

Baker



# GEOSPATIAL INFORMATION TECHNOLOGY SOLUTIONS

ESRI, 2007

# MAPPING TO MANAGE™

Challenge Us.

# Introduction



Steve Schonhaut, Ph.D  
Senior Consultant  
Planning & Analysis  
Kaiser Permanente  
[Steven.Schonhaut@kp.org](mailto:Steven.Schonhaut@kp.org)

James Johnston, GISP  
Mapping Supervisor  
Michael Baker Jr., Inc.  
[jjohnston@mbakercorp.com](mailto:jjohnston@mbakercorp.com)

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# Project Background



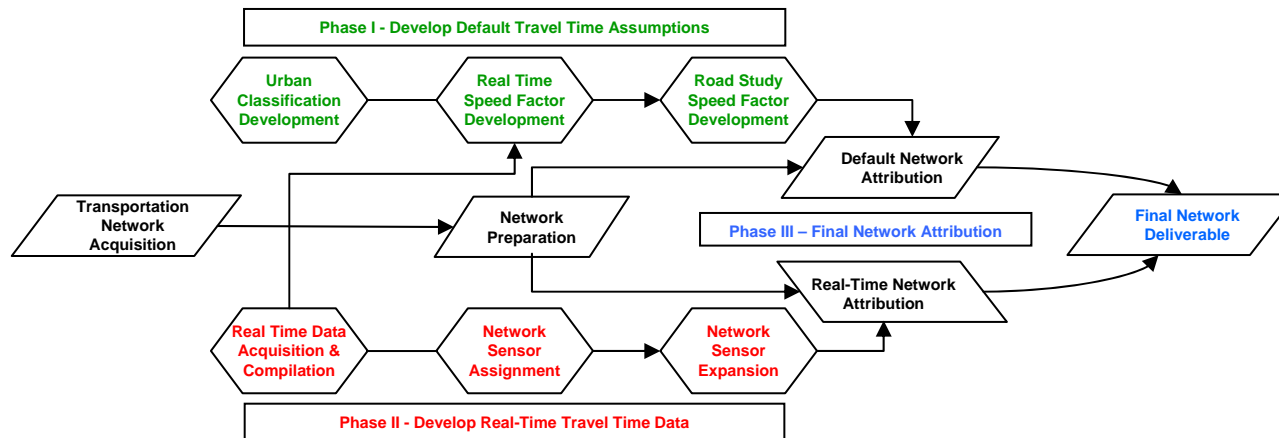
- Kaiser uses ArcInfo Network Analysis to evaluate member access to clinical services, and to optimize the location of new facilities.
- Network analyses at Kaiser were being done using impedances developed from 1997 Caltrans floating-car rush travel time reports.
- Travel times had changed substantially over 8 years, and new roads had been built.
- Kaiser needed to update its road data, and engaged Baker as partner in the development of a new California Road Network.

# Project Overview



- Project Goals

- Update Road Network Geometry
- Gather Real-Time Speed Data
- Develop Drive Time Data Models



# Network Geometry



- Network Geometry Update
  - Old ETAK Geometry outdated
  - Purchase Up-to-Date TeleAtlas Geometry
- Network Attribution
  - Expanded road classifications
  - Assigned Speed Limit Values



Road Type	Etak Road Class	TeleAtlas FCC Code
Freeways	1	A1 (A10 - A18)
Major Avenues	2	A2 (A20 - A28)
Major Avenues	3	A3 (A30 - A38)
Major Avenues	4	A3 (A30 - A38)
Type B Streets	5	A4 (A40 - A48)
High Speed Freeway Ramp	8	A60
Low Speed Freeway Ramp	9	A63
Unpaved Road	6	A5 (A50 - A53)
Private Road	7	A7 (A70, A74, A73, A75)



# Real Time Speed Data



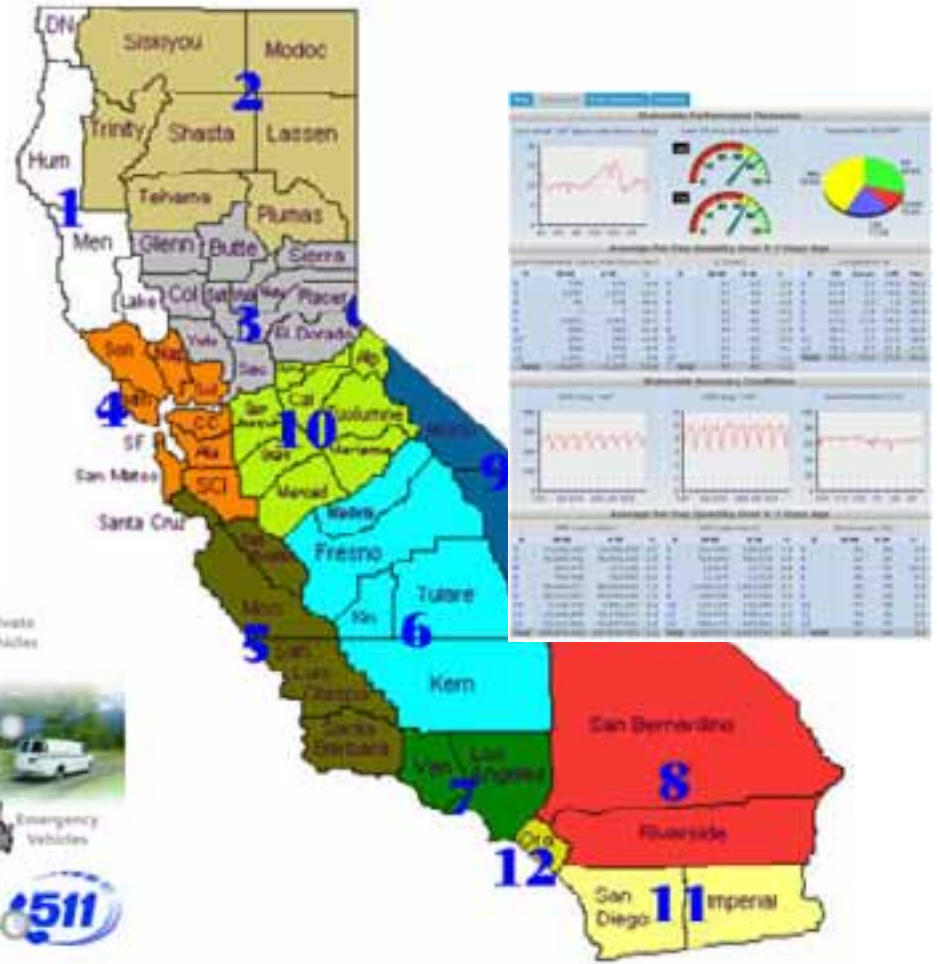
- Availability of Sensor Data

- Public systems

- PeMS

- Commercial Data

- SpeedInfo



# Real Time Speed Data

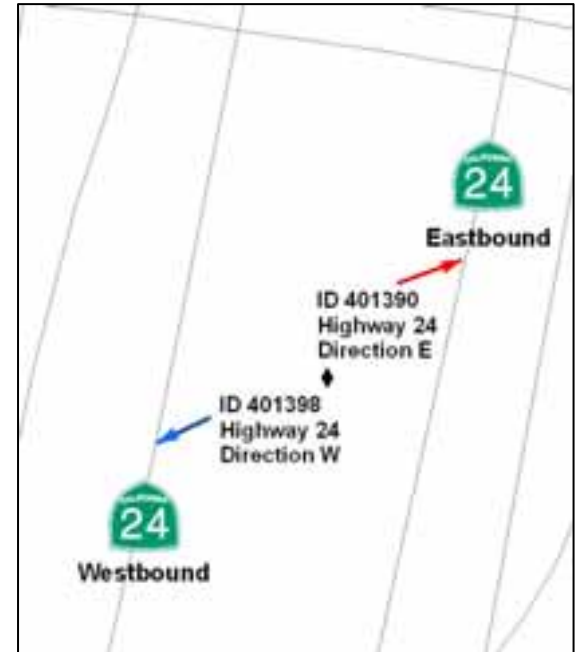


- Sensor Data Processing
  - Data Collection Period
    - Synchronizing available data sets to 3 month period
  - Time of Day Driving Variability
    - Rush Peak times : 7-9 AM / 4-6 PM
    - Mid Day : 10AM to 2PM
    - Off Peak : 8 PM to 5 AM

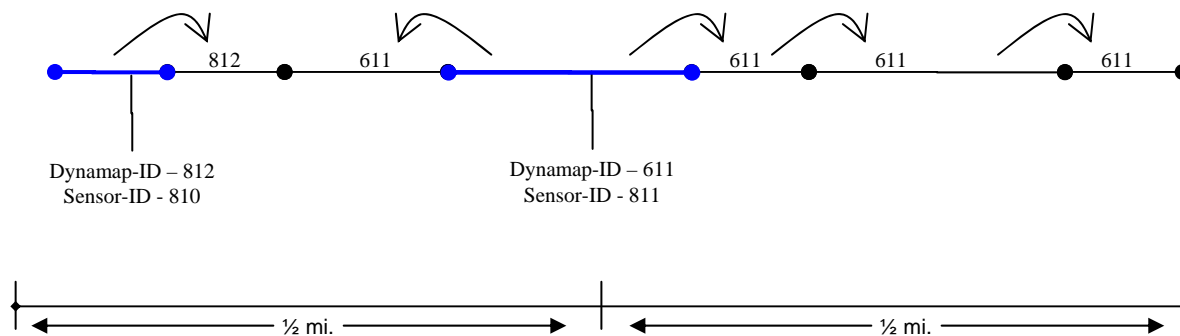
# Real Time Speed Data



- Geo-Coding Sensor Locations



- Linear Sensor Expansion





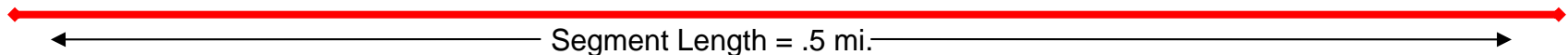
# Derived Drive Time Data



- Previous Kaiser Speed Estimation Model

Speed Limit (45 mph) X Stop Factor (0.7) = Normal Speed (31 mph)

Speed Limit (45 mph) X Stop Factor (0.70) X Rush Factor (0.70) = Rush Speed (22 mph)



Drive Time in Minutes = Segment Length (.5) / Speed X 60

**Normal Drive Time = 1.15 minutes**

**Rush Drive Time = 1.28 minutes**

Road Type	Etak Road Class	Speed Limit	Stop Factor	Norm Speed	Rush Factor	Rush Speed
Freeways	1	65	1.00	65.0	0.42	27.3
Major Avenues	2,3,4	45	0.70	31.5	0.70	22.1
Type B Streets	5	35	0.50	17.5	0.90	15.8
High Speed Freeway Ramp	0	45	1.00	45.0	0.51	23.1
Low Speed Freeway Ramp	9	35	0.70	24.5	0.54	13.2
Unpaved Road	6	20	0.90	18.0	1.00	18.0
Private Road	V	25	0.50	12.5	0.90	11.3

# New Drive Time Data Model



- Improved Speed Estimation Model
  - Urban Density Classification – Used to create travel times dependent upon both road class and population density
  - Freeway Speed Model - Based on real time speed data
  - Major Road Speed Model - Developed from data gathered in the Road Field Study
- Speed Modeling Factors
  - Speed Limit
  - Time of Day
  - Urban Rural Density
  - Stop Resistance
  - Special considerations

# Urban Rural Density Class



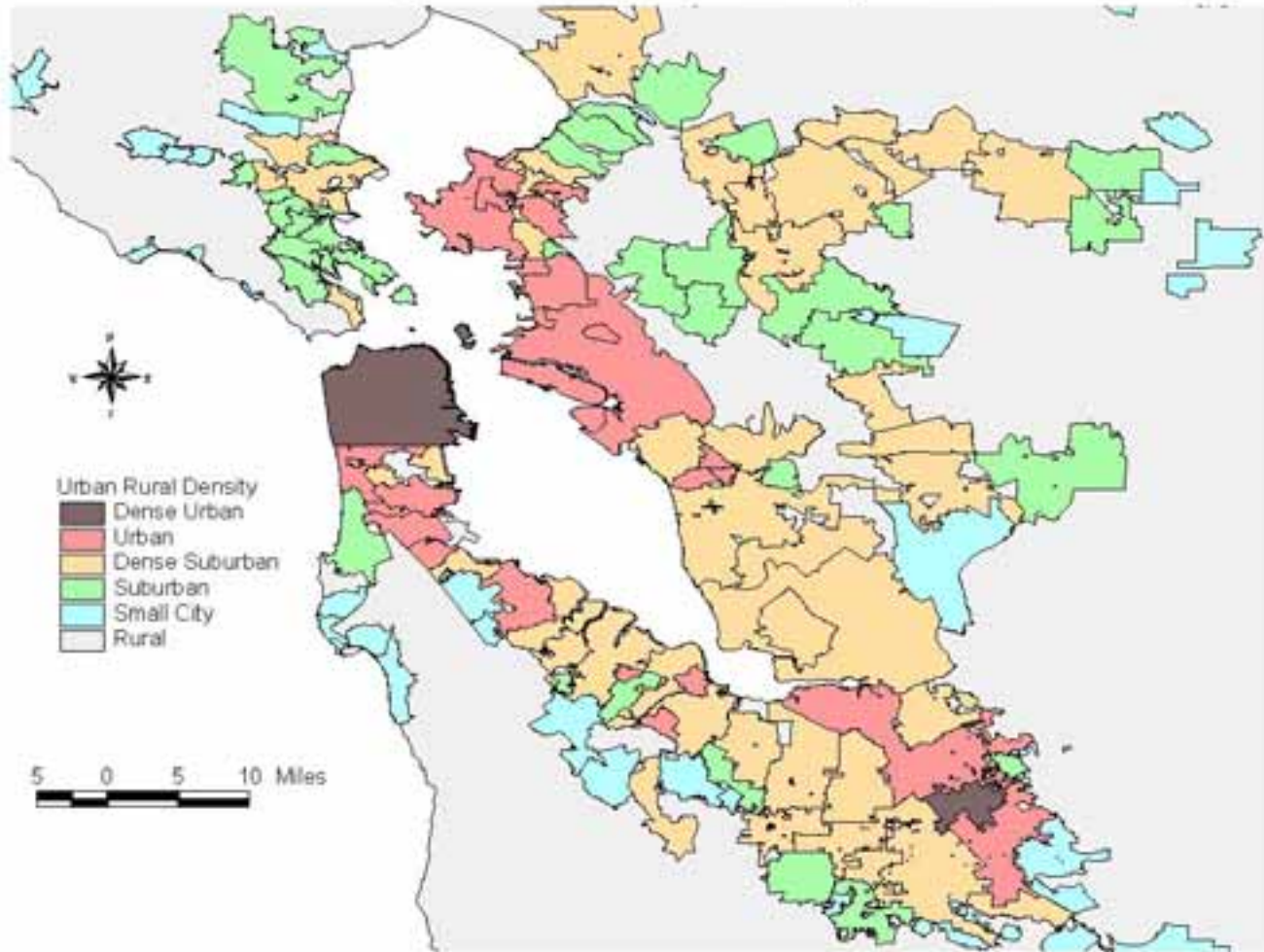
- Developed from census data and polygon geometry (populated places, block groups)
- Places were classified into 6 groups based on population density per square mile:

Class	Population per sq mi
Dense Urban	> 15, 000 (San Francisco)
Urban	8,000 to 15,000 (Oakland)
Dense Suburban	4,500 to 8,000 (Fremont)
Suburban	2,000 to 4,500 (Livermore)
Small Town	< 2,000 (Sunol)
Rural	Outside populated place boundaries

# Urban Rural Density Class



Bay Area Urban Rural Density Areas



# Freeway Speed Model



- Real time speeds were applied to the network for roads with sensors.
- A speed model was developed for freeways without sensors:

$$\text{Speed} = \text{Speed Limit} * \text{Time of Day Factor (density specific)}$$

- A speed limit of 65 MPH was assumed (with a few exceptions)
- Factors for Caltrans District 8 (Los Angeles) were somewhat different from other areas of California

# Major Road Study



- Major Road Study – Provided empirical data for developing the major road speed model:

**Speed= Density Specific (Speed Limit \* Stop Factor \* Time of Day Factor)**

- Data collection method:
  - Data gathered by road segment
  - Type of road (divided or unseparated)
  - Urban rural density of road
  - Segment Speed Limit
  - Road segment distance
  - Road segment travel time

# Major Road Study

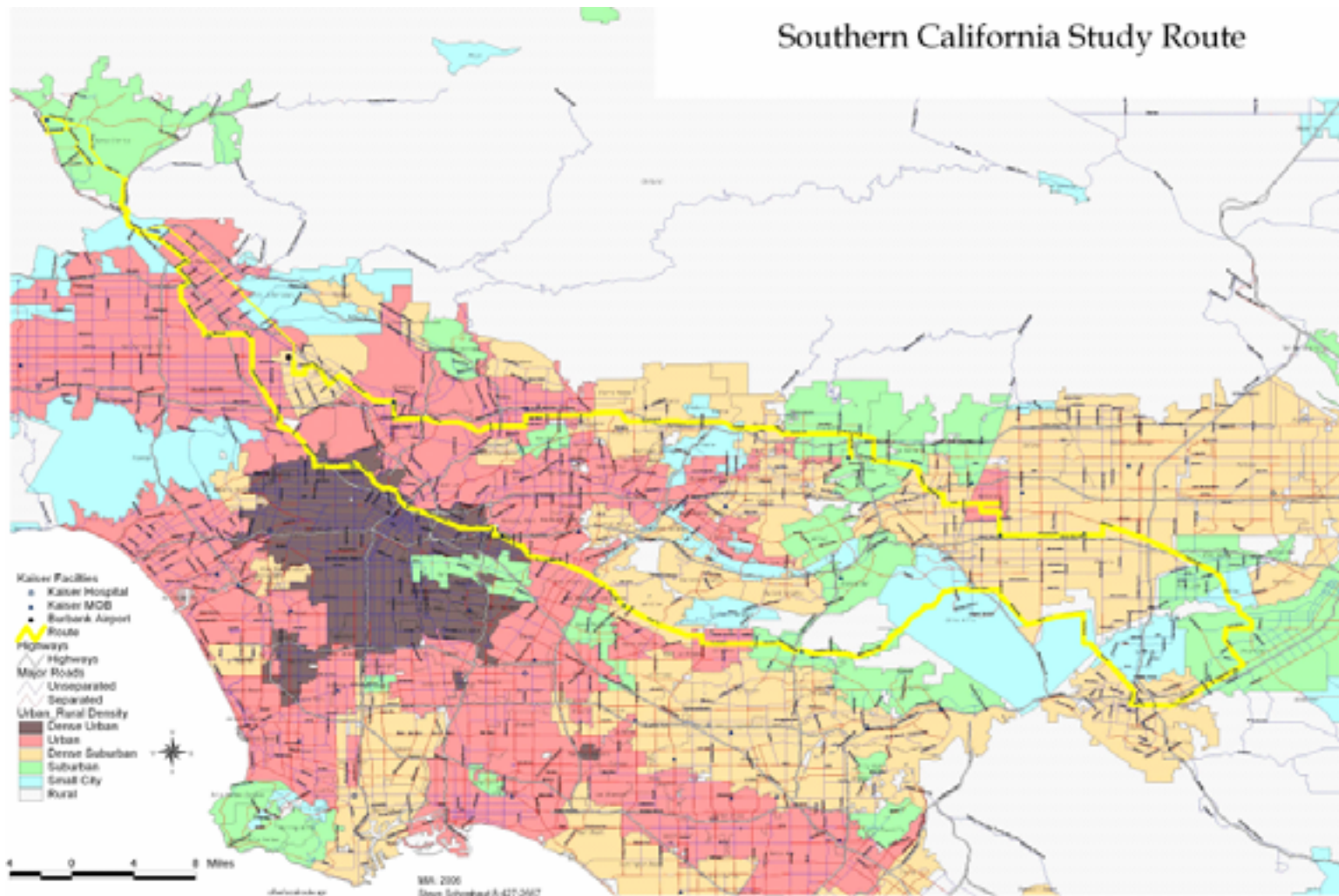


- Bay Area and Southern California area routes were mapped
  - Each route was about 175 miles
  - Routes sampled a cross-section of density areas and road types

## Sample Study Data

Route Directions	Road	Rd Type	Density	Dist	Travel Time	Speed Limit	Actual Speed	Speed Factor
Turn right on	Victory Pl	Unseparated	Dense Suburb	2.3	7.43	35	19	0.53
Turn right on	Glenoaks Blvd	Divided	Urban	3.5	9.67	38	22	0.57
Turn left on	Colorado St	Unseparated	Urban	1.7	7.03	35	15	0.41
Continue straight on	Colorado Blvd	Divided	Urban	1.3	3.23	35	24	0.69
Bear left on	La Loma Rd (becomes Colorado)	Unseparated	Dense Suburb	2.6	7.55	32	21	0.65
Turn right on	Colorado Blvd	Unseparated	Dense Suburb	5.2	12.03	34	26	0.75
Turn left on	Huntington Dr (becomes Foothill)	Divided	Dense Suburb	8.1	18.75	37	26	0.70
Bear right on	Alosta Ave (becomes Route 66)	Divided	Suburb	3.9	10.68	43	22	0.51
Turn right on	Lone Hill Ave	Divided	Suburb	1.6	4.85	40	20	0.49
Turn left on	Arrow Hwy	Divided	Suburb	3.8	8.53	43	27	0.62
Turn right on	White Ave	Divided	Dense Suburb	1.2	1.67	45	43	0.96
Bear left on	McKinley Ave	Unseparated	Dense Suburb	1.1	3.27	35	20	0.58

# Major Road Study





# Speed Model Factors



## Speed Limits

### A10 HIGHWAY SPEEDS

65 MPH except for 70 MPH for roads specified by CalTrans

### A20 ROAD SPEEDS

Road Type	KP_UCC DENSITY					
	1	2	3	4	5	6
Divided	30	35	40	45	45	50
Unseparated	30	35	35	40	45	50

### A30 MAJOR ROAD SPEEDS - FROM MAJOR ROADS STUDY

Road Type	KP_UCC DENSITY					
	1	2	3	4	5	6
Divided	30	35	40	45	45	50
Unseparated	30	35	35	40	45	50

### A40 LOCAL ROAD SPEEDS

Road Type	KP_UCC DENSITY					
	1	2	3	4	5	6
Divided	25	25	25	25	25	35
Unseparated	25	25	25	25	25	35

## Stop Factors

### A10 HIGHWAY STOP FACTOR

No stop resistance

### A20 and A30 MAJOR ROAD STOP FACTORS

KP_UCC DENSITY					
1	2	3	4	5	6
0.55	0.60	0.65	0.70	0.80	0.90

### A40 LOCAL ROAD STOP FACTORS

Use same factors as for major roads.

KP_UCC DENSITY					
1	2	3	4	5	6
0.55	0.60	0.65	0.70	0.80	0.90

# Speed Model Factors



## Time of Day Factors

### A10 HIGHWAY RUSH AND MID-DAY FACTORS

#### RUSH FACTORS

		KP_UCC DENSITY					
District	District Name	1	2	3	4	5	6
7	LA	0.65	0.75	0.80	0.85	0.85	0.95
NOT LA	NOT LA	0.80	0.80	0.85	0.85	0.90	0.95

#### MID-DAY FACTORS

		KP_UCC DENSITY					
District	District Name	1	2	3	4	5	6
7	LA	0.90	0.90	0.95	0.95	0.95	0.95
NOT LA	NOT LA	0.95	0.95	0.95	0.95	1.00	1.00

### A30 and A20 MAJOR ROADs RUSH AND MID-DAY FACTORS

#### RUSH FACTORS

		KP_UCC DENSITY					
District	District Name	1	2	3	4	5	6
ALL	ALL	0.90	0.90	0.90	0.95	1.00	1.00

#### MID-DAY FACTORS

		KP_UCC DENSITY					
District	District Name	1	2	3	4	5	6
ALL	ALL	1.00	1.00	1.00	1.00	1.00	1.00

### A40 LOCAL ROAD RUSH AND MID-DAY FACTORS

No Time of Day Difference

# Special Considerations



- 70 MPH Highways
  - Listed on Caltrans website
- Bay Area Bridges
  - Not in “populated places”
  - Used Dense Urban factors - assuming maximum time of day differences
- I-205 through Tracy
  - Specific information about the impact of major road work was incorporated



# Questions



Steve Schonhaut, Ph.D  
Senior Consultant  
Planning & Analysis  
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Steven.Schonhaut@kp.org

James Johnston, GISP  
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jjohnston@mbakercorp.com



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