Network, Placemaking and Sustainability

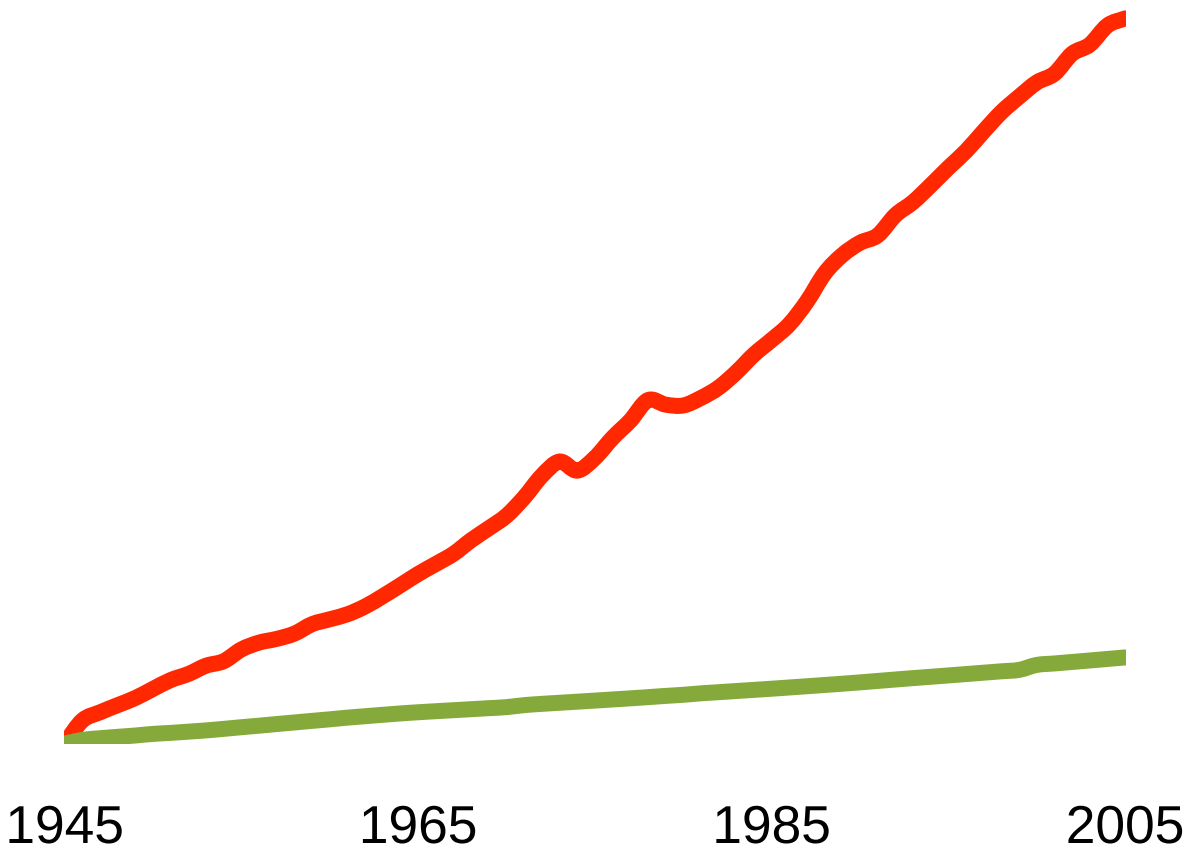
Norman W. Garrick

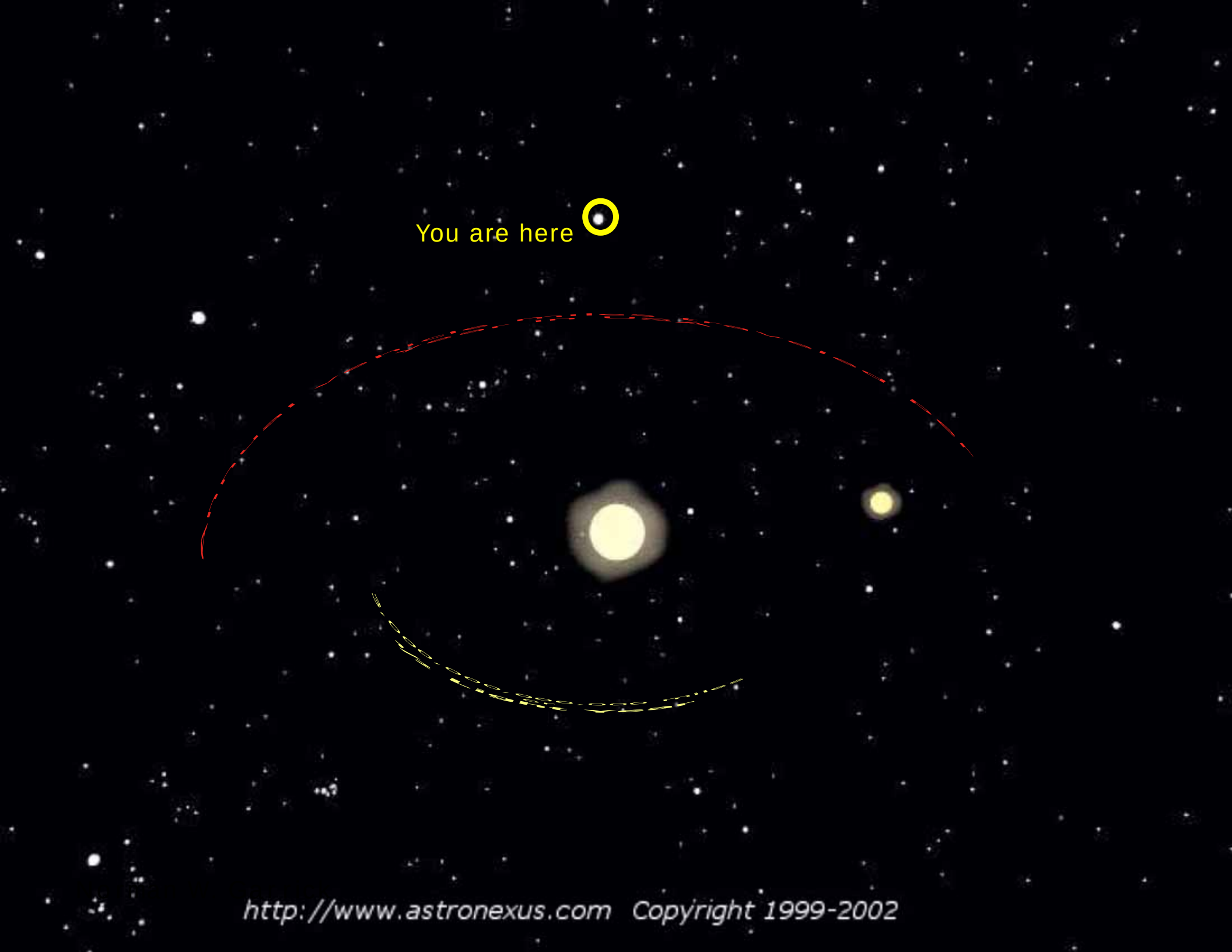
Wesley Marshall

CENTER FOR TRANSPORTATION and URBAN PLANNING
University of Connecticut

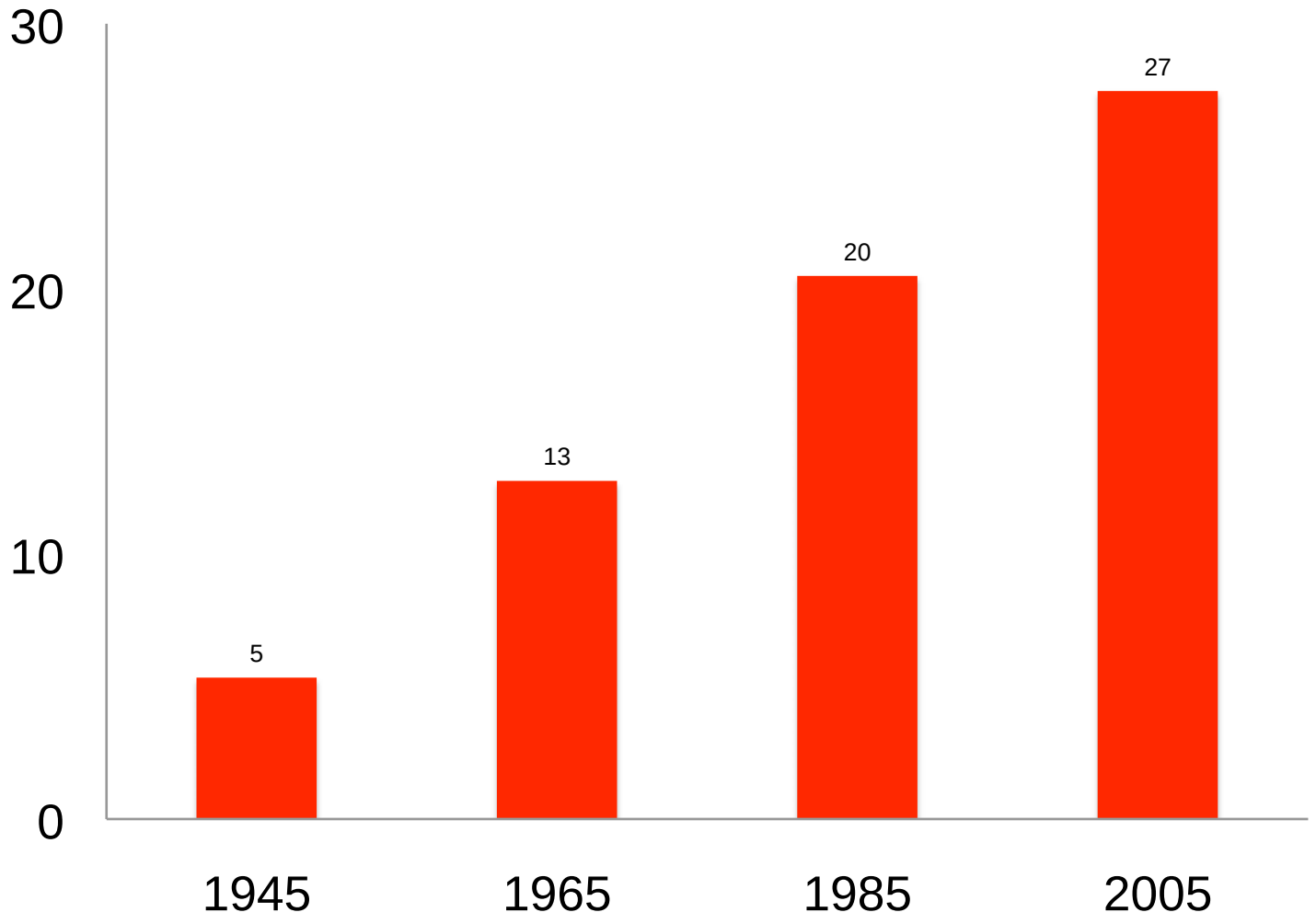
Vehicle Miles Traveled

1945 to 2005

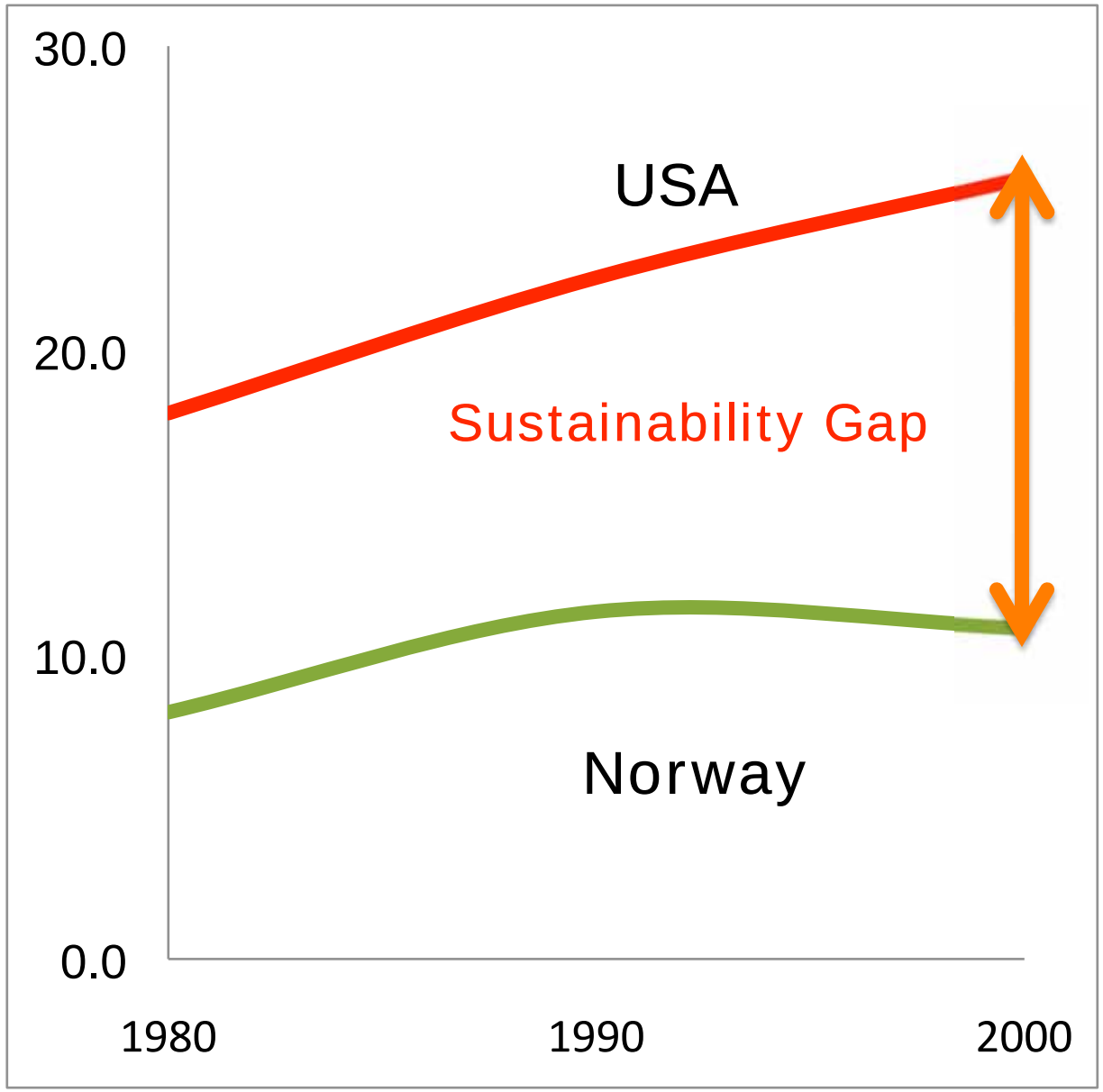



You are here
http://www.astronexus.com Copyright 1999-2002

Miles per day per capita
1945 and 2008



The Transportation Sustainability Gap

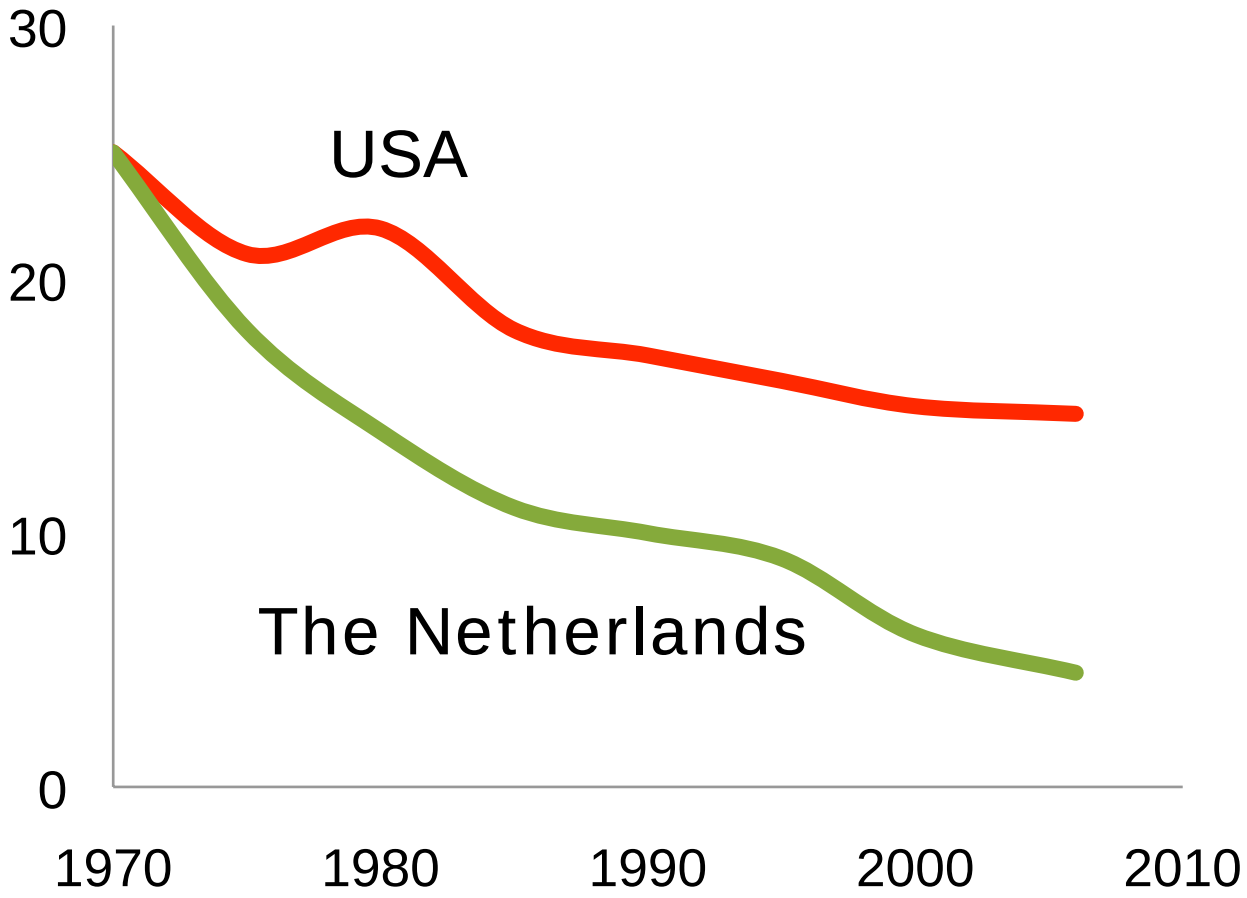


Daily Miles Traveled
For every man, woman and child

Norman W. Garrick

Traffic Fatality

(per 100,000)



Norman W. Garrick

Davis, California

California Cities Study

Street network, safety and sustainability in 24 medium sized California cities

Cities selected to represent a range of traffic safety level

24 California Cities

Safer Cities

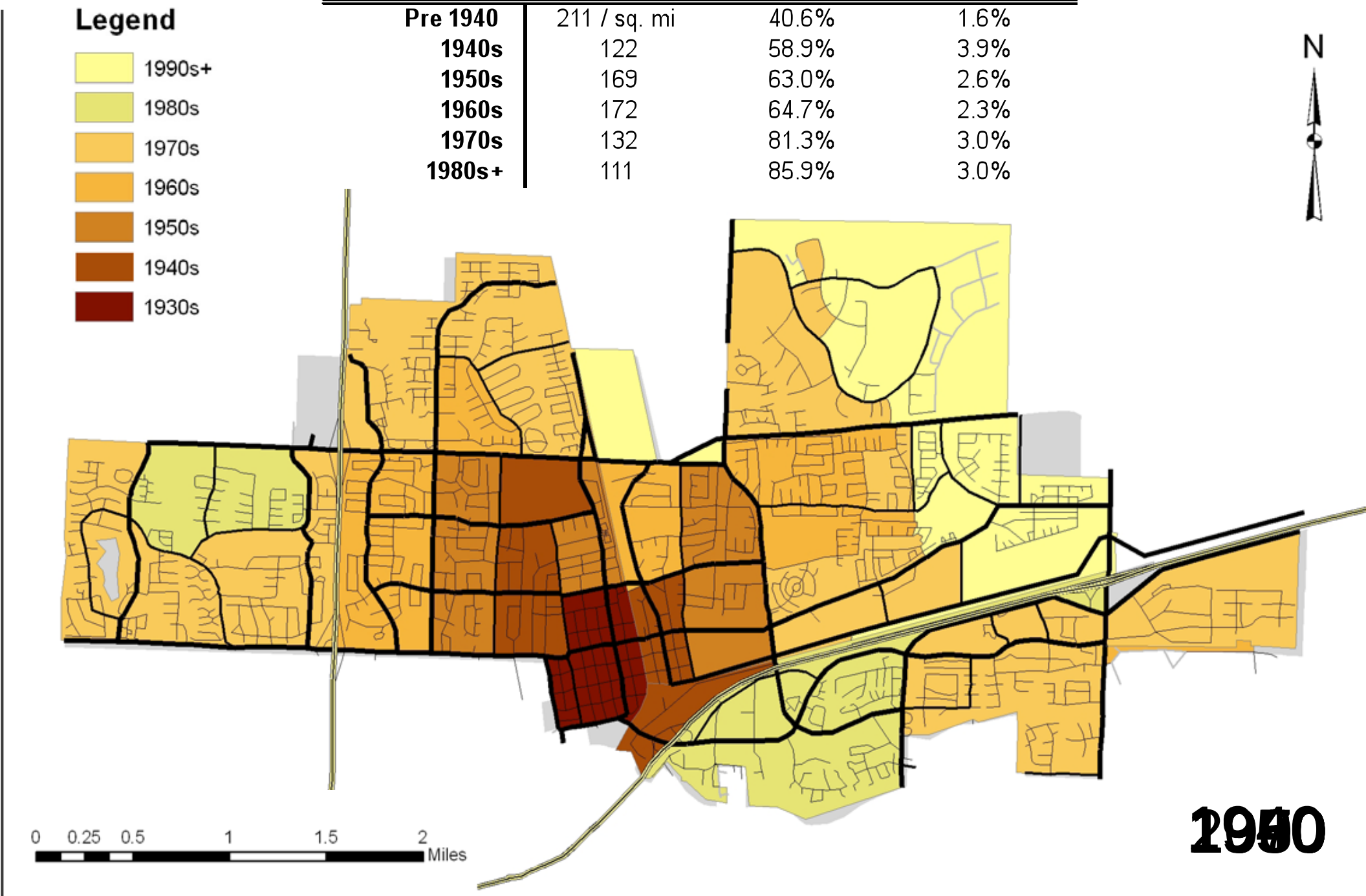
- Alameda
- Berkeley
- Chico
- Cupertino
- Danville
- Davis
- La Habra
- Palo Alto
- San Luis Obispo
- San Mateo
- Santa Barbara
- Santa Cruz

Less Safe Cities

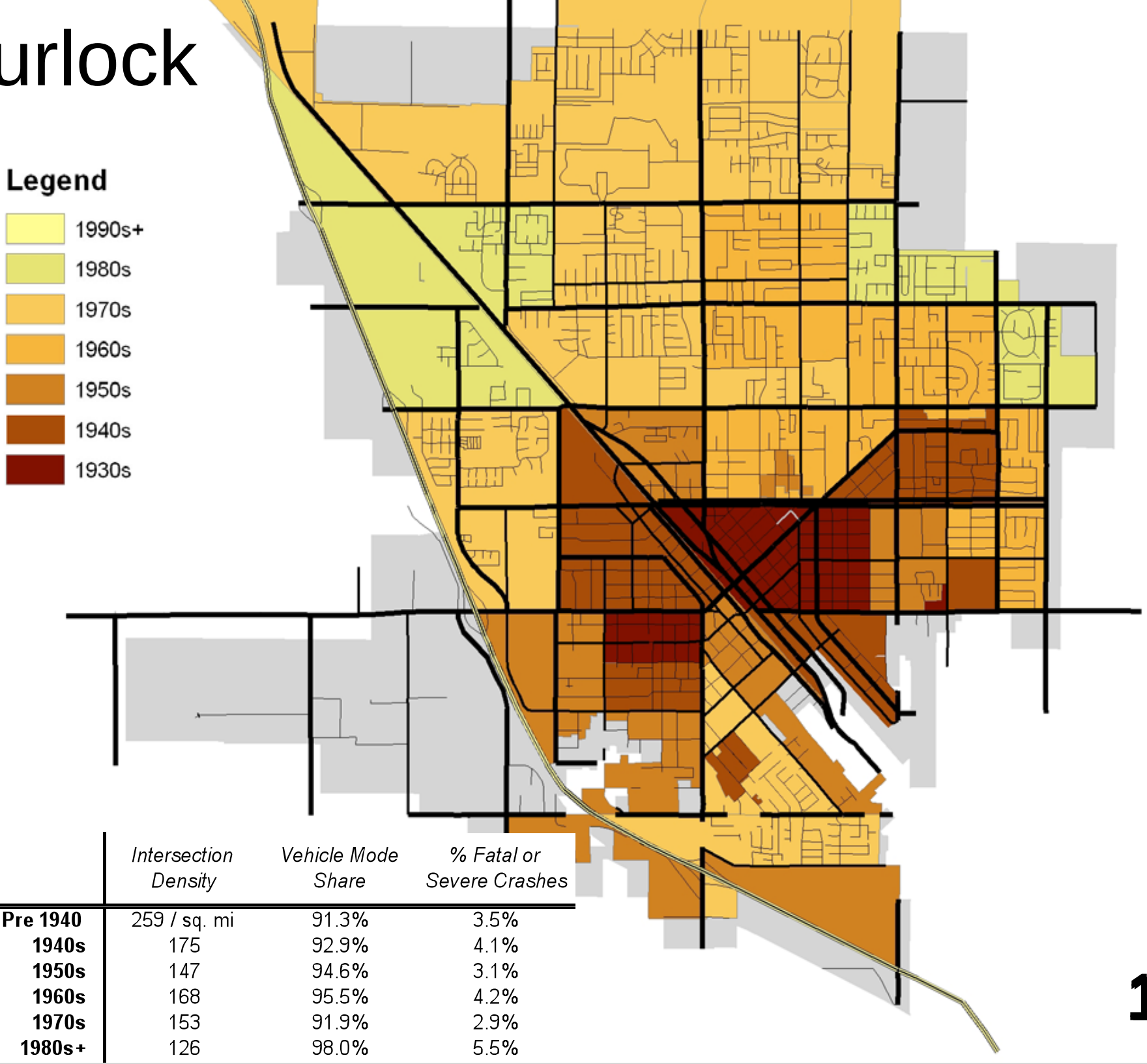
- Antioch
- Apple Valley
- Carlsbad
- Madera
- Morgan Hill
- Perris
- Redding
- Rialto
- Temecula
- Turlock
- Victorville
- West Sacramento

Davis

	Intersection Density	*Vehicle Mode Share*	*% Fatal or Severe Crashes*
Pre 1940	211 / sq. mi	40.6%	1.6%
1940s	122	58.9%	3.9%
1950s	169	63.0%	2.6%
1960s	172	64.7%	2.3%
1970s	132	81.3%	3.0%
1980s+	111	85.9%	3.0%



Turlock



	Intersection Density	*Vehicle Mode Share*	*% Fatal or Severe Crashes*
Pre 1940	259 / sq. mi	91.3%	3.5%
1940s	175	92.9%	4.1%
1950s	147	94.6%	3.1%
1960s	168	95.5%	4.2%
1970s	153	91.9%	2.9%
1980s+	126	98.0%	5.5%

1940

CALIFORNIA CITY COMPARISON

	Safer Cities	Less Safe Cities
Population	65,719	59,845
Population Density	5,736 per sq. mi.	2,673 per sq. mi.
Intersection Density	106 per sq. mi.	63 per sq. mi.
Mode Share		
Driving	84.1%	95.8%
Walking	5.4%	1.7%
Biking	4.1%	0.7%
Transit	6.6%	1.7%
Road Fatalities per 100,000 population	3.2 per year	10.5 per year

How Do we Characterize Street Networks?

Intersection Density

Gridded

Hierarchical

Sparse

Street Length

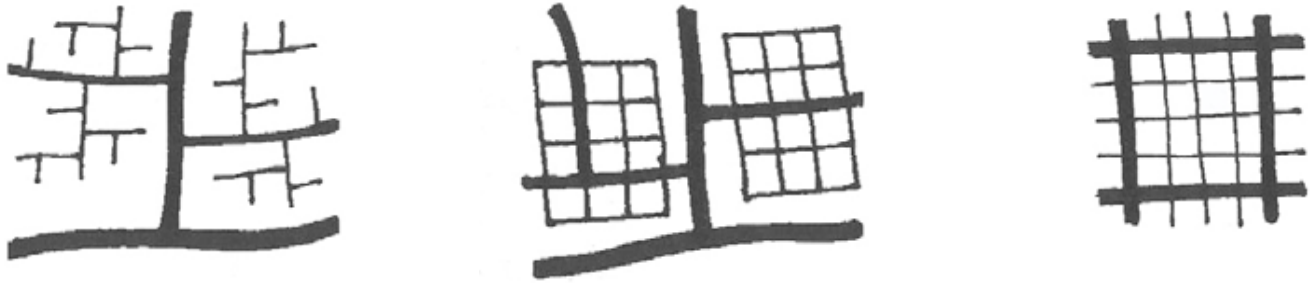
Connected

Dense

Connected Nodes

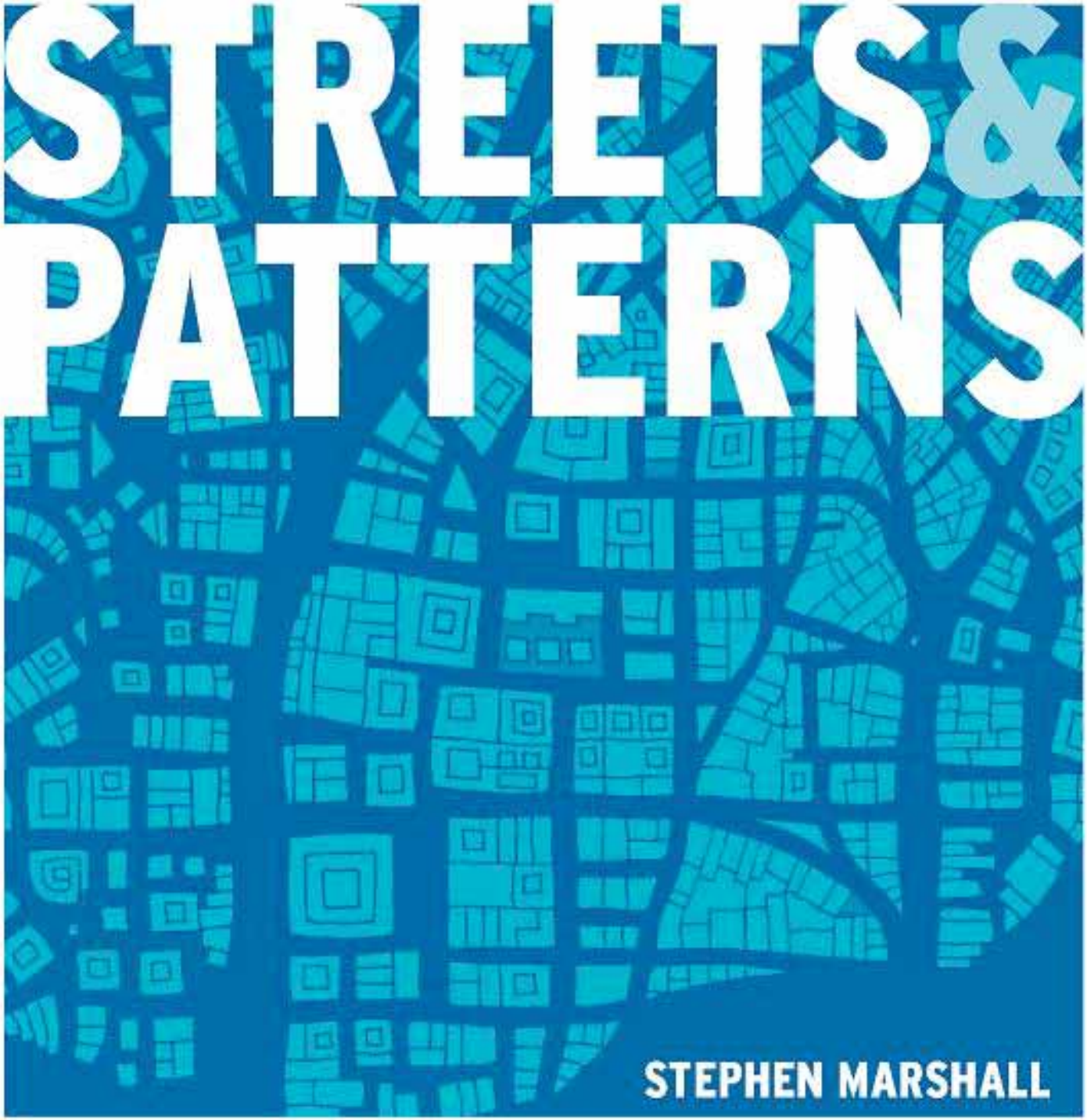
Characterizing Street Networks

- Street Network Configuration



- Street Network Scale

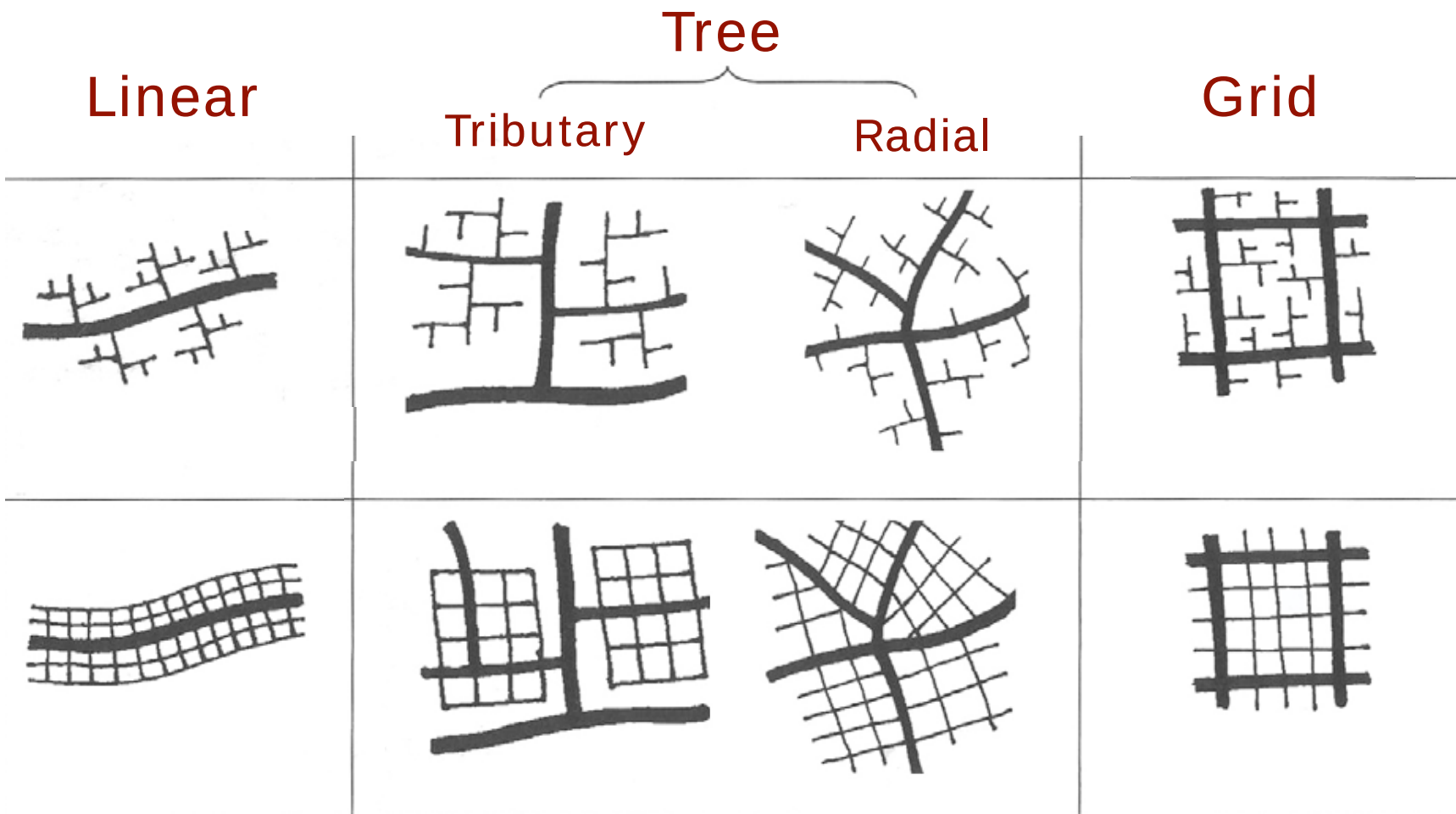
STREETS & PATTERNS

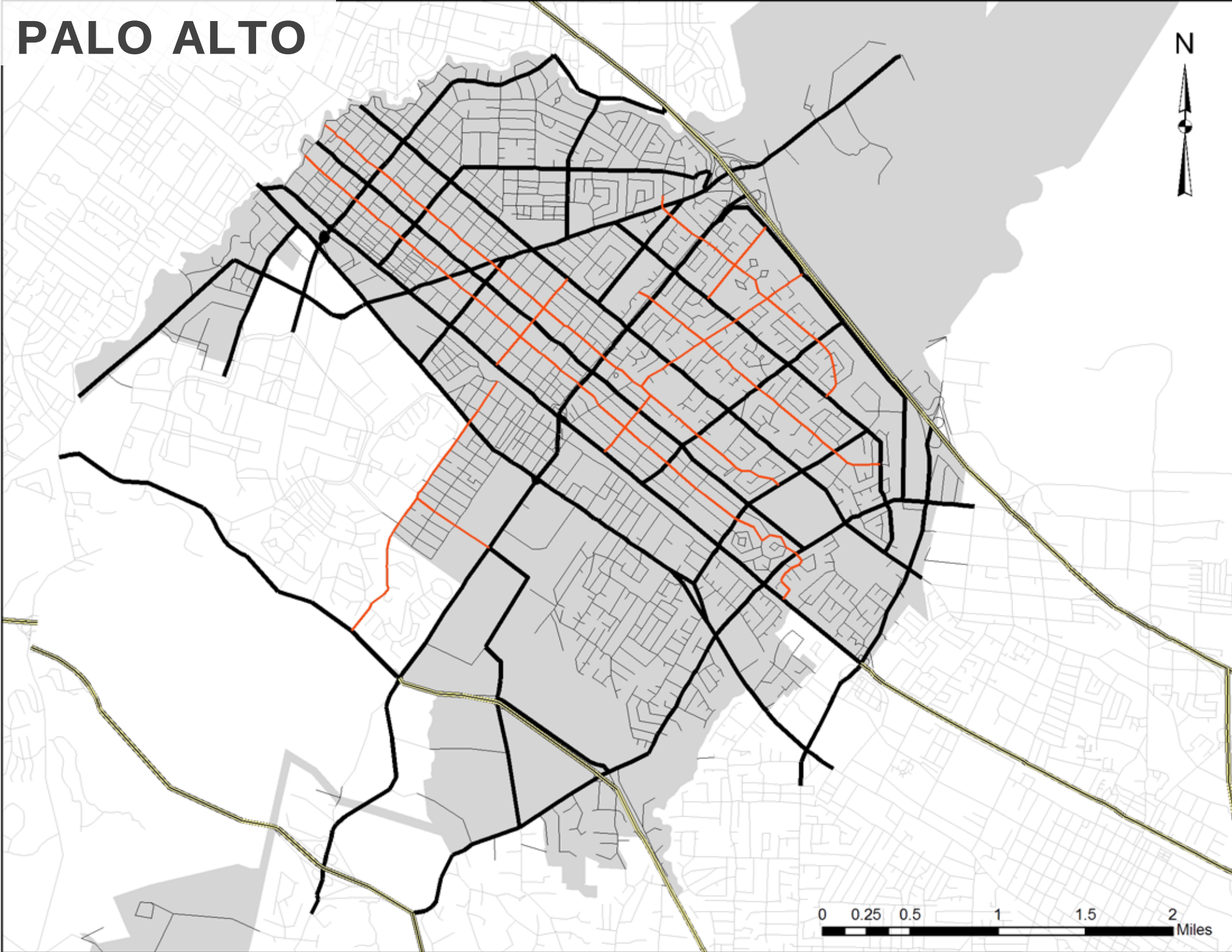


STEPHEN MARSHALL

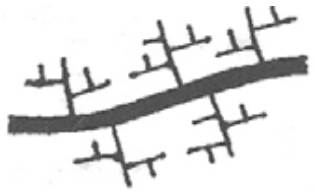
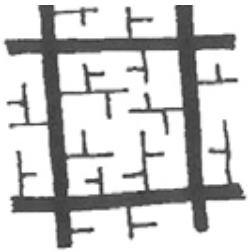
MACRO NETWORK

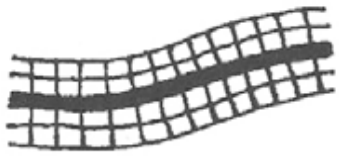
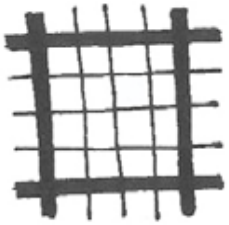
MICRO NETWORK



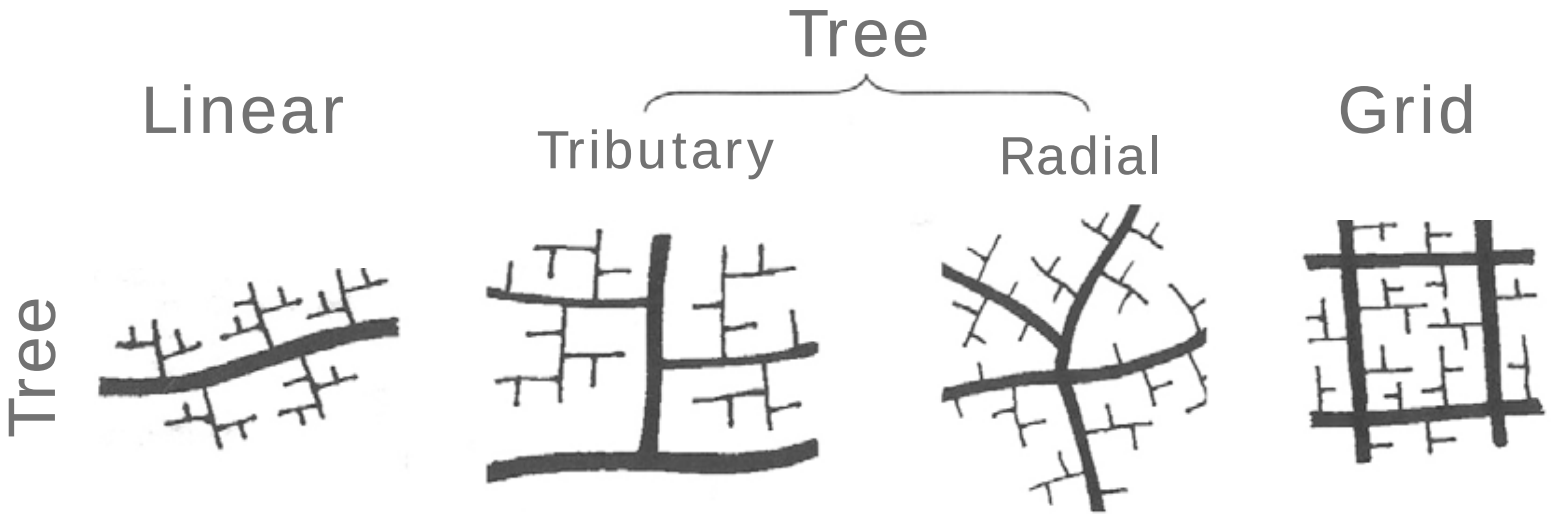

PALO ALTO
N
0 0.25 0.5 1 1.5 2
Miles

NETWORK COMPARISON

	Linear	Tree		Grid
		Tributary	Radial	
Tree				
Avg. Year of Development	**1966**	**1965**	**1974**	**1966**

Grid				
Avg. Year of Development	**1950**	**Pre 1940**	**Pre 1940**	

NETWORK COMPARISON



	Linear	Tree: Tributary	Tree: Radial	Grid
Safer Cities	5%	40%	2%	21%
Less Safe Cities	6%	30%	15%	34%

	Linear	Tree: Tributary	Tree: Radial	Grid
Safer Cities	N/A	4%	3%	25%
Less Safe Cities	N/A	5%	1%	9%

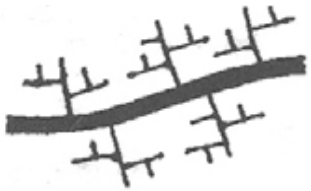
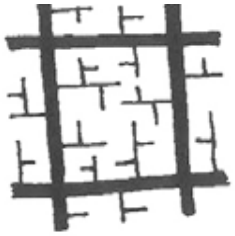
NODE COMPARISON

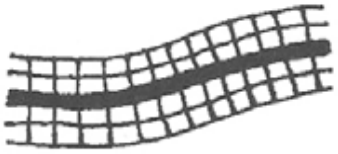
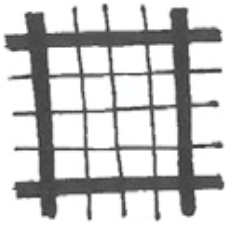
	Safer Cities	Less Safe Cities
Total Node Density	106 per sq. mi.	63 per sq. mi.
Macro & Intermediate Node Density	6.9 per sq. mi.	5.2 per sq. mi.
% Major Nodes	6.3%	8.2%
Dead End Node Density	32 per sq. mi.	23 per sq mi.
% Dead Ends	30.2%	36.5%
LEED-ND Node Density	74	40

SAFETY COMPARISON

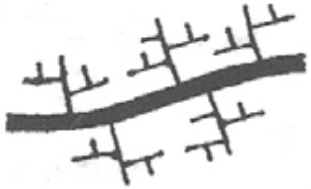
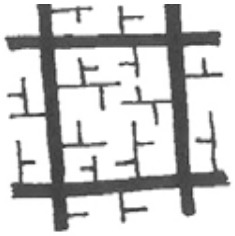
	Safer Cities	Less Safe Cities
Fatal or Severe Crashes	12.7 per year	17.0 per year
% Fatal or Severe	1.6 %	3.1 %
Macro & Intermediate Fatal or Severe	9.1 per year	13.7 per year
% Fatal or Severe	1.8 %	3.3 %
Micro Road Fatal or Severe	2.0 per year	1.7 per year
% Fatal or Severe	1.7 %	2.7 %

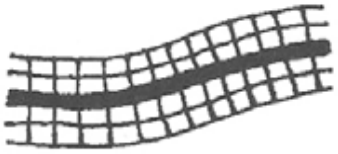
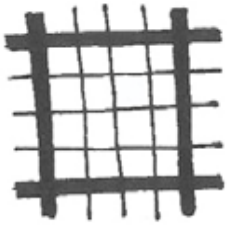
SAFER CITIES - NETWORK TYPE COMPARISON

	LT	TT	RT	GT
				
Node Density	105	155	185	195
Dead End Density	42	42	33	39
Vehicle Mode Share	87.8%	86.1%	88.9%	87.5%
% Fatal or Severe (Non-HW Crashes)	2.9%	2.8%	1.7%	2.0%

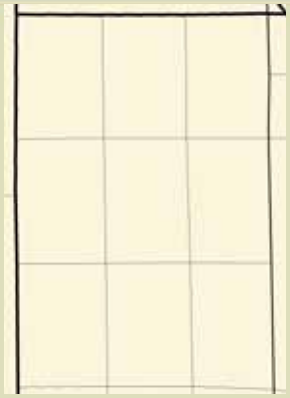
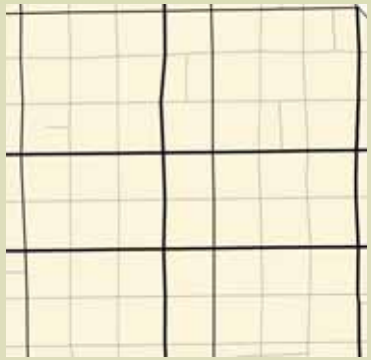
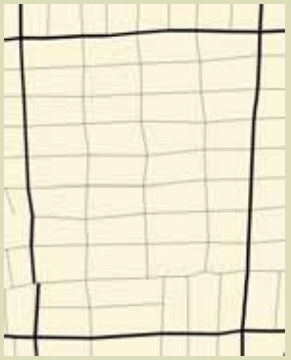
	LG	TG	RG	GG
				
Node Density	N/A	250	279	256
Dead End Density	N/A	26	16	13
Vehicle Mode Share	N/A	84.9%	79.4%	70.8%
% Fatal or Severe	N/A	2.0%	1.6%	1.5%

LESS SAFE CITIES - NETWORK TYPE COMPARISON

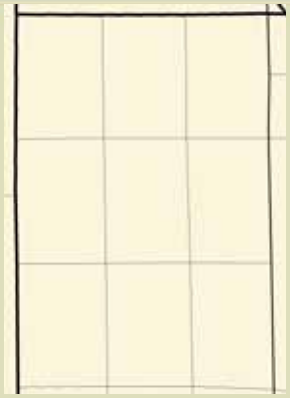
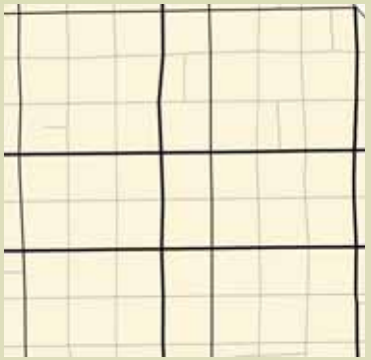
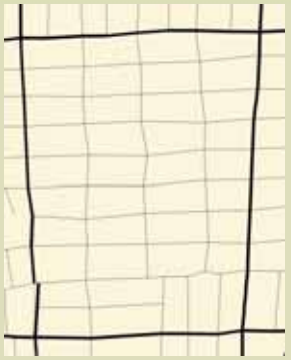
	LT	TT	RT	GT
				
Node Density	65	88	111	116
Dead End Density	28	31	41	25
Vehicle Mode Share	95.5%	94.5%	95.5%	94.9%
% Fatal or Severe (Non-HW Crashes)	11.9%	4.4%	3.9%	3.8%

	LG	TG	RG	GG
				
Node Density	N/A	158	N/A	201
Dead End Density	N/A	12	N/A	10
Vehicle Mode Share	N/A	90.2%	N/A	89.2%
% Fatal or Severe	N/A	2.6%	N/A	2.4%

SAFER CITIES – NETWORK DENSITY

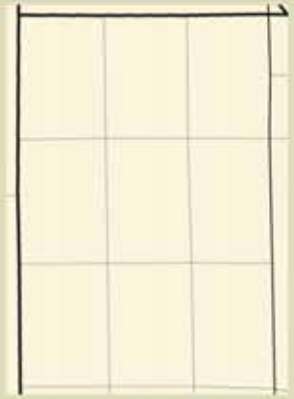
Network Density Comparison			
1 Sq. Mile Grid Size	**9x9**	**12x12**	**15x15**
Block Length	660’	480’	375’
Intersection Density	81	144	225
	< 81	**81-144**	**144-225**	**225+**
Mode Share				
Driving	**88.1%**	**86.7%**	**82.9%**	**76.2%**
Walking	5.3%	3.9%	5.3%	8.1%
Biking	2.4%	3.8%	4.0%	4.2%
Transit	3.0%	4.5%	6.8%	10.4%
% Fatal or Severe	**4.9%**	**2.3%**	**1.8%**	**2.0%**

LESS SAFE CITIES – NETWORK DENSITY

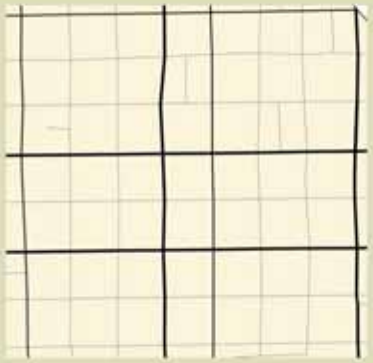
Network Density Comparison			
1 Sq. Mile Grid Size	**9x9**	**12x12**	**15x15**
Block Length	660’	480’	375’
Intersection Density	81	144	225
	< 81	**81-144**	**144-225**	**225+**
Mode Share				
Driving	**94.9%**	**95.0%**	**93.6%**	**89.4%**
Walking	2.1%	1.6%	2.1%	4.9%
Biking	0.4%	0.6%	0.6%	1.0%
Transit	1.4%	2.0%	2.3%	2.8%
% Fatal or Severe	**5.8%**	**3.3%**	**3.4%**	**4.0%**

HIGH CONNECTIVITY ≠ A DENSE NETWORK

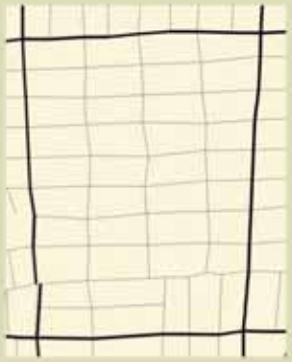
Assuming a
1 Sq. Mile Grid



9x9



12x12



15x15

Connectivity Index = Link to Node Ratio

Links	**144**	**264**	**420**
Nodes	**81**	**144**	**225**
Connectivity Index	**1.78**	**1.83**	**1.87**

$$\text{Connected Node Ratio (CNR)} = \frac{\#\text{ of real intersections}}{\#\text{ of real intersections + dead ends}}$$

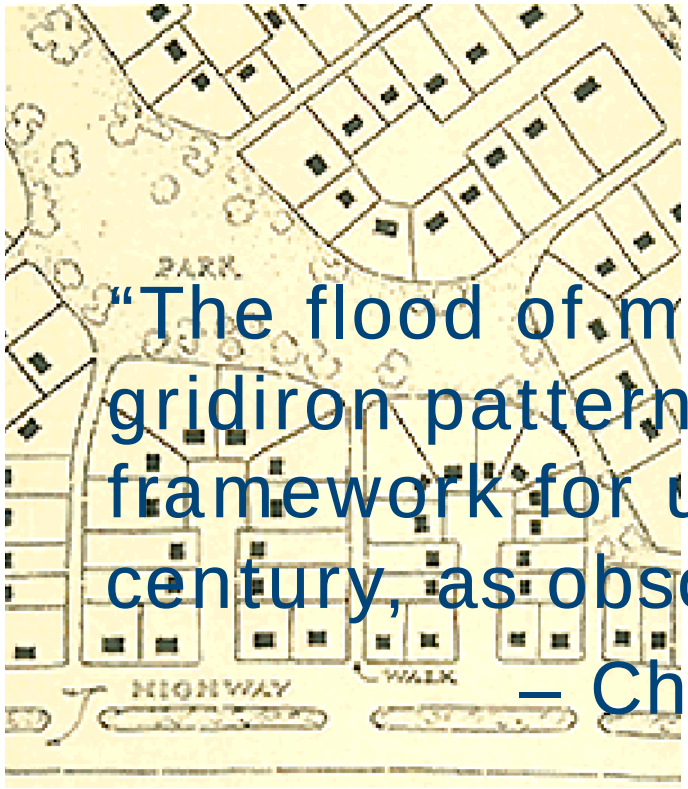
Real Intersections	**81**	**144**	**225**
Dead Ends	**0**	**0**	**0**
Connected Node Ratio	**1.0**	**1.0**	**1.0**

Radburn, New Jersey

(Southworth & Ben-Joseph, 1997)

- American version of English Garden City
  - "Superblock" design each block between 30 and 50 acres
  - One of the earliest American road hierarchies including cul-de-sacs

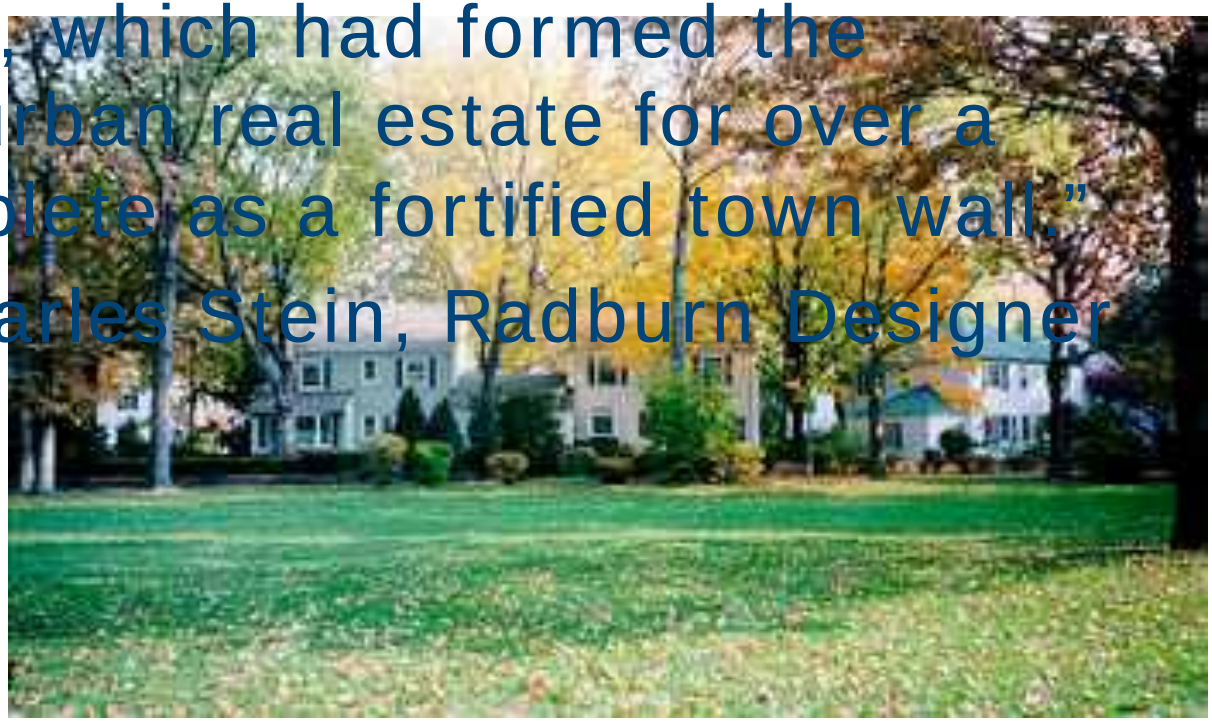
Radburn Cul-de-sacs



(www.columbia.edu/cu/gsapp/projs/call-it-home/html/chapter8.1.html)

"The flood of motors had already made the gridiron pattern, which had formed the framework for urban real estate for over a century, as obsolete as a fortified town wall."

– Charles Stein, Radburn Designer



(www.radburn.org/map3n.html)

Federal Housing Administration

- Federal Housing Administration (FHA) created publications recommending specific street patterns
  - Endorsed hierarchical street layouts with cul-de-sacs that minimize through traffic on residential streets

(www.columbia.edu/cu/gsapp/projs/call-it-home/html/chapter8.2.html)

FHA called the grid layout:

monotonous,

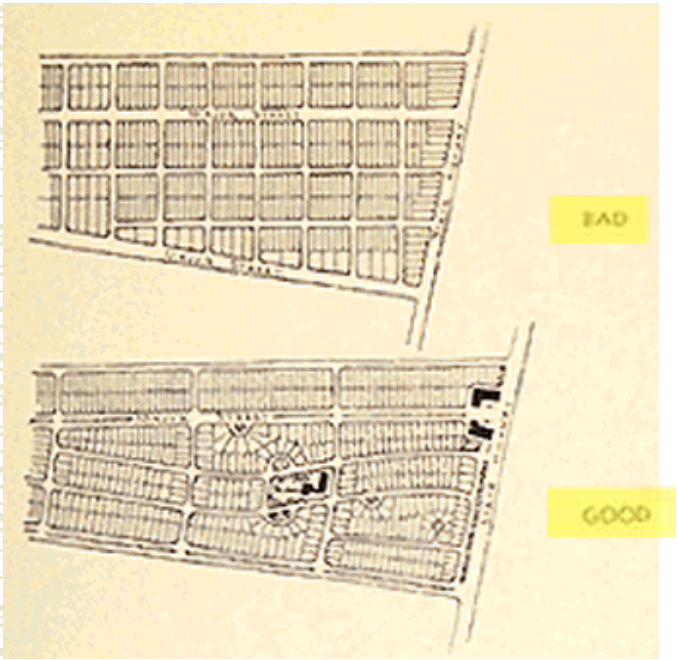
with little character,

uneconomical,

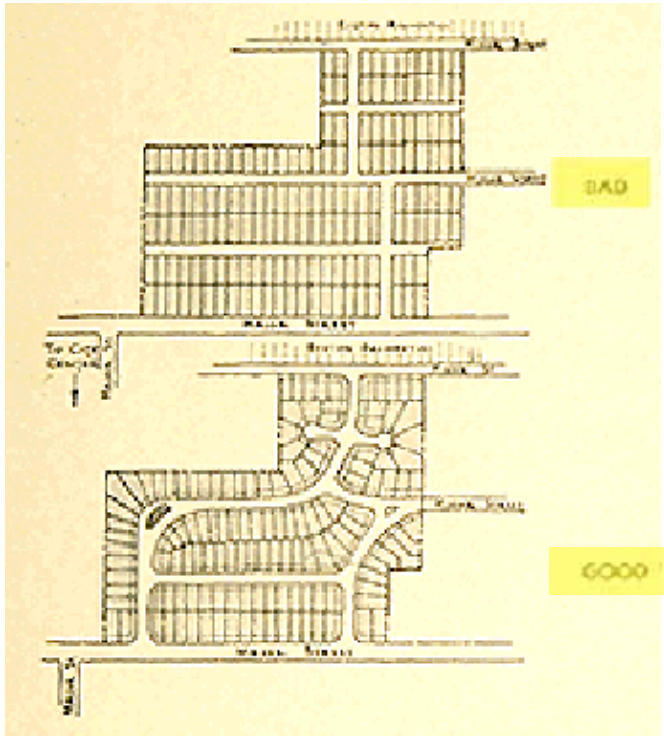
and unsafe...

(www.columbia.edu/cu/gsapp/projs/call-it-home/html/chapter8.2.html)

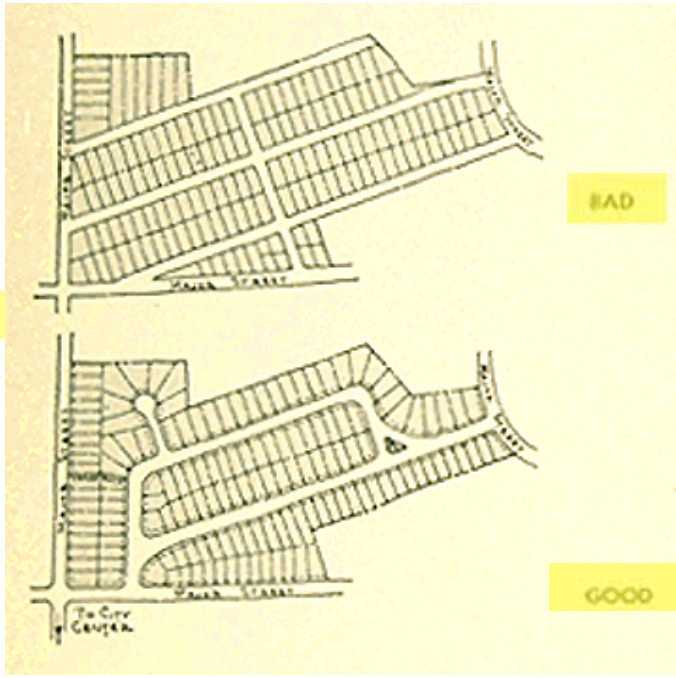
1938 - FHA Technical Bulletin No. 7 Planning Profitable Neighborhoods



"short blocks not economical"



We should "discourage through traffic"



(www.columbia.edu/cu/gsapp/projs/call-it-home/html/chapter8.2.html)

Making Savannah

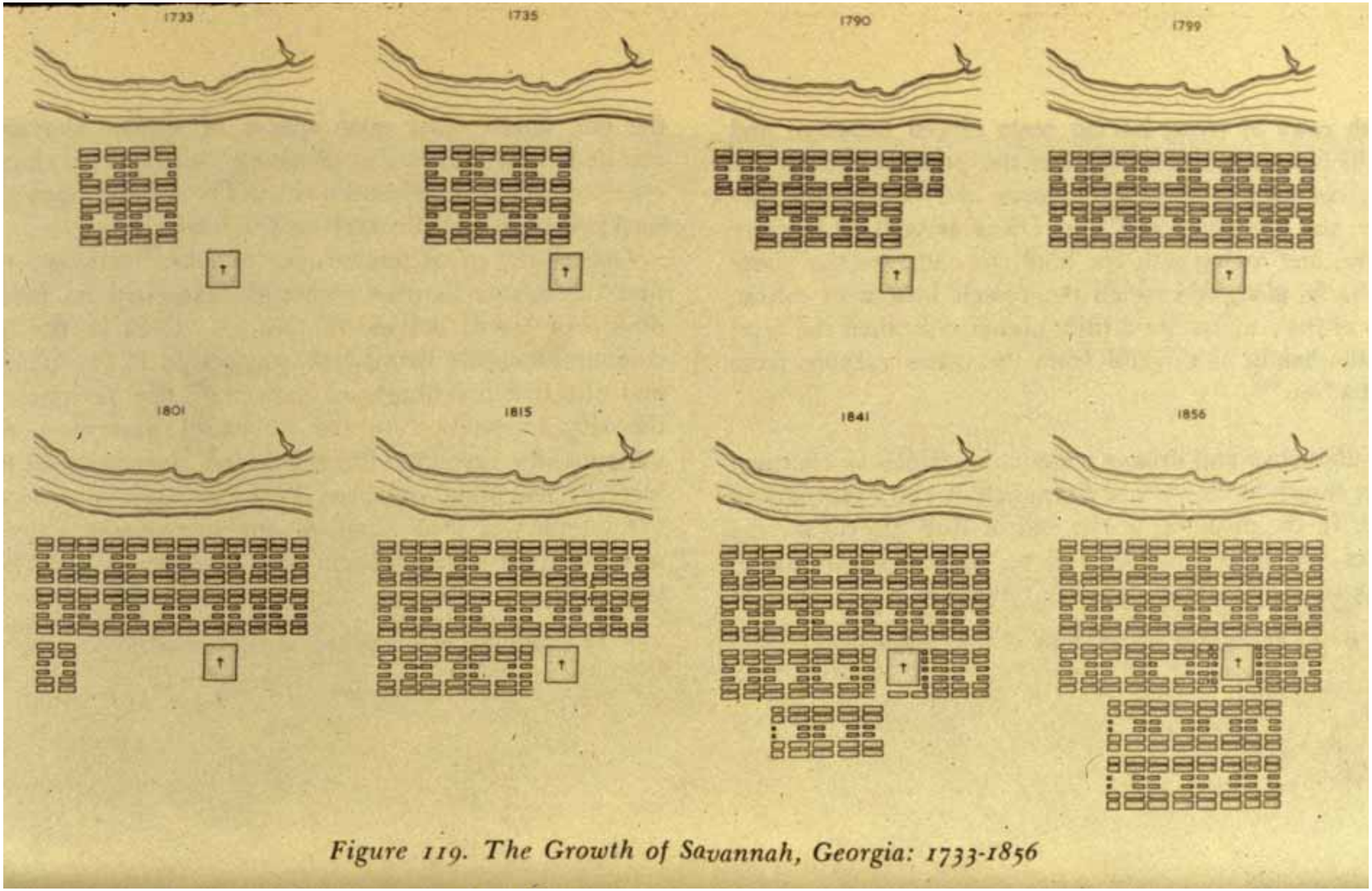


Figure 119. The Growth of Savannah, Georgia: 1733-1856

(http://ocw.mit.edu/ans7870/11/11.001j/f01/lectureimages/3/image24.html)