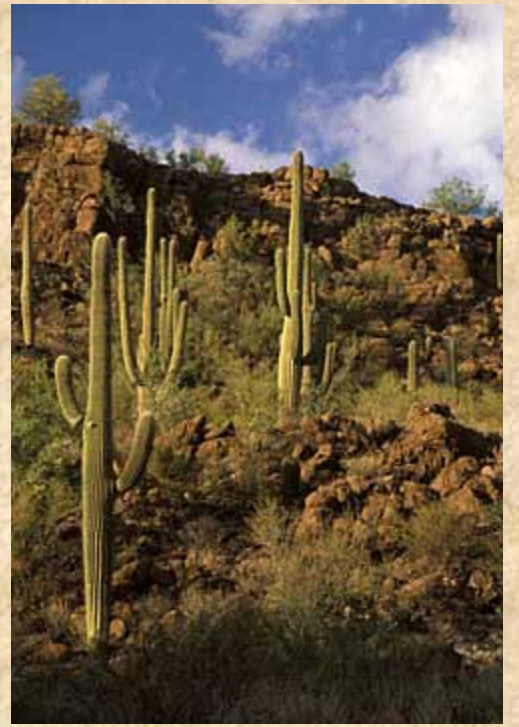


NRCS Natural Resources Conservation Service

The Conservation Effects Assessment Project: Western Rangelands

A National Project to Assess Impacts of US Conservation Programs

Mark Weltz
Fred Pierson
Jeff Arnold
Jeffry Stone
Leonard Jolley
Gerardo Armendez
Dave Bubenheim
Phil Guertin
Mark Nearing
Jim Kiniry
Haiyan Wei
Ken Spaeth
Mariano Hernandez
Mary Nichols
Dave Goodrich
Mitch McClaran

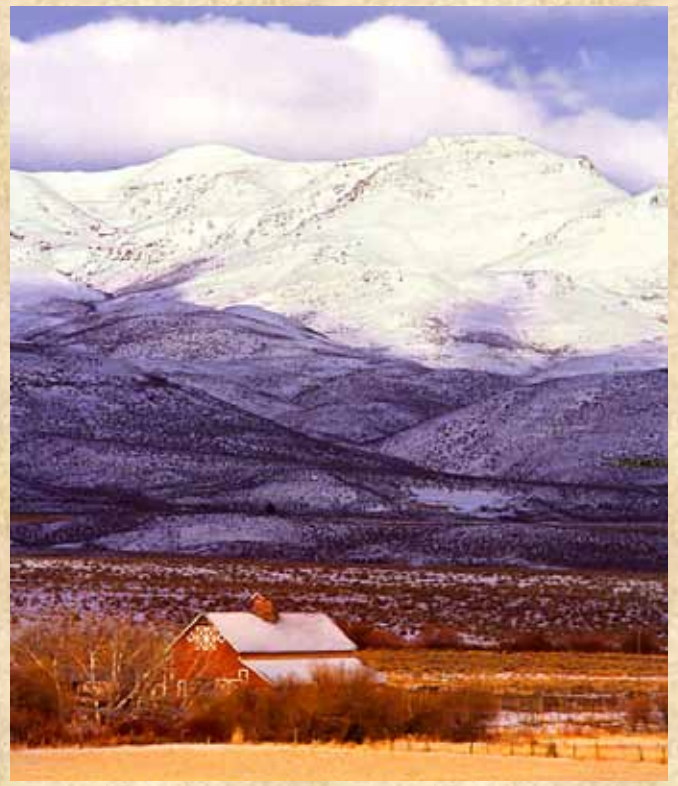
USDA United States Department Of Agriculture Agricultural Research Service

Southwest Watershed Research Center Tucson, Arizona

Conservation Effects Assessment Project (CEAP)

The Soil and Water Resources Conservation Act (RCA) requires USDA to report to Congress in January of 2011 and 2016 on the status of our Nation's private lands.

The Food, Conservation, and Energy Act of 2008 (Farm Bill) requires USDA to report on annual environmental and economic benefits derived from conservation programs (> $30 billion for the Farm Bill).



USDA Conservation Programs (Examples)

- Environmental Quality Incentives Program (cost-share)
- Conservation Reserve Program
- Wetland Reserve Program
- Wildlife Habitat Incentives Program
- Conservation Security Program (watershed based)
- Grassland Reserve

CEAP land use categories & teams

§ Croplands (since 2002)

§ Grazing Lands:

<u>Rangelands</u> & Pasture (2007)

§ Tropical:

Hawaii & Puerto Rico

Categories of Management Practices to be Emphasized for Rangelands

Prescribed grazing

Pest management

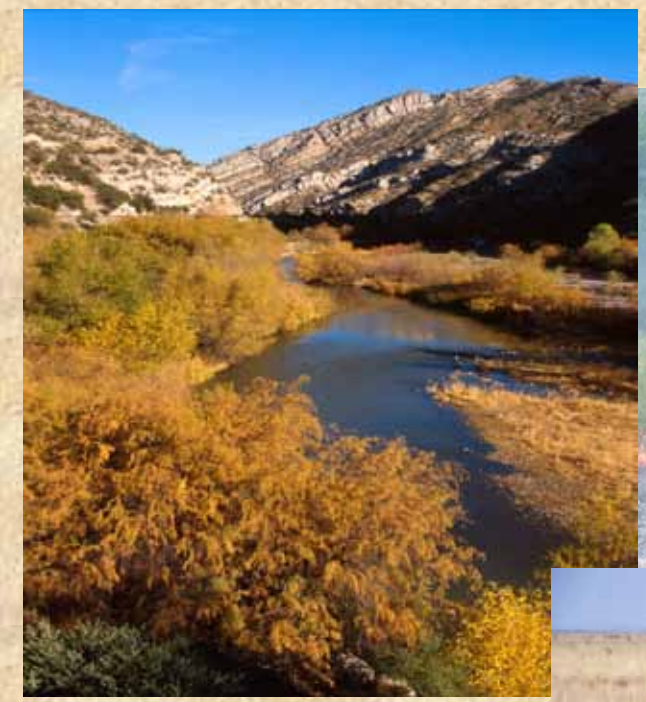
Fire management

Brush management

Riparian management

Range Seeding

Upland Habitat Management

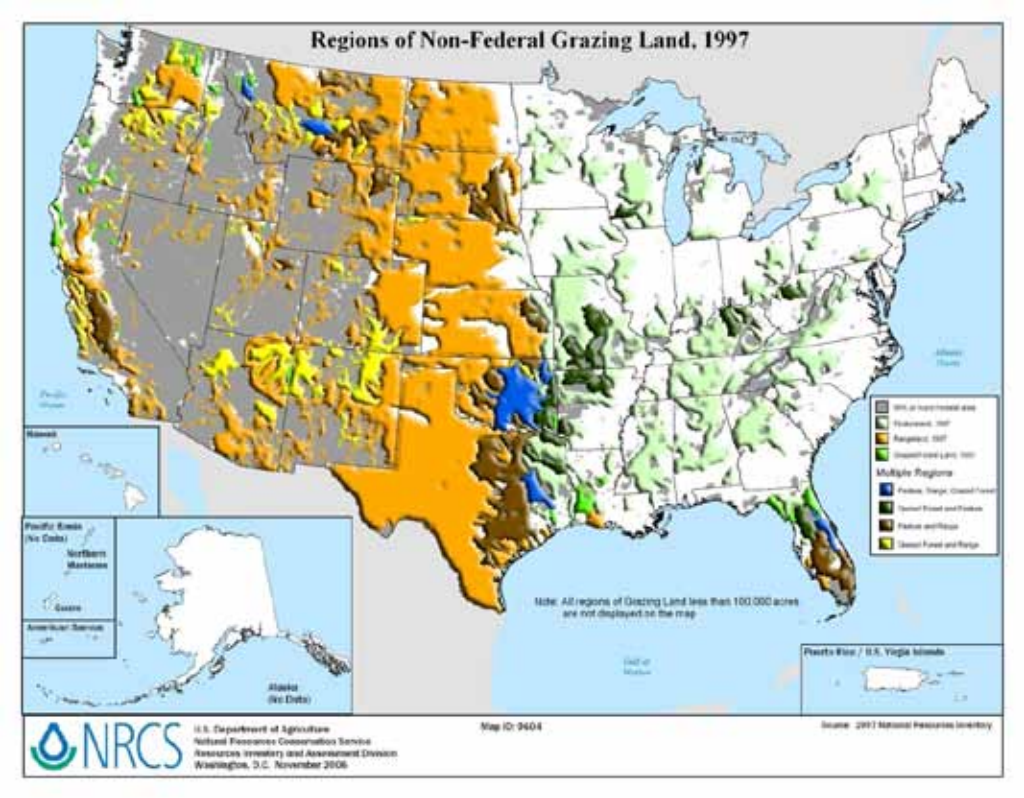


Grazing Land CEAP: Extent of the Challenge

Over 55% of the United States is defined as grazing lands, 40% as rangelands

There are 238 million ha non-Federal grazing lands in the United States

80% of the area of the western states is rangelands



Rangeland National Assessment Strategy:

1. The Rangeland Hydrology and Erosion Model (RHEM) will be used to calculate runoff and erosion at <u>site scale</u>:
2. Rainfall Simulation Experiments in selected basins for model evaluation relative to CEAP goals
3. AGWA-SWAT-KINEROS w/RHEM Model for <u>basin scale</u> assessment

1. Rangeland Hydrology and Erosion Model

- Core Engine: computes hydrograph and sediment yield based on information on storm, slope, soil and hydrology, erosion parameters and is intended to function as an "engine“ within e.g., KINEROS or SWAT watershed models
- System for parameter estimation: that groups rangeland vegetation into bunchgrass, sodgrass, annual grass and forbs, or shrubs based on the dominant plant form on a rangeland hillslope, and provides a separate set of equations for each group
- User-friendly, web-based interface

Rangeland Hydrology and Erosion Model

RHEM is designed to:

- Estimates runoff, erosion, and sediment delivery rates and volumes at
  - the spatial scale of the hillslope
  - the temporal scale of a single rainfall event.

RHEM does not:

- Predict sediment yields from watersheds
  - where channel processes are active

- Track system properties, such as vegetative cover, as they change through time due to seasonal or inter-annual growth or management responses.
  - Intended to link with another model that track such changes
  - Has the parameter estimation equations that allow the RHEM model parameters to be updated as a function of temporally changing variables such as plant foliar cover percentage.

RHEM Parameterization

The parameter estimation equations:

- **Model the interactions between plant growth form and hydrology, erosion processes (shrub, sod-grass, bunchgrass, forbs)**
- **Based on the experimental data collected by ARS and NRCS (1988-1993)**
- **Are flexible and changeable to meet differing assessment needs and different data availability (SAS database)**

Old Rainfall Simulator Experimental Data

16 States
26 Locations
49 Sites
Rotating Boom

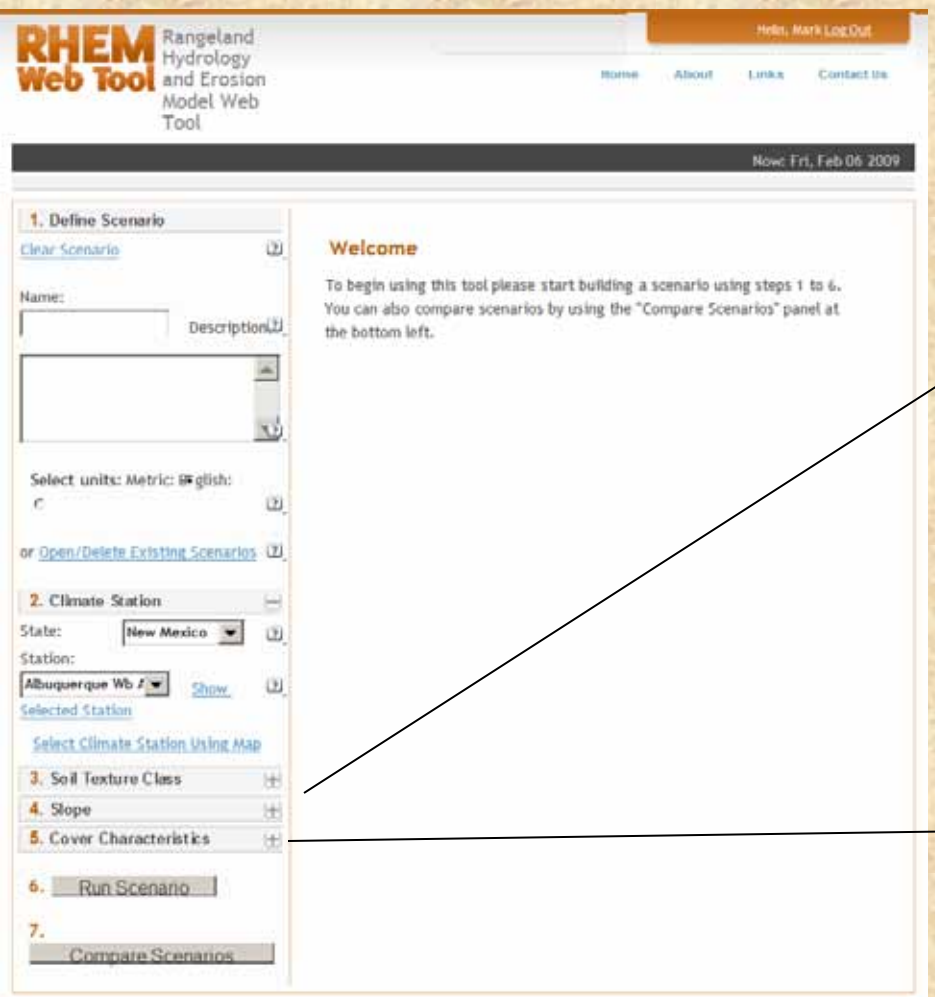
Collected
1988-1993
(ARS, NRCS)

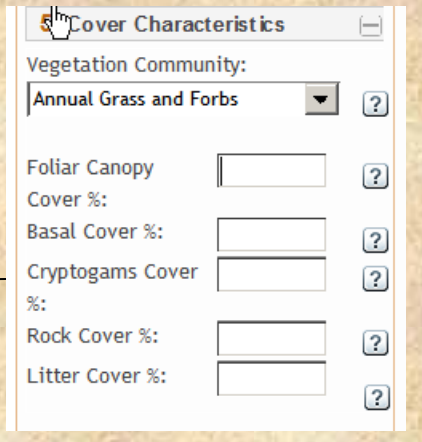
Additional Data
from Tucson,
Boise, and Reno

Interface

http://dss.tucson.ars.ag.gov/rhem/

RHEM Web Tool Rangeland Hydrology and Erosion Model Web Tool





Interface

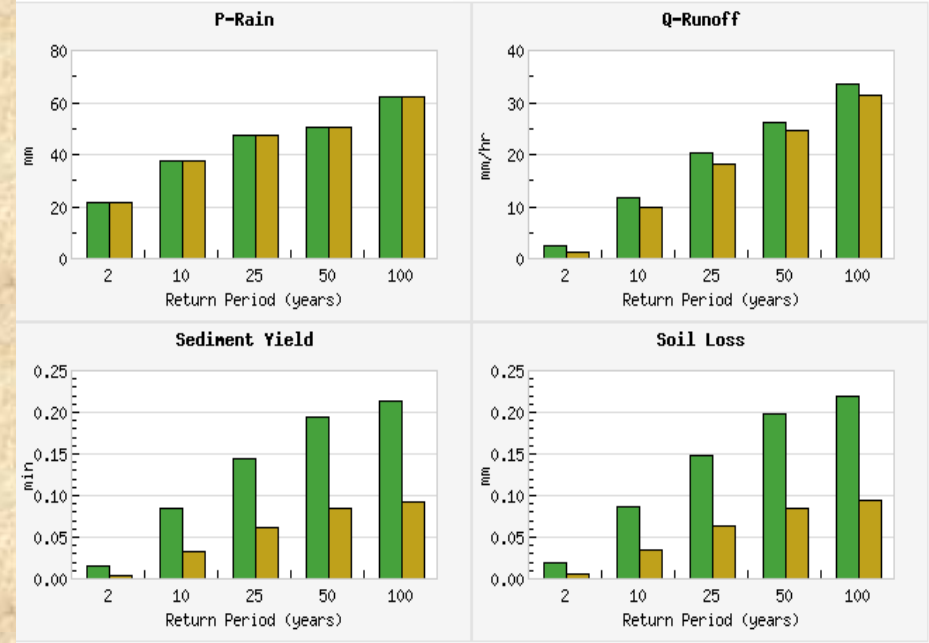
SCENARIO INPUTS

Download report as CSV

	MARK1	MARK2
State ID	NM	NM
Climate Station	ALBUQUERQUE WB AP	ALBUQUERQUE WB AP
Soil Texture	Sandy Clay Loam	Sandy Clay Loam
Moisture Content	0.25	0.25
Slope Length (meters)	30	30
Slope Shape	S-Shaped	S-Shaped
Slope Steepness	10	10
Vegetation Community	Bunch Grass	Bunch Grass
Canopy Cover %	50	80
Basal Cover %	5	8
Cryptogams Cover %	5	8
Rock Cover %	0	0
Litter Cover %	50	80
Total Ground Cover %	60	96

Total Ground Cover %	60	96

RETURN PERIOD GRAPHS



2 YEAR RETURN PERIOD RESULTS

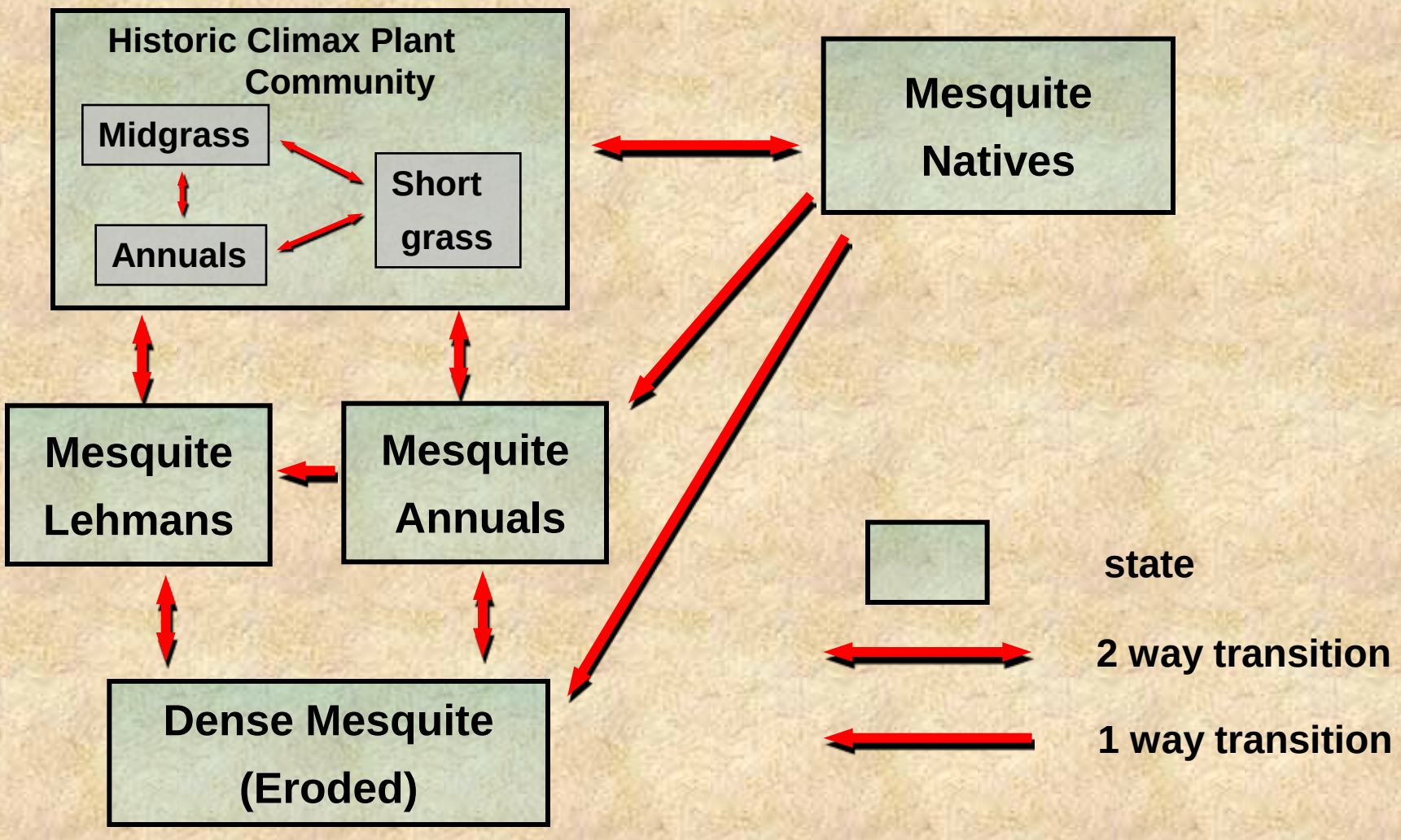
	MARK1	MARK2
Rain (mm)	21.80	21.80
Runoff (mm)	2.31	1.10
Sediment Yield (ton/ha)	0.02	0.00
Soil Loss (ton/ha)	0.02	0.00

10 YEAR RETURN PERIOD RESULTS

2. New Rainfall Simulation Studies

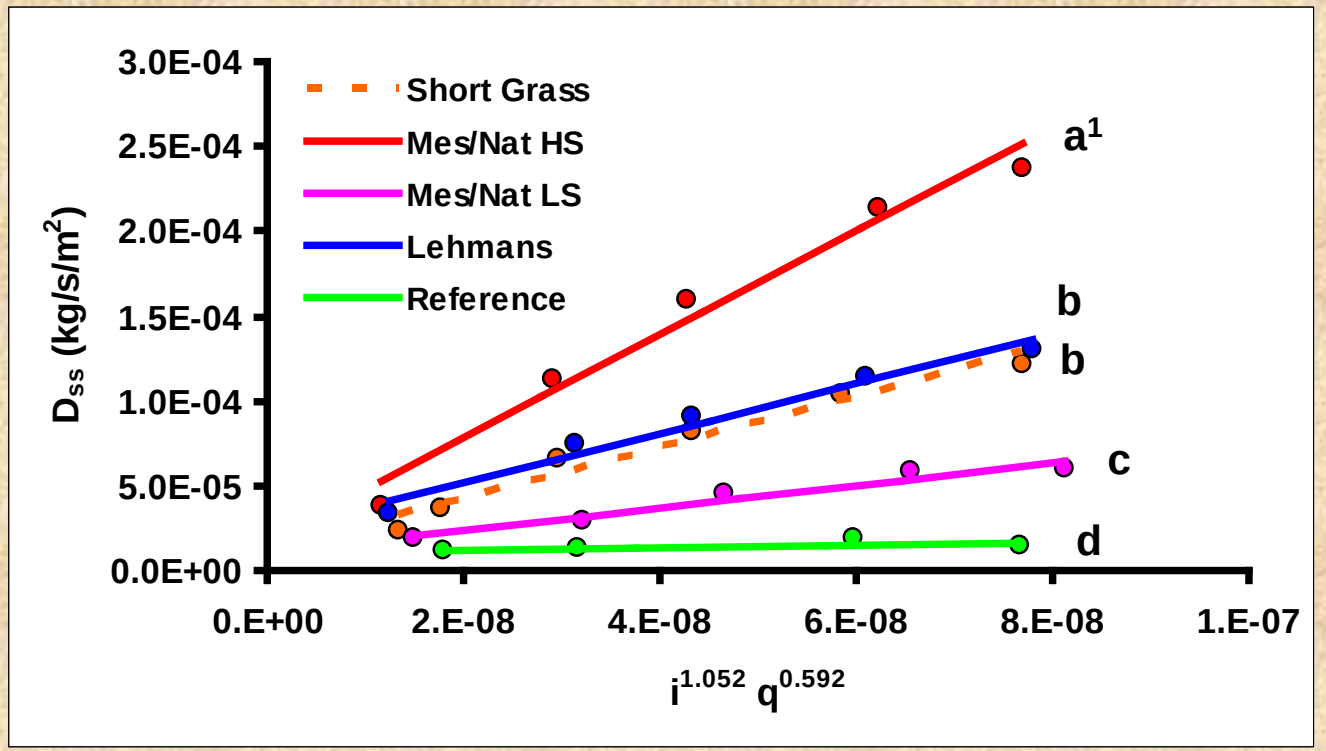
- Select test basins (8-digit HUC) in Arizona, Nevada, and Idaho
- Identify primary <u>Ecological Site Descriptions</u> & their states in the basins
- Run simulator experiments on those identified states

Loamy Uplands (12-16 p.z.) State & Transition Model



D_{ss} Equation

Variability of K_{ss} among States

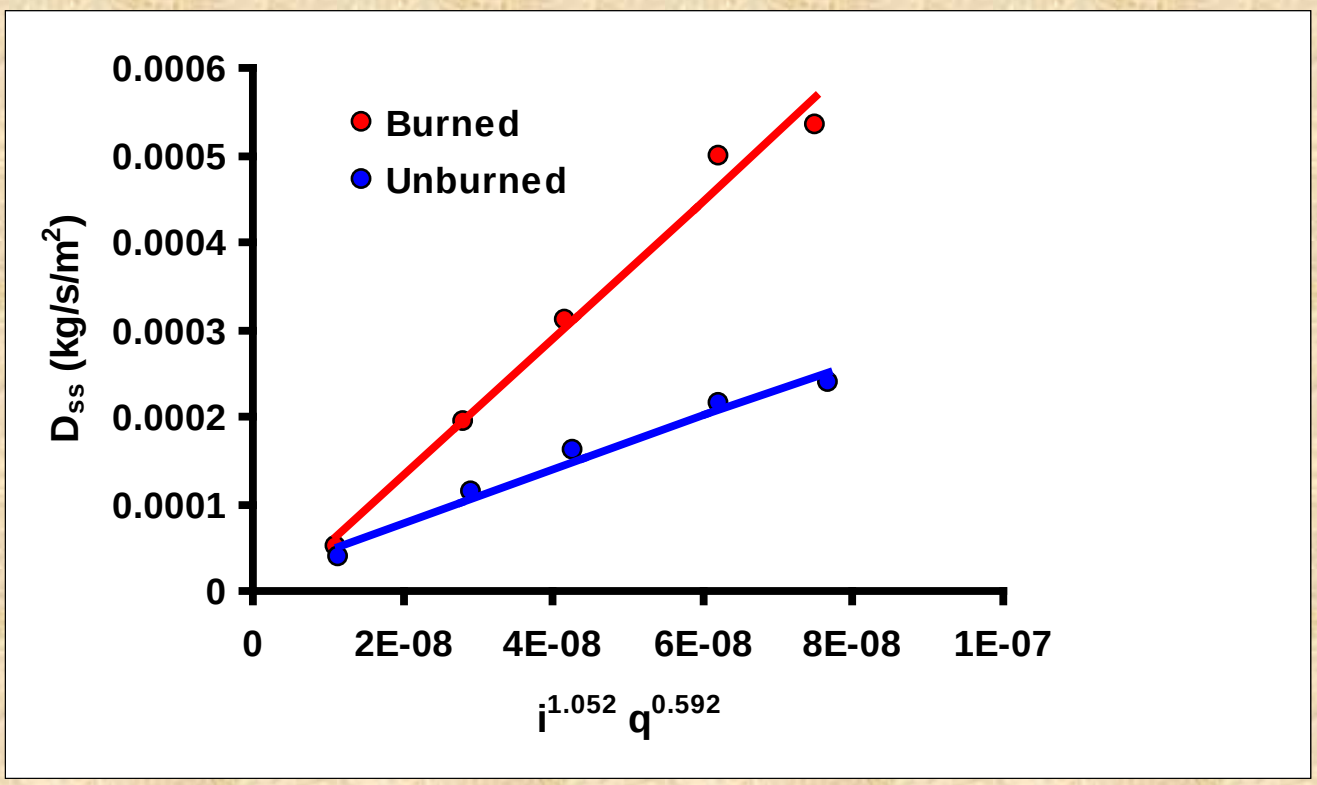


[1] different letter means K_{ss} significantly different (a = 0.05)

* HS, LS = High Slope, Low Slope

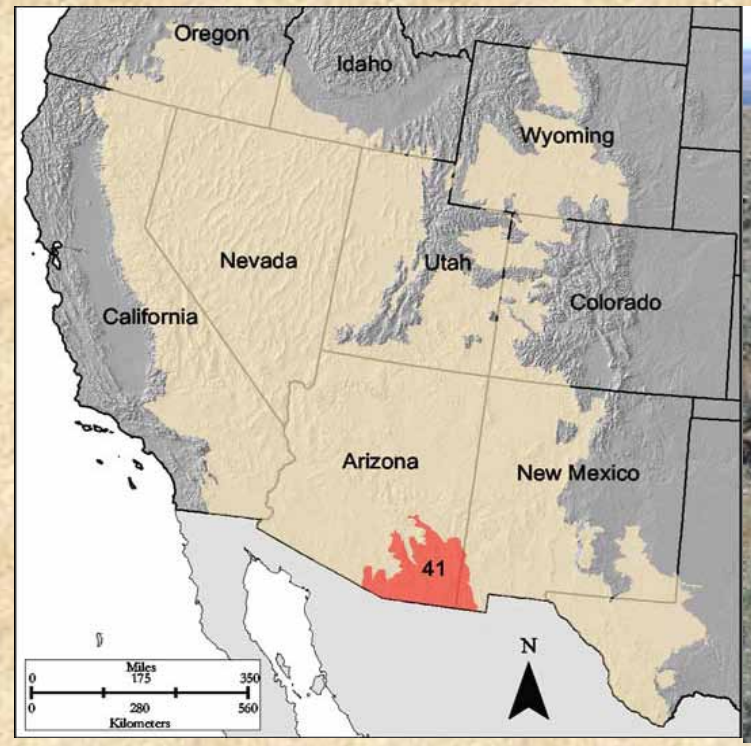
D_{ss} Equation

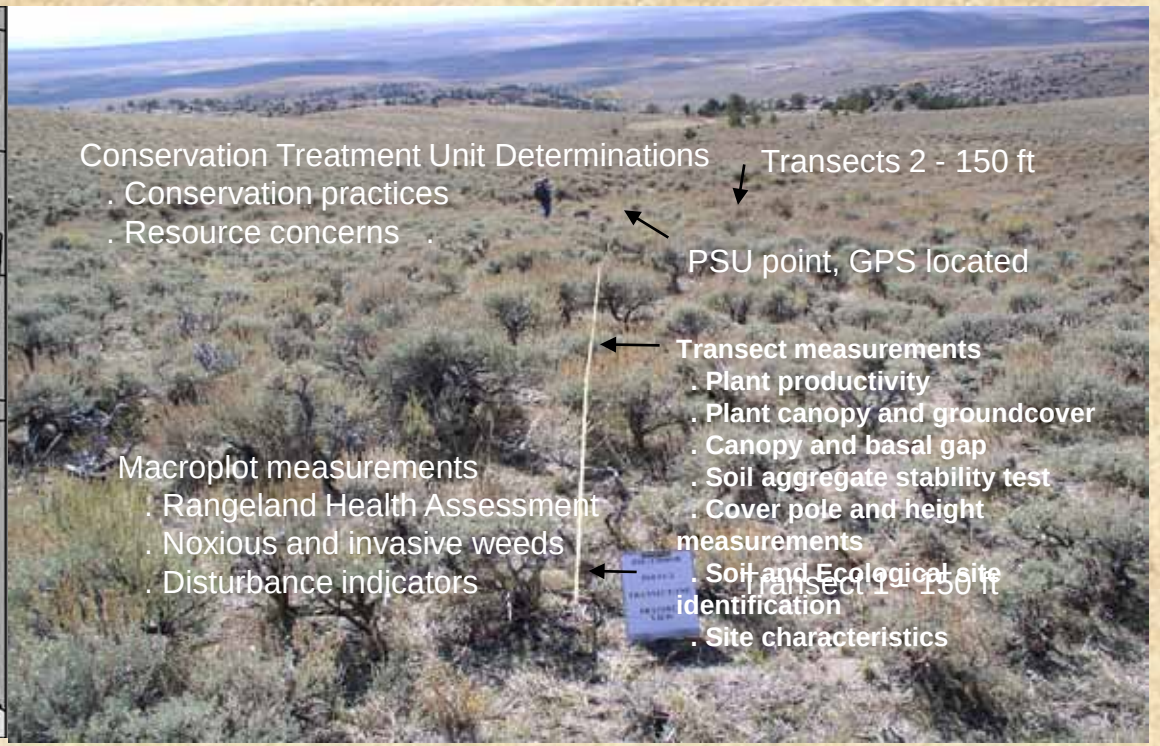
Change in K_{ss} – Wildfire



Applications

National Resource Inventory & CEAP





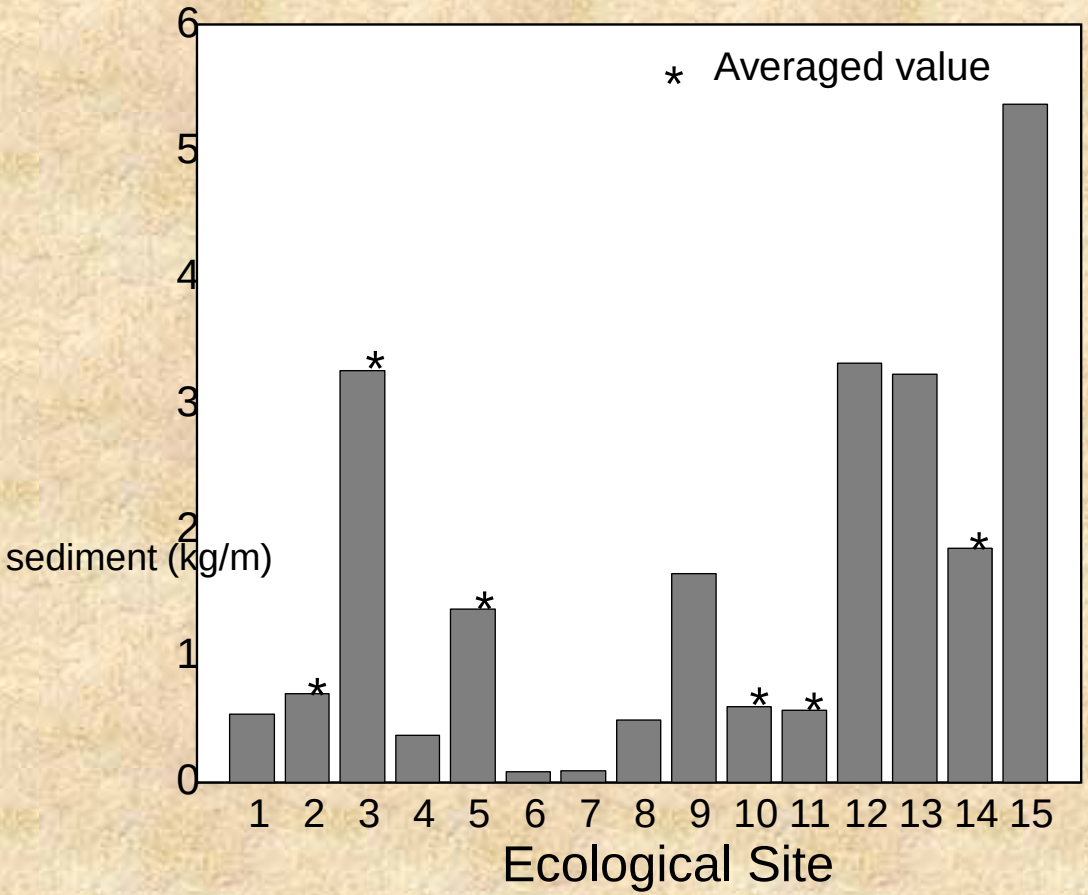
Rainfall:

A **10-yr, 60 min design storm** (NOAA Atlas 14)

Model Parameters:

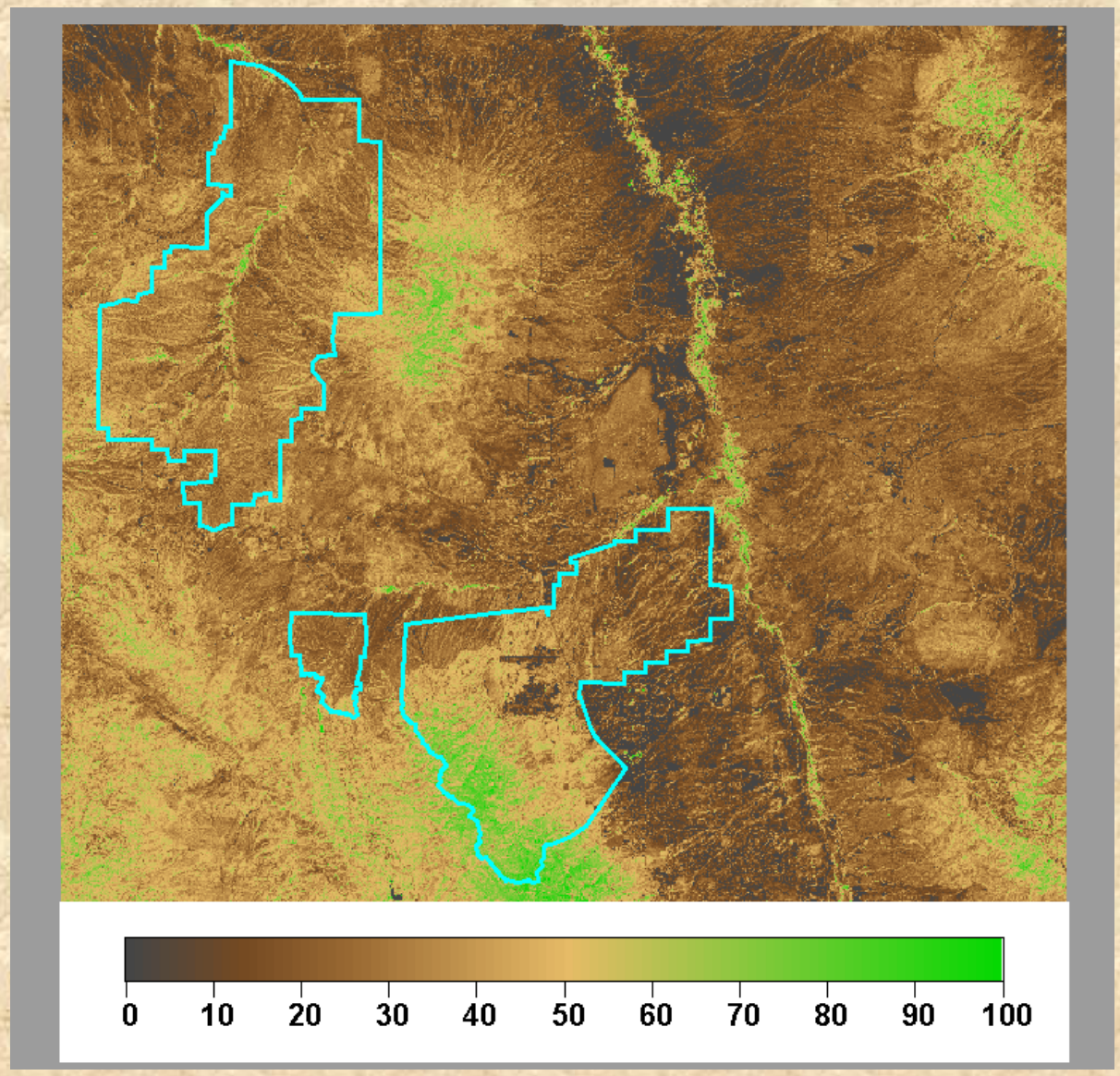
NRI database: canopy cover, ground cover, litter cover, rock cover, primary species
SSURGO: hydrologic group, percent sand and clay
Parameter Estimation Equations: ke and kss.

Erosion at each NRI point within the Ecological Sites MLRA 41

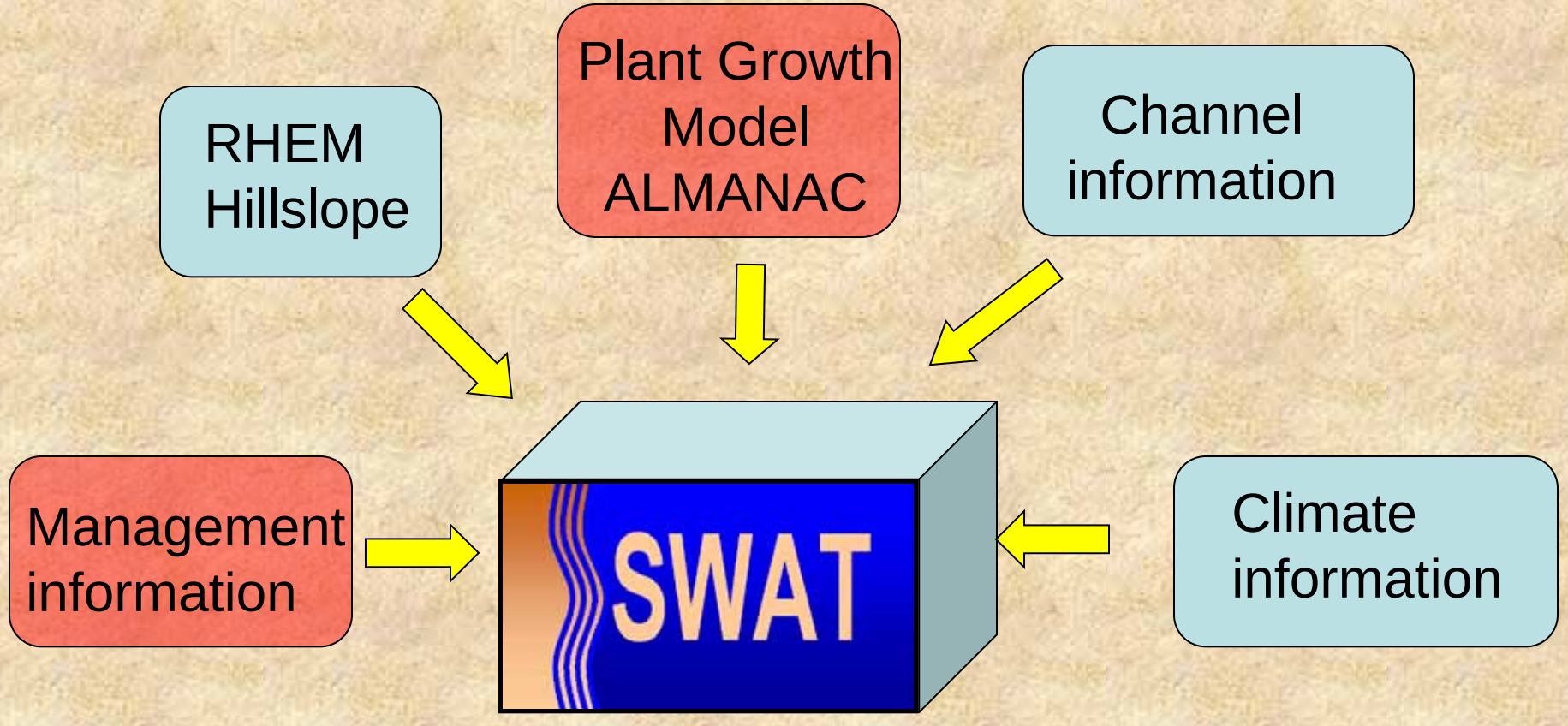


1) XA101 - Clayey Swale 16 - 20" p. z.
2) XA108 - Loamy Upland 16 - 20" p. z.
3) XA111 - Volcanic Hills 16 - 20" p. z.
4) XB202 - Clayey Swale 8 - 12" p. z.
5) XB206 - Limy Fan 8 - 12" p. z.
6) XB209 - Loamy Swales 8 - 12 p. z.
7) XB210 - Loamy Upland 8 - 12" p. z.
8) XB215 - Sandy Loam Upland 8 - 12" p. z.
9) XB216 - Clayey Slopes 8 - 12" p. z.
10) XC304 - Clayey Upland 16 - 20" p. z.
11) XC305 - Clay Loam Upland 12 - 16" p. z.
12) XC306 - Granitic Hills 12 - 16" p. z.
13) XB308 - Limy Slopes 12 - 16" p. z.
14) XC313 - Loamy Upland 12 - 16 p. z.
15) XC314 - Loamy Slopes 12 - 16" p. z.

Use Remote Sensing to expand the NRI assessments

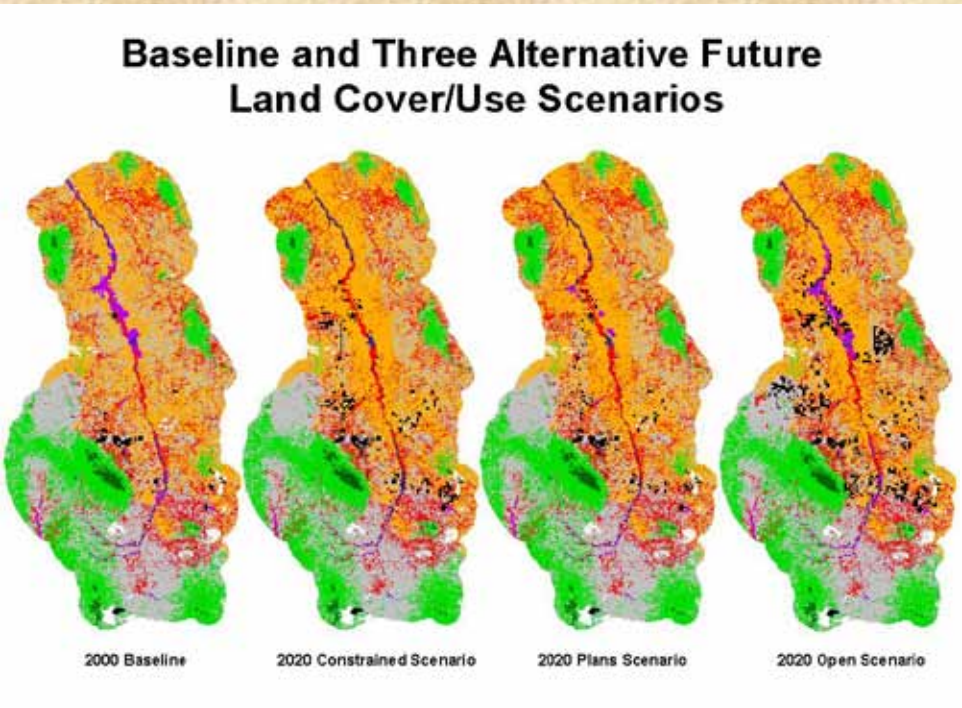
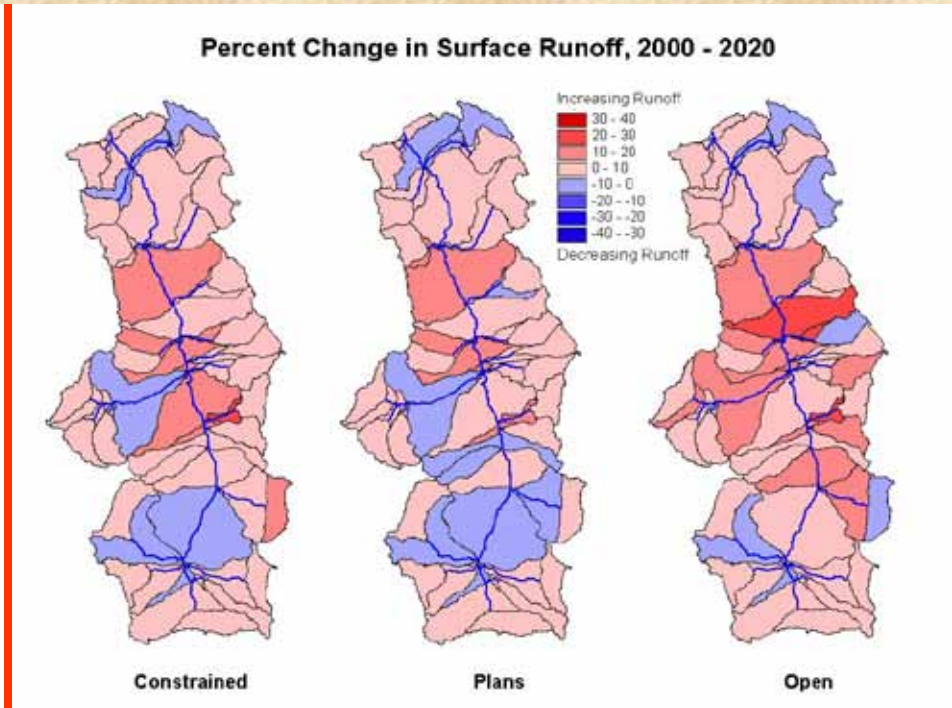


3. The Basin Scale: Automated Geospatial Watershed Assessment (AGWA) Soil Water Assessment Tool (SWAT) & KINEROS



Assessment at the 8-digit HUC

Basin scale

Alternative Scenario Example

- *Focus Groups to define stakeholder preferences*
- *Acquire spatial data*
- *Model the future landscape*
- *Apply AGWA for each Alternative Scenario, Visualize and Compare Results*