Landscape Integrity Index:
Evaluating Cumulative Impacts of BLM Resource Programs

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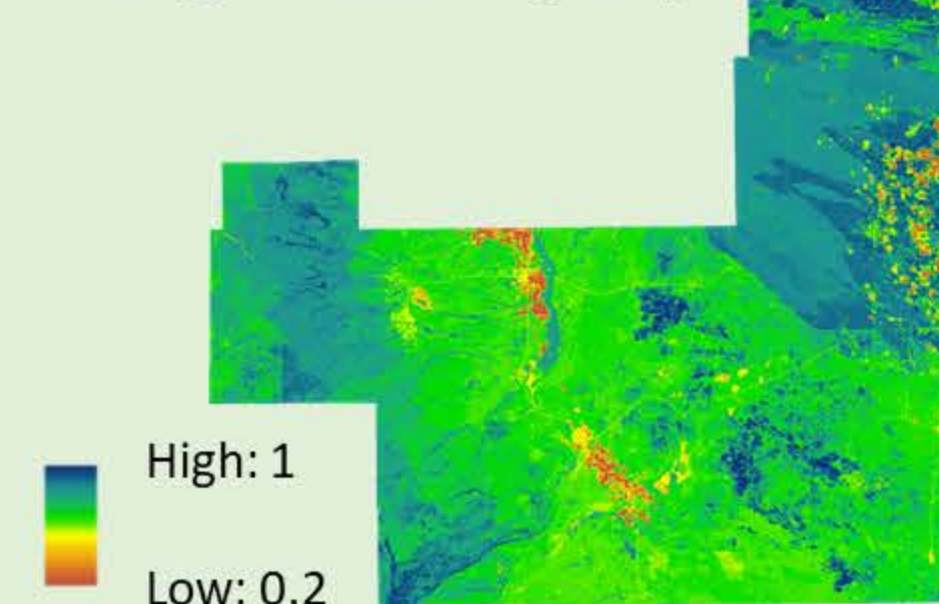*Spatial Sciences Institute*

Introduction

The Bureau of Land Management (BLM) is a federal agency that manages the public lands under the principles of *multiple use* and *sustained yield* for the benefit of present and future generations. The BLM supports various resource management programs such as energy development, conservation stewardship, and recreation, which can affect the ecological integrity of the lands in different ways.

Cumulative effects of these programs are difficult to assess when the area comprises multiple programs with potential contrasting management goals and impacts. The **aim** of this research is to develop and use a Landscape Integrity Index (*LII*) that evaluates the cumulative impacts of BLM programs using (1) ecological integrity indicators, (2) resource- and stressor-based metrics, and (3) landscape metrics.
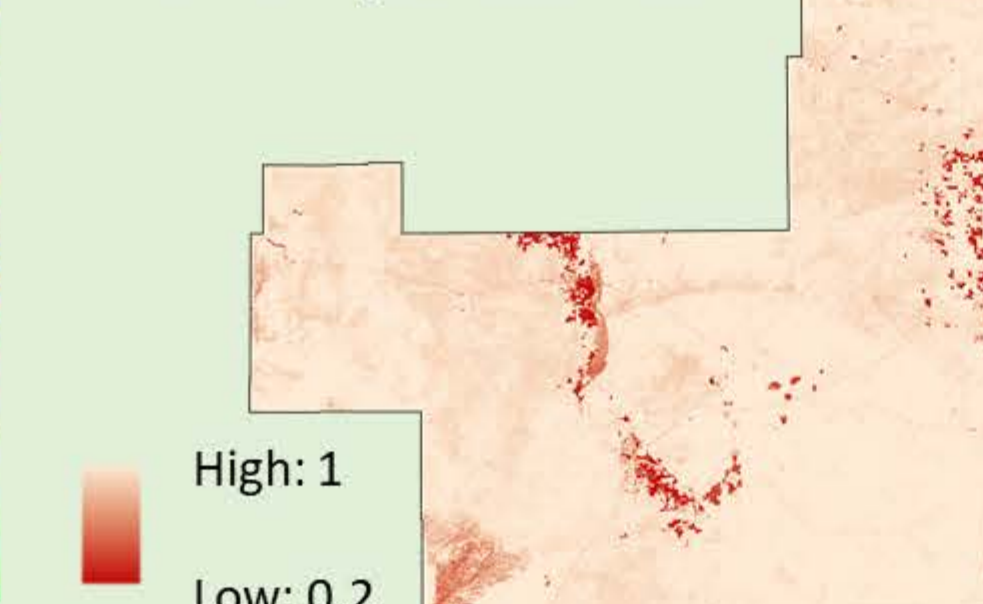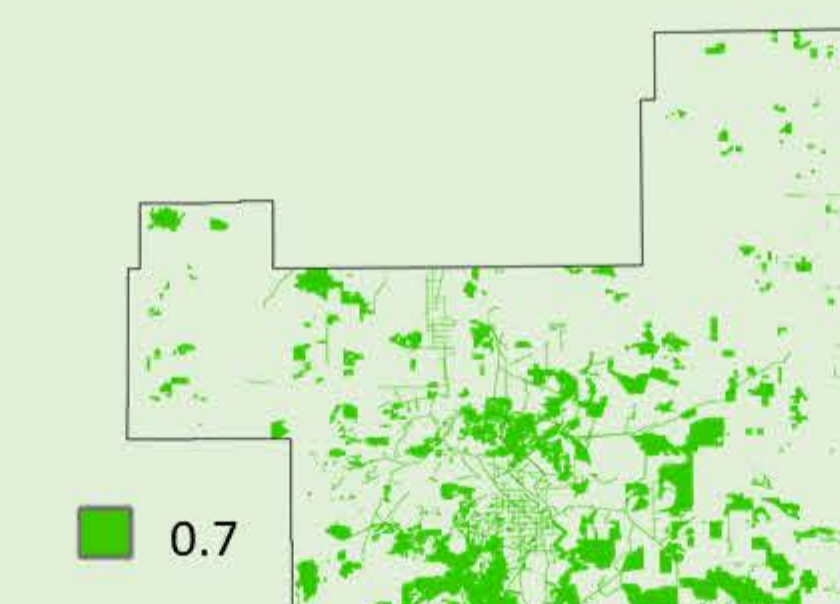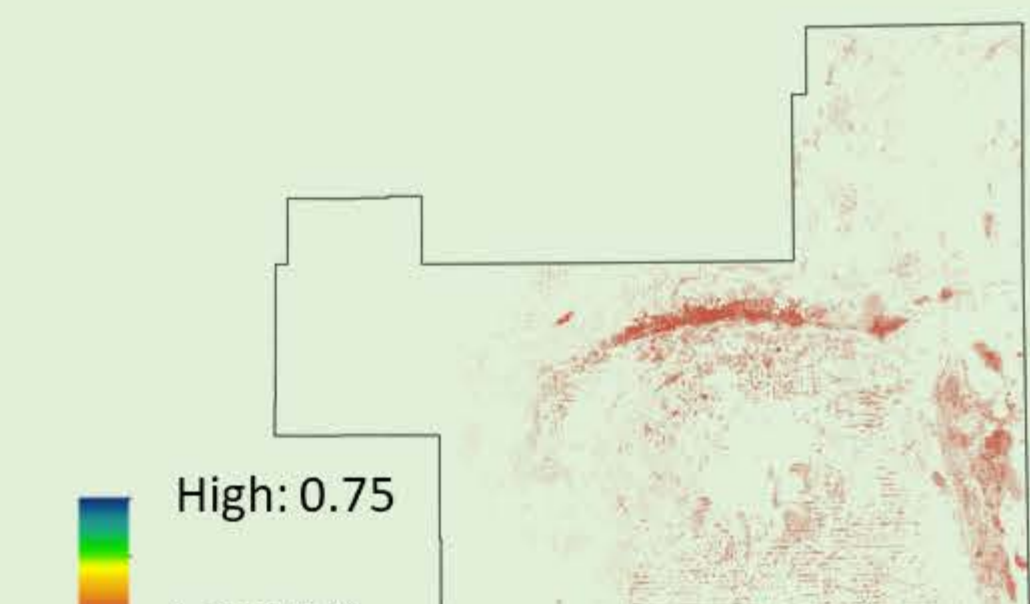
Study Area

BLM Carlsbad Field Office (CFO) Planning Area, New Mexico
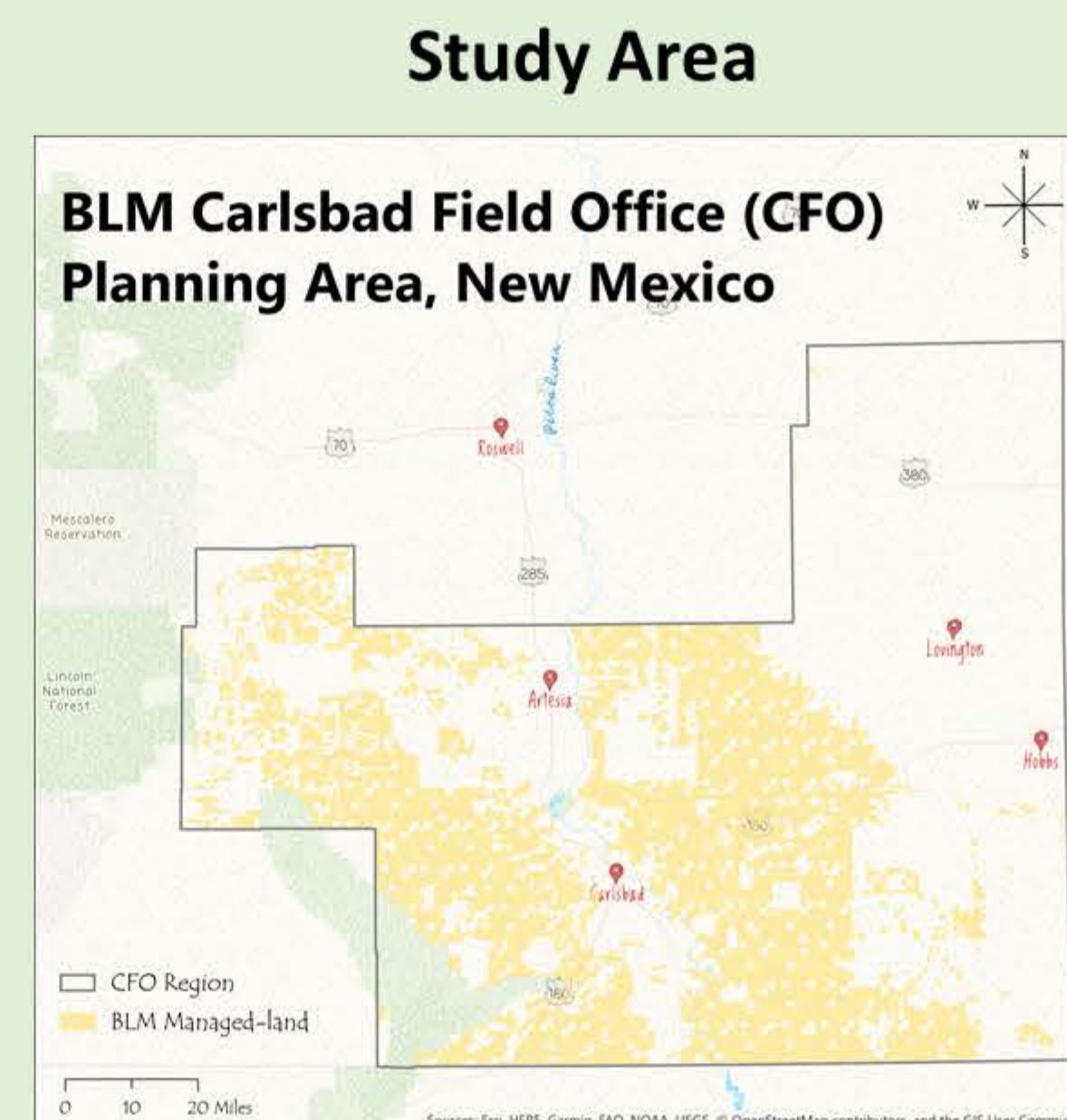
Results

Ecological Integrity — High: 1, Low: 0.2

Landscape Metrics — High: 1, Low: 0.2

Resource-based Metrics — 0.7

Stressor-based Metrics — High: 0.75, Low: 0.2

Landscape Integrity Index (*LII*) — High: 1, Low: 0.2
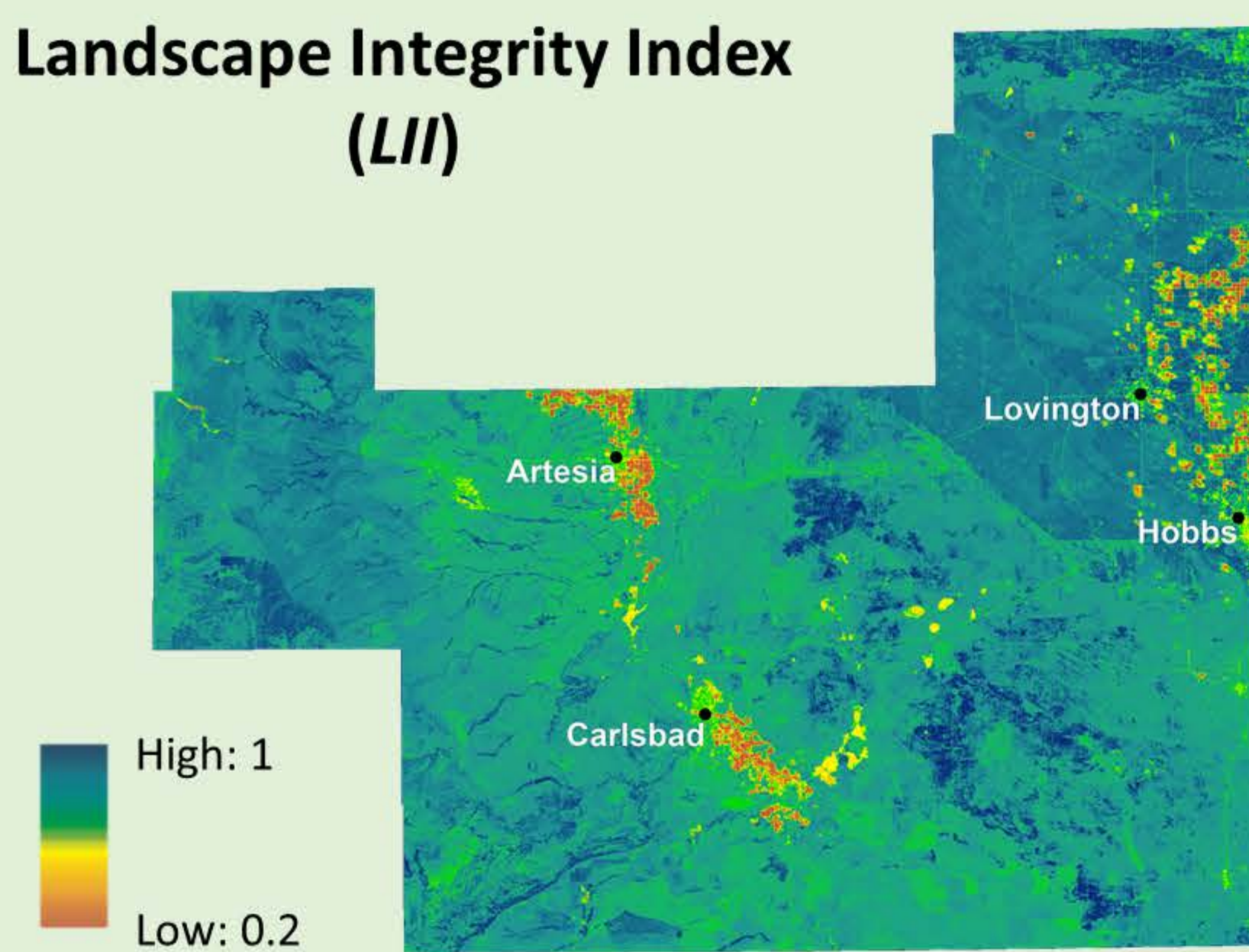
***LII* model result:**
- Overall landscape integrity in CFO is at a moderate level (average value = 0.48)

***LII* map results:**
- Areas of **low** landscape integrity are near the major cities and the northeast corner of CFO planning area
- Areas of **high** landscape integrity were near central and southwest corner of CFO planning area
- Low landscape integrity may be attributed by urban and industrial development, and agriculture

Methods

General Workflow
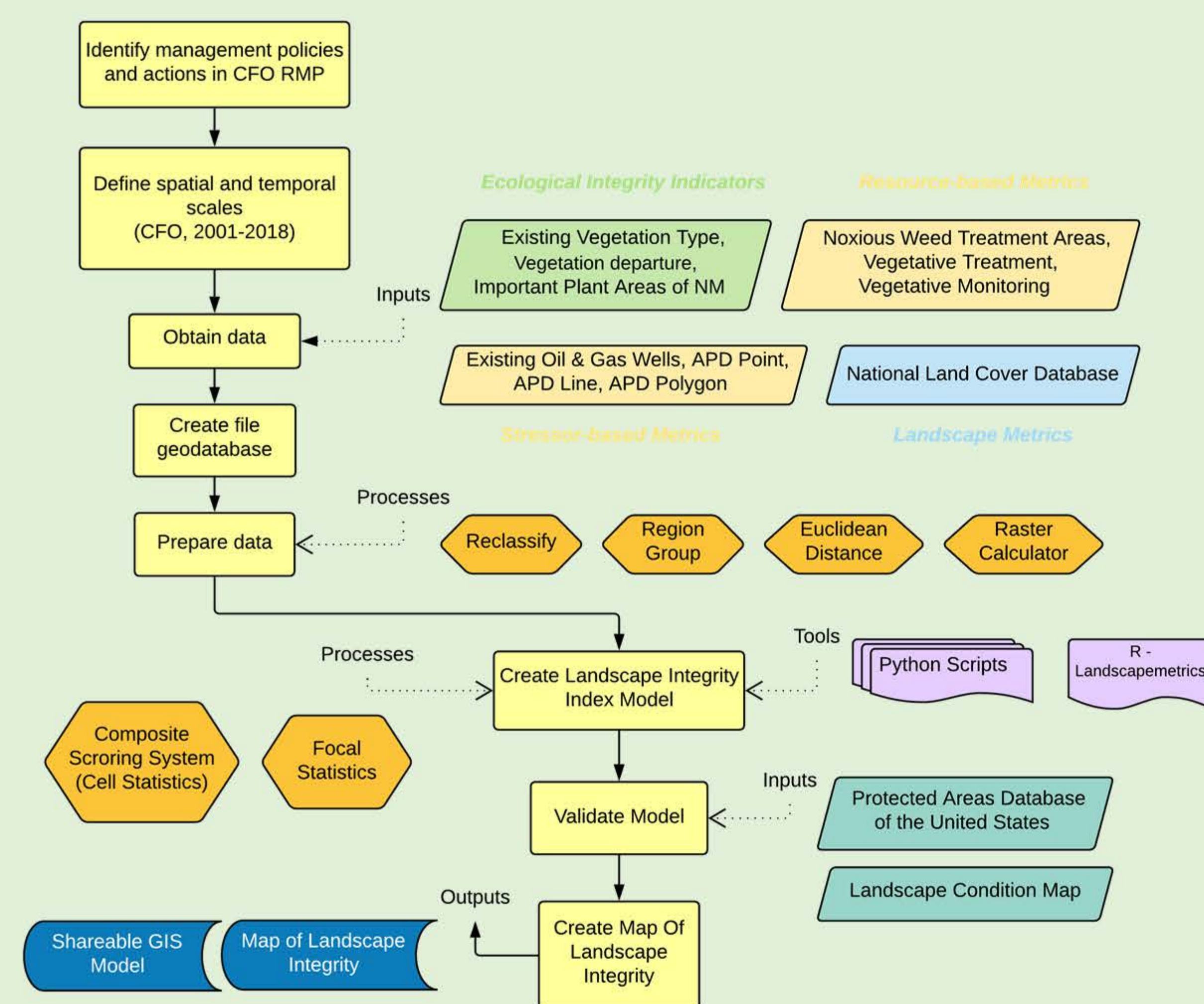
Major Steps

Ecological Integrity Indicators
1. Reclassify
2. Inverse Normalize VDEP
3. Cell Statistics (Minimum)

Resource- and Stressor-based Metrics
1. Euclidean Distance
2. Distance Decay Function (Log10)
3. Multiply Impact Score with normalized Log10
4. Cell Statistics (Minimum)

Ecological Integrity Indicators
1. R – landscapemetrics
2. Reclassify
3. Normalize landscape metrics
4. Cell Statistics (Minimum)

Landscape Integrity Index
1. Cell Statistics (Mean)
2. Focal Statistics (Mean)

Model Validation
1. Compare *LII* values with Landscape Condition Map values with a linear regression model
2. Compare *LII* values in protected areas to *LII* values in multiple-use areas with a Welch's two sample t-test

Applications of *LII* Model and Map

The *LII* model is a comprehensive, standardized, and transparent GIS approach that can be used to improve the current Cumulative Effects Assessment, help inform the decision-making process, and enhance communication and public outreach.

The *LII* map reveals valuable information for landscape-level planning like identifying potential areas of restoration management or important zones for resources and ecosystem services that need active monitoring.

Future Research

Future improvements can be made on:
- Spatial and temporal scales
- Indicator species
- Site impact scores
- Buffer distance for resource- and stressor-based metrics
- Thresholds of significance
- Indicators and metrics refinement
- Communication and sharing of *LII* model

Acknowledgement