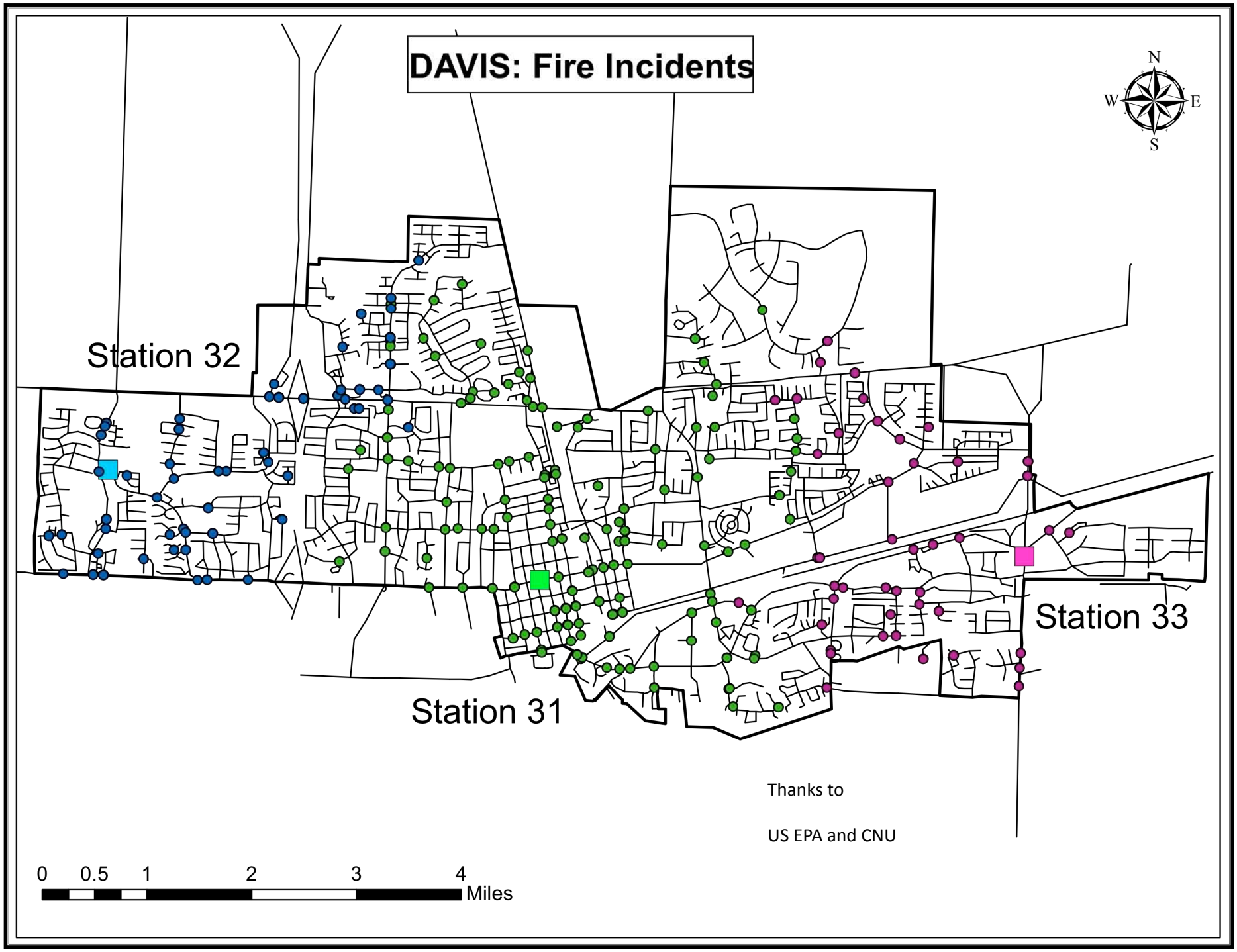
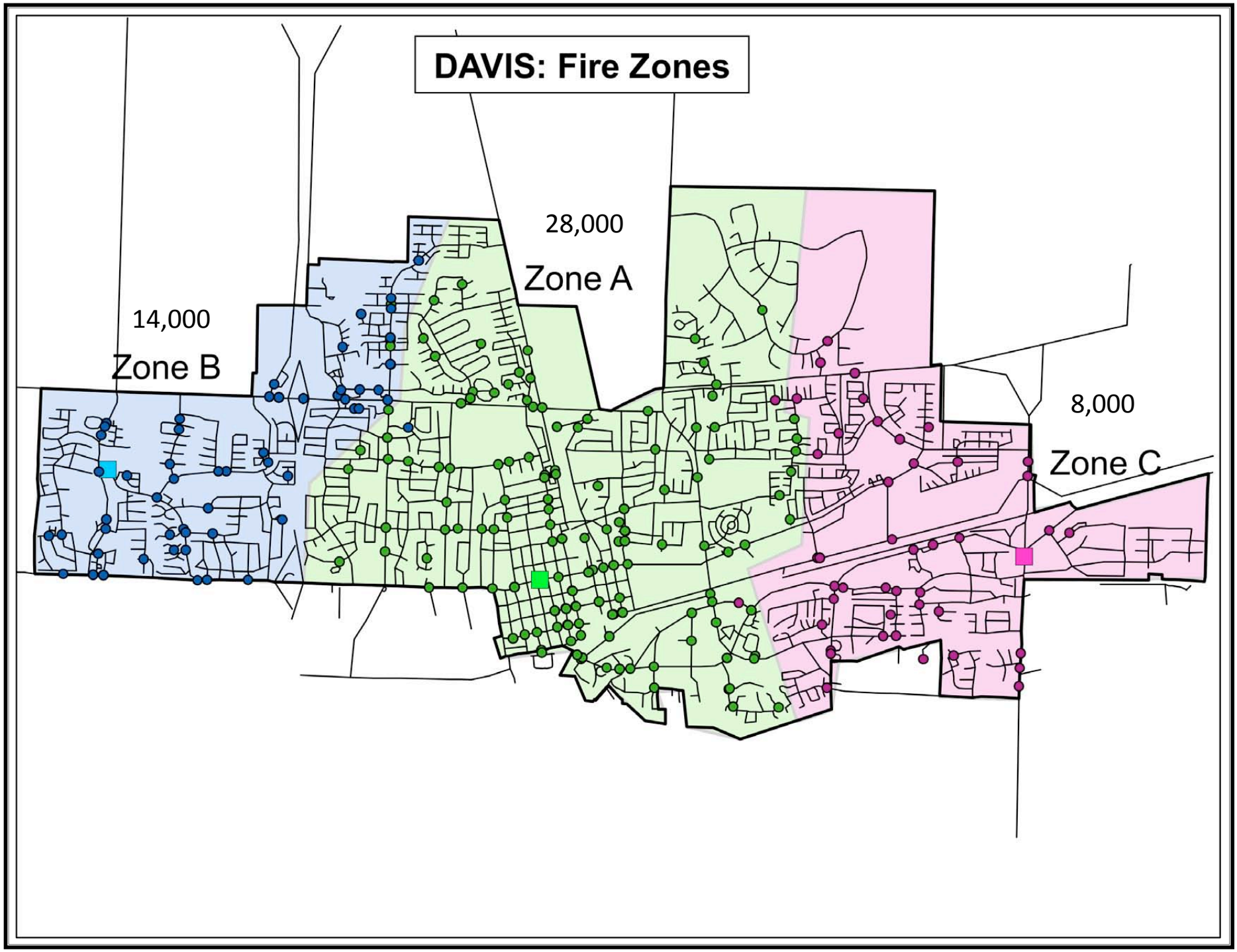
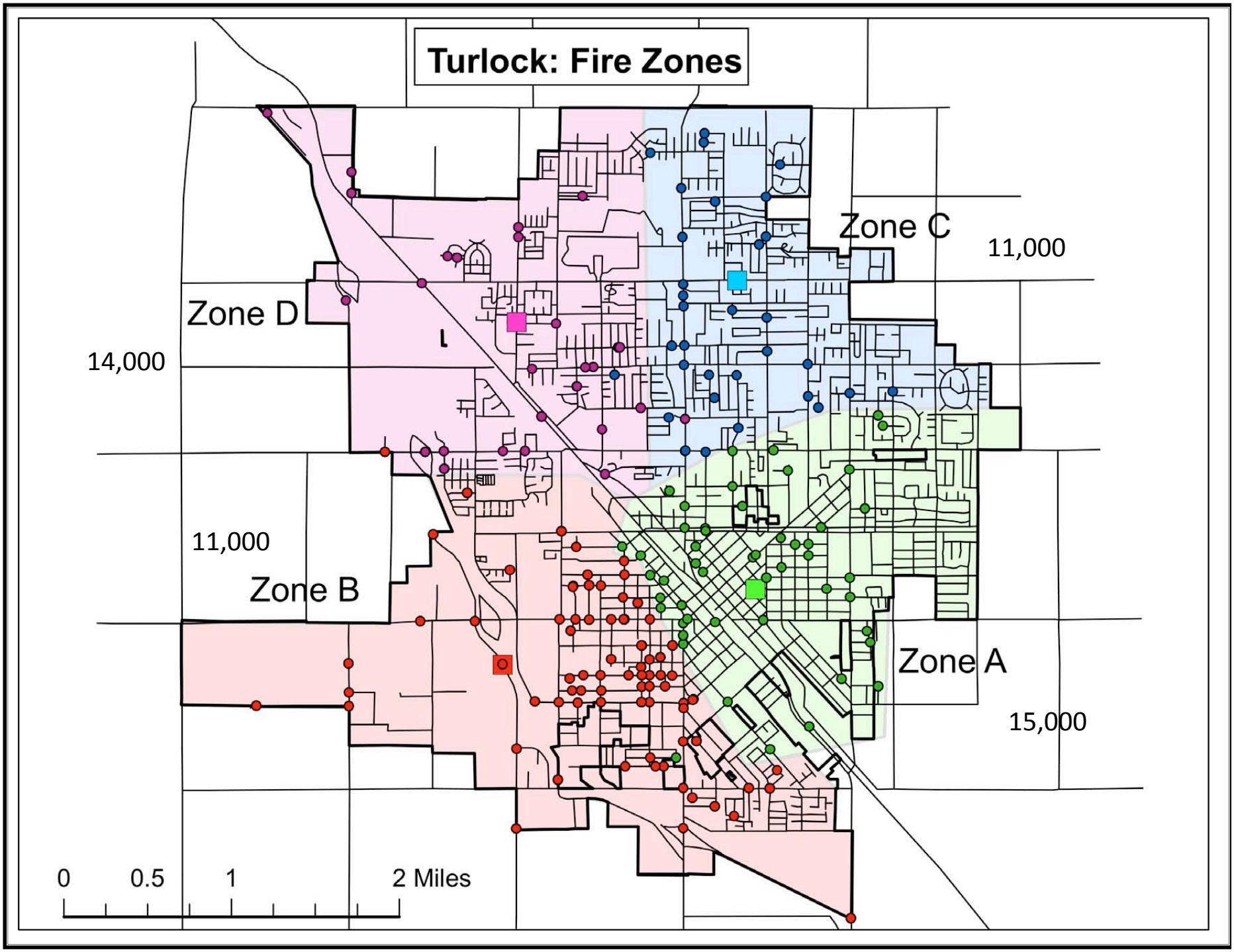
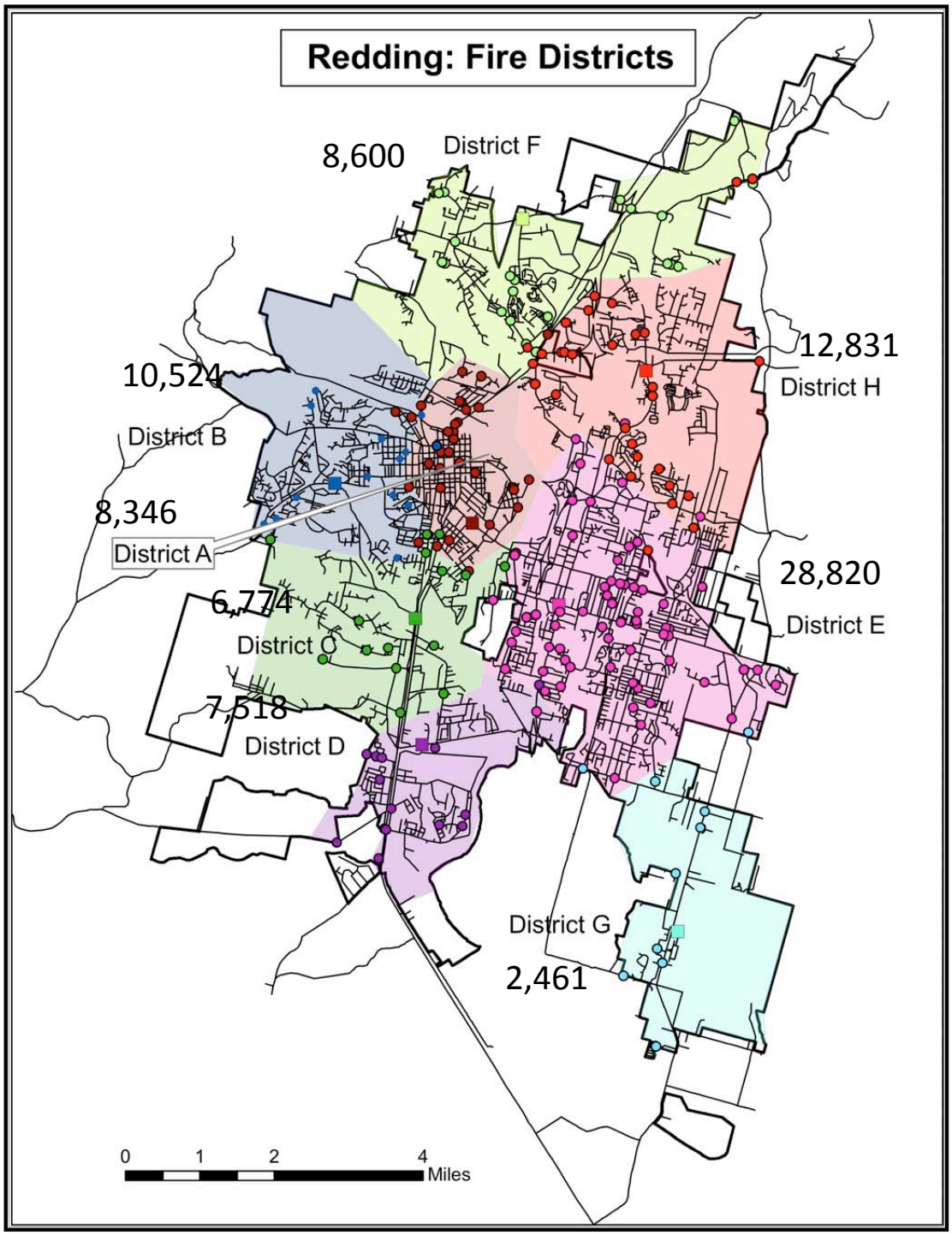
Emergency Response and the Role of Street Networks

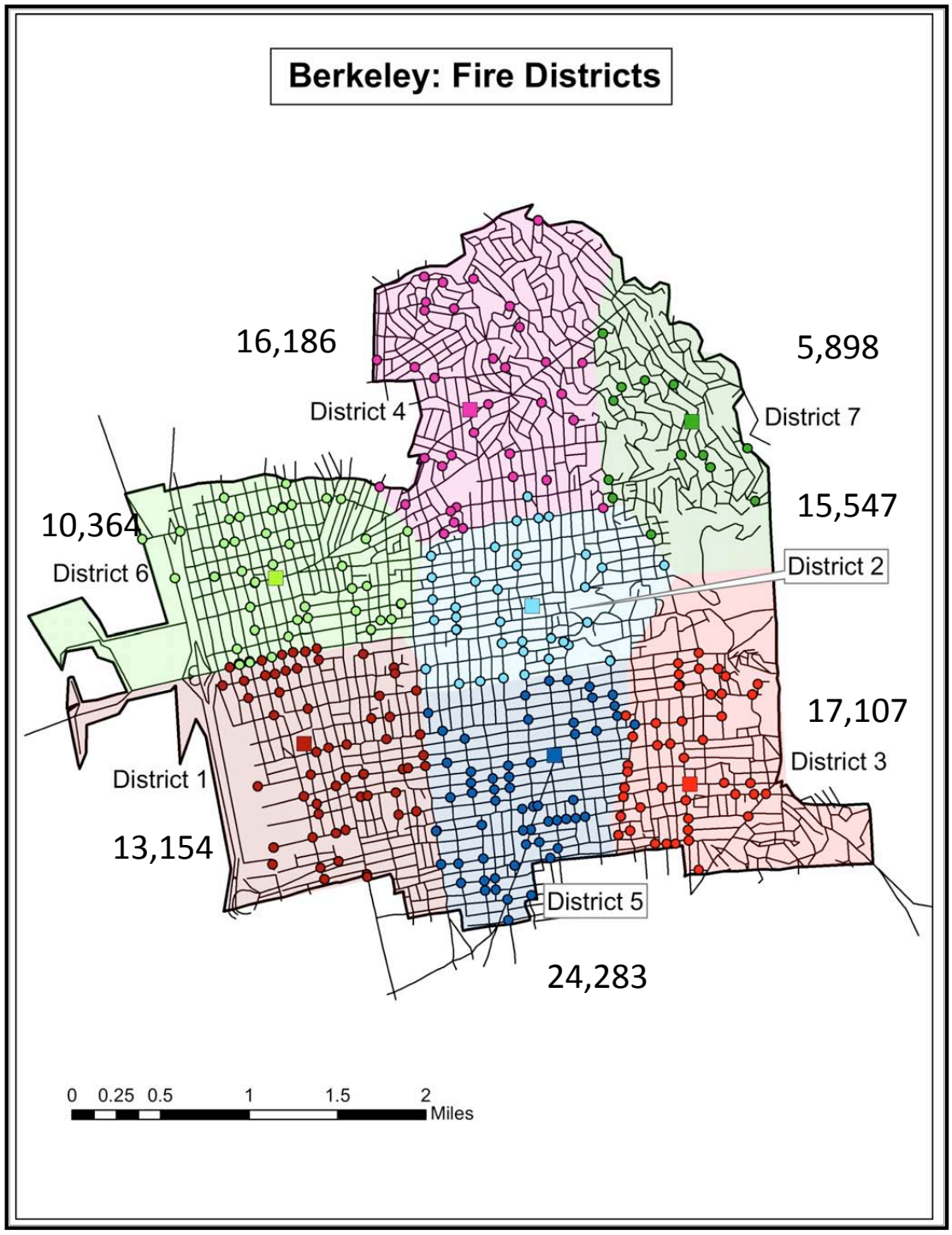
Norman W. Garrick
University of Connecticut


DAVIS: Fire Incidents
N
W
E
S
Station 32
Station 31
Station 33
Thanks to
US EPA and CNU
0
0.5
1
2
3
4
Miles


DAVIS: Fire Zones
28,000
Zone A
14,000
Zone B
8,000
Zone C


Turlock: Fire Zones
Zone C
11,000
Zone D
14,000
11,000
Zone B
Zone A
15,000
0
0.5
1
2 Miles


Redding: Fire Districts
8,600
District F
12,831
District H
10,524
District B
8,346
District A
28,820
District E
6,774
District C
7,518
District D
District G
2,461
0
1
2
4
Miles


Berkeley: Fire Districts
16,186
District 4
5,898
District 7
15,547
10,364
District 6
District 2
17,107
District 3
District 1
13,154
District 5
24,283
0 0.25 0.5 1 1.5 2
Miles

Davis: Response Time

14.2 mph

Station 32

Station 31

14.9 mph

Station 33

12.7 mph

0 0.5 1 2 3 4 Miles

Street Network affect Emergency Response

This is very preliminary work but it suggests that

Streets networks affect

- The population that can be serviced by each station

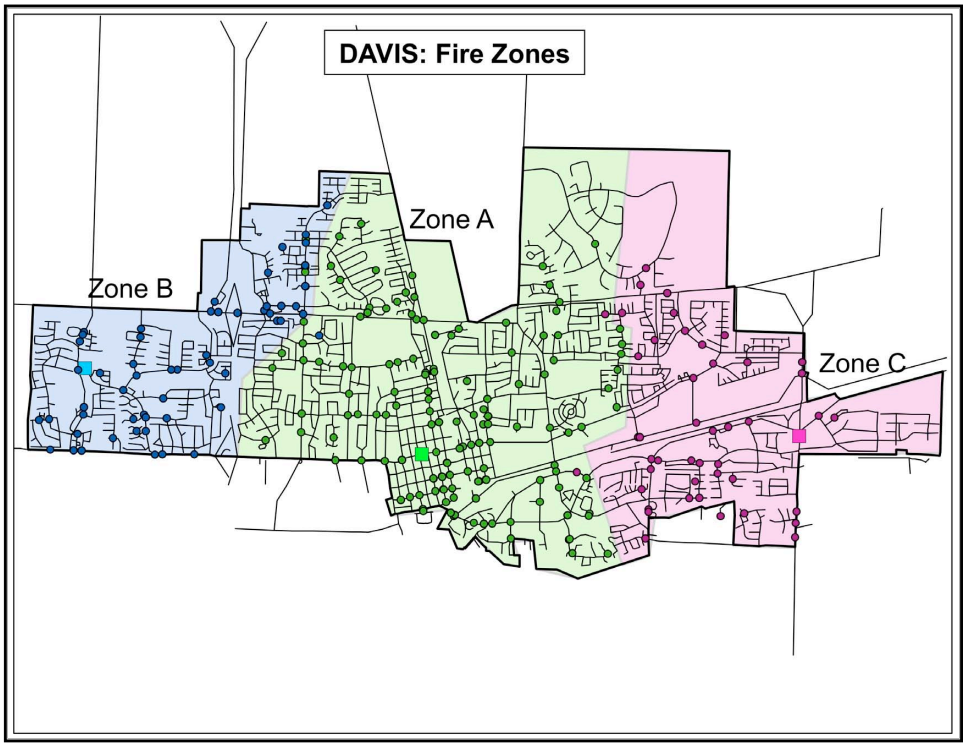
  Depending on the type of street network the station can server upwards of six times more people

- The response times

  In a connected network the path is much more direct, therefore, actual distances are much shorter

What Type of Street Networks Are Best?

The preliminary analysis suggests that the best street network for efficient emergency response are denser and more grid like



Why is this Important?

Current street design codes (including fire codes) make it more difficult to design smart growth street networks

Danger of Focusing on Speed

The advent of the automobile has altered

not simply the time it takes to get to point b,

but where point a and point b are in the first place,

our reasons for going there,

what we see along the way and,

ultimately, the structure of the society

within which a and b become destinations

- Justin Good

California Cities Study of Street Networks

Does the Street Network Matters?

Twenty-four Cities

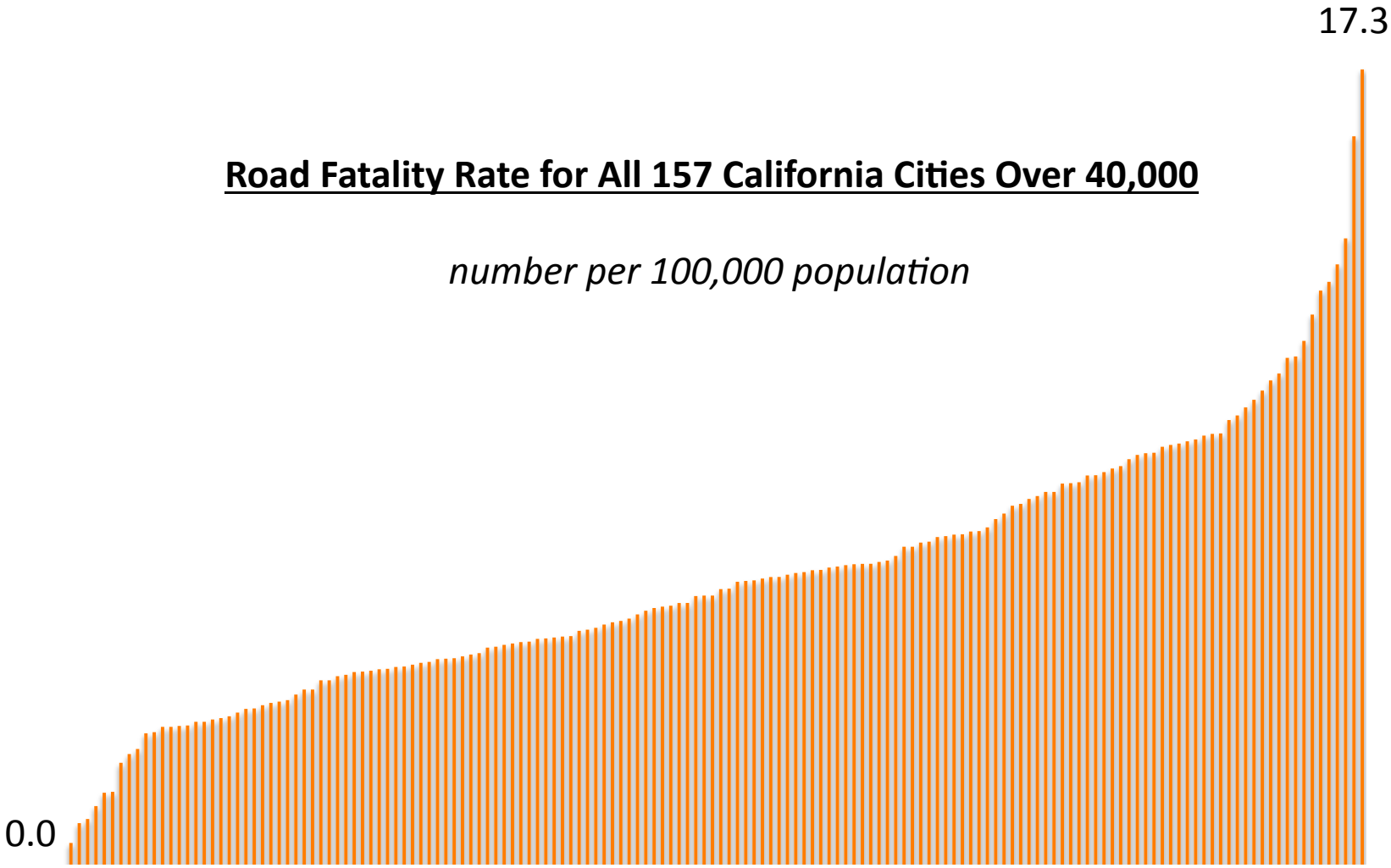

Davis, CA
14 % of people ride to work

Davis, CA

Road Fatality Rate: **1 per 100,000**

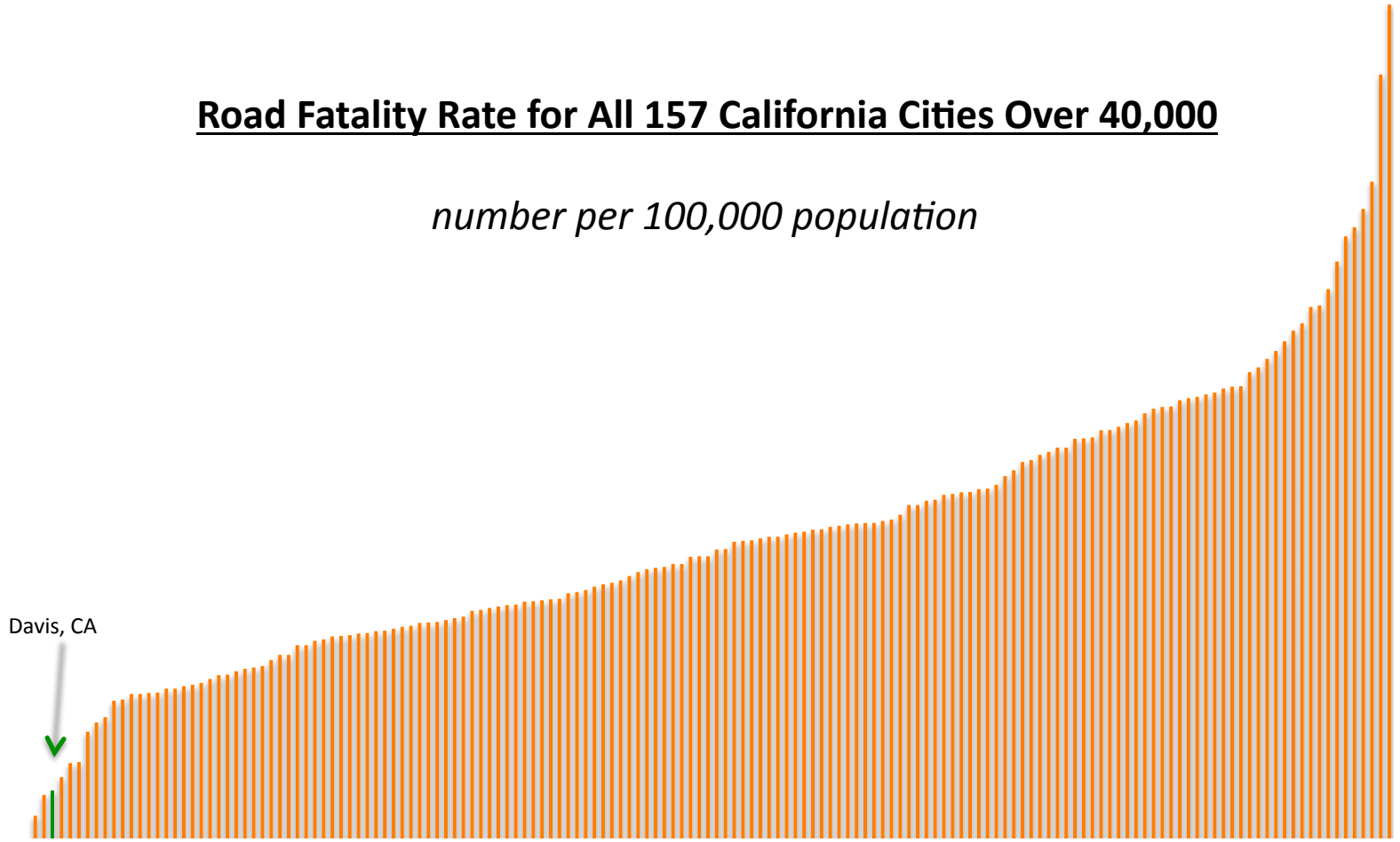
Road Fatality Rate for All 157 California Cities Over 40,000

number per 100,000 population



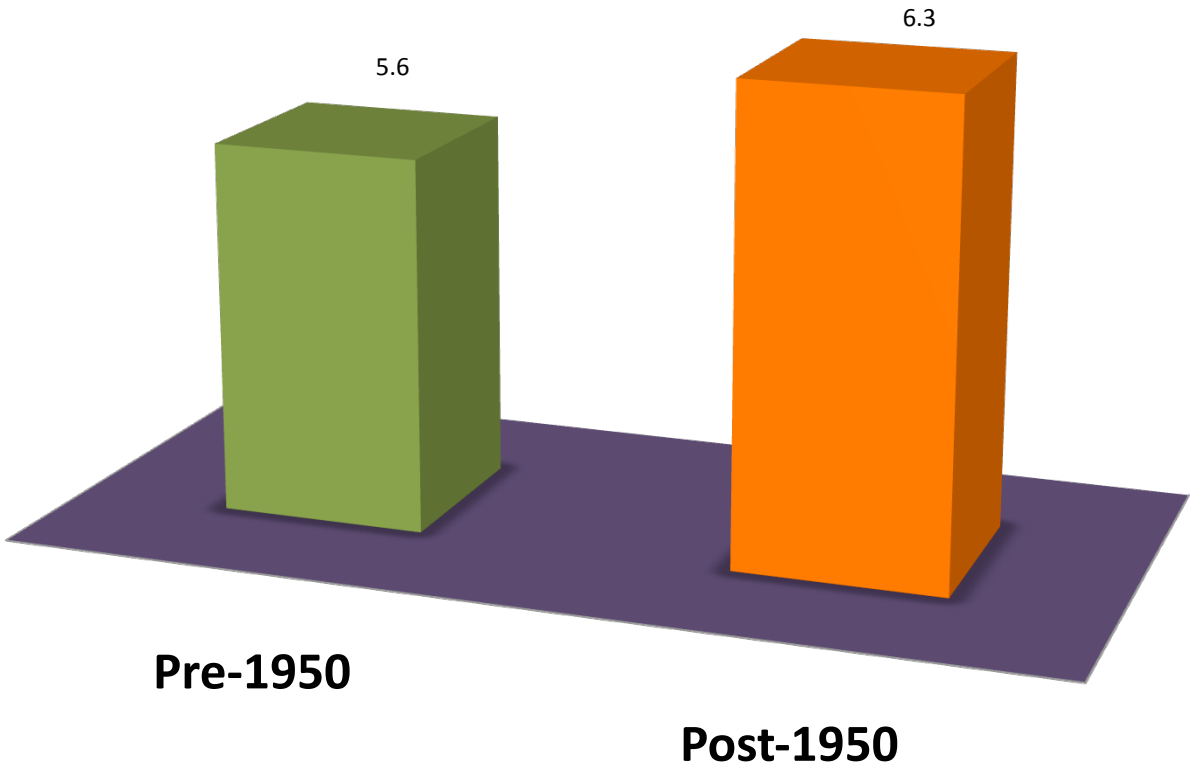
Road Fatality Rate for All 157 California Cities Over 40,000

number per 100,000 population



Road Fatalities per 100,000

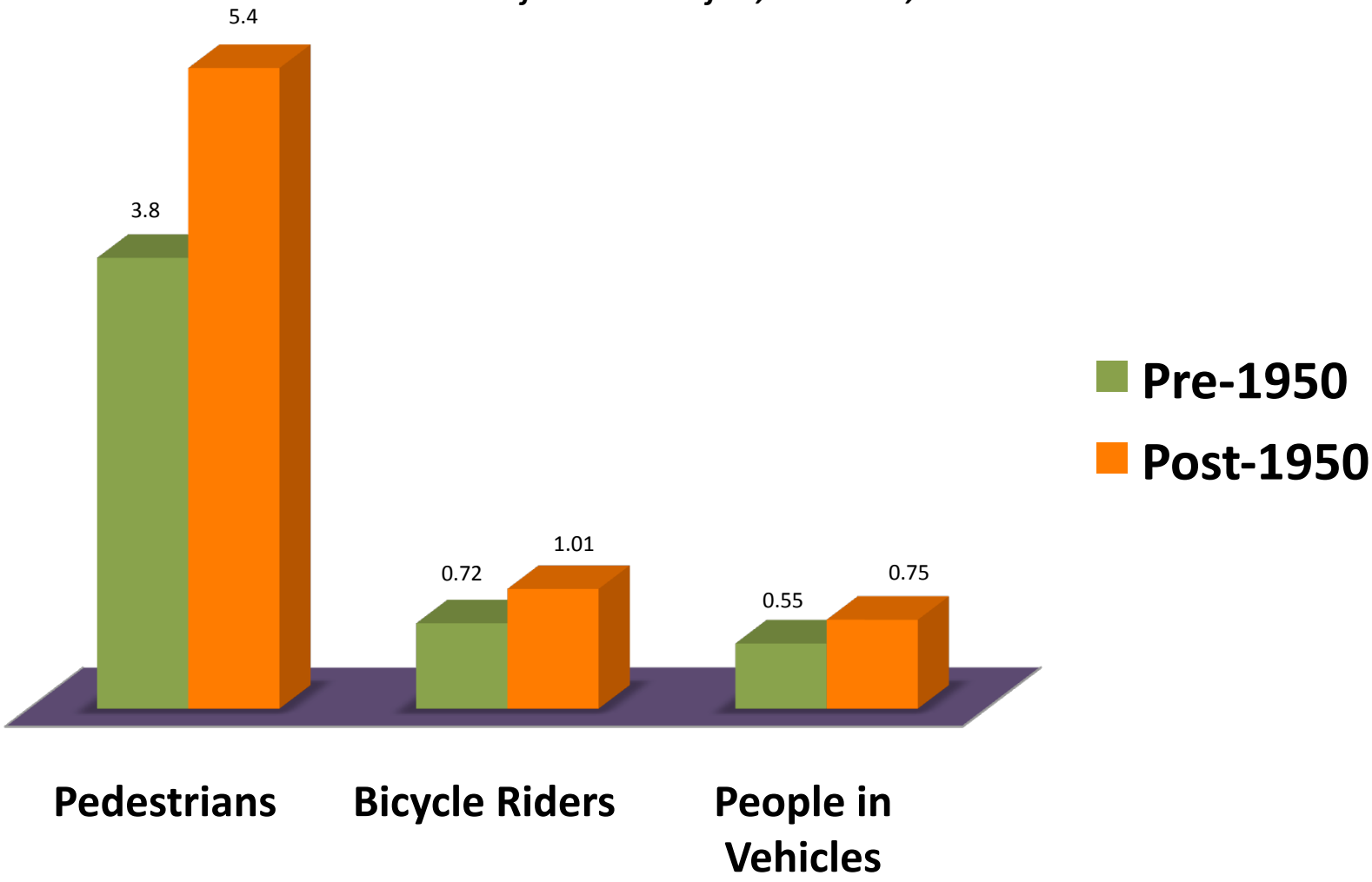
California Cities of 40,000 to 120,000



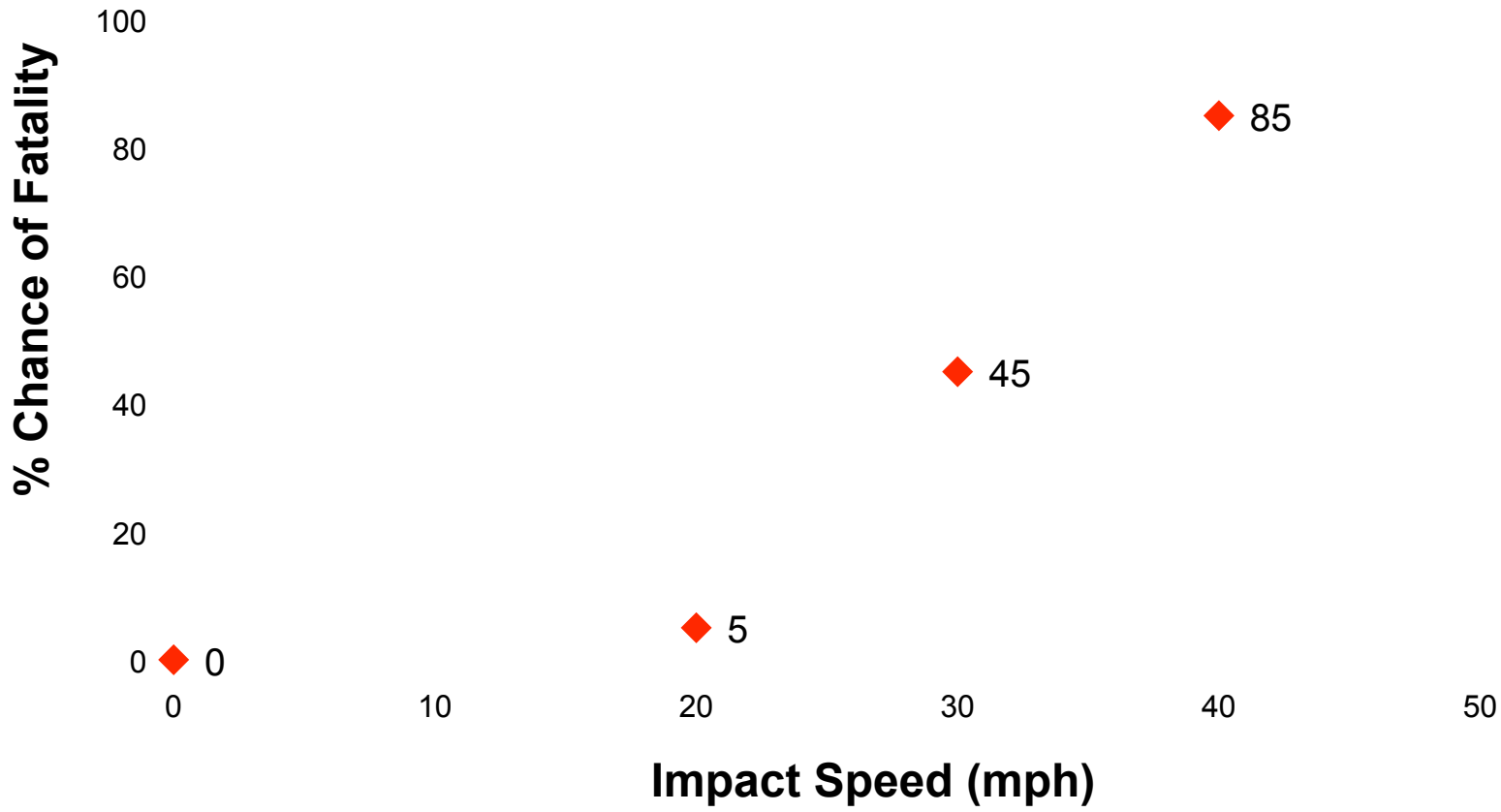
Risk of Fatality

(Fatalities as % of Injuries)

California Cities of 40,000 to 120,000

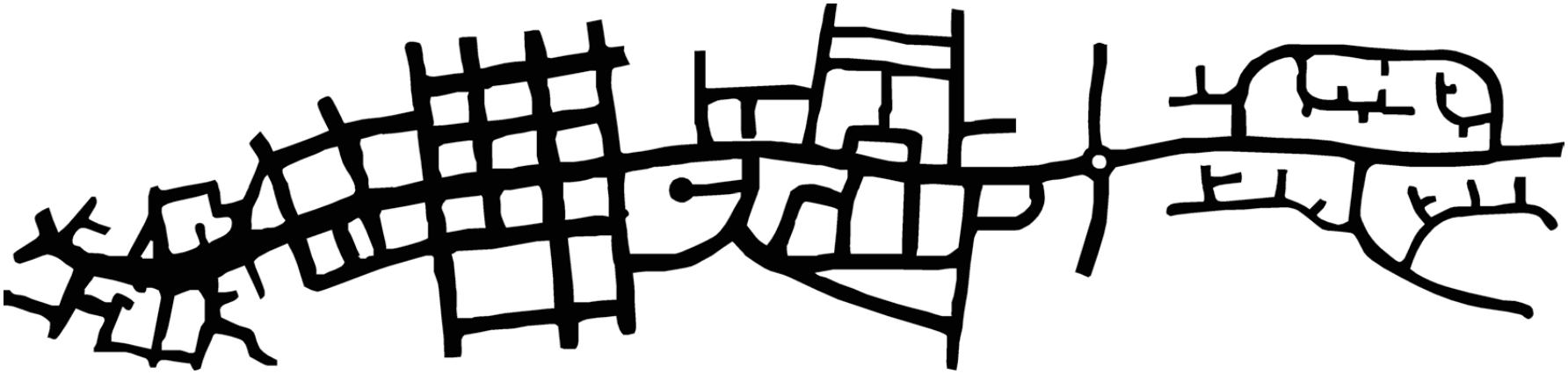


Chance of Pedestrian Fatality vs. Impact Speed



Source: U.K. Department of Transportation, Killing Speed and Saving Lives, London, 1987.

Evolution of the Street Network



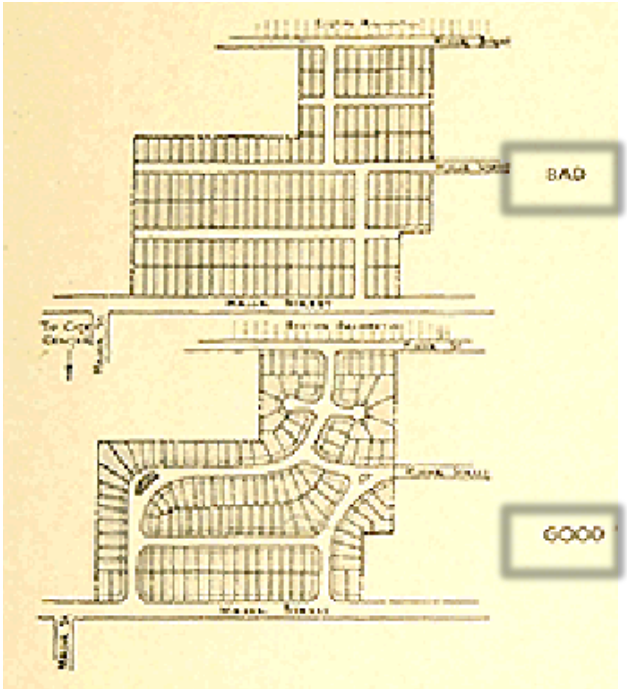
Pre-1950's

Post-1950's

Adapted from Stephen Marshall

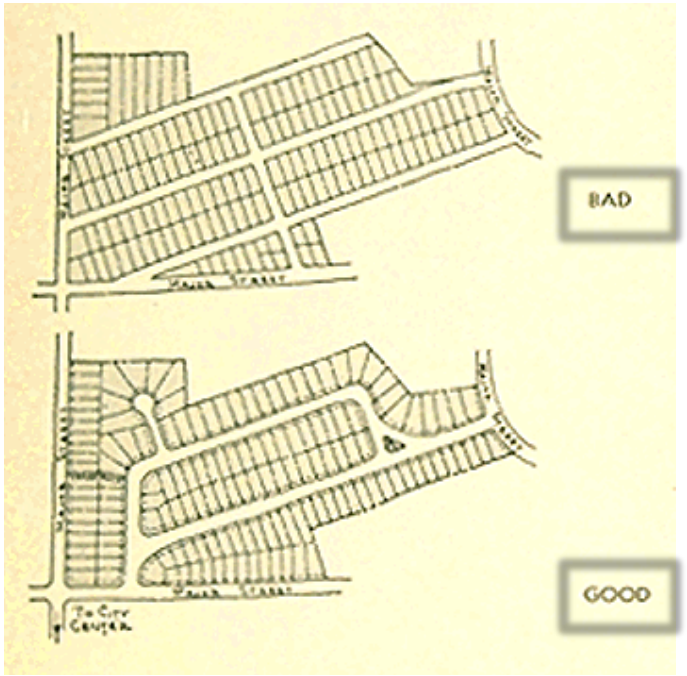

Image © 2006 Sanborn
washington, dc
Pointer 38°54'14.98" N 77°02'12.75" W
Streaming 100%
Eye alt 928

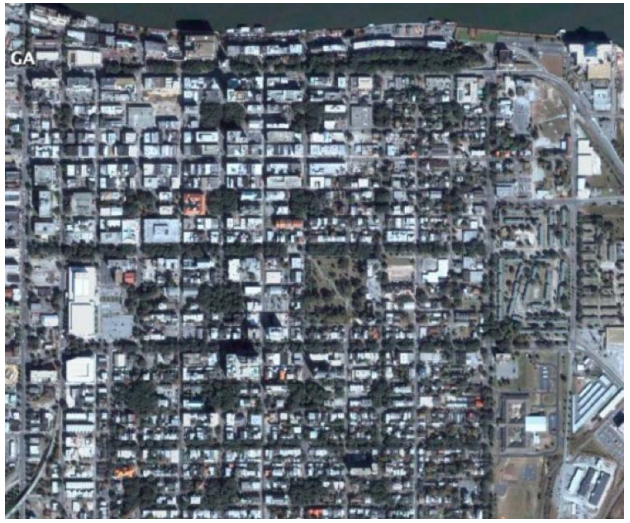
How Did This Drastic Change Occur?



FHA Technical Bulletin No. 7 (1938)
Planning Profitable Neighborhoods

One important agency in getting rid of the grid network was the ***Federal Housing Authority***





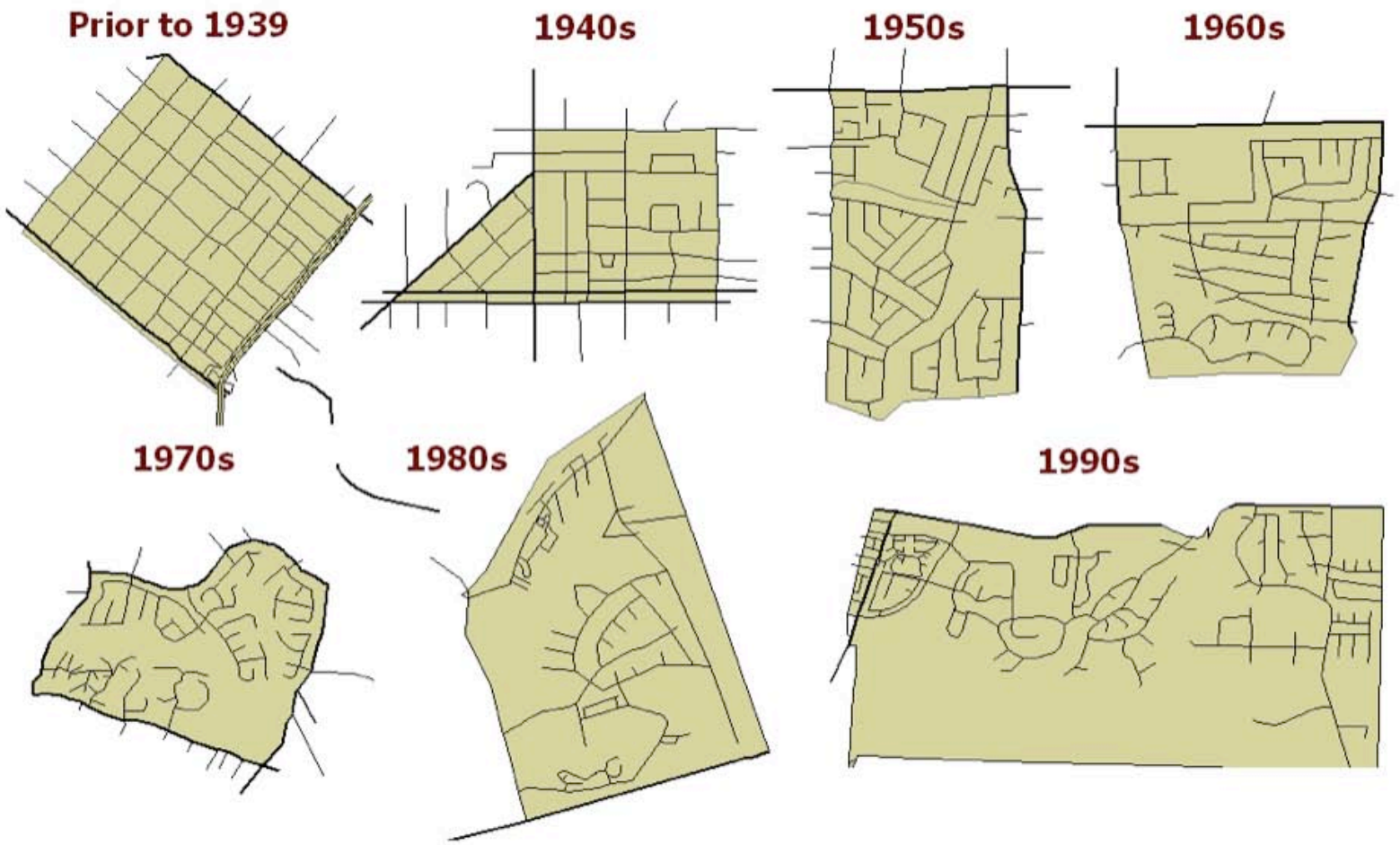
According to the FHA the grid layout was

- Monotonous
- Had Little Character
- Uneconomical
- Posed Safety Concerns


Redding
Chico
Davis
West Sacramento
Berkeley
Antioch
Alameda
Danville
San Mateo
Palo Alto
Turlock
Cupertino
Morgan Hill
Santa Cruz
Madera
San Luis Obispo
Victorville
Apple Valley
Santa Barbara
Rialto
La Habra
Perris
Temecula
Carlsbad

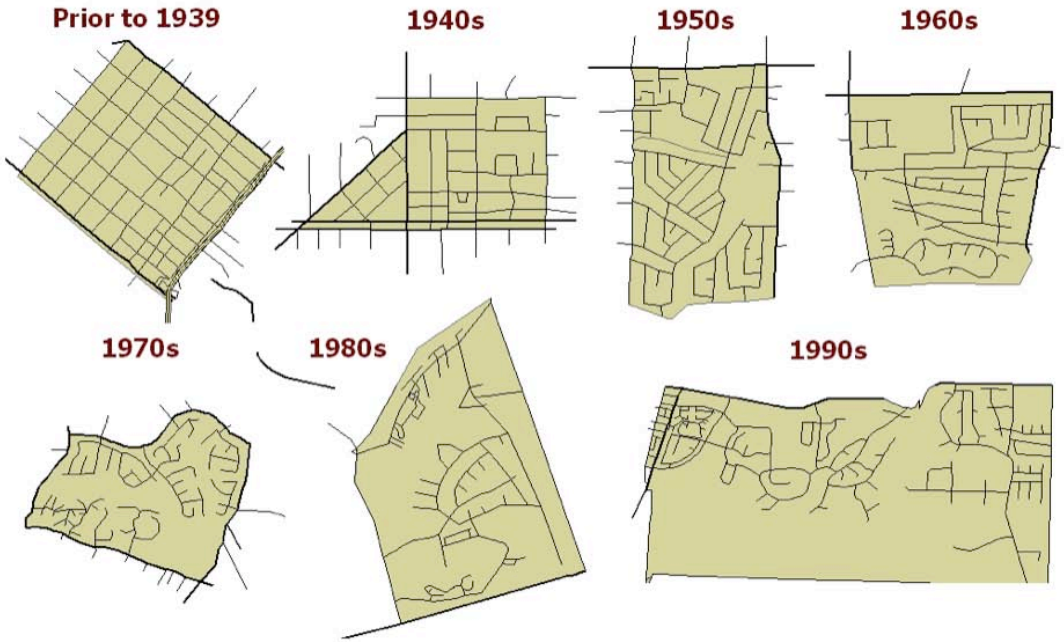
Research

Evolution of the Street Network



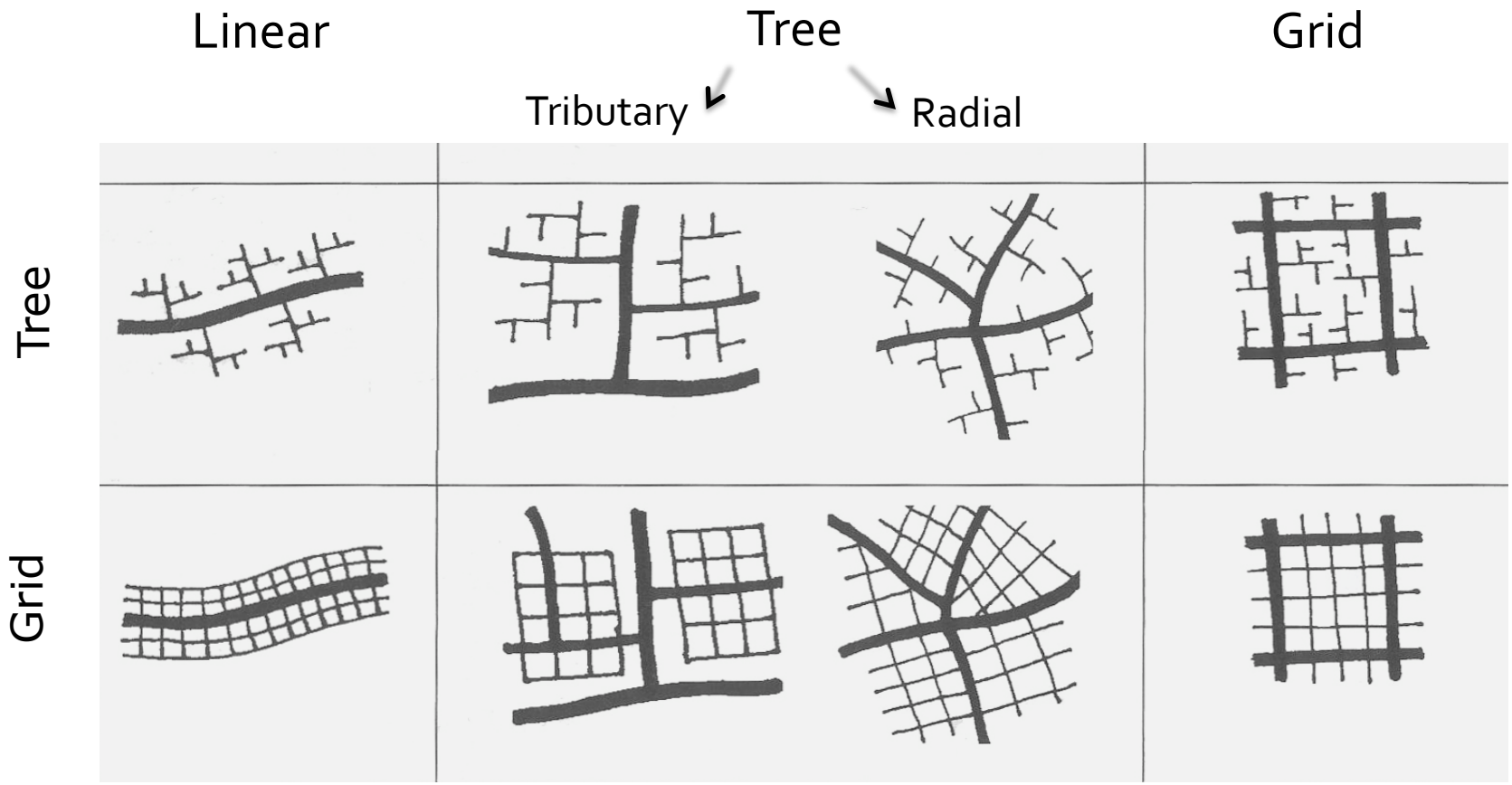
Characterizing the the Street Network

- Shape and Configuration
- Street Network Scale
- Street Network Connectivity



Citywide Street Network

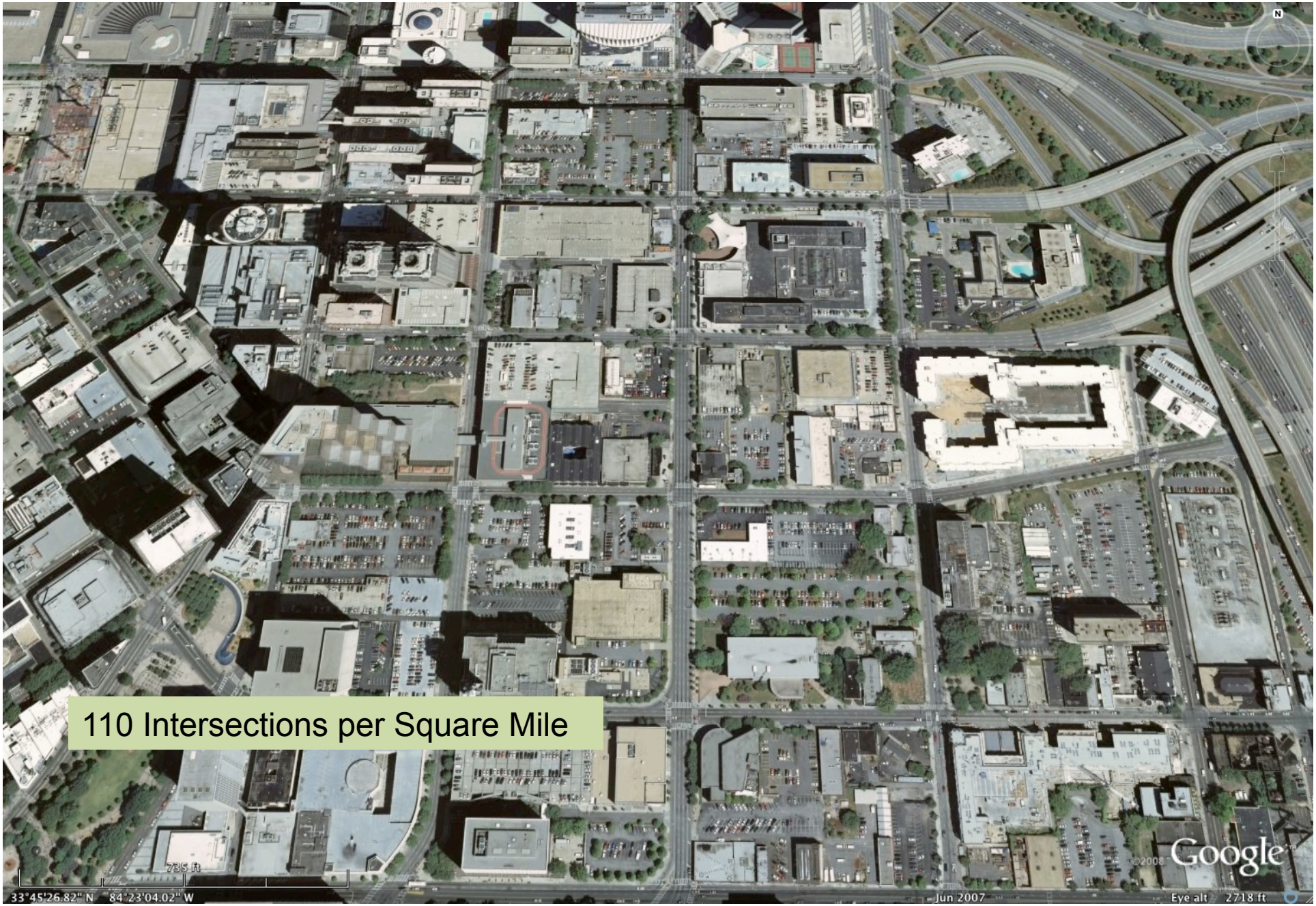
Neighborhood Street Network



Adapted from Stephen Marshall, *Streets & Patterns*

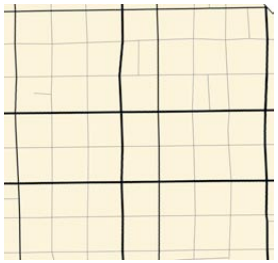
Network Scale

Network Scale

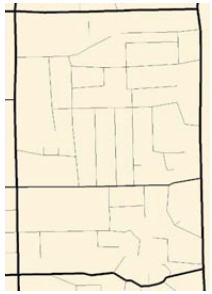


Network Scale

Network Connectivity



Link-to-Node Ratio = 1.61



Link-to-Node Ratio = 1.13

Link-to-Node Ratio = 1.16

Variables included in Our Safety and Travel Choice Models

Street Network Properties

Street Design Properties

- Average Total Number of Lanes
- Average Outside Shoulder Width
- Raised Median
- Painted Median
- On-Street Parking
- Bike Lanes
- Raised Curbs

Travel and Activity Level

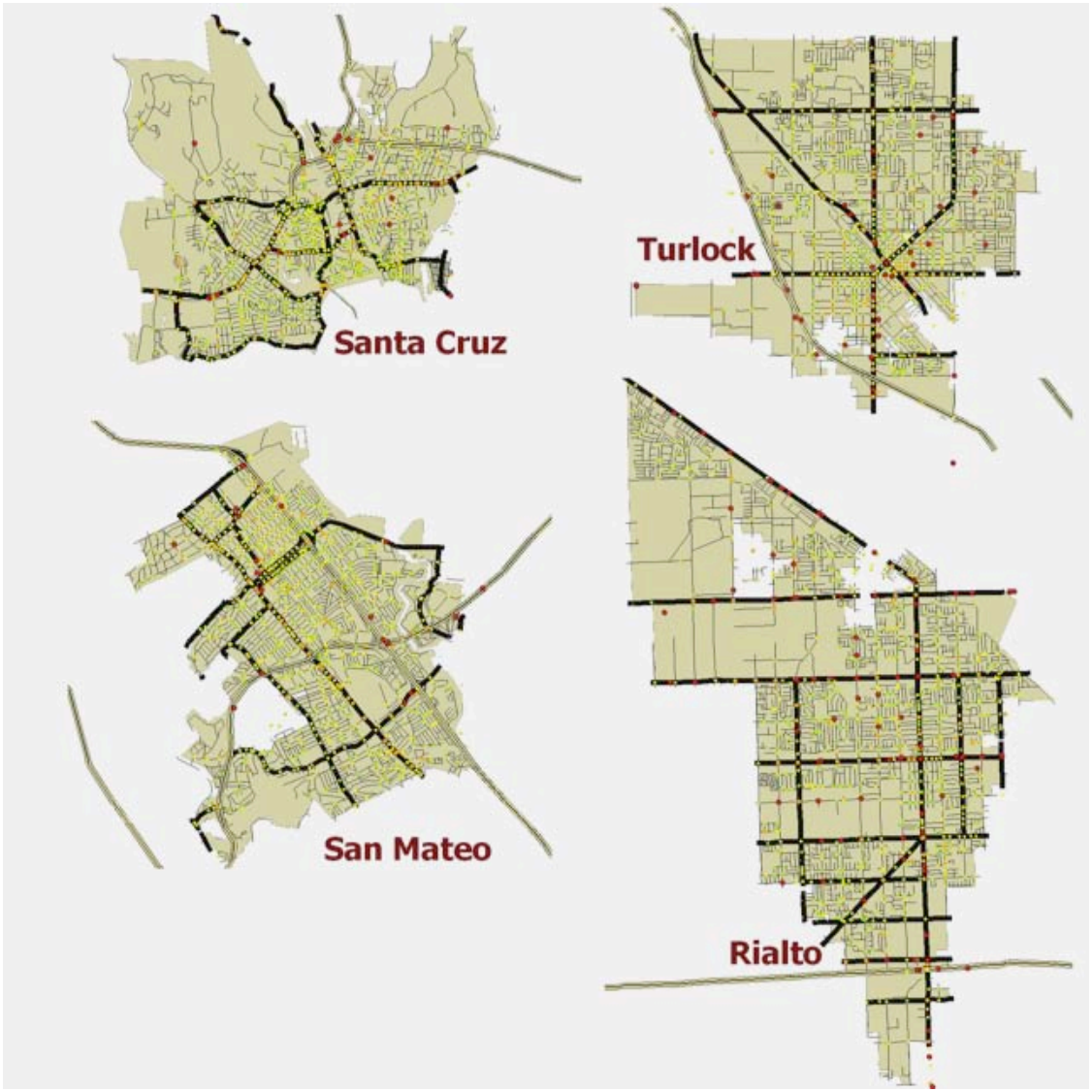
Distance from City Center

Income

Mix of Land Use

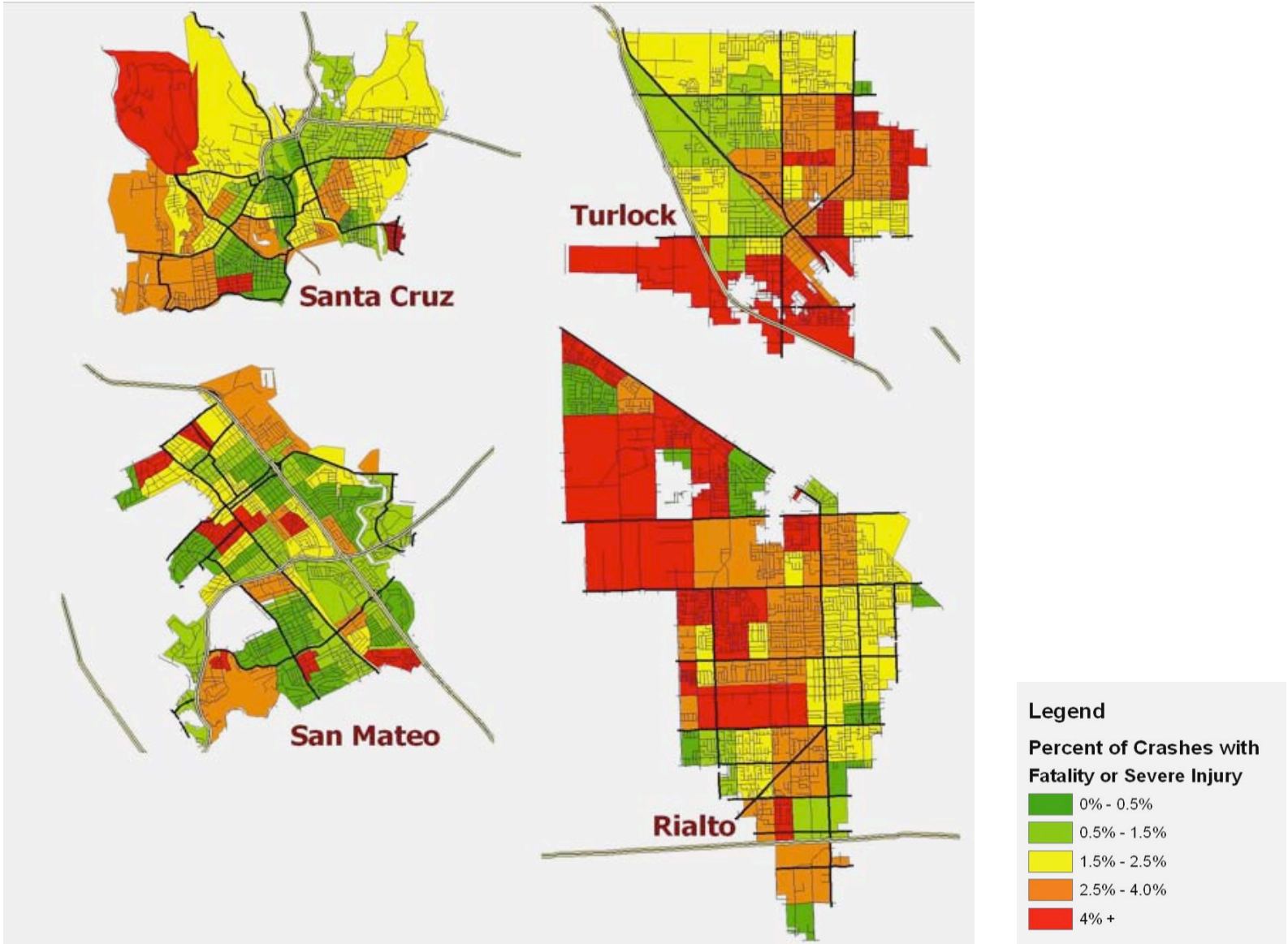
Safety Analysis Based on Geo-coding 230,000 Accident Records

in 24 California Cities



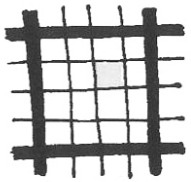
Safety and Travel Choice Analysis done for 1040 Census Block Groups

24 California Cities

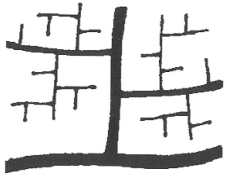


versus

Risk of Severe Injury or Fatality*



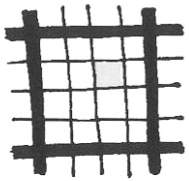
versus



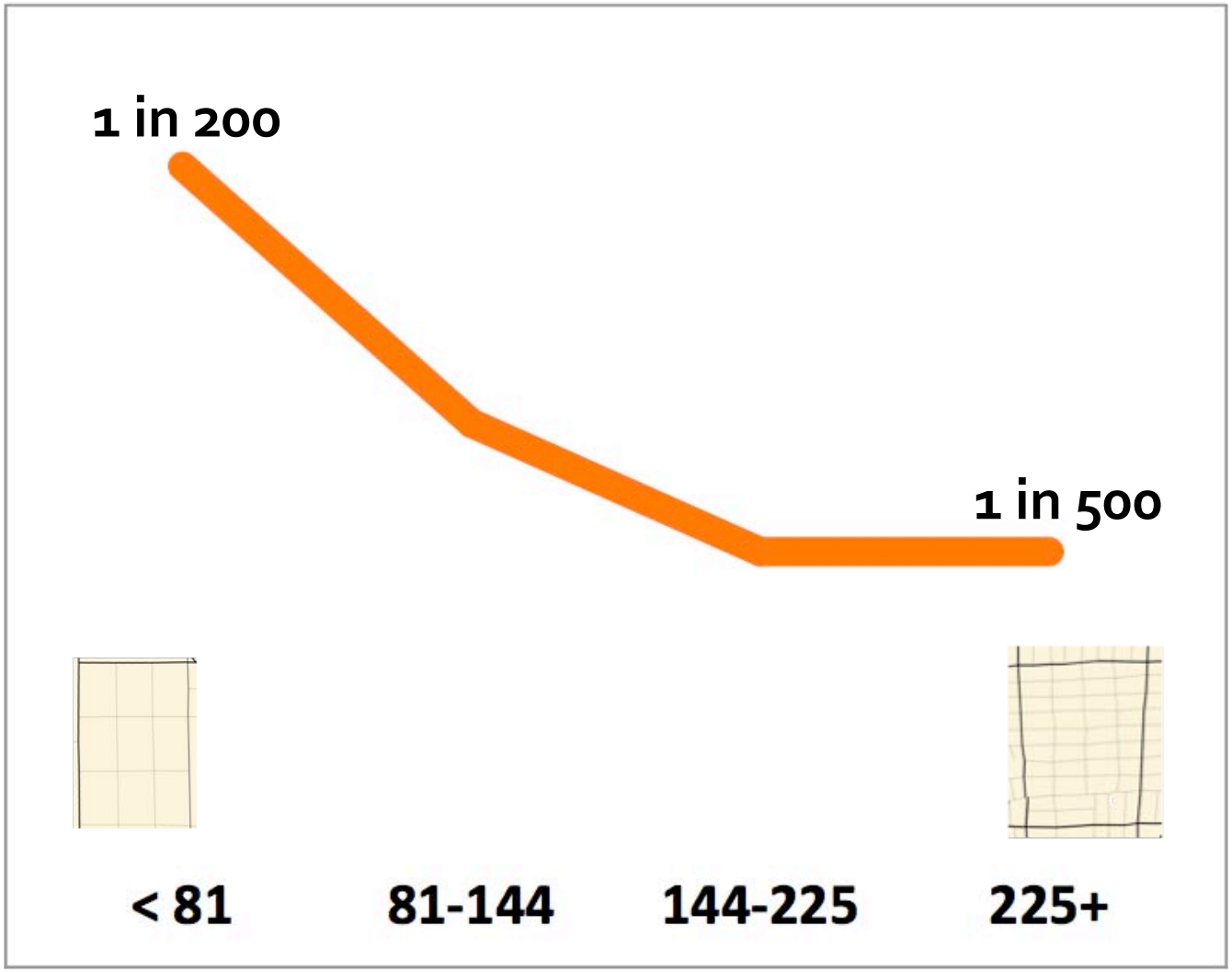
Chance of being Severely Injured
30% Higher

Chance of being Killed
50% Higher

*Given that an injury occurred

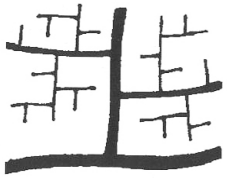


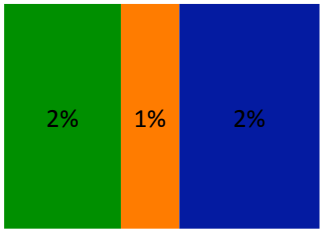
Odds of Dying in a Road Accident based on Intersection Density*

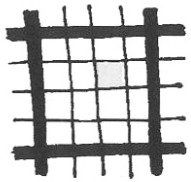


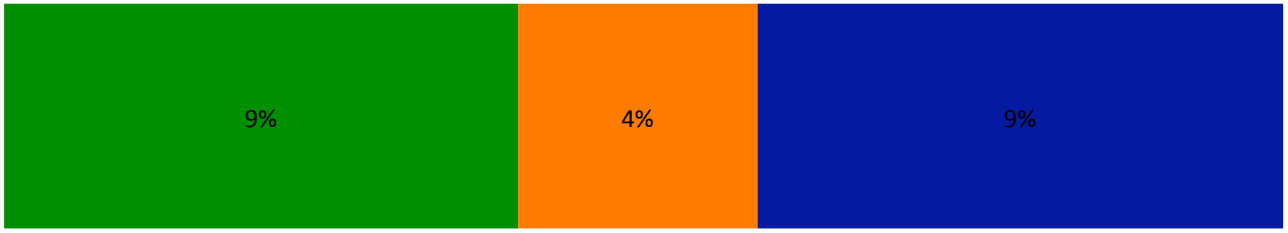
*Given that an injury occurred

Percentage of People Walking, Biking or Taking Transit

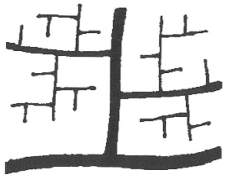


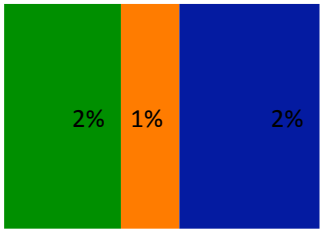


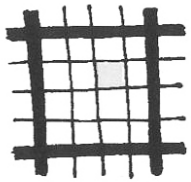


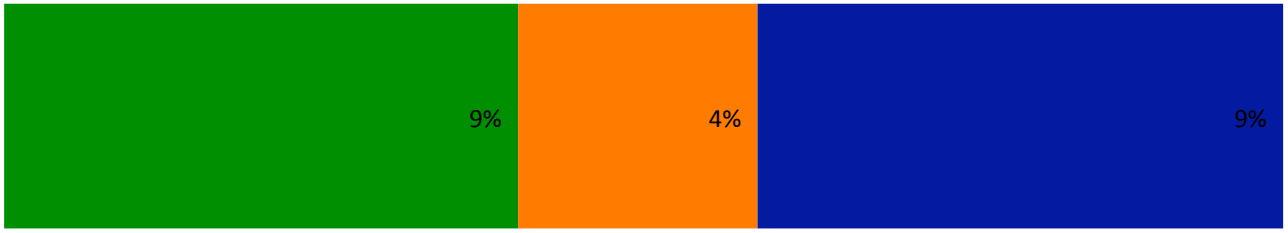


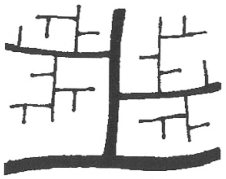
Percentage of People Walking, Biking or Taking Transit











Percentage of People Walking, Biking or Taking Transit

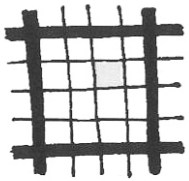
Effect of Intersection Density for Cul-de-sac Network

10%

5%

0%

< 81 | 81-144 | 144-225 | 225+



Percentage of People Walking, Biking or Taking Transit

Effect of Intersection Density for Gridded Network

10%

5%

0%

< 81 | 81-144 | 144-225 | 225+

What About Emergency Response?

As discussed earlier, the results suggest that the best street network for emergency response would be

1. Dense

2. Well connected

Smart Growth and Street Networks

We need a holistic approach to design

We need to focus on designing whole communities
not the individual components

Street networks are the basic building blocks for communities

Residents of Washington's outer suburbs struggled Wednesday night with horrendous traffic on the city's commuter routes.

At the same time, many D.C. residents were enjoying happy hours, snowball fights and otherwise carrying on with their lives. By the time people in the central city were fast asleep, many suburbanites were still fighting to get home.

- Erik Webber