VGP11

Sustainable Land-Use Planning

tools for sustainable planning and policy formation

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landuse evolution and impact assessment model

Slide 1

VGP11 This slide will have the presentation slide, yes?
Varkki Pallathucheril, 3/7/2005

Overview

- Sustainability
- Approach
- Some insight

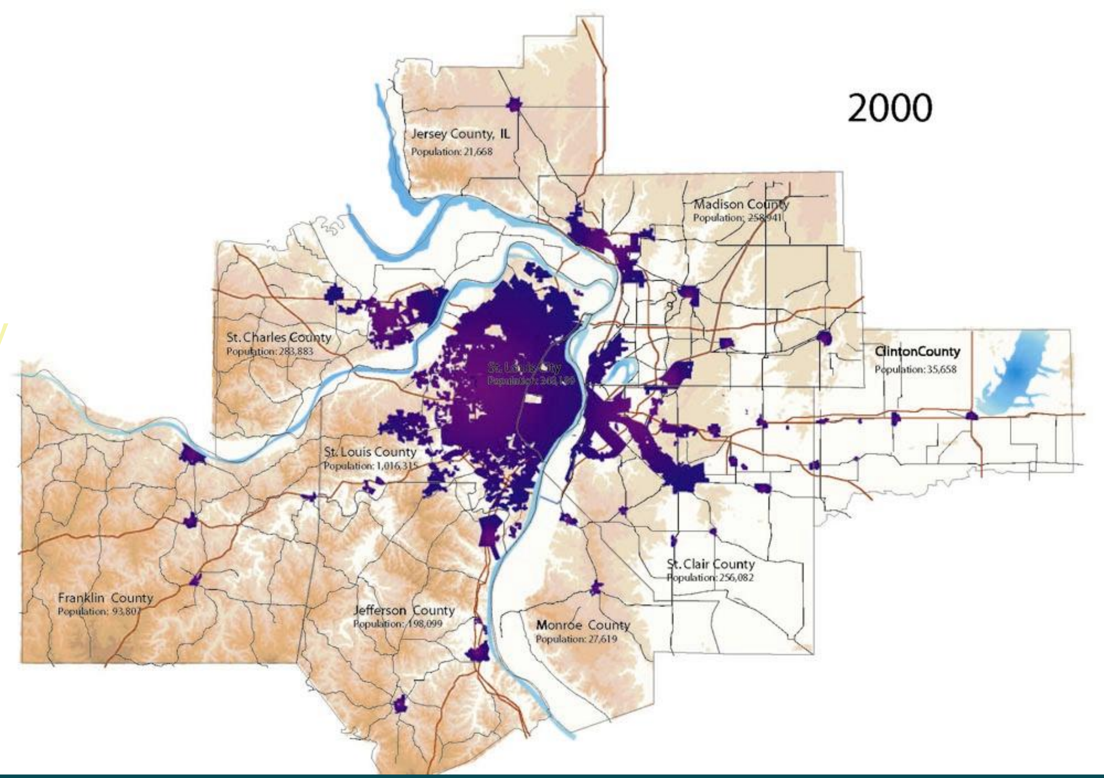
Slide 2

VGP10 This might actually be a good place for an overview slide.
Varkki Pallathucheril, 3/7/2005

Sustainability is a Planning and Design Issue

- Emissions
- Water quality and quantity
- Land use
- Transportation systems
- Energy use
- Green infrastructure
- Connections to buildings
  - Land around buildings
- Process based sustainability
  - Information
  - Dialogue
  - Communal consensus

St Louis Mo 1954-2000



landuse evolution leam model and impact assessment

VGP2

How do we effectively facilitate sustainable decisions?

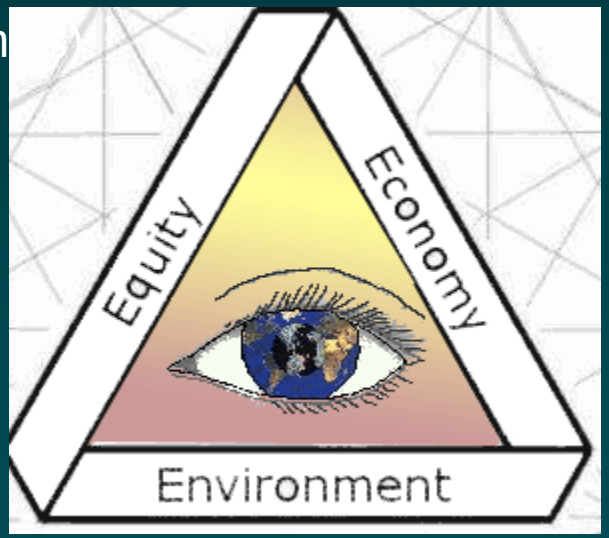
Tools can inform the process and outcome

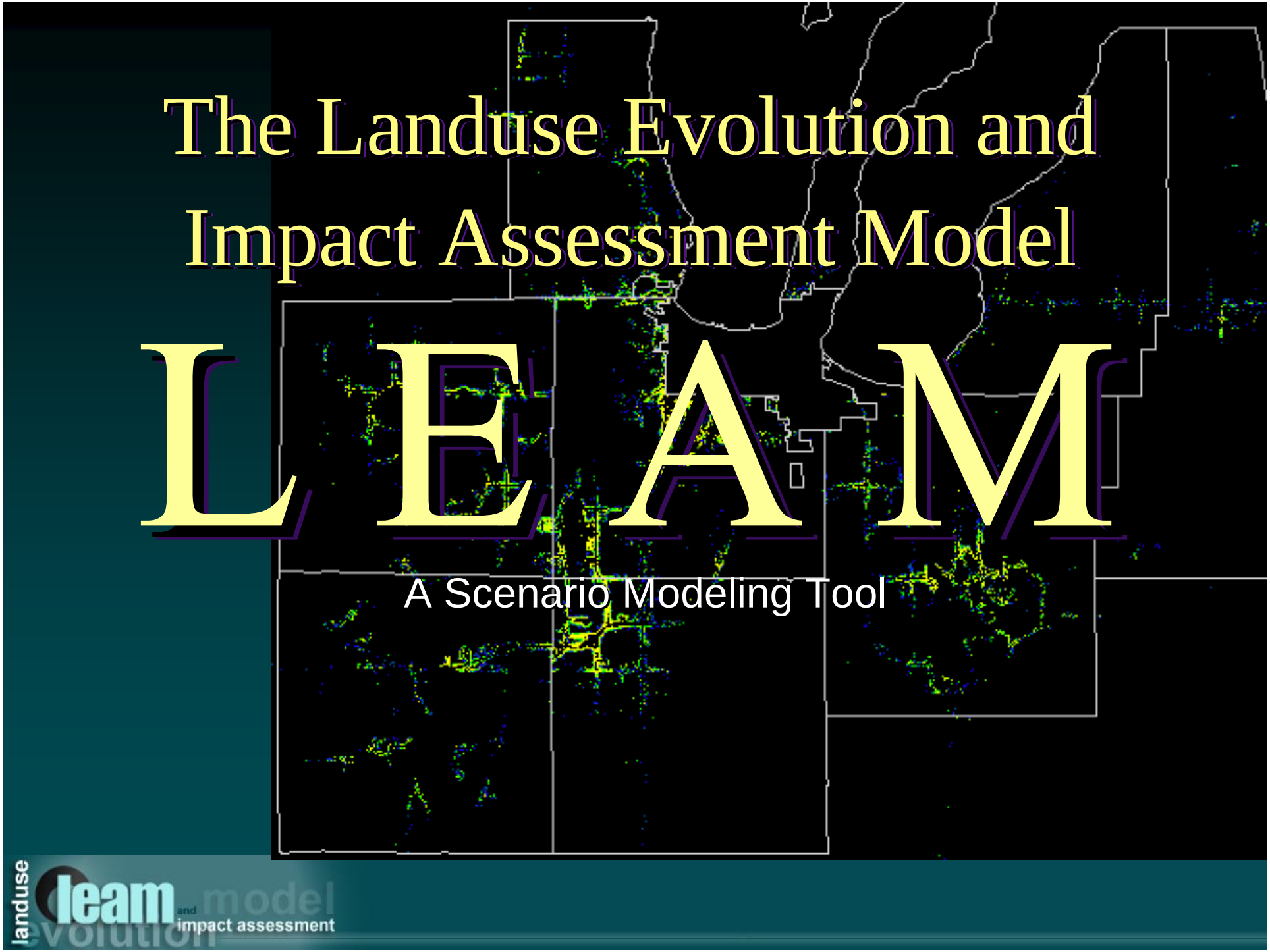
Slide 4

VGP2 Need to be indicate on this slide that you are interested in this question at three different scales.
Varkki Pallathucheril, 3/7/2005

Hypothesis

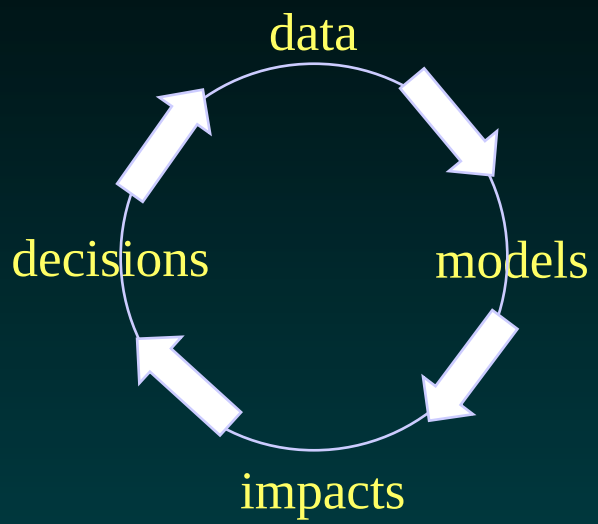
- We can facilitate more effective sustainable decisions by showing people the future consequences of current actions.
  - Communal goals vs personal aspirations
    - Personal vs Communal discounting
    - Economics
      - AC Pigou (welfare Economics)
      - Herman Daly (ecologic econom
      - David Orr (sense of place)



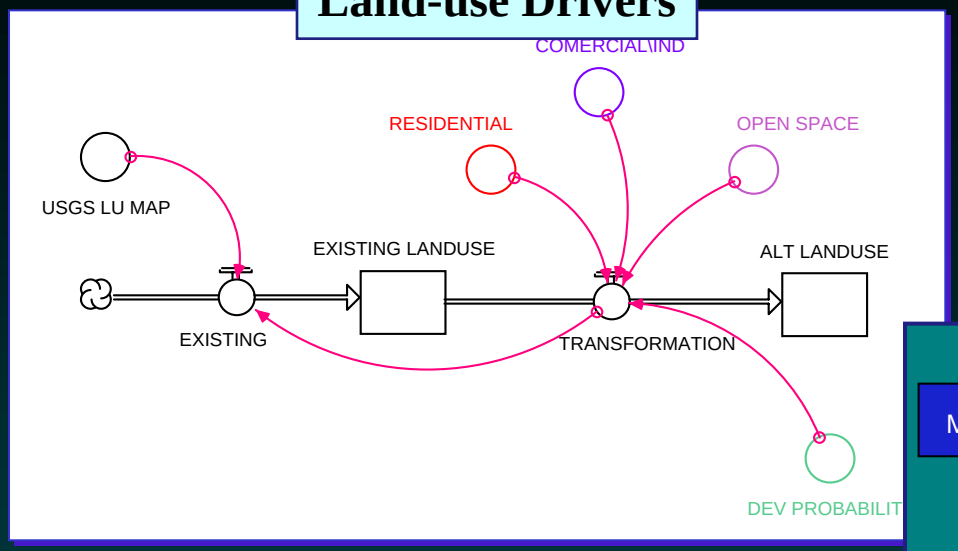

The Landuse Evolution and
Impact Assessment Model
L E A M
A Scenario Modeling Tool
landuse
leam
and
impact assessment
evolution
model

LEAM Approach

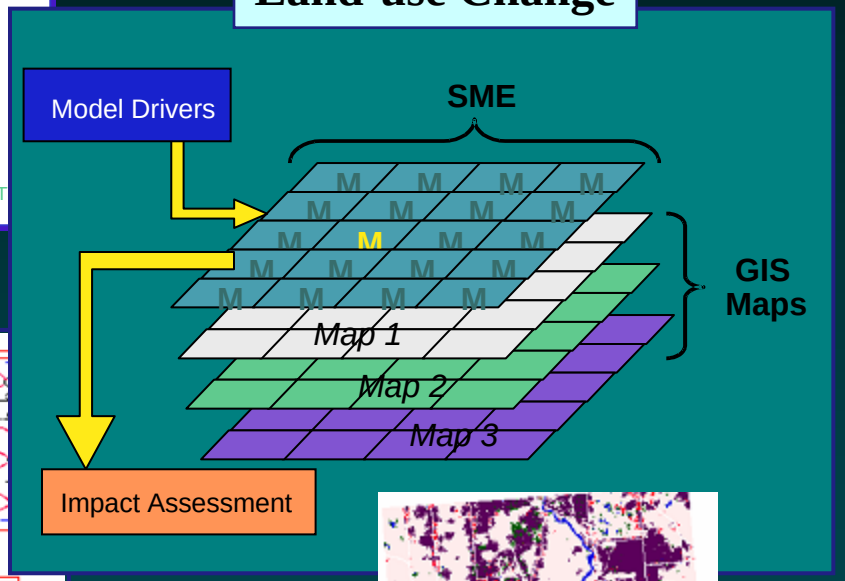
- Captures causal mechanisms of land-use change
  - Environmental, Social, Economic
  - Appropriate scales
- Captures dynamics of complex systems
  - Feedbacks
  - Lags
- Captures impacts of land use change
  - Causal relationships
  - Environmental, Social, Economic
- Incorporates calibration and validation
  - Quantify uncertainty

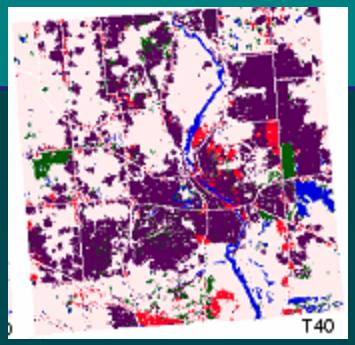


Land-use Drivers

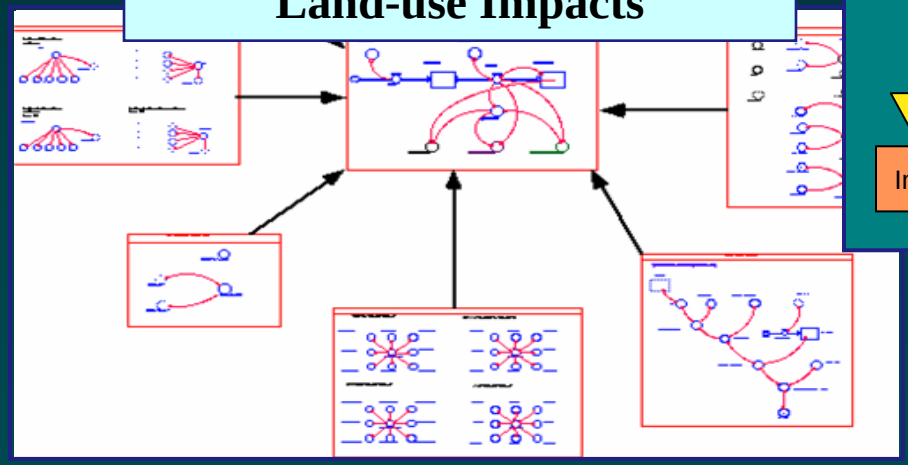


Land-use Change





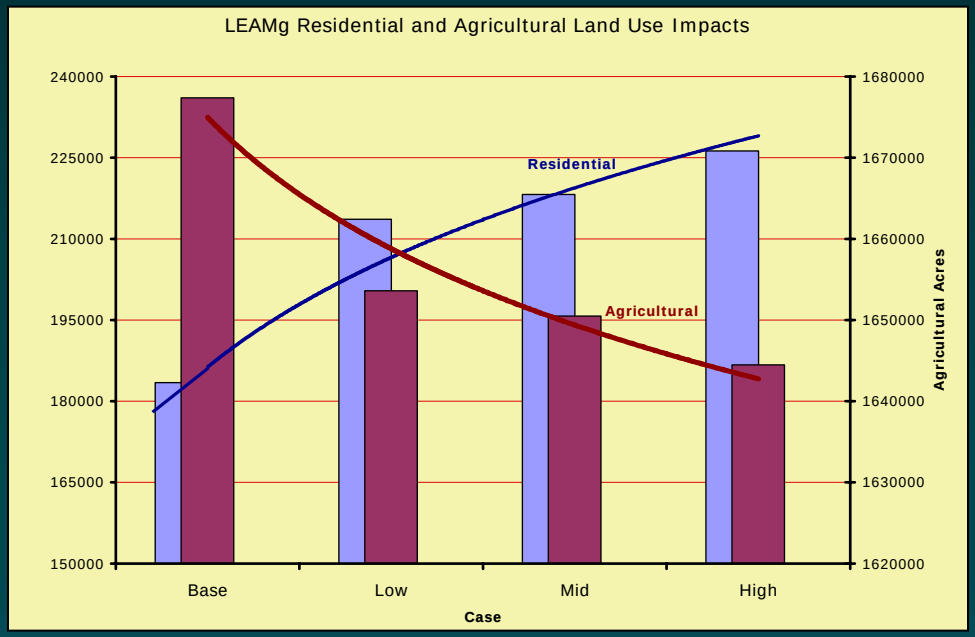
Land-use Impacts



LEAMimpacts

- Economic Impacts
  - Housing
  - Fiscal
  - Work force
  - Vacant land
- Social Impacts
  - quality of life
  - drive times
- Environmental Impacts
  - biodiversity
  - water quality
  - energy
  - air quality
  - habitat loss/ fragmentation

Landcover Classification	1993 Landcover	2025 High	2025 Mid	2025 Low
Water	93,781	93,781	93,781	93,781
Residential	183,408	226,230	218,187	213,641
Commercial/Industrial	232,747	241,615	239,717	238,901
Agricultural	1,677,371	1,644,462	1,650,485	1,653,606
Urban Openspace	164,252	181,133	181,539	181,750
Forested	963,332	930,195	933,314	935,110
Grasslands	37,969	36,684	36,828	36,905
Others	142,001	140,262	140,513	140,669
Total	**3,494,861**	**3,494,861**	**3,494,861**	**3,494,861**

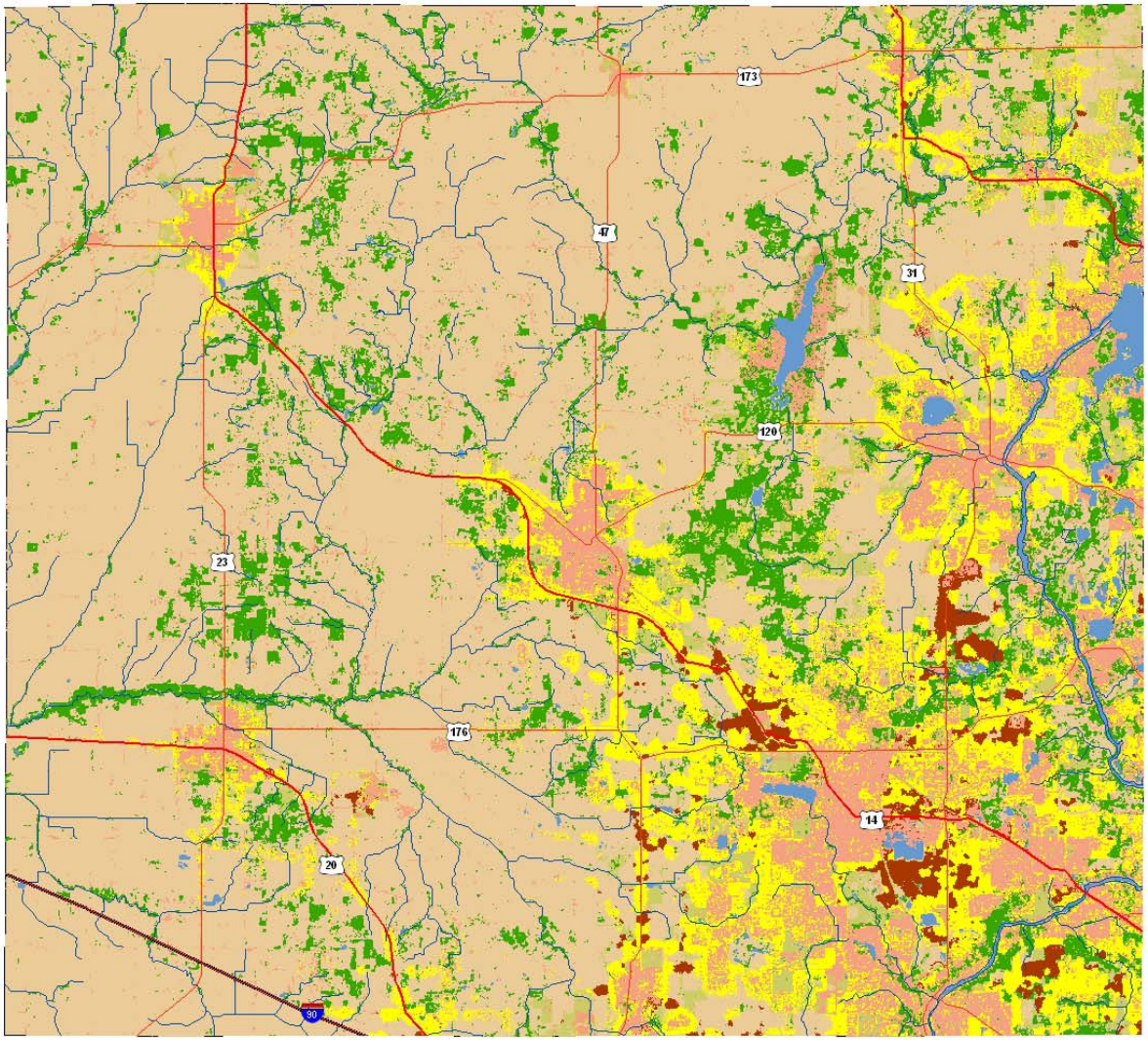


landuse leam and impact assessment model evolution

LEAM Simulations

- A dynamic simulation modeling environment
  - Projecting futures
  - Assessing their implications
    - Legacy resources
    - Watershed planning
    - Hydrological impacts
  - A scenario planning tool

LEAMmchenry



McHenry County 2030

Base Scenario: Landuse Change

- Stream
- Interstate
- US route
- State route

Land Use 2030

- New Commercial Development
- New Residential Development
- Developed
- Urban Open Space
- Others
- Forest
- Water

0 1 2 3 4 5 Miles

NORTH

leam
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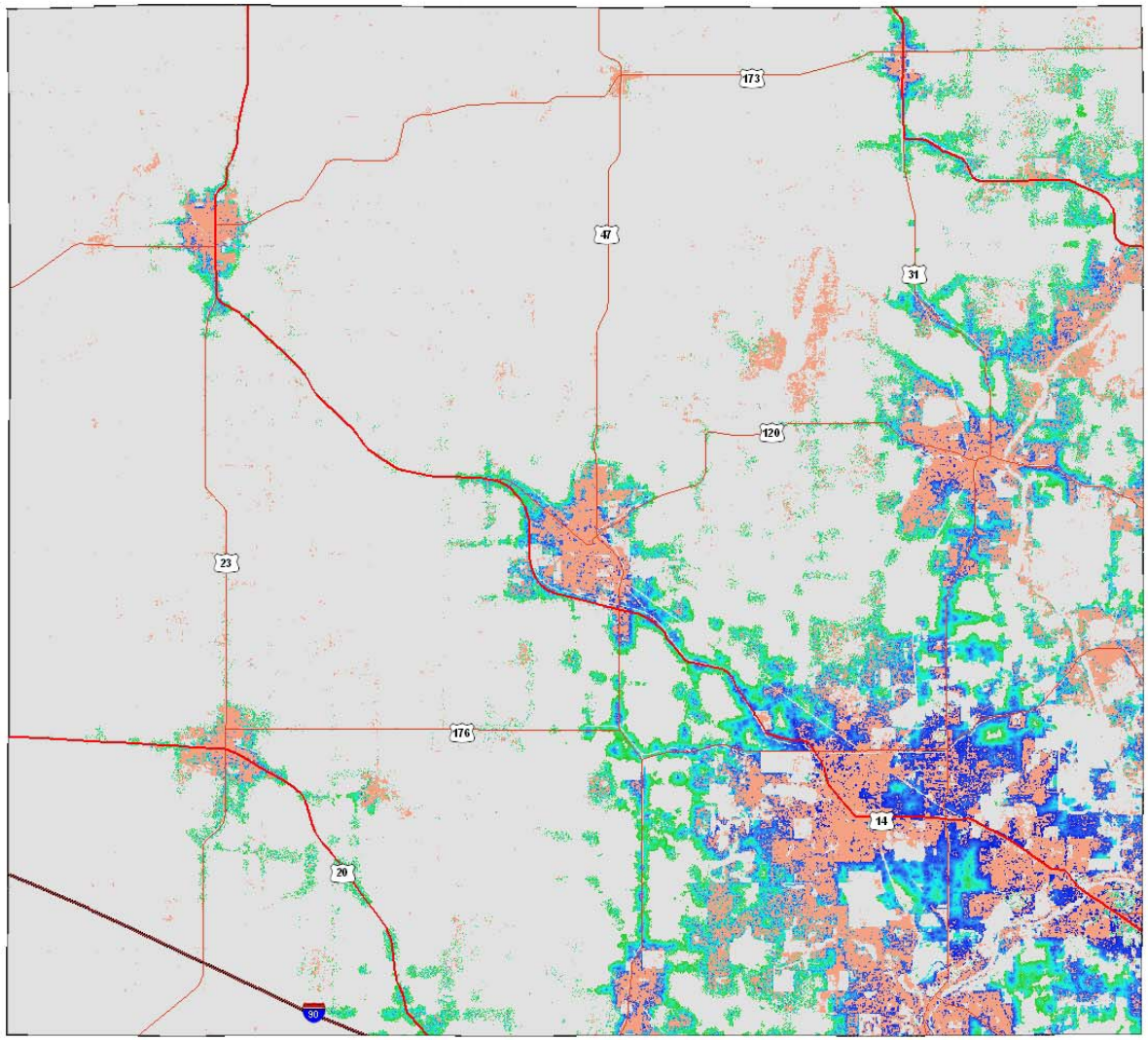
landuse evolution impact assessment

LEAM Scenario 1



McHenry County 2030

Base Scenario:
Growth over Time

- Interstate
- US route
- State route

New Development over Time

- High : 2030
- Low : 2001

Existing Development

0 1 2 3 4 5 Miles

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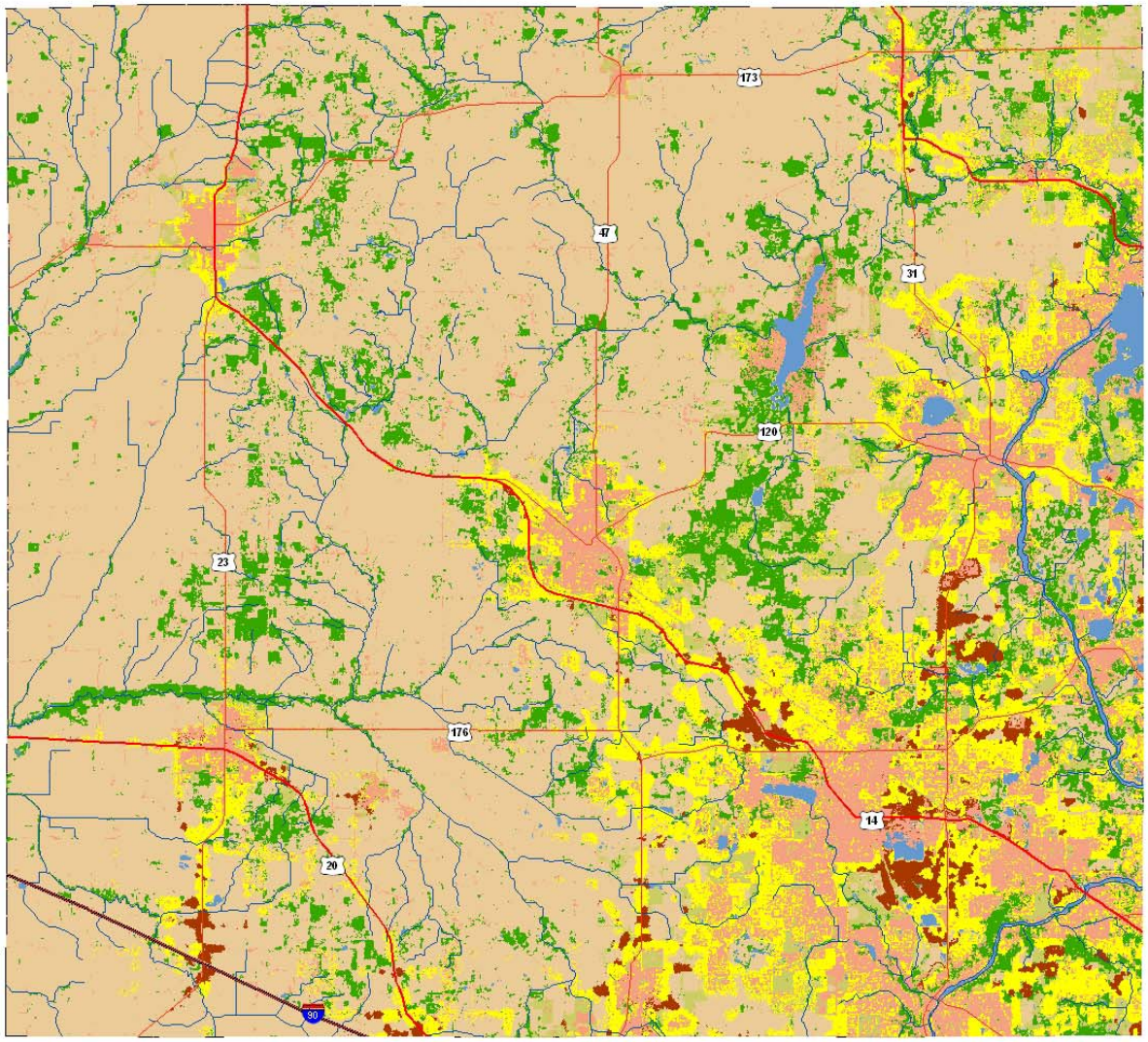
LEAM Scenario 2



McHenry County 2030

New Merta Stations and I-90/Rt.23 Interchange: Landuse Change

- Stream
- Interstate
- US route
- State route

Land Use 2030

- New Commercial Development
- New Residential Development
- Developed
- Urban Open Space
- Others
- Forest
- Water

0 1 2 3 4 5 Miles

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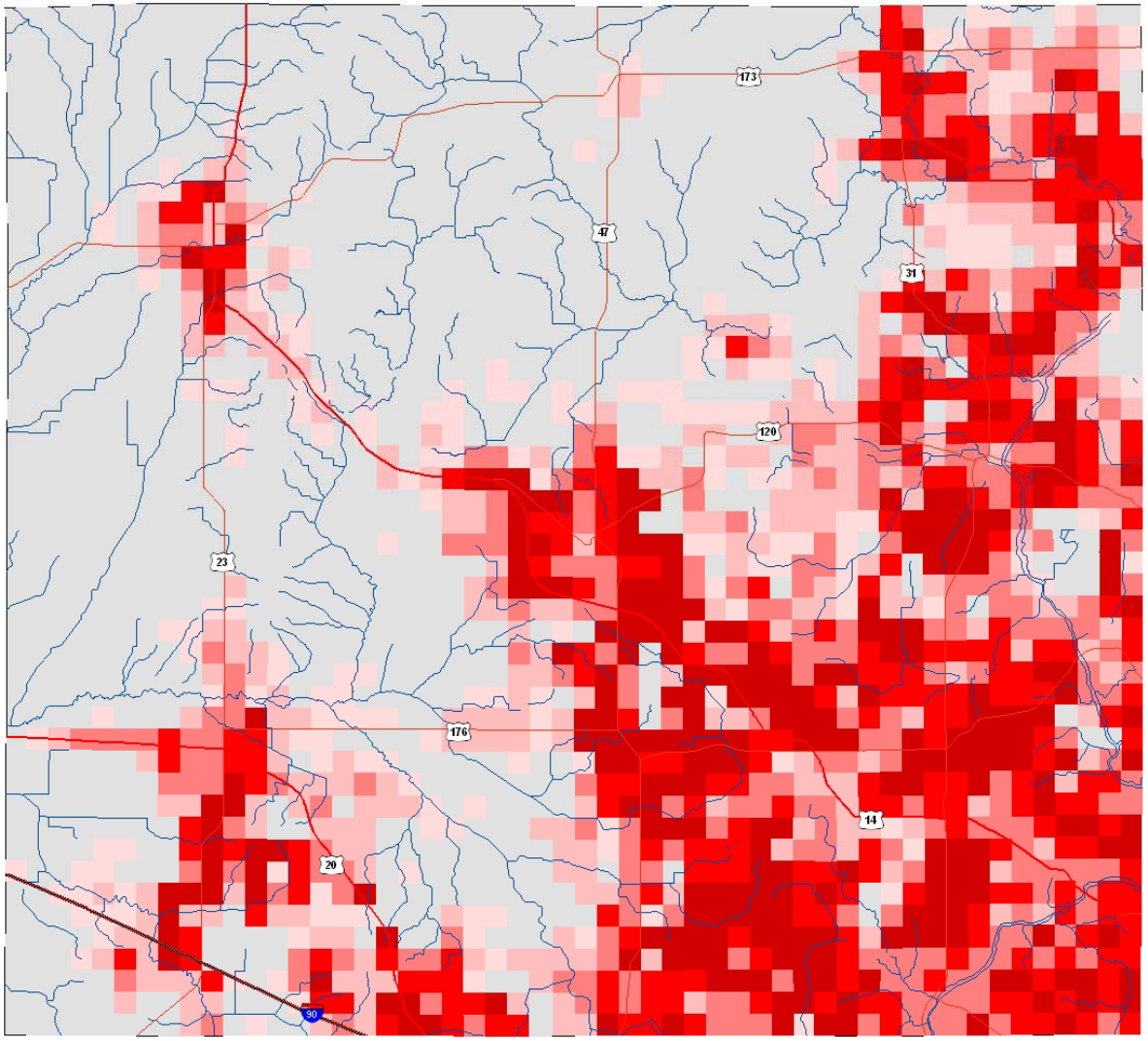
LEAM Scenario 2



McHenry County 2030

Households Change: Scenario 2

- Stream
- Interstate
- US route
- State route

Household Increase

- 1 to 7
- 7 to 33
- 33 to 79
- 79 to 146
- 146 or more

Scenario 2: New Ramp and Metra Stations

0 1 2 3 4 5 Miles

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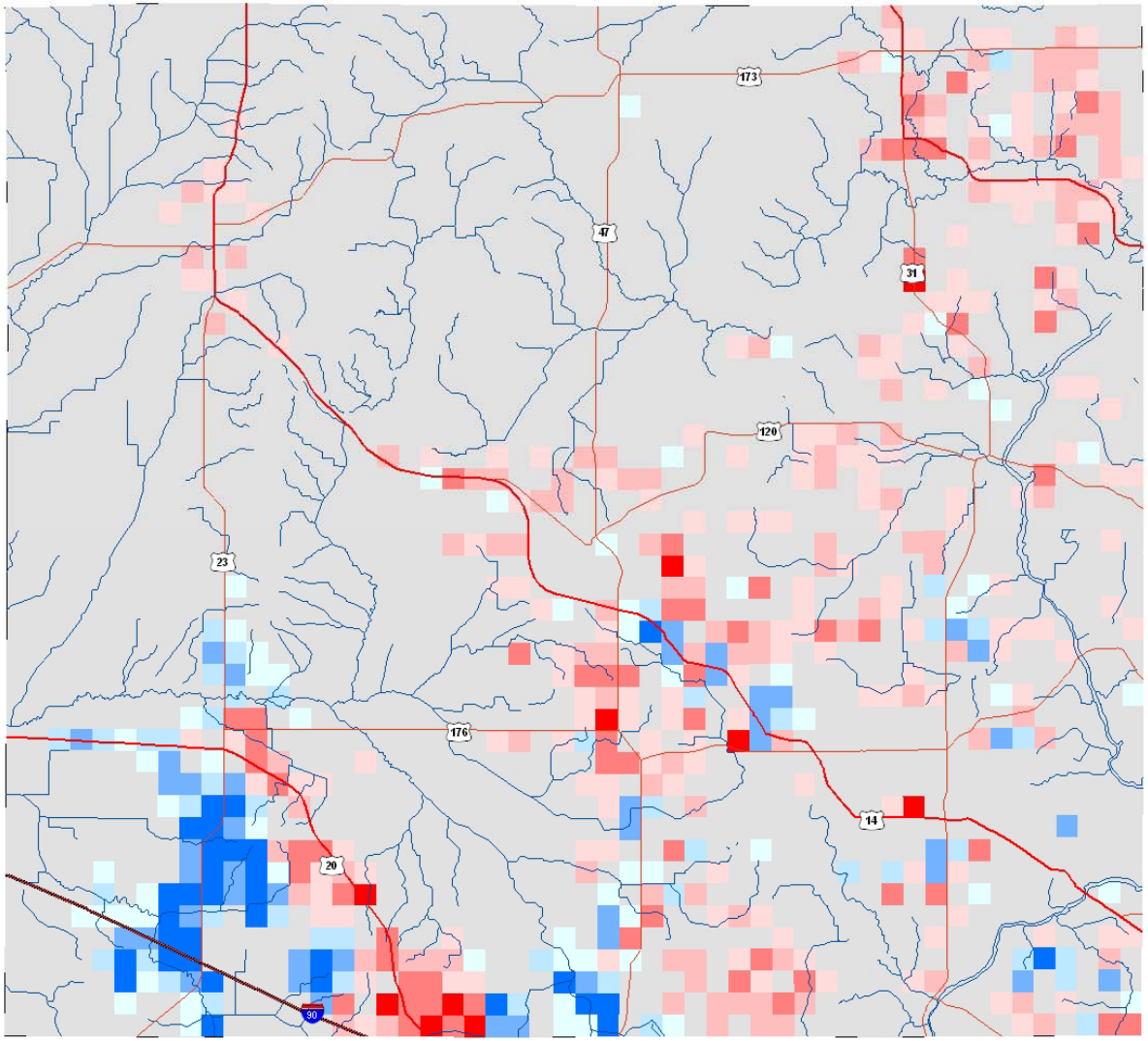
LEAM Scenario 2



McHenry County 2030

Households Change: Scenario 1 / Scenario 2

- Stream
- Interstate
- US route
- State route

Household Change

- 50 or more in Scenario 1
- 20 to 50
- 10 to 20
- 5 to 10
- Insignificant/No Change
- 5 to 10
- 10 to 20
- 20 to 50
- 50 or more in Scenario 2

Scenario 1: Baseline Scenario
Scenario 2: New ramp and Metra Stations

0 1 2 3 4 5 Miles

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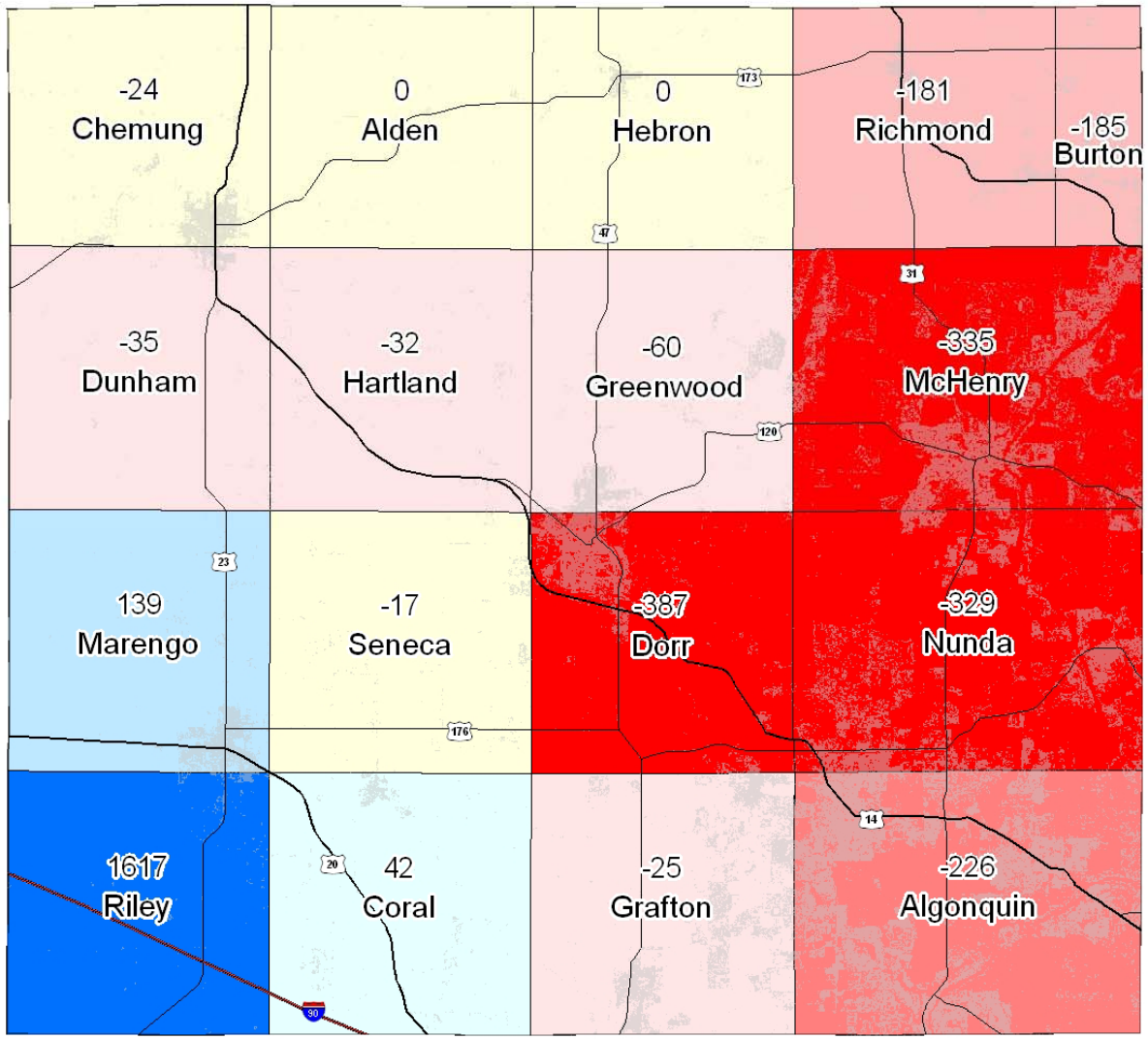
LEAM Scenario 2



McHenry County 2030

Development Comparison: Base Scenario / Ramp&Station

- Interstate
- US route
- State route
- Developed Area

Difference (in Acres)

- -300 or less (Lose)
- -300 to -200
- -200 to -100
- -100 to -25
- Insignificant change
- 25 to 100
- 100 to 200
- 200 to 300
- 300 or more (Gain)

Miles
0 1 2 3 4 5

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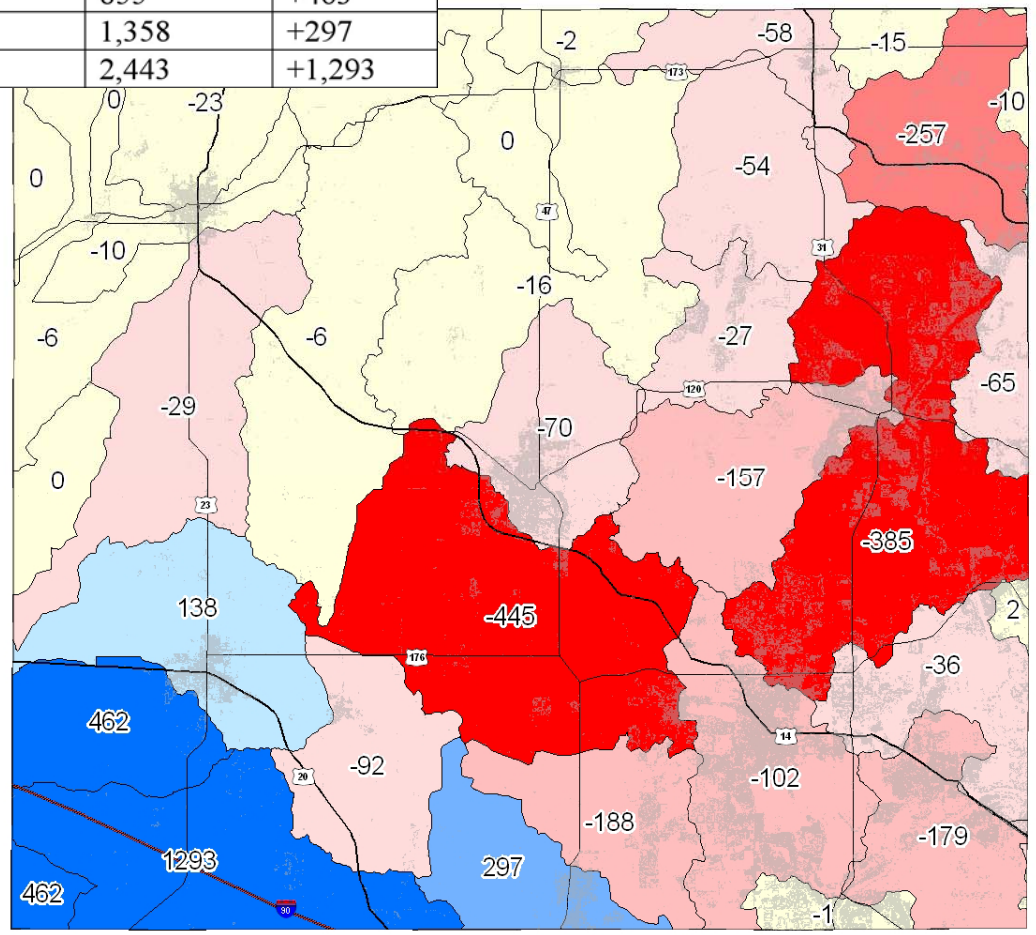
LEAM Scenario 2

Watershed ID	Scenario 1	Scenario 2	Difference
31	2,835	2,578	-257
71	11,958	11,574	-384
101	7,011	6,566	-445
123	393	855	+463
136	1,061	1,358	+297
138	1,150	2,443	+1,293



McHenry County 2030

Development Comparison by Watersheds: Scenario 1 / Scenario 2

- Interstate
- US route
- State route
- Developed Area

Difference (in Acres)

- 300 or more in Scenaro 1
- 200 to 300
- 100 to 200
- 25 to 100
- Insignificant change
- 25 to 100
- 100 to 200
- 200 to 300
- 300 or more in Scenario 2

Scenario 1: Baseline Scenario
Scenario 2: New Ramp and Metra Stations

Miles
0 1 2 3 4 5

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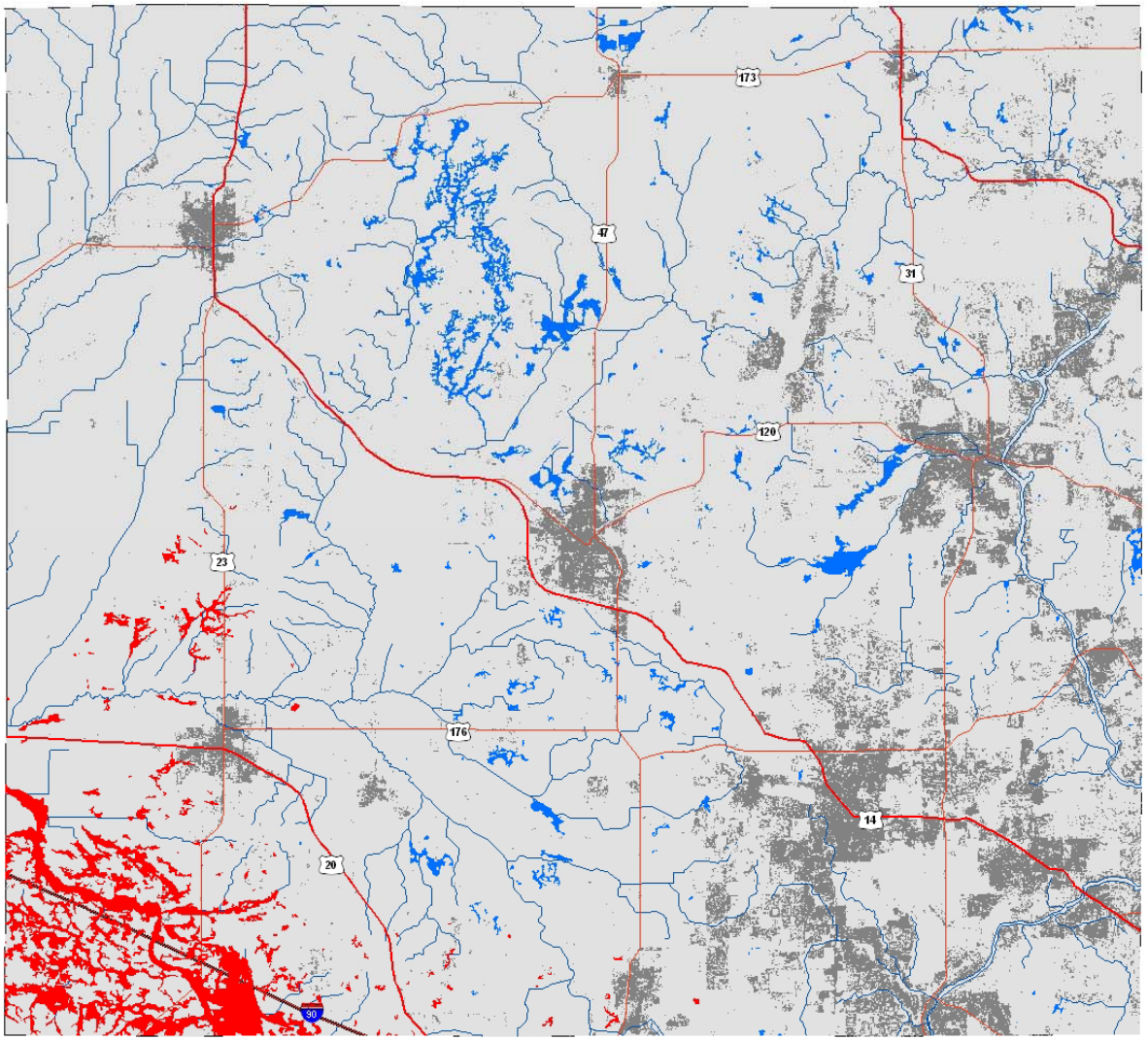
Stress Analysis



McHenry County

Development Pressure on Hydric Soils Scenario 1/ Scenario 2

- Stream
- Interstate
- US route
- State route
- Developed Area

Stress Difference

- Hydric Soil stress is higher in Scenario 1
- Hydric Soil stress is higher in Scenario 2

Scenario 1: Baseline Scenario

Scenario 2: New ramp and Metra stations

0 1 2 3 4 5 Miles

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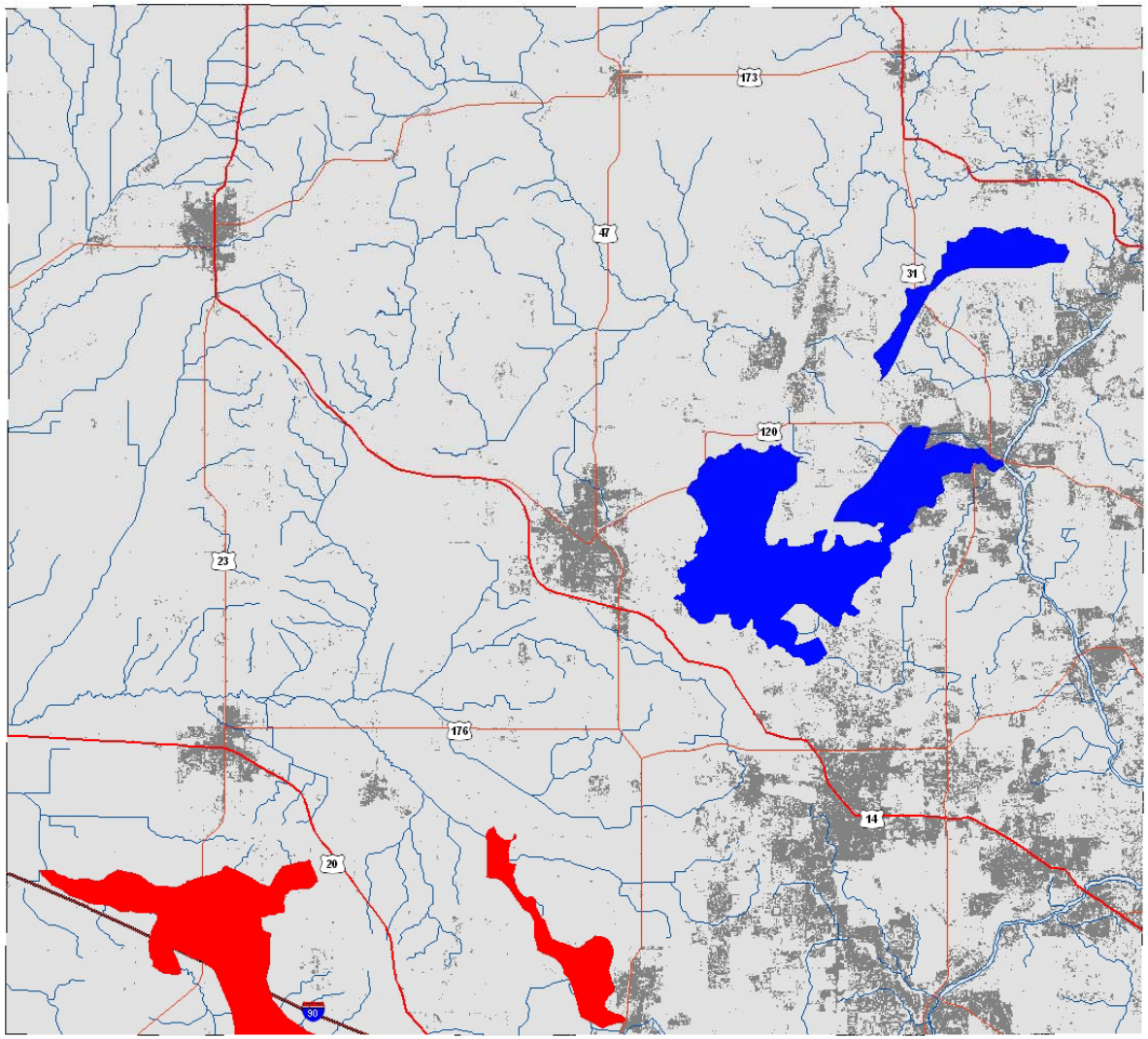
Stress Analysis



McHenry County

Development Pressure on Areas with Very High Recharge Potential Scenario 1/ Scenario 2

- Stream
- Interstate
- US route
- State route
- Developed Area

Stress Difference

- Stress is higher in Scenario 1
- Stress is higher in Scenario 2

Scenario 1: Baseline Scenario

Scenario 2: New ramp and Metra stations

0 1 2 3 4 5 Miles

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pLEAM

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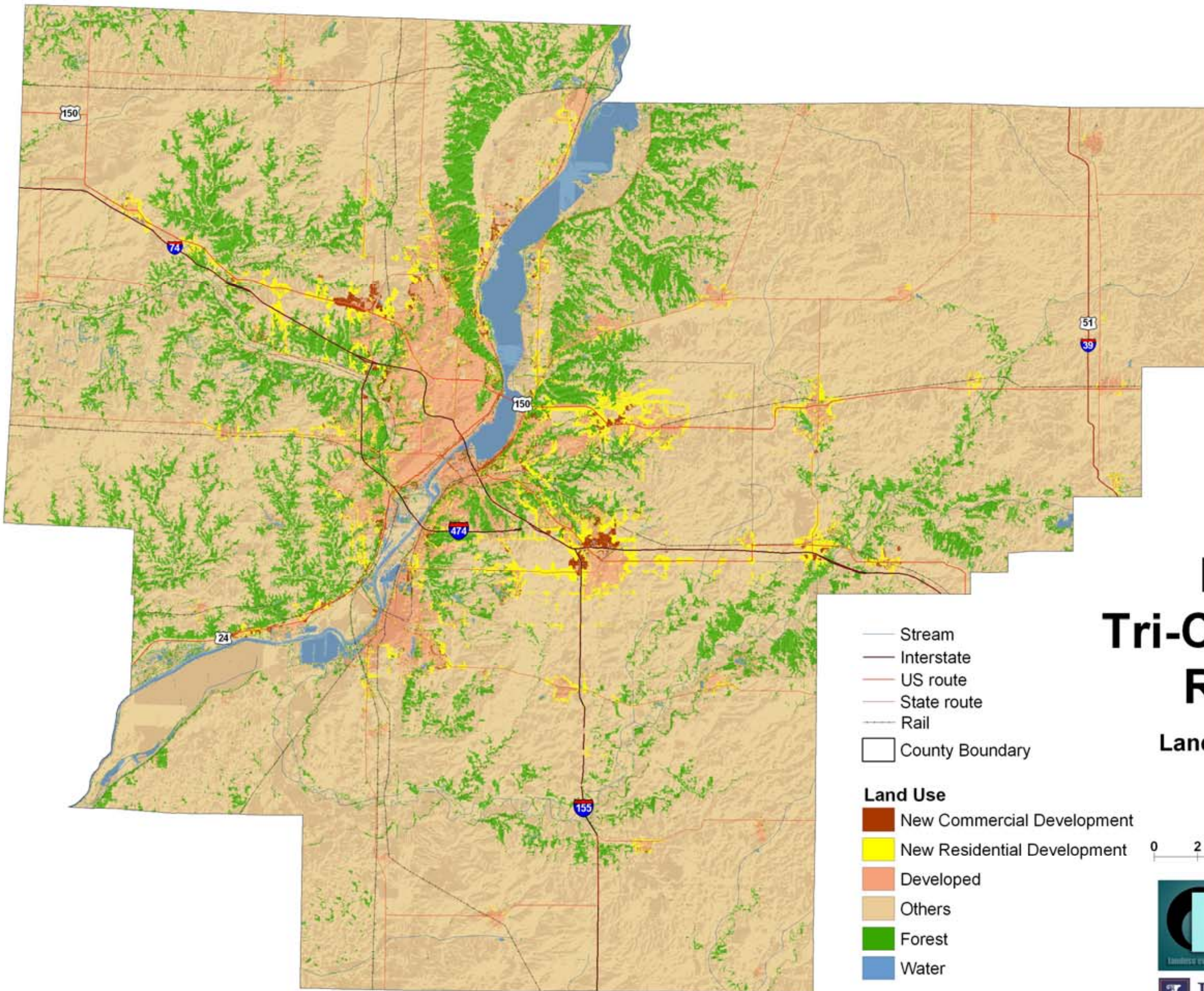

Peoria Tri-County Region

Landuse Change

Stream
Interstate
US route
State route
Rail
County Boundary

Land Use

- New Commercial Development
- New Residential Development
- Developed
- Others
- Forest
- Water

0 2 4 Miles

NORTH

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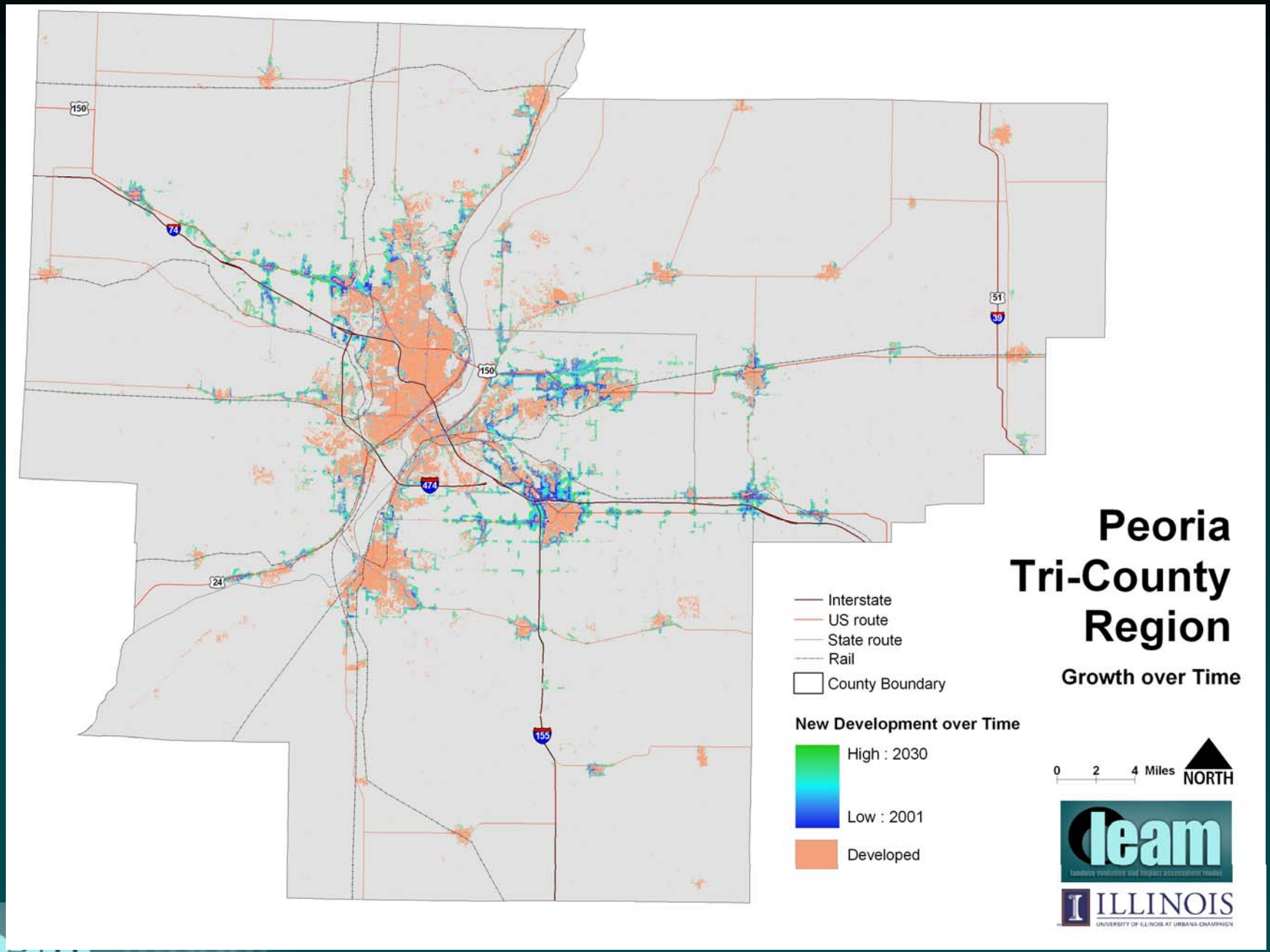
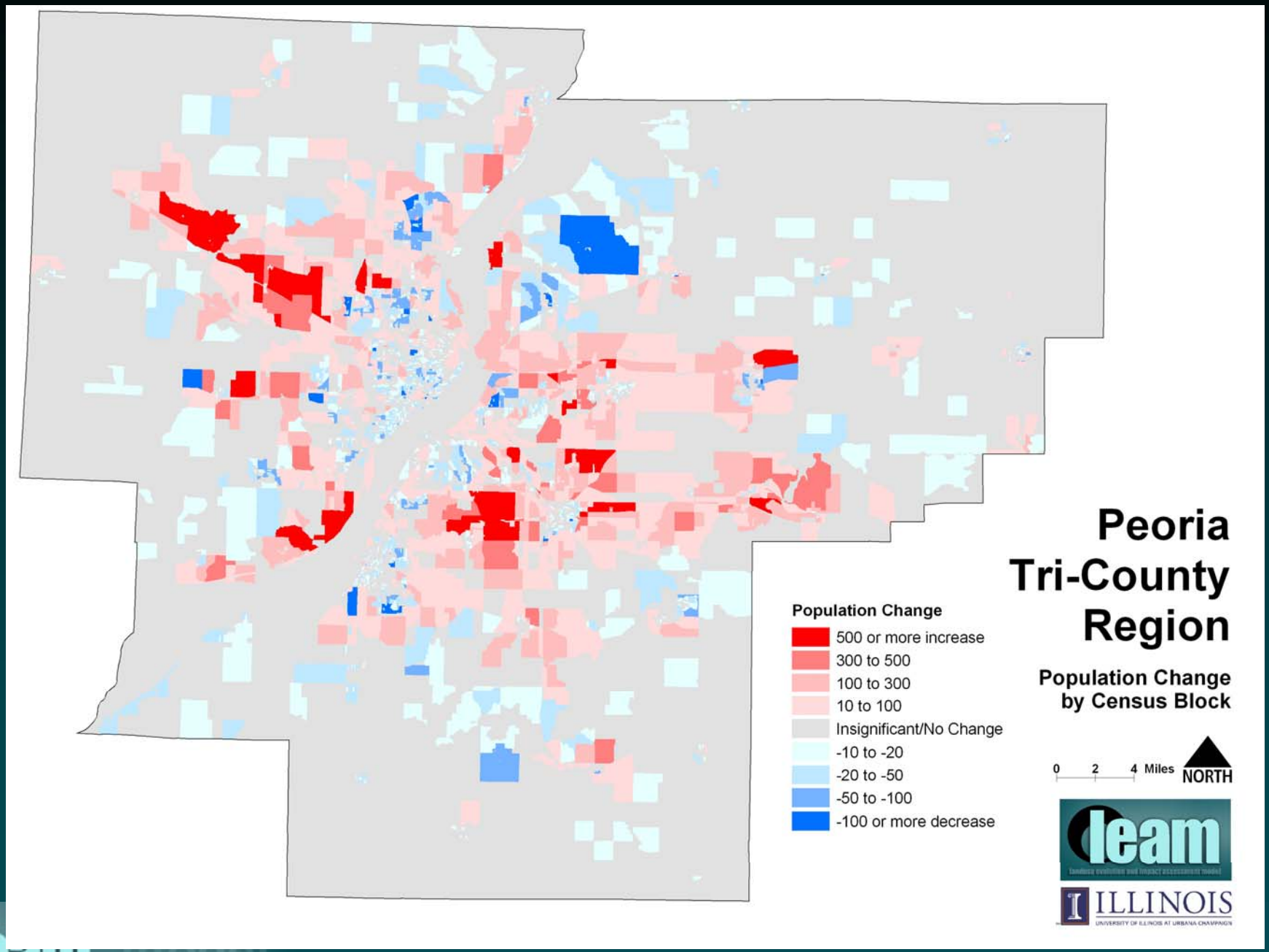


landuse evolution and impact assessment model

Population Changes

- New cells in each Census Block translated into households
  - Land consumed per household increases
- New households translated into population
  - People per household decreases
  - Blocks with no new development see population declines
- Blocks aggregated to School Districts
  - Some Districts with little growth see declining population


Peoria
Tri-County
Region
Population Change
by Census Block
Population Change
500 or more increase
300 to 500
100 to 300
10 to 100
Insignificant/No Change
-10 to -20
-20 to -50
-50 to -100
-100 or more decrease
0 2 4 Miles
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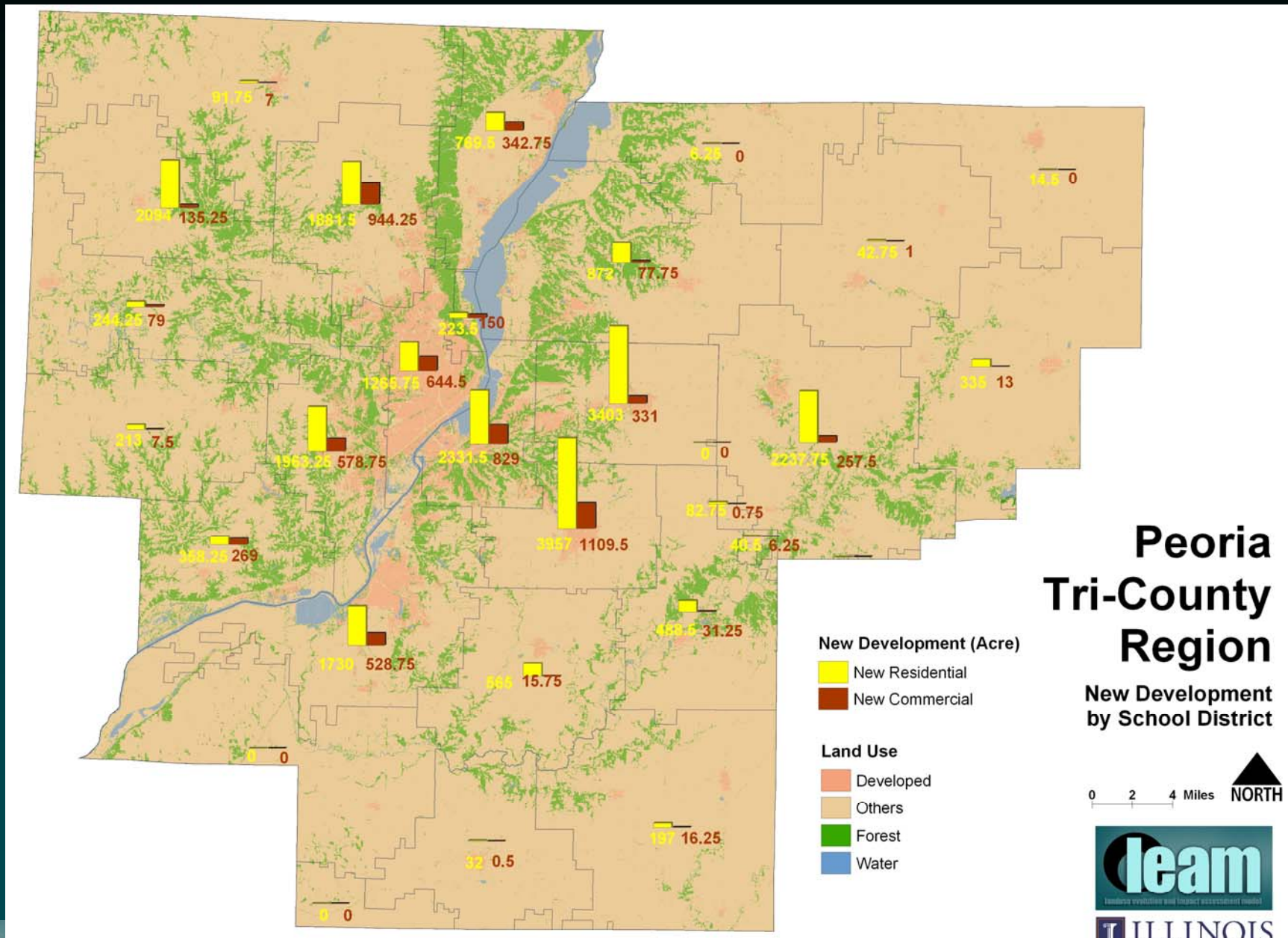

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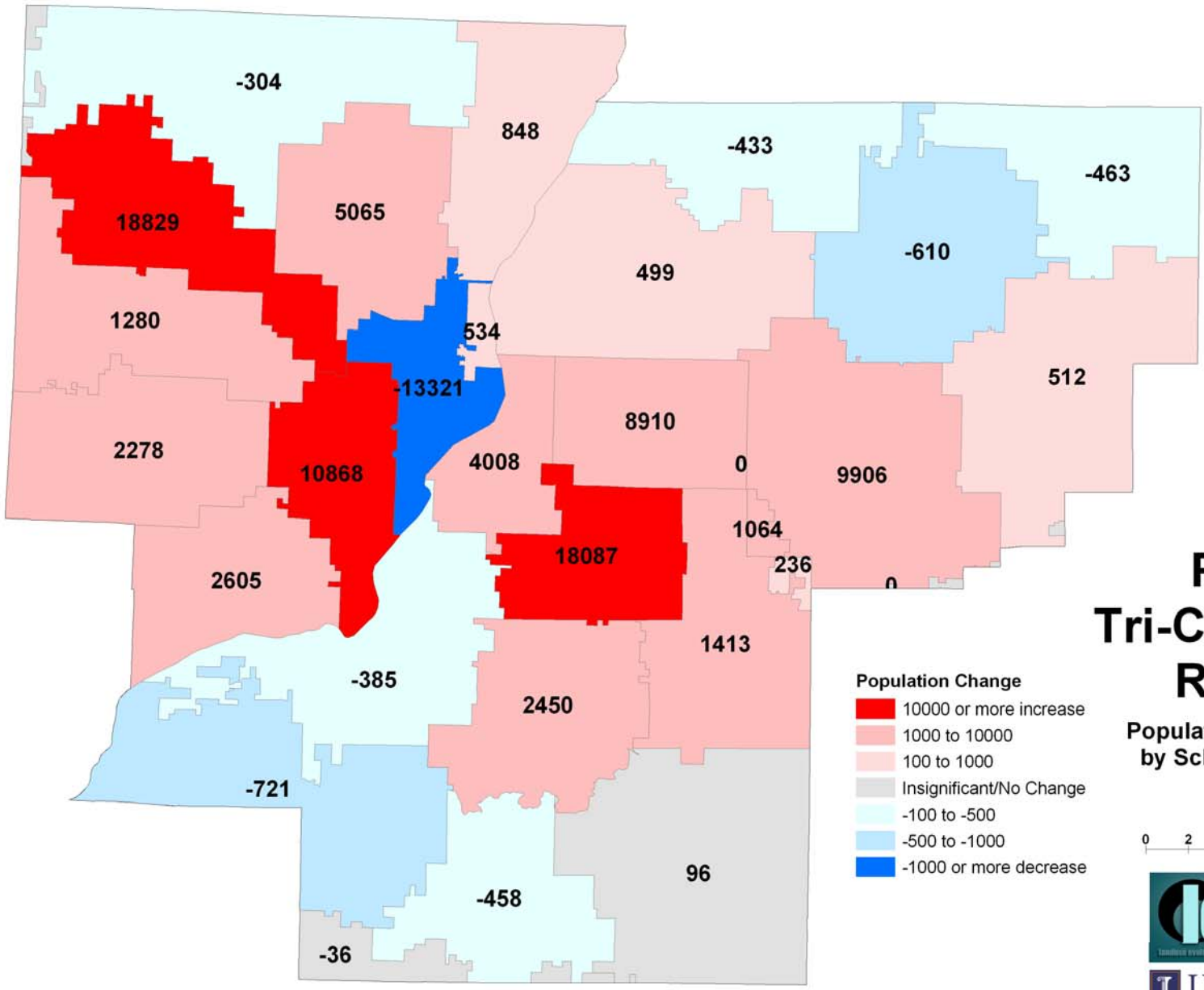
-304
848
-433
-463
18829
5065
499
-610
1280
534
512
-13321
8910
2278
10868
4008
0
9906
1064
18087
236
2605
0
1413
-385
2450
-721
96
-458
-36
Population Change
10000 or more increase
1000 to 10000
100 to 1000
Insignificant/No Change
-100 to -500
-500 to -1000
-1000 or more decrease
Peoria Tri-County Region
Population Change by School District
0 2 4 Miles
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and
impact assessment

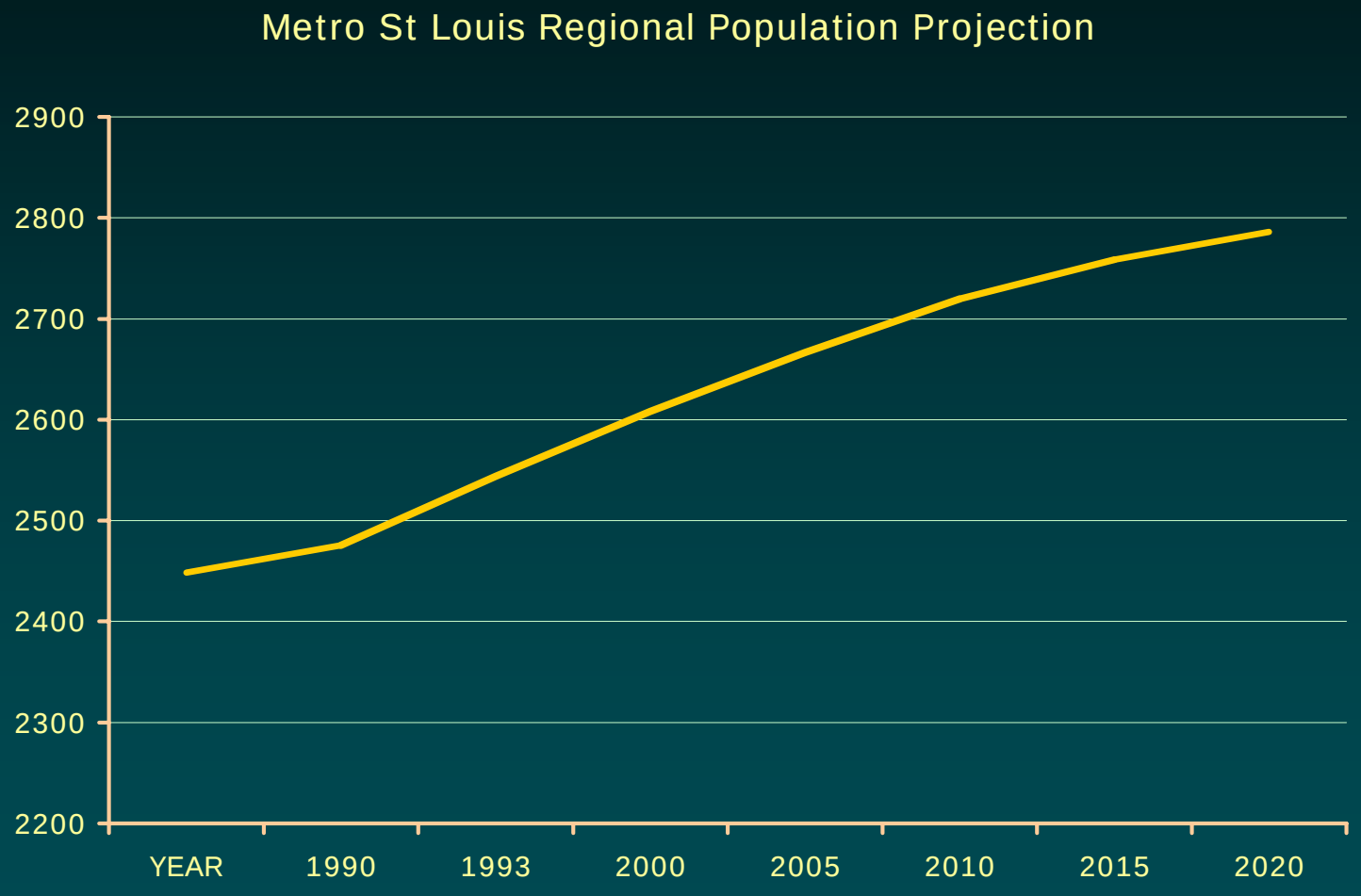
Blueprint-LEAM

landuse evolution leam and impact assessment model

Blueprint-LEAM Objectives

- Promote regional dialogue on land-use and planning
  - Simulate land-use change in the region
  - Engage and educate stakeholders in the region
- Examine development patterns in order to:
  - Improve the efficiency of the transportation system
  - Reduce their environmental impacts
    - Watershed planning efforts
  - Reduce the need for costly infrastructure investments
  - Insure efficient access to jobs, services and center of trade
- Create partnerships
  - Between governmental and non-governmental entities

LEAMecon Regional Population Projection



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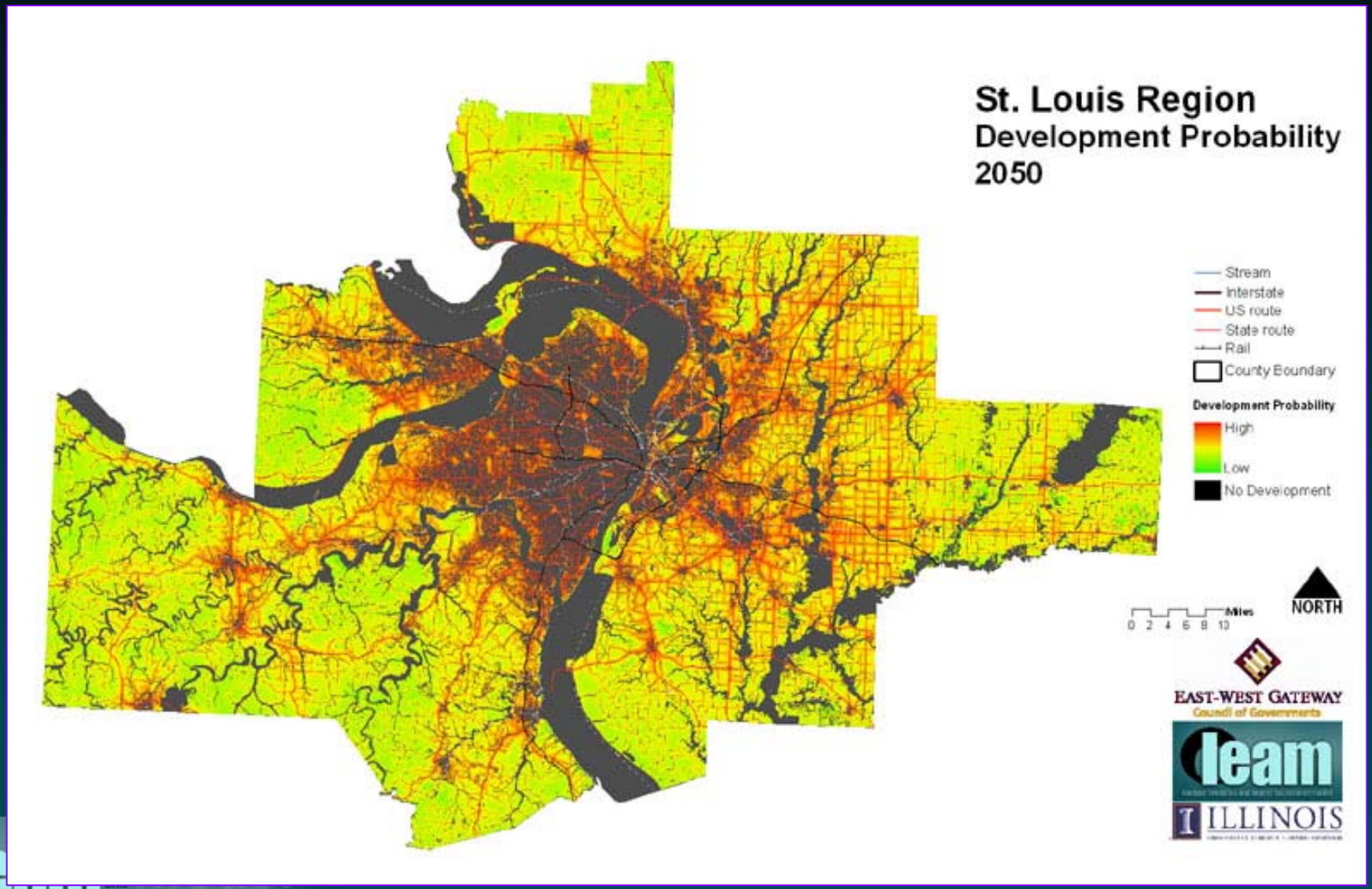
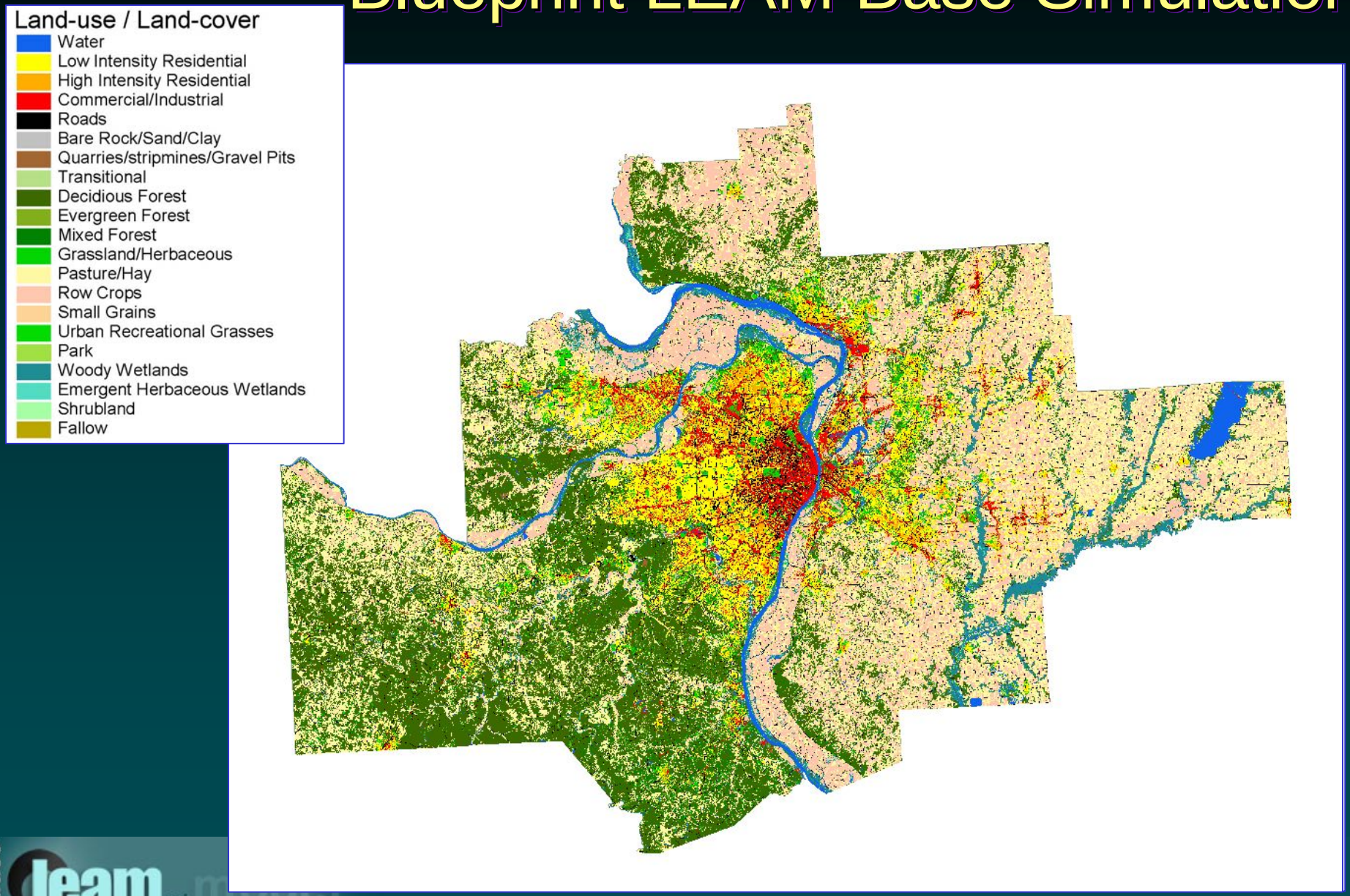
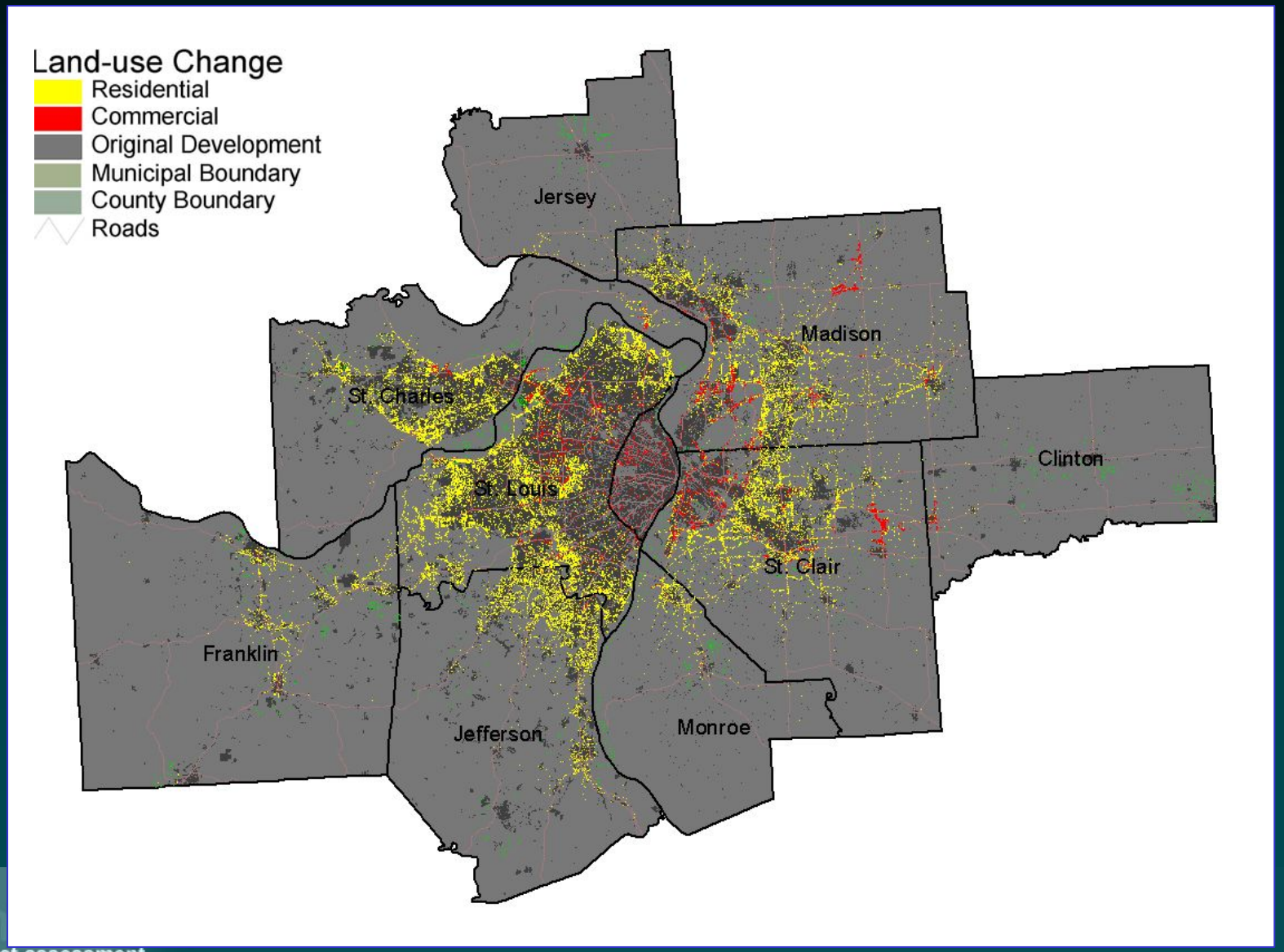
Blueprint-LEAM
Development Probabilities



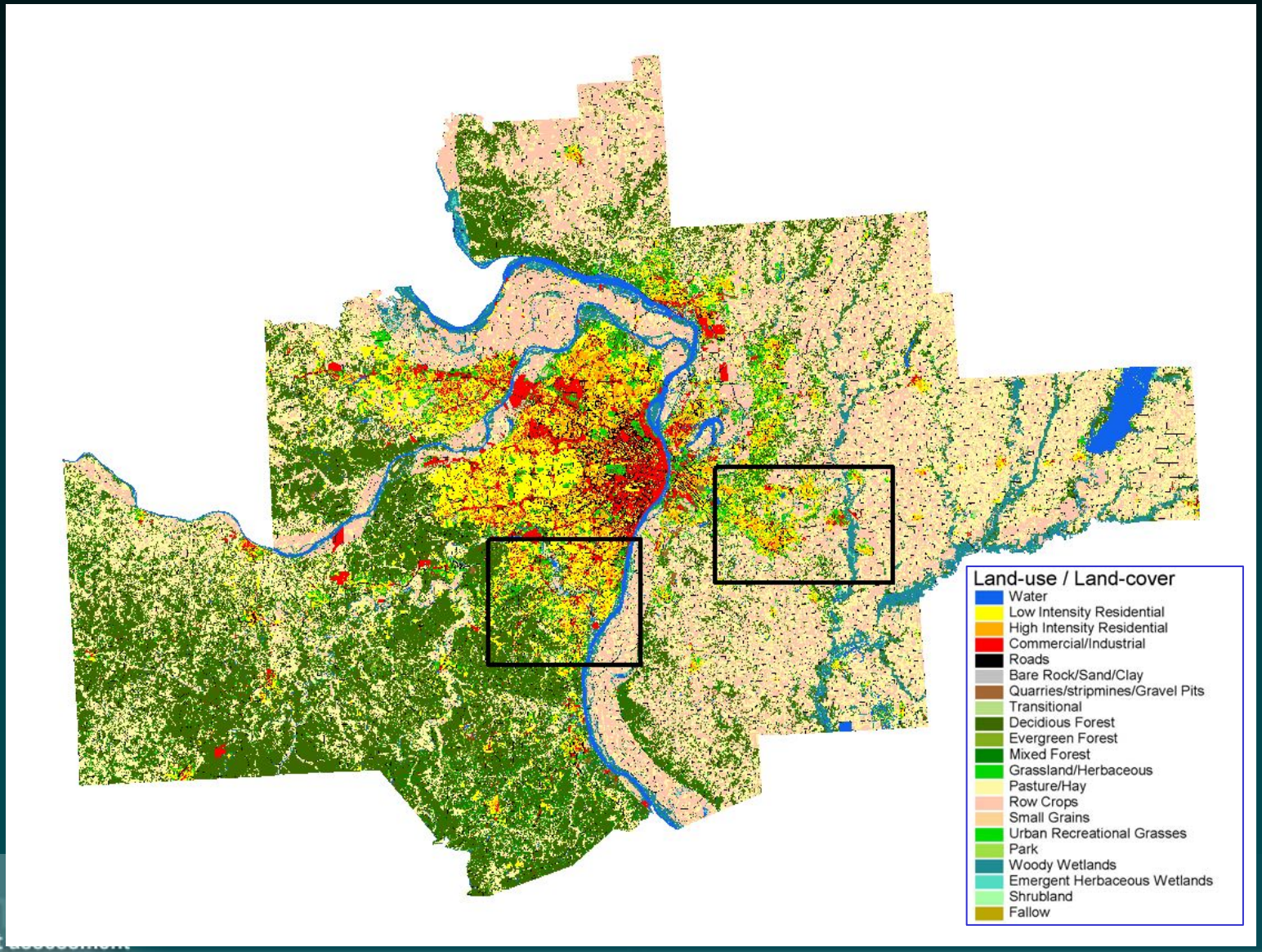
Blueprint LEAM Base Simulation



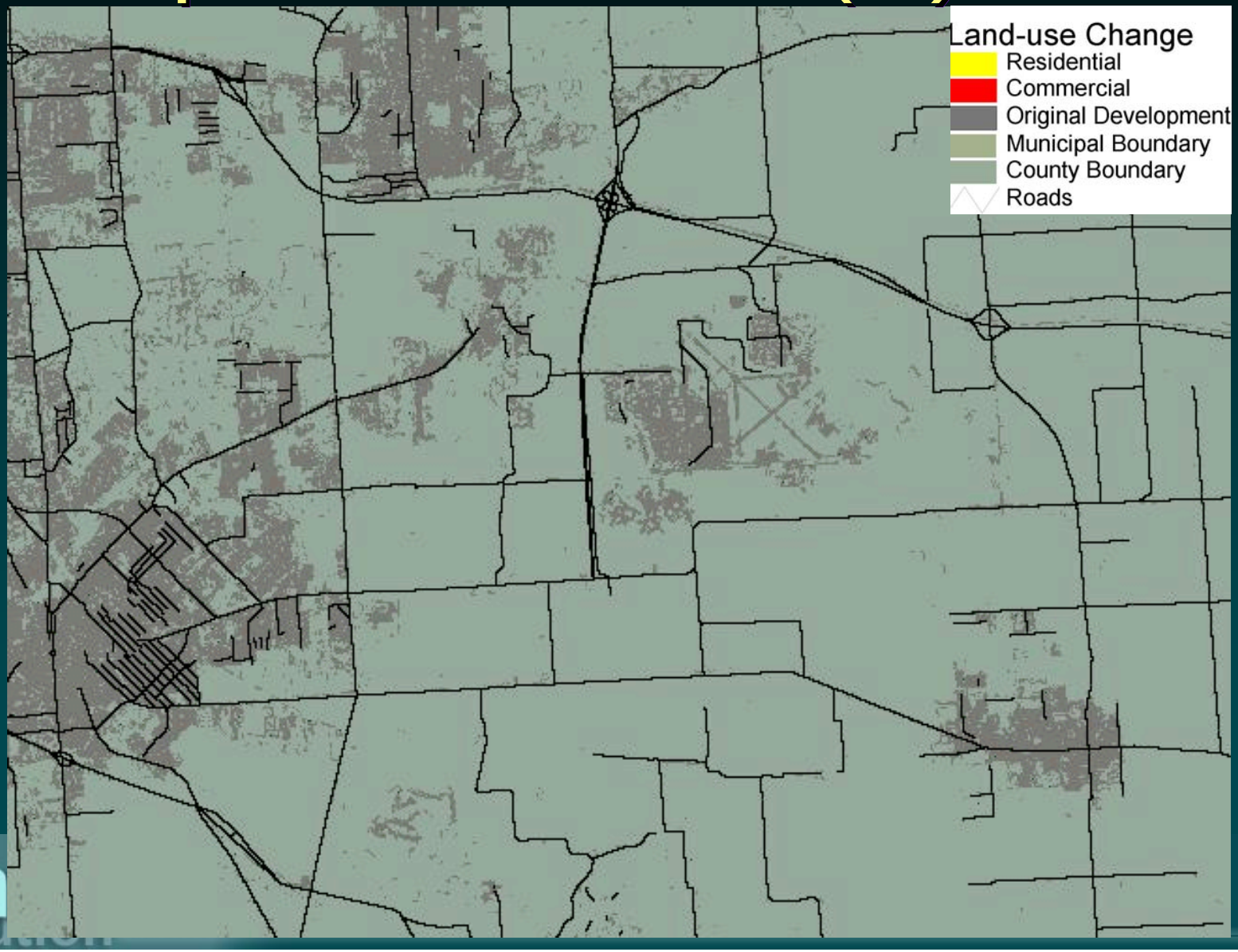
Blueprint Summary Map



Blueprint Animations



Blueprint Animation (IL)



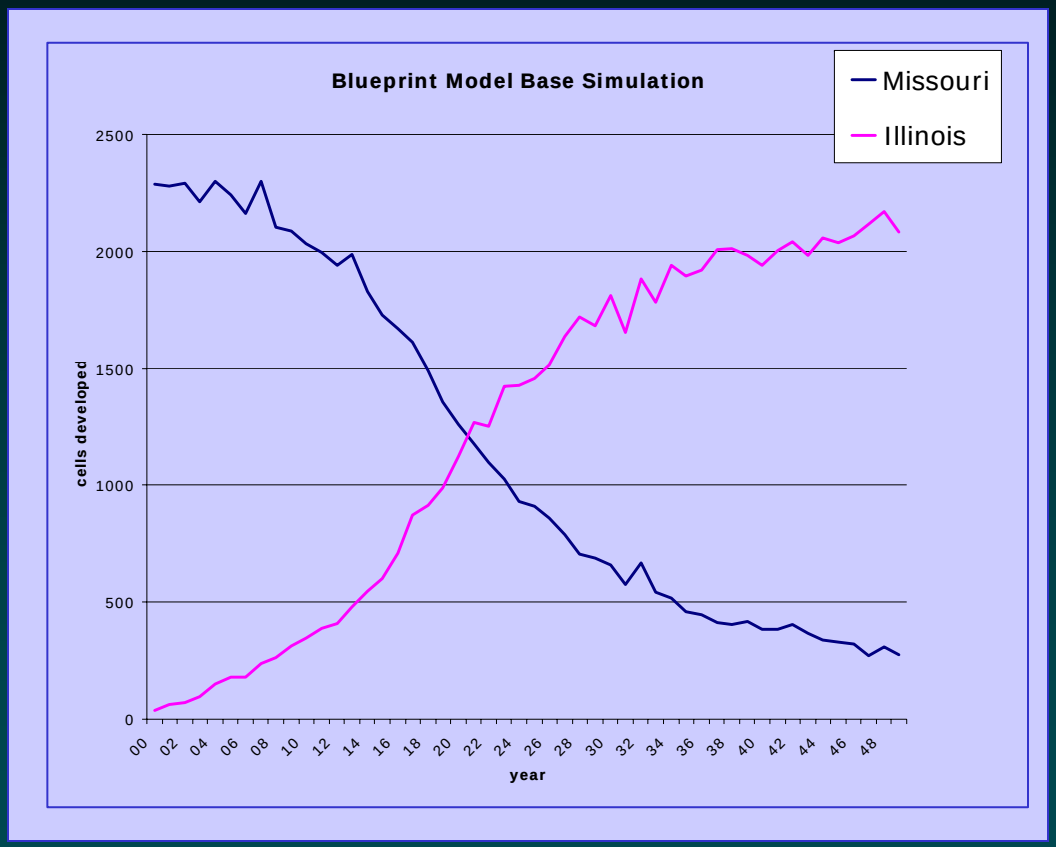
Analysis

Share of Growth by County and Region

	Residential		Commercial	
	Bluprnt		Bluprnt	
St. Louis City	0.1%		11.8%	
St. Charles	12.4%		3.8%	
St. Louis	35.5%		31.7%	
Jefferson	11.3%		0.6%	
Franklin	4.0%		0.5%	
MO Total	**63.3%**		**48.4%**	
Jersey	0.3%		0.2%	
Madison	18.9%		24.2%	
St. Clair	15.4%		25.9%	
Monroe	1.9%		0.3%	
Clinton	0.3%		1.0%	
IL Total	**36.7%**		**51.6%**	
Region Total	691057		119564	

- Residential Growth
  - A reasonable outcome
    - Based on historic patterns
  - Gainers
    - St Louis, St Charles, Jefferson
    - Madison, St Clair
- Commercial growth
  - Still needs calibration

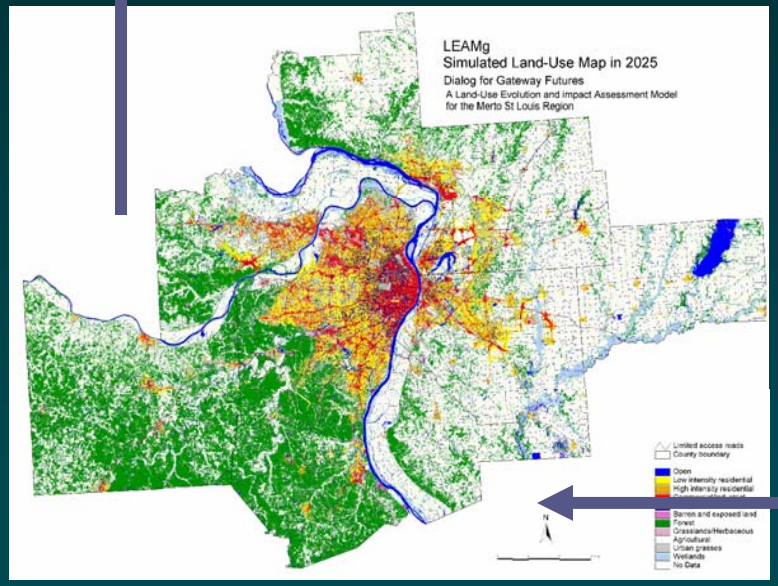
Analysis



- Quick MO growth
- Begins to decline as valuable cells are built-up
- Growth moves to Illinois

Blueprint-LEAM Implications

LEAMtrans



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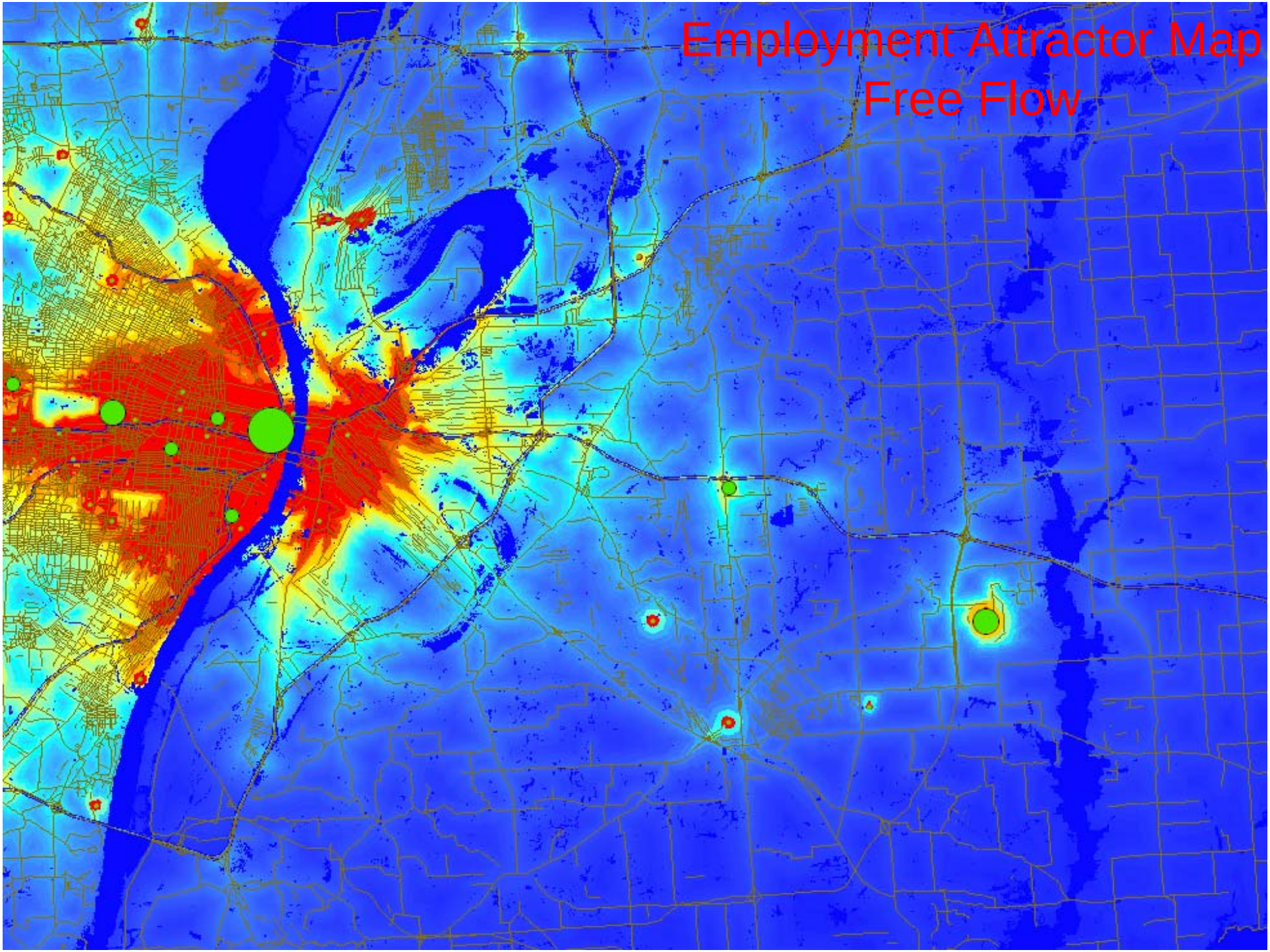
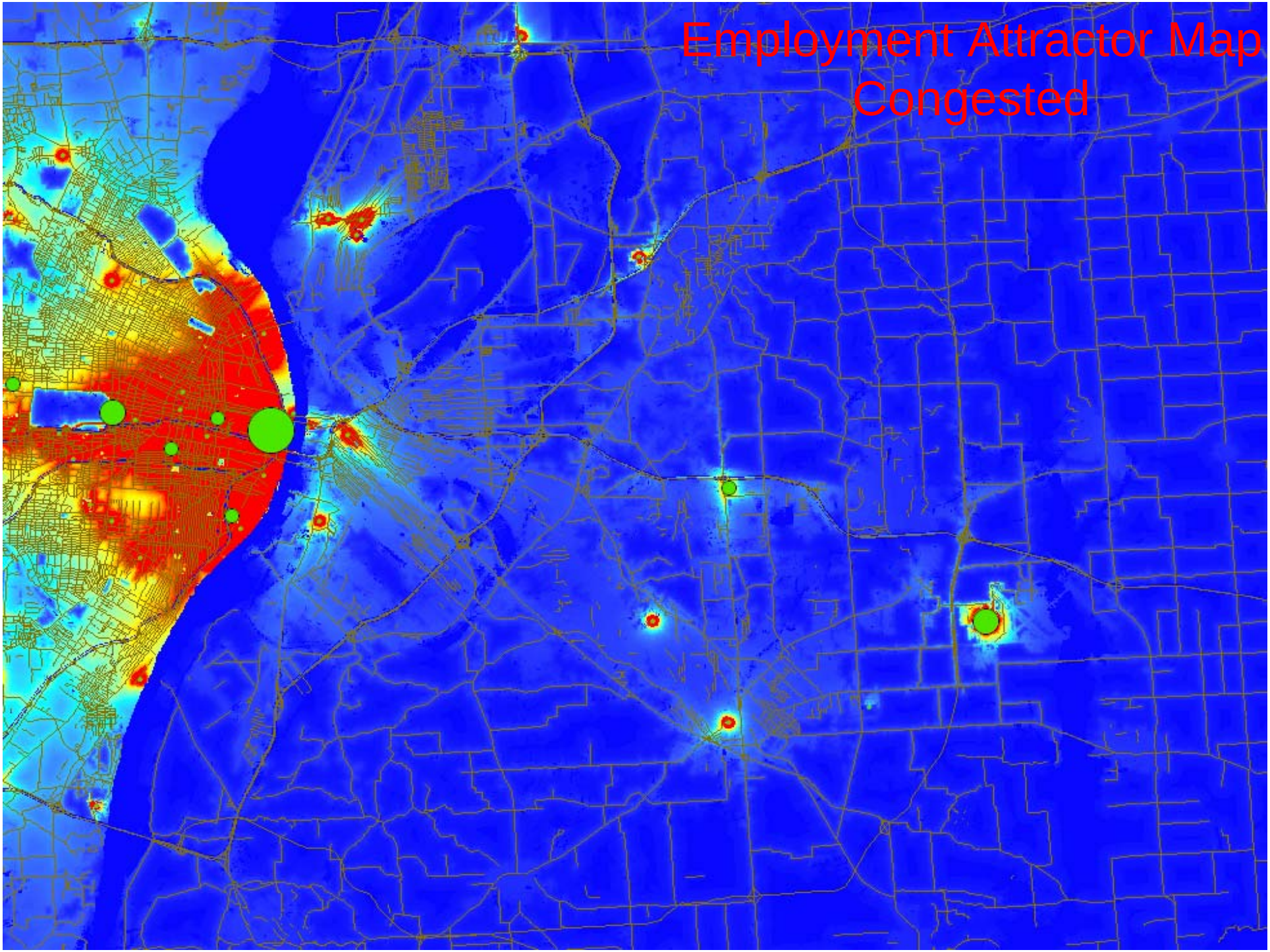

Employment Attractor Map
Free Flow


Employment Attractor Map
Congested

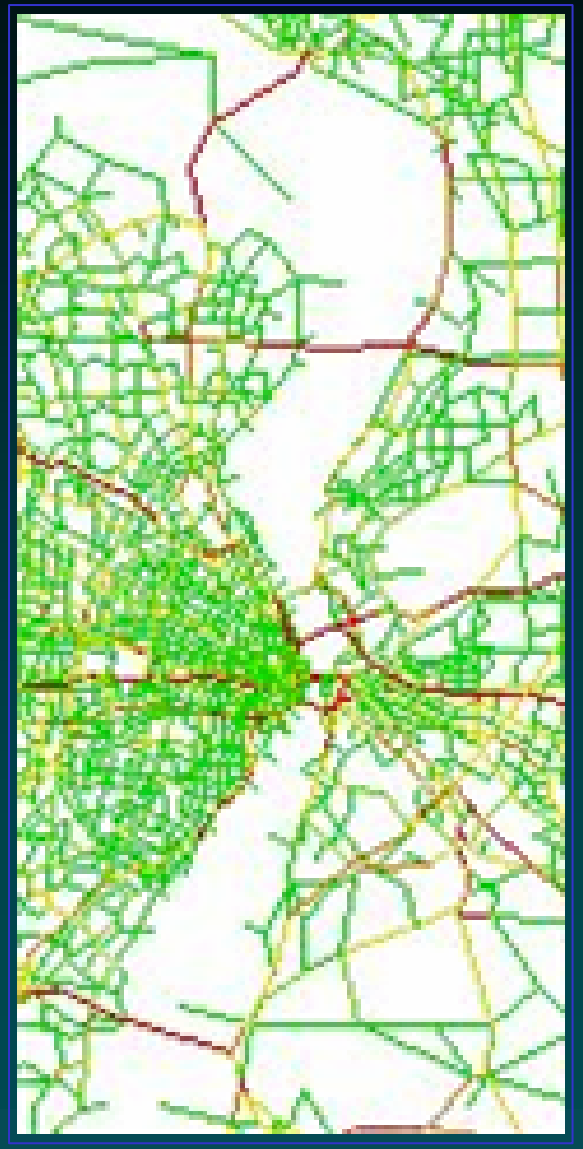
Trans Impacts

2025 traffic forecast

volume over capacity

Output Detail

- 2025
  - Bridge congestion
  - Illinois growth and congestion



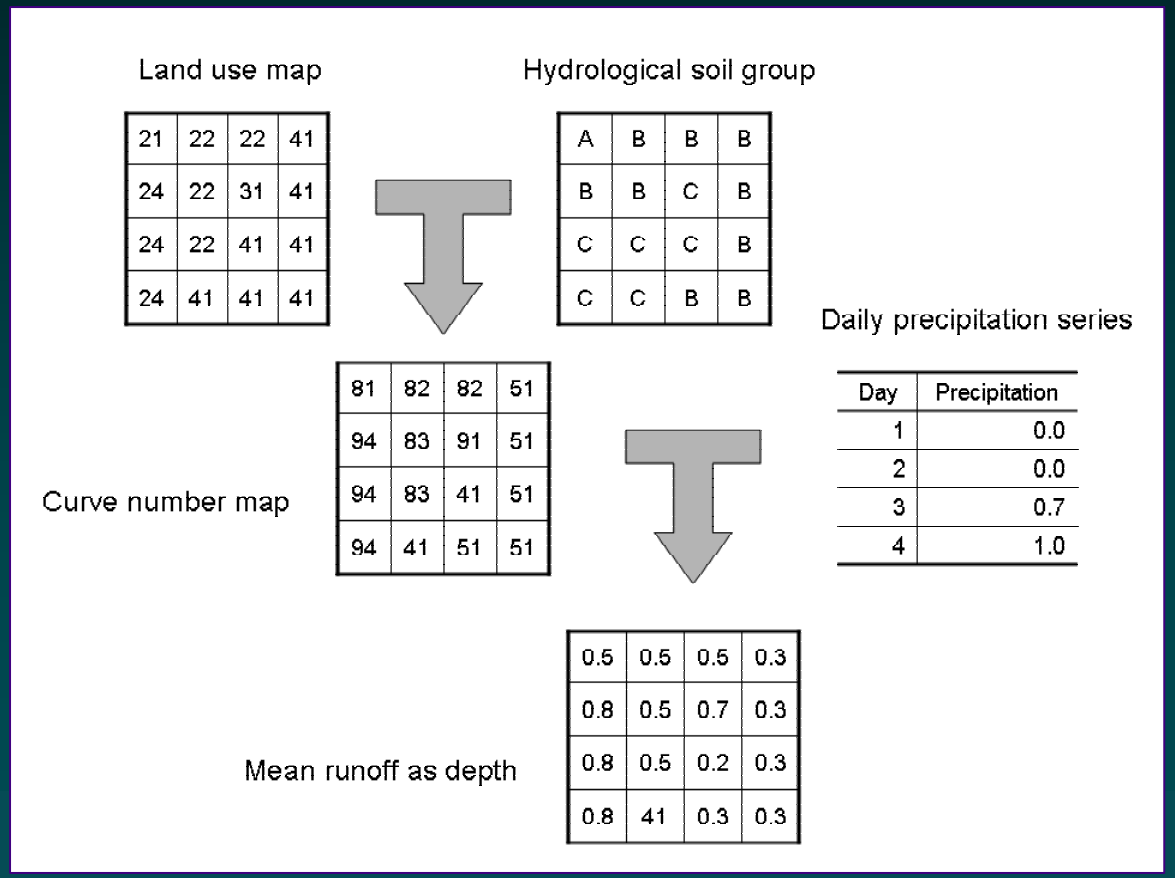
LEAMwq

Assessing Land Use, Water Quality and Quantity

- Begin with first-order approximations
  - L-THIA
  - Long-Term Hydrologic Impact Assessment
- Escalate
  - to HSPF
    - Aggregate watershed modeling
      - If red flags are raised
      - If satisfactory answers are not forthcoming
- Escalate again
  - GSSHA
    - Cell based analysis
      - If red flags are raised
      - If satisfactory answers are not forthcoming

L-THIA

- Estimates average impacts on annual runoff and pollutant loading in runoff based on computations of daily runoff from long term climate records, soil data, curve number (CN) value, and land use of the study area.



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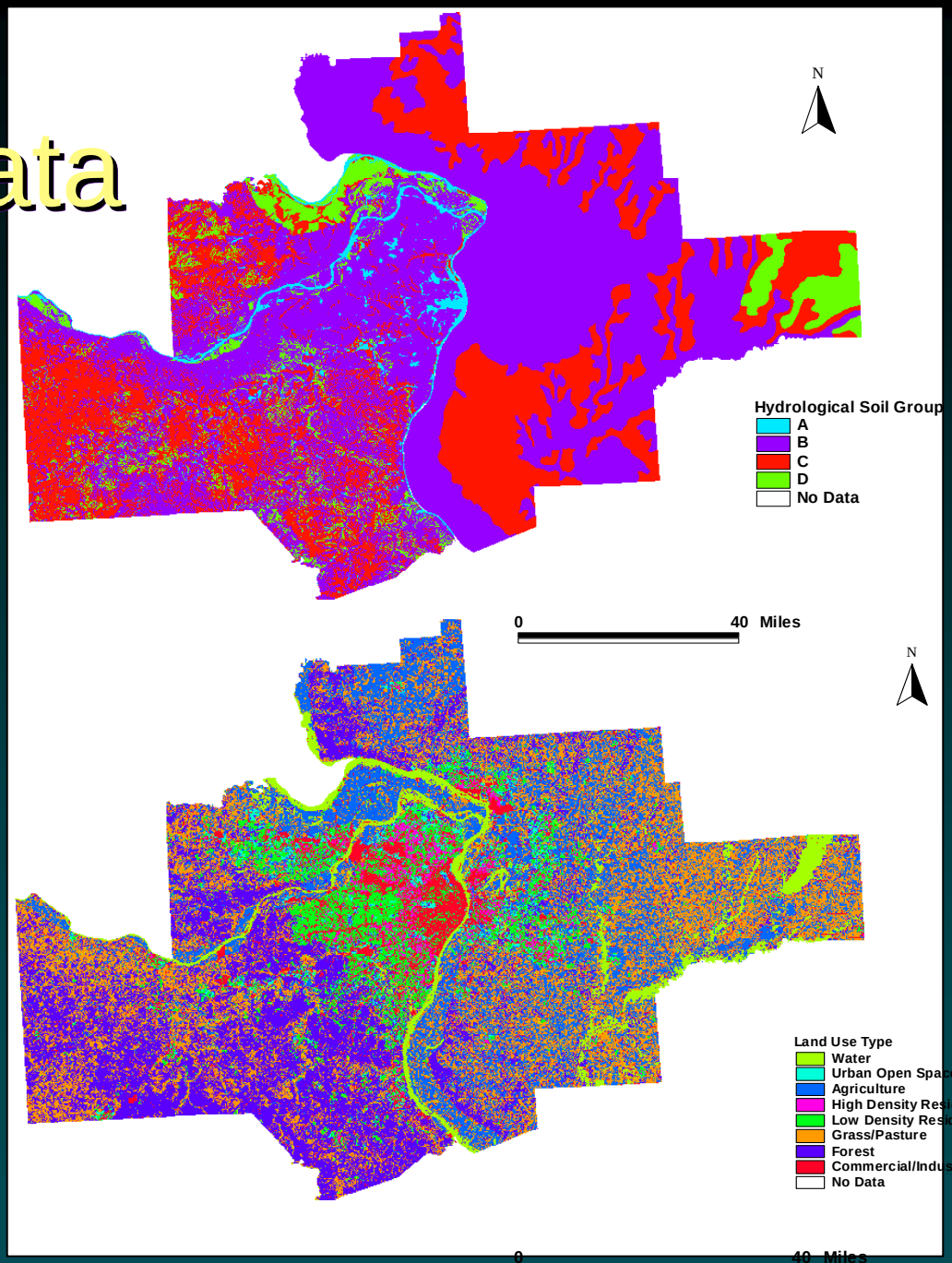
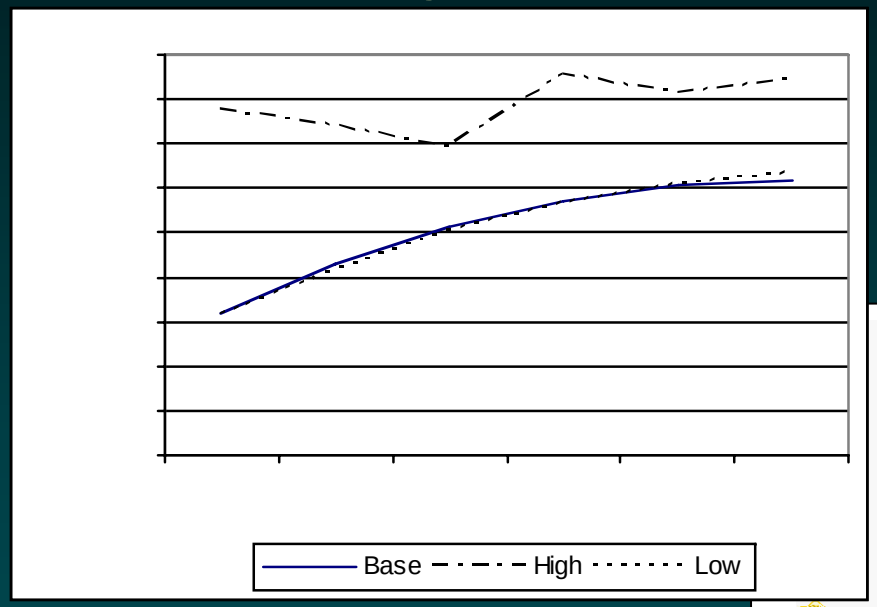
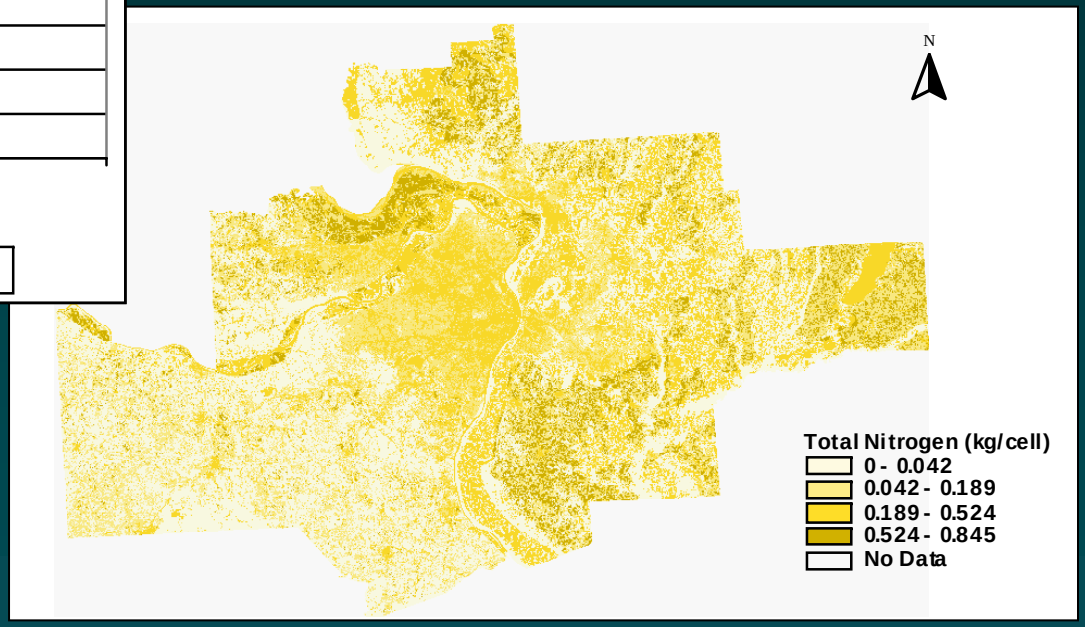
Some Input Data



LEAMwq Results

- The predicted total nitrogen (TN) loading under different growth scenarios: 2005-2030





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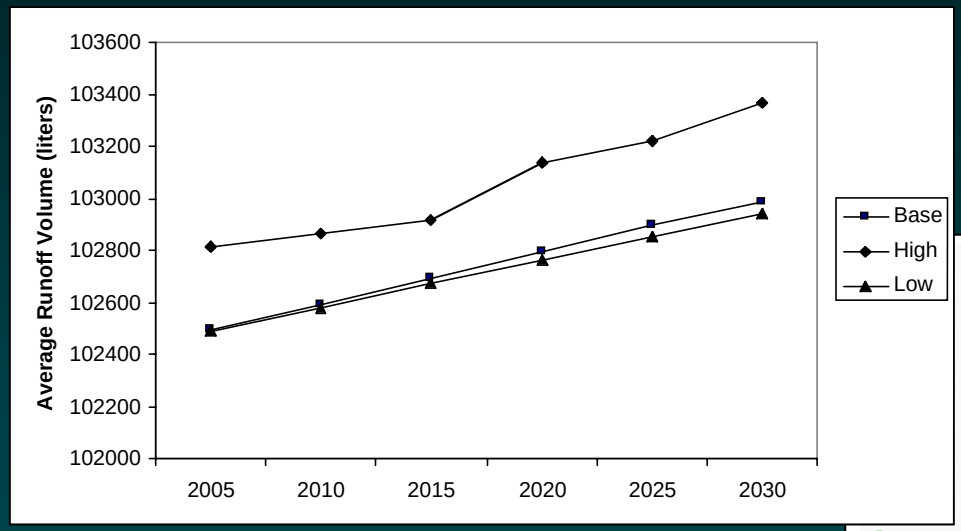
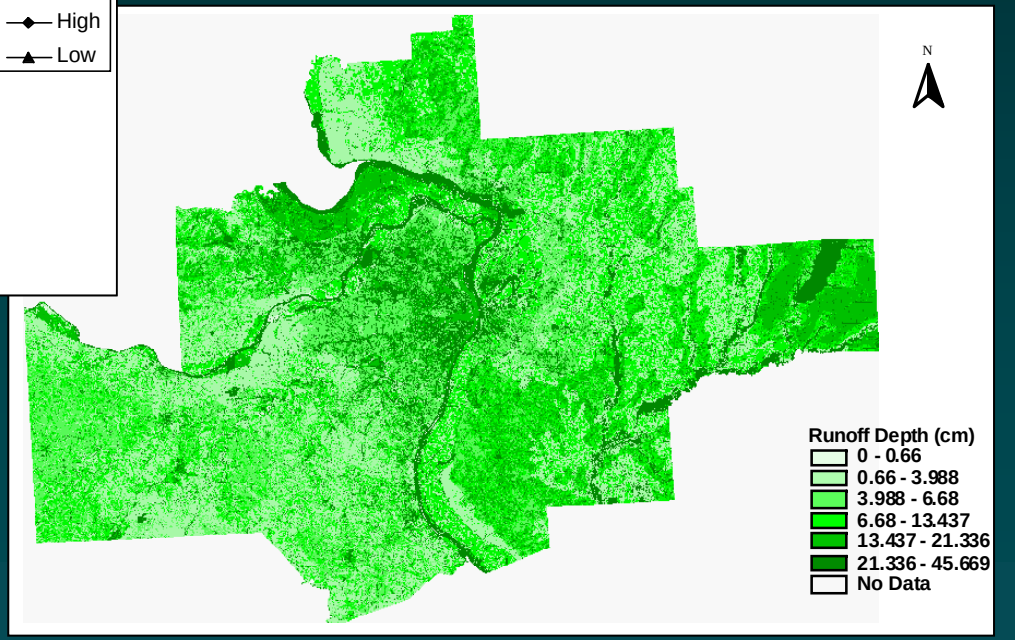
LEAMwq Runoff

- The predicted surface runoff with changing land use under different growth scenarios: 2005-2030





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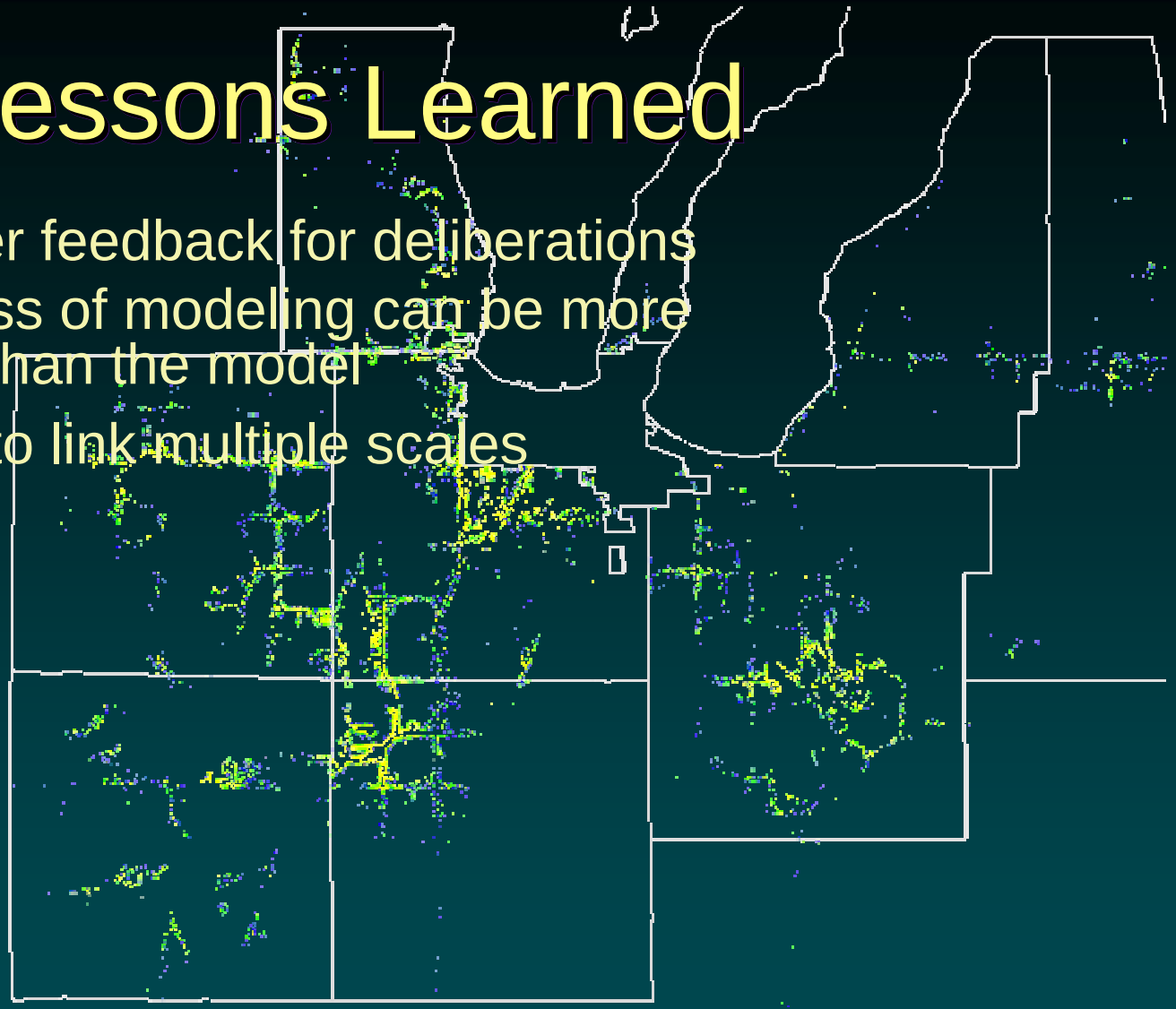
VGP8

Some Lessons Learned

- Need faster feedback for deliberations
- The process of modeling can be more important than the model
- The need to link multiple scales



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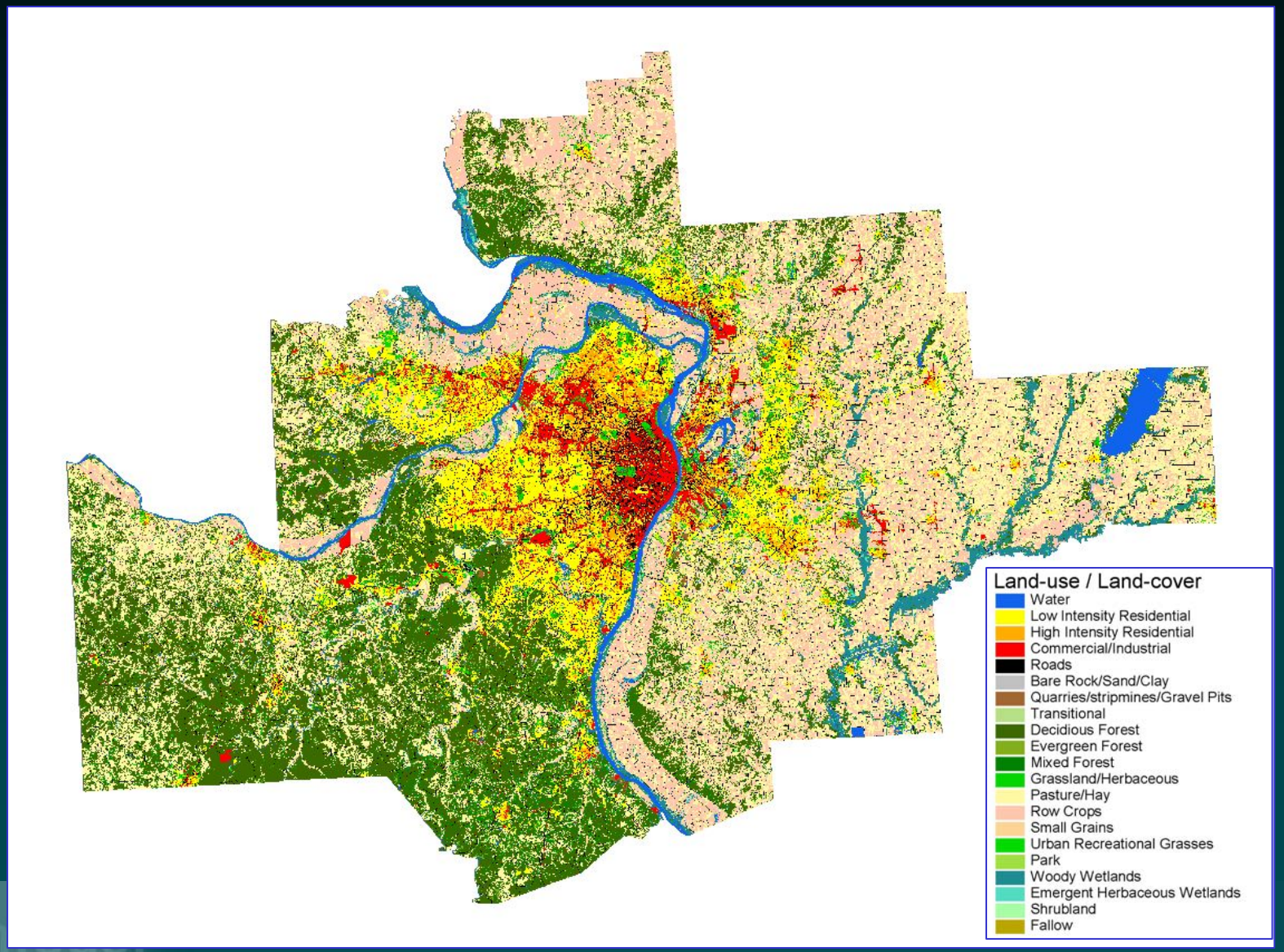
Slide 48

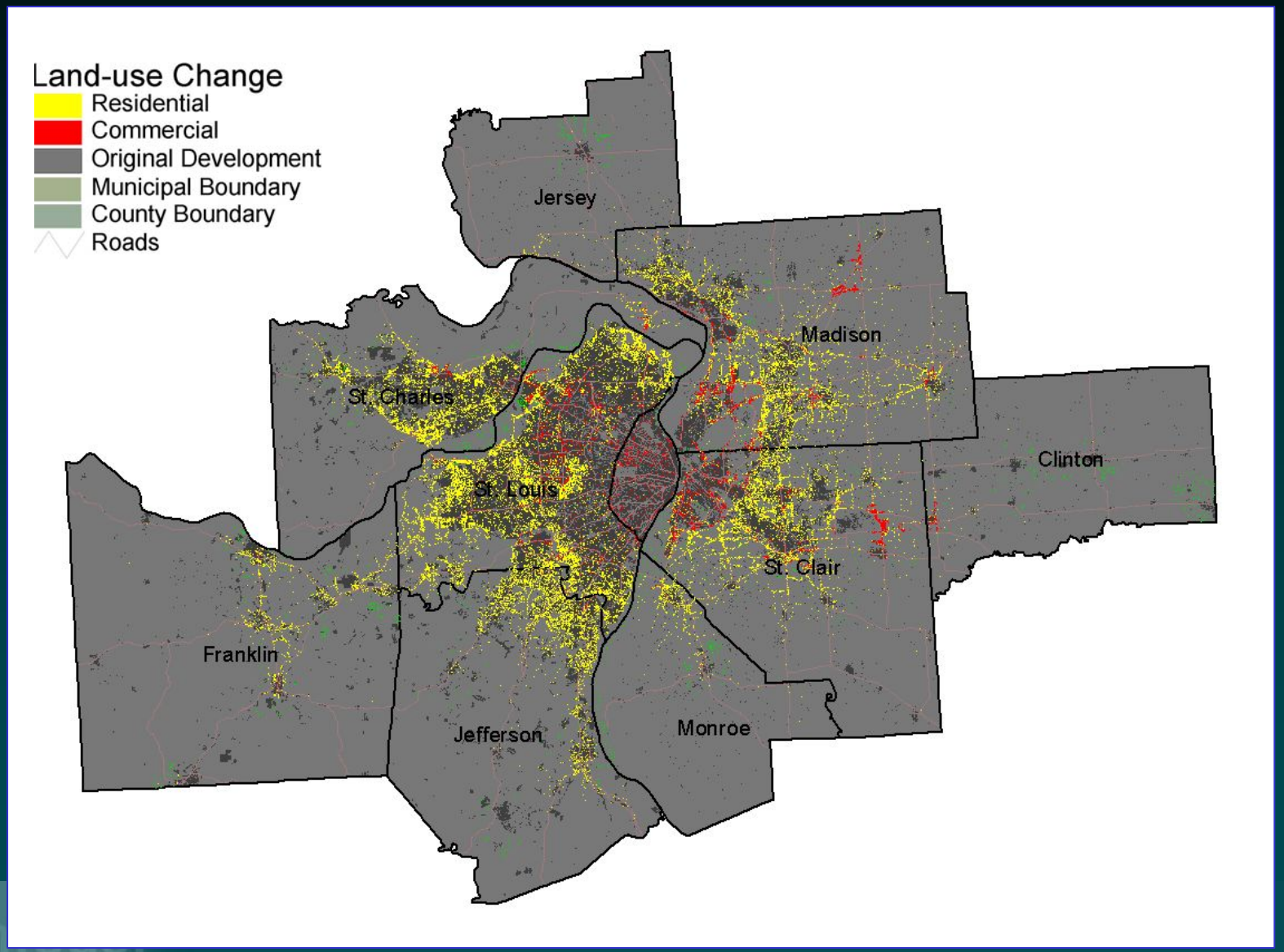
VGP8 Here is where you could use examples of models created for different applications and explain how developing the models was more useful than the models themselves

Varkki Pallathucheril, 3/7/2005

Regional Scales



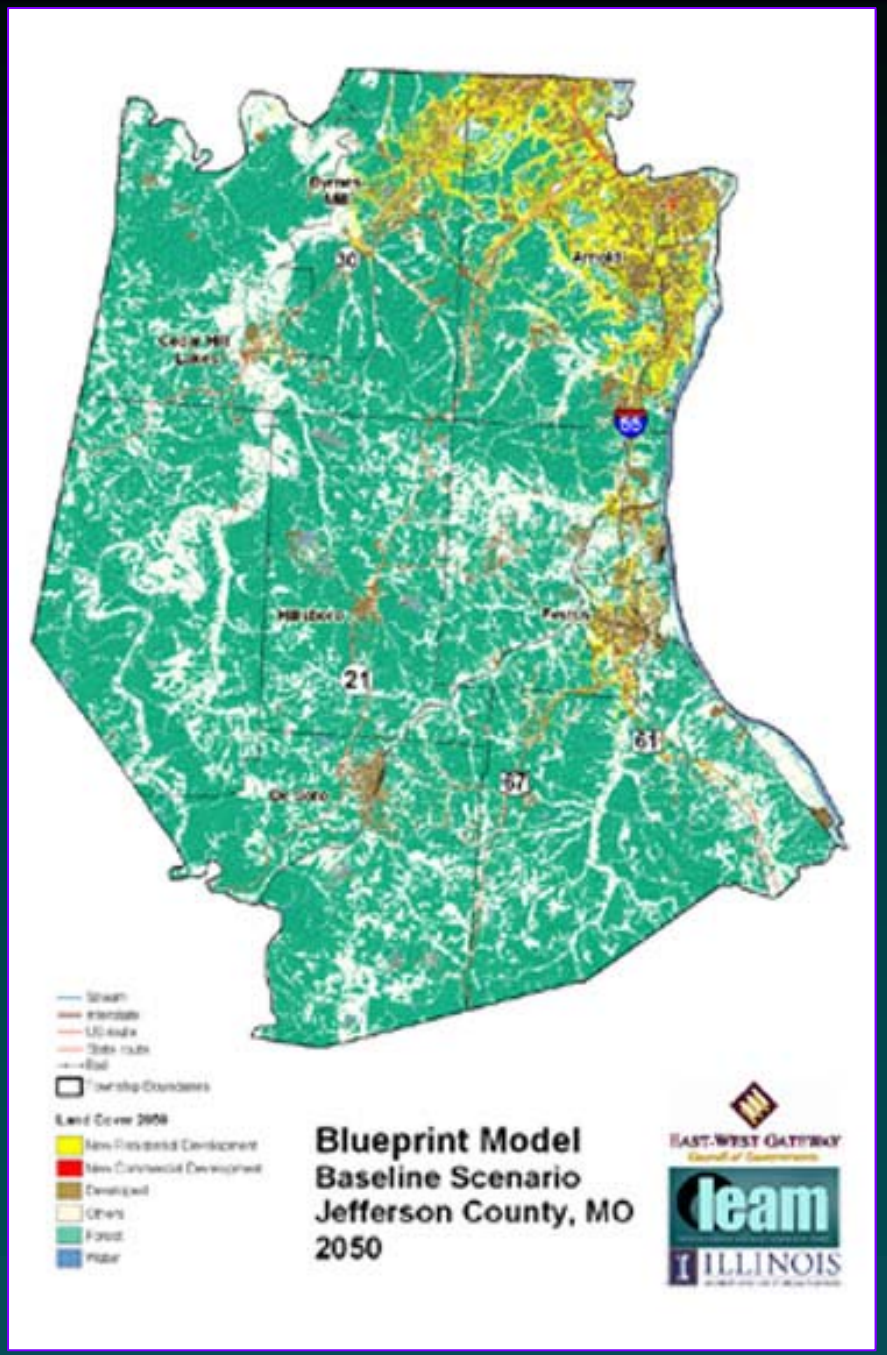
Regional Analysis



County Level Analysis

Blueprint-LEAM

Jefferson County Landuse



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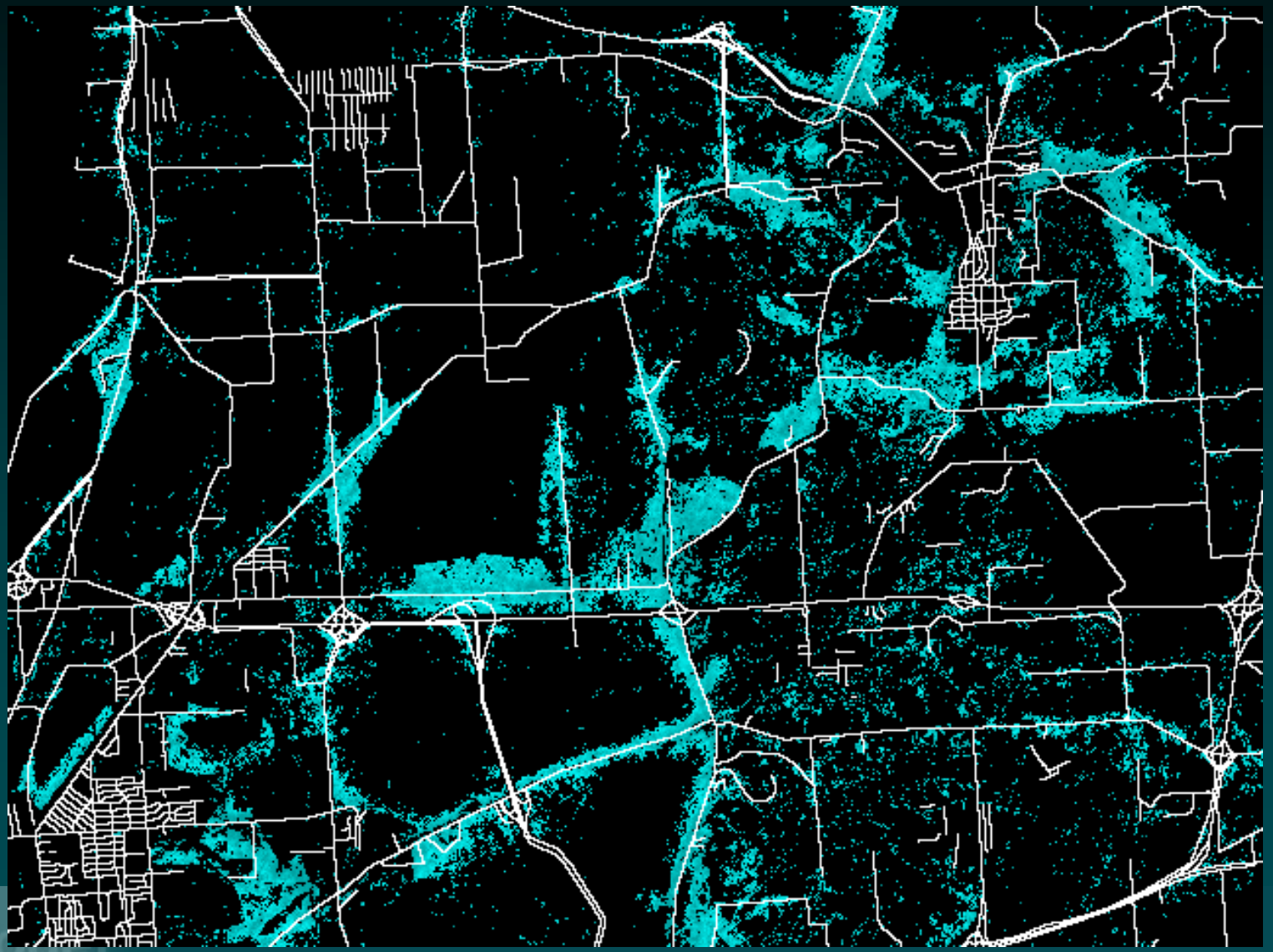
Community Scales

QuickTime™ and a GIF decompressor are needed to see this picture.

Run 5

Community Based Analysis



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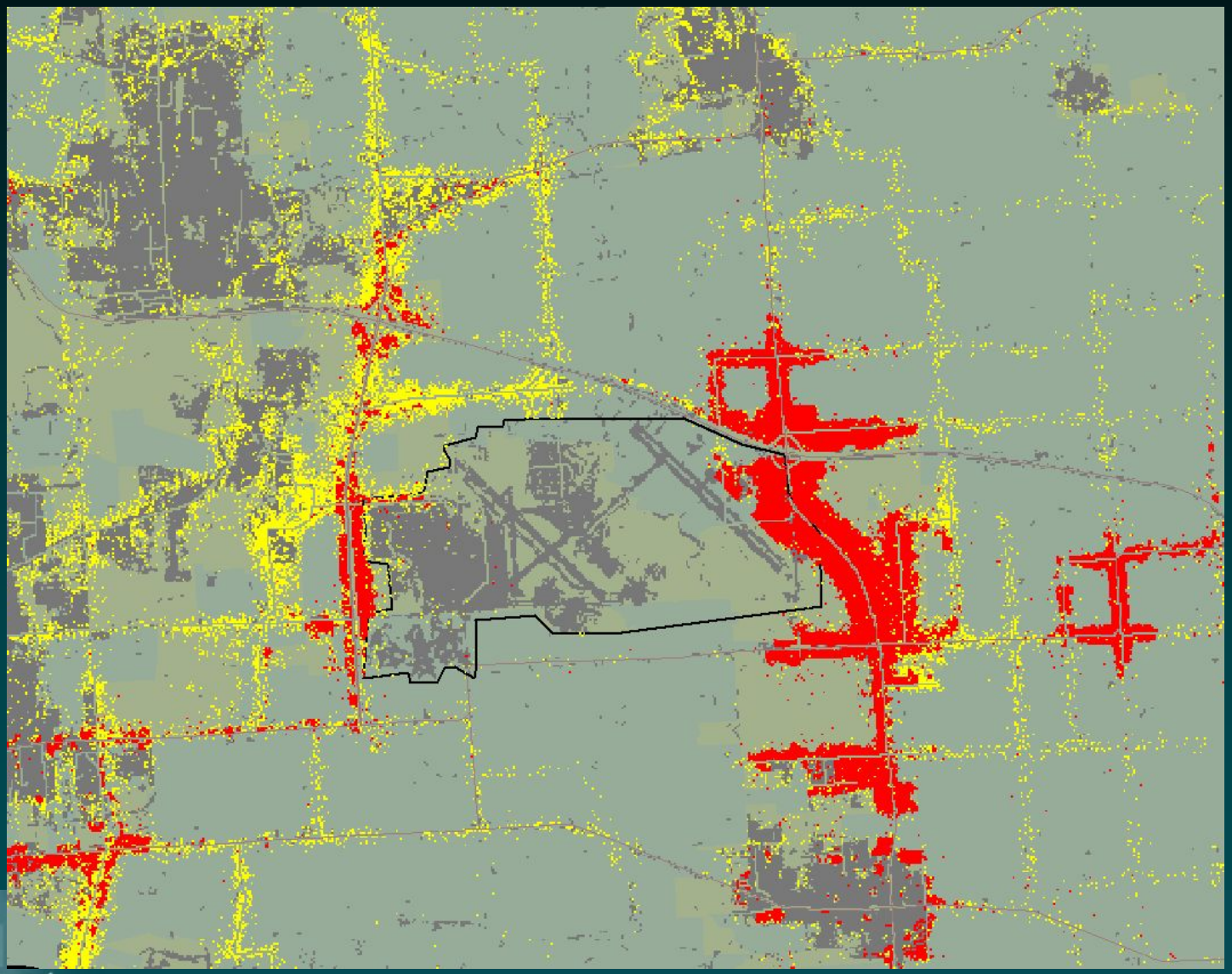
Specific Scenario Analysis



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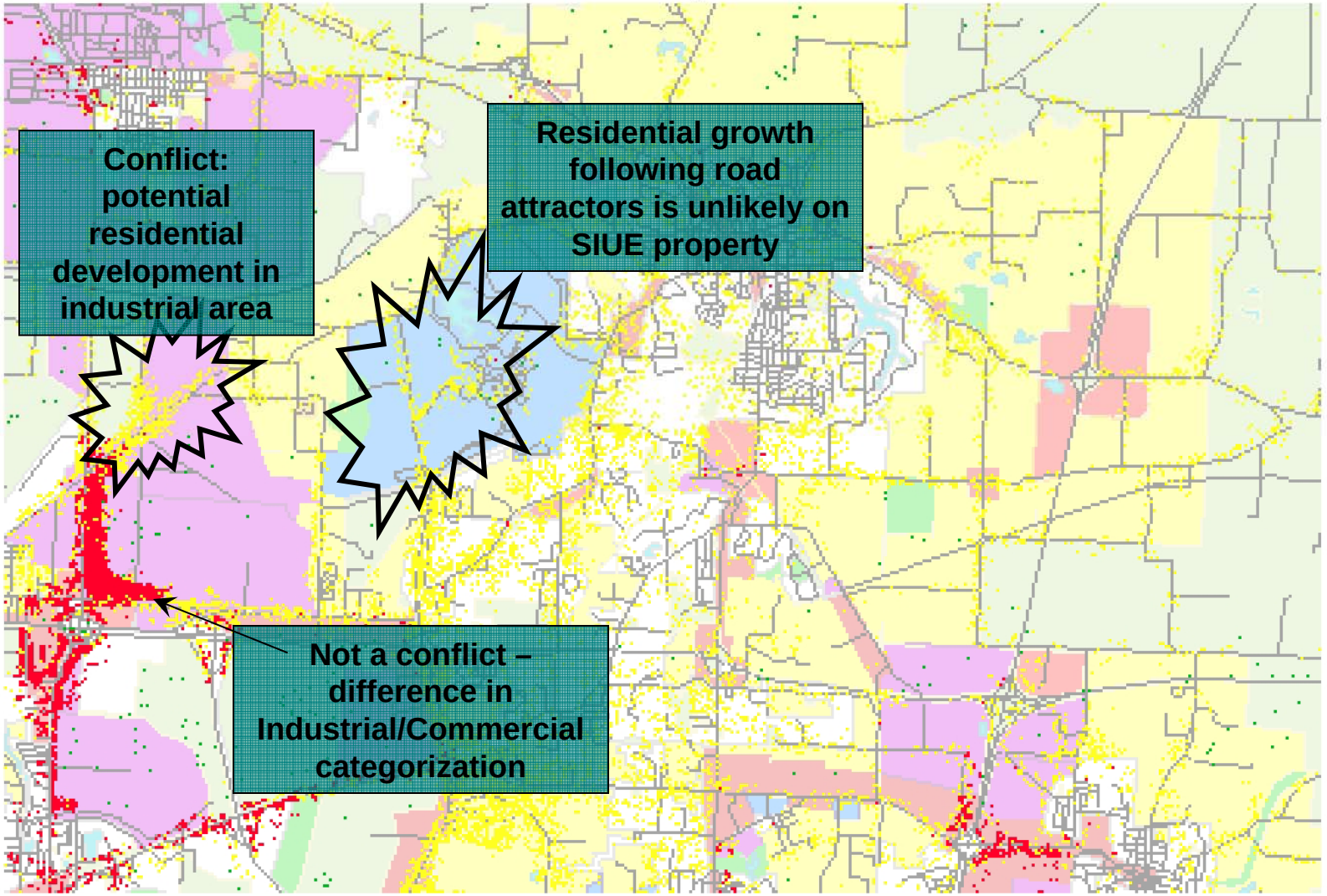
LEAM Blueprint 2030 and Madison County Plan 2020 - Edwardsville/Glen Carbon



Sustainability Can Be a Common Frame of Reference

"All ethics so far evolved rest upon a single premise: that the individual is a member of a community of interdependent parts... That man is, in fact, only a member of a biotic team is shown by an ecological interpretation of history. Many historical events, hitherto explained solely in terms of human enterprise, were actually biotic interactions between people and land....Is history taught in this spirit? It will be, once the concept of land as a community really penetrates intellectual life."

Aldo Leopold, 'A Sand County Almanac'

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