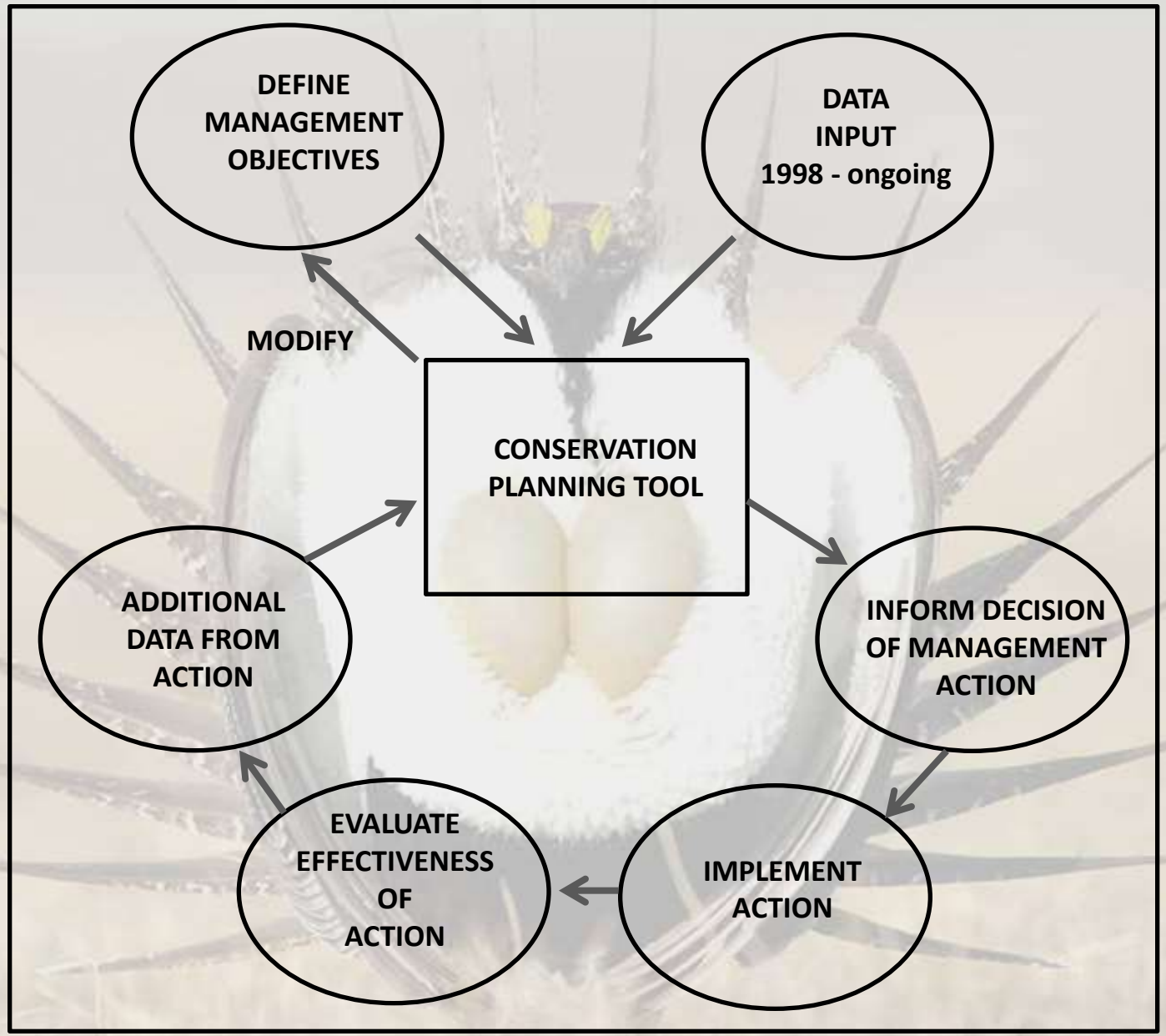
Start of Agenda Item 8

Greater Sage-Grouse Habitat:
Nevada Statewide Modeling and Mapping

A Decision Support Tool


DEFINE MANAGEMENT OBJECTIVES
DATA INPUT 1998 - ongoing
MODIFY
CONSERVATION PLANNING TOOL
ADDITIONAL DATA FROM ACTION
INFORM DECISION OF MANAGEMENT ACTION
EVALUATE EFFECTIVENESS OF ACTION
IMPLEMENT ACTION

Data Driven Approach

- **Map areas important to sage-grouse (seasonal and composite)**
- **Identify factors that influence grouse populations**
- **Identify management action and where they are needed**
- **Provide a basis to evaluate those actions**

Existing Information

Maps

(Good)	**Existing vegetation layers (i.e., 30-m resolution)**
(Better)	**High resolution map layers (i.e., 1-m to 5-m)**

Sage-grouse Monitoring

(Good)	**Telemetry location data**
(Better)	**Survival and reproduction information (i.e., nest, chick, juvenile, adult survival)**

Existing Information

Maps

(Good) **Existing vegetation layers (i.e., 30-m resolution)**

(Better) High resolution map layers (i.e., 1-m to 5-m)

Sage-grouse Monitoring

(Good) **Telemetry location data**

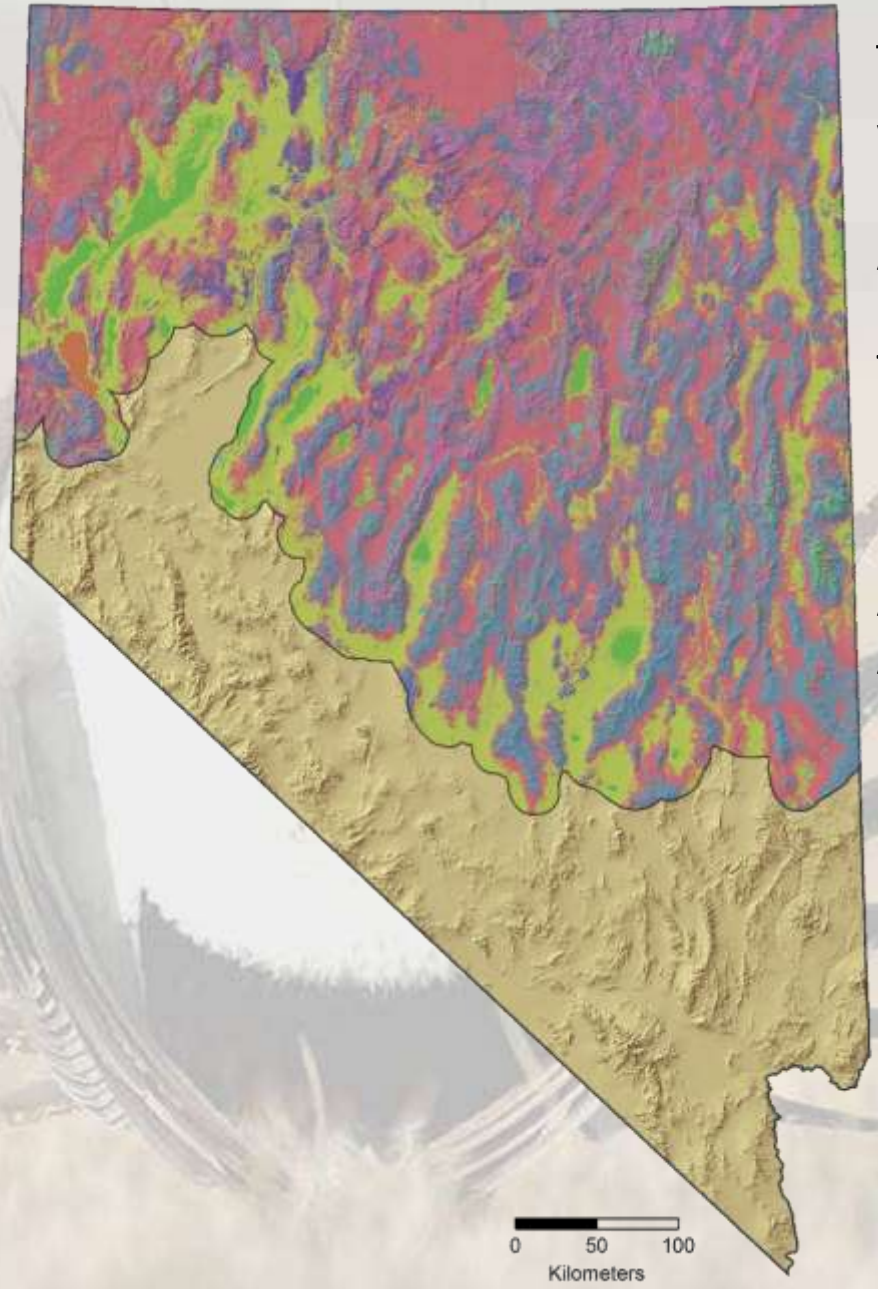
(Better) [illegible] and reproduct[illegible]ion

Defining the Modeling Area

Used existing PMU boundaries (10 km)

Approximated potential sage-grouse range

Land Cover Maps



Model Covariates

Vegetation Communities

Agricultural Areas

Topographic Indices

Elevation Model

Anthropogenic Attributes

- Urbanization

- Recreational Indices

- *Power Lines**

Vegetation Variables

Big Sage

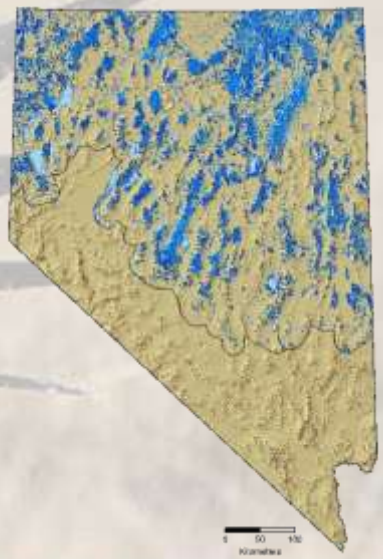
Low Sage

Mtn. Big Sage

Low Other Shrub

Annual Grass

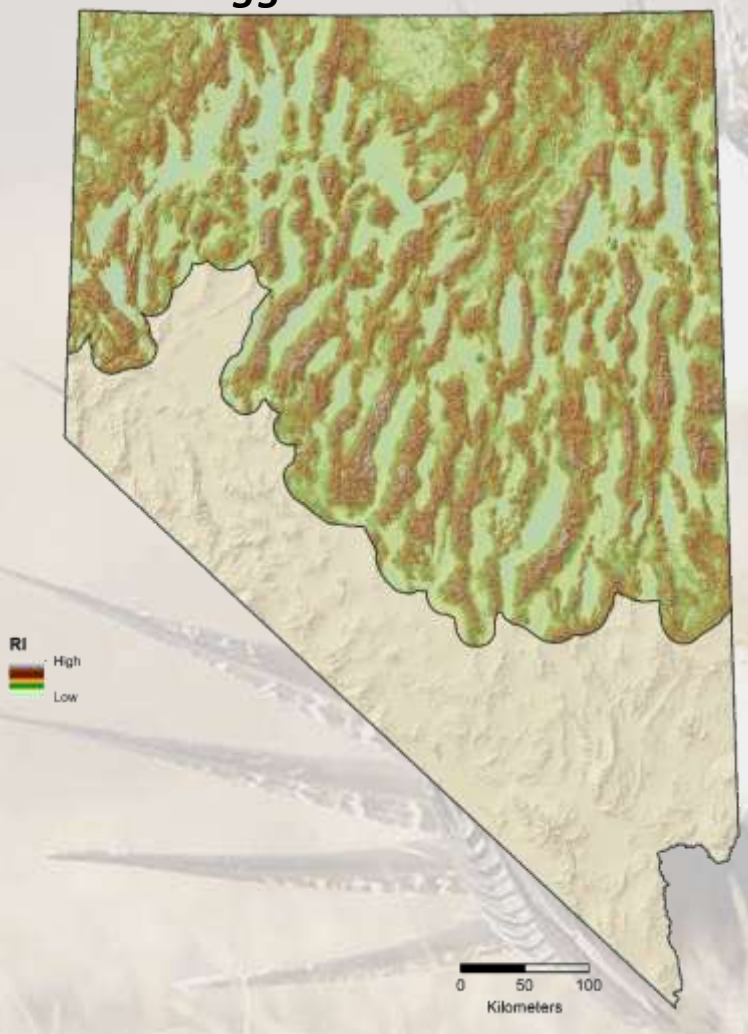
Water Bodies



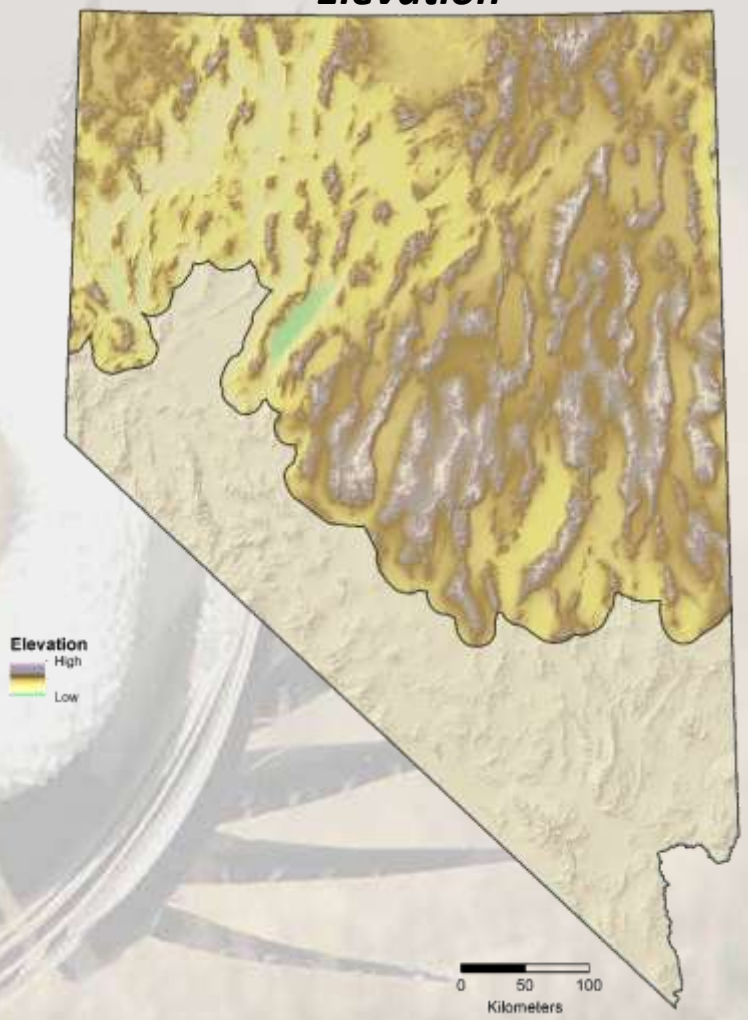
Pinyon-Juniper Cover

Physiographic Variables

Ruggedness Index



Elevation



Model Variable List

Annual Grass (660 ha)
Annual Grass (60 ha)
Annual Grass (8 ha)

Agriculture (660 ha)
Agriculture (60 ha)
Agriculture (8 ha)

Bare Ground (660 ha)
Bare Ground (60 ha)
Bare Ground (8 ha)

Big Sage (660 ha)
Big Sage (60 ha)
Big Sage (8 ha)

Edge Variation (660 ha)
Edge Variation (60 ha)
Edge Variation (8 ha)

Forested (660 ha)
Forested (60 ha)
Forested (8 ha)

Land Cover Variation (660 ha)
Land Cover Variation (60 ha)
Land Cover Variation (8 ha)

Lowland Shrub (660 ha)
Lowland Shrub (60 ha)
Lowland Shrub (8 ha)

Low Sagebrush (660 ha)
Low Sagebrush (60 ha)
Low Sagebrush (8 ha)

Mountain Big Sagebrush (660 ha)
Mountain Big Sagebrush (66 ha)
Mountain Big Sagebrush (8 ha)

Open Water (660 ha)
Open Water (60 ha)
Open Water (8 ha)

Perennial Grass (660 ha)
Perennial Grass (60 ha)
Perennial Grass (8 ha)

Pinyon-Juniper (660 ha)
Pinyon-Juniper (60 ha)
Pinyon-Juniper (8 ha)

Riparian (660 ha)
Riparian (60 ha)
Riparian (8 ha)

Upland Shrubs (660 ha)
Upland Shrubs (60 ha)
Upland Shrubs (8 ha)

Wet Meadow (660 ha)
Wet Meadow (60 ha)
Wet Meadow (8 ha)

Distance to Edge
Distance to Edge (exp)

Distance to Agriculture
Distance to Agriculture (exp)

Distance to Perennial Stream
Distance to Perennial Stream (exp)
Distance to Ephemeral Stream
Distance to Ephemeral Stream (exp)
Distance to Intermittent Stream
Distance to Intermittent Stream (exp)
Distance to Water Body
Distance to Water Body (exp)
Distance to Spring
Distance to Spring (exp)
Distance to all Streams
Distance to all Streams (exp)
Distance to Open Water
Distance to Open Water (exp)
Distance to Wet Meadow
Distance to Wet Meadow (exp)

Elevation
Elevation (quadratic)
Ruggedness Index
Slope
Topographic Position Index (510 m)
Topographic Position Index (2010 m)

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Modeling Procedure

Five Steps:

1) **Compile GIS coverages for all areas**

2) **Overlay telemetry points and generate random points**

3) **Extract environmental information from points**

4) **Estimate model parameters (coefficients) of each environmental factor by contrasting the used from the random points**

5) **Predict the probability of occurrence for each grid cell using the model parameters**

Modeling Procedure

Five Steps:

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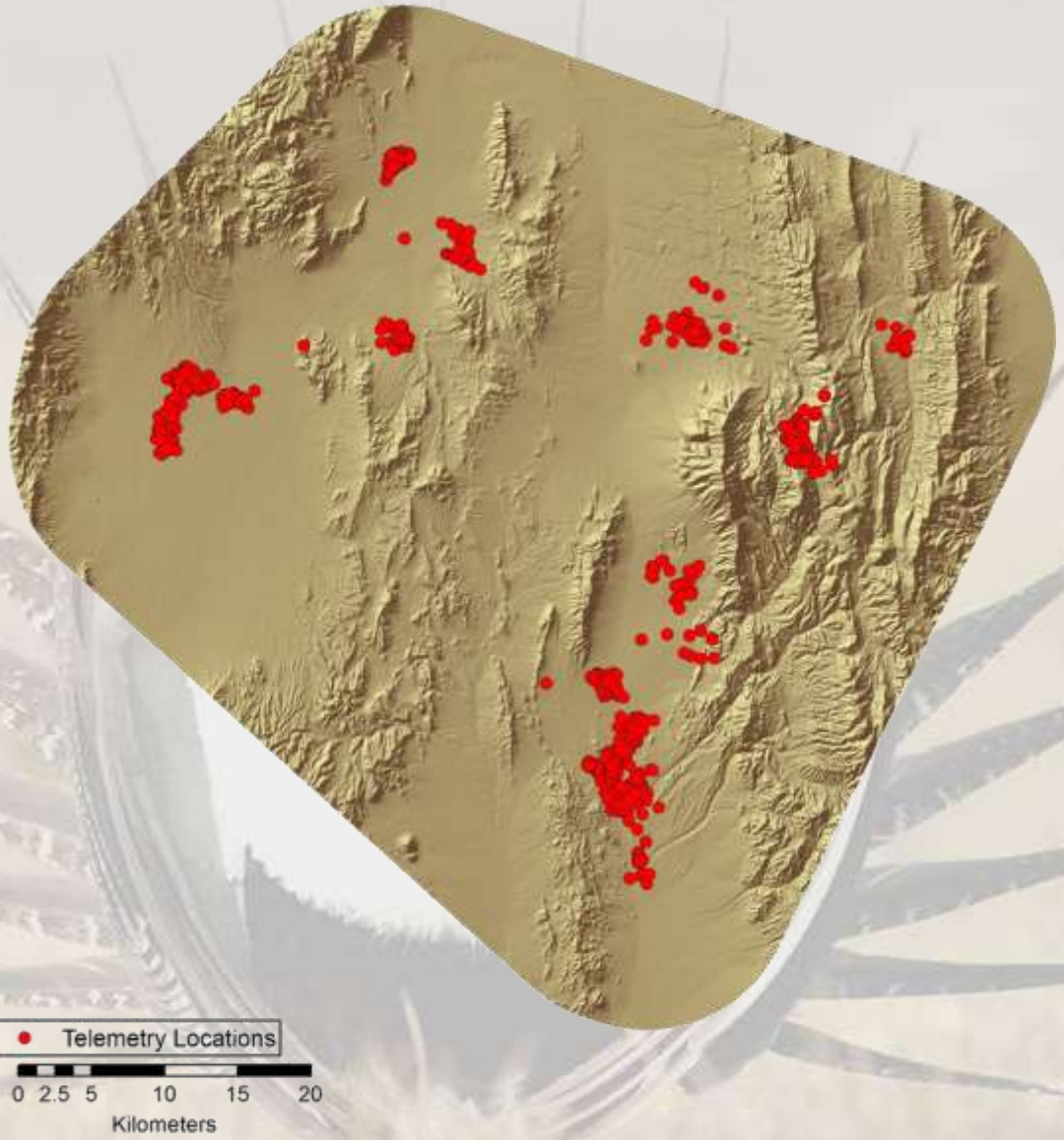
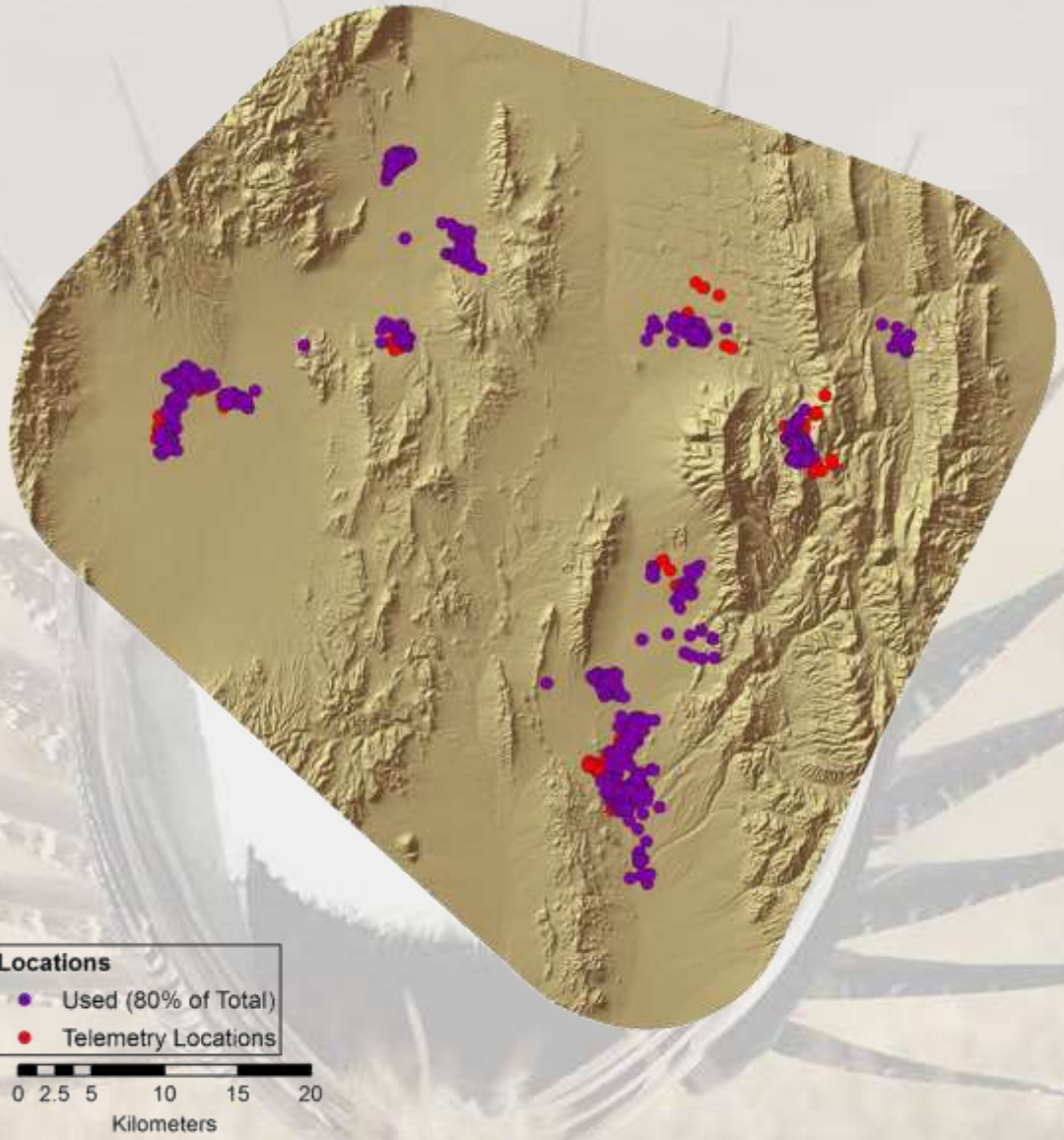
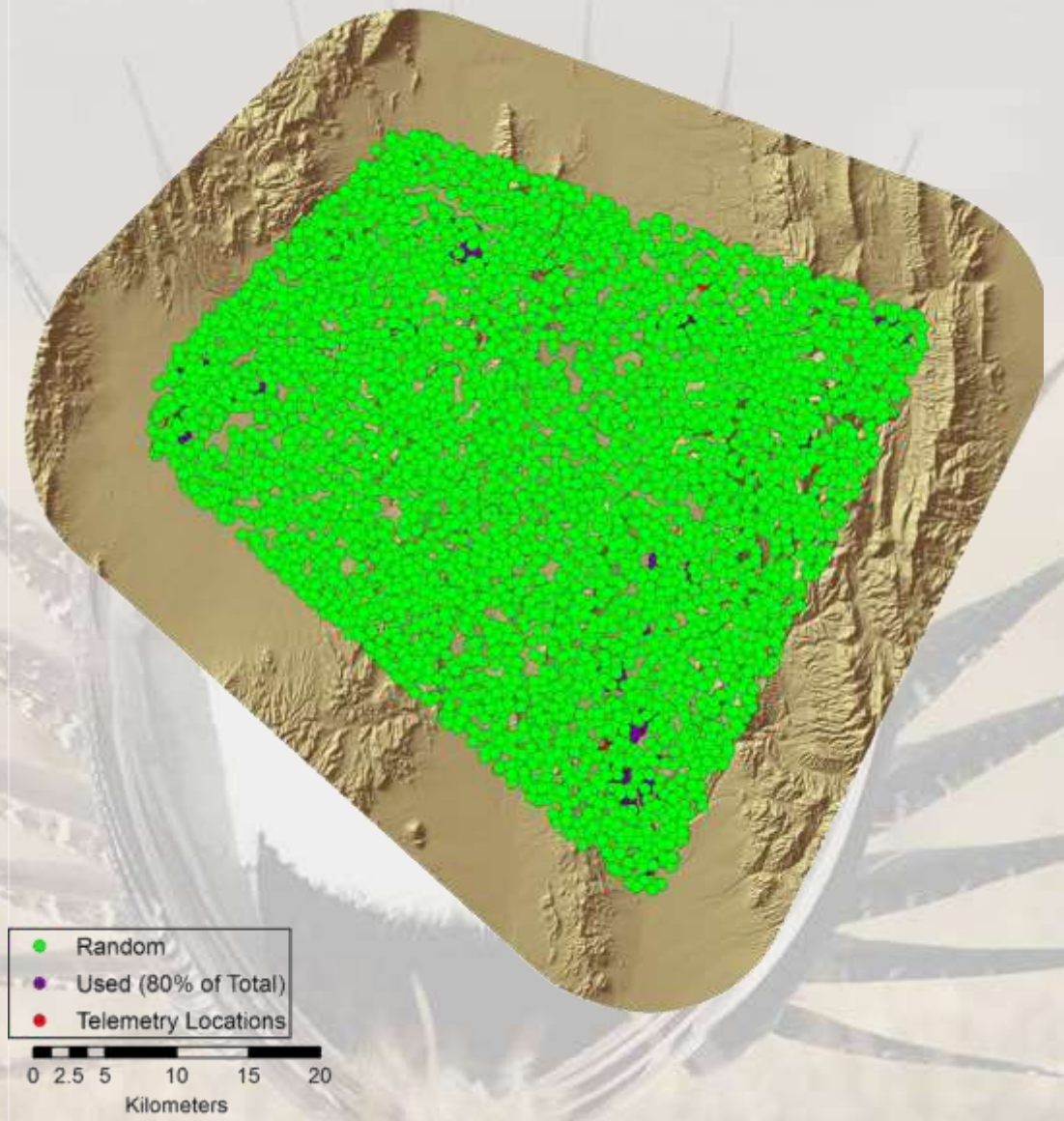
RSF input: study site example



RSF input: study site example



RSF input: study site example



Modeling Procedure

Five Steps:

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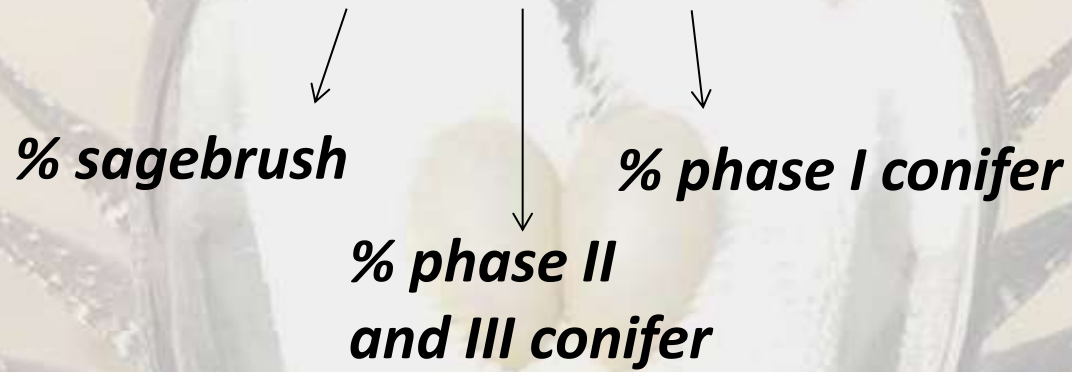
Extract and Model Data

Contrast the used versus the available points to estimate the effect of each model variable

$$Logit\,(Y) = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X_n$$



Apply coefficients to map layers to calculate the probability of use per pixel

$$RSF = \exp(\beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X_n)$$

Modeling Procedure

Five Steps:

1) Compile GIS coverages for all areas

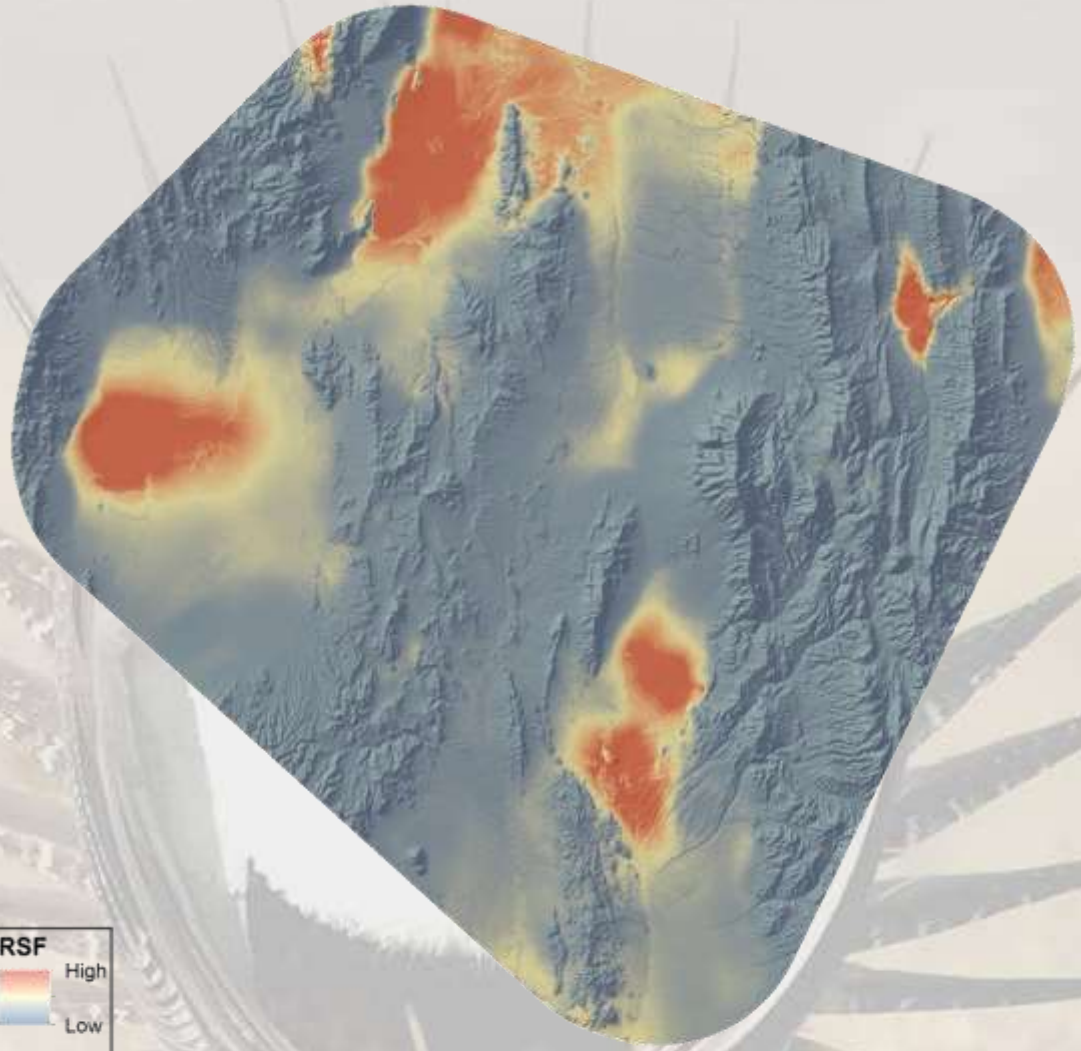
2) Overlay telemetry points and generate random points

3) Extract environmental information from points

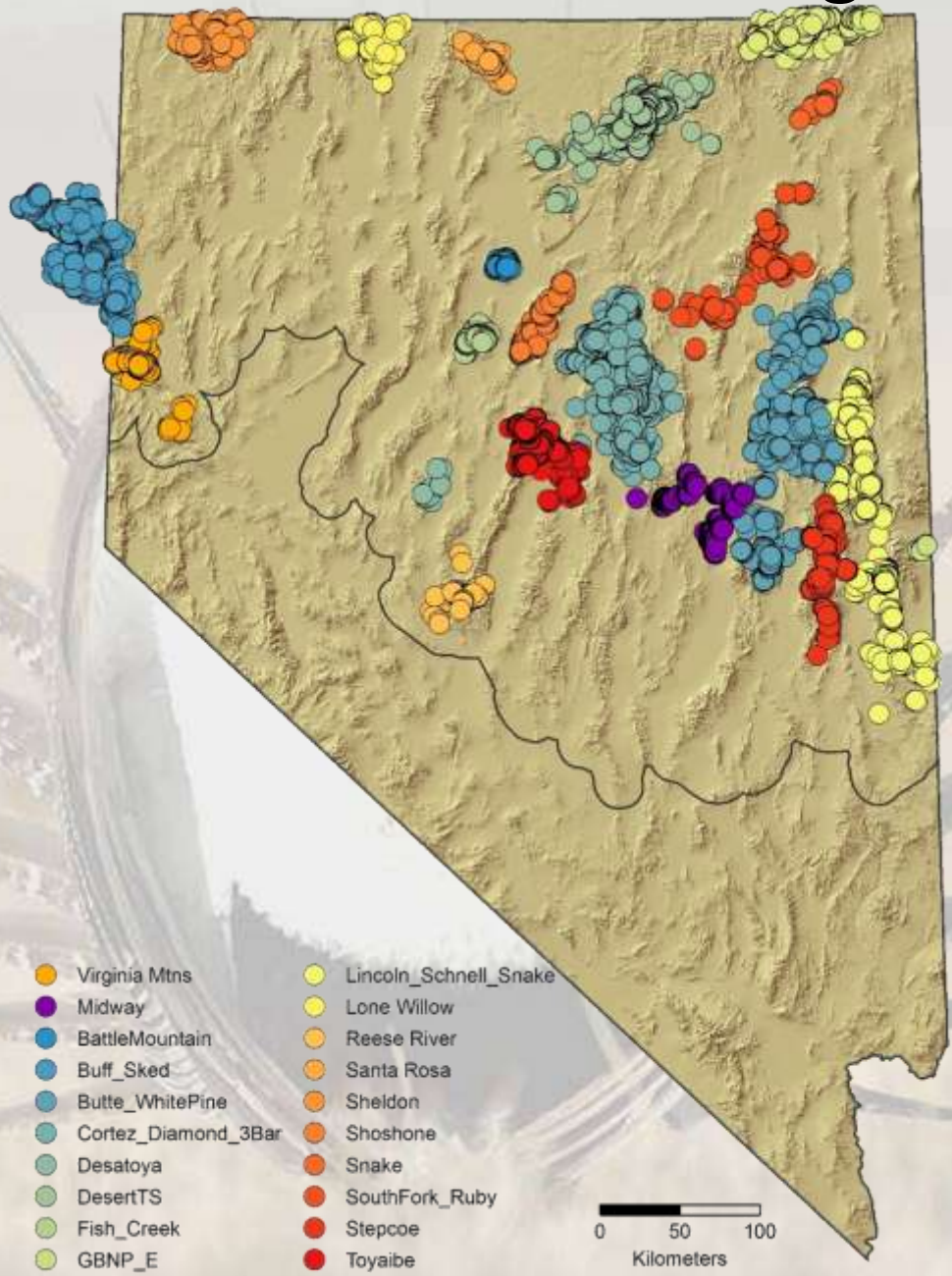
4) Estimate model parameters (coefficients) of each environmental factor by contrasting the used from the random points

5) **Predict the probability of occurrence for each grid cell using the model parameters**

DRAFT – Example Area (Habitat Suitability Index)



Statewide Modeling



Three independent datasets:

- **Model Training**
- **Category Training**
- **Validation**

- **>10 years of telemetry data**
- **> 31,000 telemetry locations**
- **> 1,500 sage grouse**
- ***Grouped by PMU boundaries and distance (30 km)***
- ***Included all of Buffalo-Skedadle PMU to improve power***

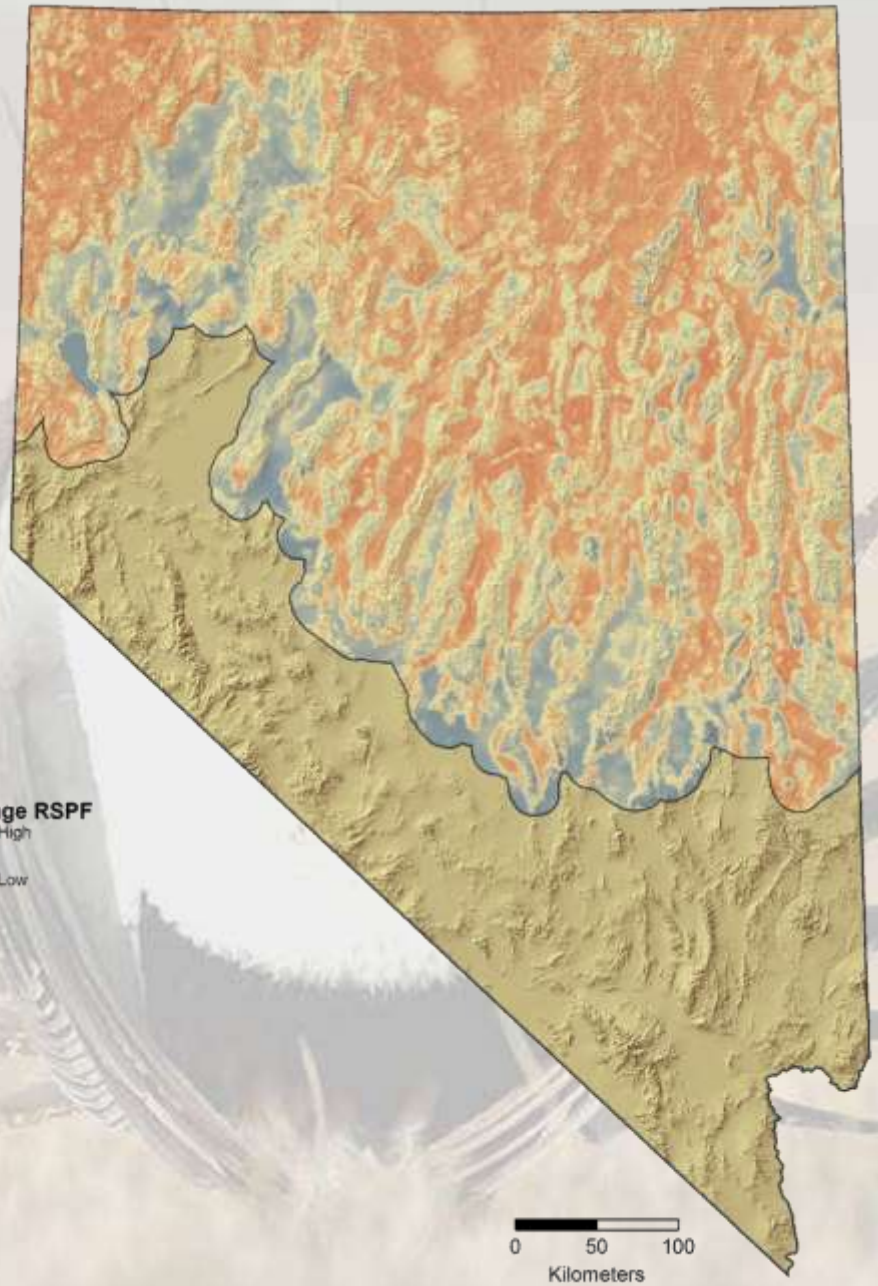
Preliminary Influential Covariates

SITE DEPENDENT

Agriculture	Upland Shrubs
Edge	Riparian Areas
Land Cover Variation	Springs
Lowland Shrubs	Topographic Position Index
Perennial Grass	Open Water

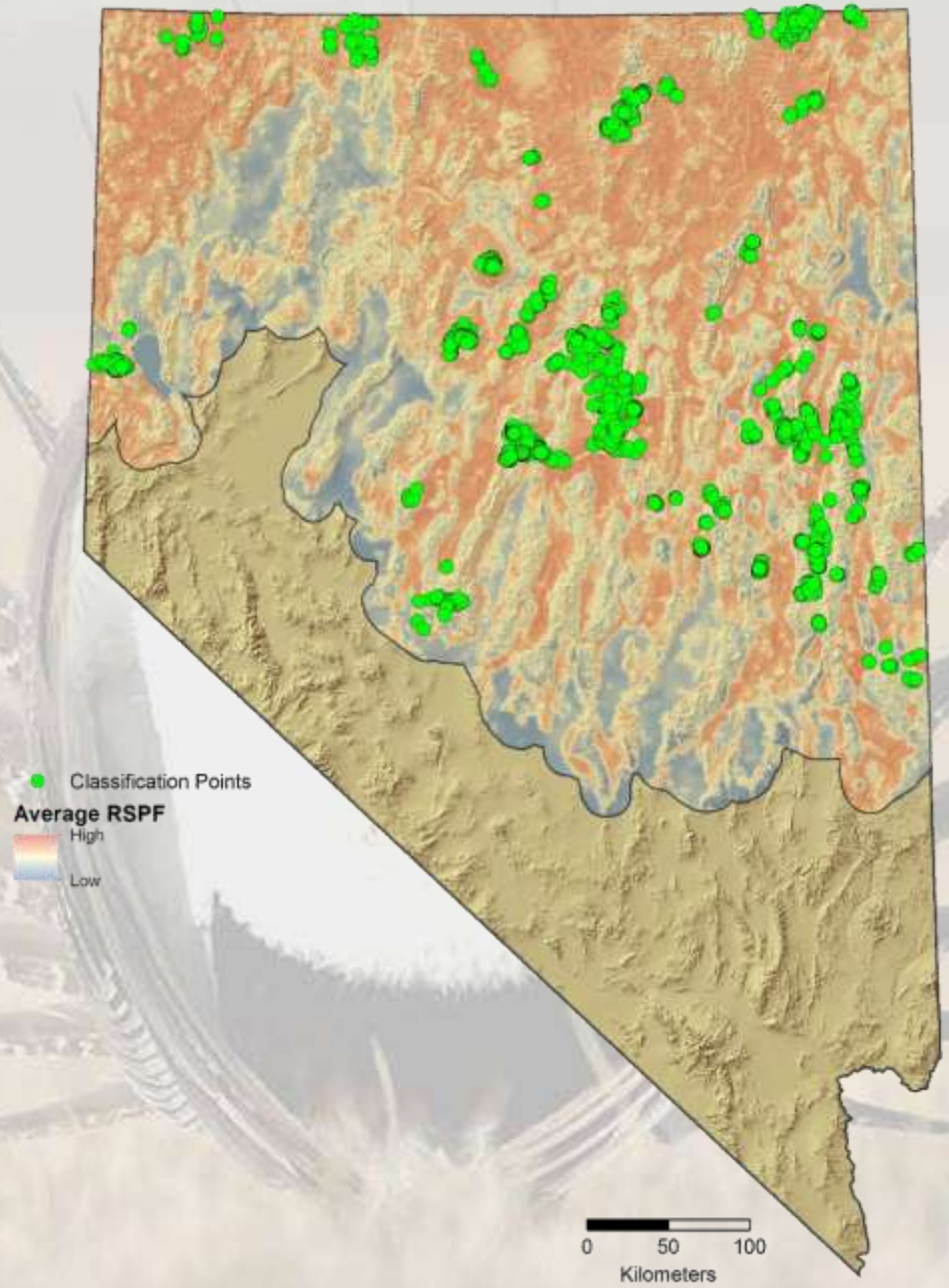
Mostly SELECTED	Mostly AVOIDED
Sagebrush	Annual Grass
Streams	Ruggedness
Higher Elevation	Bare Ground
	Forest
	Pinyon-Juniper

DRAFT - Habitat Suitability Index (HSI)



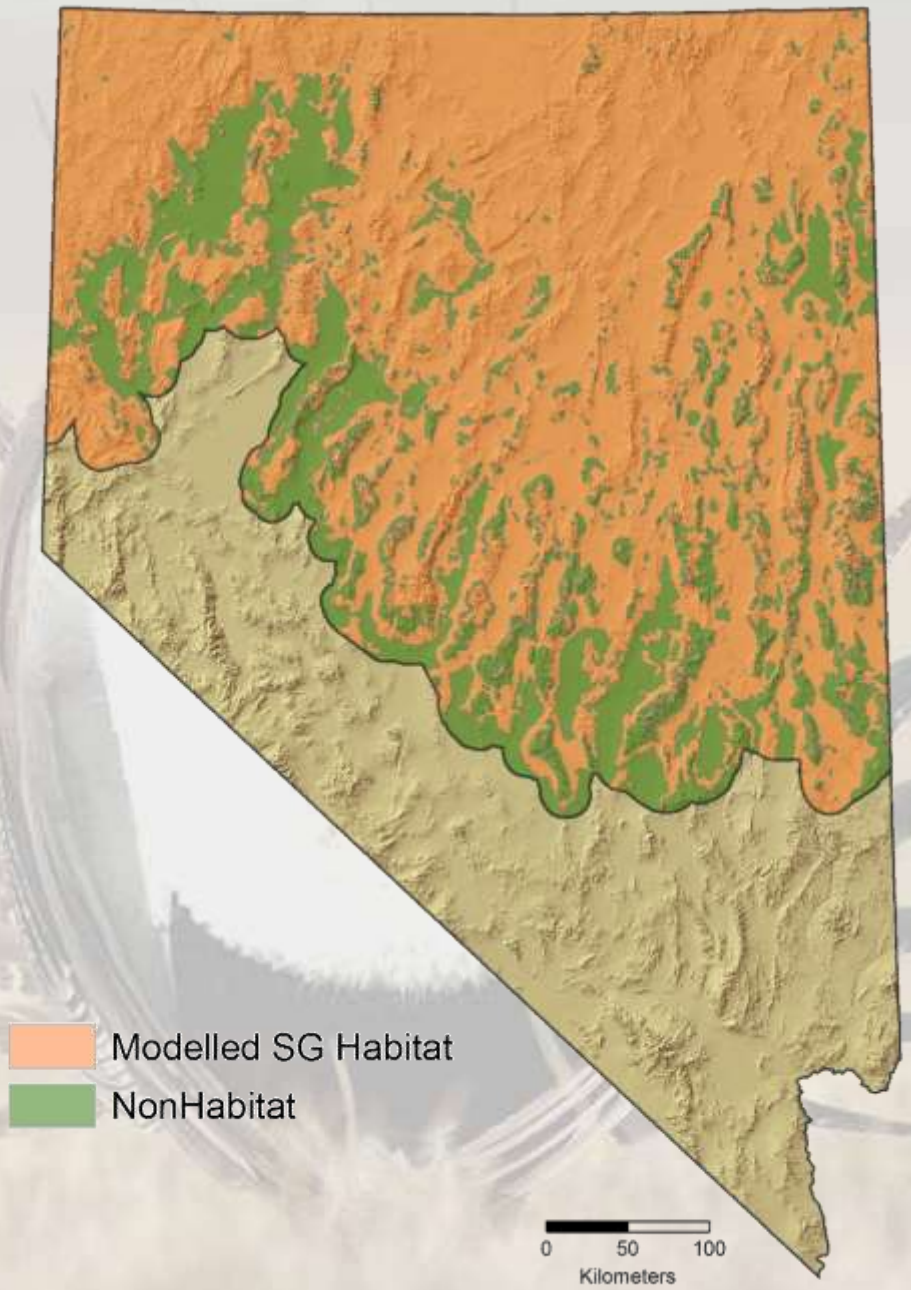
- **Relative probability of occurrence**
- **Continuous Index (0 to 1)**

Classifying ‘Suitable’ Habitats



- **Extract HIS values**
- ***3,552 telemetry points***
- ***Use variance of the RSPF distribution to determine suitability cutoffs***
- ***-Biological and statistical basis for cutoff***

DRAFT – Suitable Habitat



- **Index value:**

  $\bar{x} - 2\sigma$

- **Percentile rank 2.5%**

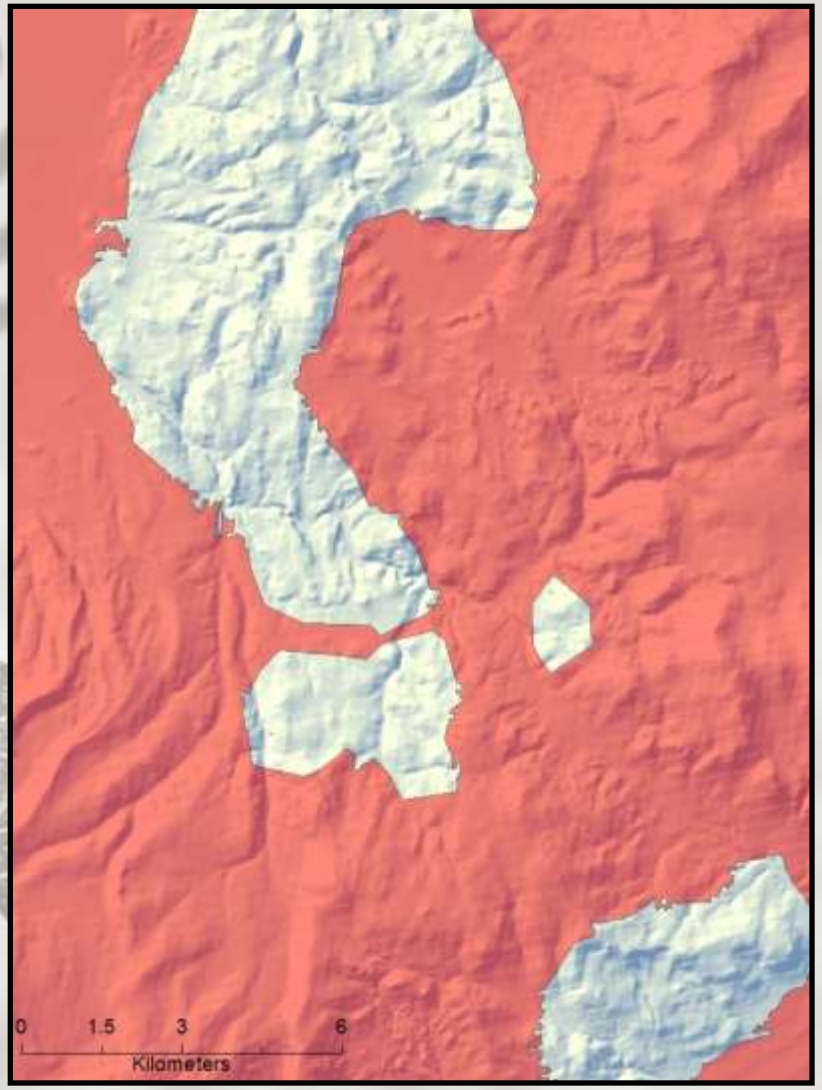
- **Removes ‘outliers’ points**

- **Accounts for movement between seasonal areas**

Accounting for Corridors

Without accounting for patches

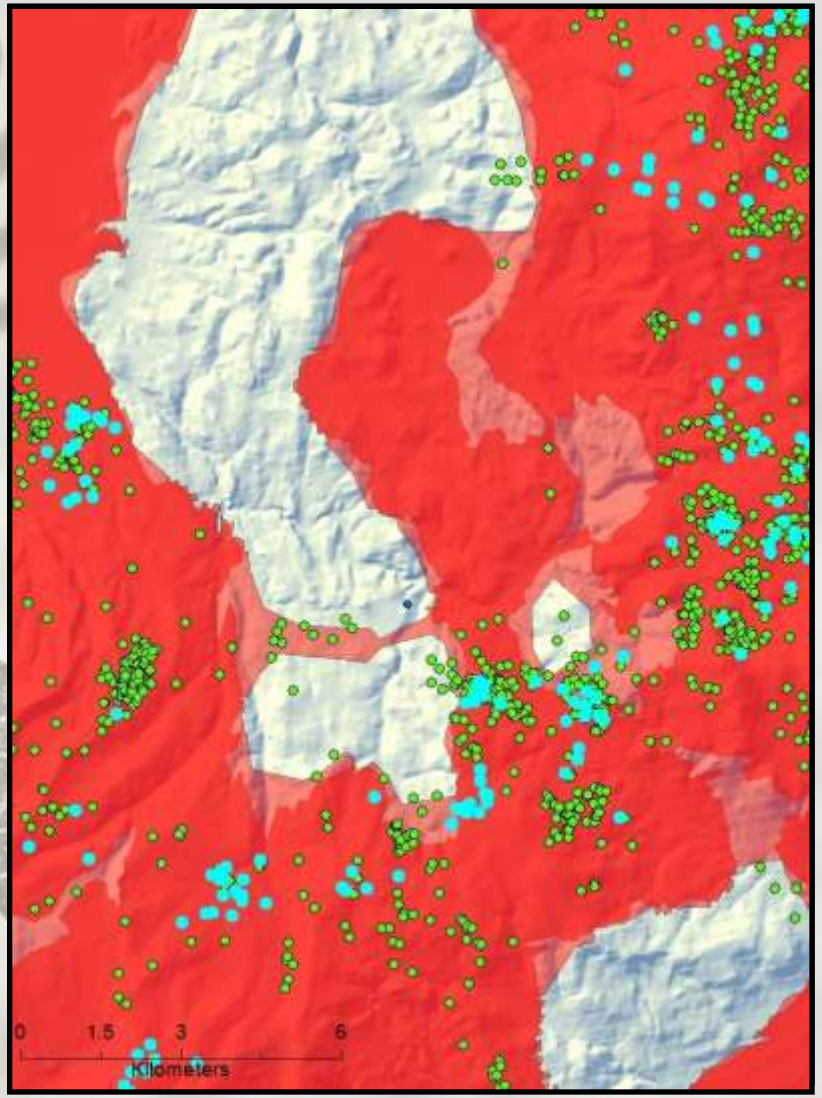
Aggregate and remove small patches



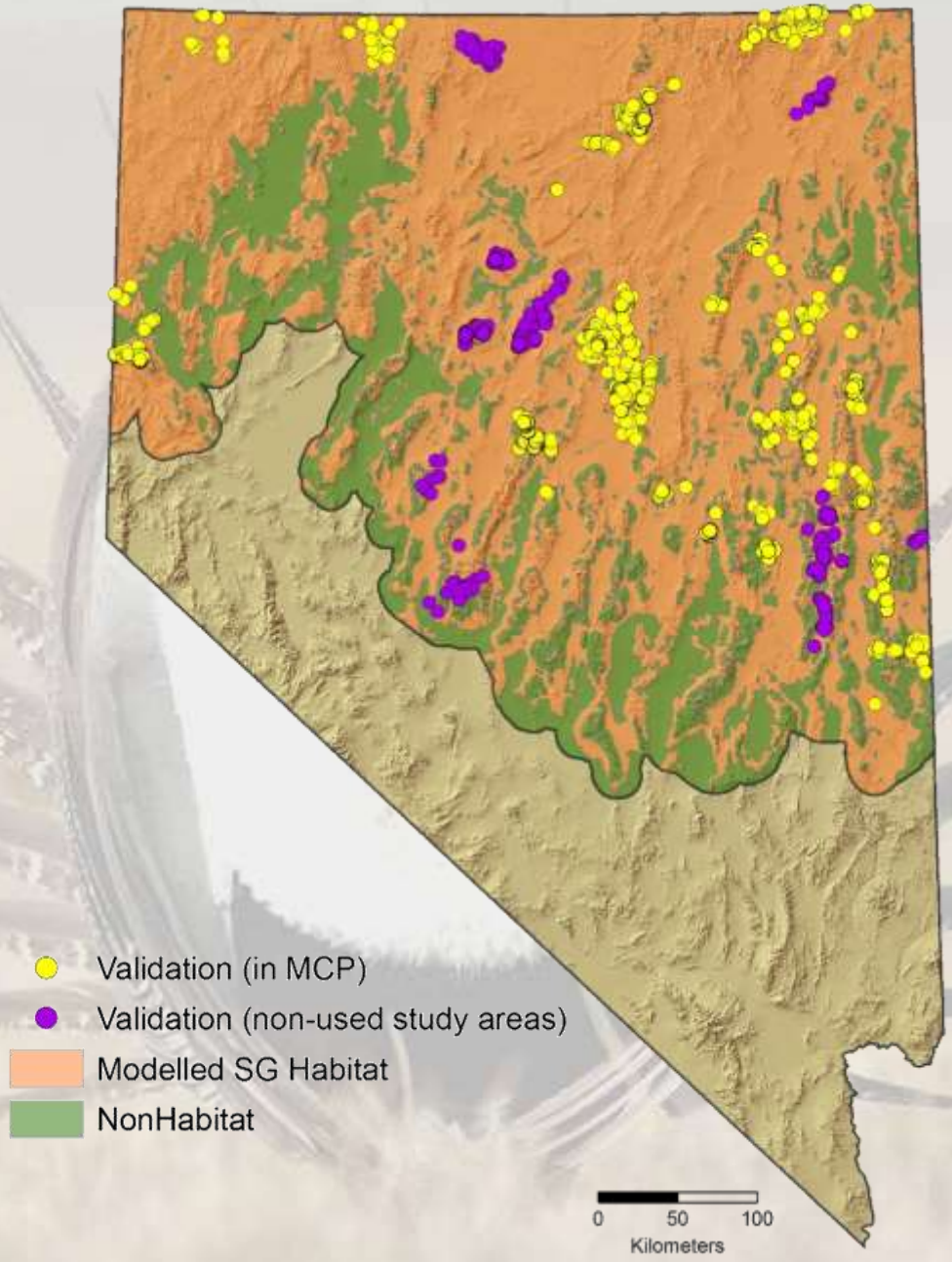
Accounting for Corridors

Without accounting for patches

Aggregate and remove small patches



DRAFT Model Validation



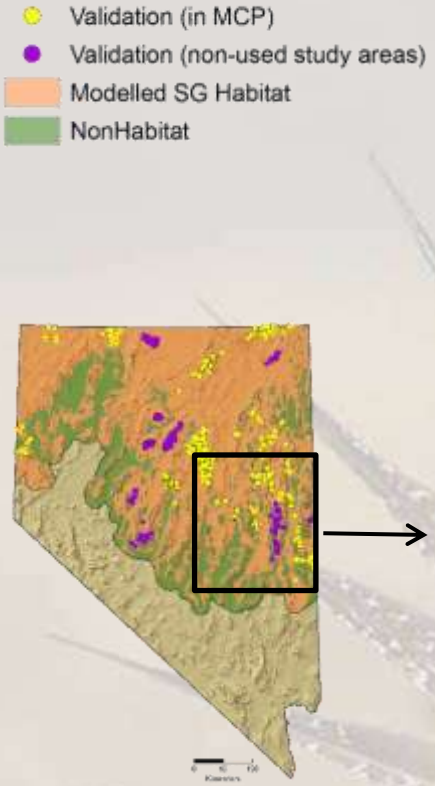
- **Two Independent Telemetry Data Sets**

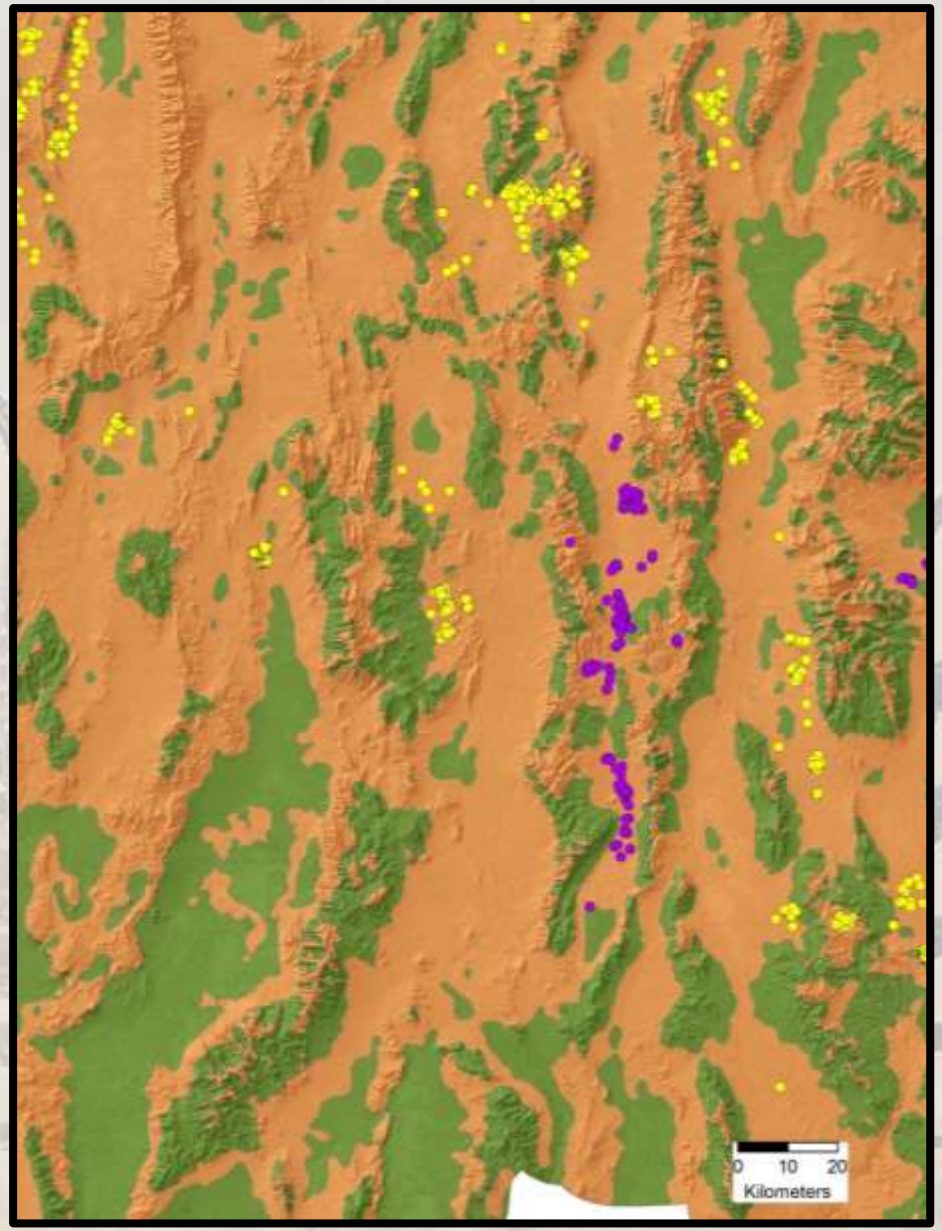
  97.1 – 99.7% agreement

- **Lek data as validation**

  100% agreement

DRAFT Model Validation

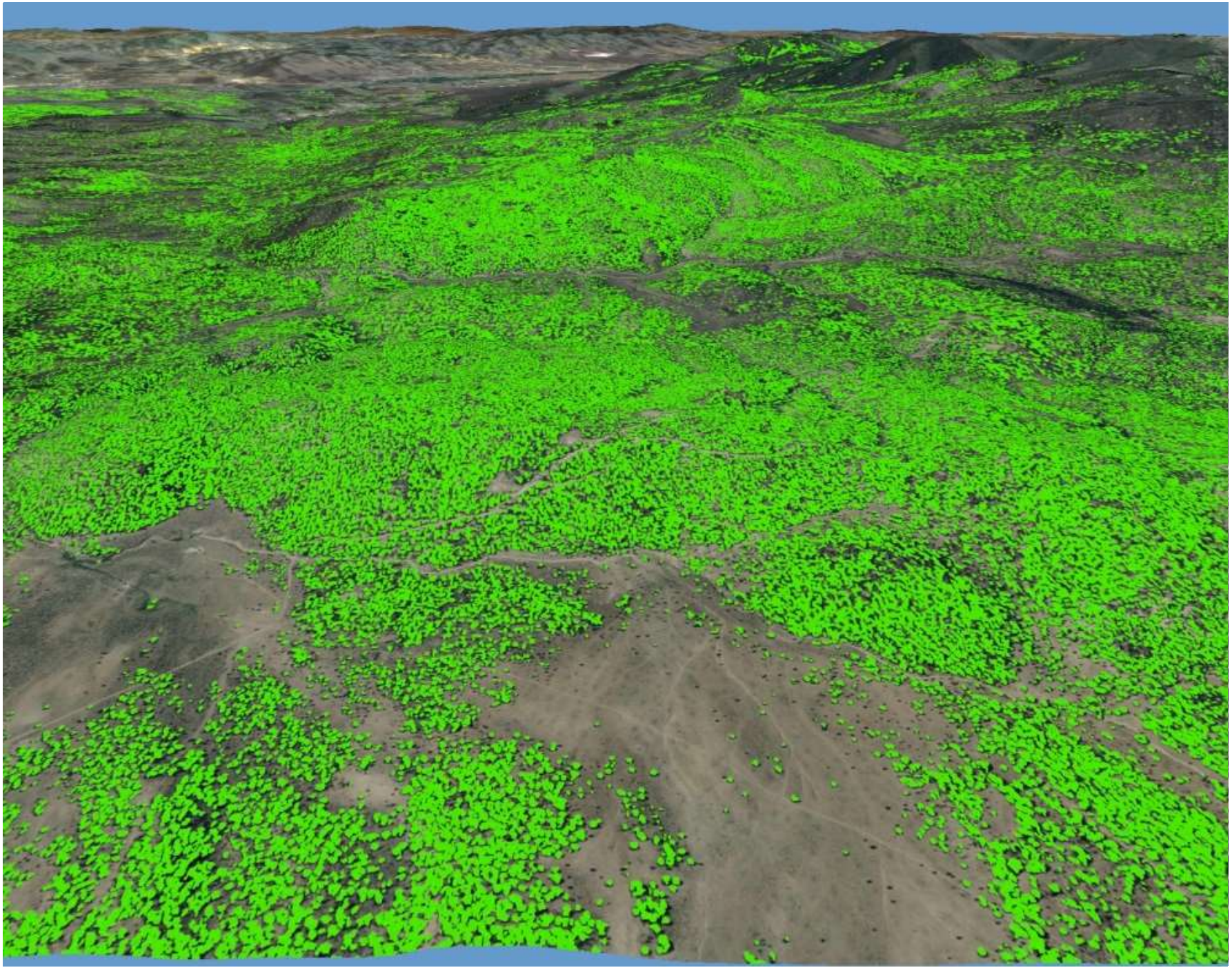




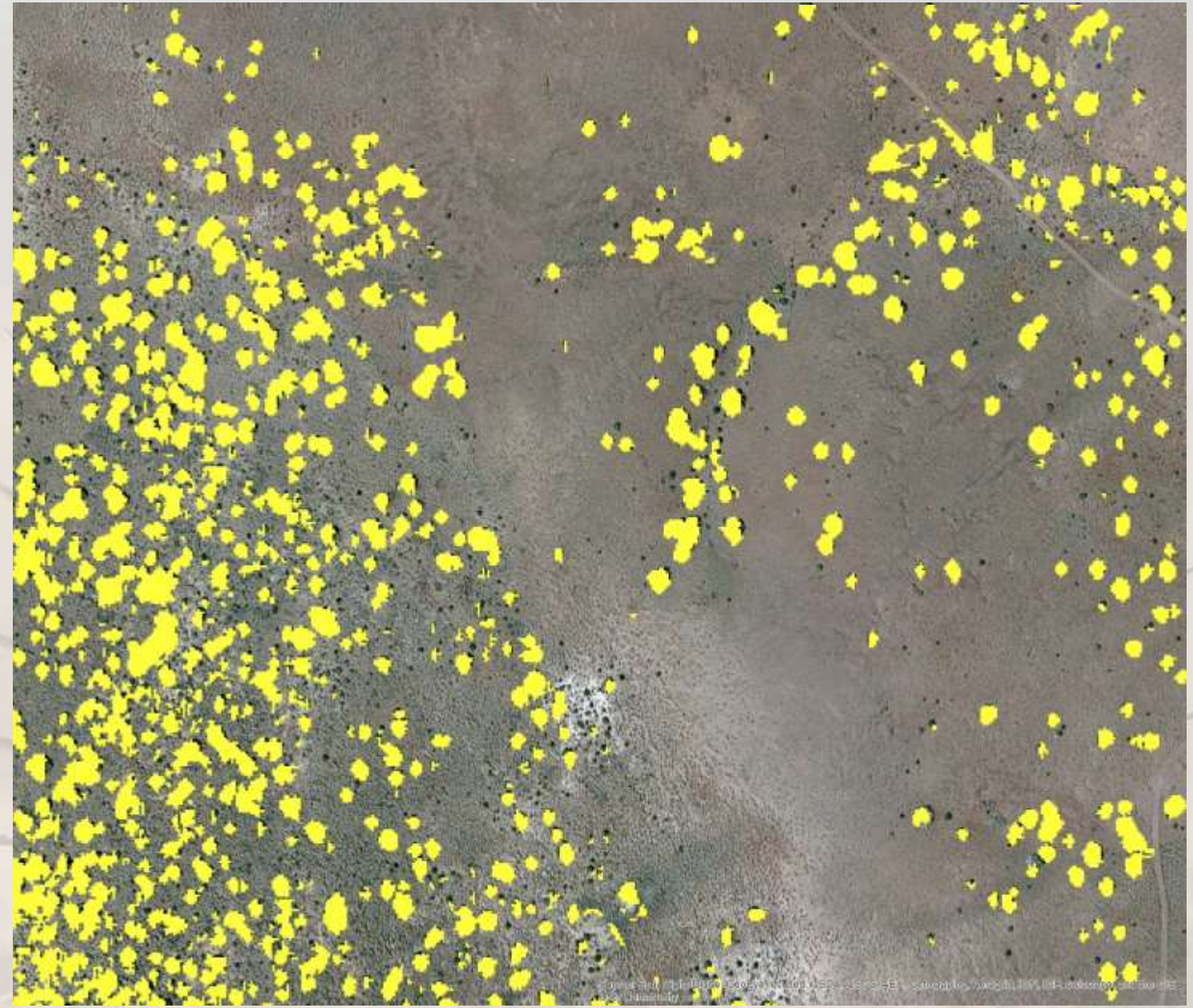
- **Two Validation Sets**
- ***97.1 – 99.7% agreement***

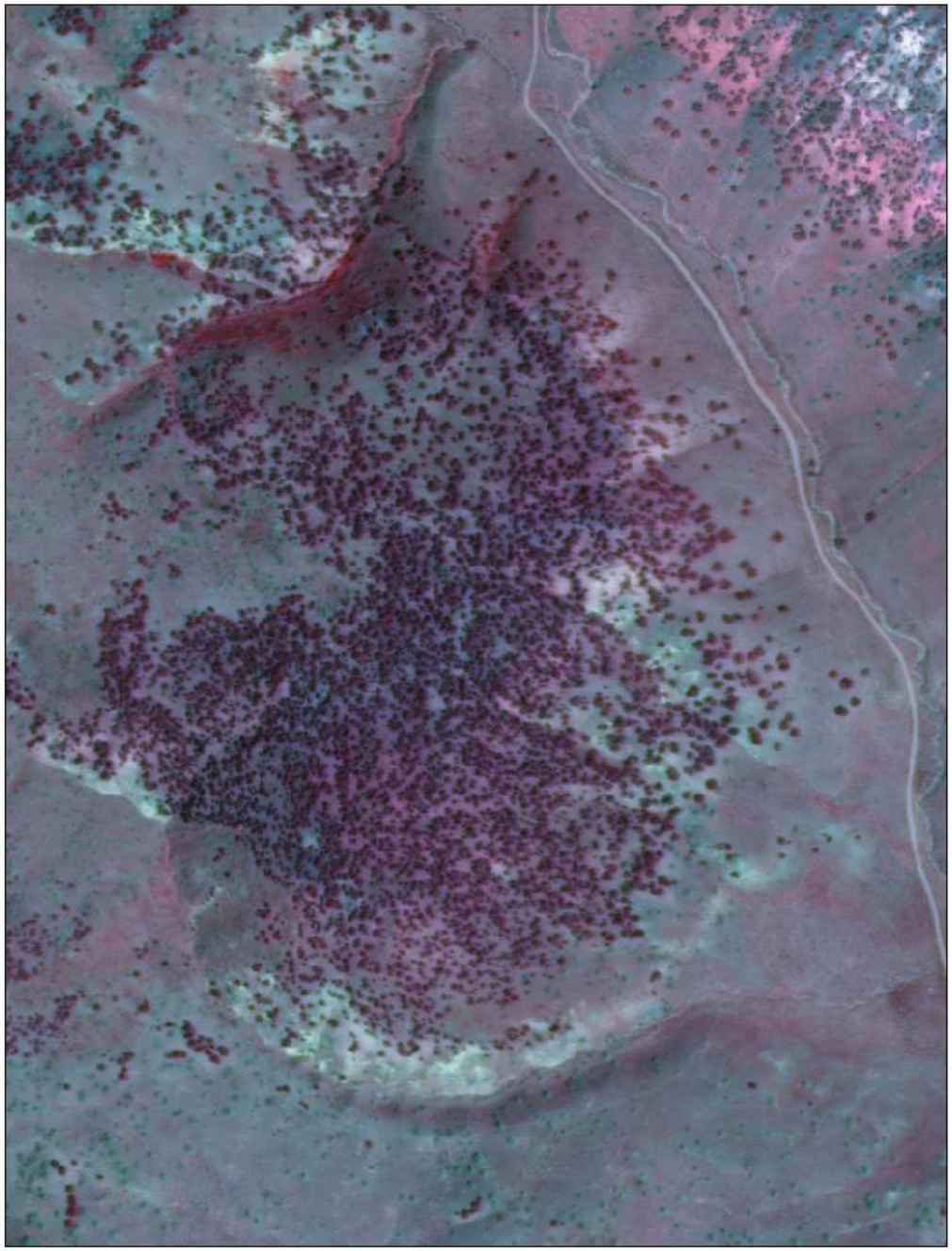
Next Steps

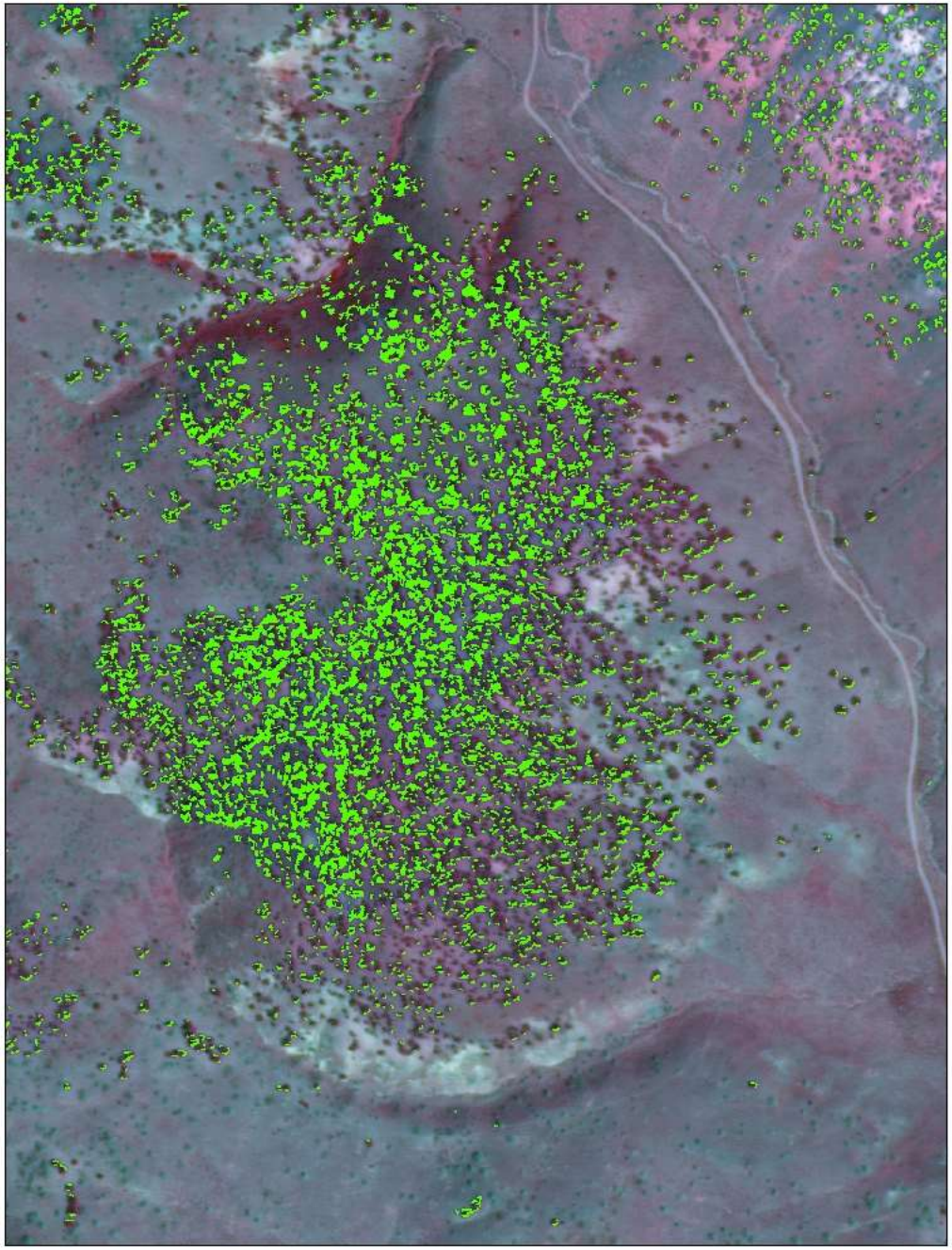
- Incorporate roads and powerlines as distance functions
- Include urbanization indices
- Incorporate effects of fire
  - Adjust land cover types to reflect changes from recent fires
  - Field verification
- Finalize Expert Review Team and meet in early-mid February
  (NDOW, BLM, USFS, USFWS, UNR, and others)
- Incorporate finer resolution conifer mapping



Landsat-derived classification (30-m) GREEN; Feature Analyst (1-m) Yellow







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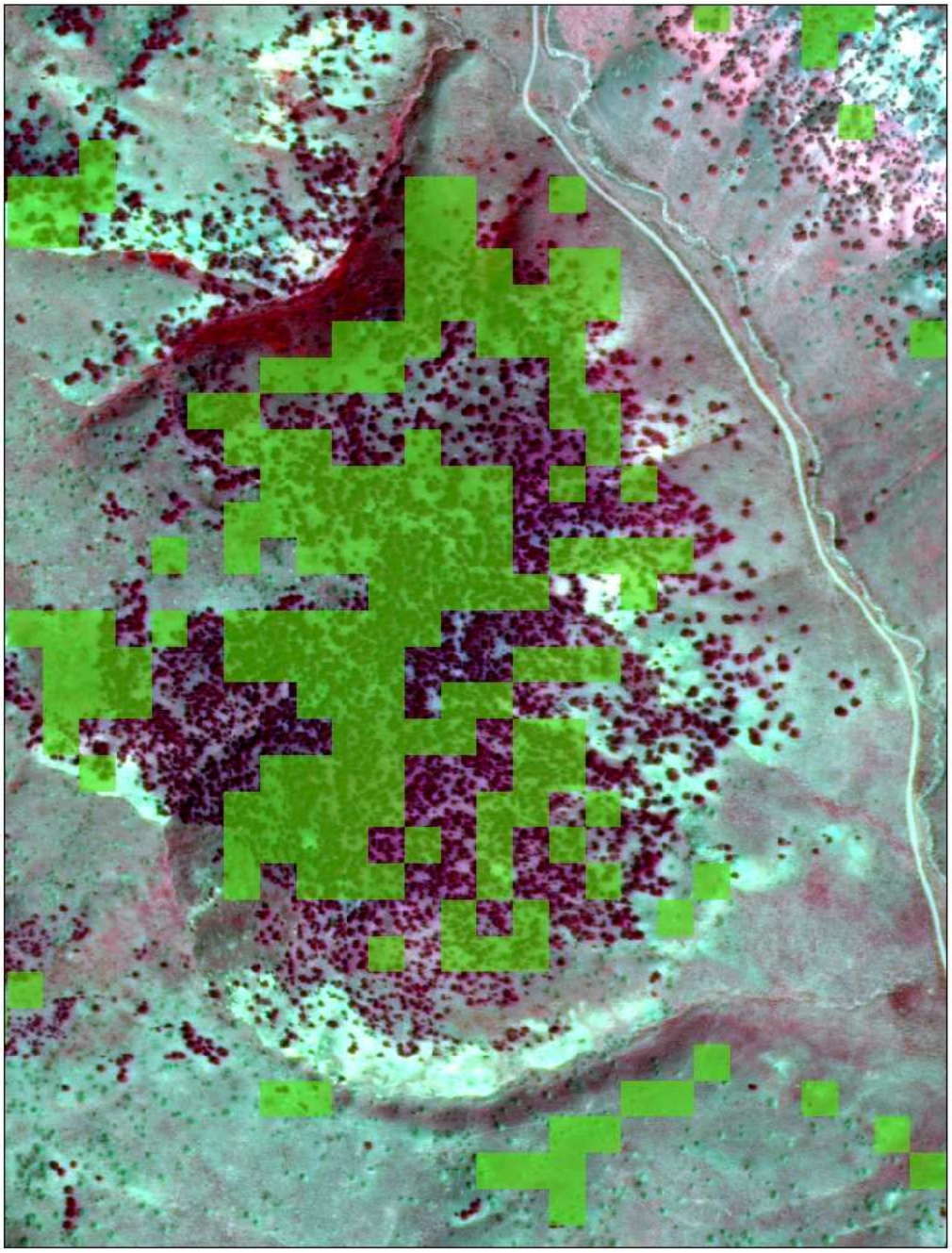
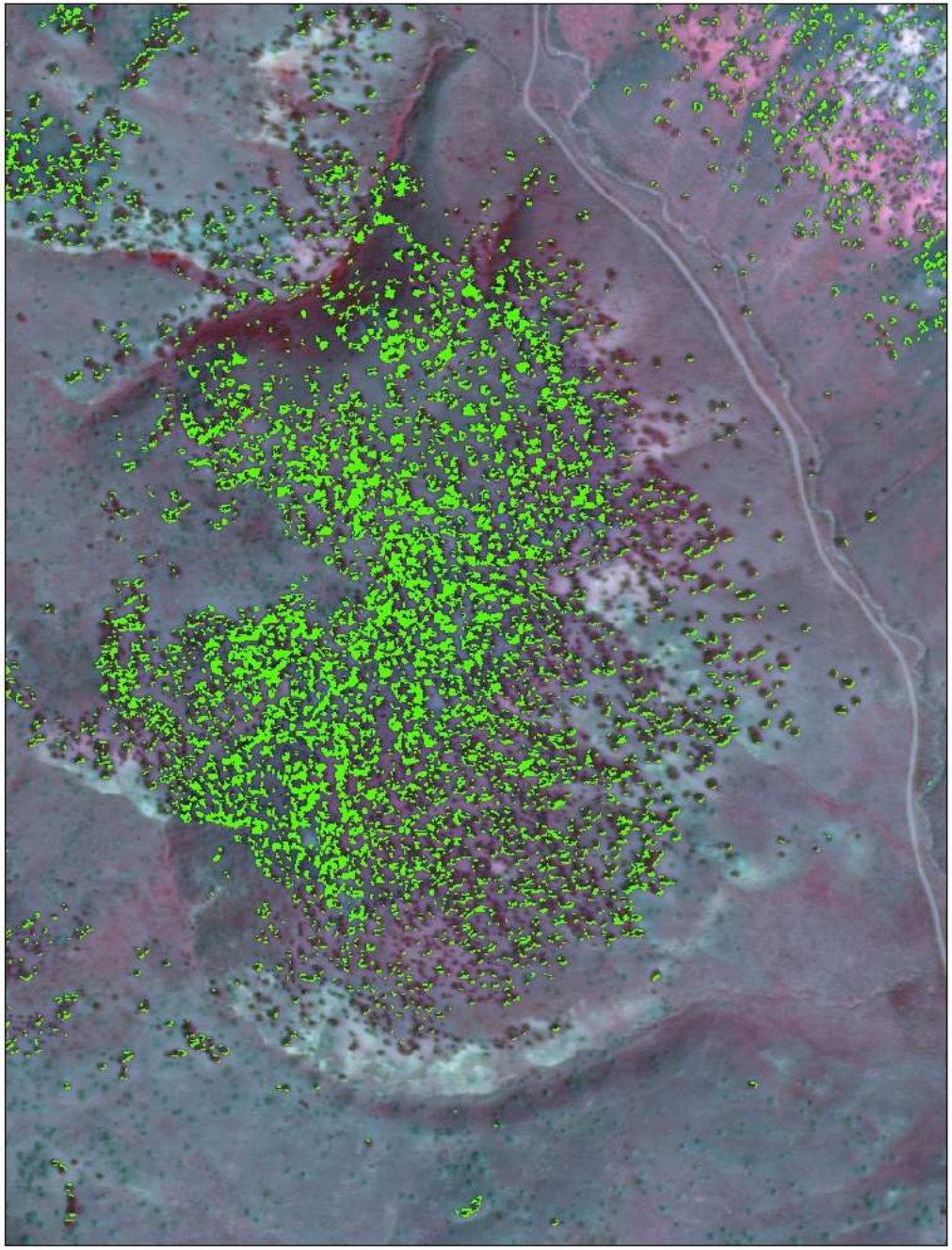
Phase Classification

Phase I
<10%

Phase II
10% - <25%

Phase III
25% +





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Phase Classification

Phase I
<10%

Phase II
10% - <25%

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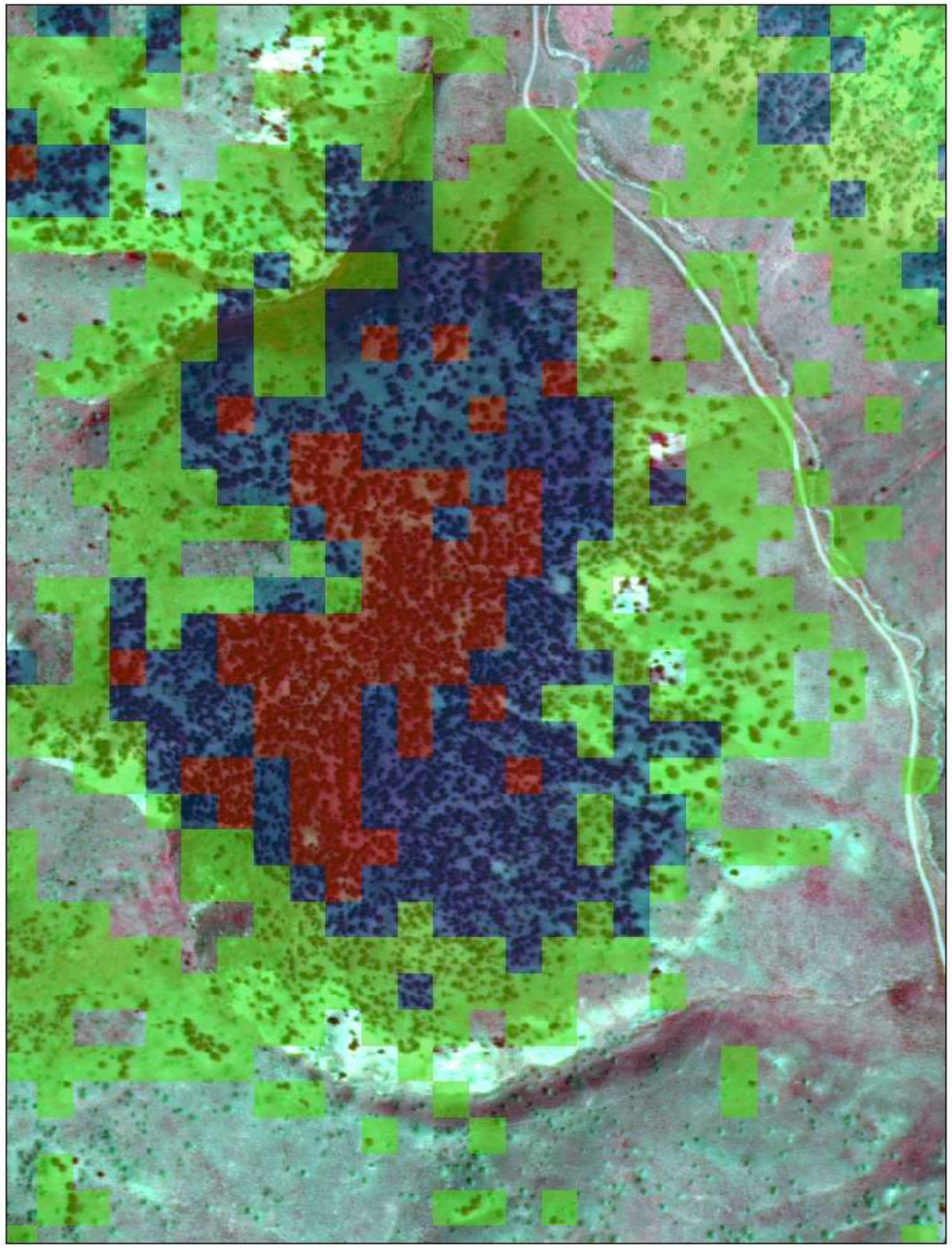
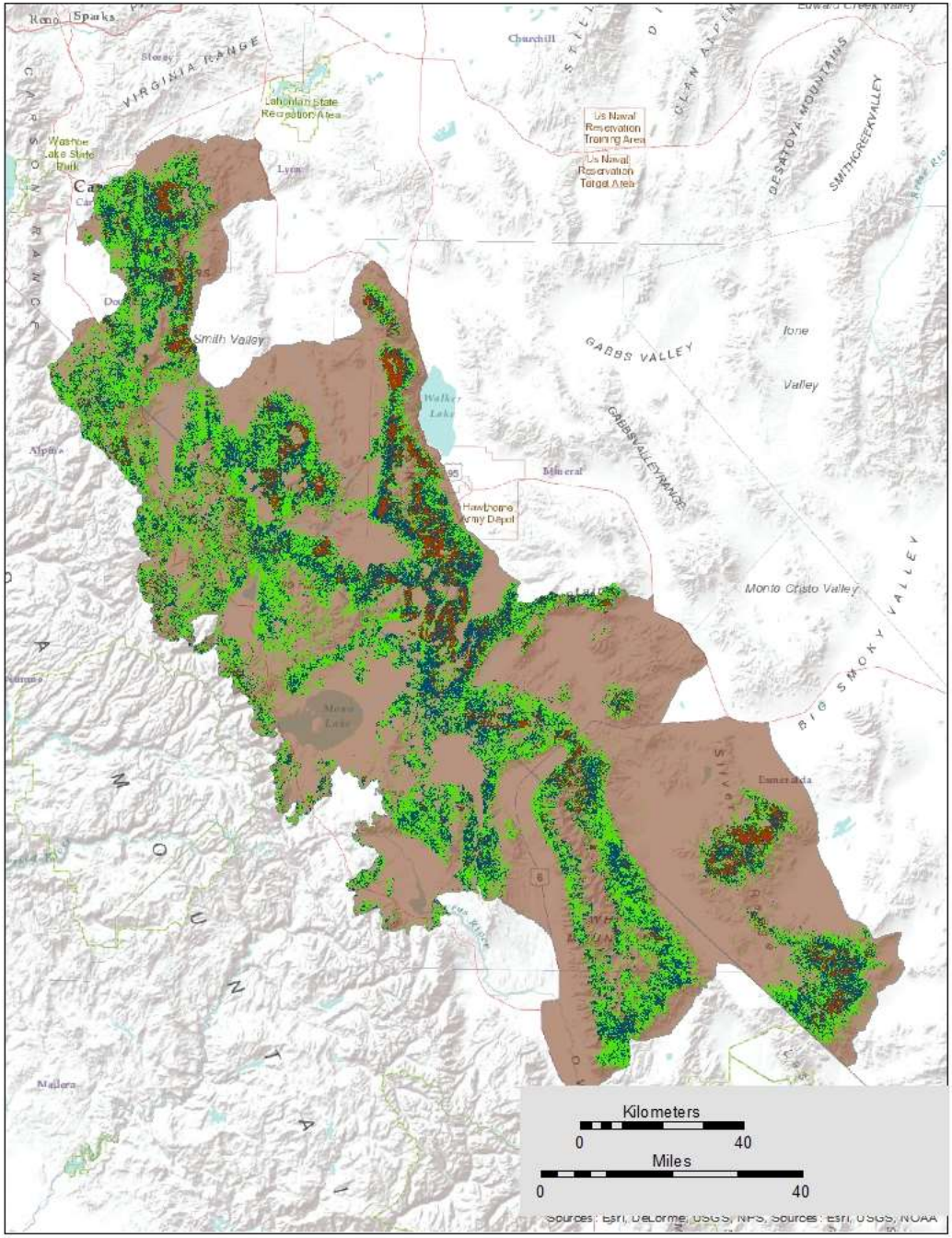
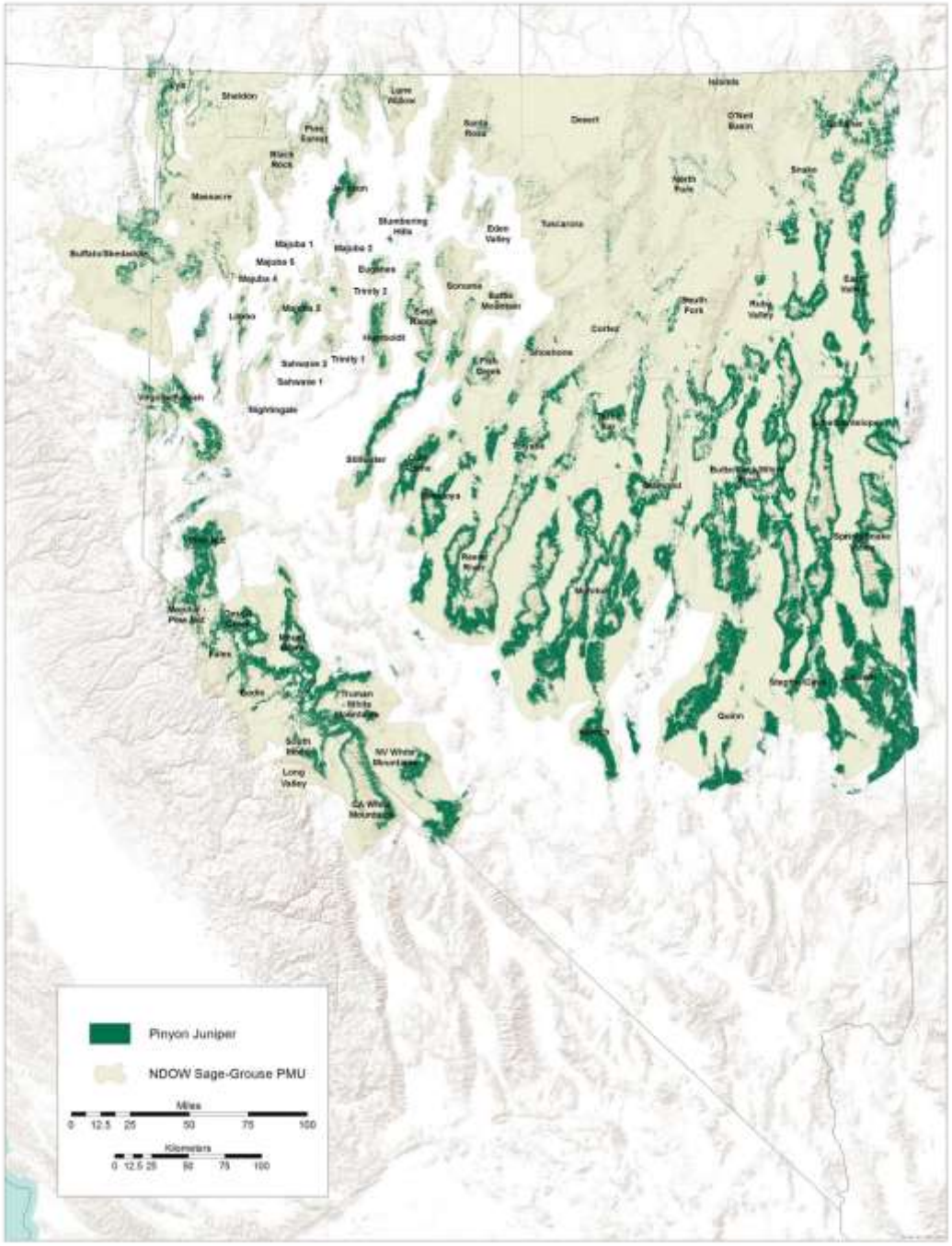
25% +




Reno
Sparks
Churchill
Edwards Creek Valley
VIRGINIA RANGE
Lahontan State Recreation Area
Washoe Lake State Park
Lyon
Us Naval Reservation Training Area
Us Naval Reservation Target Area
CLAN ALPIN
DESATOYA MOUNTAINS
SMITHCREEKVALLEY
Smith Valley
GABBS VALLEY
Walker Lake
Mineral
Hawthorne Army Depot
CABBSVALLEYRANGE
Monte Cristo Valley
BIG SMOKY VALLEY
Esmeralda
Kilometers
0
40
Miles
0
40
Sources: Esri, DeLorme, USGS, NPS, Sources: Esri, USGS, NOAA


Pinyon Juniper
NDOW Sage-Grouse PMU
Miles
0 12.5 25 50 75 100
Kilometers
0 12.5 25 50 75 100

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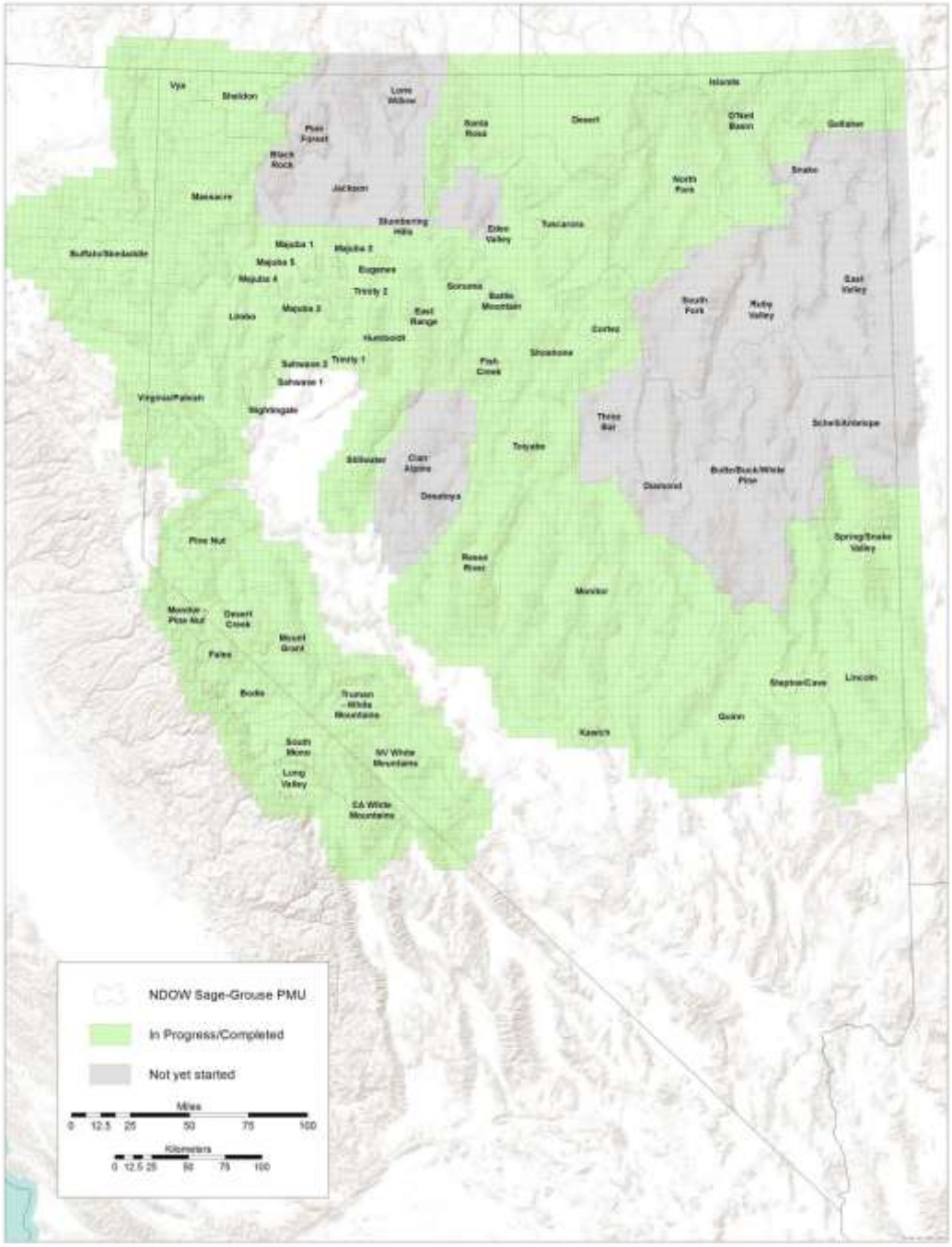
>7,000 tiles state-wide

1,800 tiles completed

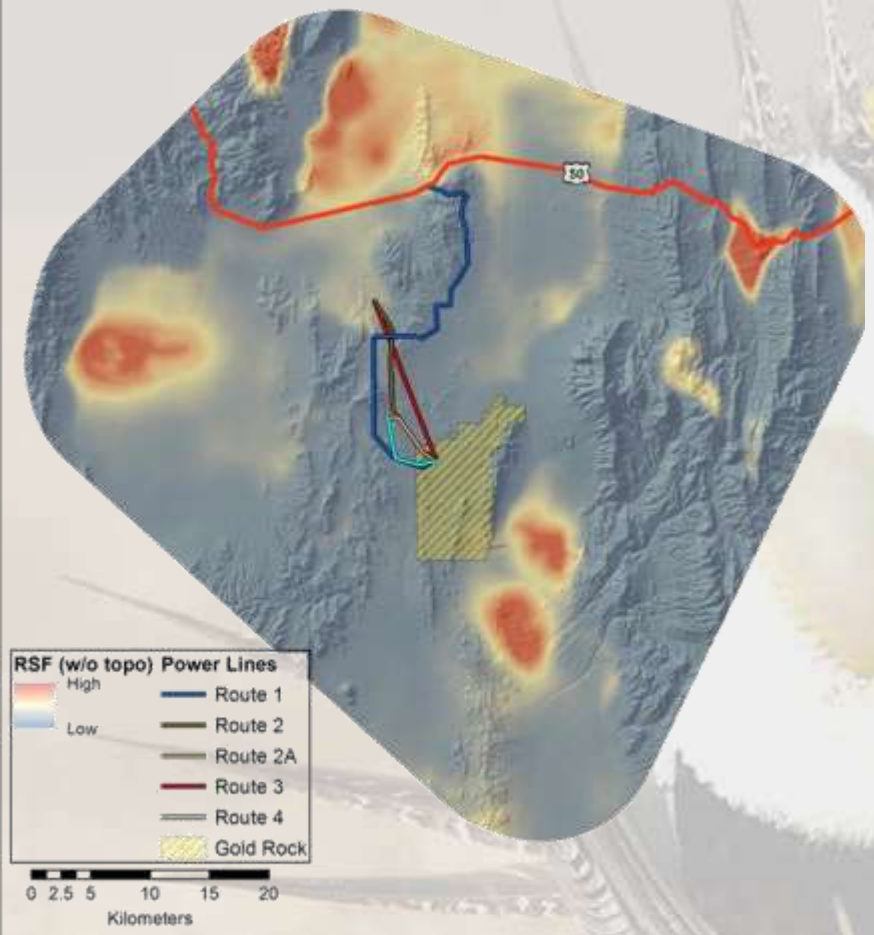


MORE THAN JUST A MAP

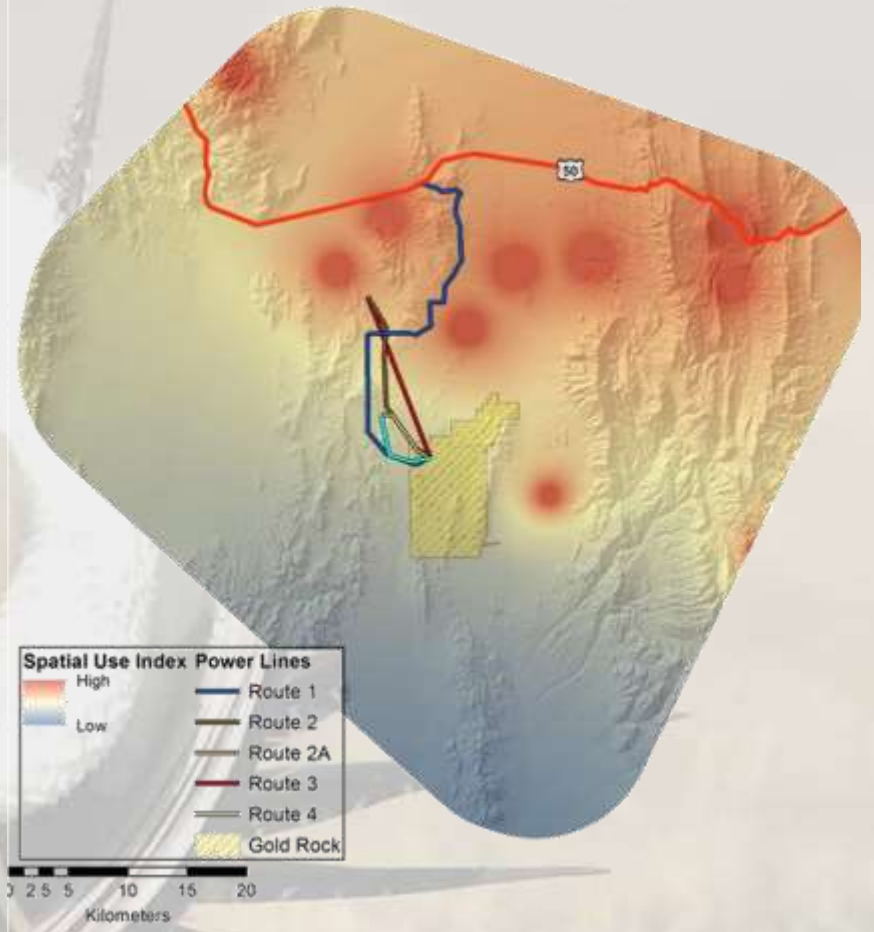
Decision Support Tool for Population Management

Transmission Line Placement Example

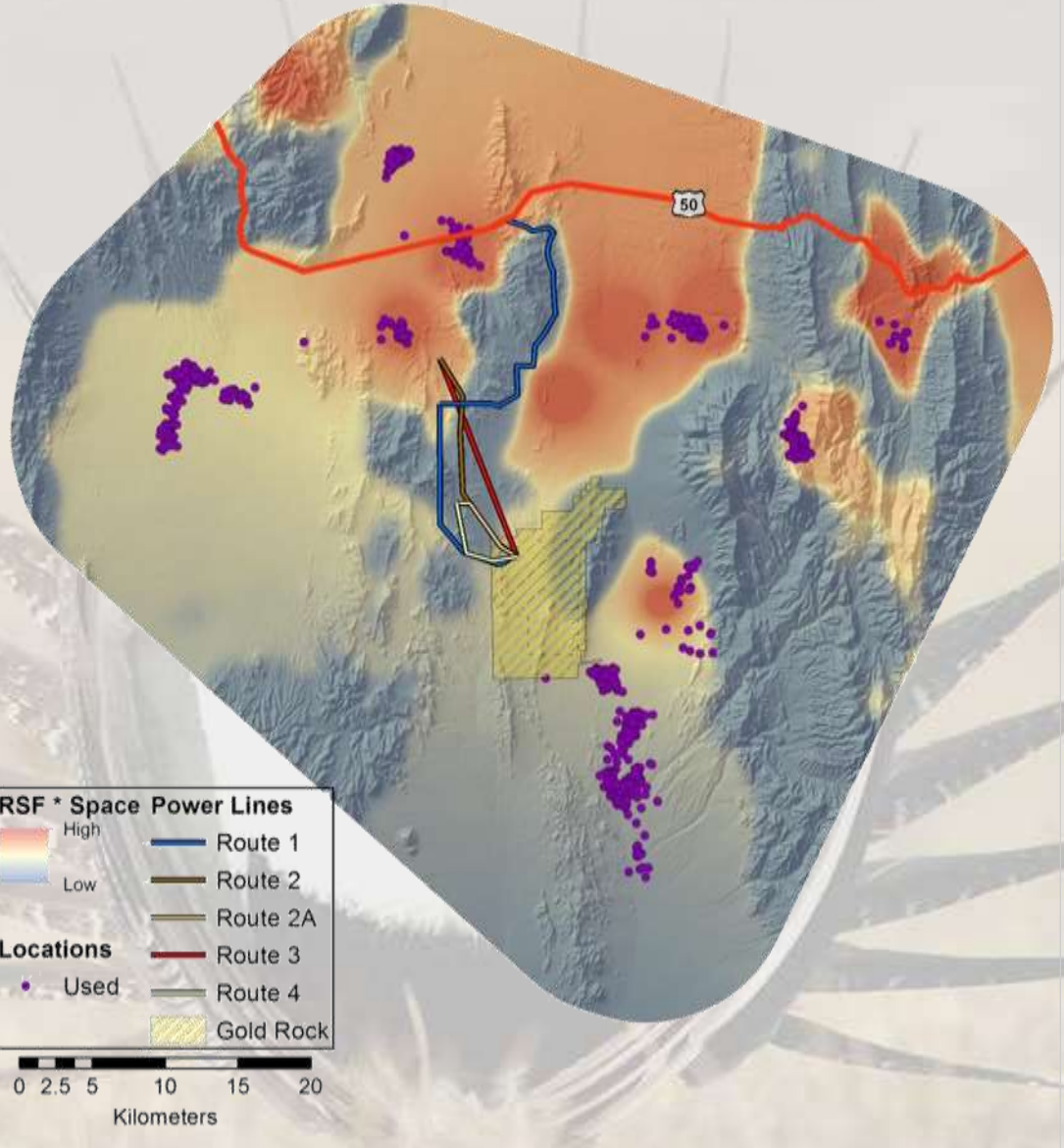
Habitat Suitability



Space Use



Probability of Occurrence Index



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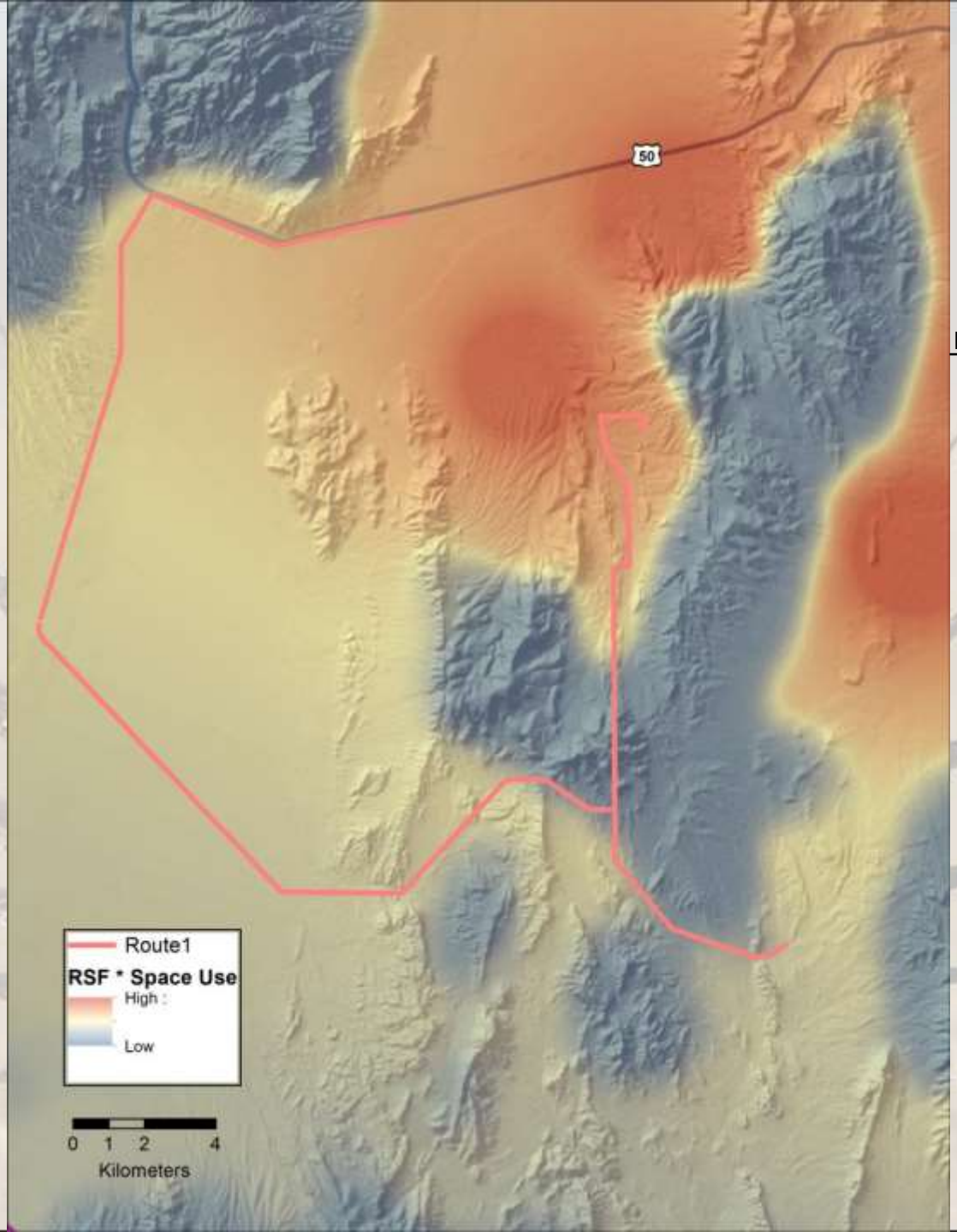
Alternative Route 1



	Grouse Impact	
Route	MEAN	SUM
1	0.27	677.1

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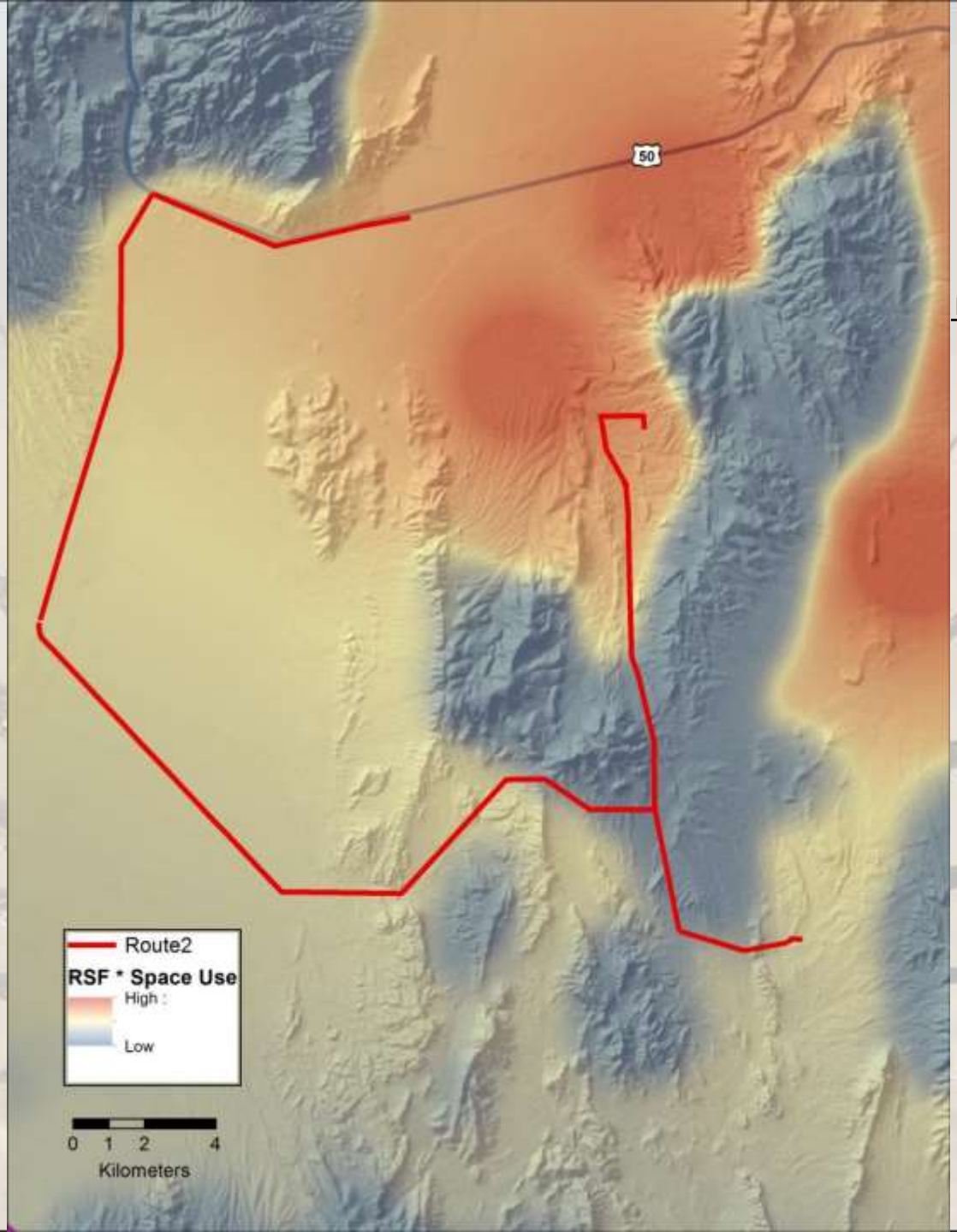
Alternative Route 2



Route	MEAN	SUM
1	0.27	677.1
2	**0.25**	**647.3**

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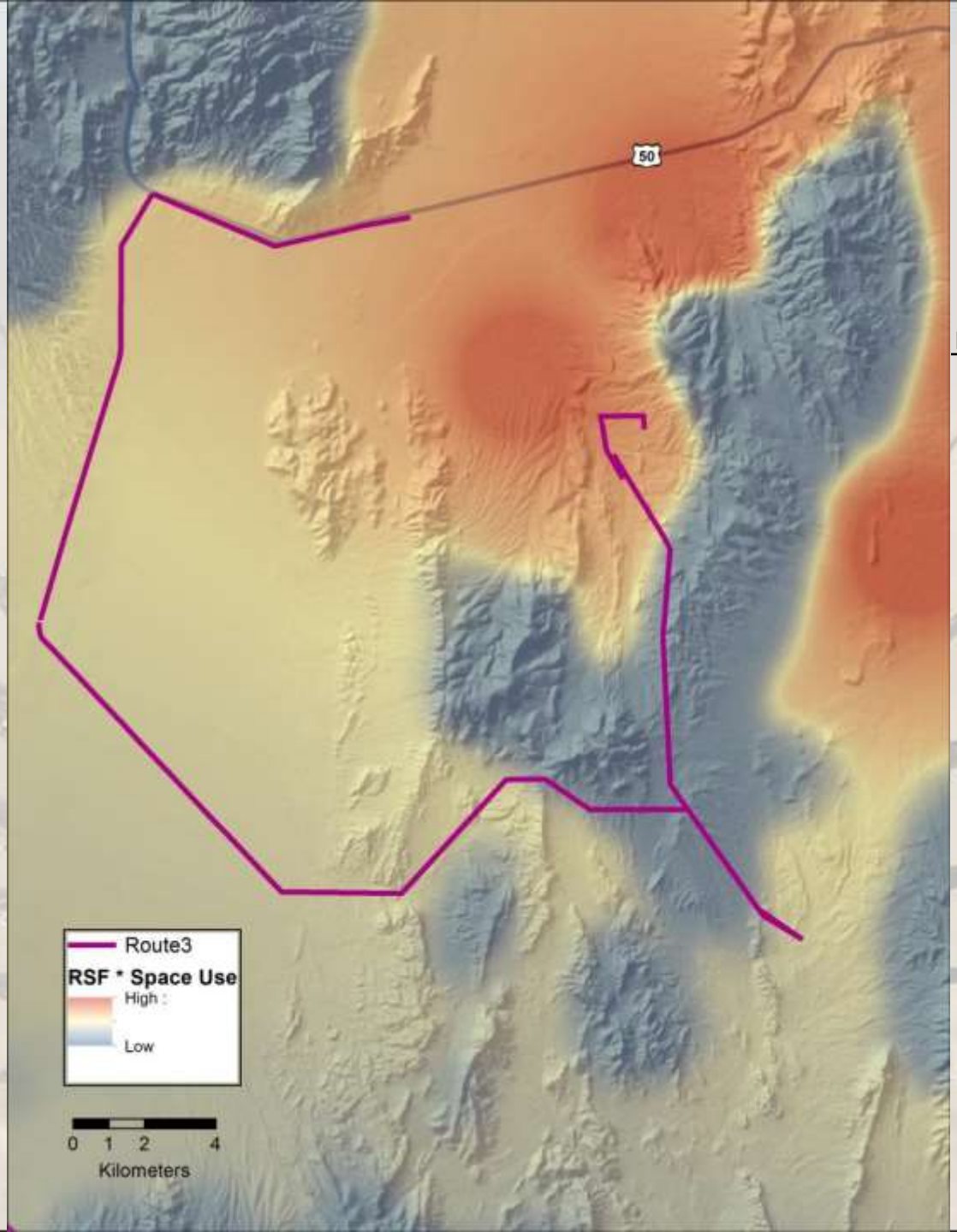
Alternative Route 3



	Grouse Impact	
Route	MEAN	SUM
1	0.27	677.1
2	0.25	647.3
3	**0.24**	**647.5**

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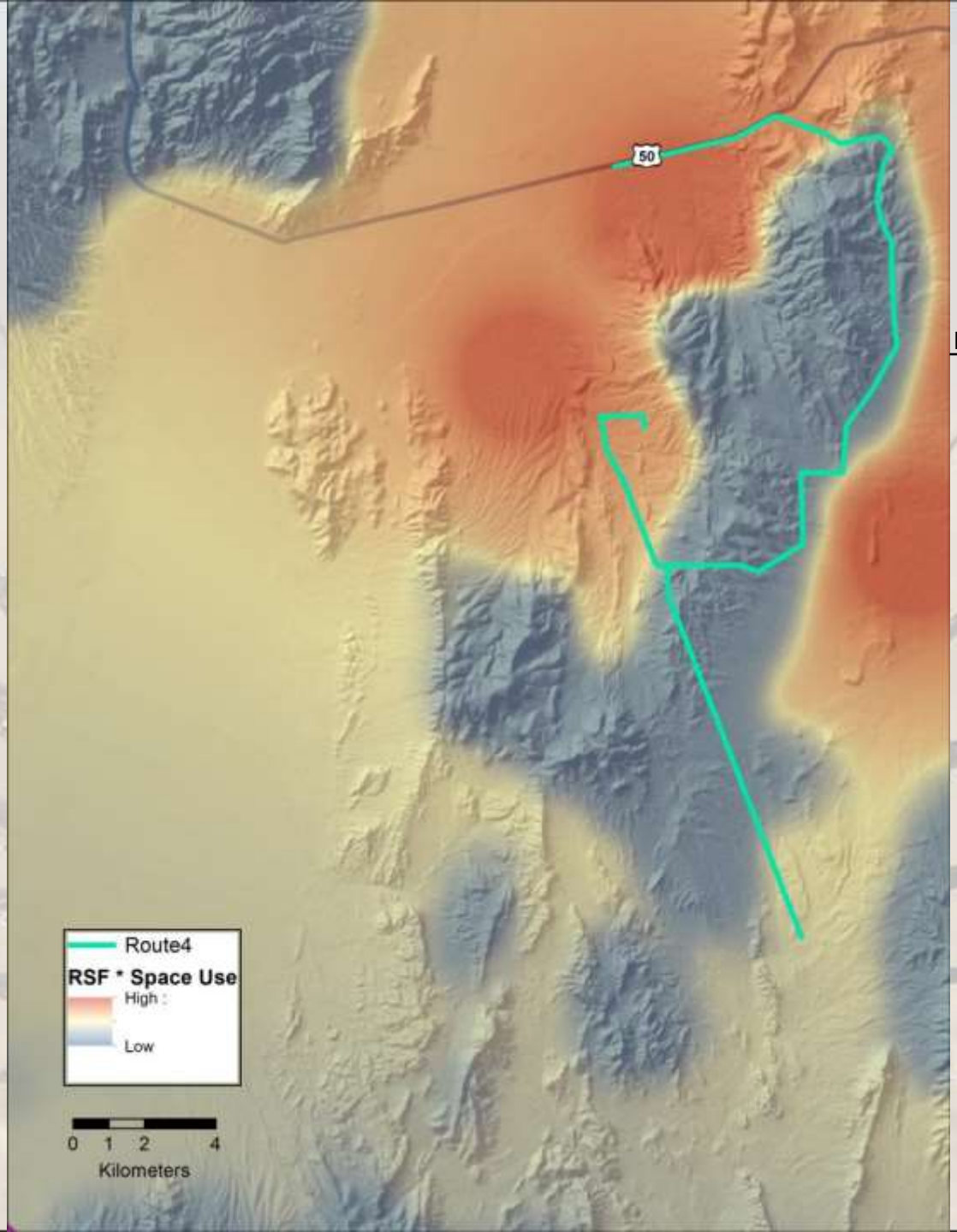
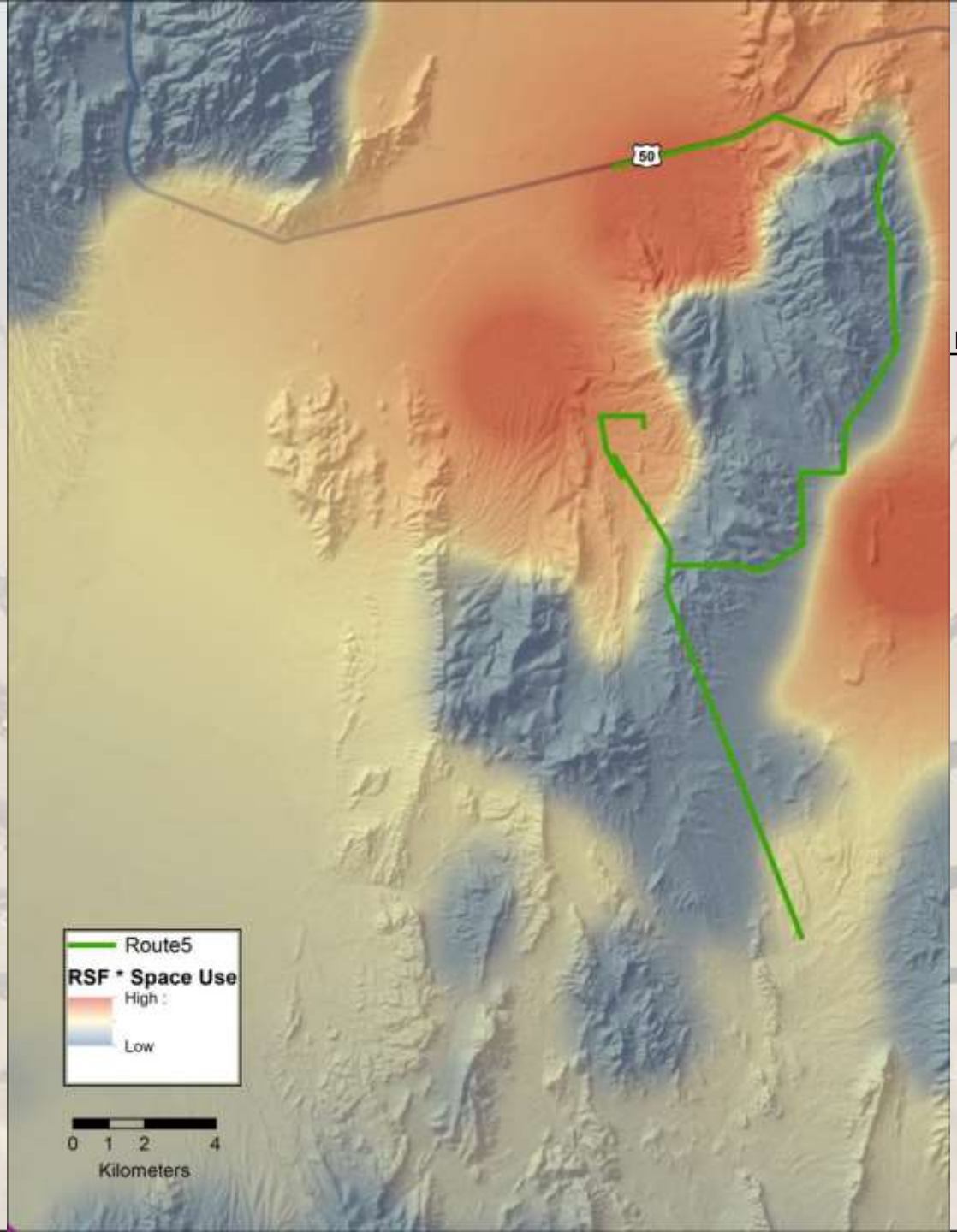
Alternative Route 4



	Grouse Impact	
Route	MEAN	SUM
1	0.27	677.1
2	0.25	647.3
3	0.24	647.5
4	**0.19**	**337.6**

Alternative Route 5



	Grouse Impact	
Route	MEAN	SUM
1	0.27	677.1
2	0.25	647.3
3	0.24	647.5
4	0.19	337.6
5	**0.20**	**348.1**

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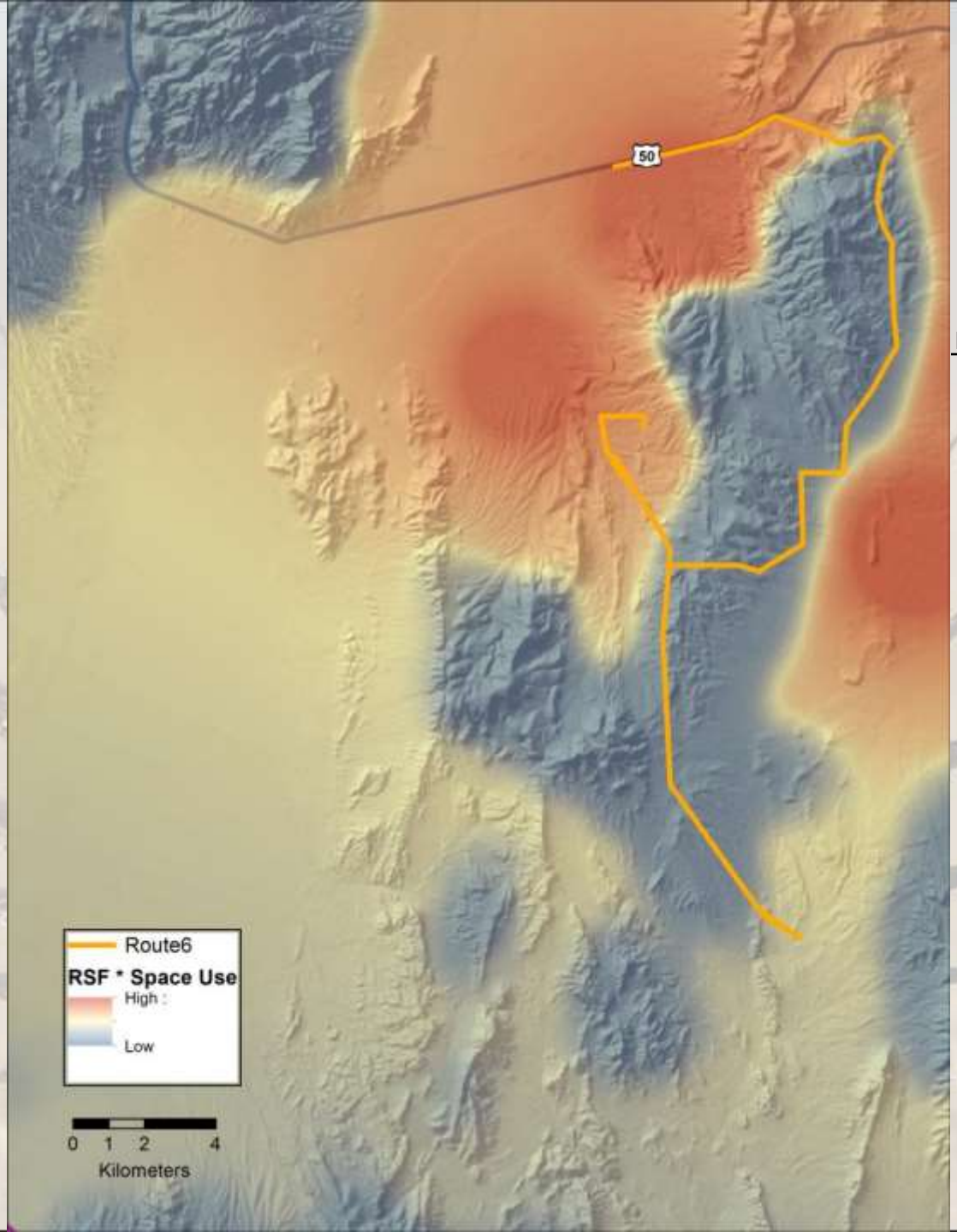
Alternative Route 6



	Grouse Impact	
Route	MEAN	SUM
1	0.27	677.1
2	0.25	647.3
3	0.24	647.5
4	0.19	337.6
5	0.20	348.1
6	**0.18**	**342.4**

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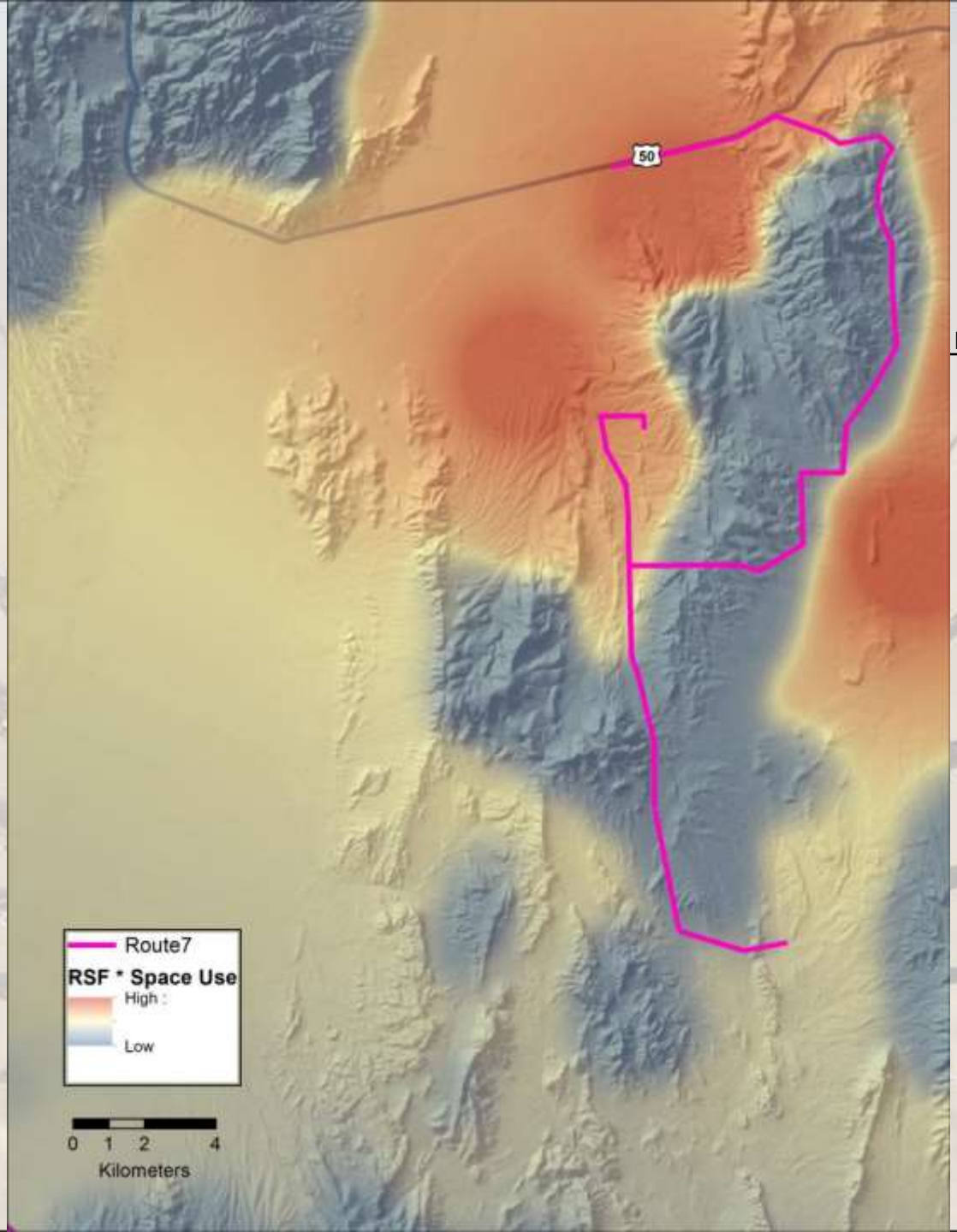
Alternative Route 7



	Grouse Impact	
Route	MEAN	SUM
1	0.27	677.1
2	0.25	647.3
3	0.24	647.5
4	0.19	337.6
5	0.20	348.1
6	0.18	342.4
7	**0.19**	**347.4**

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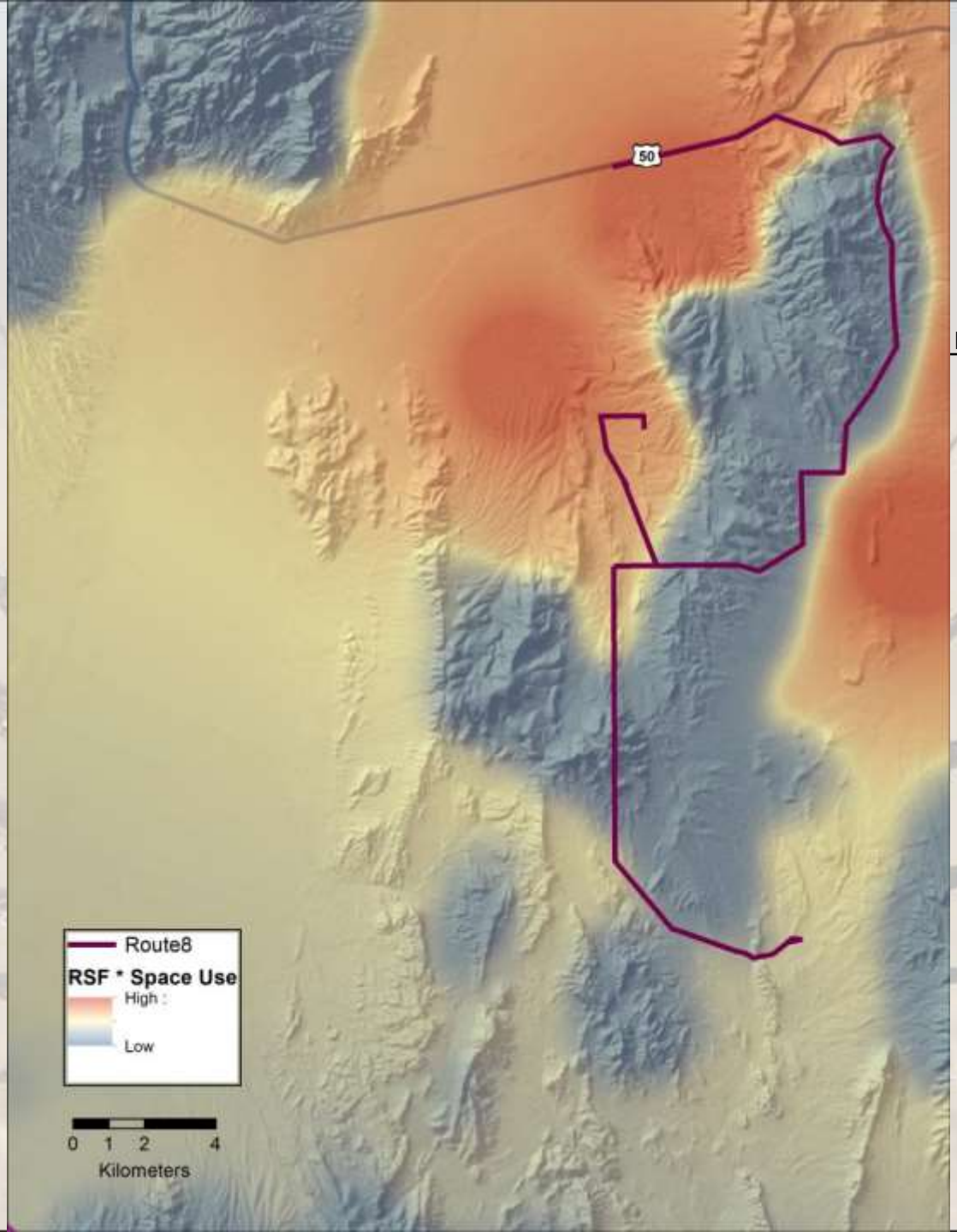
Alternative Route 8



	Grouse Impact	
Route	MEAN	SUM
1	0.27	677.1
2	0.25	647.3
3	0.24	647.5
4	0.19	337.6
5	0.20	348.1
6	0.18	342.4
7	0.19	347.4
8	**0.21**	**394.5**

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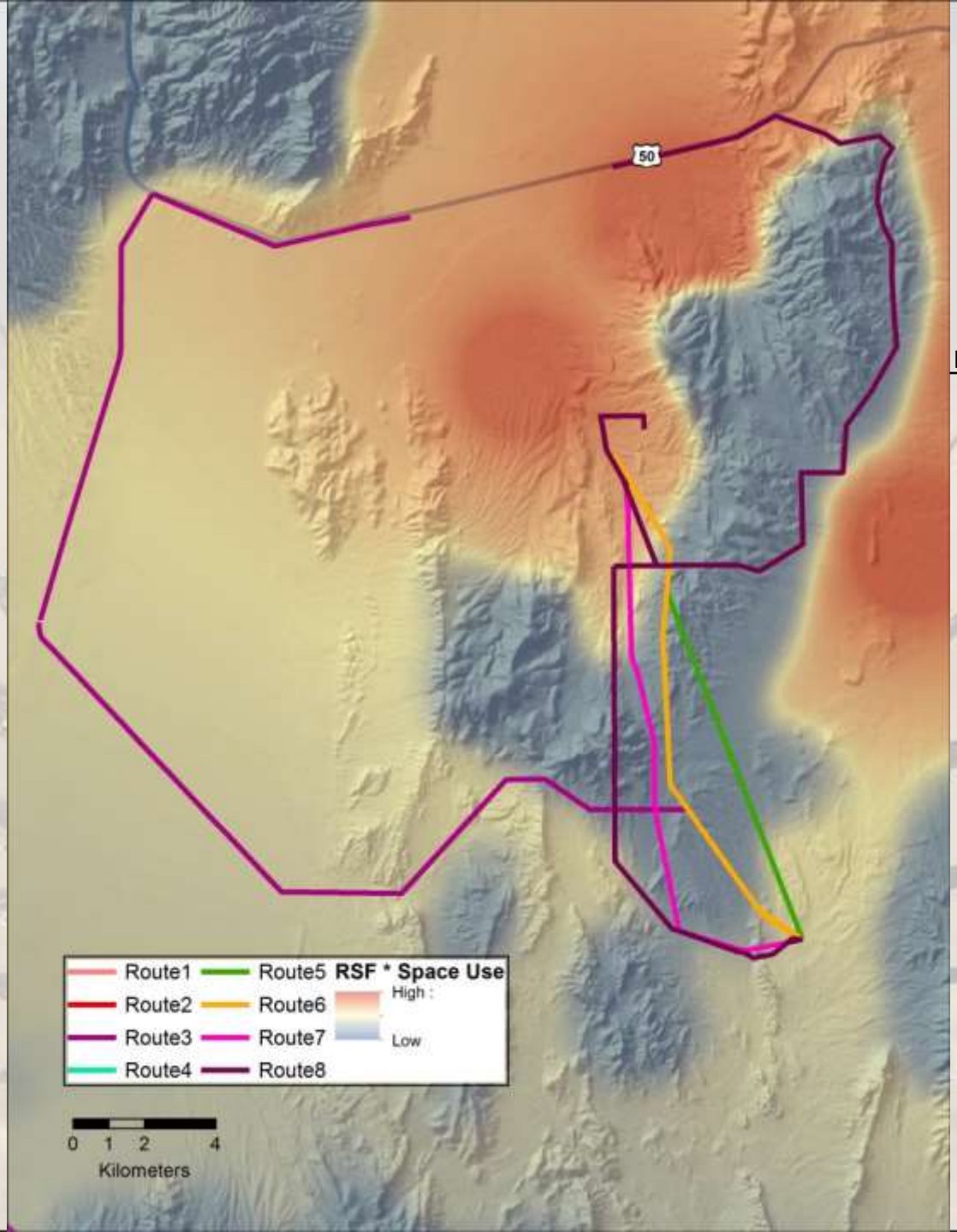
Alternative Routes 1 - 8



Route	Grouse Impact MEAN	Grouse Impact SUM
6	***0.18***	***342.4***
4	0.19	337.6
7	0.19	347.4
5	0.20	348.1
8	0.21	394.5
3	0.24	647.5
2	0.25	647.3
1	0.27	677.1

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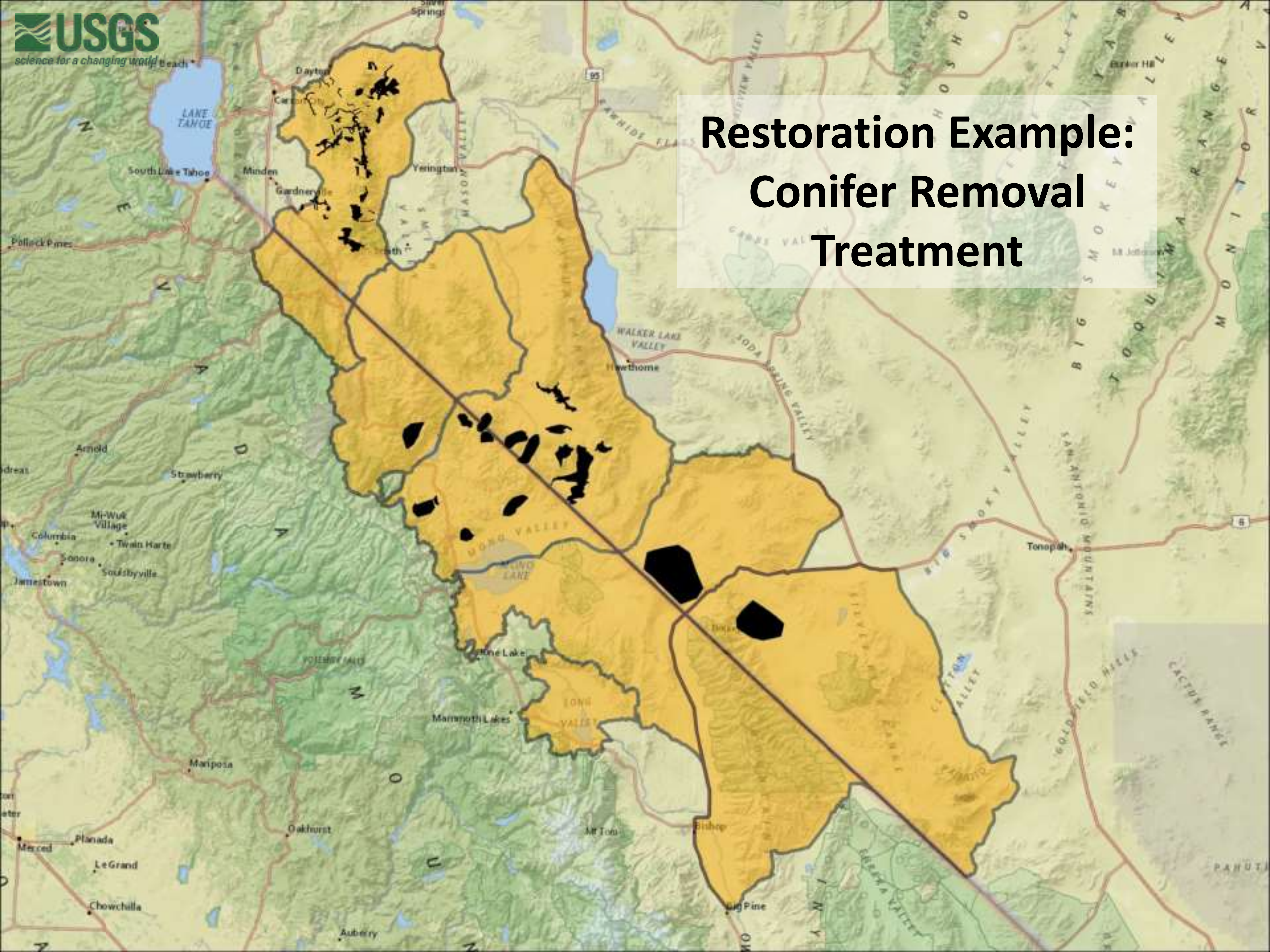
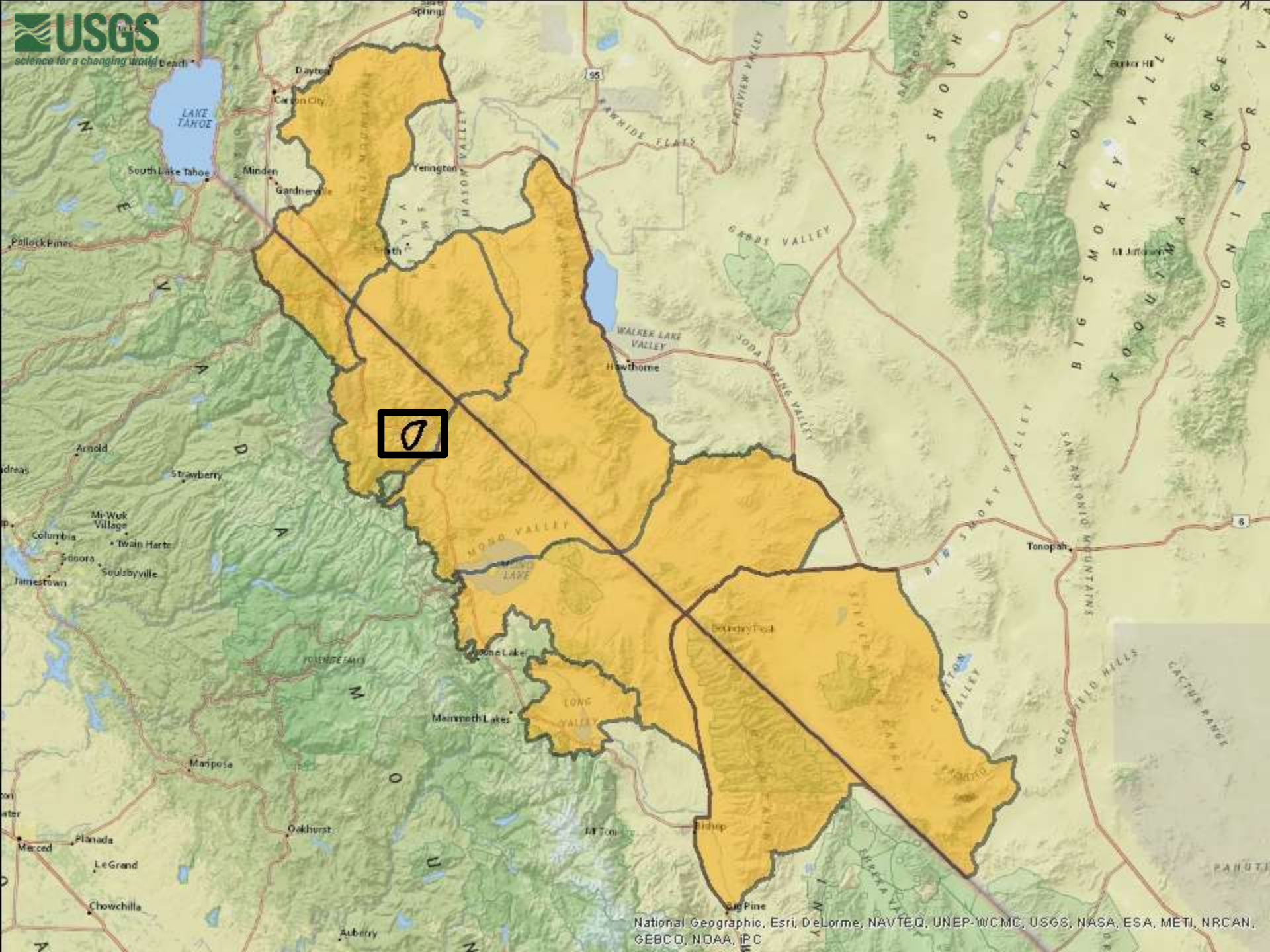
Restoration Example: Conifer Removal Treatment




USGS
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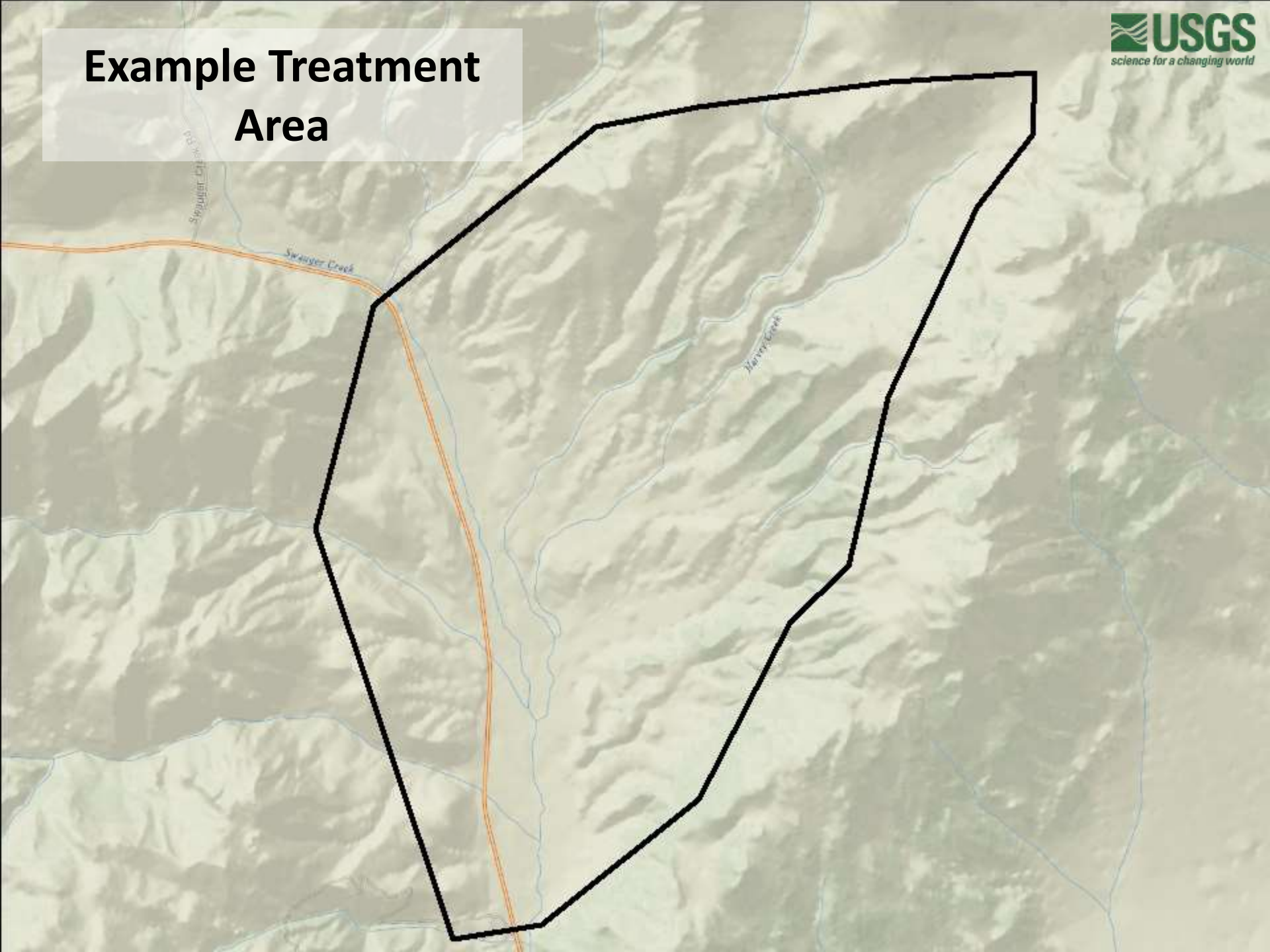
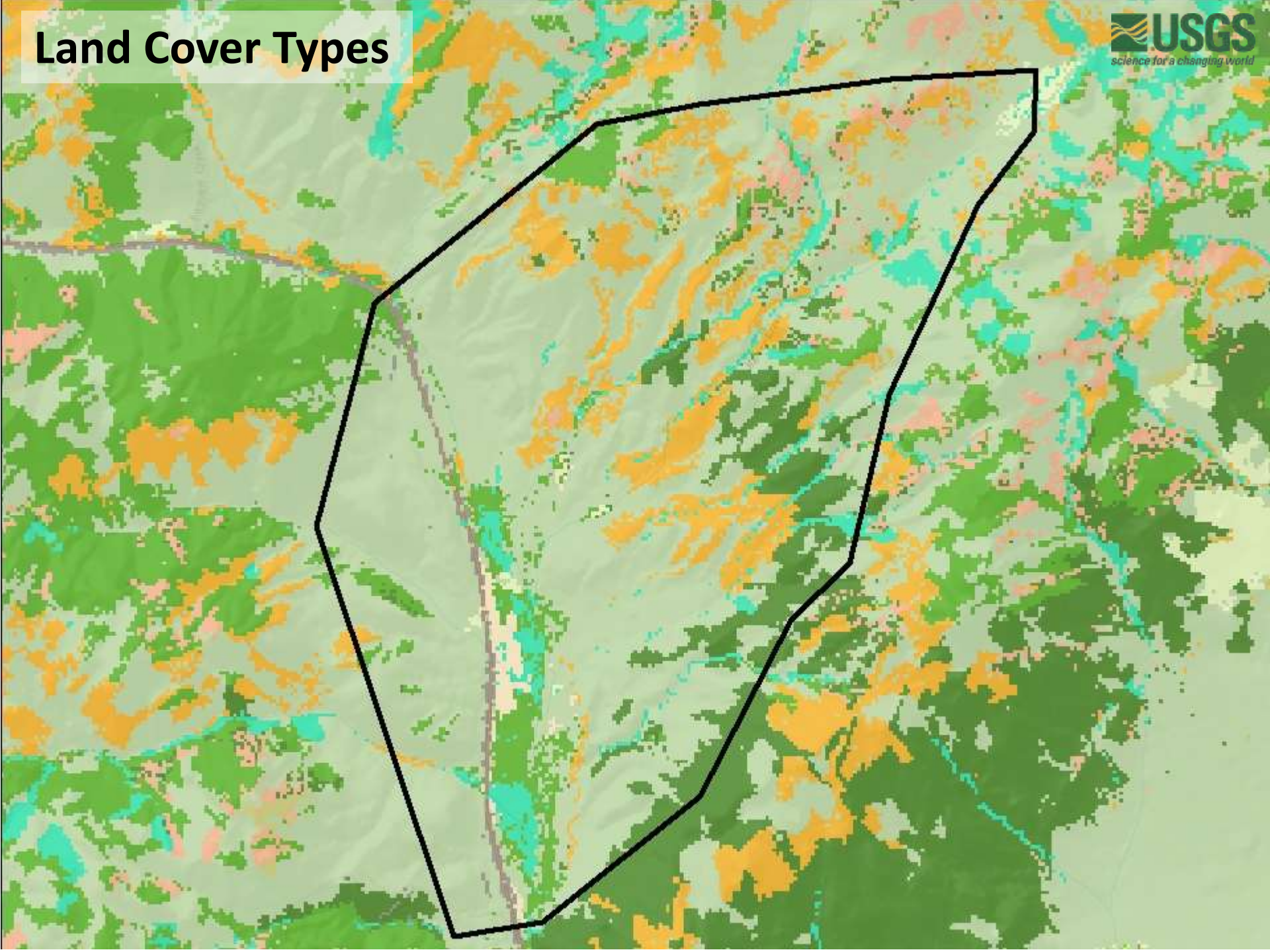
0
LAKE TAHOE
South Lake Tahoe
Minden
Gardnerville
Pollock Pines
Dayton
Carson City
Yerington
MASON VALLEY
WALKER LAKE VALLEY
Hawthorne
GABBS VALLEY
SODA SPRING VALLEY
BIG SMOKEY VALLEY
TOQUIMA RANGE
MONITOR
Tonopah
SAN ANTONIO MOUNTAINS
Arnold
Strawberry
Mi-Wuk Village
Columbia
Twain Harte
Sonora
Soulsbyville
Jamestown
MONO VALLEY
Mono Lake
Mammoth Lakes
LONG VALLEY
Mariposa
Oakhurst
Merced
Planada
LeGrand
Chowchilla
Auberry
Bishop
Big Pine
National Geographic, Esri, DeLorme, NAVTEQ, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC

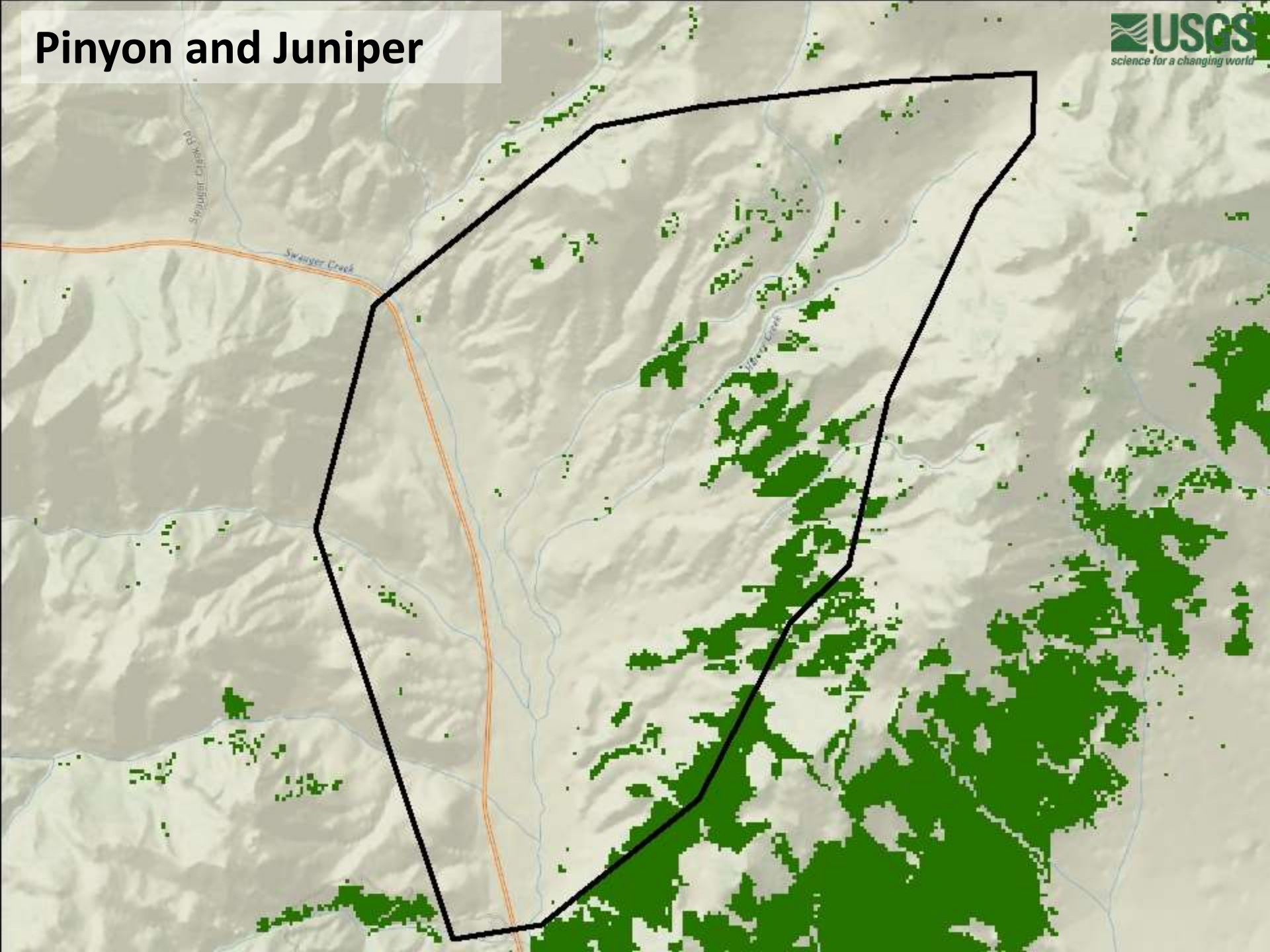
Example Treatment Area



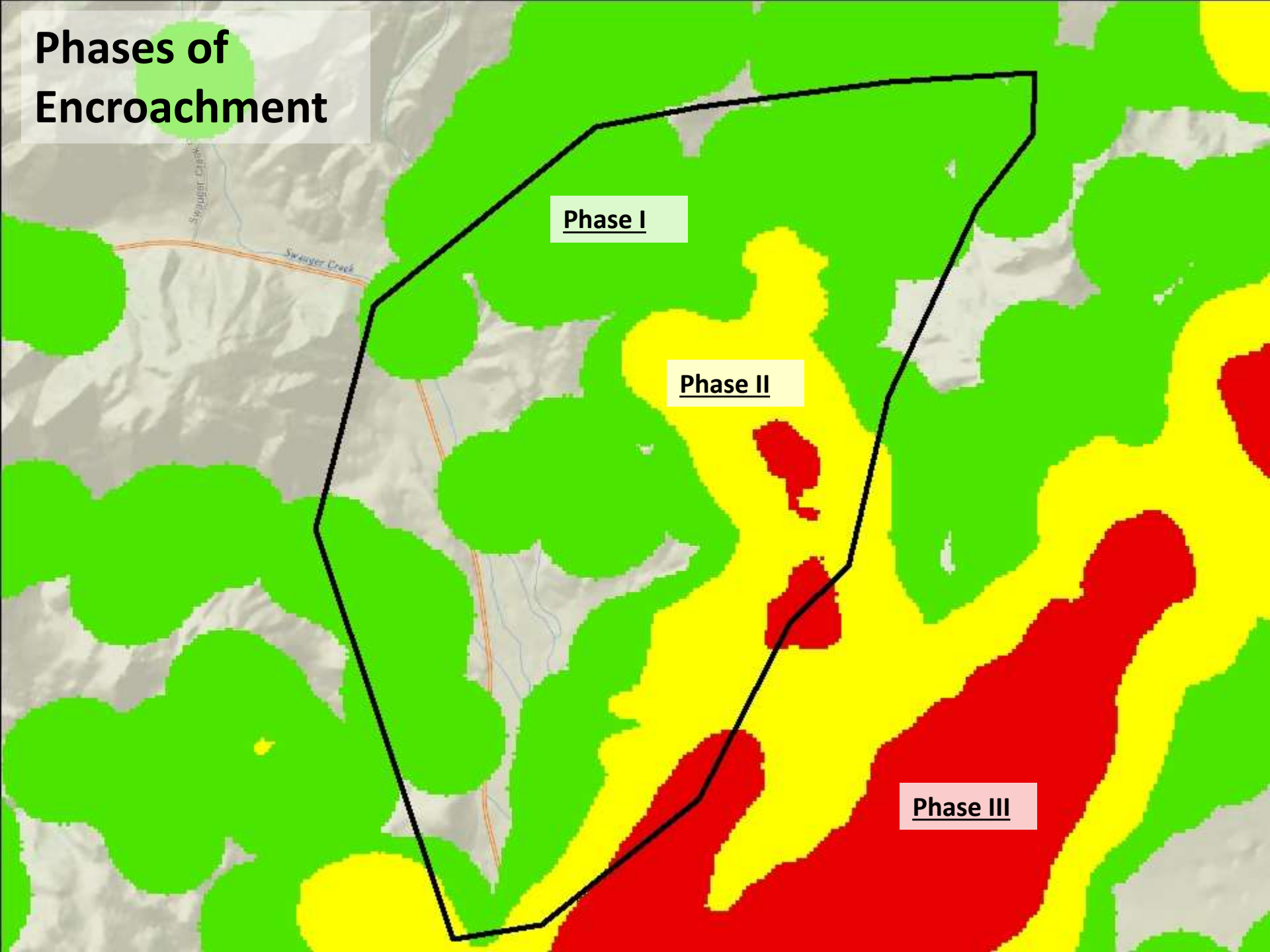
Land Cover Types



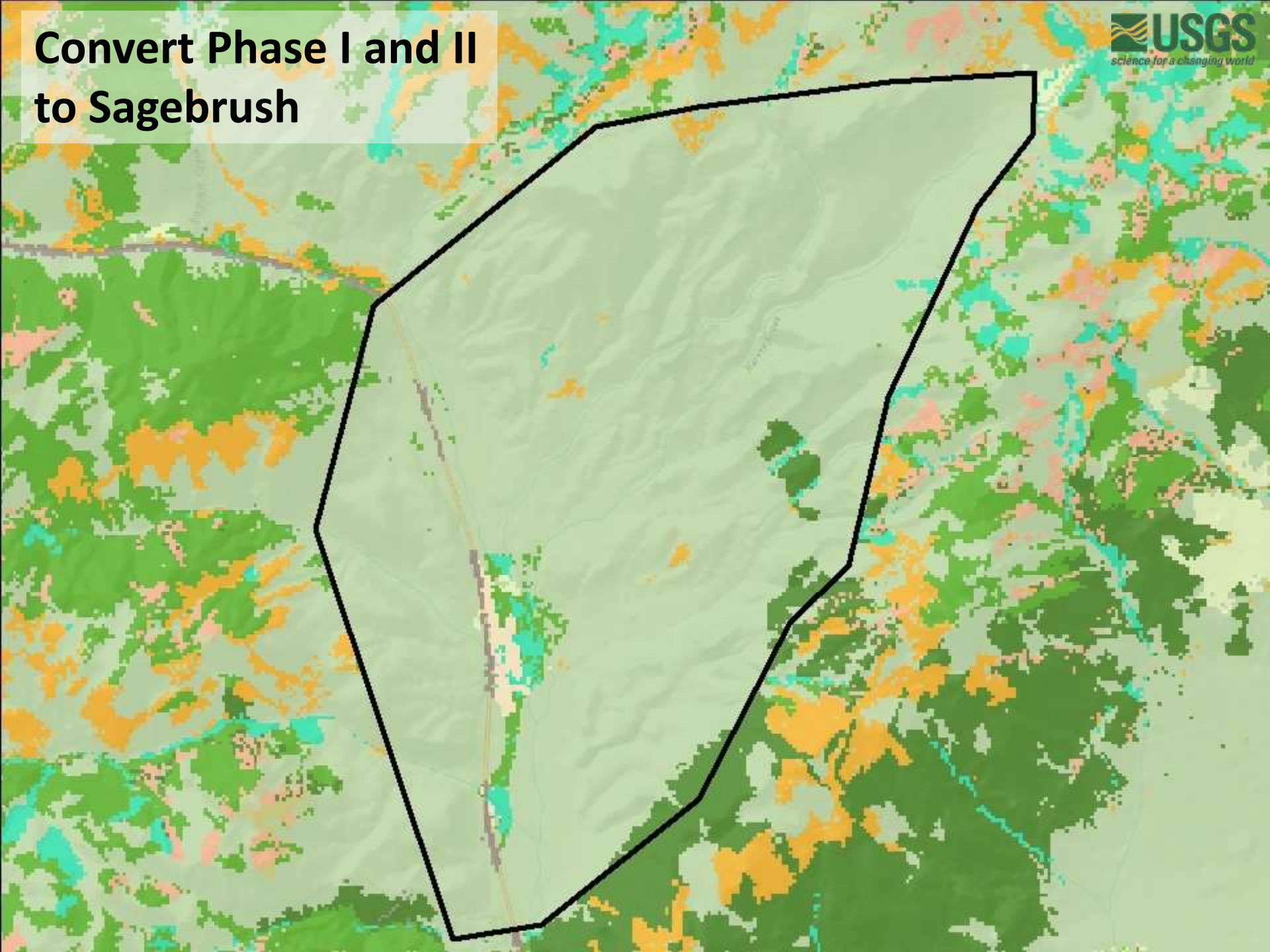
Pinyon and Juniper



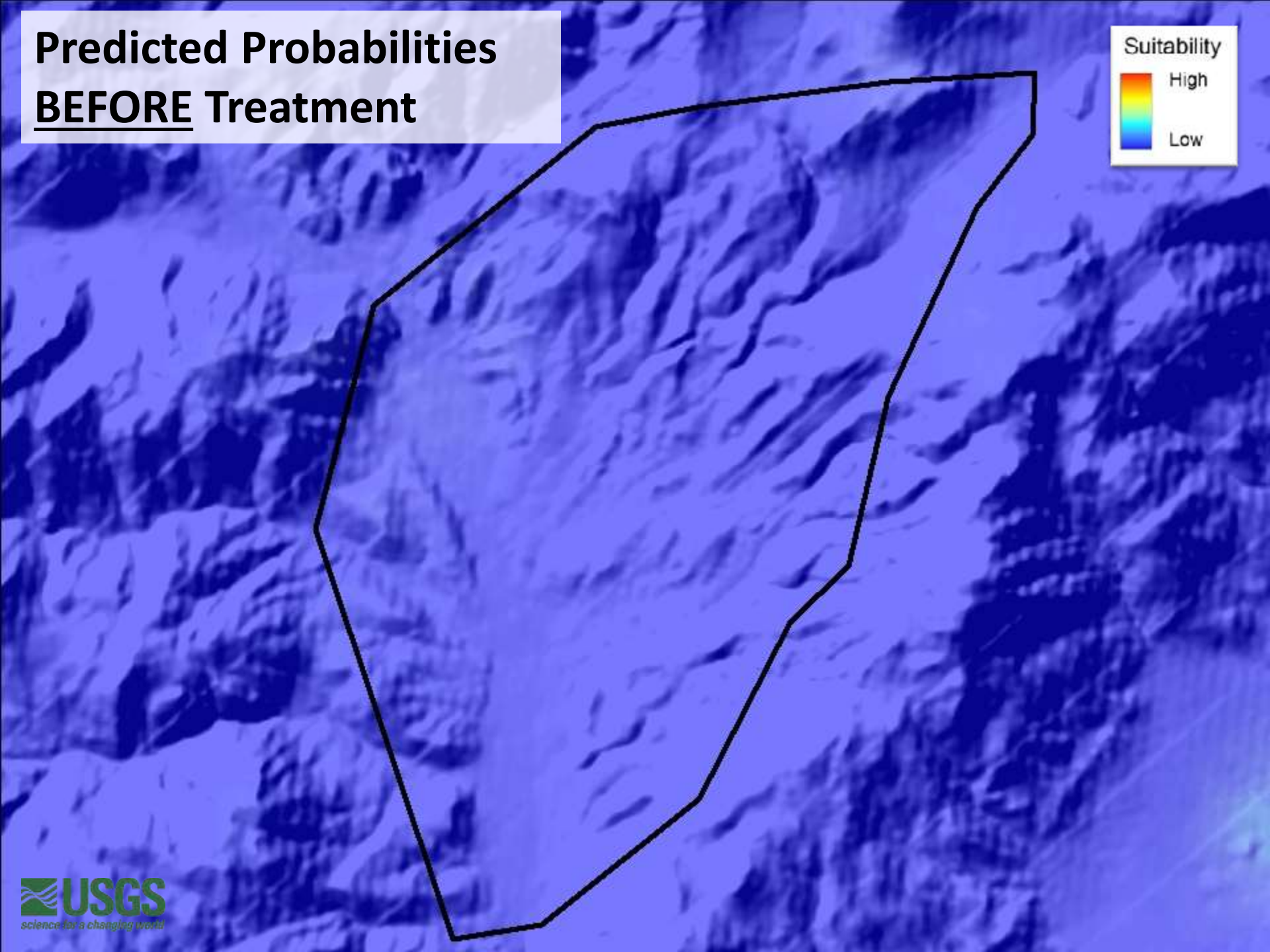
Phases of Encroachment



Convert Phase I and II to Sagebrush



Predicted Probabilities BEFORE Treatment



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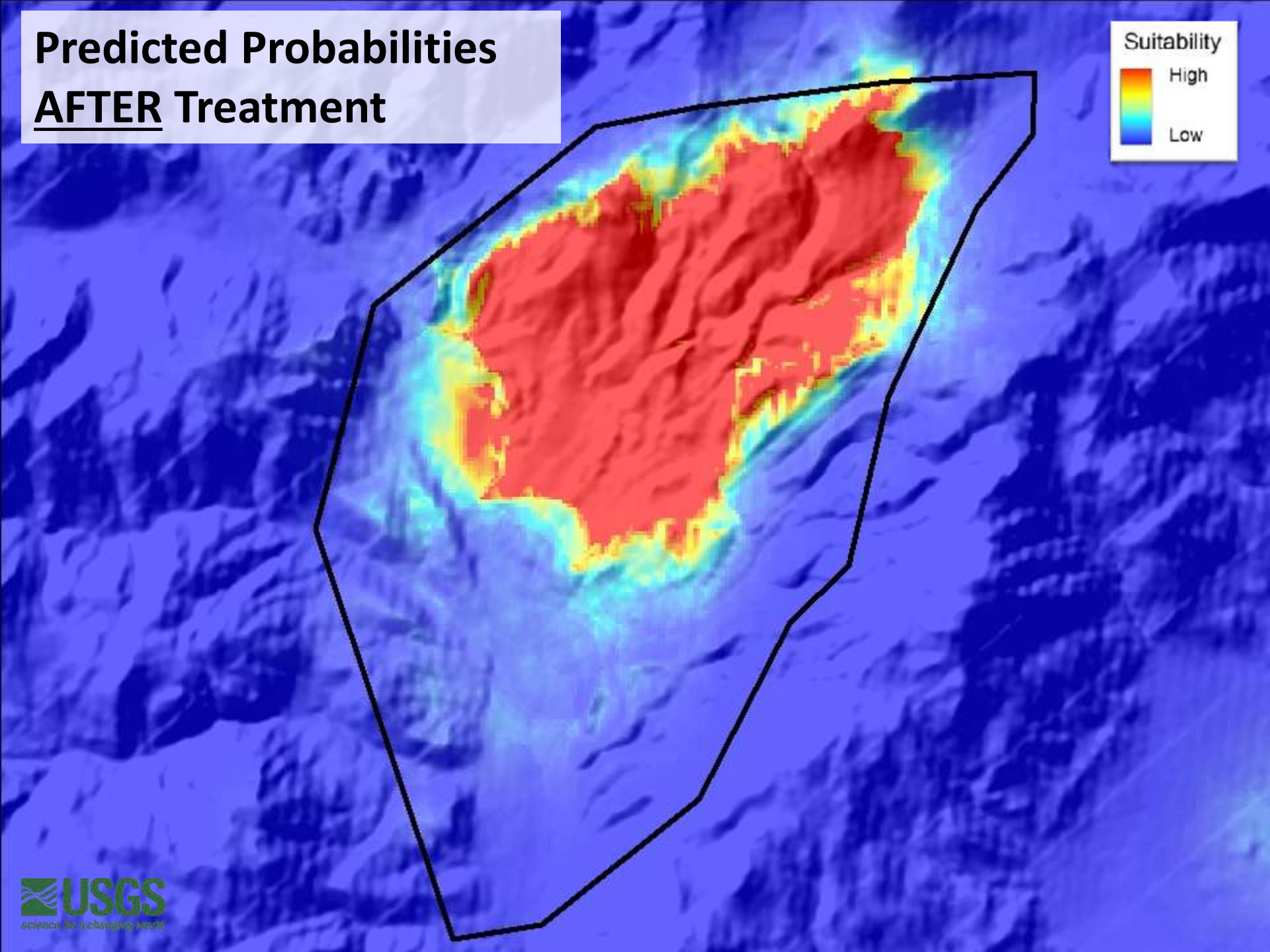
Predicted Probabilities AFTER Treatment



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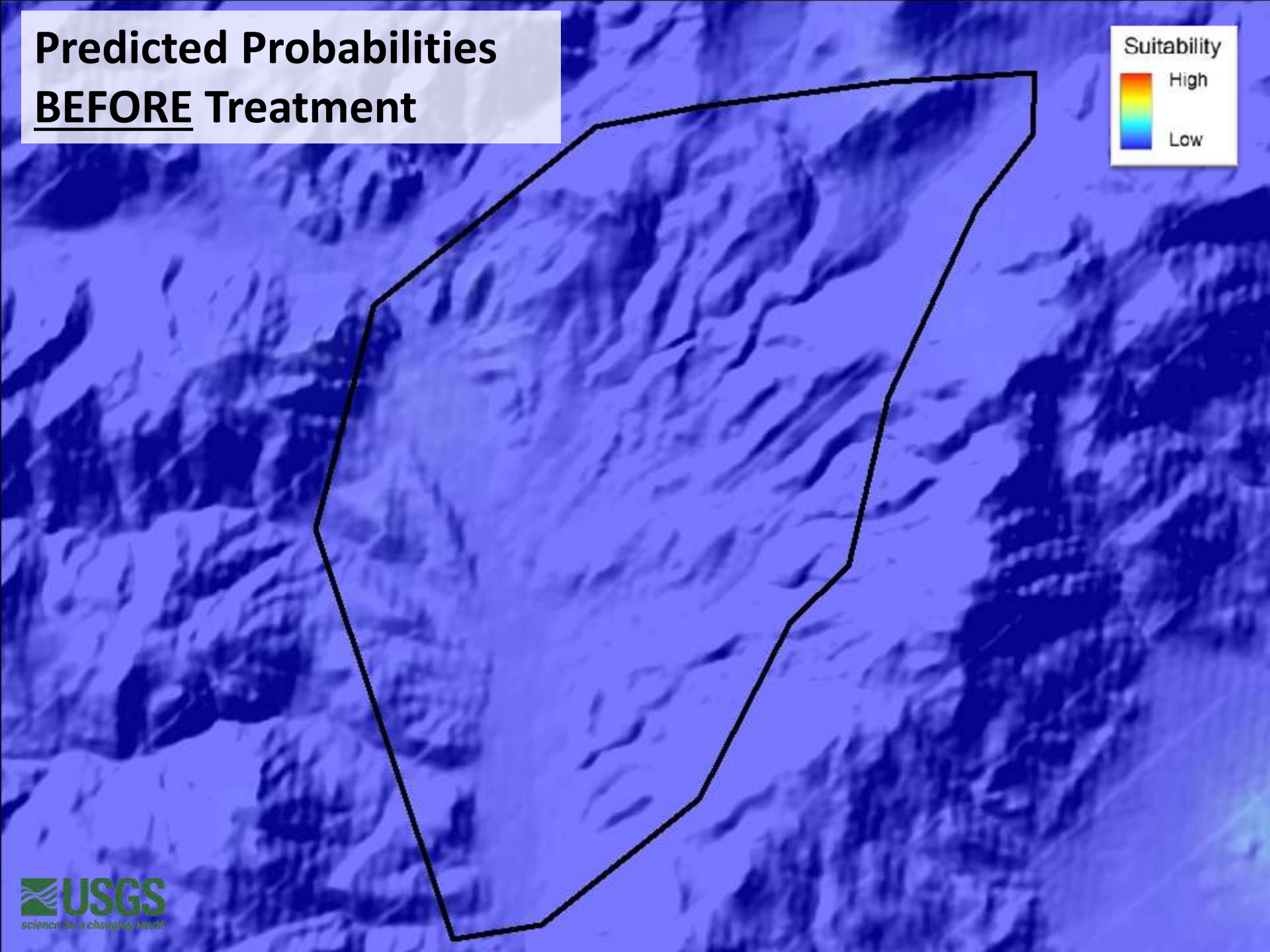
Predicted Probabilities BEFORE Treatment



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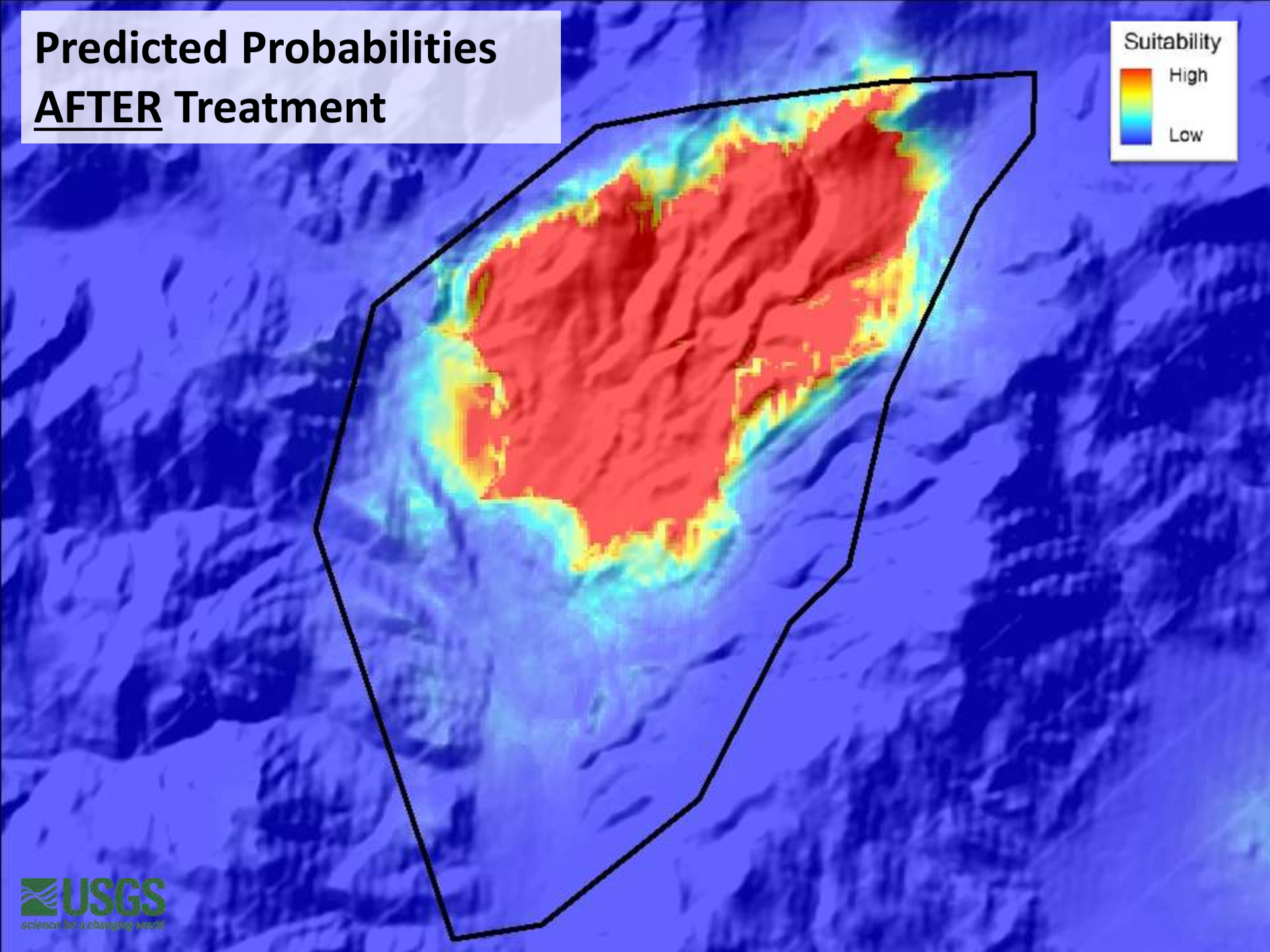
Predicted Probabilities AFTER Treatment



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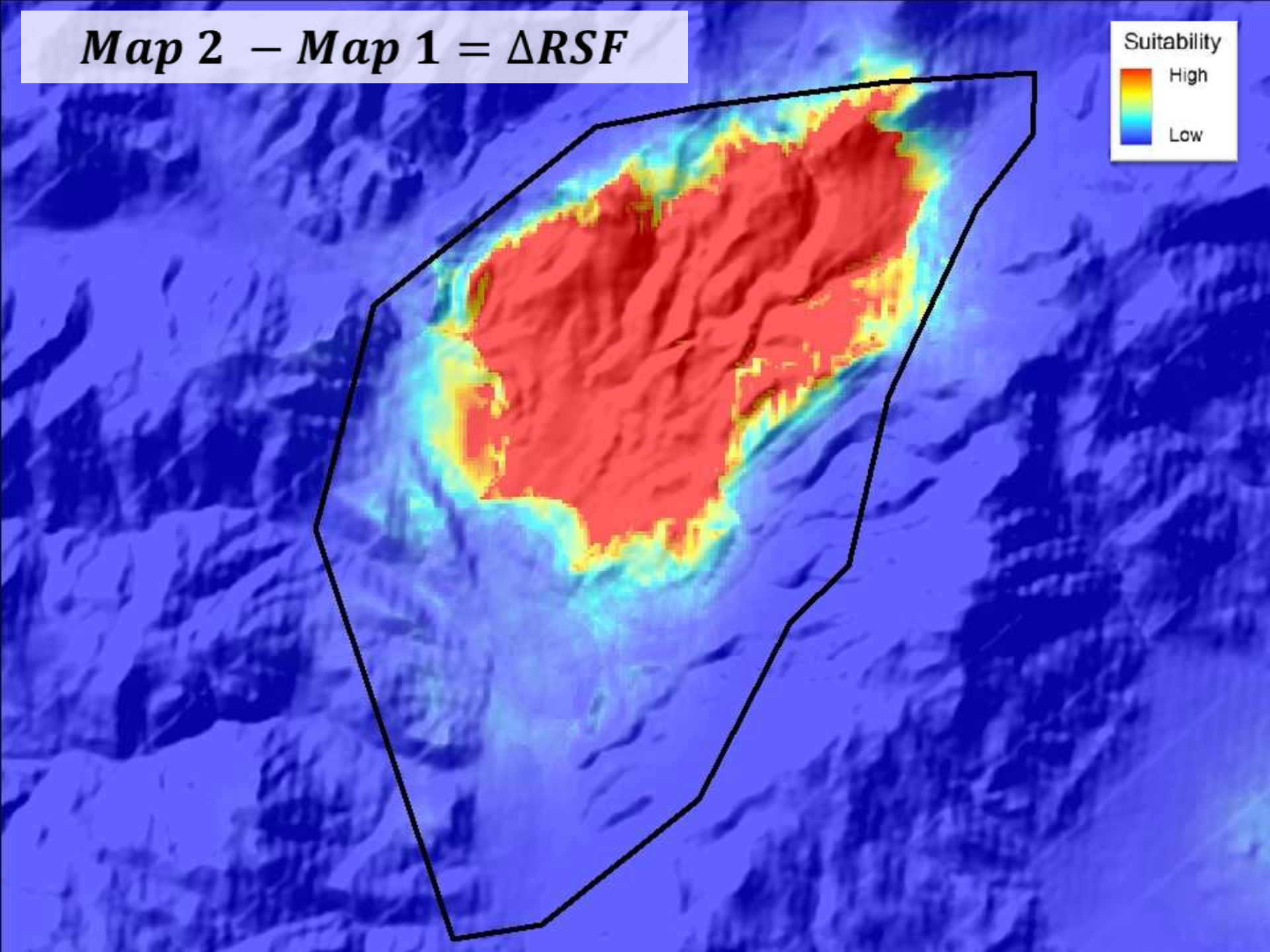
$$Map\ 2\ -\ Map\ 1 = \Delta RSF$$



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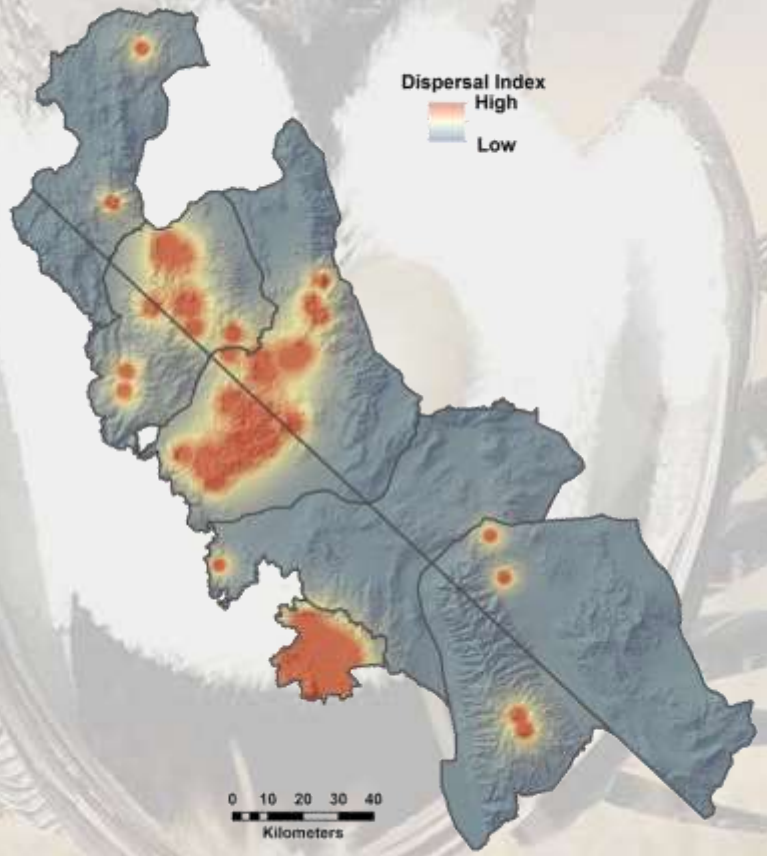
$$Total\ Ranking\ Index = \Delta RSF \times Dispersal\ Index$$



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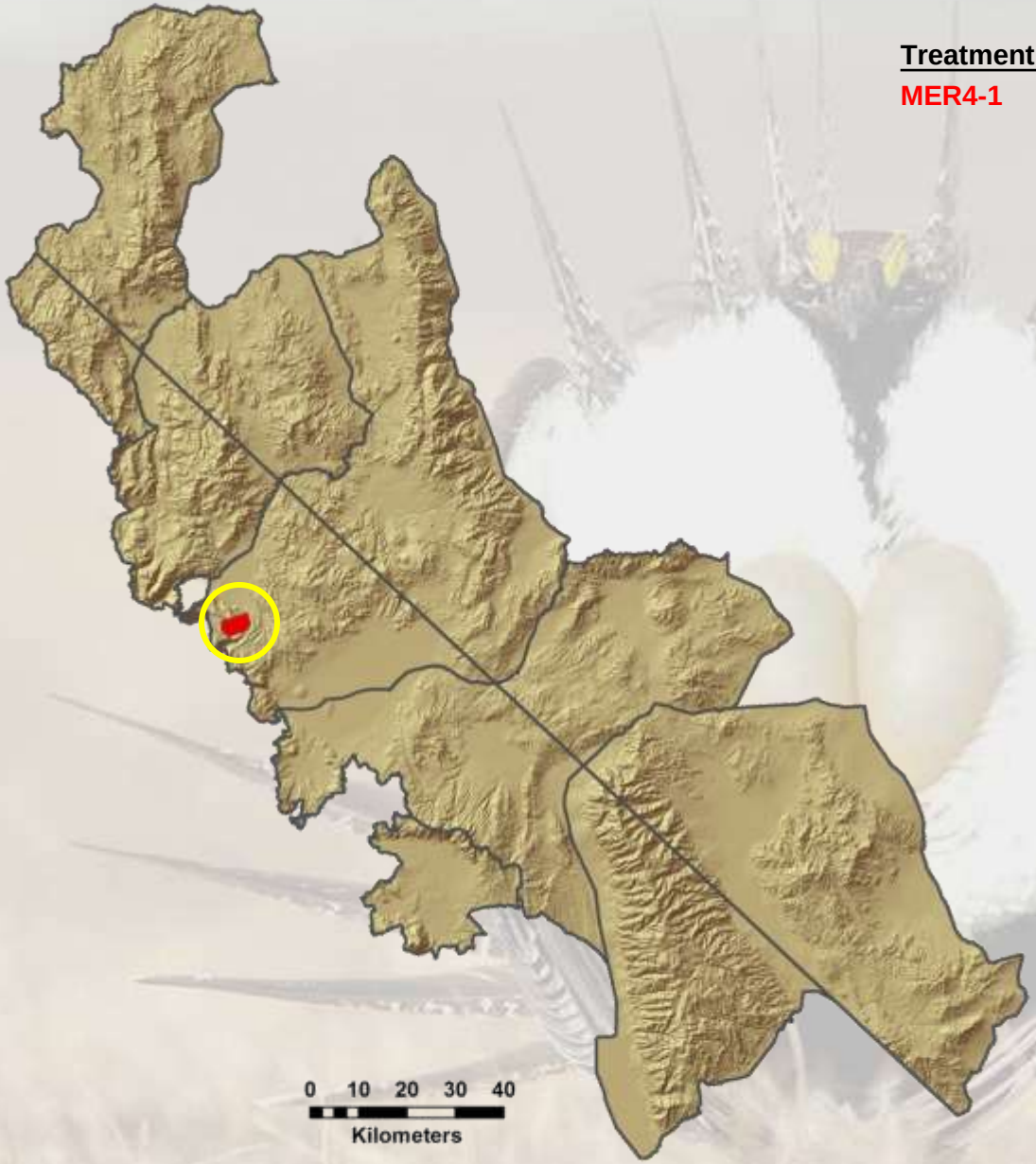
Phase I and II

Treatment	Treatment Subgroup	Relative Ben:Cost	Rank	Evidence Ratio		Cost
MER4-1	M1b	1.00	1	1.0	$	1,376,010



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Phase I and II

Treatment	Treatment Subgroup	Relative Ben:Cost	Rank	Evidence Ratio		Cost
MER4-1	M1b	1.00	1	1.0	$	1,376,010
MER4-3	M3	0.40	2	2.5	$	1,937,457

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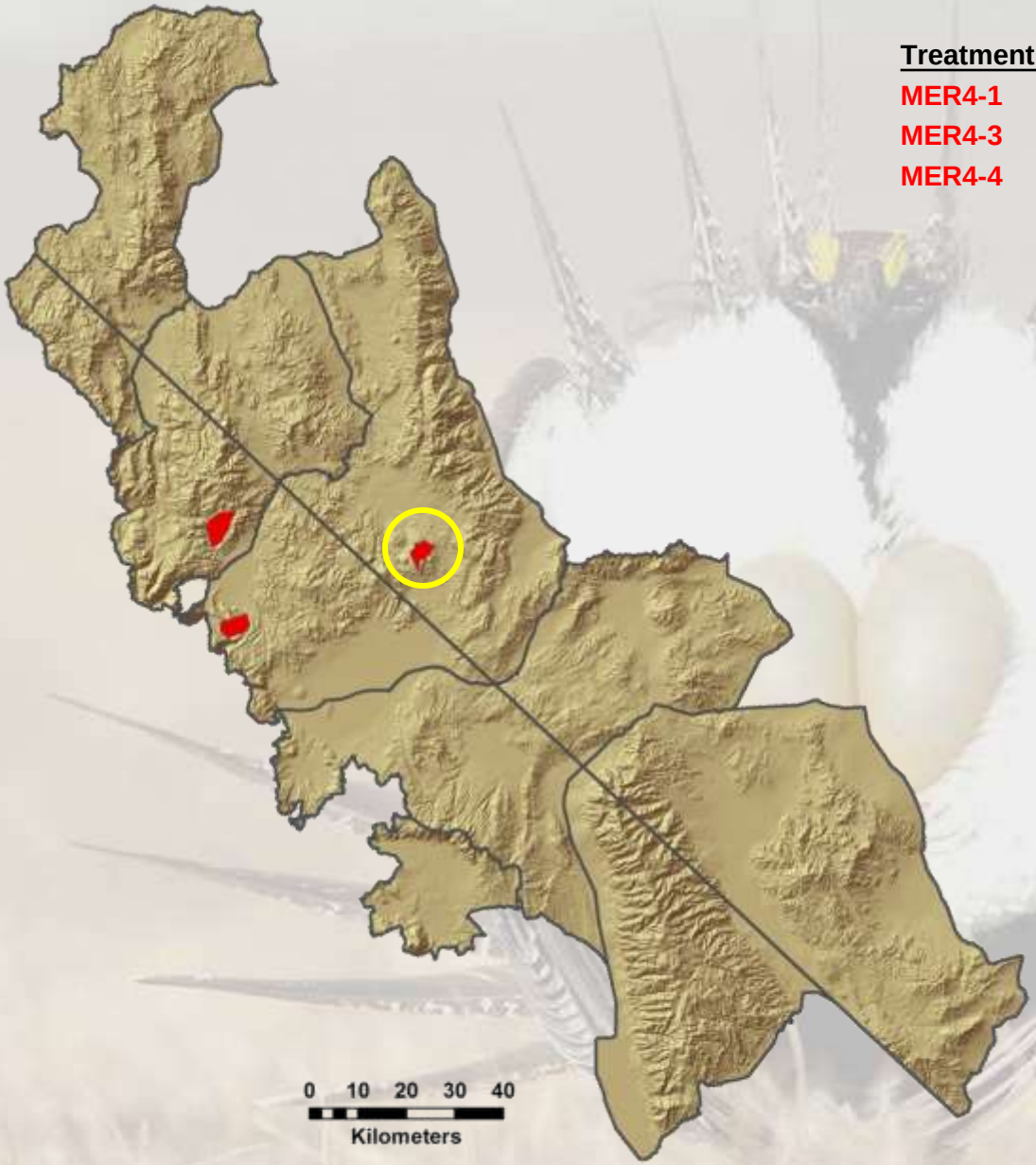
Phase I and II

Treatment	Treatment Subgroup	Relative Ben:Cost	Rank	Evidence Ratio		Cost
MER4-1	M1b	1.00	1	1.0	$	1,376,010
MER4-3	M3	0.40	2	2.5	$	1,937,457
MER4-4	M4b	0.30	3	3.3	$	1,198,119



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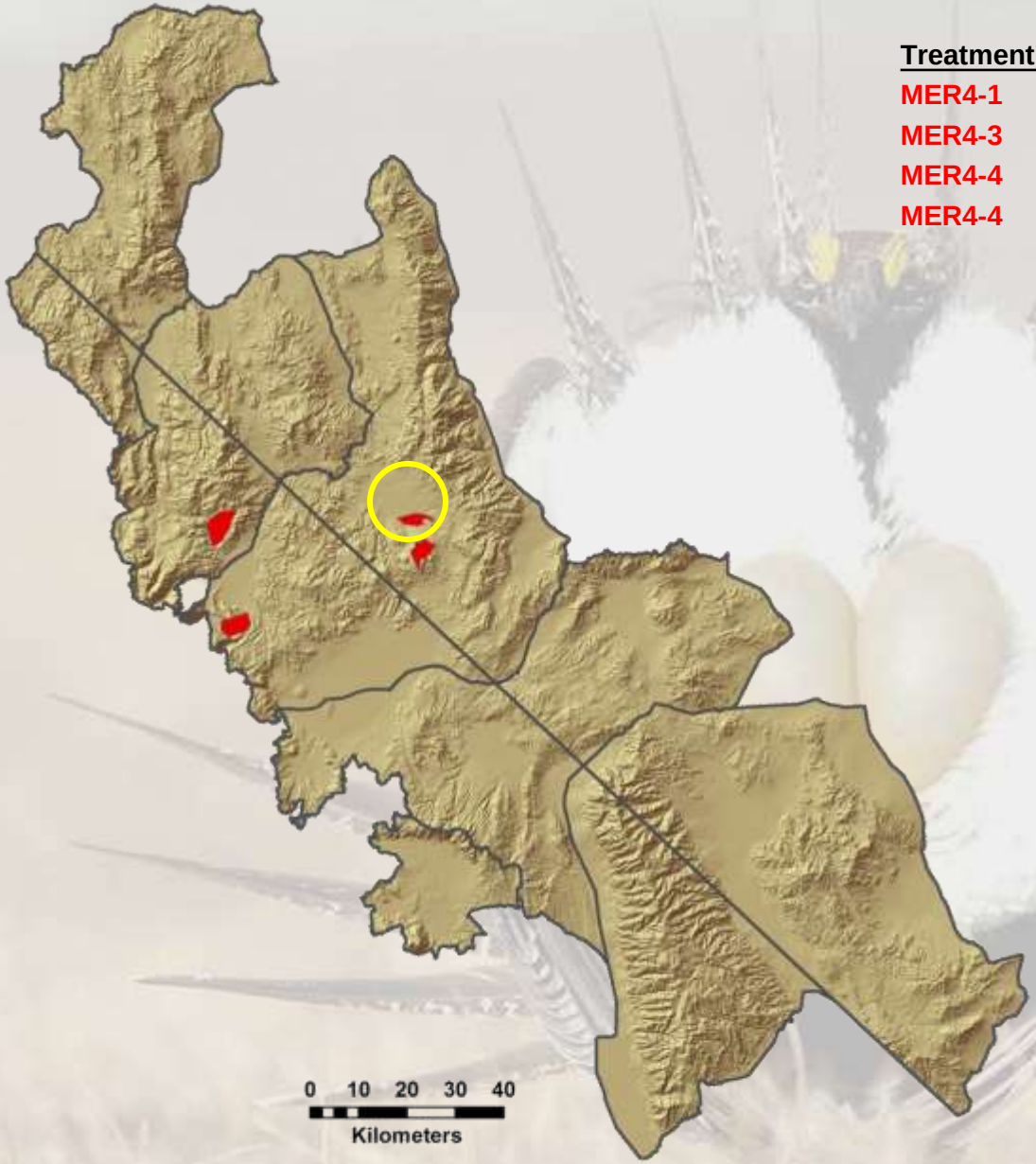
Phase I and II

Treatment	Treatment Subgroup	Relative Ben:Cost	Rank	Evidence Ratio		Cost
MER4-1	M1b	1.00	1	1.0	$	1,376,010
MER4-3	M3	0.40	2	2.5	$	1,937,457
MER4-4	M4b	0.30	3	3.3	$	1,198,119
MER4-4	M4a	0.21	4	4.7	$	677,622



USGS
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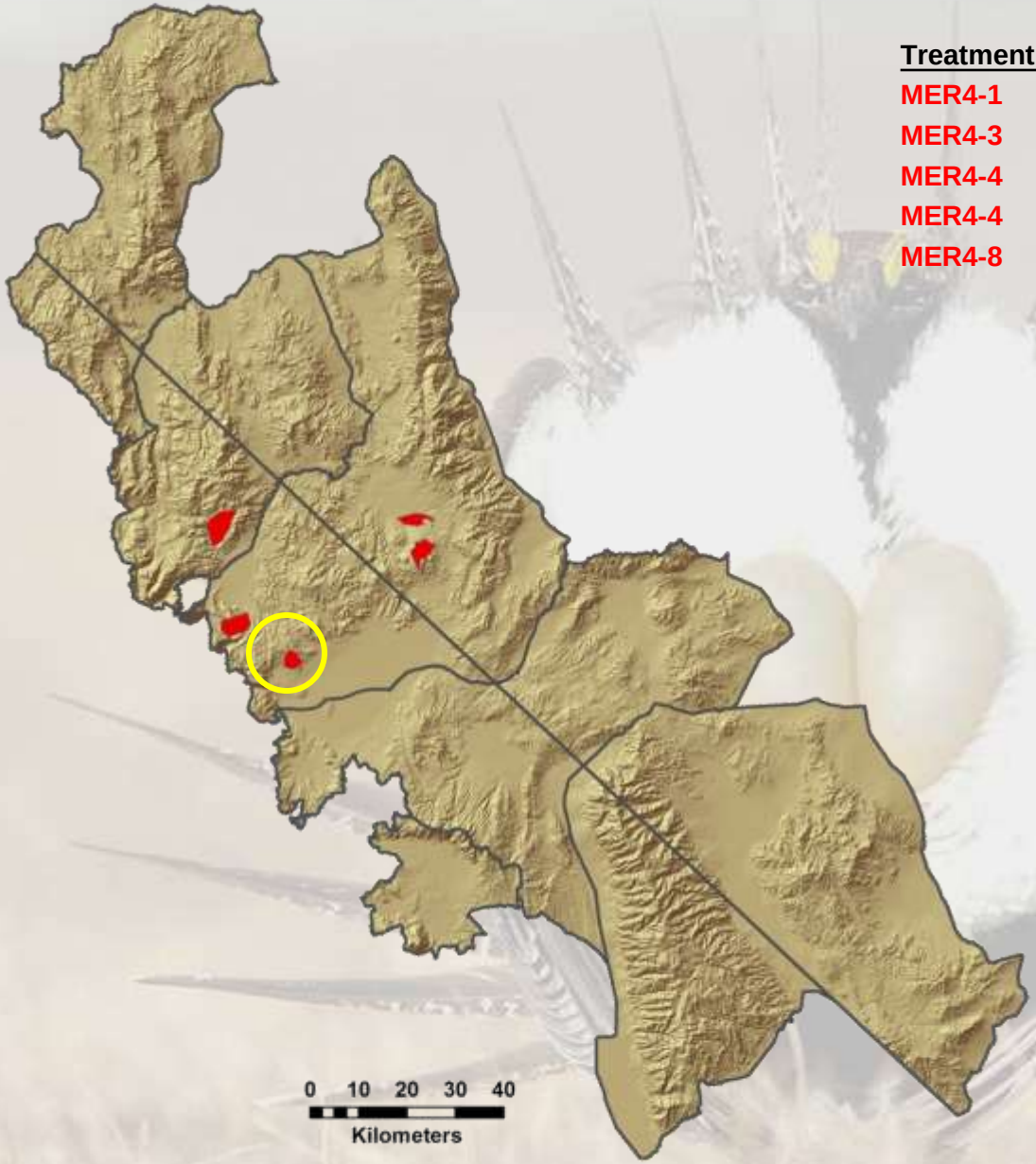
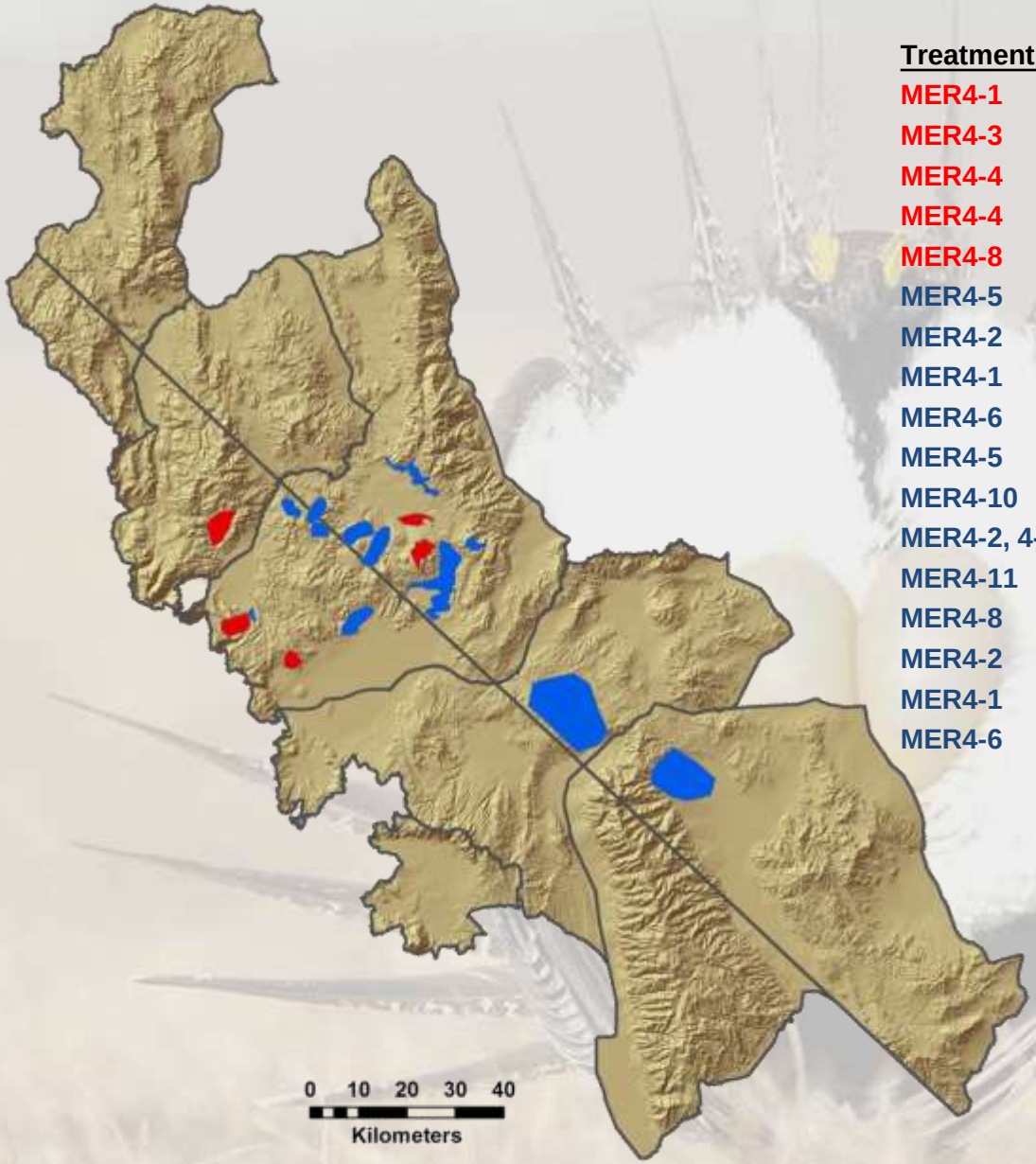
Phase I and II

Treatment	Treatment Subgroup	Relative Ben:Cost	Rank	Evidence Ratio		Cost
MER4-1	M1b	1.00	1	1.0	$	1,376,010
MER4-3	M3	0.40	2	2.5	$	1,937,457
MER4-4	M4b	0.30	3	3.3	$	1,198,119
MER4-4	M4a	0.21	4	4.7	$	677,622
MER4-8	M8a	0.21	5	4.9	$	551,188





Phase I and II

Treatment	Treatment Subgroup	Relative Ben:Cost	Rank	Evidence Ratio		Cost
MER4-1	M1b	1.00	1	1.0	$	1,376,010
MER4-3	M3	0.40	2	2.5	$	1,937,457
MER4-4	M4b	0.30	3	3.3	$	1,198,119
MER4-4	M4a	0.21	4	4.7	$	677,622
MER4-8	M8a	0.21	5	4.9	$	551,188
MER4-5	M5a	0.15	6	6.8	$	52,375
MER4-2	M2a	0.13	7	7.5	$	78,979
MER4-1	M1a	0.08	8	13.0	$	275,719
MER4-6	M6a	0.07	9	13.7	$	3,682,761
MER4-5	M5b	0.06	10	16.4	$	489,472
MER4-10	M10	0.05	11	22.2	$	1,120,057
MER4-2, 4-7	M2_7	0.04	12	22.7	$	1,155,752
MER4-11	M11	0.04	13	26.5	$	1,120,057
MER4-8	M8b	0.04	14	26.6	$	1,120,057
MER4-2	M2b	0.02	15	59.8	$	480,632
MER4-1	M1c	0.01	16	93.6	$	209,833
MER4-6	M6b	0.00	17	1372.5	$	249,532

End of Agenda Item 7

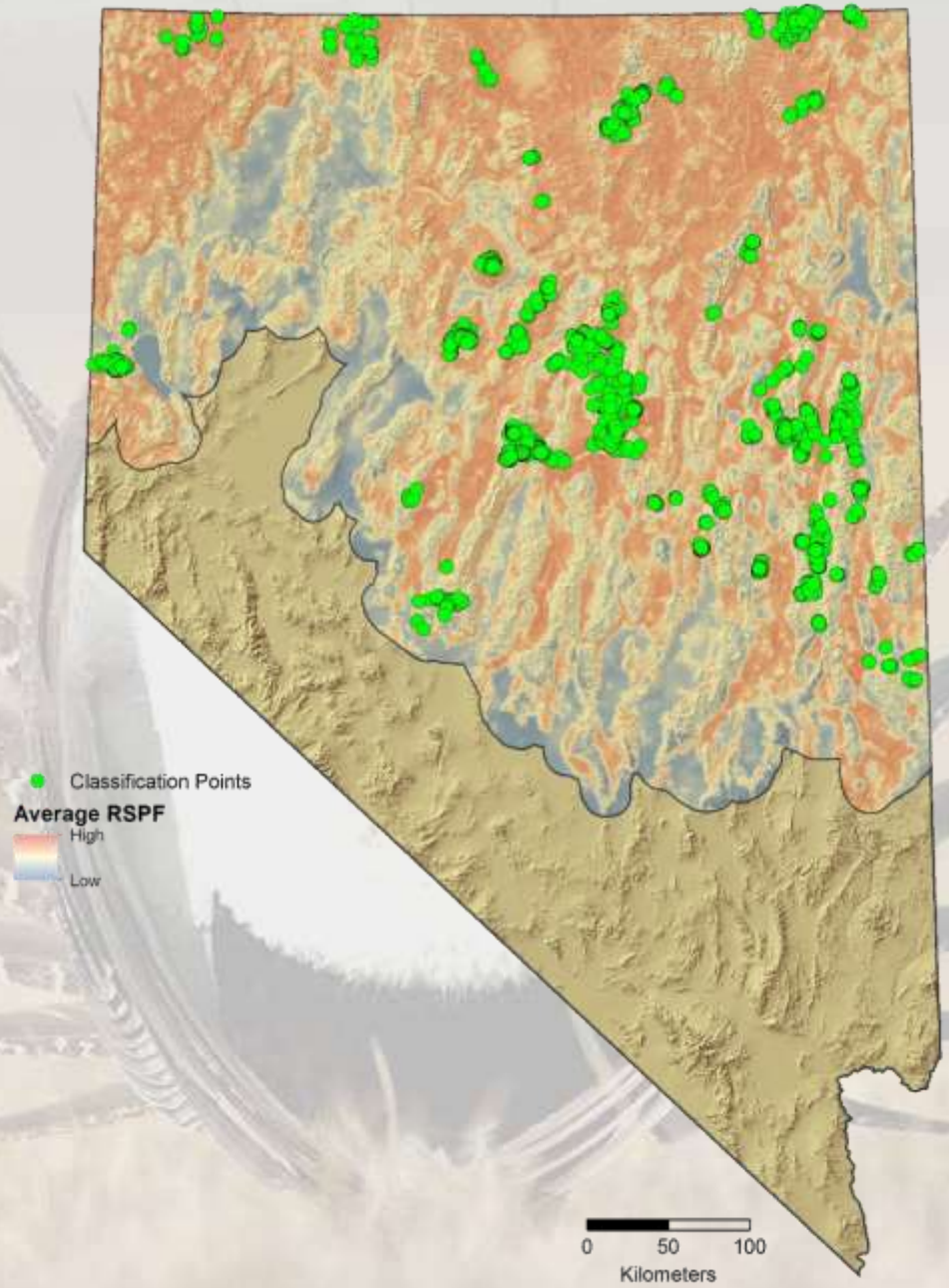
Start of Agenda Item 8

Management Categories and Sage-Grouse Management Areas

Presented on Behalf of Sagebrush Ecosystem Technical Team

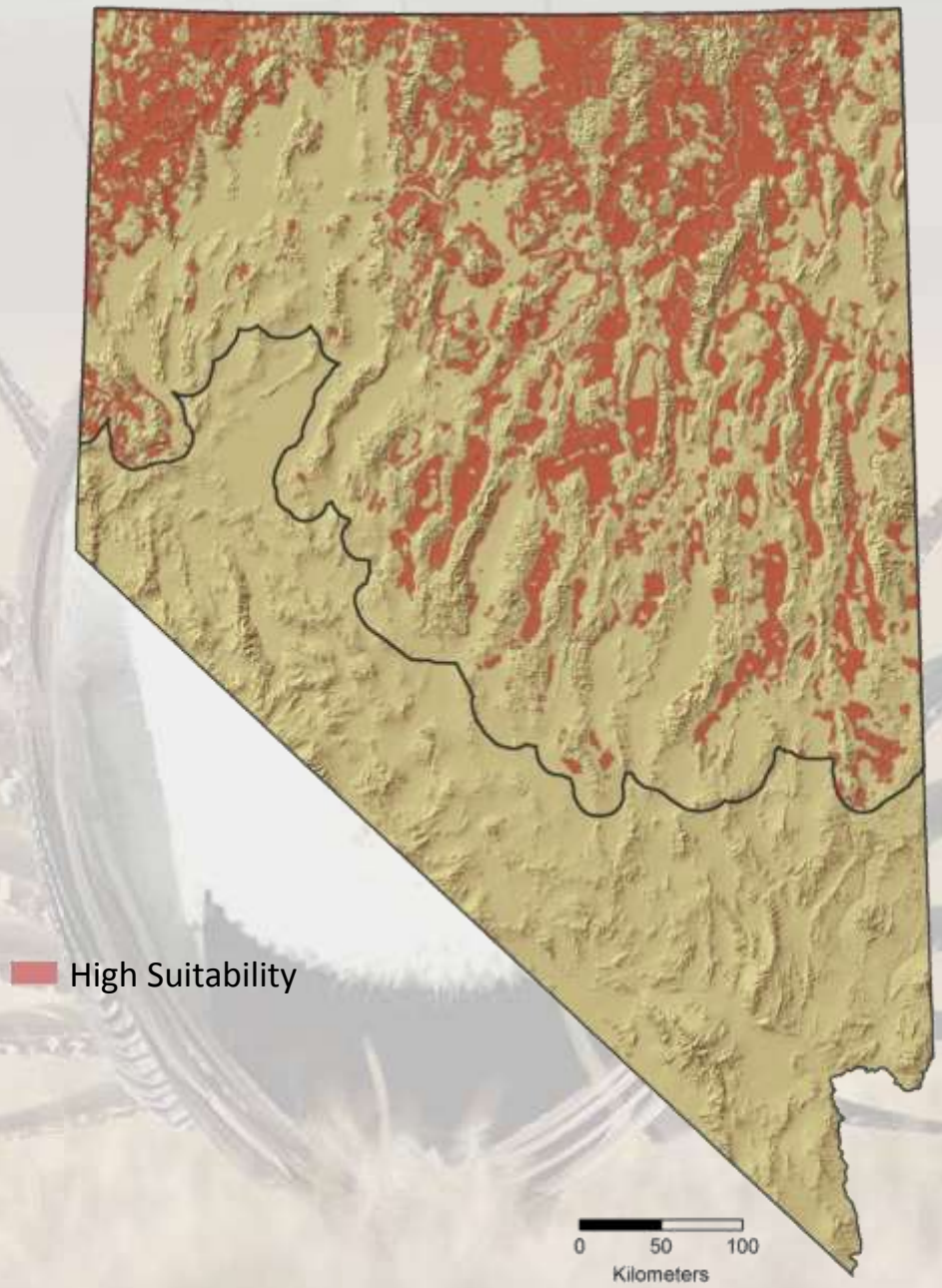
Technical Assistance from:
Nevada Department of Wildlife
U. S. Geological Survey

Classifying Habitat Importance



- **Extract HIS values**
- ***3,552 telemetry points***
- ***Use variance of the RSPF distribution to determine suitability cutoffs***
- ***Biological and statistical basis for cutoff***

DRAFT - High Suitability Habitat



- **Index value:**

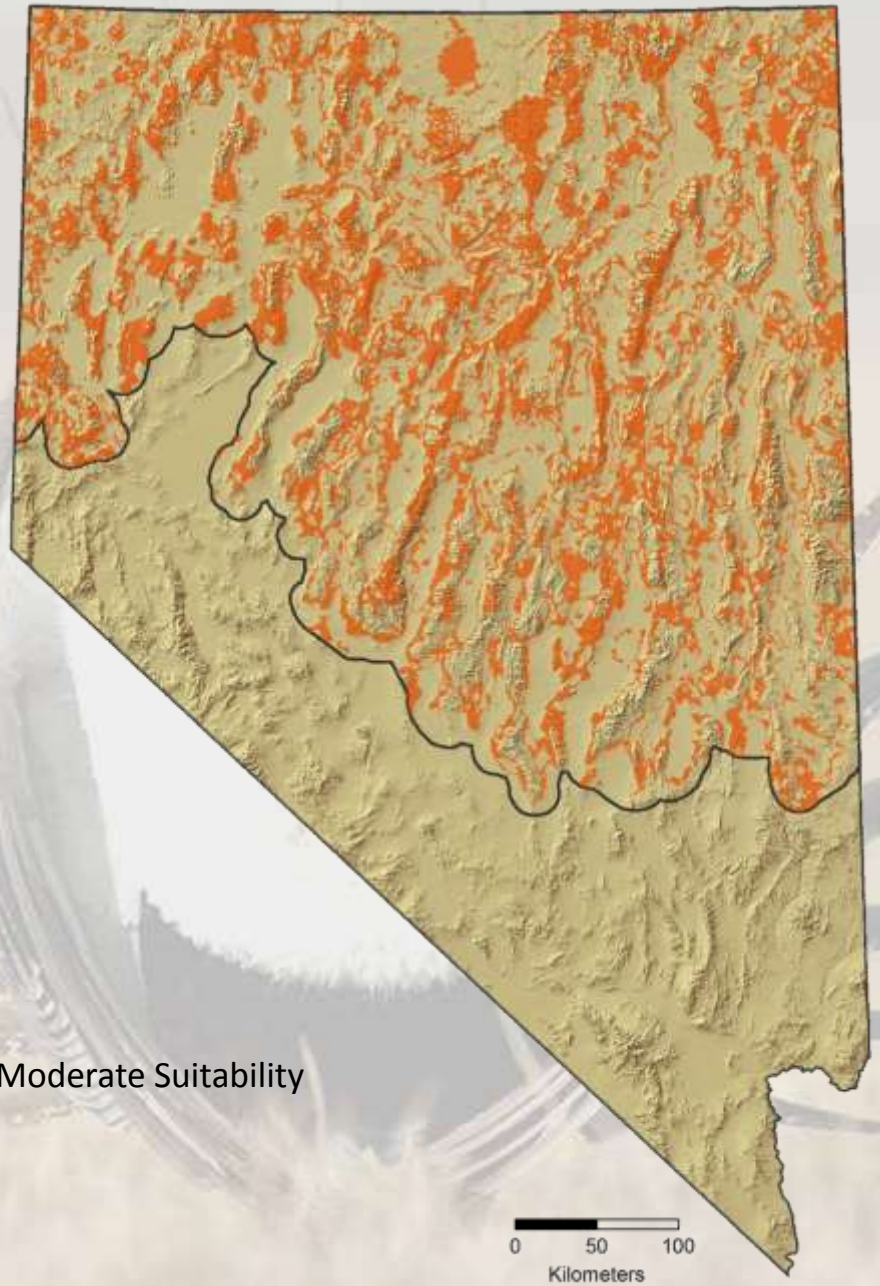
  $\bar{x} - \frac{\sigma}{2}$

- **Percentile rank 30.9%**

- **Identifies 'best' habitat using variance estimate**

- **77.5% of leks**

DRAFT - Moderate Suitability Habitat



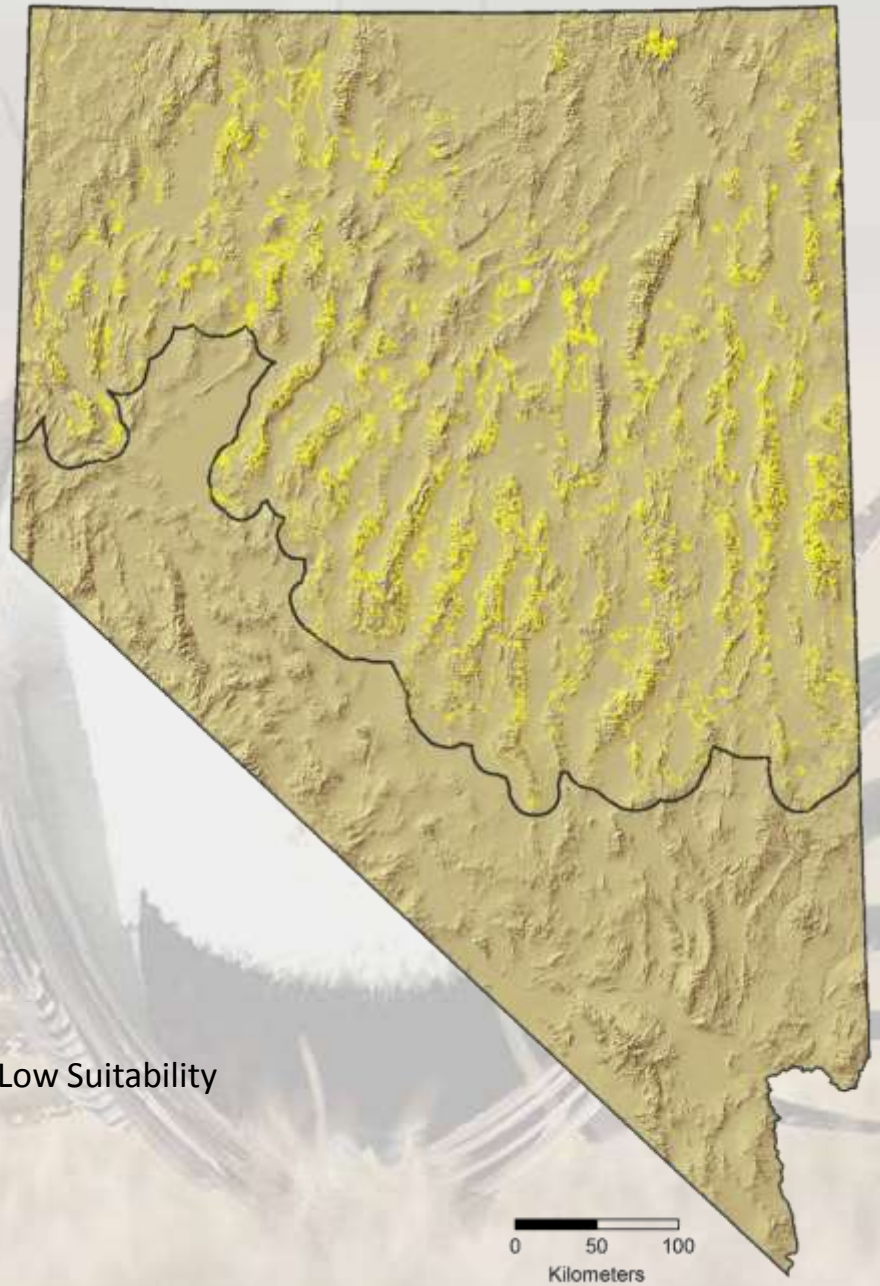
- **Index value:**

  $\bar{x} - 1.5 \times \sigma$

- **Percentile rank 6.7% – 30.9%**

- **99.1% of leks (cumulative)**

DRAFT - Low Suitability Habitat



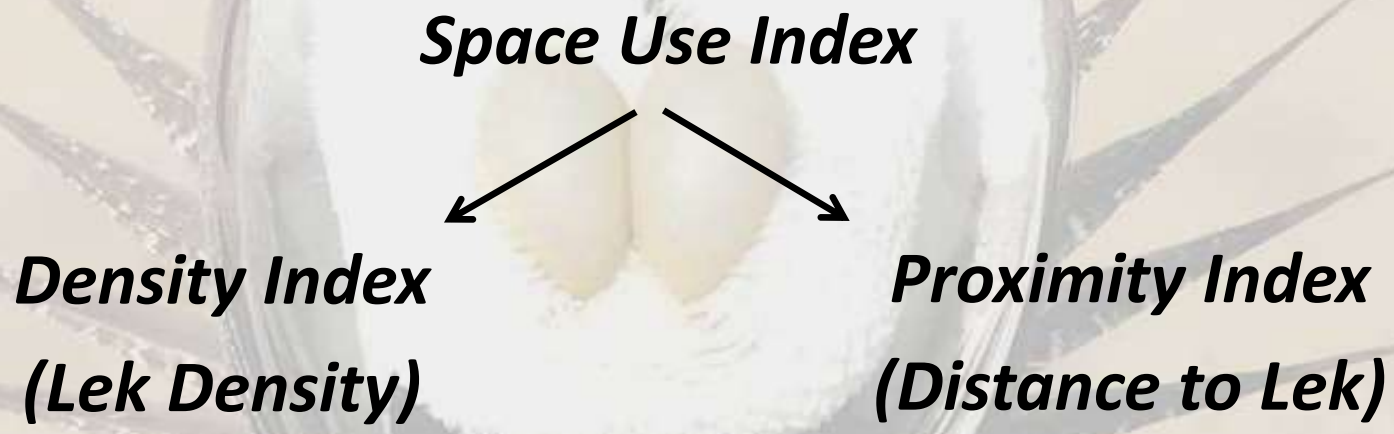
- **Index value:**

  $\bar{x} - 2\sigma$

- **Percentile rank 2.5% – 6.7%**

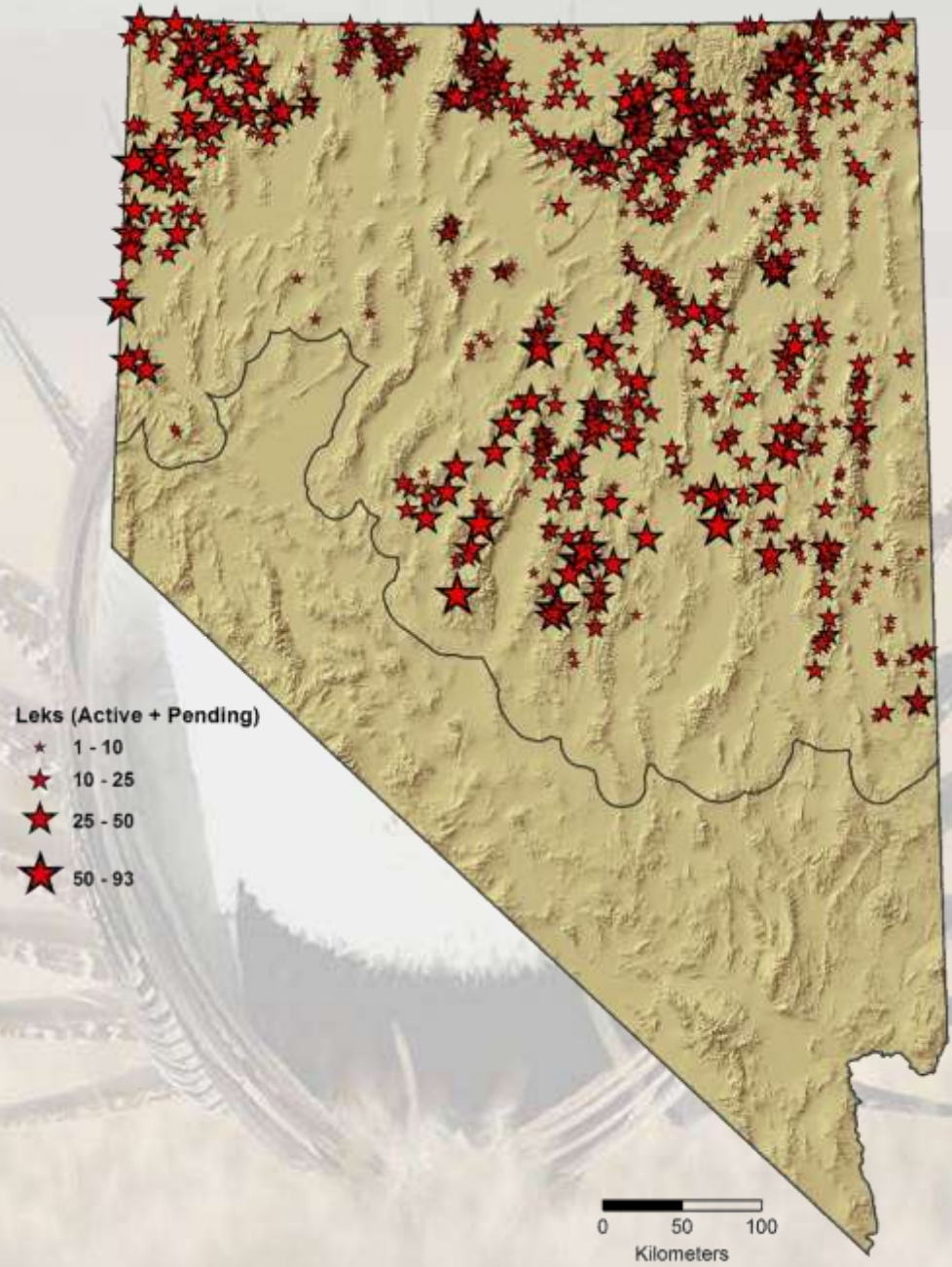
- **100% of leks (cumulative)**

Accounting for Known Occupancy of Lek Sites Sage-Grouse

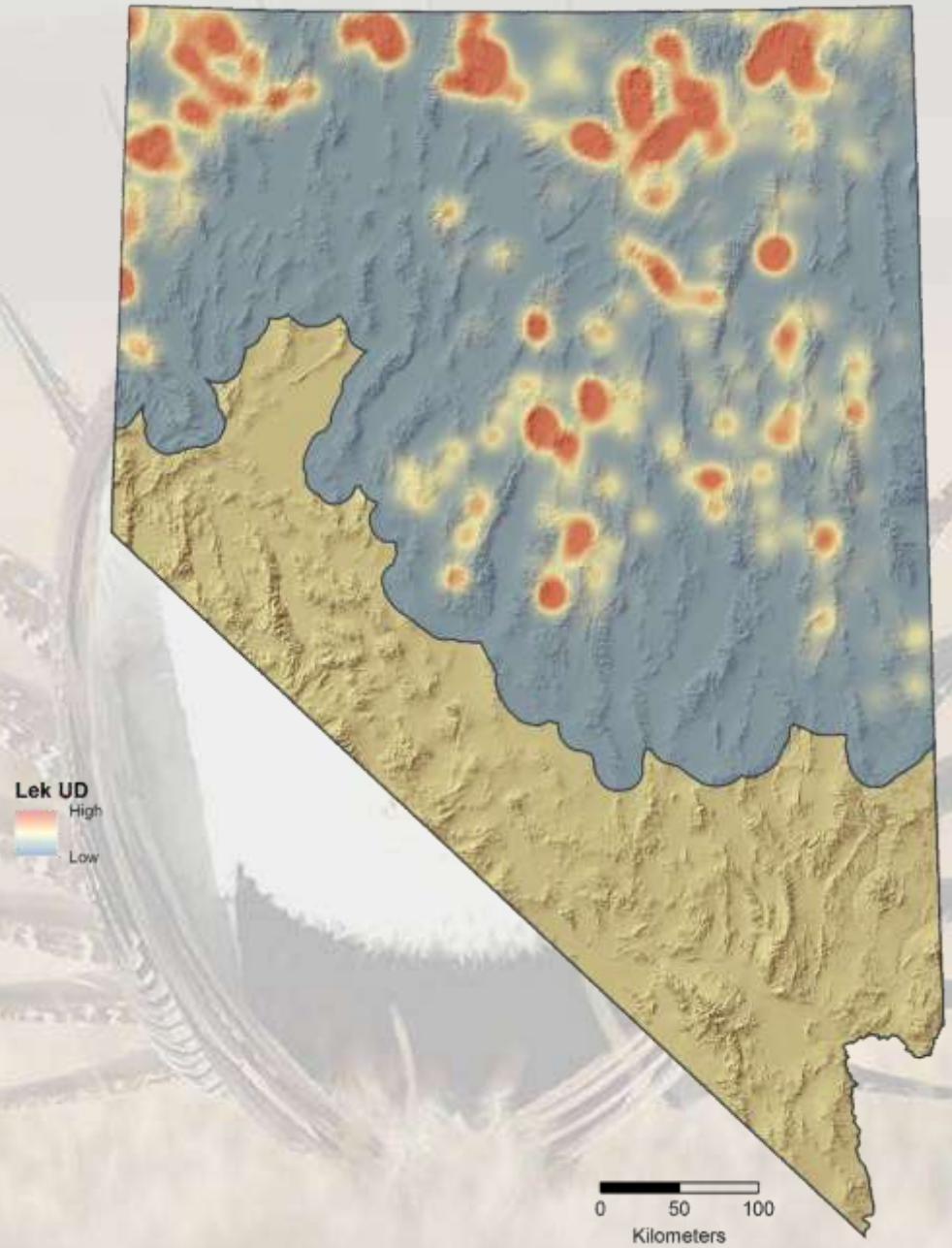


Lek Locations

Average 5-year lek counts



DRAFT - Lek Density Index Estimator

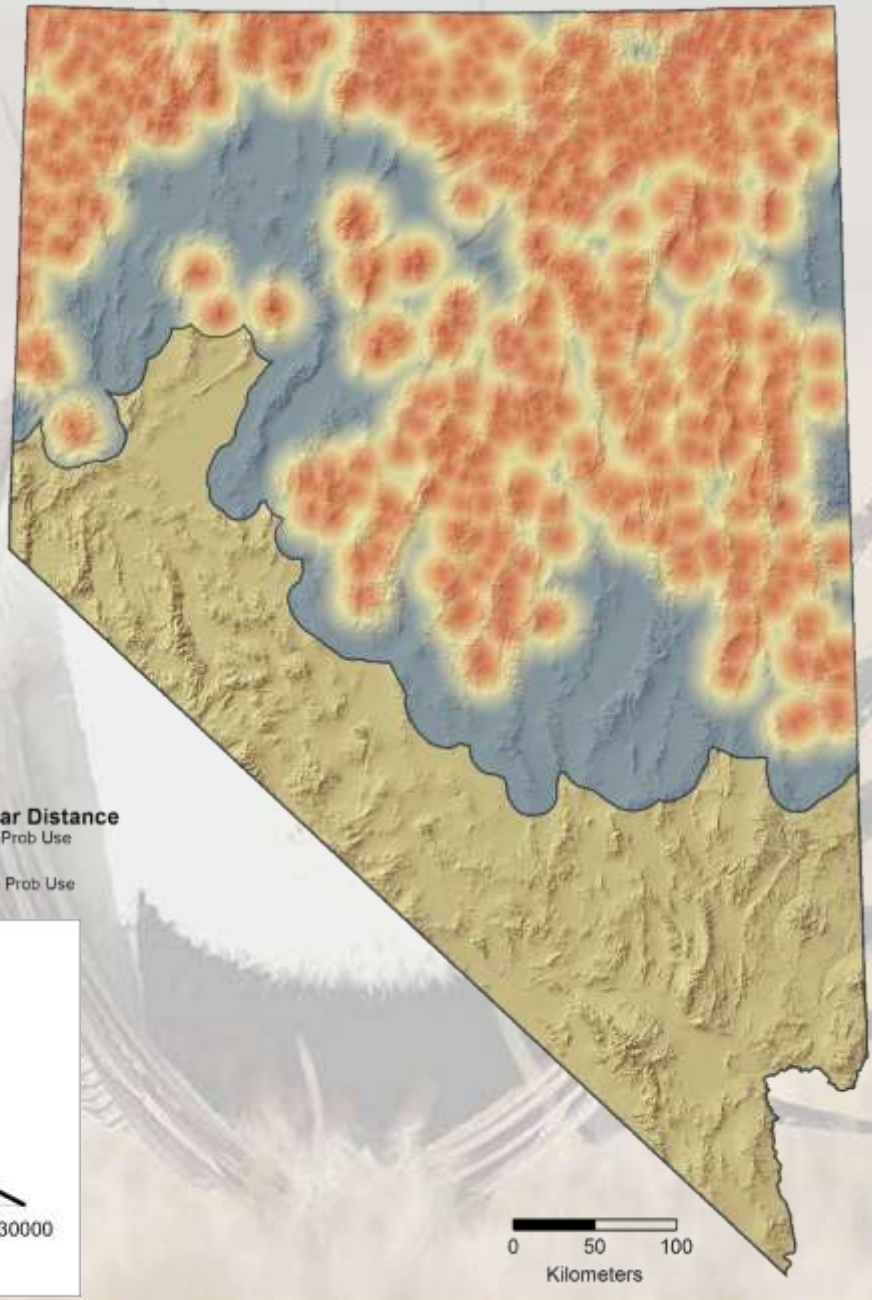


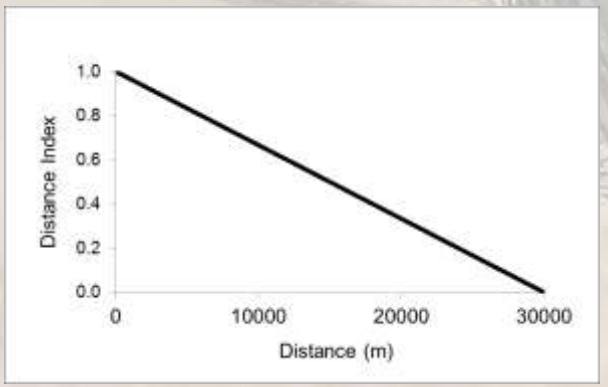
- *Kernel Estimator*

- *Weighted by 5-year count*

- *CVh smoothing*

Probability of Use: Linear Distance to Lek





The Journal of Wildlife Management 77(8):1598–1609; 2013; DOI: 10.1002/jwmg.618

Management and Conservation

Evaluating Greater Sage-Grouse Seasonal Space Use Relative to Leks: Implications for Surface Use Designations in Sagebrush Ecosystems

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SCOTT C. GARDNER, *California Department of Fish and Wildlife, 1416 9th Street, 12th Floor, Sacramento, CA 95814, USA*

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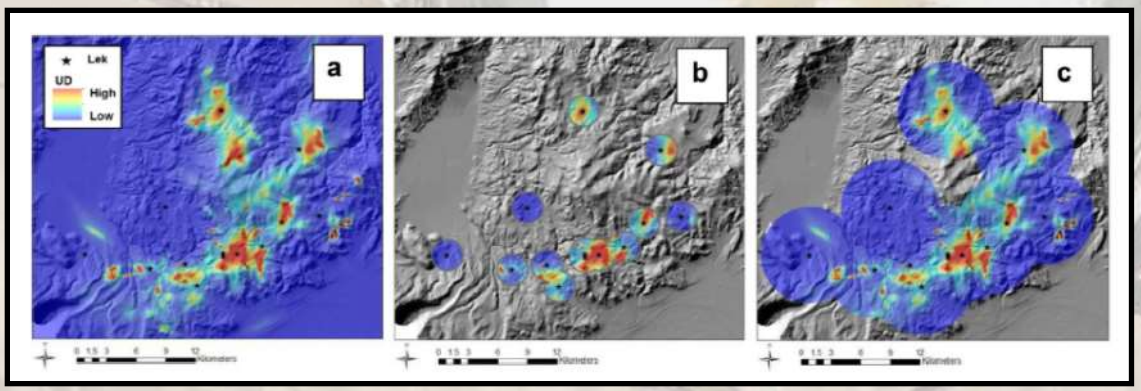
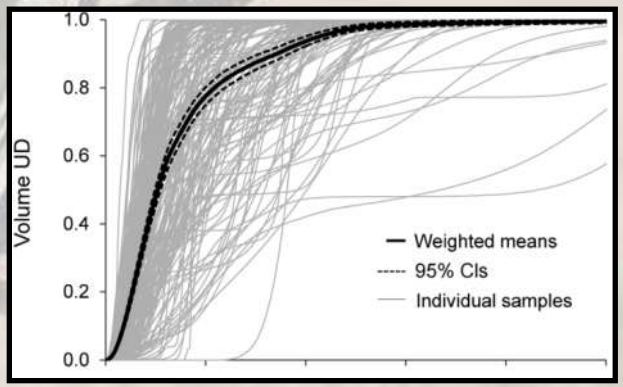
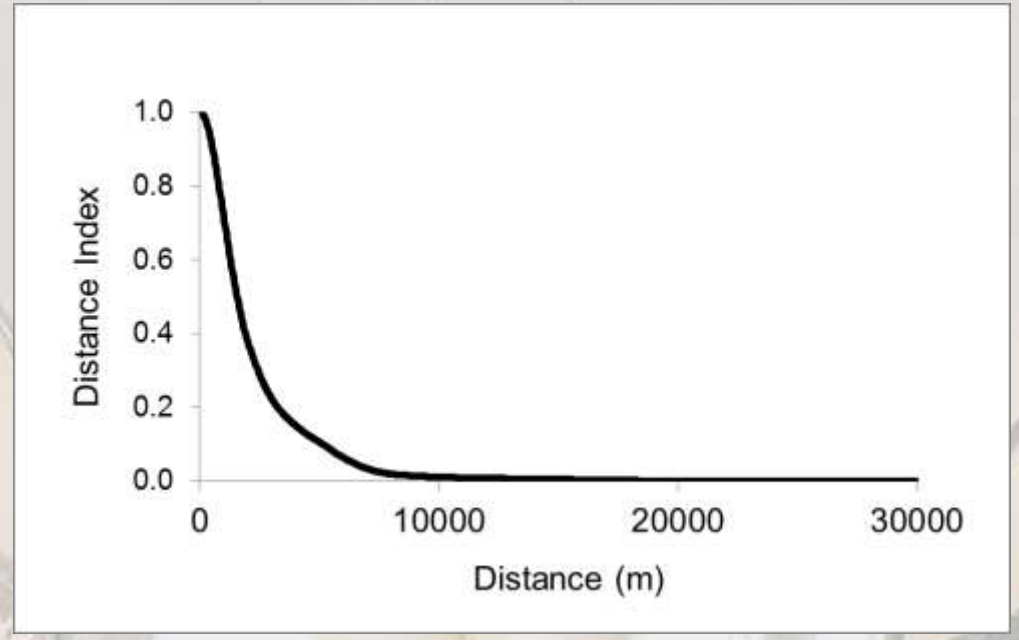
JULIE L. YEE, *U.S. Geological Survey, Western Ecological Research Center, 3020 State University Drive East, Modoc Hall, Suite 3006, Sacramento, CA 95819, USA*

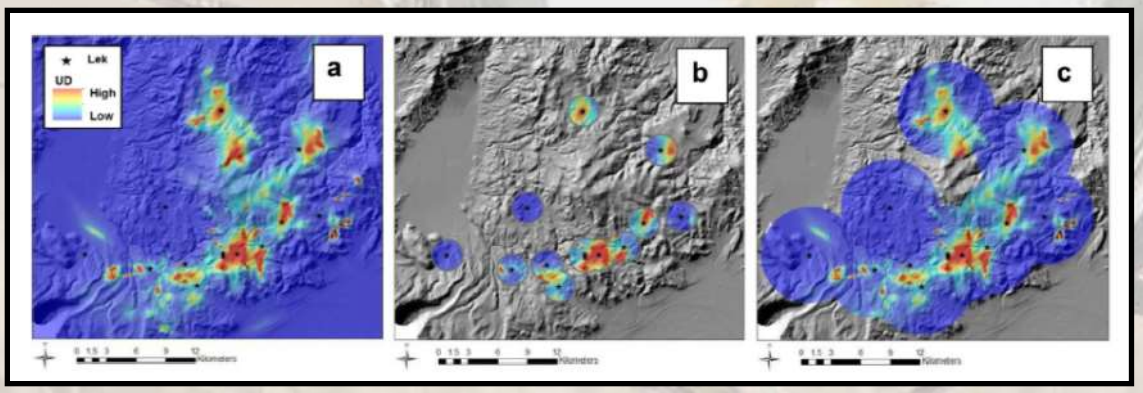
LIEF WIECHMAN, *Department of Fish and Wildlife Resources and Statistics, University of Idaho, P.O. Box 441136, Moscow, ID 83844, USA*

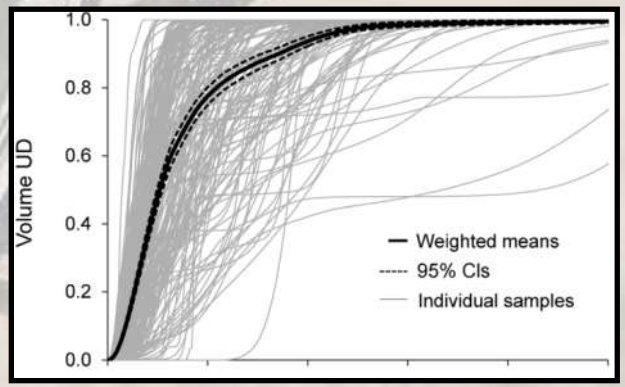
BRIAN J. HALSTEAD, *U.S. Geological Survey, Western Ecological Research Center, Dixon Field Station, 800 Business Park Drive, Suite D, Dixon, CA 95620, USA*



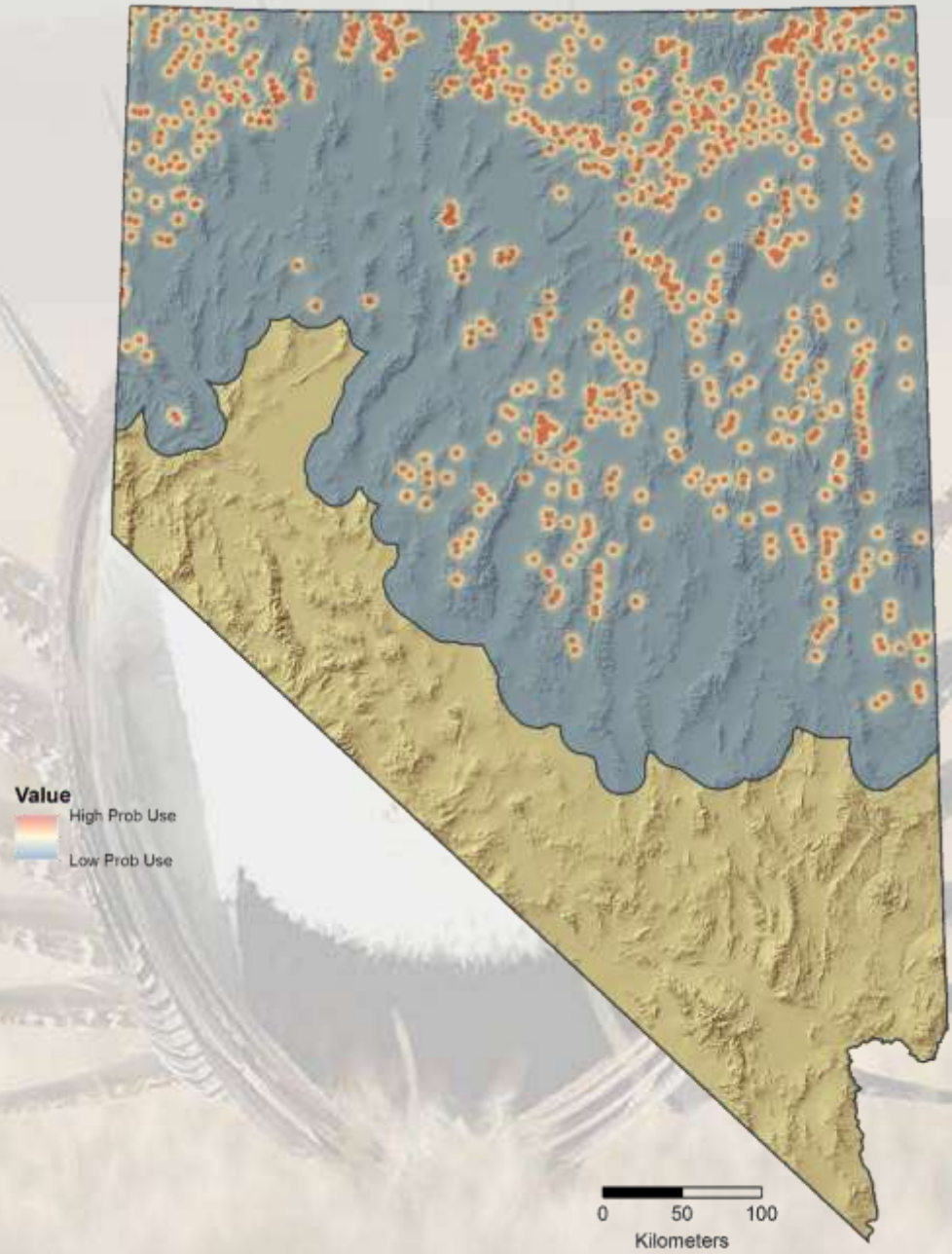



1.0
0.8
0.6
0.4
0.2
0.0
Distance Index
0
10000
20000
30000
Distance (m)

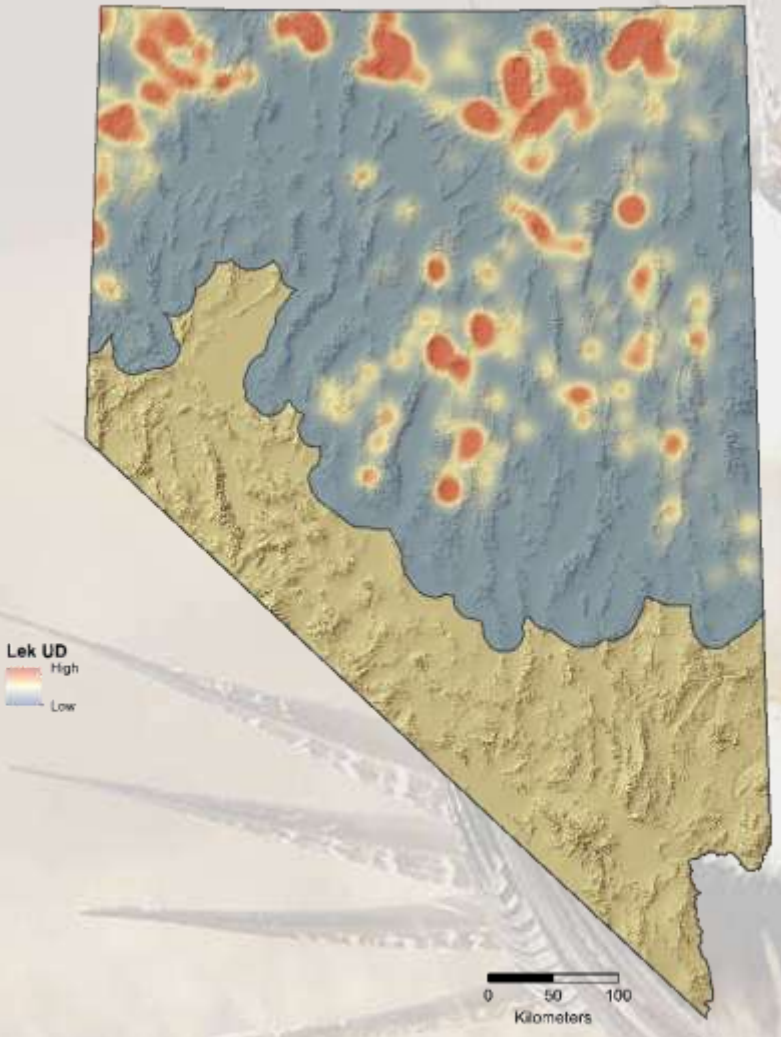

Lek
UD
High
Low
a
b
c


1.0
0.8
0.6
0.4
0.2
0.0
Volume UD
Weighted means
95% CIs
Individual samples

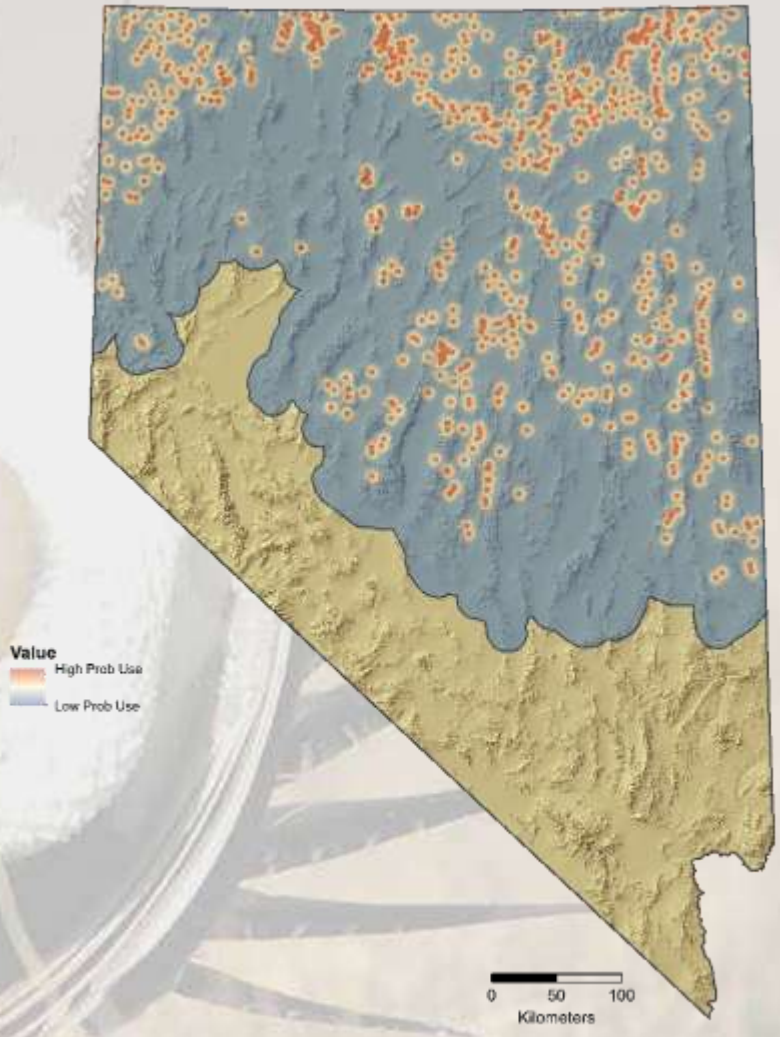
Probability of Use: Exponential Distance to Lek



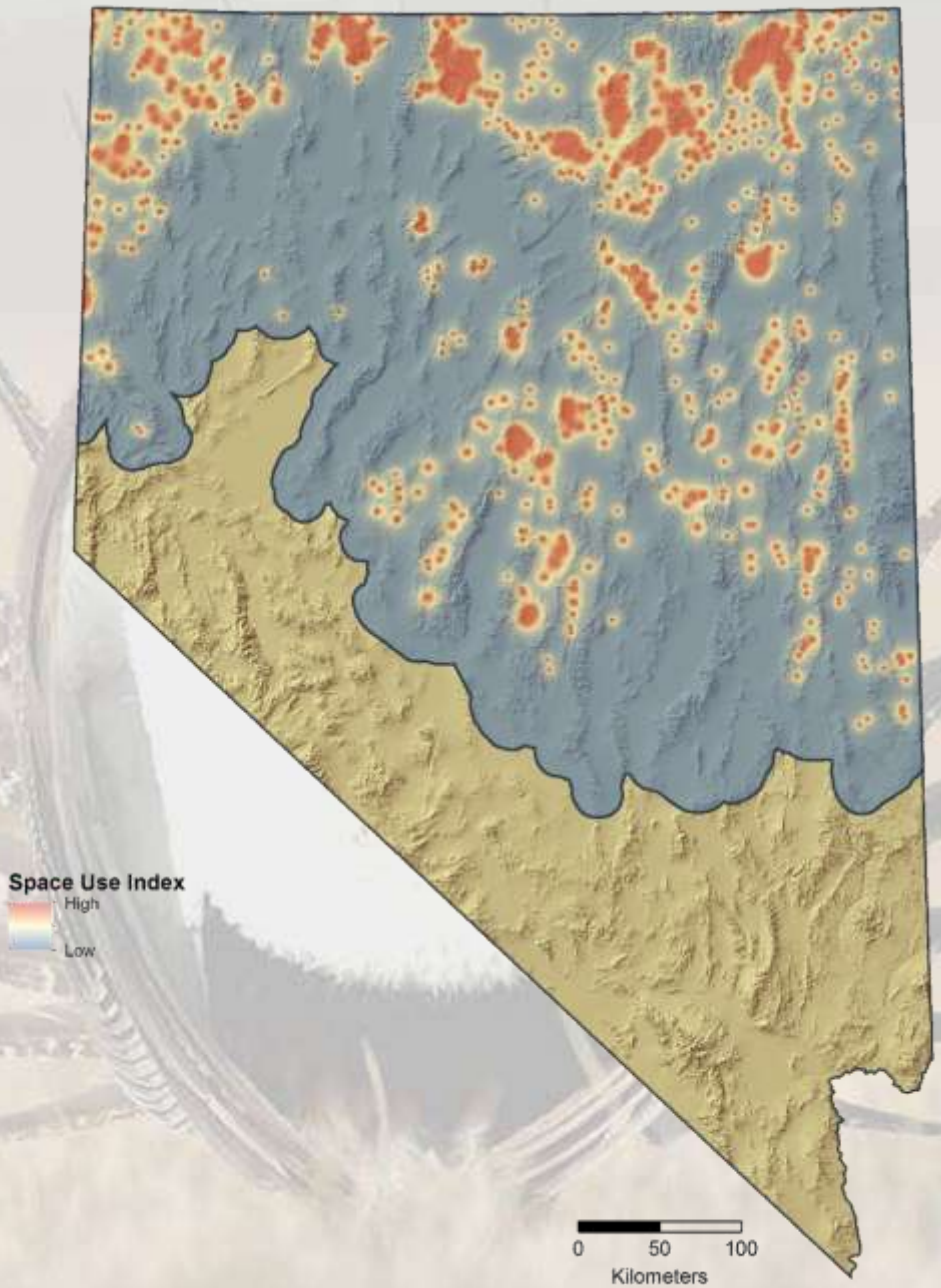
Density Index



Distance Index



DRAFT - Space Use Index (SUI)



Classifying ‘High’ Use Areas

≥85 percentile of SUI Surface

Validation telemetry data

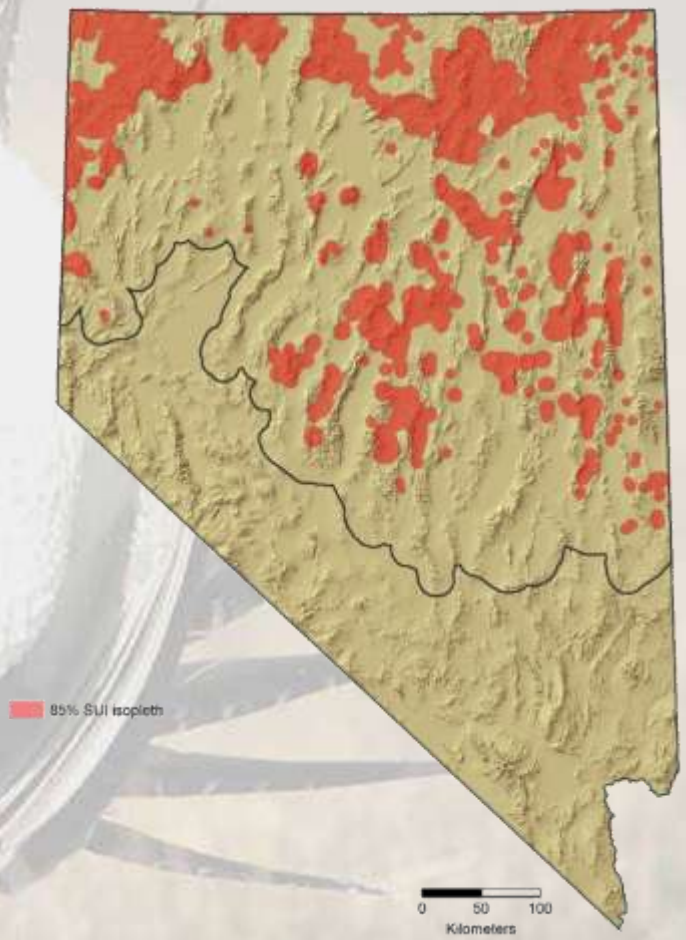
89.1% (82 – 92%)

Defining Core Areas

All 'Suitable' Habitat

∩

High Space Use



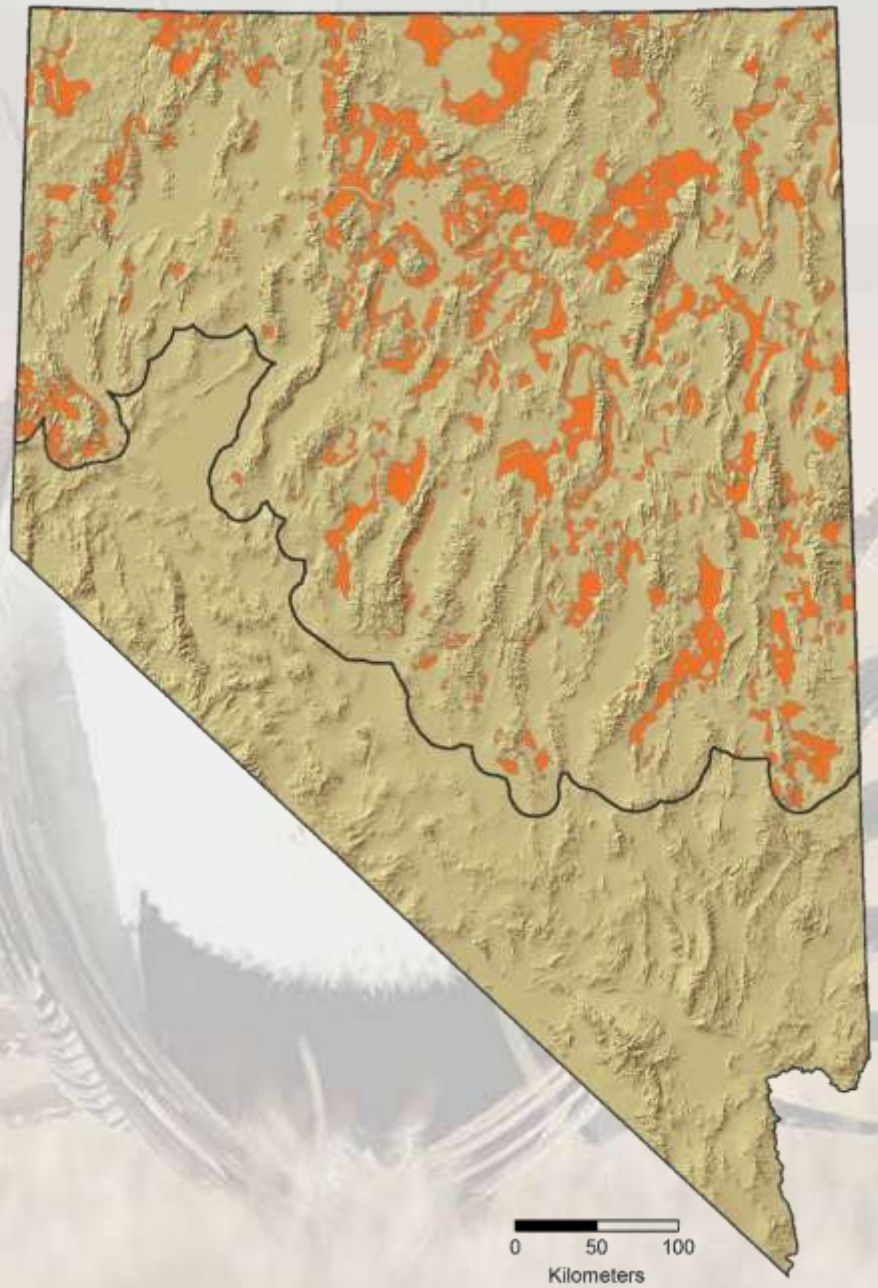
DRAFT - Core Area

Criteria:

- ***All habitat classes***
- ***Predicted high use areas*** **(estimated 89%)**

('Best of the best')

DRAFT - Priority Area



Criteria:

- **Outside of Core Areas**
- **High suitability habitat**
- **Estimated as low use (estimated ~6%)**

DRAFT - Low Suitable to General Area

Criteria:

- **Outside of Core Area**
- **Low and moderate suitability**
- **Estimated as low use (estimated <5%)**

DRAFT - Non-Habitat near High Use Area

Criteria:

- **Non-habitat**
- **Close proximity to high use areas (overlap with 85% SUI)**

Potential 'Indirect Effects'

DRAFT - Non-Habitat

Criteria:

- **Non-habitat**
- **Estimated as low use areas (estimated <1%)**

DRAFT – Four Management Categories for the Avoid Process

Core Management Category

- core area

Priority Management Category

- Priority area and non-habitat near high use area

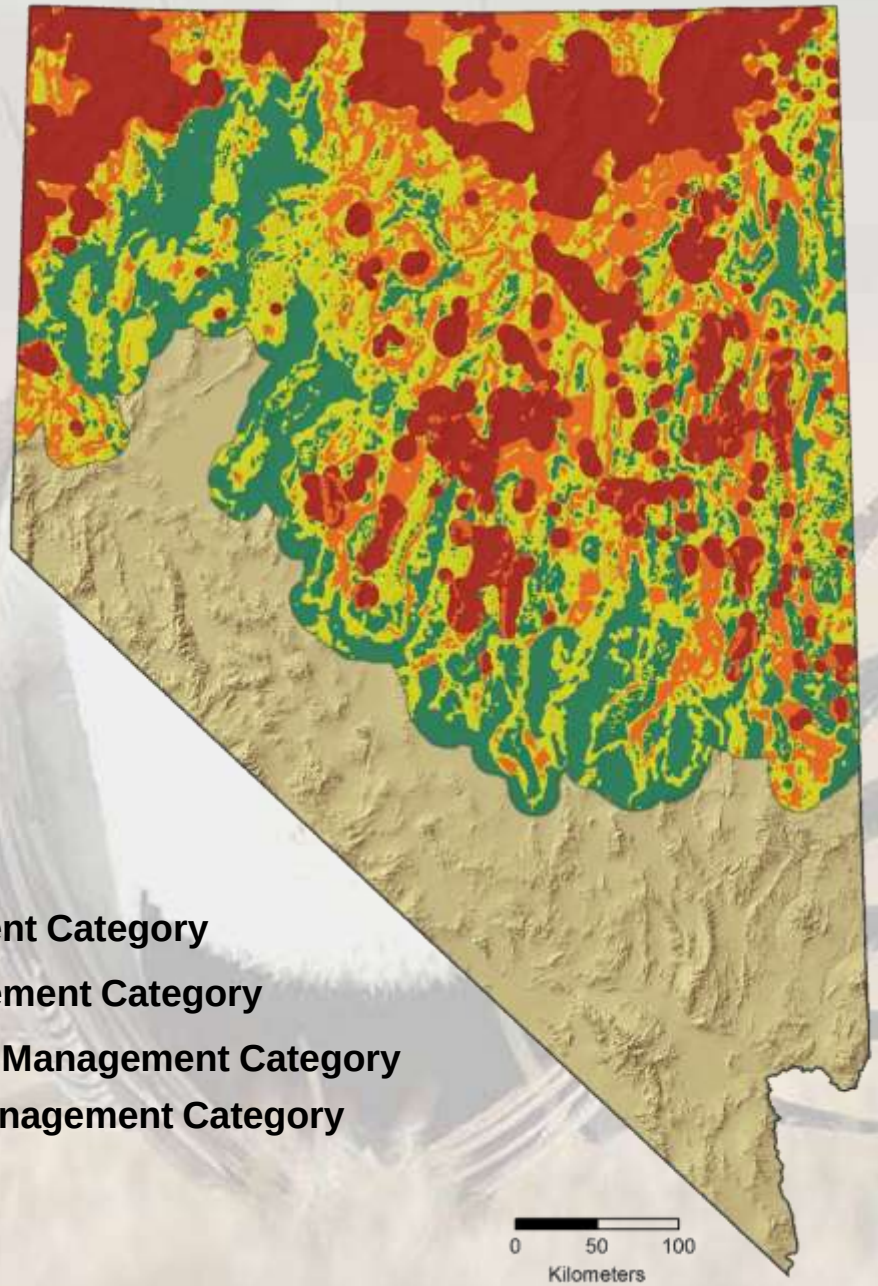
General Management Category

- low to general area

Non-Habitat Management Category

- Non-habitat area

DRAFT - Management Categories



Four management categories for the 'avoid process'

- Core Management Category
- Priority Management Category
- Low to General Management Category
- Non-Habitat Management Category

DRAFT - Sage-Grouse Management Area

- Area defined by modeled sage-grouse habitat
- Delineated area into four management categories:
  - Core Management Area
  - Priority Management Area
  - Low to General Management Area
  - Non-habitat Management Area