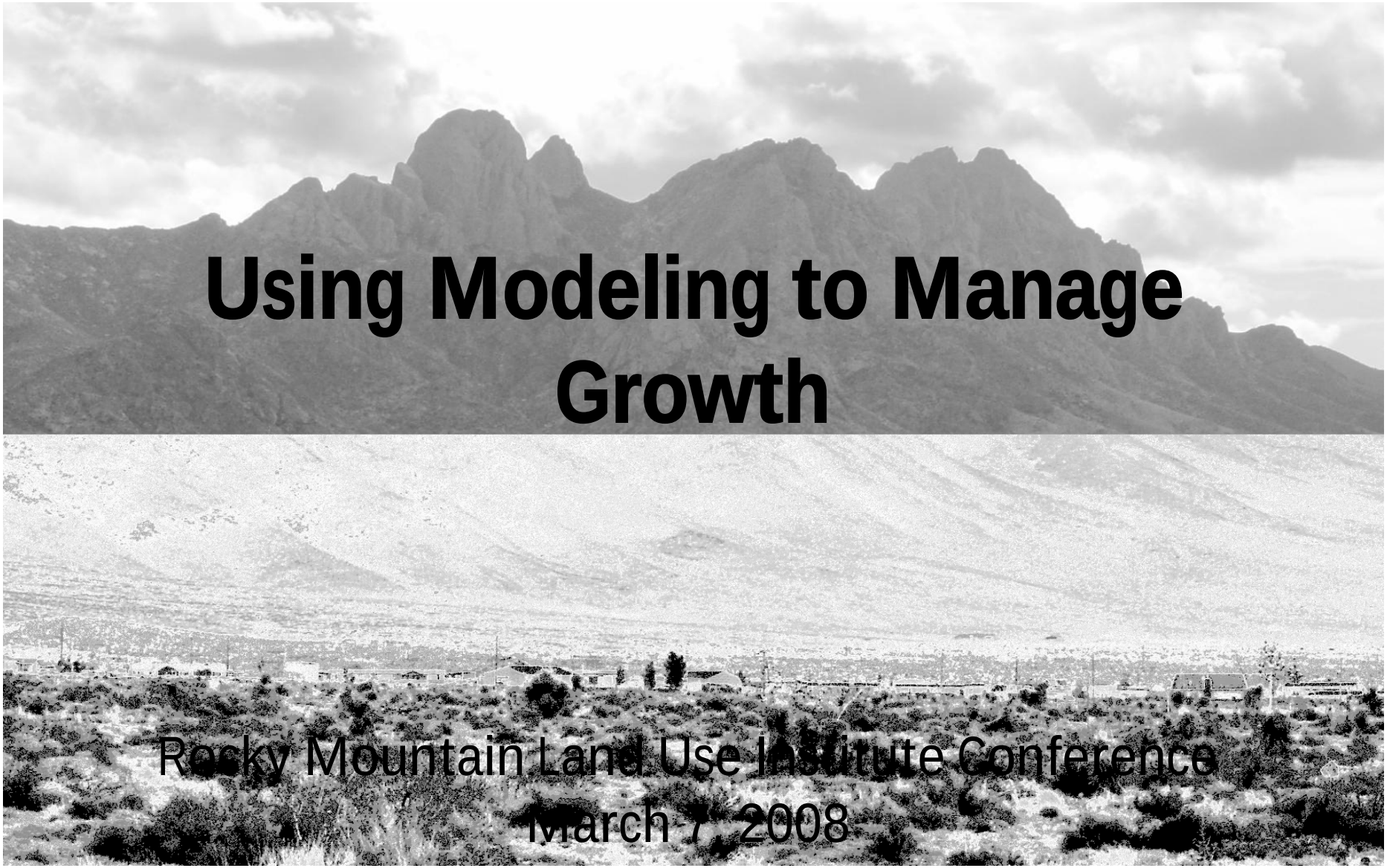

Using Modeling to Manage Growth

Rocky Mountain Land Use Institute Conference

March 7, 2008

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Sonoran Institute Growth Modeling

Prototype model: Western Montana

Pilot implementation of SIGM: Doña Ana County, New Mexico

Rocky Mountain Land Use Institute Conference
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Outline

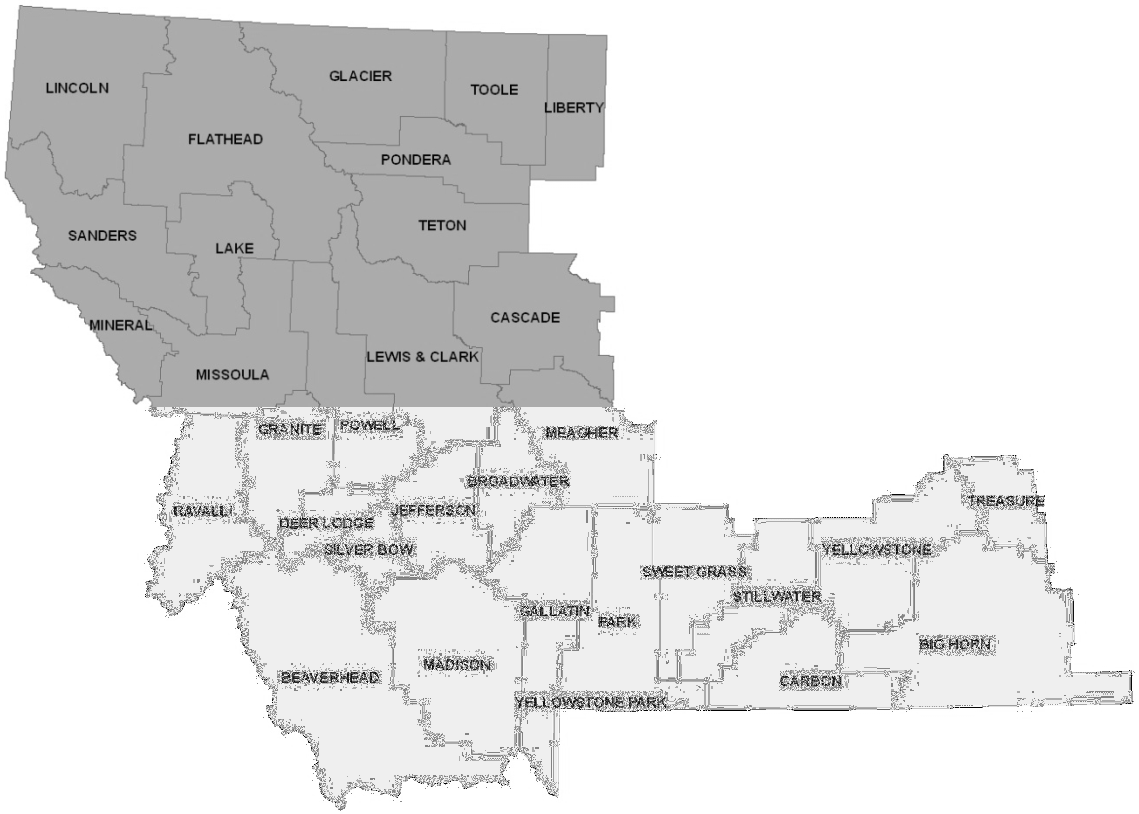
- Prototype model – State Trust Lands, MT
  - Model description, Implementation, Results
  - Linkages to managing growth
  - Lessons learned
- SI Growth Model – Doña Ana County, NM
  - Model description, Implementation, Results
  - Linkages to managing growth
  - Lessons learned

Prototype model

- Uncover the drivers of growth
- Make projections
  - Existing policies and conditions (status quo scenario)
- Map changes in number and distribution of residences over time
- Evaluate State Trust Lands in context of potential future growth
  - Appropriate uses of these lands?

Implementation scale

- Regional implementation
  - 31 counties in western Montana



Modeling concept

Measure change in number of residences

Past and present development trends 1995-2005

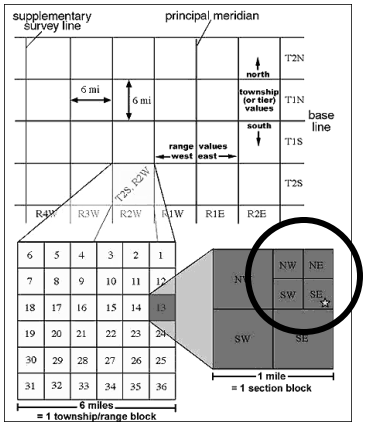
Landscape characteristics

Infrastructure
Services
Natural Resources
Past Development

(GIS layers)

Regression framework

- GLM
- Variable selection
- Model fitting



Resolved to quarter section level

10-year forward projection – 2015, 2025

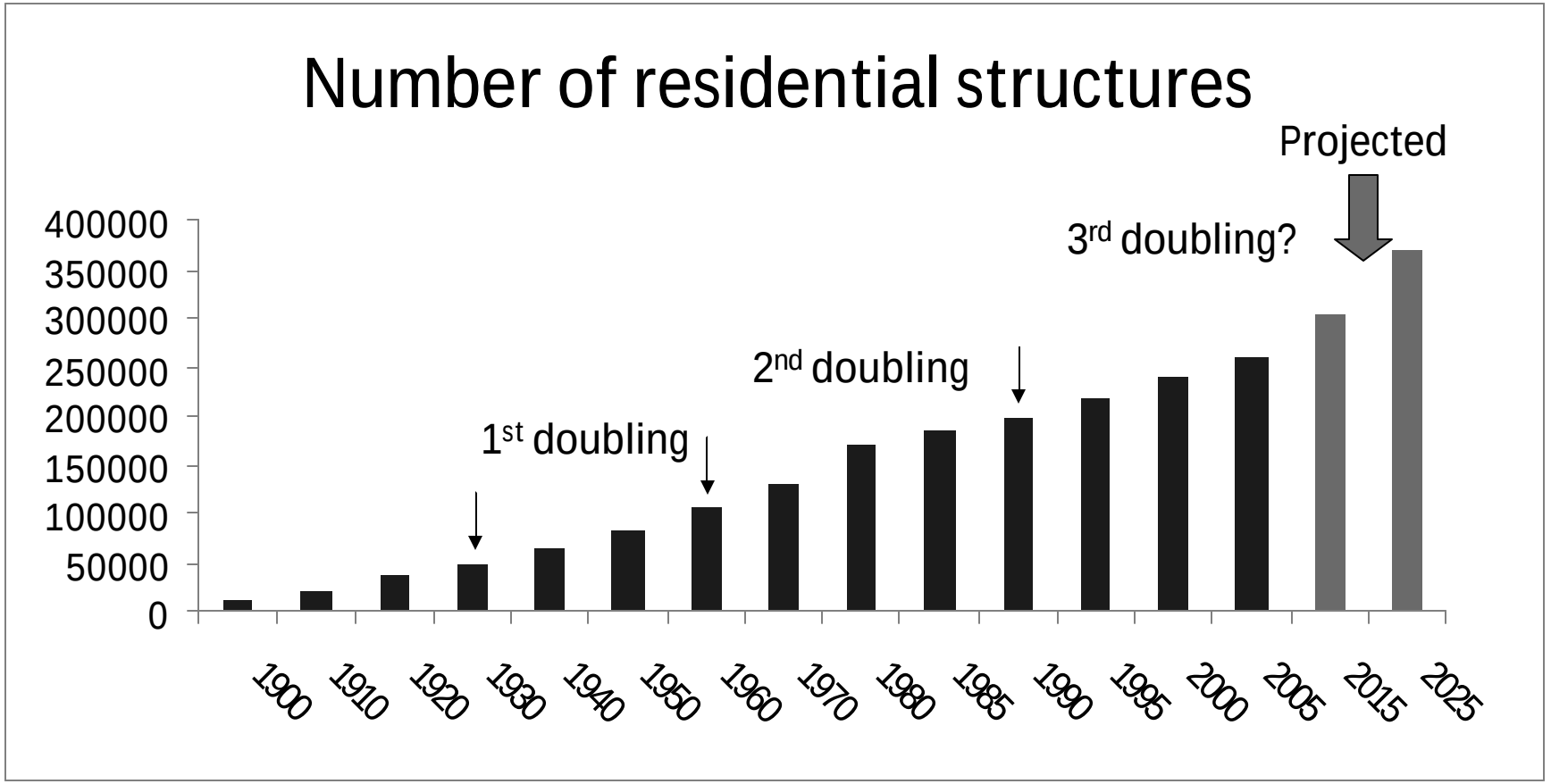
Data and processing

- Variable categories
  - Natural resources
  - Transportation
  - Services
  - Natural amenities
  - Encroachment
- Data assigned to each quarter section

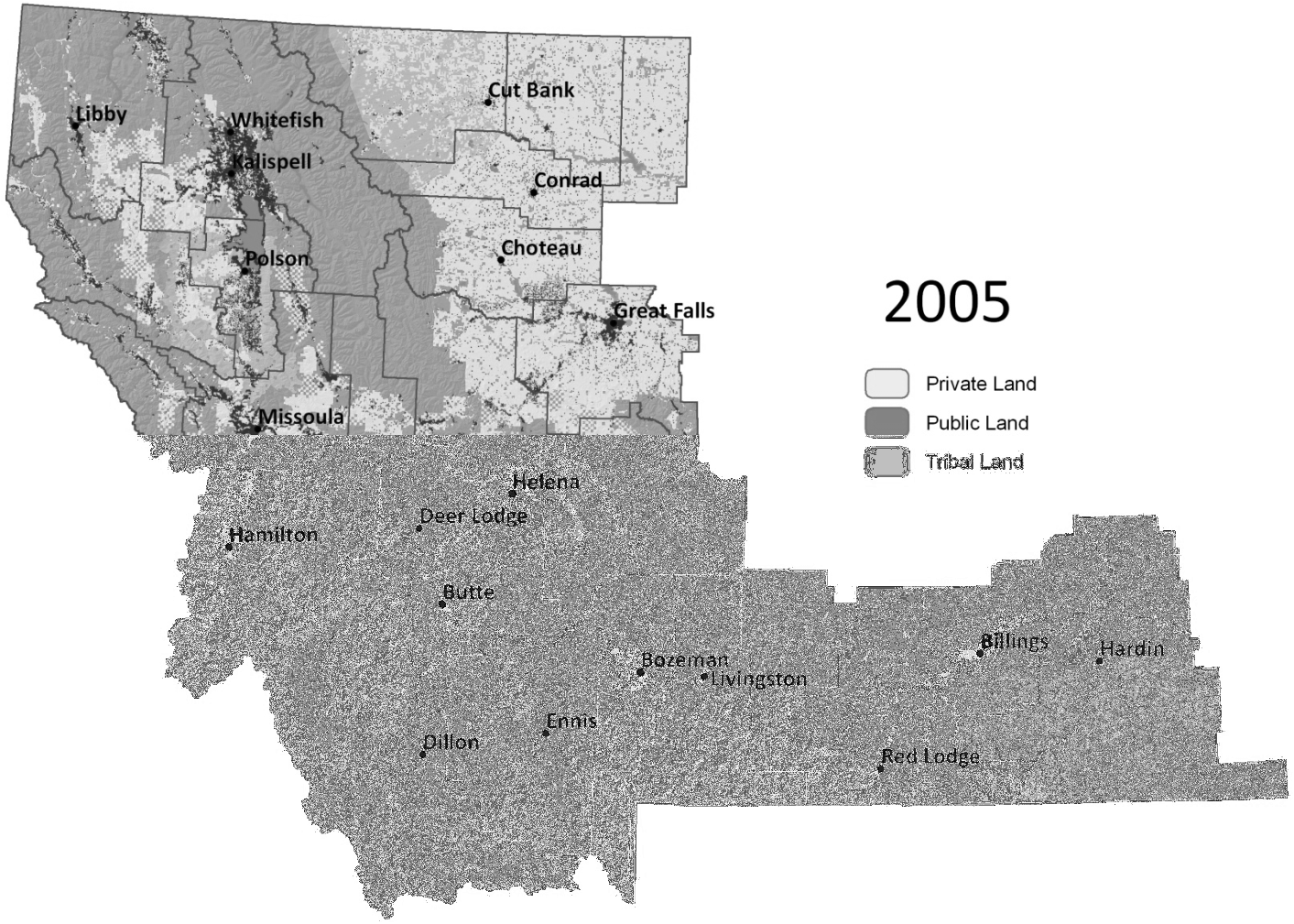
Significant variables – drivers

- Distance to major roads
- Road density
- Travel time to an airport (enp > 50k)
- In town (yes/no)
- Travel time to mountains
- Travel time to a national park
- Agricultural suitability
- Previous development (yes/no)
- Dwellings within 1mi. (built ’85-95)
- Commercial within 1 mi. (built ’85-95)

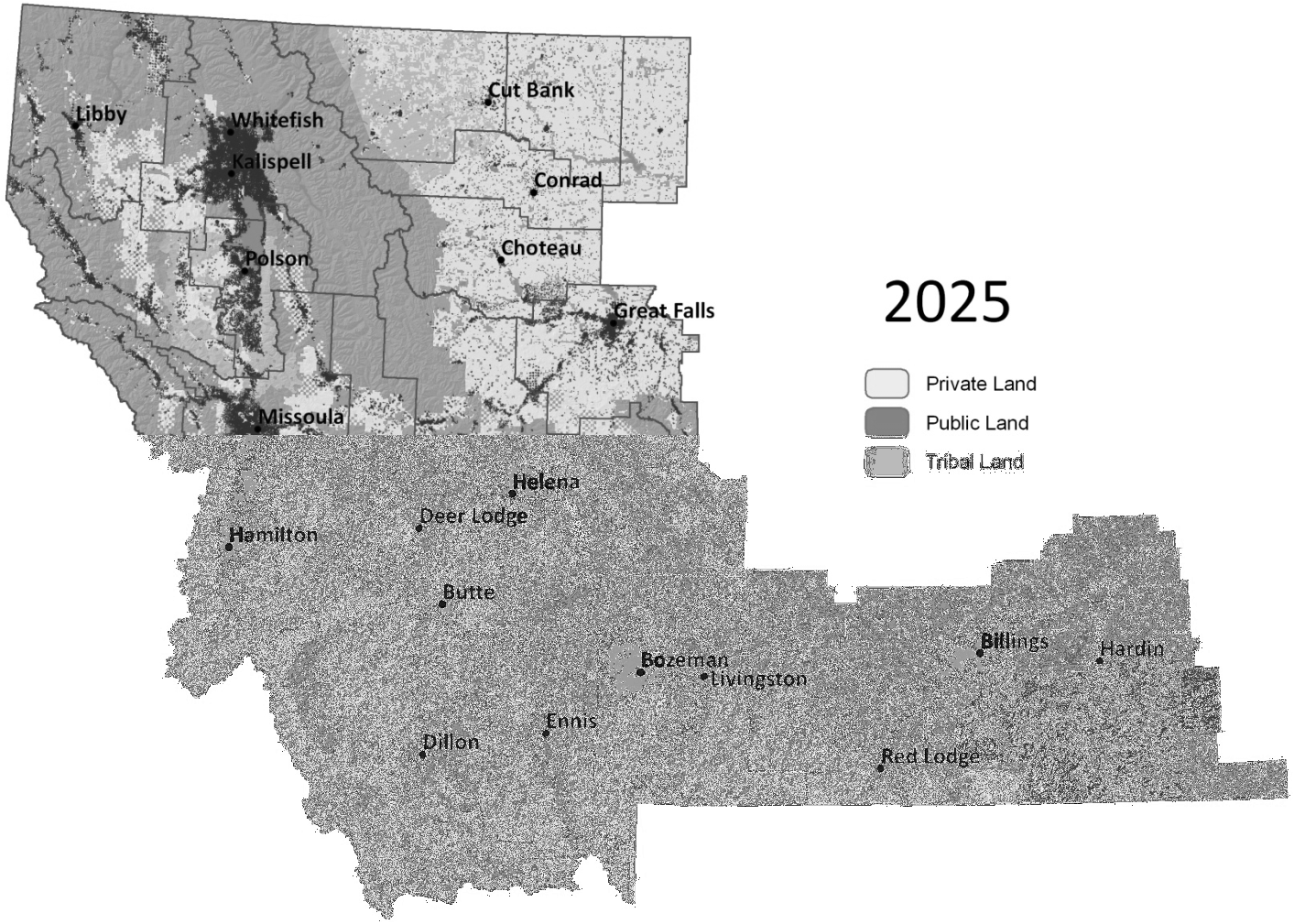
Trends in growth



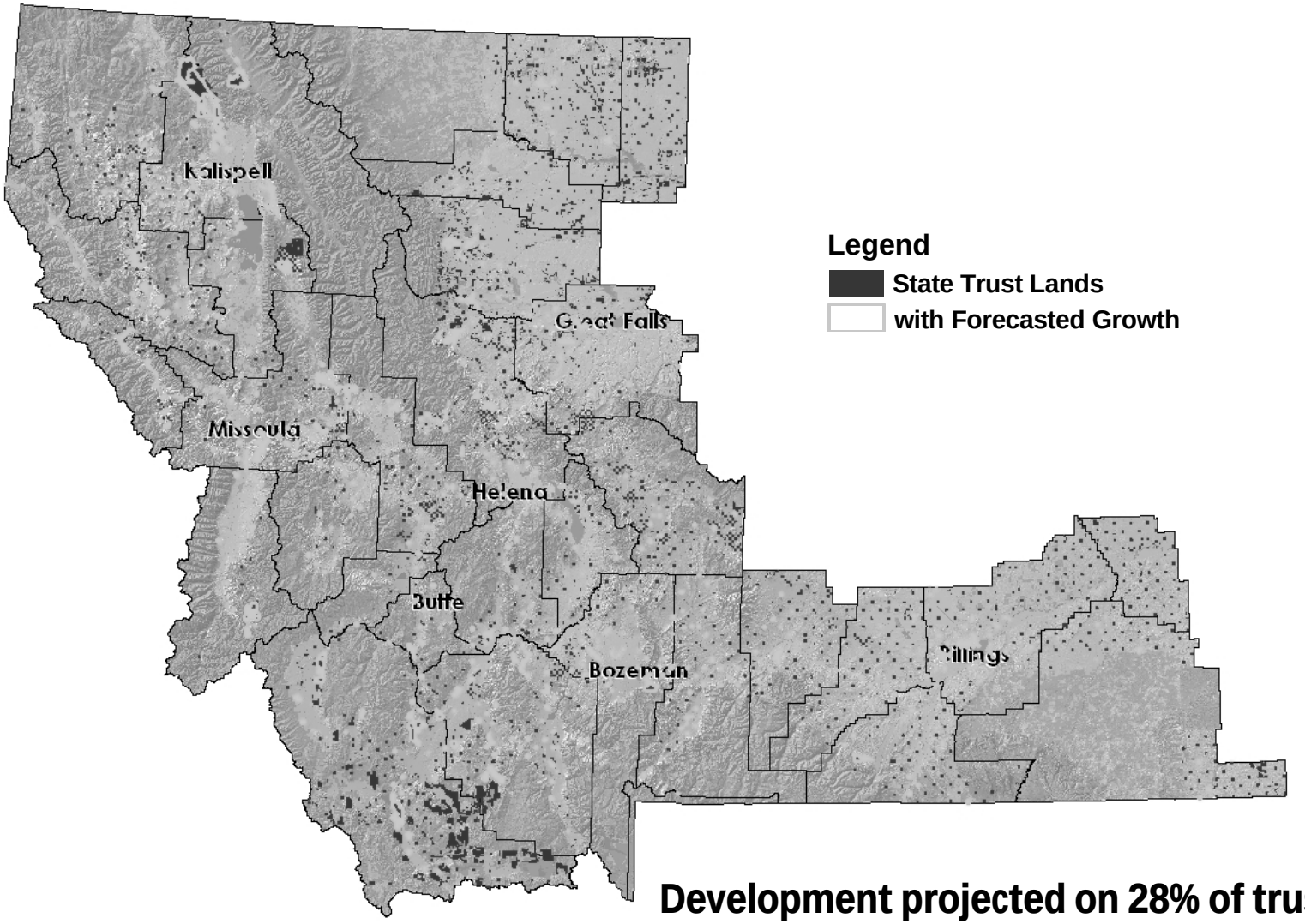
Actual residential structures



Projected residential structures



State trust lands: projected growth



Development projected on 28% of trust lands
Nearly 600,000 acres

State trust lands: analysis goals

- Generally
  - Provide guidance re: land management & real estate activities
  - Encourage DNRC to adopt an active rather than reactive approach to disposals
- Specifically
  - Understand which lands are “in the path of” development
    - Improve understanding of value & management options
    - Lead to more appropriate growth patterns
      - Land use efficiencies and fiscal responsibility

Outreach

- Montana Department of Natural Resources and Conservation, Helena, MT, 2006
- Beaverhead and Madison County Workshop, Dillon, MT, 2006
- Lewis and Clark County Workshop, Helena, MT, 2006
- Missoula, Ravalli, and Lake County Workshop, Missoula, MT, 2006
- Madison Growth Solutions Community Meeting, Ennis, MT, 2006

How things worked

- Uses of approach
  - State trust lands analysis
  - Beaverhead County fiscal impact analysis
  - Spurred discussion of county and sub-county planning/zoning efforts
  - Informed efforts on stream-side protection
  - Highlighted issues regarding the WUI
  - Provided information to non-profit organizations interested in growth issues

How things worked

- Pros of approach
  - Great tool for visualizing growth
  - Fostered discussion and action
- Cons of approach
  - Variable selection & model fitting
  - Error measurement?
  - Not user friendly
    - Convoluted analytical process
    - Alternative scenario creation
    - Visualization

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What we learned

- Great concept
- Really engaged citizens and decision-makers
- Suggested a second cut was warranted

SI Growth Model

Pilot implementation:

Doña Ana County, NM

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What we want to do

- Project the number and distribution of residences into the future
  - Existing policies and conditions (status quo scenario)
  - User-defined policies and conditions (alternative scenarios)
- Map changes over time
- Examine effects of federal and state land disposal

Why we want to do this

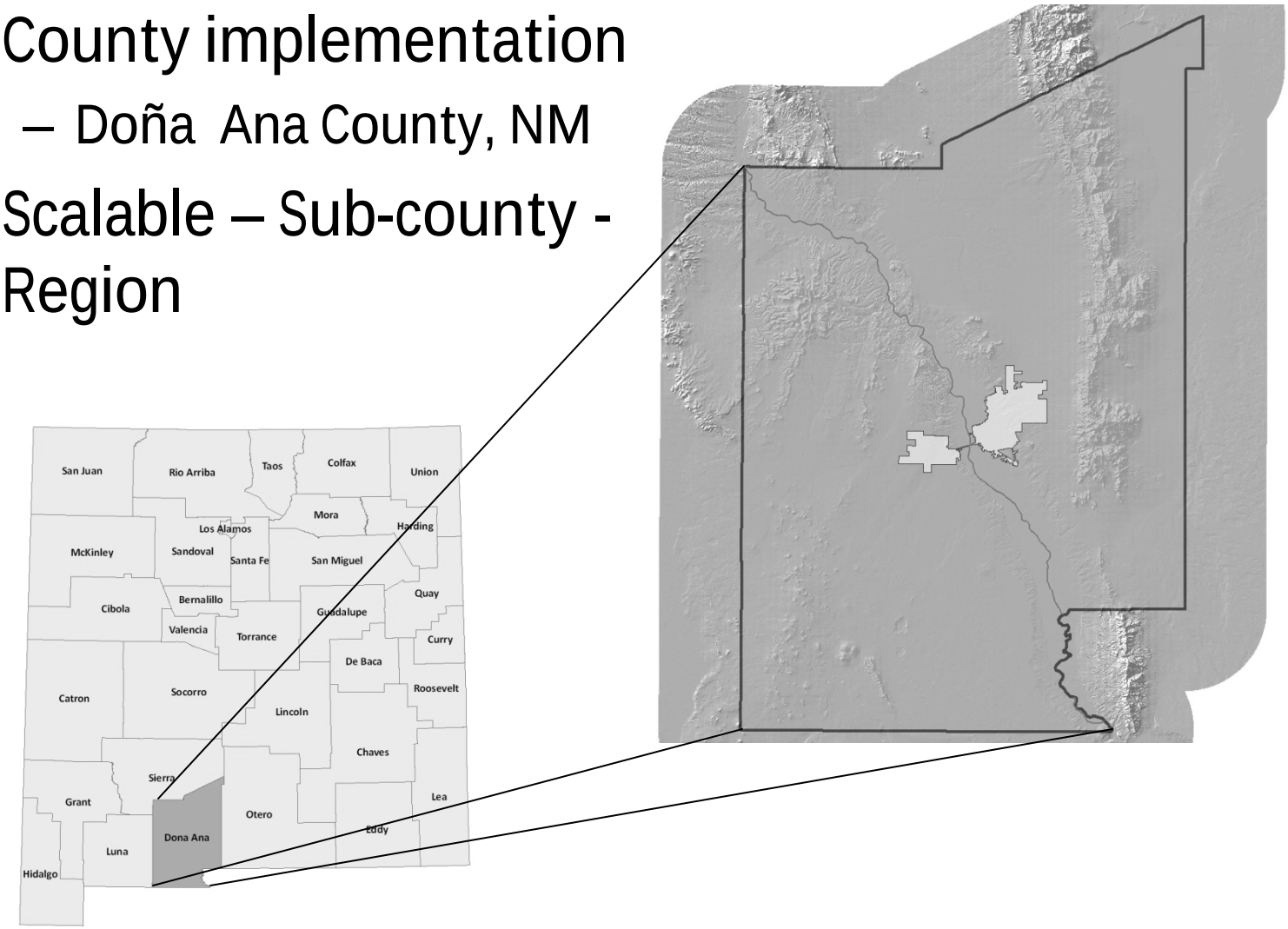
- Visualize future conditions given what we know about past and current conditions
- "Game" alternative views of growth
  - Apply user-defined policies and "expert knowledge"
- Compare patterns of growth
  - Which alternatives most closely approximate desired future conditions
- Produce information that can inform planning decisions

How we do this, general view

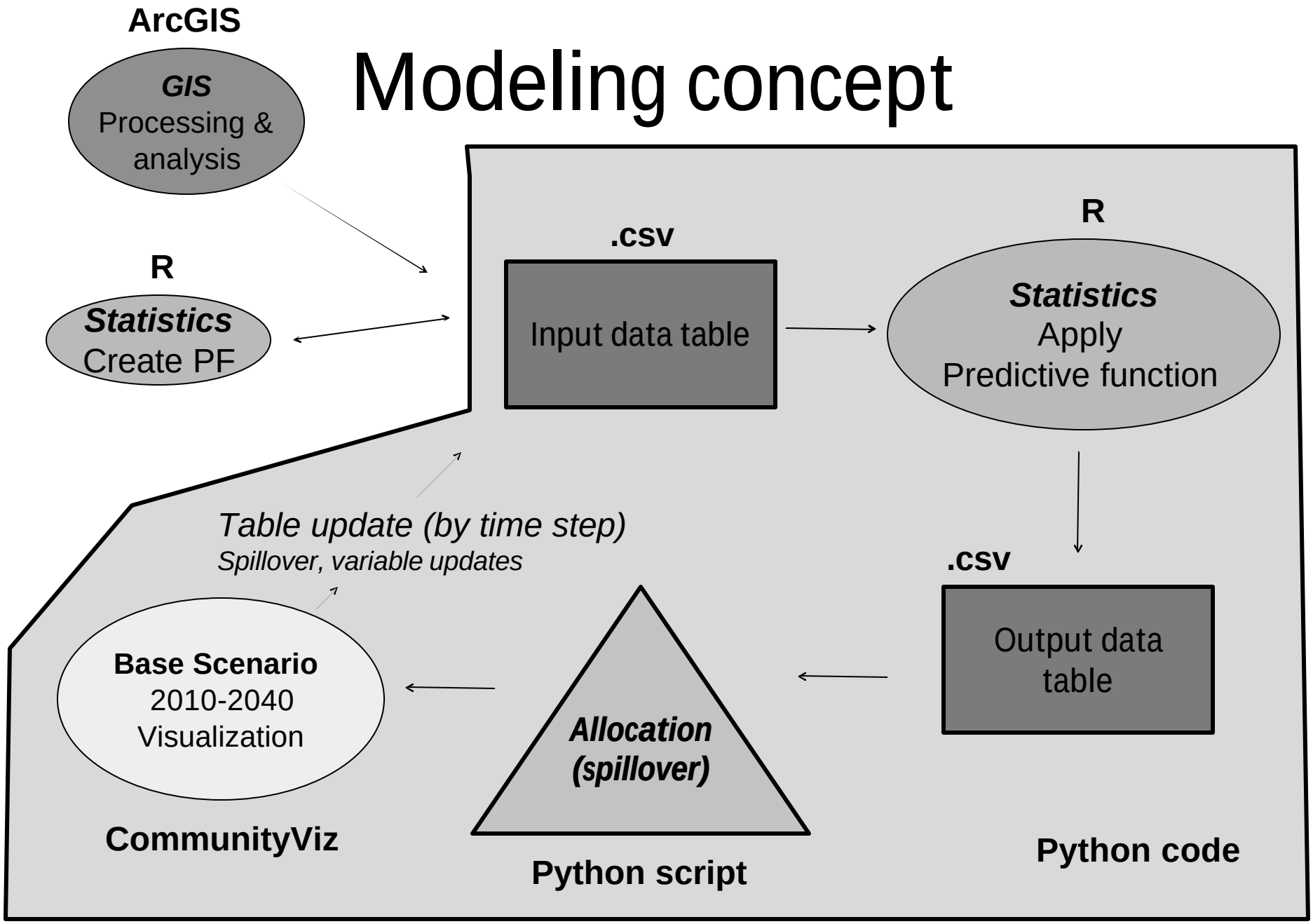
- Measure change in number of residences over time
- Capture the essence of this change using information that describes past and current conditions
  - Response variable: change in # of residences
  - Suite of explanatory or predictor variables
- Use this information in a statistical context to make predictions

Implementation scale

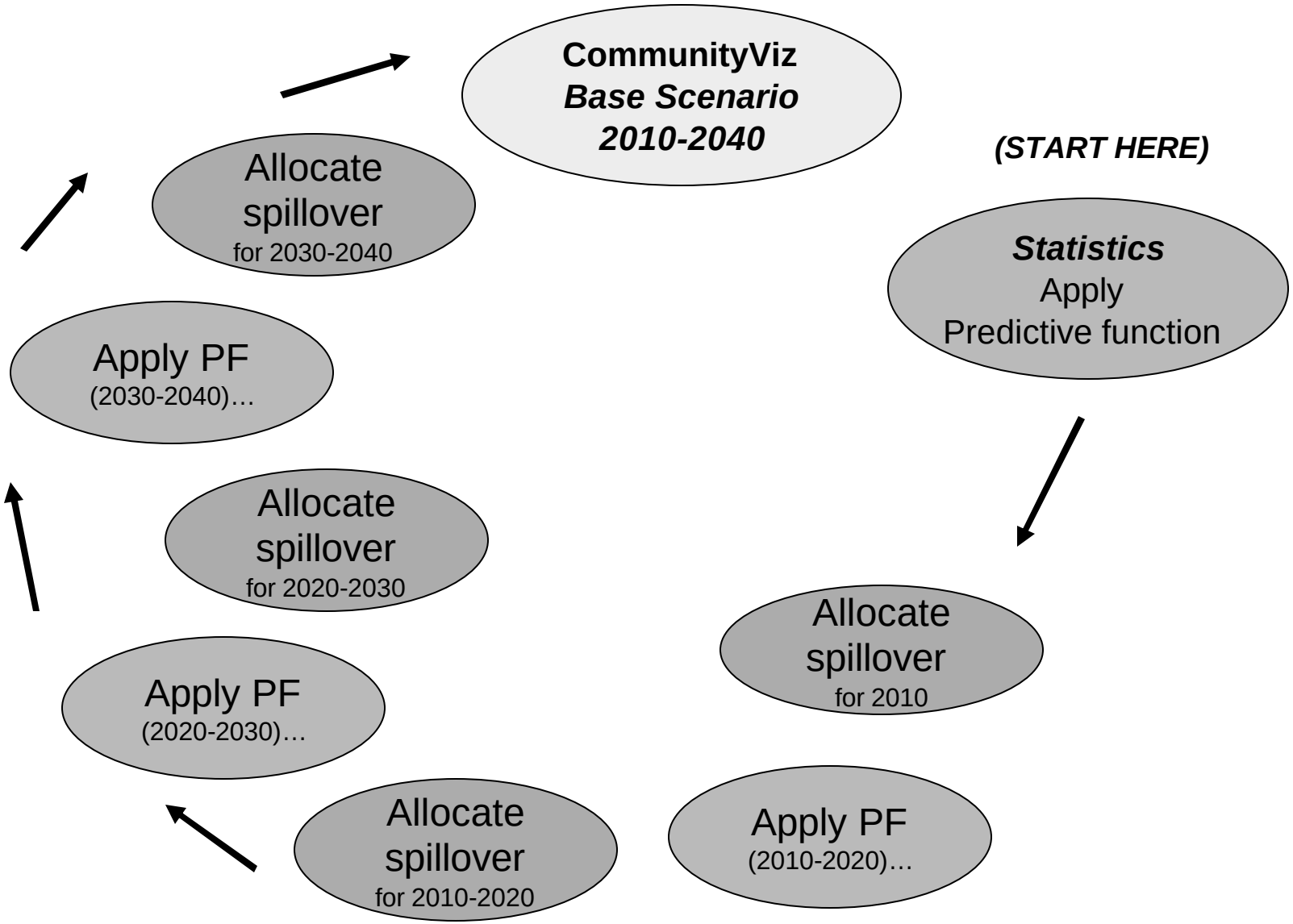
- County implementation
  - Doña Ana County, NM
- Scalable – Sub-county - Region



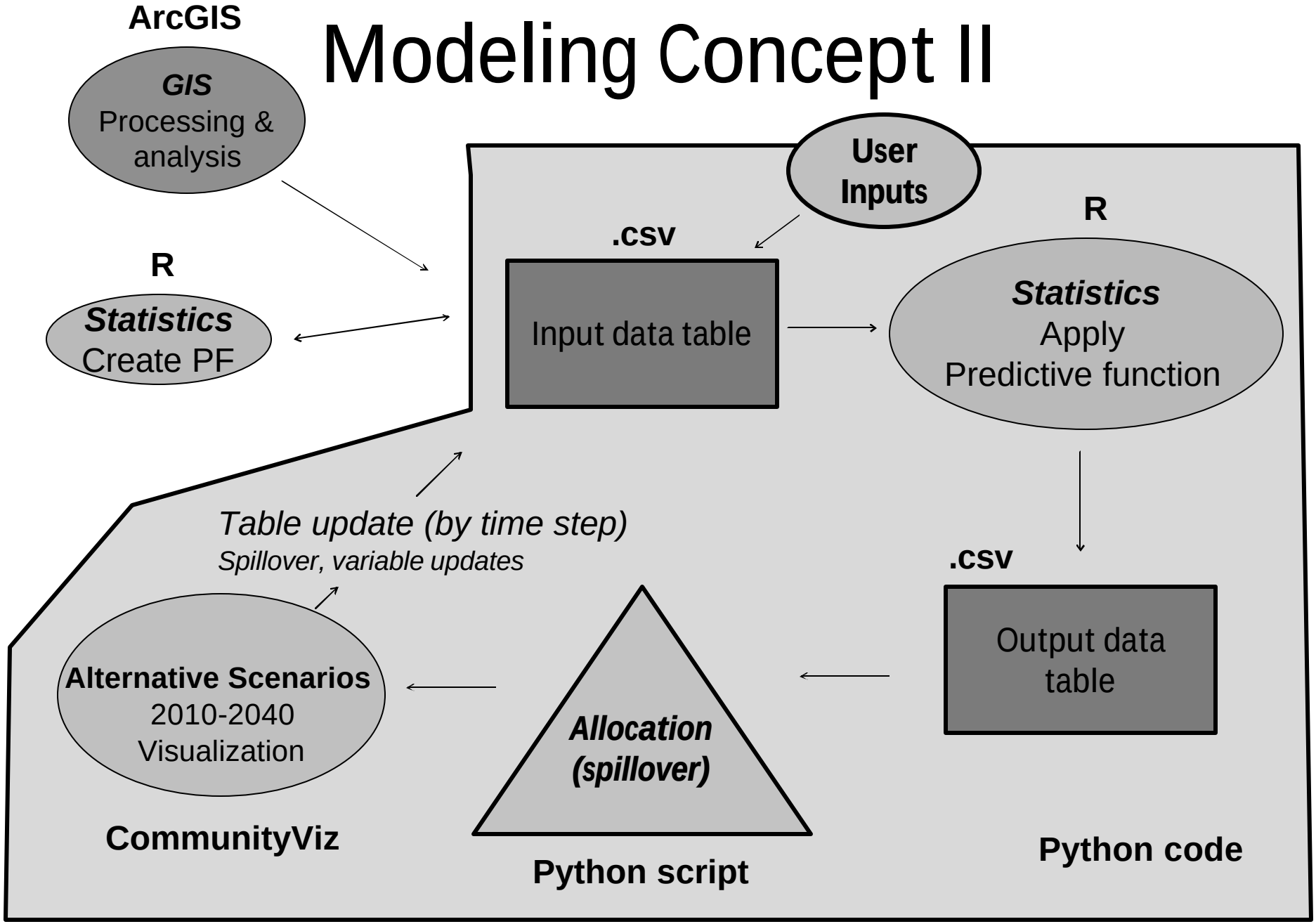
Modeling concept

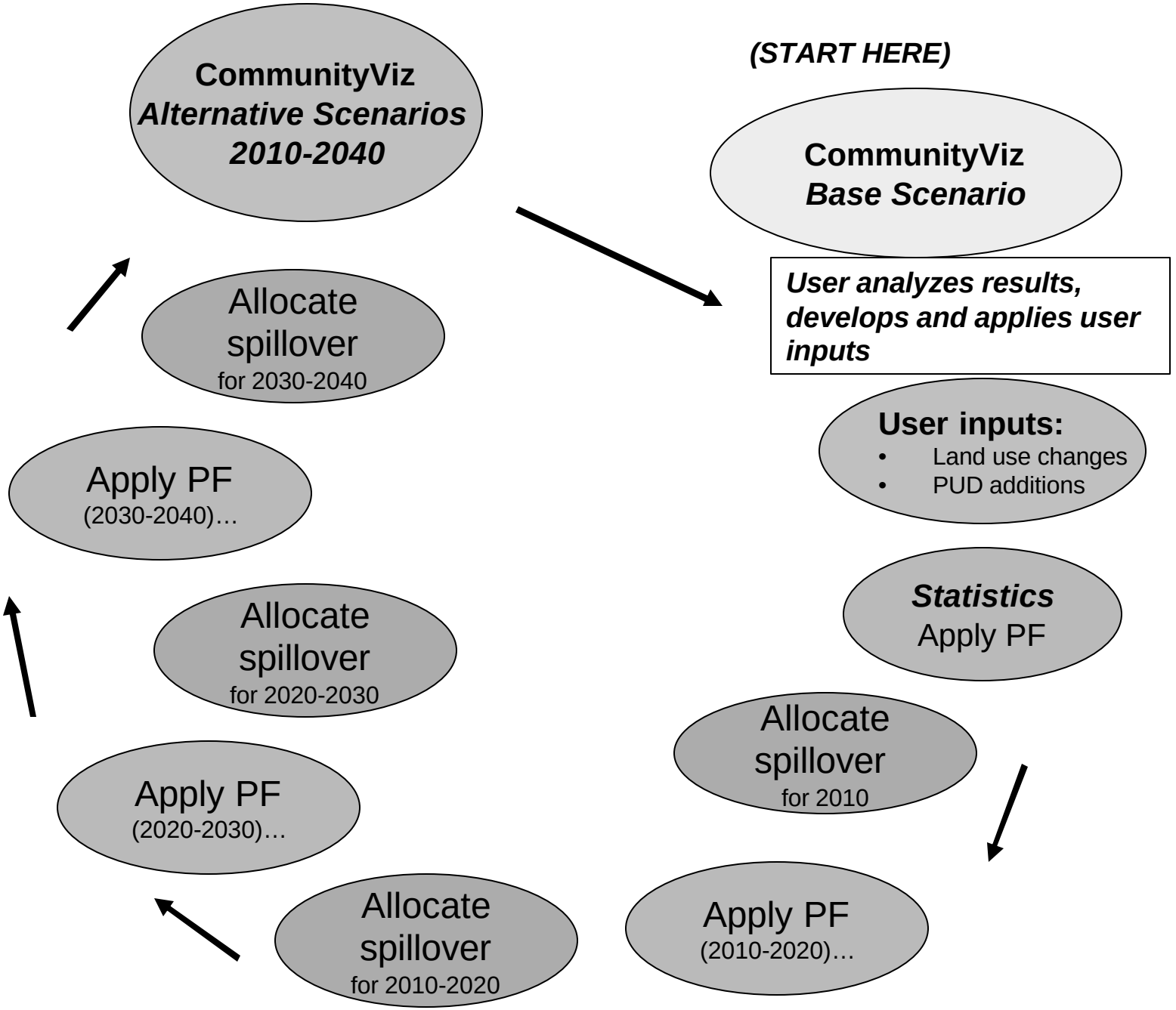


Closer look…


CommunityViz
Base Scenario
2010-2040
(START HERE)
Statistics
Apply
Predictive function
Allocate spillover for 2010
Apply PF (2010-2020)…
Allocate spillover for 2010-2020
Apply PF (2020-2030)…
Allocate spillover for 2020-2030
Apply PF (2030-2040)…
Allocate spillover for 2030-2040

Modeling Concept II




CommunityViz
Alternative Scenarios
2010-2040
(START HERE)
CommunityViz
Base Scenario
User analyzes results, develops and applies user inputs
User inputs:
• Land use changes
• PUD additions
Statistics
Apply PF
Allocate spillover for 2010
Apply PF (2010-2020)…
Allocate spillover for 2010-2020
Apply PF (2020-2030)…
Allocate spillover for 2020-2030
Apply PF (2030-2040)…
Allocate spillover for 2030-2040

Data and processing

- Variable categories
  - Proportions
  - Distance-to
  - Socio-economic
  - Residences
- Data for each predictor variable assigned to its respective QS
- Use any predictor variable you think may be informative – Caveats: map-able, time

Predictor variables (19 used)

- Proportion of ag land
- Proportion of forested lands
- Proportion of public lands (within 5, 10, and 15 miles)
- Distance to any road
- Distance to water
- Distance to ag land
- Distance to forested lands
- Number of residences (year built)
- QS centroid coordinates
- Number of second homes
- Viewshed
- Average household size
- Owner occupied residences
- Renter occupied residences
- Vacant residences
- Median age
- Per capita income
- Total number of households
- Population

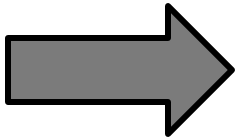
Response variable

- Change in number of residences
  - Assigned to each QS too
- Creation of the predictive function 1990 – 2000
- Application of predictive function 2000 – 2010, 2010 – 2020, 2020 – 2030, 2030 - 2040

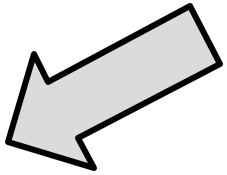
Statistical context

Unit of analysis:
Quarter section

Statistical framework:
Random forests



Prediction:
Change in number of residences



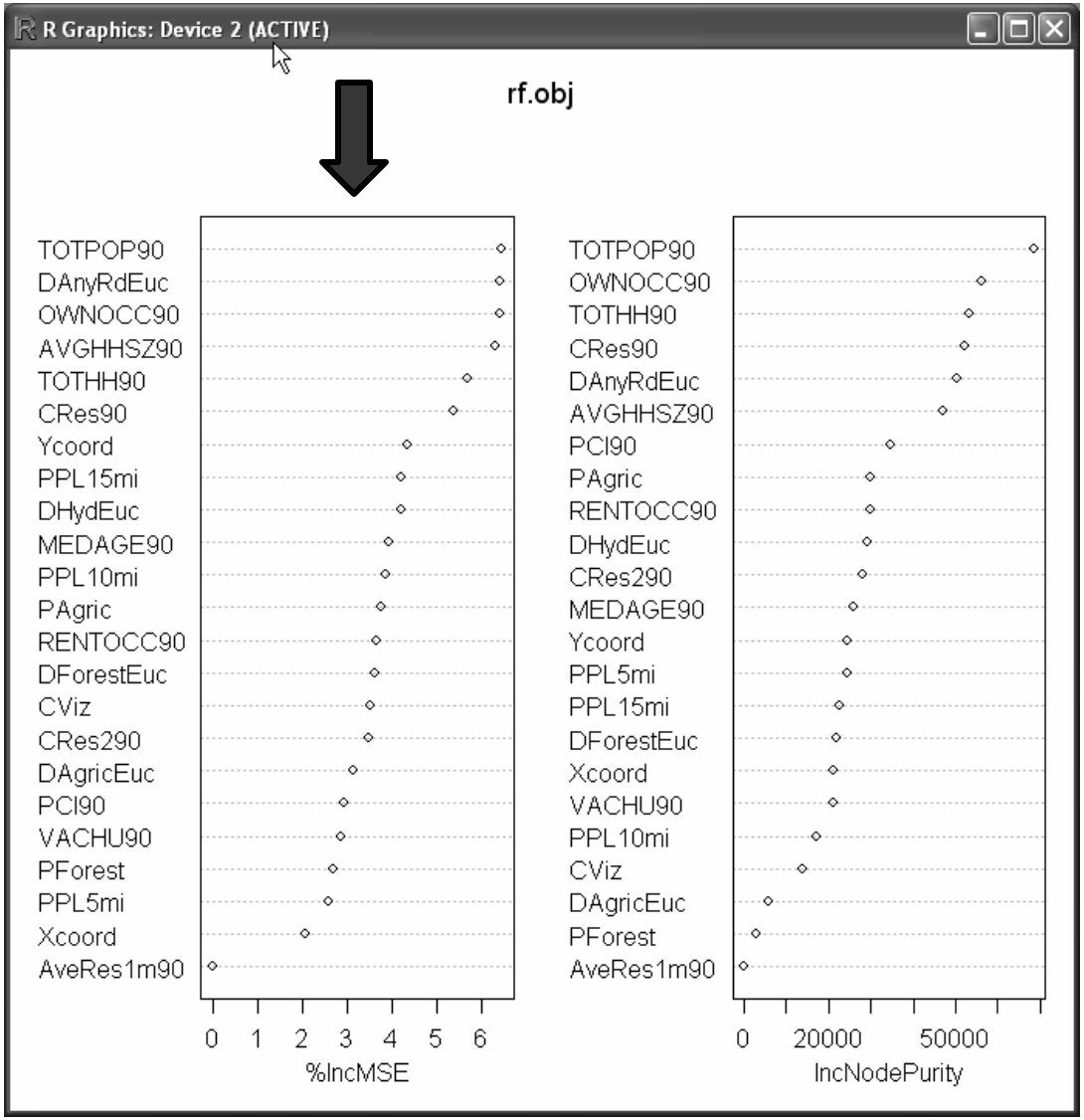
Predictor variables (1990, 2000)

- Proportion of ag land
- Distance to any road
- Distance to water
- Distance to ag land
- Distance to forested lands
- Proportion of forested lands
- Proportion of protected lands (5,10, and 15 miles)
- Number of residences
- Number of second homes
- Viewshed
- Average household size
- Owner occupied residences
- Renter occupied residences
- Vacant residences
- Median age
- Per capita income
- Total number of households
- Population
- QS centroid coordinates

Statistics

- Statistical framework called Random forests
  - Regression tree technique
  - Not like linear regression
    - No variable reduction, model fitting, coefficients
- Advantages of Random forests
  - Better suited to these data
  - Proceed using all predictor variables with the confidence you end up with the best subset as if you had gone through variable selection manually

Variable importance



User interaction and visualization

CommunityViz based

- Base scenario
  - Given existing zoning densities and supply of developable land, what would growth look like?
- Alternative scenarios
  - Create urban growth boundary
  - Preserve working landscapes
  - Make zoning changes
  - Add in approved or speculative PUDs
  - Apply “expert” knowledge

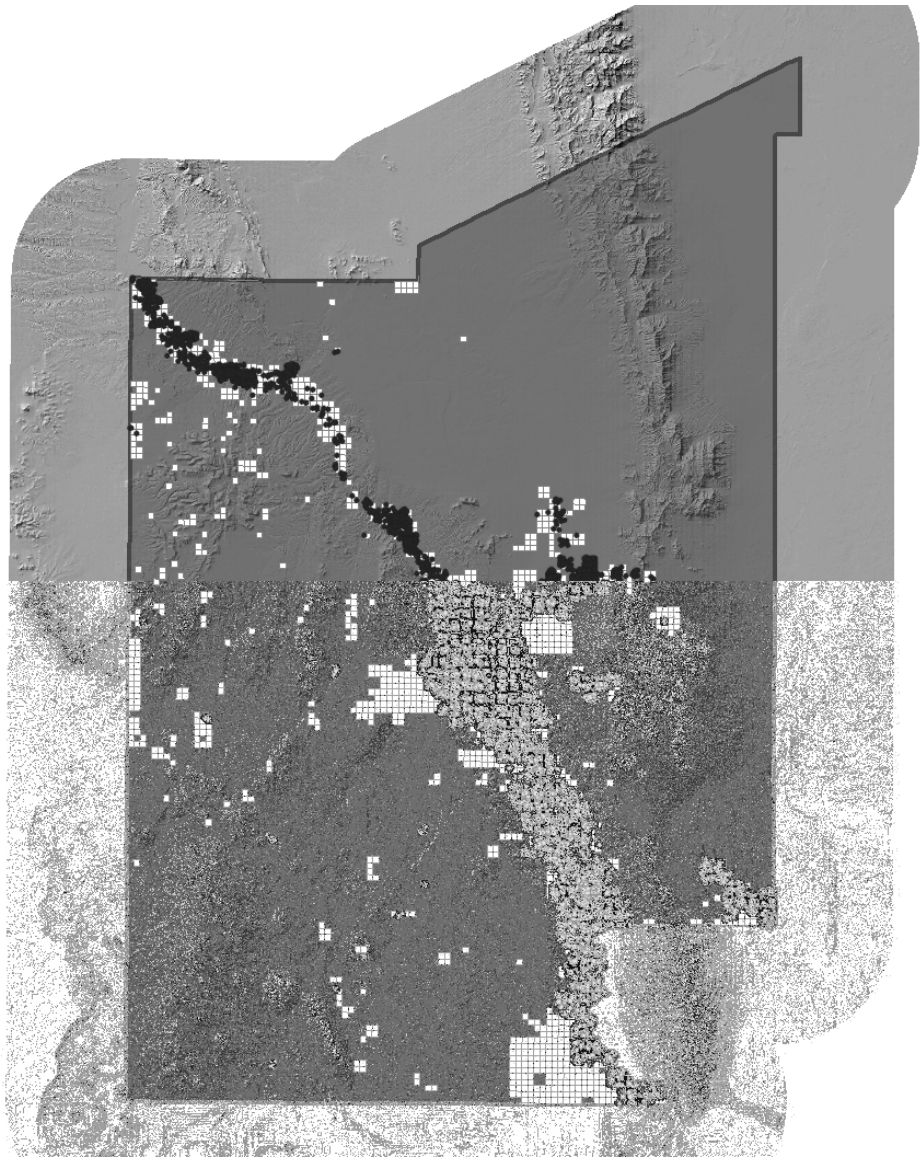
Results

- Projections
  - Base scenario
- Disposed lands
  - Alternative “Not disposed” scenario
    - Make pretend no land disposal occurred

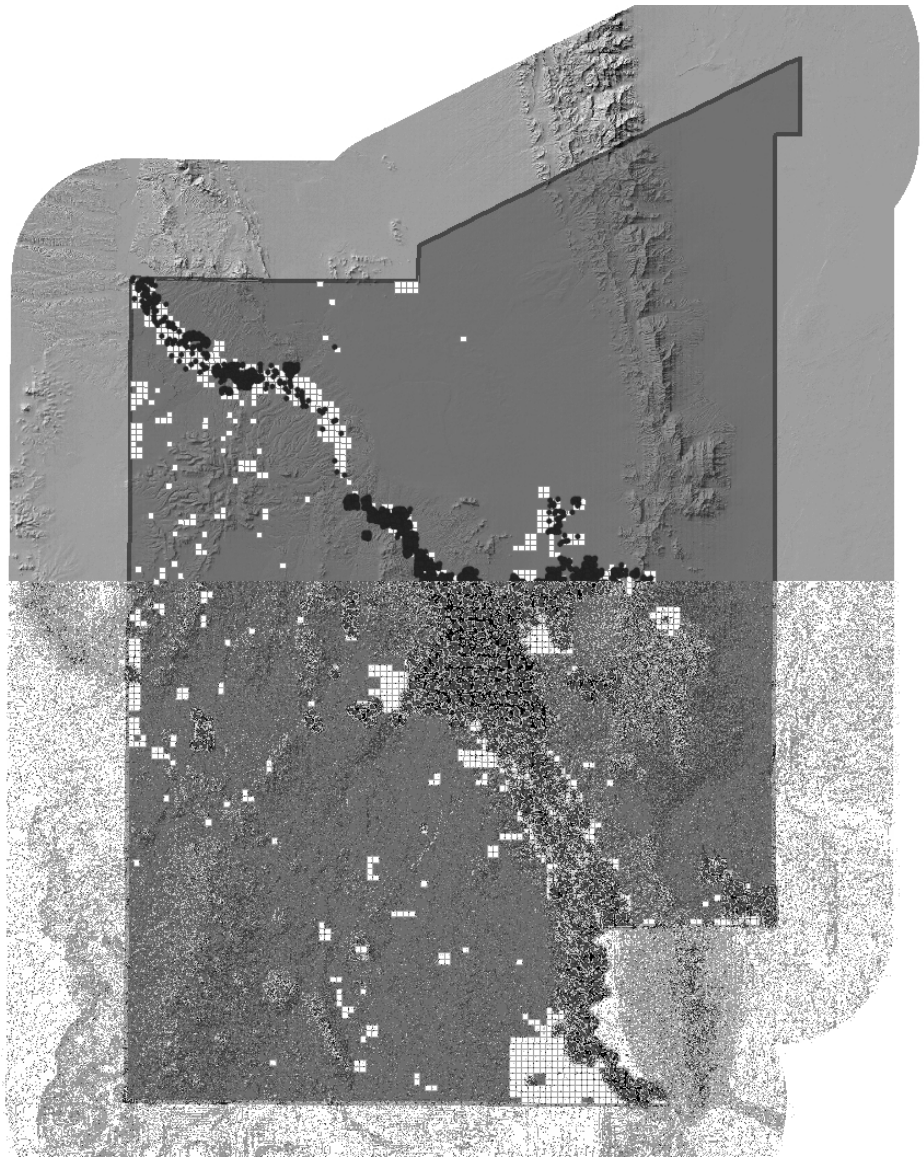
Base scenario, # of residences

- 1990 – 29,134
- 2000 – 38,300
  - 31% increase (1990)
- 2006 – 47,391
- 2010 – 56,671
  - 48% increase (2000)

Residences & Private QSs -2000

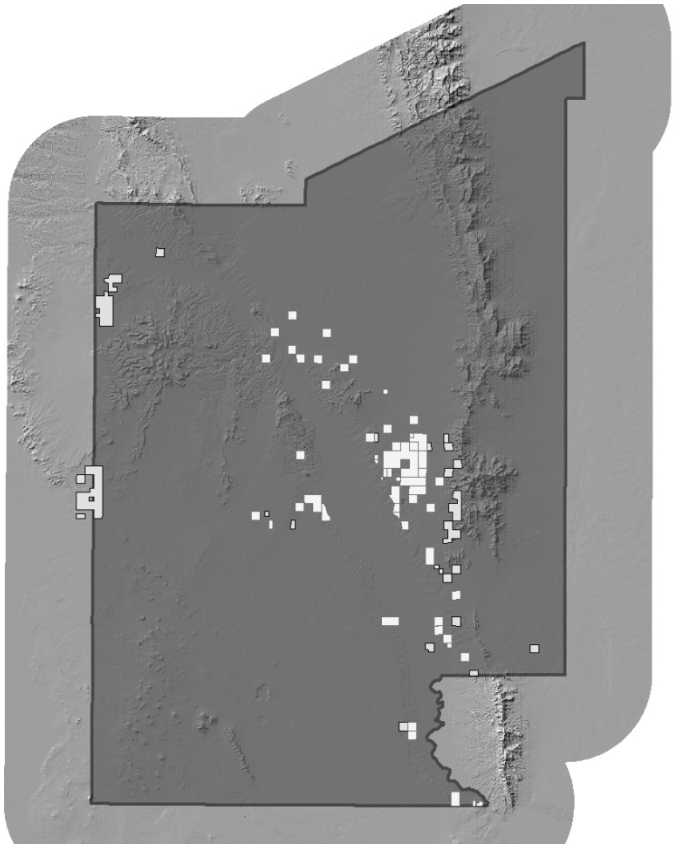


Residences & Private QSs -2010 (proj)



Disposed lands

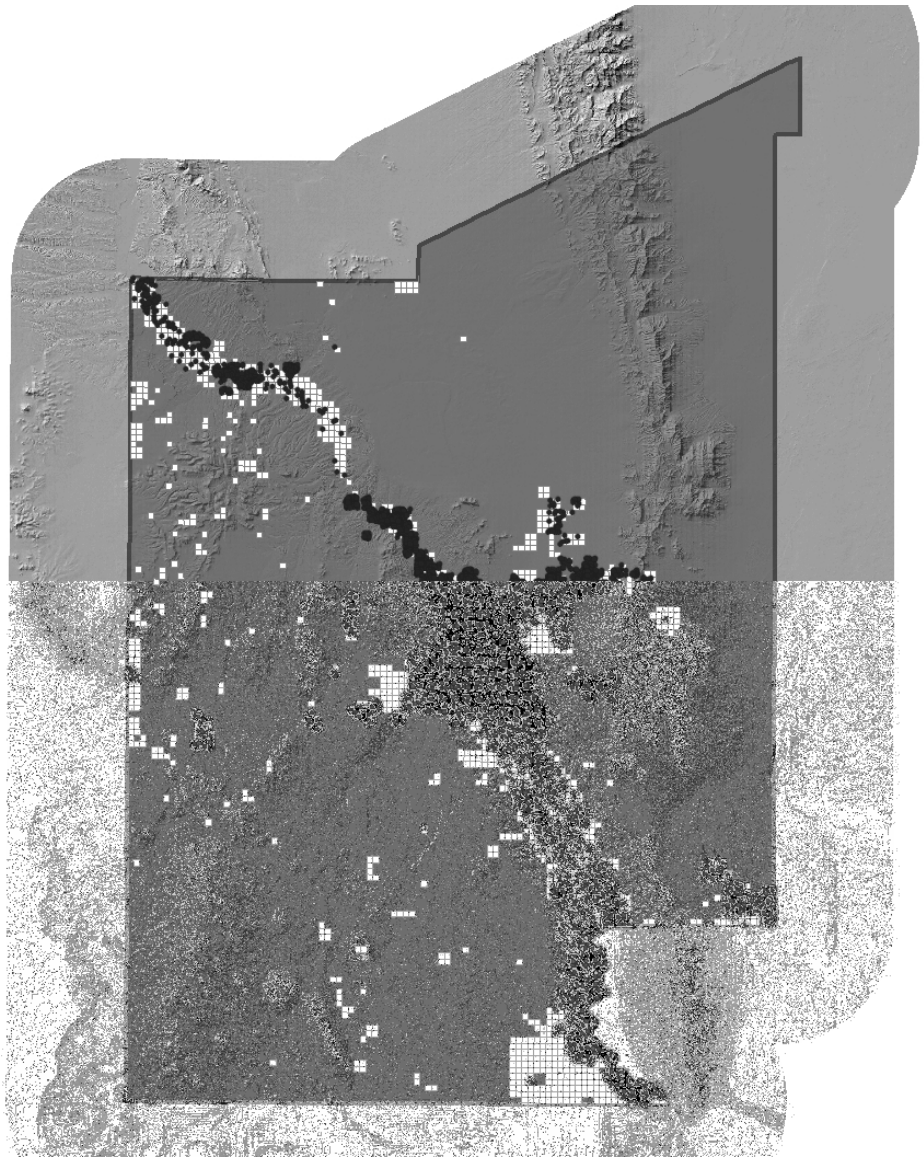
- 53,784 acres disposed since 1980
  - 21,646 acres State lands – 11 transactions
  - 32,138 acres BLM – 59 transactions



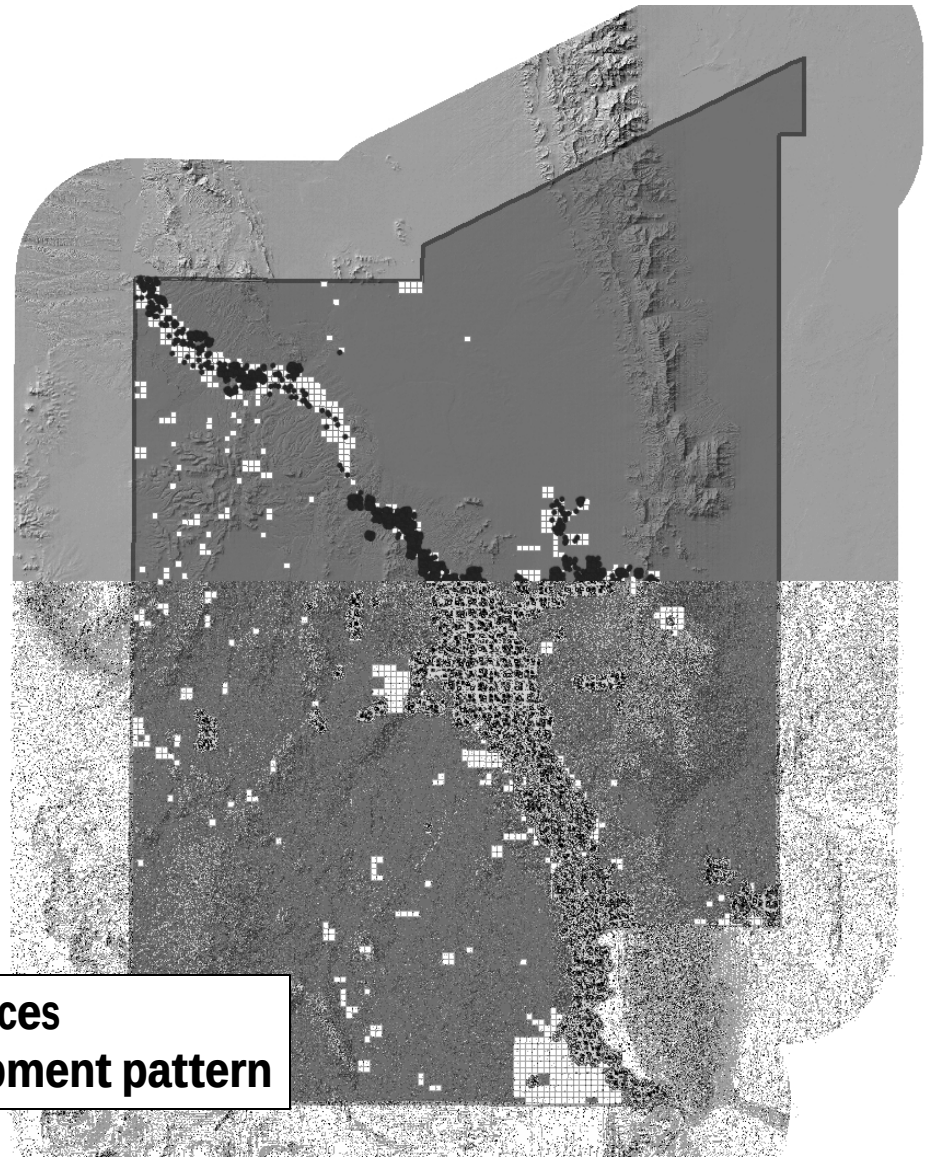
Continued…

- Alternative scenario I
  - Make un-developable all disposed quarter sections
  - 16,567 residences projected in 2010
    - 45% increase (2000)
- Alternative scenario II
  - Model projections using proposed disposals in the BLM's new Resource Management Plan

Residences & Private QSs -2010 (proj)



Residences – projected 2010



3% decrease in residences
More compact development pattern

Outreach

- Local government
  - Planners from Doña Ana County and the City of Las Cruces
  - Metropolitan Planning Organization
  - GIS staff
  - New Mexico State University, Geography Dept.
- Public meeting – about 85 attendees
  - Quality Growth Alliance
  - Councilors from Mesilla and Las Cruces
  - Dona Ana County commissioner
  - State legislator
  - Numerous interested citizens

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How things worked

- Uses of approach
  - Illustrate potential number and distribution of residences
  - Inform discussion regarding public land disposal
  - Inform on-going work on a City\County comprehensive plan revision
  - Provide a basis to revisit development of alternative scenarios
    - For example, future land disposals

How things worked

- Pros of approach
  - Great tool for visualizing growth
  - Best statistical framework for the data
  - Foster discussion and action
  - Uses open source statistical and programming tools
- Cons of approach
  - Data collection and processing
  - Requires analysis skills – GIS, stats, visualization

What we learned

- Repeatable, science-based methodology
- Excellent tool for visualizing growth
- Ability to develop alternative scenarios
- Scaleable
  - Applicable across the West

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More complicated approaches

- California Urban Futures I & II
- METROPILUS (DRAM/EMPAL)
  - Disaggregated residential allocation model
  - Employment allocation model
- SAM-IM
  - Subarea allocation model – Information manager
- UrbanSim
- Metroquest
- What if?
- Others…