactive Demos - TransCAD Software
- HCAOG Model – Structure and Approach
- HCAOG Model – Interactive Demo

Travel Modeling Basics

Opening the Black Box



The Four Steps



Transportation Supply

Transportation Demand

How many trips?

Where will they go?

What mode?

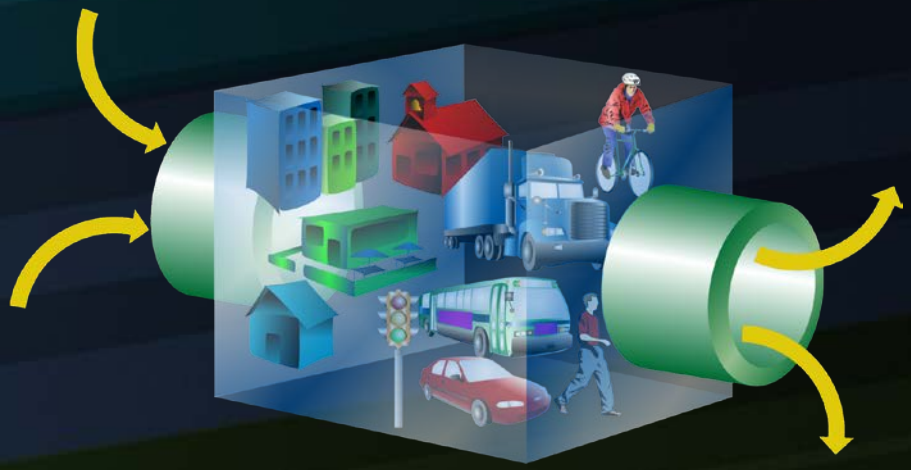
What route?

Forecasts

Model Inputs and Outputs

Inputs

- Transportation Networks
- Socioeconomic Data
- External Data
- Special Generators
- Model Parameters



Outputs

- Trips by Mode
- Traffic Volumes
- Congested Speeds
- Transit Volumes
- Summary Information

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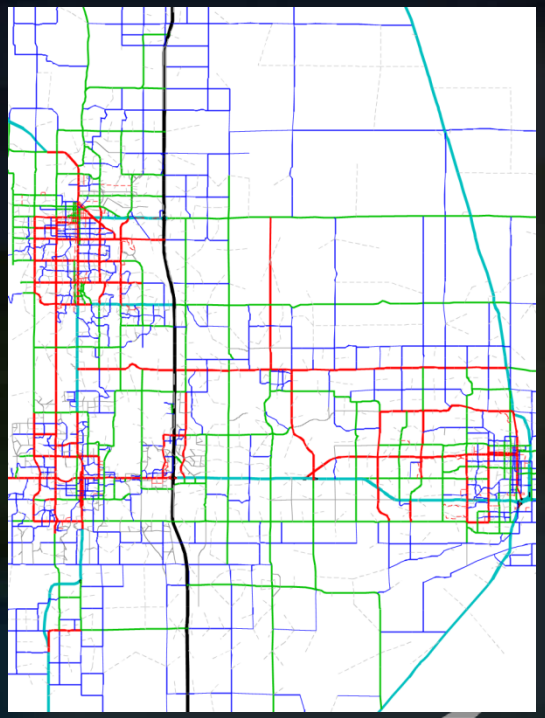
Model Inputs and Outputs

Inputs

- **Transportation Networks**
- Socioeconomic Data
- External Data
- Special Generators
- Model Parameters

- Roadway Networks
  - » Contains roadway characteristics
    - – Number of Lanes
    - – Roadway Type (Freeway, arterial, etc.)
    - – Area Type (CBD, Urban, Suburban, Rural)
- Transit Networks
  - » All fixed route transit service
  - » The model is sensitive to transit level of service (frequency, speed, coverage)
  - » Local/Express Bus, BRT, Rail



Model Inputs and Outputs

Inputs

- Transportation Networks
- **Socioeconomic Data**
- External Data
- Special Generators
- Model Parameters

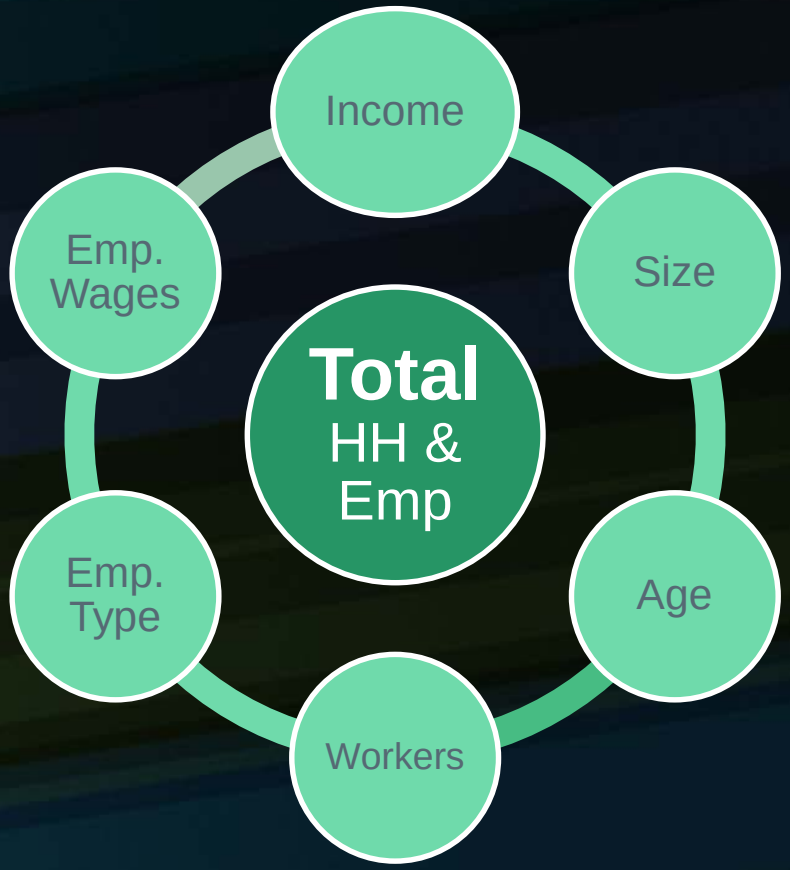
- Identifies **demand** for travel
- Household data
  - Average household **size**
  - Median household **income**
  - Number of resident **workers**
  - **Age** of household residents
  - And more…
- Employment data
  - By 13 industries
  - By Wage level

Model Inputs and Outputs

Inputs

- Transportation Networks
- **Socioeconomic Data**
- External Data
- Special Generators
- Model Parameters

- How Much Detail is Needed for scenario testing?
  - » Only totals are required



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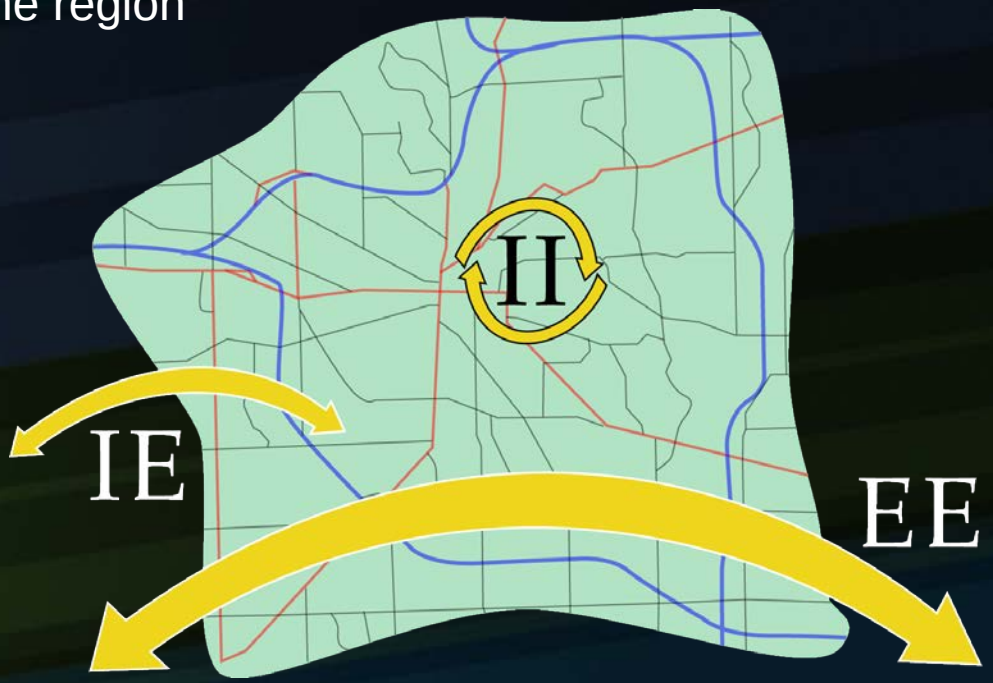
Model Inputs and Outputs

Inputs

- Transportation Networks
- Socioeconomic Data
- **External Data**
- Special Generators
- Model Parameters

- Model travel:
  - To/from the region
  - Through the region



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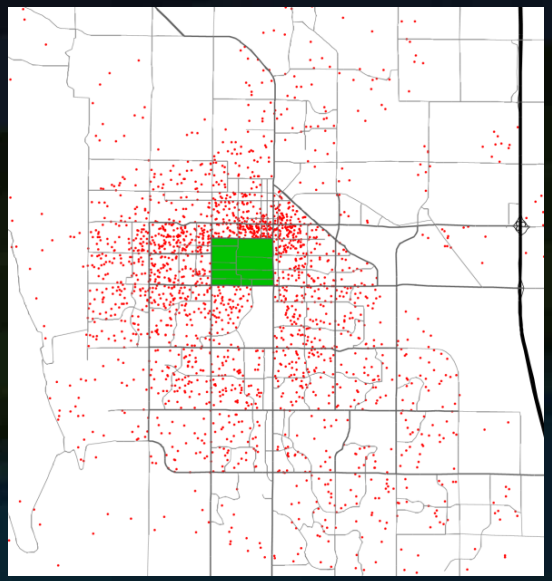
Model Inputs and Outputs

Inputs

- Transportation Networks
- Socioeconomic Data
- External Data
- **Special Generators**
- Model Parameters

- Unique locations not well represented by employment data
  - Humboldt County Special Generators:
    - –Humboldt State University
    - –Casinos



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Model Inputs and Outputs

Inputs

- Transportation Networks
- Socioeconomic Data
- External Data
- Special Generators
- **Model Parameters**

- Represent the way people behave
  - How many trips are made?
  - How far will people travel?
  - What impacts decisions about travel mode?
  - How does congestion impact travel?
- Source Data
  - SCAG / Caltrans Household Travel Survey
  - On-Board Transit Surveys
  - Speed Surveys
  - Big Data
  - Validated to traffic counts

Model Inputs and Outputs

- Information about each trip
  - » Start/end
  - » Time of day
  - » Mode of travel
  - » Purpose of trip
  - » Trip time and distance

Outputs

- **Trips by Mode**
- Traffic Volumes
- Congested Speeds
- Transit Volumes
- Summary Information

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Model Inputs and Outputs

- By Time of Day
  - » Daily
  - » AM, PM, Mid-Day, Evening, Night
  - » AM and PM Peak Hours
- Turn Movements
  - » Better estimated with assistance of base-year counts
- Congested speed based on volume

Outputs

- Trips by Mode
- **Traffic Volumes**
- **Congested Speeds**
- Transit Volumes
- Summary Information

Model Inputs and Outputs

- By Time of Day
  - » Peak and Off-Peak
  - » Daily sum
- By route or route group
  - » Also by stop, but with less accuracy
- Useful for Big-Picture transit analysis
  - » Detailed analysis requires localized model refinement
- Transit trips are removed from the highway network

Outputs

- Trips by Mode
- Traffic Volumes
- Congested Speeds
- **Transit Volumes**
- Summary Information

Model Inputs and Outputs

- Performance Report
  - » Summaries of model results
  - » Useful for planners and engineers
- Planning Tools
  - » Maps and charts
  - » Results presented for general understanding
    - – VMT, VHT, Delay
    - – Level of Service
    - – Trip Lengths
    - – Trip Patterns

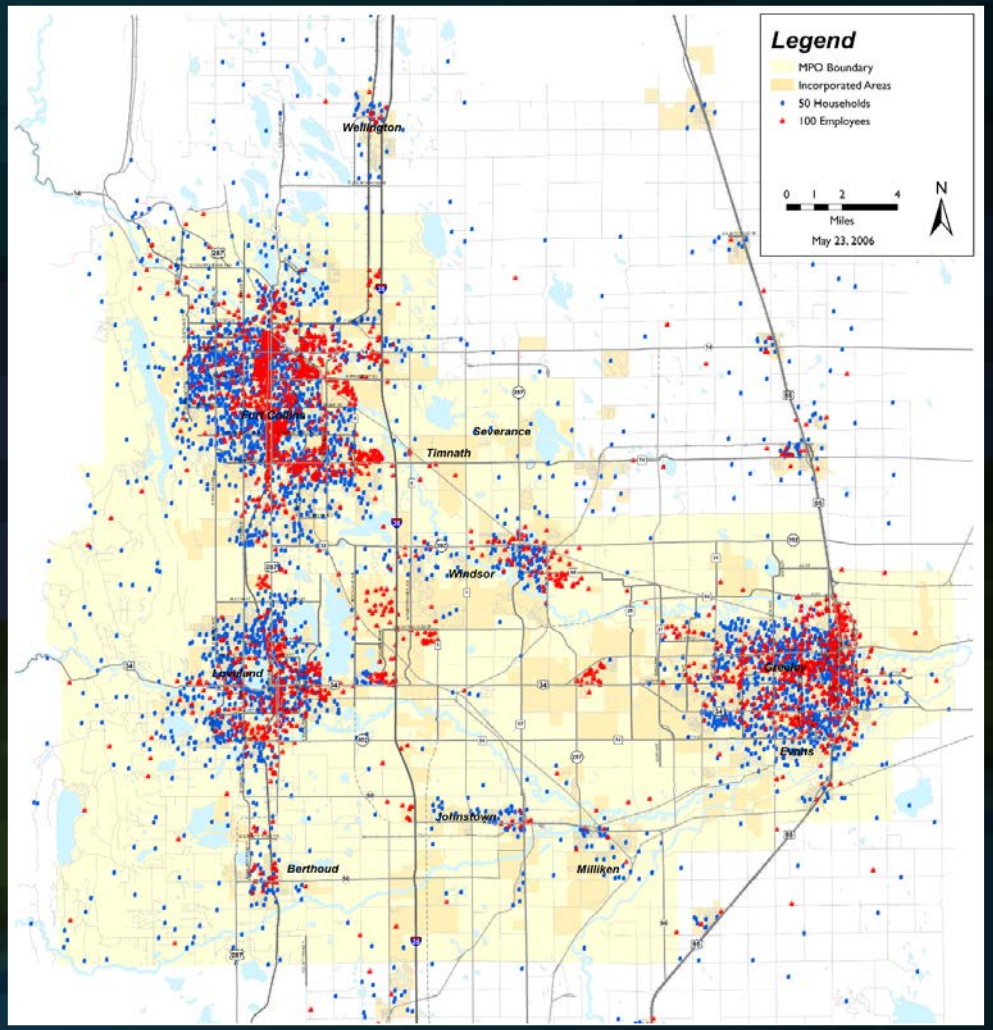
Outputs

- Trips by Mode
- Traffic Volumes
- Congested Speeds
- Transit Volumes
- **Summary Information**

Example Applications

Household And Employment Growth

Today



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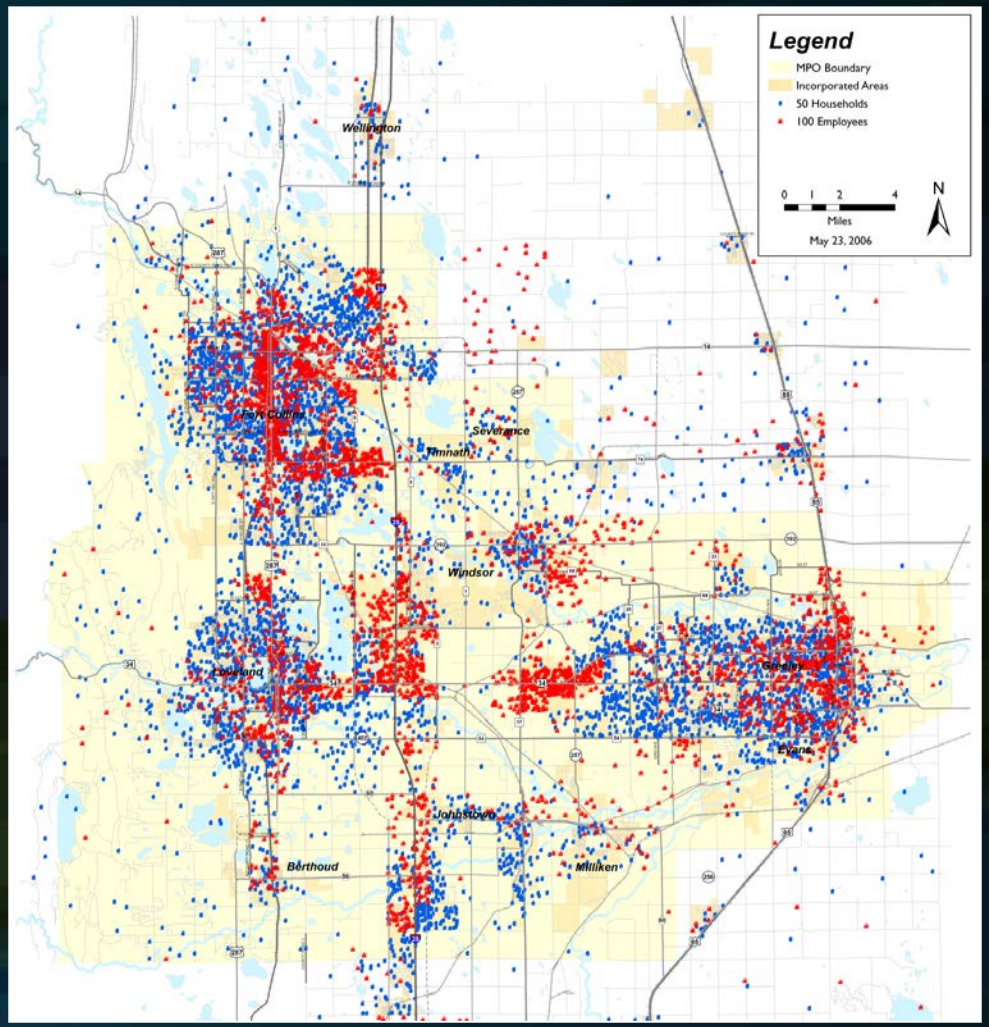
Household And Employment Growth

Future



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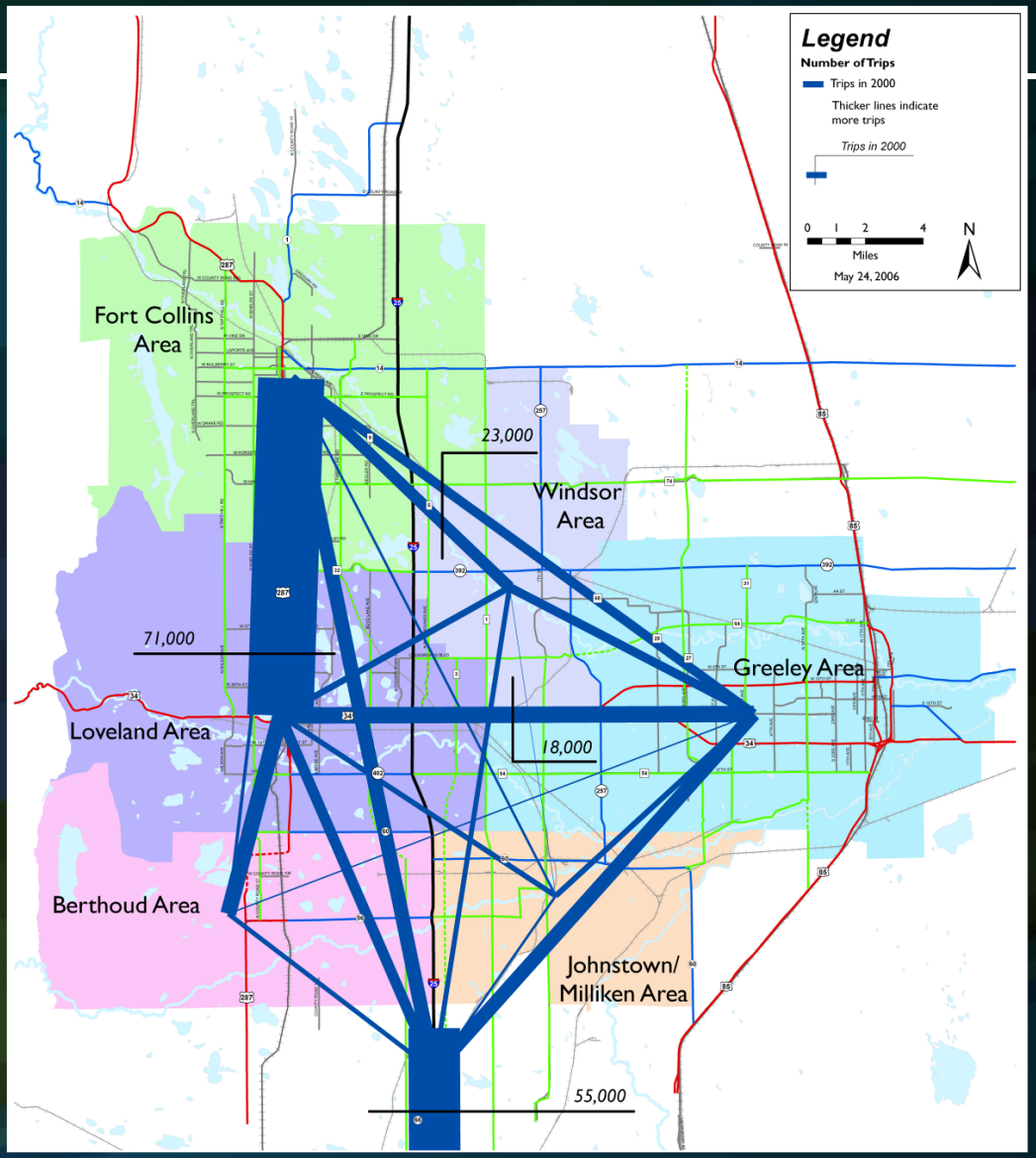
Travel Patterns

Today



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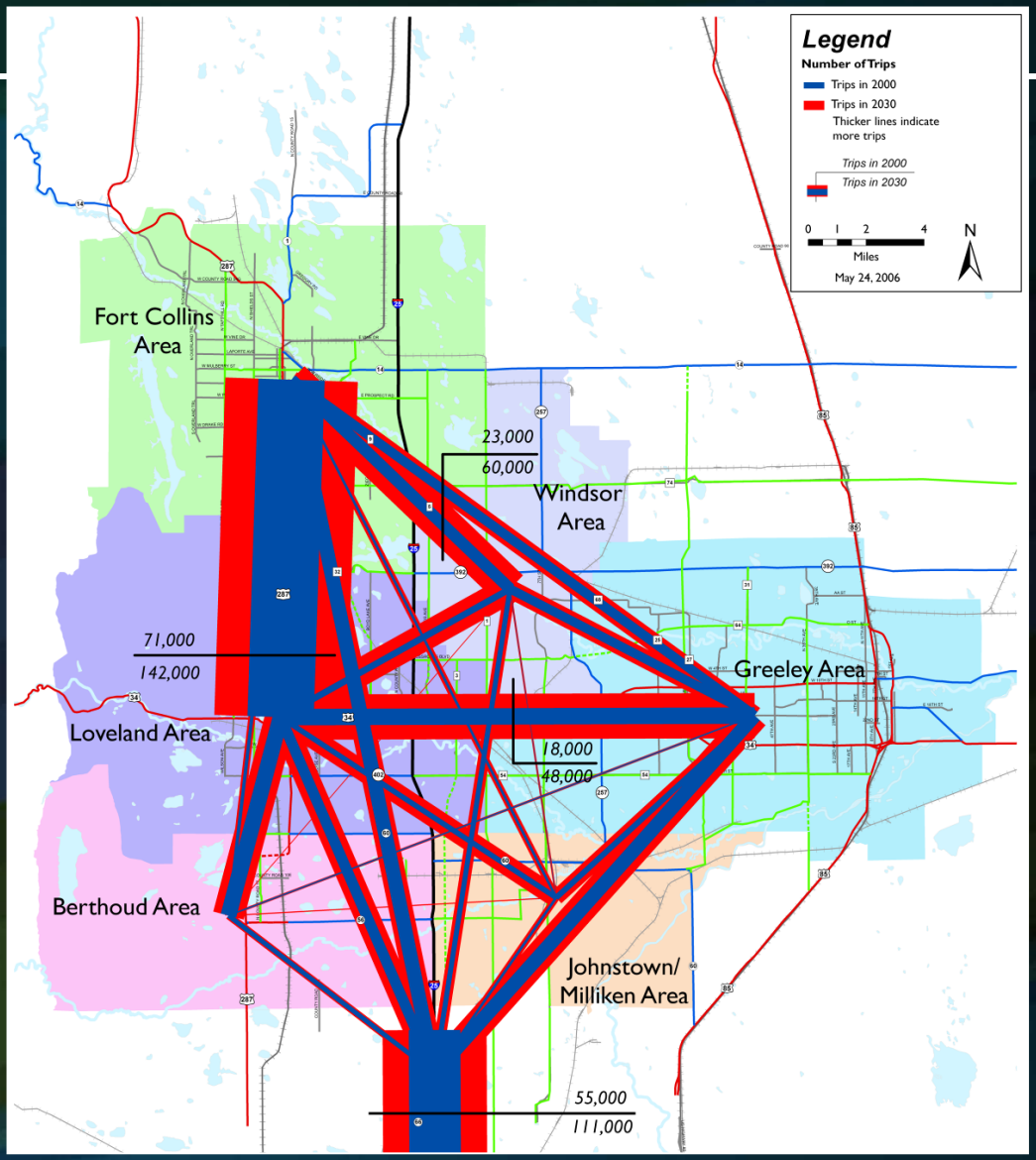
Travel Patterns

Future



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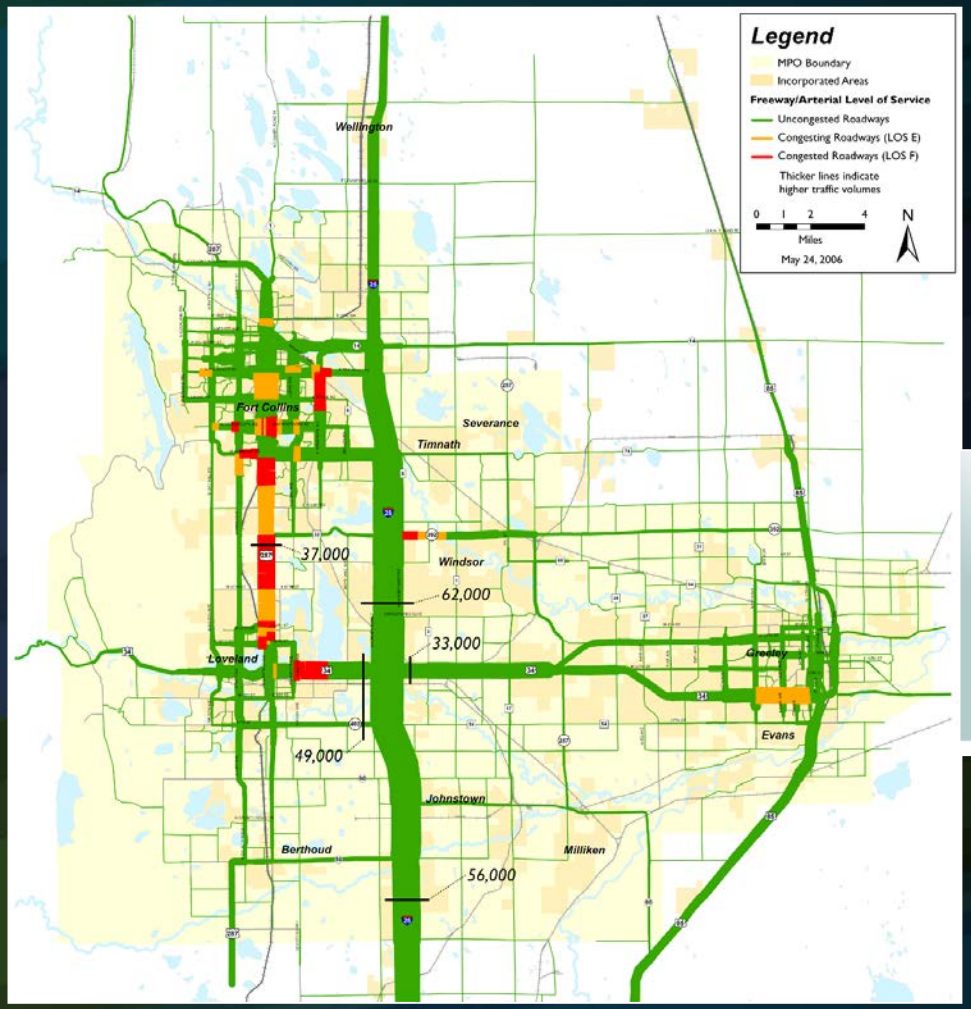
Traffic Volumes And Congestion



Today

Travel Times

From/To	Today	2030	Increase
Fort Collins to Denver	73 Minutes	119 Minutes	46 Minutes (63%)
Fort Collins to Greeley	37 Minutes	49 Minutes	12 Minutes (32%)
Greeley to Loveland	29 Minutes	39 Minutes	10 Minutes (34%)
Berthoud to Windsor	24 Minutes	37 Minutes	13 Minutes (54%)

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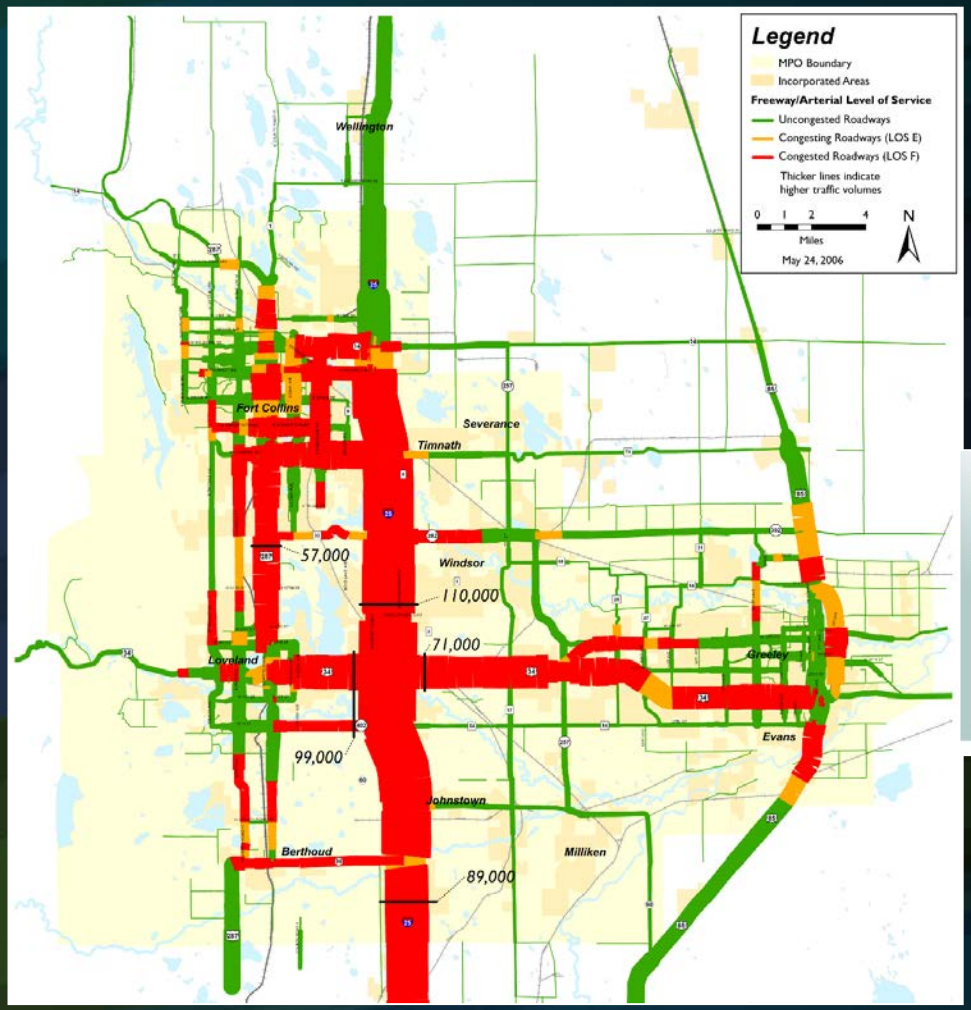
Traffic Volumes And Congestion



Future

Travel Times			
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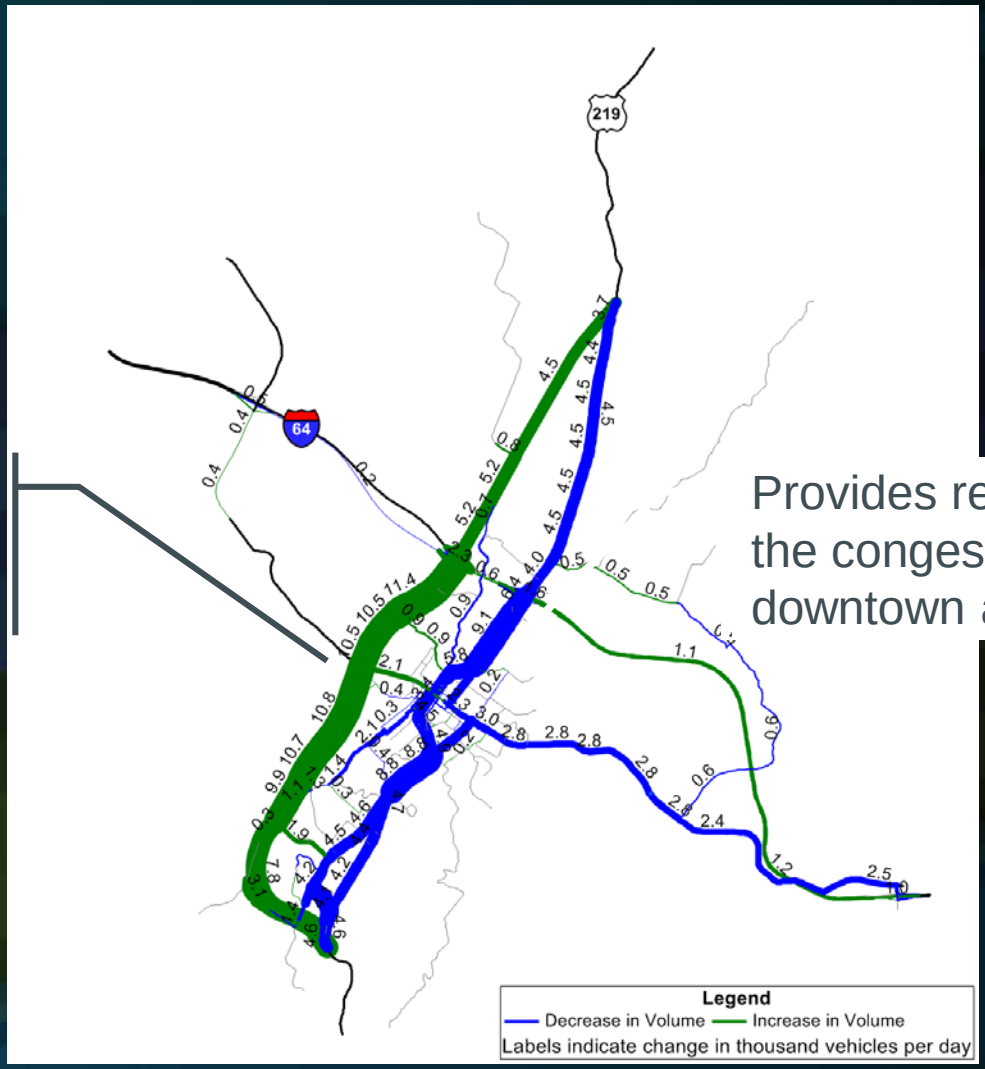
Where Does The Traffic Go?

A new parkway serves through traffic



Provides relief in the congested downtown area

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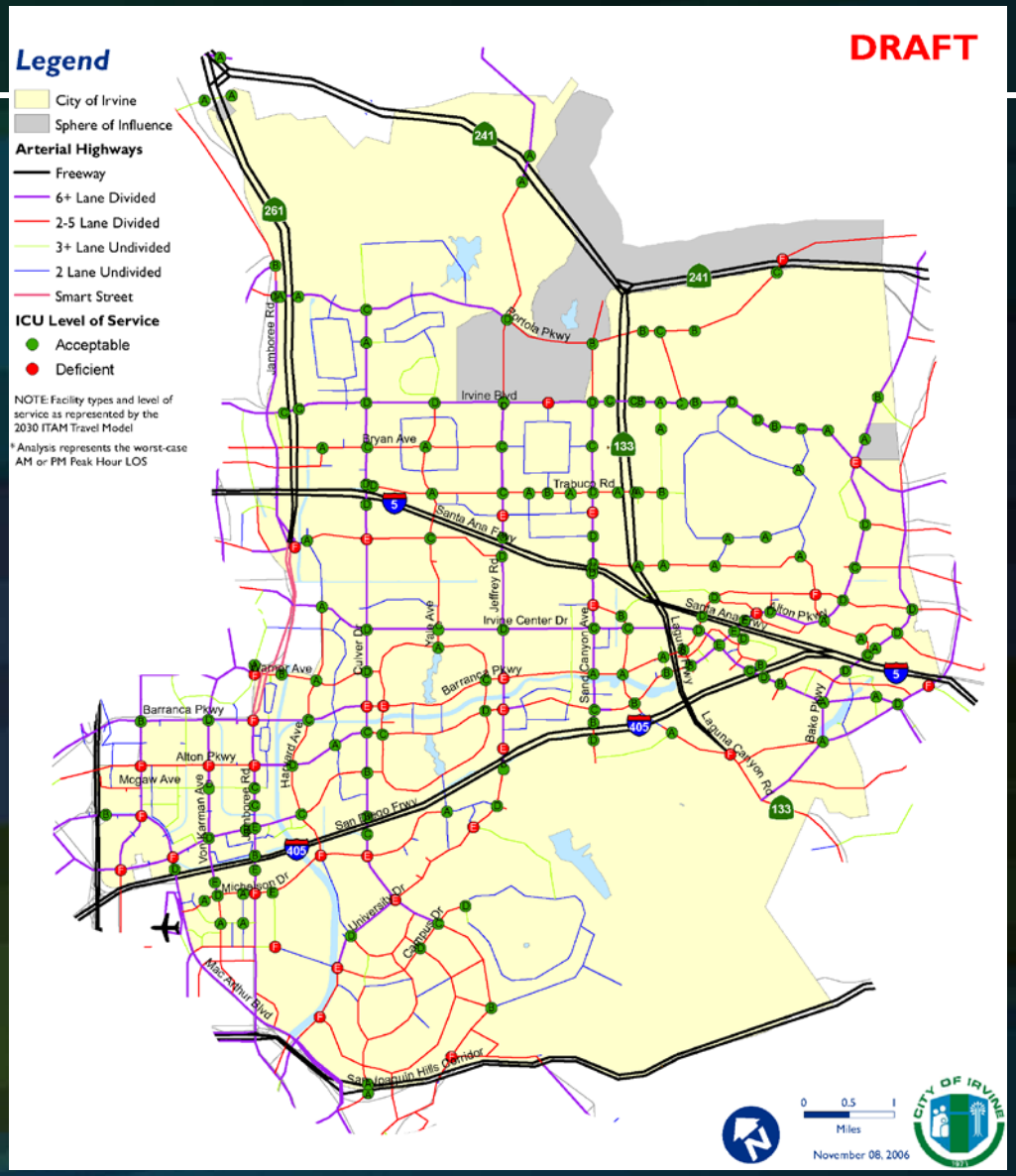
Intersection Los Reporting



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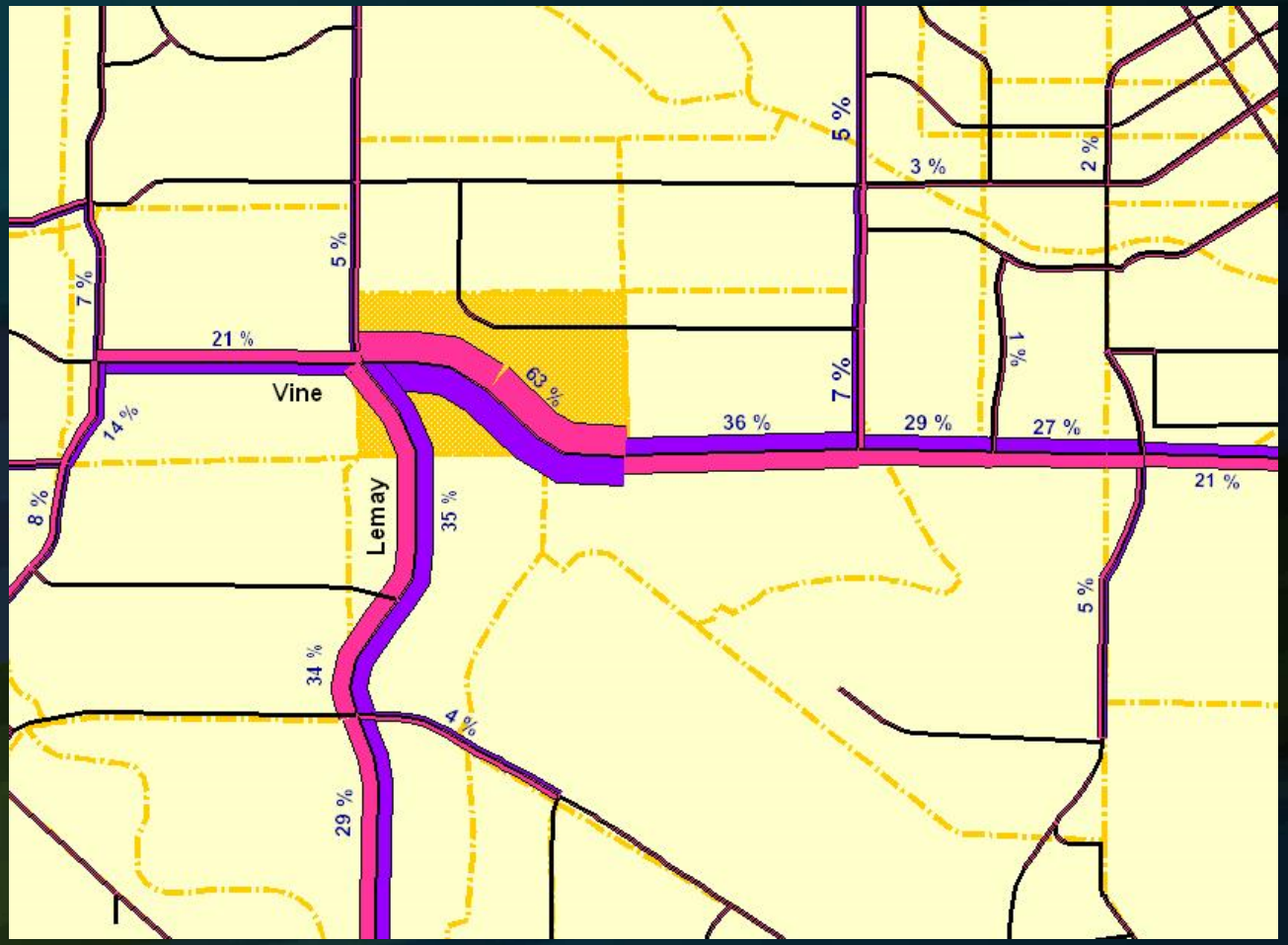
Traffic Impact Analysis



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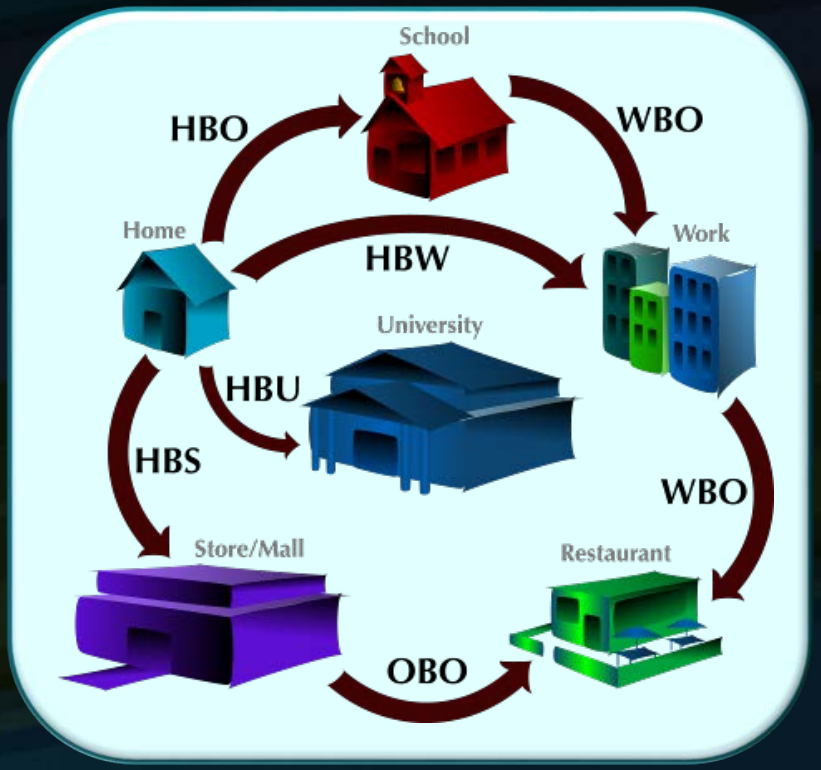
Model Steps

Trip Generation: How Many Trips?

- Based on household survey
- Different trip purposes
- Generate all trips*
  - Walk
  - Bike
  - Transit
  - Auto

** This is different than ITE Trip Generation, which only considers vehicle trips*



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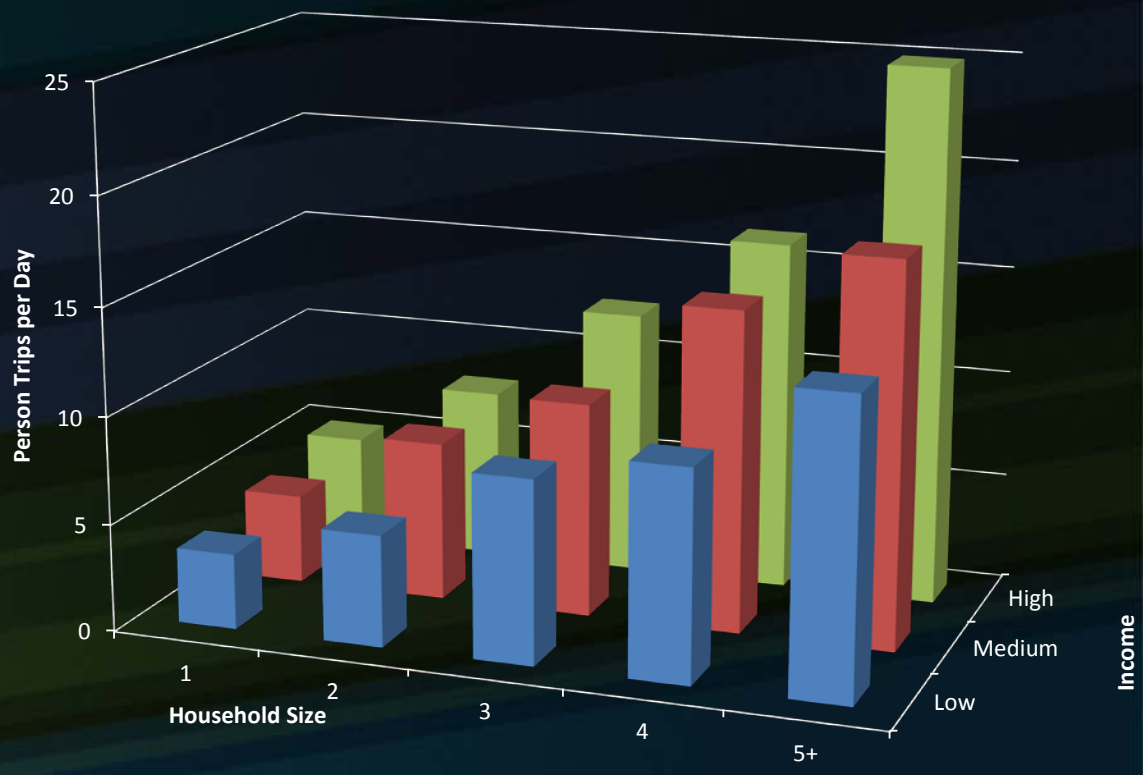
Trip Generation: How Many Trips?

- Cross-classified production rates
  - » Household size & income
  - » Household Workers & Income



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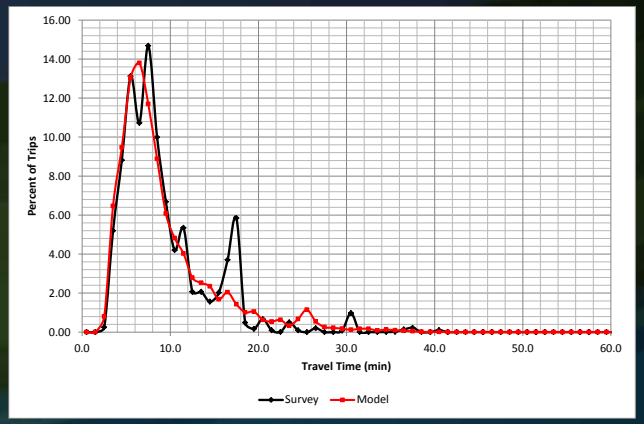
Trip Distribution: Where will they go?

- Match
  - » Productions & attractions
- Survey Data
  - » Trip length distributions
  - » Subregion to subregion patterns

The *Gravity* concept can be used to model travel!



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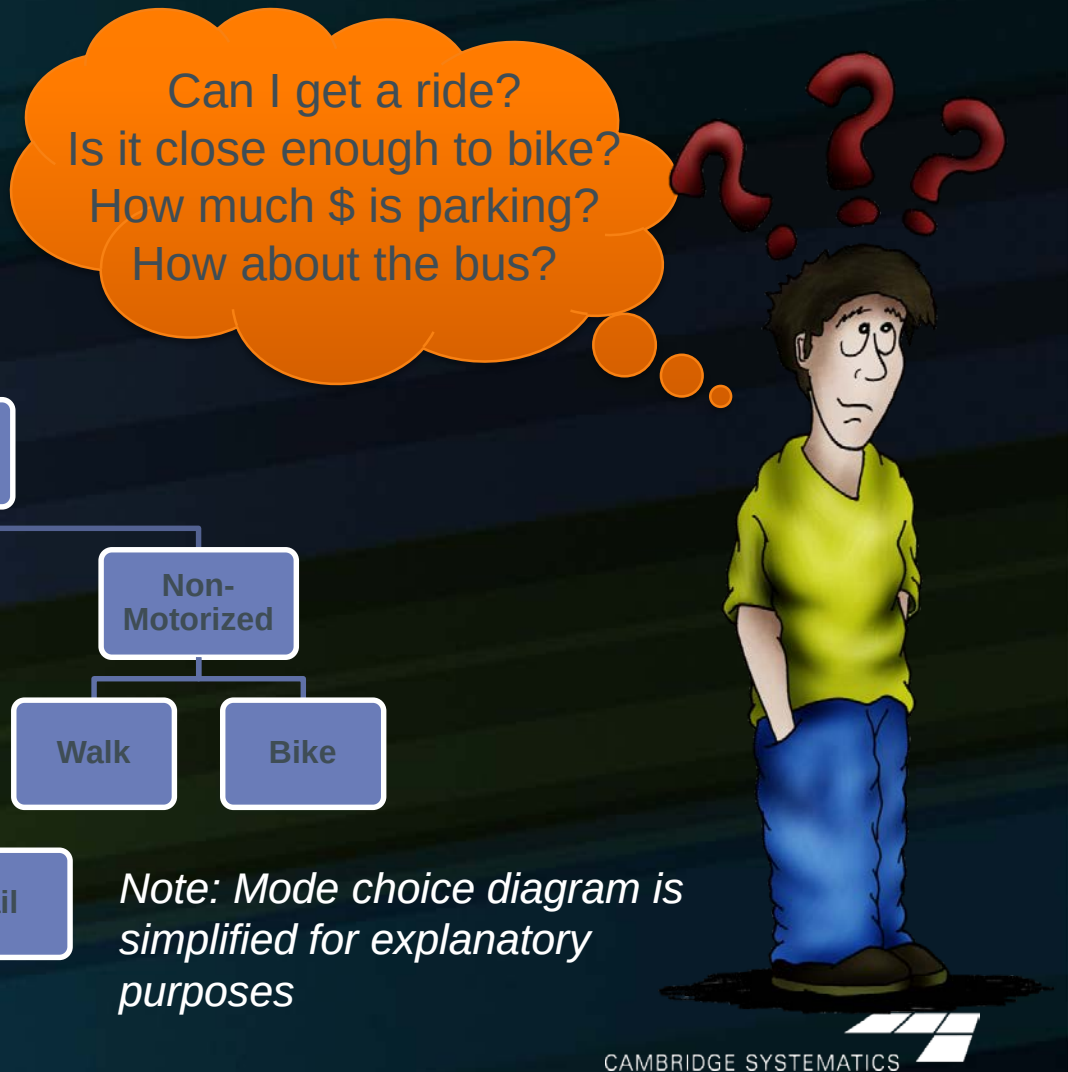
Mode Choice: What Mode?

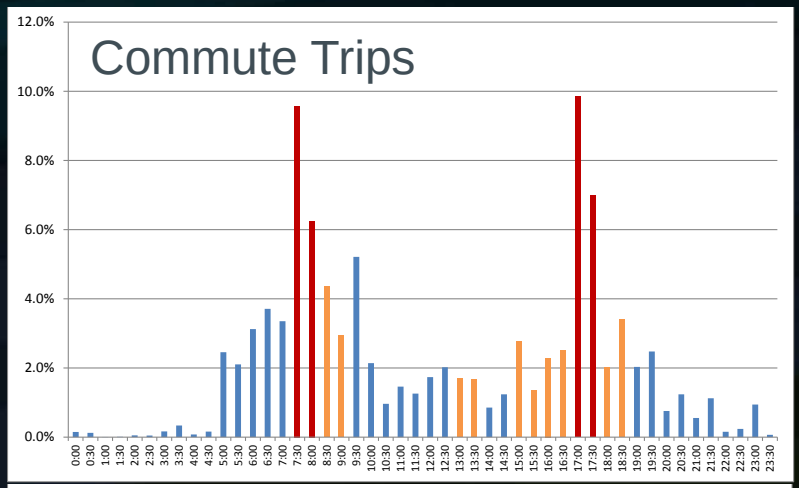
- Nested Logit Model
  - Consider all modes for each zone pair

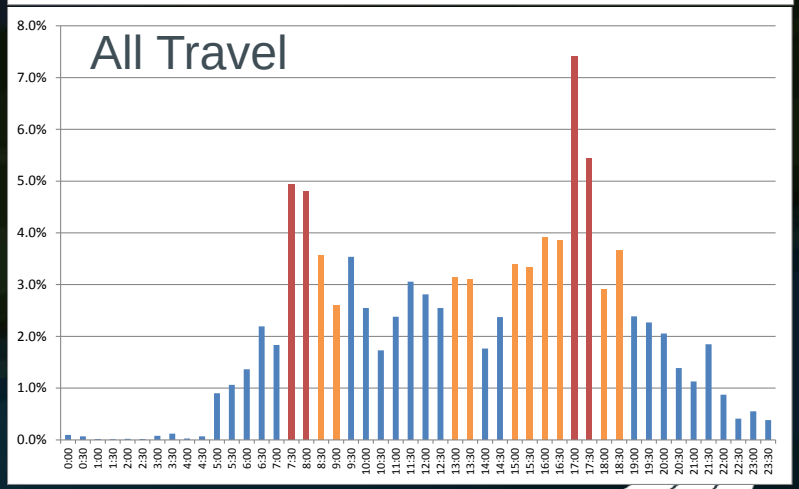


Note: Mode choice diagram is simplified for explanatory purposes

Traffic Assignment: What Route?

- 4 to 5 time periods (depending on model version)
- Account for localized and peak period congestion





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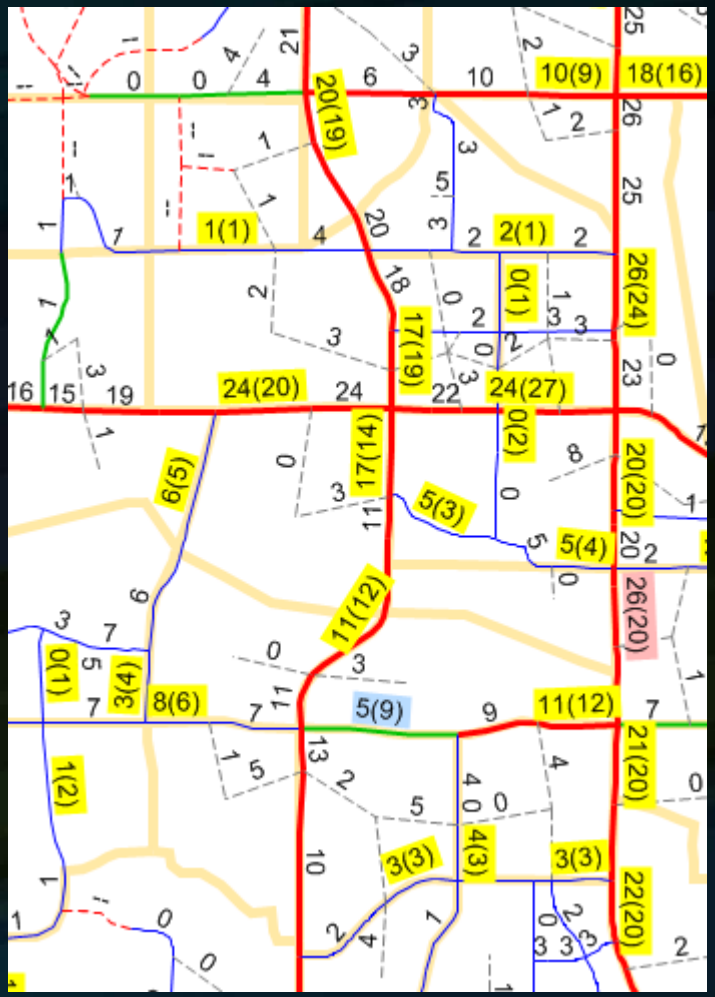
Model Validation / Post-Processing

Matching Local Data

- Surveys & reasonableness checks
  - » Final Trip Rates
  - » Travel Times
  - » District to District travel patterns
- Traffic count data
  - » VMT by subregion, facility type, and area type
  - » Corridor and localized review



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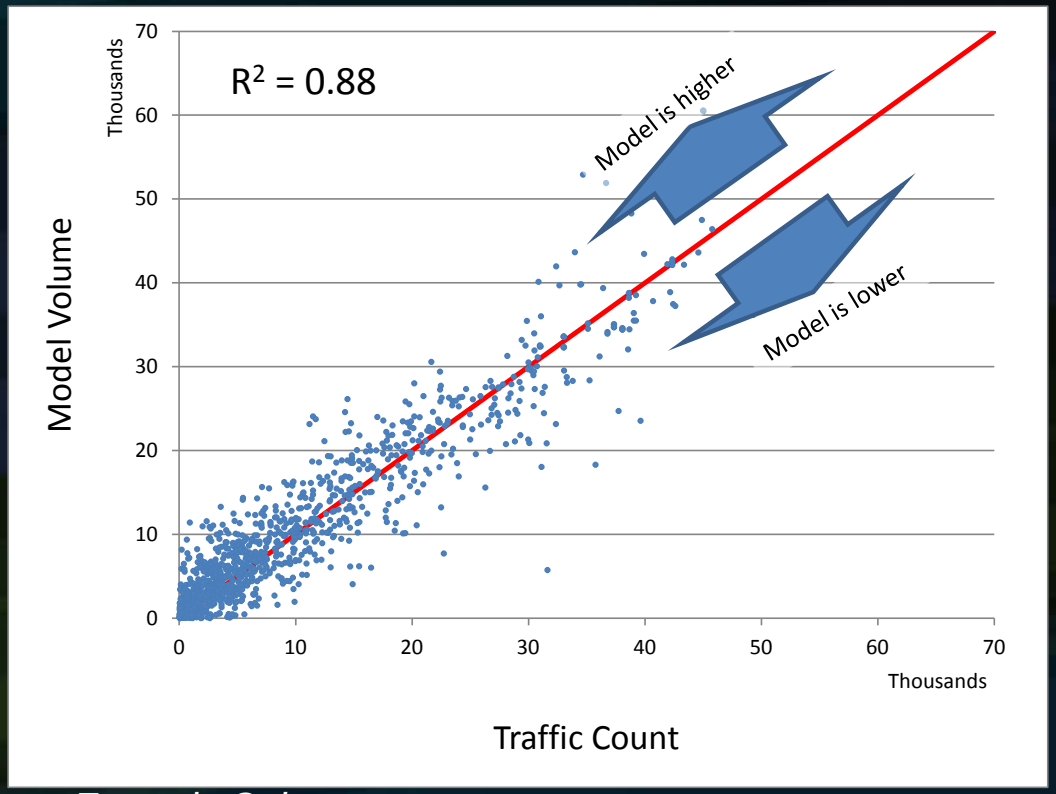
Matching Counts

- How does the model work for today
  - Statistics
    - R-Squared
    - % RMSE
    - Volume / Count Ratio
    - Etc…
  - Screenlines
  - Corridor Review
  - Highest Errors



Example Only

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Testing Sensitivity

- Dynamic validation
  - » Observe how the model reacts changes
    - – Test big and small changes
    - – Test the base and forecast year
  - » Do results make sense?

Post Processing: Reconciling to Counts

- Is the model too low in the base year?
  - » Then the forecast is increased by the same amount
- Is the model too high in the base year?
  - » Then the forecast is decreased by the same amount
- Both ***Post Processed*** and ***Raw*** volumes are available for analysis

Post Processing: Reconciling to Counts

Use % Growth *(e.g., traffic increases by 30%)*

$$Forecast_{ratio} = Raw\ Volume \cdot \frac{Count\ Volume}{Raw\ Base\ Year\ Volume}$$

Use Volume Growth *(e.g., traffic increases by 5,000 vehicles)*

$$Forecast_{diff} = Raw\ Volume + Count\ Volume - Raw\ Base\ Year\ Volume$$

Use the Average

$$Forecast_{avg} = \frac{Forecast_{ratio} + Forecast_{diff}}{2}$$

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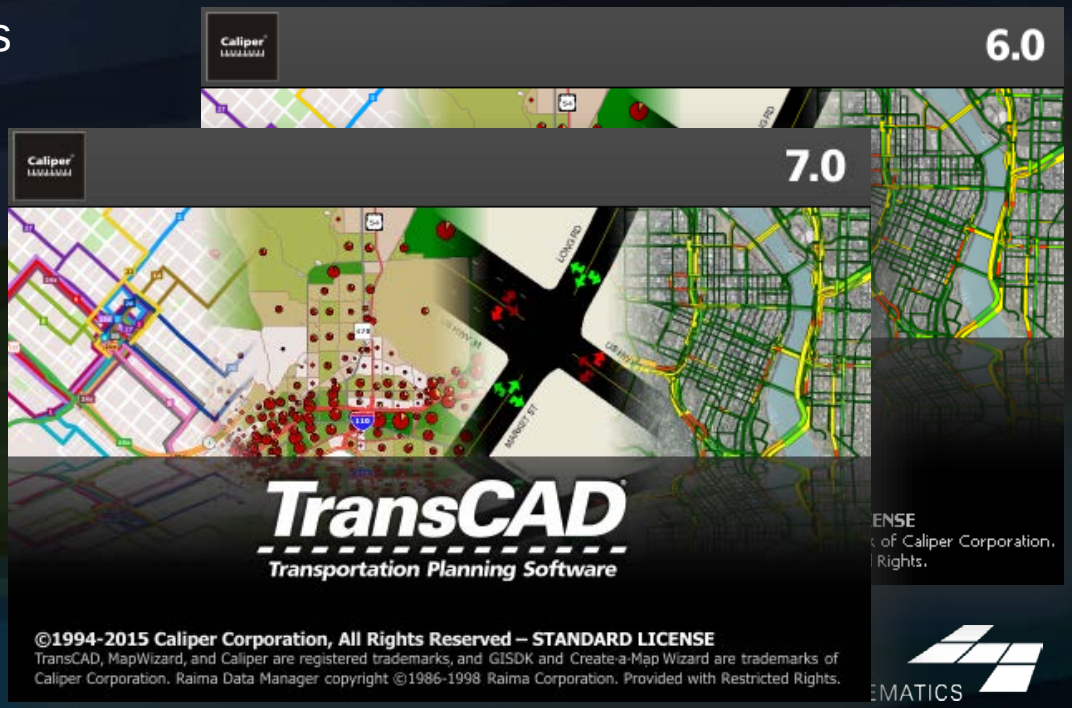
TransCAD Basics

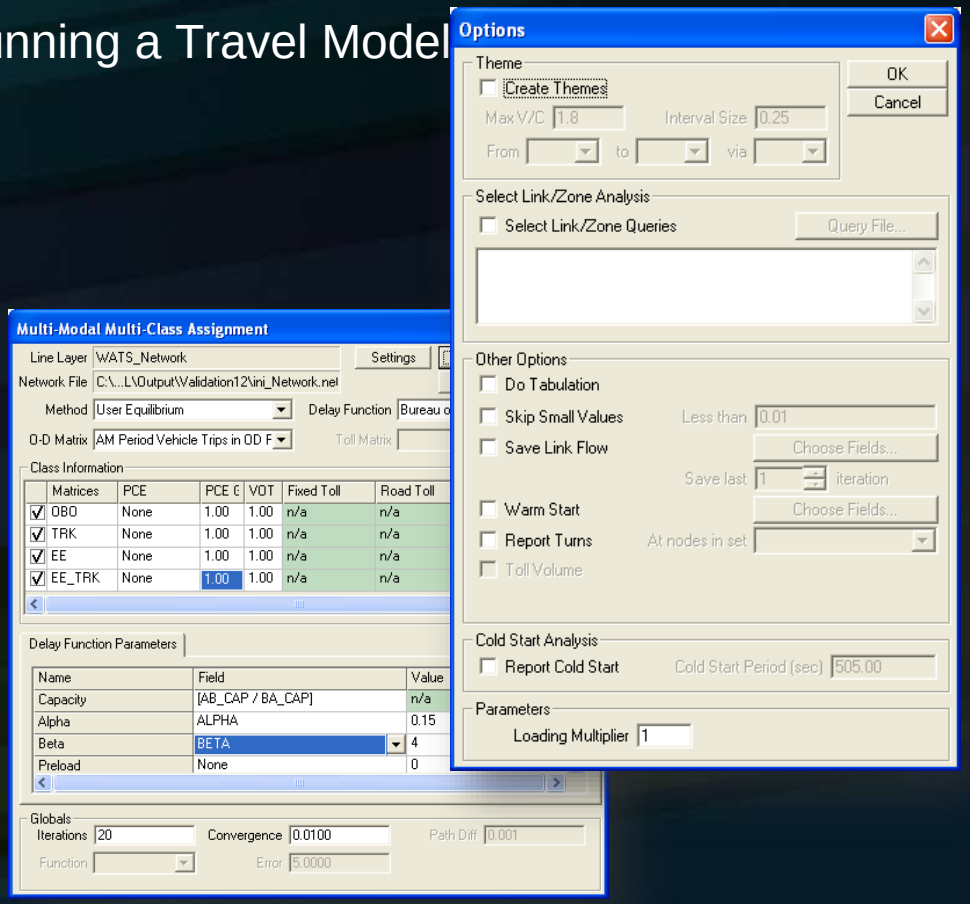
Built-In Forecasting Tools

- 4-Step Travel Model
- Model Calibration/Estimation Utilities
- GIS-Based Roadway and Transit Data
- Intermediate Results Analysis
- Matrix Editor
- Spatial Analysis Tools



Built In Interface

- Provides an interactive method of running a Travel Model
- Very flexible, but can be a bit tedious to use
- Is enhanced through use of customized "Add-Ins"



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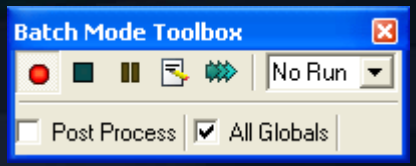
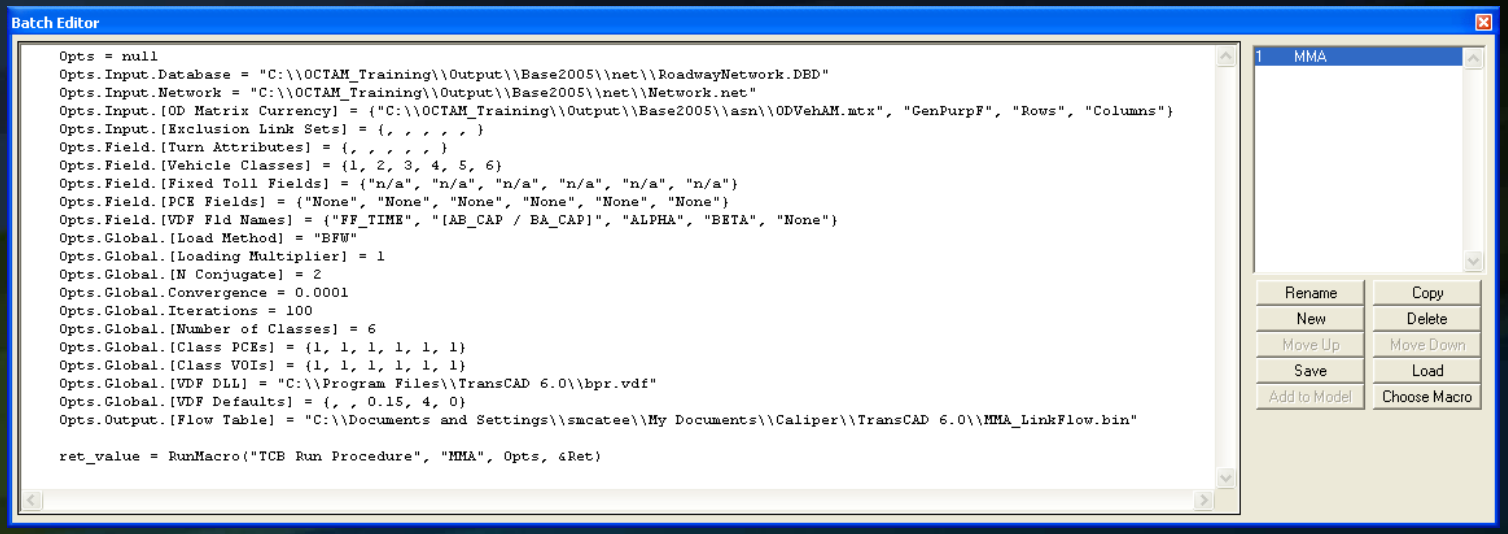
Batch Mode

- Settings from the interface can be saved
- With looping, repetitive tasks can be automated (e.g., run assignment 5 times with different input data but mostly similar settings)





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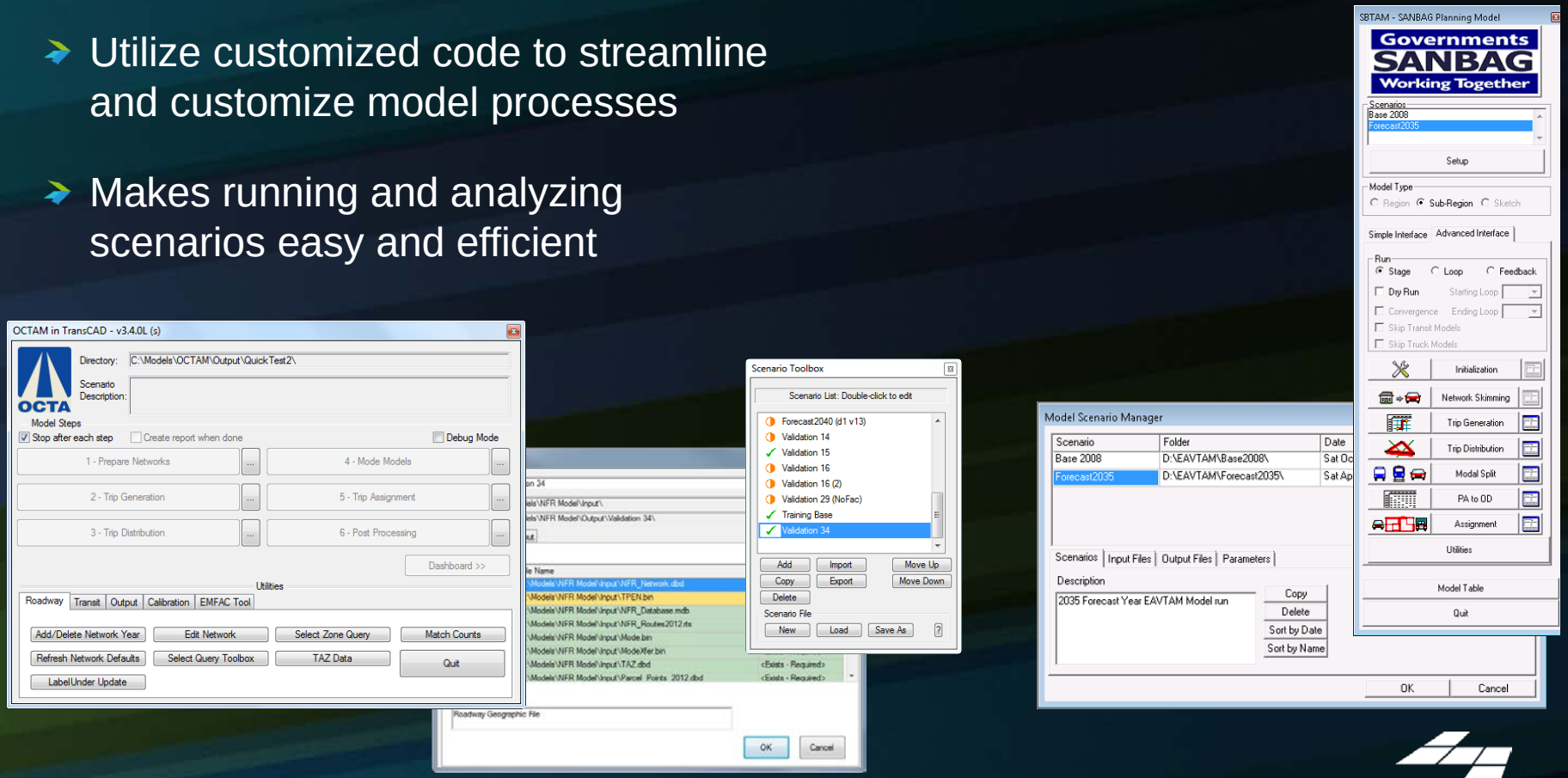
Customized Interfaces

- Created with the GISDK scripting language
- Utilize Batch Mode to automate tasks
- Utilize customized code to streamline and customize model processes
- Makes running and analyzing scenarios easy and efficient



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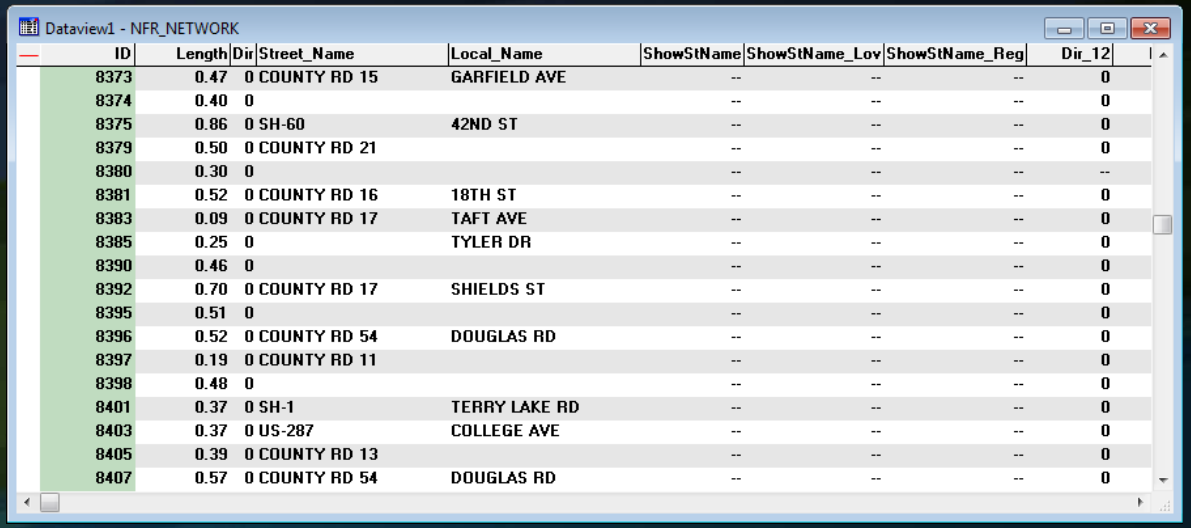
Open Architecture

- Allows for inclusion of any amount or type of data
- Requires deliberate and careful definition of input data requirements
- Almost any aggregate travel model algorithm that can be thought up can be implemented in TransCAD



Dataview1 - NFR_NETWORK

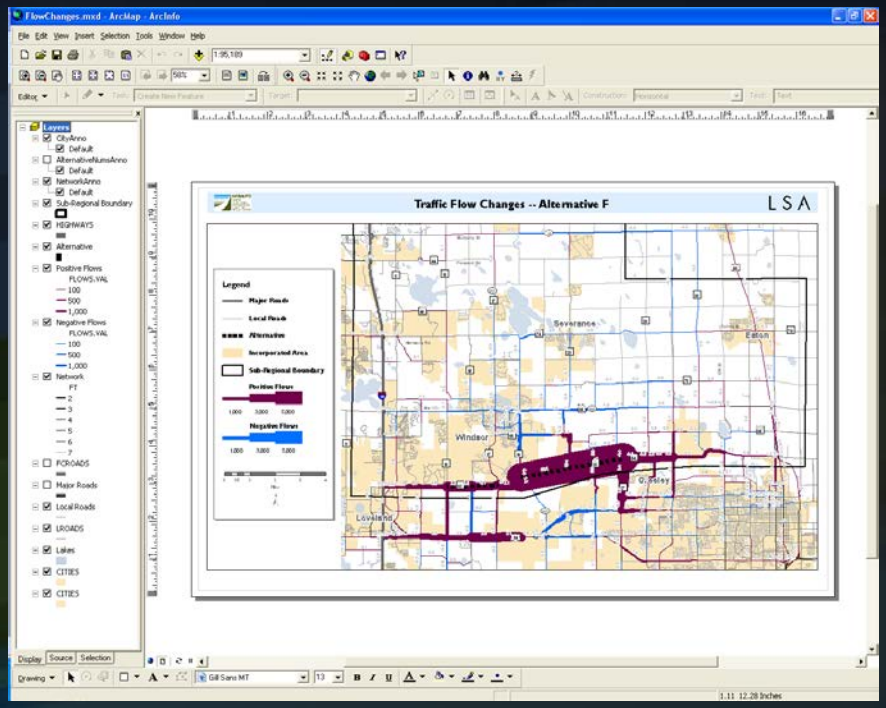
ID	Length	Dir	Street_Name	Local_Name	ShowStName	ShowStName_Lov	ShowStName_Reg	Dir_12
8373	0.47	0	COUNTY RD 15	GARFIELD AVE	--	--	--	0
8374	0.40	0			--	--	--	0
8375	0.86	0	SH-60	42ND ST	--	--	--	0
8379	0.50	0	COUNTY RD 21		--	--	--	0
8380	0.30	0			--	--	--	--
8381	0.52	0	COUNTY RD 16	18TH ST	--	--	--	0
8383	0.09	0	COUNTY RD 17	TAFT AVE	--	--	--	0
8385	0.25	0		TYLER DR	--	--	--	0
8390	0.46	0			--	--	--	0
8392	0.70	0	COUNTY RD 17	SHIELDS ST	--	--	--	0
8395	0.51	0			--	--	--	0
8396	0.52	0	COUNTY RD 54	DOUGLAS RD	--	--	--	0
8397	0.19	0	COUNTY RD 11		--	--	--	0
8398	0.48	0			--	--	--	0
8401	0.37	0	SH-1	TERRY LAKE RD	--	--	--	0
8403	0.37	0	US-287	COLLEGE AVE	--	--	--	0
8405	0.39	0	COUNTY RD 13		--	--	--	0
8407	0.57	0	COUNTY RD 54	DOUGLAS RD	--	--	--	0

Compatible File Formats

- TransCAD can read and write data to/from many universally accepted file formats.
  - GIS (Shapefile, Geodatabase)
  - Spreadsheet
  - Database
  - Text
  - HTML (with add-in)
  - Traffic Software (with add-in)
  - Others

GIS Applications

- Use TransCAD model results in ArcGIS to create high quality maps.
- Link TransCAD networks to GIS-based analysis tools.



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TransCAD Tips

File and Data Types

- Data Files actually contain information:
  - Tables (.bin, .DBF)
  - Geographic Files or Layers (.dbd, .shp)
  - Matrices (.mtx)

File and Data Types

- Some files do not contain information:
  - Dataviews (.dvw)
  - Maps (.map)
  - Matrix Views (.mvw)
- These files refer to other file types that contain data
  - Same concept as a project file (.mxd) in ArcMAP

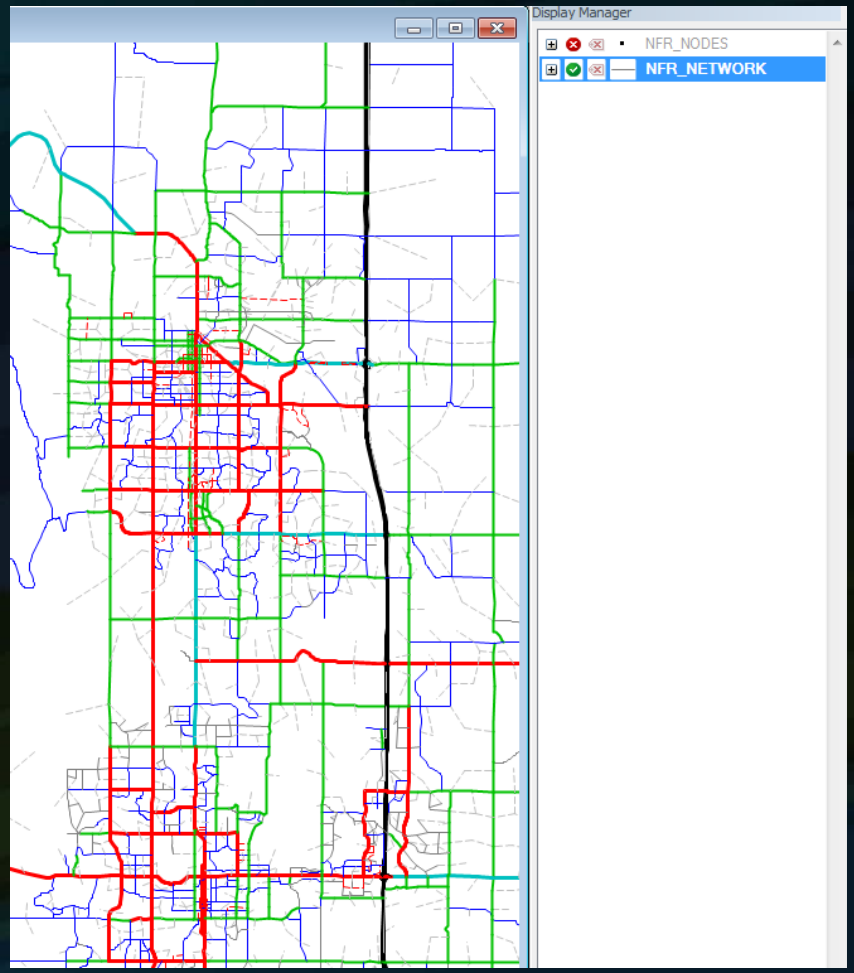
Never use File → Save As → "Dataview (.dvw)" or "Map (.map)" to save a copy for modification!

File and Data Types

- Geographic Files (.dbd) are GIS layers and can be edited and viewed.
  - We Use Line Layers as “roadway networks”
- Route Systems (.rts) contain transit information
  - Route systems are linked to line layers
- Routable Network Files (.net, .tnw) are routable networks used internally by TransCAD.
  - Routable network files must be created before running certain tasks.
  - Separate networks for roadway and transit

Useful Features

- Saved Workspaces
- Undo and Redo
- Copy and Paste directly between TransCAD and other programs (e.g., Excel)
- The Display Manager
  - » Show it from Map → Display Manager
- Multiple selection sets
- Many more…



New in TransCAD 6.0

- Read and write directly to ESRI Geodatabases
- Improved Mapping Features
  - Label customization
  - Transparency
- Under the Hood
  - 64-bit architecture
  - More multithreading
  - New procedures (e.g., drive egress to transit)

Interactive Demo

TransCAD Software

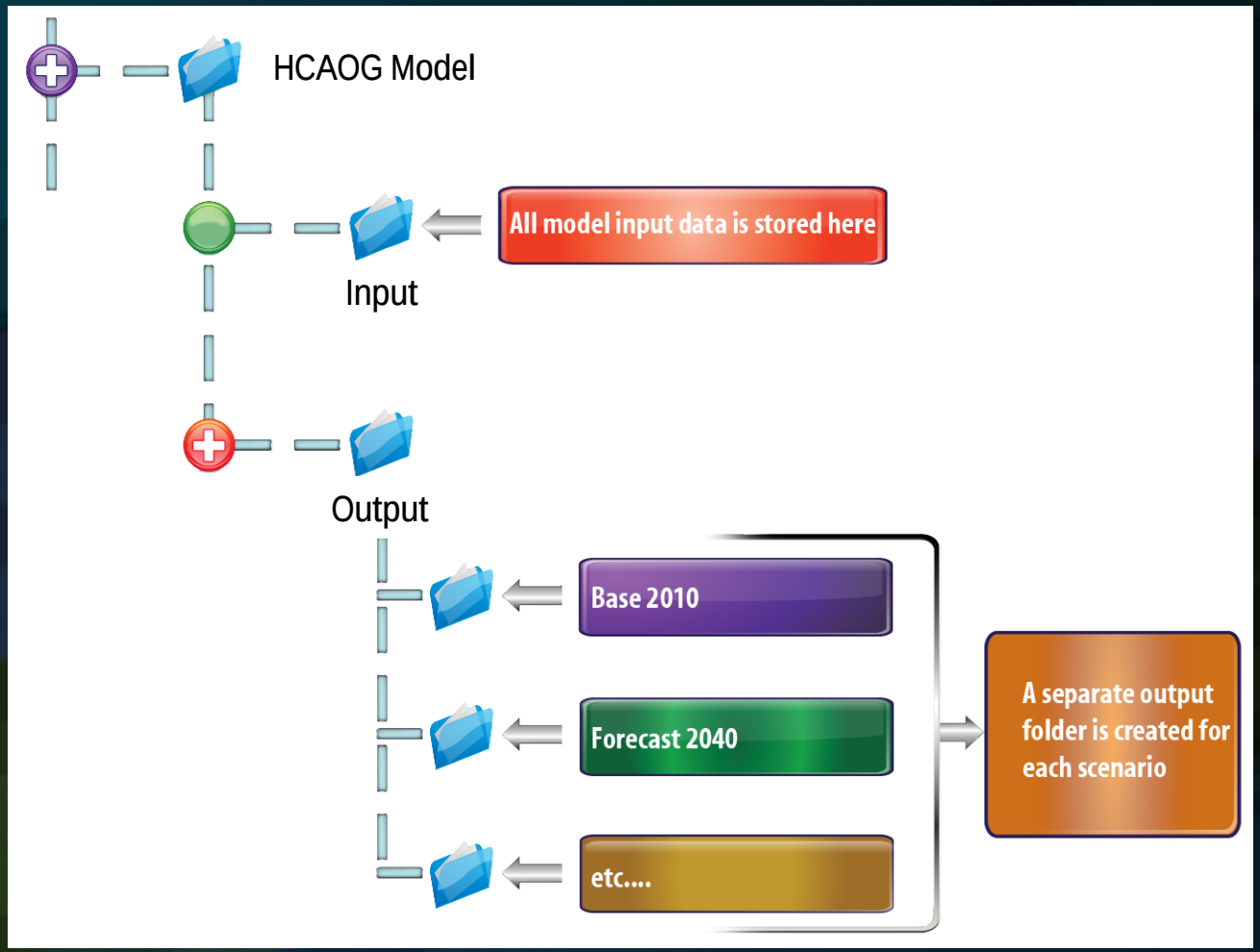
Model Basics

Model Data Structure

Running the model

1. Organize Data
2. Set up the roadway network
3. Set up the land use data
4. Create a Scenario
5. Run…
6. View the Report
7. Create and View maps

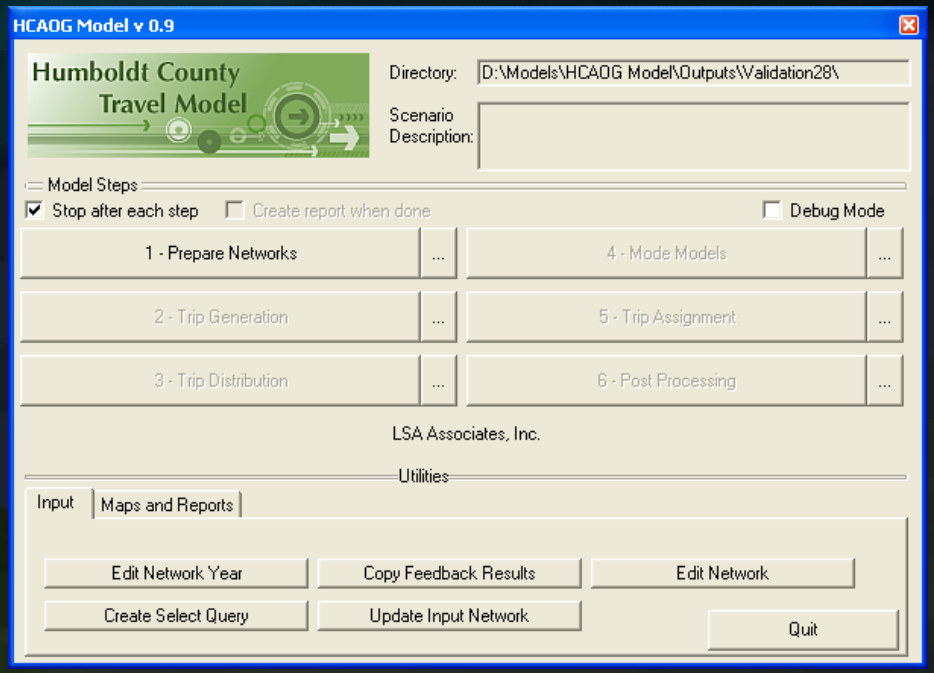
MODEL FILE STRUCTURE



MODEL INPUTS AND OUTPUTS

Inputs

- Roadway Network
- HH Data
- Employment Data
- External Data
- Special Generators
- Model Parameters



Outputs

- Total Trips
- Link Volumes
- Trips by Mode
- Congested Speeds
- VMT, VHT, etc.
- Maps and Tables

Inputs

- Roadway Network
- HH Data
- Employment Data
- External Data
- Special Generators
- Model Parameters

MODEL INPUTS AND OUTPUTS

- HumboldtNetwork.dbd
  - Stored in the Input directory
- Contains Data For:
  - 2010
- Can Store Data For:
  - 2040, interim years, etc.
  - Individual network alternatives (e.g., widen roads, build roads)

Inputs

- Roadway Network
- HH Data
- Employment Data
- External Data
- Special Generators
- Model Parameters

MODEL INPUTS AND OUTPUTS

- HumboldtDatabase.mdb
  - Stored in the input directory
- Contains Data For:
  - 2010
  - Forecast Years
  - Specific Adjustments (New retail, Housing Development, offices, etc.)
  - Land Use Scenario Testing (Low Density vs. Compact Growth)

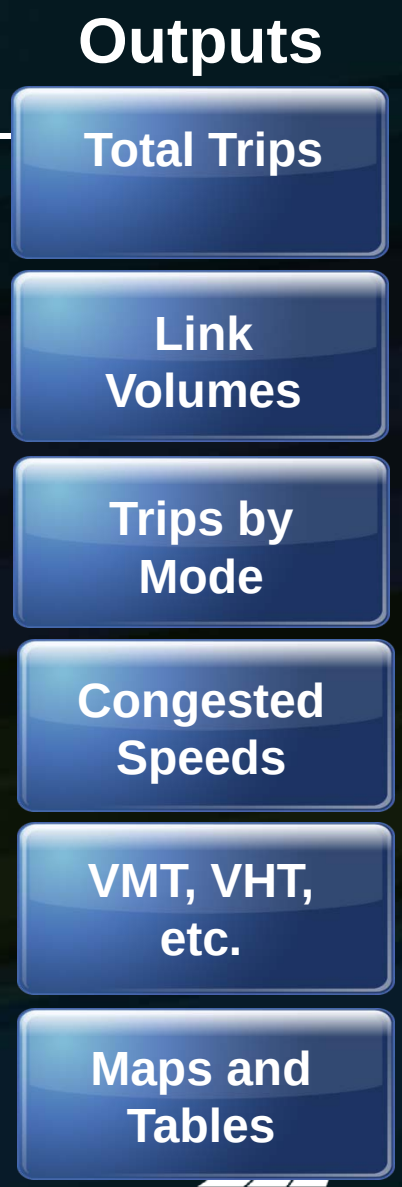
Dataset Names can use up to 6 characters

MODEL INPUTS AND OUTPUTS

- HumboldtDatabase.mdb
  - » Stored in the input directory
- Scenario.arr
  - » Stored in a user-specified location
  - » Managed through the interface
- DefaultScenario.ini
  - » Located in the All Users Application Data directory
  - » Rarely modified
- Humboldt.rsc
  - » The Model Structure (methodology, algorithms, definitions)

MODEL INPUTS AND OUTPUTS

- All outputs are stored in the “Outputs” directory
- We will cover key outputs and intermediate files associated with each step
  - All output files are defined in The Scenario Manger

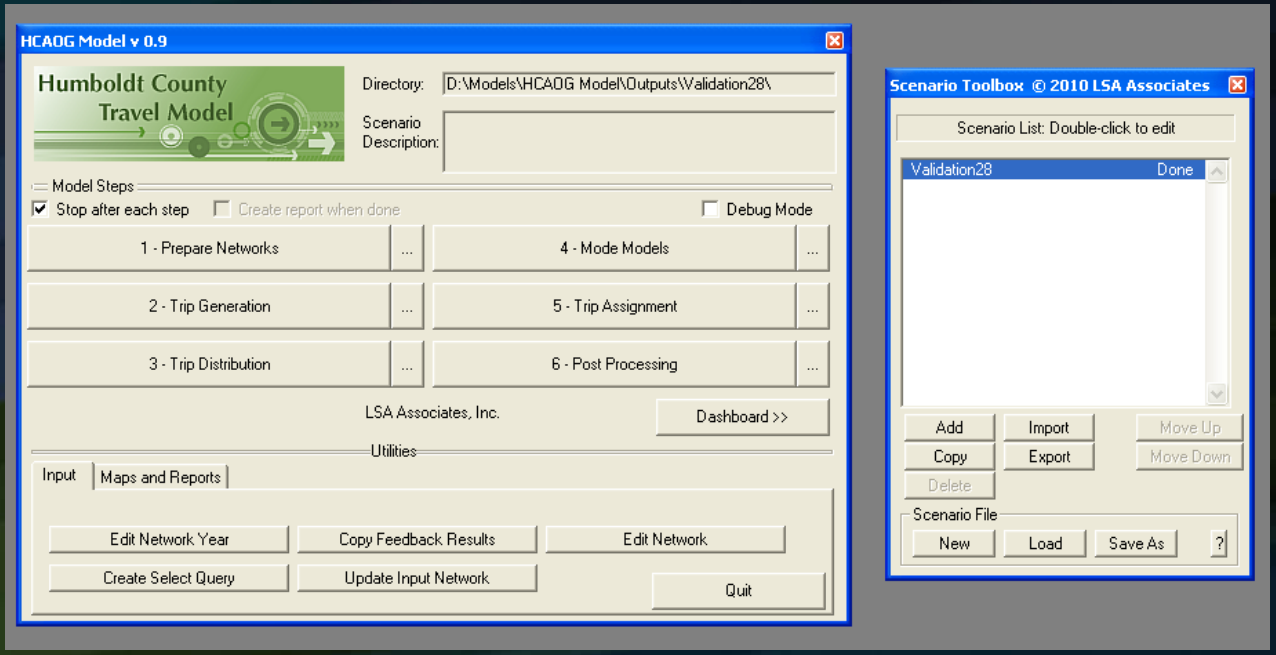


Model Basics

Dialog Box and Dashboard

Starting the Add-In

- Use Tools → HCAOG Model
  - (Alternate:
    Tools → Add-Ins → HCAOG Model)



CAMBRIDGE SYSTEMATICS

Using the Add-In

- In-program Tour
  - Setting up a model run
    - Input / Output directories
    - Alternatives, network years, and data years
    - Scenario description
  - Using model utilities
  - Viewing model output
    - Summary Report
    - Automated Maps (Dashboard)
    - Manual Maps

- Roadway Network

Network Structure

Key Fields

Field Name	Description	Comments
ID	TransCAD Unique ID	Maintained automatically by TransCAD
Length	Link Length in miles	Maintained automatically by TransCAD
Dir	Link Direction of Flow	Direction of Flow
STREETNAME	Street Name	
STREETTYPE	Street Type (St., Ave., Blvd. etc)	
Dir_yyyy	Scenario-Specific Direction Field	yyyy represents a two through four-digit year code (e.g., 09, 12, 35, 35AA) or the string “AL”
FT_yyyy	Scenario-specific facility type (see table 1.3 for definition)	
AT_yyyy	Scenario-specific area type (see Table 1.4 for definition)	
AB_LN_yyyy BA_LN_yyyy	Scenario-specific directional number of through lanes (lanes that are used for parking in the off-peak periods are included in this value)	
SPLM_yyyy	Scenario-specific posted speed limit	
CTLMED_yyyy	Scenario-specific presence of a center turn lane or median (1 indicates the presence of a center turn lane)	
FFOR_yyyy	Freeflow Speed Override (use with caution)	

Other Important Fields

Field Name	Description	Comments
AB_FBAM_yyyy AB_FBAM_yyyy BA_FBOP_yyyy BA_FBOP_yyyy	Scenario-specific fields used to hold speed feedback results. These fields are optional and usually managed by the travel model interface.	Fields ending in “AL” are not present for these fields.
ALT, ALT2	Define alternative numbers	
VAL_Count, EST_Count, etc.	Traffic count data (EST_Count includes estimated data for NCHRP adjustment on all links)	Many additional count fields are included – these contain original data.

KEY FIELDS

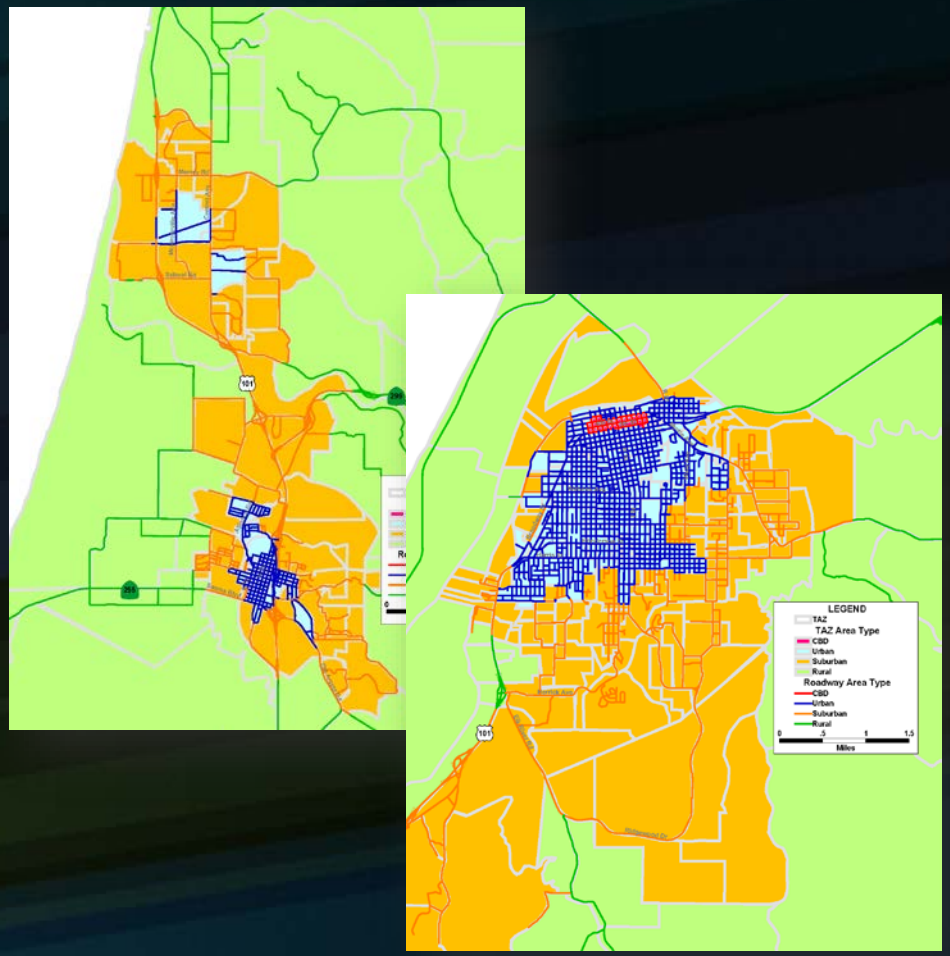
- Year-Specific Variables:
  - Listed with _yyyy in the attribute table
  - Base Year: All data must be filled in variables ending in _10
  - Future Applications: Data can be filled in variables ending in any 2-4 digit identifier
- Alternative Variables:
  - Variables end in _AL
  - Can be left empty for base year
  - Streamline alternatives analysis testing

FACILITY TYPE CODES

Code	Facility Type
1	Freeway
2	Expressway
3	Principal Arterial
4	Minor Arterial
5	Major Collector
6	Minor Collector
7	Local Road
8	Ramp
9	Centroid Connector
null	Inactive Link (does not exist in the specified network)

AREA TYPE CODES

Code	Area Type
1	CBD
2	Urban
3	Suburban
4	Rural



Note:
Area type is maintained at the network and TAZ level

USER VARIABLES

- Creating your own variables
  - » Additional fields can be added to links and nodes
  - » Field names can contain spaces and numbers, and do not have a practical limit to the number of characters

HOWEVER…

USER VARIABLES

- Creating your own variables
  - It is preferable to:
    - Limit field names to 10 characters
    - Avoid using spaces
    - Avoid starting a field name with a number
  - If these guidelines are followed, compatibility with other GIS programs will be improved
    - Field names that do not follow these guidelines will have truncated or confusing names when exported to a shapefile
    - TransCAD 6 can export to an ESRI geodatabase, making these guidelines less important

ALTERNATIVES

- Many different types of alternatives and combinations of alternatives can be stored in a single network file, however:
  - There is a limit to the number of alternatives that can traverse the same link
  - Different alternatives traversing the same link must specify the same improvement on the shared link