Integrated Assessment of Land and Water Resources

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Outline

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- Accomplishments
- Challenges
- Policy
- Integrated Resource Assessment
- Spatial Decision Support Systems
- Future Challenges and Prospects

Background on Water Resource Problems

- Clean Water Act of 1972 and National Pollution Discharge Elimination System (NPDES) have been successful in controlling point sources of water pollution.
- 1998 National WQ Inventory indicated that 291,000 miles of assessed rivers and streams (35%), 7.9 m acres of lakes (45%) and 12 thousand mi^2 of estuaries (44%) were not clean enough to support uses such as fishing and swimming.

- Agriculture is the leading source of nonpoint source pollution accounting for
  - 60% of impaired river miles
  - 50% of impaired lake acreage
- Sediment and nutrients carried by runoff from farms, pastures, urban areas, and timber harvesting and mining operations are the most significant agricultural nonpoint source pollutants.
- Groundwater contamination is significant in some areas.

Accomplishments

- From 1977 to 1992, sediment delivery from cropland to water bodies decreased by about 740 million tons or 38 percent.
- The goal over the next five years is to achieve an additional 25 percent reduction in cropland erosion.

Conservation Practices

- Reduced and no tillage
- Terraces and grassed waterways
- Contour farming
- More efficient and timely application of nutrients and pesticides
- Riparian buffers
- Others

Challenges

- *Pfiesteria*: Livestock waste lagoons have overflowed during low frequency storm events, e.g., North Carolina.
- Confined Animal Feeding Operations (CAFOs): In Missouri and other states, rural residents have complained of odor problems and several waste spills into water bodies have resulted in fish kills.

- Hypoxia: Nutrient loading originating in the Upper Mississippi and Lower Missouri River Basins has resulted in hypoxia and associated ecological degradation in the Gulf of Mexico.

Incentive-Based Policy

- Federal and state agencies have used incentive-based policies and programs to stimulate landowner adoption of conservation practices and farming systems that reduce soil erosion and water contamination.
- Examples include:

- <u>Conservation compliance</u>: Eliminated inconsistencies between commodity and soil conservation programs
- <u>Conservation Reserve Program</u>: Idled millions of acres of highly erodible cropland, thereby reducing nutrient/pesticide application and runoff.s
- <u>Wetland Reserve Program</u>: Stimulated conversion of cropland to wetland. Wetlands sequester sediment, nutrients and pesticides.
- <u>Environmental Quality Incentive Program</u>: Provides cost sharing for approved soil and water conservation practices.

Regulatory Policy

- A regulatory approach has been used to control point sources, i.e., NPDES permits.
- Total Maximum Daily Load (TMDL) requirement of the Clean Water Act is a regulatory approach for controlling all sources of water pollution in a watershed.

Tradable Emission Permits

- Regulatory agency sets an upper limit on total emissions from all sources in a particular region.
- TEPs issued up to that limit.
- Polluters can trade TEPs at a price determined by demand and supply for permits and other trading restrictions imposed by the agency.

- TEPs allow a point source to buy emission permits from a nonpoint source and vice versa.
- TEPs minimize the cost of achieving a desired reduction in total emissions.

Integrated Resource Assessment

- IRM is coordinated management of land and water resources in a particular location in a manner that reduces land degradation and water contamination, conserves biodiversity and achieves social and economic objectives.

- The location can be a parcel (farm, ranch or golf course), watershed or basin.

IRM for Parcels

- Involves combining biophysical and economic models to determine the optimal combination of land and water management systems for parcels under common ownership.
- Considerable research has been done on determining optimal management systems for privately-owned land.

IRM for Watersheds

- IRM for watersheds has gained popularity as an effective way to restore and protect water quality and natural resources (Water Environment Foundation).
- IRM for watersheds has the potential to improve the quality of natural resource management by increasing peer pressure on land owners/managers to act in accordance with the collective interests of their community.

- The Clean Water Action Plan announced by the Clinton administration in February 1998 has watersheds as the geographical unit of interest.

- Implementing IRM for watersheds is difficult because it requires effective institutional arrangements supported by cross-disciplinary knowledge, resource assessment methods and spatial data analysis.

IRM for Basins

- This is undoubtedly the most difficult and challenging application of IRM.
- A current example of the debate over river basin management is the Missouri River System.
- As we speak, the U.S. Army Corps of Engineers is in the process of selecting a preferred management alternative for the Missouri River System.

- Several groups are providing information and opinions regarding management of the Missouri River System, including:
  - American Rivers
  - Environmental Protection Agency
  - Fish and Wildlife Service
  - U.S. Geological Survey
  - Missouri River Basin Association
  - Missouri River Natural Resources Committee
  - State departments of natural resources and conservation, and
  - Numerous farm, navigation and recreation interest groups.

Missouri River Basin Consortium

- A relatively new entrant is the Missouri River Basin Consortium (MRBC), which consists of representatives from 14 colleges and universities in 9 basin states.
- MRBC’s goal is to advance knowledge and understanding of the unique ecological, economic, historical, social, political and cultural issues shaping the environmental and economic future of the Missouri River Basin.

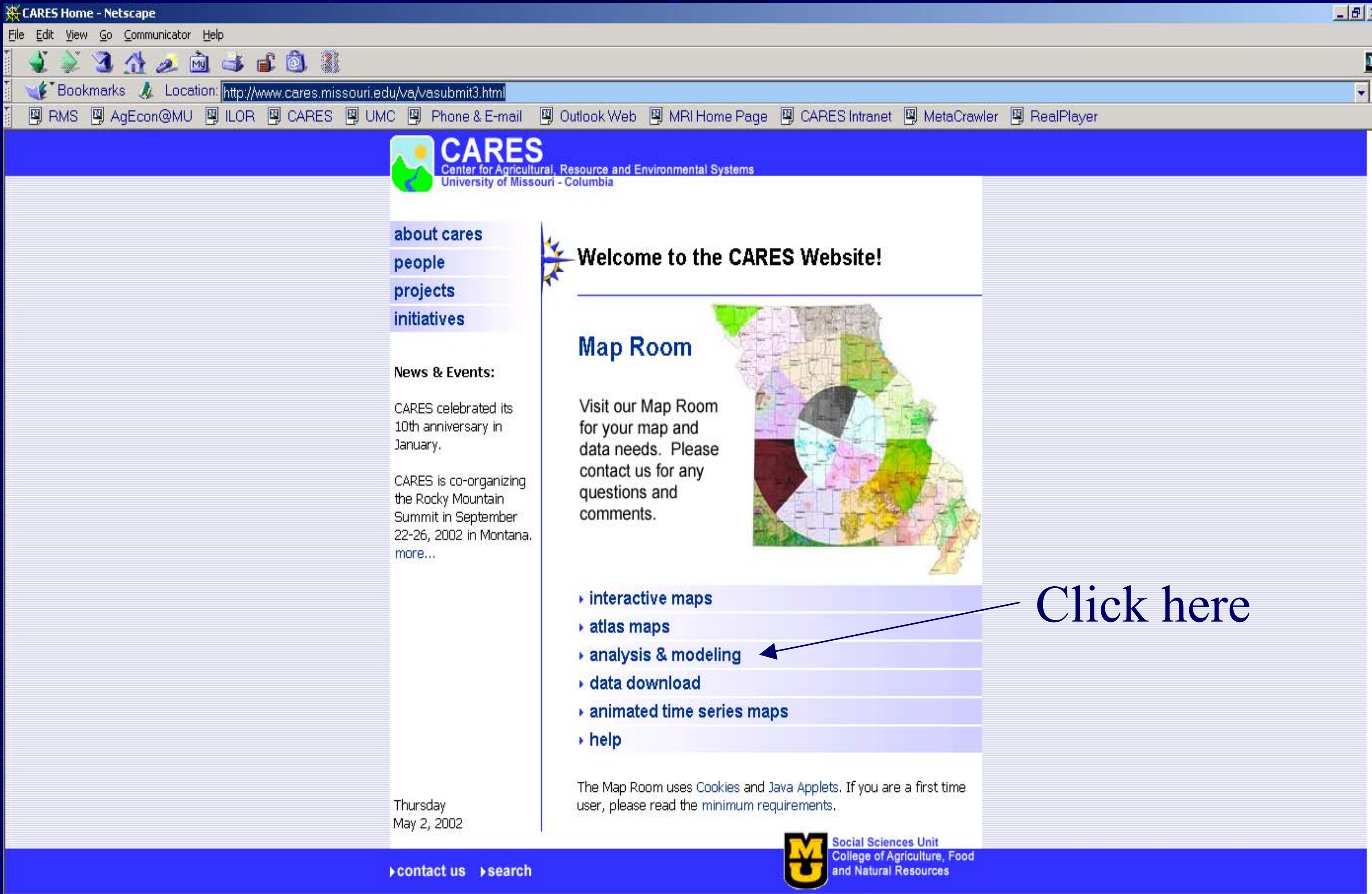
Spatial Decision Support Systems

A spatial decision support system (SDSS) is a knowledge-based computer program that integrates data, information and biophysical/economic models for the purpose of identifying and evaluating solutions to complex problems involving spatially distributed information.

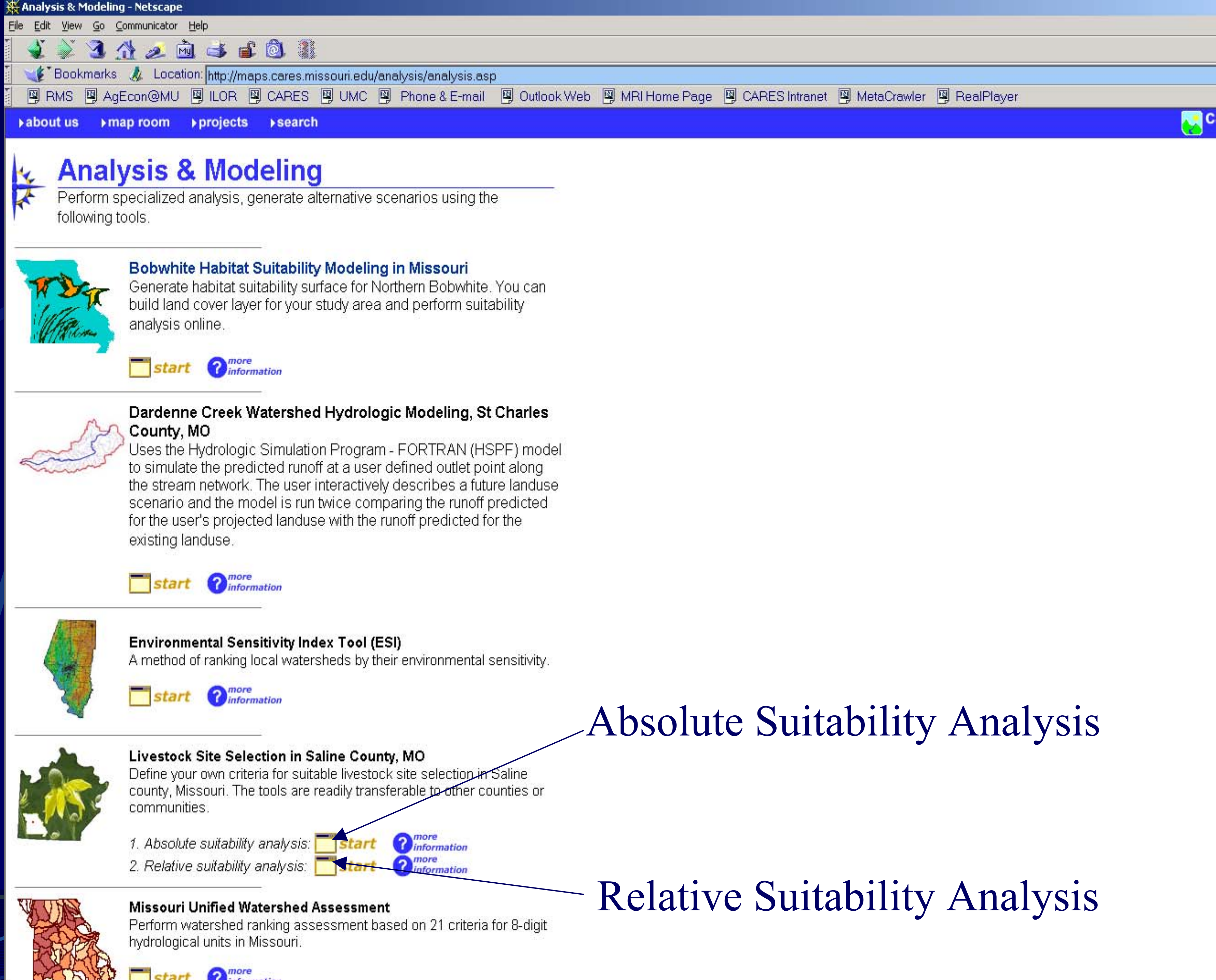
Example of SDSS for IRM

- Several years ago the Saline County Commission in Missouri asked the University of Missouri-Columbia to assist them in assessing land use and future development in their county.
- As part of the assessment, the Center for Agricultural, Resource and Environmental Systems (CARES) at MU developed a SDSS for the county.

- The Saline County SDSS allows the community to determine the proximity of existing animal feeding operations to residential areas, roads, public drinking water supplies, streams, and public facilities, as well as identify the most suitable areas for future animal feeding operations.



www.cares.missouri.edu



Analysis & Modeling - Netscape

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Bookmarks Location: http://maps.cares.missouri.edu/analysis/analysis.asp

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Analysis & Modeling

Perform specialized analysis, generate alternative scenarios using the following tools.

Bobwhite Habitat Suitability Modeling in Missouri

Generate habitat suitability surface for Northern Bobwhite. You can build land cover layer for your study area and perform suitability analysis online.

start more information

Dardenne Creek Watershed Hydrologic Modeling, St Charles County, MO

Uses the Hydrologic Simulation Program - FORTRAN (HSPF) model to simulate the predicted runoff at a user defined outlet point along the stream network. The user interactively describes a future landuse scenario and the model is run twice comparing the runoff predicted for the user's projected landuse with the runoff predicted for the existing landuse.

start more information

Environmental Sensitivity Index Tool (ESI)

A method of ranking local watersheds by their environmental sensitivity.

start more information

Livestock Site Selection in Saline County, MO

Define your own criteria for suitable livestock site selection in Saline county, Missouri. The tools are readily transferable to other counties or communities.

1. *Absolute suitability analysis:* start more information
2. *Relative suitability analysis:* start more information

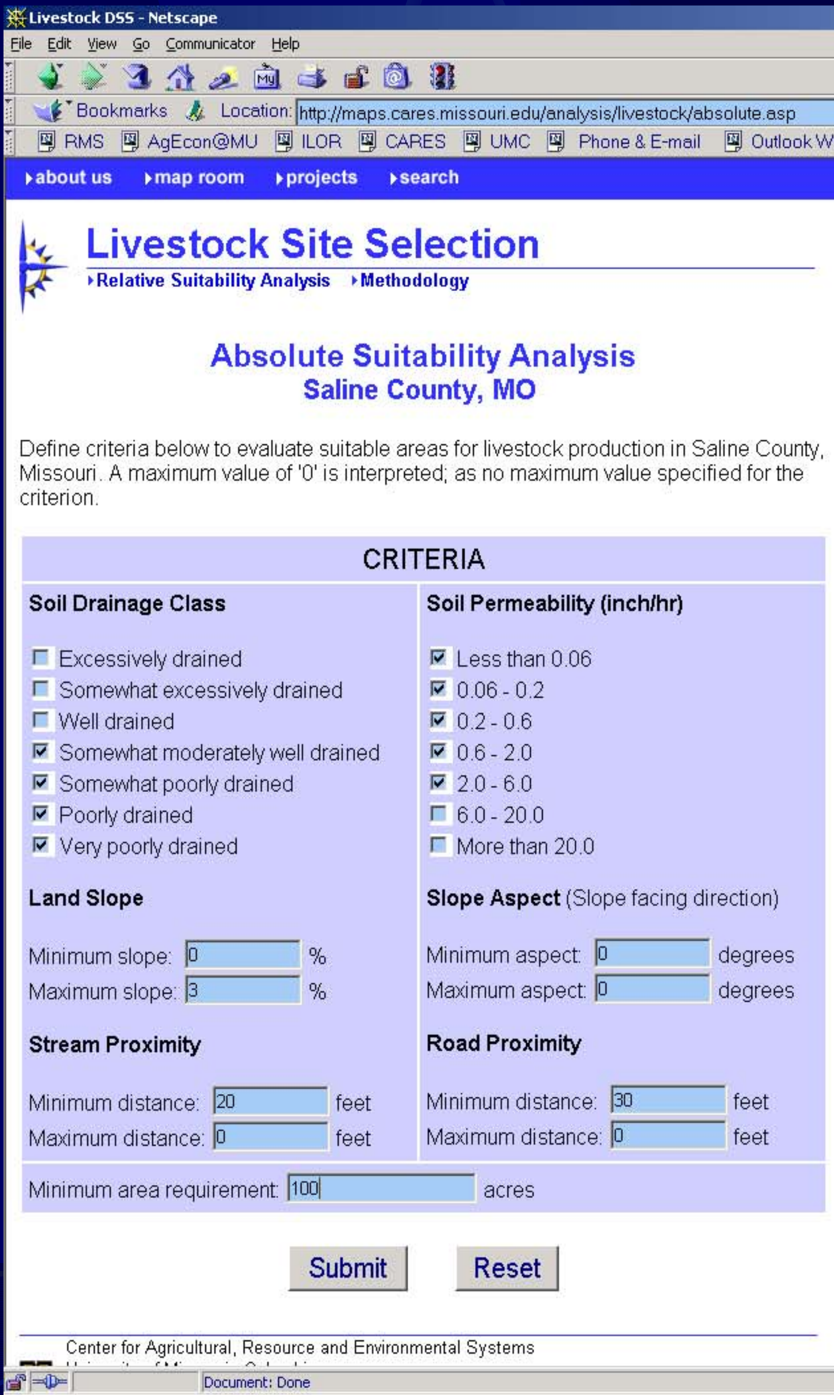
Missouri Unified Watershed Assessment

Perform watershed ranking assessment based on 21 criteria for 8-digit hydrological units in Missouri.

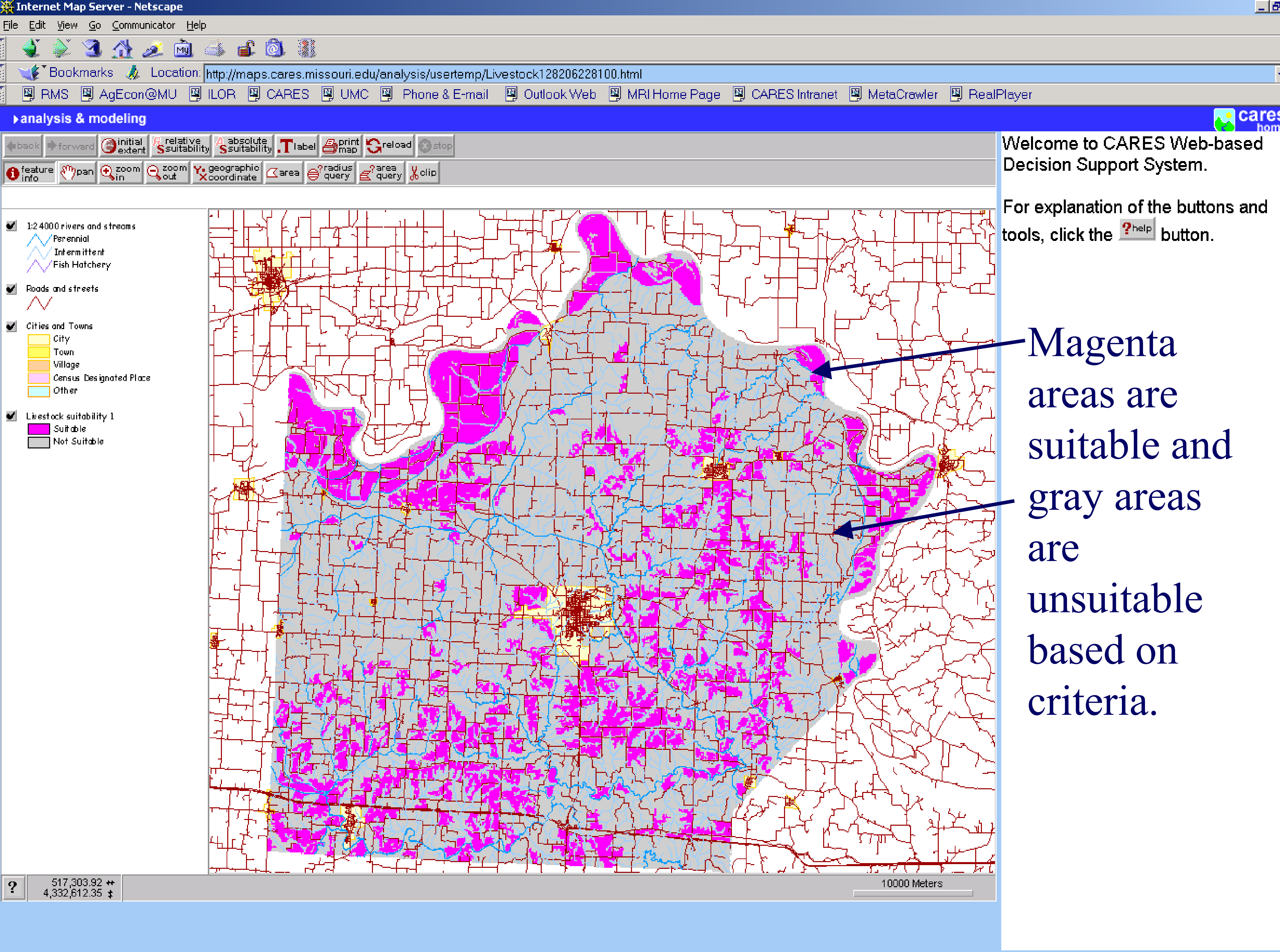
start more

Absolute Suitability Analysis

Relative Suitability Analysis

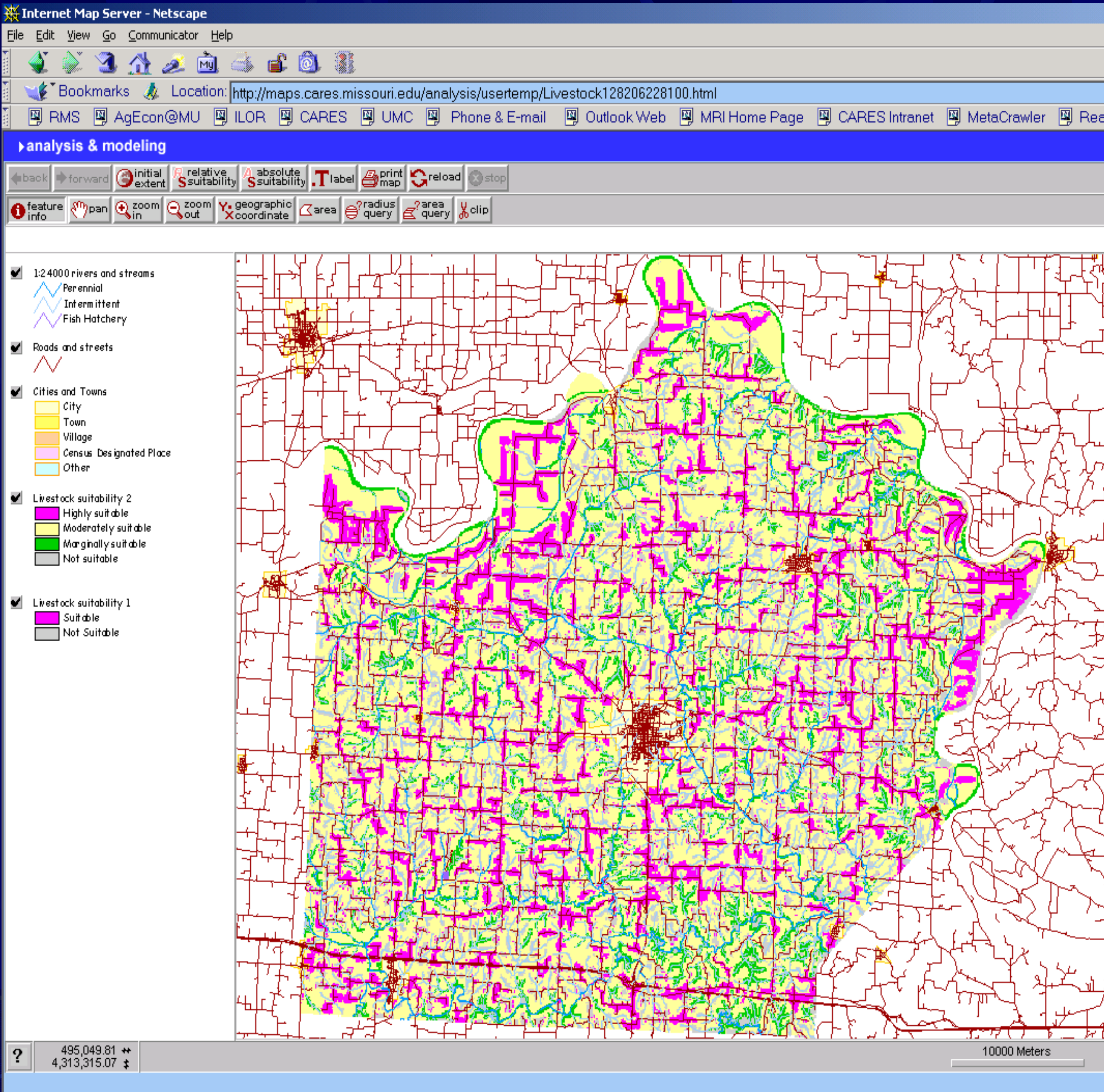


Soil criteria were set to avoid excessively drained, somewhat excessively drained and well-drained soils as well as soils with high permeability to reduce potential water contamination. Maximum slope set at 3%, minimum distance to streams at 20 feet and minimum distance to roads at 30 feet. Minimum size of area set at 100 acres.



Magenta areas are suitable and gray areas are unsuitable based on criteria.

This tool allows the user to determine suitable areas based on a weighting of the criteria and a minimum size area. User can select equal weights and reset weights.



cares home

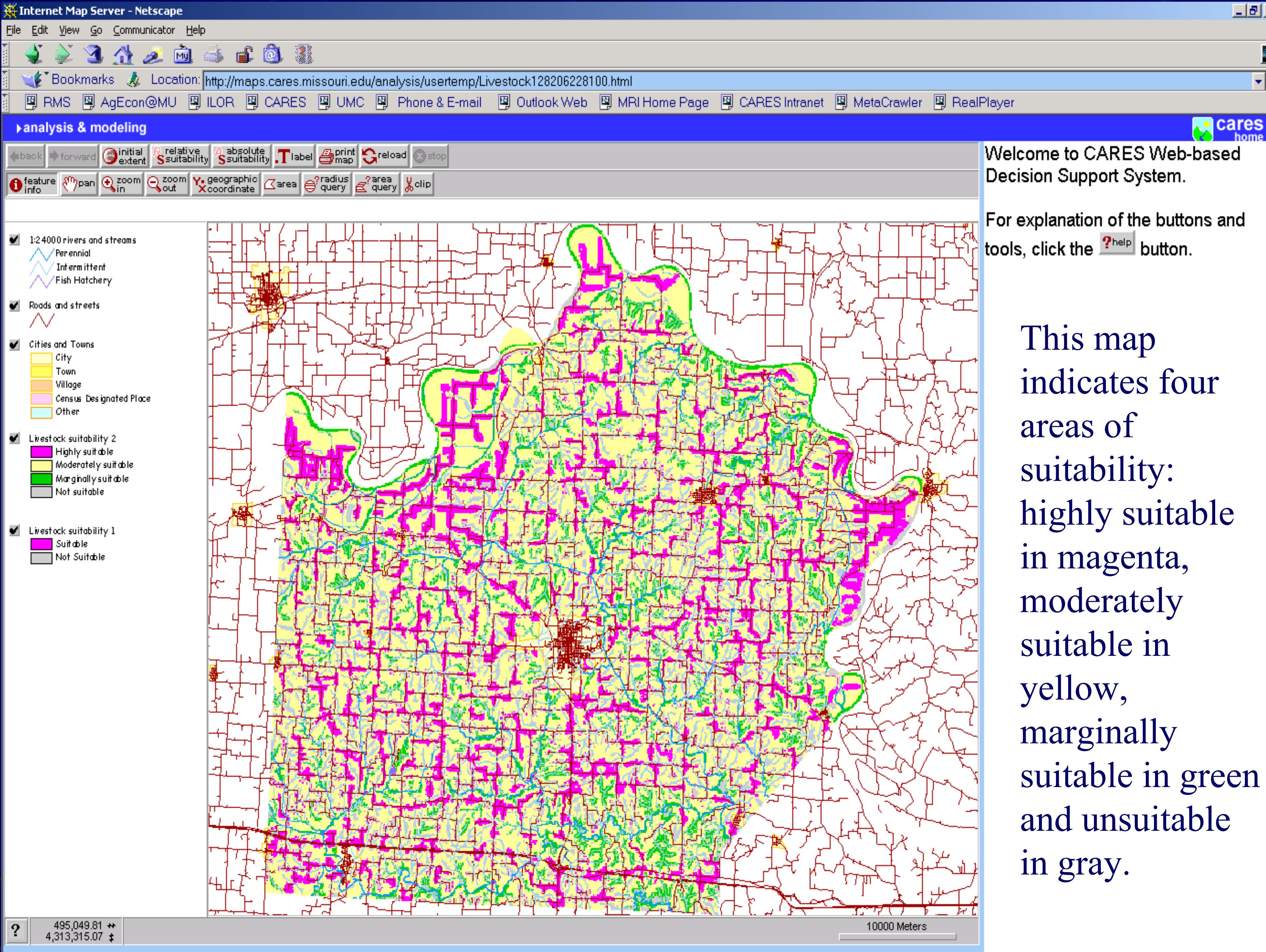
Welcome to CARES Web-based Decision Support System.

For explanation of the buttons and tools, click the ?help button.

This map indicates four areas of suitability: highly suitable in magenta, moderately suitable in yellow, marginally suitable in green and unsuitable in gray.

Zoom Feature

- Allows the user to zoom in on an area of interest to obtain greater detail.



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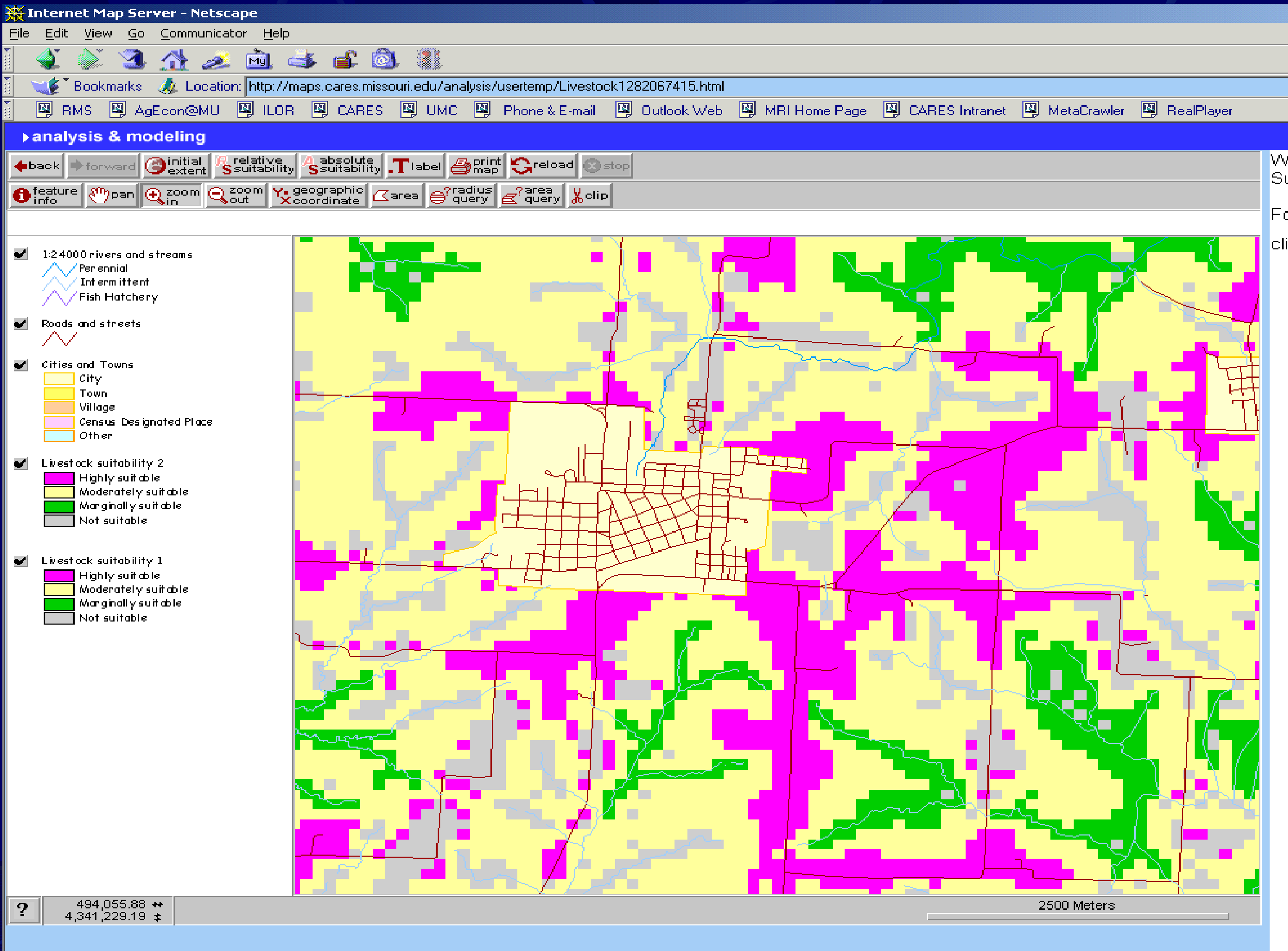
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analysis & modeling
back forward initial extent relative suitability absolute suitability label print map reload stop
feature info pan zoom in zoom out geographic coordinate area radius query area query clip
1:24000 rivers and streams
Perennial
Intermittent
Fish Hatchery
Roads and streets
Cities and Towns
City
Town
Village
Census Designated Place
Other
Livestock suitability 2
Highly suitable
Moderately suitable
Marginally suitable
Not suitable
Livestock suitability 1
Highly suitable
Moderately suitable
Marginally suitable
Not suitable
494,055.88
4,341,229.19
2500 Meters

Other Tools

- Other tools can be added for area calculations, radius queries and area queries.
- Maps can be downloaded to the user's computer and printed.
- Additional customization is possible.

Future Challenge and Prospects

- The challenge is to develop innovative and user friendly ways to use the knowledge and information technologies to manage land and water resources in a manner that protects human health, promotes economic vitality and preserves ecological integrity, i.e., sustainable resource management.

- Advancements in IRM, SDSS, integrated ecological economic modeling and Internet technologies will allow us to simulate the impacts of alternative land and water management practices and policies on a suite of social, economic and environmental indicators.


Thank You!