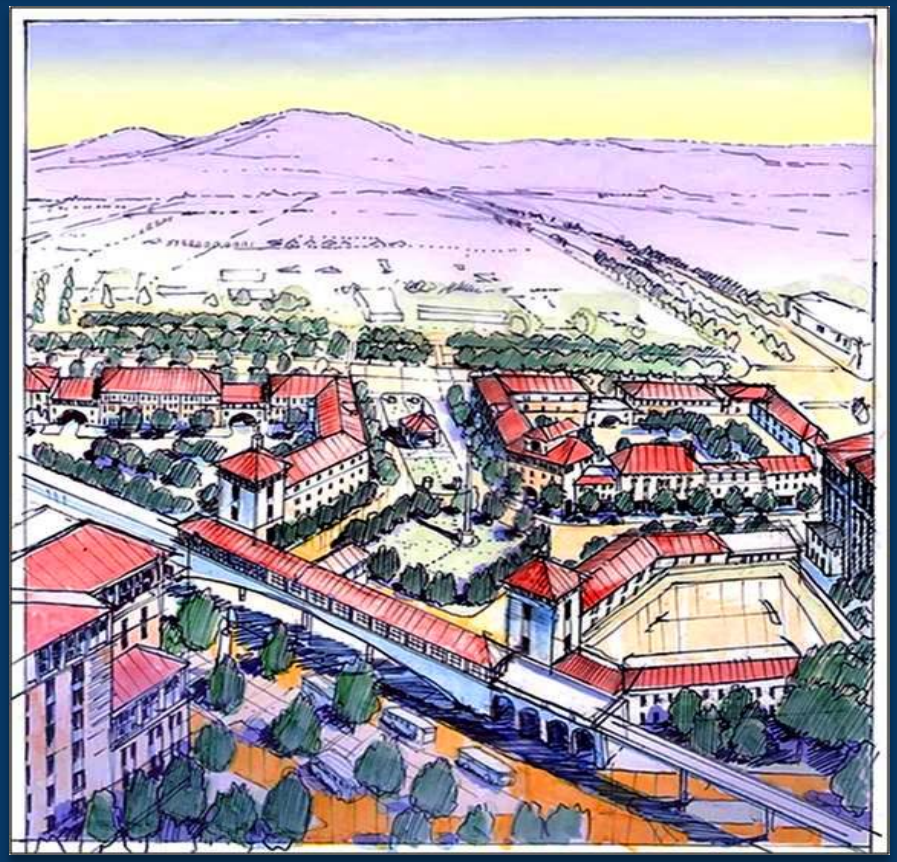
Overview of

"Improved Data and Tools for Integrated Land Use-Transportation Planning in California"

Caltrans Planning Horizons

November 7, 2012



Presentation Outline

Part 1. Overview ***- Terry Parker***

A. Integrated Land Use-Transportation Scenario Planning

B. Tools commonly used

C. The need for and goals of this Project

D. Introduce other speakers

Part 2. Data & Results

A. Areas Included in Data Collection - ***Nathaniel Roth , UCD***

B. Analysis of Data, & Results - ***Jerry Walters, Fehr & Peers***

Part 3. Application of Results with -

A. Scenario/Sketch Planning Tools - ***Nathaniel Roth; Raef Porter (SACOG)***

B. Travel Demand Models - ***Jerry Walters***

Part 4. Q & A

1A. What is "Scenario" Planning?

- ***Scenario:*** **Internally consistent view of a potential future .**
- ***Scenario Planning:*** **considers various future possibilities.**
- ***Goal:*** **identify and evaluate appropriate actions.**
- ***Many entities conduct "scenario planning" –***
  - ✓ **Private businesses and individuals.**
  - ✓ **Federal agencies, such as the Pentagon, etc.**
  - ✓ **State Departments of Transportation** (DOTs) (e.g., Caltrans).
  - ✓ **Regional agencies:** "Metropolitan Planning Organizations" (MPOs) and "Rural Transportation Planning Agencies" (RTPAs).
  - ✓ **Local governments**: cities and counties.

Land Use-Transportation Scenario Planning

- **In the late 1990s and early 2000s, "integrated" land use-transportation scenario planning became more widespread.**
  - ✓ *It considers various land use and transportation alternatives.*
  - ✓ *Uses terms such as: "vision," "blueprint," "livable," "sustainable," "smart growth," "transit-oriented development," etc.*
  - ✓ *Projected the effects of various land use patterns and transportation systems regarding selected indicators.*

- **One was the Sacramento Area Council of Governments (SACOG) "Blueprint" Plan - *adopted in December 2004.***
  - ✓ *It resulted from an extensive three-year public involvement effort.*
  - ✓ *Will guide land use and transportation decisions regionally thru 2050*

Caltrans "Blueprint" Planning Grant Program

- **In 2005, the Caltrans' HQ Transportation Planning Division (DOTP) began providing funding to regional agencies for integrated land use-transportation scenario planning.**
  - ✓ ***From 2005 to 2011, the Caltrans Blueprint Planning Grant Program provided nearly $22 million to a variety of regional agencies.***
- **The Blueprint Planning program has resulted in local and regional plans and projects that increase the efficiency and effectiveness of infrastructure and land use changes.**

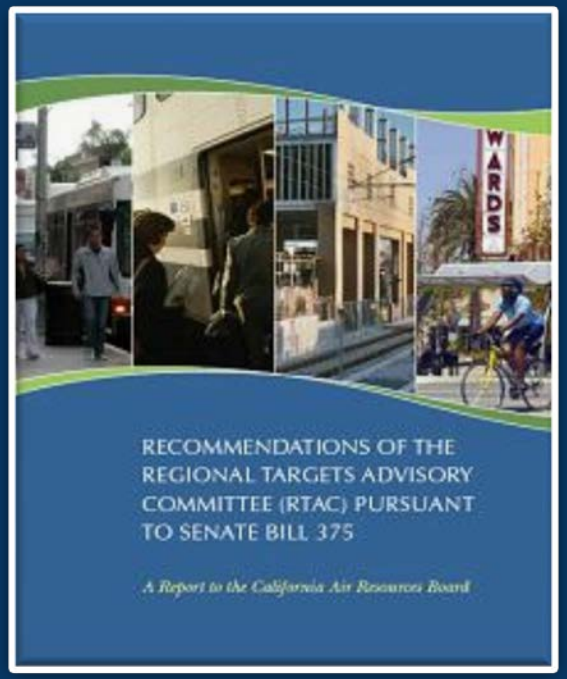
SAN JOAQUIN VALLEY Blueprint Integration

SACRAMENTO REGION Blueprint TRANSPORTATION + LAND USE PLAN

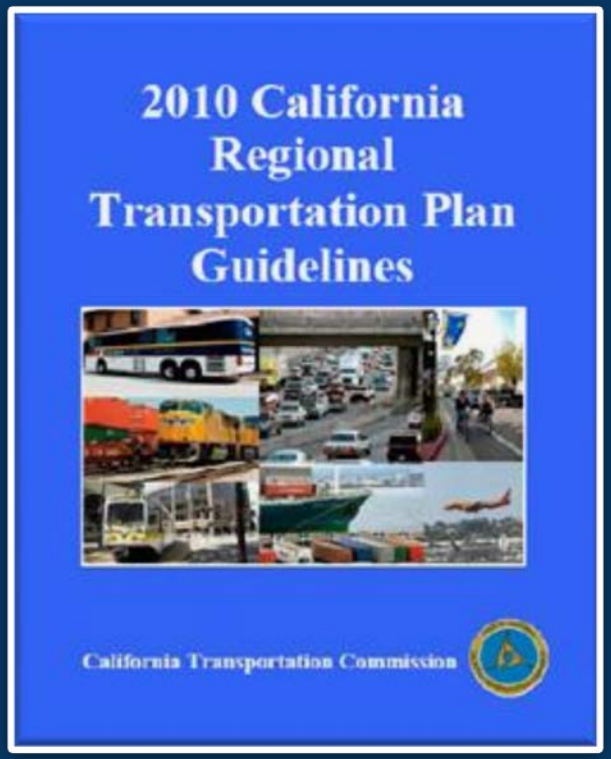
SB 375

- **In 2009, California's *"Sustainable Communities and Climate Protection Act of 2008"* (SB 375) became law.**
  - ✓ ***Its goal is reducing per-capita rates of greenhouse gas (GHG) emissions via integrated land use and transportation planning.***
- **SB 375 requires California MPOs to develop and adopt *"Sustainable Communities Strategies"* (SCS) projected to meet per-capita GHG reduction targets.**
  - ✓ ***The California Air Resources Board (ARB) sets targets for each MPO.***
- **In 2010, the California Transportation Commission (CTC) updated the *"Regional Transportation Planning (RTP) Guidelines"* to address SB 375 implementation.**
  - ✓ ***Recommend using scenario planning tools and travel models capable of assessing land use/transportation relationships.***

Recommendations & Guidelines re: SB 375 implementation



2009 Regional Targets Advisory Committee's Recommendations - to the CARB



<u>2010 RTP Guidelines</u> - California Transportation Commission

<u>Chapter 3</u> re: Tools & Models – ***Recommended the use of soft-ware tools with sensitivity to land use and transportation for SB375 –required scenario planning.***

1.B. Tools & Models used in Land Use-Transportation Planning

- **Effective scenario planning requires estimating the effects of potential alternatives re: <u>selected indicators</u>.**
  - ✓ ***Quantitative or qualitative values used to compare scenarios re: agreed-upon goals, values, or objectives.***
- **Two main types of tools/models often used in integrated land use-transportation planning are:**

i. <u>Scenario Planning/Visioning Tools</u> -

- ***Provide information to meeting participants re: potential effects of their choices, and collect their input.***

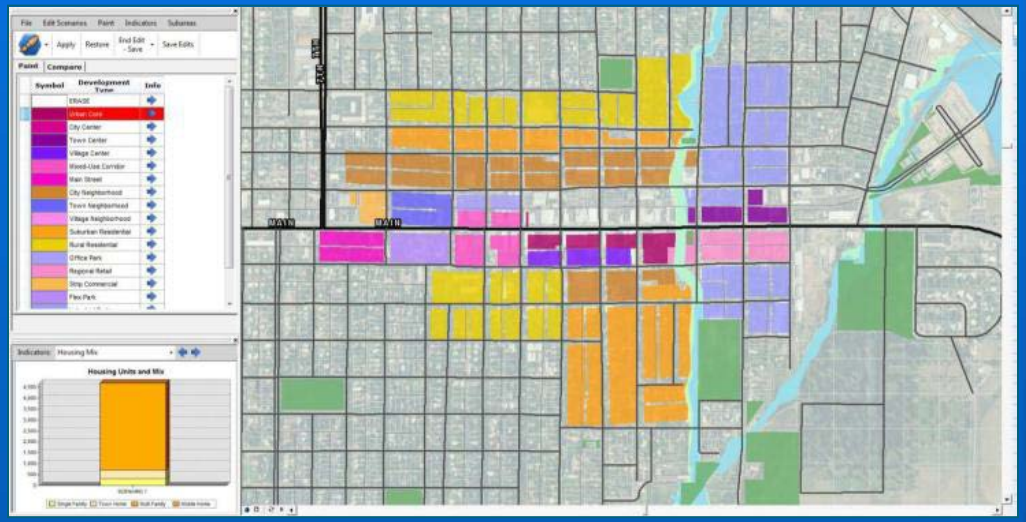
ii. <u>Travel Demand Forecasting Models</u> –

- ***Used to evaluate transportation land use-transportation scenarios regarding selected "performance indicators."***

i. What are Scenario Planning Tools and What Do They Do?

- ***Scenario "Sketch" Planning Tools:****
  - ✓ **Software used in creating various "scenarios."**
  - ✓ **Help gather input during workshops and meetings.**
  - ✓ **Provide information and estimates regarding selected "indicators"** (e.g., VMT, GHG, etc.)

- ***Two Main Types:***
  GIS: ***map-based***
  & Spreadsheet
  (e.g., "Excel")



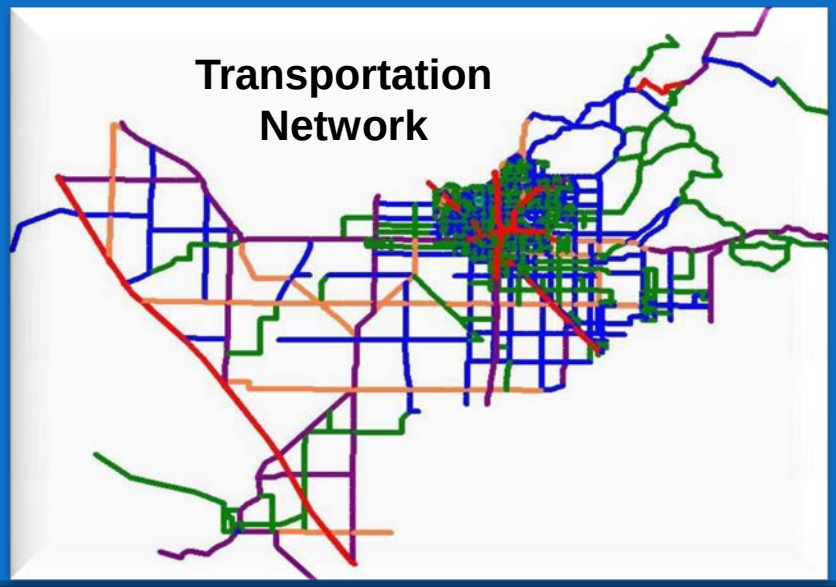
❖ ***More information later in presentation.***

ii. What are Travel Demand Models and What Do They Do?

ii. Travel Demand Forecasting (TDF) Models

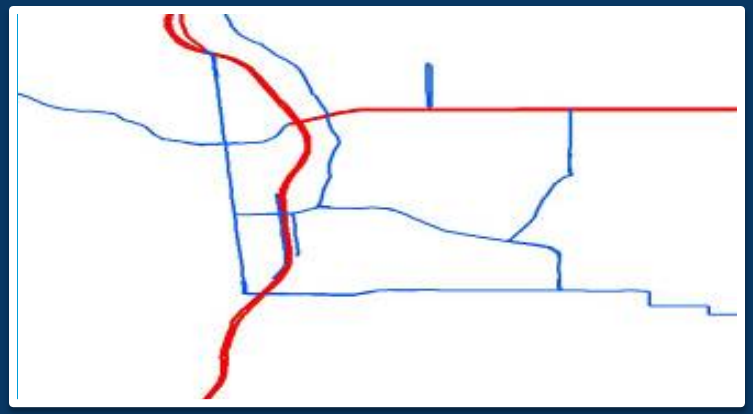
Used to evaluate various land use & transportation scenarios regarding selected "performance indicators."

- ***The Federal Highway Administration (FHWA) requires that agencies use travel demand models to analyze Regional Transportation Plans (RTPs).***

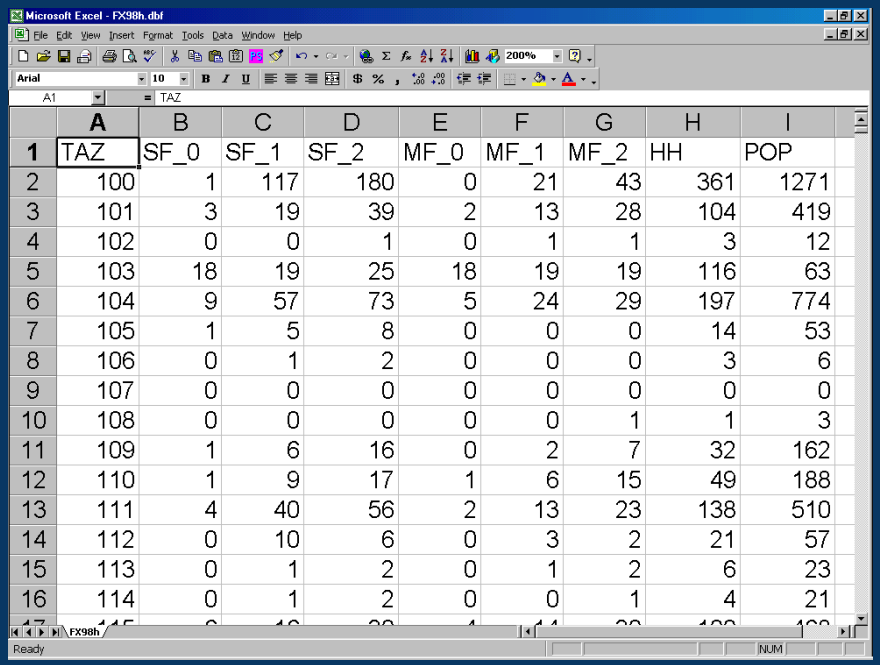


How Do Travel Demand Models *Operate?*

- **Traffic Analysis Zones *(TAZ)***
  - ✓ ***Models' basic geographic unit***
    - **# of Households**
    - **# and types of Employment**
    - **Other Zone Data**



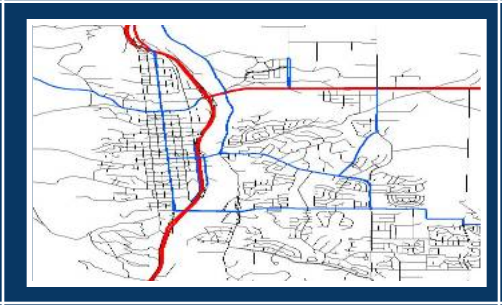
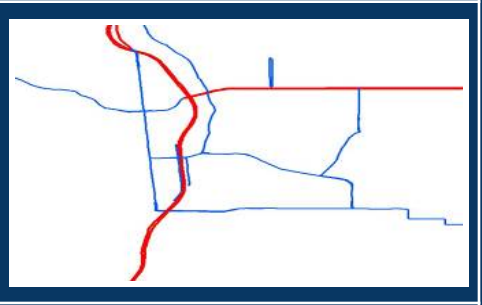
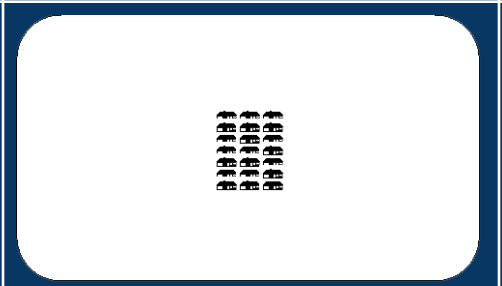
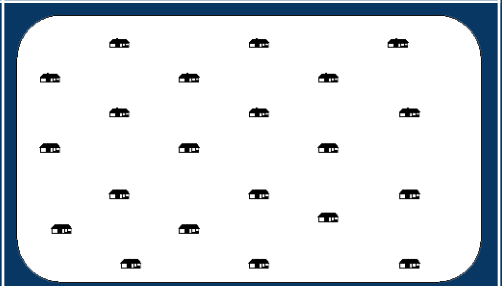
- **4-Step Modeling Process:**
  1. **Trip Generation**
  2. **Trip Distribution**
  3. **Mode Split** *(e.g., driving, transit, walk or bike)*
  4. **Trip Assignment**



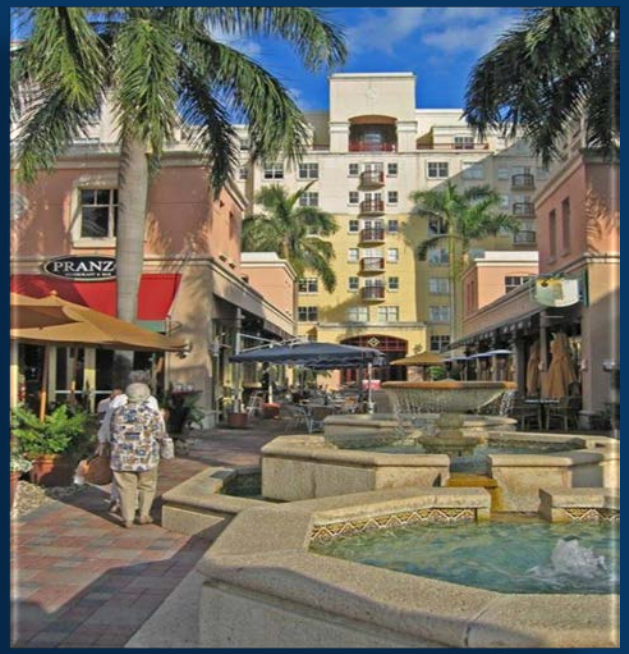
Microsoft Excel - FX98h.dbf

	A	B	C	D	E	F	G	H	I
1	TAZ	SF_0	SF_1	SF_2	MF_0	MF_1	MF_2	HH	POP
2	100	1	117	180	0	21	43	361	1271
3	101	3	19	39	2	13	28	104	419
4	102	0	0	1	0	1	1	3	12
5	103	18	19	25	18	19	19	116	63
6	104	9	57	73	5	24	29	197	774
7	105	1	5	8	0	0	0	14	53
8	106	0	1	2	0	0	0	3	6
9	107	0	0	0	0	0	0	0	0
10	108	0	0	0	0	0	1	1	3
11	109	1	6	16	0	2	7	32	162
12	110	1	9	17	1	6	15	49	188
13	111	4	40	56	2	13	23	138	510
14	112	0	10	6	0	3	2	21	57
15	113	0	1	2	0	1	2	6	23
16	114	0	1	2	0	0	1	4	21

Typical Transportation Model "Blind Spots"

e.g., ***Factors:***	***Reality***	**Model's View**
• **Circulation Network**		
• **Walking Environment**		
• **Density, Clustering**		

Land Use factors that influence travel



"Ds"

Density - *dwellings, jobs per acre*

Diversity - *mix of housing, jobs, retail*

Design - *connectivity, walkability*

Destinations - *regional accessibility*

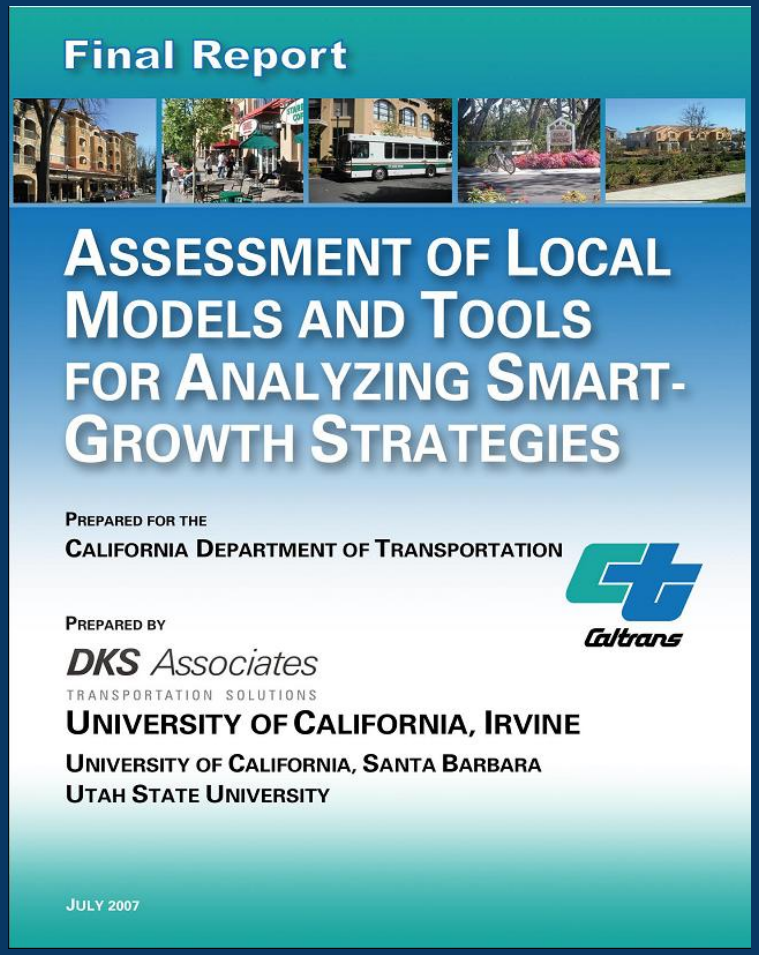
Distance to Transit - *bus, rail station*

Development Scale - *population, jobs*

Demographics - *household size, income, age (etc.)*

2007 Caltrans-funded Study

***Recommended*: Add "Ds" land use sensitivity to scenario planning tools and travel models.**



***Tools*:**

Add "Ds" →

- ***Travel Demand Models***
- ***Scenario Planning Tools – e.g., UPlan, iPLACE3S, etc.***

MPOs' travel model sensitivities to built environment & transportation (SCS)

Major Metro MPOs*	"Macro" Scale		*"Micro" Scale*		
	Location	Mix	Density	Mix	Ped Env
SCAG					
MTC/ABAG					
SANDAG					
SACOG					

** MPOs "self-reported" in 2009.*

Small & Medium MPO Areas:	MACRO-Scale		MICRO-Scale		
	Location	Mix	Density	Mix	Ped Env
FRESNO COG	🟢	🟢	🟡	🟢	🟡
KERN COG	🟢	🟢	🟡	🟡	🟢
AMBAG	🟢	⚫	🔴	🔴	🔴
SJ COG	🟢	🟢	🔴	🔴	🔴
STAN COG	🟢	🟢	🟢	🟢	🔴
TULARE CAG	🟢	🟢	🟢	🟢	🔴
SBCAG	🟢	🟢	🔴	🔴	🔴
SLO COG	🟢	🟢	⚫	⚫	⚫
MERCED CAG	🟢	🟢	🔴	🔴	🔴
BUTTE CAG	🟢	🟢	🔴	🔴	🔴
SHASTA CO. RTPA	🟢	🟢	🟡	🟢	🟡
KING CAG	🟢	🟢	🟡	🟢	🔴
MADERA CTC	🟢	⚫	🔴	🔴	🔴

1C. The Goals of *This* Project

- **In 2009, Caltrans initiated this *"Improved Data and Tools for Integrated Land Use-Transportation Planning in California"* effort *with SACOG and other partners.***
- ***Goal:*** **Obtain and analyze California-specific data and provide results to tools and models used in integrated land use-transportation scenario planning.**
- ***These uses include:***
  - ***Regional "Blueprint" plans.***
  - ***SB375-required "Sustainable Communities Strategies" (SCS)/Regional Transportation Plans.***
  - ***Local Govt. General & Specific Community Plans.***

Project Team

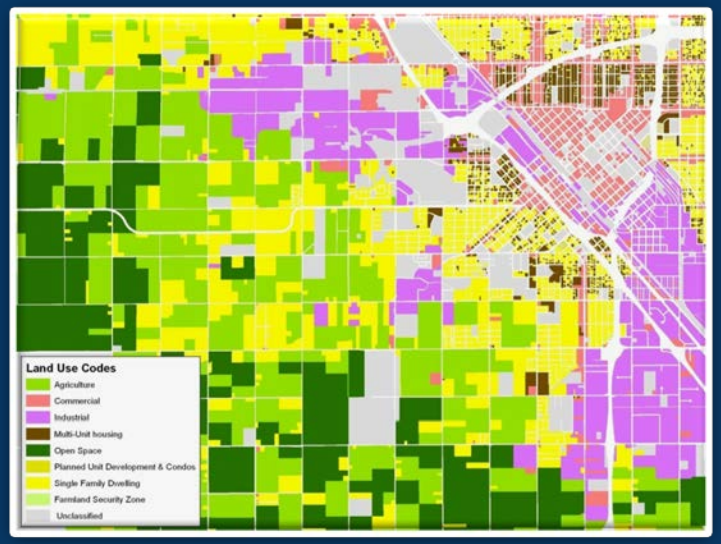
Introductions –

- ***Nathaniel Roth – UC Davis ULTRANS***
- ***Jerry Walters - Fehr & Peers Consultants***
- ***Raef Porter - Sacramento Area Council of Governments (SACOG). Prime Contractor.***

Part 2

A. Data Collection - *Nathaniel Roth, UC Davis ULTRANS*

B. Analysis of Data *and Results* – *Jerry Walters, Fehr & Peers*



Areas of CA Included -- & Why?

- **The project team identified available data throughout California.***
- ***Selected areas that had:***

  (1) **Available GIS land use & travel survey data** ***of sufficient detail & quality;***

  (2) **that was collected during roughly the same time period** ***for each area.***

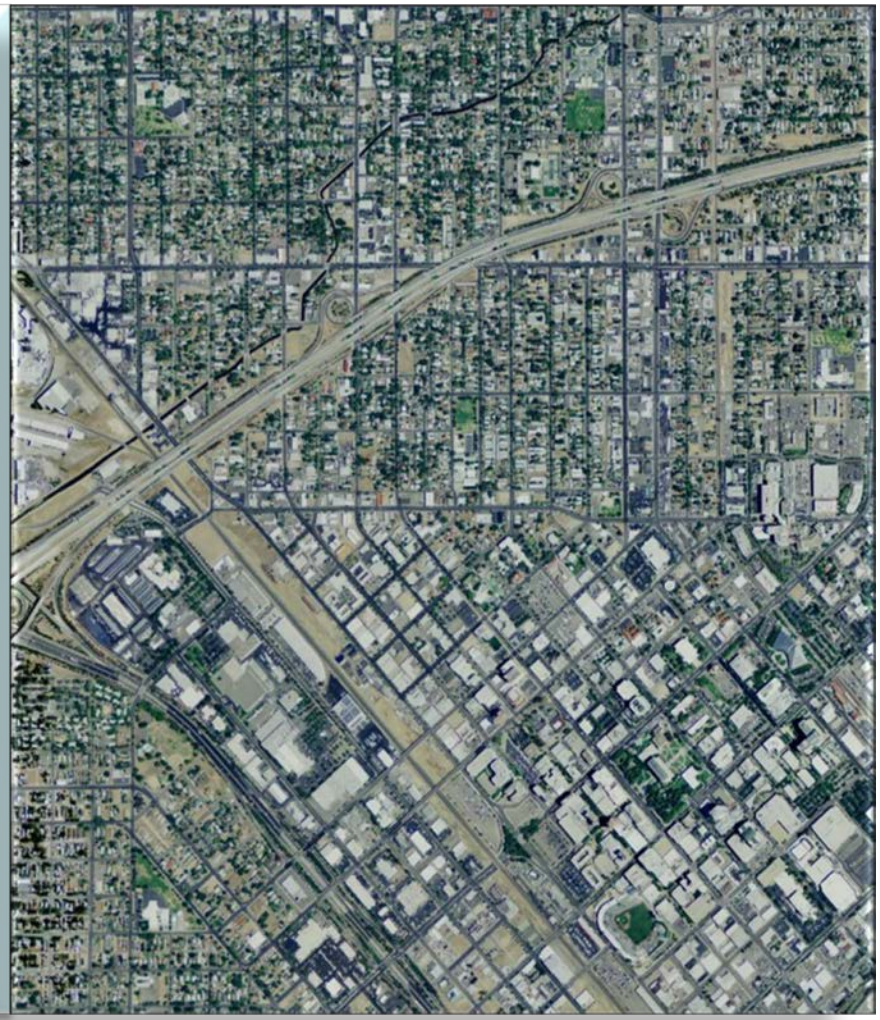
Note: the Southern CA Assoc. of Governments** (SCAG) **conducted a similar effort during the same timeframe.

Selected Areas

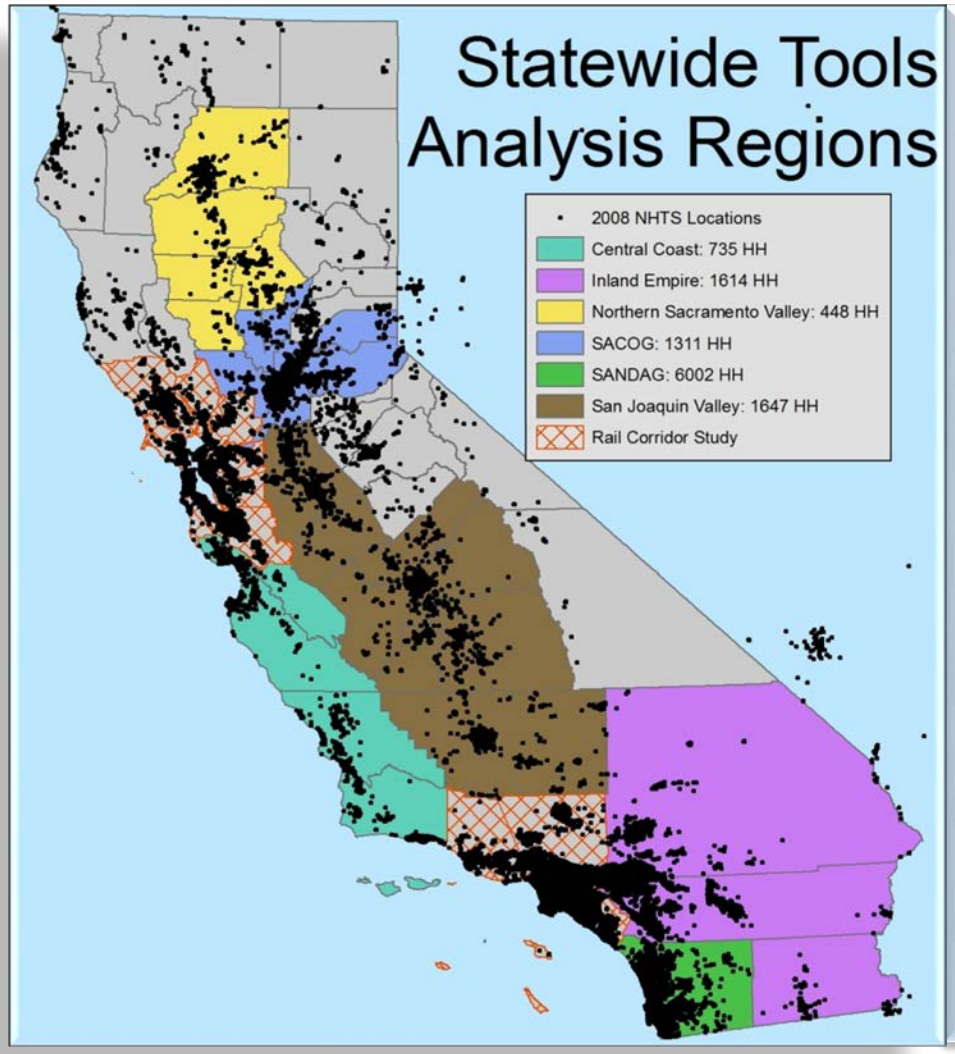
Note: light brown areas were <u>not</u> included in this project.
(A similar study was conducted for Southern CA.)

Travel & Built Environment DATA

1. Travel surveys
2. "Built Environment" data *includes:*
   - *Parcels*
   - *Land Uses*
   - *Roads, Blocks, and Intersections*
   - *Transit Stations*
   - *Etc.*



Travel Survey Data

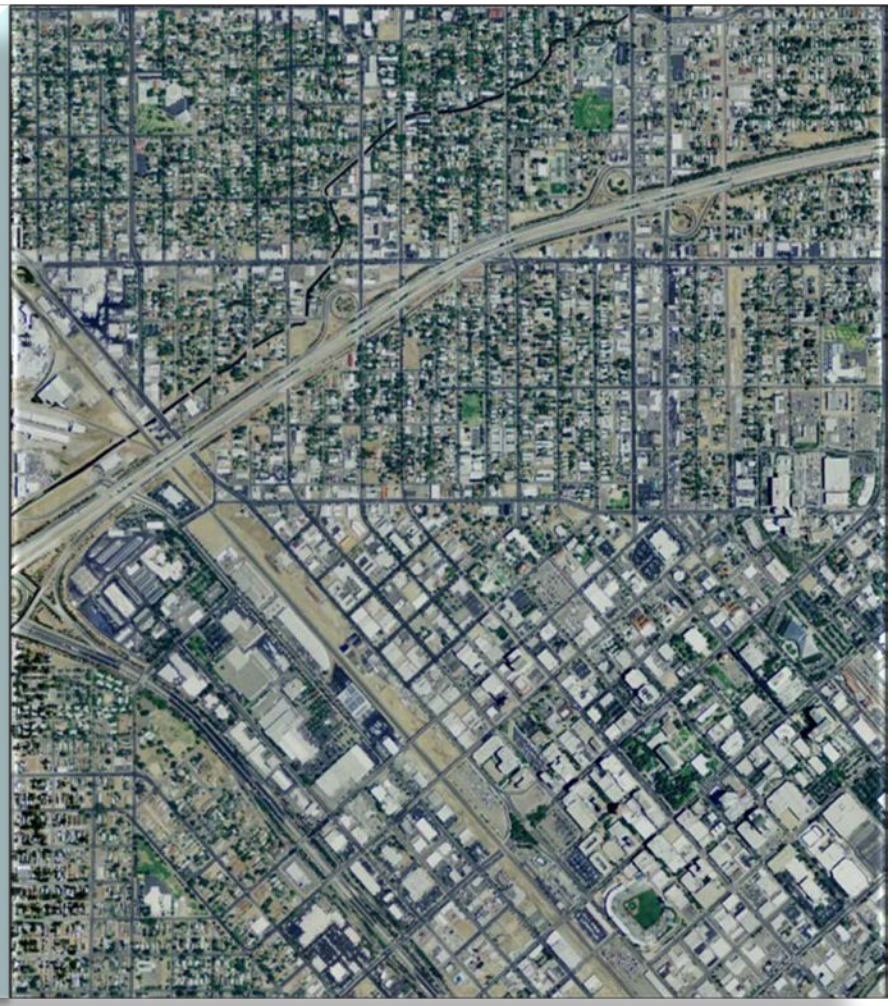


1. **"NHTS"*** Collected in *2008 and 2009*
   - ***California 'Add-on' -*** *funded by Caltrans*
   - ***Used for smaller MPO areas in study & SANDAG.***
2. ***For SACOG and MTC –*** *Used 2000 regional travel survey data.*

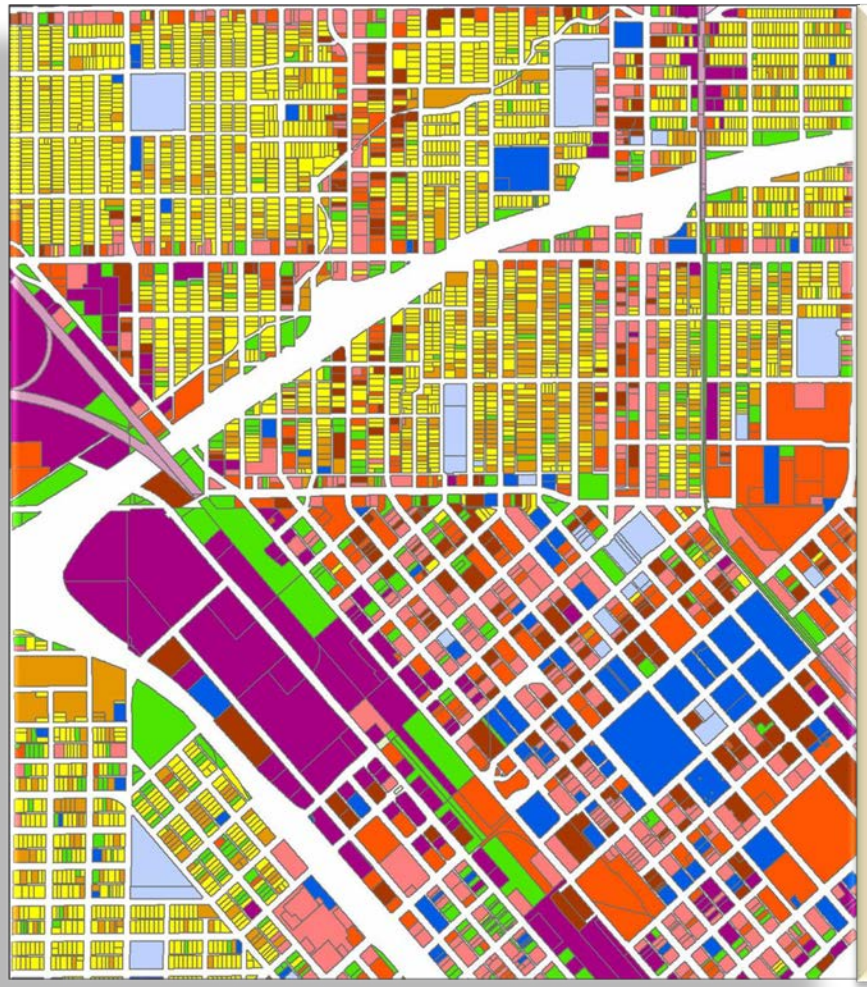
*National Household Travel Survey

Data Collection & Preparation

- Eight "focus" Regions
- Travel survey data
- Land Use data
  - *Parcels*
  - *Land Use*
- Schools/other institutions
- Roads, Blocks & Intersections
- Transit Stops
- Open spaces
- *Summarization*

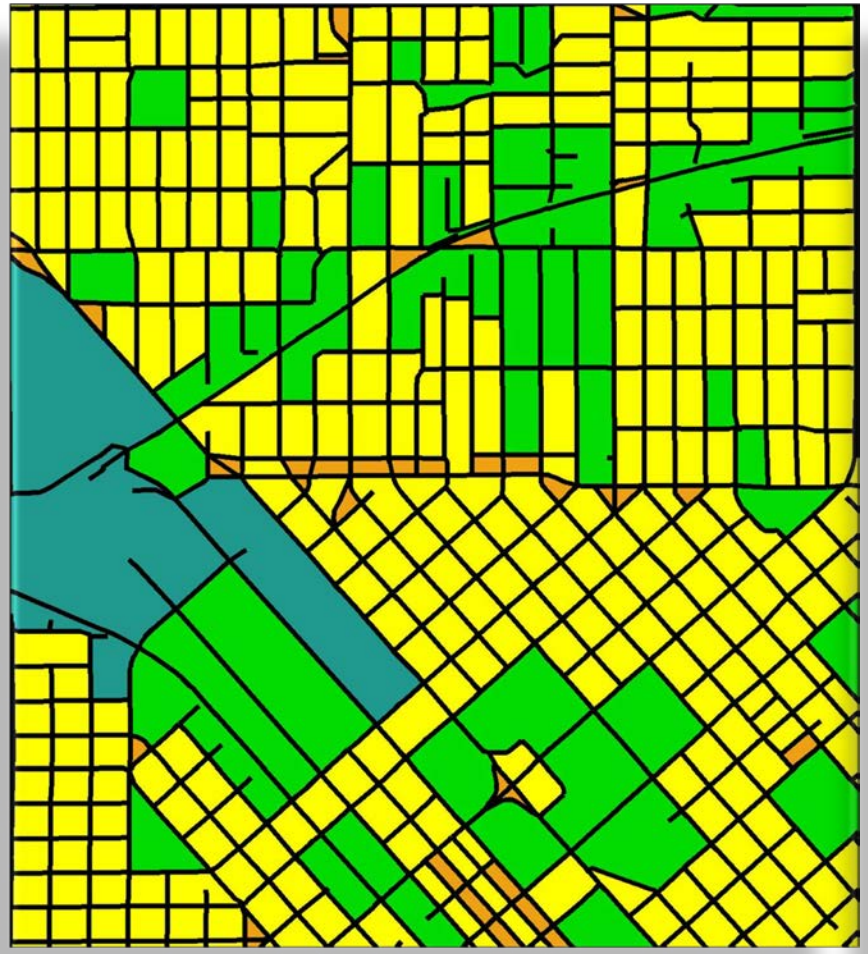


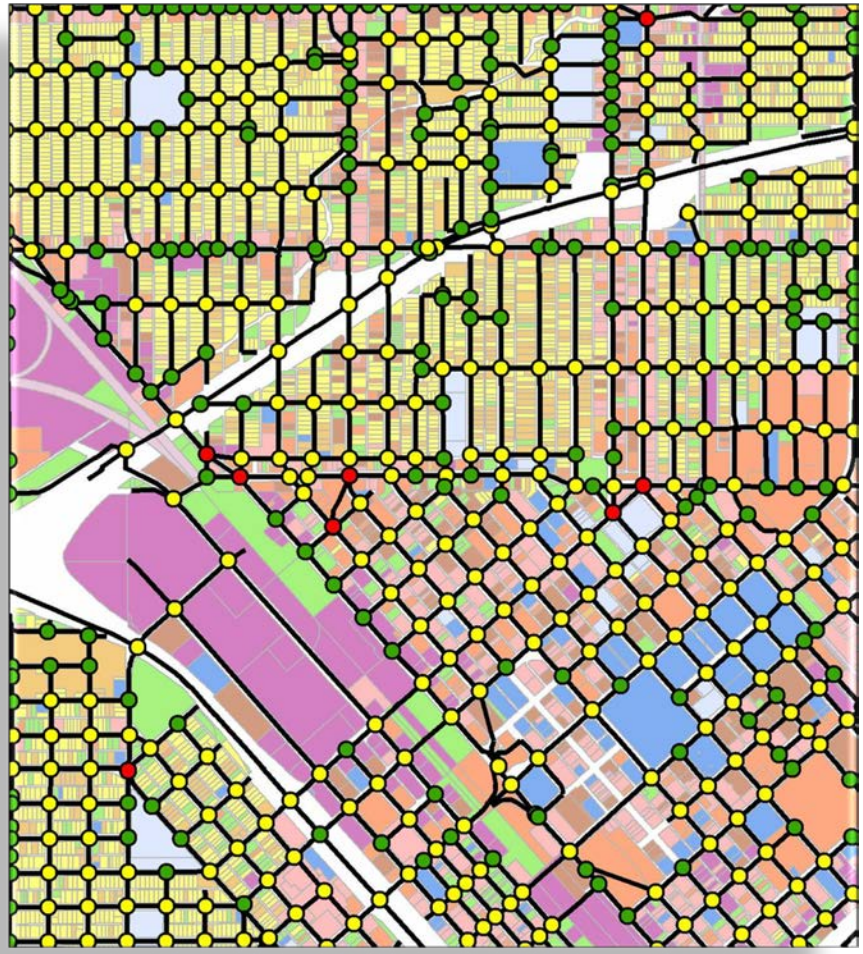
Parcel Data



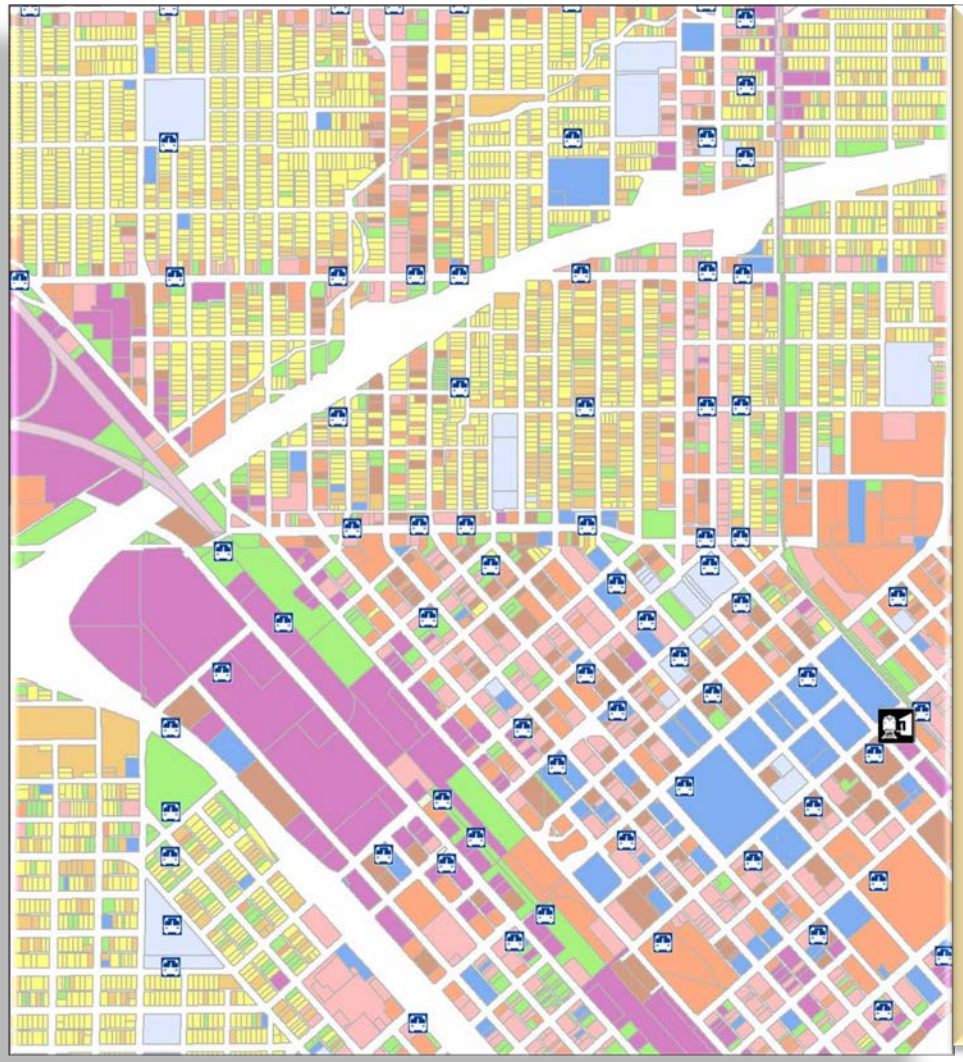
- **Data Issues:**
  - ***Availability***
  - ***Land use coding***
  - ***Quality***
  - ***Geometry***
  - ***Privacy***
- **"Crosswalk" Land Use Codes –**
  - ***for "naming" consistency among jurisdictions***

Roads, Blocks & Intersections



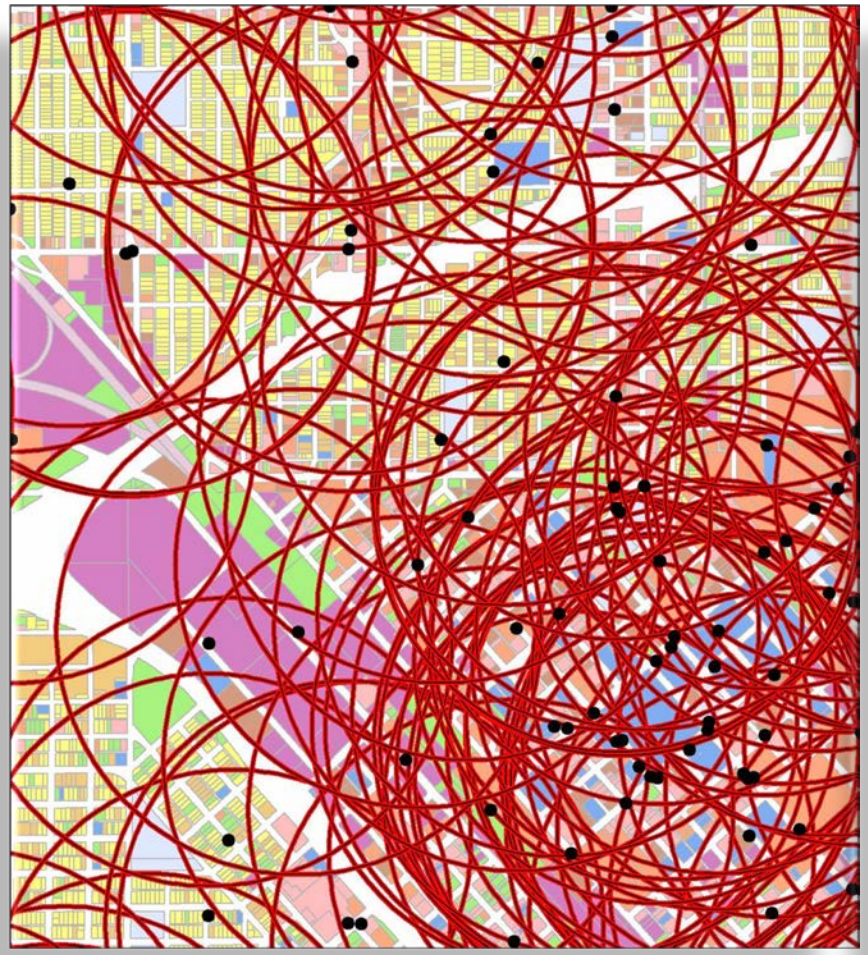


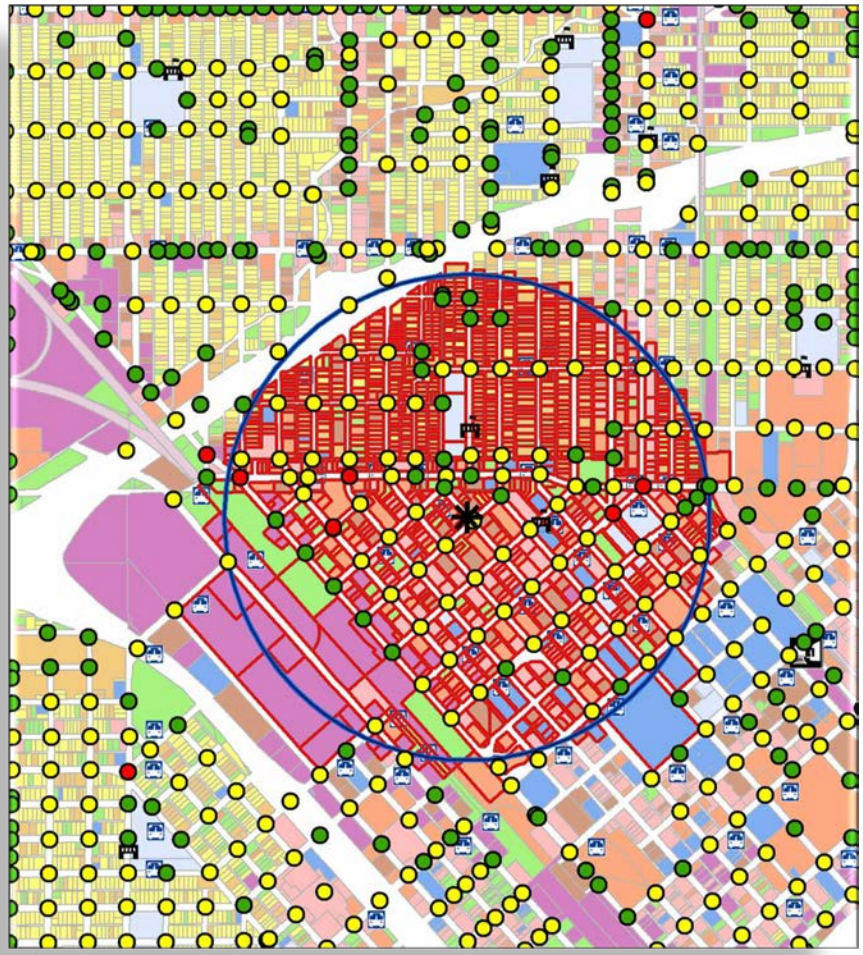
Transit – Bus & Rail



- **Bus Stops**
  - ***All stops*** *(where possible)*
  - ***Timed stops*** *(where available)*
- **Passenger Rail Stations:**
  - ***Amtrak, BART, Metrolink; light-rail systems; etc.***

Data compiled for *1/2-mile areas surrounding >200,000 travel survey "trip ends"!*





2B. Analysis of Data & Results

Jerry Walters, Principal – Fehr & Peers Consultants

5(O)	Townhouse (Owner)	
5(R)	Townhouse (Rental)	
6(O)	Low-Rise Condos (Owner)	
6(R)	Low-Rise Apartments (Rental)	
7(O)	Mid-Rise Condos (Owner)	
7(R)	Mid-Rise Apartments (Rental)	

2B. Data Analyses & Results

PRODUCED: ***"Ds Analysis Modules"***

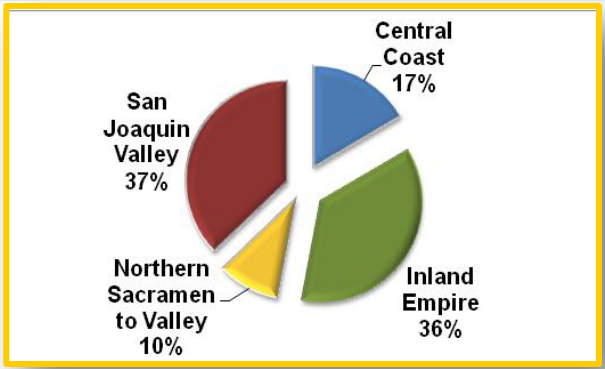
- **Equations** representing quantitative relationships between various "built environments" and travel patterns.

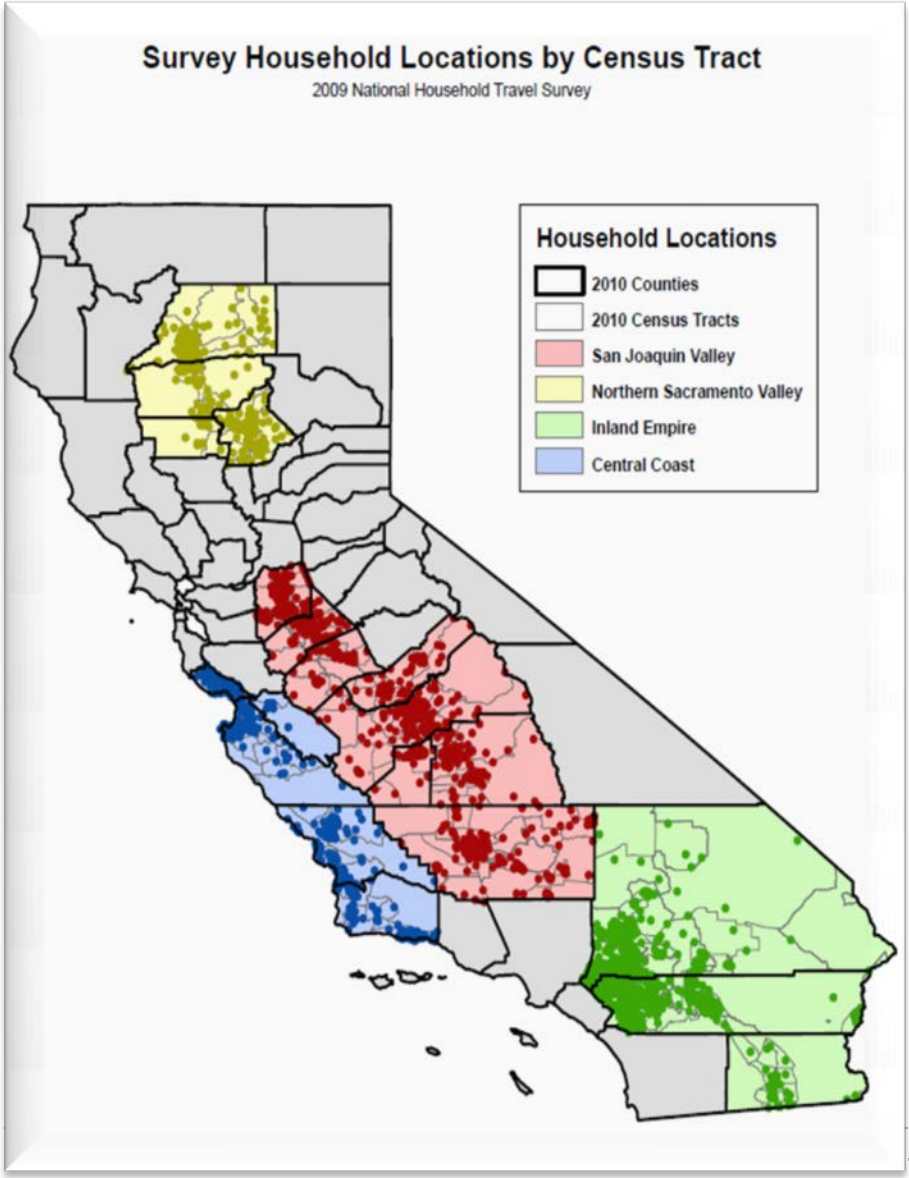
- **Modules for 3 types of regions:**
  - *i. Small/medium-sized MPOs*
  - *ii. Larger metro MPOs: SACOG & SANDAG*
  - *iii. S.F. Bay Area rail station areas*

- ***Modules can be used within existing scenario planning tools, and can also be customized to travel demand models.***

i. Ds Modules - 2009 NHTS Survey Data

County	Households
Monterey County	167
San Benito County	16
San Luis Obispo County	173
Santa Barbara County	201
Santa Cruz County	178
Imperial County	48
Riverside County	802
San Bernardino County	764
Butte County	185
Glenn County	17
Shasta County	176
Tehama County	61
Fresno County	381
Kern County	309
Kings County	63
Madera County	64
Merced County	89
San Joaquin County	306
Stanislaus County	262
Tulare County	173
TOTAL HOUSEHOLDS:	**4,435**





ii. 2-Step "Ds Module" for the Sacramento region (SACOG)

	VT Probability	VMT
Density		
Residential Dwelling Unit Density	⊖	⊖ ⊖
Diversity		⊖
Household/Employment Ratio		
Design		⊖ ⊖
Intersection Density		
Destinations		⊖ ⊖ ⊖
Destination Accessibility		

3-Step "Ds Module" for San Diego region

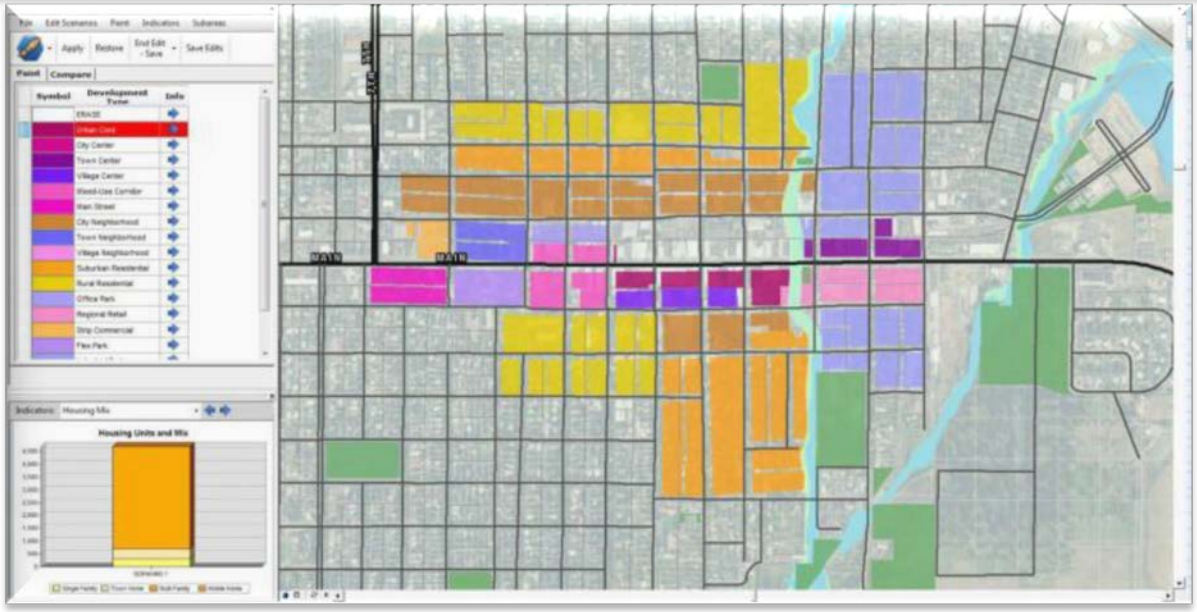
	HH Vehicle Trip Probability	HH Vehicle Trip Generation	Vehicle Trip Length
Density			
Home-End Residential Dwelling Unit Density	⊖	⊖	
Home-End Employment Density			⊖
Diversity			⊖ ⊖
Home-End Household/ School Employment Ratio	⊖	⊖	
Non-Home-End Retail/Non-Retail Employment Diversity Score			⊖
Non-Home-End Household/ Employment Diversity Score			⊖ ⊖ ⊖
Non-Home-End Household/ School Employment Ratio			⊖
Design			⊖ ⊖
Home-End Intersection Density			⊖
Home-End Walkability Score			⊖ ⊖ ⊖
Non-Home-End Roadway Density			
Non-Home-End Walkability Score			⊖
Destination Accessibility			⊖ ⊖ ⊖
Home-End Destination Accessibility			
Distance to Transit			⊕
Home-End Distance to Transit Stop			
Demand Management (Parking)			⊕
Non-Home-End Parking Charges			

iii. Rail Station Areas "Ds Module" - S.F. Bay Area

SAN FRANCISCO BAY AREA			
Variables		**Household Vehicle Trip Generation Model**	**Household Vehicle Miles Traveled Model**
Demographics	Household Size	+++	+++
	Low Income Household	-	-
	Owner-Occupied Household?	+	--
	Zero Vehicle Household?	--	
	# of HH Vehicles		+++
	Multi-Family Dwelling	-	
Density	Activity Density at Home End (Pop. + Jobs / Acre)	-	--
Diversity	Households/ Employment Diversity at Home End		-
Design	Intersection Density at Non-Home End		
Destinations	Destinations Accessibility by Auto	+	
	Destinations Accessibility by Transit	-	
	Ratio of Auto Accessibility / Transit Accessibility		++
Distance to Transit	Trains per day at nearest station	-	
	Distance to rail Transit from household	+	+

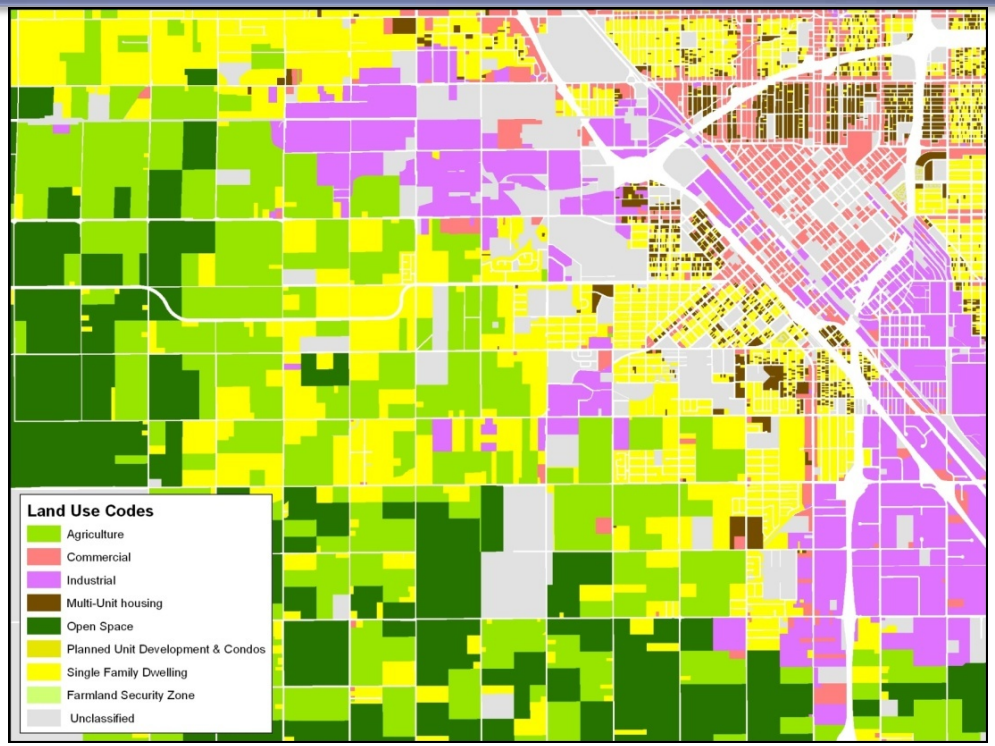
Part 3: Application of Results

- **A. in *GIS Planning Tools*:**
  - *Nathaniel Roth, UCD ULTRANS*
- **B. *VMT Estimation Spreadsheet Tool*:**
  - *Raef Porter, SACOG*



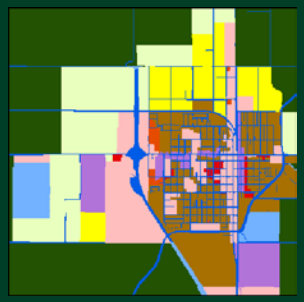
3A. GIS scenario planning tools

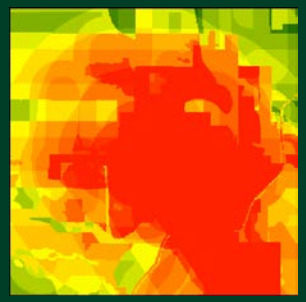
- This project incorporated "Ds" into:
  - ✓ *UCD's "UPlan" & SACOG'S "iPLACE3S" tools*
- May also be used in other GIS tools
  - ✓ *e.g., Envision Tomorrow, Urban Footprint, etc.*



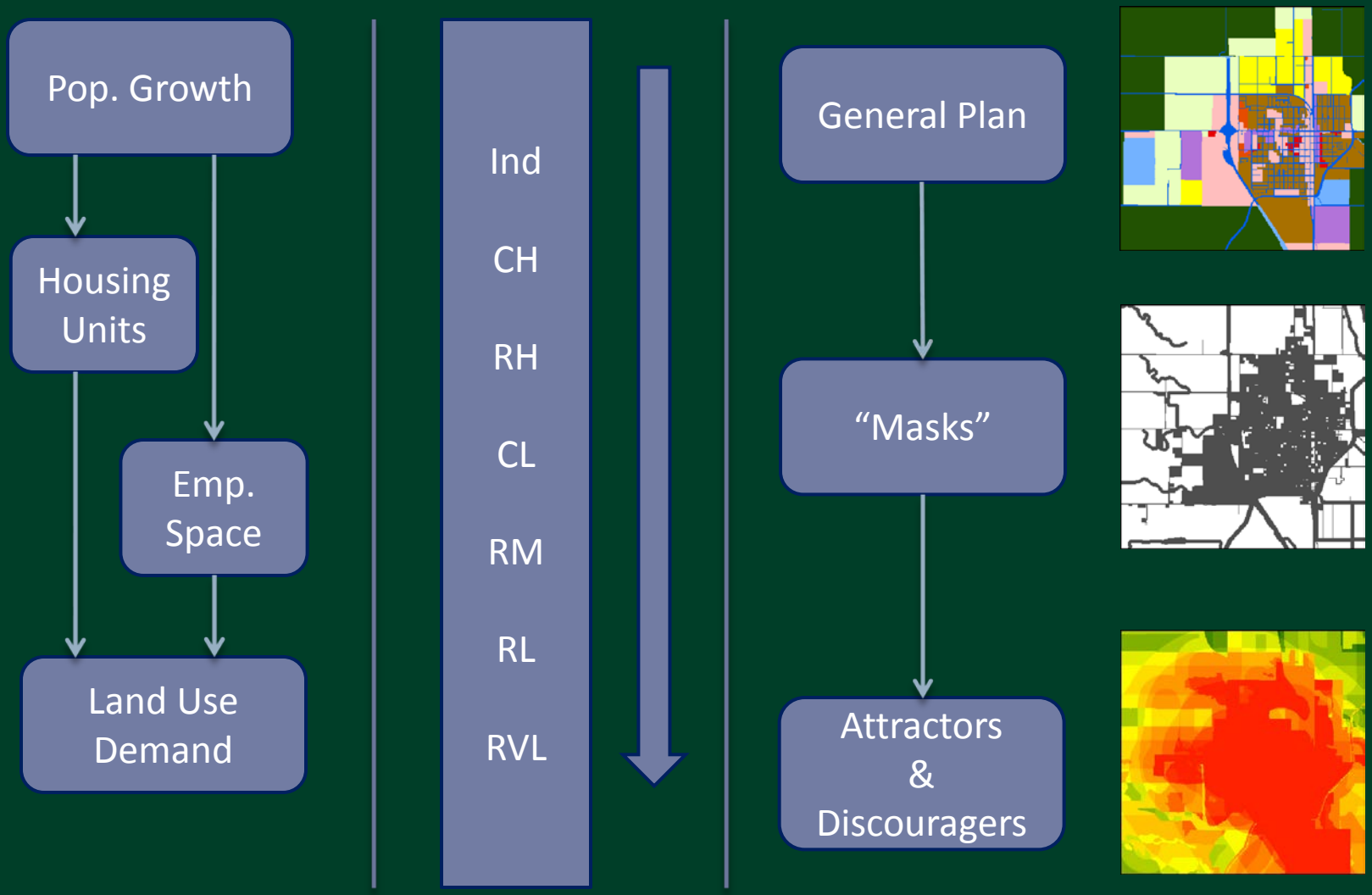
Scenario Planning

- To address **uncertainty**
  - *Through evaluating a range of scenarios*
  - *Recognize that the future is uncertain*
- Public involvement
  - *Early engagement*
  - *Active outreach to various communities*
  - *Shared vision*
- Analysis and comparison of alternatives
  - *Quantitative*
  - *Qualitative*





"UPlan" *GIS Scenario Planning Tool*



“Python” Modules

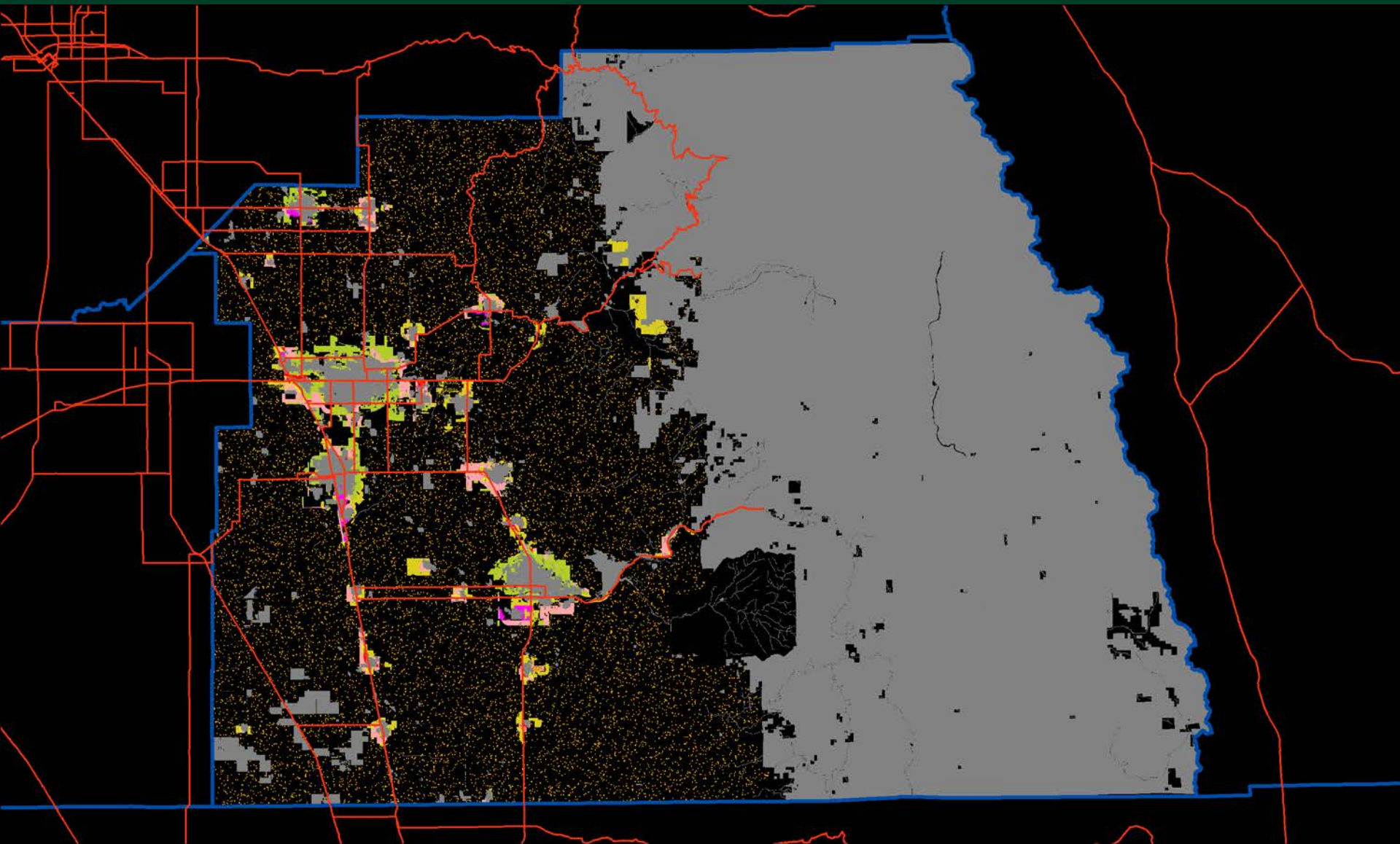
The Important Part:

- Makes the “Ds” modules produced by this project available for use in GIS scenario planning tools.
- Building block for other computer programs to use.

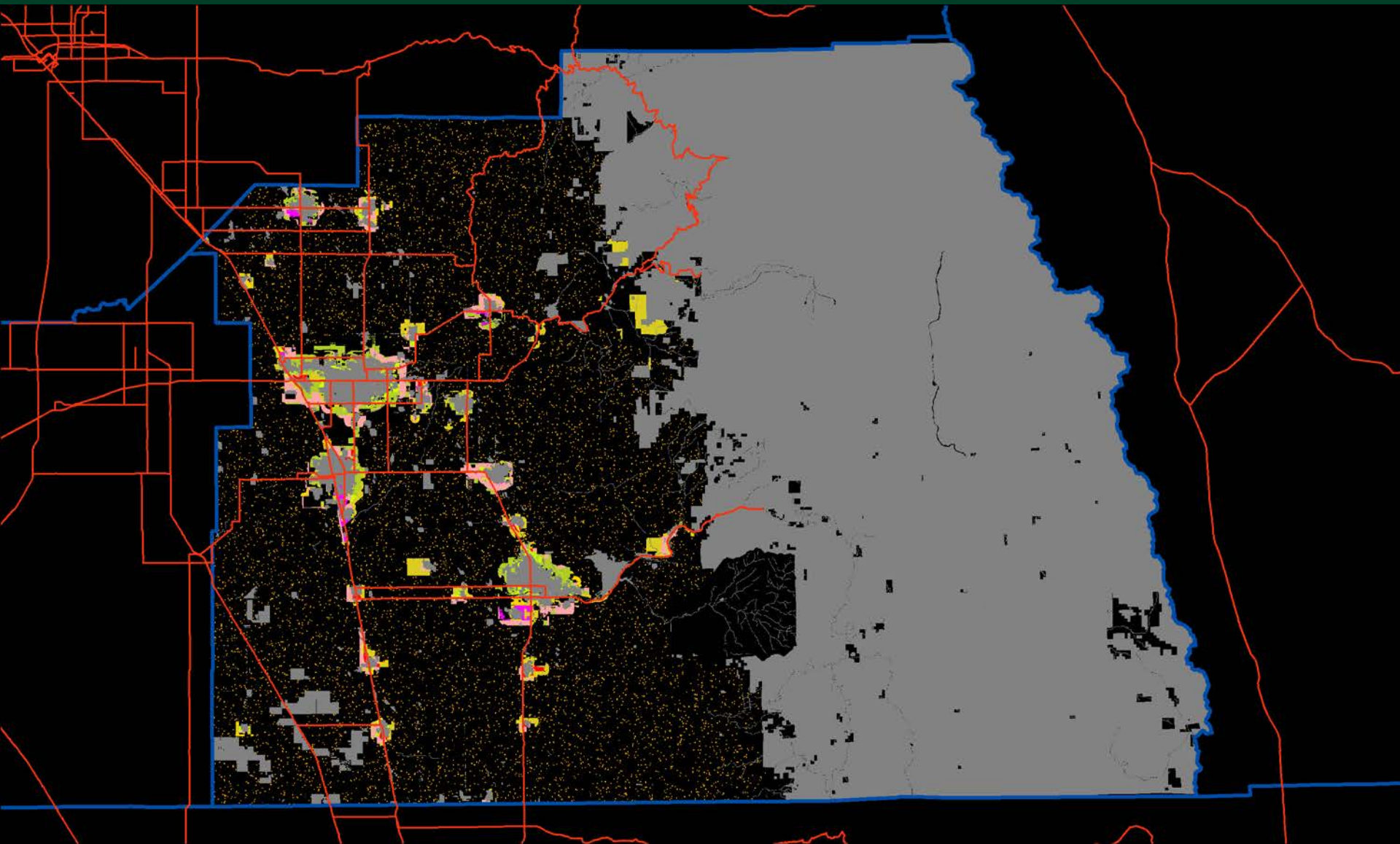
Technical Details:

- Written in the “open source” programming language *“Python”*
- It’s a calculator:
  - *The user prepares the data*
  - *Hands it to the module*
  - *Tells it to run the calculations*
  - *Is handed the results*

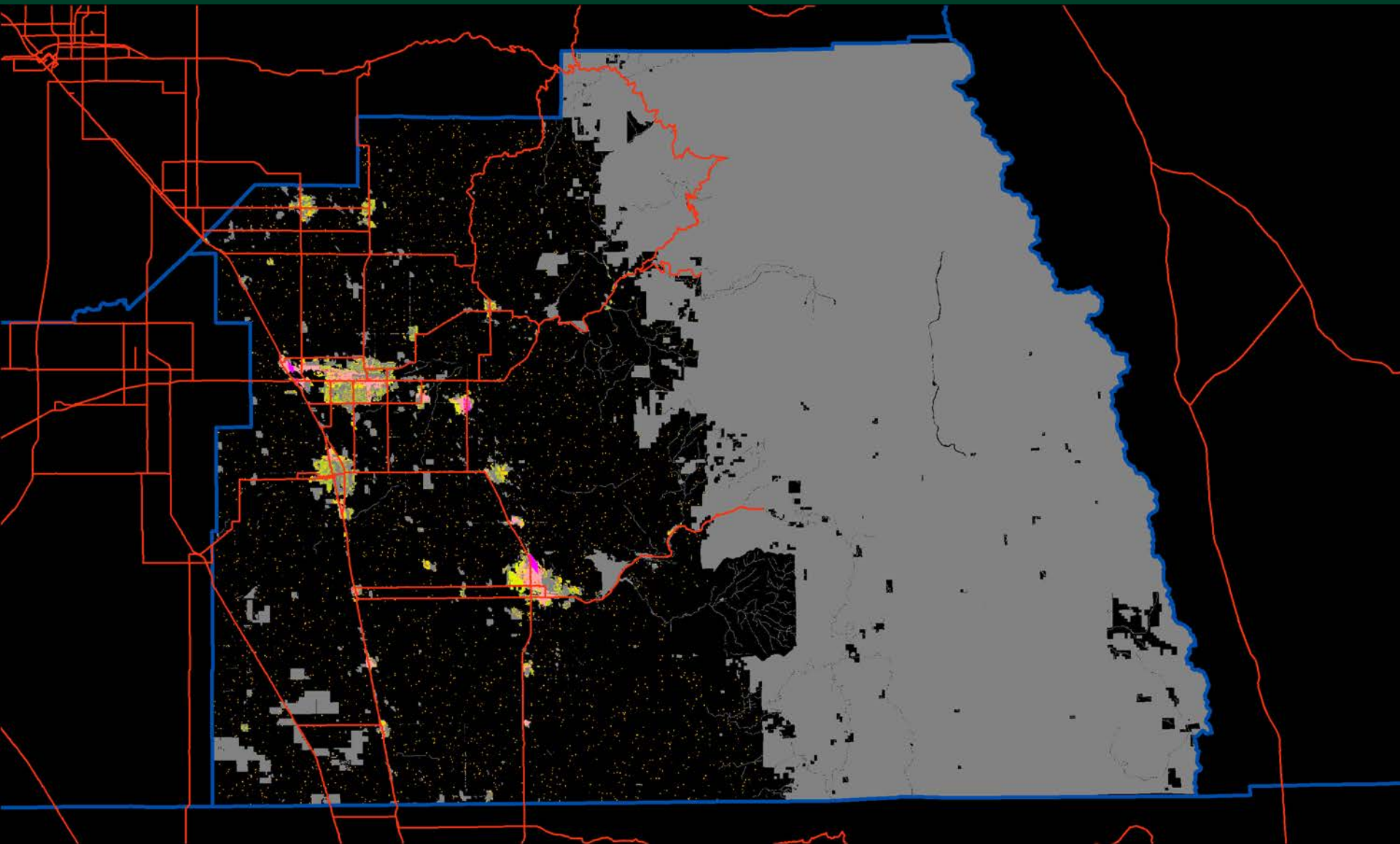
“Base Line” *Scenario*



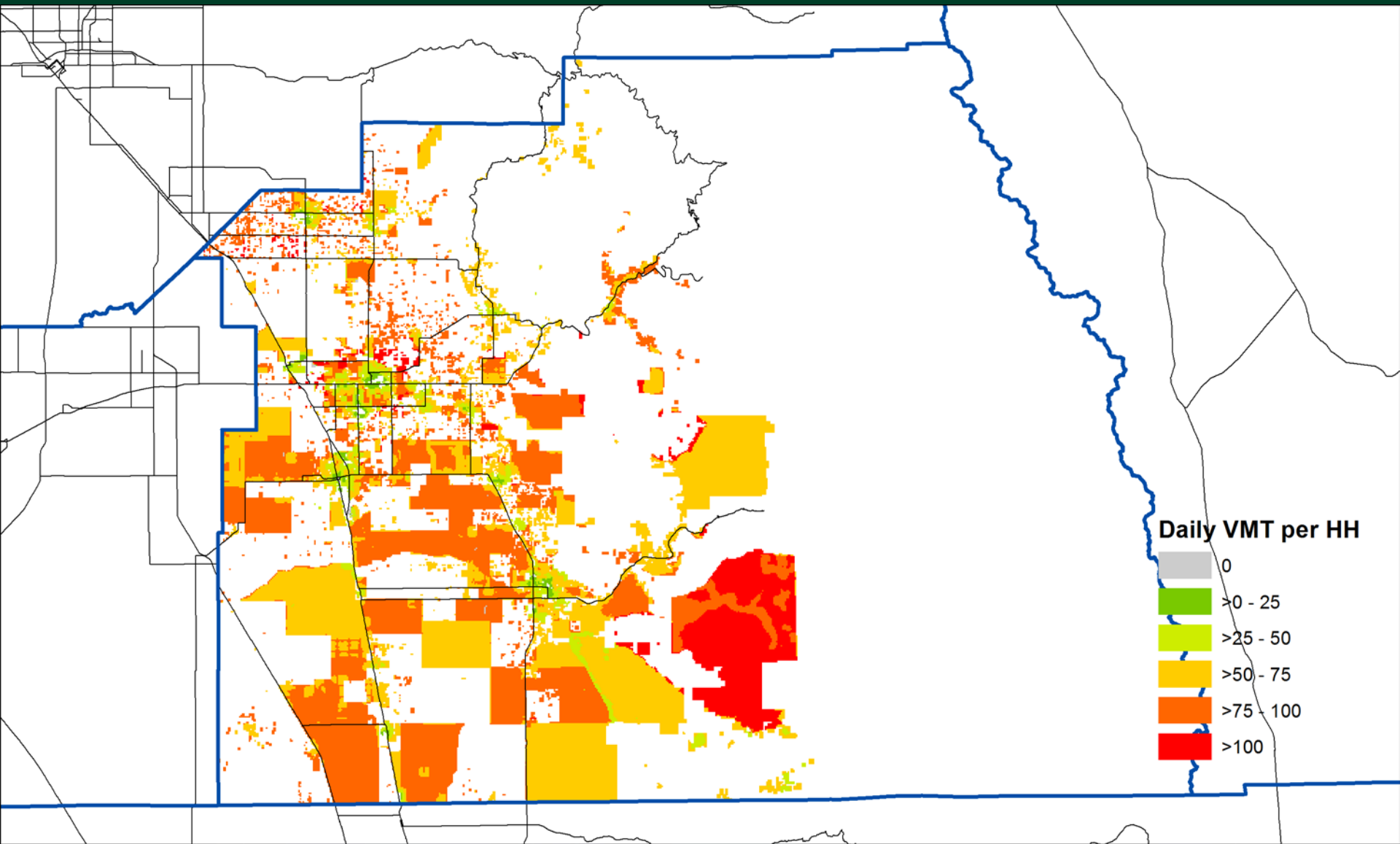
“Smart Growth” *Scenario*



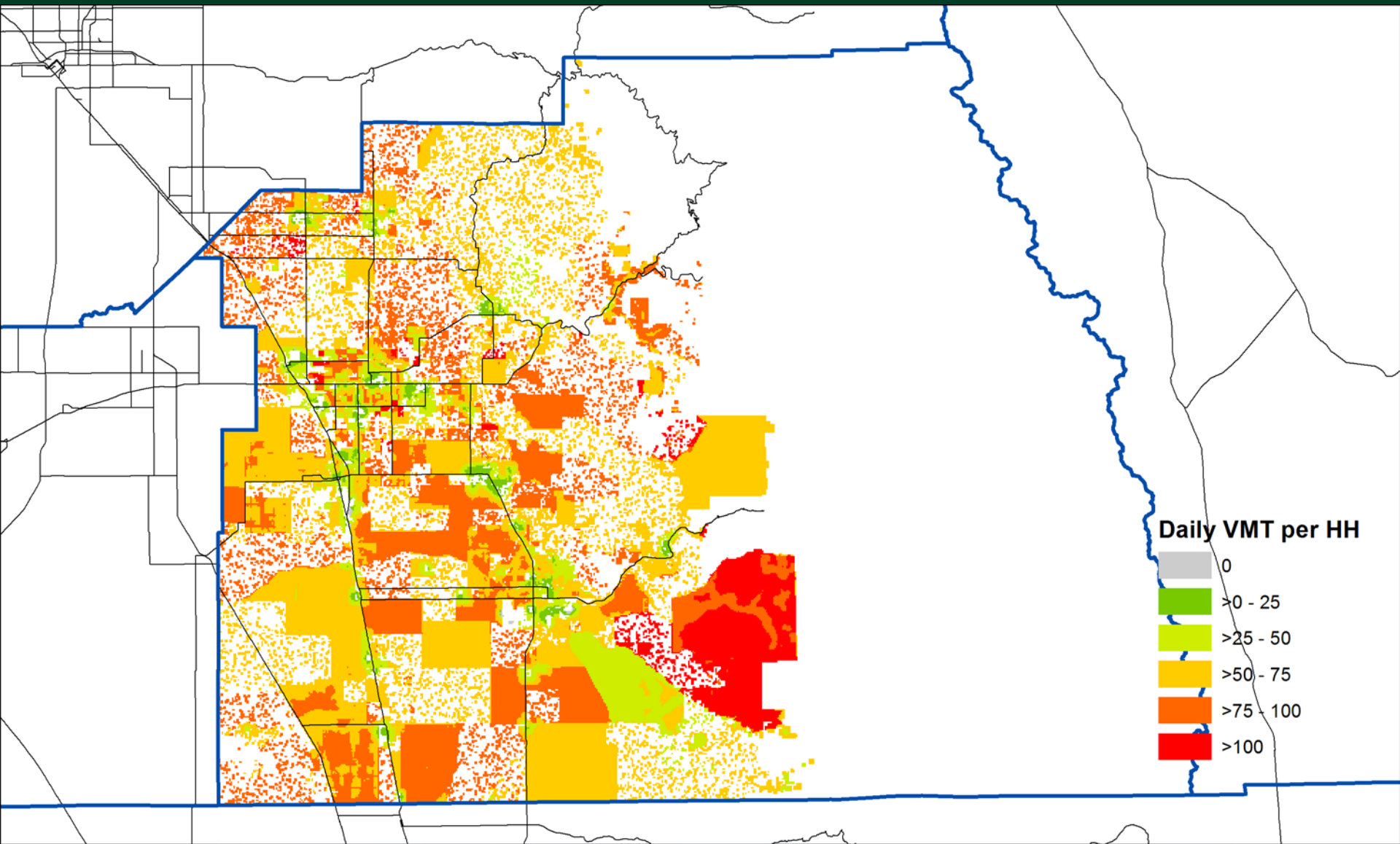
“Infill & Redevelopment” *Scenario*



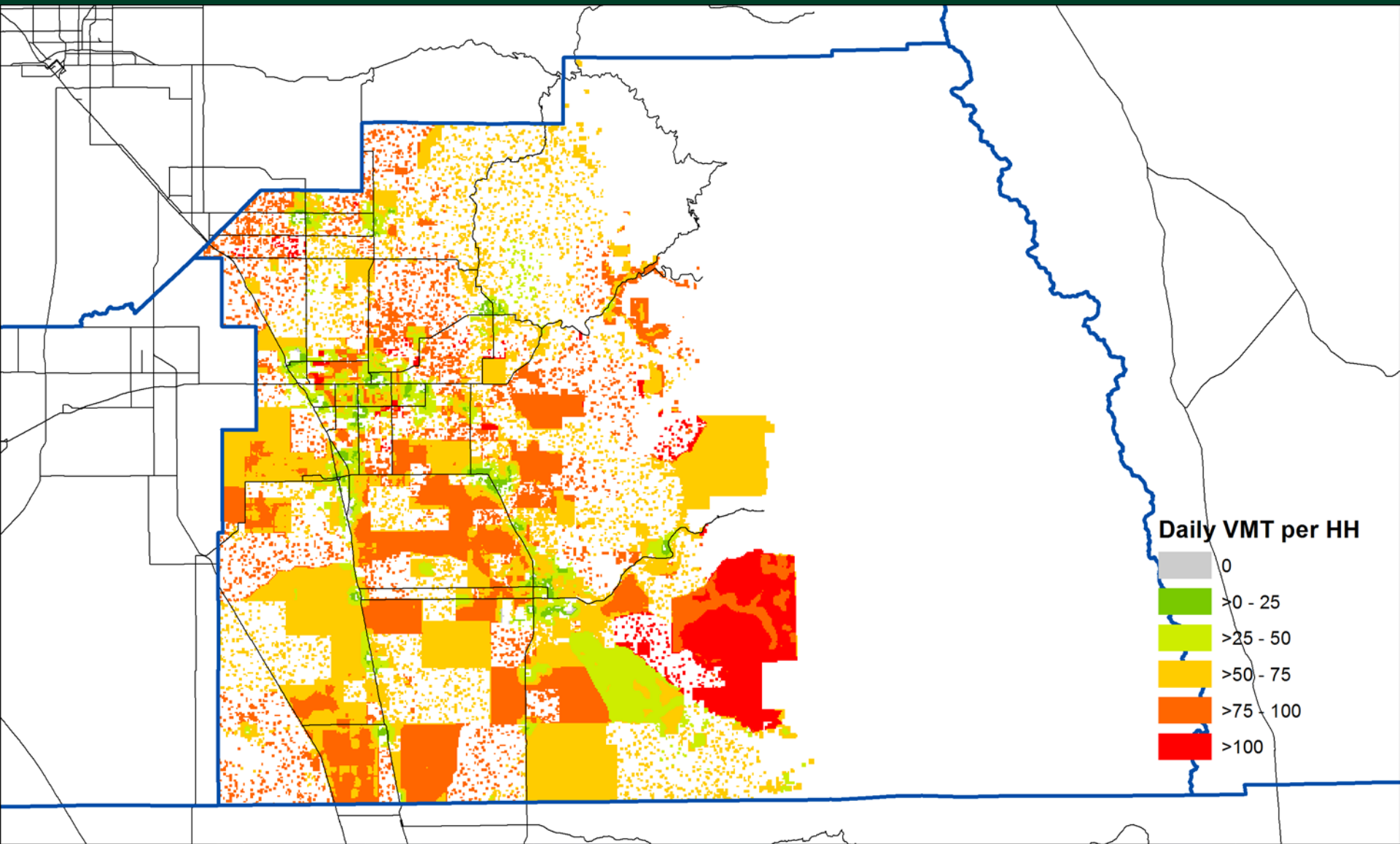
Indicator: Existing av. VMT per Household



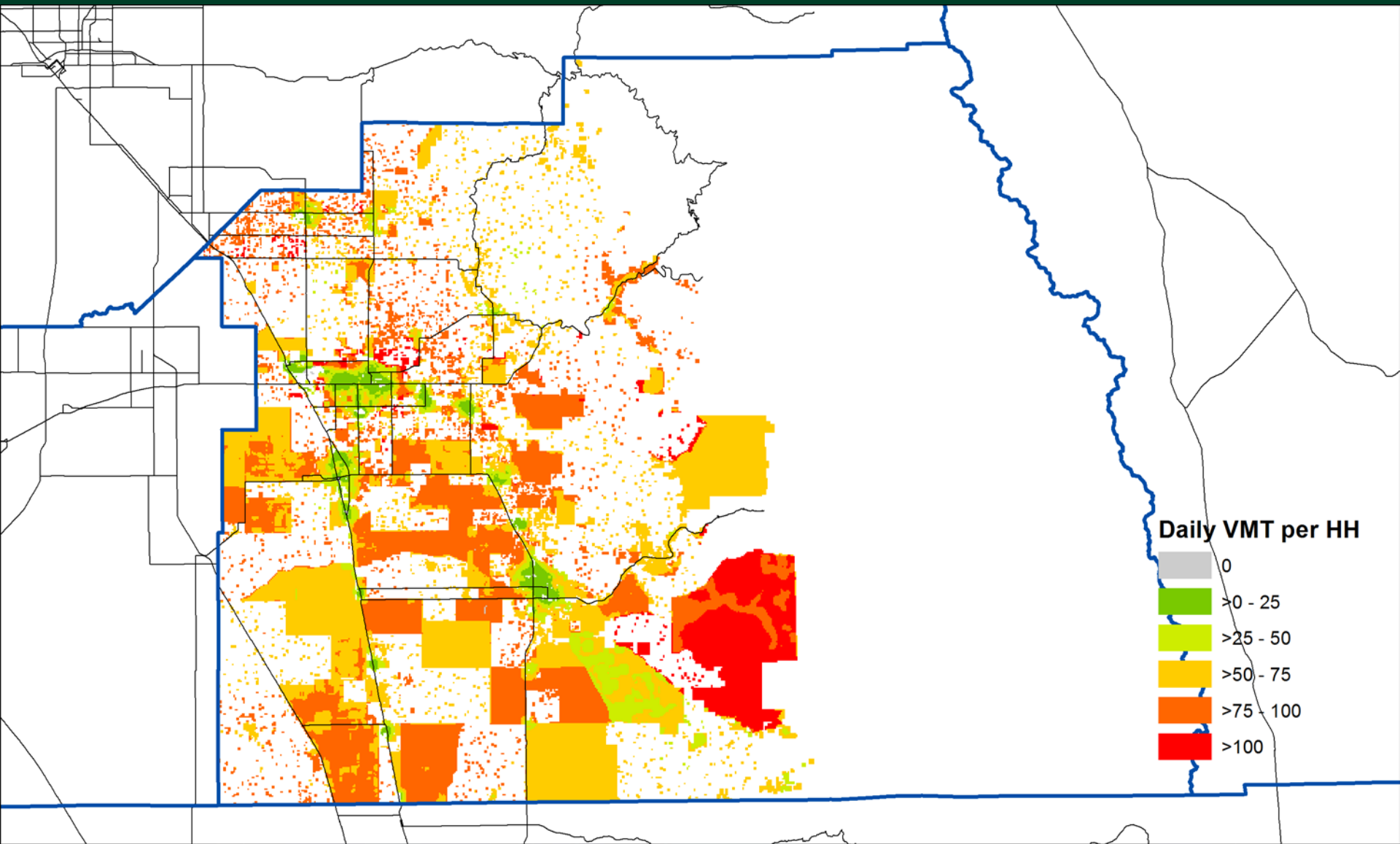
“Base Line” Scenario: *VMT per Household*



“Smart Growth” Scenario: *VMT per Household*



"Infill & Redevelopment" *VMT per Household*



" Bringing the Message Home"

ESTIMATES re: SELECTED INDICATORS *(travel modeling is still needed)*

Scenario:	Vehicle Miles Traveled	Household Count	Average daily VMT per Household	Percent difference from current conditions
Current	7,117,036	125,997	56.5	0
"Base case"	16,738,000	313,622	53.4	-5.5
"Smart Growth"	16,583,883	313,892	52.8	-6.5
"Intensive Infill"	12,776,831	313,829	40.7	-27.9

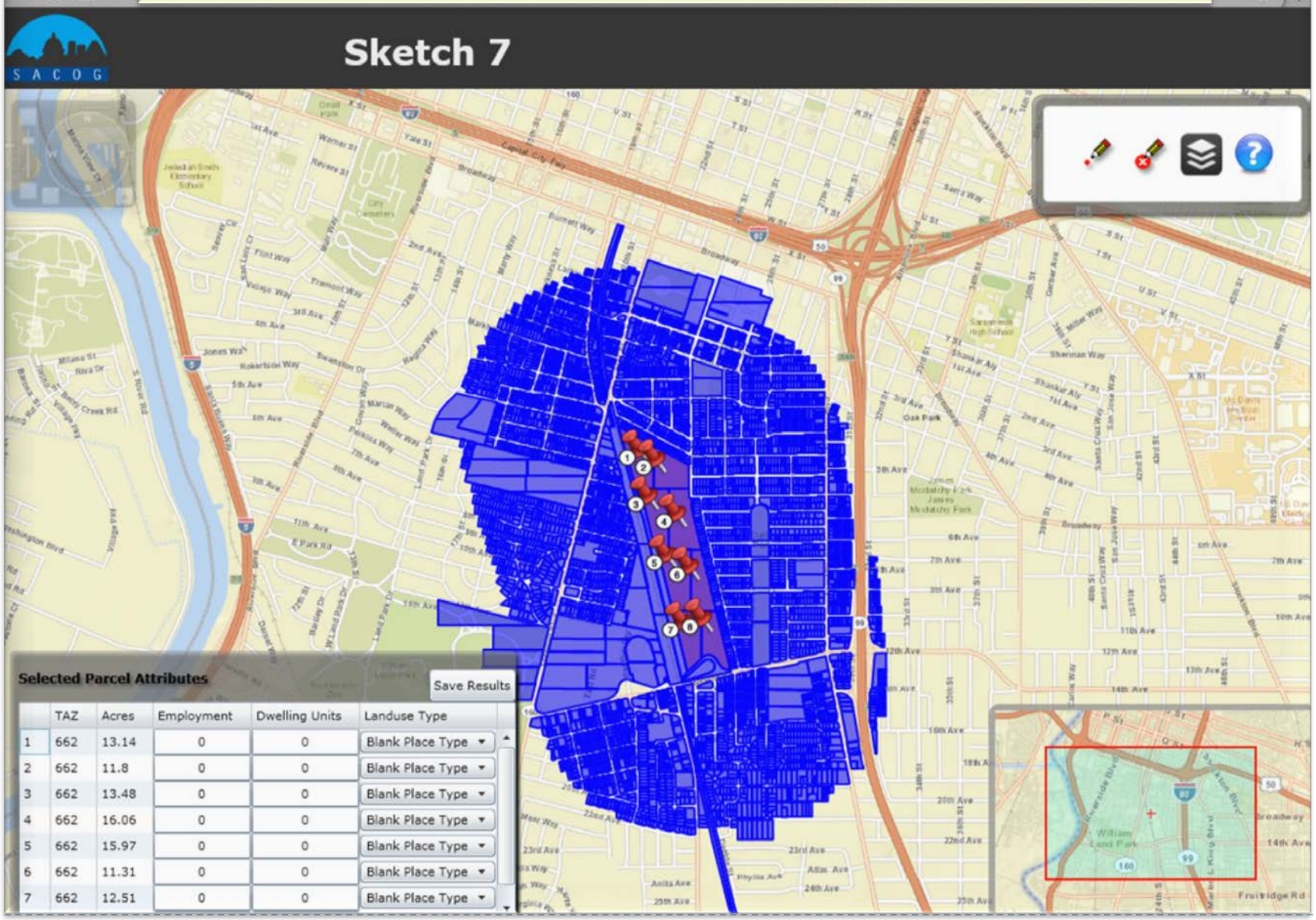
TAZ	Current VMT/HH	Baseline Scenario	% Change	Smart Scenario	% Change	Infill Scenario	% Change
392	41.4	35.6	-13.9	35.4	-14.5	28.0	-32.3
813	71.3	48.6	-31.9	50.0	-29.9	31.2	-56.2
1060	17.0	17.0	0.0	17.0	0.0	14.8	-12.9
1146	76.9	74.3	-3.4	76.0	-1.2	76.9	0.0
1293	74.5	74.5	0.0	74.5	0.0	24.5	-67.0
1350	18.9	19.0	0.4	19.4	2.5	3.2	-83.1
1875	73.0	54.2	-25.7	65.6	-10.2	72.1	-1.3

3B. Spreadsheet "sketch" planning Tool

- ***Raef Porter, SACOG***
- **VMT Estimation Tool** "Sketch 7"
  - ✓ *produced via this project*
- Potentially others
  - *e.g., "Rapid Fire", etc.*

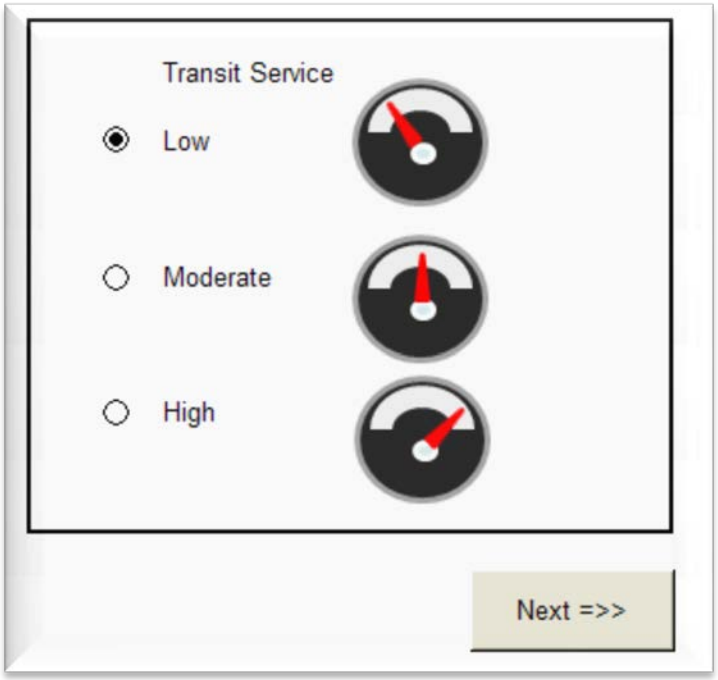
Base → Scenario → Results

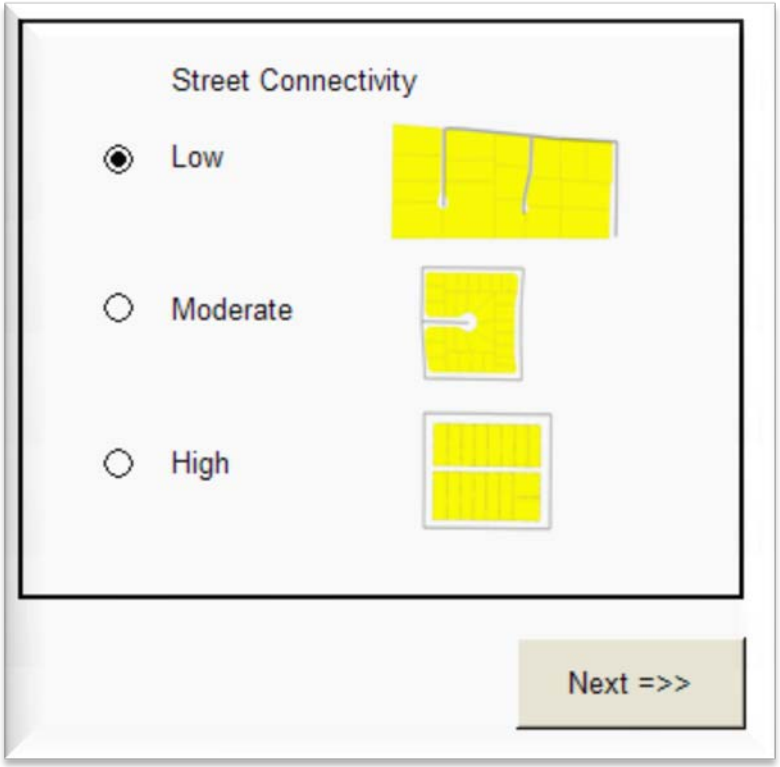
Web map tool for Base and Scenario



	TAZ	Acres	Employment	Dwelling Units	Landuse Type
1	662	13.14	0	0	Blank Place Type
2	662	11.8	0	0	Blank Place Type
3	662	13.48	0	0	Blank Place Type
4	662	16.06	0	0	Blank Place Type
5	662	15.97	0	0	Blank Place Type
6	662	11.31	0	0	Blank Place Type
7	662	12.51	0	0	Blank Place Type

"Dials" for Land Use Scenario Refinement *("Sketch 7")*





Final estimation and adjustment of travel is conducted and reported.

Table 1. Project Description and Base Rates

	Proj Desc						Base Travel Rates			
	DU's	% Low or Very Low Density	% High Density or Mixed OPType	Ret Jobs	Non-Ret Jobs	Total Jobs	Res VMT/DU	Res Bike Share	Res Walk Share	Res Transit Share
SACOG2	2	100%	0%	142	2,003	0	42.5	11.7%	4.5%	1.5%
Context Area	*22,968*	*46%*	*10%*	*2,279*	*23,641*	*25,920*	*28.9*	*17.3%*	*7.8%*	*2.4%*

Table 2. Context Evaluation

	Context Eval								
	Mixed Use				Density		Transit Service	Ped/Bike Environment	
Scenario	Project Ret Job / DU	Proj Change	Project J/H Bal	Proj Change	Proj Total Density (DU+Jobs)/Net Acres)	Proj Diff from Context	Access at Proj Location	Project	Proj Diff from Context
SACOG2	71.000	Impr	1,044.50	Impr	27.04	Higher	Low	High	Impr
Context Area Avg:	*0.094*		*1.13*		*17.63*		*Moderate*	*Low*	
Target:	*0.250*		*1.2*		*n/a*		*n/a*	*n/a*	
Context Status:	*Low*		*Low*		*n/a*		*n/a*	*n/a*	

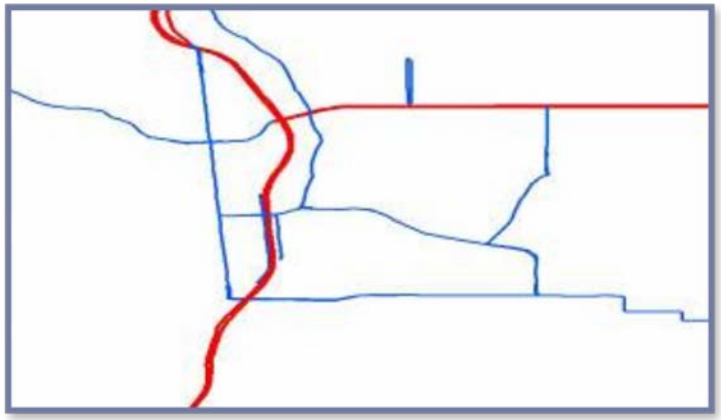
Table 3. Adjusted Base Rates

	Adjusted Base Rates								
Scenario	Res VMT/DU	Change fr Base Rate	Empl VMT/Job	Change fr Base Rate	Res Bike Share	Change fr Base Rate	Res Walk Share	Res Transit Share	Change fr Base Rate
SACOG2	37.7	-11%	0.0	+883%	13.2%	+13%	5.1%	1.5%	-2%
Context Area Avg:	*28.9*				*17.3%*		*7.8%*	*2.4%*	

How RESULTS can be used –
3C. Travel Demand Forecasting Models

Jerry Walters - **Add "Ds" to Regional & Local Travel Demand Forecast (TDF) Models –**

- ***Used to analyze land use & transportation scenarios.***
- ***Make up for "missing" model sensitivities to built environment-travel (smart growth/SCS) factors.***
- ***Must be custom-built for each agency's TDF model.***



What a travel model "sees"

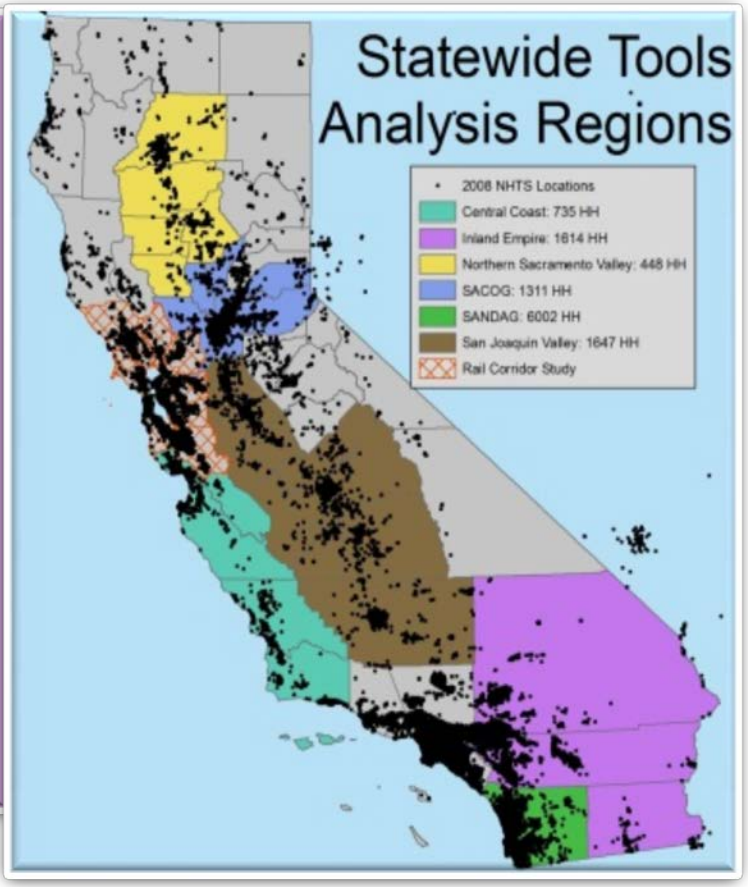
vs.

Reality

Small & Medium MPO Areas:	MACRO-Scale		MICRO-Scale		
	Location	Mix	Density	Mix	Ped Env
FRESNO COG					
KERN COG					
AMBAG					
SJ COG					
STAN COG					
TULARE CAG					
SBCAG					
SLO COG					
MERCED CAG					
BUTTE CAG					
SHASTA CO. RTPA					
KING CAG					
MADERA CTC					

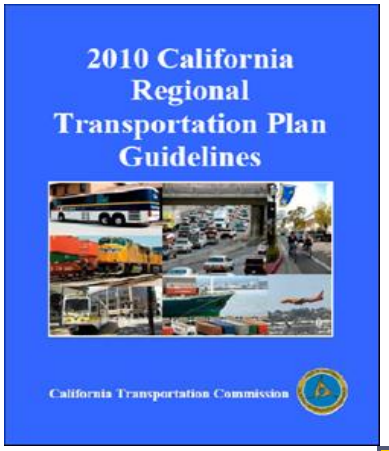
3C. "Ds" Post-Processors for use with Travel Demand Forecasting Models

- **Project provided post-processors for <u>eight</u> MPOs:**
  - ✓ **6 San Joaquin Valley** MPOs
  - ✓ **San Luis Obispo COG** *(Central Coast)*
  - ✓ **Butte CAG** *(Northern Sacramento Valley)*
- **+ Other agencies** *(outside of this study's scope).*

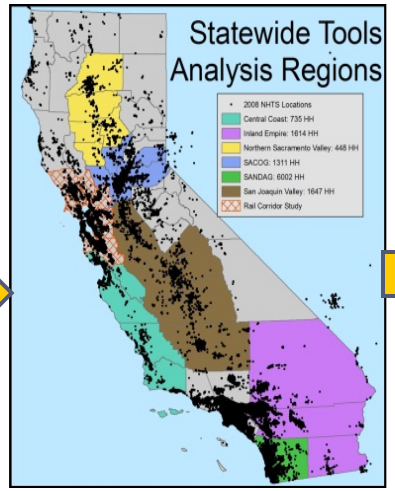


Travel Model Improvement Process for Regional SB 375 RTP/SCS Plans

SCS Guidance



Model Assessment/ Enhancement



Statistical 'Ds' Modules

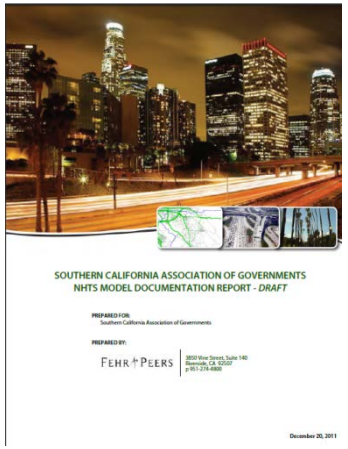
↓

Sensitivity Tests

↓

Model Post-Processor

SCS Review



Results: Provide Consistent Estimation of Land Use/Travel Effects

Household Travel Survey

Land Use "D" Characteristics

Statistical Relationships:

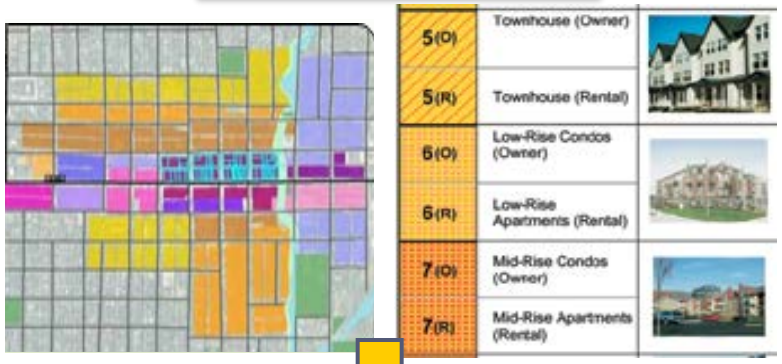
'Ds' >> Vehicle Ownership
'Ds' >> Vehicle Trips
'Ds' >> VMT

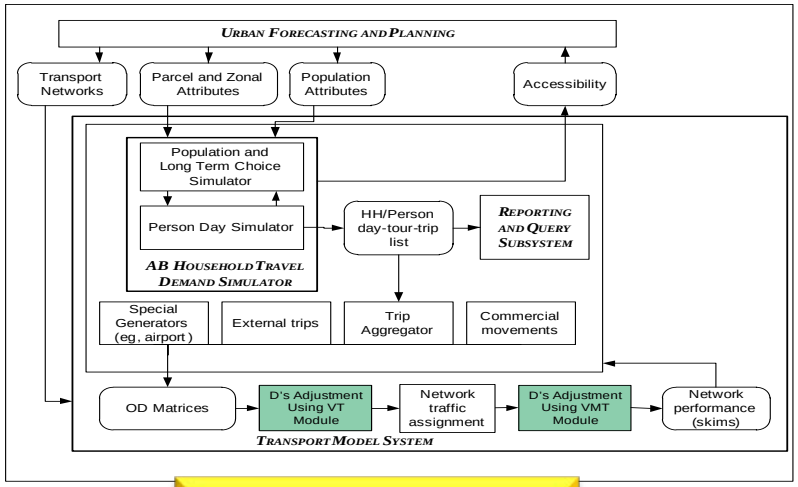
Statistical 'D' Modules

VO, VT, VMT

Scenario Planning Tools & Travel Models can incorporate similar quantitative relationships.

SCS

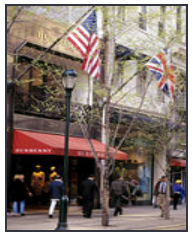




RTP

Conclusion: ***Benefits of This Project***

- ***Regional agencies, Caltrans, and cities & counties throughout California can use the tools from this project for "integrated" land use-transportation planning*:**
  - ✓ **Regional** Blueprint Plans, Sustainable Communities Strategies (SCS)/Regional Transportation Plans (RTPs)
  - ✓ **Local** governments' General and Specific Plan updates
- ***Overall*: Contributes to better-informed decisions resulting in more efficient land use and transportation systems with fewer impacts and greater benefits; and more "livable" and "sustainable" communities!**



Q & A

Thank you for your time, attention and interest!

For more information, please go to Caltrans' DOTP Office of Community Planning's "Land Use/Transportation Data & Tools" page:

http://www.dot.ca.gov/hq/tpp/offices/ocp/projects.html