Analyzing Changes in Agri-Environmental Conditions Using the National Resources Inventory [NRI]

- The NRI is not a Land Use Program
- The NRI is a Longitudinal Survey
  - What does that mean?
  - What are the implications?
- Why the NRI Program has used Certain Statistical Methodology [over its history]
- The NRI perspective on Land Use Data?
  - How does this affect Data Users?
- On-going Developments that Affect NRI Data
  - What are these developments?
  - How will these affect Data Users?

The National Resources Inventory (NRI)

- Longitudinal statistical survey
  - same sample sites kept in sample and studied repeatedly over time – to properly track changes
  - 800,000 sample sites across U.S. – studied periodically since 1982
- Conducted by NRCS, in cooperation with Center for Survey Statistics and Methodology, Iowa State University
- Designed & implemented to assess conditions & trends of soil, water, & related resources on non-Federal rural lands
- Legislative mandates [1970's]

Analyzing Changes in Agri-Environmental Conditions Using the National Resources Inventory [NRI]

- **Captures data on land cover and use, soils, soil erosion, wetlands, habitat diversity, selected conservation practices, & related resource attributes -- at 800,000 scientifically selected sample sites**
- **Purpose: To provide support for**
  - ***Agricultural* and *Environmental* Policy Development and Program Implementation**

Evolution of the NRI

Conservation Needs Inventory	• 1934, 1945 • 1958, 1967
National Resources Inventory	• 1977, 1982 • 1987, 1992
Foundation NRI	• 1997
Special Studies	• 1975 • 1991, 1995, 1996, 1997, 1998, 1999
Continuous/Annual NRI	• PI: 2000, 2001, 2002, 2003 • Range: 2003, 2004, 2005, 2006, 2007 • CEAP: 2003, 2004, 2005, 2006
Annual NRI [PI and on-site]	• 2005 - 2010

Why Consider these 30 Different Surveys

- Much has been learned over these several decades [and 30 surveys]
  - ❑ Statistical/survey methodologies
  - ❑ Data collection methodology
  - ❑ Needs of data users; analytical methods
- These studies must fit together and give consistent data/results; if not:
  - ❑ Waste taxpayers money
  - ❑ Waste efforts of conservationists/scientists
  - ❑ Future efforts will be discredited
    - By scientists, special interest groups, policy analysts, policy makers

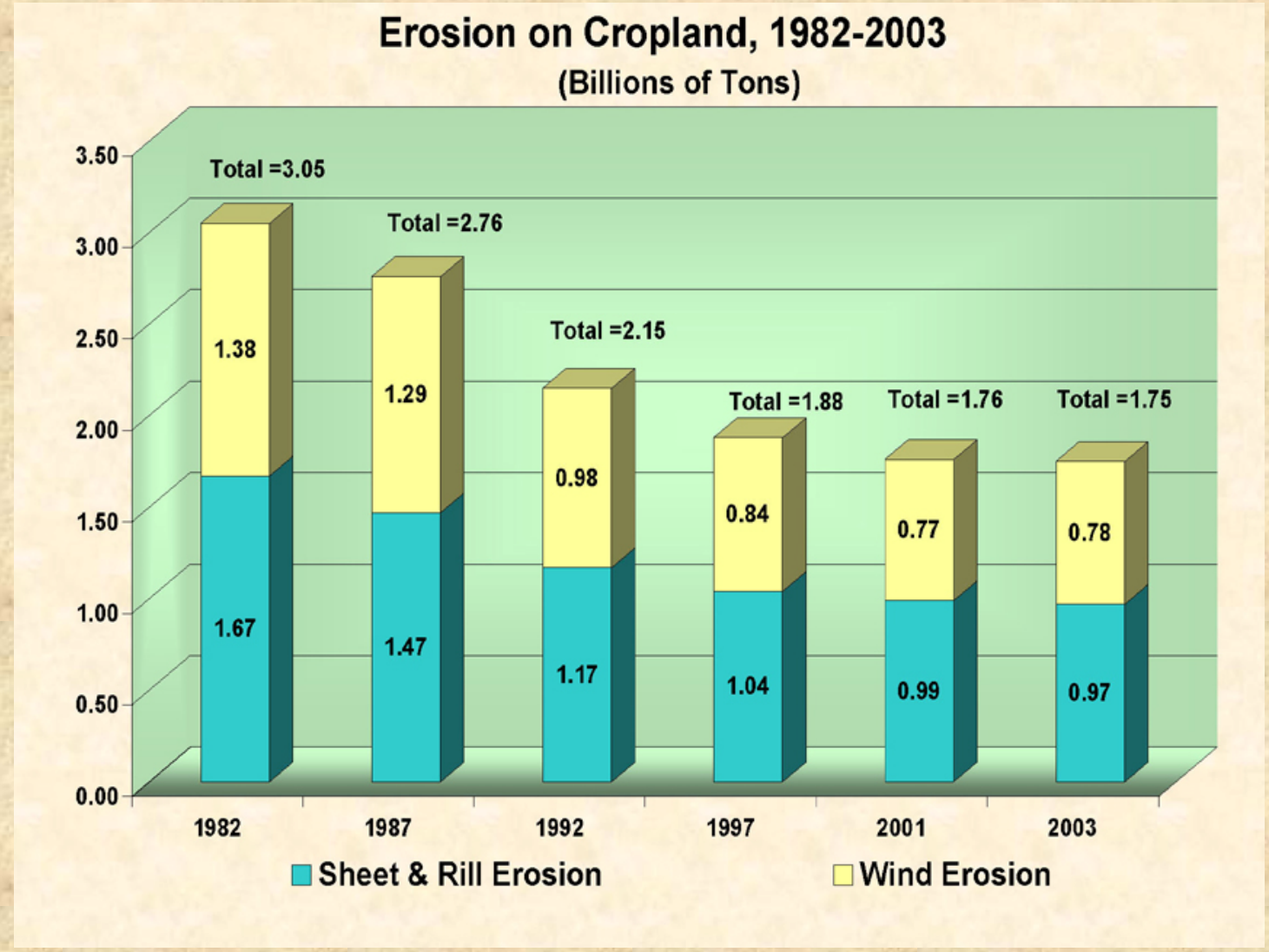
Information from NRI has been used to assist development of agri-environmental policy since 1980's:

- ❑ Provisions of 1985 Farm Bill based on NRI
- ❑ All subsequent Farm Bills
  - Identify areas where conservation initiatives and resources should be focused
  - Evaluate effectiveness of past legislation and conservation programs

Modeling with NRI Data

- Estimate changes in C-stock for current land use & mgmt.
- Use physical process models to simulate effects of Conservation Practices/Systems
  - For example, as for NRI/CEAP Cropland Assessment
  - Can do a number of "What if?" scenarios
- Issues dealing with loss of Rural Lands to Development
- Loss of Crop Productivity due to Soil Erosion
- Forestry Programs: Converting erodible cropland to trees
- Wetlands Programs
  - Potential restoration programs and locations
  - Economic effect of relaxing restrictions [to Agriculture]
- Development of Rules/Reg's for Farm Bill Programs
  - Development of HEL and CRP concepts in 1980's
  - Development of 25% rule for CRP eligible land, by county

Analyzing Changes in Agri-Environmental Conditions Using the National Resources Inventory [NRI]

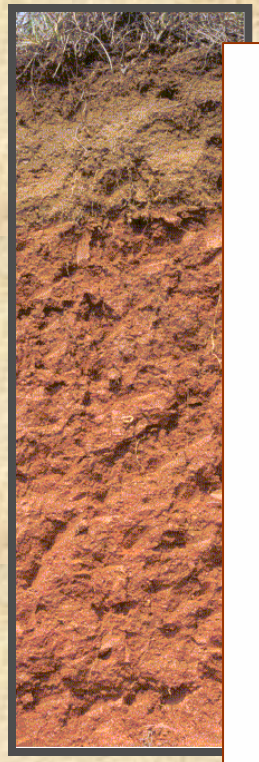


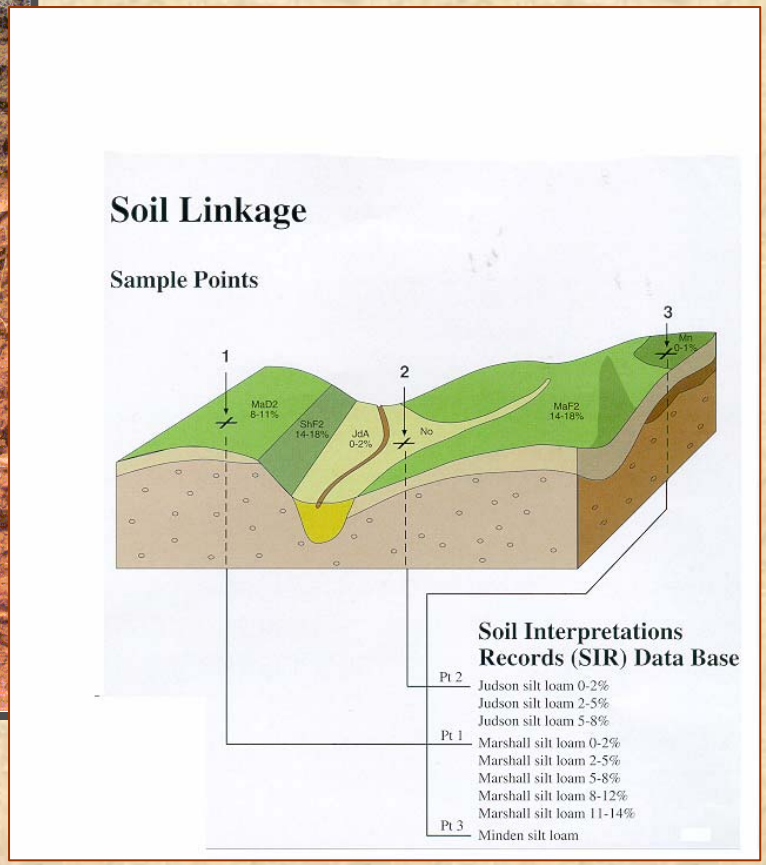
NRI is "Soil-Based"

- Interpretations made from a "soils perspective", for example with land condition, or wetland determinations
- Use of soil attributes very important in analysis and assessment [NRI and NRCS soils data bases are "linked"]
- NRCS – formerly the "Soil Conservation Service"

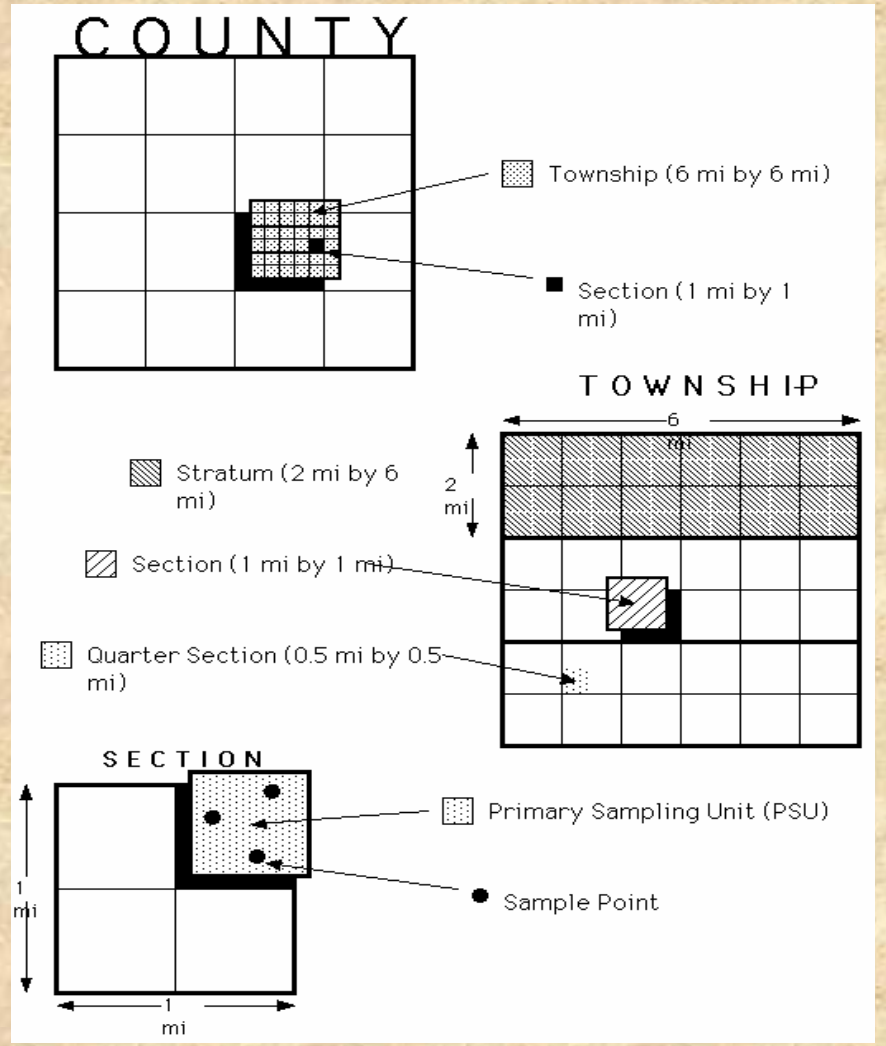
Soils information

- Unique to NRI
- Crucial for --
  - Data collection
  - Processing NRI data
  - Interpretation, analysis; physical-process models





Sample Design, Foundation NRI



- **Stratification**
- **Area Segments**

  typically half-mile square areas of land

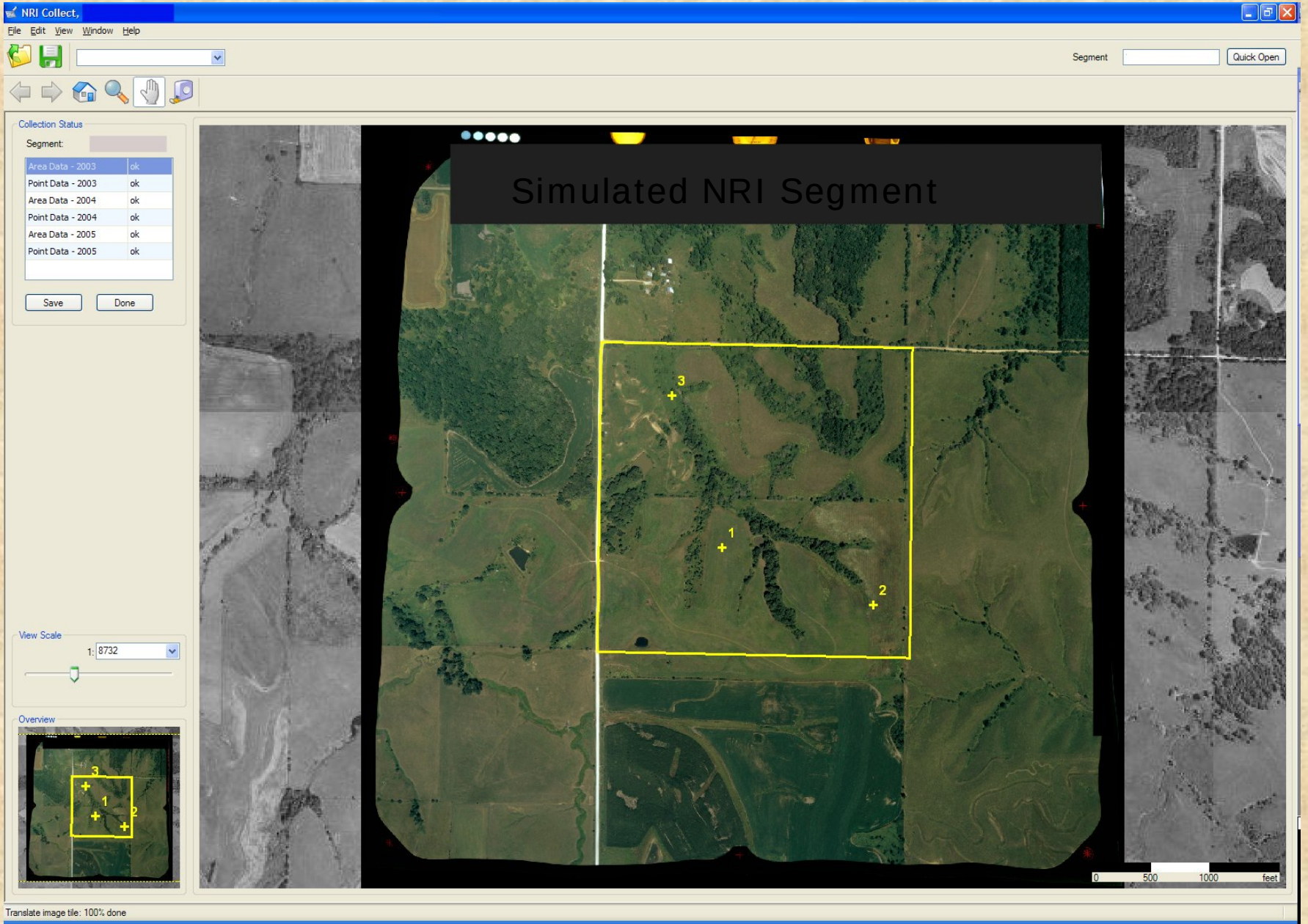
  [300,000 located across U.S.]
- **Point Samples**

  800,000 Points selected within the Segments; typically 3 points per Segment

NRI Sampling Units

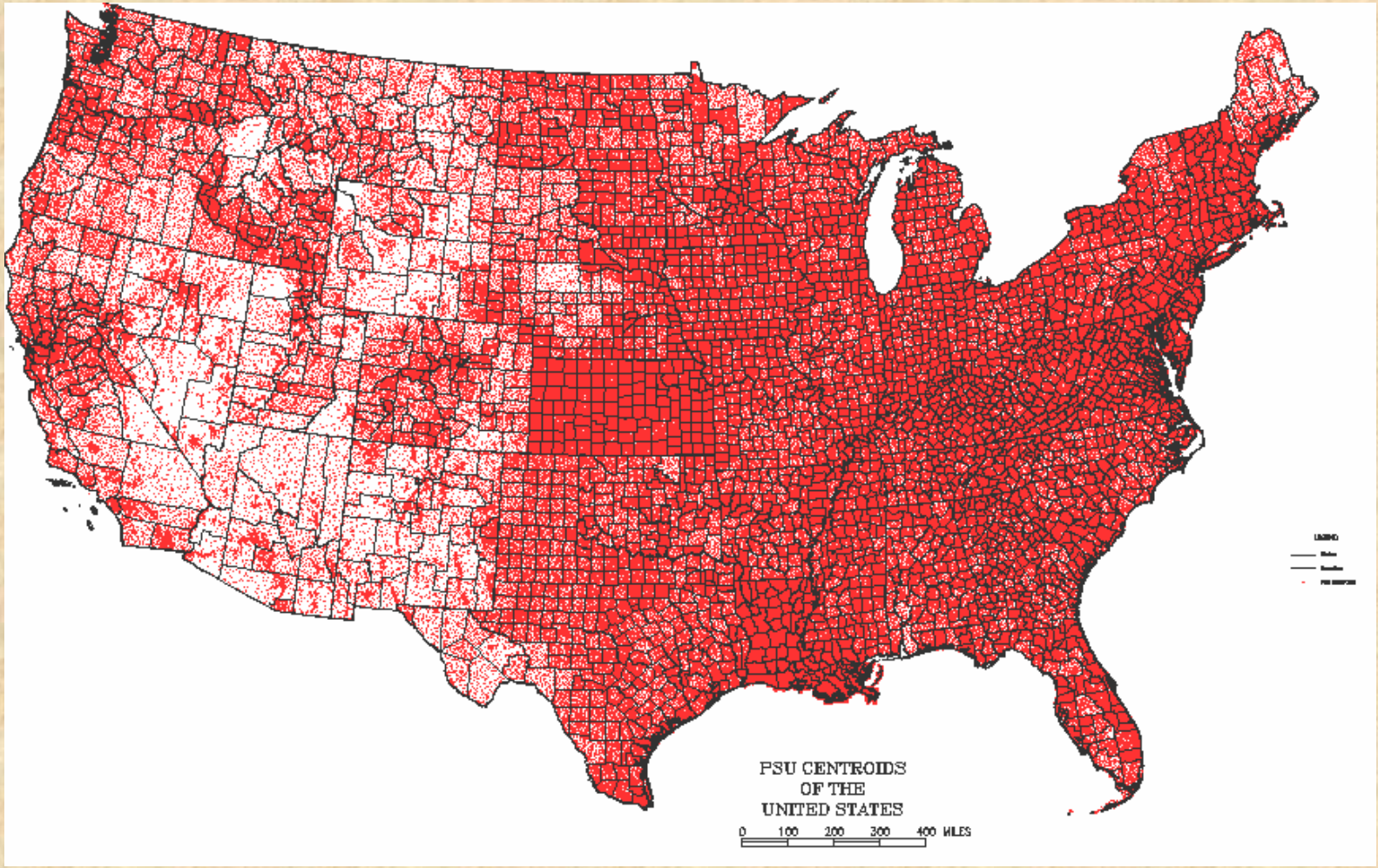
Sampling Units:

Segment and 3 internal points


NRI Collect,
File Edit View Window Help
Segment
Quick Open
Collection Status
Segment:
Area Data - 2003 ok
Point Data - 2003 ok
Area Data - 2004 ok
Point Data - 2004 ok
Area Data - 2005 ok
Point Data - 2005 ok
Save
Done
Simulated NRI Segment
1
2
3
View Scale
1: 8732
Overview
0 500 1000 feet
Translate image tile: 100% done

Repeated measurements on sample units over time

National Sample Density



NRI Data Collection –

Variety of Methodologies

- **High resolution aerial photographs**
  - Many data elements; monitoring; where to go on-site
- **Intensive on-site protocols**
  - Cropland; grazing land; wetlands; farmer interviews
- **Field Office records; Ancillary materials**
- **Satellite data**
  - Some monitoring; data elements [plant productivity]
- **Imputation from generalized data sources**

  [this particularly supports application of process models]

NRI Sampling

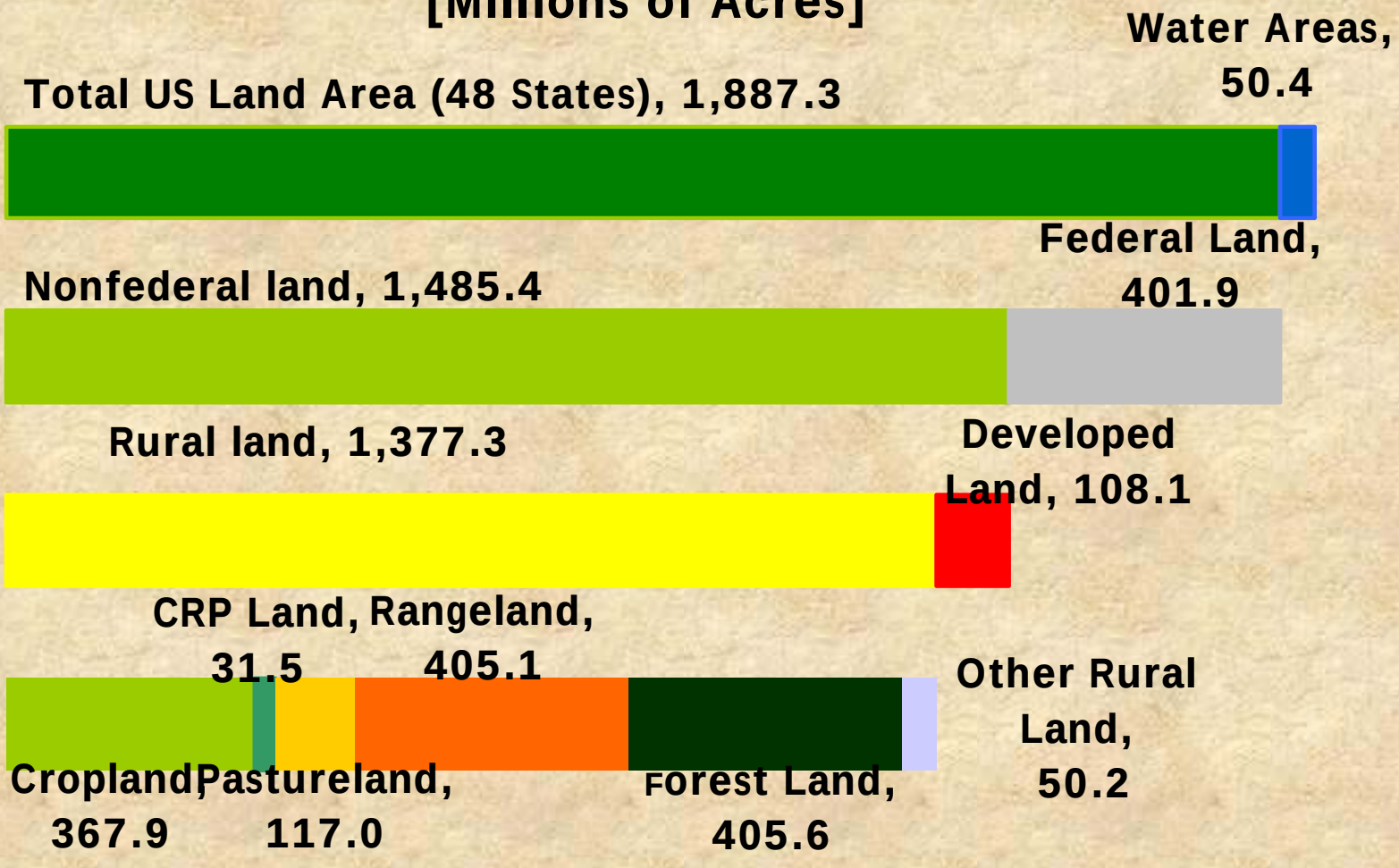
- NRI Framework Sample:
  - 300,000 Segments & 800,000 sample points
  - Historical data back to 1982; soils; field-visited
- Photo-interpretation Sample [Annual since 2000]
  - Core Panel – same 40,000 segments each year
  - Rotating/Supplemental Panel – different 30,000 segments each year
- On-site protocols
  - Sample sites selected from photo sample
  - 5,000 - 8,000 sample points per year

Land Use in the NRI

- Land Use and Land Use History
  - Very important for understanding the NRI
  - Very important when using NRI data for analysis
- Changes in Land Use
  - Very important for understanding natural resource issues, conservation, agri-environmental concerns
  - NRI program spends much effort in preserving the capability to look at these changes over time
  - Unique feature of the NRI survey approach
- Loss of Prime Farmland to Development

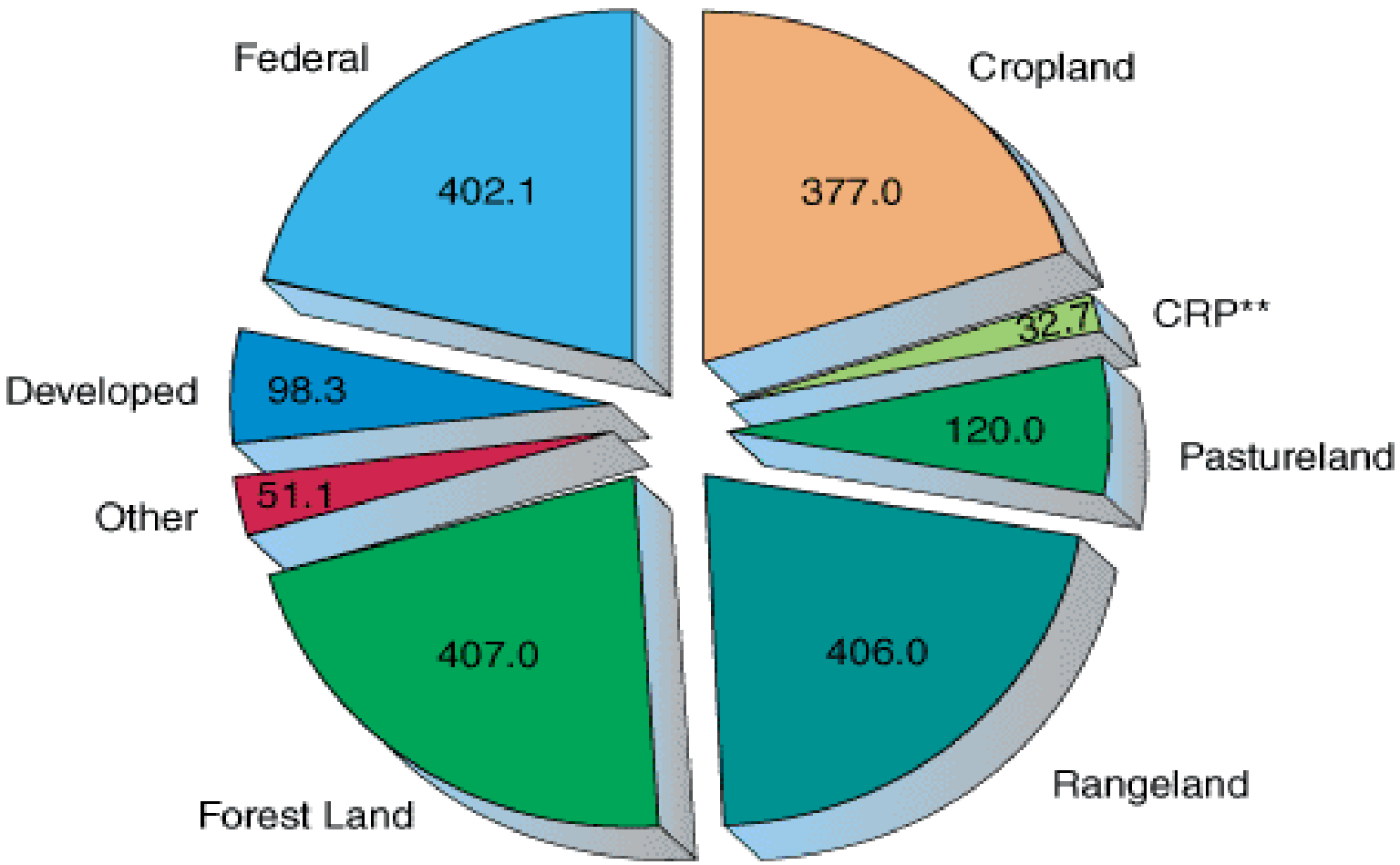
Surface Area, Contiguous 48 States, 2003

[Millions of Acres]



How Our Land is Used

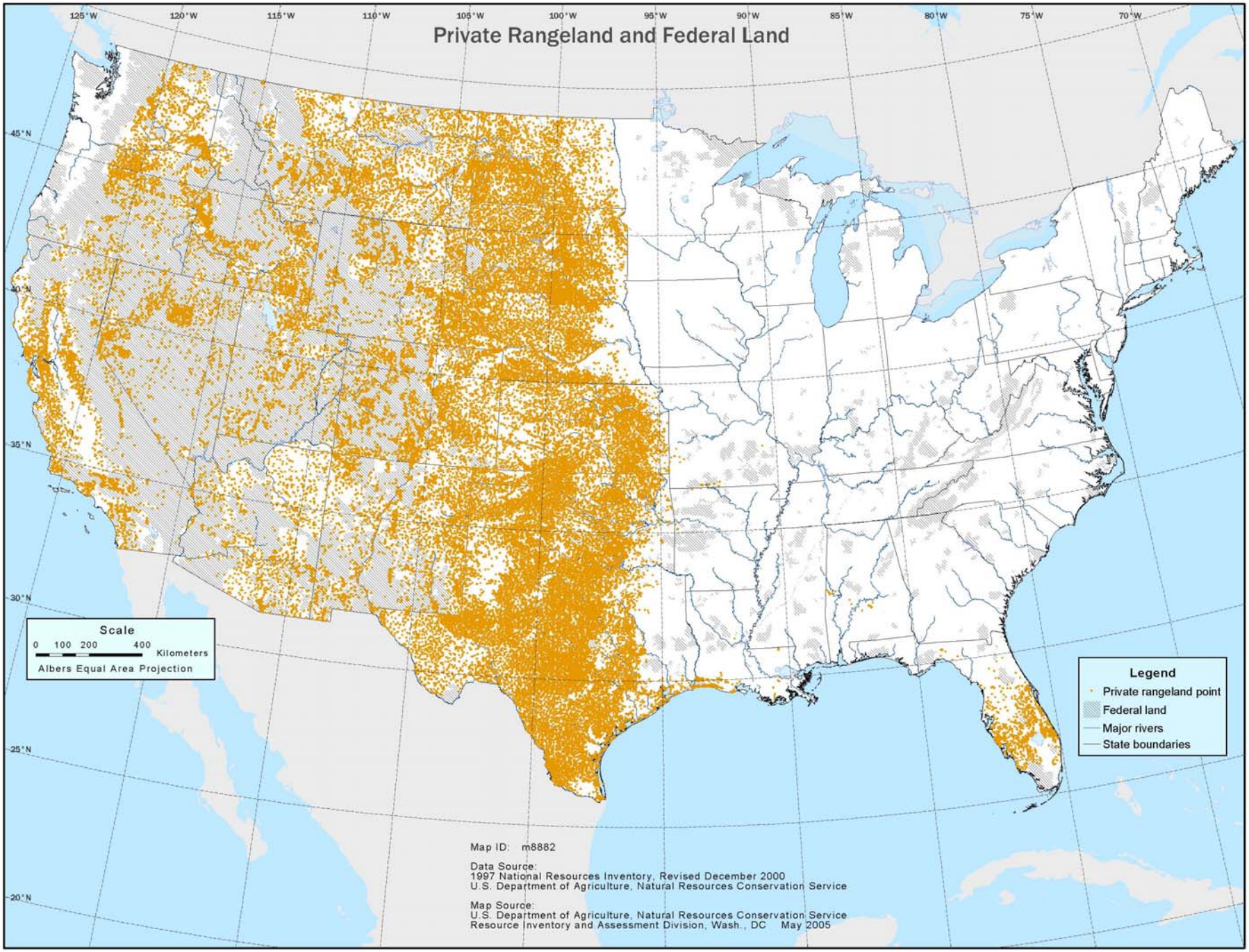
Millions of Acres*



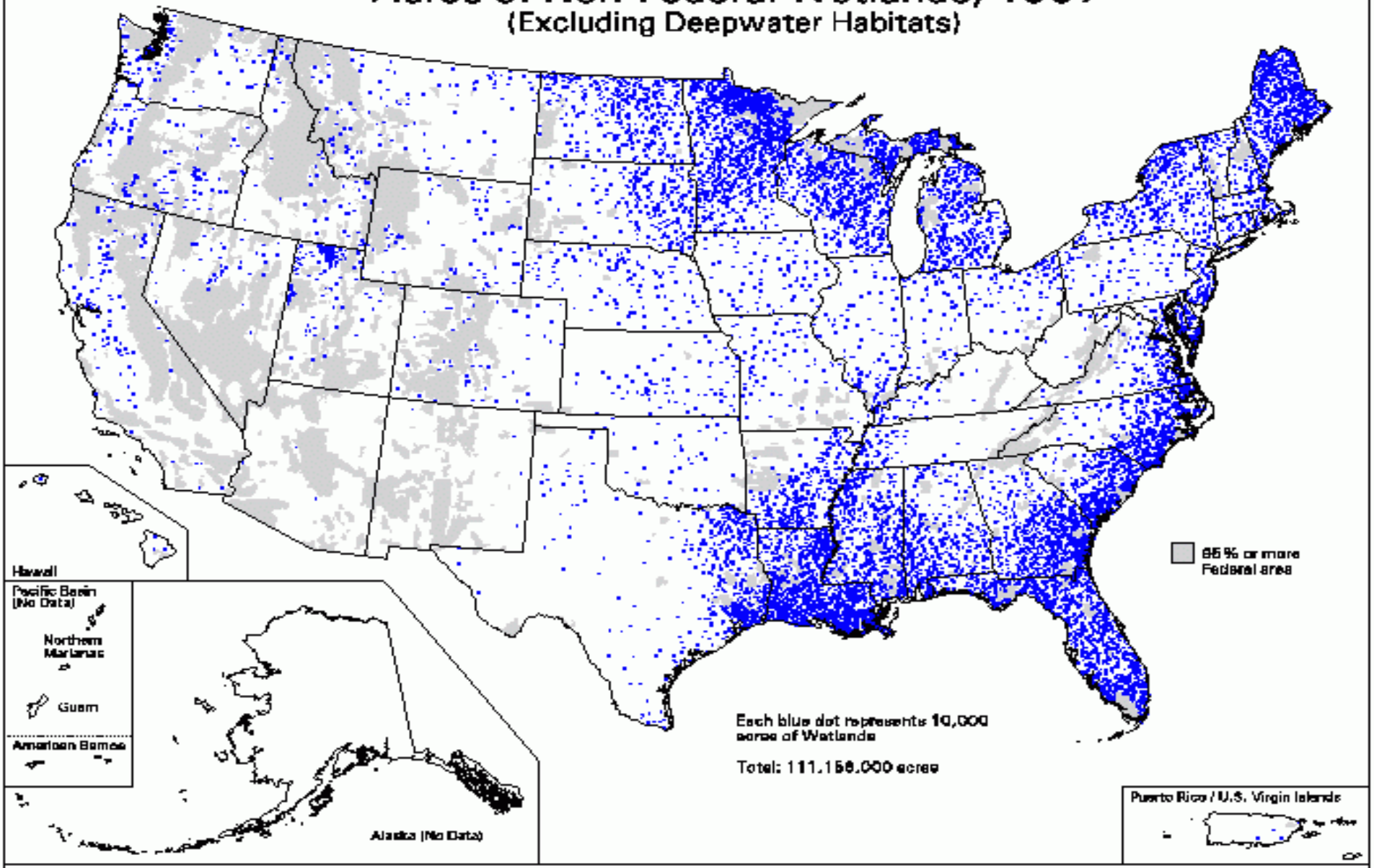
*Non-Federal Land 1,491.1 million acres, including conterminous United States, Hawaii, Puerto Rico, and U.S. Virgin Islands.

**Conservation Reserve Program Land

Source: USDA, Natural Resources Conservation Service
1997 National Resources Inventory
Revised December 2000


Private Rangeland and Federal Land
125°W
120°W
115°W
110°W
105°W
100°W
95°W
90°W
85°W
80°W
75°W
70°W
45°N
40°N
35°N
30°N
25°N
20°N
Scale
0 100 200 400 Kilometers
Albers Equal Area Projection
Legend
Private rangeland point
Federal land
Major rivers
State boundaries
Map ID: m8882
Data Source:
1997 National Resources Inventory, Revised December 2000
U.S. Department of Agriculture, Natural Resources Conservation Service
Map Source:
U.S. Department of Agriculture, Natural Resources Conservation Service
Resource Inventory and Assessment Division, Wash., DC May 2005

Acres of Non-Federal Wetlands, 1997
(Excluding Deepwater Habitats)



USDA NRCS
U.S. Department of Agriculture
Natural Resources Conservation Service
Resource Assessment Division
Washington DC January 2001

Map ID: m5032
For proper interpretation, see Explanation of Analysis for this map at our web site. Search for "USDABOTL" to locate our map index.

Data Source: 1997 National Resources Inventory
Revised December 2000

Changes in Land Cover/Use, 1982 – 2003
[in millions of acres]

CATEGORY	GAINS	LOSSES	NET CHANGE
Cropland	30.3	82.3	- 52.0
Land in CRP	31.5	----	+ 31.5
Pastureland	34.5	48.6	- 14.1
Rangeland	14.7	25.1	- 10.4
Forest Land	31.8	28.7	+ 3.1
Other Rural Land	9.9	7.9	+ 2.0
Developed Land	36.1	0.8	+ 35.3
Water Areas	2.8	1.0	+ 1.8
Federal Land	6.4	3.5	+ 2.9

Notes regarding Land Use [and Change]

- There were changes on 10% of U.S. land over 20 year period
  - For 200 million acres
  - Table just gives changes in broad/major categories
  - Additional changes within Cropland
- NRI provides the *Dynamics* and many characteristics of the land that has changed
  - 14.7 million acres of Forest was Developed
  - 9.6 million acres of Cropland was Developed
  - 30% of new Development had bee Prime Farmland
  - New Cropland has a different set of conservation issues than those acres converted

Additional Notes on NRI Land Use

- History of the NRI system
  - Comments [Good? Bad?]
  - Is a hybrid of land cover and use
- Note that Wetlands are not listed
  - NRI considers it a separate attribute
  - Could change system – but more complicated
- Grazing is also a separate attribute
- *Land in CRP* is not part of Cropland
- What is in each Category?

NRI Land Use Classification

Cropland

- Cultivated Cropland
  - Row crops; Close-grown; Other
  - Then can sub-divide by Rotation
    - 37% Corn & Soybeans
    - 17% Wheat [including Fallow]
    - 10% Corn [and Other, but not Soybeans]
    - 10% Soybeans [and Other, but no Corn]
- Non-Cultivated Cropland
  - Permanent Hayland
  - Permanent Horticulture

NRI Land Use Classification

Other Rural Lands [misc.]

- Farmsteads; Other Land in Farms
- Barren Lands
  - Salt flats; Bare exposed; Strip mines; Beaches; Sand dunes; Mixed barren lands; Mud flats; River wash; Oil wasteland; Other barren land
- Marshland
- Permanent snow and ice fields
- Not vegetated construction sites
- All other land

Comments on Other Categories

- Pastureland
- Rangeland
- Forest land
- Developed Land
  - Urban and built-up, in units 10 acres or larger
  - Small built-up, in a unit 0.25 – 10 acres
  - Rural transportation [7 sub-categories]
- Water Areas, by size
  - Streams
  - Water bodies

Changes in Land Use System

- Developed Land and Farmsteads
  - Our new digital data collection process allows very objective methods, for example, identifying individual structures, eligible areas, roads surrounded by these features
  - Using statistical calibration procedures to preserve trending [for 20 year old concepts]
  - Will provide additional perspectives, for example density of structures]
- Rangeland, Pastureland, etc.
  - 1st level categories are grassland and scrub-shrub
  - Additional questions preserve trending but will eventually provide more analytical capability
- Better breakout of **Agroforestry** areas

Where is the NRI today

- 2003 Annual NRI: Release results
- 2005 Annual NRI (the "New" NRI):
  - Data collection at RSLs
  - Digital methodology at RSLs
- 2006-2010: Complete the progression to fully implemented Annual NRI, **including on-site data collection**

Ongoing Developments in NRI

- Full implementation of NRI on-site data collection [for subset of PI sample sites] “):
  - ❑ For subset of NRI PI sites
  - ❑ For grazing lands
  - ❑ For soil quality
  - ❑ For QA purposes
  - ❑ NRI/CEAP Cropland survey data [interviews]
- Modeling to support and enhance NRI assessment capabilities
  - ❑ Simulation (physical process) modeling, as being employed for NRI/CEAP process
  - ❑ Provide estimates for smaller areas, using Statistical and Geospatial modeling
- Other

NRI Rangeland Field Study

NRI Rangeland Assessment - Objectives

- Usual NRI objectives as stated in policy
  - Provides data on land use, and vegetative cover and composition; extent of invasive species spread
  - Provides data on extent and severity of resource problems requiring management intervention – and information necessary to formulate science-based solutions
- Obtain data necessary to
  - Identify new program needs for Nation's private rangelands
  - Justify continuing Congressional support for existing programs, including Technical Assistance
- Provide data to further range science

Sample Design for Field and Special Resource Studies

- **Use Photo-Interpretation Sample as Base**
  - 1st phase in multi-phase design
  - Use historical information to design sample
  - Borrow strength from photo-interp. data in estimation
- **On-site data collection provides "Benchmark"**
  - Monitoring can utilize high-resolution aerial photography [and other imagery]
- **Often requires extra stage in sampling**
  - Reduce study costs by selecting geographic clusters [example: select counties within states 1st, then PSUs]

Statistical (Longitudinal) Survey vs. Experimental Design

- Some scientists may not like some design aspects
- But statistical survey design provides
  - Scientific Credibility
  - Integrity [also, use of independent Stat. Unit (ISU)]
  - Ability to evaluate results ["how good"]
- Some Soil Scientists and Some Range Scientists
  - Very uncomfortable
  - Not trying to characterize a particular field or soil or ecological site – but rather trying to characterize some geographical area – can them make inferences (or describe)

NRI Modeling

NRI survey structure → simulation framework

- Sample sites = "representative fields"
- Linked data used to impute values
- Predict outcomes
- NRI weights -- estimates of distribution, extent of predicted conditions

Modeling & policy analysis

- Agri-environmental simulations examine—
  - ❑ Effects of policies + programs
  - ❑ Predicted outcomes of alternative practices

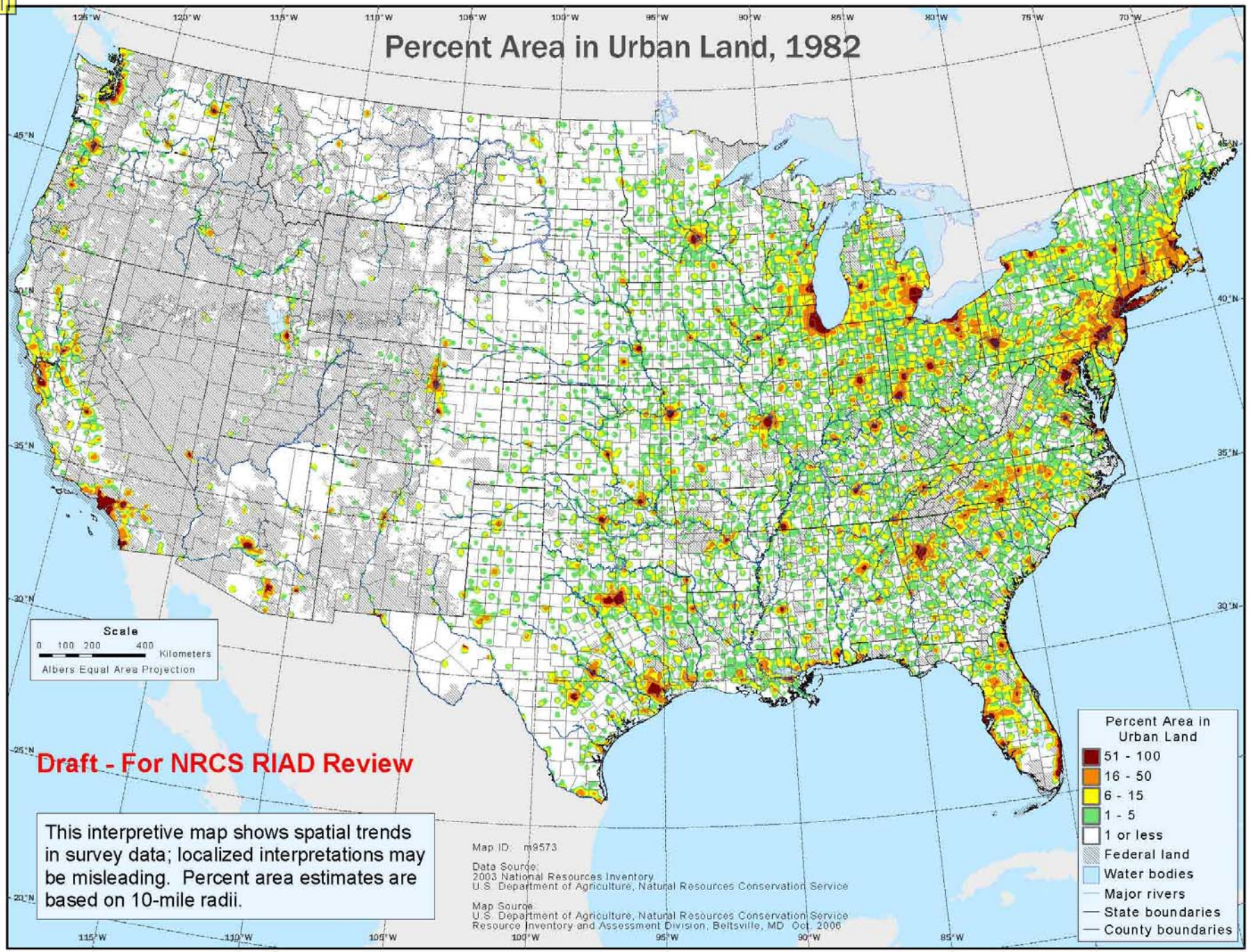
Modeling Strategy, NRI-CEAP Cropland

1. Estimate “Current Conditions” using NRI-CEAP farmer survey data
2. Construct an alternative scenario assuming “no practices”

Difference between these two scenarios represents the benefits of the accumulation of conservation practices currently in place.

Comments on *Monitoring*

- **Much more powerful to use Longitudinal Survey" techniques**
  - **i.e., do "Panel Survey" where same sample units are revisited periodically**
- **Power of paired observations**
  - **Acreage of wetlands, 1997**
    - **111.2 mil Acres [+/- 1.2 mil. Acres]**
  - **Change in wetland acres, 1992 – 1997**
    - **- 163,000 [+/- 63,000 acres]**
- **Also have more information on dynamics, etc. of the changes [e.g., what are the characteristics of the lost wetlands vs. newly created wetlands]**


Percent Area in Urban Land, 1982
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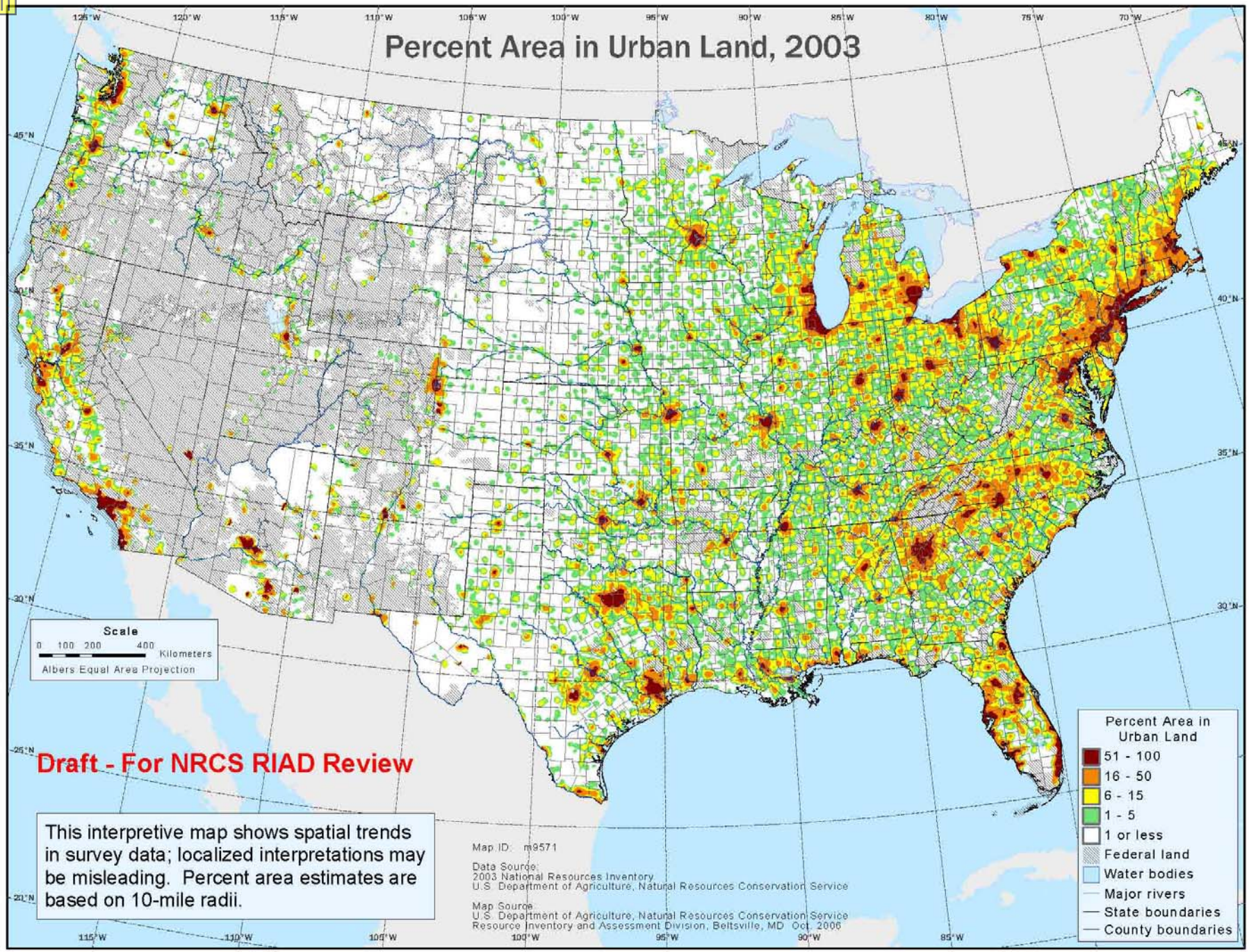
0 100 200 400 Kilometers
Albers Equal Area Projection
Draft - For NRCS RIAD Review
This interpretive map shows spatial trends in survey data; localized interpretations may be misleading. Percent area estimates are based on 10-mile radii.
Map ID: m9573
Data Source:
2003 National Resources Inventory
U.S. Department of Agriculture, Natural Resources Conservation Service
Map Source
U.S. Department of Agriculture, Natural Resources Conservation Service
Resource Inventory and Assessment Division, Beltsville, MD Oct. 2006
Percent Area in Urban Land
51 - 100
16 - 50
6 - 15
1 - 5
1 or less
Federal land
Water bodies
Major rivers
State boundaries
County boundaries


Percent Area in Urban Land, 2003
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75°W
70°W
45°N
40°N
35°N
30°N
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Scale
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Albers Equal Area Projection
Draft - For NRCS RIAD Review
This interpretive map shows spatial trends in survey data; localized interpretations may be misleading. Percent area estimates are based on 10-mile radii.
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Data Source:
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U.S. Department of Agriculture, Natural Resources Conservation Service
Map Source
U.S. Department of Agriculture, Natural Resources Conservation Service
Resource Inventory and Assessment Division, Beltsville, MD Oct. 2006
Percent Area in Urban Land
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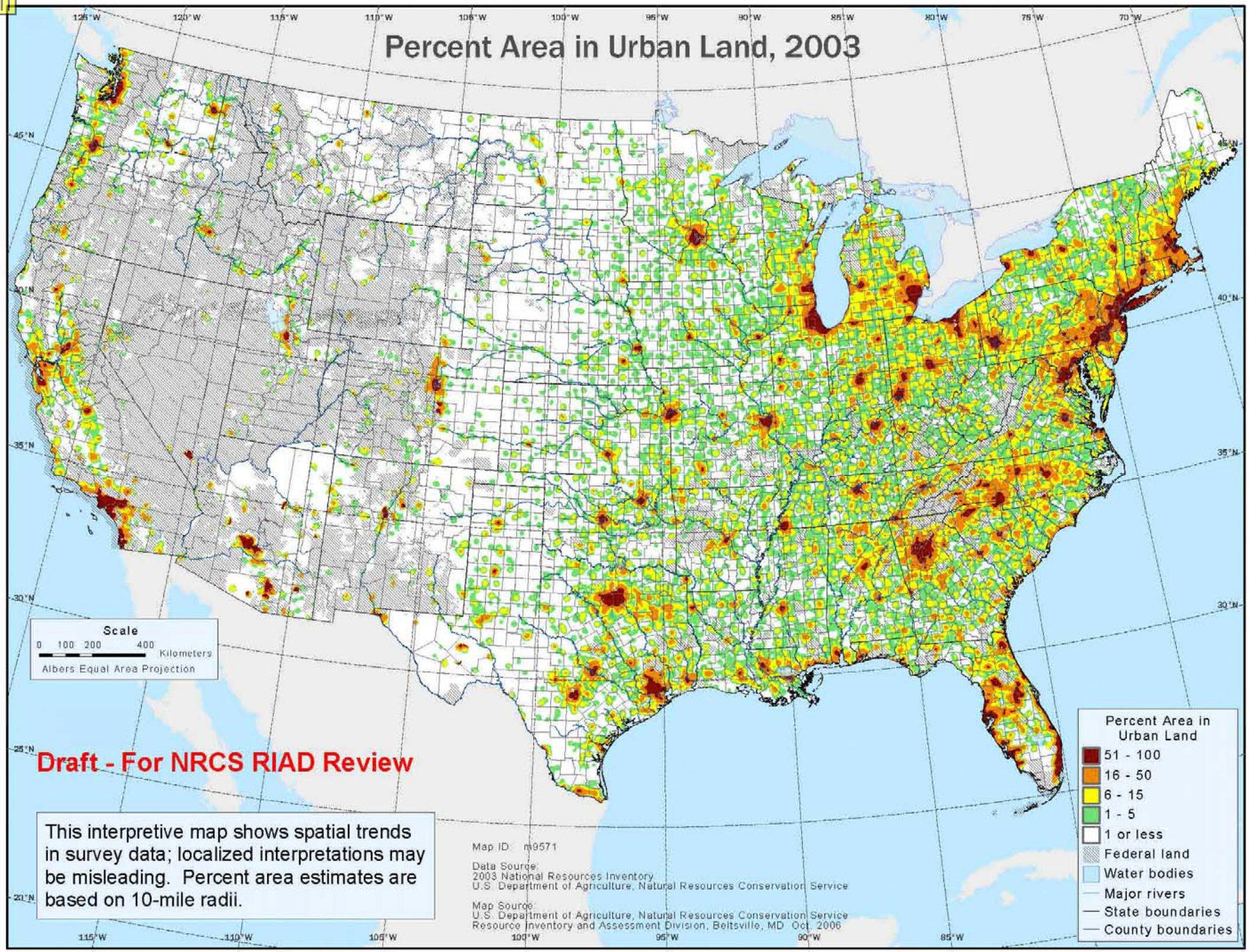
Percent Area in Urban Land, 2003
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Map Source:
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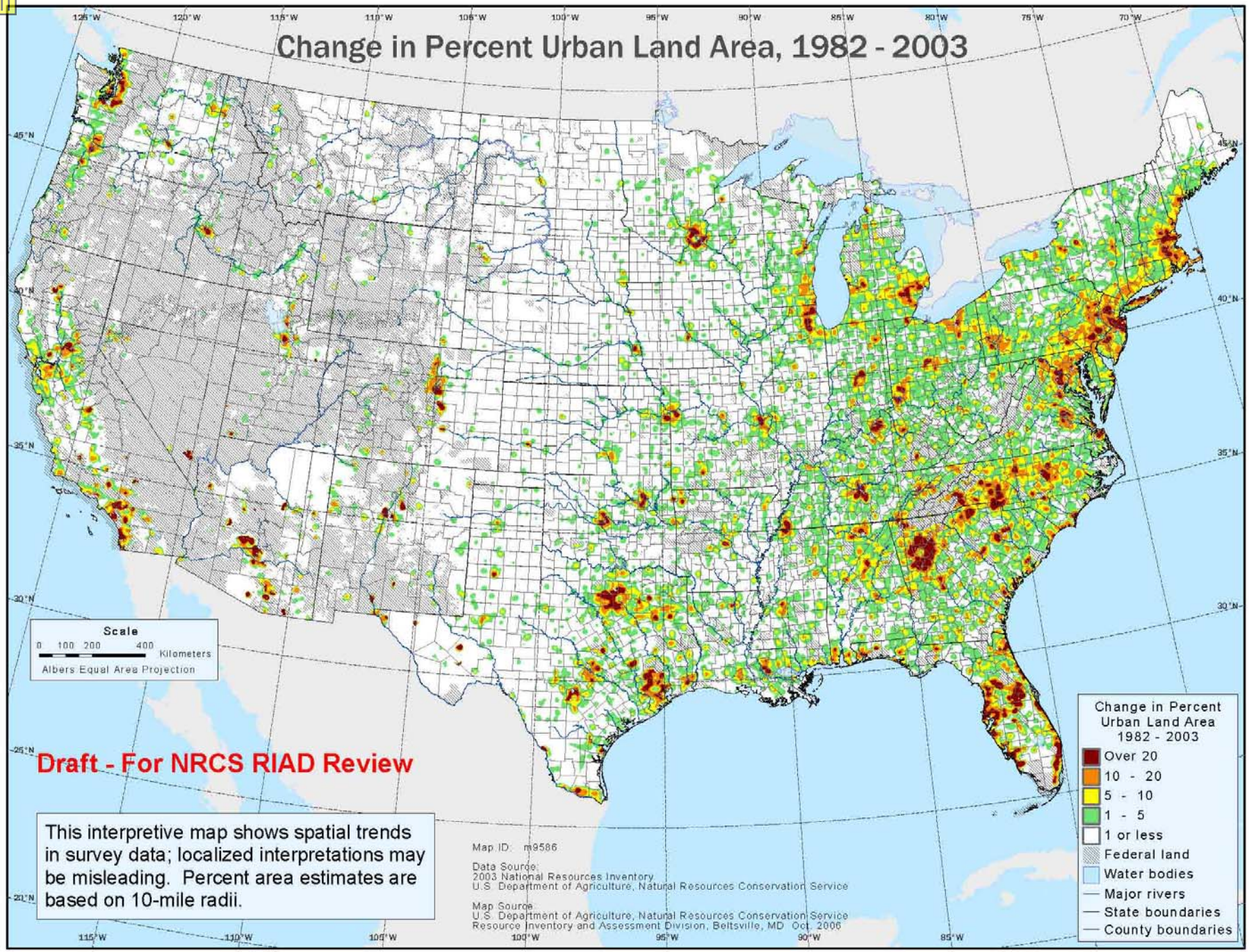
Change in Percent Urban Land Area, 1982 - 2003
Scale
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Albers Equal Area Projection
Draft - For NRCS RIAD Review
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U.S. Department of Agriculture, Natural Resources Conservation Service
Map Source
U.S. Department of Agriculture, Natural Resources Conservation Service
Resource Inventory and Assessment Division, Beltsville, MD Oct. 2006
Change in Percent Urban Land Area 1982 - 2003
Over 20
10 - 20
5 - 10
1 - 5
1 or less
Federal land
Water bodies
Major rivers
State boundaries
County boundaries

Discussion/Comments

- NRI collects data in manner that allows "What if?"
- NRI moved from 5-year cycle after 1997 to the annual inventory approach
- "Longitudinal Survey" approach is necessary
  - "Panel Survey" where sampling units are re-visited periodically
  - Much more powerful
  - Provides information on *Dynamics* of change
- NRI utilizes Area Sampling approach
  - Cannot use farms, fields, & ownership units because they can change dramatically over time [also difficult to define]

Additional Comments

- Use of site-specific data vs. aggregated – for models
- NRI is soil-based
- Use of Models is necessary
- NRI is land/resource based – not enterprise based