Quantifying Risks to Sustainability of Great Basin Rangelands

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Rangeland Hydrology and Erosion Model (RHEM)

- RHEM is designed for government agencies, land managers and conservationists who need sound, science-based technology to model and predict runoff and erosion rates on rangelands and to assist in assessing rangeland conservation practices effects at hillslope scale.

- Agricultural, Runoff, Erosion, and Salinity (ARES) rainfall simulation database can be used to assist in developing model inputs and validating model output to assess soil health and sustainability of site based on erosion rates.

Capabilities

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

- RHEM is designed so to be used as a runoff and erosion calculator, or "engine", within other models that works on larger scales, such as KINEROS2, APEX or SWAT watershed models.

- A user-friendly web-based interface to parametrize model:

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

Model Characteristics

- RHEM is developed specifically for rangeland applications, based on fundamentals of infiltration, hydrology, plant science, hydraulics, and erosion mechanics. It adopts a new splash and sheet erosion equation developed from rangeland soils.

- RHEM models splash erosion and thin sheet-flow transport as the dominant set of processes on undisturbed rangeland sites. For representing erosion on sites with significant disturbances, the model has the capacity to combine splash and sheet erosion with concentrated flow erosion based on the degree of the system disturbance.

Risk Assessment of soil erosion as a function of plant community dynamics

Limy Slopes 12-16" PZ Ecological Site

Historic Community | Exotic Grass

Shrub Invaded | Eroded

RHEM Assessment and Applications

National Resource Inventory 2011-12 reports — National soil erosion estimates on rangelands

Watershed Models KINEROS2 — Estimate runoff and sediment yield as a function management

Informing Ecological Site Descriptions (ESD) — ESDs are being developed by NRCS, BLM, and FS across the United States.

A Change in Biotic Structure with Woodland Encroachment

Shrub-Steppe State | At-Risk Phase | Woodland State

B Respective Changes in Hydrologic/Erosion Function

Rainsplash | Sheetflow | Concentrated Flow

RHEM can address soil erosion processes from disturbances such as:
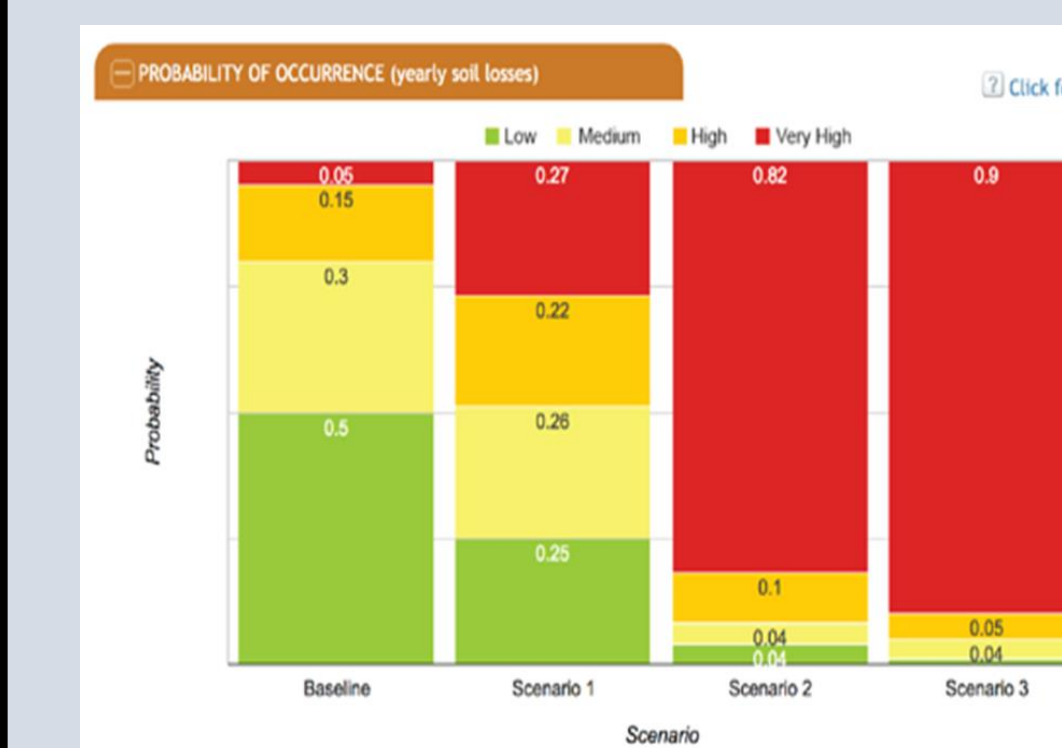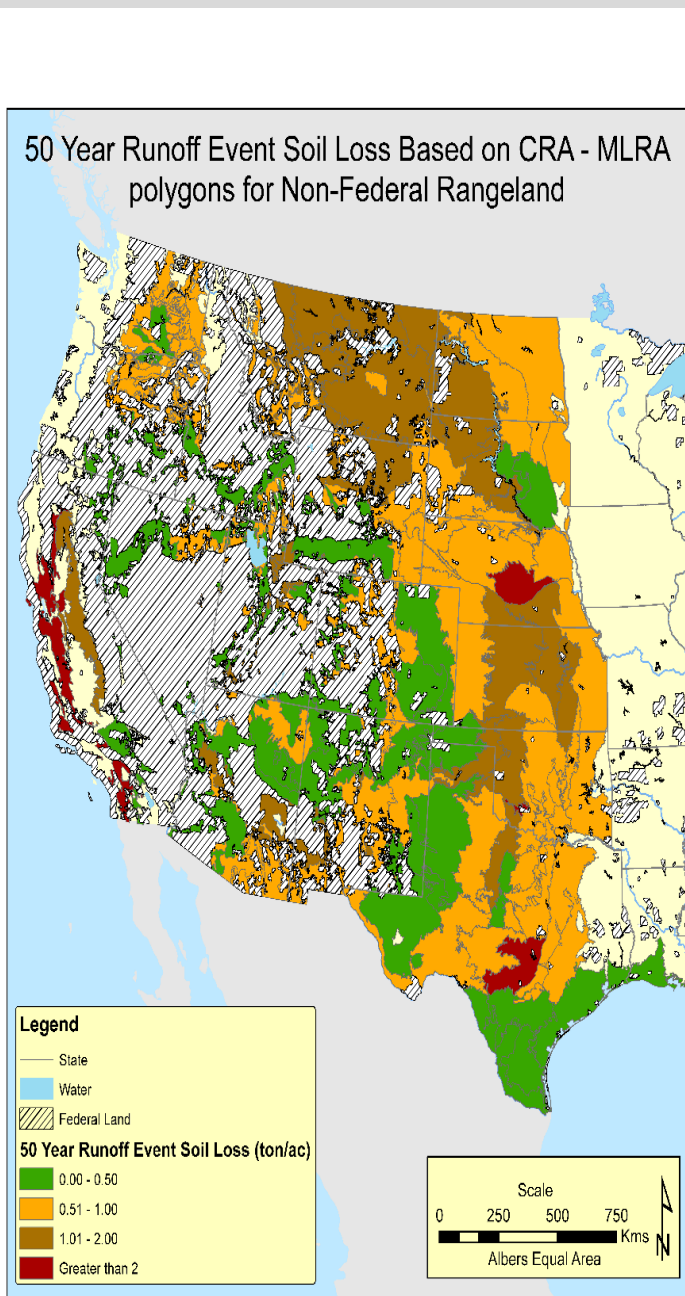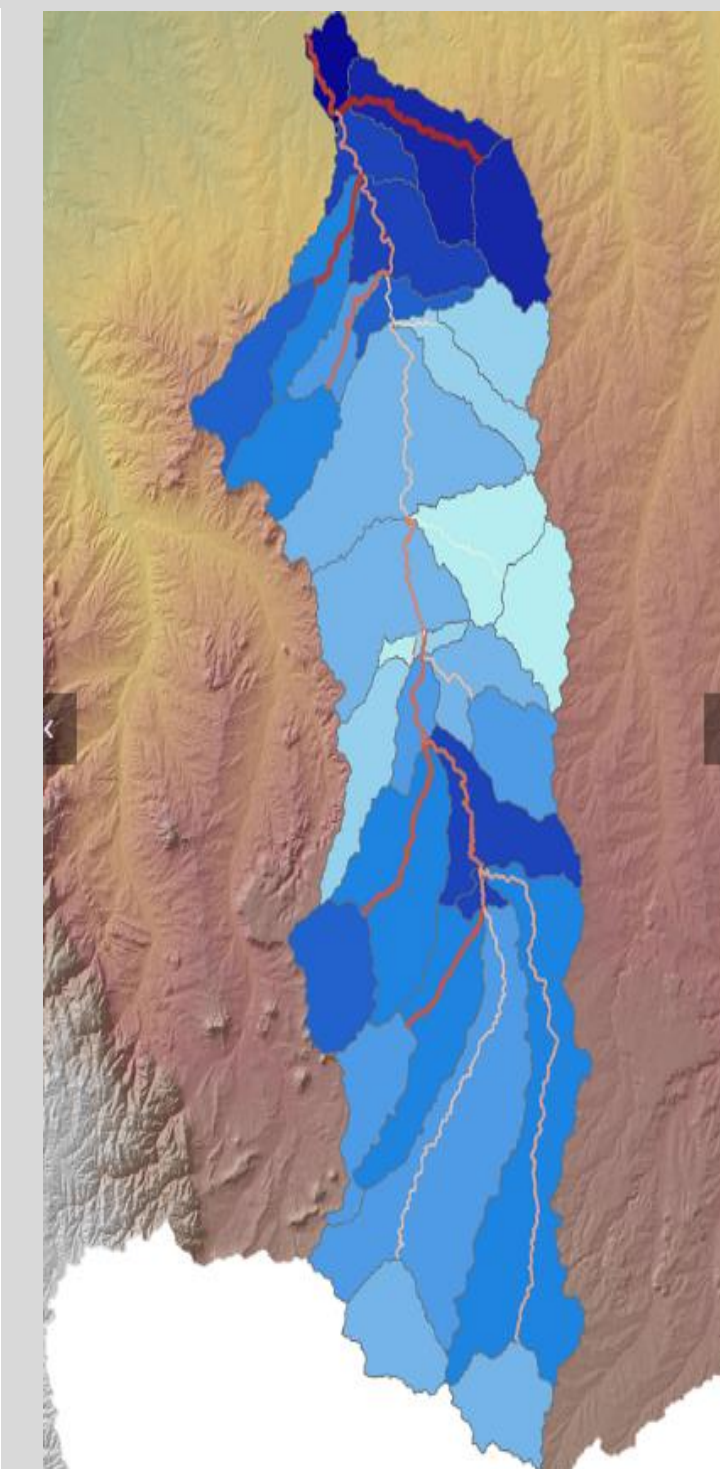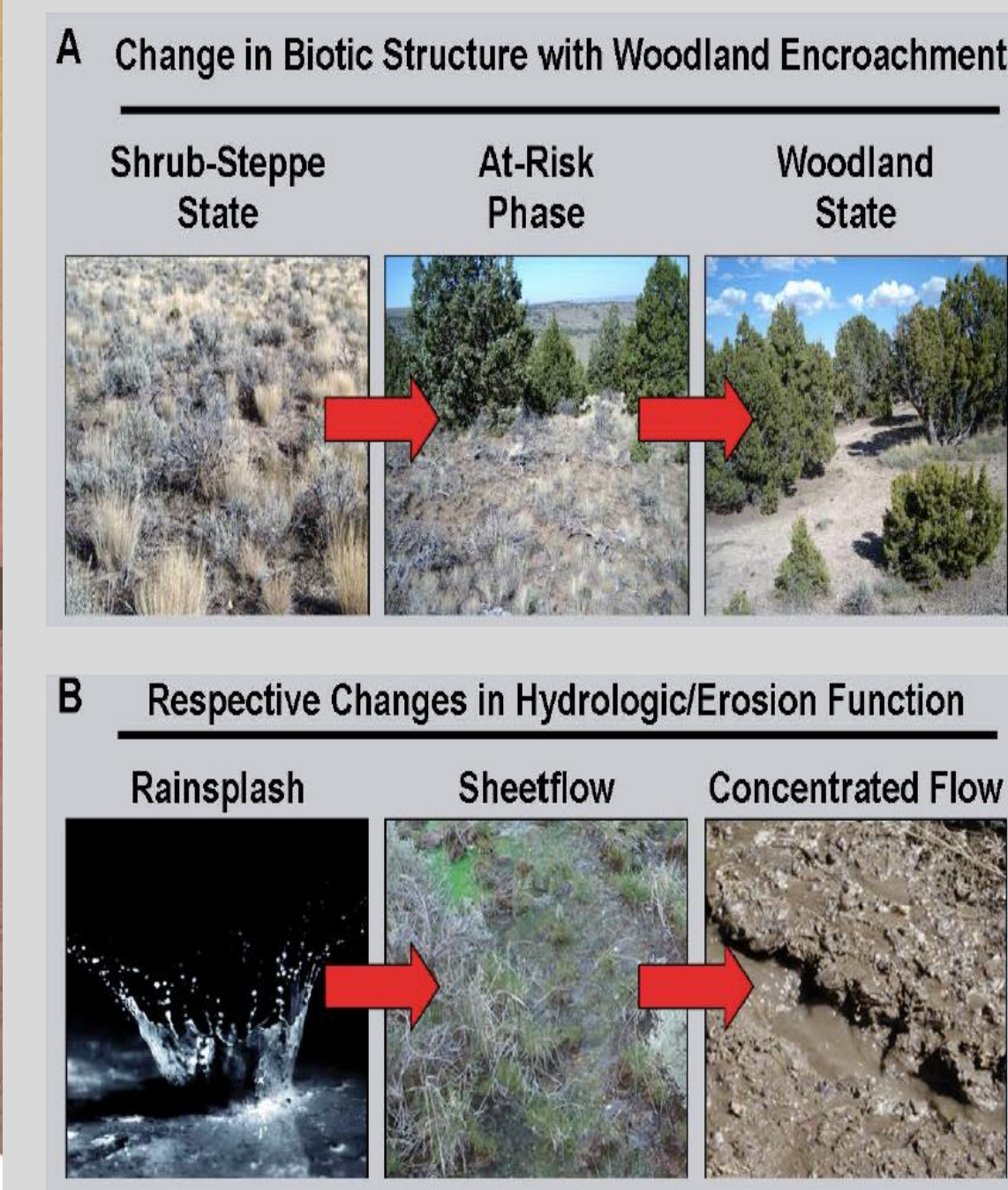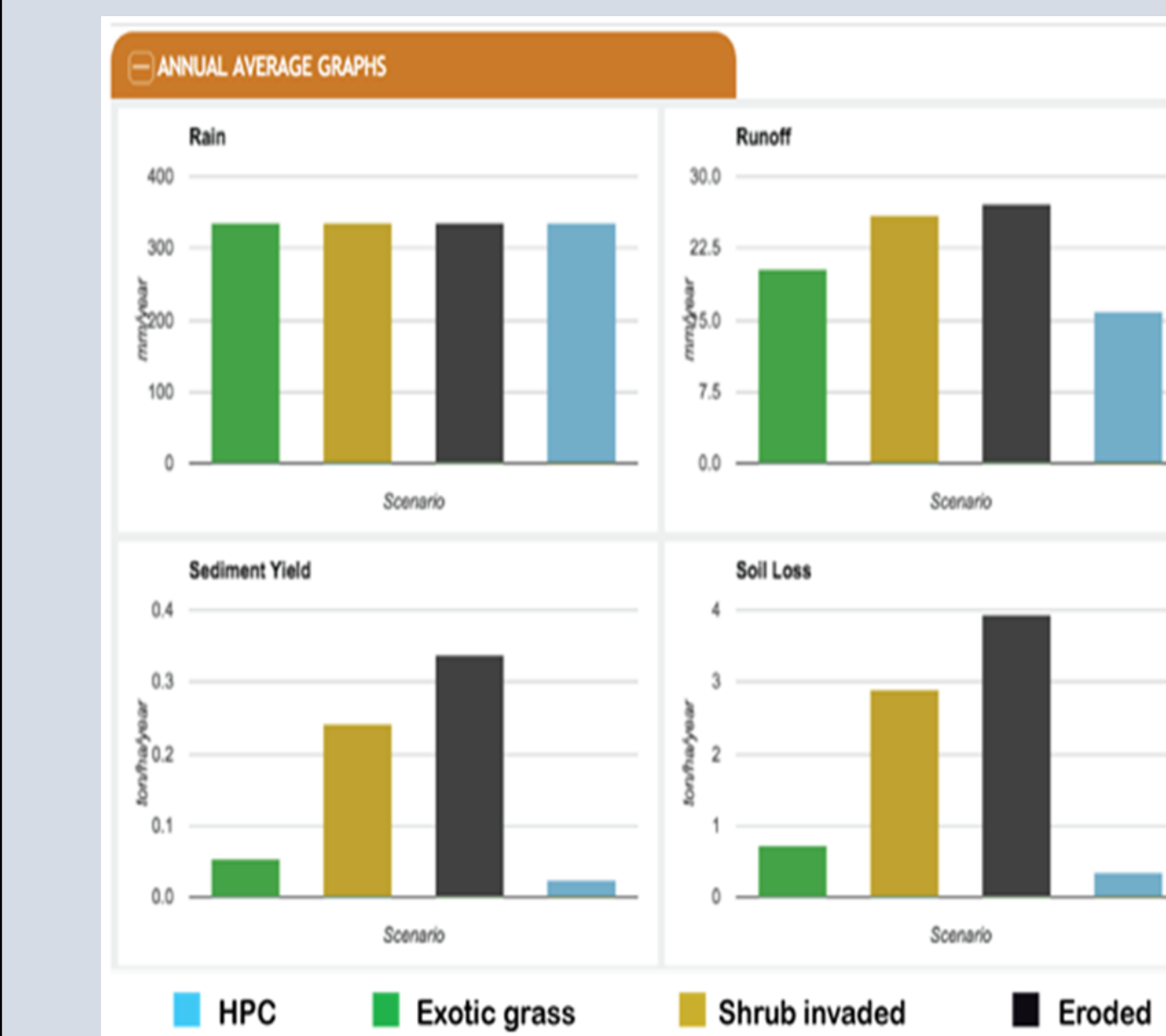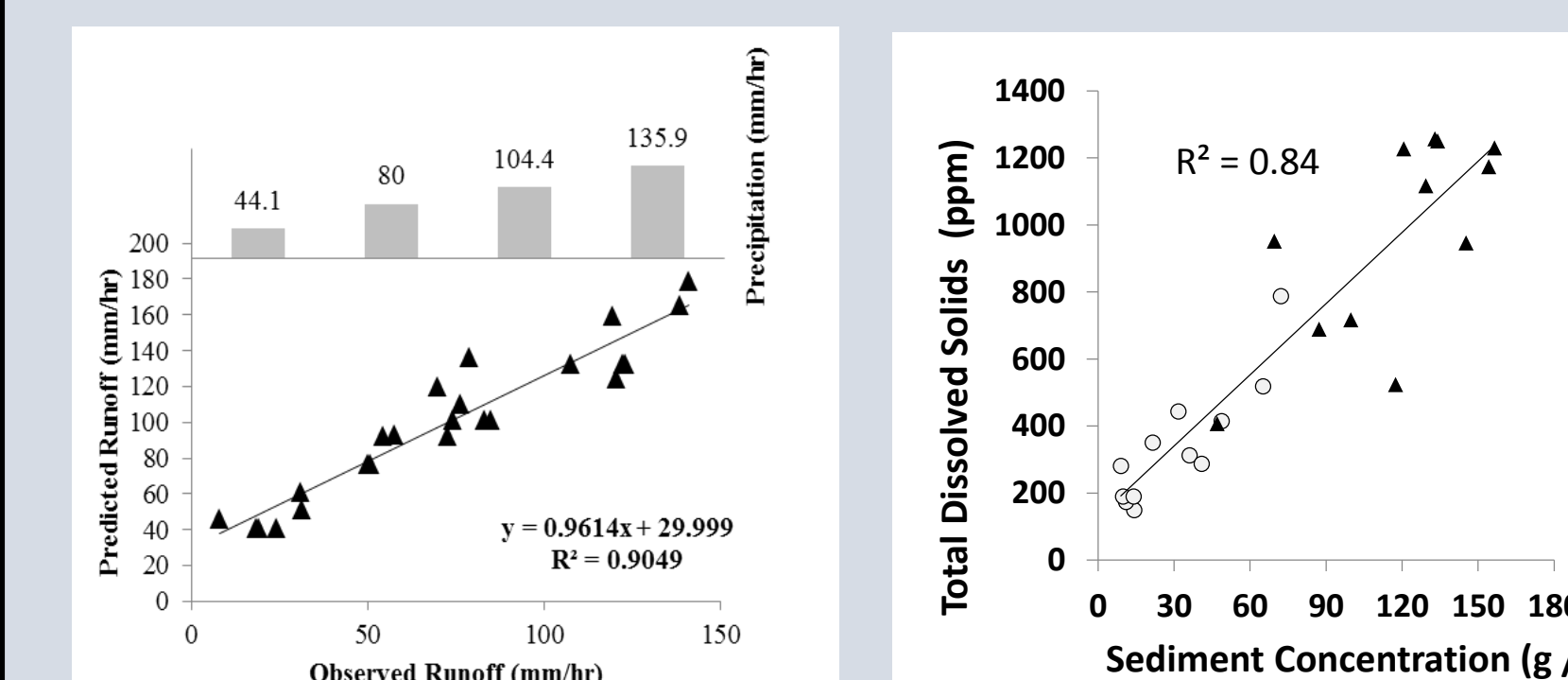

Wildfire in Pinyon-Juniper woodland.
Source: www.blm.gov

RHEM has been adapted by NRCS and available for use in 2017 to predict risks of soil erosion pre and post wildfire and impacts of sustainability of the site.

RHEM Model Outputs at the Plant Community Level

Risk of soil erosion as a function of state of plant community

ANNUAL AVERAGES	EXOTIC GRASS	SHRUB INVADED	ERODED	HPC
Avg. Precipitation (mm/year)	335.330	335.330	335.330	335.330
Avg. Runoff (mm/year)	20.288	26.035	27.187	15.839
Avg. Sediment Yield (ton/ha/year)	0.054	0.243	0.339	0.025
Avg. Soil Loss (ton/ha/year)	0.725	2.898	3.949	0.360

Annual soil erosion as a function of state of plant community

HPC Low soil loss vulnerability 50% probability of < 0.367 ton/ha

GRASS Very High soil loss vulnerability 27% probability of ≥ 1.049 ton/ha

ERODED Very High soil loss vulnerability 90% probability of ≥ 1.049 ton/ha

Coming Soon

Estimating total dissolved solids as a function of sediment yield

Integrating into NRCS field office workflow

Rangeland Hydrology and Erosion Model

Office of the Chief Information Officer
Natural Resources Conservation Service
Washington, D.C.

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