California Urban and Biodiversity Analysis (CURBA) Model

Presentation Overview

- Model Overview
- Urban Growth Model
- Policy Simulation and Evaluation Model
- Habitat Fragmentation Analysis
- Case Study: Santa Cruz County
- Evaluation and Conclusions

Model Overview

- Urban Growth Model (Similar to CUF-2)

- Policy Simulation and Evaluation Model (CUF2)

- A Predicted Land-Use Future Scenario

- Habitat Loss and Fragmentation Analysis Modules

- Indication of Effects of Policy on Biodiversity

Model Overview

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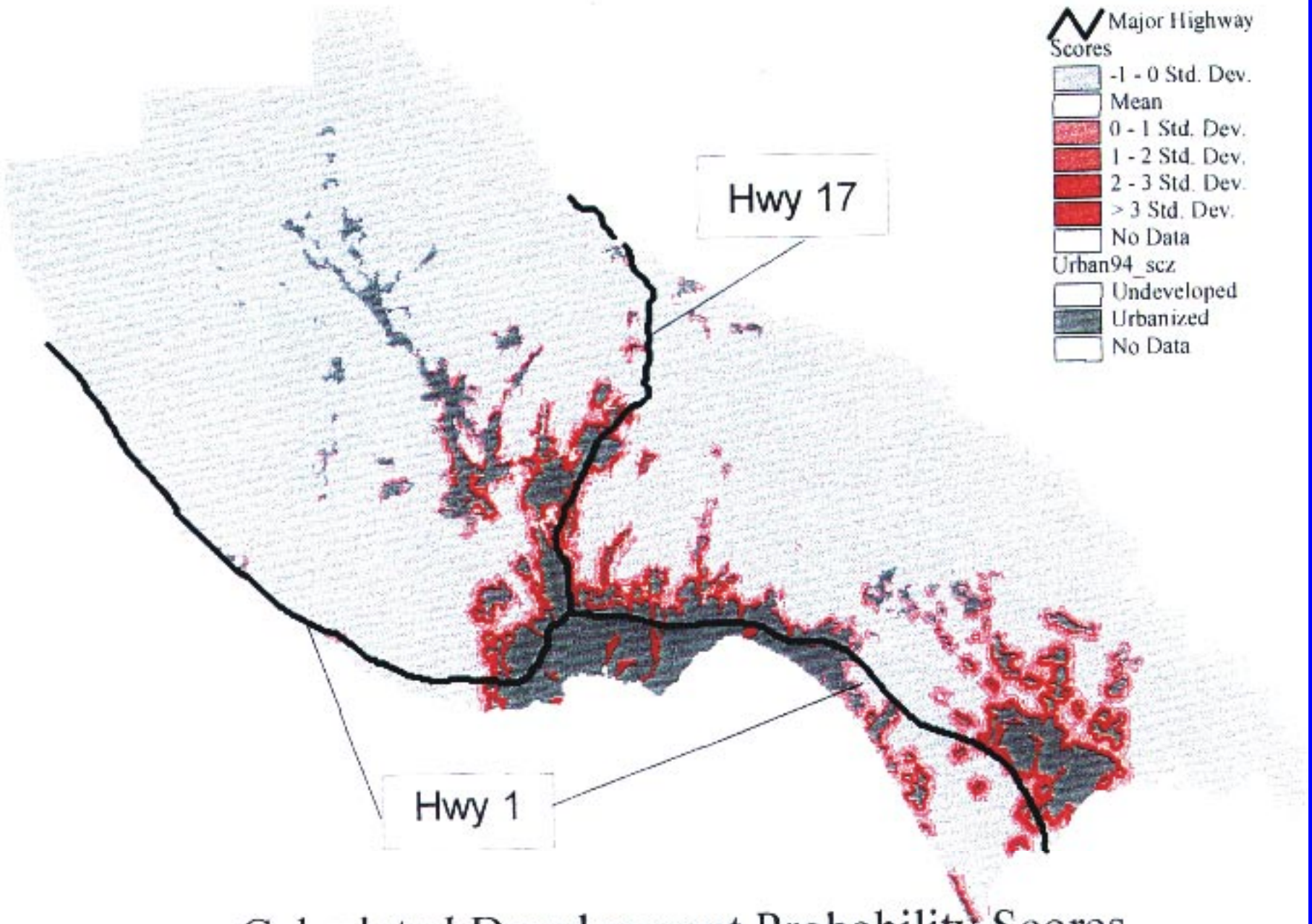
- **Habitat Loss and Fragmentation Analysis Modules**

- **Indication of Effects of Policy on Biodiversity**

Urban Growth Model: Review

- Estimate county based urbanization equations: Prob{grid-cell I urbanizing] = f{proximity to highways, proximity to city boundaries, site slope, site development constraints, other factors}
- Calculates future urbanization probabilities for all undeveloped sites



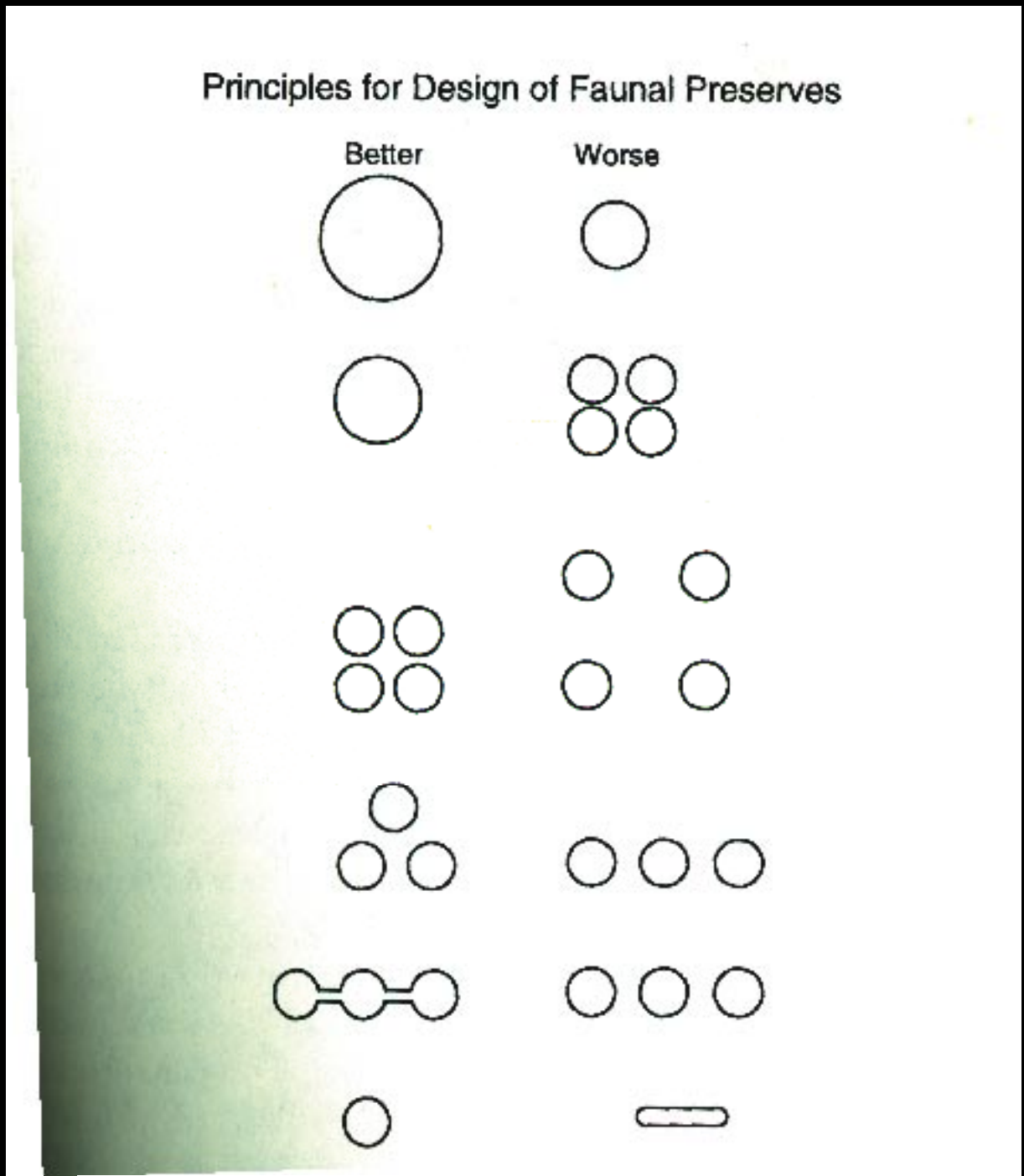
Calculated Development Probability Scores

Policy Simulation and Evaluation Model

- Import future urbanization probabilities
- Enter community-wide population growth increment
- Construct a policy scenario
  - Wetlands, floodplains, river corridors
  - Site slope
  - Farmland
  - Urban boundaries
- Eliminate “undevelopable” sites
- Run the model
- Map and analyze outputs

Habitat Loss Module Evaluates:

- Loss of vegetative land cover by type (GAP Analysis Data)
- Loss of mammal, reptile, and bird habitat for multiple or individual species
  - Uses Wildlife Habitat Relationships Model, not real observations
- Loss of lands associated with varying eco-regional value



From Noss (1995) citing Diamond (1975)

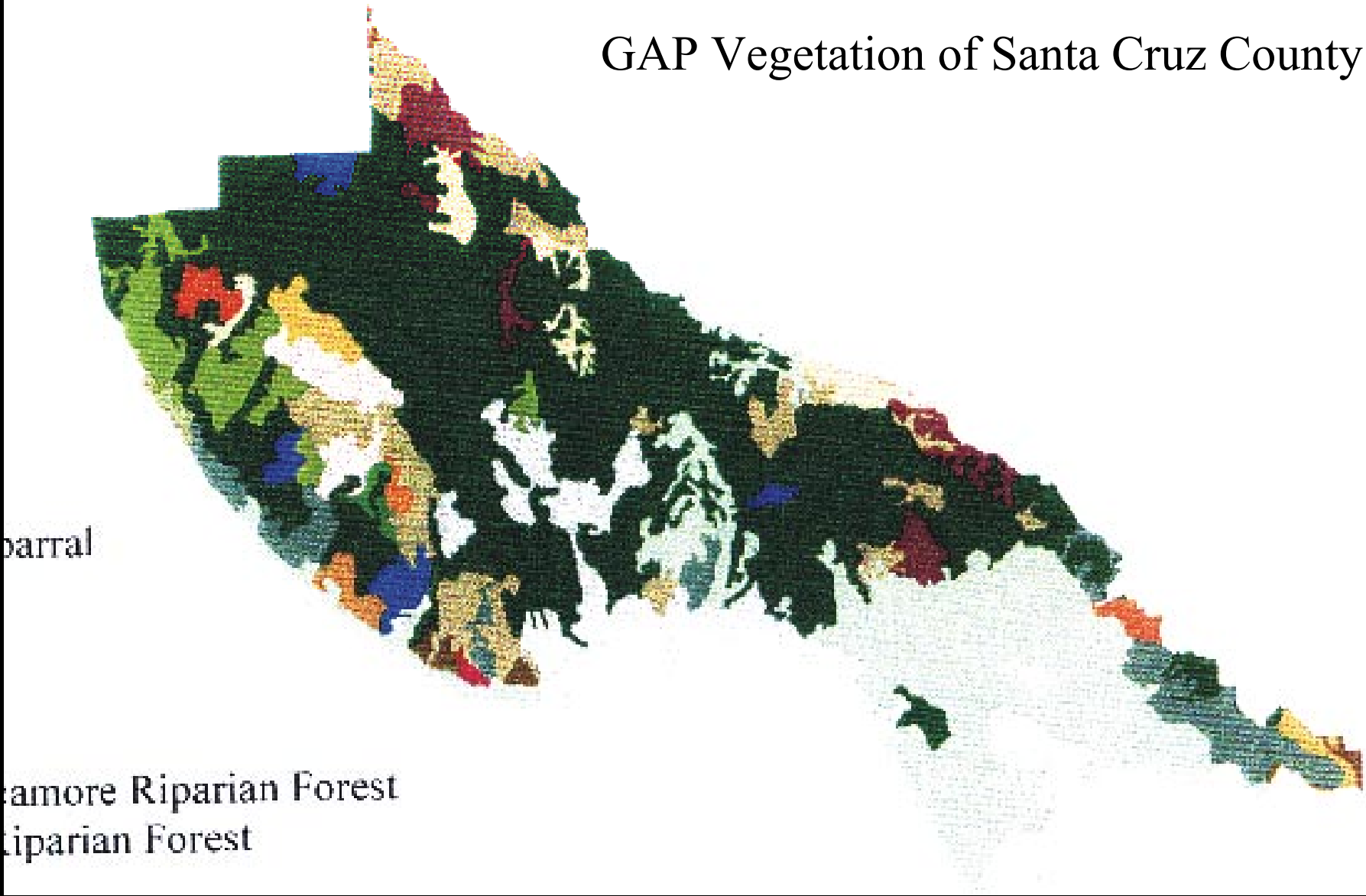
Habitat Fragmentation Module Outputs

- Percent of Landscape (of a particular habitat type)
- Number of Patches
- Maximum Patch Size
- Minimum Patch Size
- Mean Patch Size
- Patch size Variance and Standard Deviation
- Patch Density
- Largest Patch Index
- Total Edge
- Average Edge-Area Ratio
- Edge Density

Example: Santa Cruz County

- It is one of Nine counties evaluated.
- Three Scenarios for Santa Cruz:
  - No Constraints
  - Farmland Protection: No development on
    - prime or unique agricultural lands
    - farmlands of importance to state or local economy
    - wetlands
  - Environmental Protection: No development on
    - Wetlands, floodzones or 100 m of a stream
    - Slopes greater than 10%
    - Areas outside of 500 m from existing spheres of influence
    - And, development density is 25 people per ha instead of 20

GAP Vegetation of Santa Cruz County



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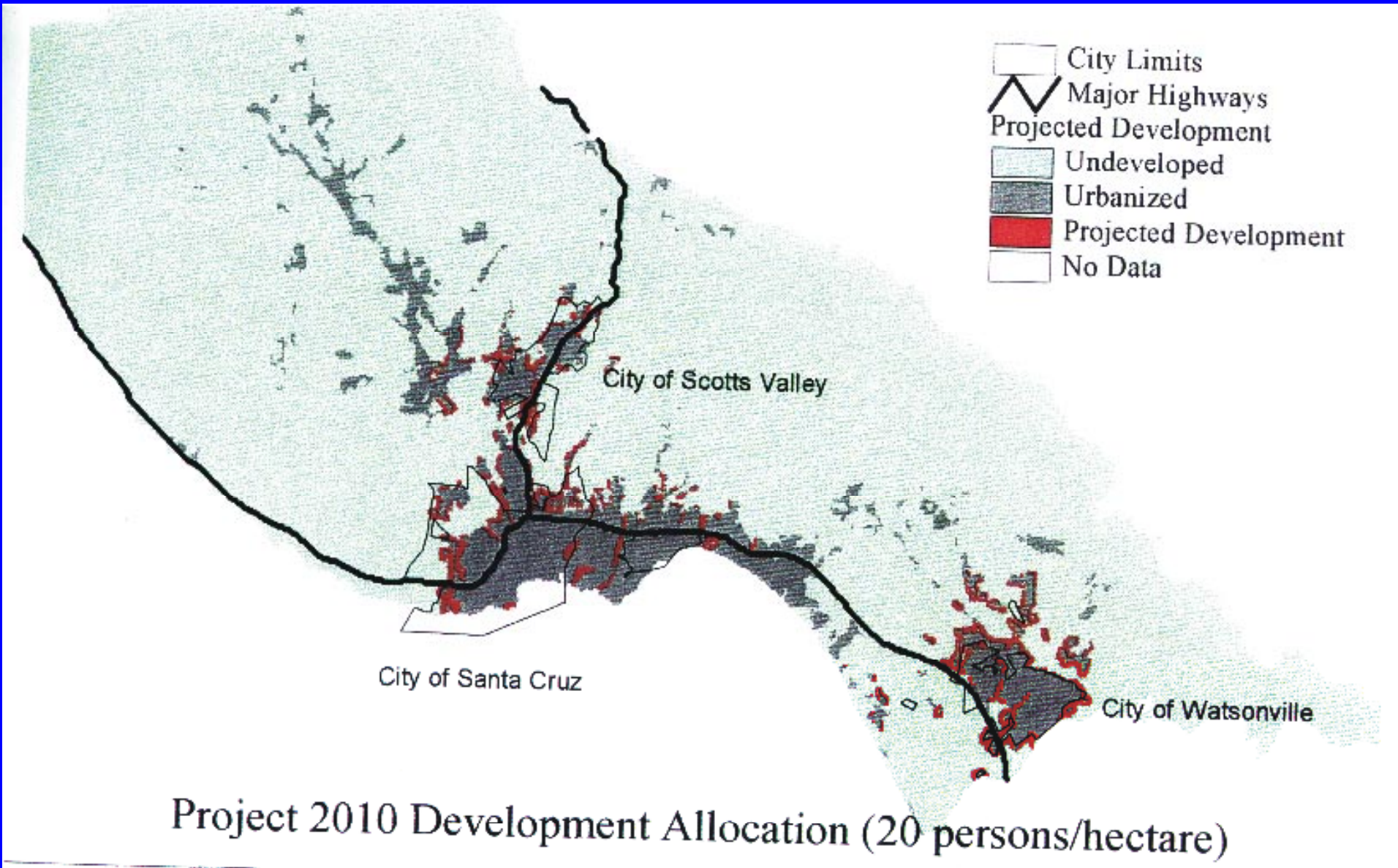
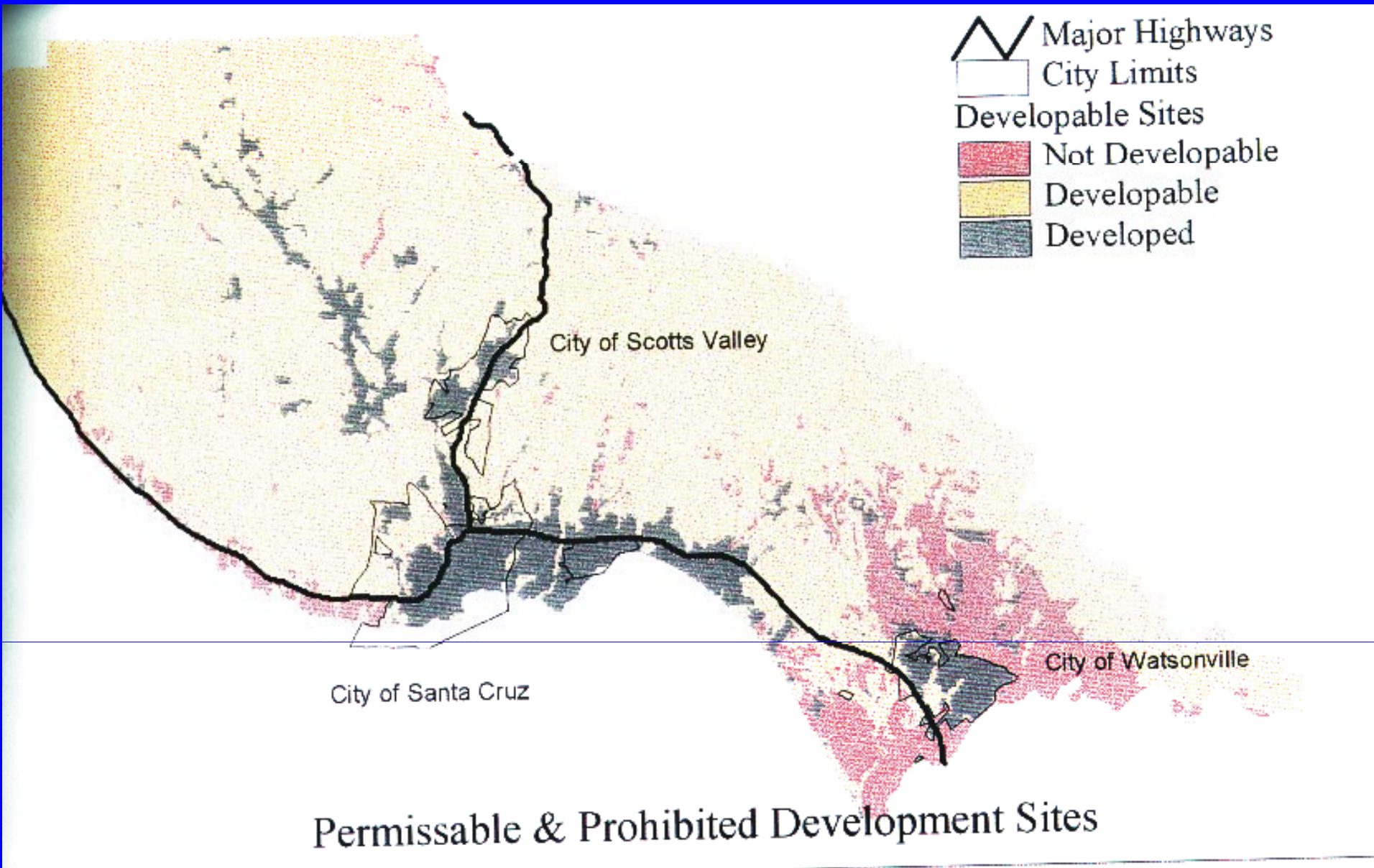
No Constraints

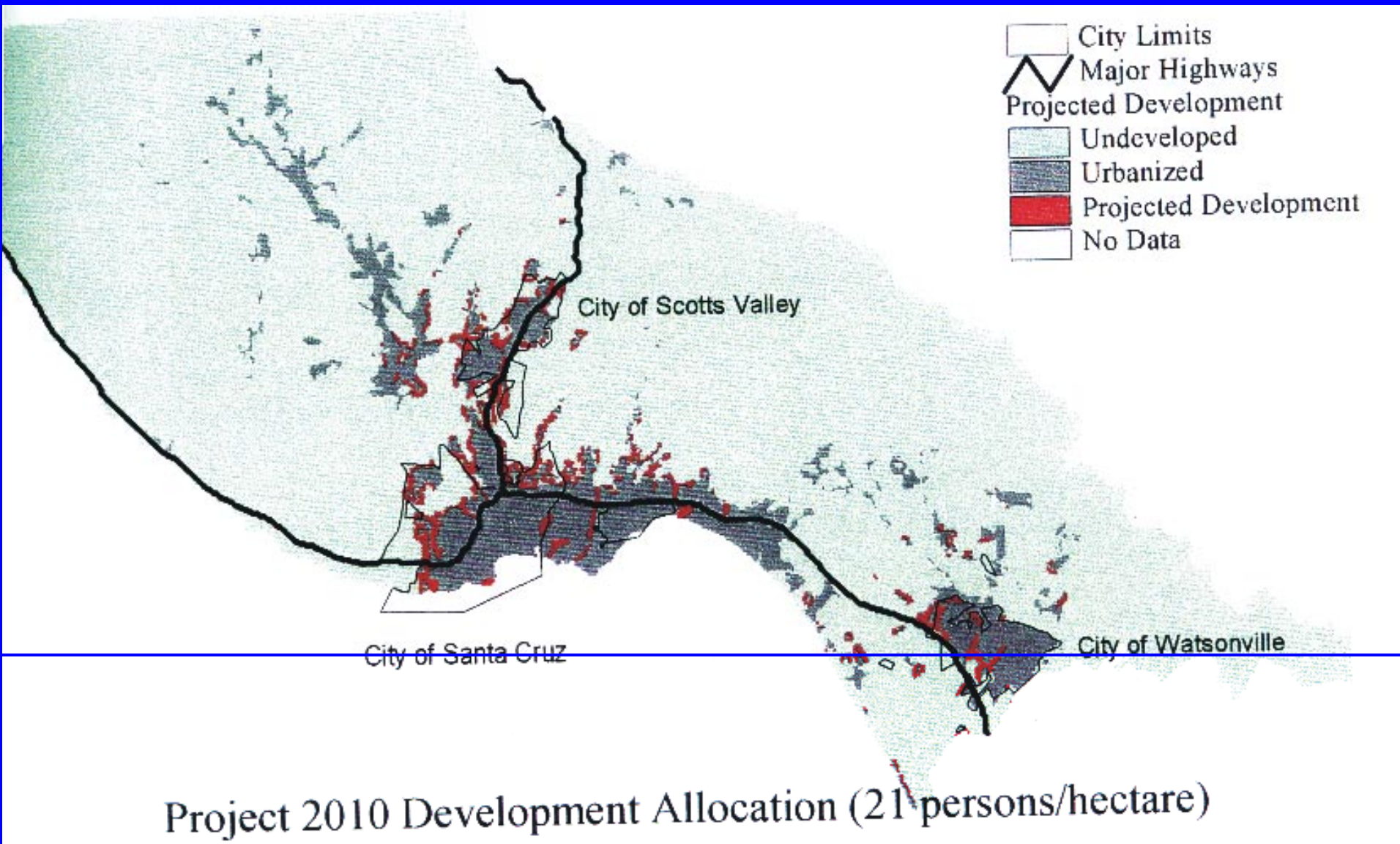


Project 2010 Development Allocation (20 persons/hectare)

Farmland Protection Scenario: Constraints

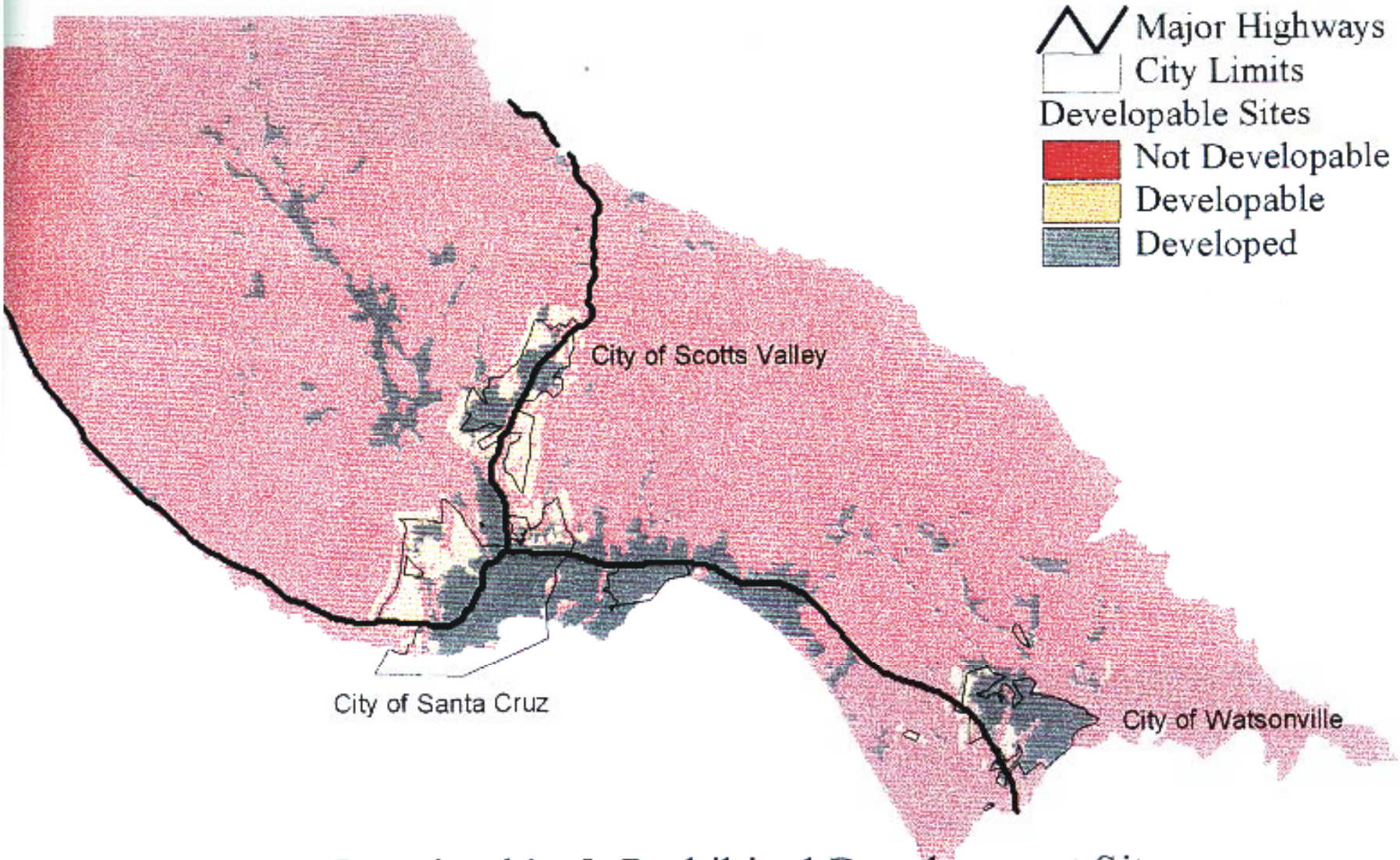


Farmland Protection Scenario



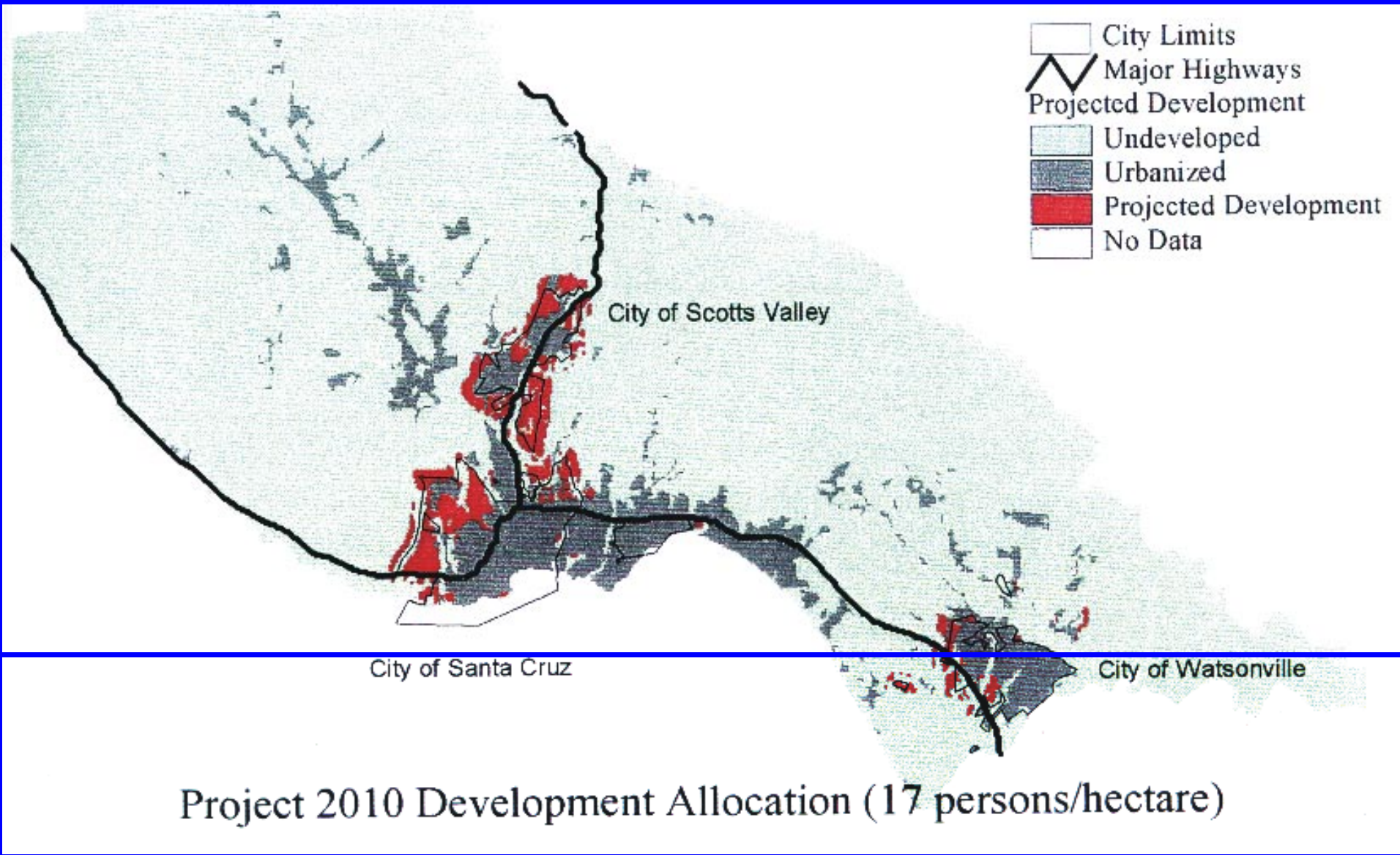
Project 2010 Development Allocation (21 persons/hectare)

Map 4: Santa Cruz County Scenario SC3: Environmental Protection



Permissable & Prohibited Development Sites

“Environemental Protection” Scenario



Project 2010 Development Allocation (17 persons/hectare)

Results: Habitat Loss

Scenario	Agricultural Loss (ha)	% Loss	Upland Redwood Forest(ha)	% Loss
No Constraints	902	4.4	405	0.8
Farmland Protection	447	2.2	620	1.3
Environmental Protection	367	1.8	1232	2.5

Reason for such a result

- The requirement of <500 m from “sphere-of-influence” skews the results
  - Spheres-of-influence are not defined for non city urban areas.

Results: Fragmentation

- The “environmental protection” scenario resulted in the MOST fragmentation of upland redwood forest, and the “No Constraints” scenario the least.
  - The spheres-of-influence issue is again the cause.

Results: Species Fragmentation

- Red Fox
  - Loses 6% of its habitat in C1; 2% in C3
  - C1 also increases fragmentation
- Yuma Myotis
  - Loses 40% of its land in C2, and 28% in C1;
  - but fragmentation indices increase equally

Conclusions of Case-study

- Potential mismatch between policies designed to conserve and protect natural features versus the actual protection of species habitat
- The model allows the user to examine these scenarios and the impact of various policy decisions

Limitations

- Based on the past, and do not able to predict the effects of future investments (i.e. roads) on future patterns
- All urban growth is equal, and no redevelopment is possible.
- It's surrogates for biodiversity requirements are a step in the right direction, but not adequate.
  - Biodiversity requirements are much more complex

Enhancements needed to meet biodiversity requirements

- Focal habitats and species need to be identified based on ecological merits
  - Then it is these species and habitats that should be highlighted in the outputs
- Habitat connectivity is related but not directly converse to habitat fragmentation, and needs acknowledgement
- Provisions for species census or sightings layers should be incorporated

Conclusions

- CURBA needs much more landscape ecology if it is to satisfy it's objectives
- A more normative approach to identifying the constraints of the Environmental Scenario is mandatory, and often overlooked or downplayed.

Notes

- Compare loss of ag and Redwood
- Compare fragmentation
- Compare fragmentation for species
  - Yumi Myotis
  - Red Fox
- Lessons
  - Biodiversity requiremetns is a complex issue

The CURBA Model

- integrates three sets of data sources and modeling approaches which have heretofore been separate:

  1) A statistical model of urban growth incorporating spatial and non-spatial components.
  2) Procedures for simulating the effect of alternative development and conservation policies on the amount and pattern of urban growth
  3) Detailed and spatially explicit map and data layers regarding habitat types, biodiversity, and other natural factors.

  Has been performed on 9 counties.

  It is like CUF II in that it has an Urban Growth Model that