A Landscape Model to Predict Total Nitrogen Levels in Surface Waters of the Willamette and Central Valley Ecoregions of the Western United States

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RESEARCH & DEVELOPMENT

Building a scientific foundation for sound environmental decisions

U.S. Environmental Protection Agency

EMAP - West

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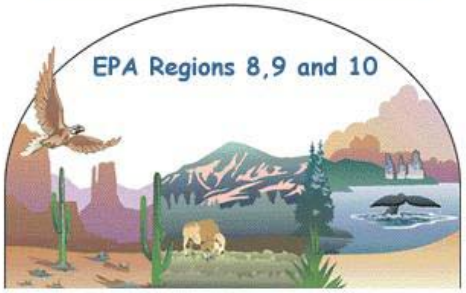


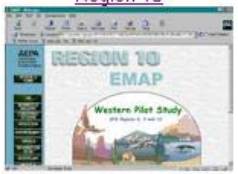
The purpose of EMAP-West is to demonstrate the value of the EMAP approach by applying it to environmental problems across a large and diverse geographical region, and to advance the science of ecosystem monitoring. This will be accomplished by applying EMAP designs to urgent and practical problems facing the western EPA Regional Offices. The strategy is described in the EMAP-West Research Strategy. For a quick overview of EMAP-West activities, see the One-page summaries.

More detailed information on implementation of EMAP-West in the Regions is available on the EMAP-West pages of Region 8, Region 9, and Region 10.

Region 8

Region 9

Region 10



What is Landscape Ecology

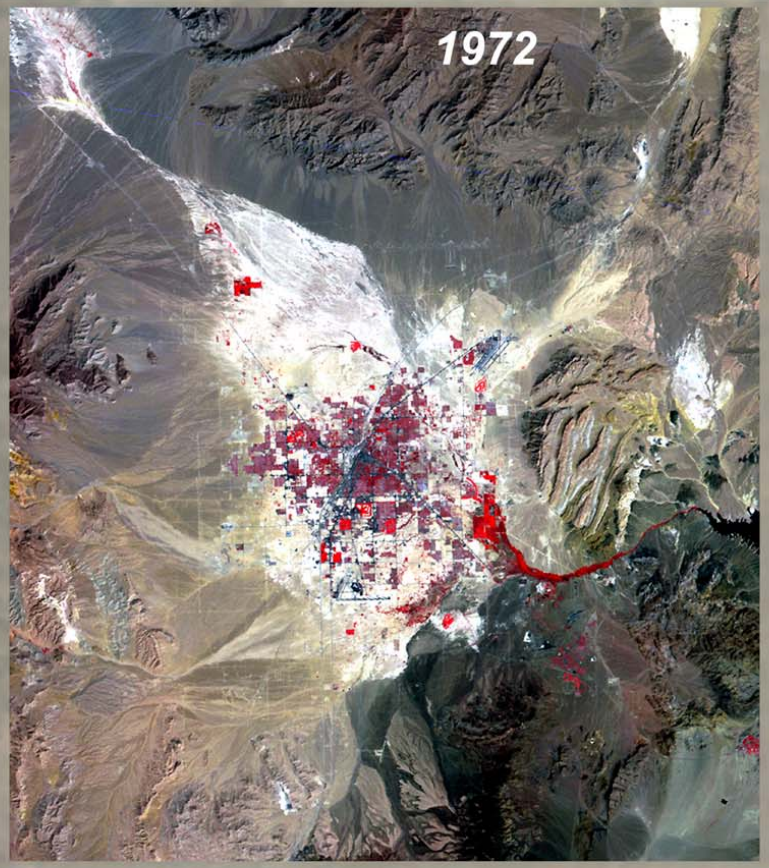
Landscape Pattern

Linked to...

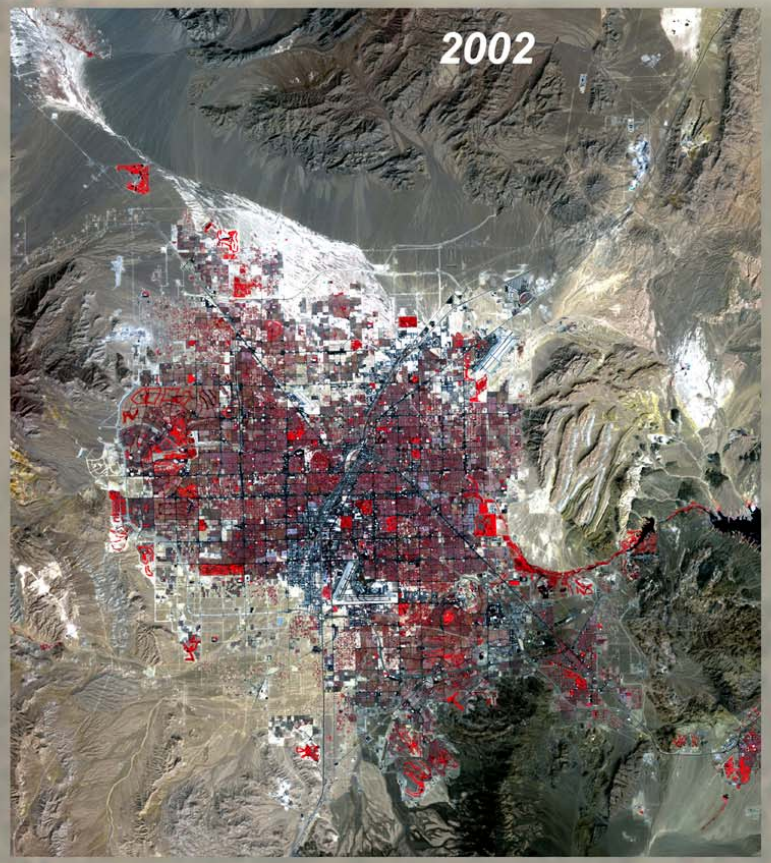
An Ecological Process

30 Years of Landscape Change in the Las Vegas Valley

1972 to 2002



Landsat 1 - Multi-Spectral Scanner Image September 13, 1972



Landsat 7 - Enhanced Thematic Mapper Image September 14, 2002

Las Vegas has become one of the fastest growing metropolitan areas in the United States. The cities population has doubled from 1980 to 1994 and in 1995 Las Vegas has surpassed the one million mark. The population of Las Vegas is currently growing at a rate of 7 percent annually. At this rate, the number of people will double again in ten years.

These satellite images are shown in false color, which means the vegetation is shown in red.

U.S. Environmental Protection Agency
ORD/NERL/ESD
Landscape Ecology Branch
Las Vegas, Nevada
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Future growth may be limited by the availability of water. Water allocation and resource management will be a subject of great concern. Water usage and water quality can be linked to the landscape changes which occur in a region. It is possible to measure landscape change over a large area and determine the trends in ecological and hydrological condition.

RESEARCH & DEVELOPMENT

Building a scientific foundation for sound environmental decisions

What Can the Landscape Analyses Tell Me?

Monitoring - Change Detection
Ecosystem Targeting
Ecosystem Restoration
Modeling/Predictions
Habitat

U_INDEX - Percentage of all human land use
RHUM0 - Percentage of stream corridor classified as all human land use
RHUM30 - Percentage of stream corridor buffered to 30 meters classified as all human land use
RHUM90 - Percentage of stream corridor buffered to 90 meters classified as all human land use
N_INDEX - Percentage of all natural land use
RNAT0 - Percentage of stream corridor classified as all natural land use
RNAT30 - Percentage of stream corridor buffered to 30 meters classified as all natural land use
RNAT90 - Percentage of stream corridor buffered to 90 meters classified as all natural land use
PBAR - Percentage of barren
RBAR0 - Percentage of stream corridor classified as barren
RBAR30 - Percentage of stream corridor buffered to 30 meters classified as barren
RBAR90 - Percentage of stream corridor buffered to 90 meters classified as barren
PAGT - Percentage of all agriculture
RAGT0 - Percentage of stream corridor classified as all agricultural use
RAGT30 - Percentage of stream corridor buffered to 30 meters classified as all agricultural use
RAGT90 - Percentage of stream corridor buffered to 90 meters classified as all agricultural use
PAGC - Percentage of cropland
RAGC0 - Percentage of stream corridor classified as cropland
RAGC30 - Percentage of stream corridor buffered to 30 meters classified as cropland
RAGC90 - Percentage of stream length within 90 meters of cropland
PAGP - Percentage of pasture
RAGP0 - Percentage of stream corridor classified as pasture
RAGP30 - Percentage of stream corridor buffered to 30 meters classified as pasture
RAGP90 - Percentage of stream corridor buffered to 90 meters classified as pasture
PURB - Percentage of urban
RURB0 - Percentage of stream corridor classified as urban
RURB30 - Percentage of stream corridor buffered to 30 meters classified as urban
RURB90 - Percentage of stream length within 90 meters of urban
PWETL - Percentage of wetland
RWETL0 - Percentage of stream corridor classified as wetland
RWETL30 - Percentage of stream corridor buffered to 30 meters classified as wetland
RWETL90 - Percentage of stream corridor buffered to 90 meters classified as wetland
PFOR - Percentage of forest
RFOR0 - Percentage of stream corridor classified as forest
RFOR30 - Percentage of stream corridor buffered to 30 meters classified as forest
RFOR90 - Percentage of corridor buffered to 90 meters classified as forest
AGTSL5 - Total agricultural land use on steep slopes
STRMLEN - Total stream length
STRMDENS - Stream density
RDLEN - Total road length by class
RDLENCINTE - Total road length of interstates
RDLENCHIGH - Total road length of highways
RDLENCROAD - Total road length of surface roads
RDDENS - Road density by road class
RDDENSCINT - Road density of interstates
RDDENSCHIG - Road density of highways
RDDENSCROA - Road density of surface roads
FNUMBER - Number of forest patches in watershed
FPATDENS - Forest patch density
FLARGEST - Largest forest patch size
FAVGSIZE - Average forest patch size
PLGP - Proportion of largest forest patch to total forest area
MDCP - Mean minimum distance to closest forest patch
FEDGE210 - Percentage of watershed classified forest edge (210m)
FCORE210 - Percentage of watershed classified interior forest (210m)
FEA210 - Proportion of forest edge area to total forest (210m)
PFF9 - Probability of forest cell having neighboring forest cell (9x9)
PFPTCH9 - Percentage of watershed classified as patch forest (9x9)
PFTRAN9 - Percentage of watershed classified as transitional forest (9x9)
PFEDGE9 - Percentage of watershed classified as edge forest (9x9)
PFPERF9 - Percentage of watershed classified as perforated forest (9x9)
PFINTR9 - Percentage of watershed classified as interior forest (9x9)
REGFAC_COUNT - Number of regulated facilities
MINES_COUNT - Number of mines
COWDENS - Cattle grazing intensity
POPDENS - Population density

Western EMAP Landscapes

Metrics

Potential nitrogen and phosphorus loadings to streams
Estimates export (kg/ha/yr) of nitrogen and phosphorus by using the reported median coefficients for comparable agricultural uses multiplied by the amount of land cover in the agriculture land cover classes.

Susceptibility/Incidence of Landslides
Assigns qualitative weighted-mean values (normalized range 1.0 to 3.0) to LSW watersheds based on component polygon values of low, medium, or high, as generated from formal field- and map-derived geologic overviews of landslide occurrence.

Susceptibility to Mass Wasting as a Function of Slope Morphology
Assigns qualitative weighted-mean values (normalized range 1.0 to 3.0) to LSW watersheds based on component polygon values of low, medium, or high susceptibility to mass wasting due to slope shape and configuration parameters.

RUSLE Erosion Susceptibility Rating
Assigns qualitative weighted-mean values (normalized range 1.0 to 3.0) to LSW watersheds based on component polygon values of low, medium, or high RUSLE gross sheet/rill erosion estimates.

RUSLE Gross Sheet/Rill Erosion, in tons/acre/year
Assigns quantitative weighted-mean values to LSW watersheds based on computed RUSLE A grid values.

Net Sediment Delivery of RUSLE-based Gross Sheet/Rill Erosion to Riparian Zones, in tons/acre/year
Assigns quantitative weighted-mean values to LSW watersheds by utilizing numerous slope/path characteristics and the computed RUSLE A grid values to estimate the quantity of eroded material that enters riparian zones bordering streams.

LANDSCAPE INDICATOR AND MODEL DEVELOPMENT

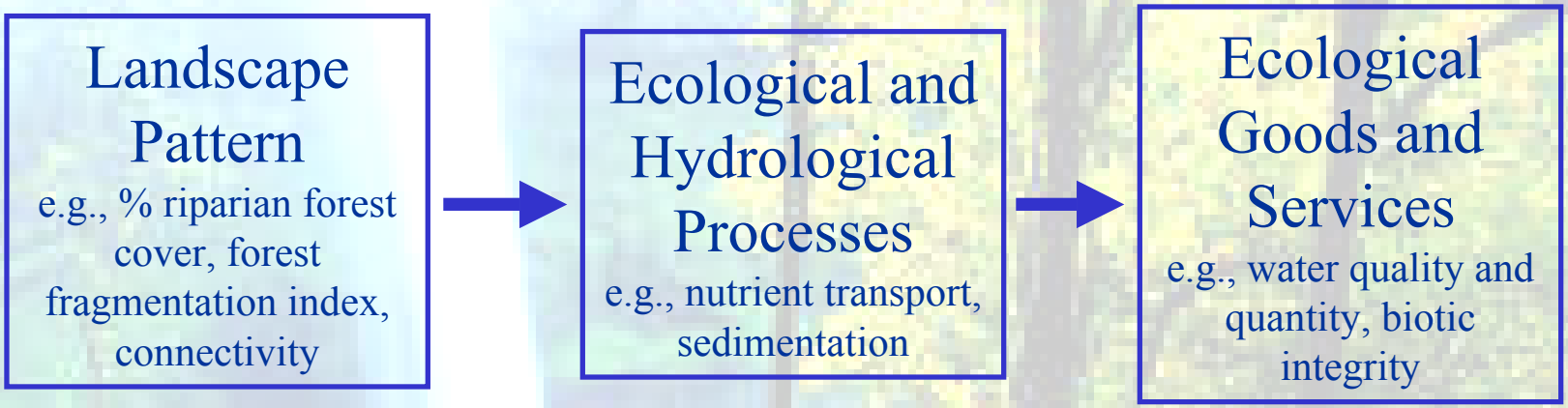
General approach

- Conduct gradient studies to determine which landscape metrics are good indicators of ecological resource conditions and stressors to ecological resources
- Develop spatially-distributed landscape models from studies
- Conduct studies across scales and in different biophysical settings
- Develop stratification and classification approaches to reduce variance in indicator interpretations and model applications

Associations between Landscape Metrics and Environmental Endpoints

Goal:

Establish quantitative relationships between landscape metrics and environmental endpoints

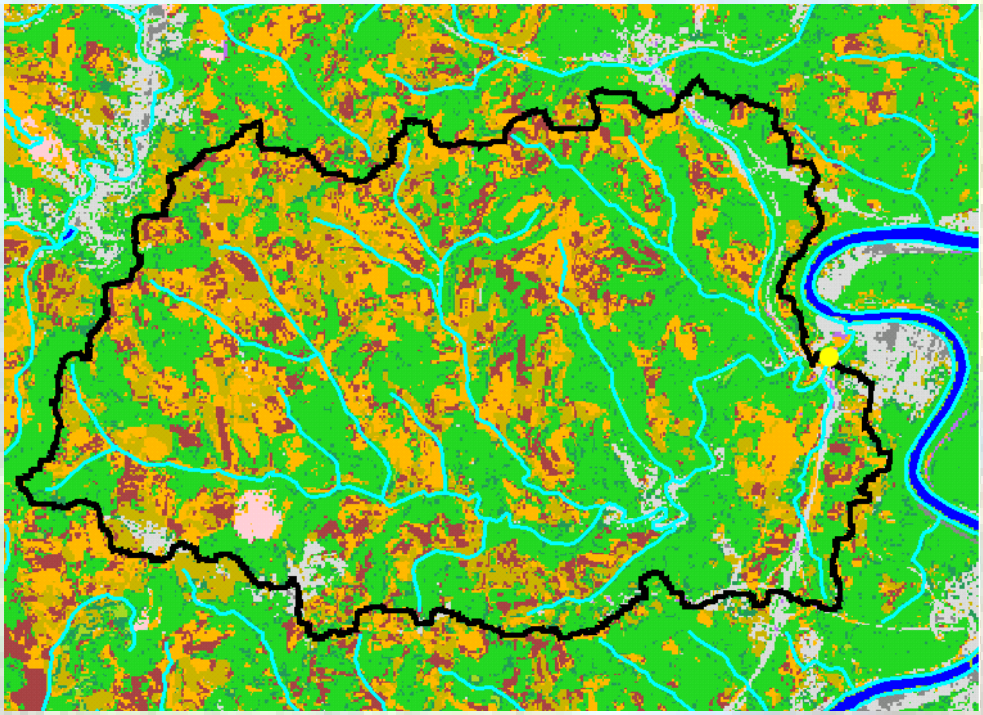


Fact:

This is ongoing research and the results are preliminary. There is still a lot we don't know.

General Process

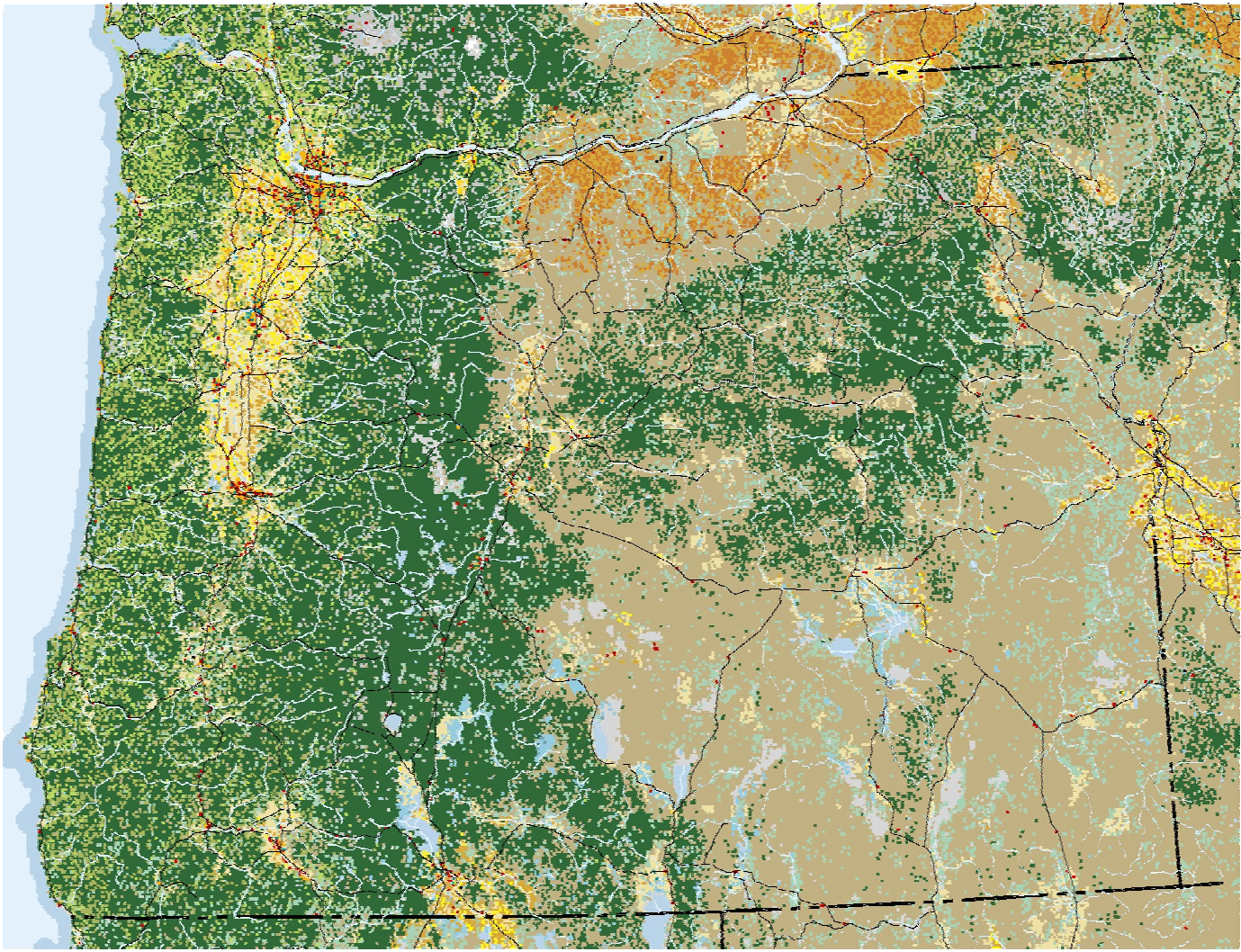
- Define assessment endpoint
- Define assessment and reporting unit
- Delineate assessment unit



- Develop and calculate the right landscape metrics
- Gather endpoint data
- Merge landscape data with endpoint data
- Employ multivariate analysis techniques to quantify relationships

- Apply validated relationships to reporting units

Oregon Landscape Data

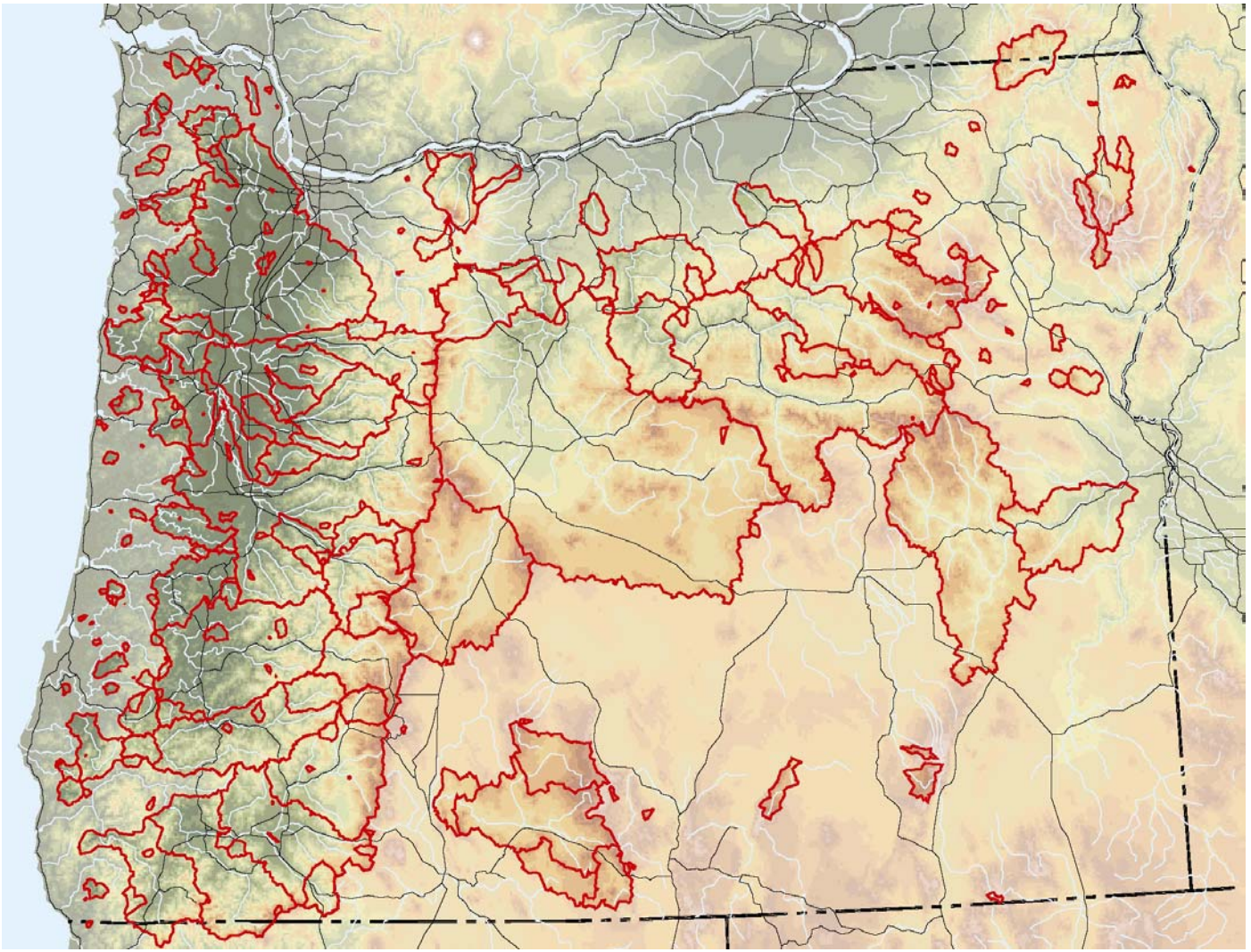


Land Cover Classes

- Open Water
- Perennial Ice/Snow
- Low Intensity Residential
- High Intensity Residential
- Commercial/Industrial/Transportation
- Bare Rock/Sand/Clay
- Quarries/Strip Mines/Gravel Pits
- Transitional
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrubland
- Orchards/Vineyards/Other
- Grasslands/Herbaceous
- Pasture/Hay
- Row Crops
- Small Grains
- Fallow
- Urban/Recreational Grasses
- Woody Wetlands
- Emergent Herbaceous Wetlands

From Stoddard, Heggem and Neale

Oregon EMAP Data Sources



From Stoddard, Heggem and Neale

ca. 300 stream and river watersheds

Analytical Tools Interface for Landscape Assessments (ATtILA)