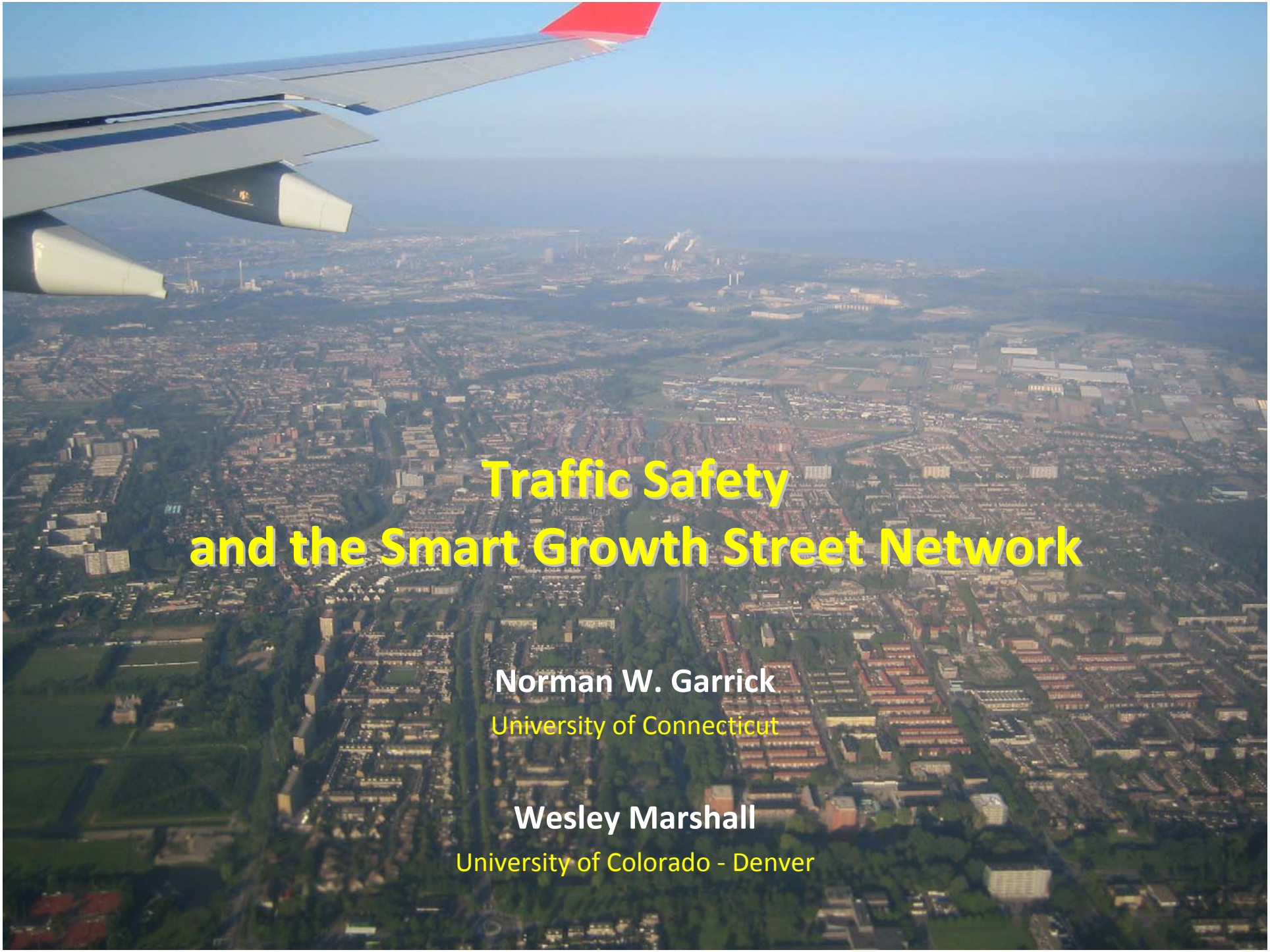
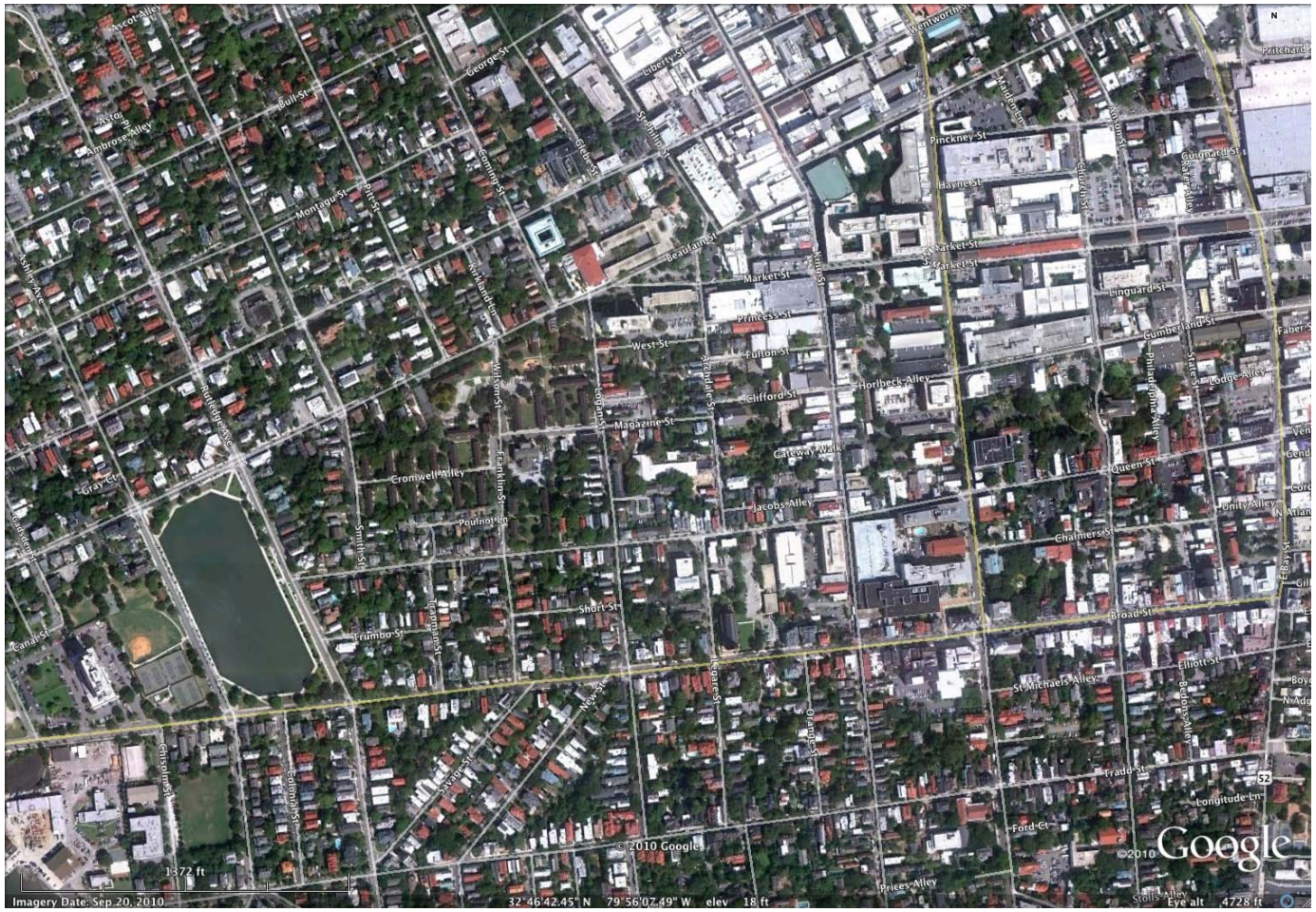


Traffic Safety and the Smart Growth Street Network

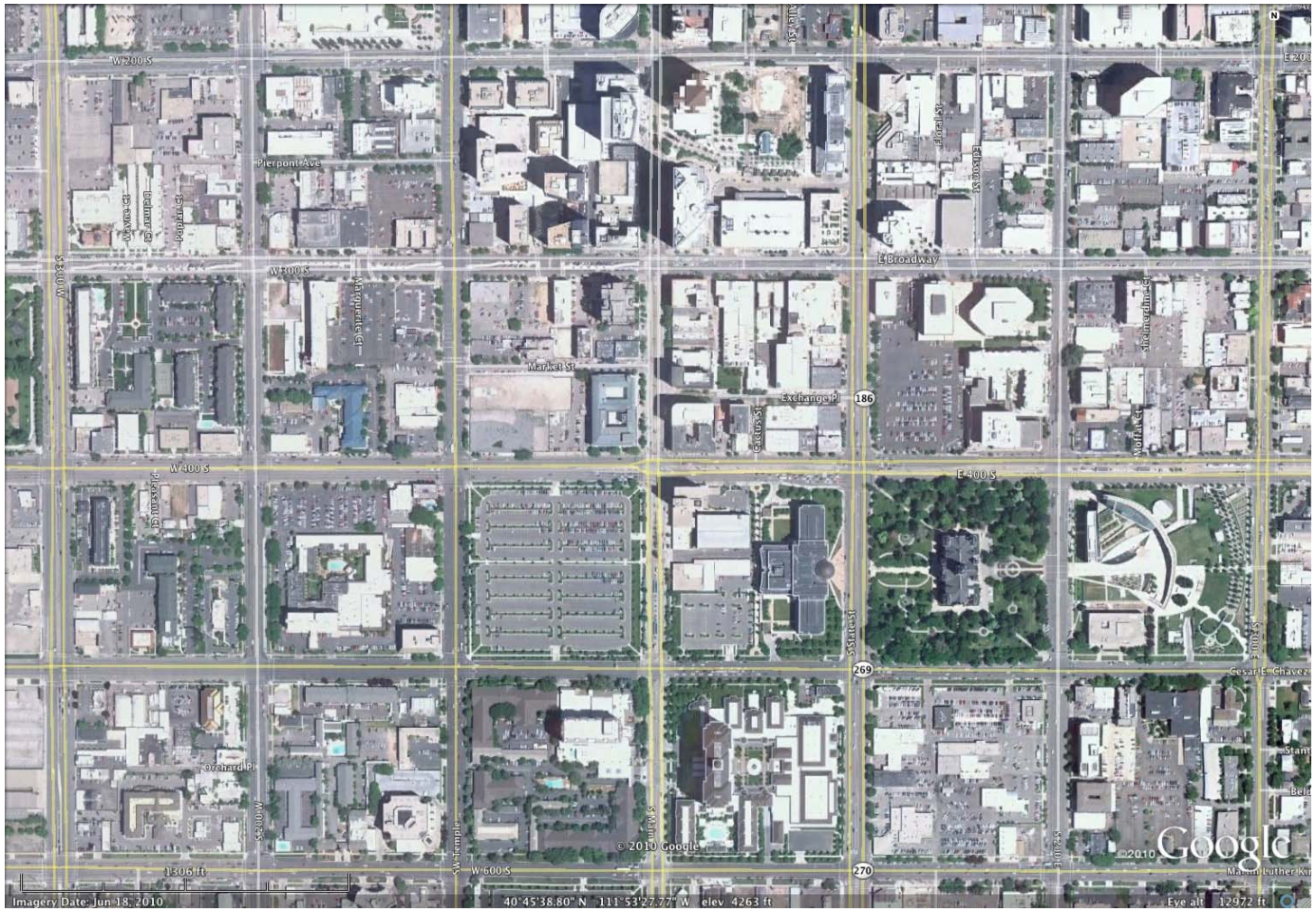
Norman W. Garrick
University of Connecticut

Wesley Marshall
University of Colorado - Denver

What Does a Smart Growth Street Network look Like?



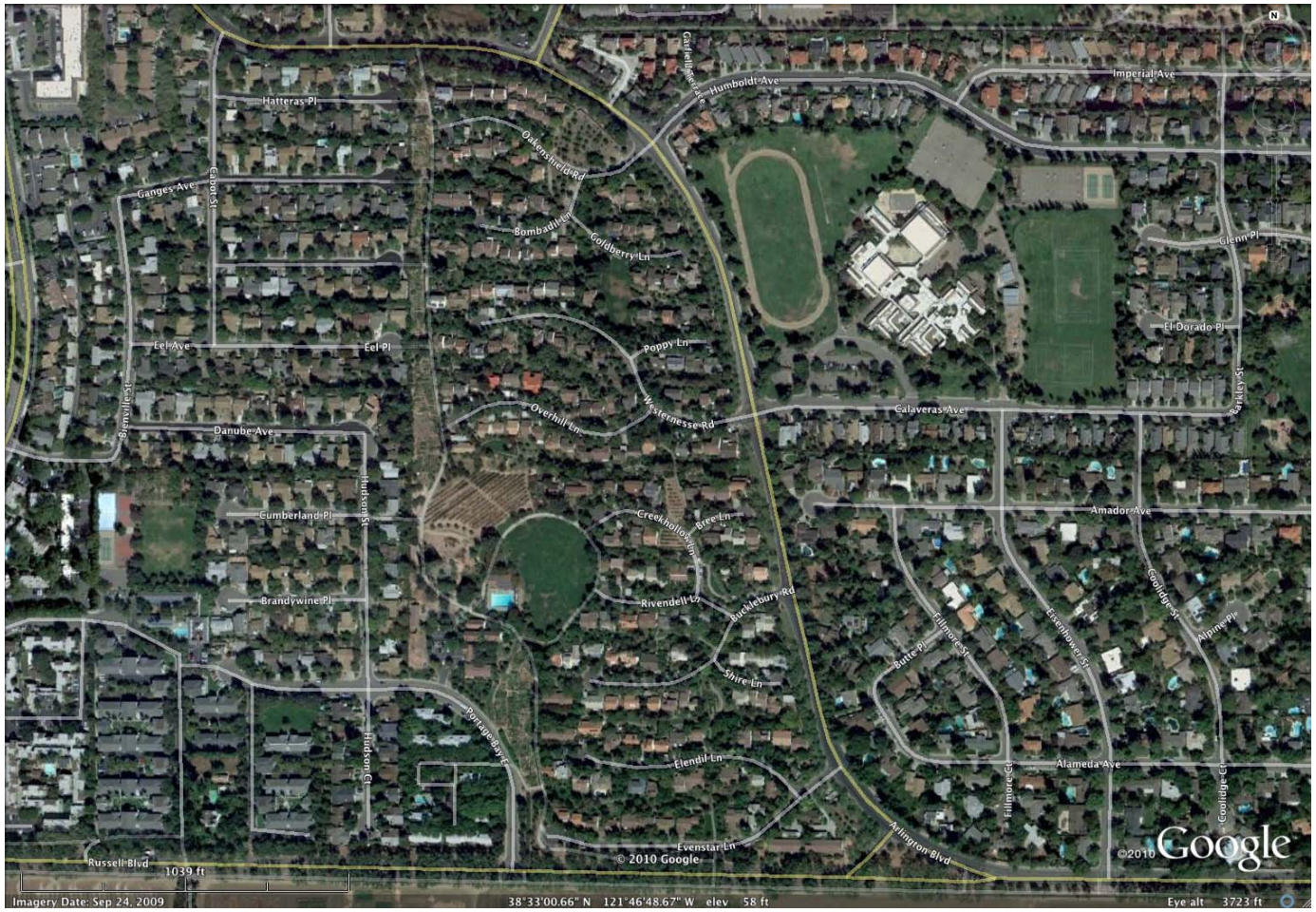
Or this?


W 200 S
Pierpont Ave
W 300 S
E Broadway
Market St
Exchange Pl
186
W 400 S
E 400 S
269
Cesar E. Chavez
Orchard Pl
1306 ft
W 600 S
270
© 2010 Google
Imagery Date: Jun 18, 2010
40°45'38.80" N 111°53'27.77" W elev 4263 ft
Eye alt 12972 ft

Or this?

Bell Ln
Bluegrass Ln
Salem Ln
Pebble Ln
Hollow Ln
Farm Ln
Shelter Ln
Academy Ln
Hill Ln
Mill Ln
Spur Ln
Plow Ln
Knoll Ln
Cliff Ln
Glen Ln
Brixton Ln
Chelsea Ln
Dorset Ln
Foston Ln
Roxbury Ln
Jeffries Rd
Nod St
Johnson
Reeds Ln
White Ln
Amber Ln
Blossom Ln
Troll Ln
Robin Ln
Bayberry Ln
Tallow Ln
Abbey Ln
Halter Ln
Castle Ln
Green Ln
Glade Ln
Tower Ln
Homestead Ln
Penny Ln
Bluejay Ln
Needle Ln
Cosey Ln
Spoon Ln
Beaver Ln
Cooper Ln
Clay Ln
Tanners
Acorn Ln
Bellows Ln
Bowling Ln
Gold Oak Ln
Sunrise Ln
Anchor Ln
Grey Ln
Spoke Ct
Gardner Ln
Sandy Ln
Creek Ln
Harvest Ln
Maple Ln
Cedar Ln
Hunt Ln
Cooper Ln
Wagon Ln
Waterhouse Ln
Swamp Ln
Ridge Ln
Foundry Ln
Chestnut Ln
Jarvis Ln
Sparrow Ln
Hunt Ln
Johnson Ln
Dalton Ln
Ridge Ln
Foundry

Or this?


Hatteras Pl
Ganges Ave
Eel Ave
Eel Pl
Danube Ave
Cumberland Pl
Brandywine Pl
Russell Blvd
1039 ft
Humboldt Ave
Imperial Ave
Oakenshield Rd
Bombadil Ln
Goldberry Ln
Poppy Ln
Overhill Ln
Westerness Rd
Calaveras Ave
El Dorado Pl
Glenn Pl
Amador Ave
Creekhollow Ln
Bree Ln
Rivendell Ln
Buckleboury Rd
Shire Ln
Elendil Ln
Evenstar Ln
Alameda Ave
Arlington Blvd
© 2010 Google
Imagery Date: Sep 24, 2009
38°33'00.66" N 121°46'48.67" W elev 58 ft
Eye alt 3723 ft

Characterizing Street Networks

Streets networks are devilishly complicated

- The possible variations are infinite and even subtle differences can have a huge impacts
- Street networks simultaneously operate at numerous geographic scales while serving many different – some times conflicting - functions
- The common descriptors are not all that good for illuminating the differences between networks

California Cities Study of Street Networks

Does the Street Network Matters?

Twenty-four Cities

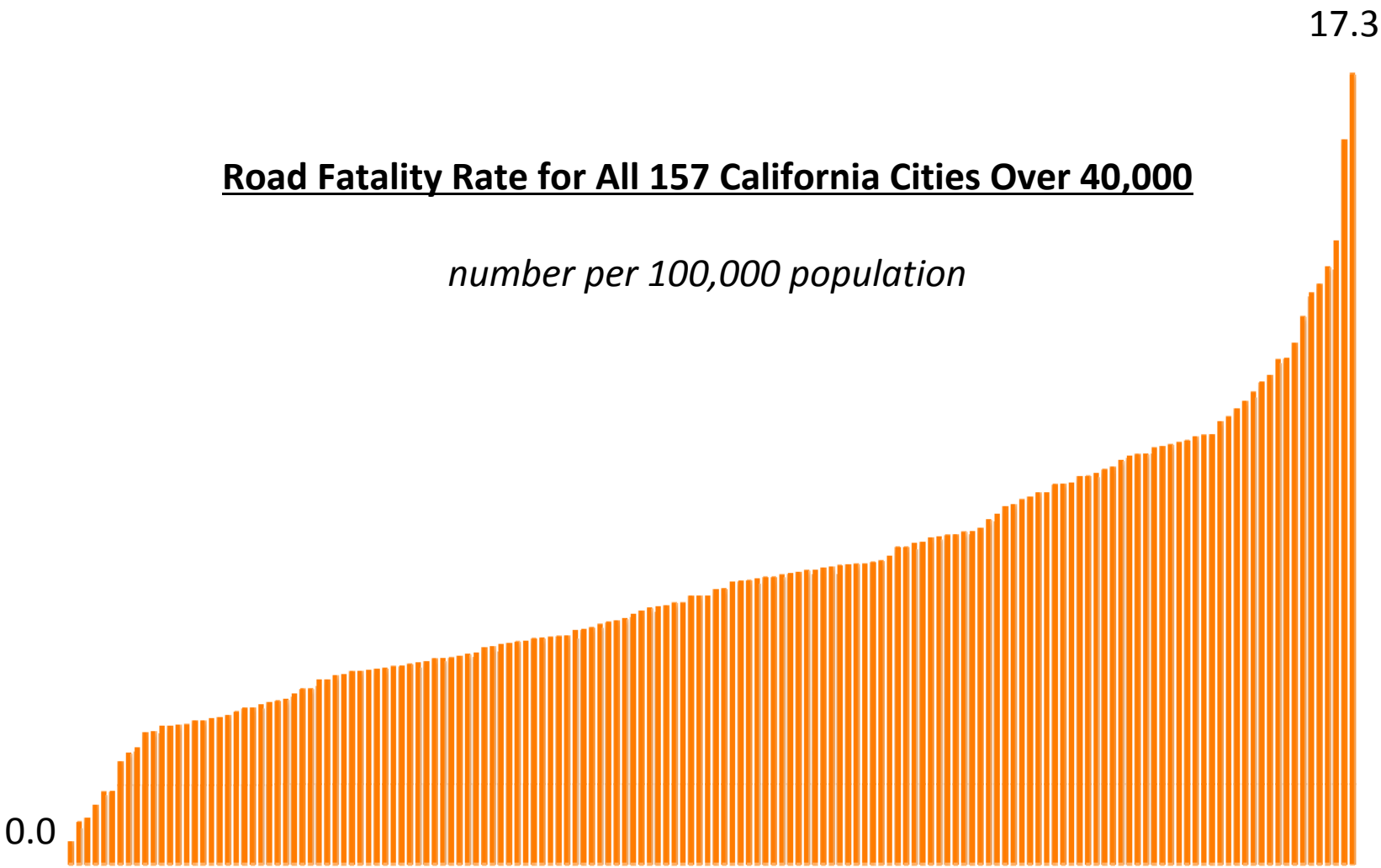
Davis, CA
14 % of people ride to work

Davis, CA

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

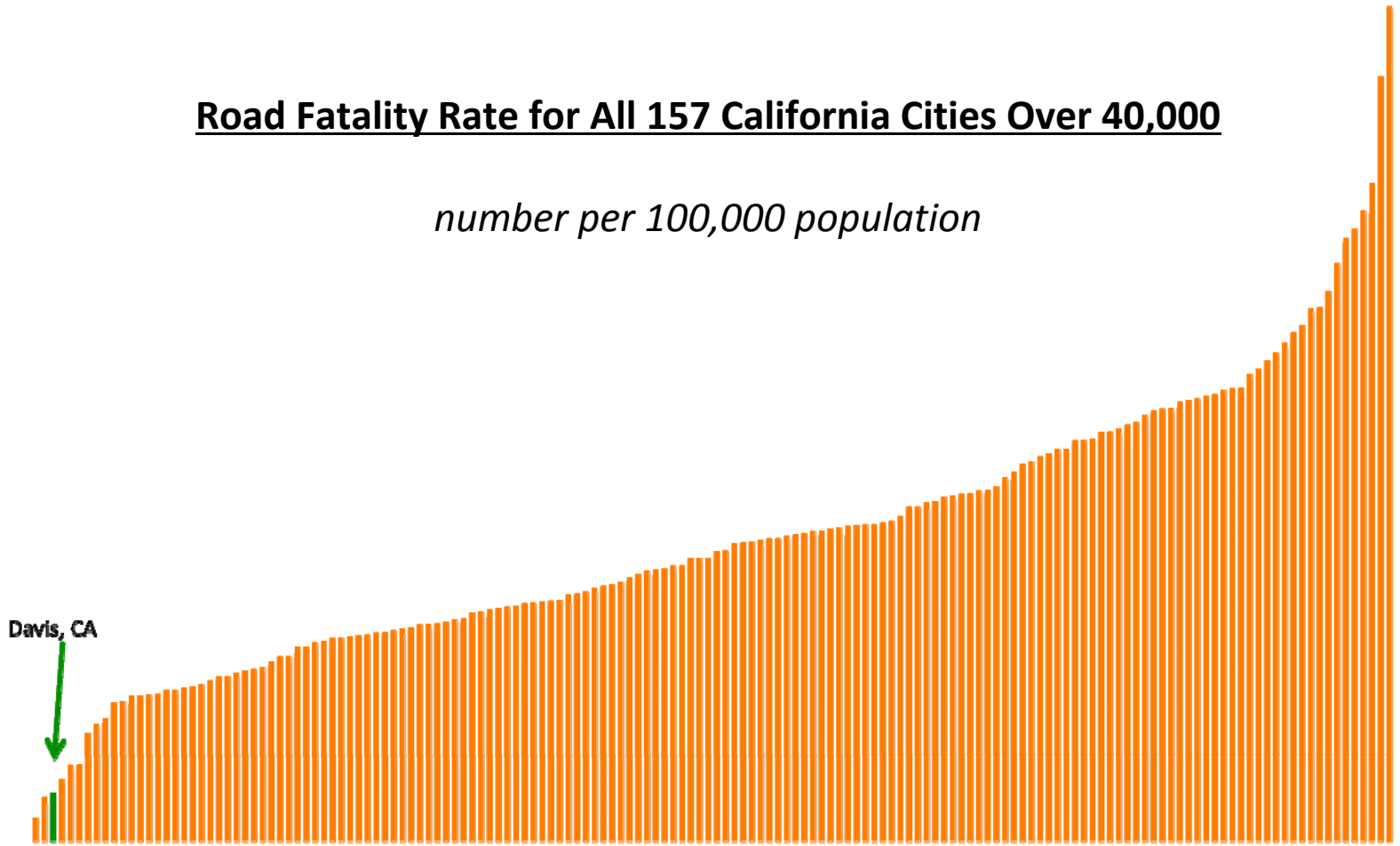
Road Fatality Rate for All 157 California Cities Over 40,000

number per 100,000 population



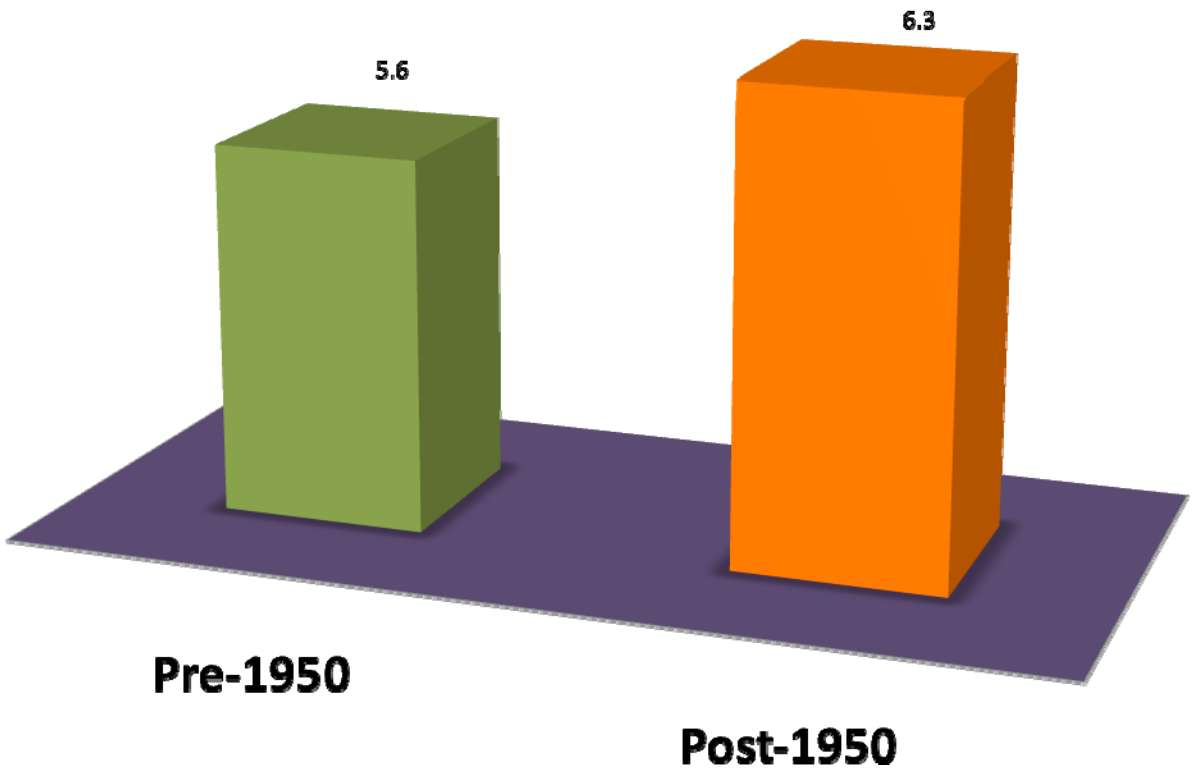
Road Fatality Rate for All 157 California Cities Over 40,000

number per 100,000 population



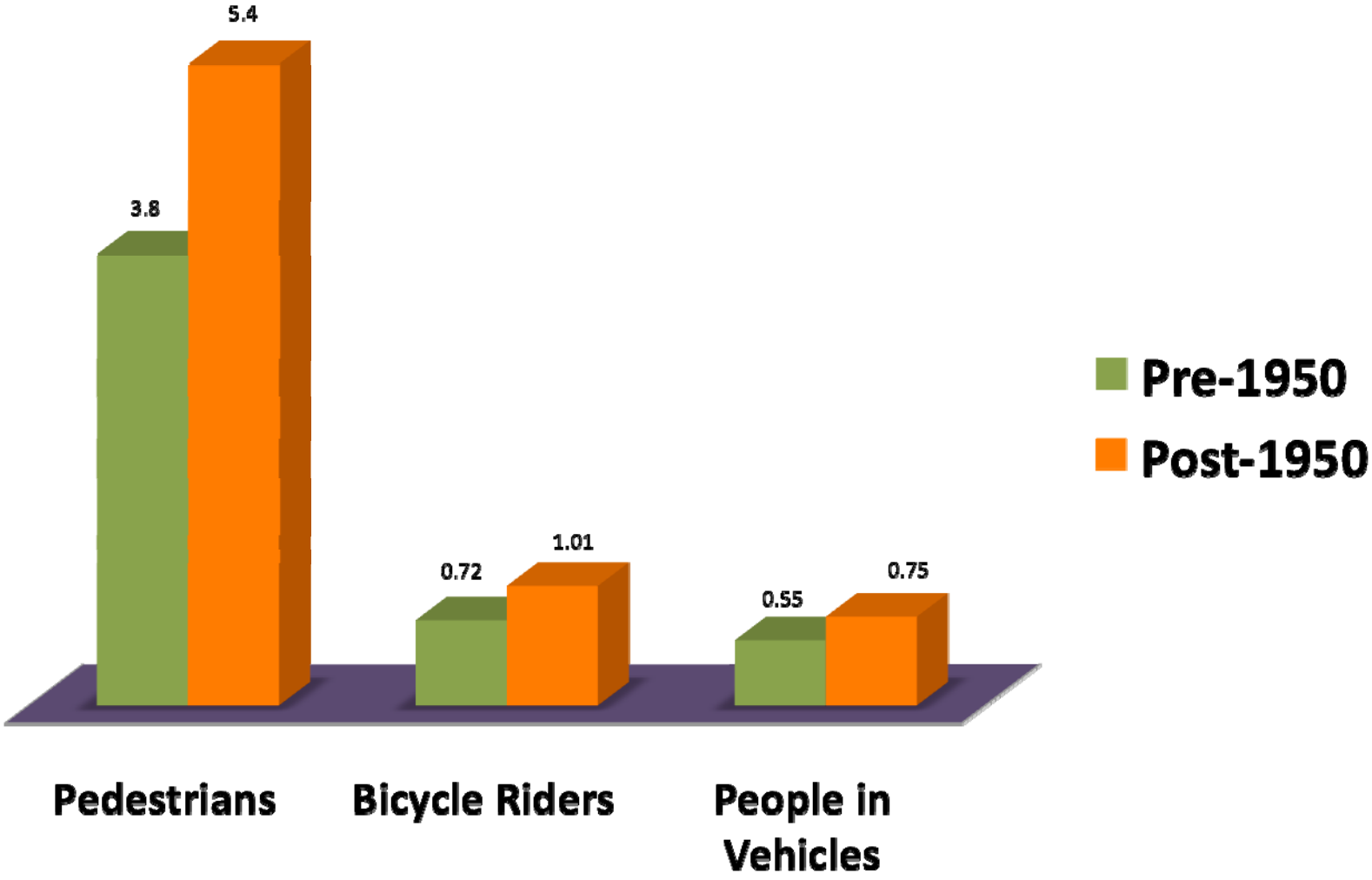
Road Fatalities per 100,000

California Cities of 40,000 to 120,000

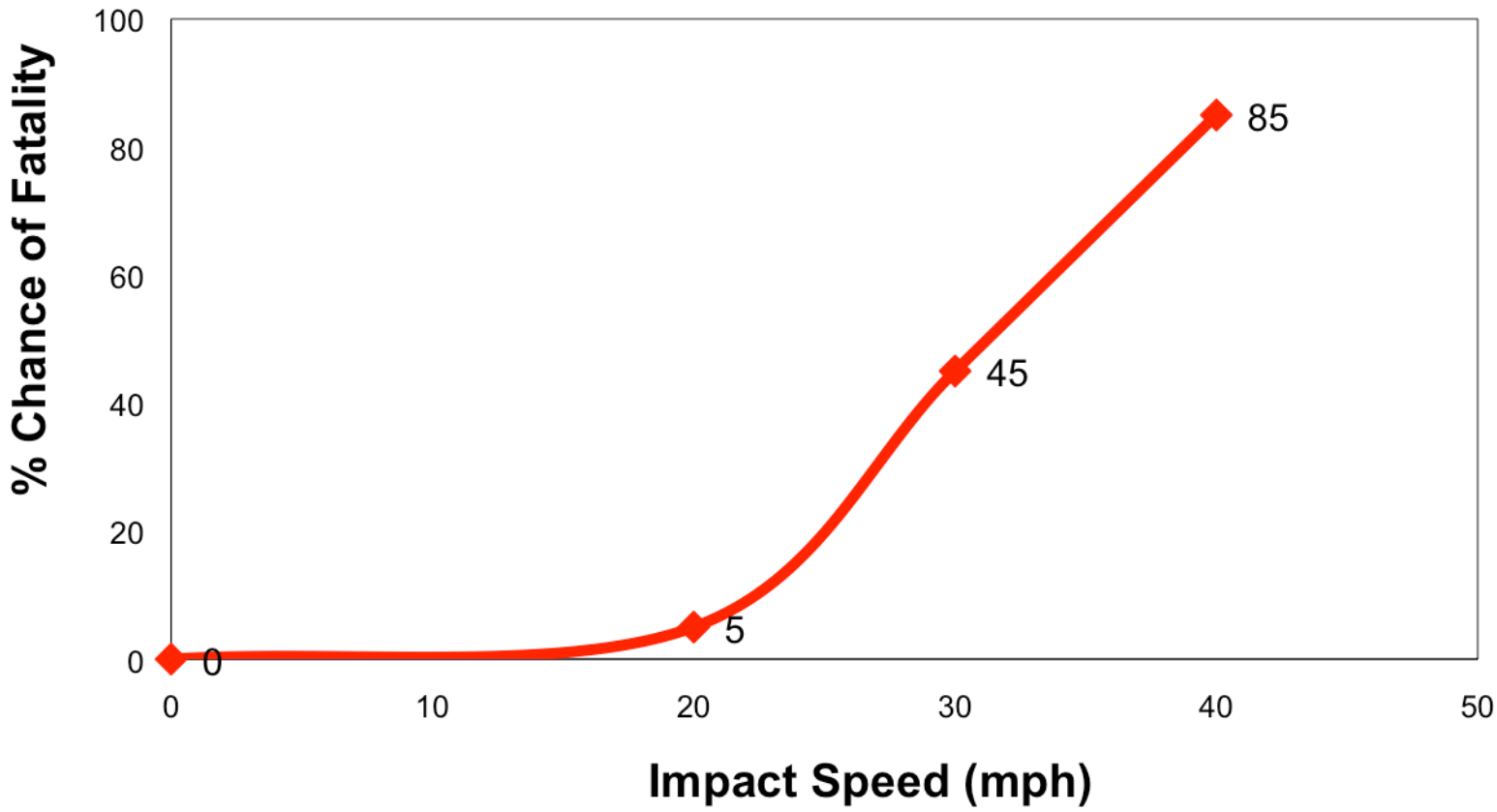


Risk of Fatality

(Fatalities as % of Injuries)
California Cities of 40,000 to 120,000

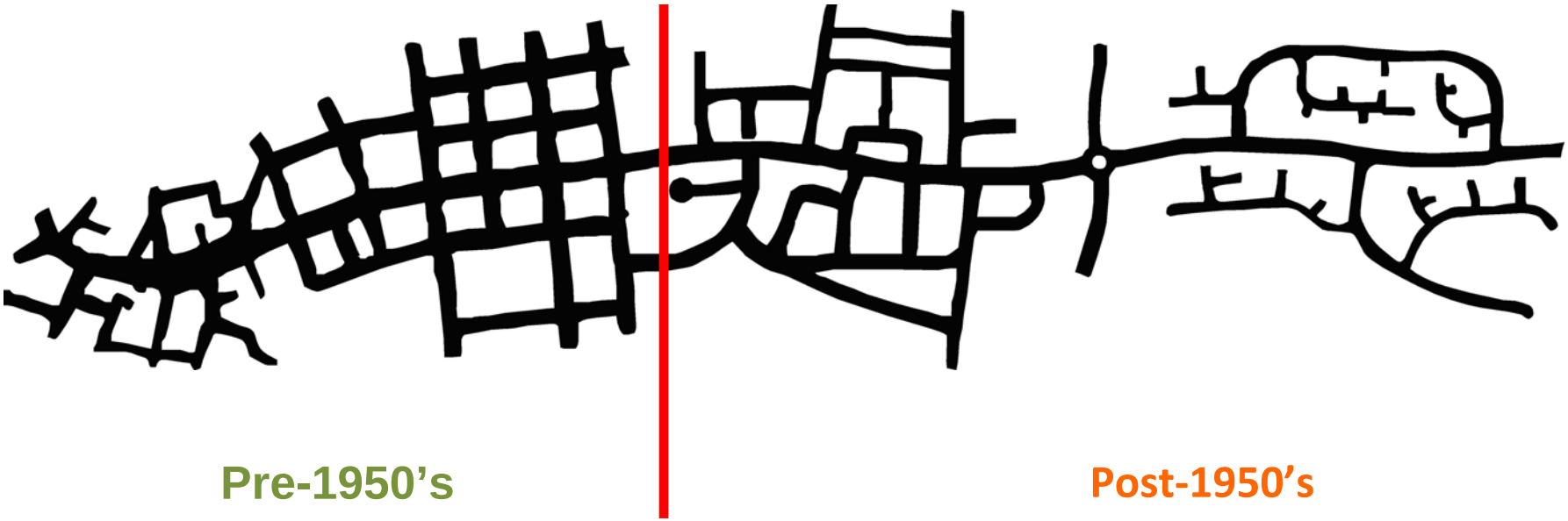


Chance of Pedestrian Fatality vs. Impact Speed



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

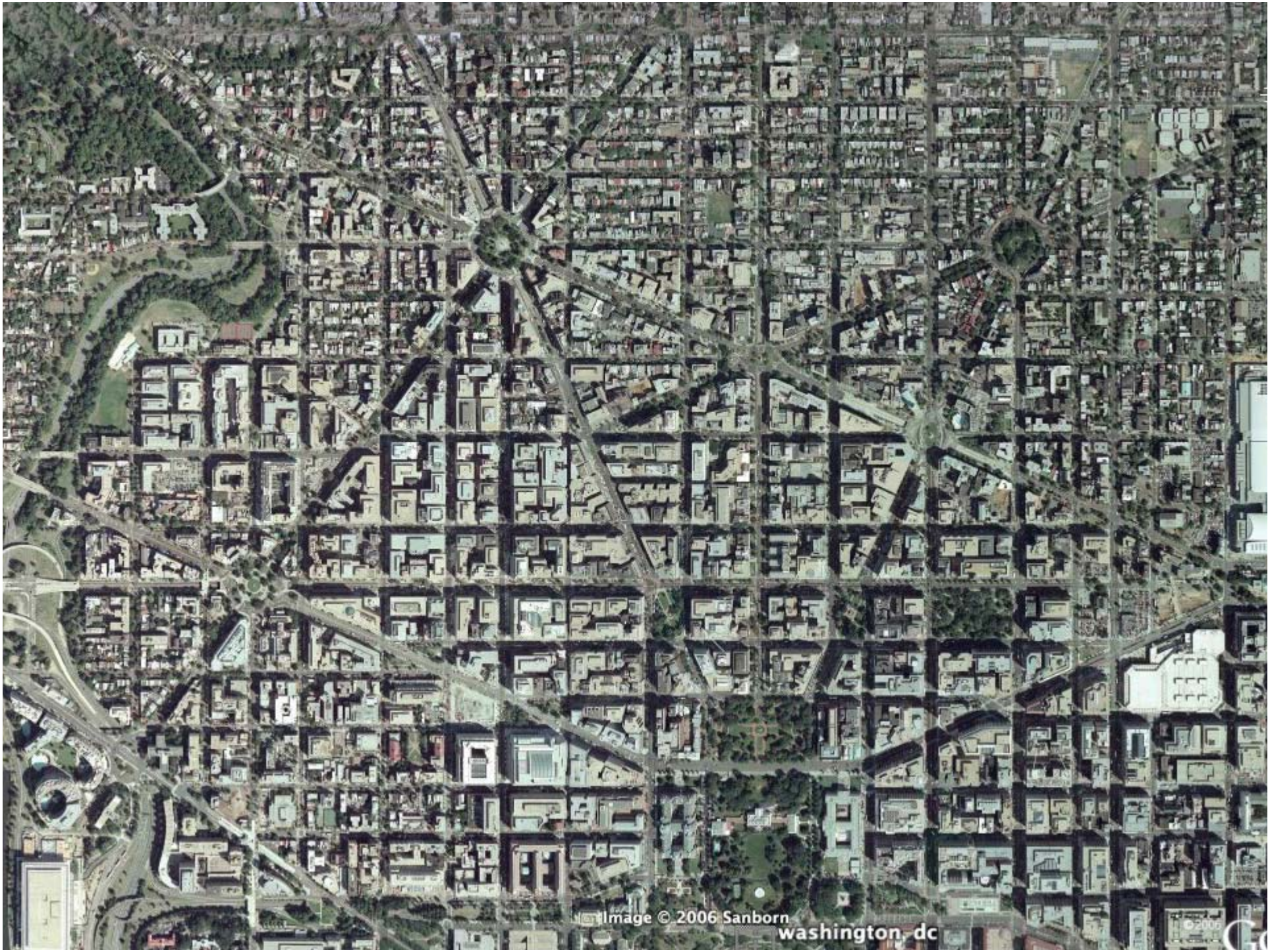
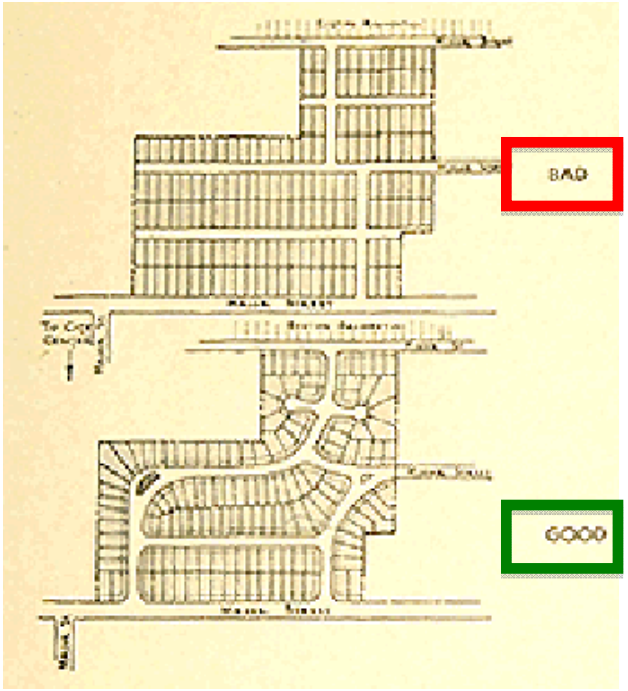


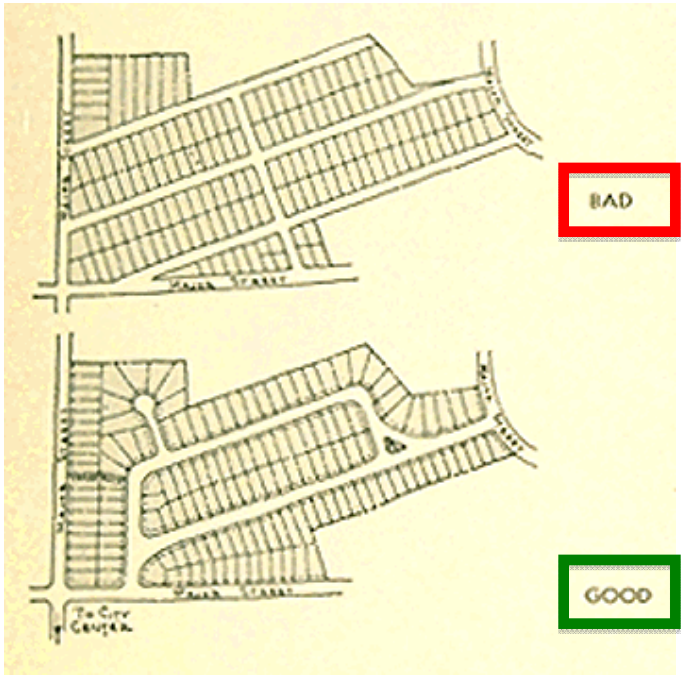
Image © 2006 Sanborn
washington, dc

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***



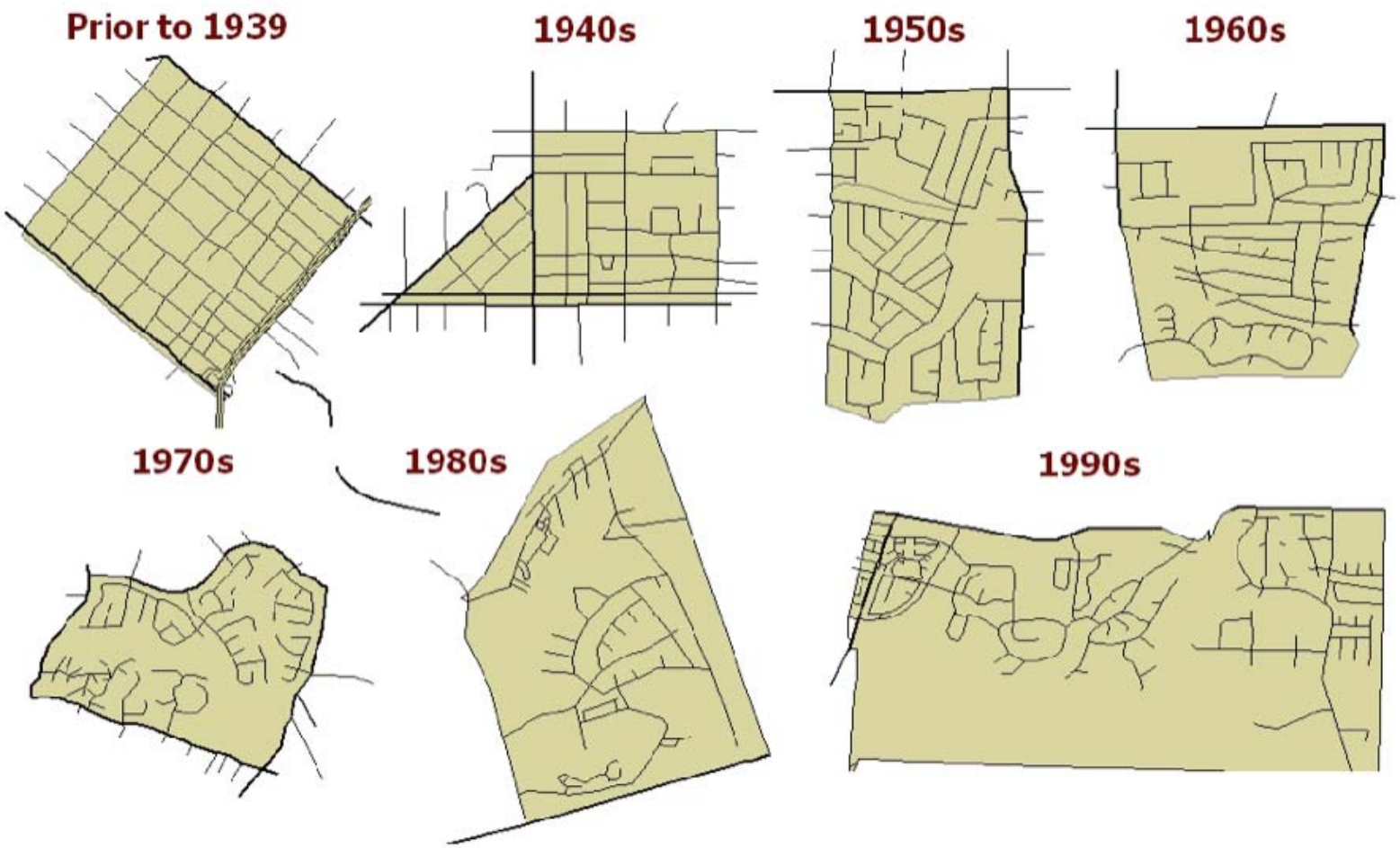
According to the FHA the grid layout was

- 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

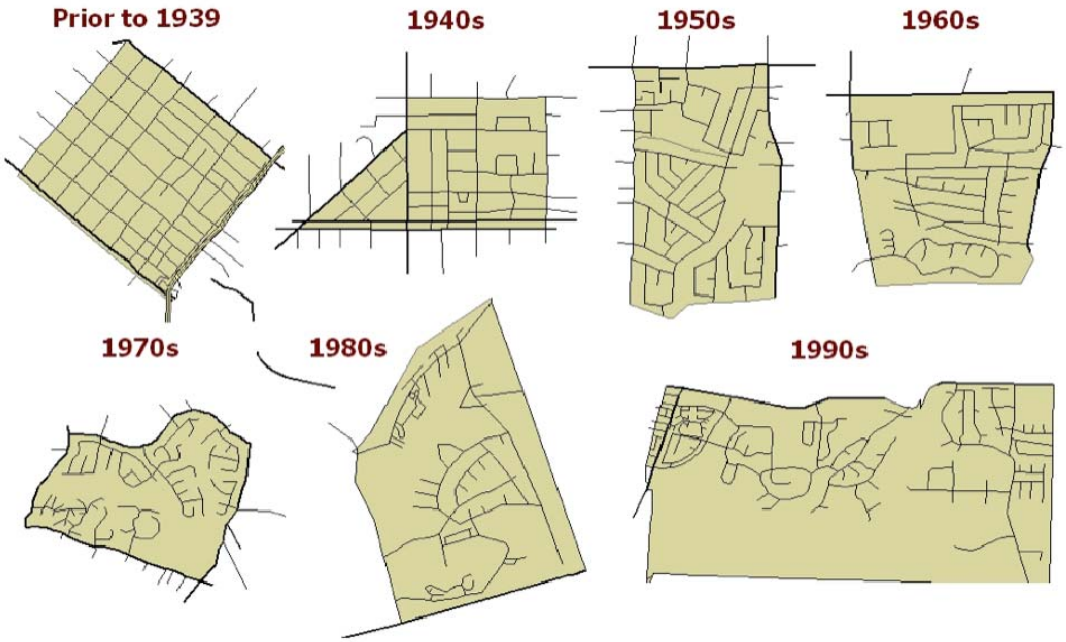
Research

Evolution of the Street Network



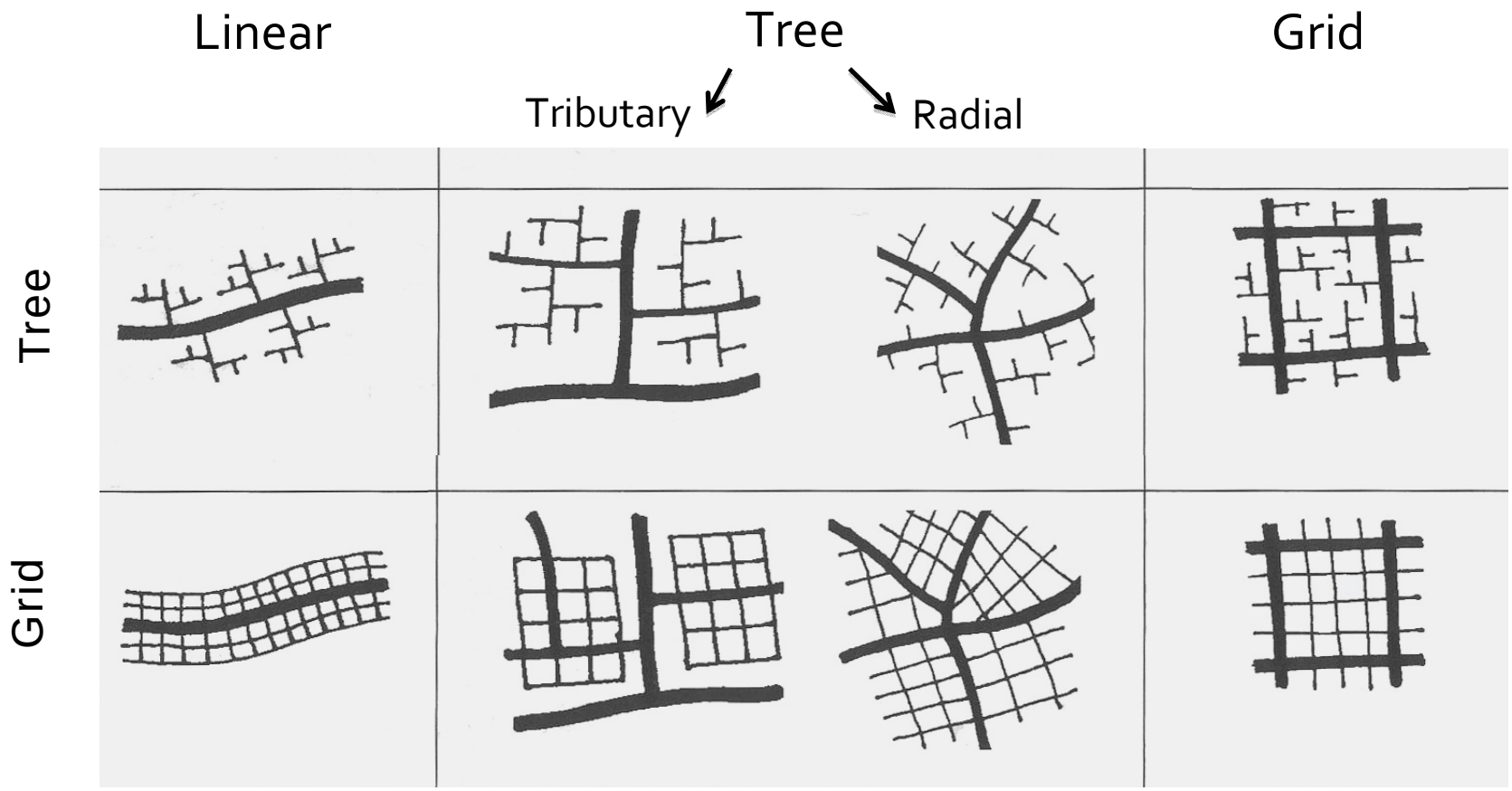
Characterizing the the Street Network

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



Neighborhood Street Network

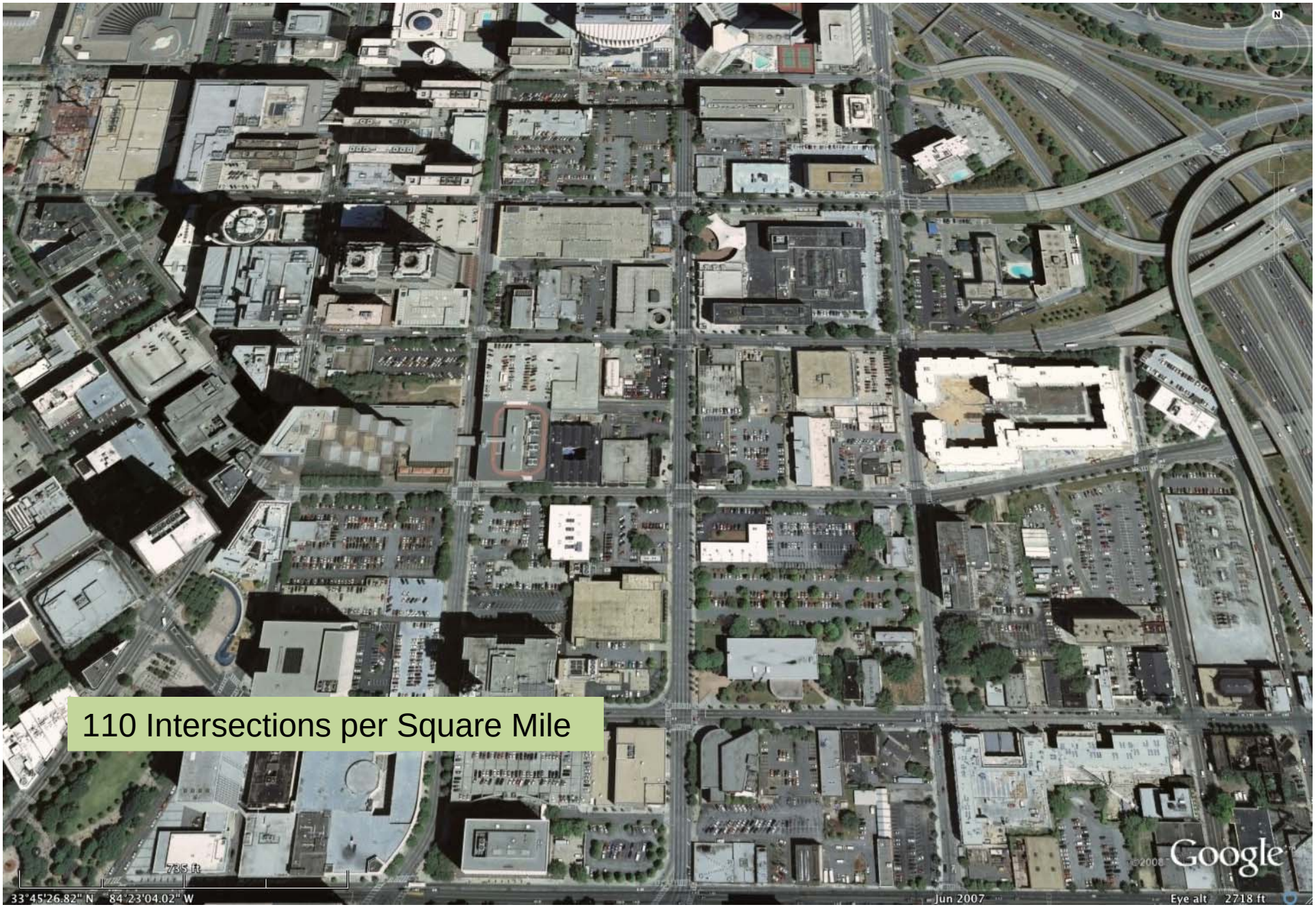
Citywide Street Network



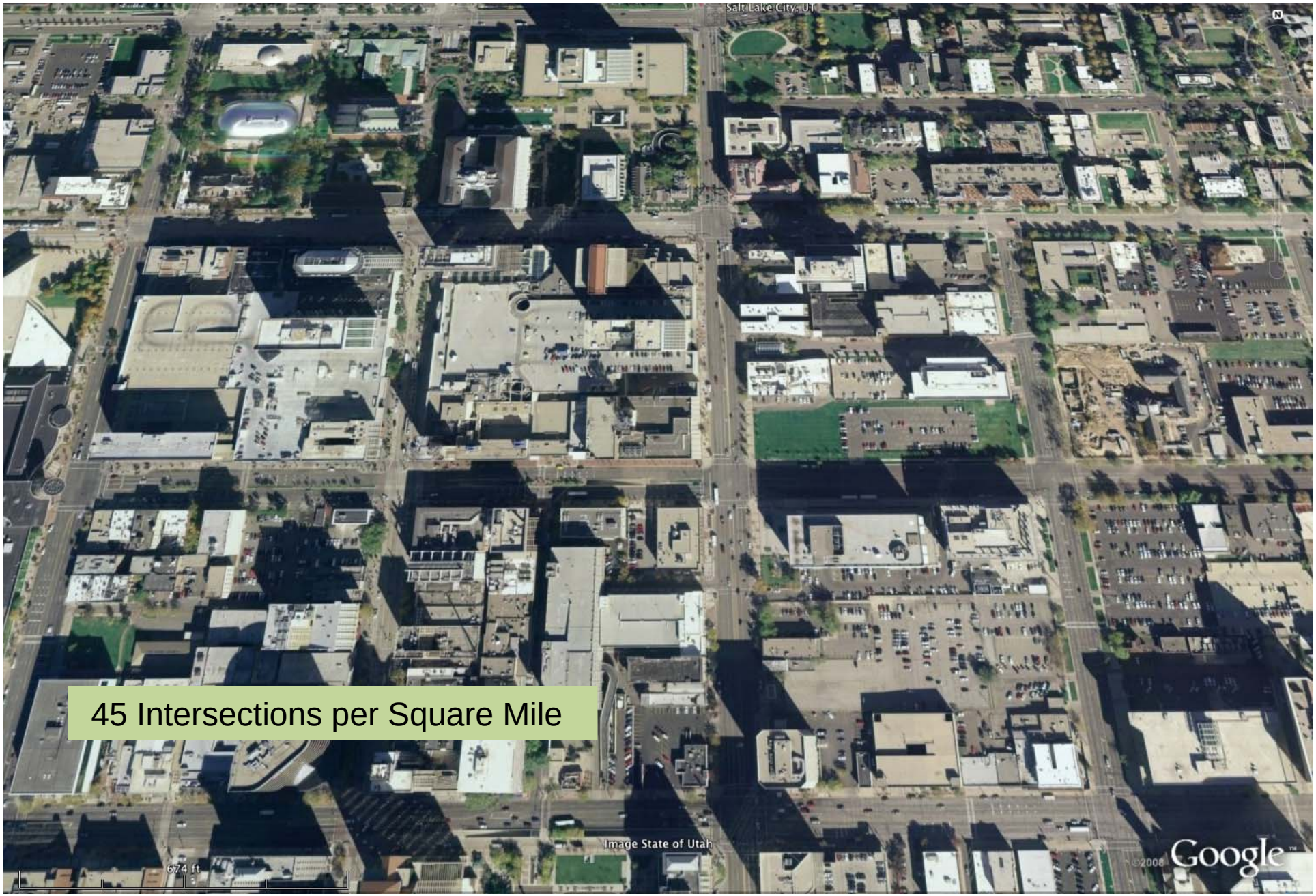
Adapted from Stephen Marshall, *Streets & Patterns*

Network Scale

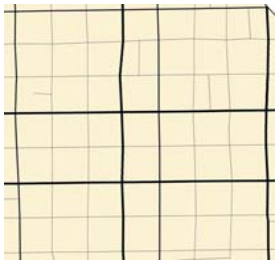
Network Scale



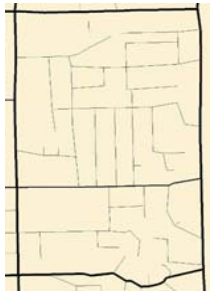
Network Scale



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

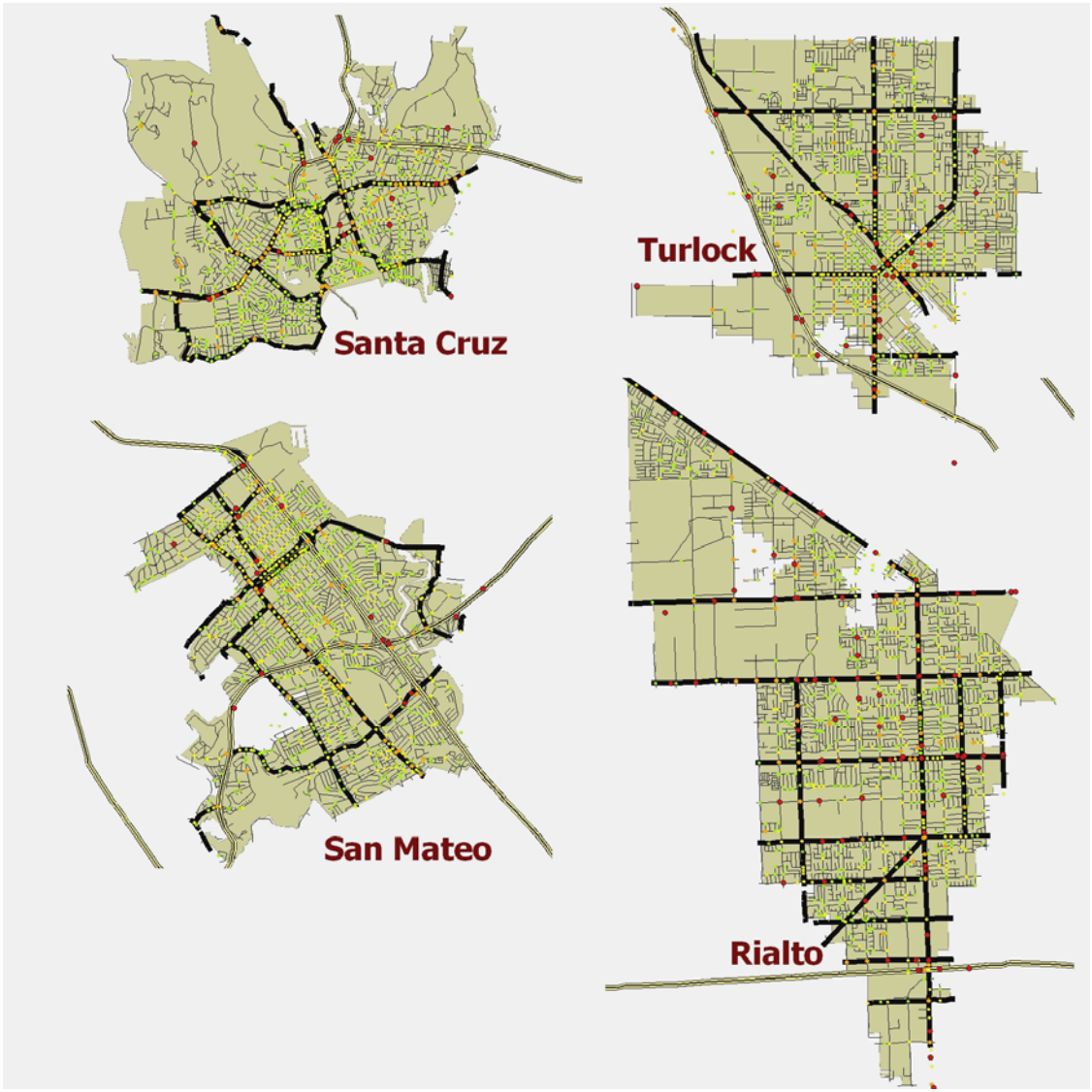
Distance from City Center

Income

Mix of Land Use

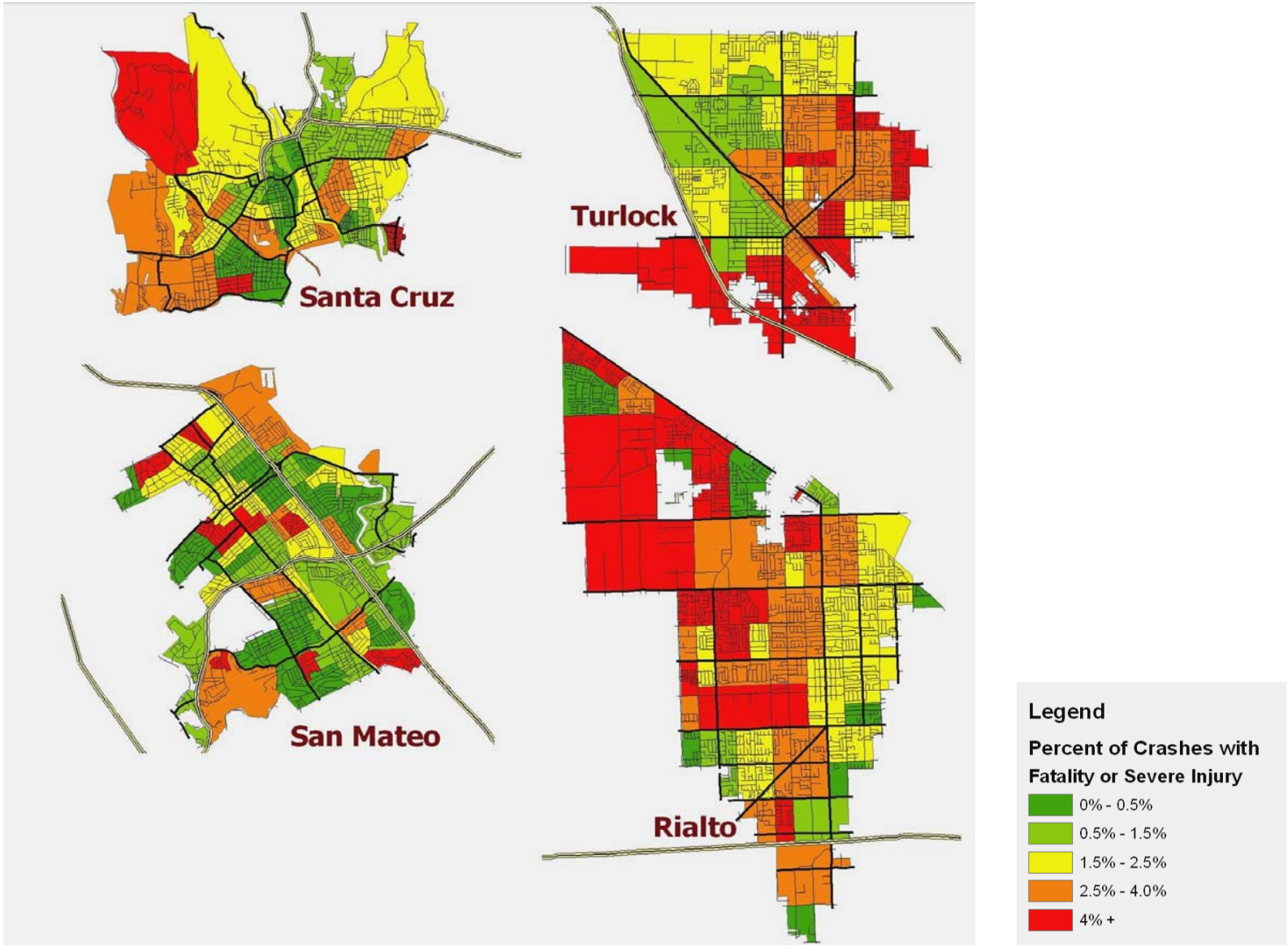
Safety Analysis Based on Geo-coding 230,000 Accident Records

in 24 California Cities



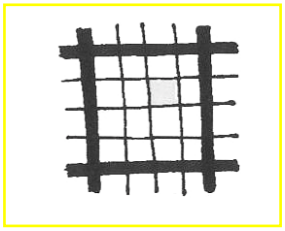
Safety and Travel Choice Analysis done for 1040 Census Block Groups

24 California Cities

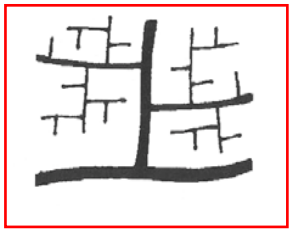


versus

Risk of Severe Injury or Fatality*



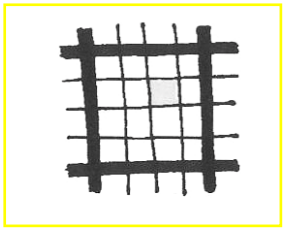
versus



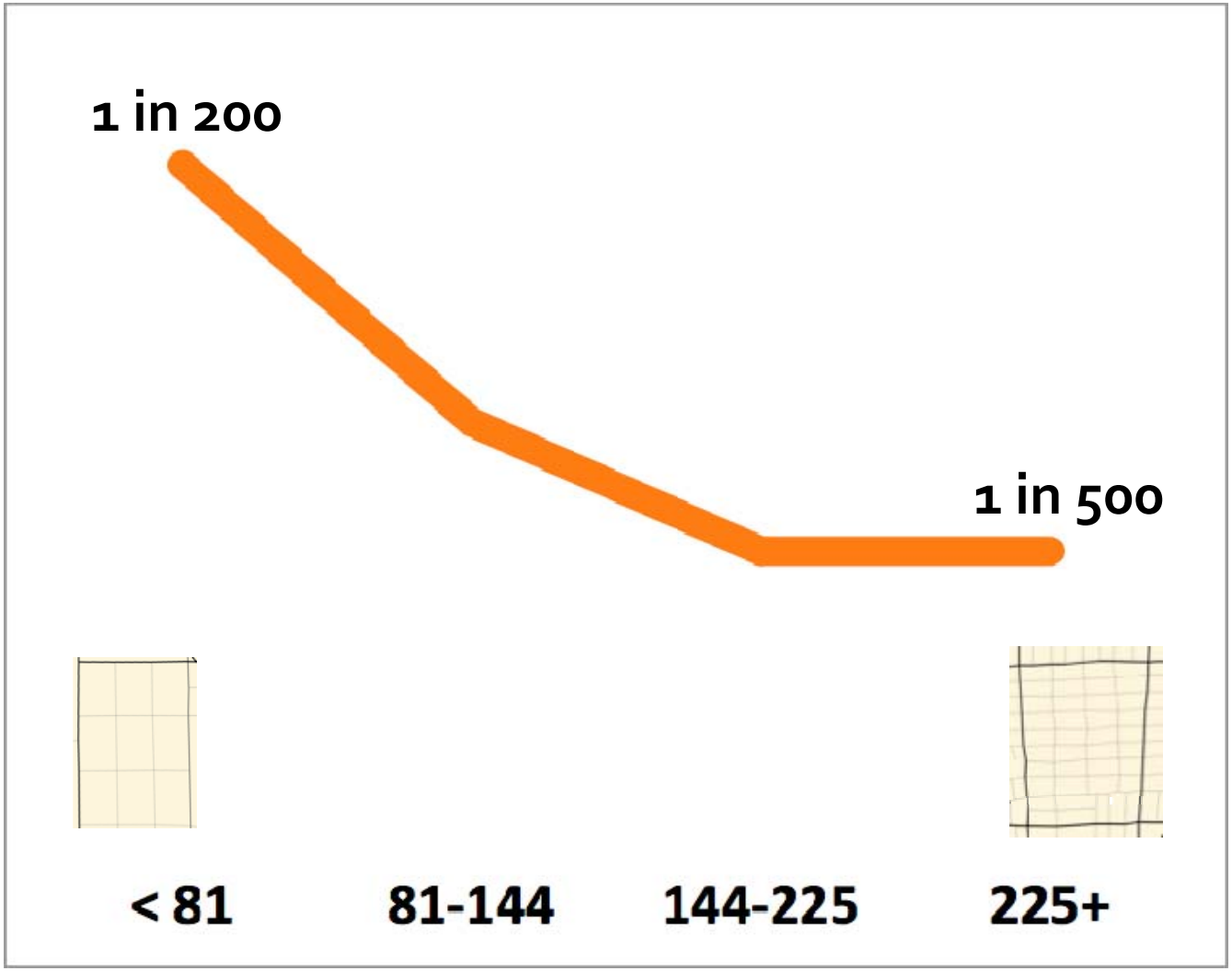
Chance of being Severely Injured
30% Higher

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

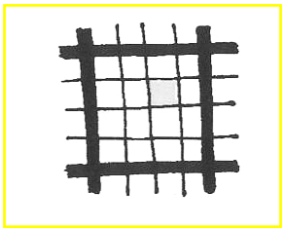
Does Street Network Matter for Safety?

The street network plays a huge role in terms of traffic safety

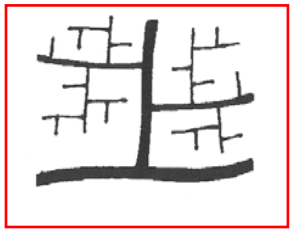
1. Street density seem to be the most important factor
2. Street network configuration is also important
3. The results with respect to ‘connectivity’ is a bit more complicated

What About Connectivity?

Street patterns types that are more connected are safer

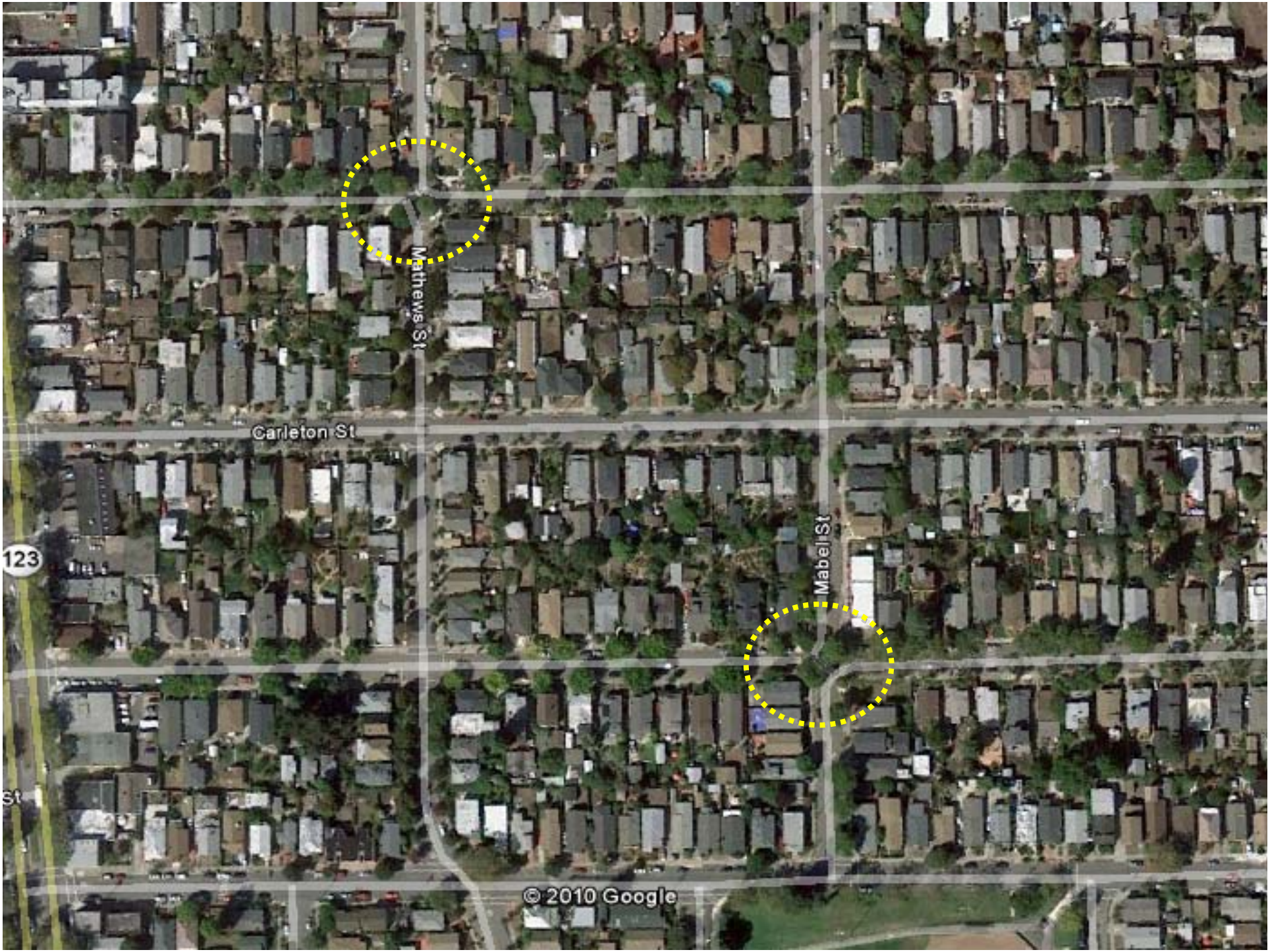


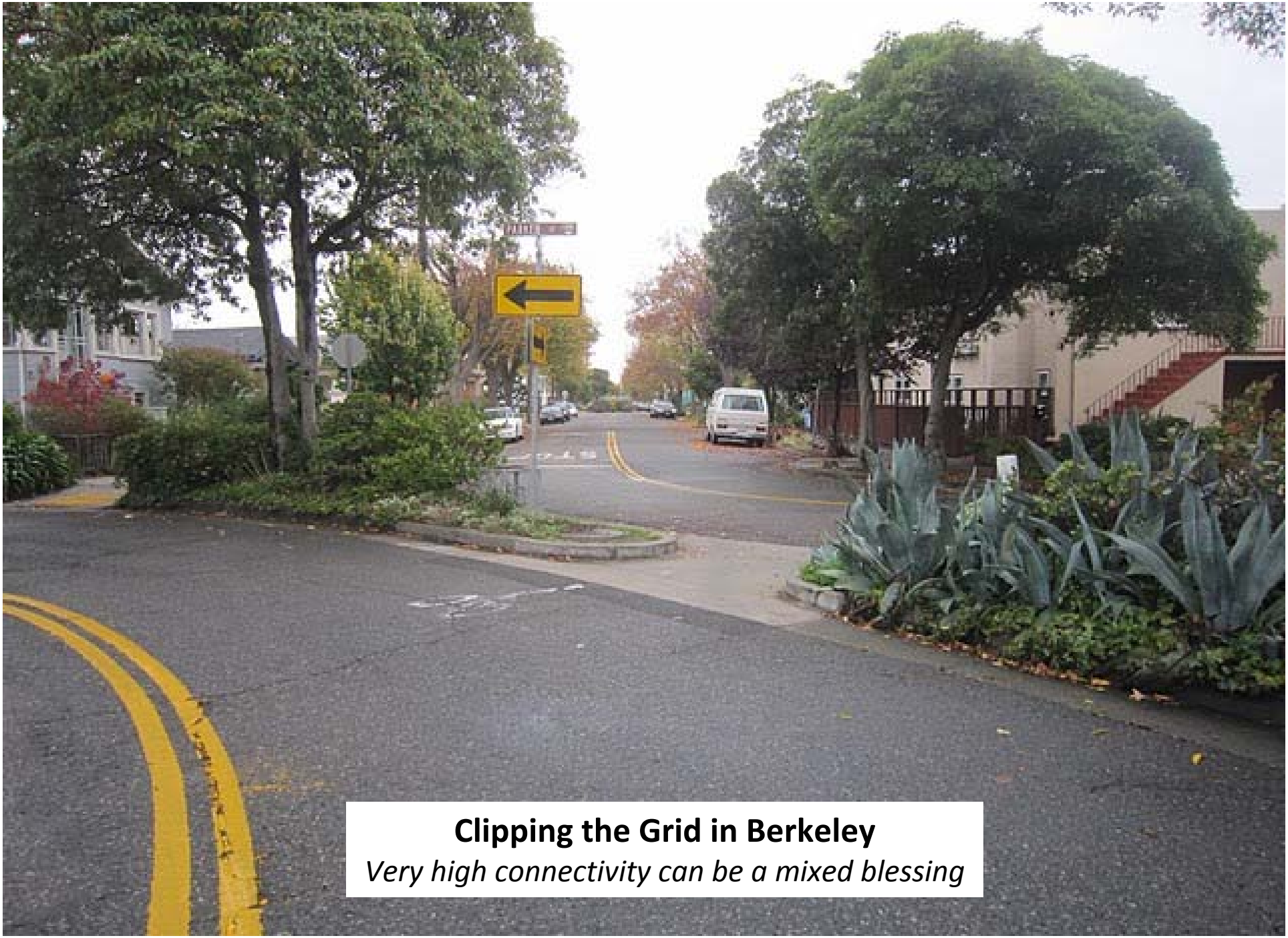
Safer



Less Safe

Within each type of street pattern increasing connectivity – measured by link-to-node ratio - was not correlated with improved safety


Matthews St
Carleton St
Mabel St
123
© 2010 Google



Clipping the Grid in Berkeley

Very high connectivity can be a mixed blessing

Why Does Street Network Matter?

Why does street network matter for safety?

Understanding this issue is important helping us understand how to develop a new approach for designing street network

Street network affects

- Speed control
- Travel mode choice and VMT
- Traffic distribution

Speed control reduces accident severity

More diverse mode choice and good traffic distribution reduces the demand for road capacity and means that we are more likely to keep the streets to a human scale

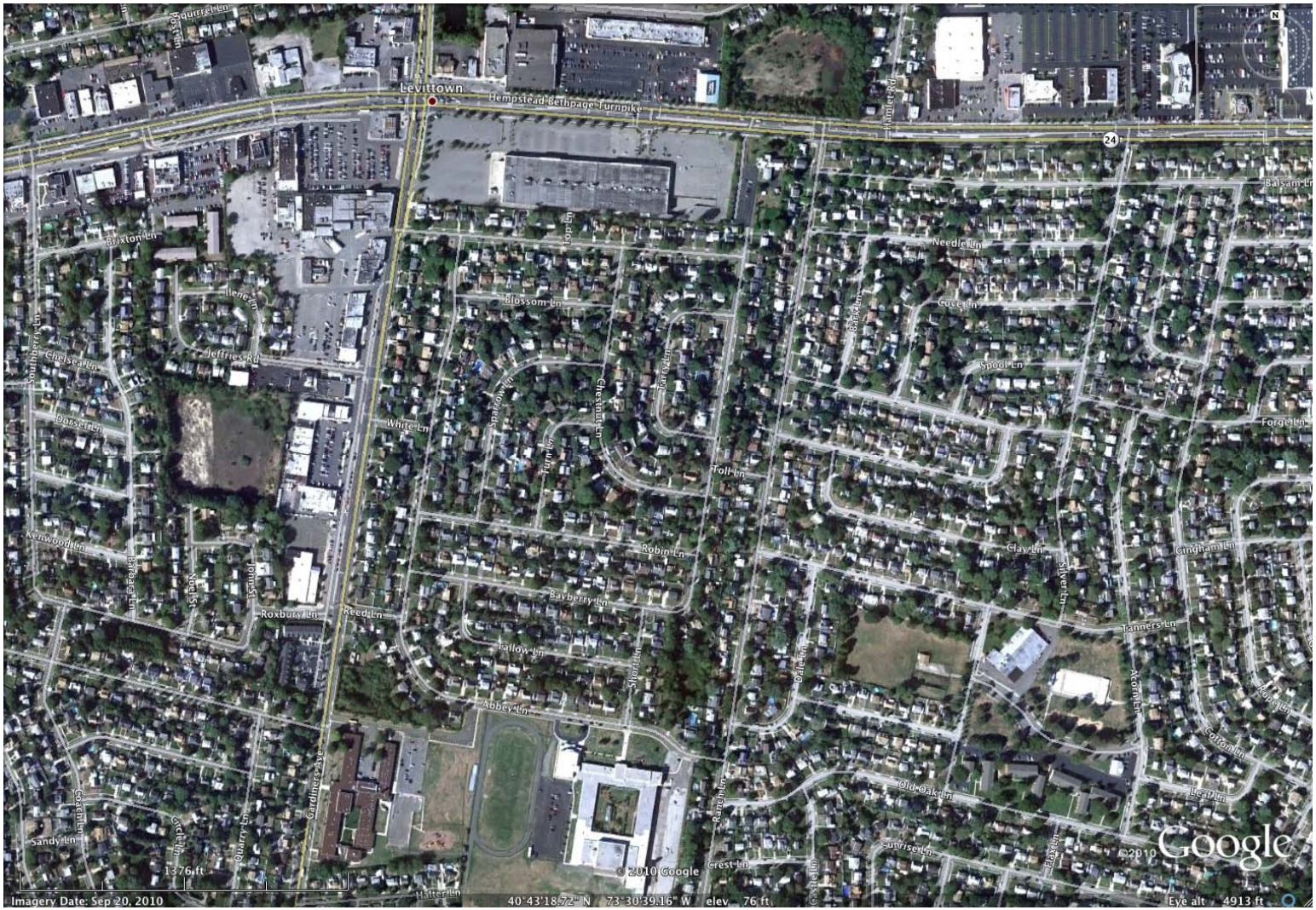
Design for Safety

The two most important characteristics of the street network in designing for safety are

1. Dense (Fine Grained) Fabric
2. Functional Connection for walking within and between neighborhoods

Connected?

Yes… based on convention matrices



Functionally Connected for Walking?

No…. Each neighborhood is an isolated pod

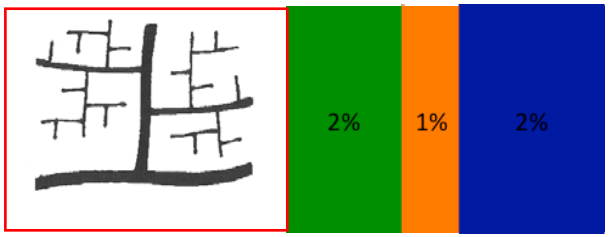
Traffic Safety and Smart Growth

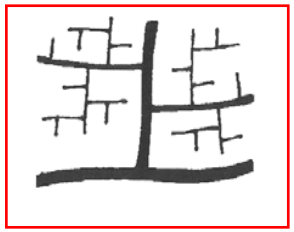
The same street design features that supports traffic safety also

- Promote use of active transportation
- Reduce VMT
- Create value

In other words, a safe street network is also a smart growth street network

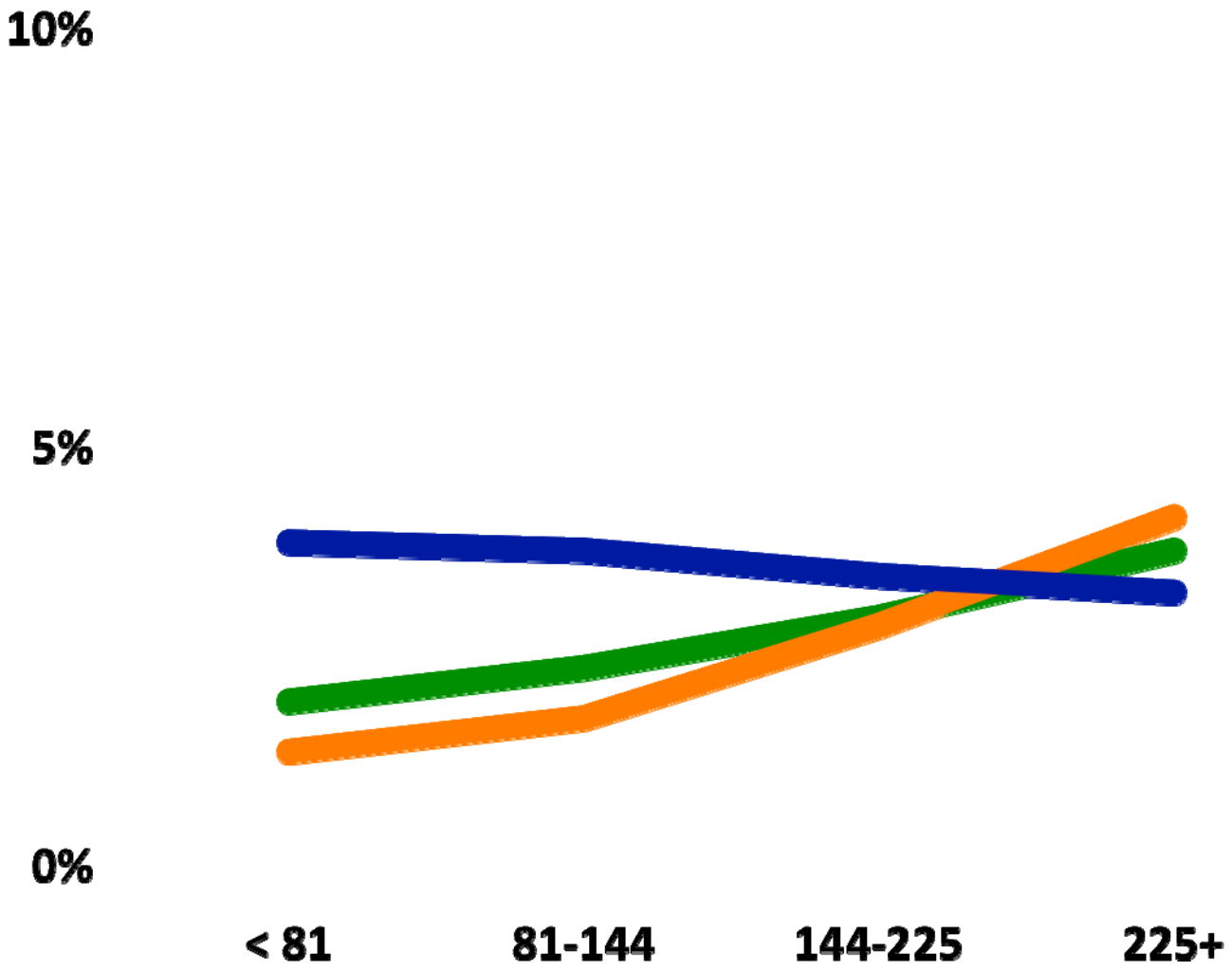
Percentage of People Walking, Biking or Taking Transit

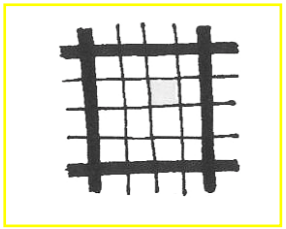




Percentage of People Walking, Biking or Taking Transit

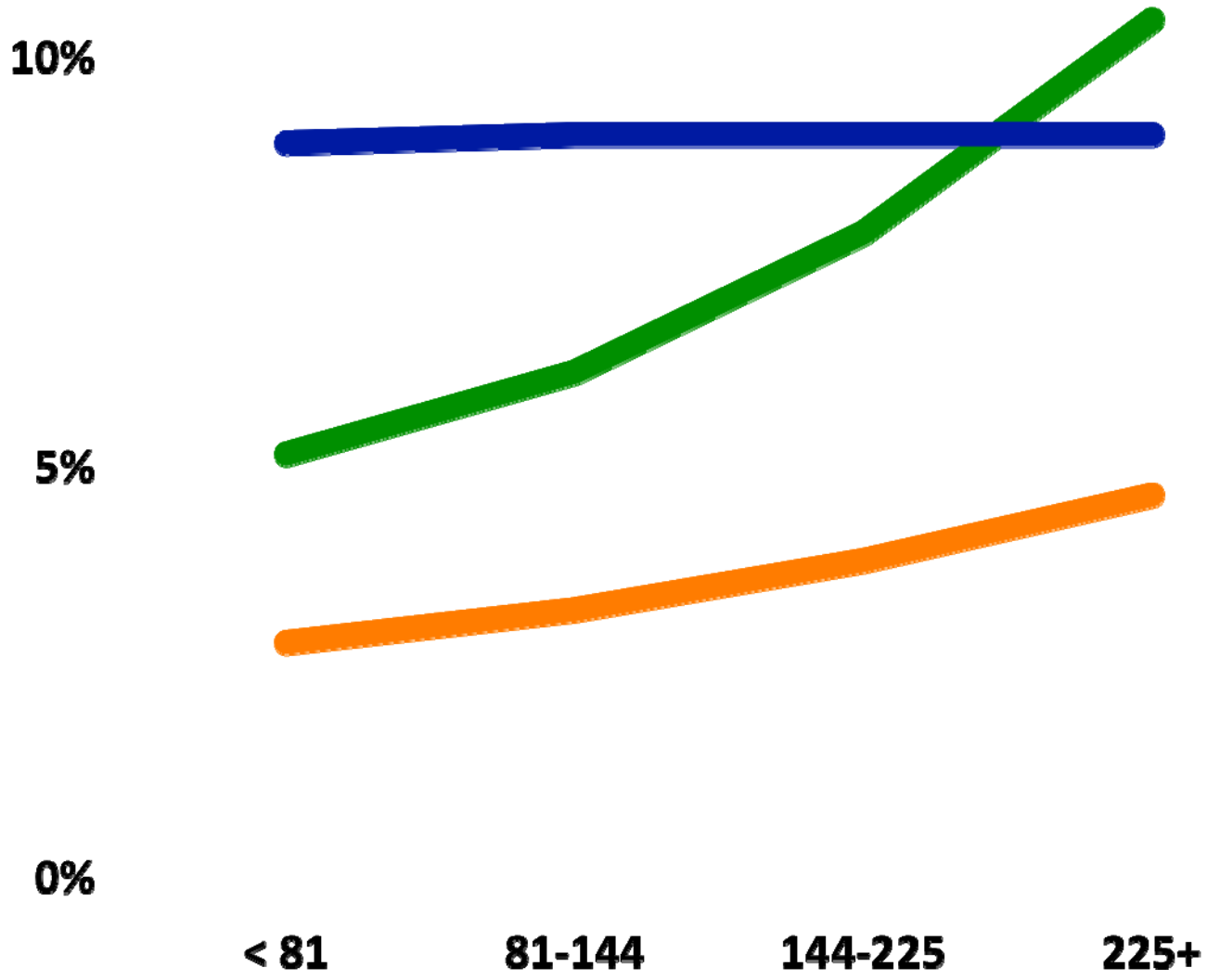
Effect of Intersection Density for Cul-de-sac Network





Percentage of People Walking, Biking or Taking Transit

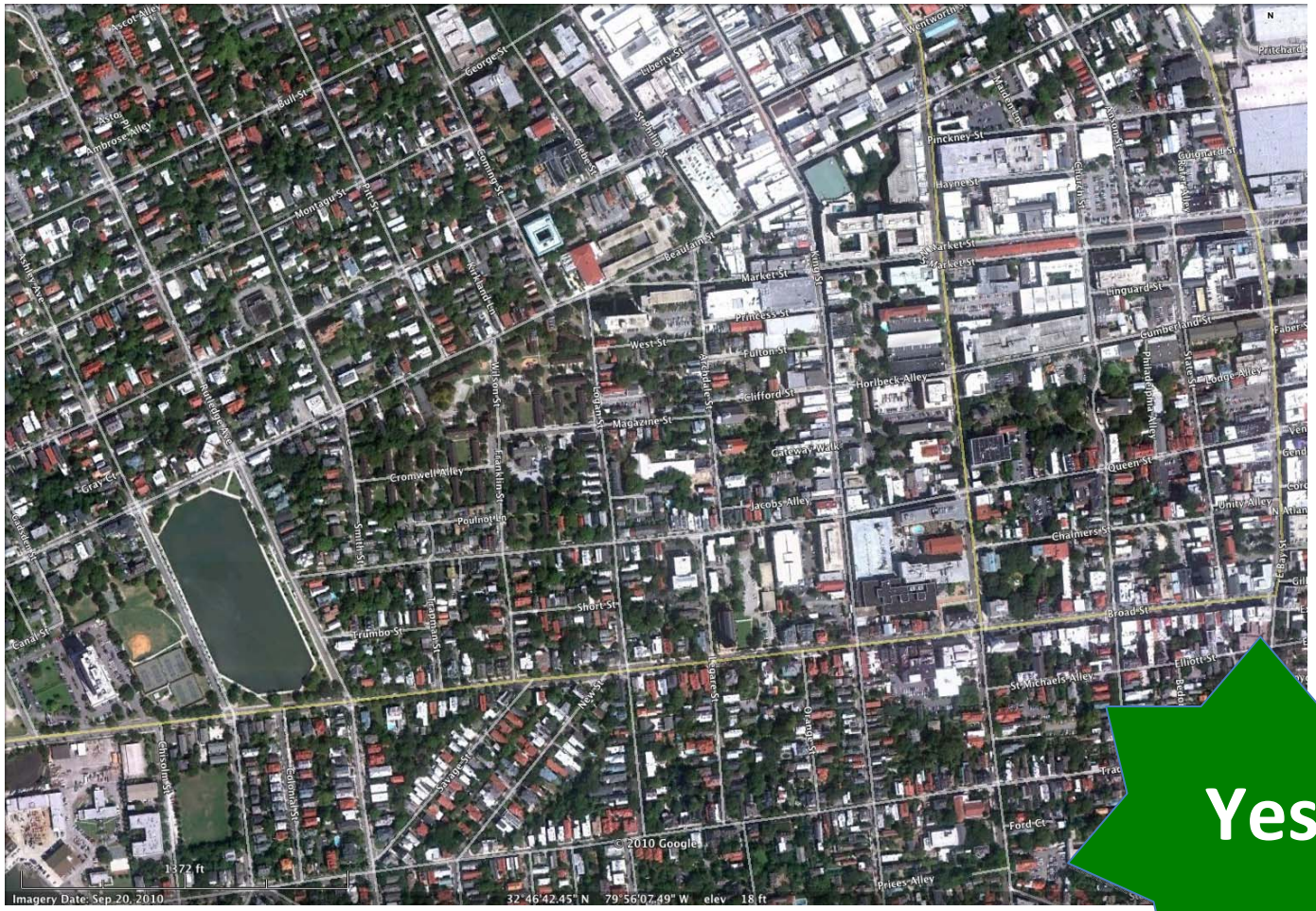
Effect of Intersection Density for Gridded Network



Street Networks for Smart Growth

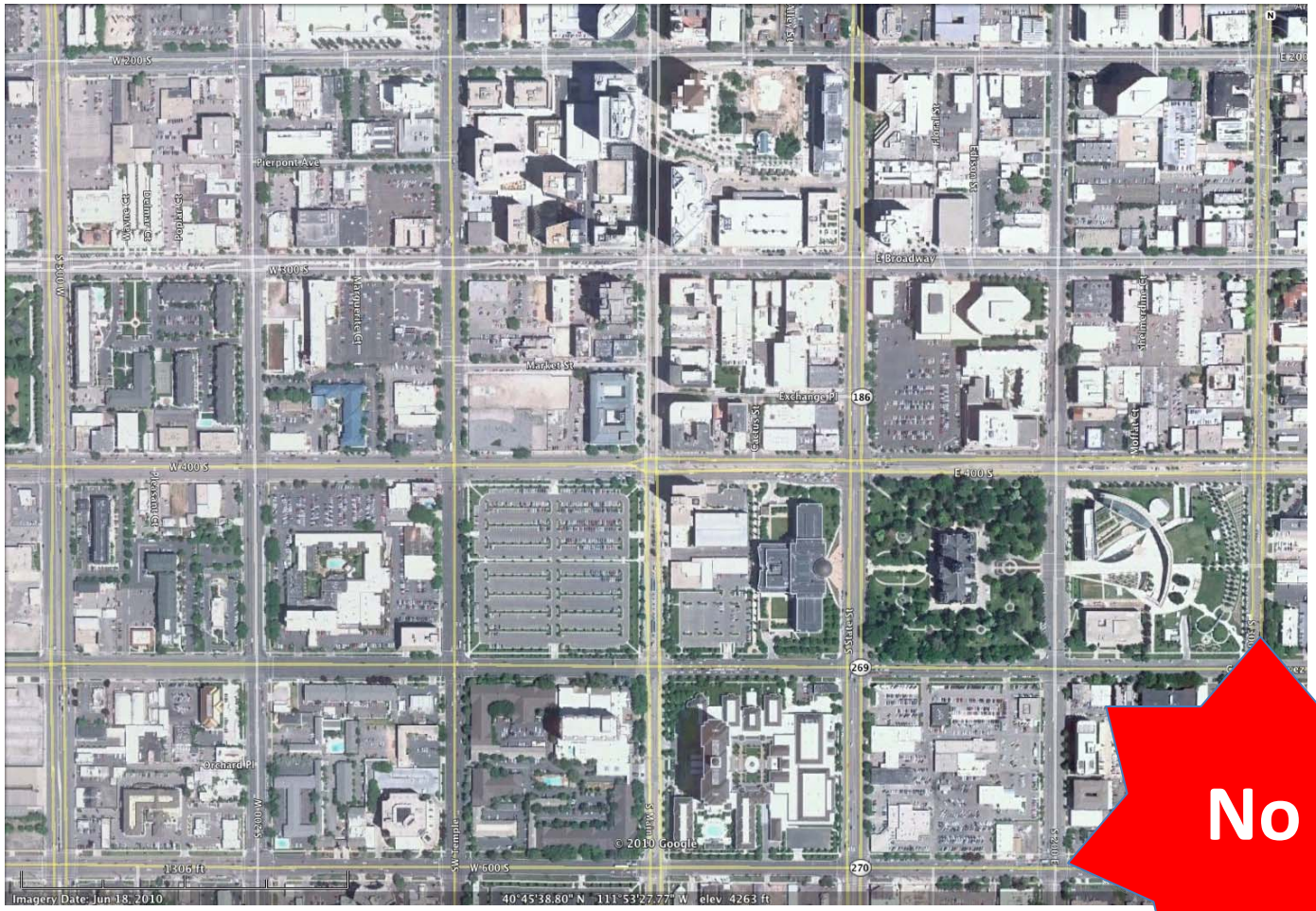
There is no one type of ‘smart growth street network’

Smart Growth Street Network?



Yes

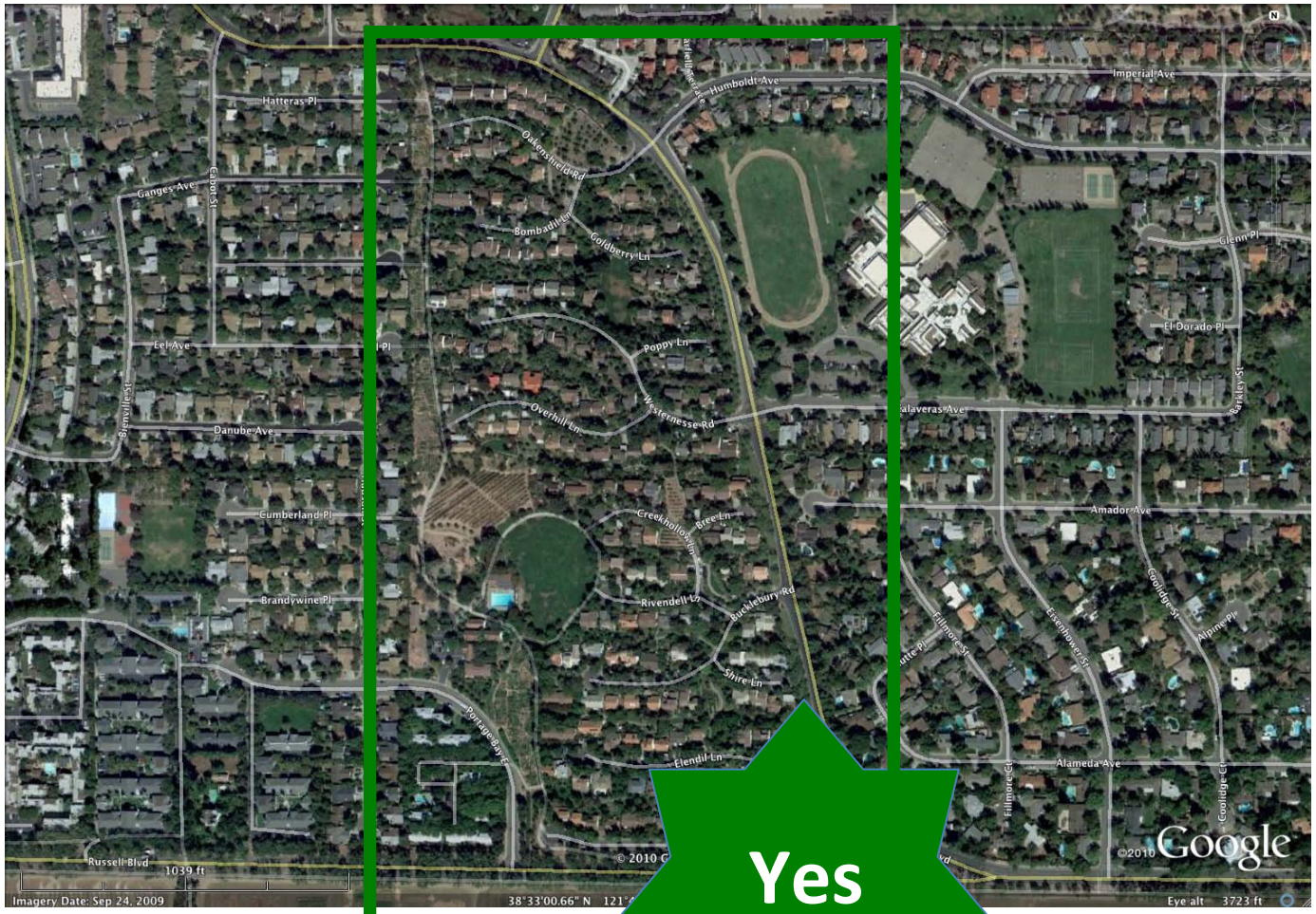
Smart Growth Street Network?



No

What is a Smart Growth Street Network?

Smart Growth Street Network?



Connectivity Standards

A handful of number of jurisdictions have enacted connectivity standards

Connectivity standards by themselves will not necessarily produce safer communities or smart growth communities

We need more focus on the issues of

street network scale and functional connectivity

After years of ignoring the role of street network on traffic safety we are beginning to build a body of knowledge – we need to embrace the complexities of the issues

Great cities are built on the foundation of a Great Street Network