MAG Transportation Model Overview

MARICOPA ASSOCIATION of GOVERNMENTS

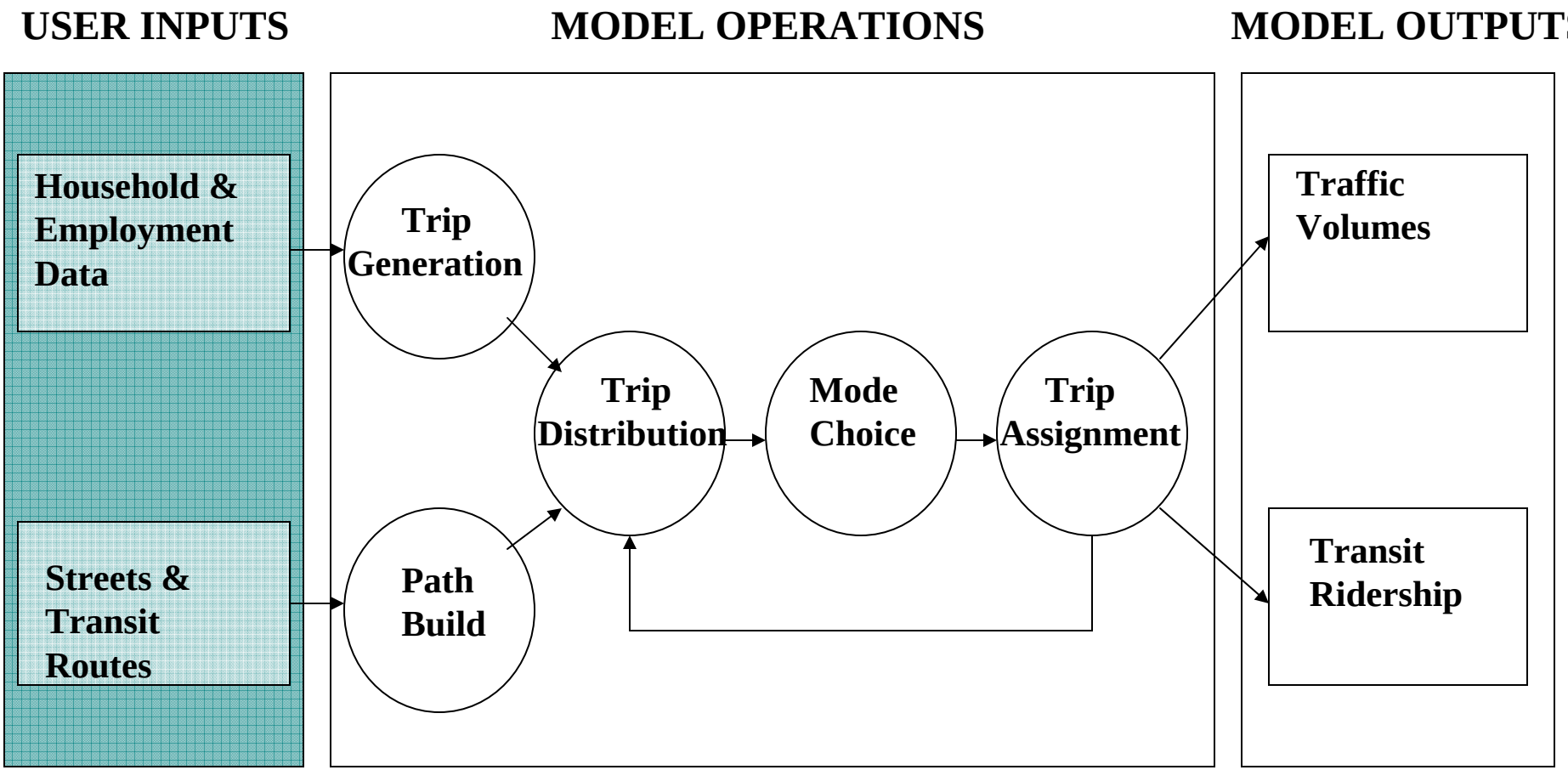
Presentation Agenda

- **Purpose**
- **User Inputs**
  - **Household & Employment**
  - **Street & Transit Networks**
- **Model and Validation**
- **Products**

What does the Model do?

- It estimates the amount of travel demand caused by various activities (jobs, shopping, etc.)
- It estimates the travel demand between these activities.
- It estimates the amount of this demand that will be on each transportation facility
  - Highway
  - Transit

MAG Travel Demand Model



User Inputs

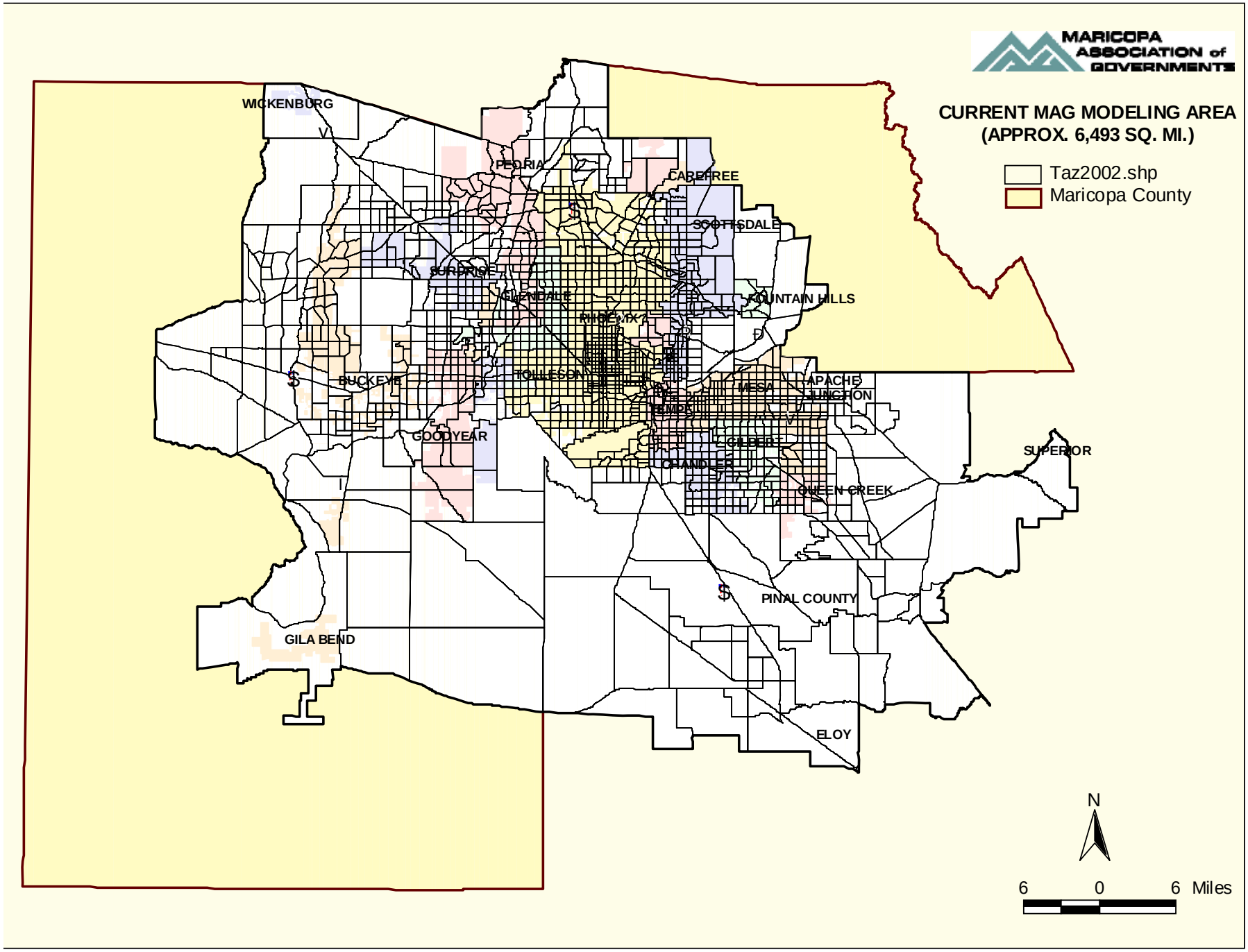
- Households and Employment for Trip Generation
- Transportation Facilities for Path Building and Assignment

Trip Generation Inputs

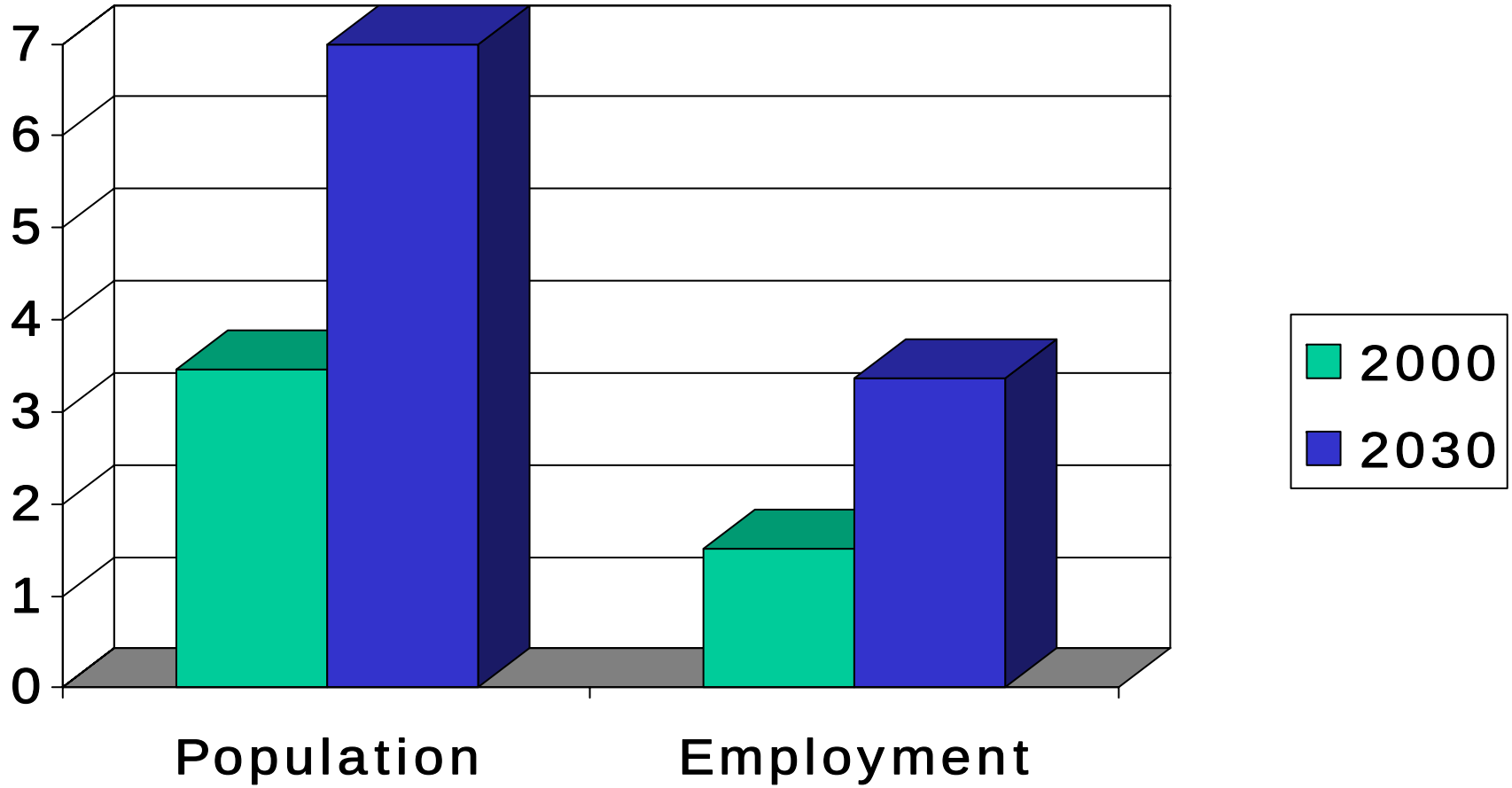
- Household
  - Location
  - Household Income
  - Household size
  - Auto Ownership
  - Age Household Head
  - Dwelling unit type
- Employment
  - Location
  - Type
  - Office Area

Modeled Area

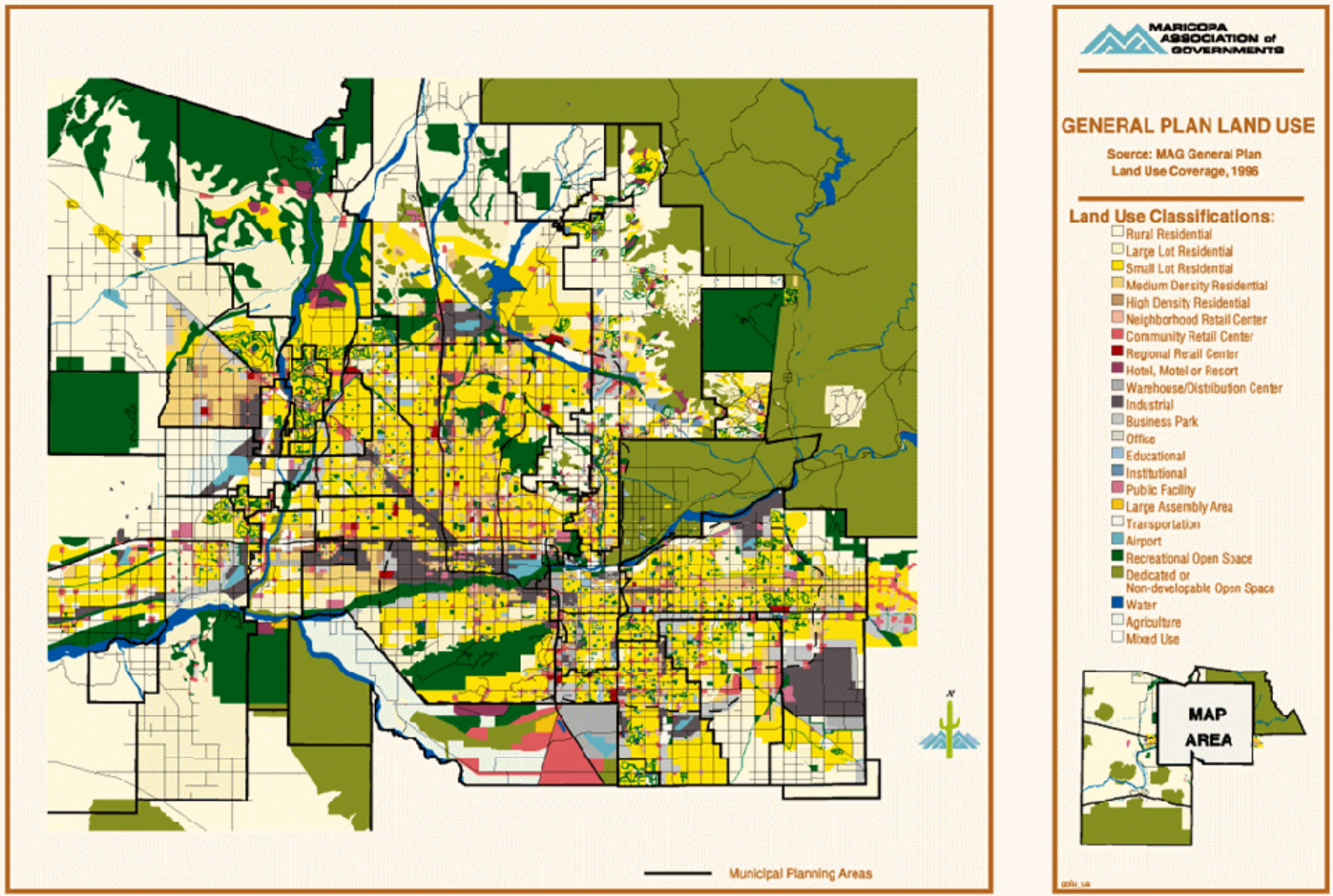
- Area is 70 x 80 miles (6,493 square miles)
- 1995 Transportation Analysis Zones

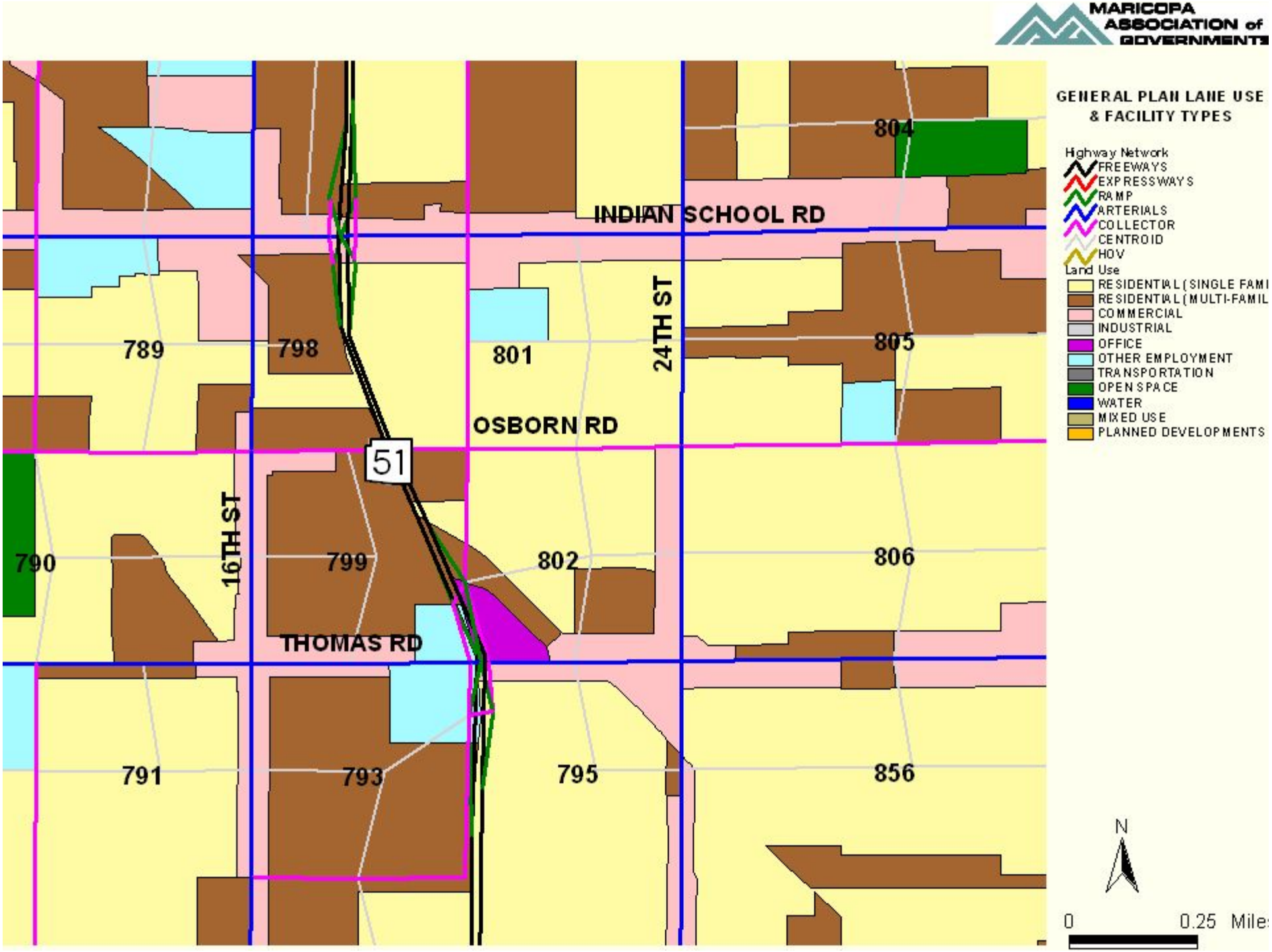

MARICOPA ASSOCIATION of GOVERNMENTS
CURRENT MAG MODELING AREA
(APPROX. 6,493 SQ. MI.)
Taz2002.shp
Maricopa County
WICKENBURG
PEORIA
CAREFREE
SCOTTSDALE
SURPRISE
GLENDALE
FOUNTAIN HILLS
PHOENIX
BUCKEYE
TOLLESON
MESA
APACHE JUNCTION
TEMPE
GOODYEAR
GILBERT
CHANDLER
SUPERIOR
QUEEN CREEK
PINAL COUNTY
GILA BEND
ELOY
N
6 0 6 Miles

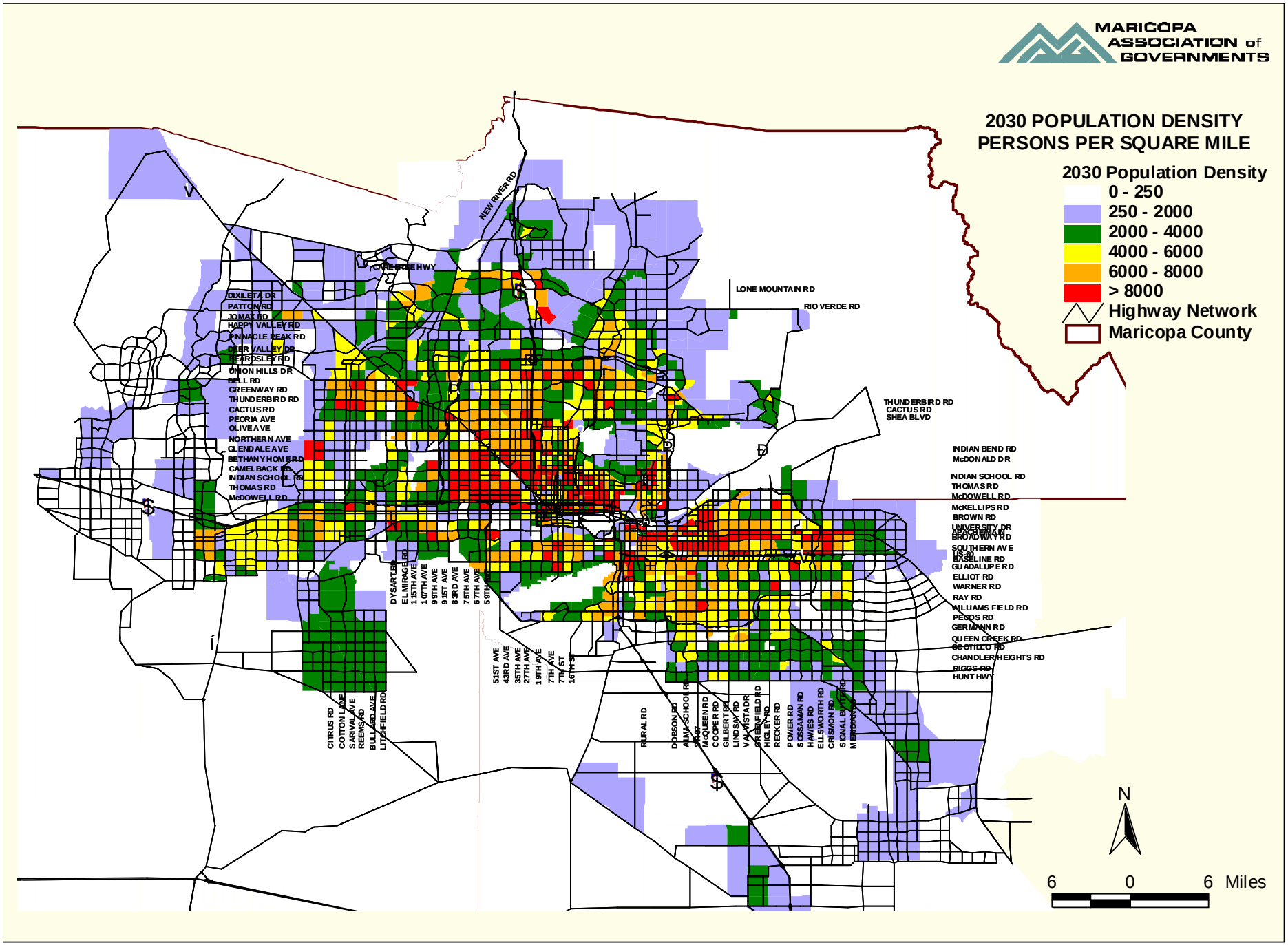
Population & Employment Growth (In Millions)



General Plans

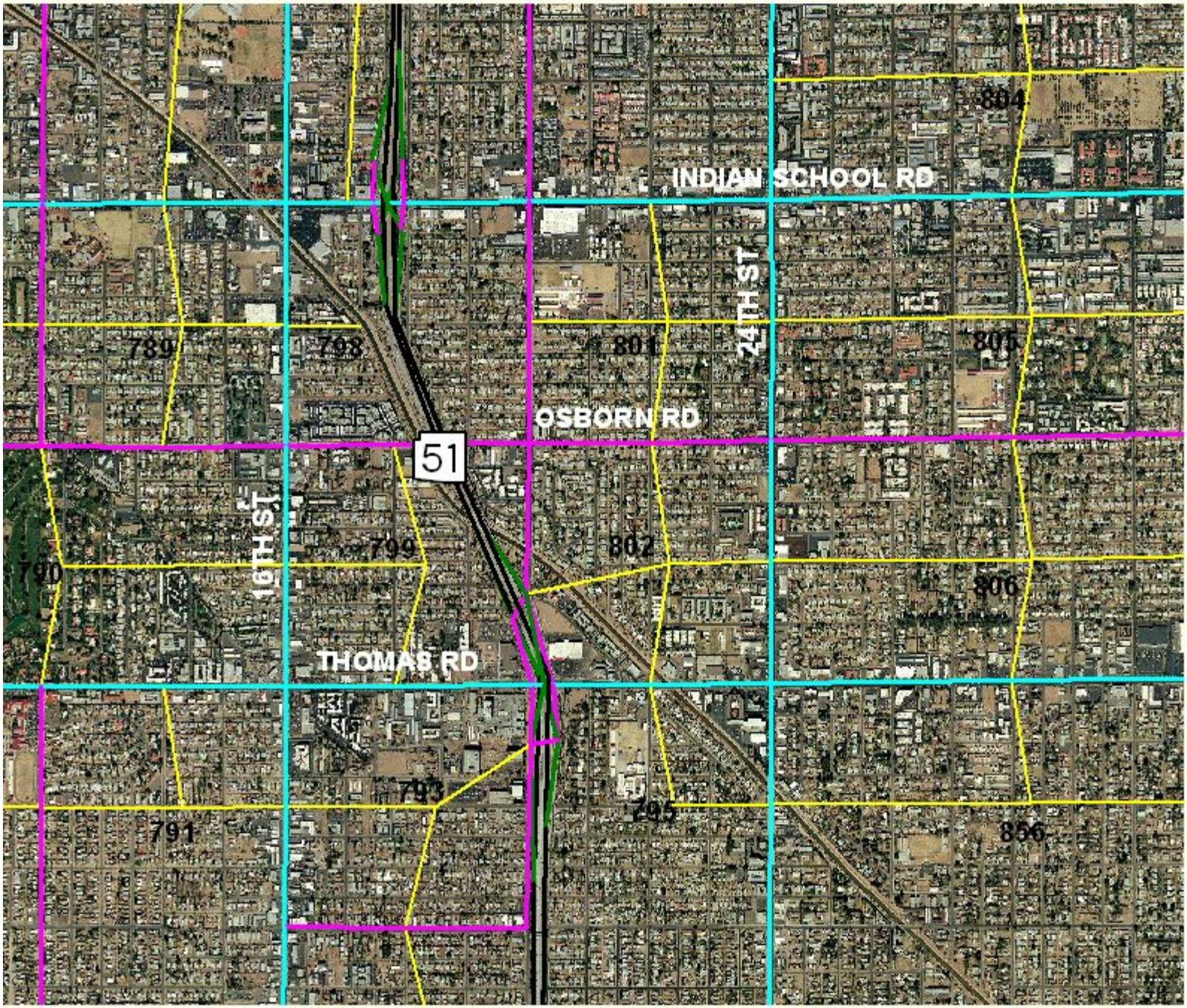



MARICOPA ASSOCIATION of GOVERNMENTS
GENERAL PLAN LAND USE & FACILITY TYPES
Highway Network
FREEWAYS
EXPRESSWAYS
RAMP
ARTERIALS
COLLECTOR
CENTROID
HOV
Land Use
RESIDENTIAL (SINGLE FAMI
RESIDENTIAL (MULTI-FAMIL
COMMERCIAL
INDUSTRIAL
OFFICE
OTHER EMPLOYMENT
TRANSPORTATION
OPEN SPACE
WATER
MIXED USE
PLANNED DEVELOPMENTS
INDIAN SCHOOL RD
OSBORN RD
THOMAS RD
24TH ST
16TH ST
51
789
798
801
804
805
790
799
802
806
791
793
795
856
N
0
0.25 Miles


MARICOPA ASSOCIATION of GOVERNMENTS
2030 POPULATION DENSITY
PERSONS PER SQUARE MILE
2030 Population Density
0 - 250
250 - 2000
2000 - 4000
4000 - 6000
6000 - 8000
> 8000
Highway Network
Maricopa County
NEW RIVER RD
CAREFREE HWY
LONE MOUNTAIN RD
RIO VERDE RD
DIXILETA DR
PATTON RD
JOMAX RD
HAPPY VALLEY RD
PINNACLE PEAK RD
DEER VALLEY DR
BEARDSLEY RD
UNION HILLS DR
BELL RD
GREENWAY RD
THUNDERBIRD RD
CACTUS RD
PEORIA AVE
OLIVE AVE
NORTHERN AVE
GLENDALE AVE
BETHANY HOME RD
CAMELBACK RD
INDIAN SCHOOL RD
THOMAS RD
McDOWELL RD
THUNDERBIRD RD
CACTUS RD
SHEA BLVD
INDIAN BEND RD
McDONALD DR
INDIAN SCHOOL RD
THOMAS RD
McDOWELL RD
McKELLIPS RD
BROWN RD
UNIVERSITY DR
BROADWAY RD
SOUTHERN AVE
US-60
BASELINE RD
GUADALUPE RD
ELLIOT RD
WARNER RD
RAY RD
WILLIAMS FIELD RD
PECOS RD
GERMANN RD
QUEEN CREEK RD
CHANDLER HEIGHTS RD
RIGGS RD
HUNT HWY
DYSART RD
EL MIRAGE RD
115TH AVE
107TH AVE
99TH AVE
91ST AVE
83RD AVE
75TH AVE
67TH AVE
59TH AVE
51ST AVE
43RD AVE
35TH AVE
27TH AVE
19TH AVE
7TH AVE
7TH ST
16TH ST
CITRUS RD
COTTON LANE
SARIVAL AVE
REEMS RD
BULLARD AVE
LITCHFIELD RD
RURAL RD
DOBSON RD
ALMA SCHOOL RD
MCQUEEN RD
COOPER RD
GILBERT RD
LINDSAY RD
VAL VISTA DR
GREENFIELD RD
HIGLEY RD
RECKER RD
POWER RD
SOSSAMAN RD
HAWES RD
ELLSWORTH RD
CRISMON RD
SIGNAL BUTTE RD
MERIDIAN RD
N
6 0 6 Miles

Transportation Facilities

- Highway
- Local Bus
- Express Bus
- Rail



MARICOPA ASSOCIATION of GOVERNMENTS

STREET NETWORK FACILITY TYPES

Highway Network
- FREEWAYS
- EXPRESSWAYS
- RAMP
- ARTERIALS
- COLLECTOR
- CENTROID
- HOV

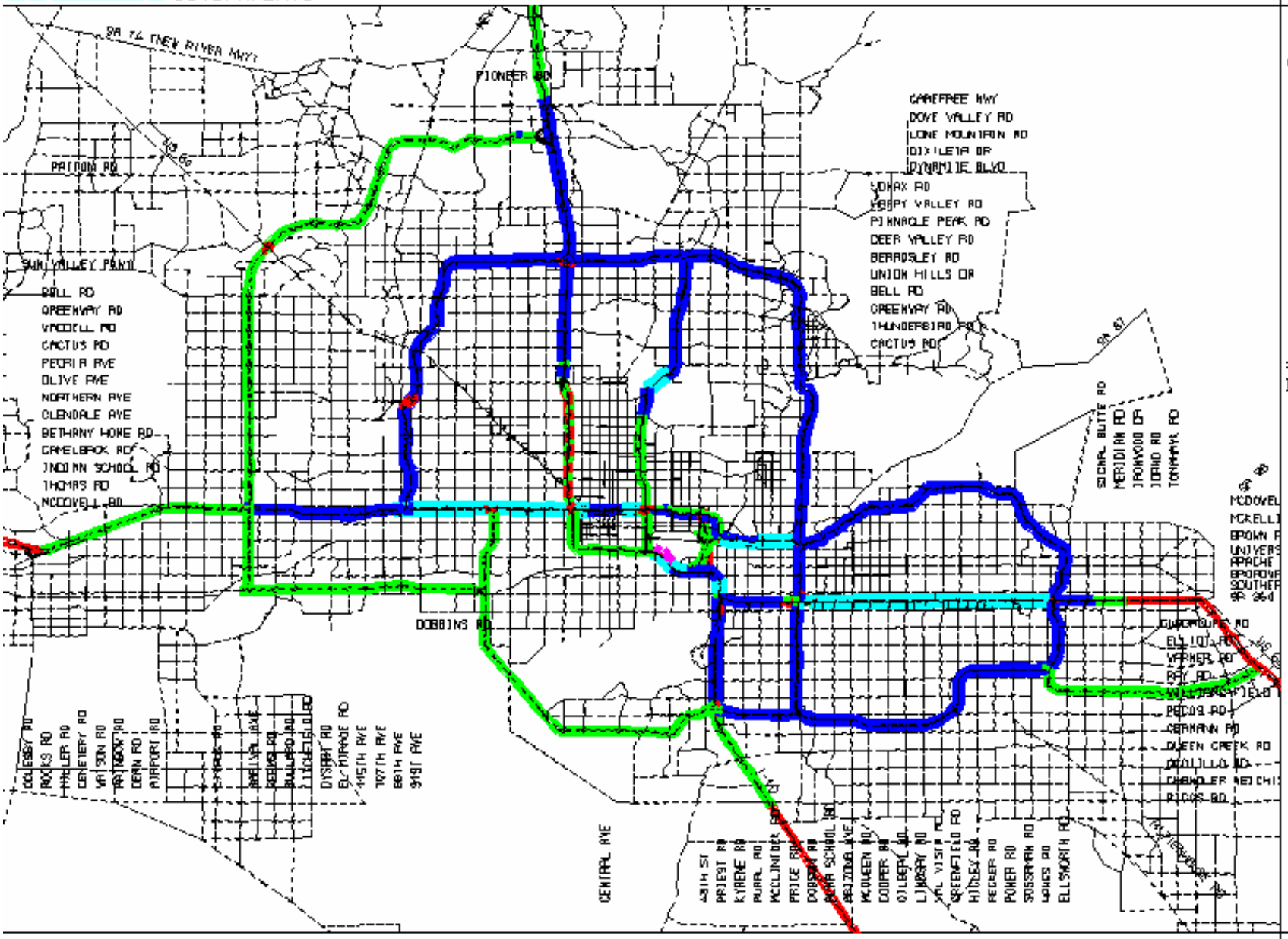
N

0 0.25 Miles

MARICOPA ASSOCIATION of GOVERNMENTS

RTP NETWORK NUMBER OF LANES

emme/2



LINKS:
!vdf=15,55,10

COL-IND:@lcol

THRESHOLD:
LOWER: -*****
UPPER: 999999

LEGEND

NUMBER OF LANES

- ONE
- TWO
- THREE
- FOUR
- FIVE
- SIX
- SEVEN
- EIGHT

WINDOW:
474084/ 767499
848070/1047988

EMME/2 PROJECT: 2025ROGERHRTPpj2003/04/0910:03 AM
SCENARIO 7: 24-HR Hwy Assignment (validation)
ATTRIB. @lcol: Lane Color

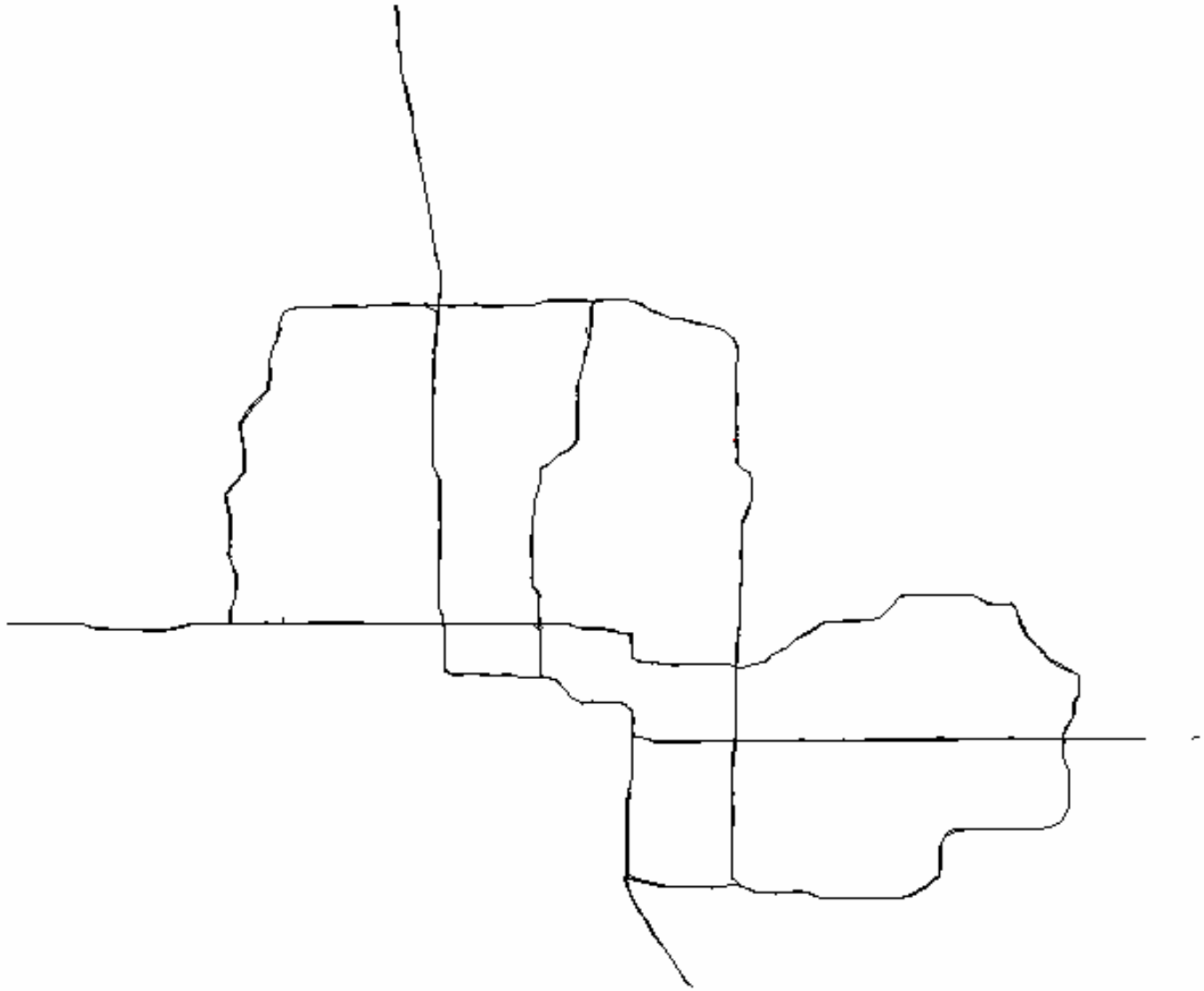
05-08-23 15:21
MODULE: 2.13
MAG.....VL

MARICOPA ASSOCIATION of GOVERNMENTS

RTP NETWORK HOV LANES

emme/2

LINKS:
vdf=10,50,10
COL-IND:@lane
THRESHOLD:
LOWER: -*****
UPPER: 999999



LEGEND

NUMBER OF LANES

WINDOW:
499491/ 796414
839305/1051274

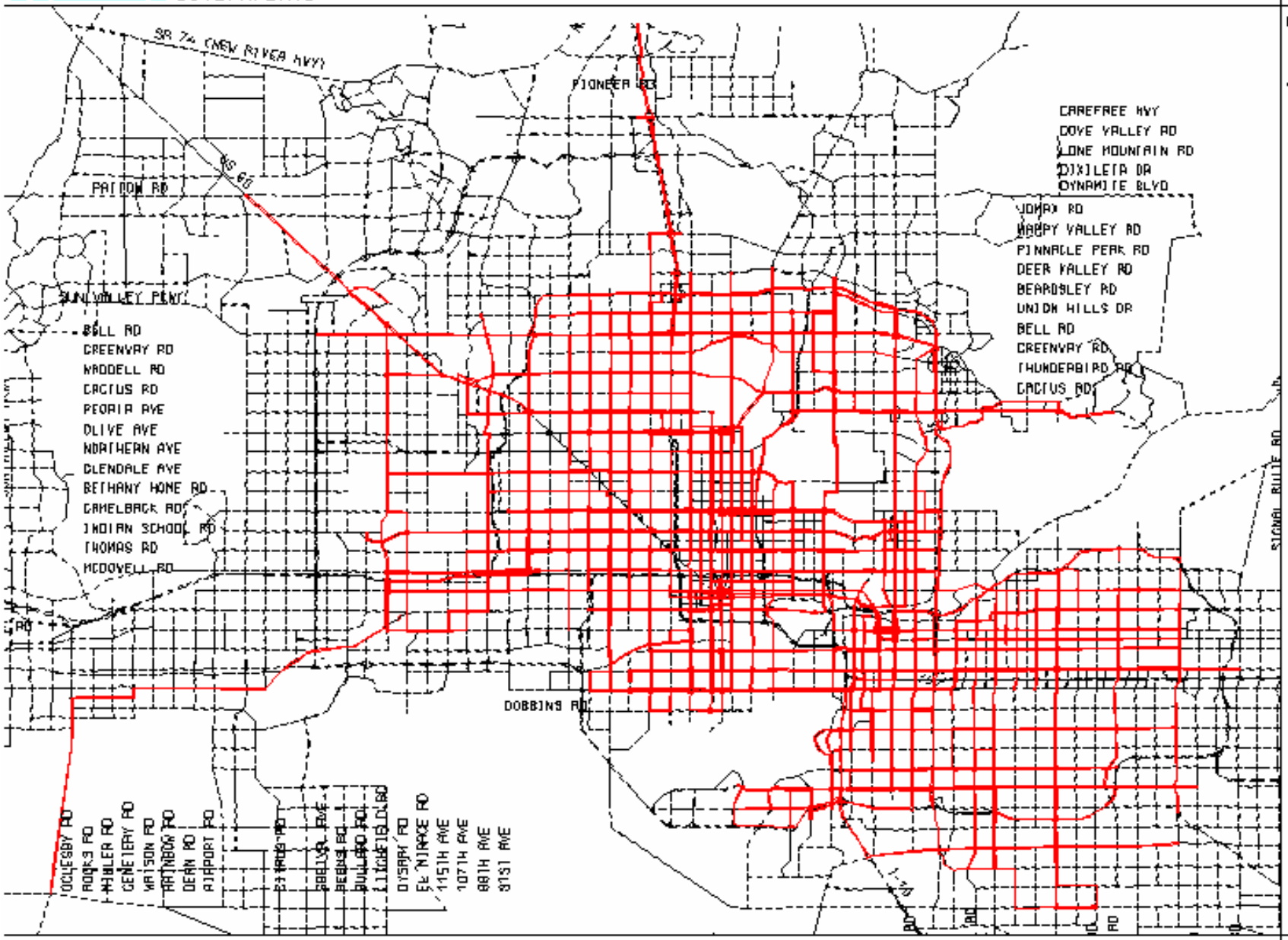
EMME/2 PROJECT: 2025ROGERHRTPpj2003/04/0910:03 AM
SCENARIO 7: 24-HR Hwy Assignment (validation)
ATTRIB. @lane: number of lanes

05-08-24 11:14
MODULE: 2.13
MAG.....VL

MARICOPA ASSOCIATION of GOVERNMENTS

RTP LOCAL BUS ROUTES

emme/2



MODES: bxrsf

LINKS: !vdf=15,55,10

TRANSIT LINES: 117 LINES

COL-IND: @lb

WINDOW:
465689/ 799387
796882/1047782

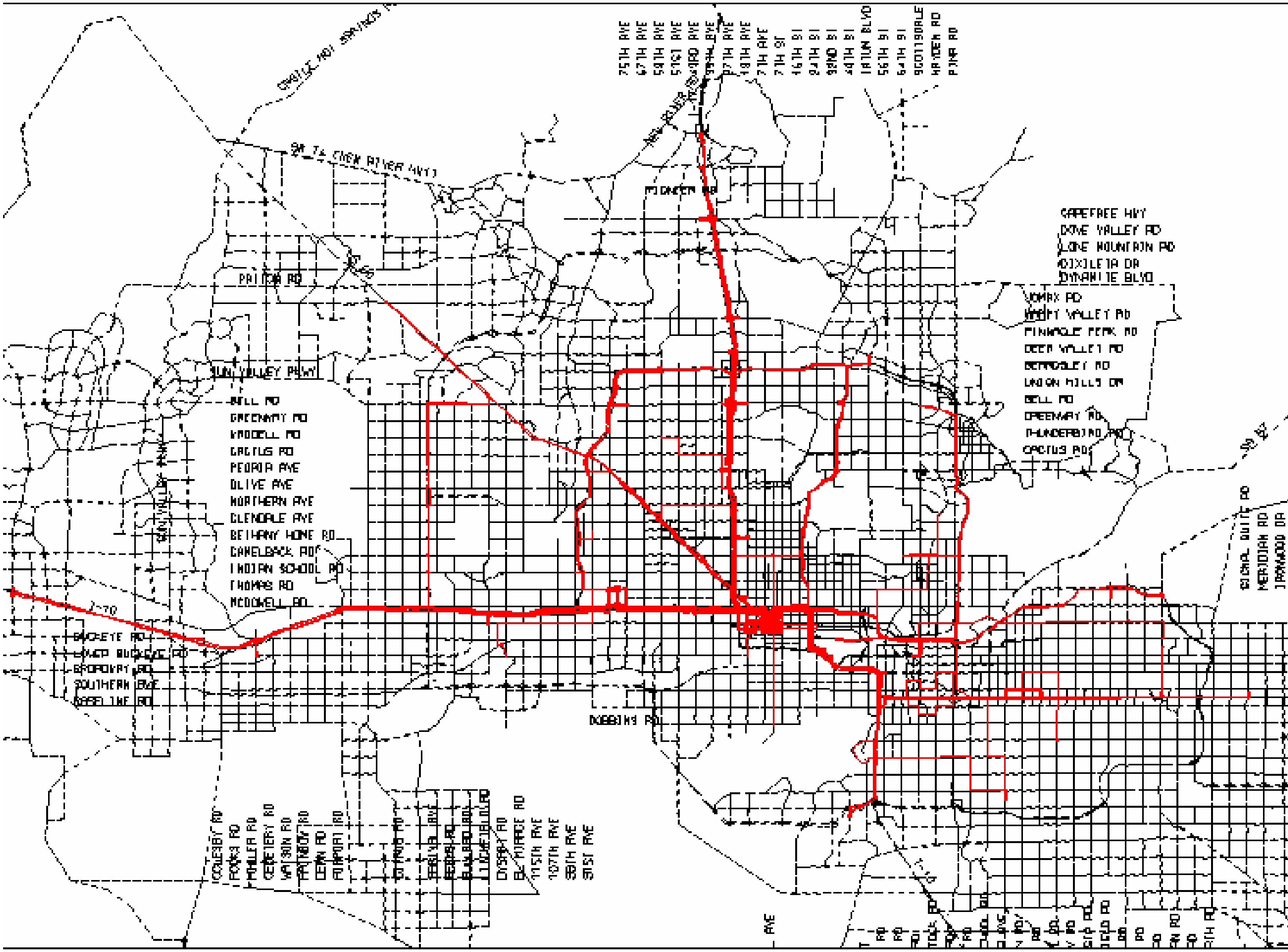
EMME/2 PROJECT: 2025ROGERHRTPpj2003/04/0910:03 AM
SCENARIO 15: Peak Walk-Transit Network

05-08-23 16:00
MODULE: 2.23
MAG.....VL

MARICOPA ASSOCIATION of GOVERNMENTS

RTP EXPRESS BUS ROUTES

emme/2



MODES: bxrsf

LINKS: mod=bsfxr

TRANSIT LINES: 42 LINES

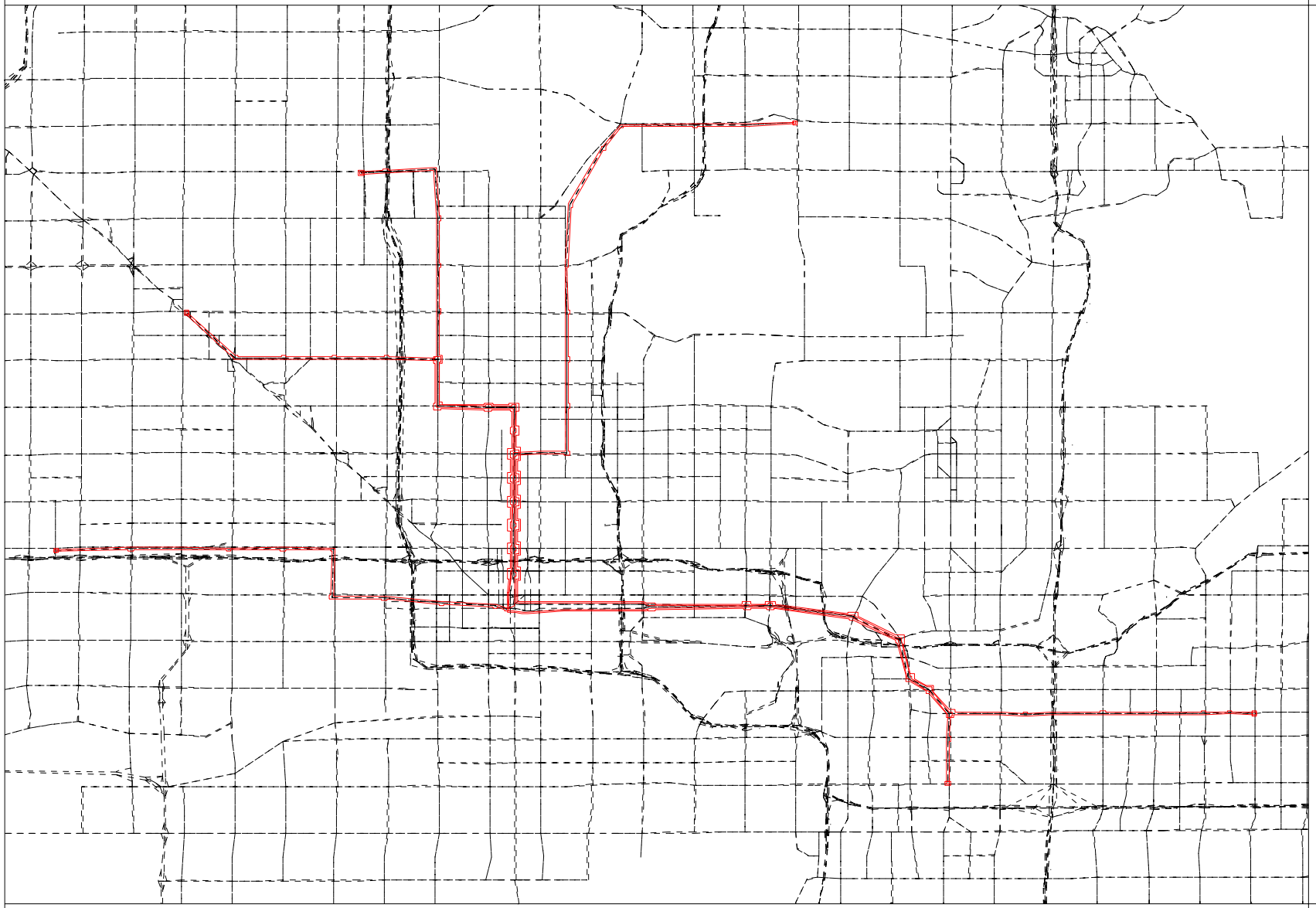
COL-IND: @color

WINDOW: 416872/ 789446
811351/ 1085305

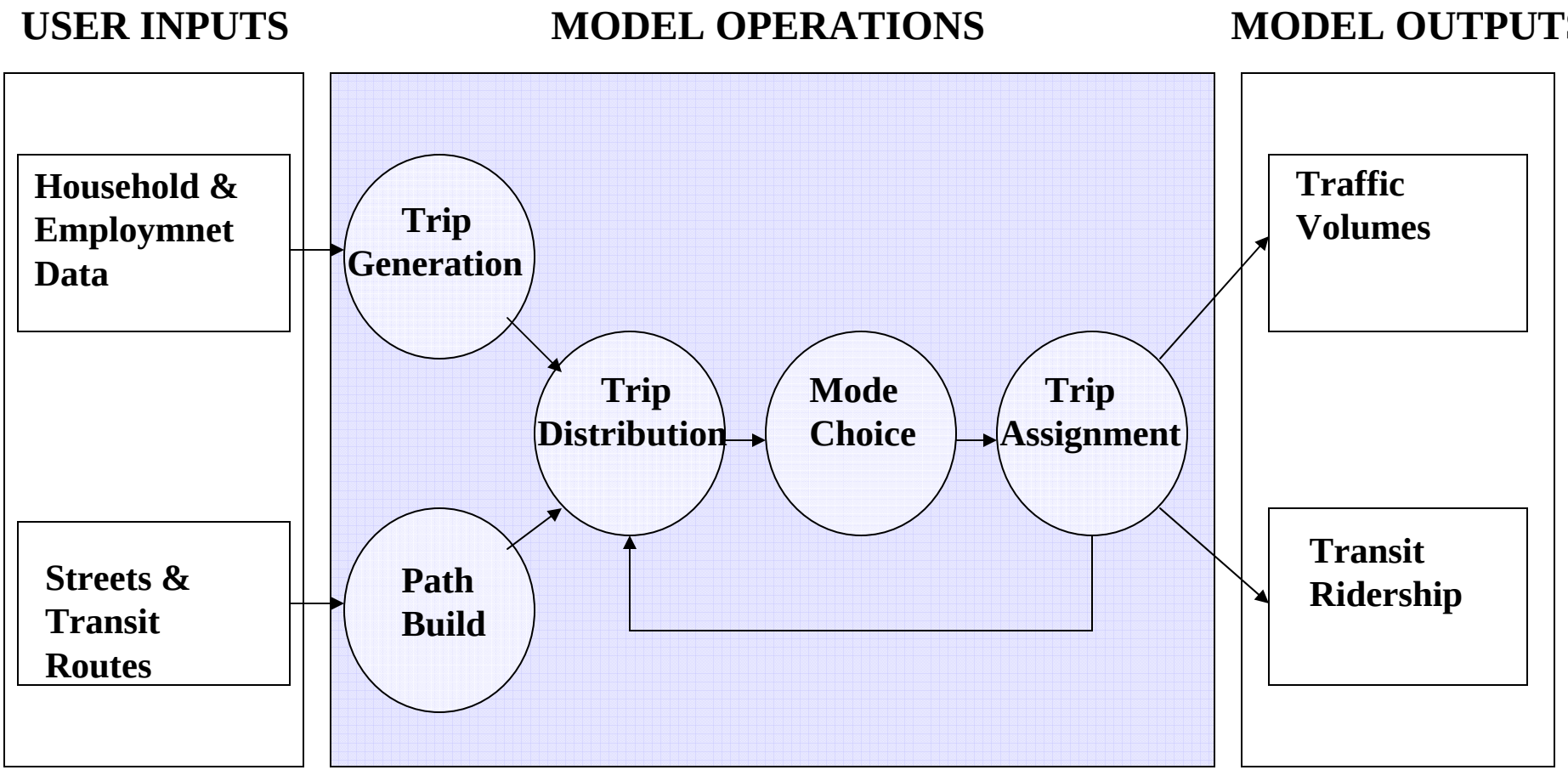
EMME/2 PROJECT: 2025ROGERHRTPpj2003/04/0910:03 AM
SCENARIO 15: Peak Walk-Transit Network

05-08-23 16:07
MODULE: 2.23
MAG.........UL

RPT Rail Routes



MAG Travel Demand Model

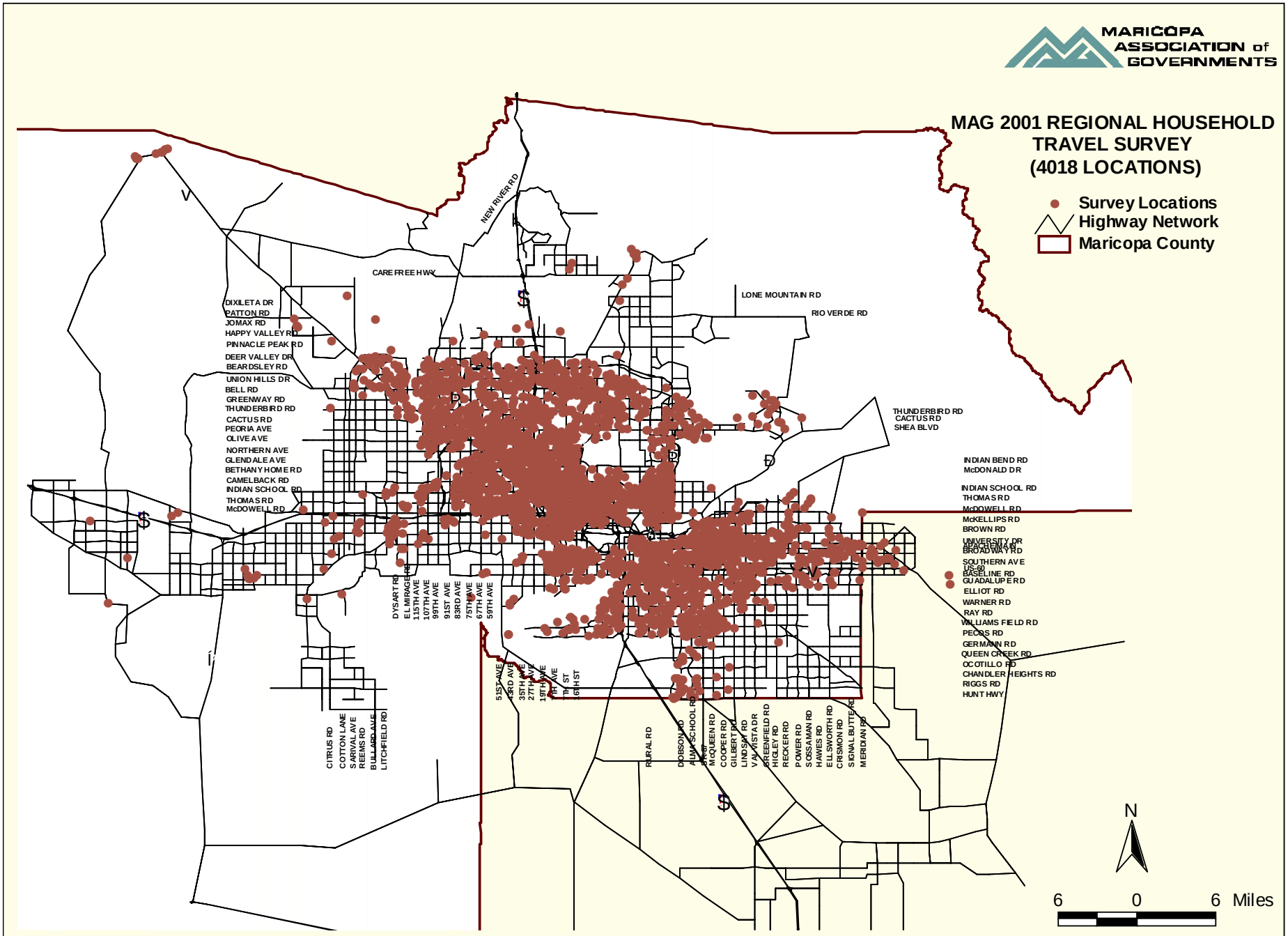


Trip Generation

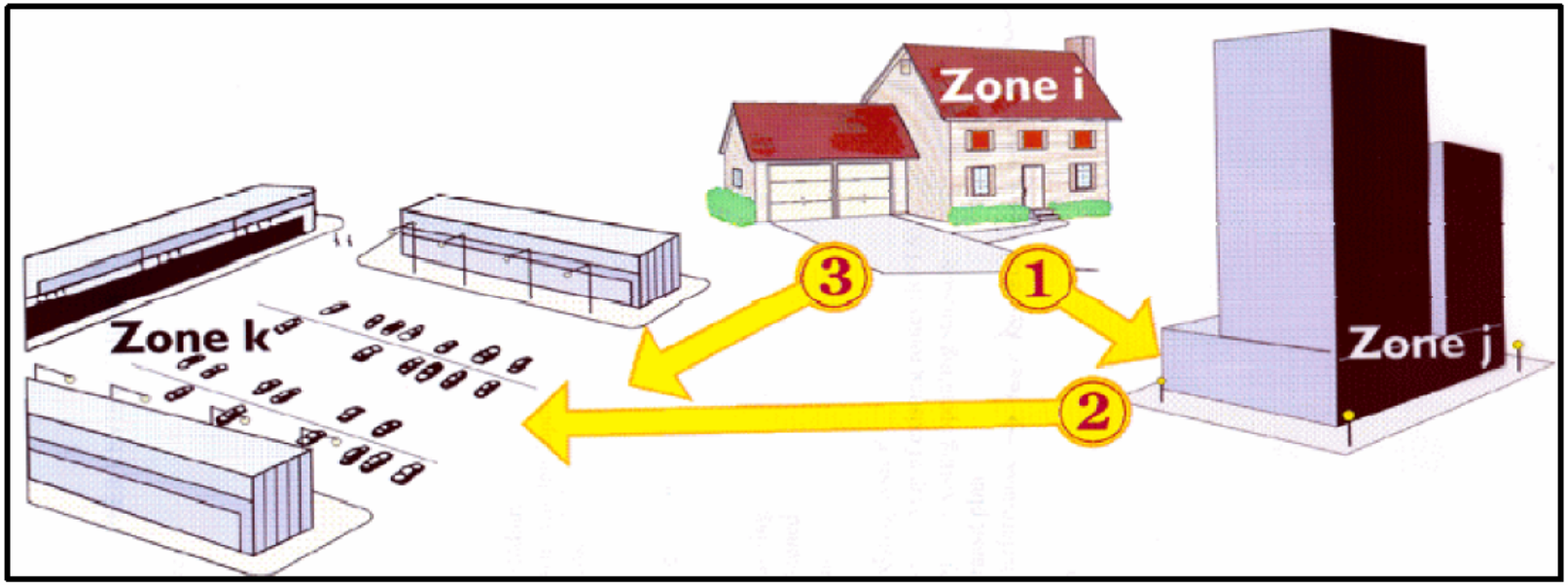
- Trip Production
  - i = f (Household size i, Household income i, Number of workers i, vehicles i)
- Trip Attraction
  - j = f (Retail Employment j, other employment j, households j)

Trip Purposes

- Work
- Shopping
- Elementary and High School
- University
- Other Home Based
- Non-Home-Based
- Truck
- External
- Sky Harbor
- ASU


MARICOPA ASSOCIATION of GOVERNMENTS
MAG 2001 REGIONAL HOUSEHOLD TRAVEL SURVEY
(4018 LOCATIONS)
Survey Locations
Highway Network
Maricopa County
NEW RIVER RD
CAREFREE HWY
LONE MOUNTAIN RD
RIO VERDE RD
DIXILETA DR
PATTON RD
JOMAX RD
HAPPY VALLEY RD
PINNACLE PEAK RD
DEER VALLEY DR
BEARDSLEY RD
UNION HILLS DR
BELL RD
GREENWAY RD
THUNDERBIRD RD
CACTUS RD
PEORIA AVE
OLIVE AVE
NORTHERN AVE
GLENDALE AVE
BETHANY HOME RD
CAMELBACK RD
INDIAN SCHOOL RD
THOMAS RD
McDOWELL RD
THUNDERBIRD RD
CACTUS RD
SHEA BLVD
INDIAN BEND RD
McDONALD DR
INDIAN SCHOOL RD
THOMAS RD
McDOWELL RD
McKELLIPS RD
BROWN RD
UNIVERSITY DR
APACHE TRAIL
BROADWAY RD
SOUTHERN AVE
US-60
BASELINE RD
GUADALUPE RD
ELLIOT RD
WARNER RD
RAY RD
WILLIAMS FIELD RD
PECOS RD
GERMANN RD
QUEEN CREEK RD
OCOTILLO RD
CHANDLER HEIGHTS RD
RIGGS RD
HUNT HWY
DYSART RD
EL MIRAGE RD
115TH AVE
107TH AVE
99TH AVE
91ST AVE
83RD AVE
75TH AVE
67TH AVE
59TH AVE
51ST AVE
43RD AVE
35TH AVE
27TH AVE
19TH AVE
7TH ST
16TH ST
CITRUS RD
COTTON LANE
SARIVAL AVE
REEMS RD
BULLARD AVE
LITCHFIELD RD
RURAL RD
DOBSON RD
ALMA SCHOOL RD
MCQUEEN RD
COOPER RD
GILBERT RD
LINDSAY RD
VAL VISTA DR
GREENFIELD RD
HIGLEY RD
RECKER RD
POWER RD
SOSSAMAN RD
HAWES RD
ELLSWORTH RD
CRISMON RD
SIGNAL BUTTE RD
MERIDIAN RD
N
6 0 6 Miles

Productions andAttractions



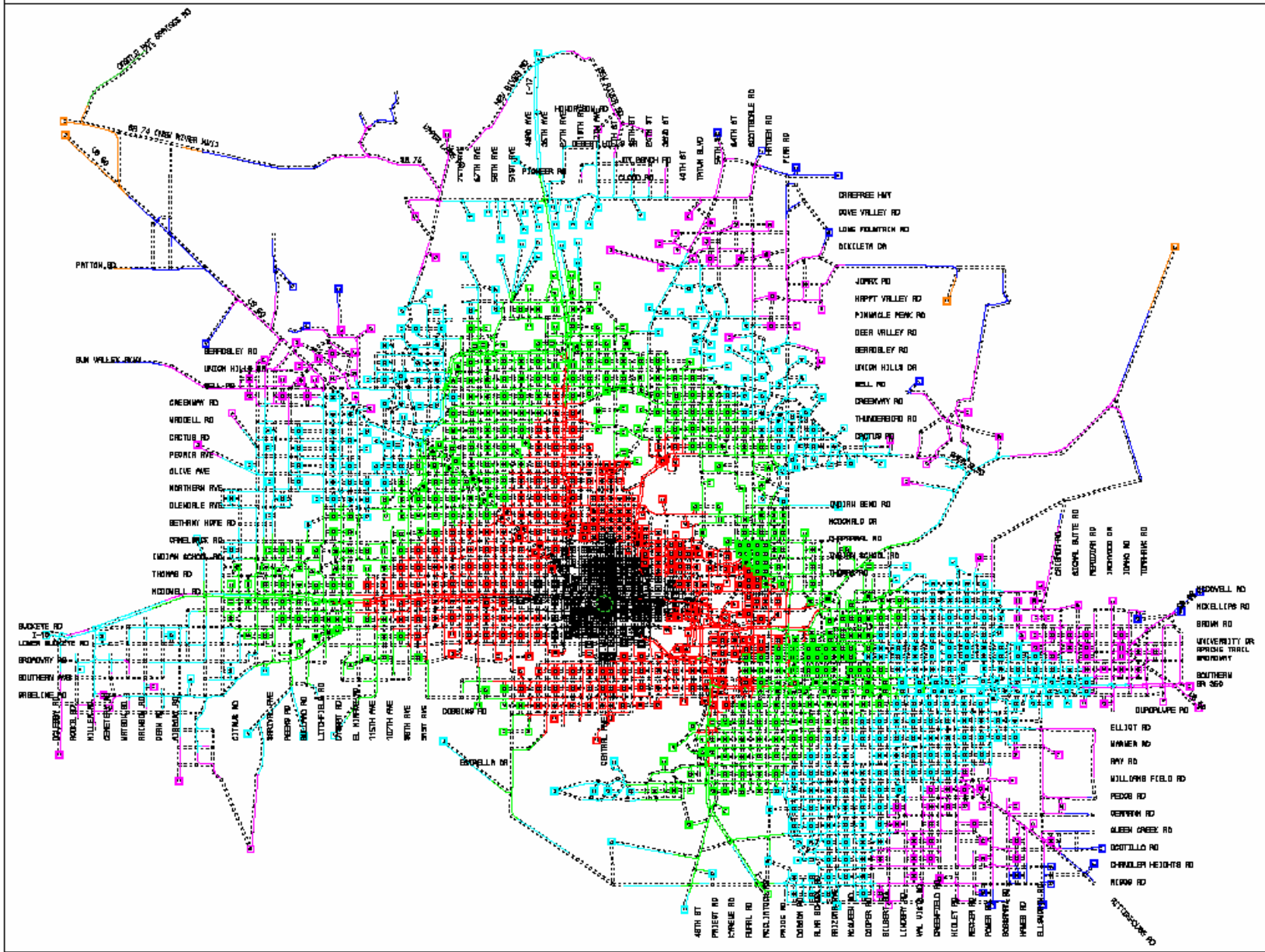
Trip	Purpose	Production	Attraction
1	HB Work	Zone i	Zone j
2	NHB	Zone j	Zone k
3	HB Shop	Zone i	Zone k

Gravity Model Theory

- Number of trips between zones are:
  - Directly proportional to the attraction of each zone.
  - Inversely proportional to spatial separation between zones

MINIMUM TIME PATHS FROM ALL ZONES TO DOWNTOWN PHOENIX

emme/2



LINKS:
mod=a

TO 689

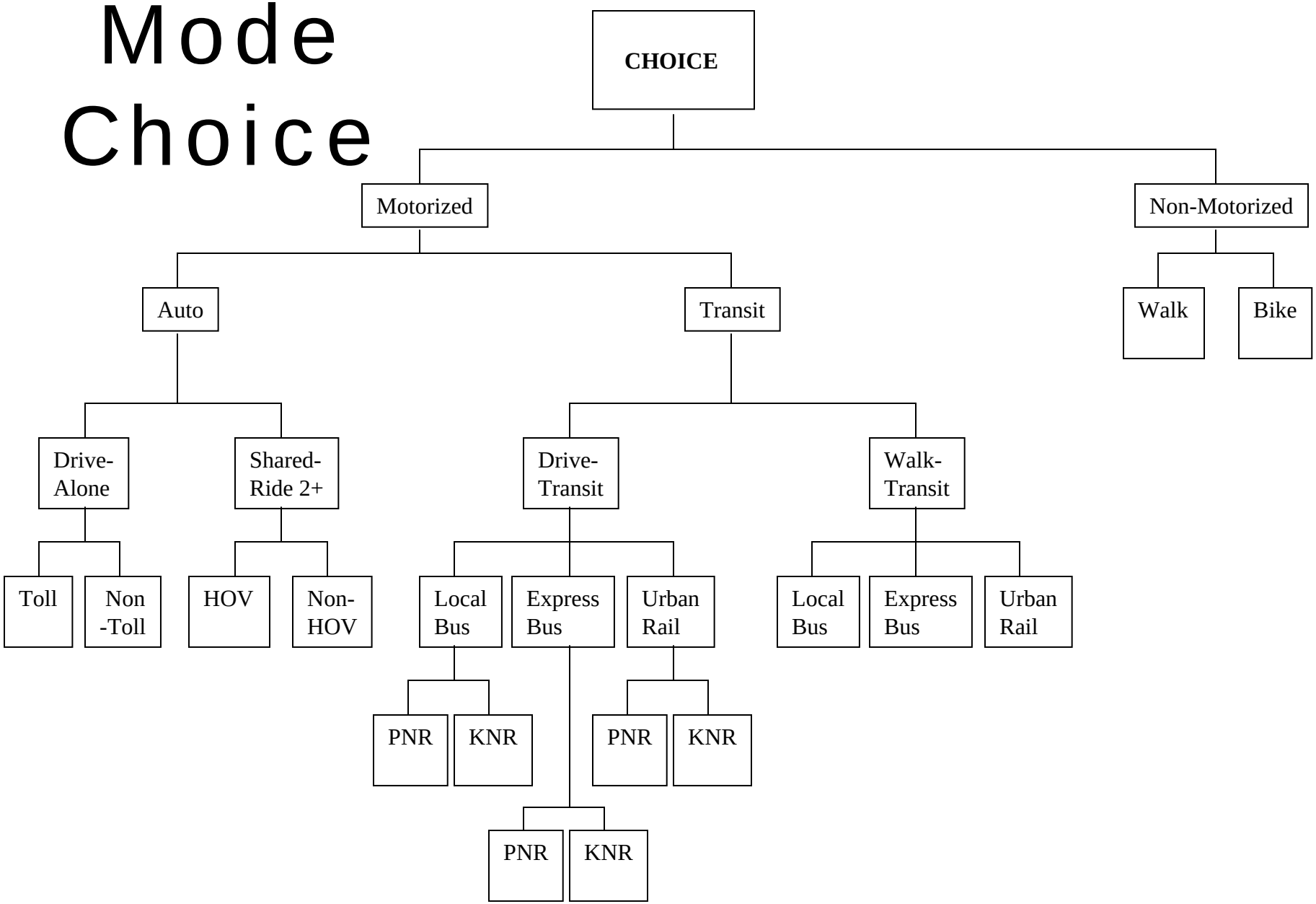
TIME < 10 MIN
TIME < 20 MIN
TIME < 30 MIN
TIME < 40 MIN
TIME < 50 MIN
TIME < 60 MIN
TIME < 70 MIN
TIME < 80 MIN

WINDOW:
267199/ 786438
656099/1078112

EMME/2 PROJECT: 1997i2
SCENARIO 11: Midday vehicle assignment

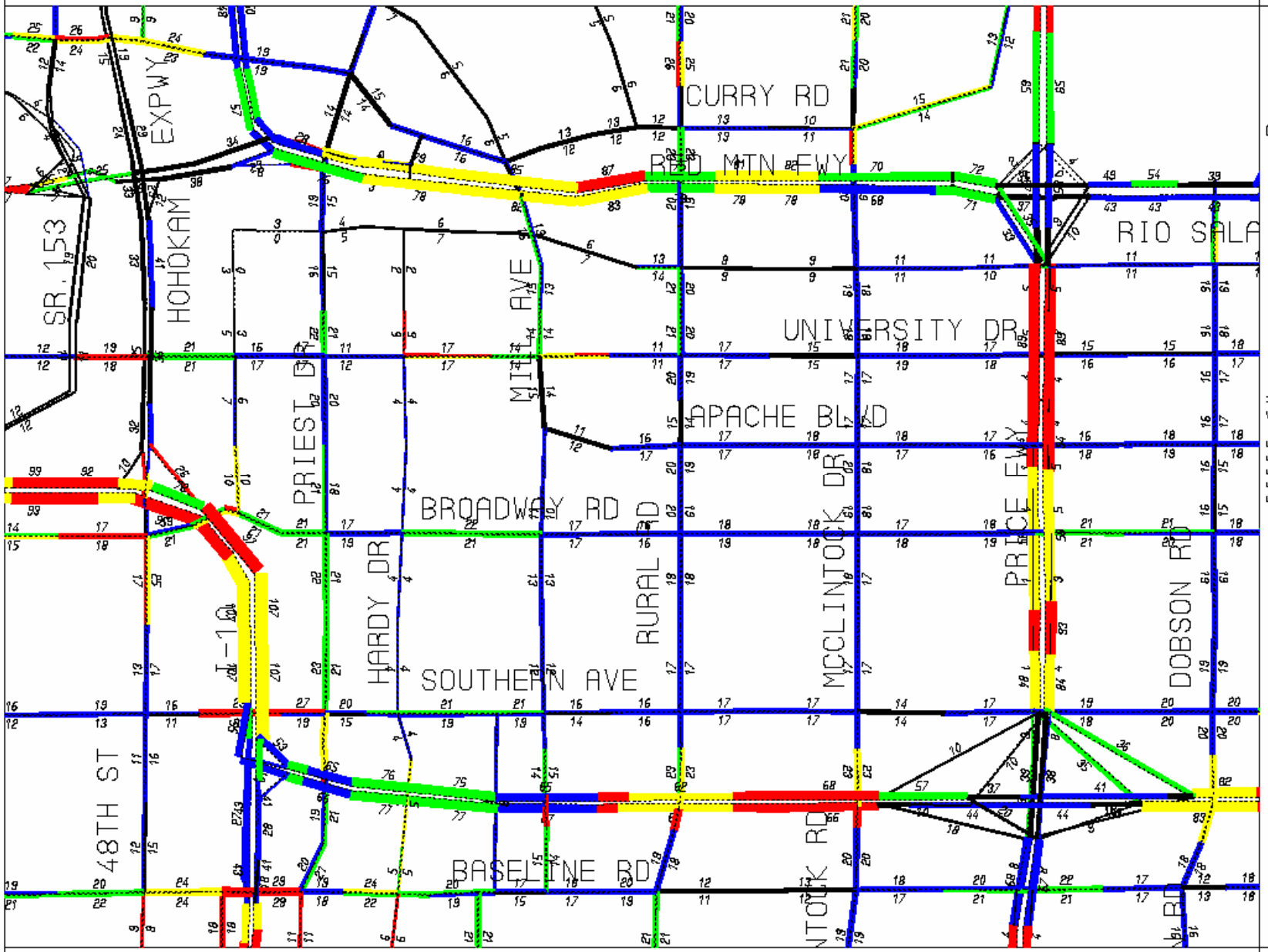
98-04-20 12:30
MODULE: 6.15
MACTPO.....pj

Mode Choice


CHOICE
Motorized
Non-Motorized
Auto
Transit
Walk
Bike
Drive-Alone
Shared-Ride 2+
Drive-Transit
Walk-Transit
Toll
Non-Toll
HOV
Non-HOV
Local Bus
Express Bus
Urban Rail
Local Bus
Express Bus
Urban Rail
PNR
KNR
PNR
KNR
PNR
KNR

Trip Assignment

AVERAGE DAILY TRAFFIC (IN THOUSANDS)



emme/2

LINKS:
mod=a
&!vdf=10.50.10
&!vdf=15.55.10
&!vdf=17.57.10
&!vdf=18.58.10

COL-IND: @vcidx

THRESHOLD:
LOWER: -*******
UPPER: *******

LEGEND

VOLUME/CAPACITY RATIO

LOS A: 0 - .60
LOS B-C: .61 - .90
LOS D: .91 - 1.00
LOS E: 1.01 - 1.10
LOS F: 1.01 - UP

SCALE: 12

20
40
60
80
100

WINDOW:
477266/ 863479
514439/ 891359

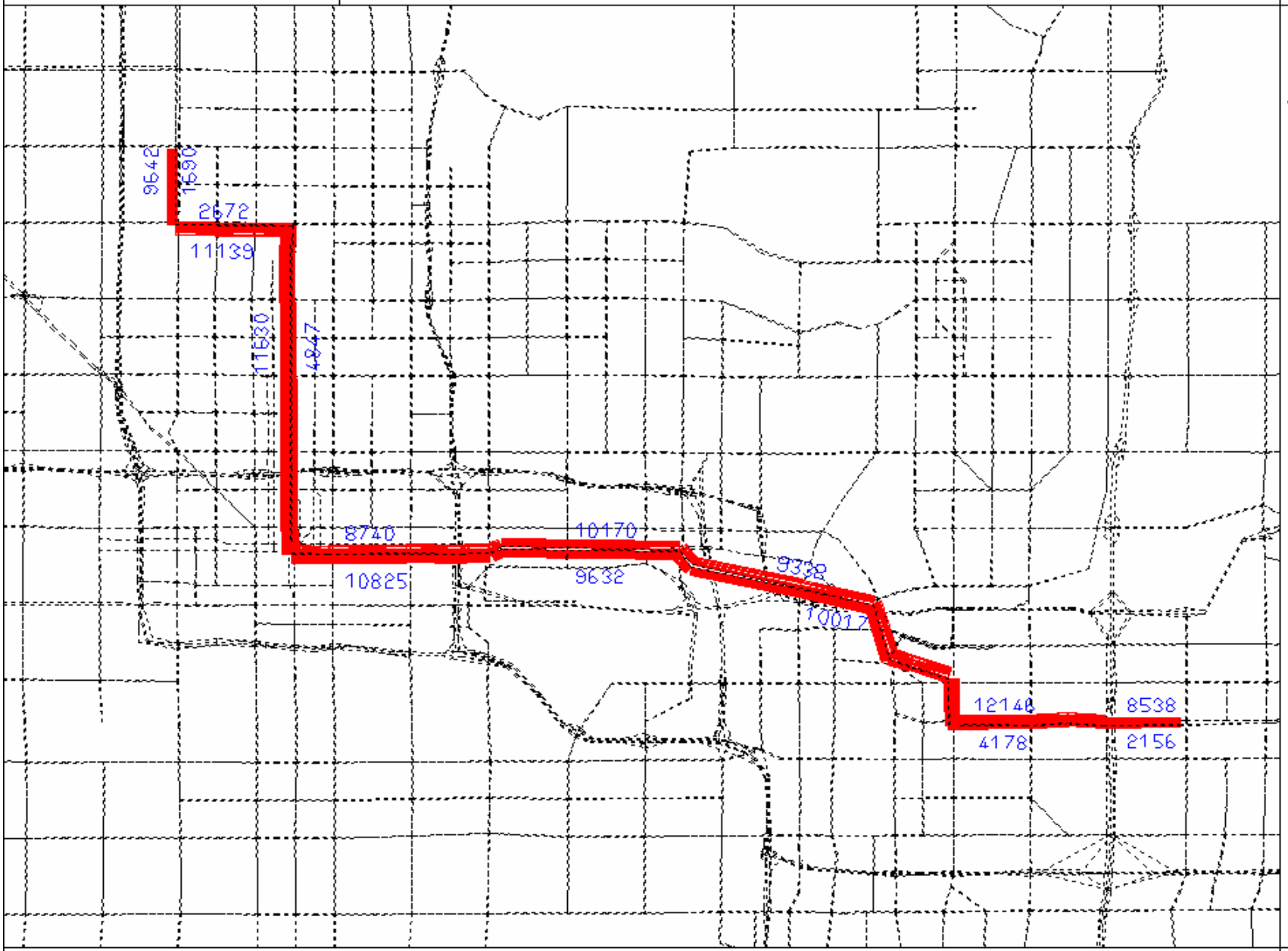
EMME/2 PROJECT: 2015G2
SCENARIO 2: Daily Highway Network
ATTRIBUTE @adt: adt in thousands

98-04-17 13:20
MODULE: 2.13
MACTPO.....pj

MARICOPA ASSOCIATION of GOVERNMENTS

LIGHT RAIL VOLUMES

emme/2



LINKS:
mod=bxsfr

THRESHOLD:
UPPER: 999999

TRANSIT LINES:
900 901

SCALE: 1600

5000
10000
15000
20000
25000

WINDOW:
432436/ 862608
519470/ 927884

EMME/2 PROJECT: "MOS newmc peomov. $const. 2/26 newbuf"
SCENARIO 100 : Total Selected Mode Volumes
ATTRIB. @totl: total selected mode volumes

01-04-20 13:17
MODULE: 2.23
MAG.....pj

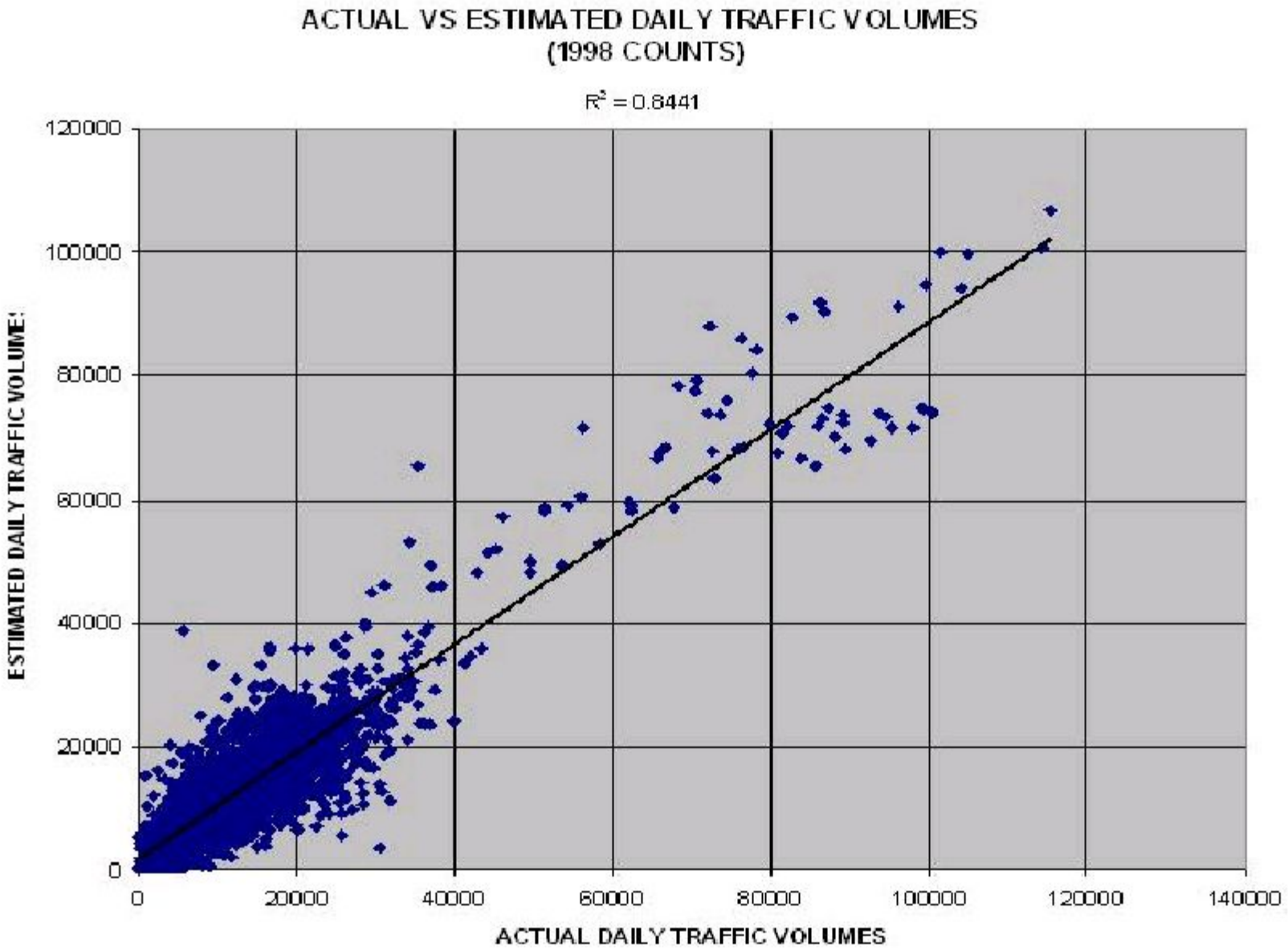
Model Validation

- Highway
- Transit

2002 Highway Validation

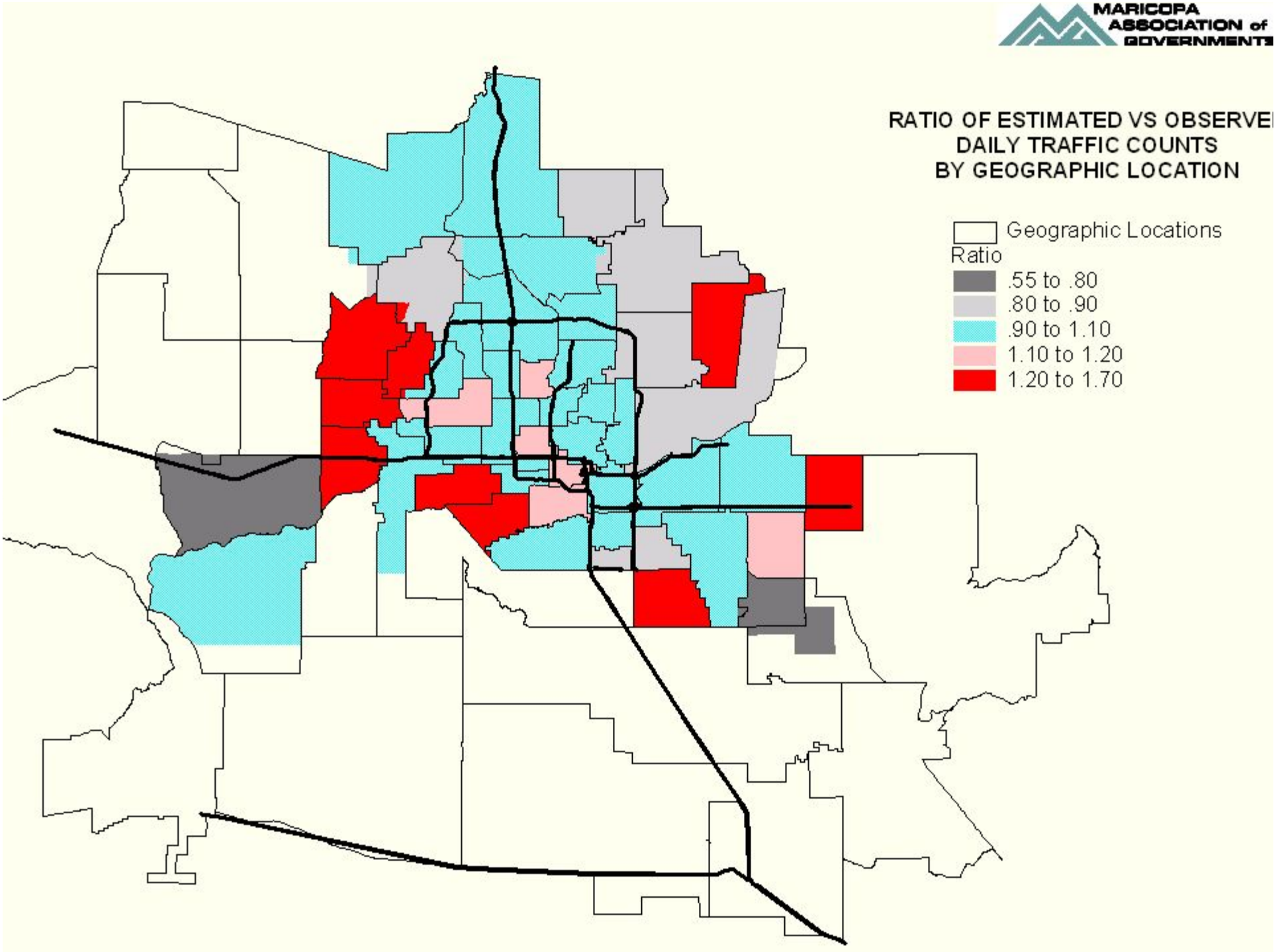
- 2895 One-way Count Locations
- 36% Daily RMSE
- 1.004 Estimated/Observed VMT

MARICOPA
ASSOCIATION of
GOVERNMENTS

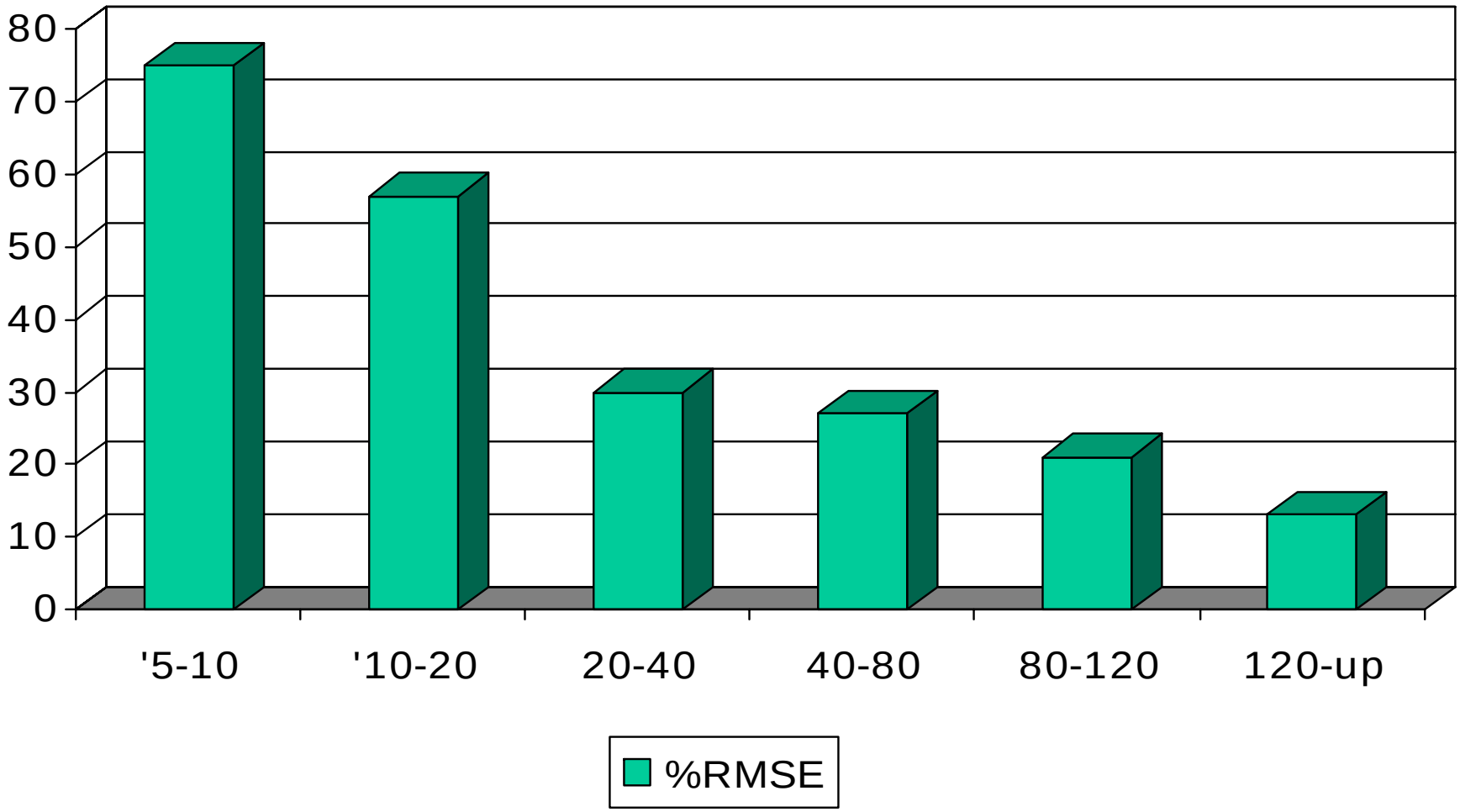

ACTUAL VS ESTIMATED DAILY TRAFFIC VOLUMES
(1998 COUNTS)
R² = 0.8441
ESTIMATED DAILY TRAFFIC VOLUME
ACTUAL DAILY TRAFFIC VOLUMES
0
20000
40000
60000
80000
100000
120000
140000

MARICOPA ASSOCIATION of GOVERNMENTS

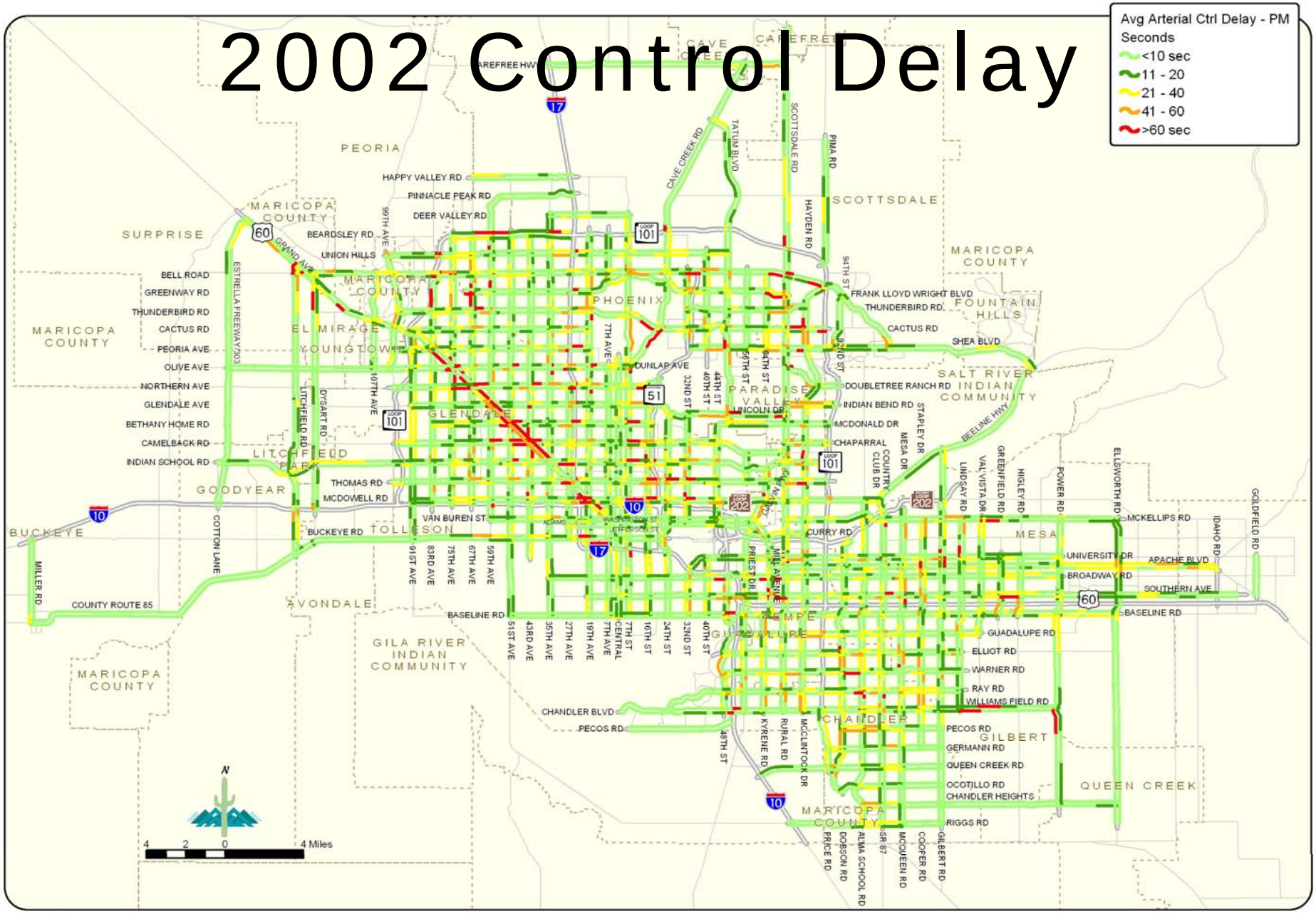
RATIO OF ESTIMATED VS OBSERVED DAILY TRAFFIC COUNTS BY GEOGRAPHIC LOCATION



%RMSE by Volume (in thousends)



2002 Control Delay



MARICOPA ASSOCIATION of GOVERNMENTS

Average Arterial Control Delay - PM

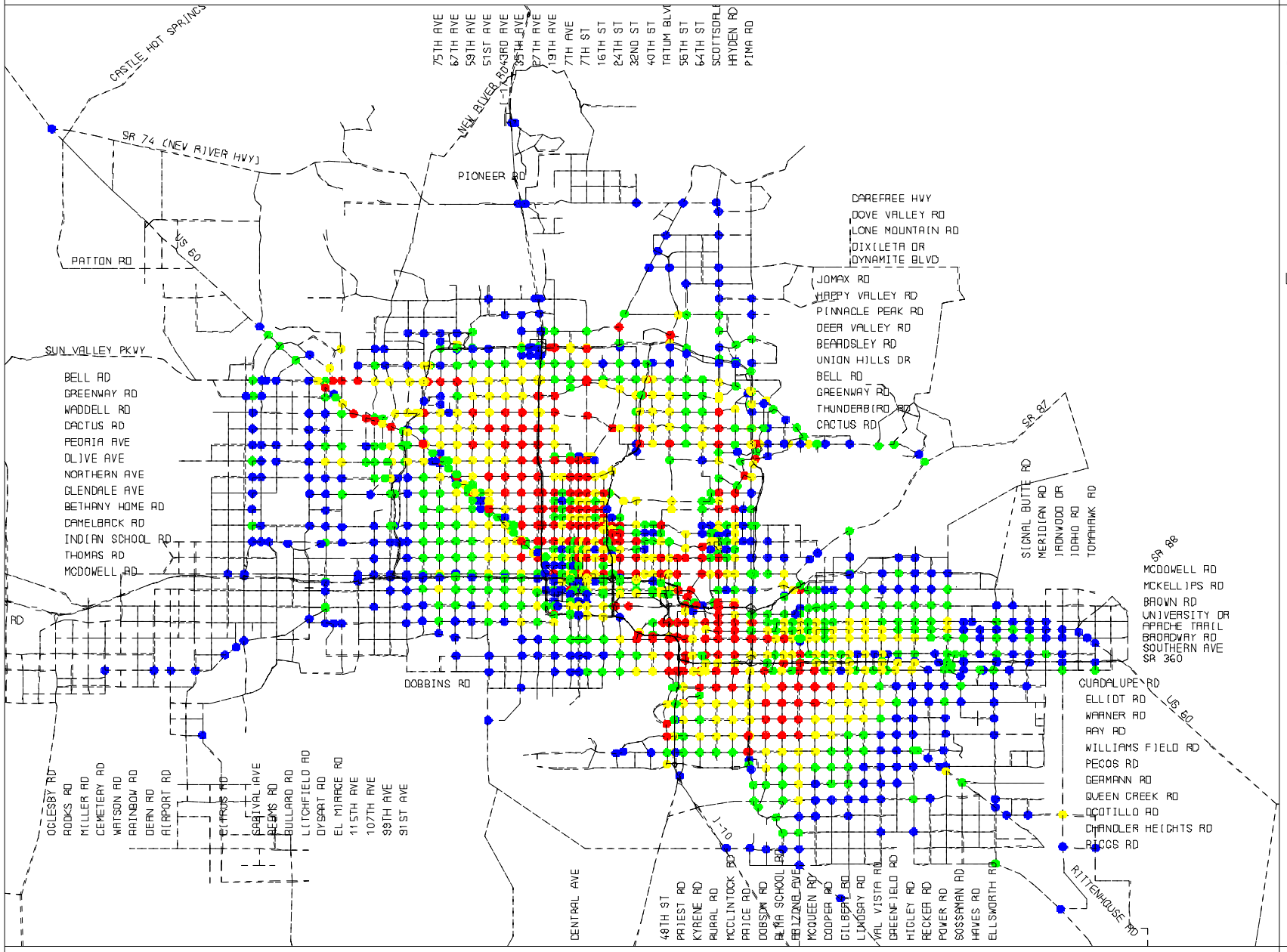
Source: MAG 2003 Regional Travel Speed Study

Carter Burgess

MARICOPA ASSOCIATION of GOVERNMENTS

2004 INTERSECTION LOS

emme/2



LINKS:
!vdf=15,55,10
COL-IND:UI2

THRESHOLD:
LOWER: -*****
UPPER: 999999

LEVEL OF SERVICE

A	[blank]
B	
C	
D	
E-F	

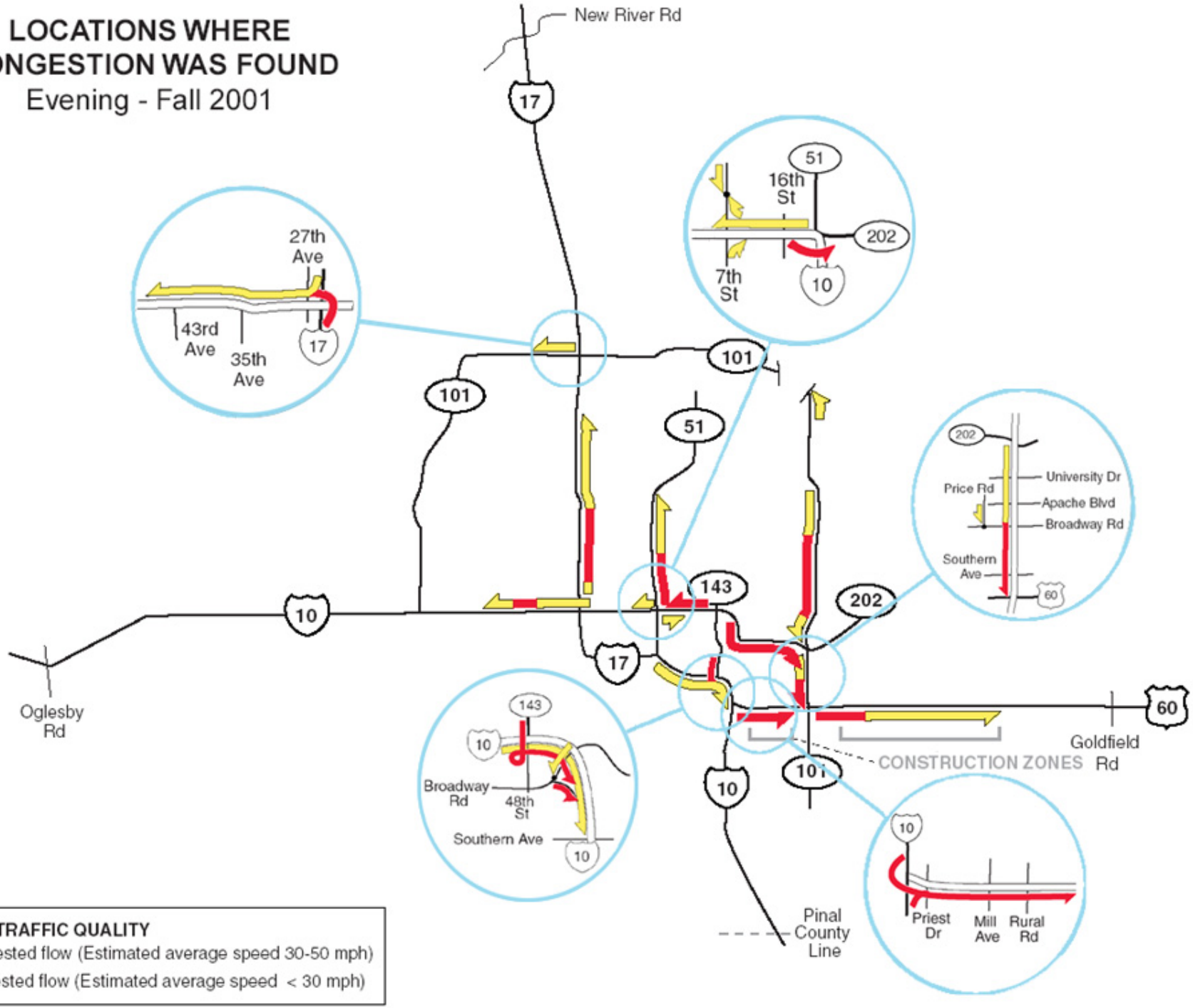
WINDOW:
467047/ 775007
877477/1082830

EMME/2 PROJECT: 2004MarkAll New W ConformityRR2005/03/0604:31 PM
SCENARIO 6000: PM PK HR ASSIGNMENT

05-08-25 14:22
MODULE: 2.13
MAG.....VL

LOCATIONS WHERE CONGESTION WAS FOUND

Evening - Fall 2001



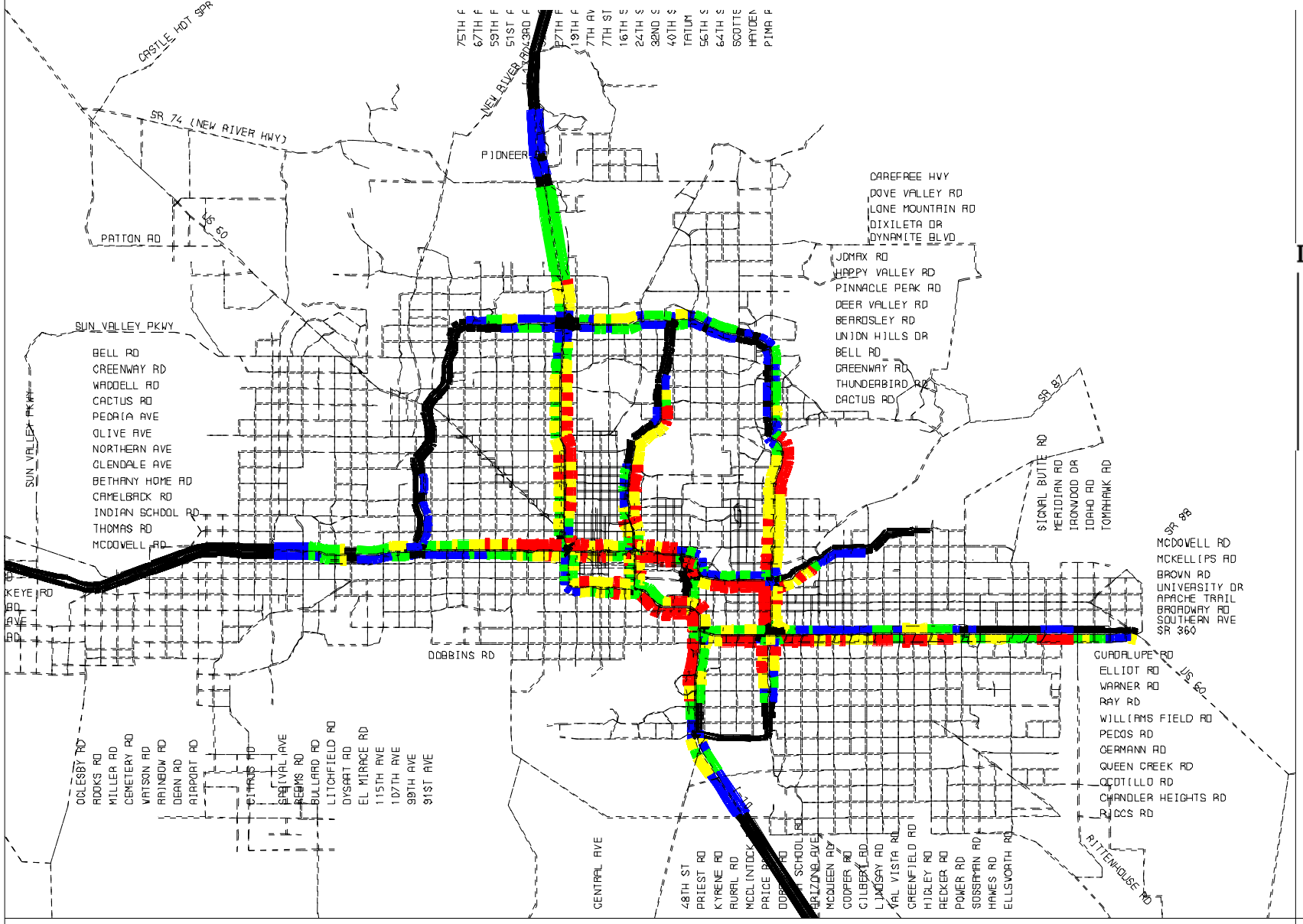
MARICC
ASSOC
COV

2004-PM PK HR LOS

me/2

INKS:
=15,55,10

COL-IND:@vc2



Level of Service

A	
B	
C	
D	
E-F	

SCALE: .125

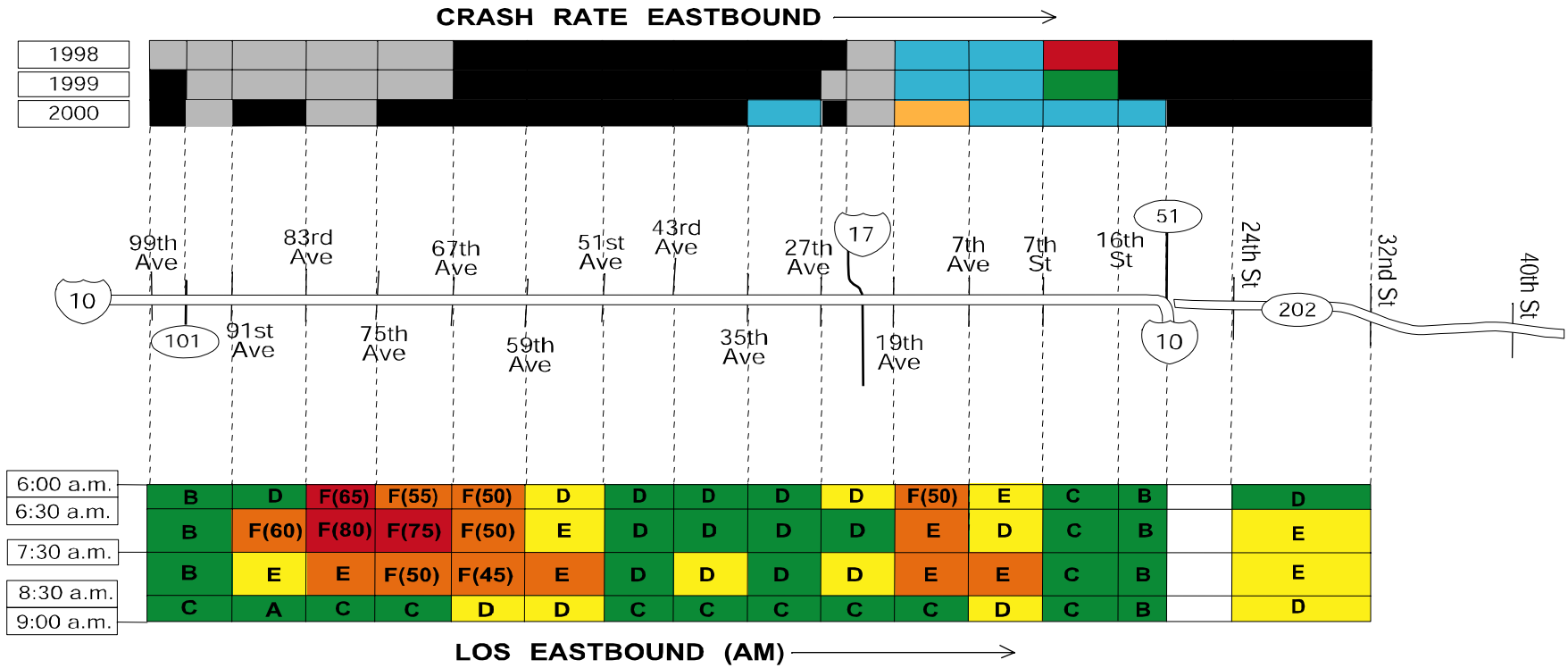
WINDOW:
457258/ 773641
878767/1089773

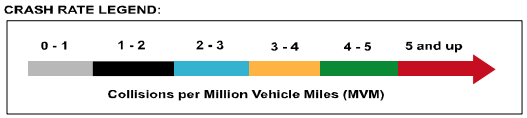
EMME/2 PROJECT: 2004MarkAll New W ConformityRR2005/03/0604:31 PM
SCENARIO 6000: PM PK HR ASSIGNMENT
ATTRIBUTE @vc1: vcrat

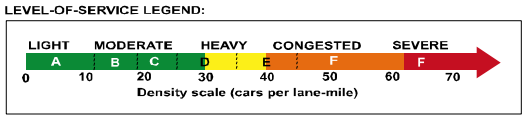
05-08-25 13:43
MODULE: 2.13
MAG.....VL

Observed Freeway Conditions

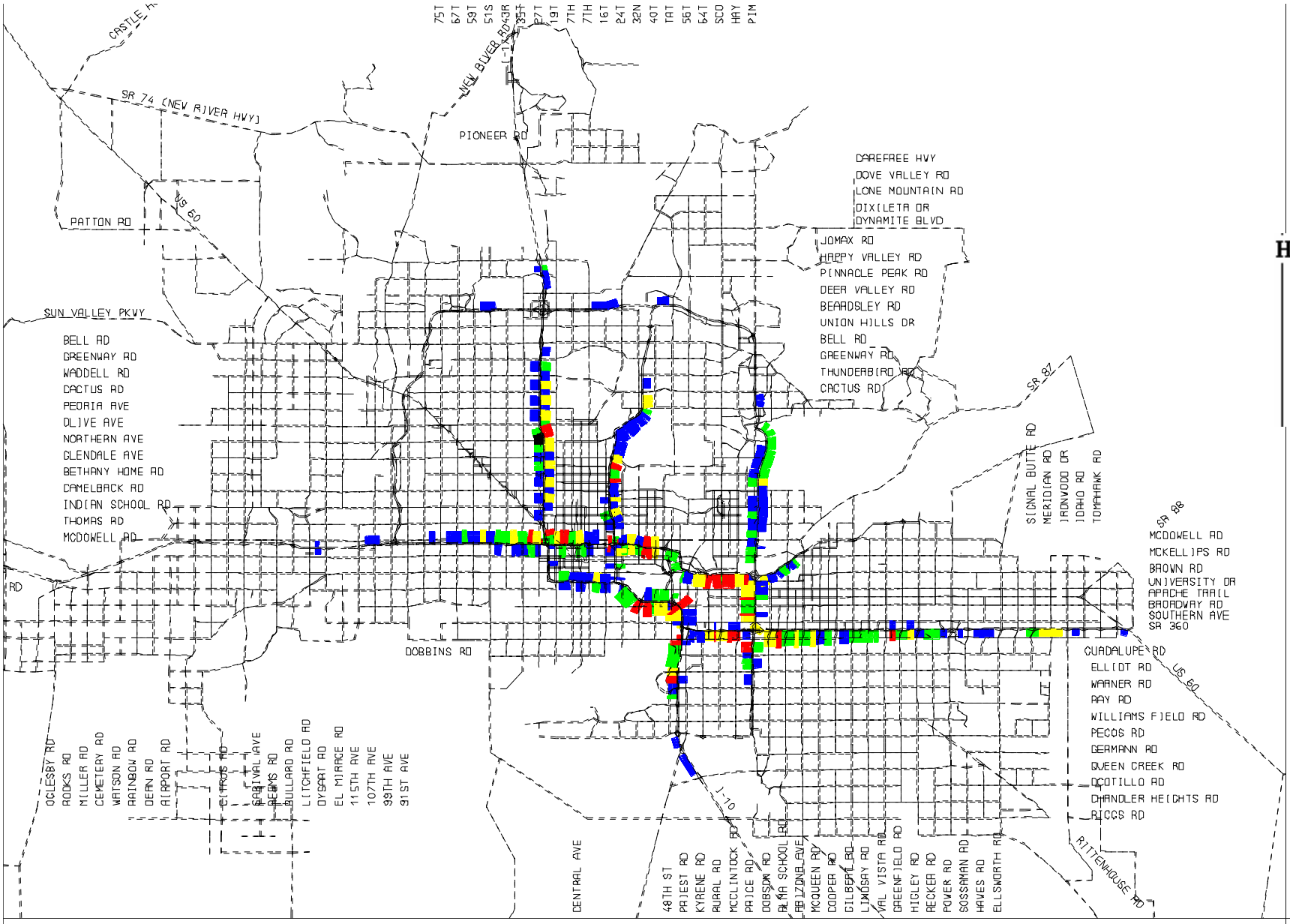
Bottleneck A
I-10 Eastbound, 99th Avenue to
32nd Street (on Loop 202)
Fall 2001







2004-Duration of LOS E & F



5,1
COL-IND:@hrid
THRESHOLD:
LOWER: -*****
UPPER: 999999

HRS OF LOS E &

< 1.0
1.0-2.0
2.0-3.0
> 3.0

SCALE: 2.5

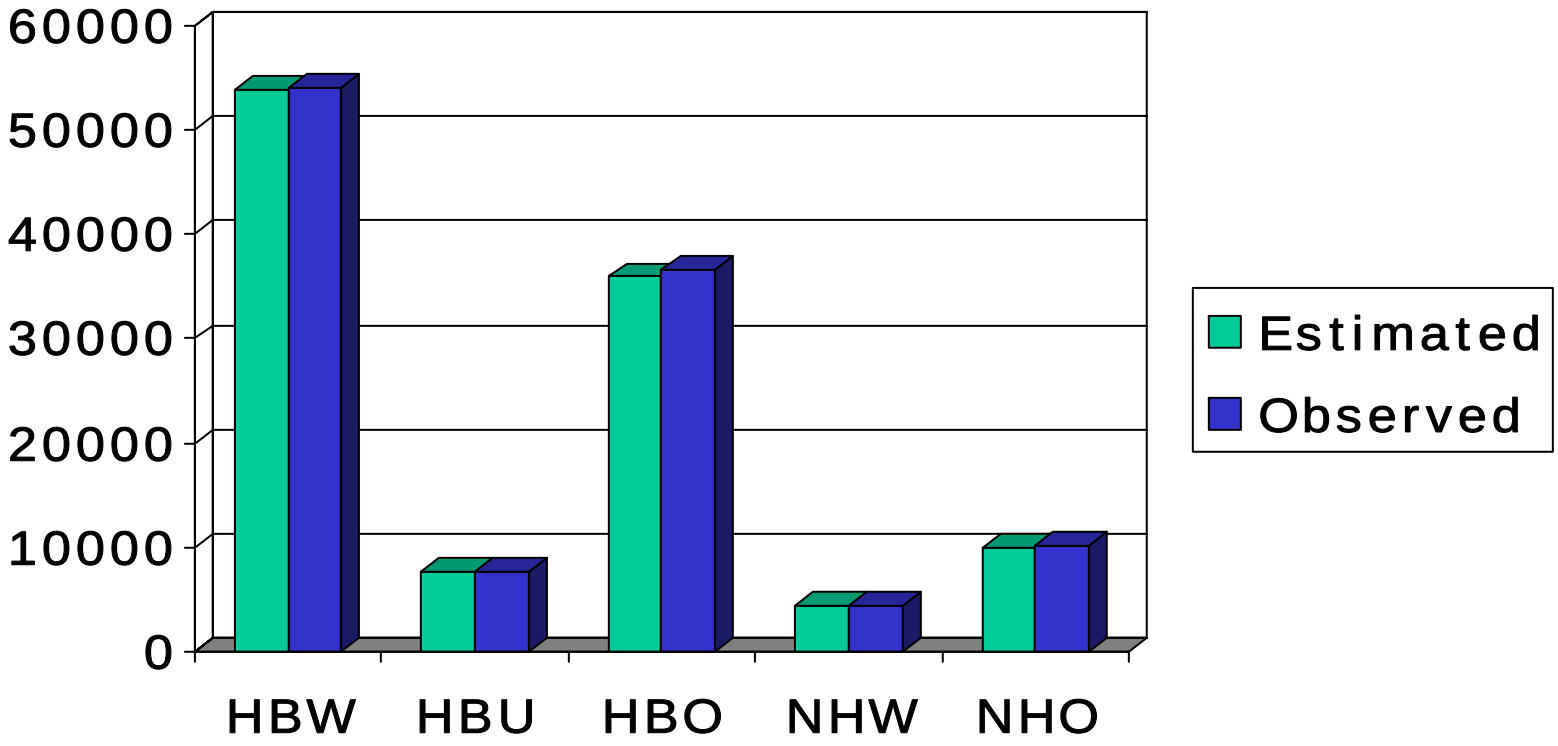
5
10
15
20
25

WINDOW:
467047/ 77500
877477/108283

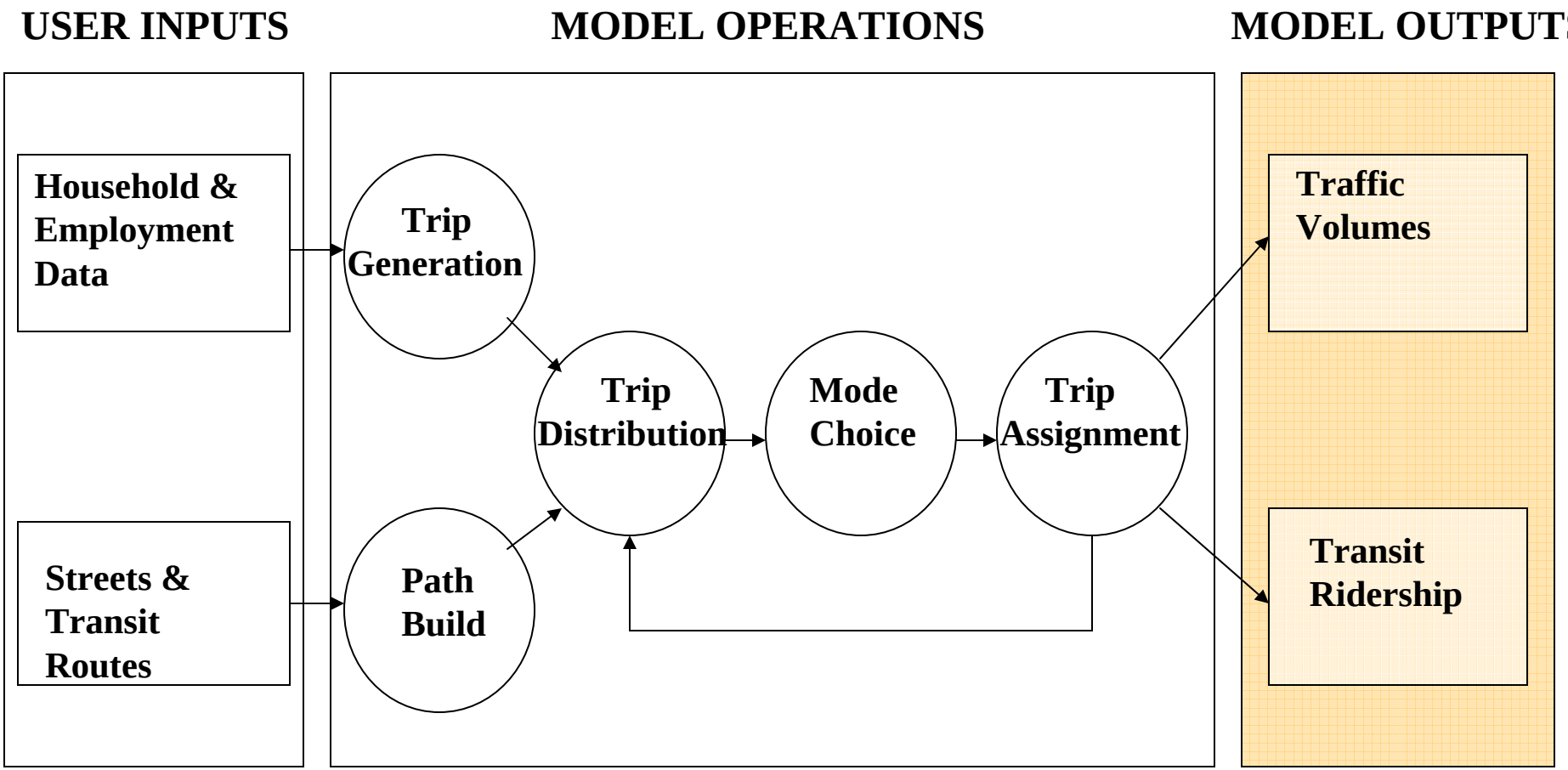
EMME/2 PROJECT: 2004MarkAll New W ConformityRR2005/03/0604:31 PM
SCENARIO 600: PM PEAK PERIOD MULTICLASS ASGMT

05-08-25 14:0
MODULE: 2.1

Estimated vs Observed Transit Trips by Purpose



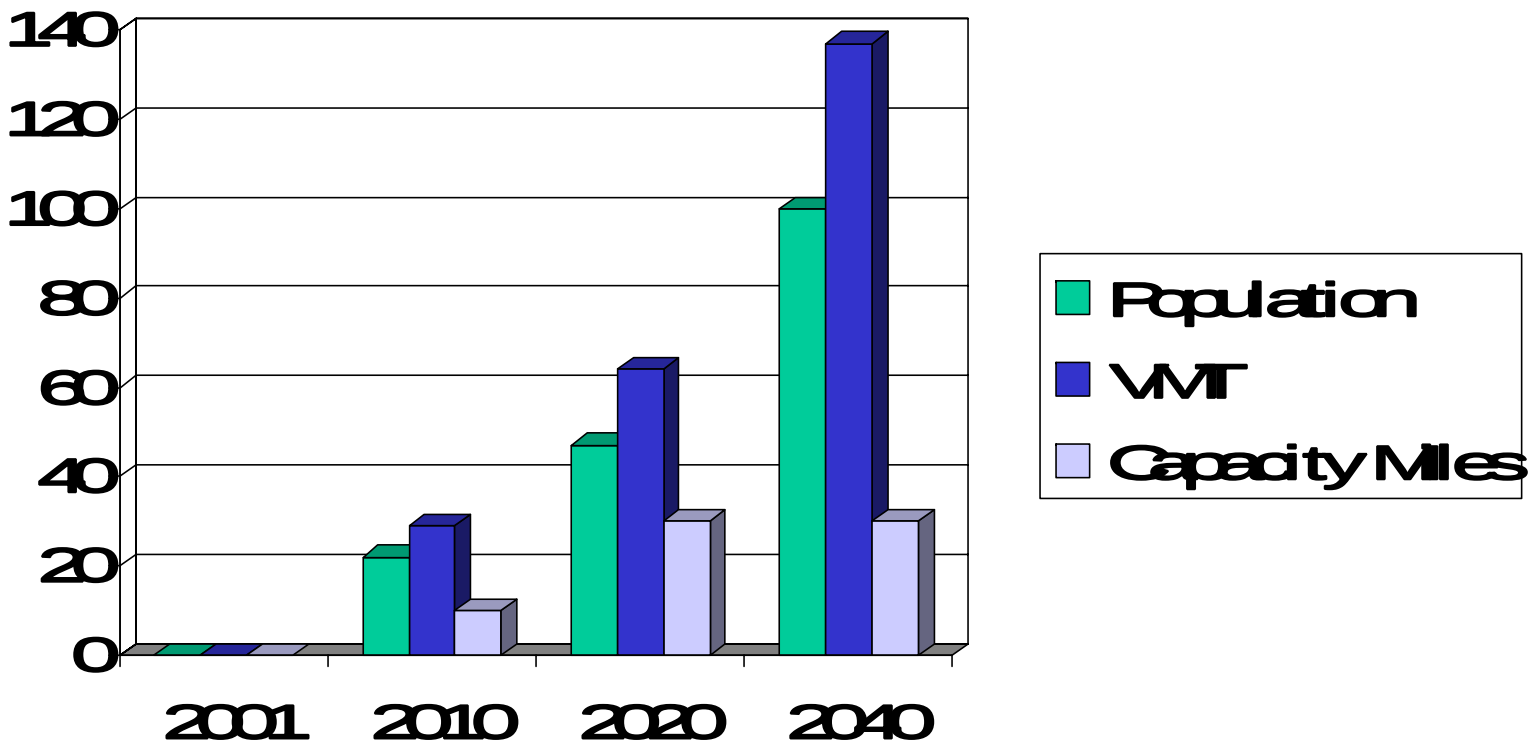
MAG Travel Demand Model

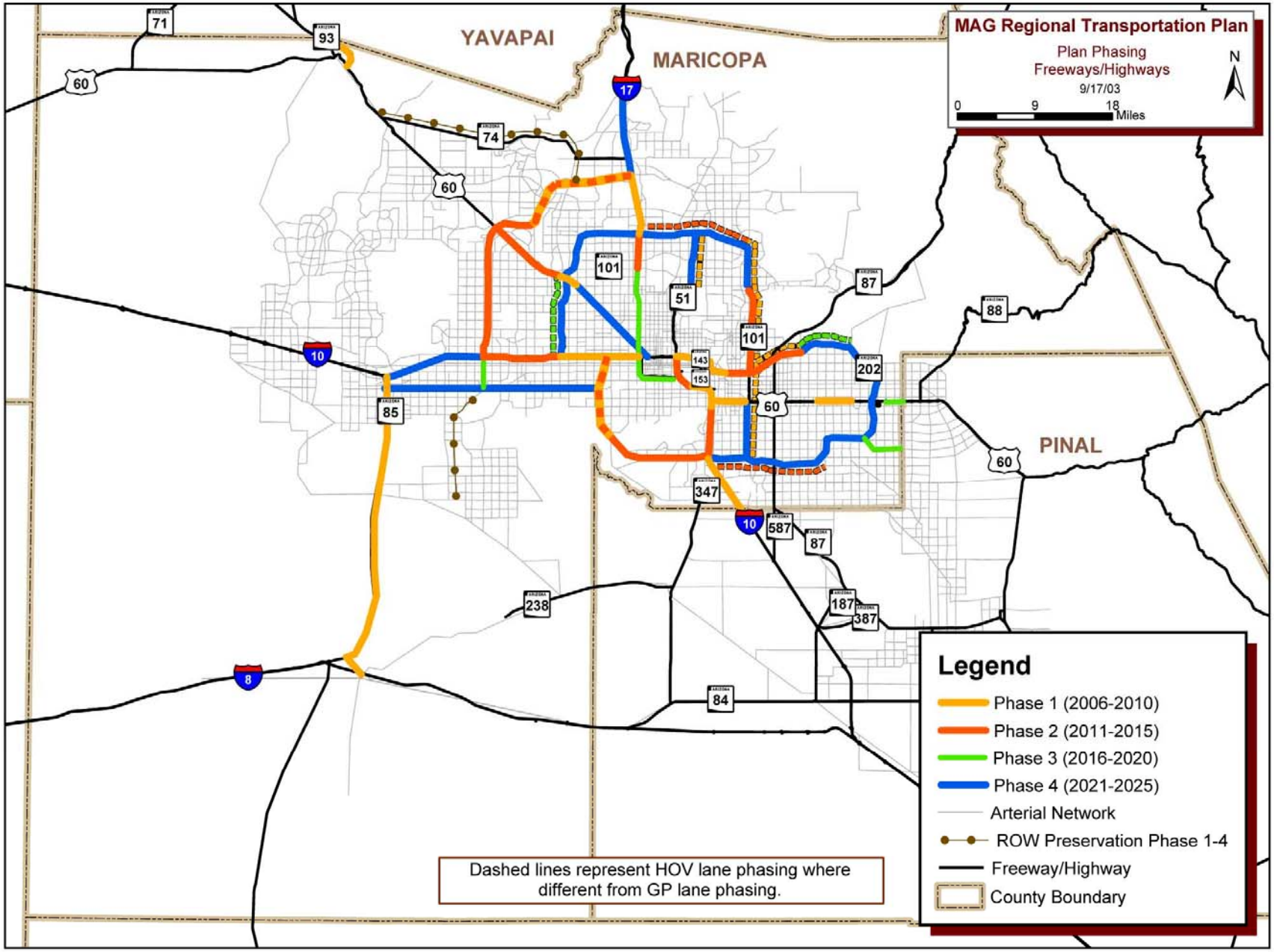


Model Outputs

- Freeway Level of Service
- Intersection Level of Service
- Travel Paths
- Transit Ridership
- Total travel

% Increase


140
120
100
80
60
40
20
0
2001
2010
2020
2040
Population
VMT
Capacity Miles

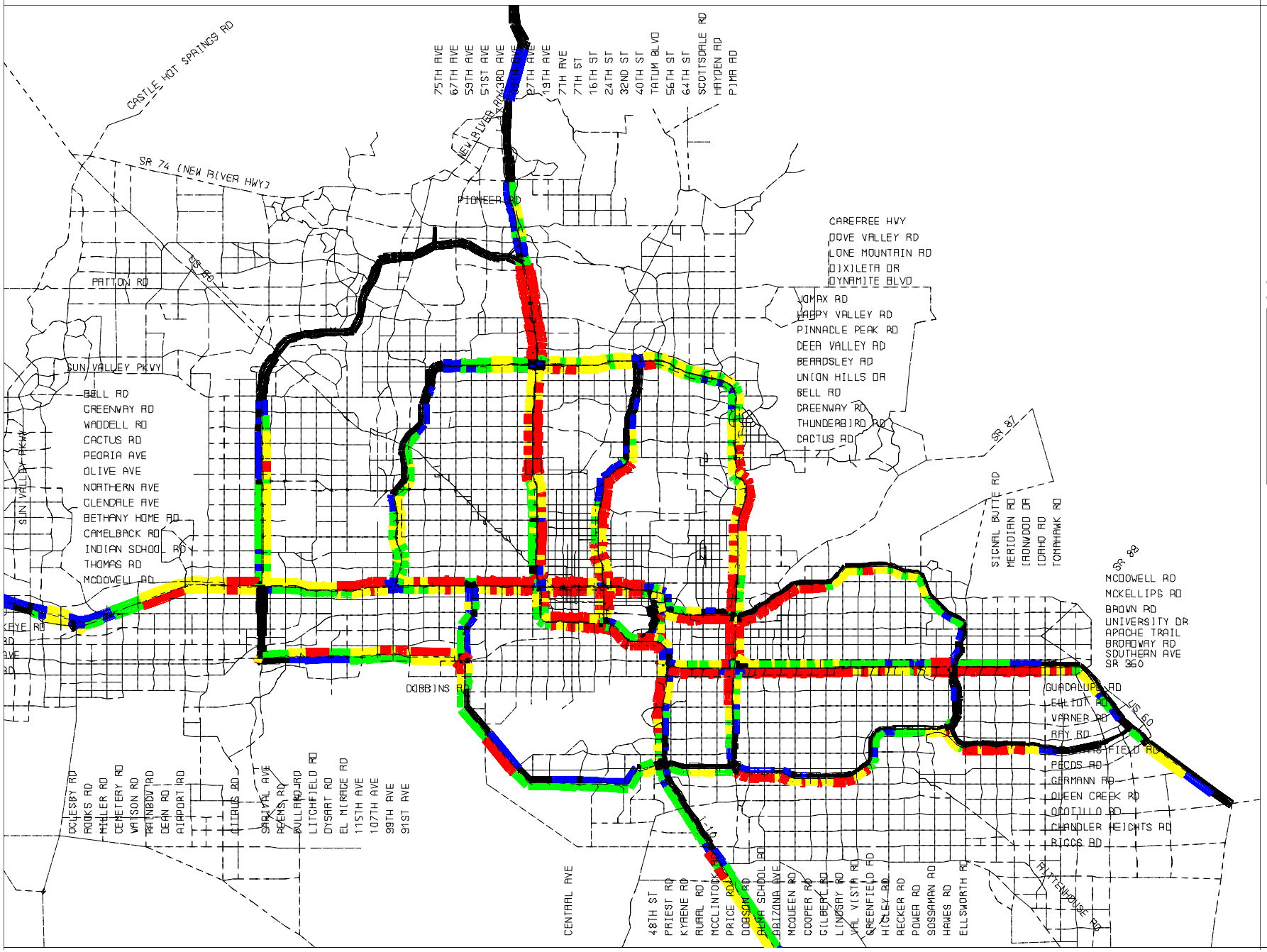

MAG Regional Transportation Plan
Plan Phasing
Freeways/Highways
9/17/03
0 9 18 Miles
N
YAVAPAI
MARICOPA
PINAL
Legend
Phase 1 (2006-2010)
Phase 2 (2011-2015)
Phase 3 (2016-2020)
Phase 4 (2021-2025)
Arterial Network
ROW Preservation Phase 1-4
Freeway/Highway
County Boundary
Dashed lines represent HOV lane phasing where different from GP lane phasing.
E:Projects\MAG\RTP\RTP_TAC\phase_plan090803\freeway_phase090803.mxd

Level of Service C

Level of Service F

MARICOPA ASSOCIATION of GOVERNMENTS

PM PK HR LEVEL OF SERVICE



LINKS
!vdf=15,
COL-IND:@
THRESH(
LOWER: -*
UPPER: 99

Level of S

A
B
C
D
E-F

SCALE:
5
1
1.5
2
2.5

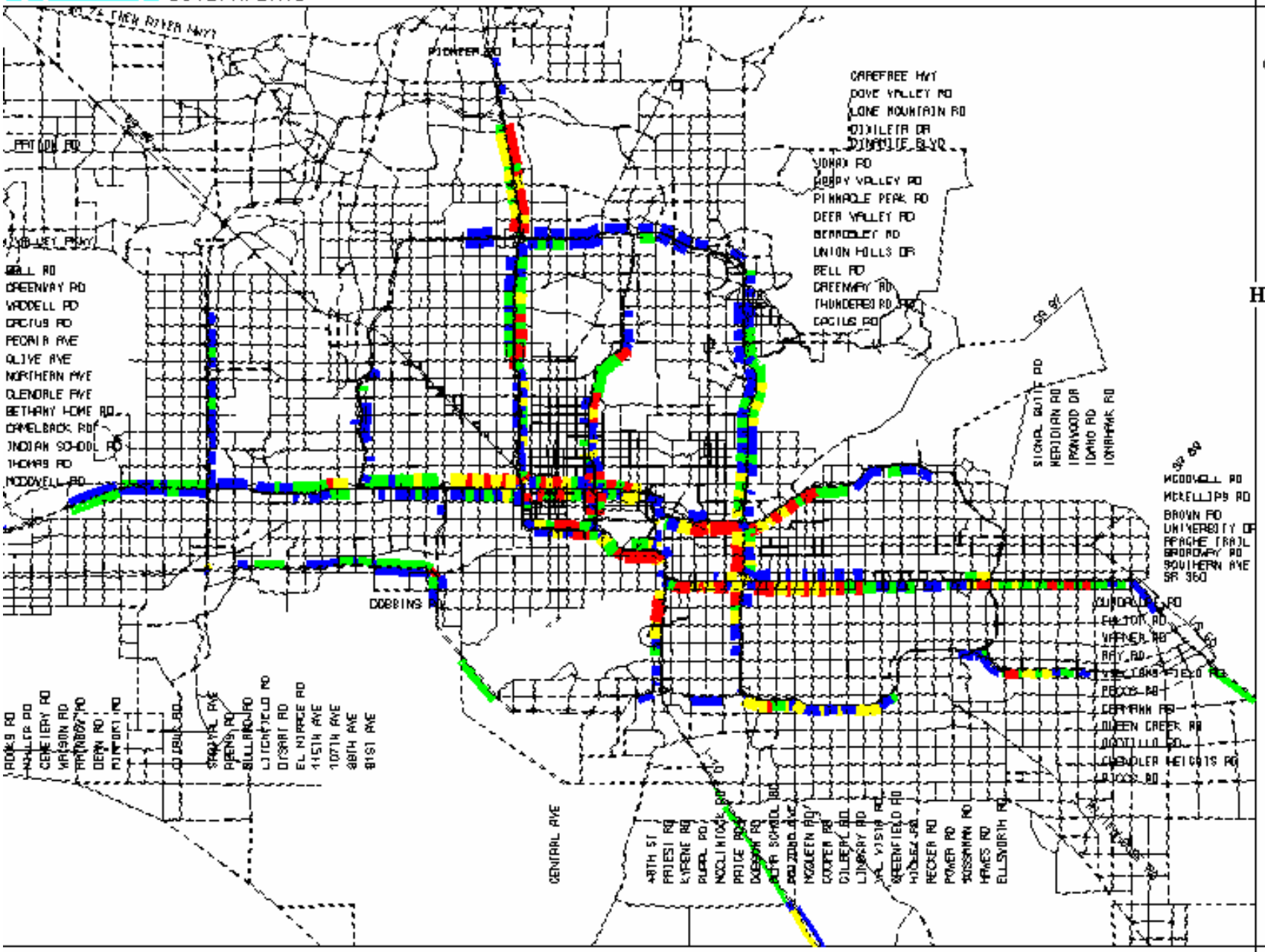
WINDOW
458812/ 7
886044/10

MARICOPA ASSOCIATION of GOVERNMENTS

DURATION OF LOS E & F

emme/2

LINKS:
!vdf=15,55,10
COL-IND:@hridx
THRESHOLD:
LOWER: -*****
UPPER: 999999



HRS OF LOS E & F

- < 1.0
- 1.0-2.0
- 2.0-3.0
- > 3.0

WINDOW:
484077/ 757808
861003/1040503

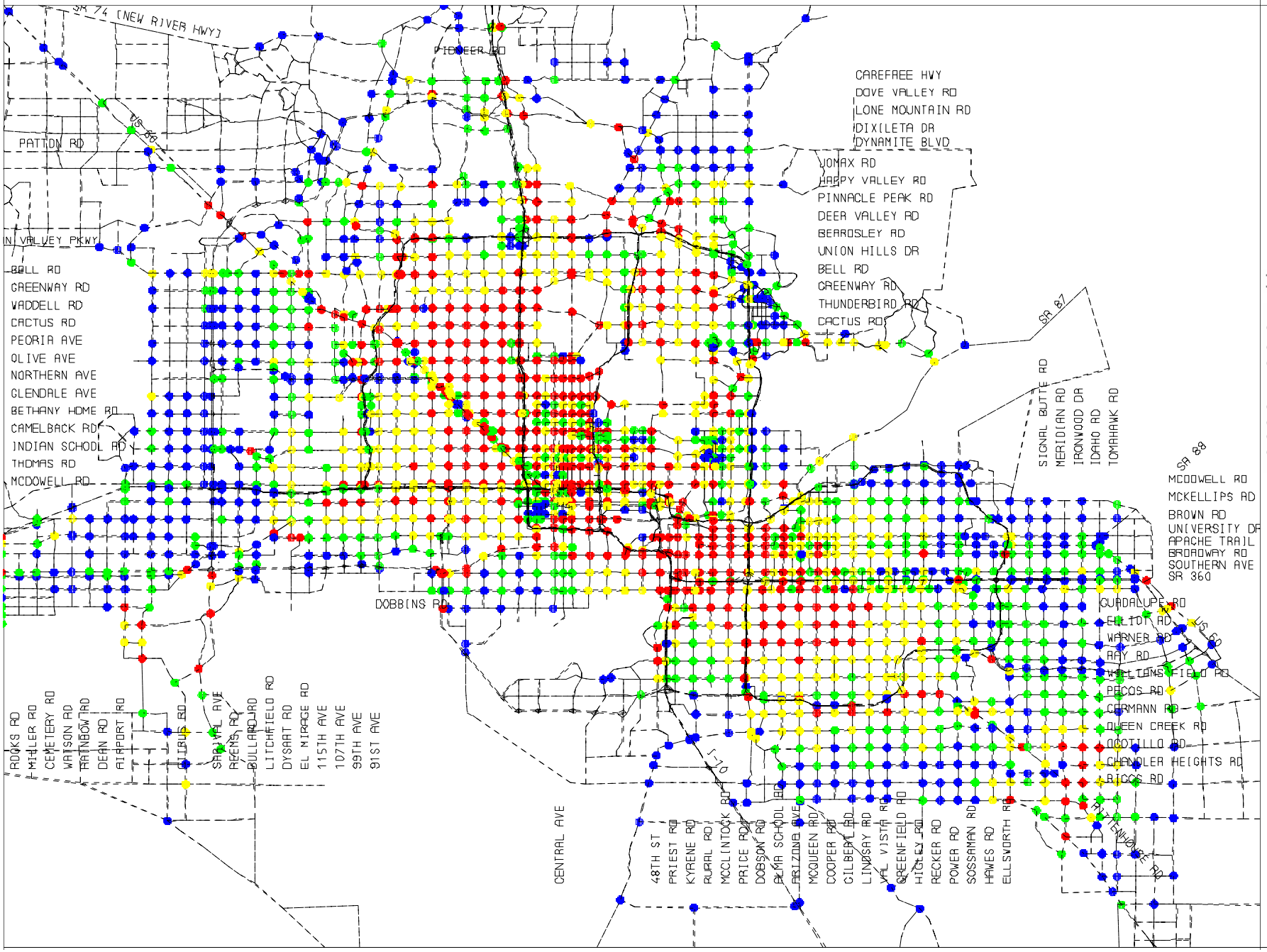
EMME/2 PROJECT: 2026MarkAll New W ConformityRR2005/22/04
SCENARIO 600: PM PK PERIOD ASSIGNMENT
ATTRIBUTE @vol: pk period volumes (000's)

05-08-25 12:35
MODULE: 2.13
MAG.....VL

Level of
Service F

MARICOPA ASSOCIATION of GOVERNMENTS

INTERSECTION LOS



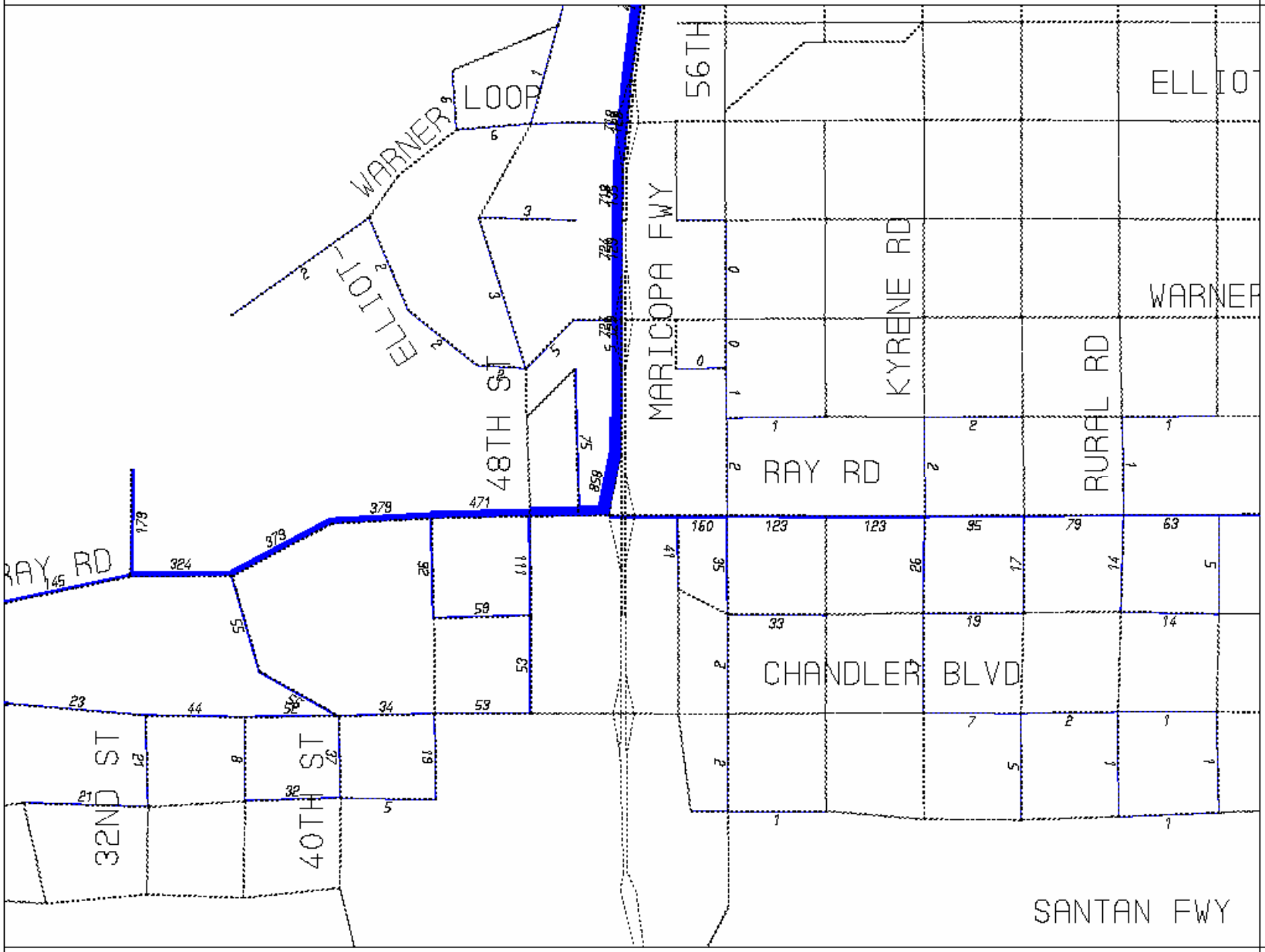
LINKS
!vdf=15,
COL-IND:U
THRESH(
LOWER: -*
UPPER: 99

LEVEL OF SI

A [bl
B
C
D
E-F

WINDOW
484077/ 7
861003/10

SELECT LINK FOR I-10 SB-OFF RAMP AT RAY RD



LINKS:
mod=a

SCALE: 100
200
400
600
800
1000

WINDOW:
466546/ 832263
500418/ 857667

EMME/2 PROJECT: 2000 BUILD W/T2000R2 w/runall5 (revised)
SCENARIO 100: select link

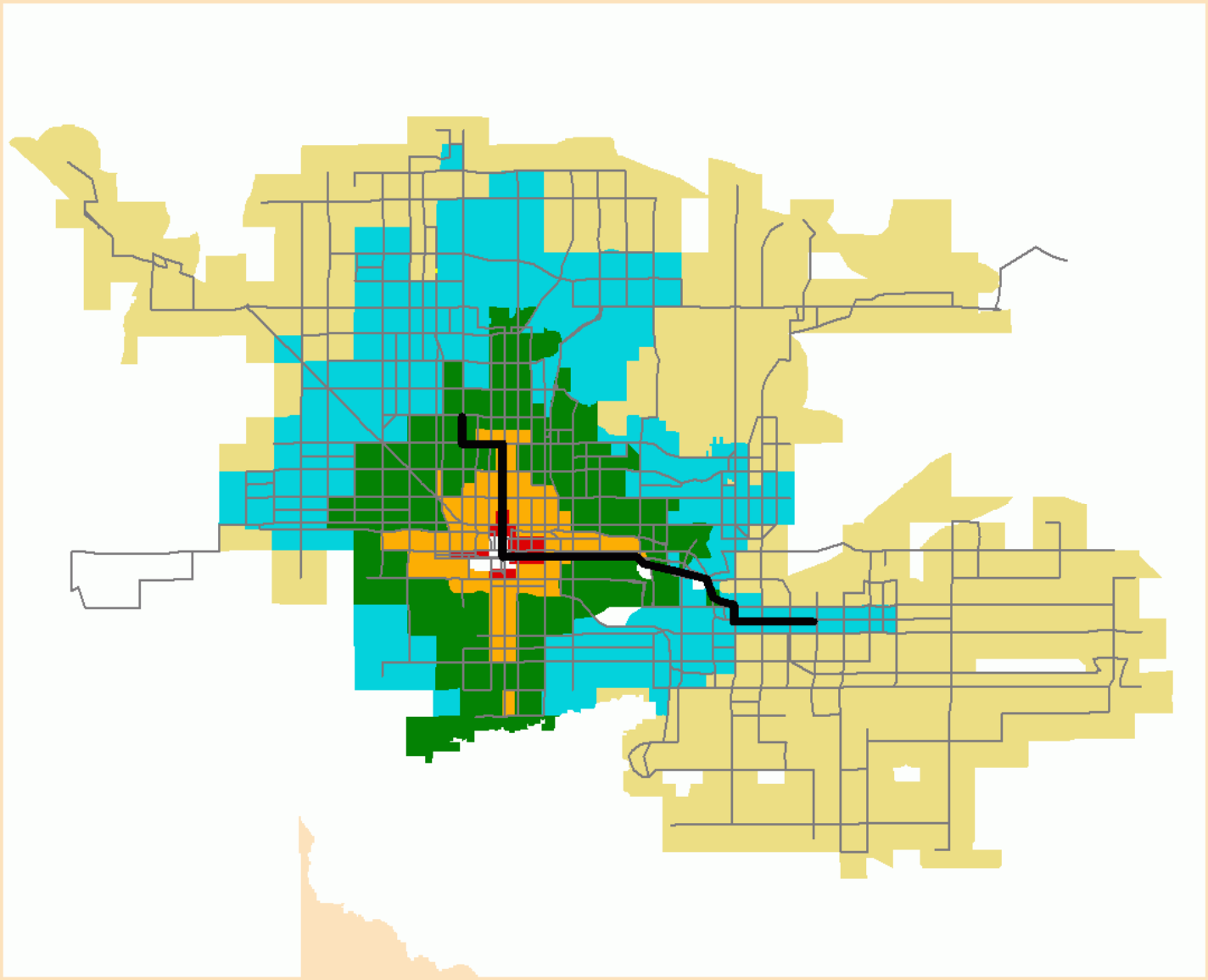
98-04-17 17:08
MODULE: 6.12
MACTPO.....pj

Central Phoenix/East Valley PE/DEIS

MARICOPA ASSOCIATION of GOVERNMENTS

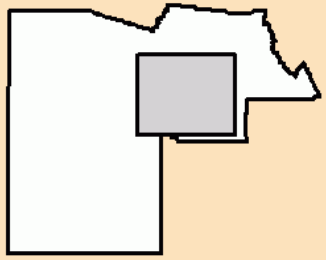
ZONE 842
1998
WEIGHTED
TRAVEL TIME
WALK TO LOCAL BUS

Maricopa County, Arizona
(Transit Service Area)



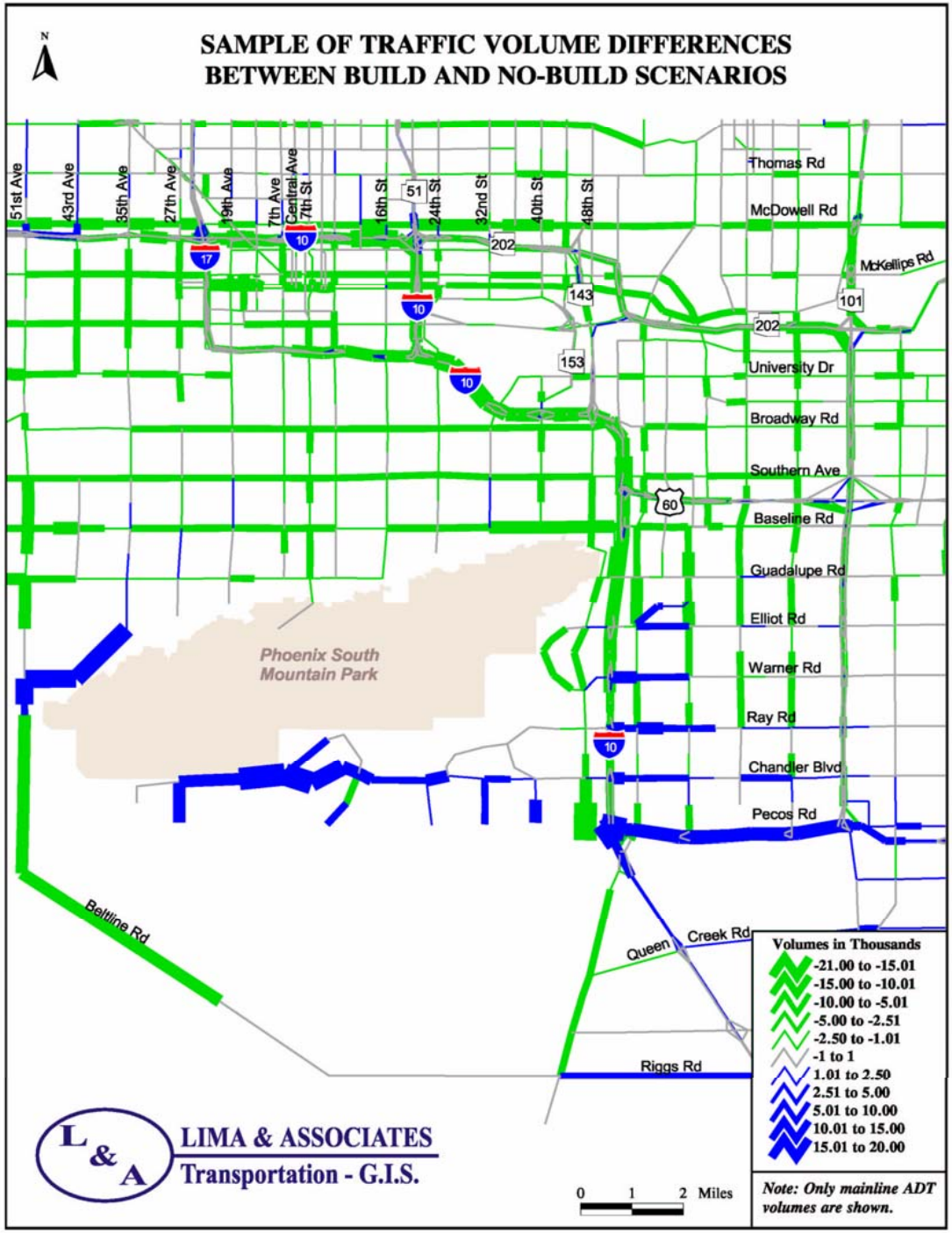
Travel Time
- Disconnected
- 10 to 20 minutes
- 20 to 30 minutes
- 30 to 45 minutes
- 60 to 90 minutes
- more than 90 minutes
- Light Rail Route
- Transit Network

MAP AREA

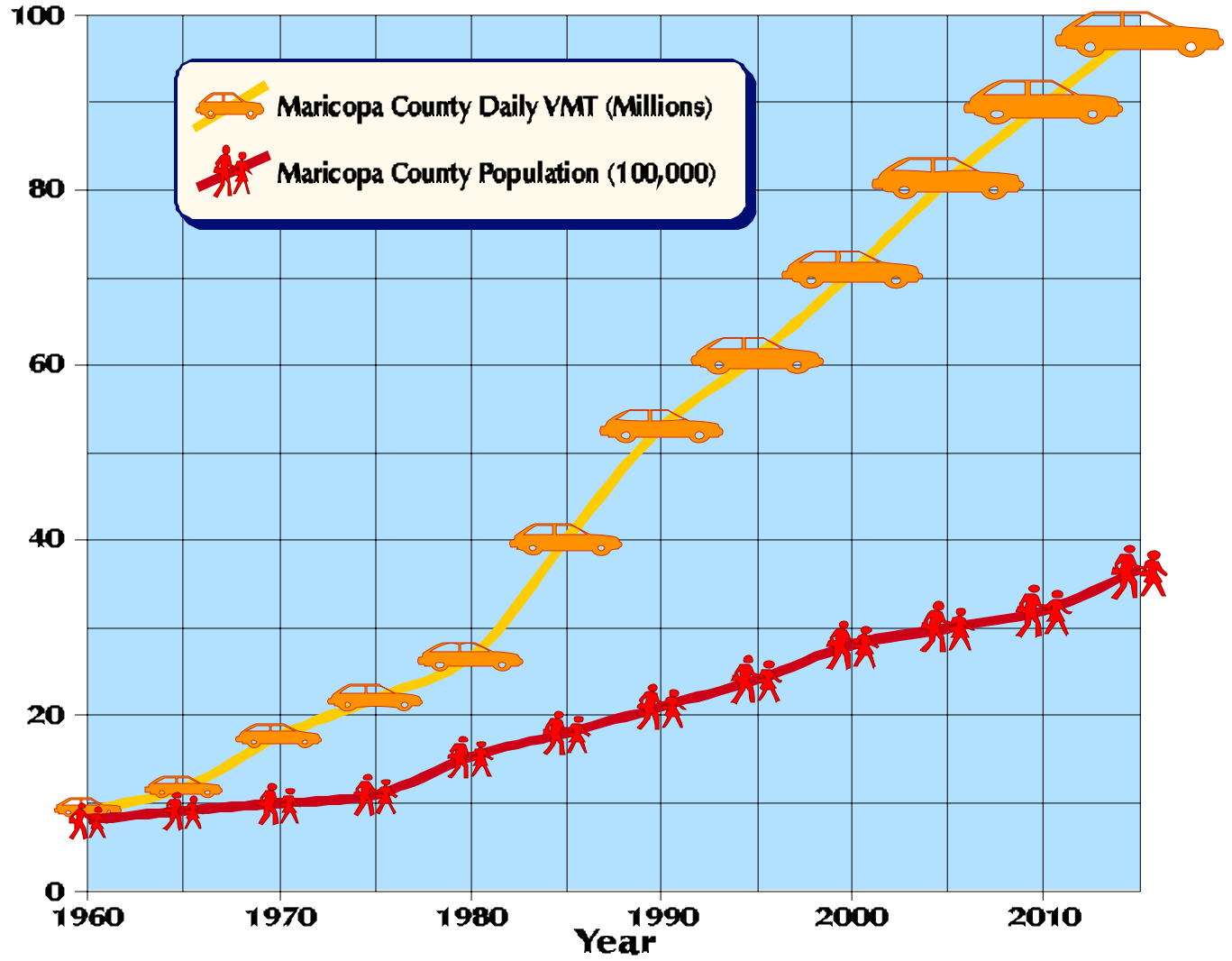


Source: MAG Transportation Model, 2000
RPTA Transit Networks

SAMPLE OF TRAFFIC VOLUME DIFFERENCES BETWEEN BUILD AND NO-BUILD SCENARIOS



Population and Average Daily VMT



Recent Projects

- **Household Travel Survey**
- **Travel Speed Study**
- **Traffic Volume Study**
- **Freeway Bottleneck Study**

Current Projects

- Arterial Traffic Volume Survey
- Freeway Level of Service Study
- Auto Occupancy Survey

Agencies That Have the MAG Model

- Phoenix
- Maricopa County
- Regional Public Transportation Authority
- Scottsdale
- Tempe
- Mesa

Agencies Supported

- ADOT
- Buckeye
- Chandler
- Fountain Hills
- Gila River Indian Community
- Gilbert
- Glendale
- Goodyear
- Mesa
- Peoria
- Phoenix
- Pima Association of Governments
- Salt River Pima-Maricopa Indian Community
- US HUD

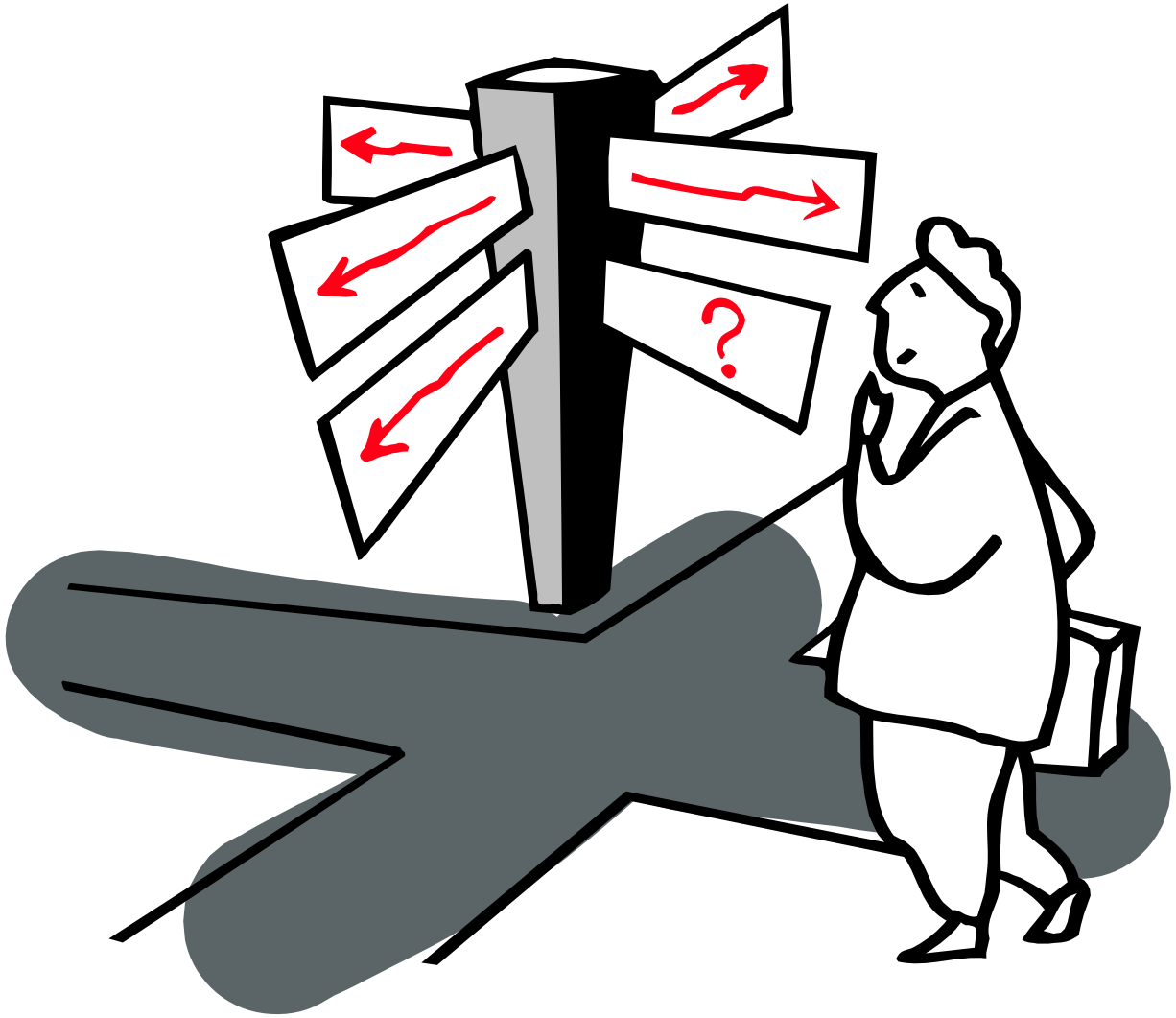
Transportation Modeling Overview

For more information

Mark Schlappi

(602) 254-6300

Schlappi@mag.maricopa.gov

MARICOPA ASSOCIATION of GOVERNMENTS

Questions?