Using the Geodesign to Model Development Trends in Upstate South Carolina

A Template for GeoDesign and Comprehensive Planning

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Outline

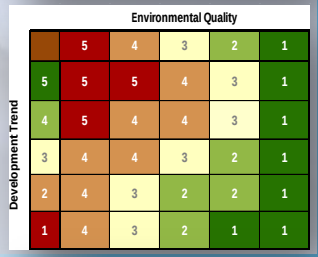
- **The Geodesign Process**
- **Process Modeling**
  - § Land Use and Environment
- **Growth Models**
  - § Development Trends
  - § 2030 Vision Plan
- **Future Planning**
  - § The Competition for Land
- **3D Modeling**

Clemson Planning, Development and Preservation Department

- **Emphasis on land use development**
- **Taught planners, landscape architects and developers**
- **Address the urban and rural transition of the Upstate**
  - The Geodesign process
  - Design and quantitative assessment
- **Worked with Ten at the Top**
  - Greenville /Spartanburg region
  - 10 Upstate counties
  - Seneca and Lake Keowee

Spatial Modeling

Visualization for Spatial Thinkers



Development Trend \ Environmental Quality					
	5	4	3	2	1
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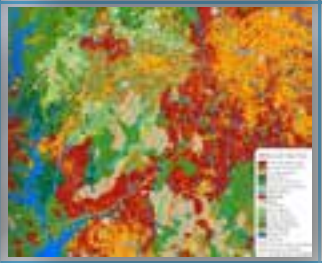
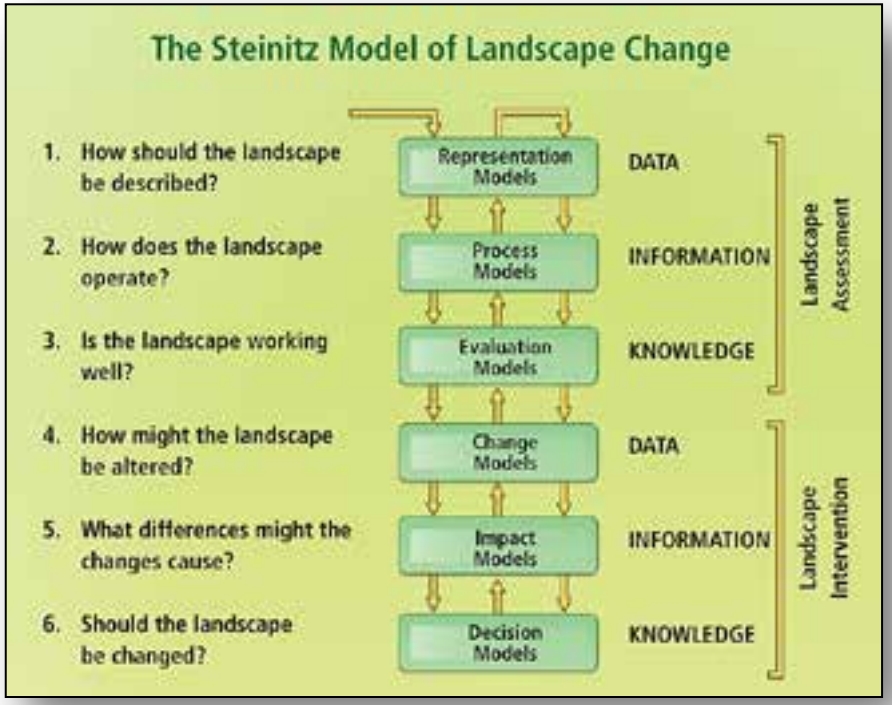


The Geodesign Process

- **Followed Carl Steinitz's Alternative Futures for Changing Landscapes**
  - § Developed over 3 decades from his original work at Harvard
- **Developed deterministic models for landscape analysis and urban planning**
  - § Built the database or Representation
  - § Find the Process for development and environmental patterns
  - § Developed growth scenarios
    - Forecast population and employment
    - Change Models
  - § Competition for Land
    - Evaluate the Impacts
  - § Downtown Seneca
    - The design is a Decision model
- **Used with Ten at the Top**



Source: Esri Press

Spatial Modeling

- **Deterministic Models**
  - Models having no random components
  - A given input always produces the same output
- **Stochastic Models**
  - Models whose output is described by a probability distribution
- **Suitability Models Verses Climate Change Models**

Goodchild, 1993

Computer Models

- **Human verses Computer**
  - To much emphasis on the machine doing it all
  - It is better to look at a combination of both
- **Humans are stronger at understanding spatial patterns than computers**
- **Models should not be a black or gray box**
  - Models must be understood and easily explained
    - Fred Smith, Harvard University (1974)
- **Models are really visualization tools for discussion**

Designing for the Future

Deterministic Modeling

Development Trend \ Environmental Quality					
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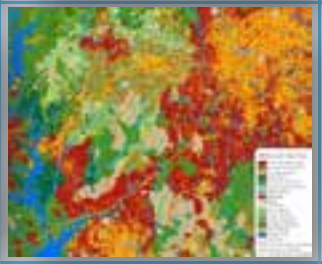
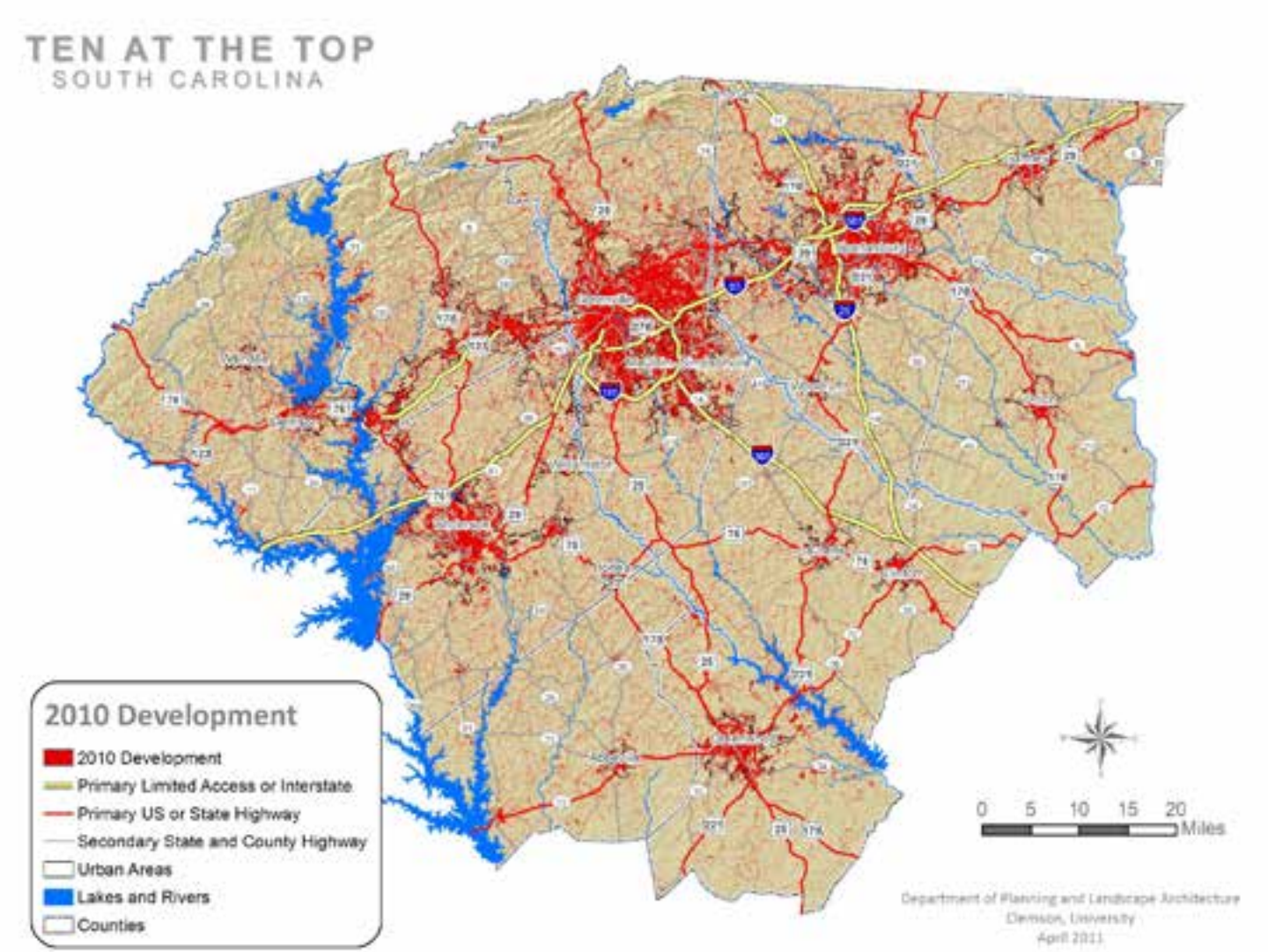


2010 Development



Process Models

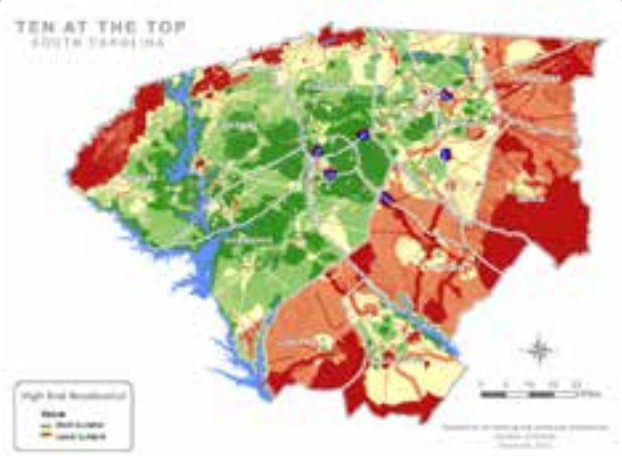
Development / Opportunities

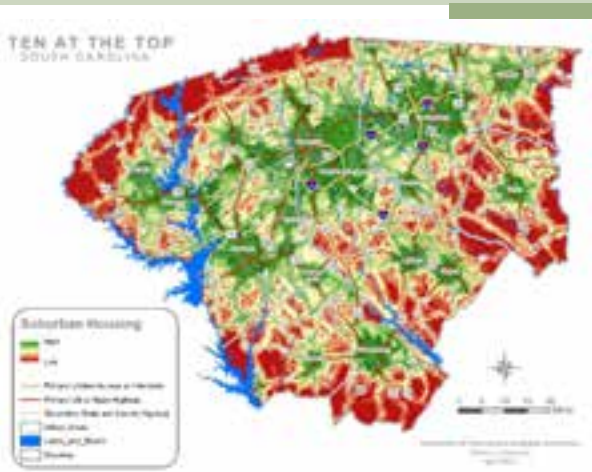
- **The models explore the criteria underlying land use location**
- The models explored:
  - High-end residential
  - Suburban residential
  - Rural residential
  - Mixed Use
  - Commercial
  - Industrial

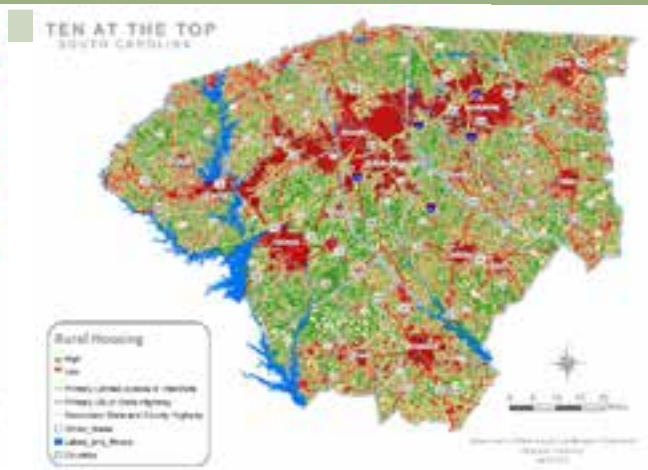
Environment / Constraints

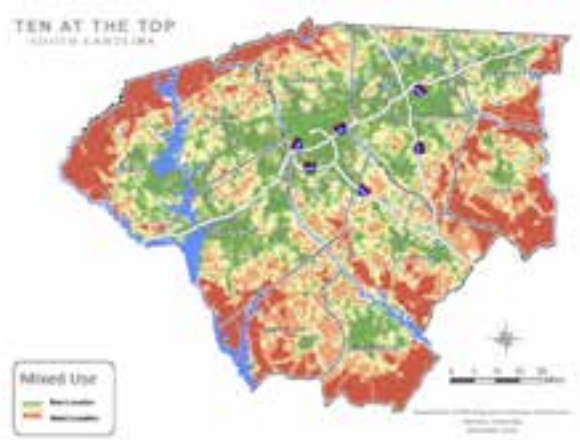
- **The models explore the constraints of the natural environment**
- **The models explored:**
  - Agriculture Preservation
  - Surface Water Quality
  - Groundwater Quality
  - GAP Analysis
  - Viewshed Analysis

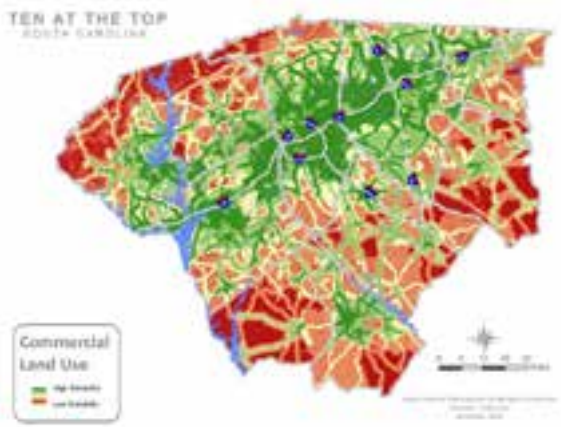
Development Models



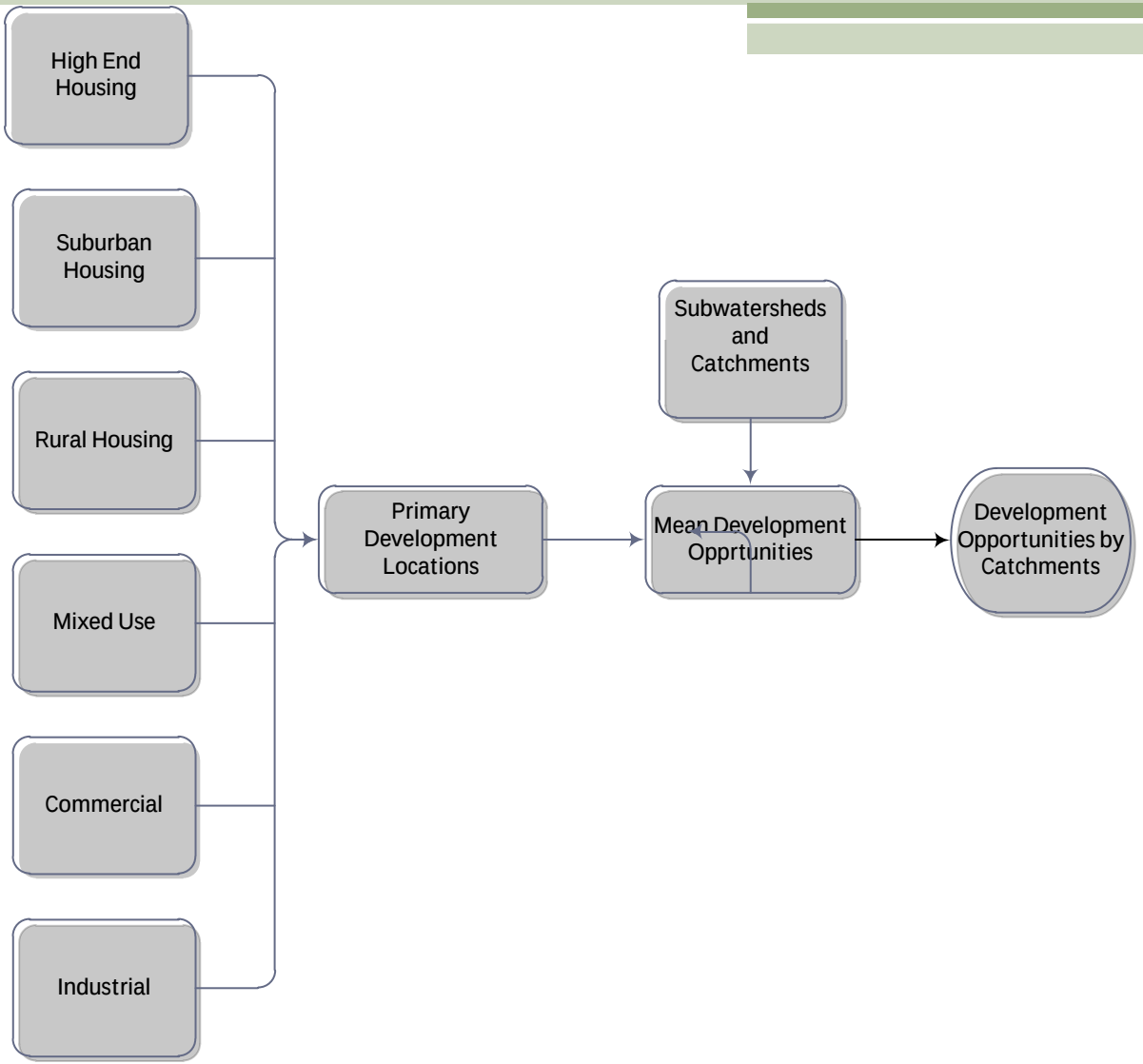




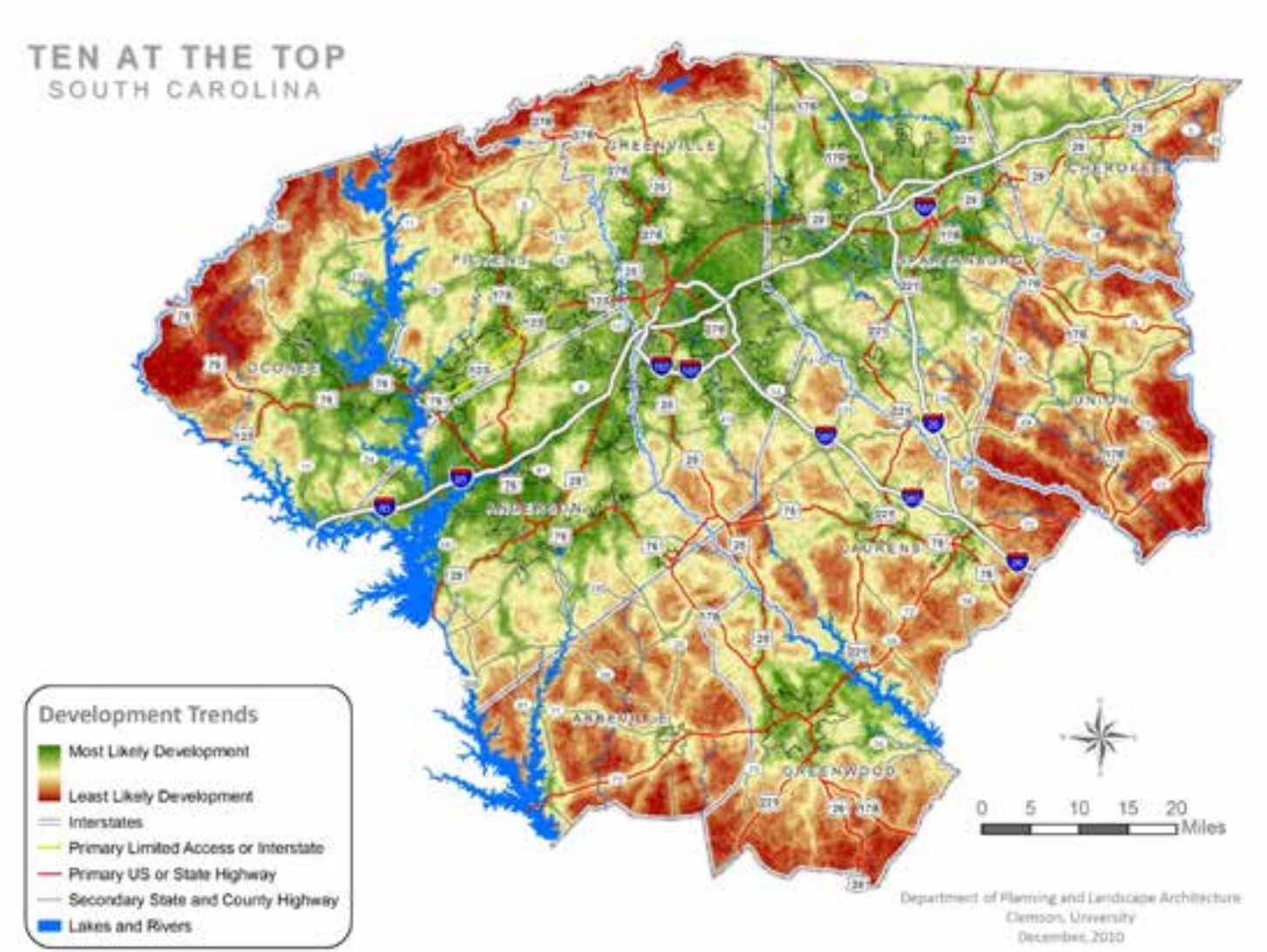




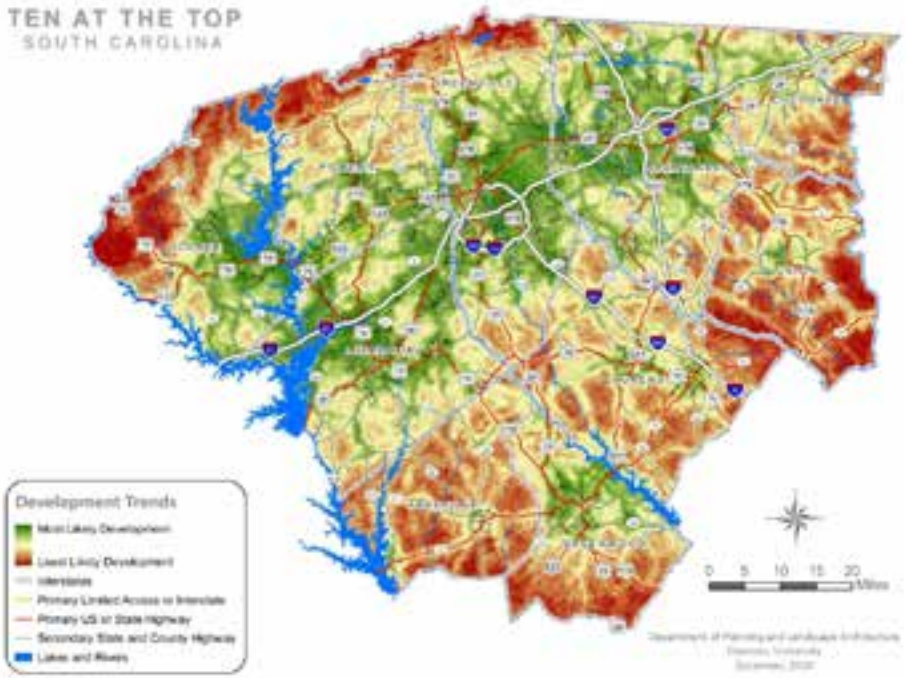
Final Development Model

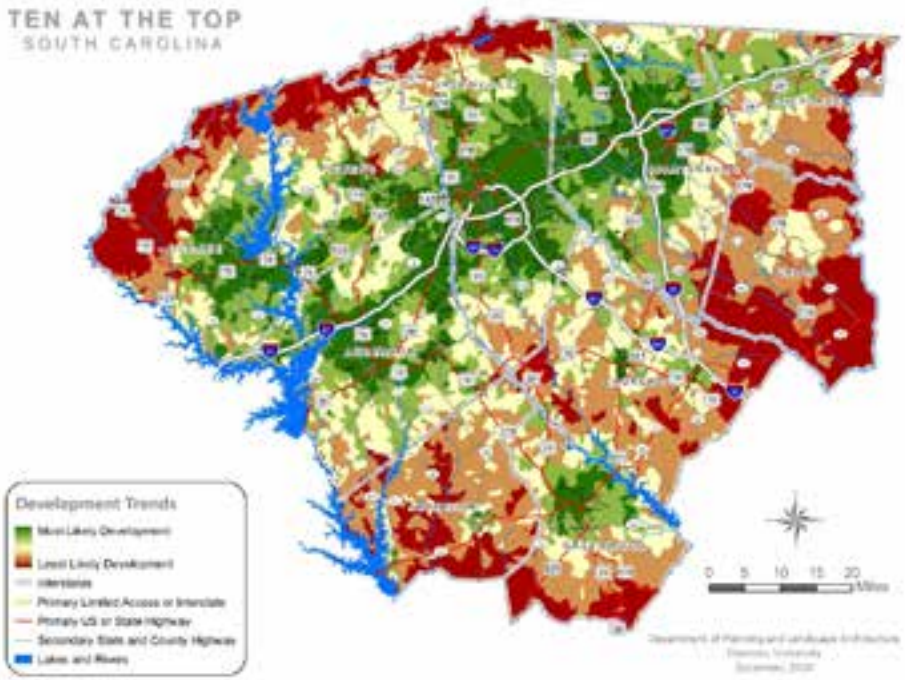


Development Trends

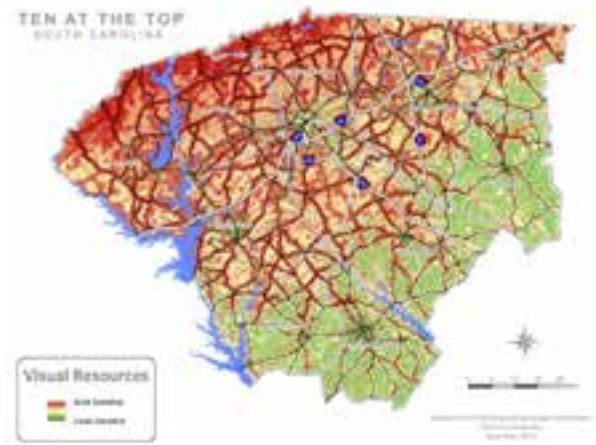


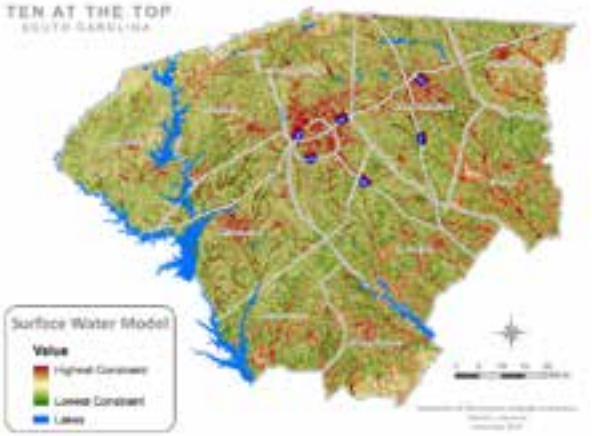
Raster to Vector – Catchment Level

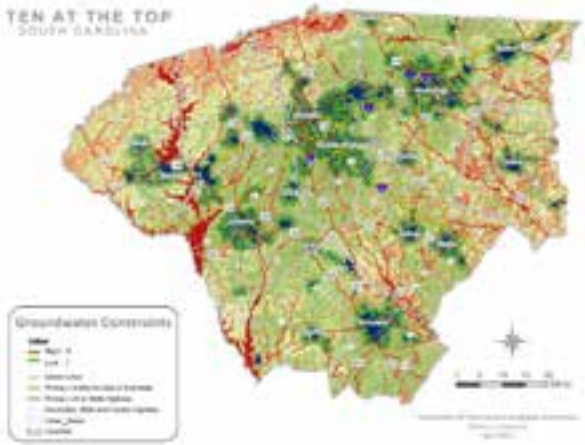




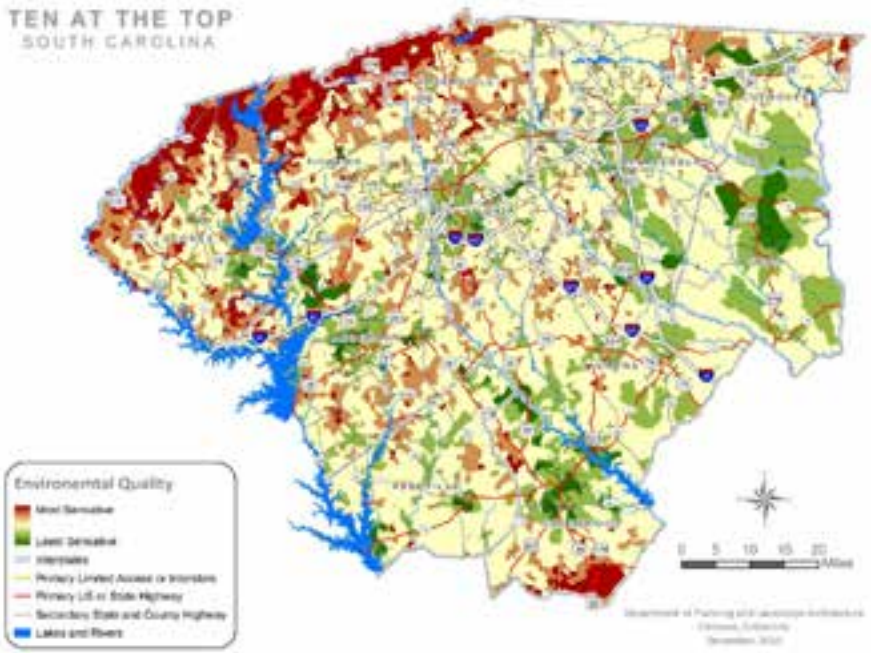
Environmental Models





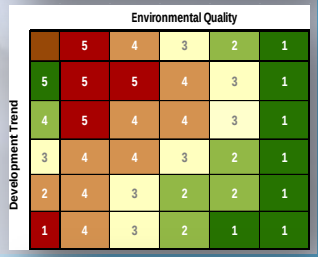


Environmental Constraints by Catchments



Change Models

Scenario Planning



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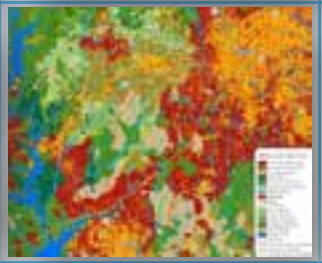


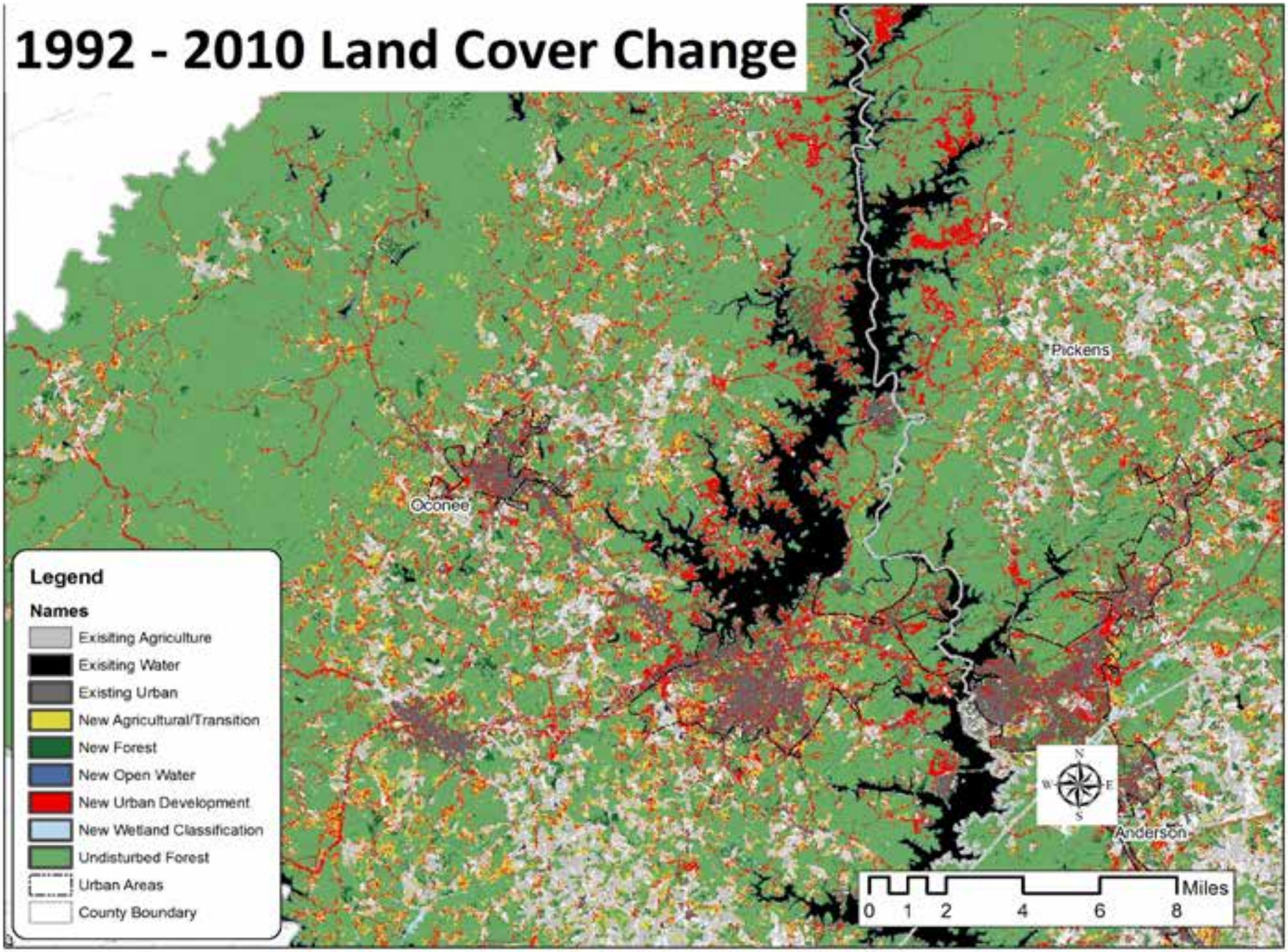
The Upstate From 2010 - 2030

	2010	2030	Change
Households	550,000	700,000	150,000
Jobs	750,000	950,000	200,000
Residents	1,350,000	1,620,000	270,000
Employ/pop	55.6%	58.6%	
HH Size	2.45	2.31	

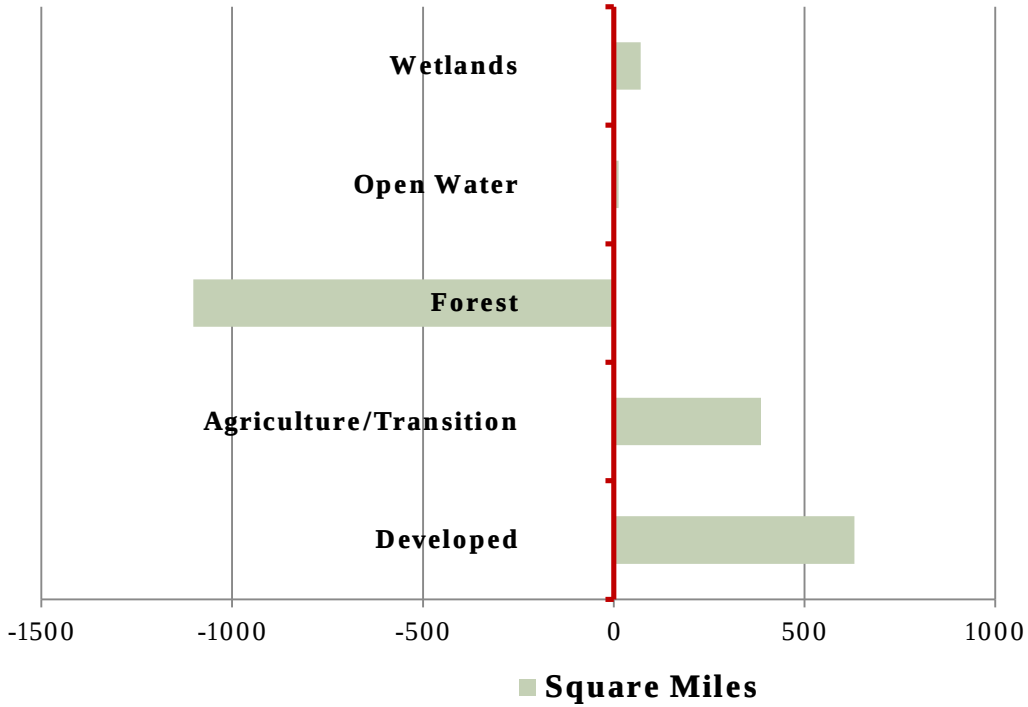
- *Located in the fifth most sprawling metropolitan region in the United States*
  (Ewing et. al., 2002)

- *Actual Census figures are:*
  - *1,362,000 population*
  - *532,000 households*

1992 - 2010 Land Cover Change

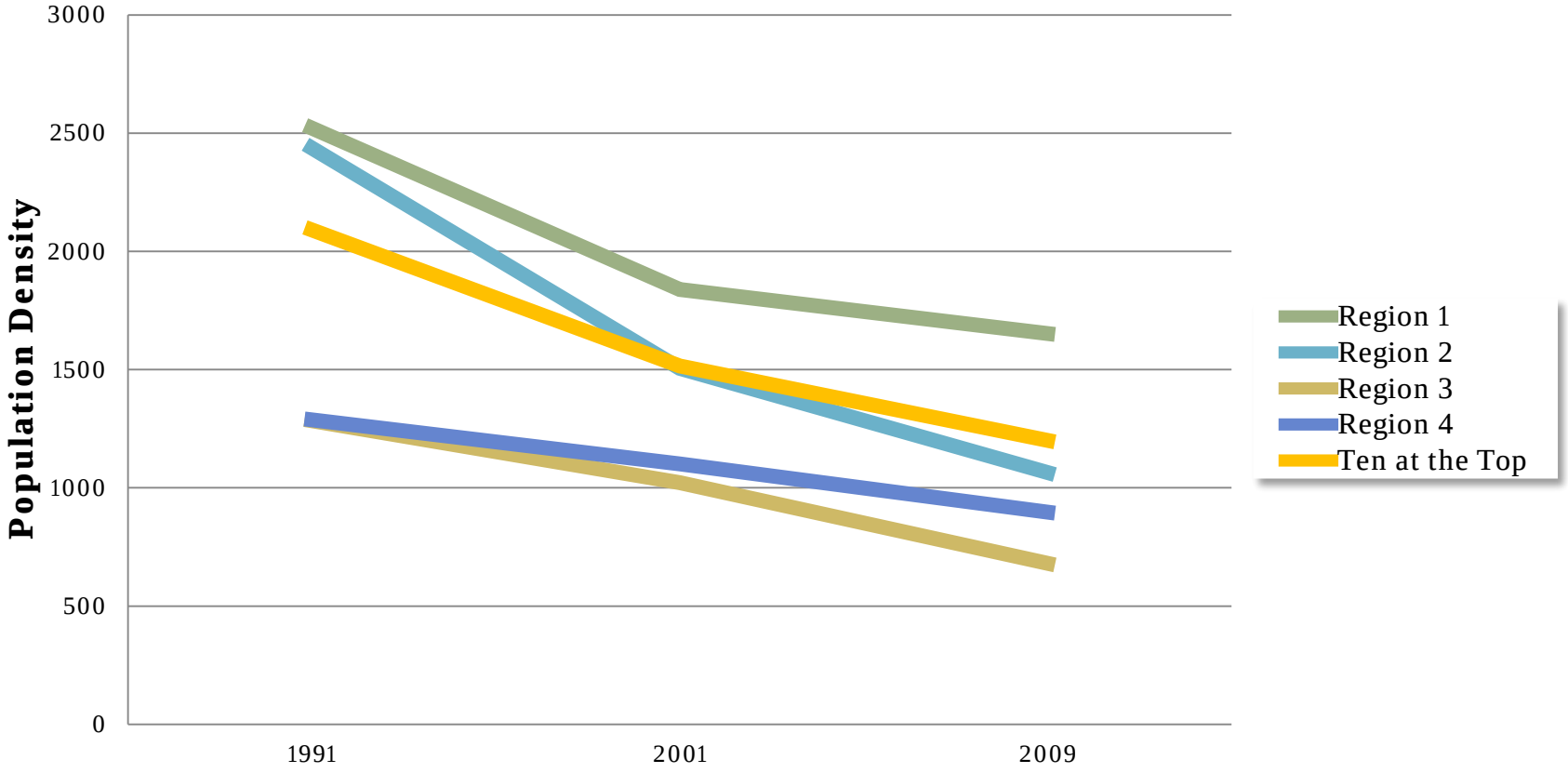


Lost Forest Land Since 1992



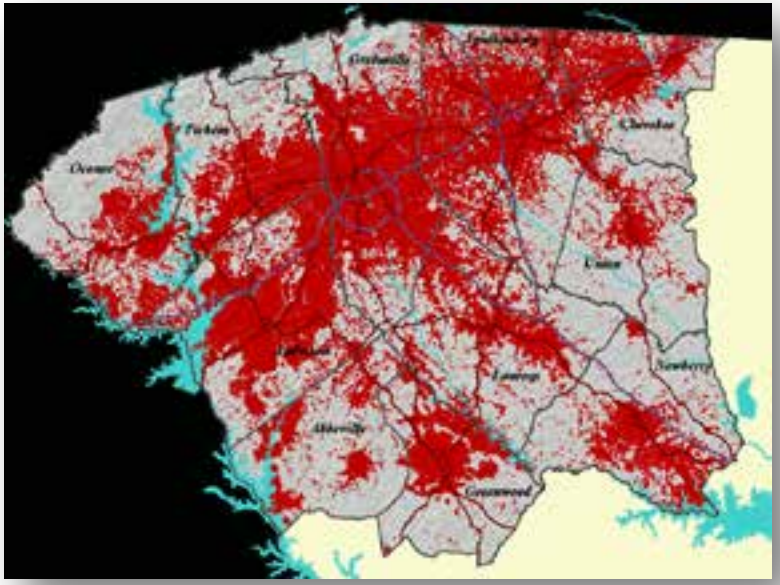
- Lost forest land is nearly the combined size of Greenville and Cherokee Counties

Population Density Trend

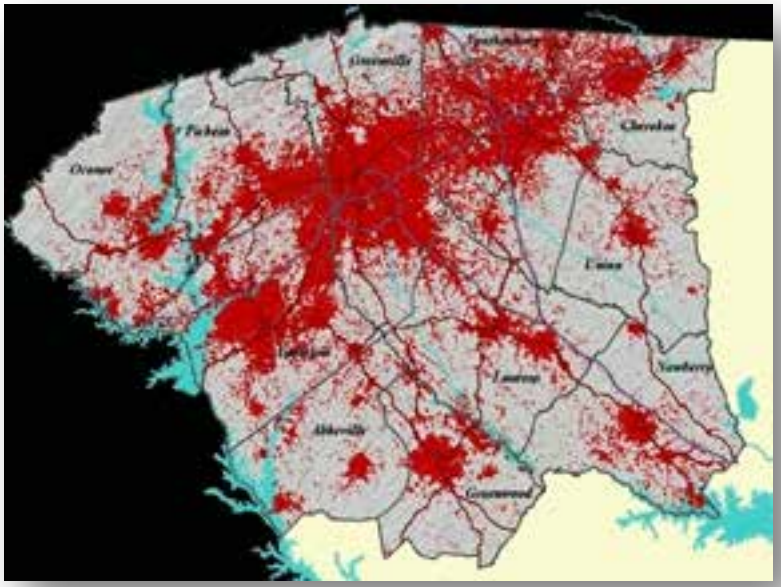


Planning for our Future – Reduce Land Consumption

***59%** of survey participants called for at least 40% reduction in land consumption over next 20 years*

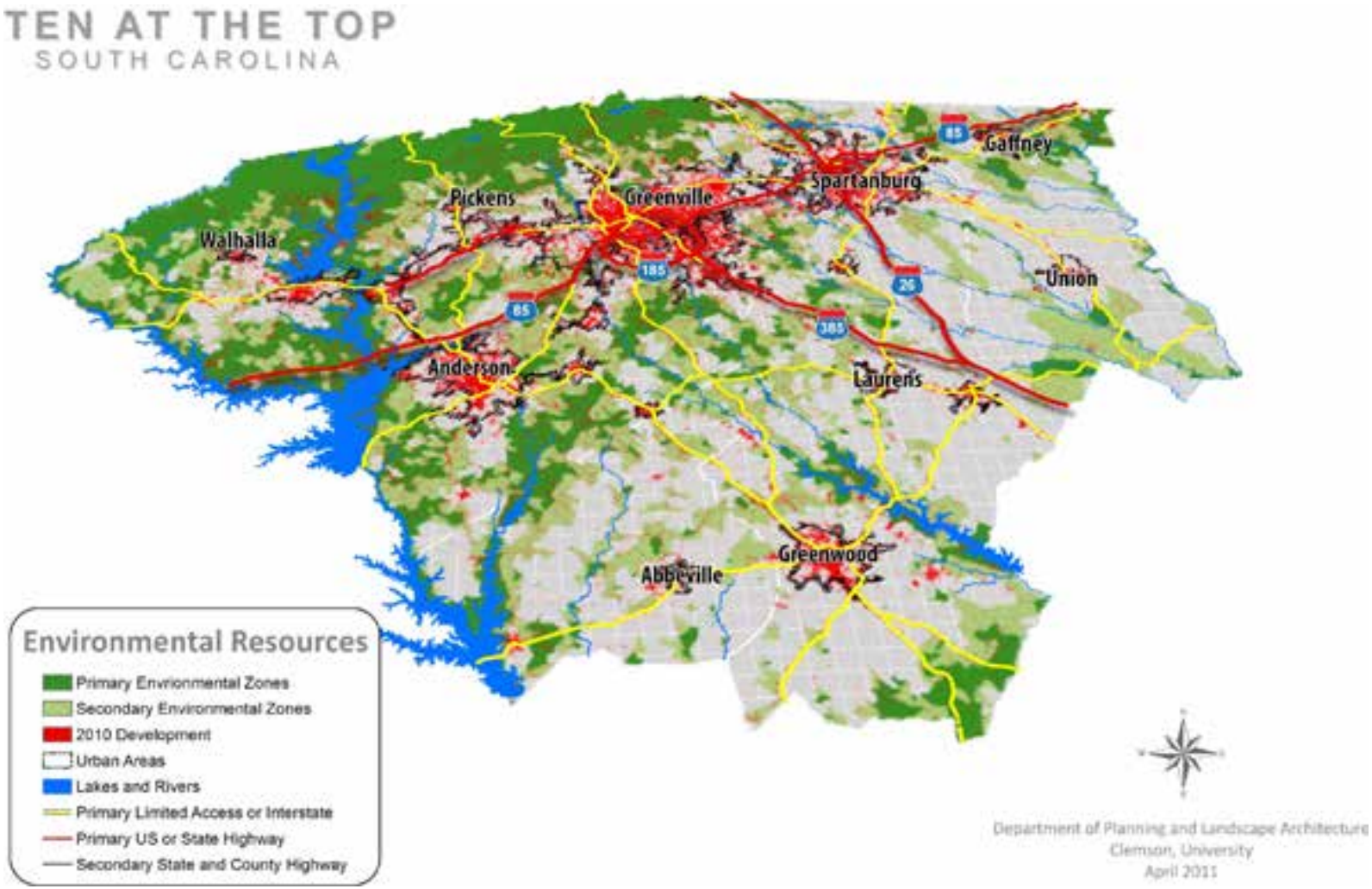


Trend

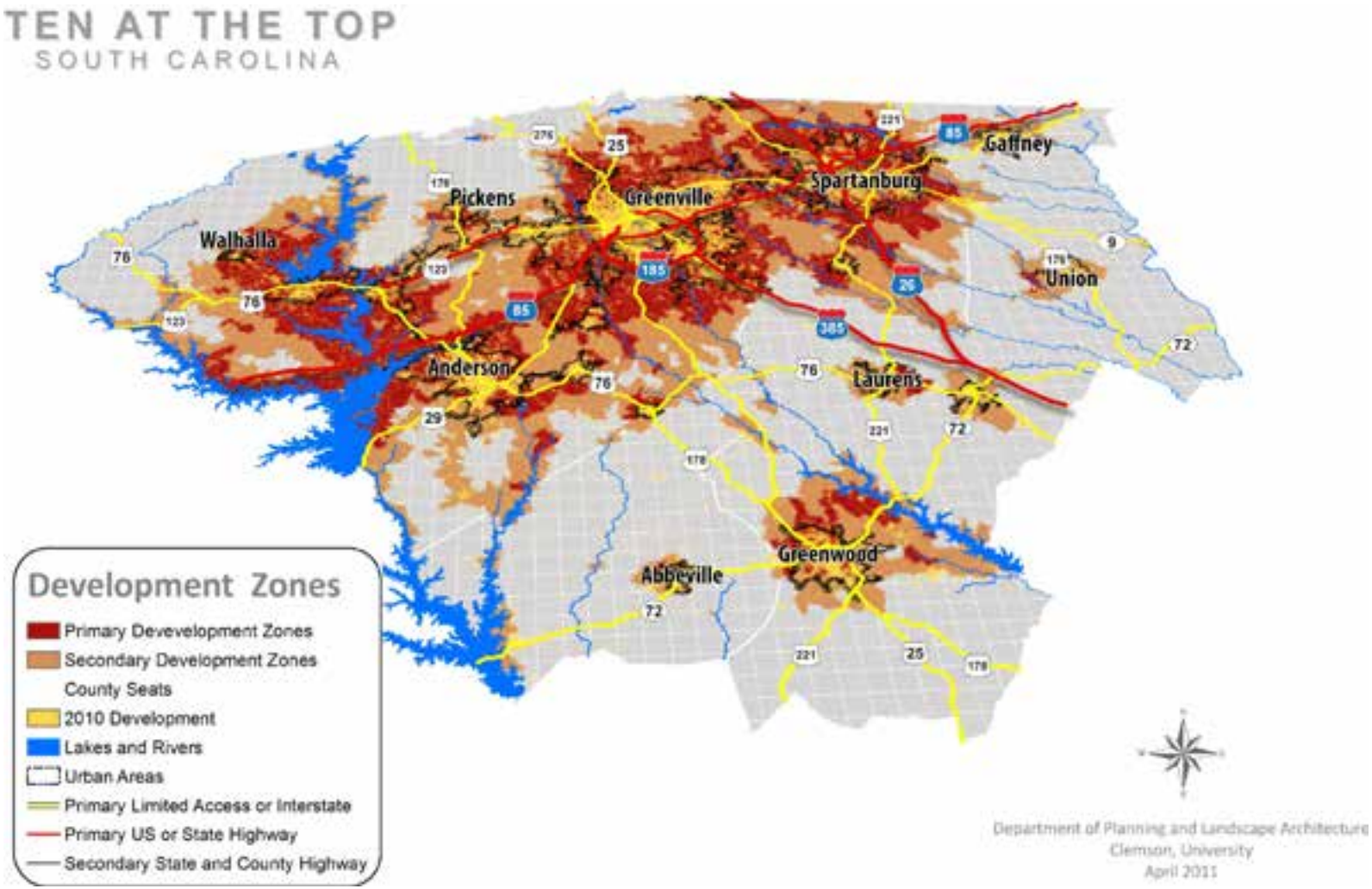


40% reduction in land used for new development

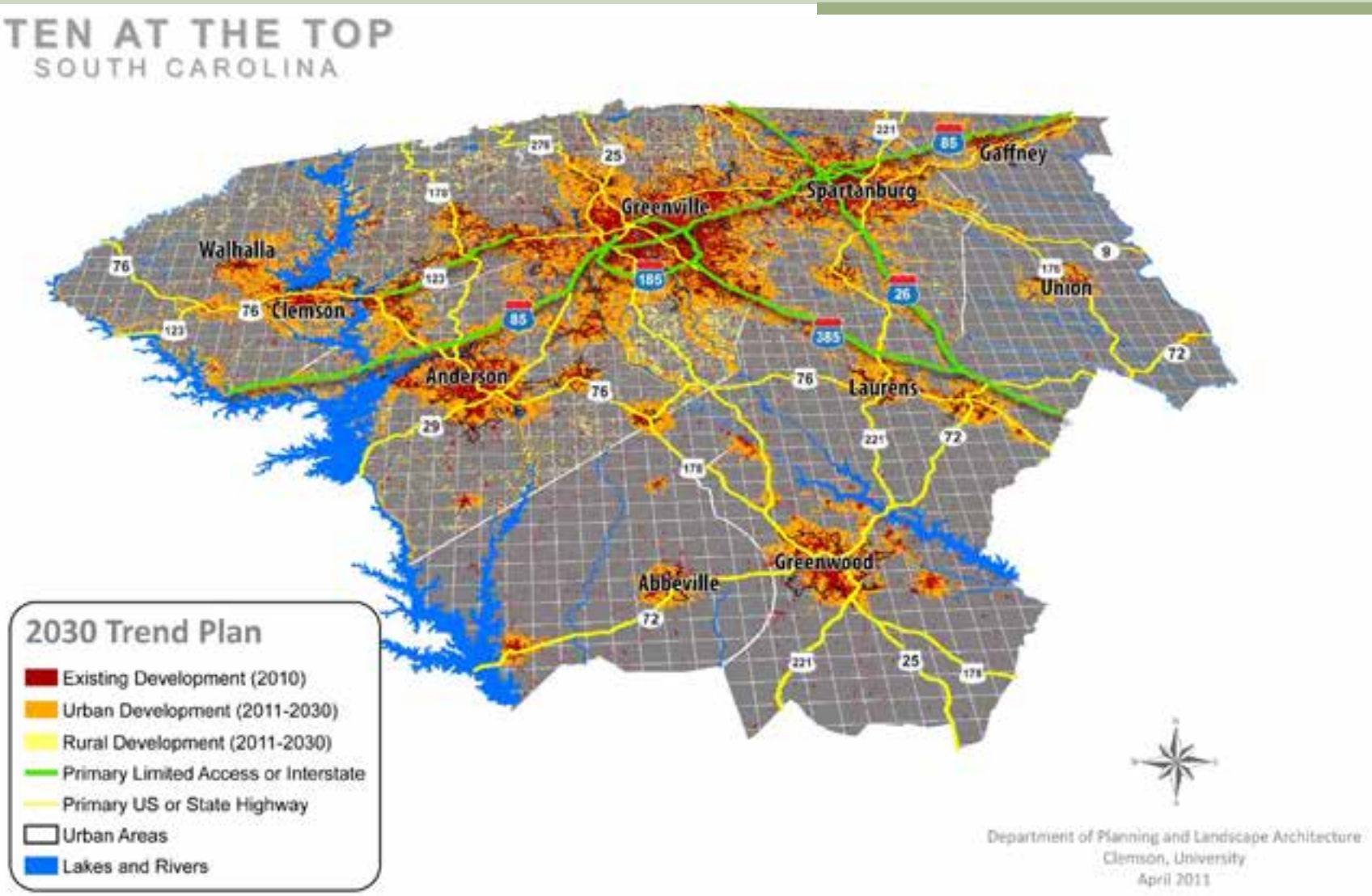
Environmental Resources



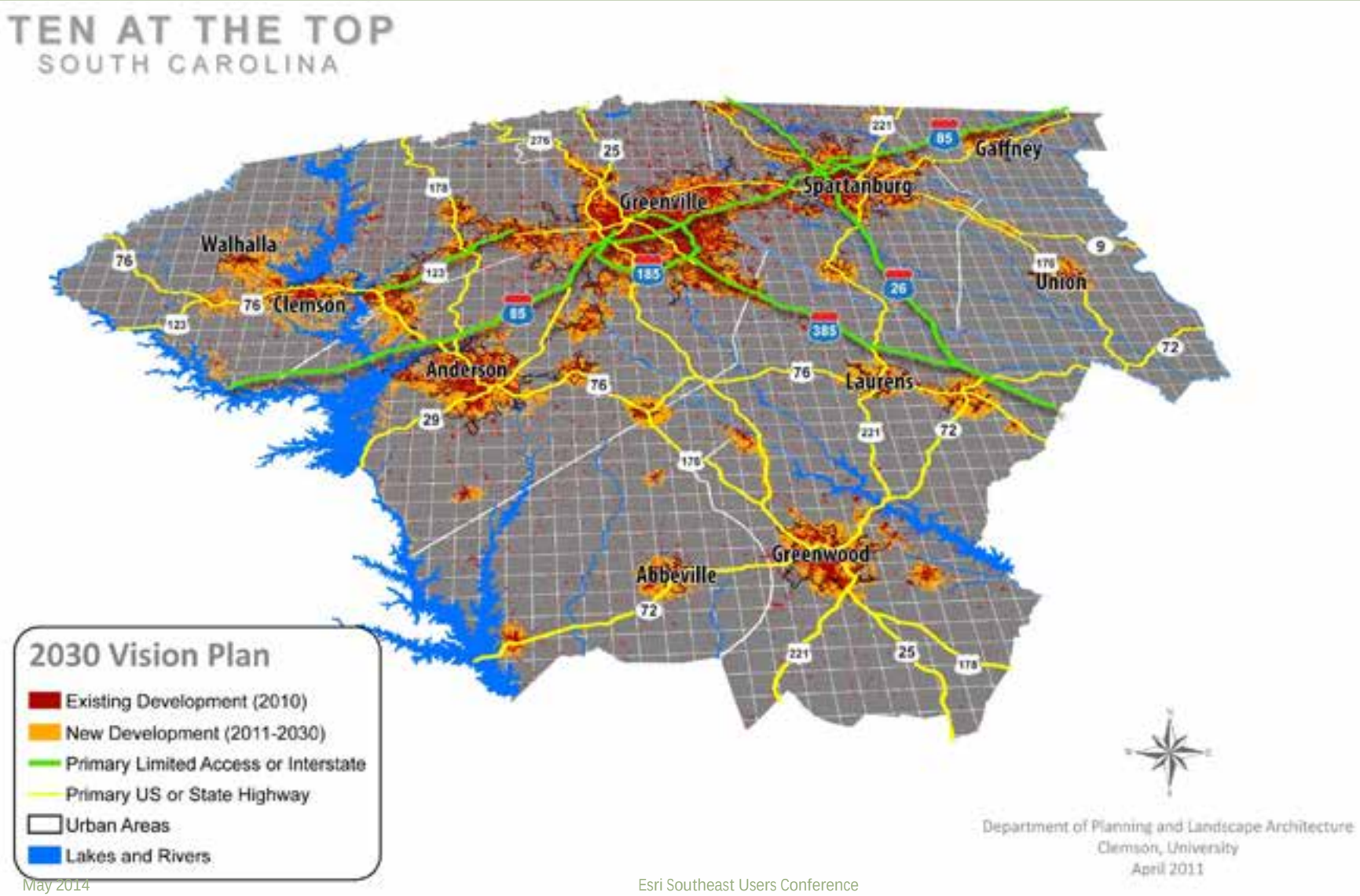
Development Trends



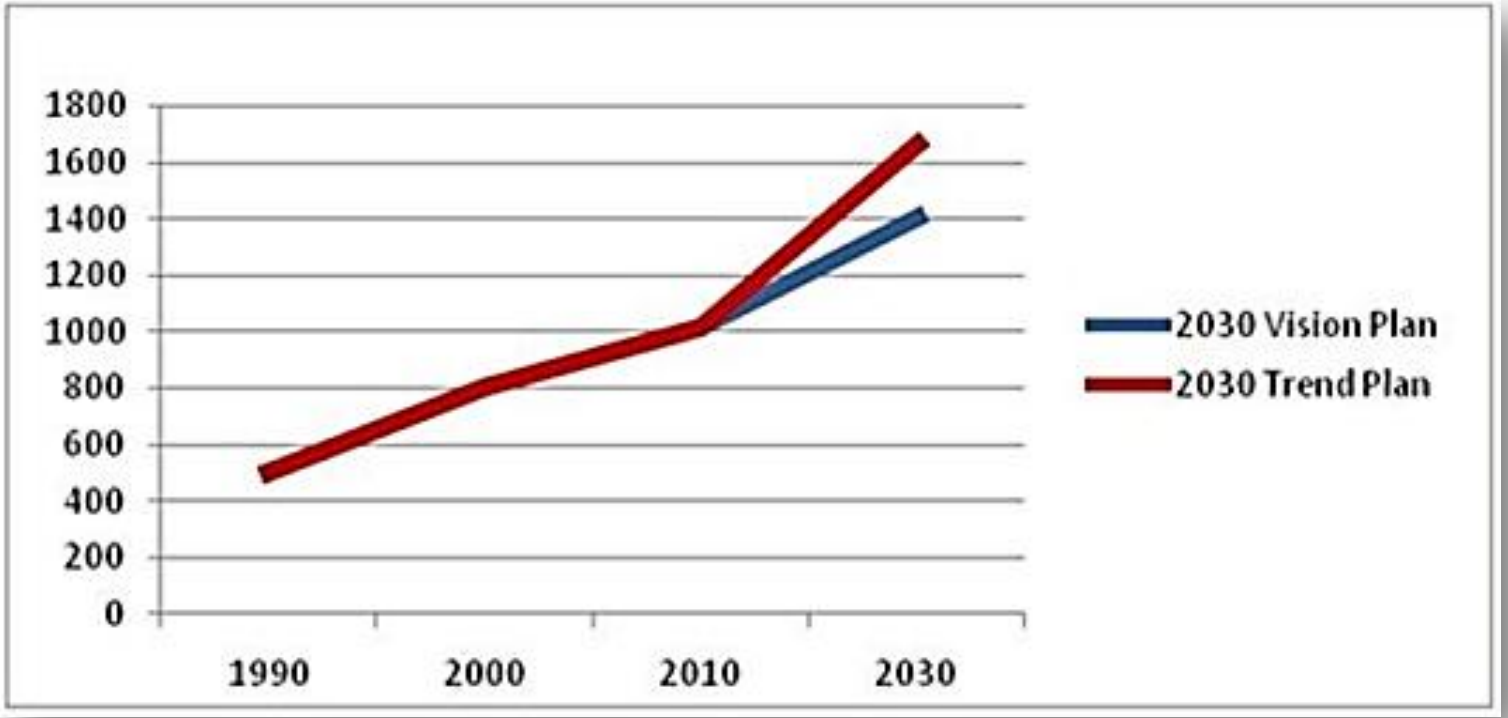
2030 Trend Plan



2030 Vision Plan



The Vision's Impact



Competition for Land

The Spine to Protect the Landscape

Environmental Quality

Development Trend

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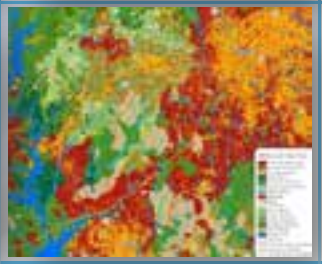
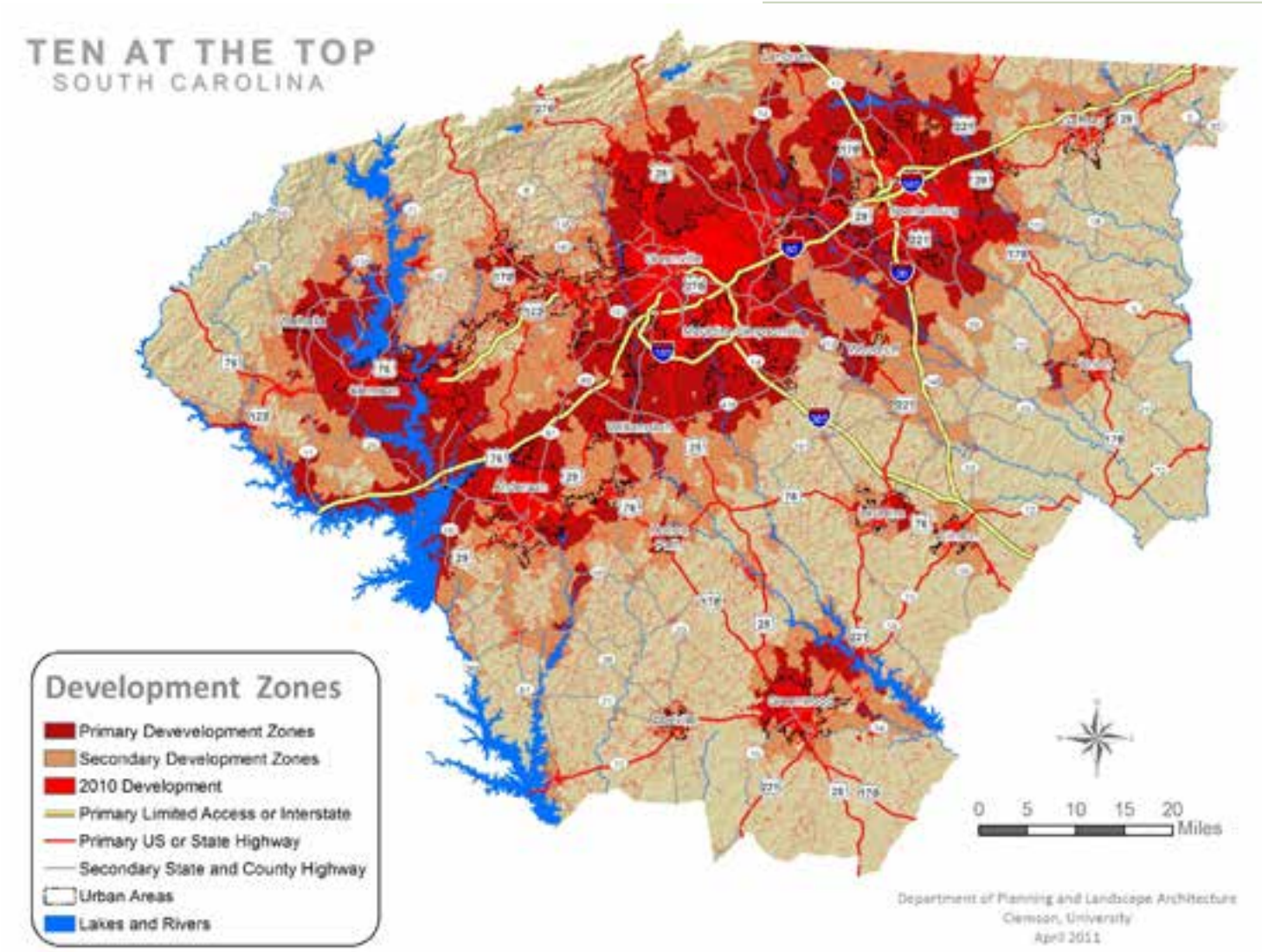
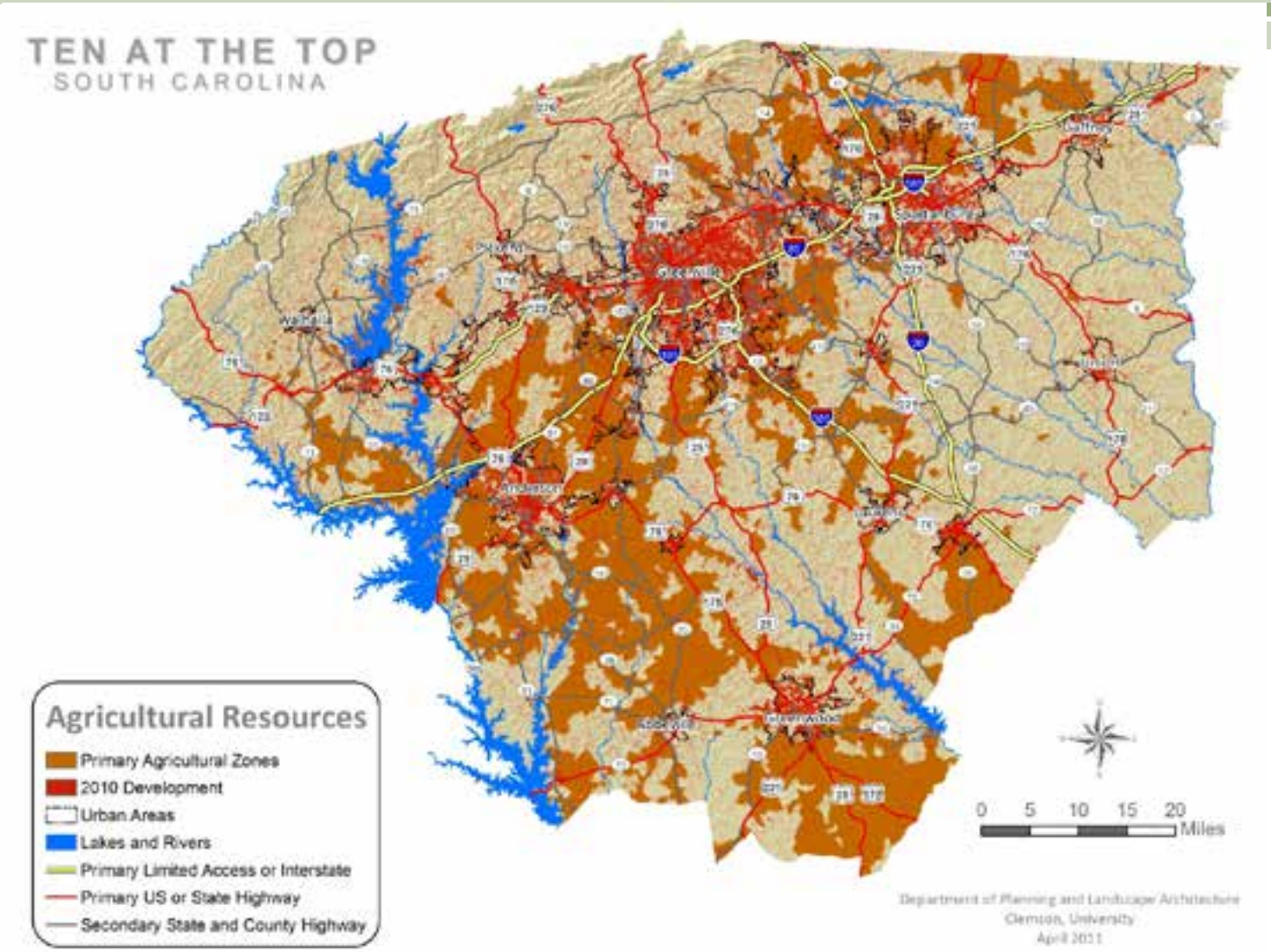


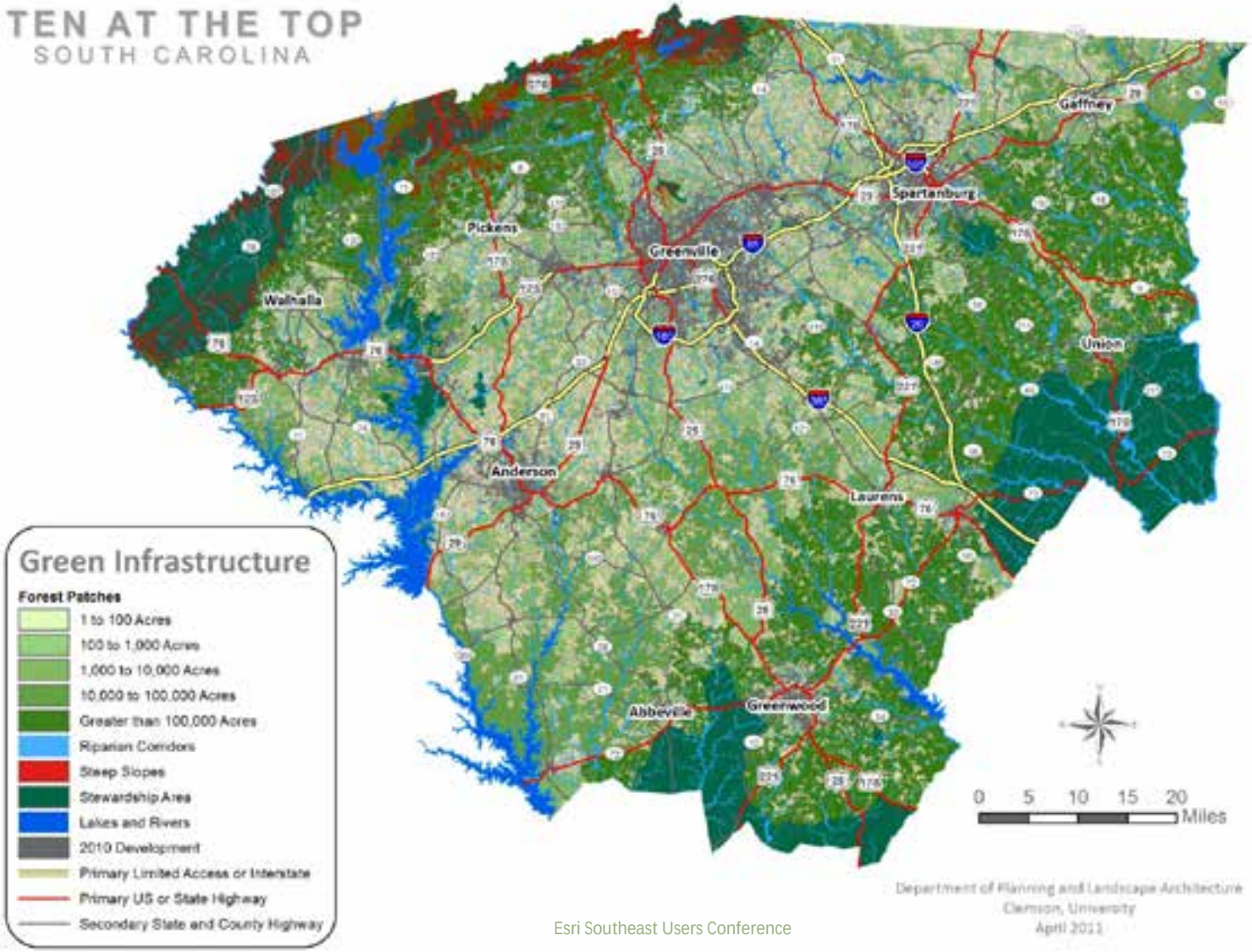
Development Zones



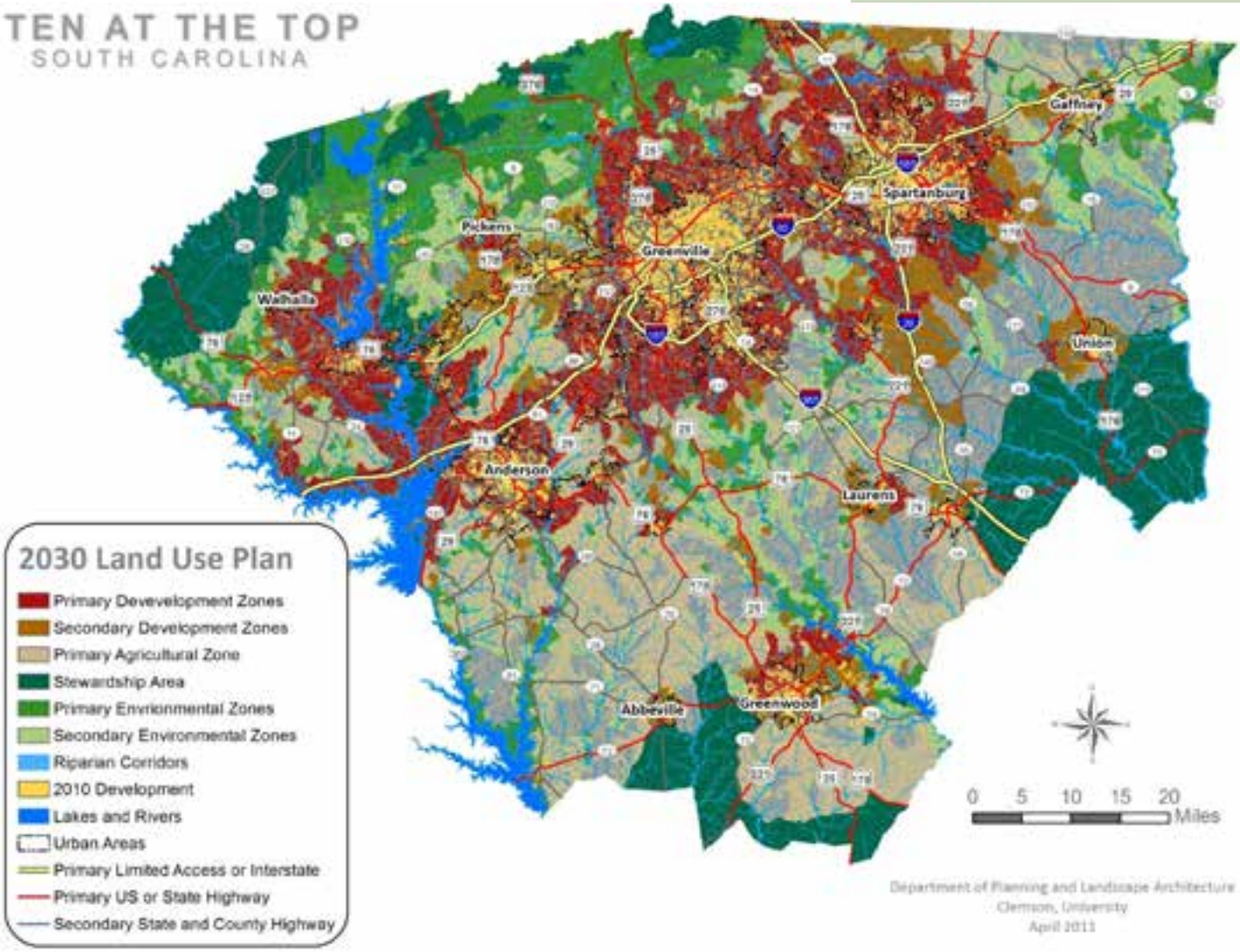
Agricultural Resources



Green Infrastructure



2030 Land Use Plan



Threat Matrix

Development Trend \ Environmental Quality	5	4	3	2	1
5	5	5	4	3	1
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3	4	4	3	2	1
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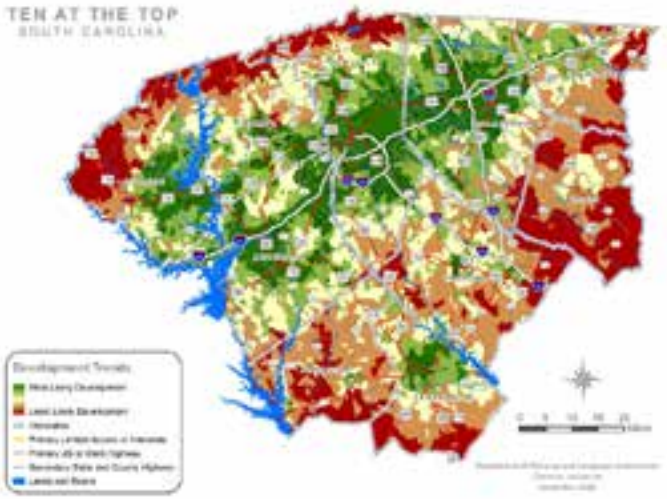
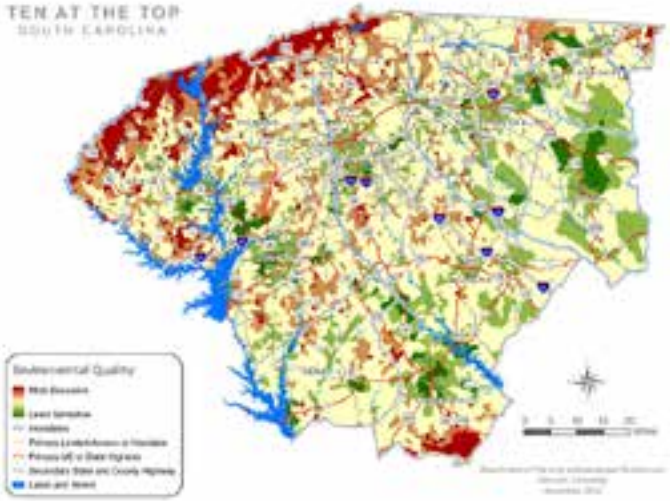
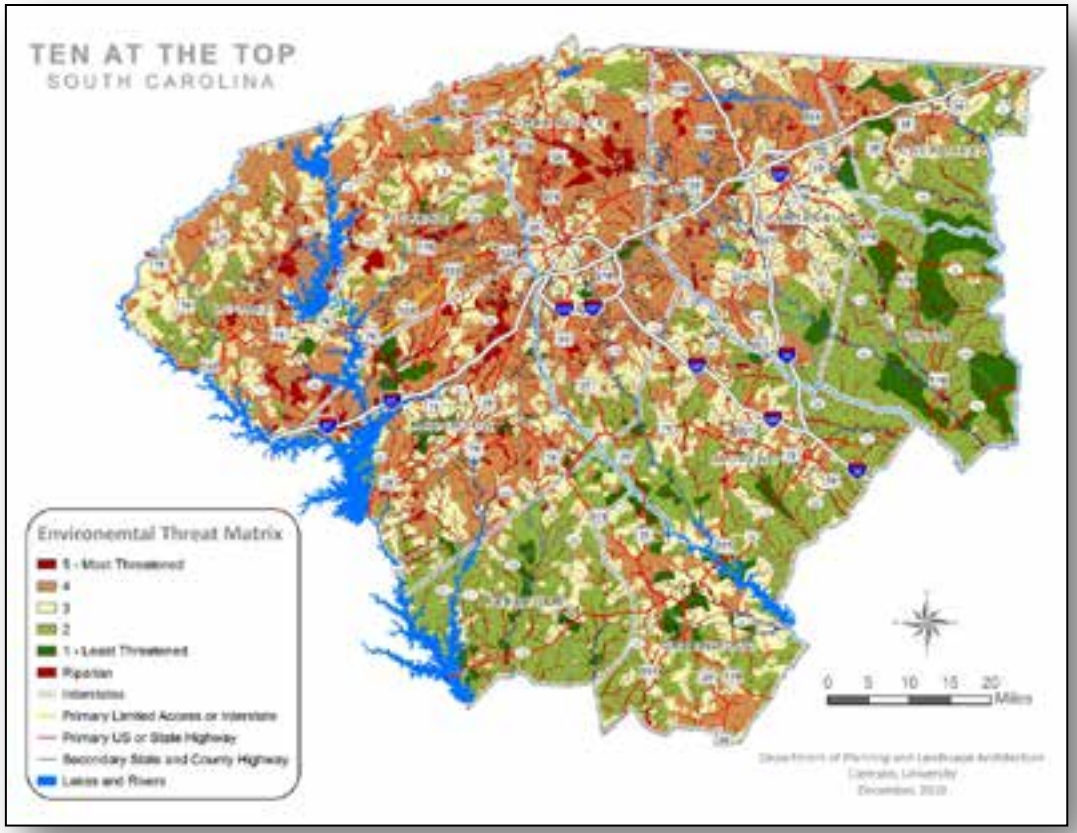
Conflicting Lands

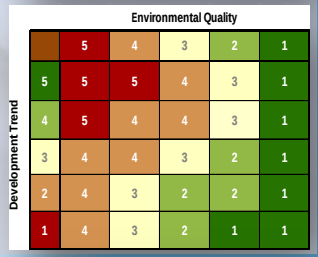






Scenarios Planning

Discussion for Balanced Plan



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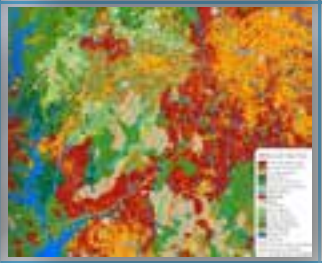


Scenarios Planning

- **Scenarios Encourage Discussion**
  - Environment
  - Projection
  - Economy

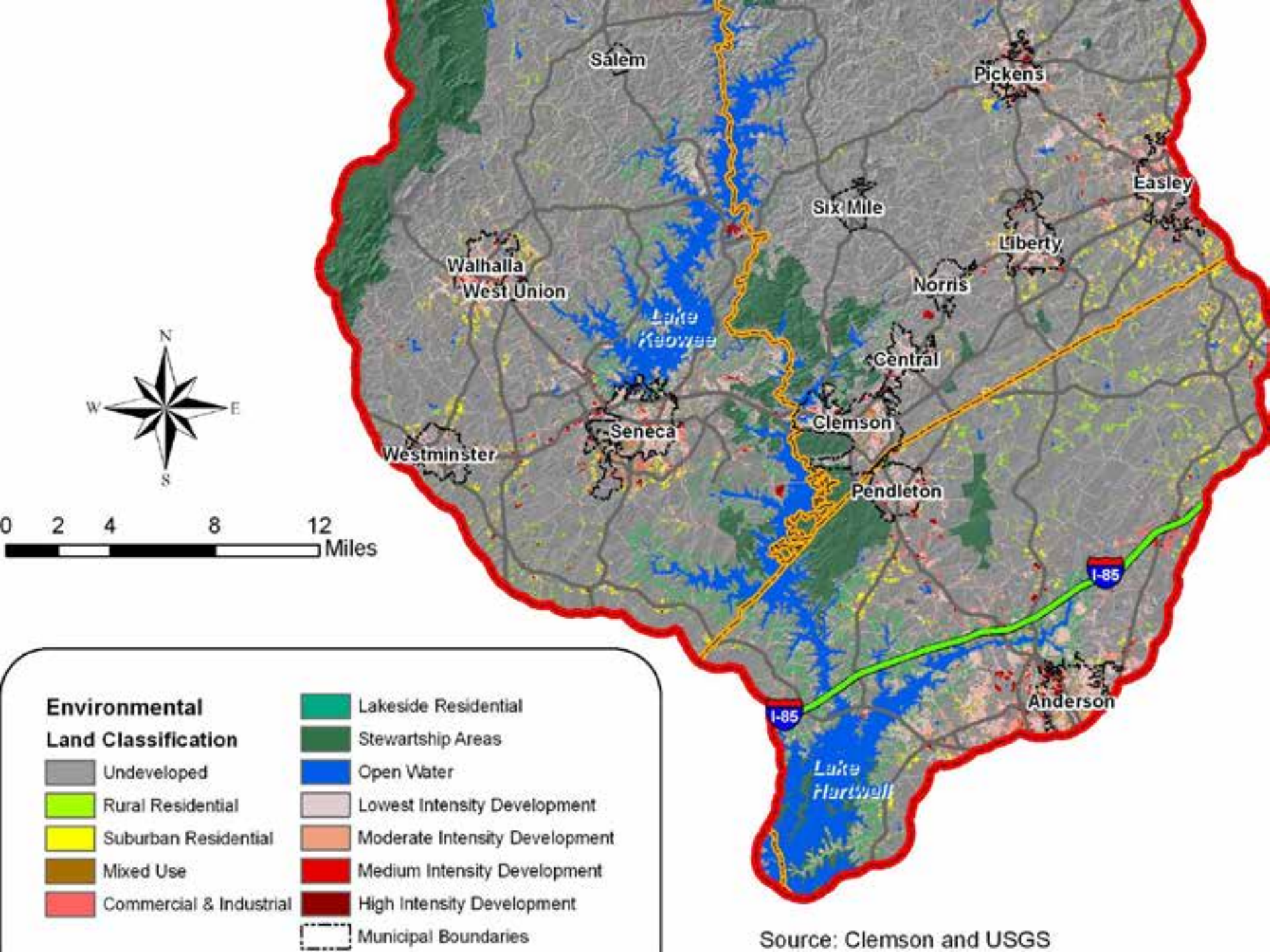
- **A Balanced Plan**
  - Pro Growth
  - Non Sprawling
  - Protects the Environment

Economic Scenario

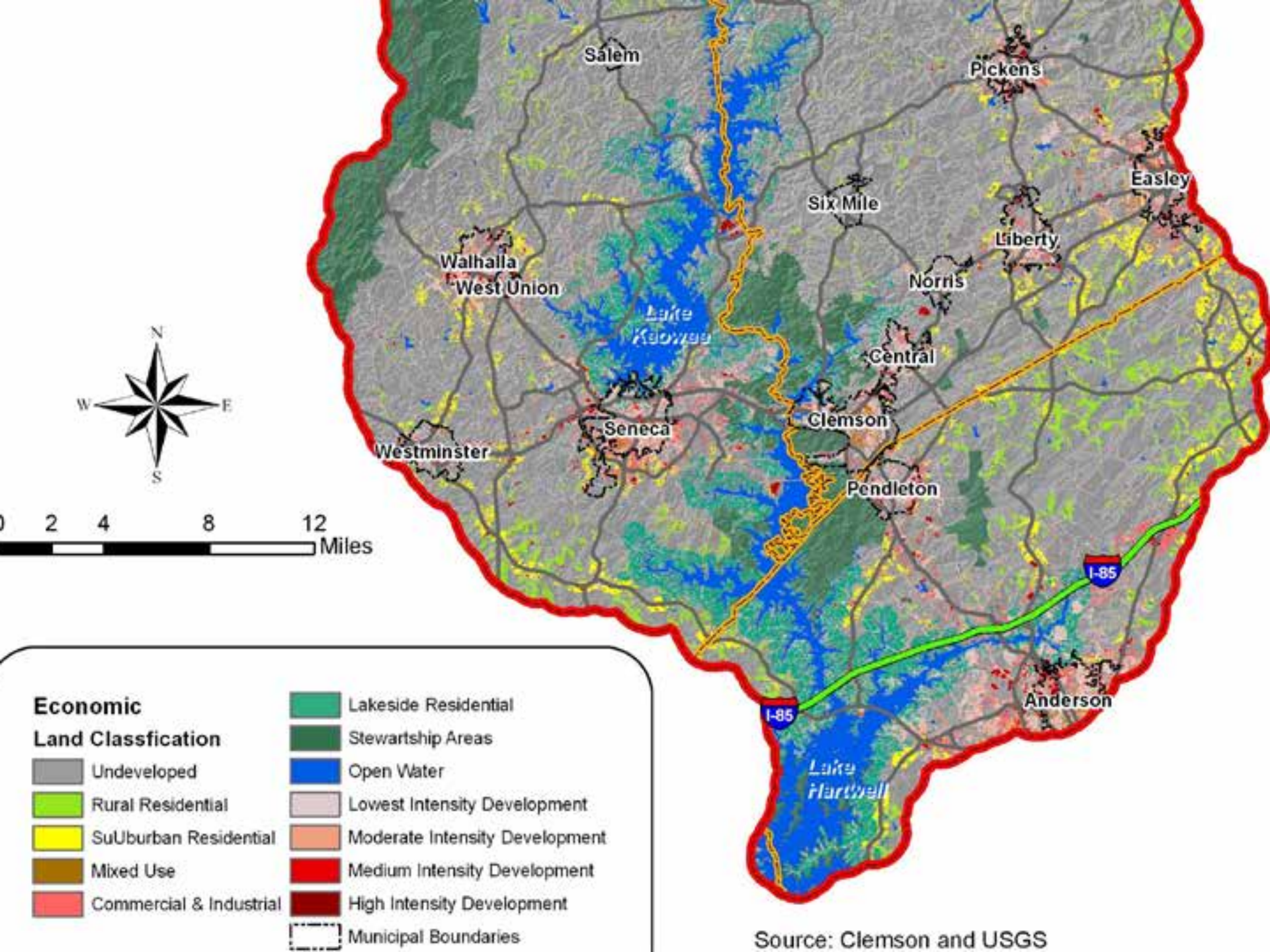
- Need 55,919 acres of new development
- Assume a doubling of the projected growth rate
- Assume highest household size because the emphasis on jobs
- All land uses are in the top 20th percentile
- Environmentally sensitive lands are not as critical
  - § Focused growth in the areas with the moderate environmental constraints
  - § The lower 40th percentiles

Population Forecast Item	Amount
Population, 2030	492,000
Population, 2000	250,000
Increase in Population, 2000-2030	242,000
Average Household Size, 2030	2.0
Increase in Households, 2030	121,000

Economic Land Use Forecast (2000-2030) Type of Development	2030 Density (units/acre)	Percent of Total Units	Distribution of 2030 Households	New Development (Acres)
High-End	0.50	33%	39,930	19,965
Suburban	0.75	17%	20,570	15,428
Rural	0.25	40%	48,400	12,100
Mixed Use	0.13	10%	12,100	1,573
Employment Acreage				6,853
				55,919



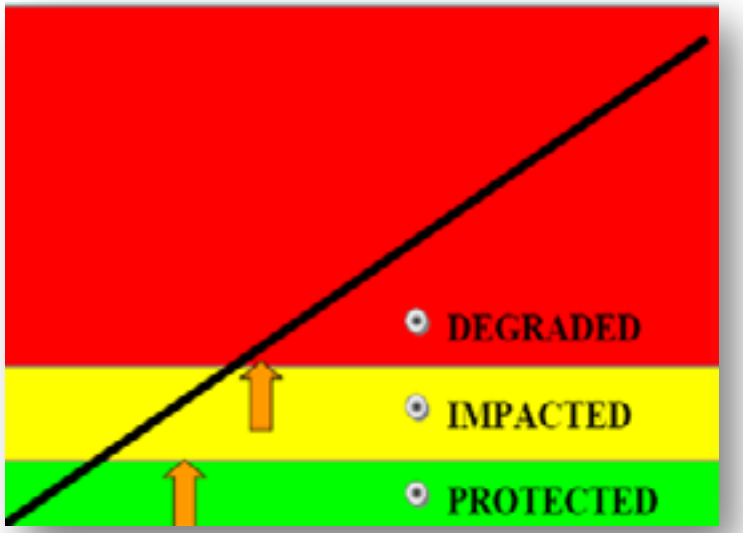
Source: Clemson and USGS



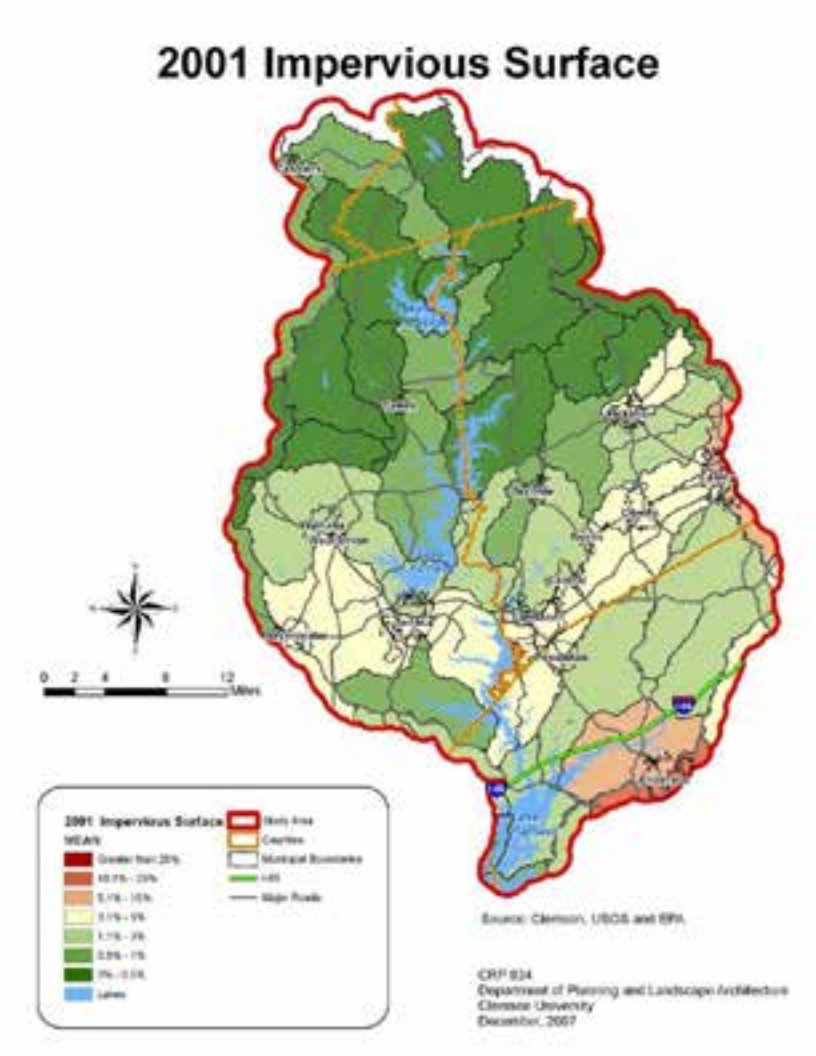
Source: Clemson and USGS

Stream Health and Impervious Surface

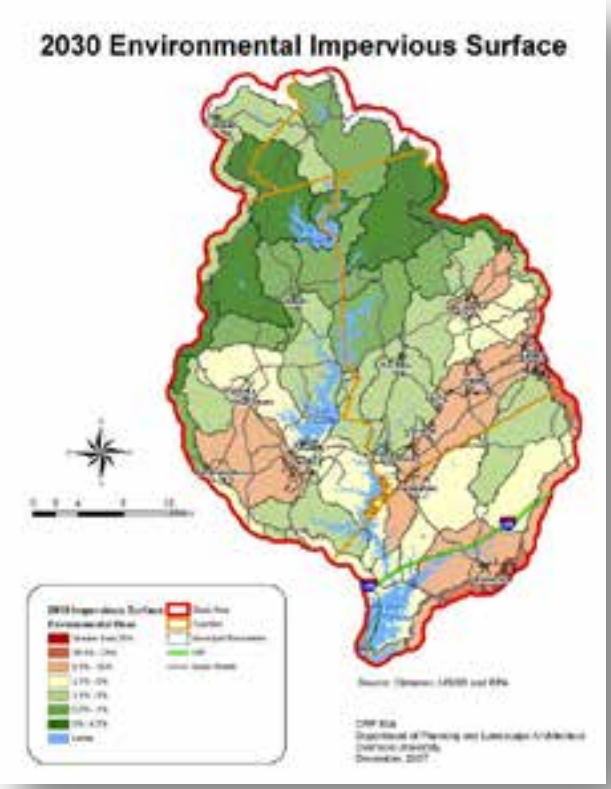
- Analysis at the subwatershed level
- Affects water quality, habitat, hydrology and stream stability
  - § Impacted at 10%
  - § Degraded at 25%

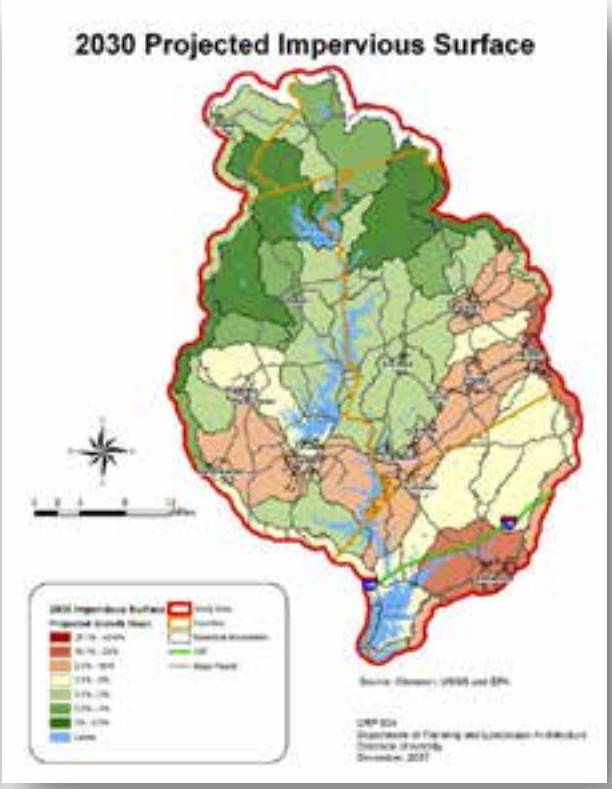


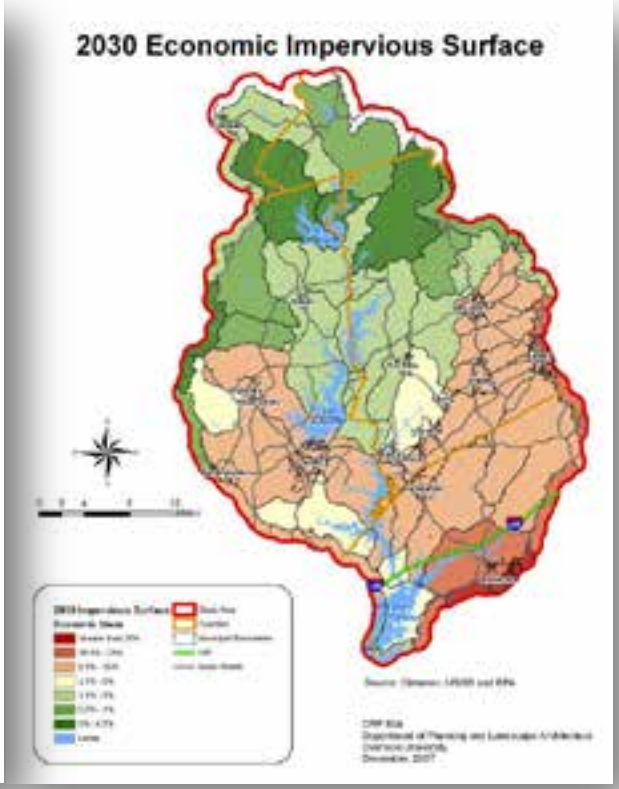
Adapted from Arnold Jr.; Chester L and C. James Gibbons, 1996, *Modified from Schueler 1992*



Impervious Surface







Impacted Watersheds

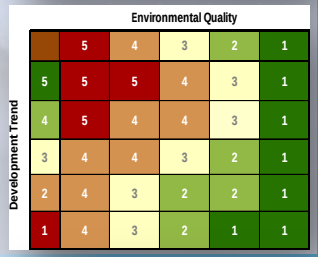
- Lake Hartwell will be impacted by development from Anderson and Easley

Scenario	Watersheds by Percent Change					
	>25%	>50%	>100%	>150%	>200%	Average
Evironmental	43	29	14	4	1	80%
Projected Growth	43	37	18	7	4	110%
Economic	44	43	31	16	12	174%

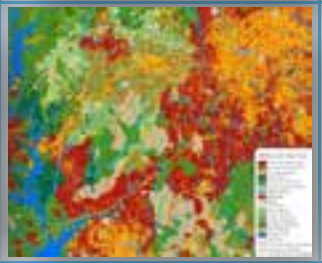
Scenario	Category	Subwatersheds	Square Kilometers	Hectares	Square Miles	Acres	Percent of Seneca Watershed	Mean Impervious Surface
2001	Mean <10%	42	2,864	286,355	1,106	707,584	99%	2.26
Evironmental	Mean <10%	42	2,864	286,355	1,106	707,584	99%	3.52
Projected Growth	Mean <10%	41	2,761	276,121	1,066	682,295	96%	3.94
Economic	Mean <10%	39	2,721	272,052	1,050	672,241	95%	5.28
2001	Mean>10%	2	26	2,613	10	6,455	1%	13.56
Evironmental	Mean>10%	2	26	2,613	10	6,455	1%	18.27
Projected Growth	Mean>10%	3	128	12,847	50	31,745	4%	18.14
Economic	Mean>10%	5	169	16,916	65	41,798	5%	17.84

3D Modeling

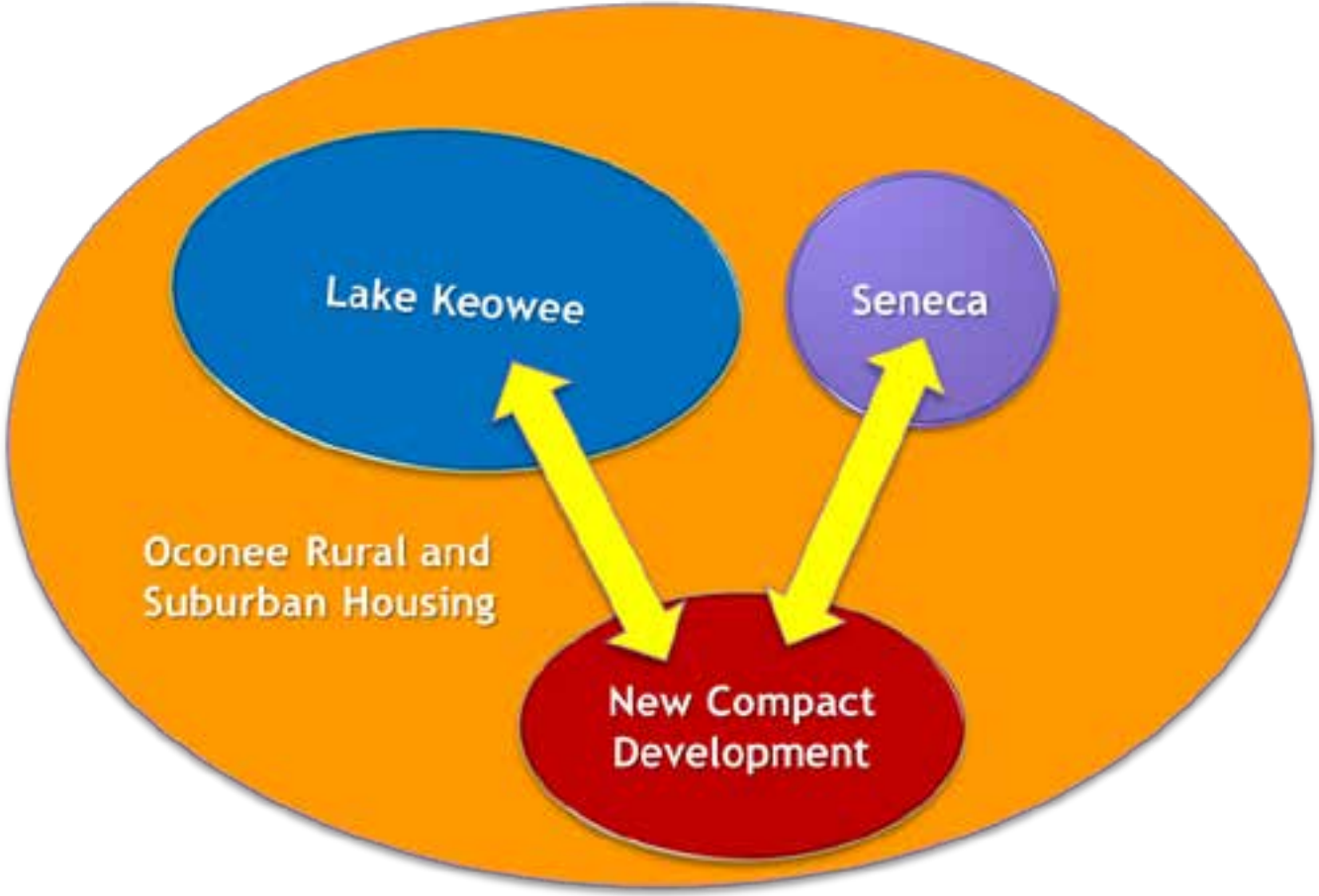
Visualizing Planning Policy with CityEngine

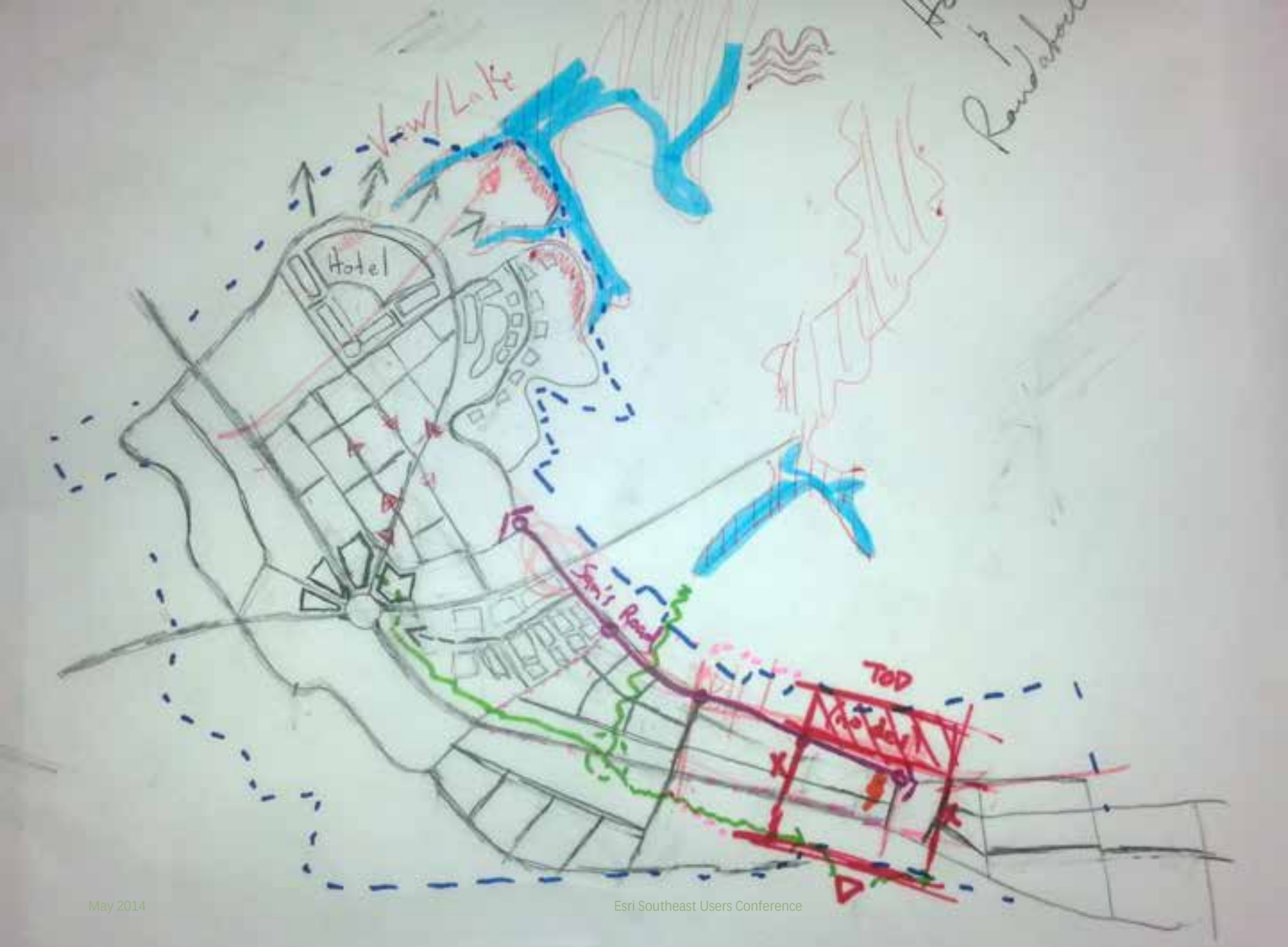


Development Trend \ Environmental Quality					
	5	4	3	2	1
5	5	5	4	3	1
4	5	4	4	3	1
3	4	4	3	2	1
2	4	3	2	2	1
1	4	3	2	1	1



Seneca Concept



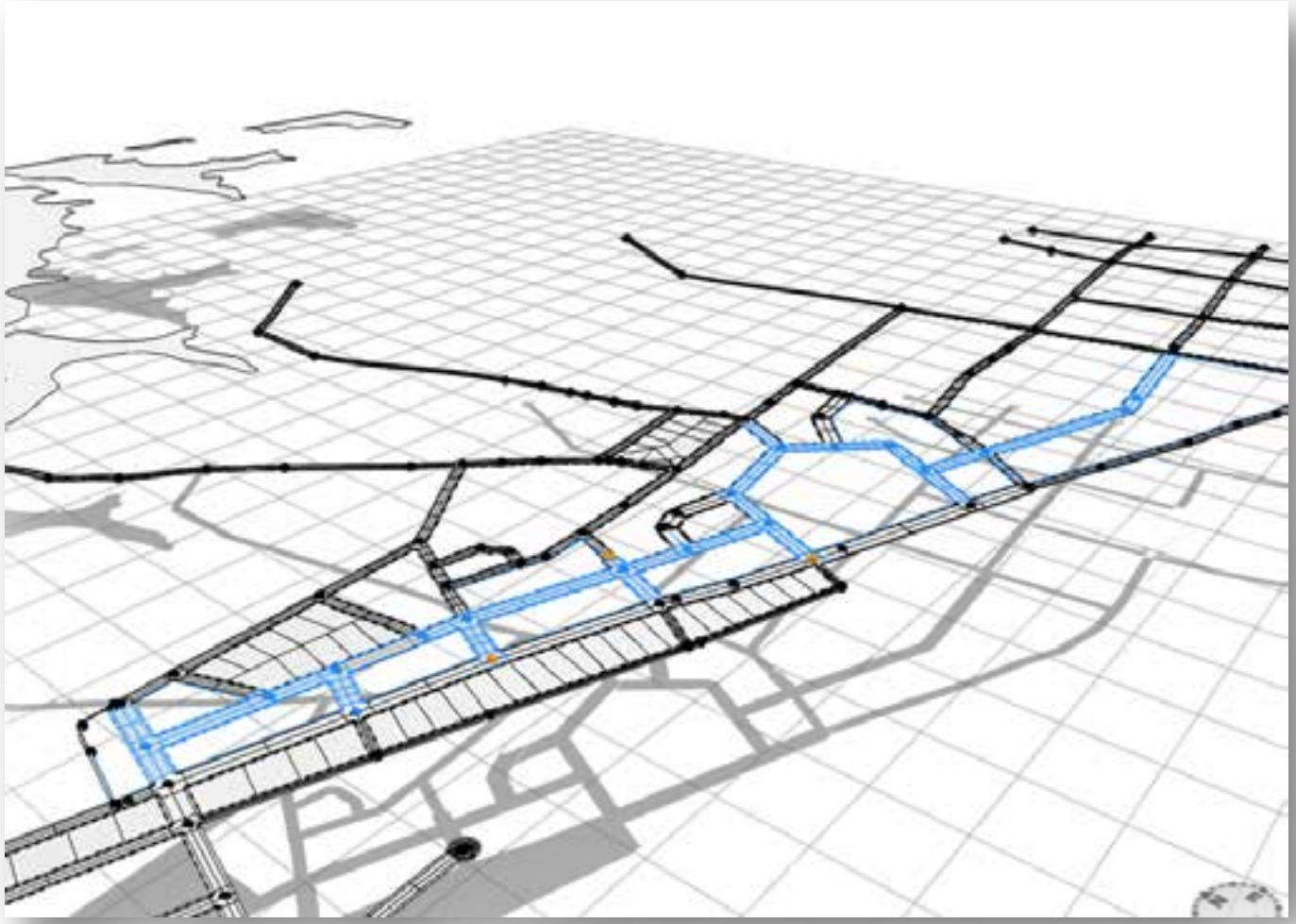

View Lake
Hotel
Sam's Road
TOD

Land Use Map

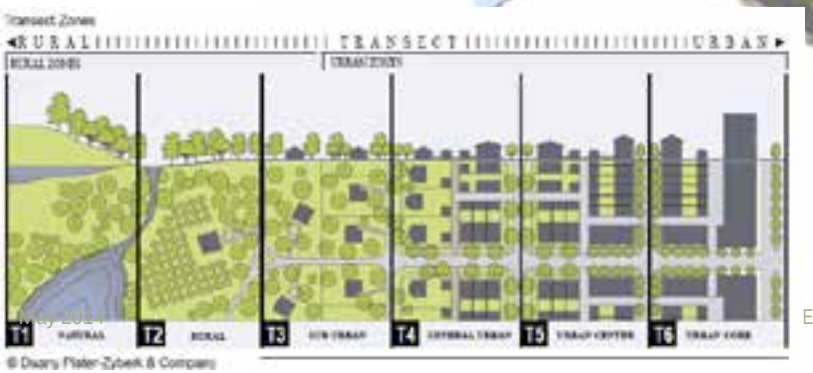
Transect and Road Classification Map

Street Network

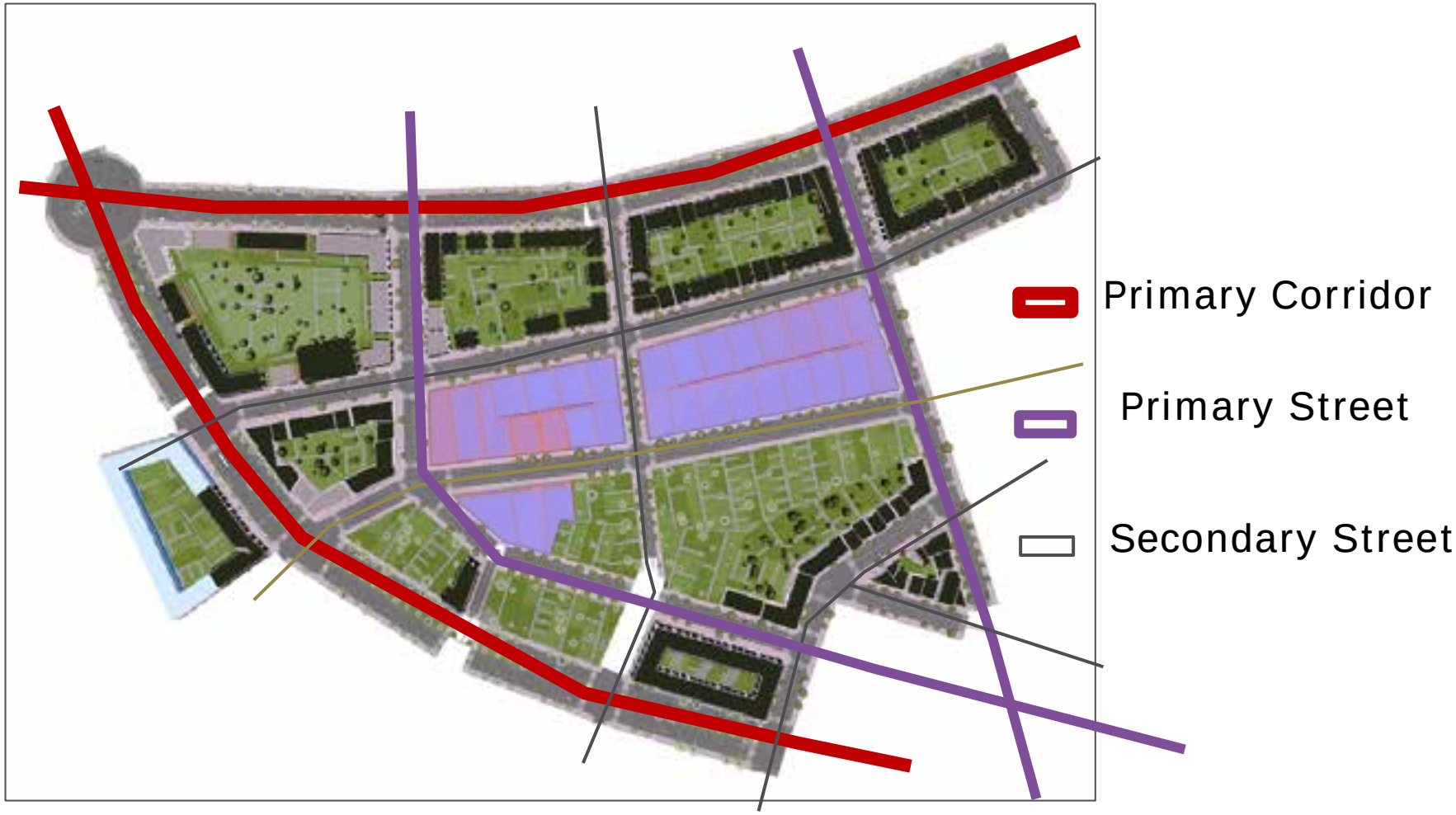
Road Hierarchy



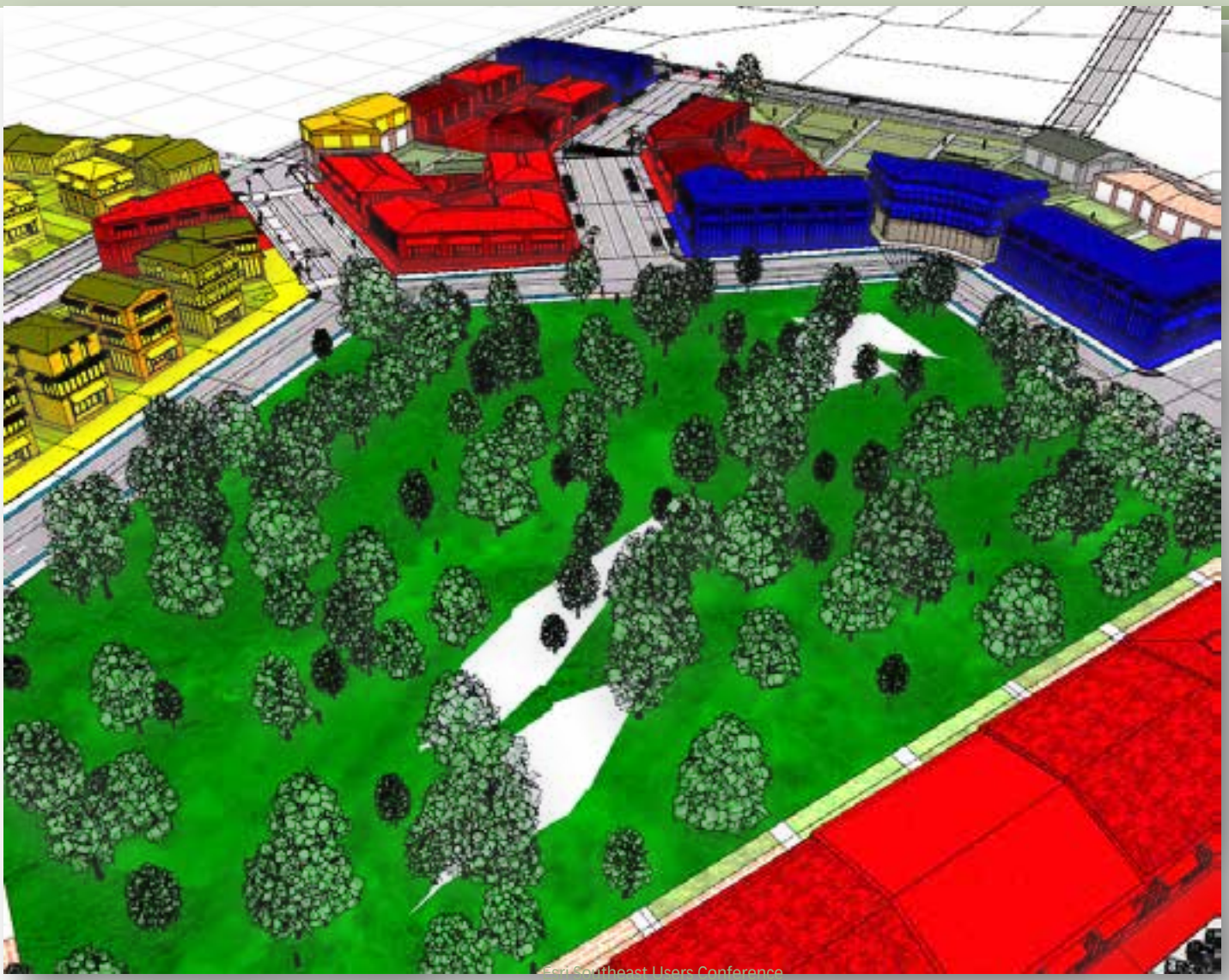
New Urbanist Transects



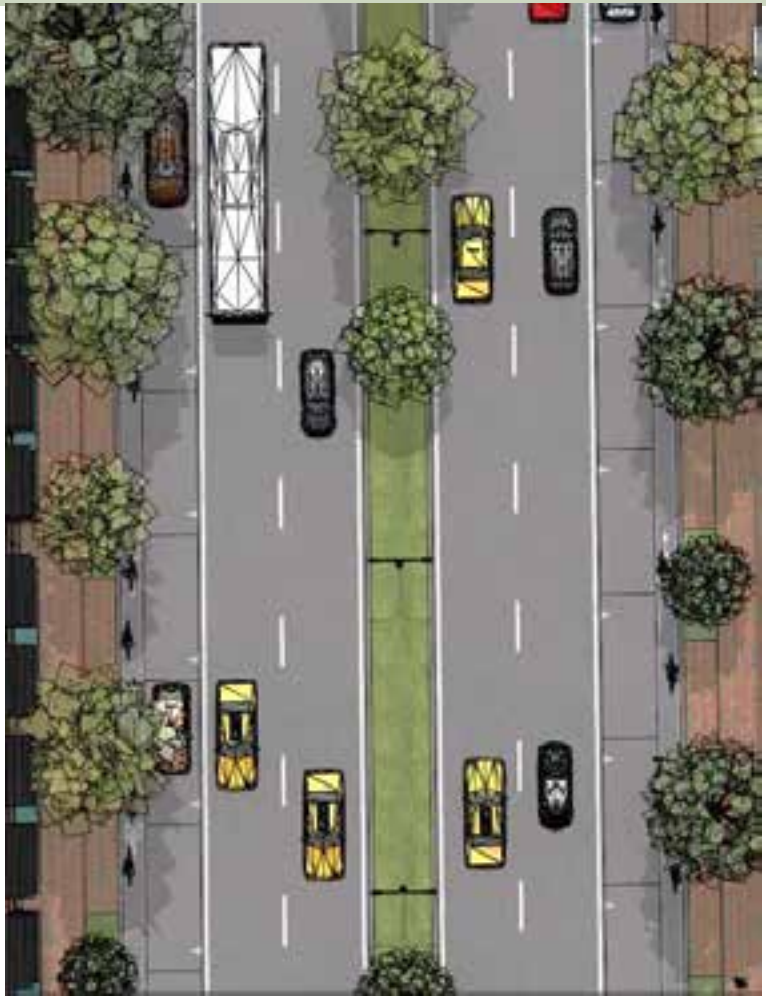
Street Network



3D Land Use



Street Types



14 ft

9.8ft

12 ft

82 ft

9.8ft

11.5 ft

32 ft

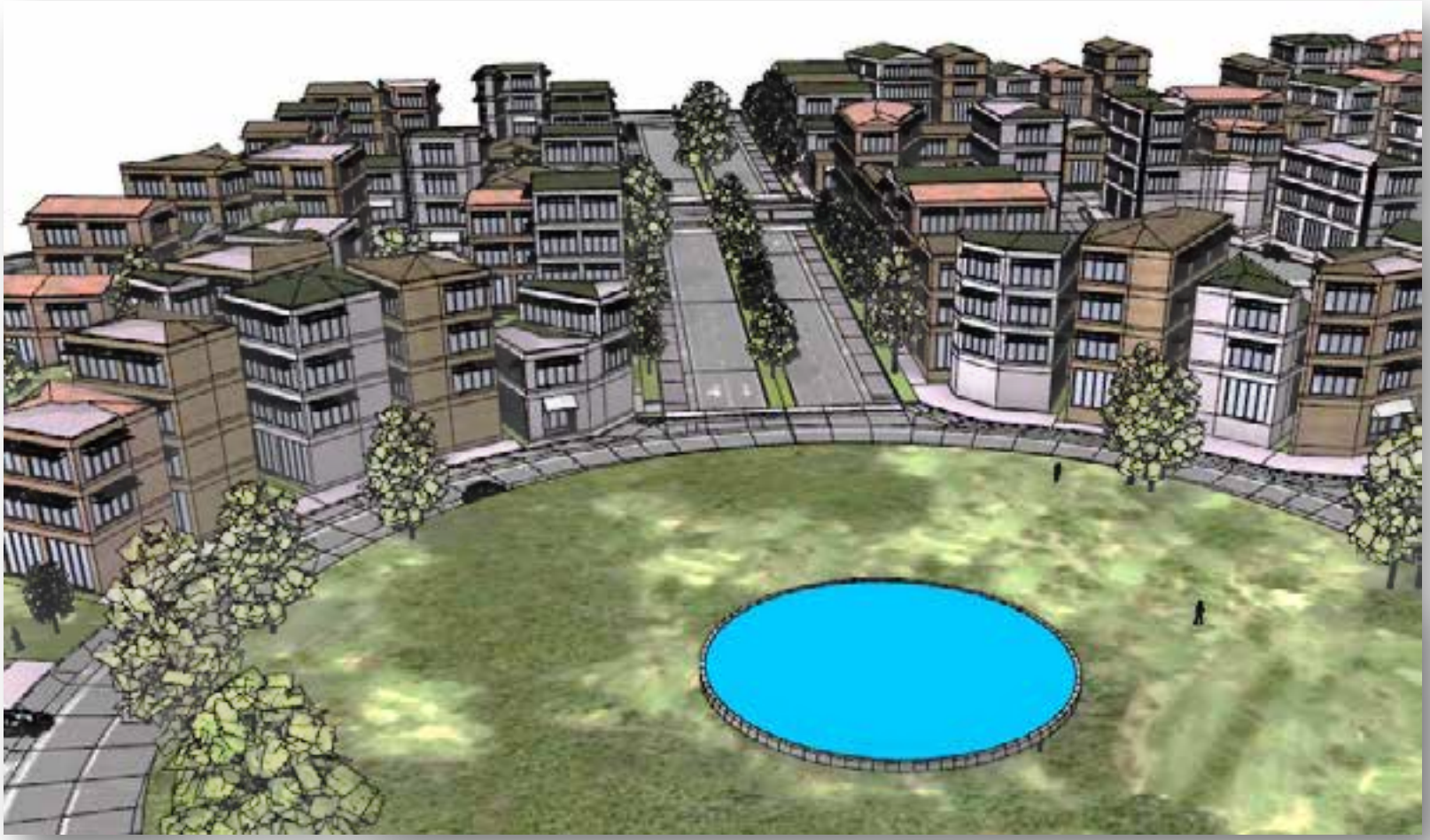
Commercial District

Build Mass and the Street Network

Lake District – T4 and T3

The Town Center – T5

Town Center



Town Center Link

Integrate with the Existing Land Use

Downtown

Downtown

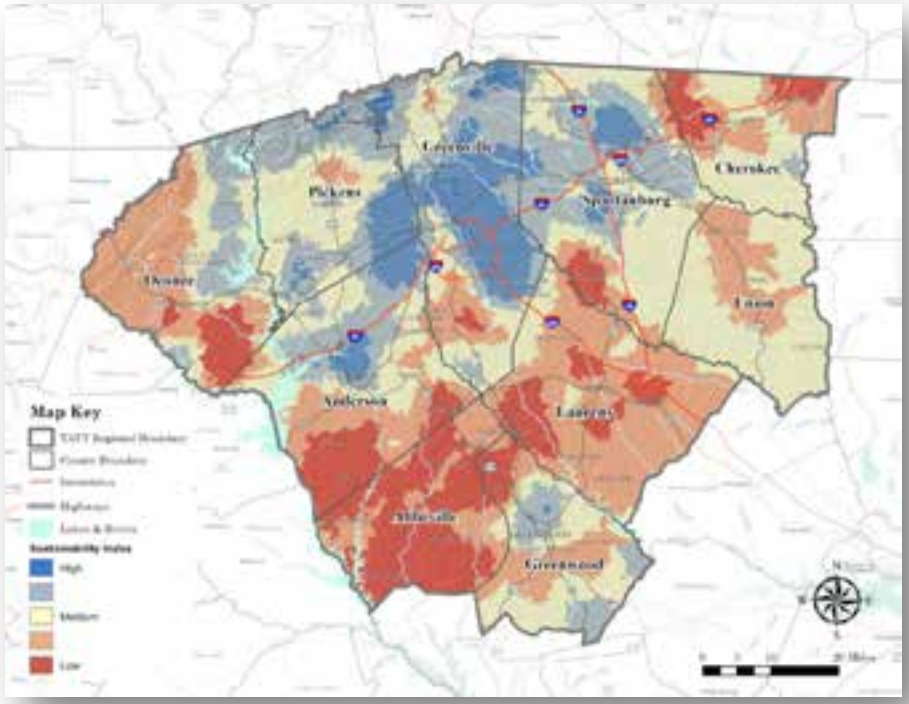
TOD Site

Downtown

Conclusion

- GIS Training In City and Regional Planning
  - § Spatial Modeling & Comprehensive Planning
  - § Land Use Change
    - Growth and Competition for Land
  - § 3D Modeling
  - § Using Standard ArcGIS capabilities with Excel
    - Familiar interface
    - All planners can use

- Future
  - § GIS and Geodesign Certificates
    - Online or on-campus
    - Incorporates planning and design
    - Taking geographic considerations into the design process



Sustainability Index – William Aultman

This Year's Graduates

- Sam Rubin
- Gregory Gordos
- Chris Clauson
- Heather M. Peterson
- Qianying Wu
- Latoisha Green
- Craig Chandler