Coordinating Land Use and Transportation (and Traffic Safety)

Design for Health

University of Minnesota

Reid Ewing

National Center for Smart Growth

Give Them War Stories and Codes

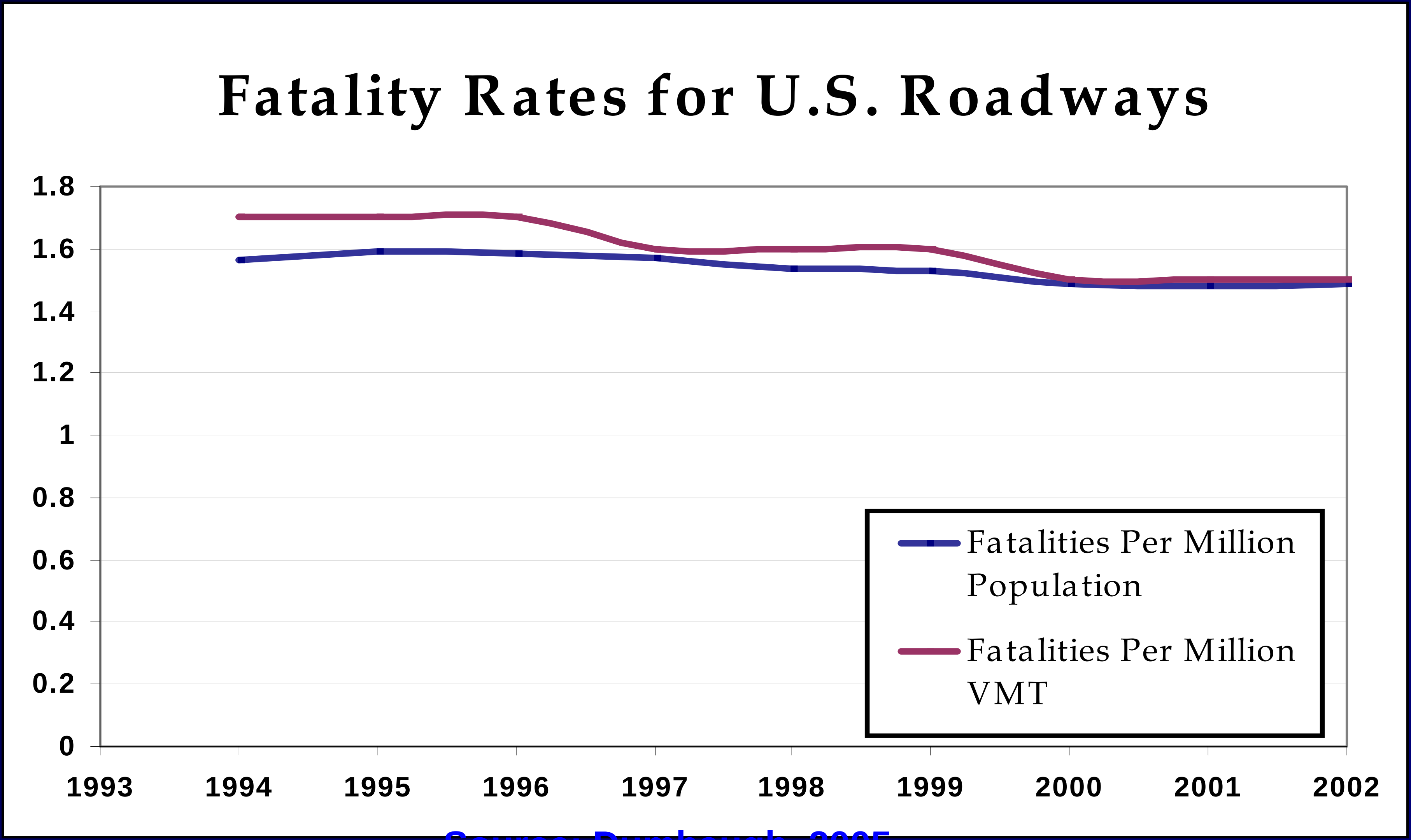
Well Maybe Not…

Considering Traffic Safety

- ***Worldwide, more than** <u>1 million</u> **people are killed in traffic crashes each year.***
- ***Up to** <u>50 million</u> **more are injured.***
- ***More than half are pedestrians.***
- ***Traffic injuries and fatalities are projected to** <u>increase by 65%</u> **by 2020.***

- Source: World Health Organization, 2004

Traffic Safety in the United States



Source: Dumbaugh, 2005

Design Improvements?

"Changes in highway infrastructure have not reduced traffic fatalities and injuries and have even had the effect of <u>increasing</u> total fatalities and injuries…"

Safety improvements attributable to :

- ***Demographics***
- ***Increases in Seat Belt Use***
- ***Medical technology***

- Robert Noland, 2003

Peer Comparisons

- ***Currently, we rank behind <u>all</u> other developed countries***

Road Traffic Fatalities (2000)

Country or Area	**Per 100,000 Inhabitants**
Australia	9.5
European Union*	11
Great Britain	5.9
Japan	8.2
Netherlands	6.8
Sweden	6.7
United States	**15.2**

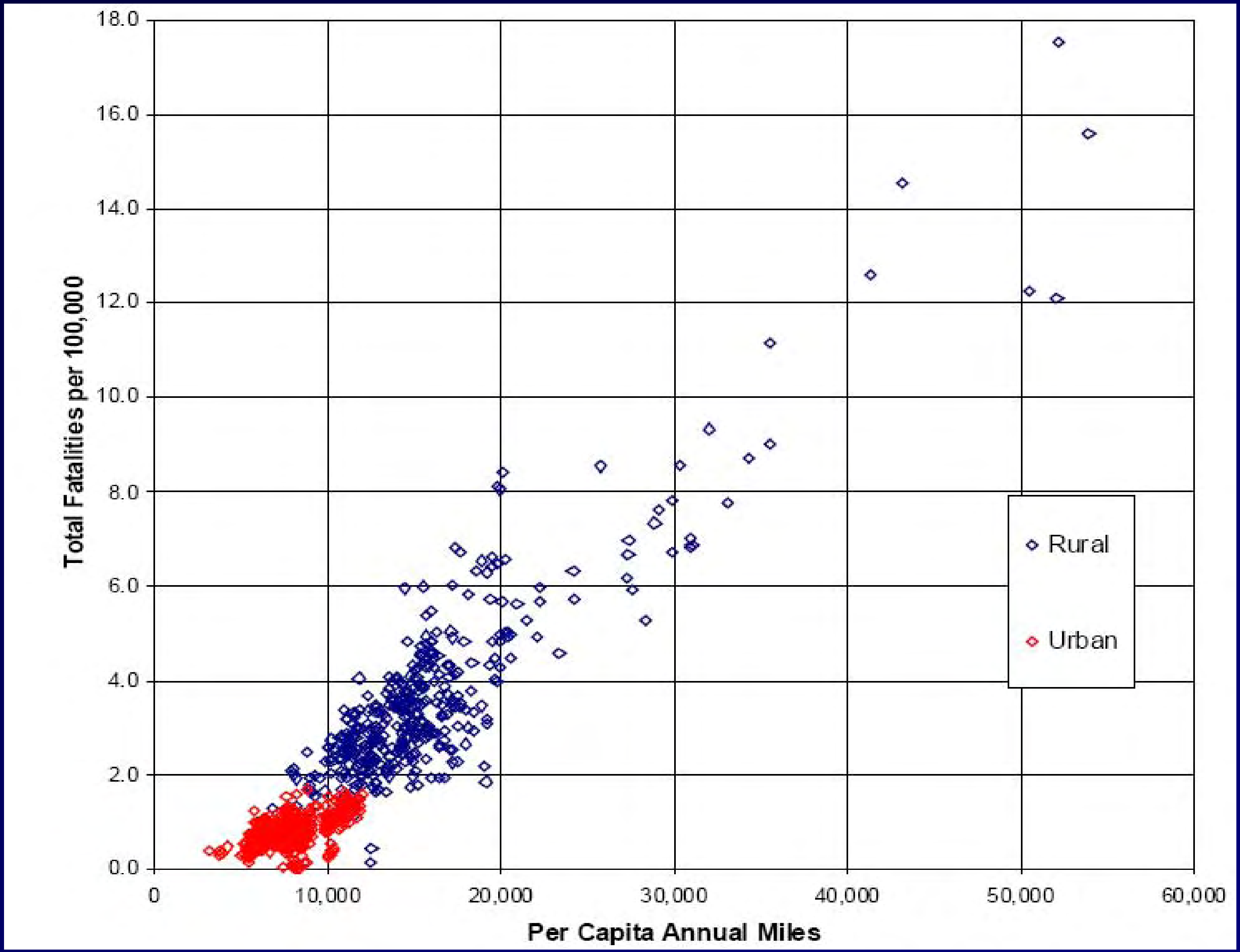
Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom

Source: World Health Organization

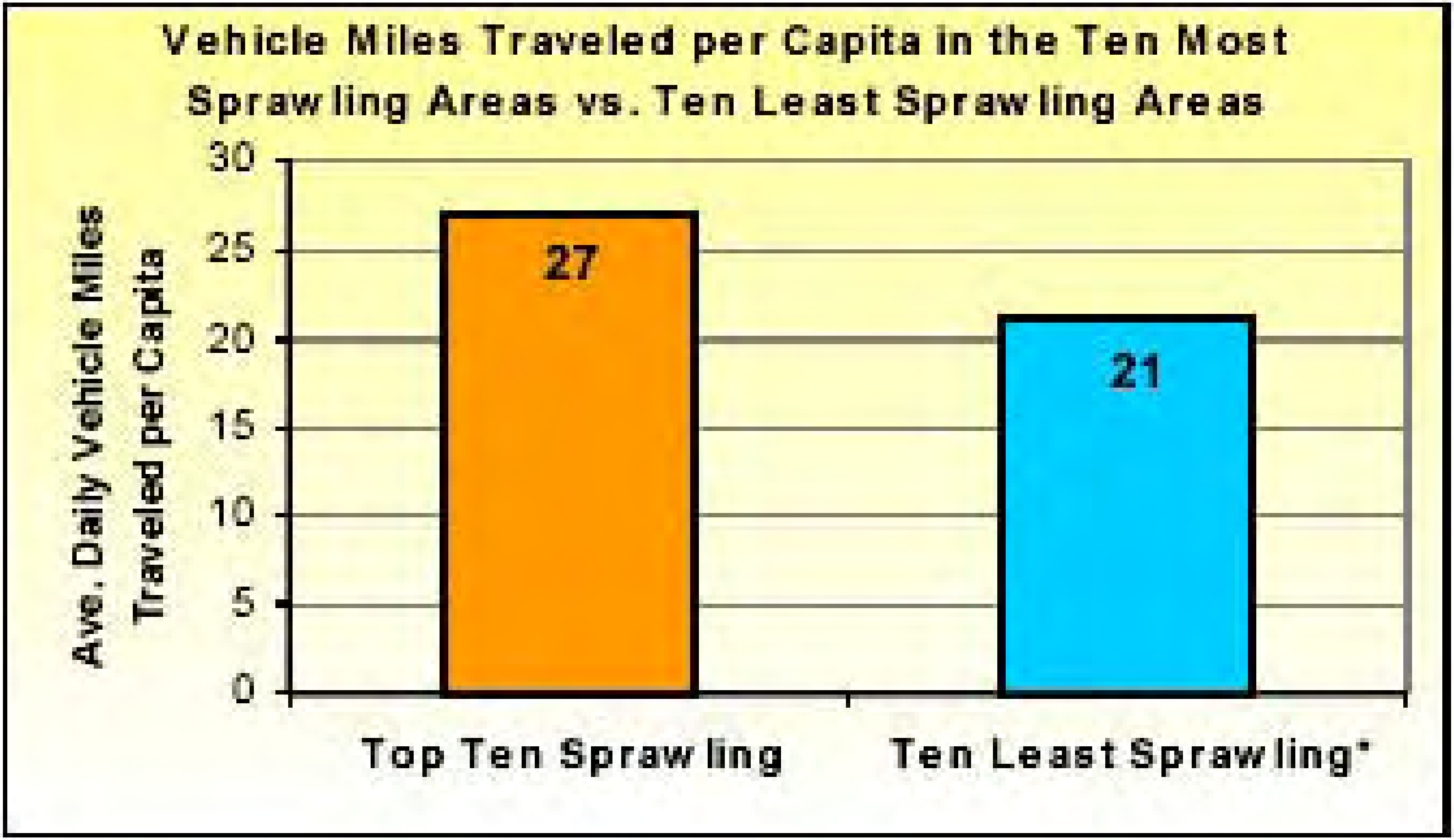
Development Patterns

Importance of Exposure

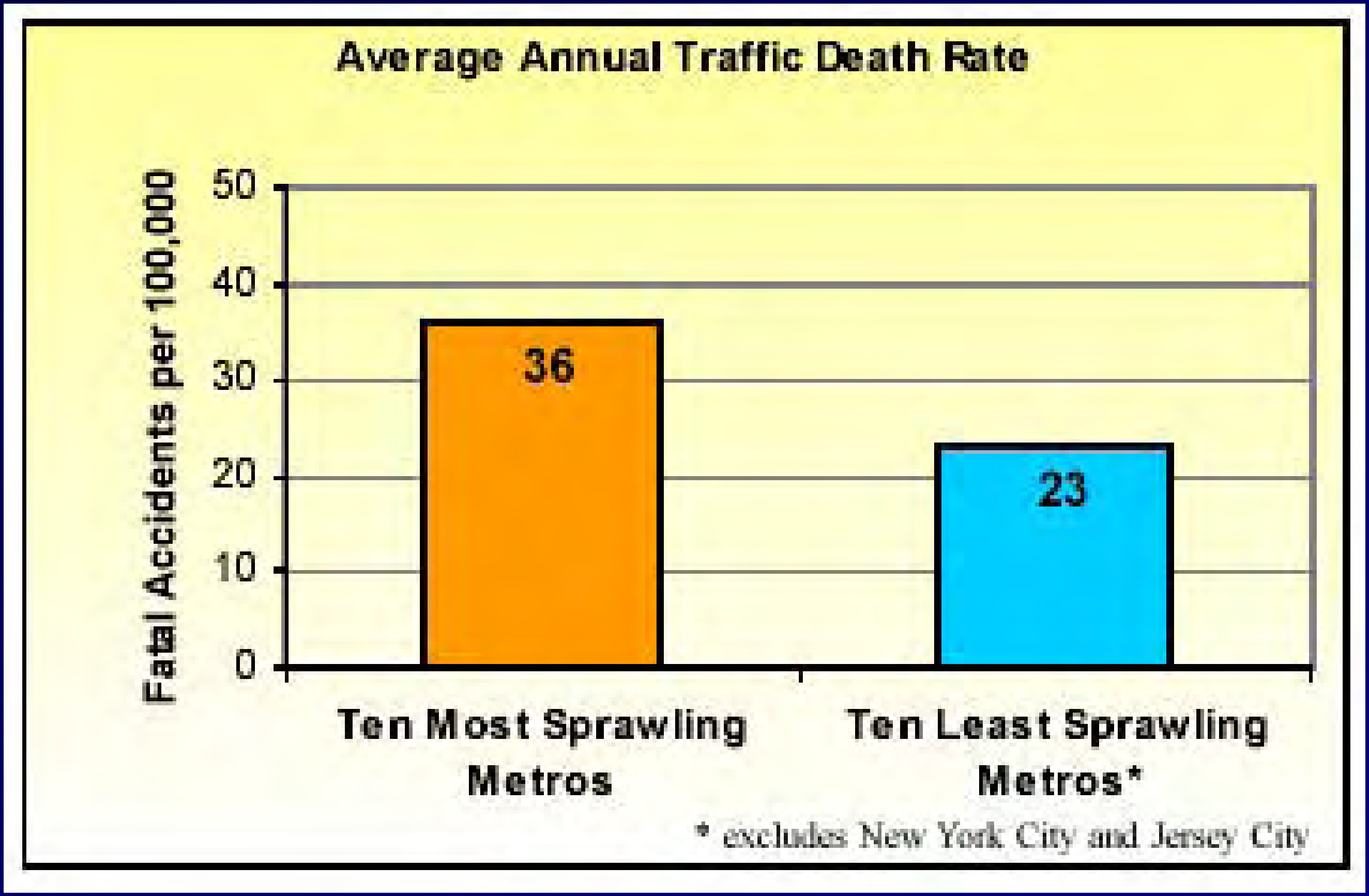
Mostly Exposure



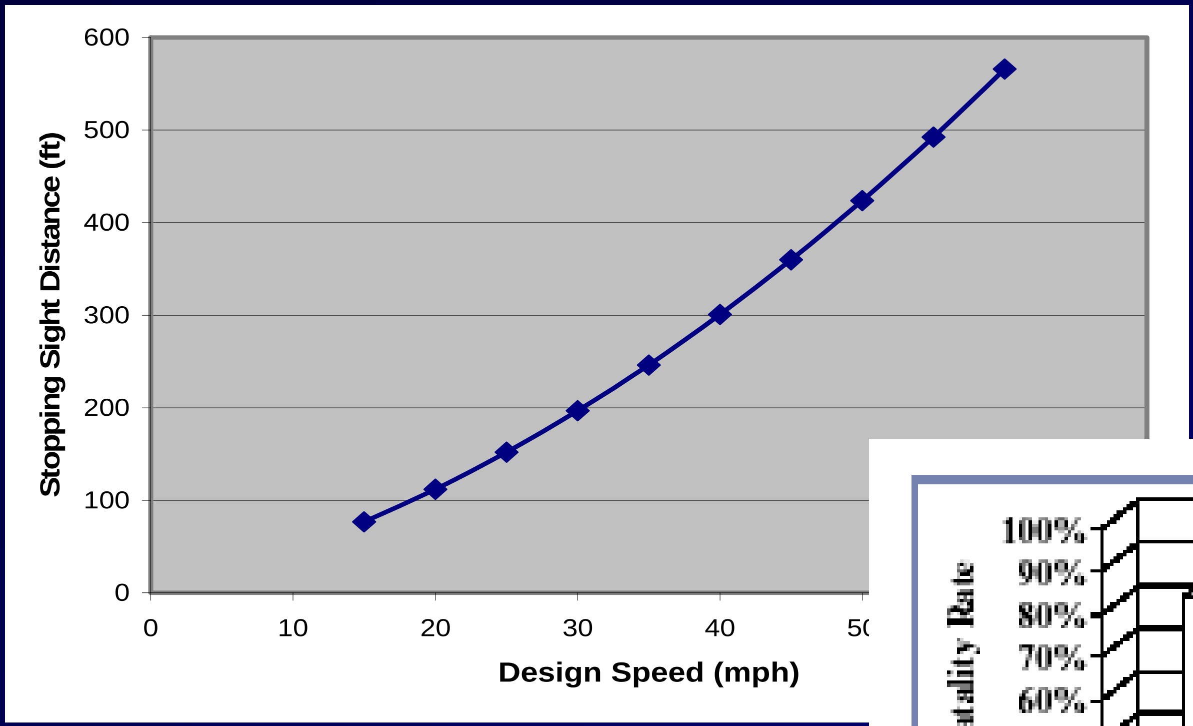
VMT vs. Sprawl

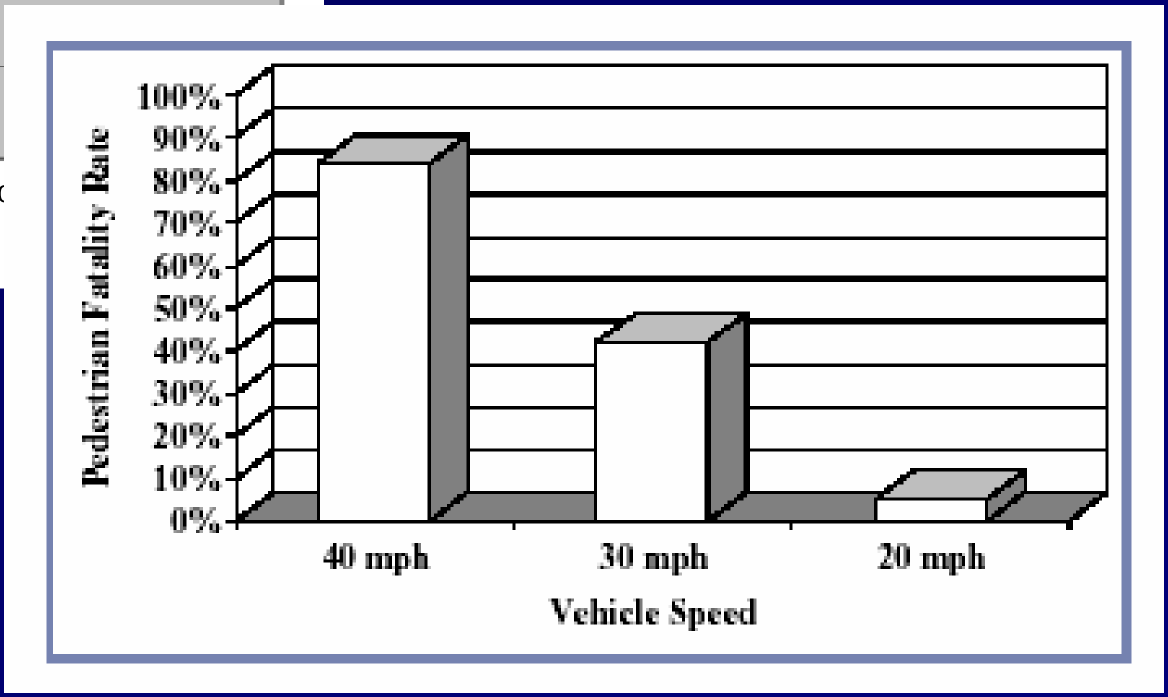


Fatal Accidents vs. Sprawl



Speed Accounts for Difference





Roadway Design

They Got It All Wrong

The Conventional Wisdom:

Passive Safety Paradigm

Highway Safety Hearings of 1966

"What we must do is to operate the 90% or more of our surface streets just as we do our freeways… [converting] the surface highway and street network to freeway road and roadside conditions."

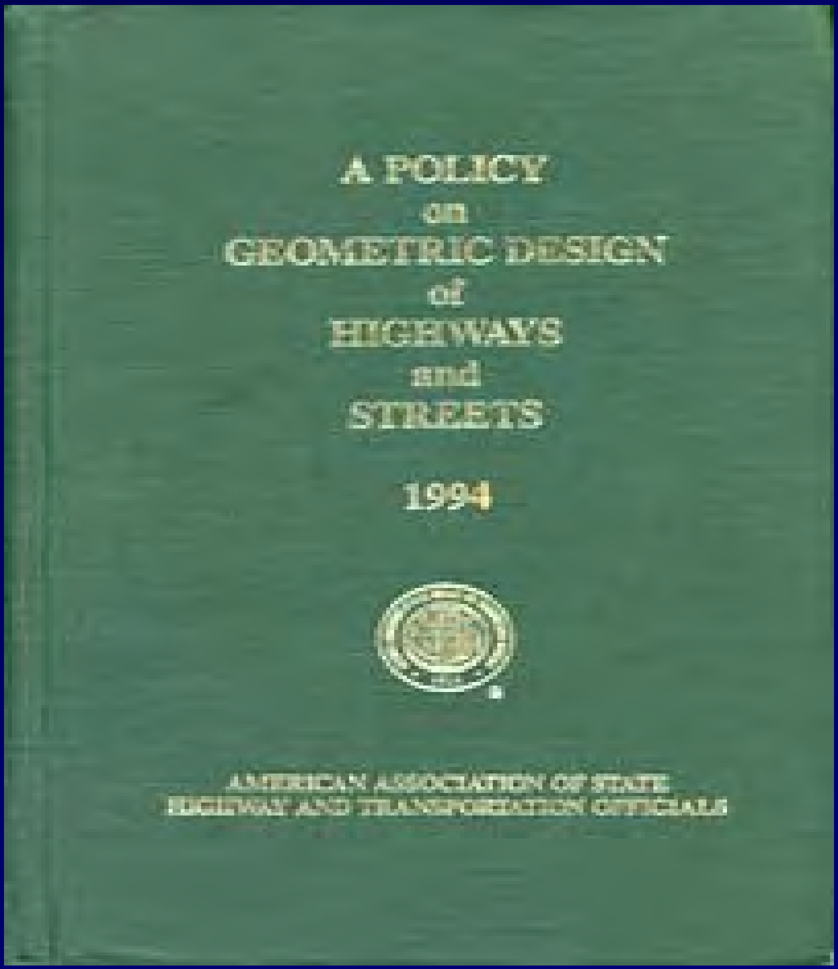
- Kenneth A. Stonex, 1966

The Alternative

Active Safety Paradigm

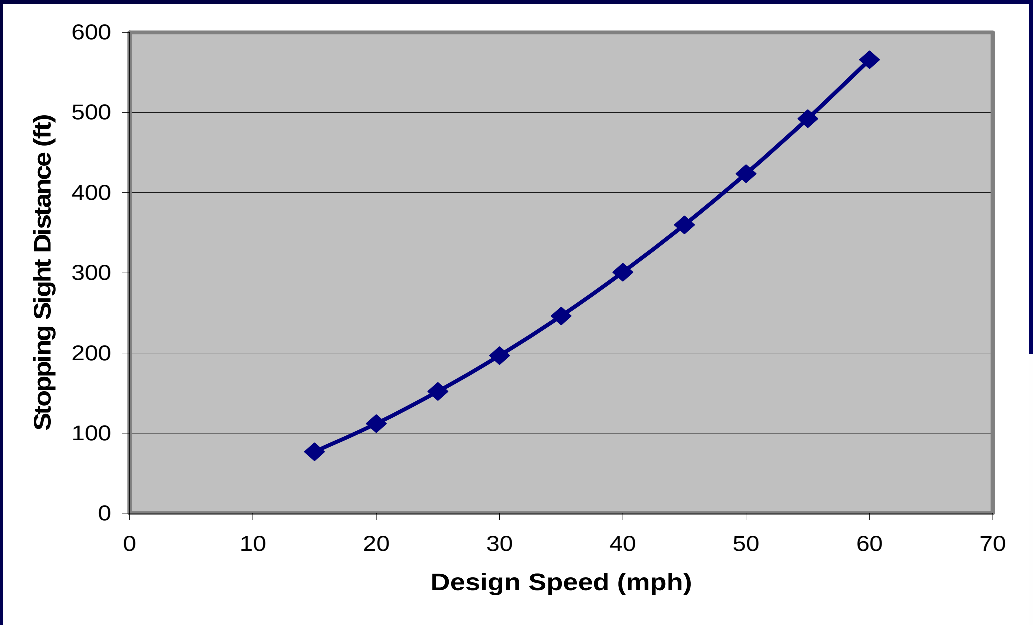
Wider, Straighter, Longer, Faster

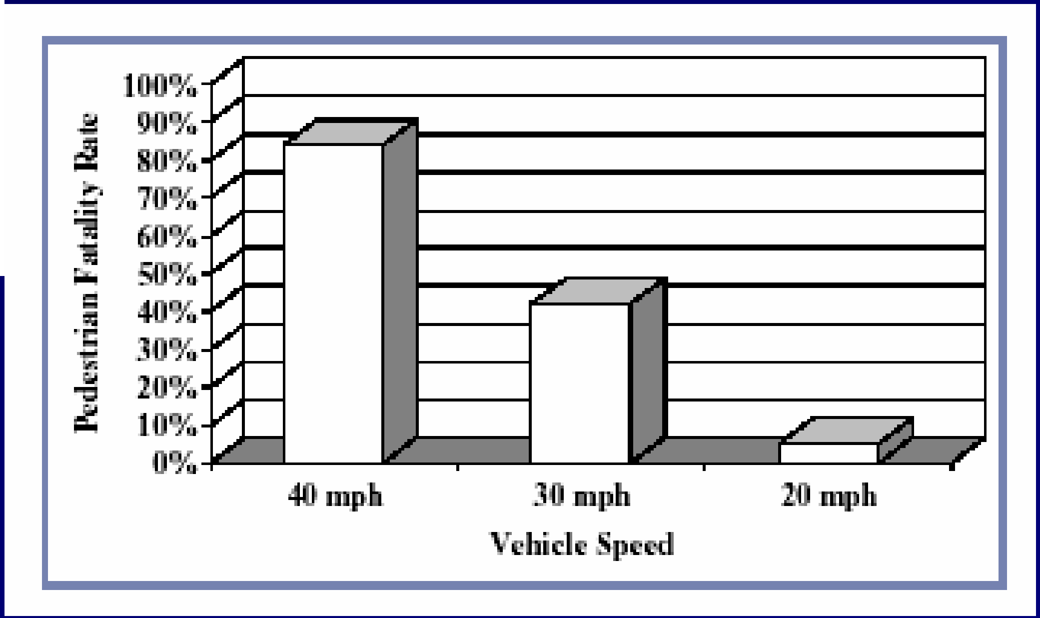
"every effort should be made to use as high a design speed as practical to attain a desired degree of safety"



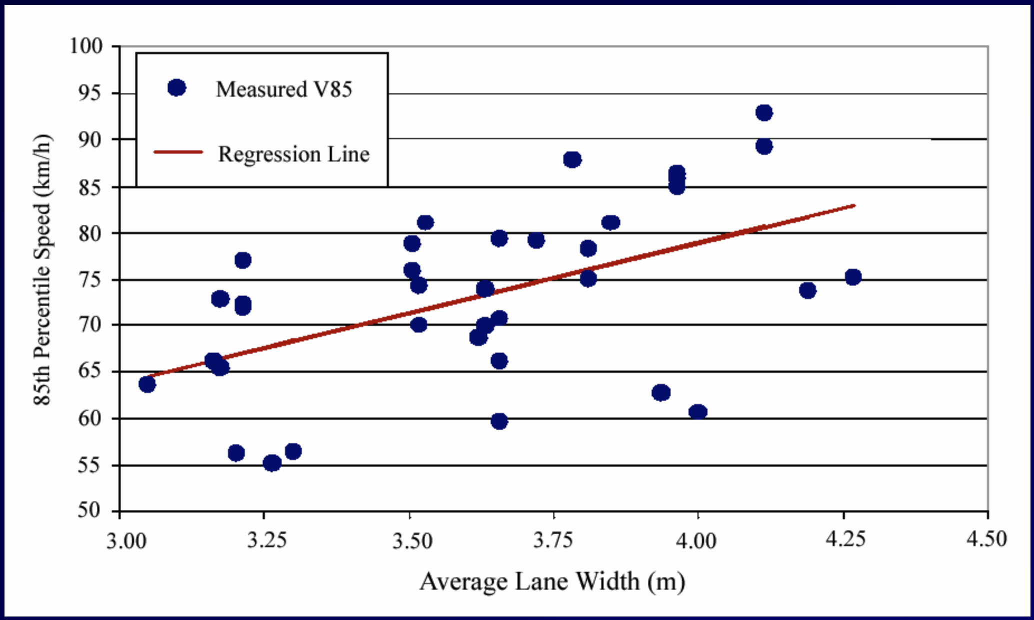
Urban =/ Rural

Speed Is the Main Issue





Wide Lanes



Measured V85
Regression Line
85th Percentile Speed (km/h)
Average Lane Width (m)
100
95
90
85
80
75
70
65
60
55
50
3.00
3.25
3.50
3.75
4.00
4.25
4.50

SPEED LIMIT 25

Lane Width

- ***Studies on lane widths report*** mixed results***, with some studies finding wider lanes are safer, and other finding wider lanes are more dangerous.***
- ***In general, lane widths appear to have a “U” shaped relationship with crash performance, with crashes decreasing until lane widths reach roughly 11.5 feet, and increasing thereafter.***

Sources: Clark, 1985; Dumbaugh, 2005; Farouki and Nixon, 1976; Fitzpatrick et al., 2001; Gattis and Watts, 1999; Harwood, 1990; Hauer, 1999; Heimbach et al., 1983; Lee and Mannering, 1999; Noland and Oh, 2004; Zegeer, Deen and Mayes,1981.

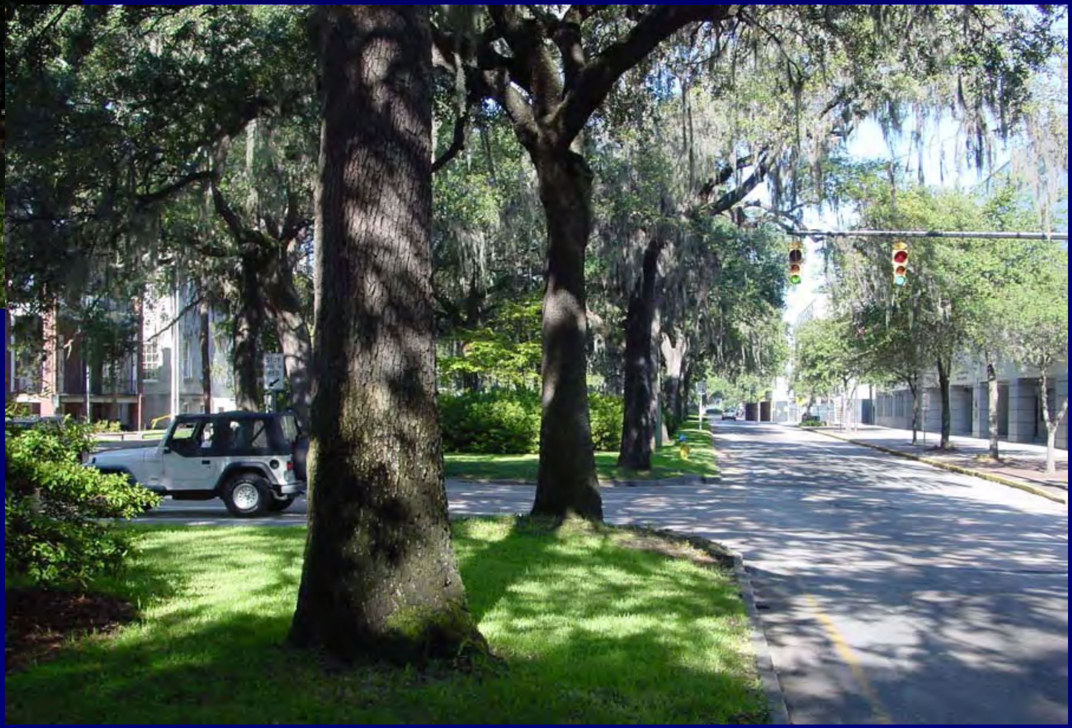
More Lanes

- ***Studies consistently find that adding lanes*** <u>increases</u> ***crashes, while eliminating lanes though "road diet" projects decreases crashes.***

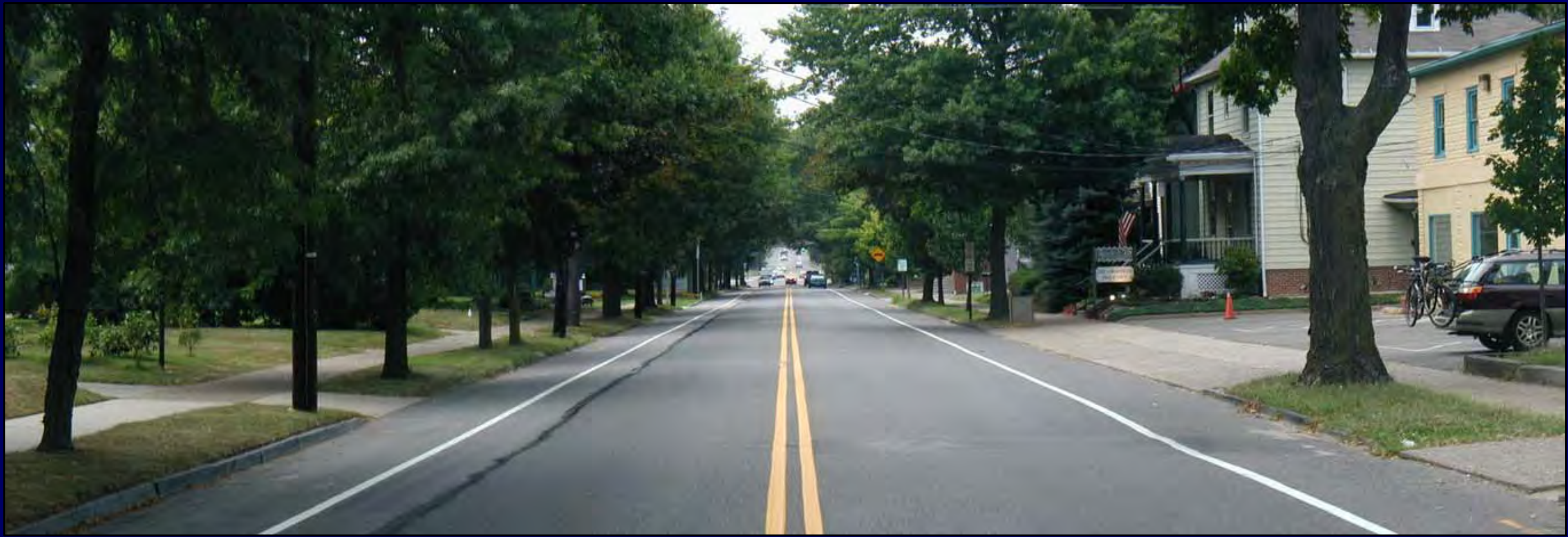
Sources: Dumbaugh, 2005; Harwood, 1986; Harwood,1990; Huang, Stewart, and Zegeer, 2001; Knapp and Giese, 2001; Milton and Mannering, 1998; Noland and Oh, 2004; Sawalha and Sayed (2001); Vitalano and Held 1991.

Wide Corners

Wide Clear Zones



Which Is Safer?



Conclusions About Traffic Safety

- ***Many of the conventional assumptions on traffic safety are unsubstantiated by empirical research.***
- ***“Sprawling” areas generally have higher rates of both pedestrian and motor vehicle crashes.***
- ***“Livable” street improvements are consistently safer than conventional roadway designs.***
- ***Few studies have meaningfully linked safe roadway design to the characteristics of the built environment – yet this is a clearly fruitful area for future research…***

Land Oriented Approaches

- ***State Growth Management Initiatives***
- ***Coordinated Regional Planning***
- ***Integrated Community Design***
- ***Transit-Oriented Development***
- ***Joint Development***

Transportation Oriented Approaches

- ***Context-Sensitive Highway Design***
- ***Traffic Calming***
- ***Access Management***
- ***Street Network Design***
- ***Adequate Public Facilities Requirements***

Illustrated with Five Successful Developments

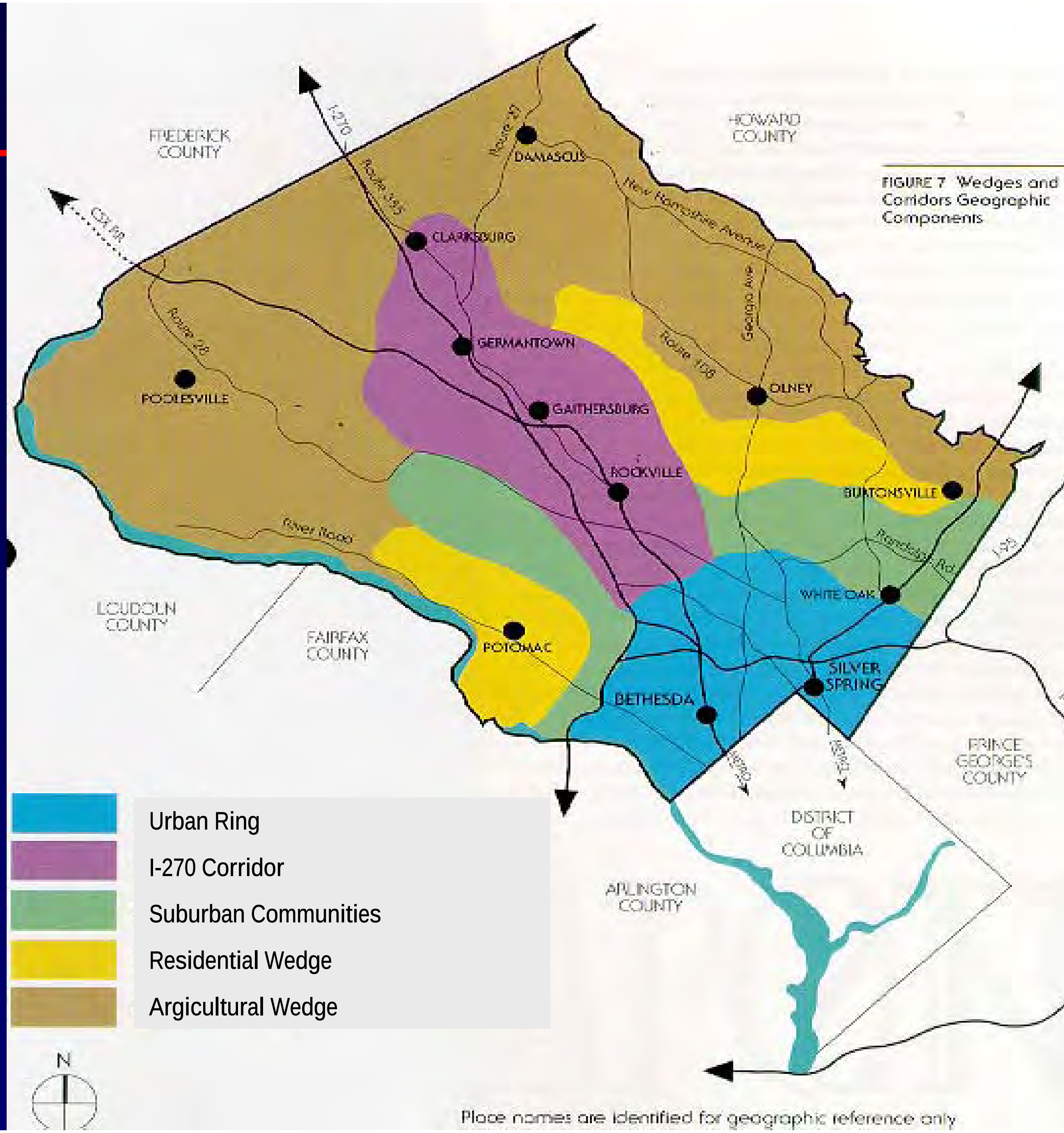
- ***Urban TOD – Downtown Bethesda, MD***
- ***Suburban TOD – Orenco Station, OR***
- ***Neo-Traditional Village – Southern Village, NC***
- ***New Town in Town – Baldwin Park, FL***
- ***Redesigned Suburb – University Place, WA***
- ***Redesigned City – Charlotte, NC***

5 Ds of Land Development

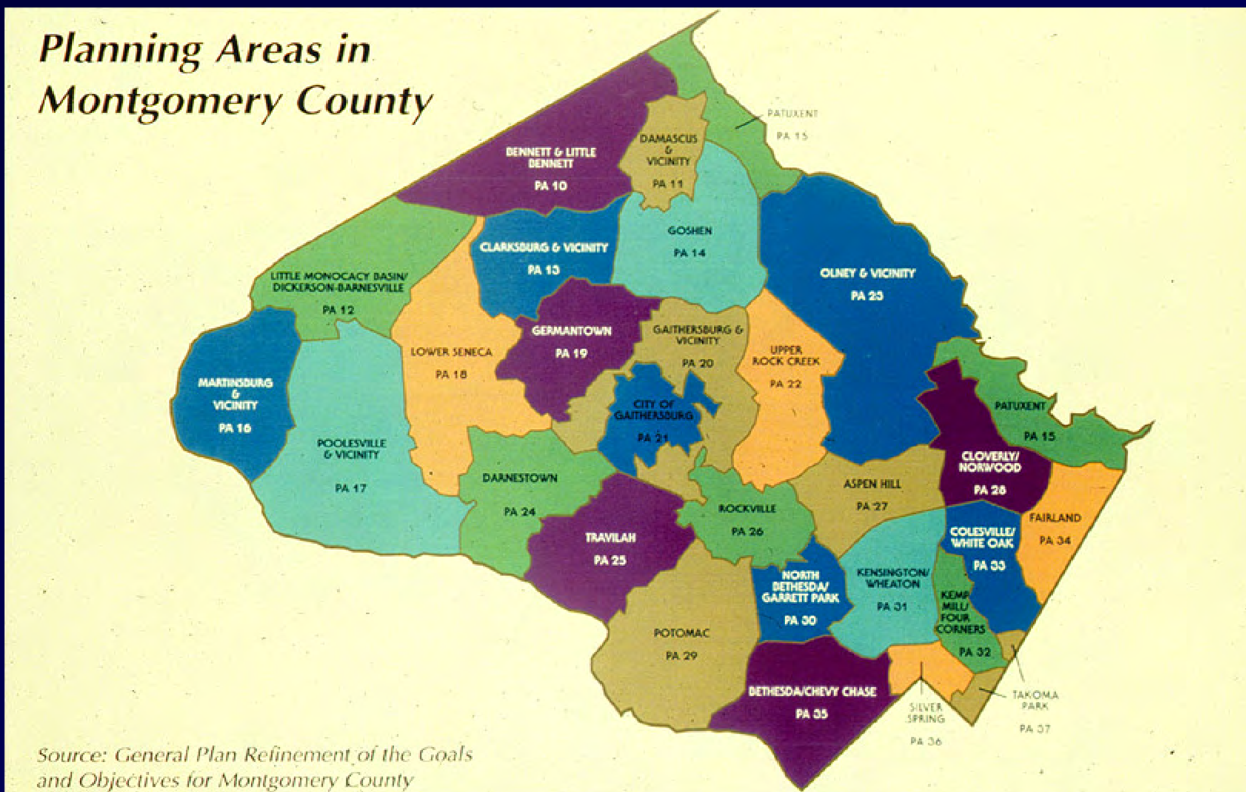
Urban TOD – Public Investment Driven Development

Bethesda, MD

Montgomery County's General Plan: "Wedges and Corridors" in 1964



Planning Areas



Source: General Plan Refinement of the Goals and Objectives for Montgomery County

Critical Lane Volume Standard	Policy Area
1450	Rural areas
1500	Clarksburg Damascus Germantown East Germantown Town Center Germantown West Montgomery Village/Airpark
1525	Cloverly Derwood North Potomac Olney Potomac R & D Village
1550	Aspen Hill Fairland/White Oak
1600	North Bethesda
1650	Bethesda/Chevy Chase Kensington/Wheaton Silver Spring/Takoma Park
1800	Bethesda CBD Grosvenor Shady Grove Silver Spring CBD Twinbrook Wheaton CBD White Flint

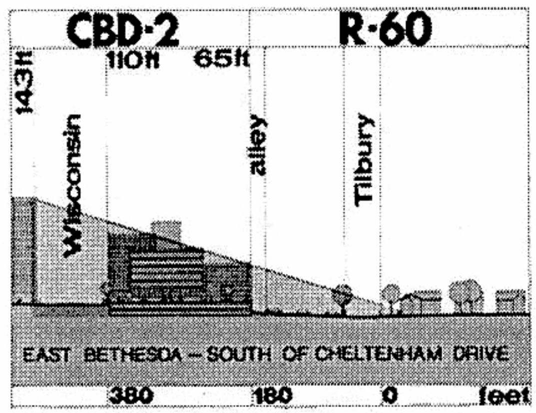
Downtown Bethesda

Qualifies as an Edge City

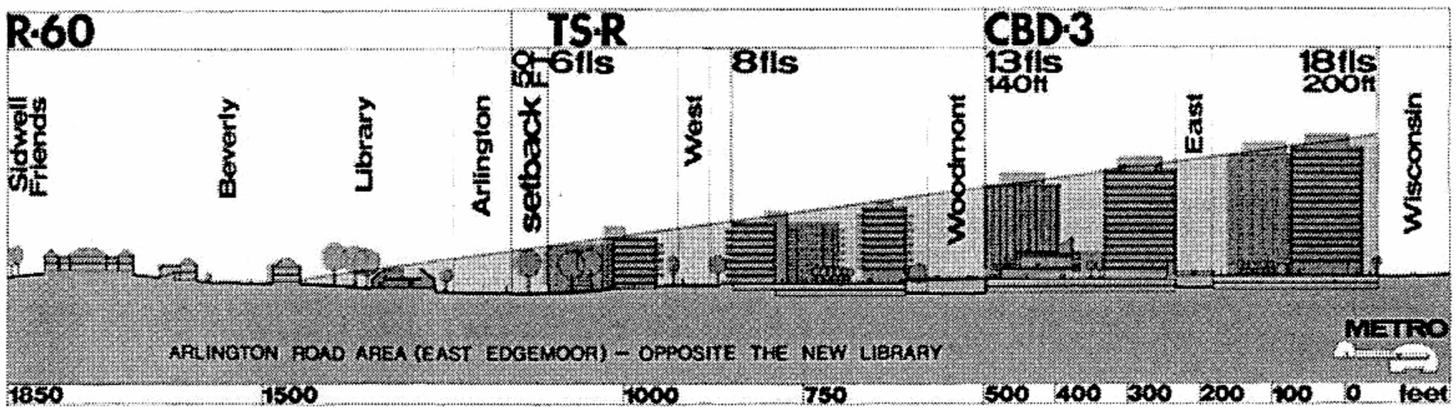
- ***400-ac suburban downtown***
- ***8 million sf of office (39,000 jobs)***
- ***2.3 million sf of retail***
- ***5,000 housing units ±***

Density -- 33 Units per Acre (gross)

Classic Density Gradient



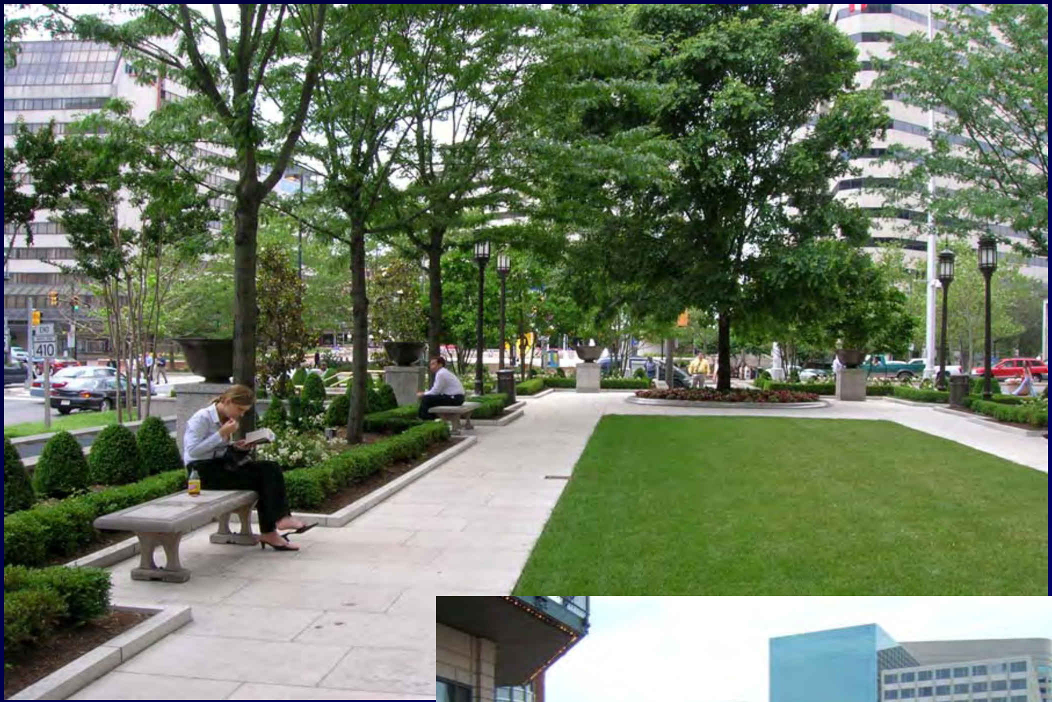
Profile A



Profile B

Diversity -- Seamless

Design -- Interconnected and Varied Spaces



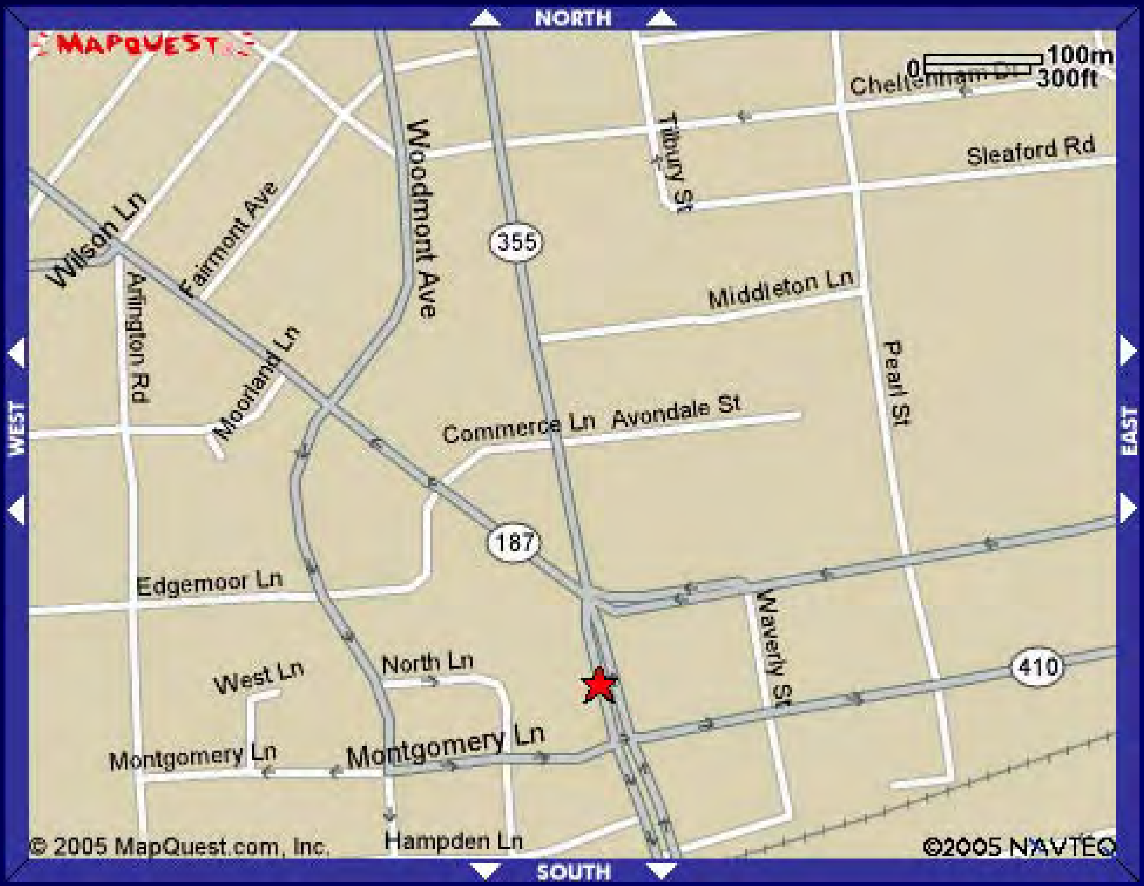
Continuous Sidewalks Appropriately Scaled

Safe Crossings

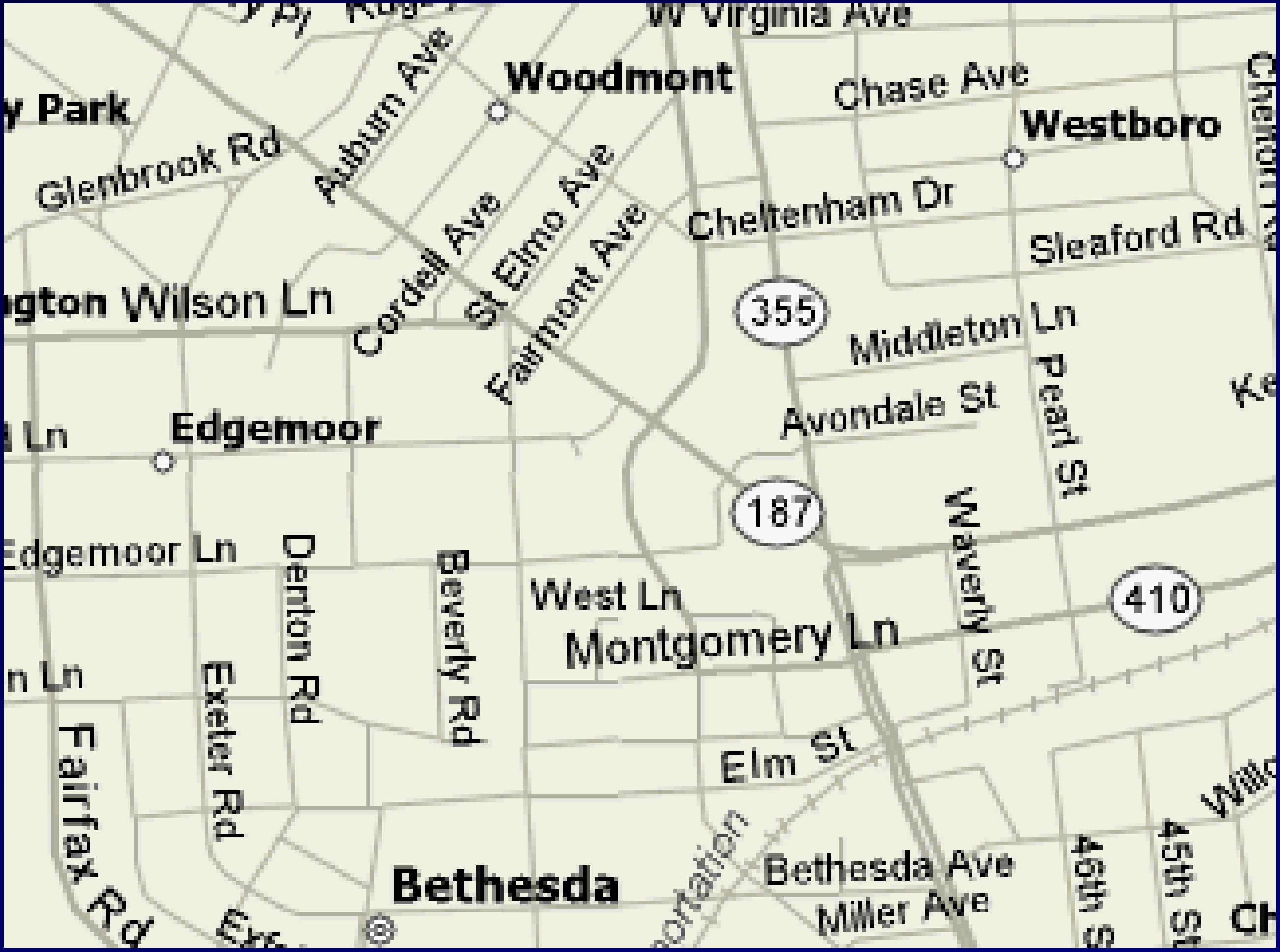
Minimal “Dead” Space

Human-Scale Buildings

Super Blocks with Pass-Throughs



Connectivity Index of 1.49



Distance to Transit

5th D -- Parking

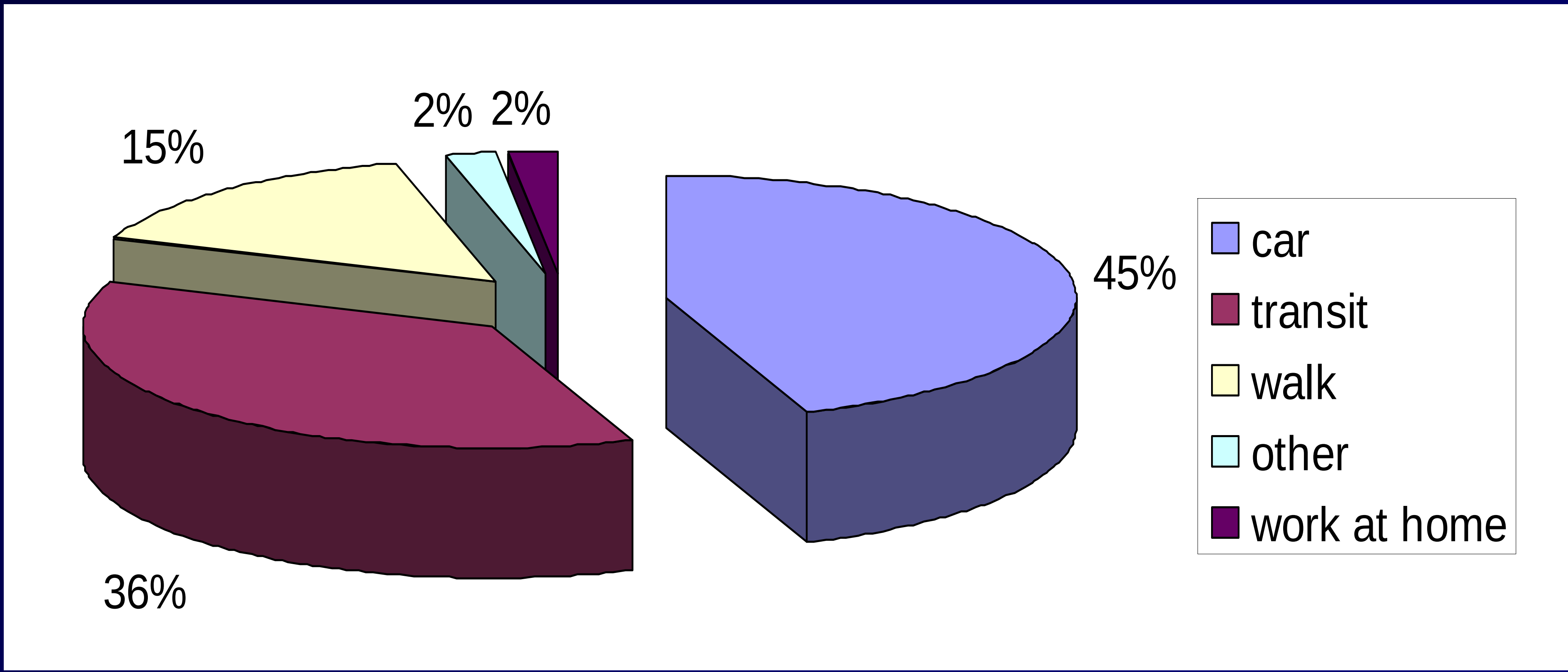
Parking Ratios

- ***1.9 spaces per 1,000 sq ft w/i 800 ft – not all on site***
- ***2.1 spaces per 1,000 sq ft from 800-1,600 ft***
- ***2.4 spaces per 1,000 sq ft beyond 1,600 ft***

Road Code Revision

[[Classification	Road/Lane Width ('urban')	Road/Lane Width ('other')	Planned Bike Lanes	Sidewalk ('urban')[6]	Sidewalk ('other')[6]
Arterial[1,4]	10.5' lanes	12' lanes	5' wide[2]	5+' wide	5' wide
Country Arterial[4]	not applicable	22' road	5' wide[2]	none	none
Minor Arterial[1,4]	10.5' lanes	11' lanes	4' wide[2]	5+' wide	4' wide
Business District Street[1]	10.5' lanes	11' lanes	none	5+' wide	5' wide
Industrial Street[1]	10.5' lanes	11' lanes	none	5+' wide	5' wide
Primary Residential Street (no curbs)	not applicable	20' road	3' wide[2]	5+' wide	4' wide
Primary Residential Street (with curbs, no parking)[5]	22' road	22' road	3' wide[2]	5+' wide	4' wide
Primary Residential Street (with curbs, 1-side parking)[5]	28' road	28' road	3' wide[2]	5+' wide	4' wide
Primary Residential Street (with curbs, 2-side parking)[5]	34' road	34' road	3' wide[2]	5+' wide	4' wide

Bethesda Town Center's Commute



Suburban TOD – Command-and-Control Development

Orenco Station, Hillsboro, OR

2040 Growth Concept

- Balance land use and transportation
- Provide cost-effective solutions
- Provide multi-modal choices
- Protect neighborhoods, environment
- Serve freight, inter-modal and commerce needs
- Enhance safety and preserve the system

Transportation Planning Rule

NEIGHBORHOOD STREET DESIGN GUIDELINES

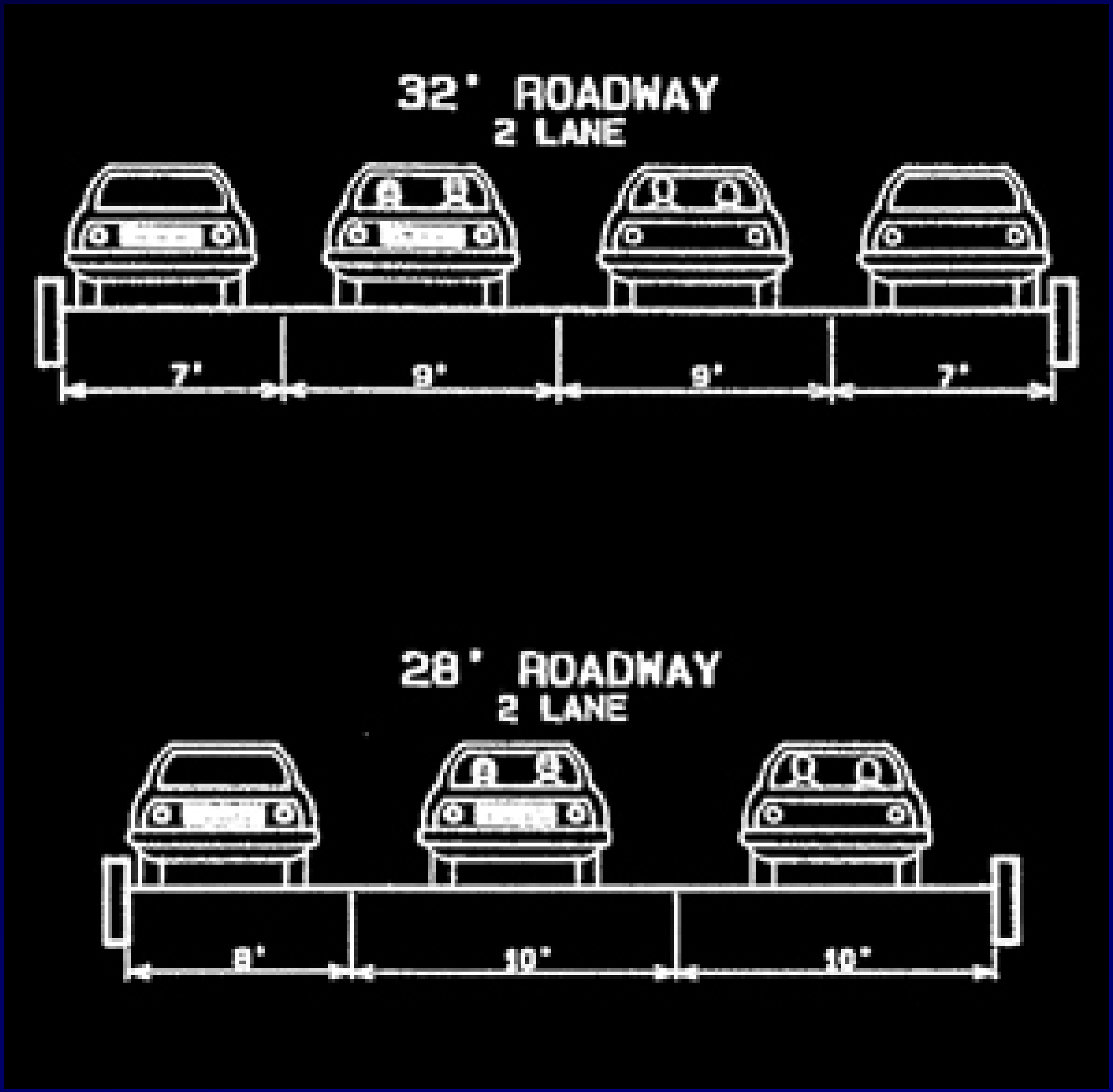
An Oregon Guide for Reducing Street Widths

A Consensus Agreement by the Stakeholder Design Team

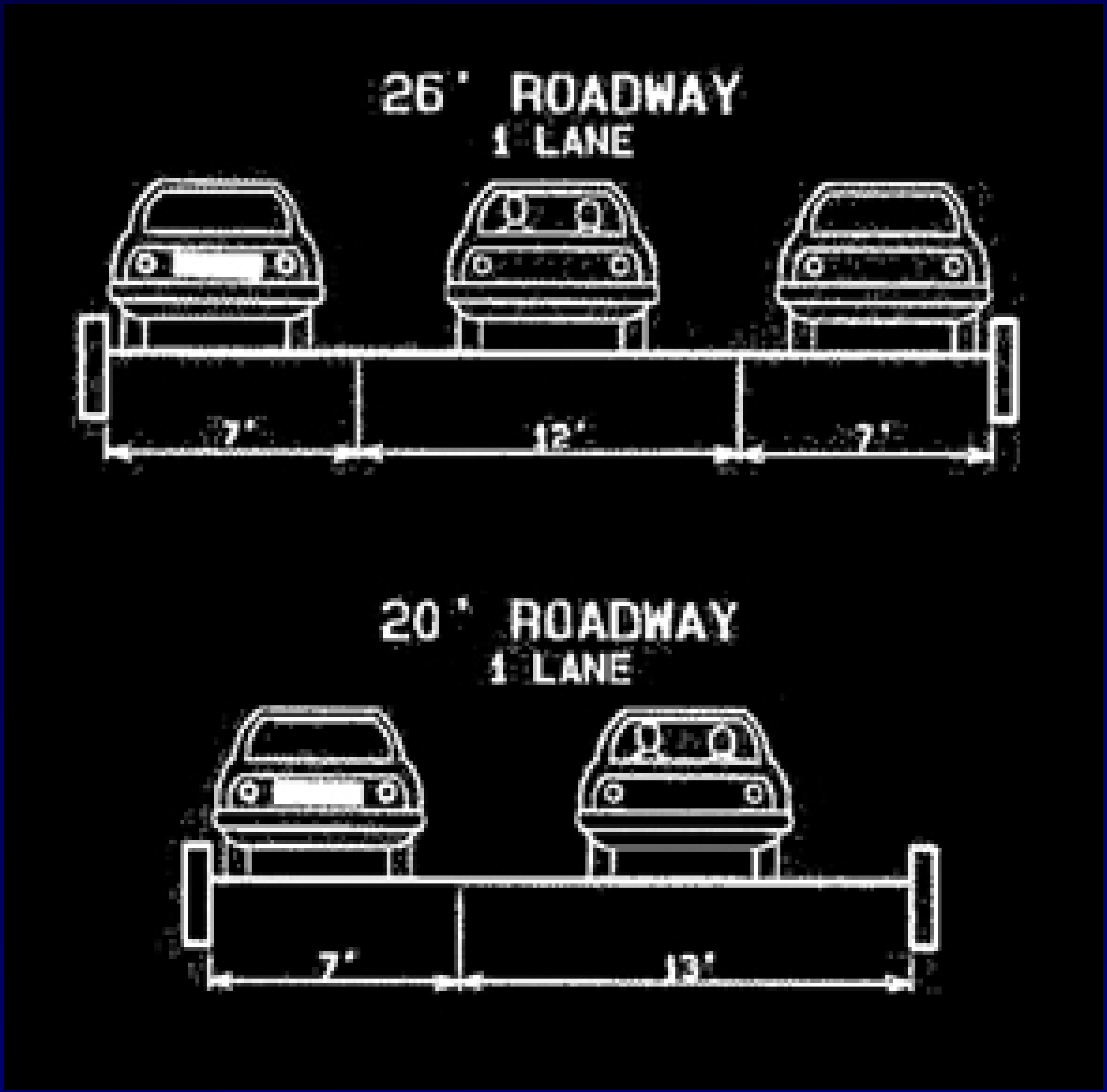
November 2000

Prepared by the Neighborhood Streets Project Stakeholders

Portland’s Old Standards



Portland's New Standards



Cul-de-Sac Length Limits

Orlando, FL	*700 ft/30 dus*
West Linn, OR	*400 ft/12 dus*
Austin, TX	*1,200 ft*
Beaverton, OR	*200 ft*
Boulder, CO	*600 ft*
Middleton, DL	*1,000 ft*
Davidson, NC	*250 ft (closes excepted)*

** With exceptions for topography or special circumstances.*

*Block Length Limits**

Salem, OR	*600 ft (120-400 ft widths)*
Portland, OR	*530 ft*
Davidson, NC	*600 ft*
Raleigh, NC	*1,500 ft*
Fort Collins, CO	*Max block size (7-12 acres)*
Boulder, CO	*350 ft (by practice)*

** With exceptions for topography or special circumstances.*

Portland Metro Study

Low -> Medium Connectivity:

- ***14% average drop in vehicle hours of delay***
- ***2% average drop in vehicle miles of travel***
- ***9% average drop in link traffic volumes***

**** Connectivity defined by number of intersections per mile of arterials. Optimum spacing of local and arterial streets was 330-530 ft. Kloster et al., "Linking Land Use and Transportation through Street Design," Transportation Research Circular E-C019, December 2000.***

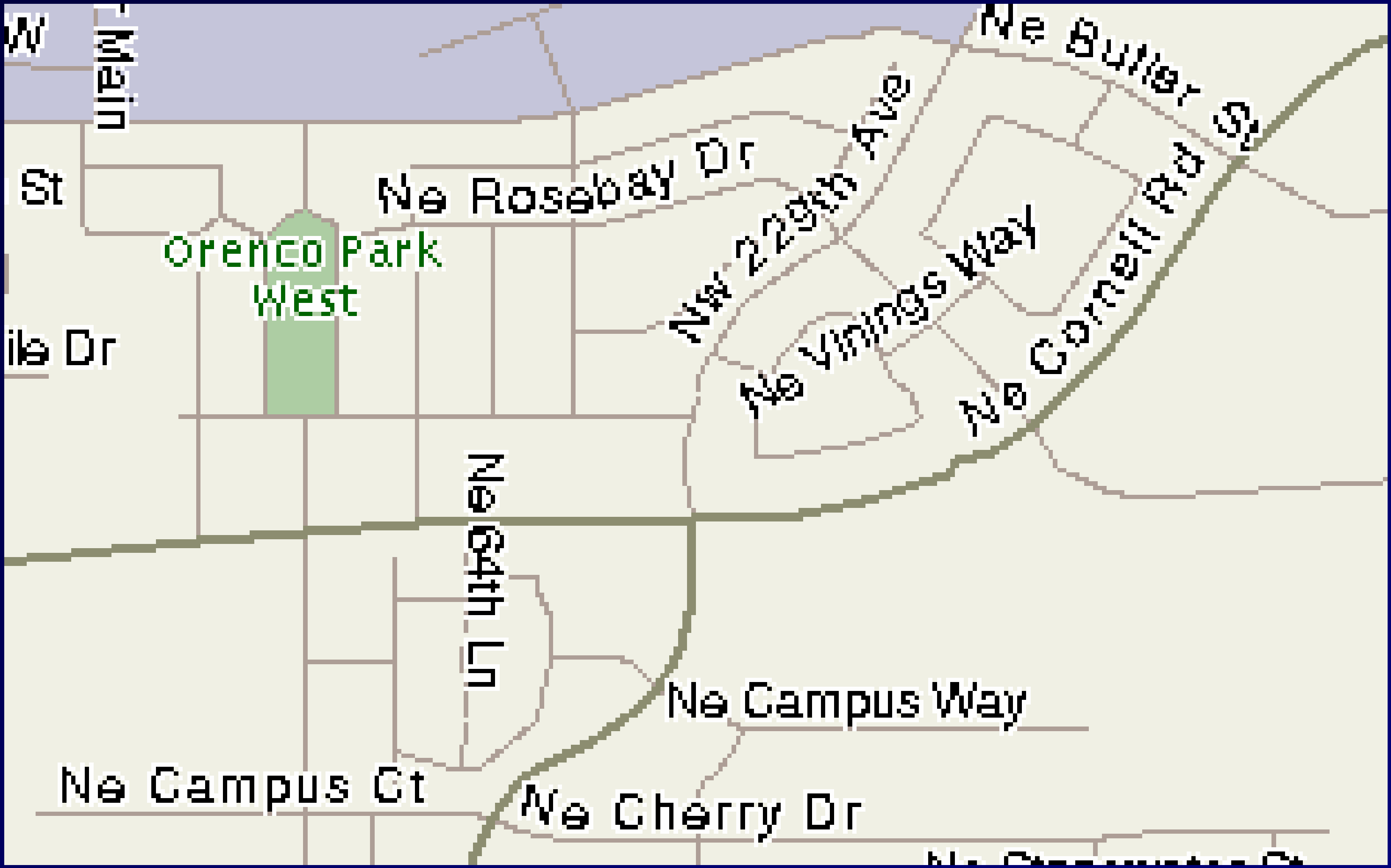
Project Description

- ***1,100 acre new town***
- ***52-acre village center concurrent with housing***
- ***3,600 -> 4,300 residential units (using full entitlement)***
- ***200,000 sf retail uses***
- ***800,000 sf of office uses (200,000 sf in village center)***
- ***Internal bus service planned***

Tied Together

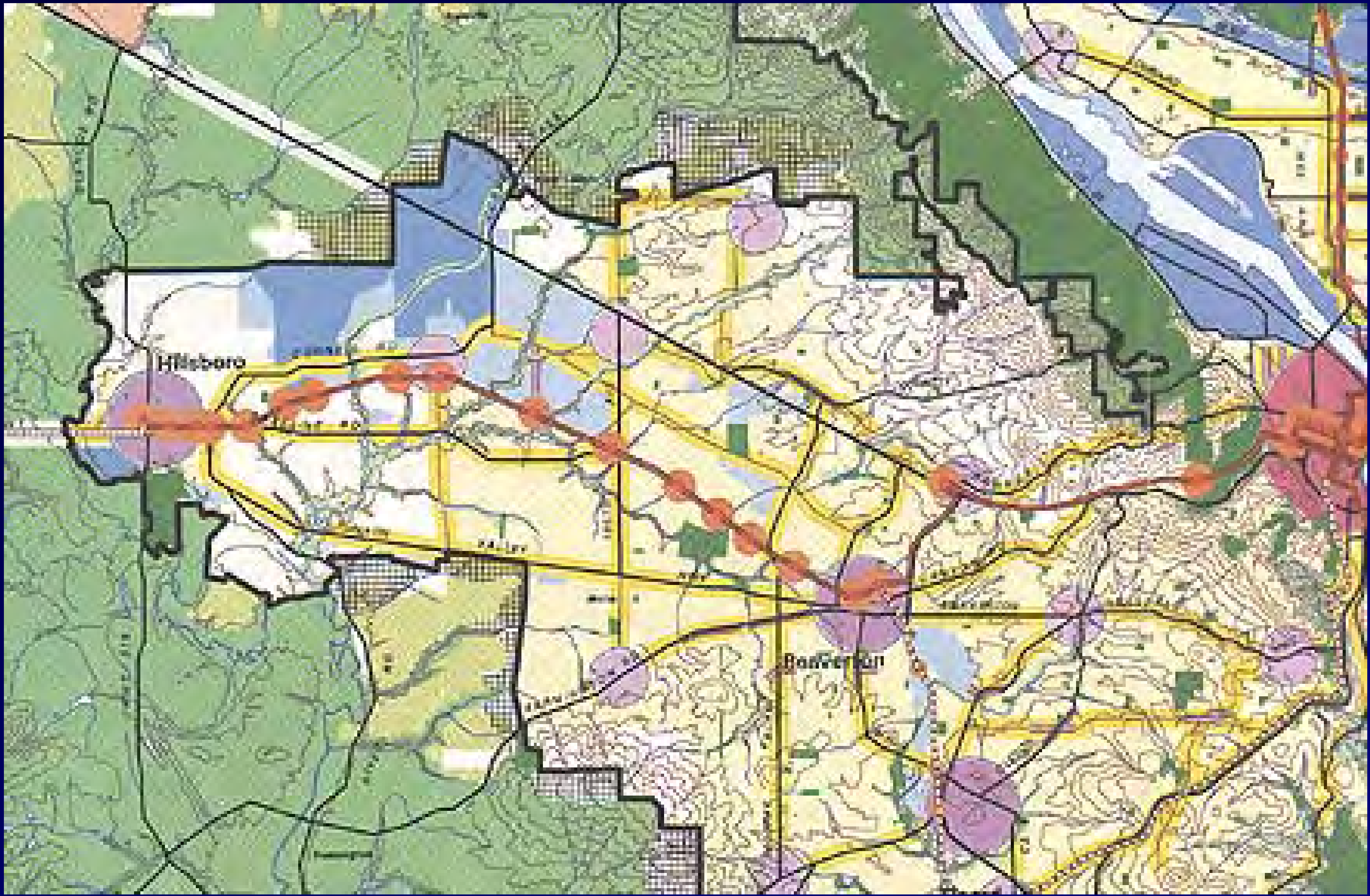
15 Units per Acre

Connectivity Index of 1.53



Orenco Parkway

Limited Rail System



Standard Auto Ownership

Light Rail Usage

- ***42% of residents considered access to Max "very important" in home buying decision***
- ***78% of residents use transit more than in their prior residence***
- ***Only 11% ride Max to work at least one day a week***

But Walkable

New-Town In-Town – Full Public-Private Partnership

Baldwin Park, Orlando, FL

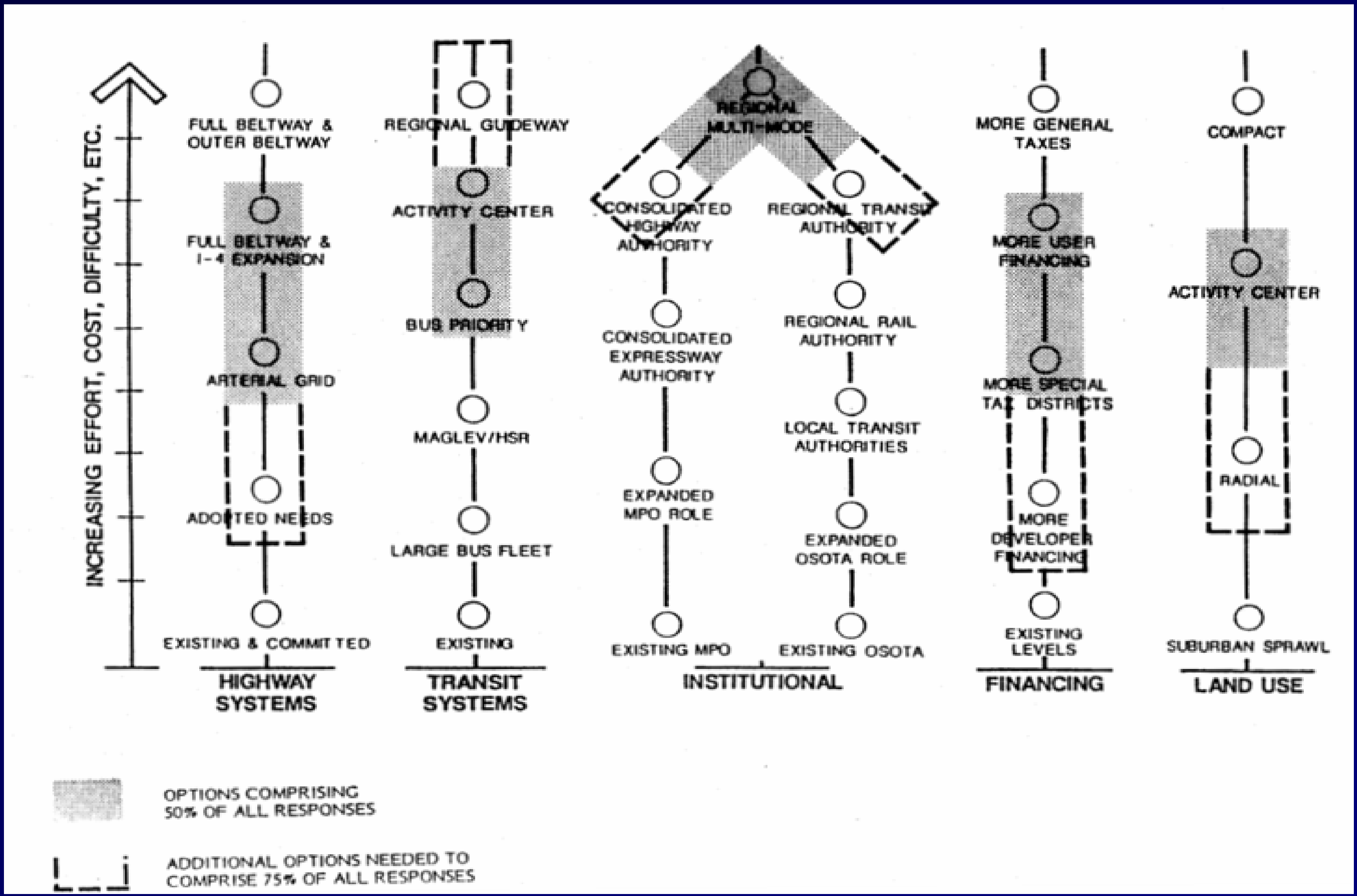
Orlando's Mission Statement

CITY OF ORLANDO

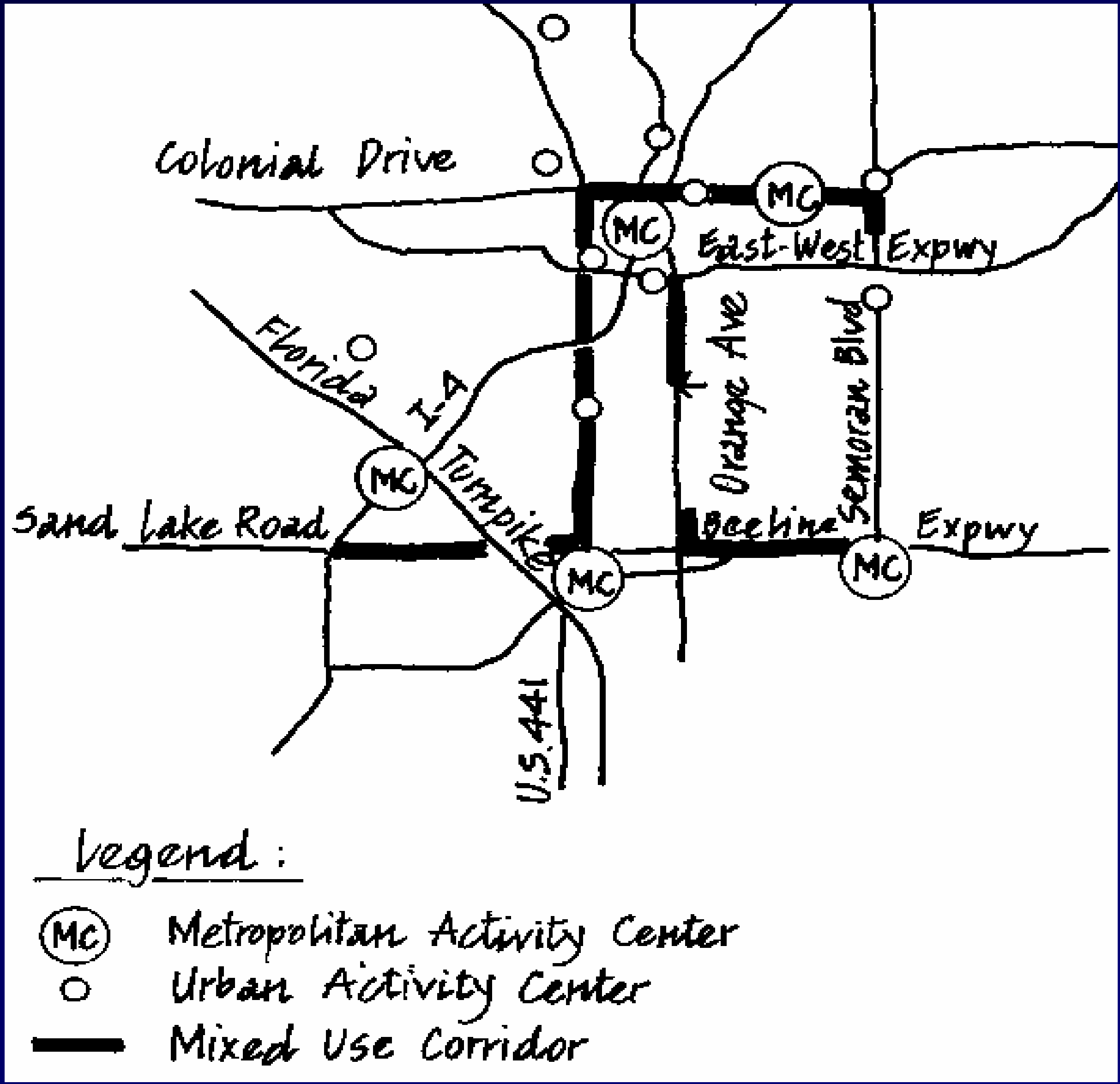
Transportation Planning Bureau

Our Mission is to promote sustainable growth and the livability of Orlando
by developing transportation systems integrated with land use patterns
that offer residents and visitors travel choices and convenient access to goods, services, jobs, schools, recreation and civic involvement.

Orlando Vision Plan



Orlando Comprehensive Plan -- Future Land Uses



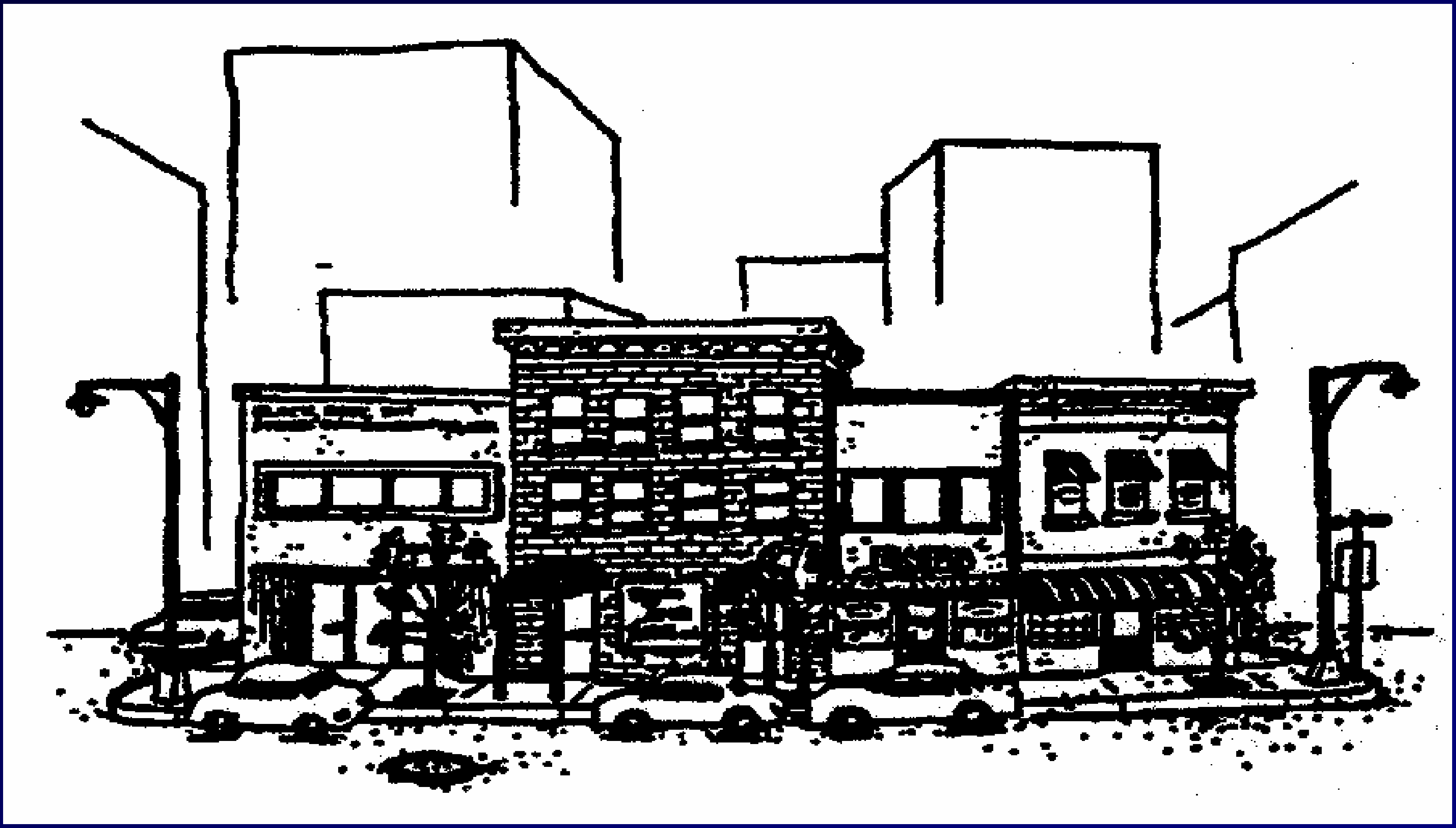
Standards for Activity Centers

	Metropolitan	Urban	Community
Minimum Intensities	75 Units/AC 0.75 FAR	30 Units/AC 0.5 FAR	20 Units/AC 0.35 FAR
Minimum Land Area	100 Acres	40 Acres	8 Acres

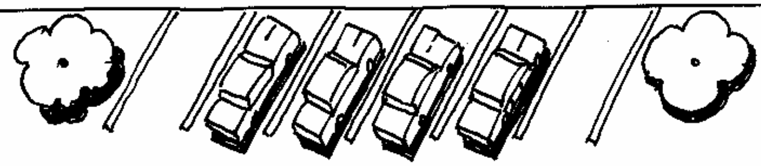
Required Uses (2010)

Residential	5 – 10%
Office	5 – 10%
Commercial	50 – 70%
Pub. Rec. + Inst.	5 – 20%
Industrial	0 – 10%

Land Development Code -- MU Zoning



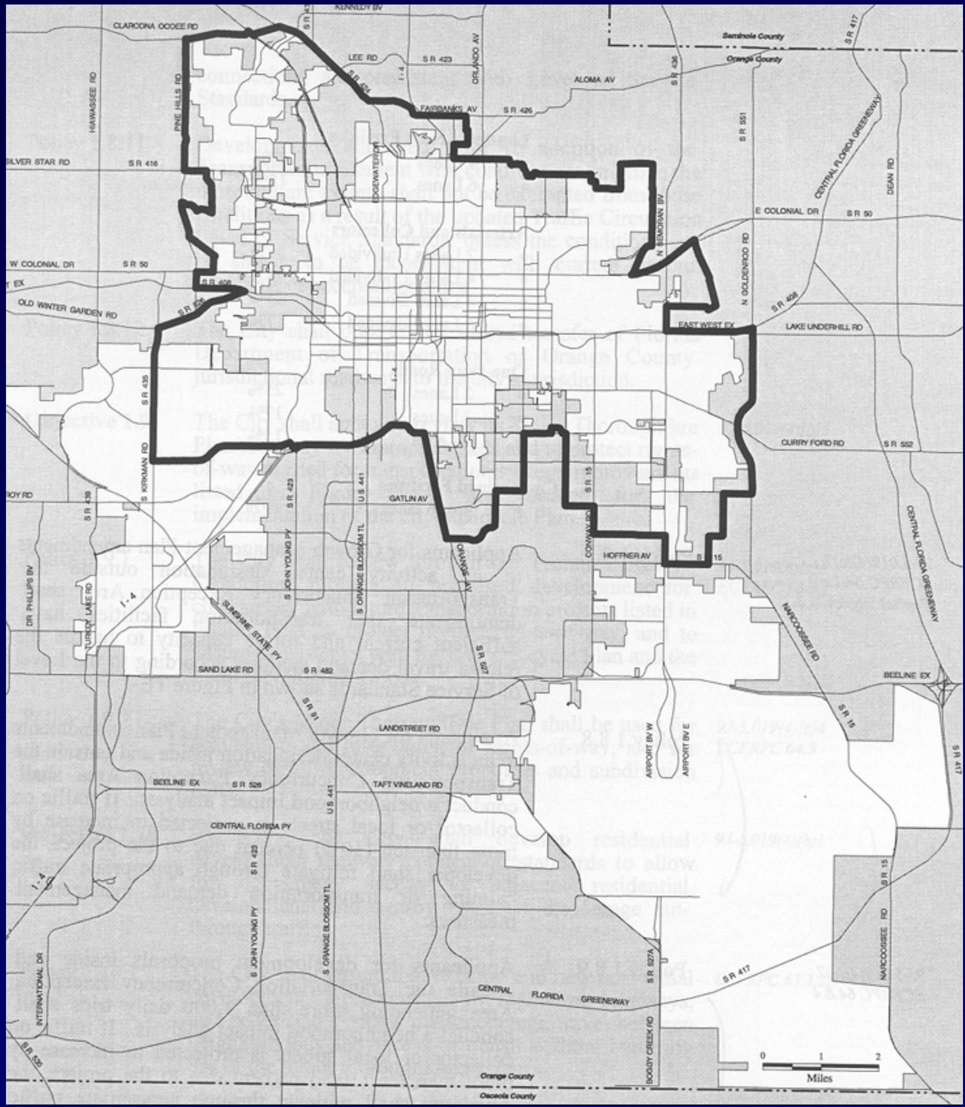
Land Development Code -- Parking Standards



	Minimum	Maximum
Downtown	2	2.5
Other Major Activity Centers	2.5	3
Elsewhere	2.5	4

☆ Standards Apply To Most Offices, Shops & Services

Transportation Concurrency Exception Area



Traditional Design Standards

- ***Allowable Uses***
- ***Maximum Block Size***
- ***Minimum Density/Intensity***
- ***Minimum Frontage***
- ***Parking Ratios***
- ***Building Heights***

	Town Center **Urban Transit Center**
Mixed Use Blocks	15% to 40% of Center
Mix of Uses* *30-80% retail, cinema, or hotel required each block, 20-70% other.	Retail, Services, Restaurants, Office, Cinema, Grocery, Hotel, Residential, Civic, Park/Plaza
Maximum Block Size	7 acres
Minimum FAR	FAR: 0.4
Minimum Frontage	65% of each street
Parking Ratio	3 spaces: 1,000 sf
Building Height	2 to 10 story

Incentives for Traditional Development

- ***Higher Densities/Intensities***
- ***Fee Waivers***
- ***Expedited Permitting***
- ***Narrower Streets***
- ***Lower Transportation Impact Fees***

Orlando Adopted Connectivity Index

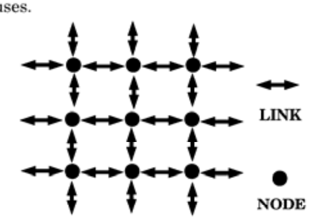
Network Connectivity

The Transportation Element of the Growth Management Plan recognizes the importance of an enhanced transportation network where developments are adequately interconnected.

The development "connections" include internal, to adjacent land uses, to the external network, and where adequate pedestrian, bicycle and transit facility connections are provided to promote alternatives to the automobile.

The Transportation Element of the Growth Management Plan requires the establishment of a Connectivity Index Standard. The Standard ensures adequate internal and external connections in single-family and multi-use developments, as well as to enhance the city's overall transportation network.

Multi-use developments include combinations of residential and/or non-residential uses.



Calculating a Connectivity Index

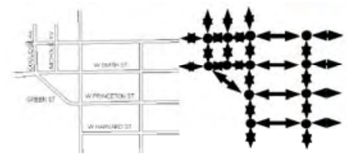
The Connectivity Index is an indicator of how efficient a transportation network is. The Connectivity Index can be evaluated for existing areas or for proposed developments.

- **Select the area.** The Connectivity Index is specific to an area or to a development, and it will be sensitive to the size of the area evaluated. A single city block in a grid network will produce a higher Connectivity Index than multiple city blocks being evaluated simultaneously.
- **Count the number of Nodes.** Nodes are any point of intersection between two roadways. A cul-de-sac end is also a Node while a stub-out end is not. New developments may include stub-outs instead of cul-de sacs, providing multi-directional access opportunities to adjacent areas, improving their Connectivity Index and promoting sustainable communities.
- **Count the number of Links.** Links are road segments interconnecting the Nodes. Count all of the internal Links within the area evaluated. Also count the external Links connecting to the Nodes within the area evaluated. Do not include a Node at the external Link ends.
- **Divide the Links by the Nodes.** The number of Links divided by the number of Nodes as defined above will produce the Connectivity Index.

CONNECTIVITY INDEX = LINKS / NODES

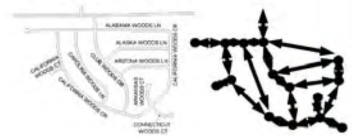
Connectivity Examples

- **Existing urban areas:**



Connectivity Index = 2.58

- **Suburban areas:**

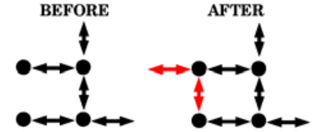


Connectivity Index = 1.33

Improving Connectivity

The Connectivity Index can be improved by removing the cul-de-sacs and connecting the street-ends to other streets. Simple changes in street design can bring about significant changes in Connectivity Index scoring.

BEFORE **AFTER**



Connectivity Index 1.25 **Connectivity Index 1.75**

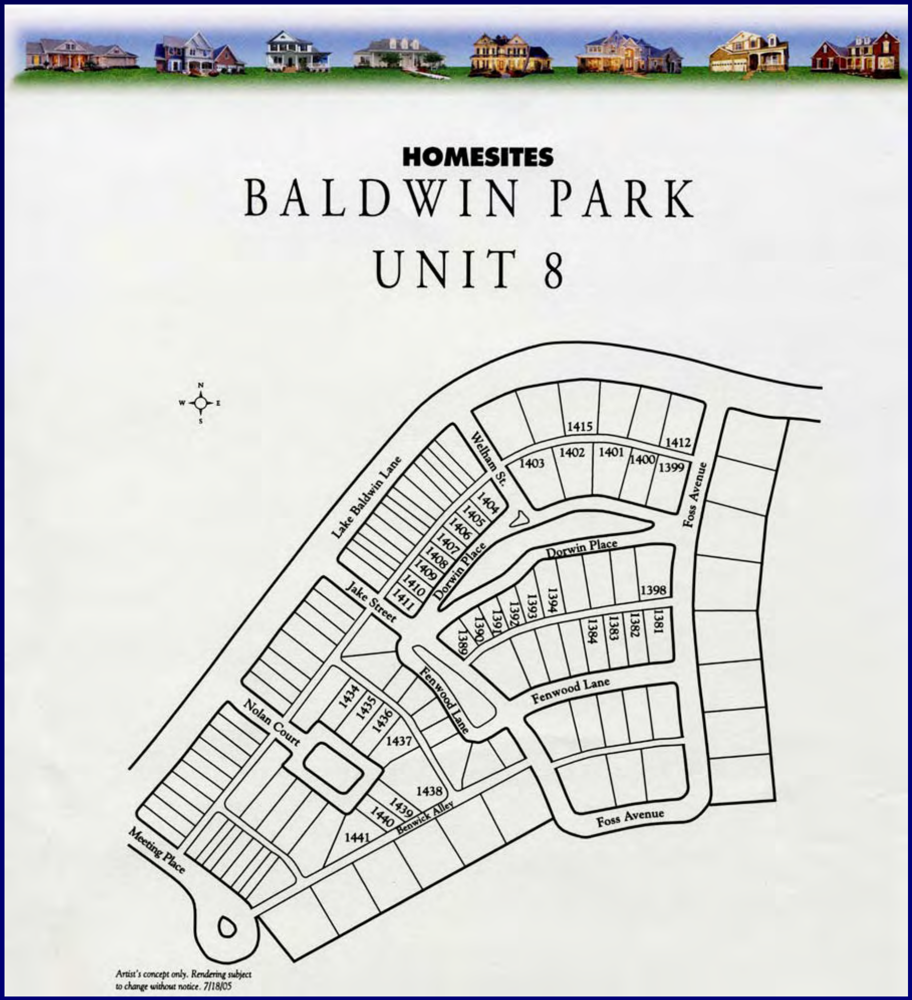
Transferred to City Under the Base Closure Act

Project Description

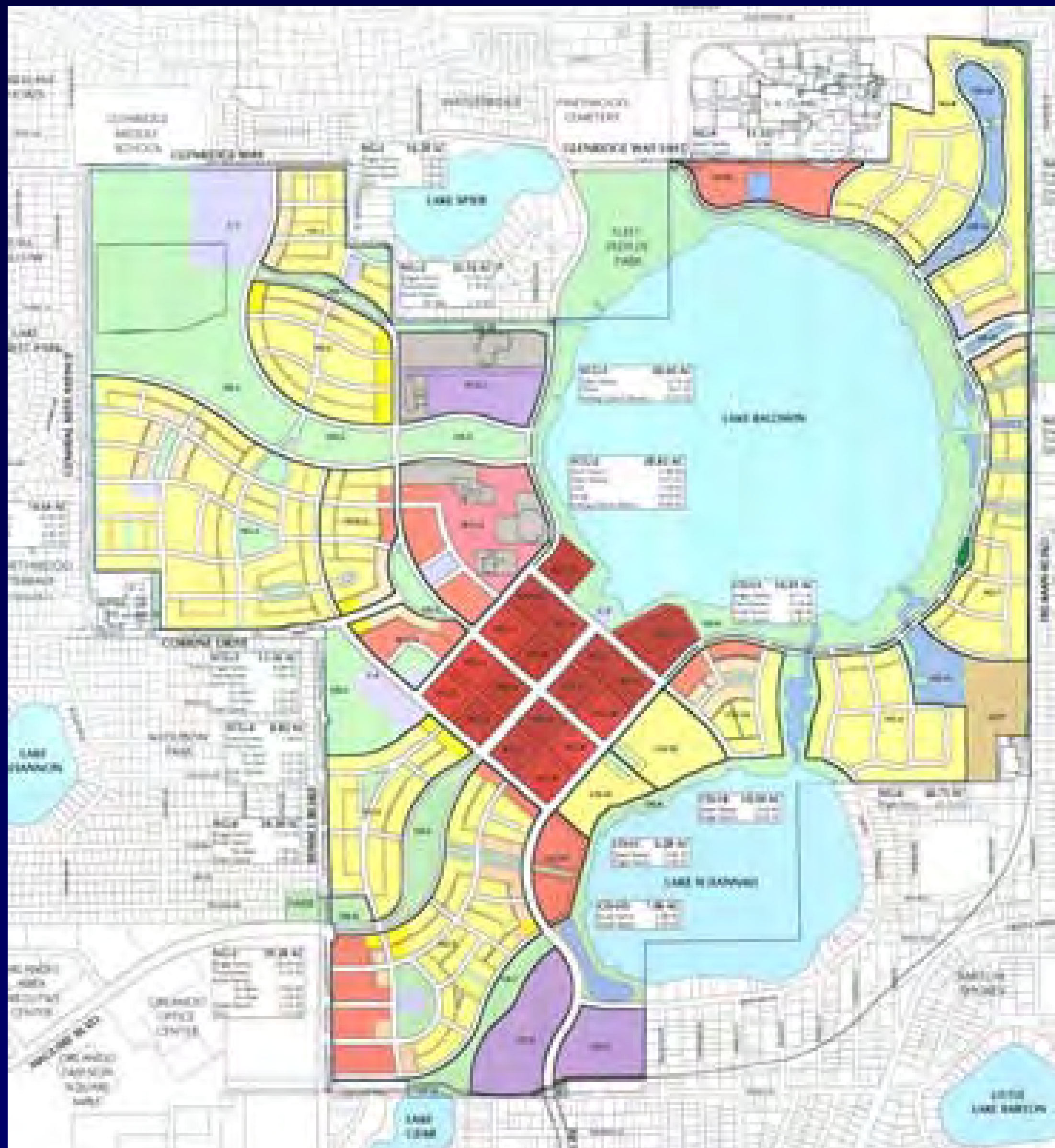
- ***1,100 acre new town***
- ***52-acre village center concurrent with housing***
- ***3,600 -> 4,300 residential units (using full entitlement)***
- ***200,000 sf retail uses***
- ***800,000 sf of office uses (200,000 sf in village center)***
- ***Internal bus service planned***

Baldwin Park

13 Units per Acre



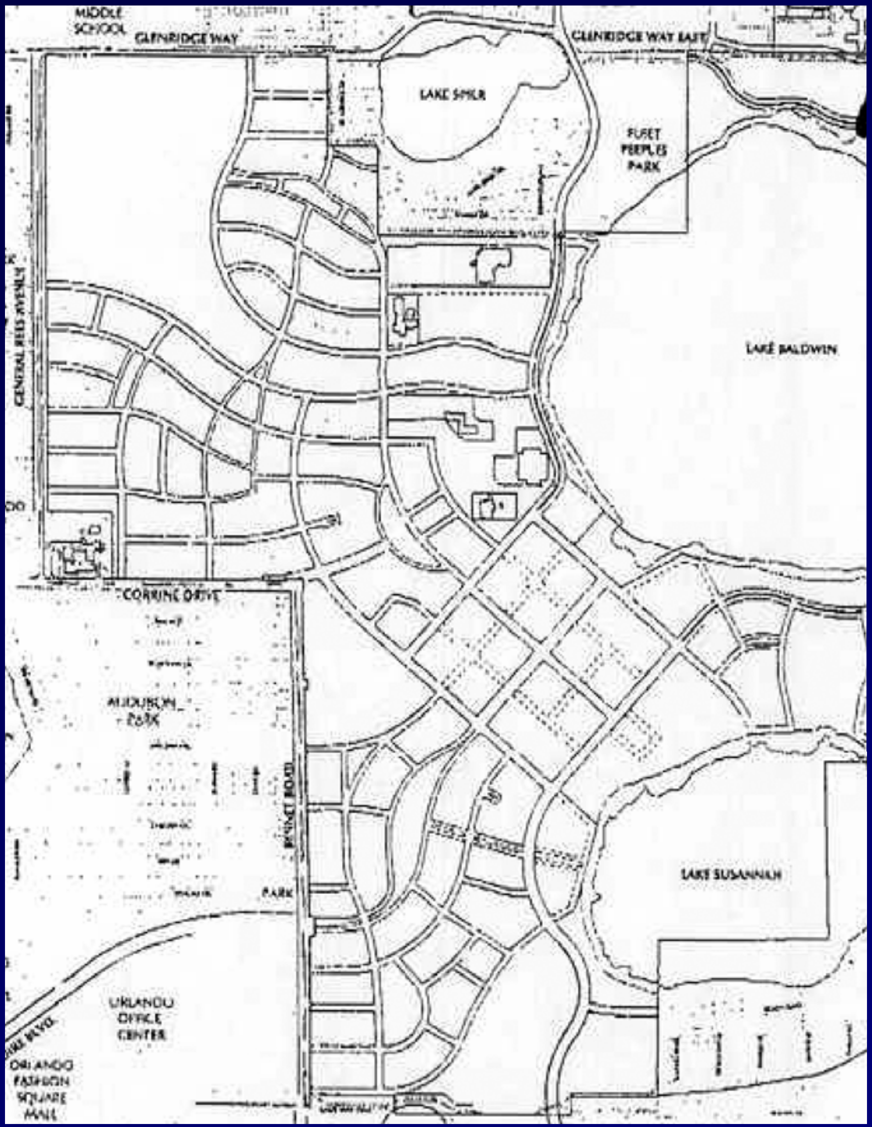
Dense Core with Dispersed Apts and Offices



Vertical and Horizontal Mix in the Town Center

Connectivity Index of 1.62

28 Connections But No Through-Street



Alike Uses Facing Each Other

Curb-to-Curb Street Widths

Lower Park Rd	27 ft
Shaw Lane	22 ft (96 + 96 + 75)
Upper Union Rd	21 ft (96 + 96 + 56)
Meeting Place at choker	11 ft (96 + 30)
Meeting Place at parking	19 ft (96 + 96 + 38)
Prospect Ave	36 ft (8 + 10 + 10 + 8)

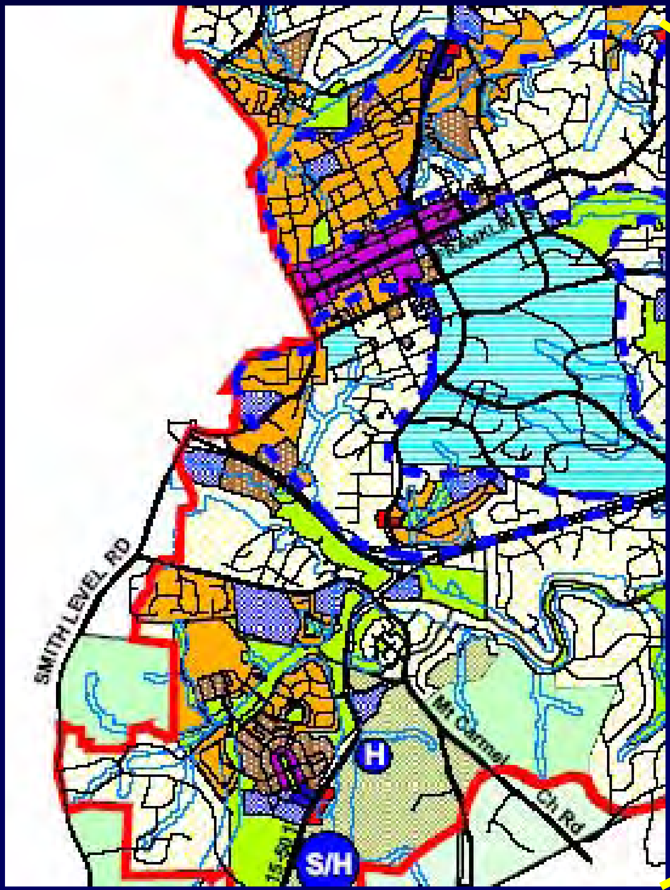
Skinny Streets

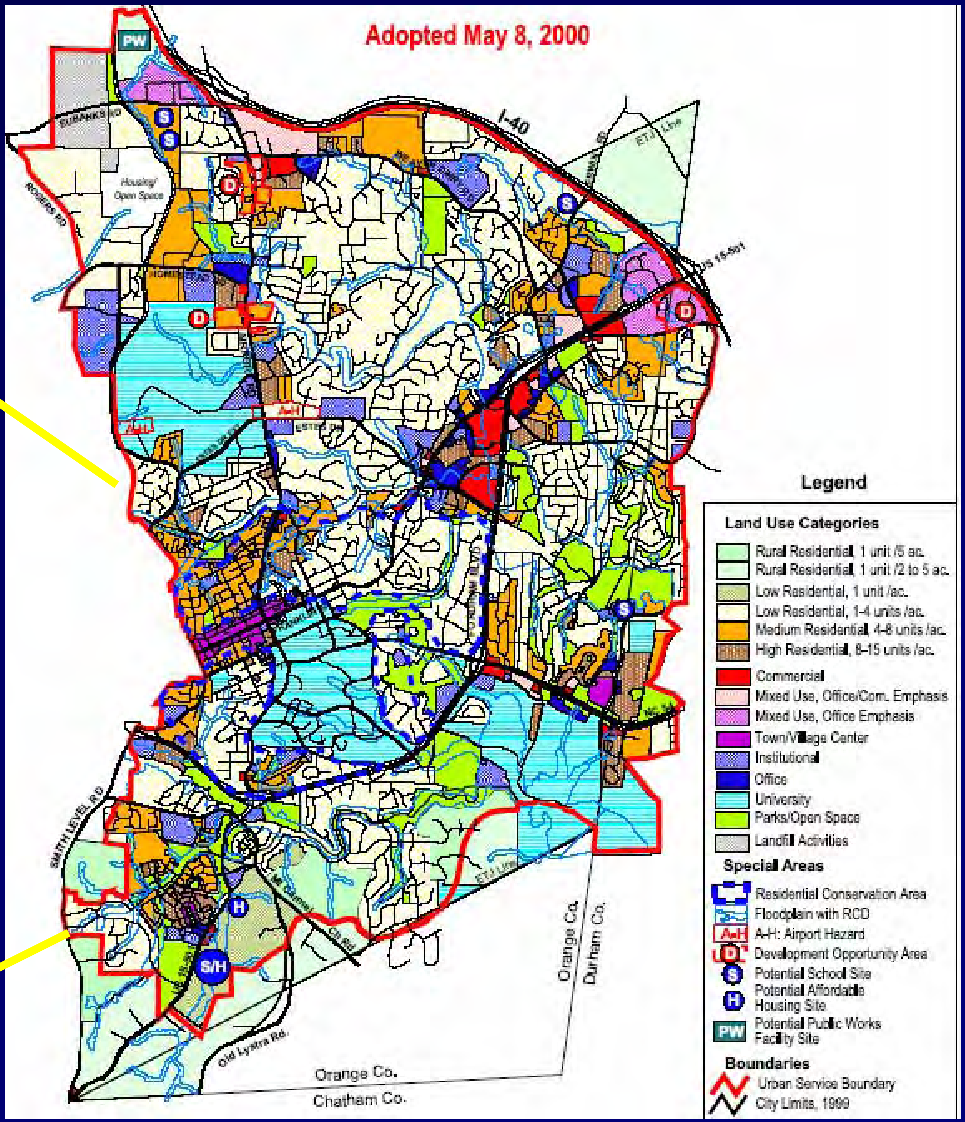
Even Collectors

Neo-Traditional Village – Friendly Regulatory Environment

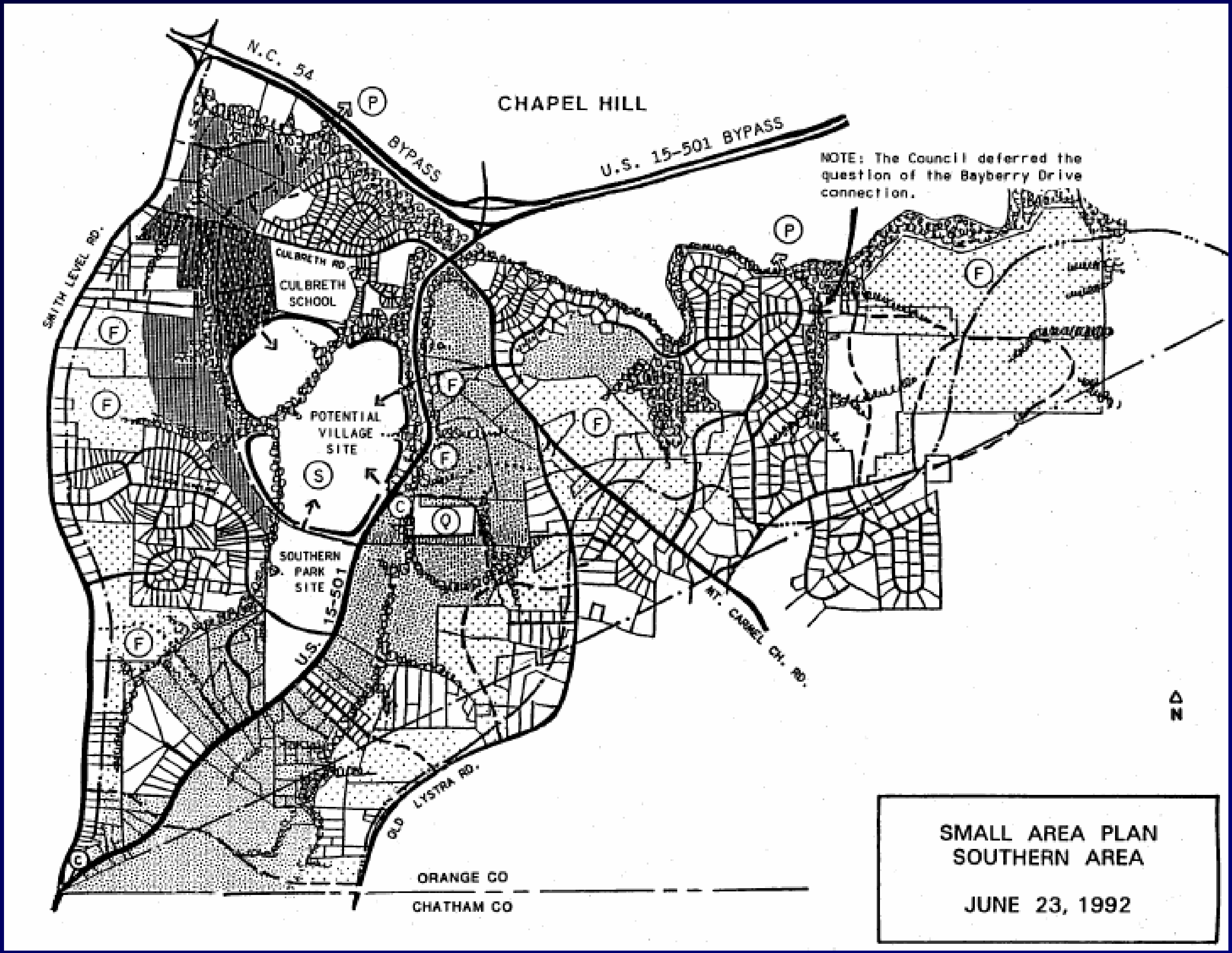
Southern Village, NC

Two Places that Don't Look Like Sprawl



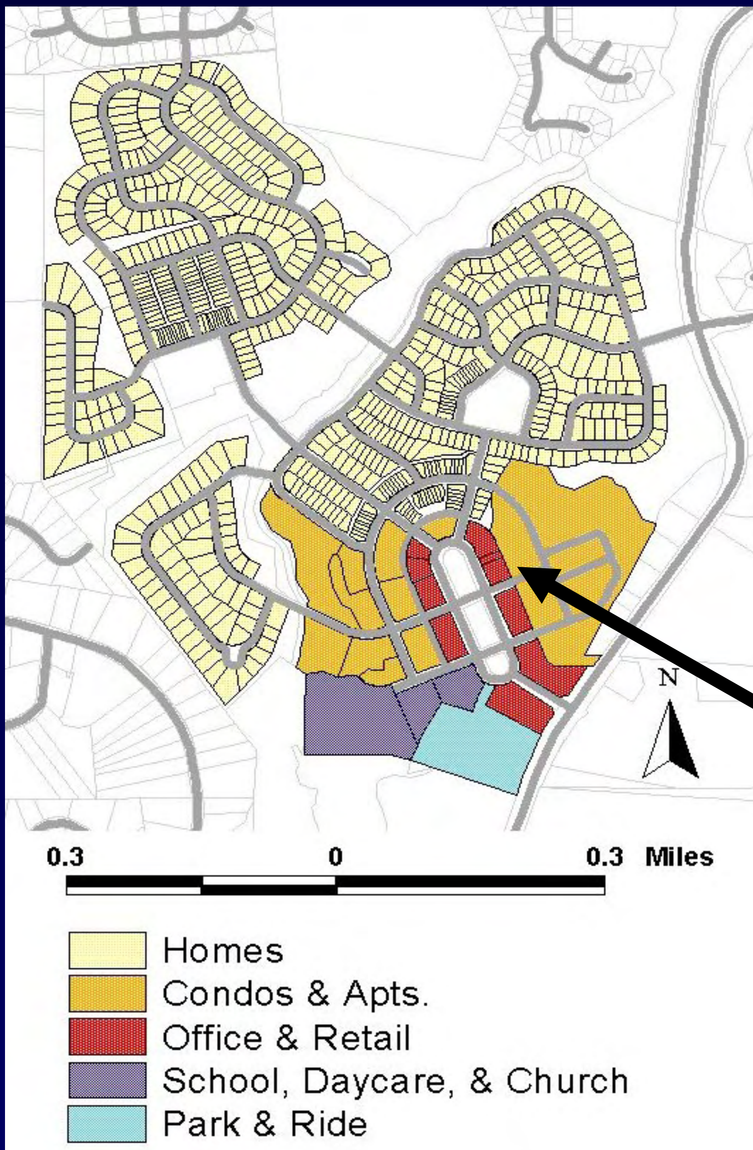


Downzoning to Direct Growth to the Village



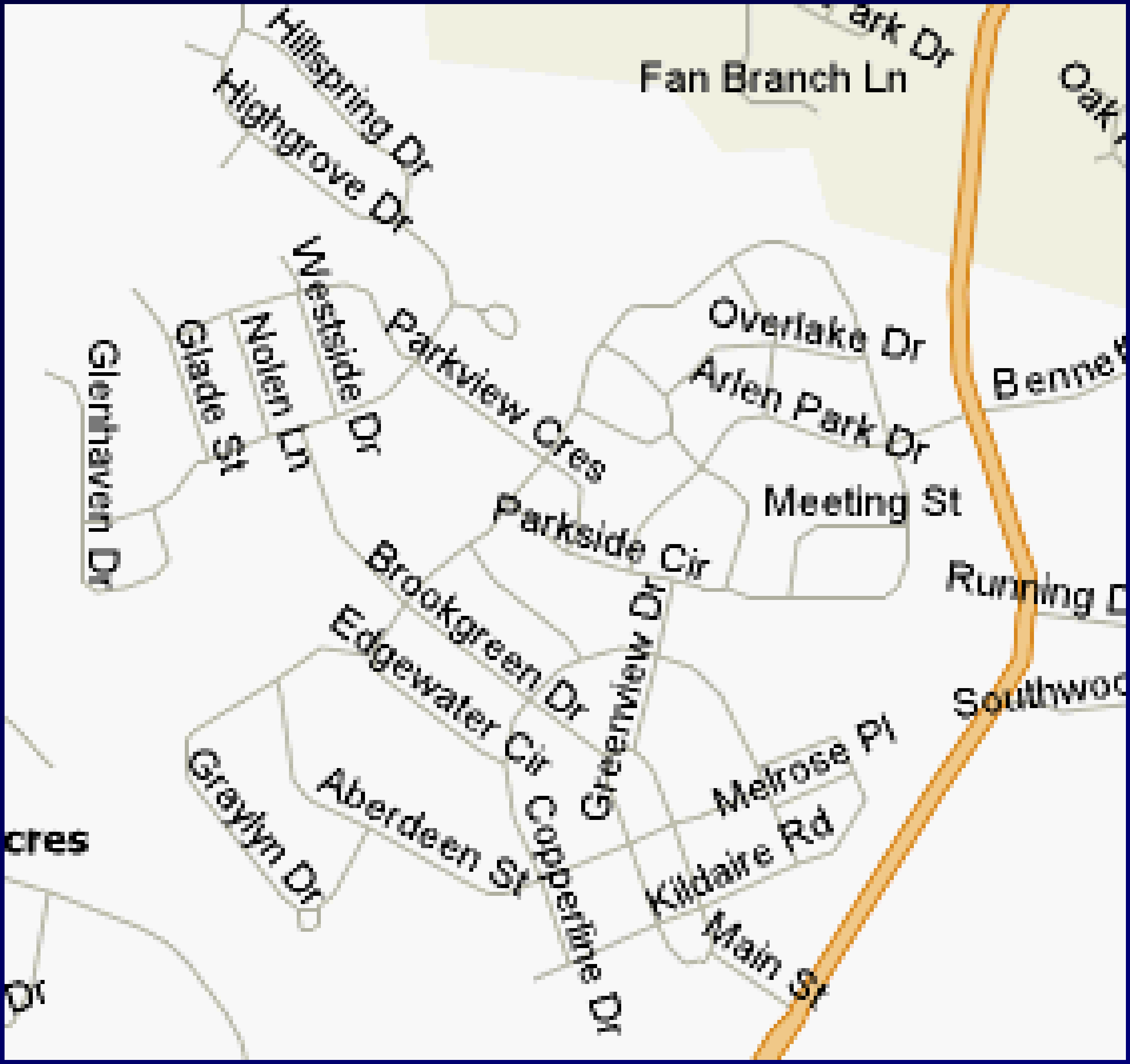
9 Units per Acre

Classic Stepdown Pattern



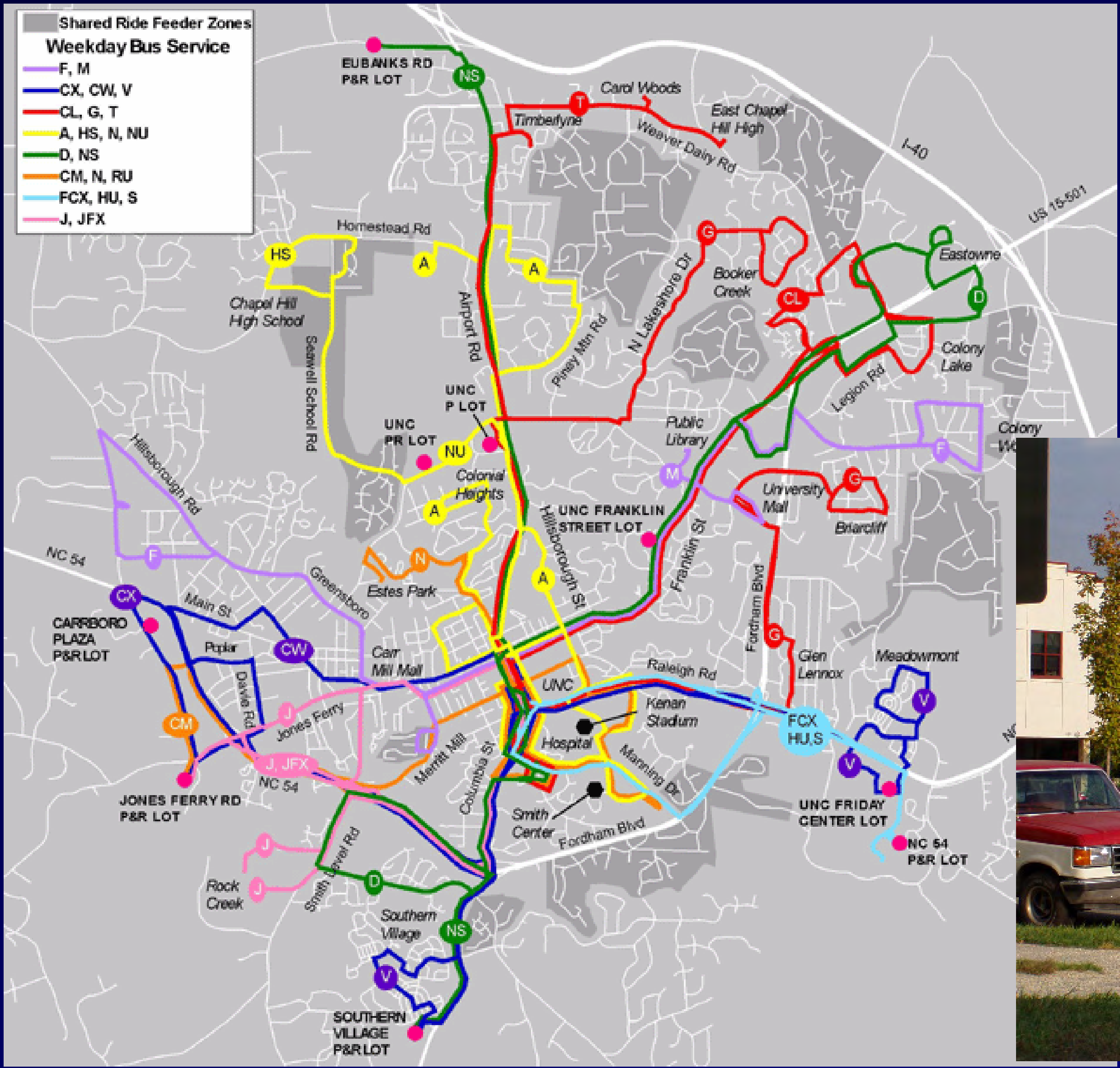
Neighborhood and Village Commercial

Southern Village – Index of 1.50



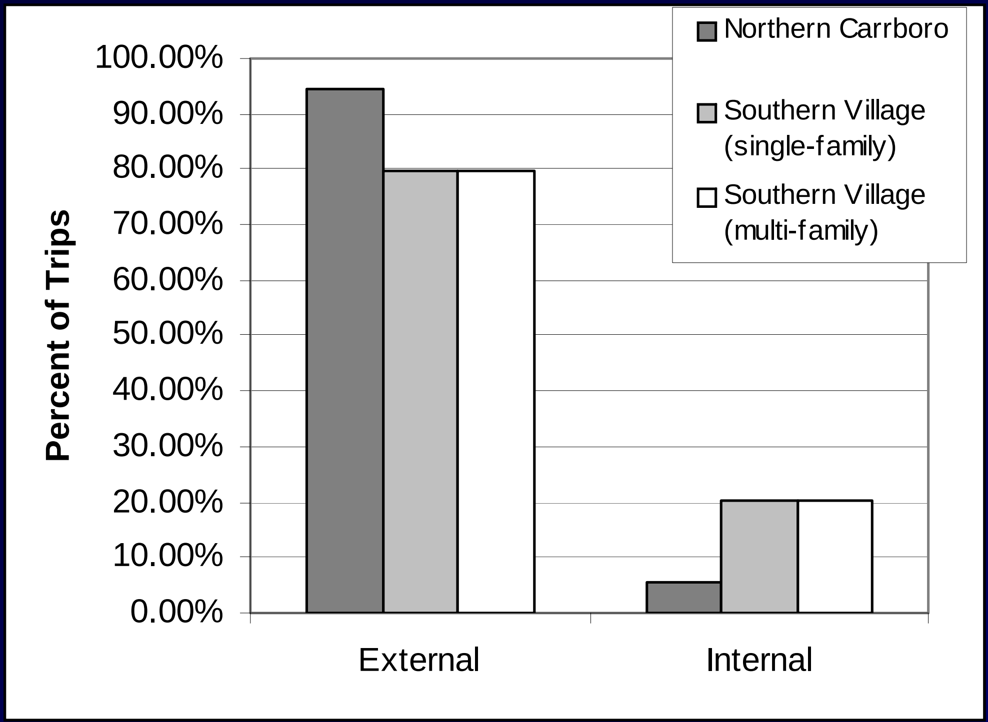
One Exception to Friendly Regulatory Environment

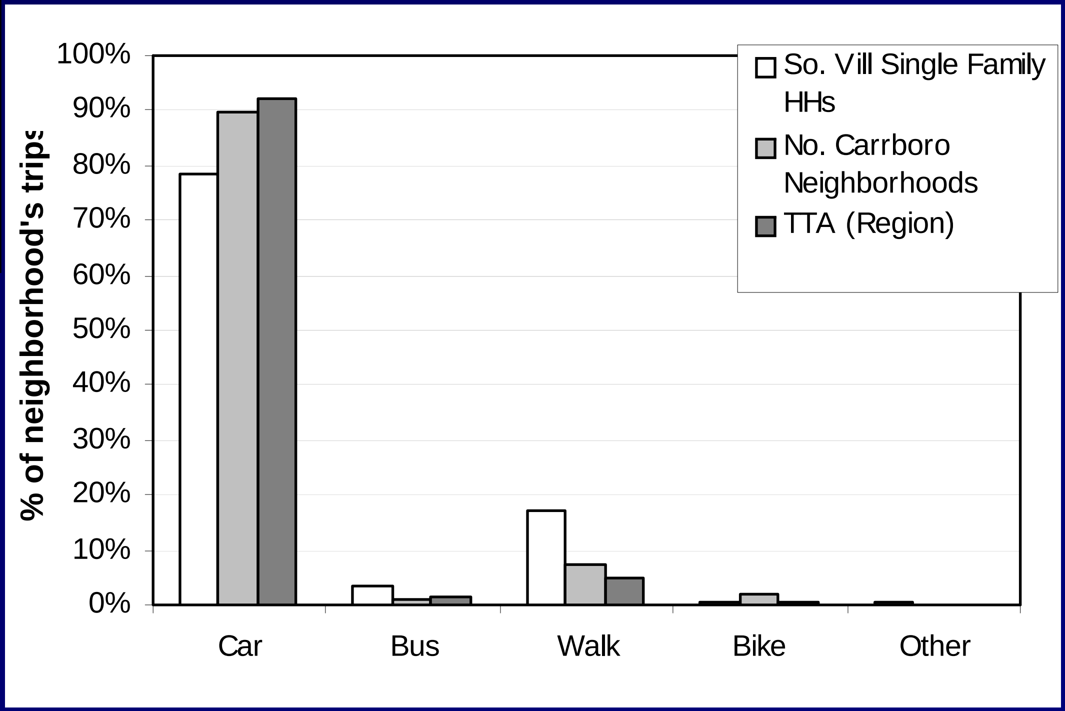
Limited Bus Service



Ped-Friendly Design

Travel Characteristics

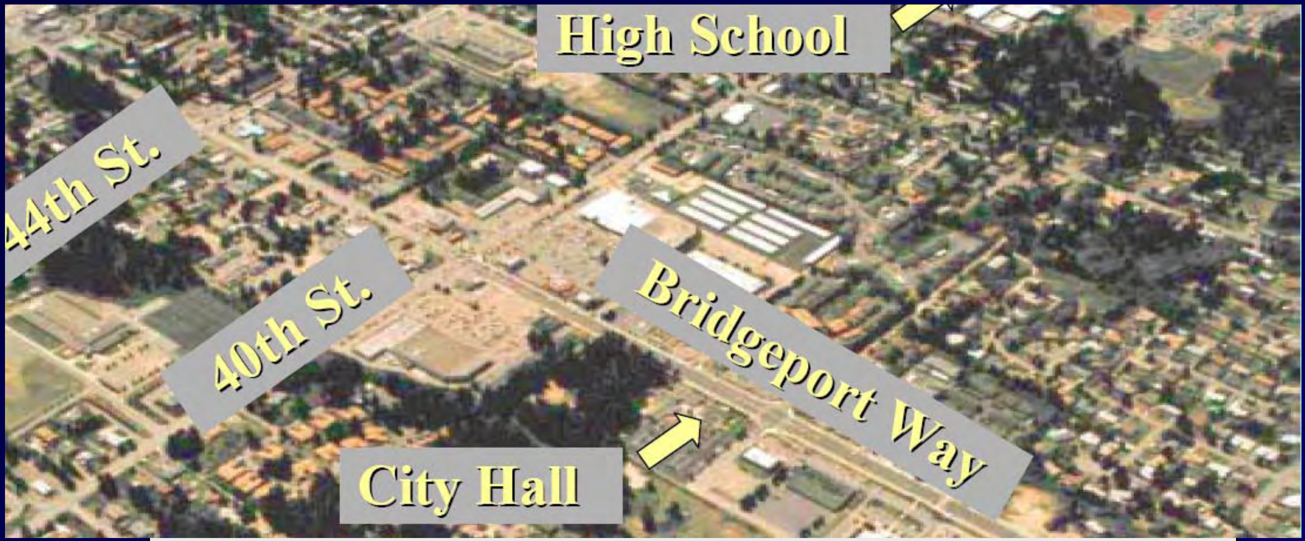




Redesigned Suburb – Public Sector Lead

Bridgeport Way/University Place

Original Conditions



Functional Class: principal arterial
Average Daily Traffic: 19,000-24,000
Through Lanes: 5
Typical Right of Way: 70-80 feet
Length of Section: 1.5 miles
Adjoining land uses: commercial, civic, offices, senior housing
Transit: highest transit volumes in Pierce County

67 Crashes per Year Before

1/3 injury crashes
1/2 right-angle collisions

Walking Before

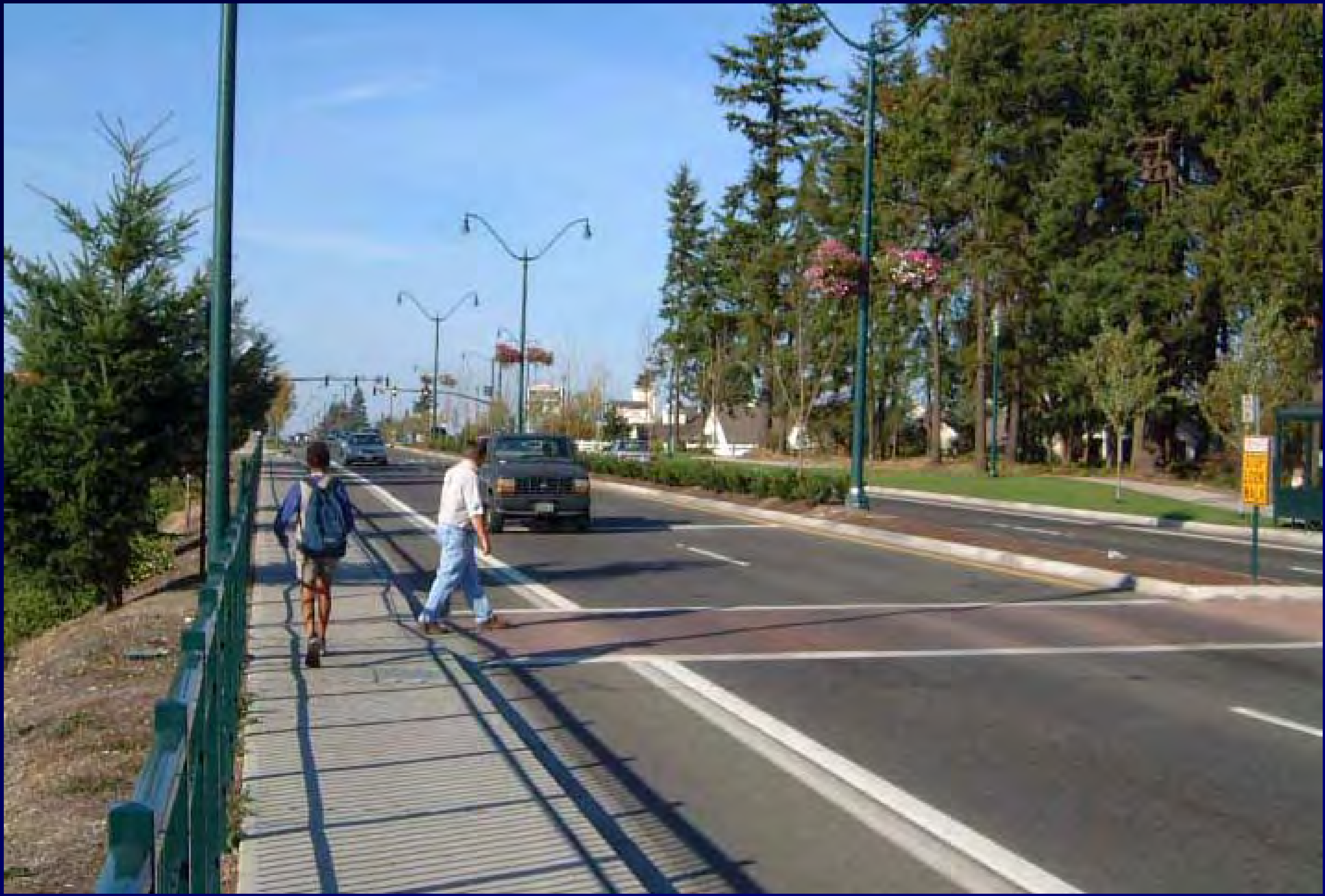
Vision

Create a main street and town center that provides residents and visitors a comfortable, convenient, efficient, safe, secure and welcoming place to shop, play, work and live.

New Street Network

Before and After

Walking After



Traffic Impacts

- ***7% Speed Reduction (35.3 -> 33.4 mph)***
- ***60% Crash Reduction (19 -> 8 in five blocks)***

Full Disclosure

Starting Point for Land Use Change

Four Years Without Development Activity

- ***Site Visits to Life Style Centers***
- ***Master Plan Charrette***
- ***Land Assembly (10 -> 15 acres)***
- ***Three Master Developers***
- ***Town Center Overlay Zoning***
- ***Proposed On-Street Parking***
- ***Intermodal Transportation Center and Streetscape Improvements***

5-Story Town Center

<u>Town Center Plan</u>
88-acre Town Center
Design standards

<u>Town Center Overlay Zone</u>
75 ft height limit
80 du/ac density cap

Final Plan

40 TH STREET W
37 TH STREET W
35 TH STREET W
Existing Retail
Existing Retail
BRIDGEPORT WAY
BRIDGEPORT WAY
Botanical Park
MARKET PLACE
DREXLER DRIVE

Redesigned City – Transportation Action Plan

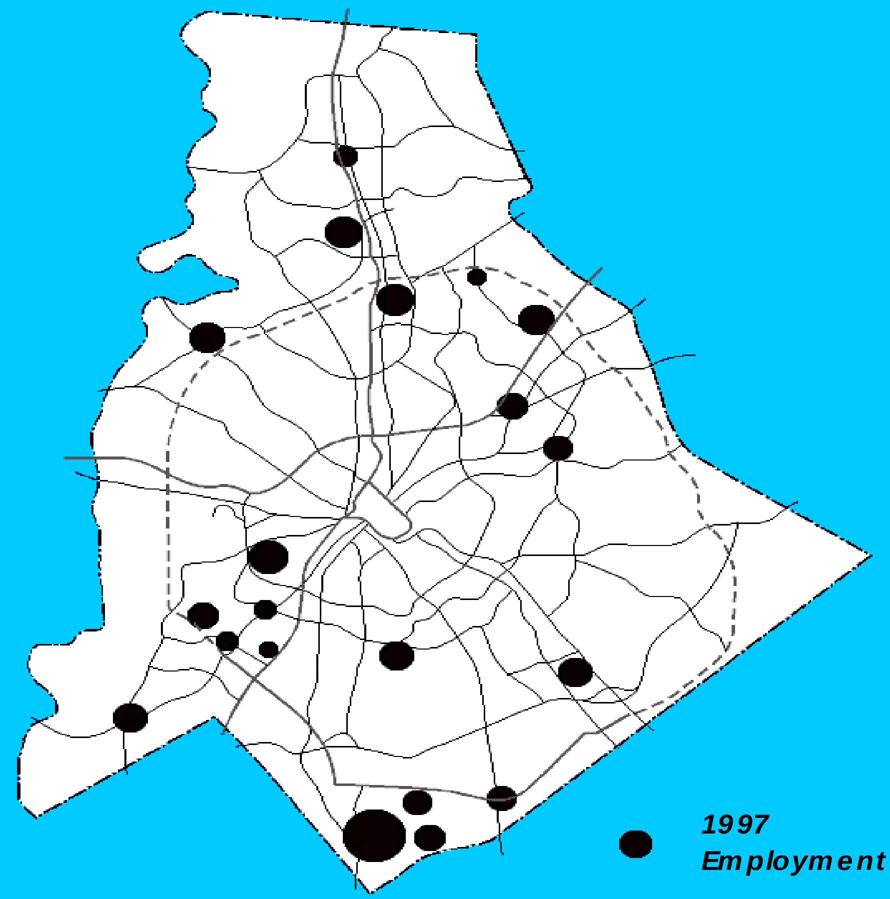
Charlotte, NC

How Does Charlotte Stack Up?

Dispersal of Jobs Out of the Corridors

Three-quarters of Pipeline outside the corridors

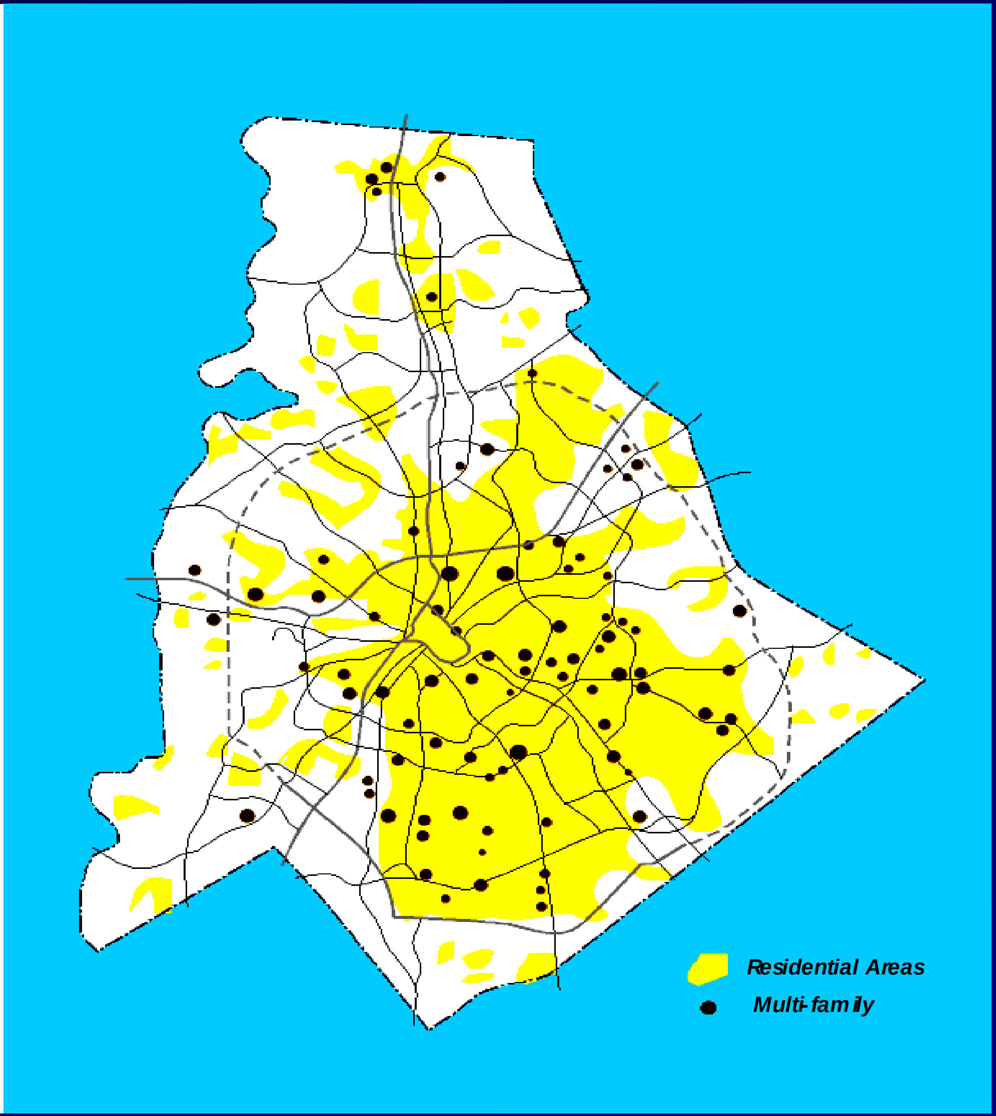
Major employment projects in the pipeline



Dispersal of Multifamily Housing

Multi-family is widely dispersed throughout C-M

Major Multi-Family development, 1998



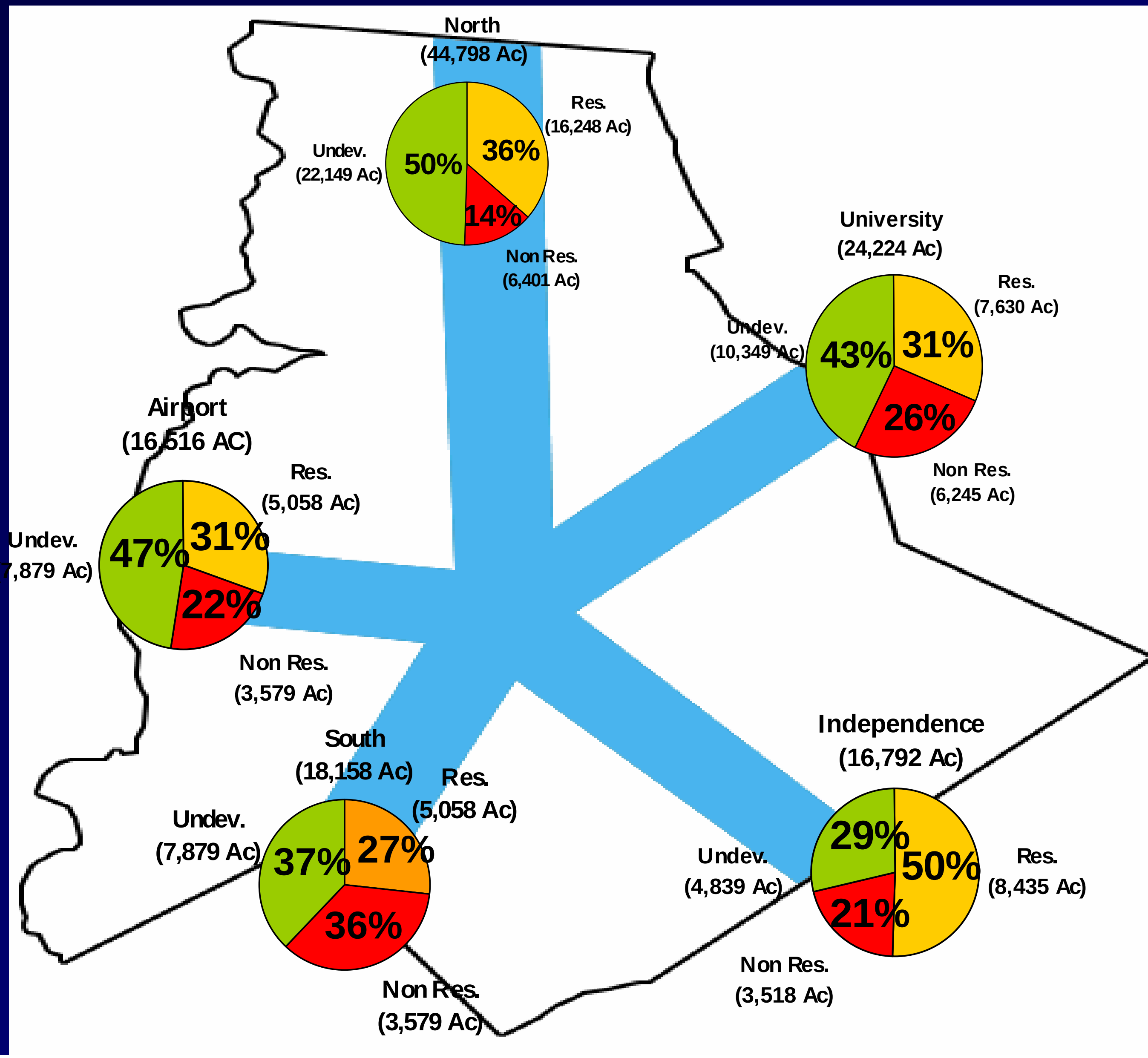
Business As Usual

- Corridor congestion increases
- Center City declines
- Jobs decentralize at low densities
- Jobs start to leave County
- Multi-family housing widely dispersed

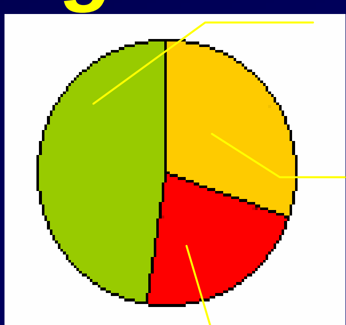
Land Use-Transit Plan Goals

- *Transit Corridors offer alternatives to auto-only access.*
- *Jobs are concentrated in corridor subcenters.*
- *Jobs stay in County.*
- *City Center continues to grow.*
- *More multi-family housing shifts to corridors*

Land Use by Corridor - 1998



Legend



Undeveloped

Residential

Non Residential

Framework for Testing Land Use Alternatives

Trends	*Jobs*	*Jobs and Housing*
Business as usual	*Focus jobs in corridors*	*Focus jobs and housing in corridors*
1	*2*	*3*

Note: Within the alternatives, various options for rail and bus were also tested.

Opportunity Area Analysis

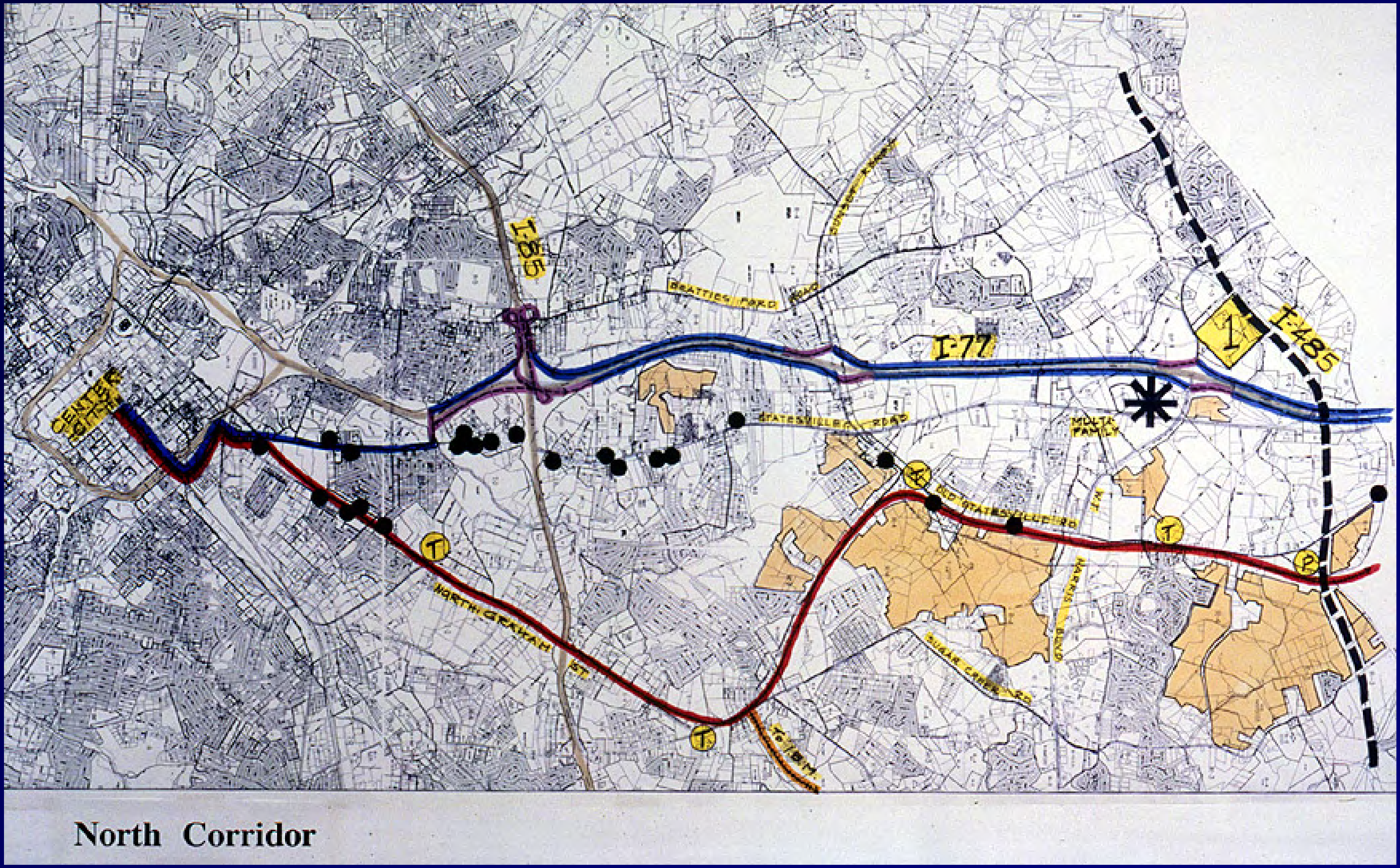
Evaluation Criteria for Developing Corridors

	Feature	Possible Score
A.	*Size*	*(30 maximum)*
B.	*Accessibility*	*(60 maximum)*
C.	*Visibility*	*(10 maximum)*
		Total Score: (100 maximum)

Rankings Based on Scores:

A = 80	*points*
B = 70-79	*points*
C = 60-69	*points*
D = 50-59	*points*
E = Below 50	*points*

Opportunities in North Corridor



Job Shifts by Transit Corridor

Corridor	1997	Trend 2025	Plan 2025
North	57,300	90,400	109,100
University	28,900	43,500	53,700
Independence	45,900	52,900	57,900
South	45,100	52,800	78,300
Airport	20,500	24,600	29,300
Center City	58,800	74,400	90,300
Total	**256,500**	**338,600**	**418,600**

Defined as one mile centered on transit line

Housing Shifts by Transit Corridor

Corridor	1997	Trend 2025	Plan 2025
North	16,700	32,500	37,400
University	7,000	10,600	12,500
Independence	14,600	18,900	19,600
South	11,400	16,600	18,500
Airport	3,900	4,600	5,200
Center City	2,800	7,900	12,500
Total	**56,400**	**91,100**	**105,700**

Defined as one mile centered on transit line

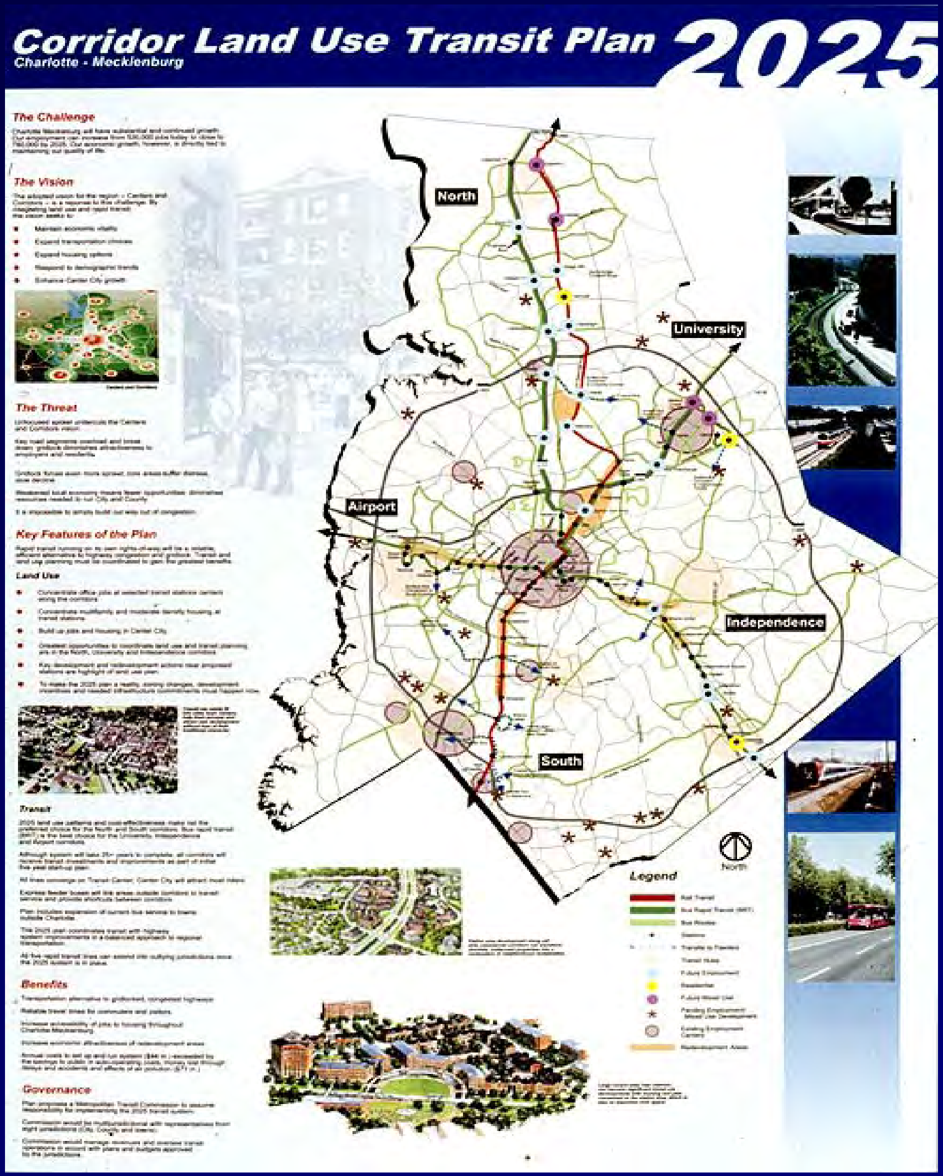
Ridership Forecast: Triangulation

- ***CM-DOT's 4-step method: input to cross-classification estimates modified to reflect lower vehicle ownership rates in TODs***

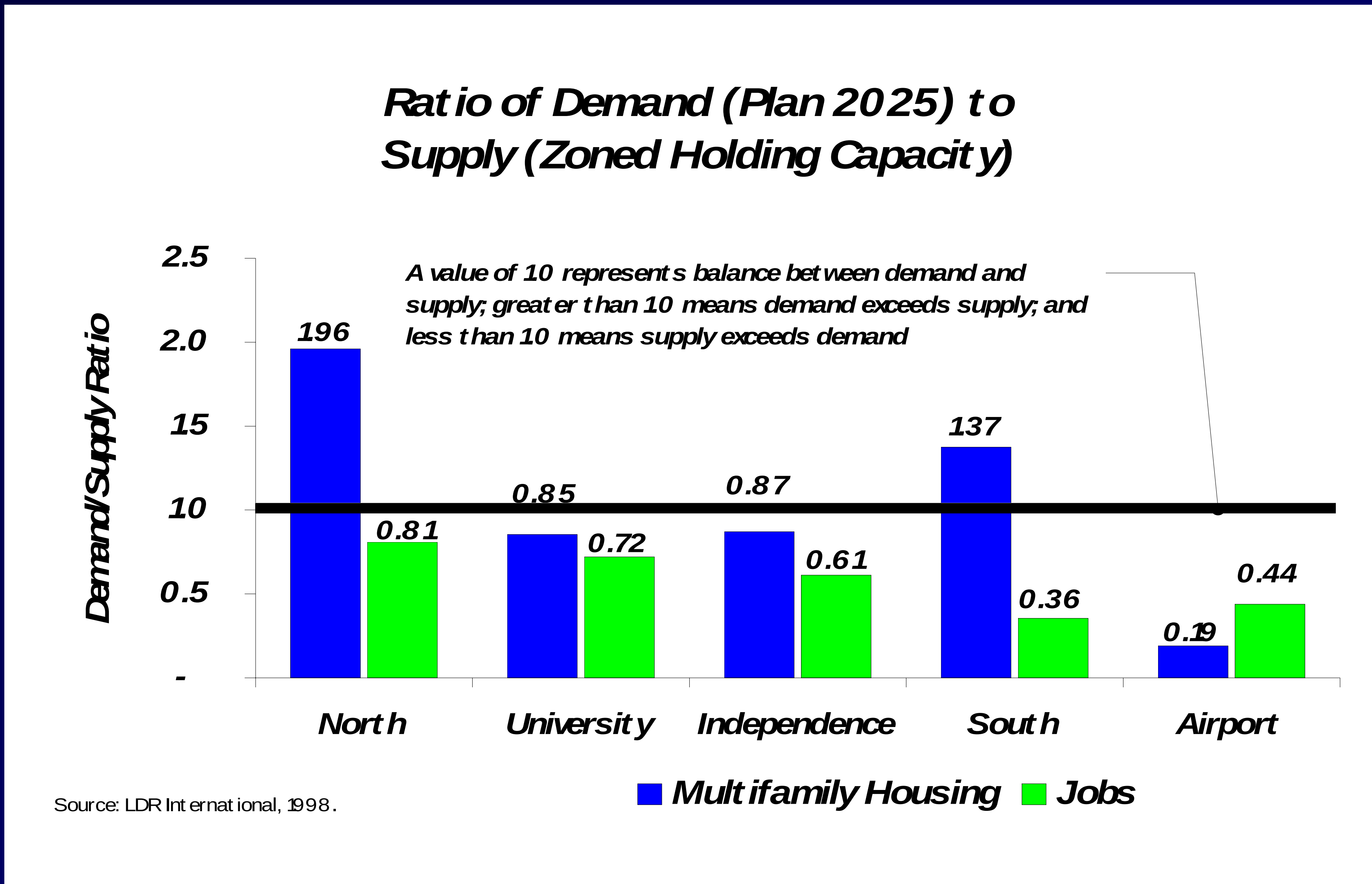
- ***TCRP H-1 Model: Estimated station boarding based on 314 LRT station across nine North American cities***

- ***Post process: non-home end; bus rapid transit; sensitivity testing***

Went to Voters



Need for Rezoning



Station Types

- ***Existing/Limited Infill***
- ***Redevelopment***
- ***New Residential***
- ***New Employment***
- ***New Mixed Use***
- ***Park & Ride Facilities City Center***

Transit-Oriented Research Park

New Transit Districts

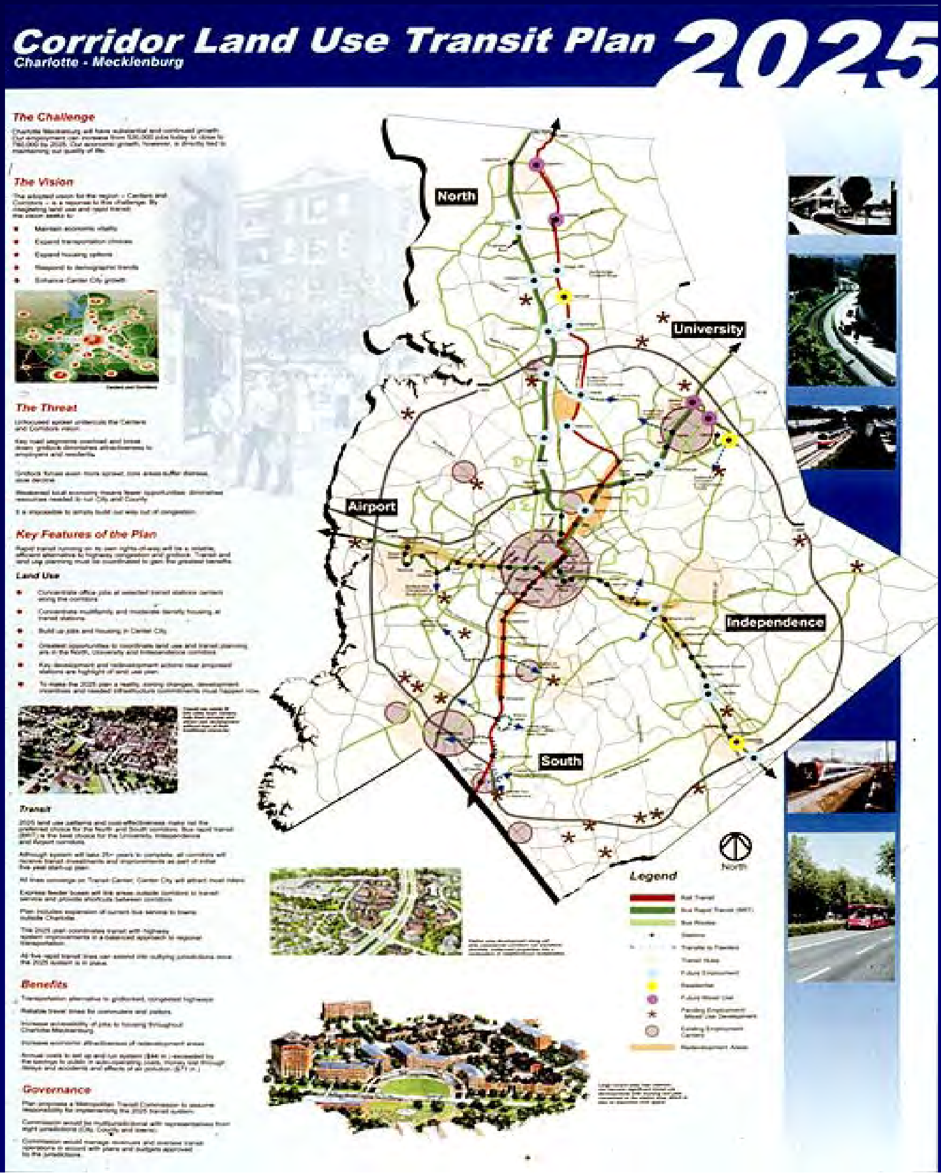
- ***Minimum Densities for Station Areas***
- ***High Maximum Densities by Station Area***
- ***Administratively Approved Site Plans***
- ***Explicit and Strong Design Standards***
- ***Accessory Apartments by Right***
- ***Lower Parking Standards***
- ***Reduced LOS Standards in Station Areas***
- ***Reduced Building Setbacks***
- ***Reduced Transitional Setbacks***

Incentives for TDs

- ***Joint Development Projects***
- ***Tax Increment Financing (if Authorized)***
- ***Assistance with Land Assembly***
- ***Streamlined Permitting Process***
- ***In-Kind Services***
- ***Lower or Delayed Development Fees***
- ***Eligibility for Energy-Efficient Mortgages***
- ***Employee Ridersharing Incentives***

Centers and Corridors

Went to Voters



Station Area Planning

New Zoning Districts

- ***Transit-Oriented Development Zoning Districts***
- ***Transit-Supportive Development Zoning Districts***

Incentives for TDs

- ***Joint Development Projects***
- ***Tax Increment Financing (if Authorized)***
- ***Assistance with Land Assembly***
- ***Streamlined Permitting Process***
- ***In-Kind Services***
- ***Lower or Delayed Development Fees***
- ***Eligibility for Energy-Efficient Mortgages***
- ***Employee Ridersharing Incentives***

Transportation Action Plan

- ***Connectivity Program***
- ***Revised Subdivision Ordinance***
- ***Thoroughfare/Collector Map***
- ***Bikeway Map***
- ***New Street Standards***
- ***Traffic Calming Guidelines***

New Street Standards

Table 3.2 Correspondence between Functional Classification and Thoroughfare Type

Functional Classification	FREEWAY/EXPRESSWAY/ PARKWAY	RURAL HIGHWAY	BOULEVARD	AVENUE	STREET	RURAL ROAD	ALLEY/REAR LANE
	Thoroughfare Types						
PRINCIPAL ARTERIAL	■	■	■	■			
MINOR ARTERIAL			■	■			
COLLECTOR				■	■		
LOCAL					■	■	■

Shaded cells represent thoroughfare types which are not addressed in the design guidance.

■ Correspondence between Functional Class and Thoroughfare Type

Road Diet Projects

Traffic Calming

Call Ian