

Mitigation Planning for the Pinedale Anticline

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Protecting nature. Preserving life.™



Development By Design

A science based process to identify, incorporate and implement the mitigation hierarchy across a region (e.g. basin) or site (e.g. permitted area) based on potential impacts and goals for species and habitats.

Objective: net gains for nature

Follow “mitigation hierarchy”

Better “early warning” and planning

Reduce development-conservation conflicts

More effective use of biodiversity offsets

Conservation actions that compensate for residual, unavoidable harm to biodiversity

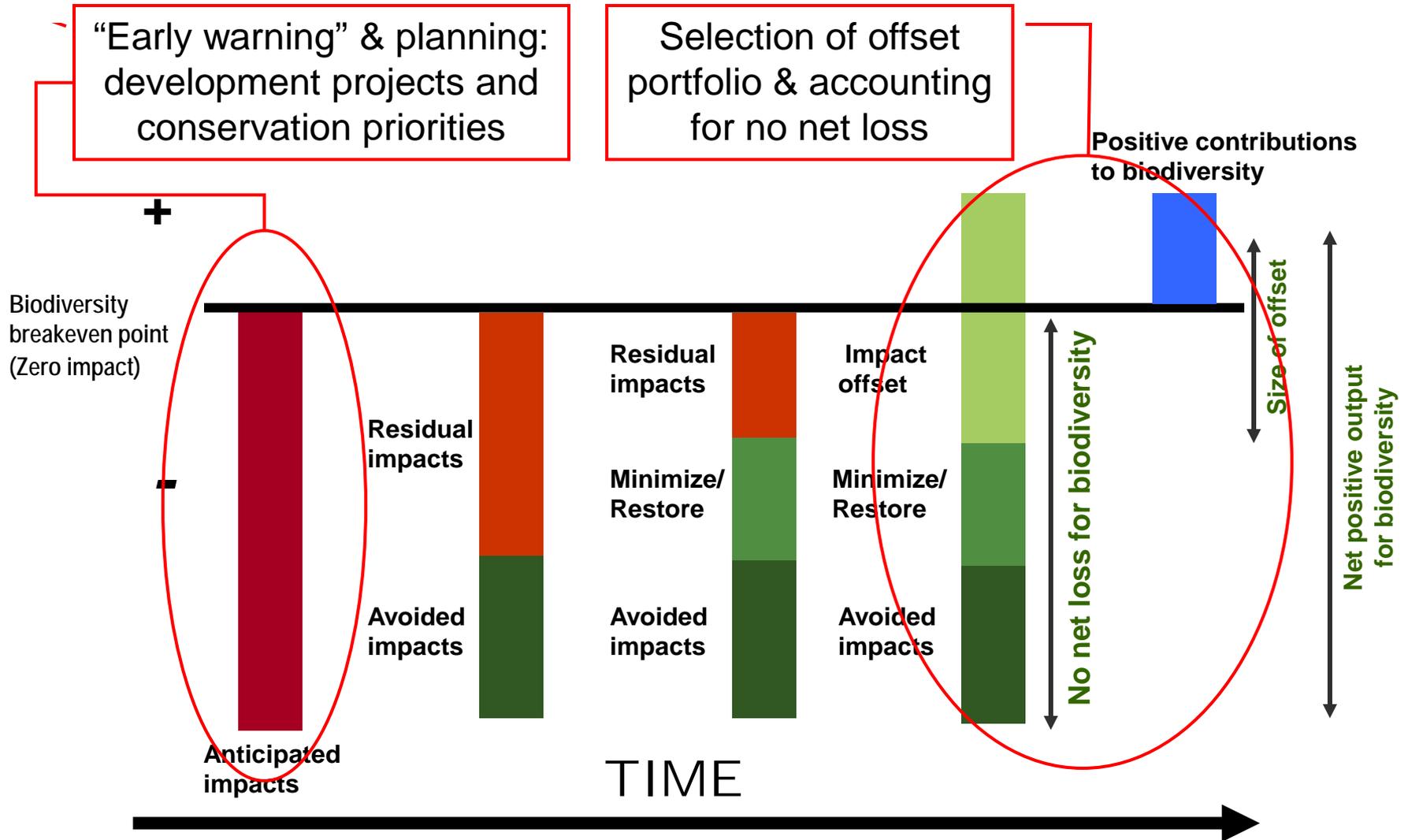
Avoid

Minimize

Restore

Offset

Avoid → **Minimize/Restore** → **Offset**



From Kiesecker et al. 2009

Kiesecker, J.M., H. Copeland, A. Pocewicz, N. Nibbelink, B. McKenney J. Dahlke, M. Holloran and D. Stroud 2009 A Framework for Implementing Biodiversity Offsets: Selecting Sites and Determining Scale. *BioScience* 59:77-84.

Kiesecker, J.M., H. Copeland, A. Pocewicz, B. McKenney 2009. Development by Design: Blending Landscape Level Planning with the Mitigation Hierarchy. *Frontiers In Ecology and the Environment* In Press

Development By Design

Key Questions



- Conforming with mitigation hierarchy
 - When should impacts be avoided vs. offset?
- Selecting suitable offset sites
 - Ecological equivalence?
 - Proximity to impact site?
 - Contribution to landscape level conservation goals?
- Achieving no net loss
 - Accounting framework?
 - How much is enough?

Development by Design Publications:

Kiesecker, JM, H Copeland, A Pocewicz, N Nibbelink, B McKenney, J Dahlke, M Holloran, and D Stroud 2009. A framework for implementing biodiversity offsets: selecting sites and determining scale. *BioScience* 59:77-84

Kiesecker, JM, H Copeland, A Pocewicz, and B McKenney 2009. Development by Design: Blending Landscape Level Planning with the Mitigation Hierarchy. *Frontiers in Ecology and the Environment* In Press

Copeland HE, Doherty KE, Naugle DE, Pocewicz A, Kiesecker JM (2009) Mapping Oil and Gas Development Potential in the US Intermountain West and Estimating Impacts to Species. *PLoS ONE* 4(10): e7400. doi:10.1371/journal.pone.0007400

McKenney, B. Kiesecker J.M. 2010. Policy Development for Biodiversity Offsets: A Review of Offset Frameworks. *Environmental Management* 45:165–176.

Sochi, K. Evans, J. and J. M. Kiesecker . 2010. Conservation in the Wyoming Basins Ecoregion: Planning Today by Assessing Future Scenarios . *Gap Analysis Bulletin* 17: 23-25

Doherty KE, DE Naugle, H Copeland, A Pocewicz, and JM Kiesecker 2009 Energy development and conservation tradeoffs: systematic planning for sage-grouse in their eastern range. *Studies in Avian Biology* In Press

Copeland, HE, A Pocewicz, and J Kiesecker (In Press) Geography of energy development in Western North America: Potential impacts to terrestrial ecosystems. Chapter in: *Energy development and wildlife conservation in Western North America* (Edited by DE Naugle)

Copeland, HE, KE Doherty, DE Naugle, A Pocewicz, and J Kiesecker (In Press) Forecasting development scenarios to aid in conservation design. Chapter in: *Energy development and wildlife conservation in Western North America* (Edited by DE Naugle)

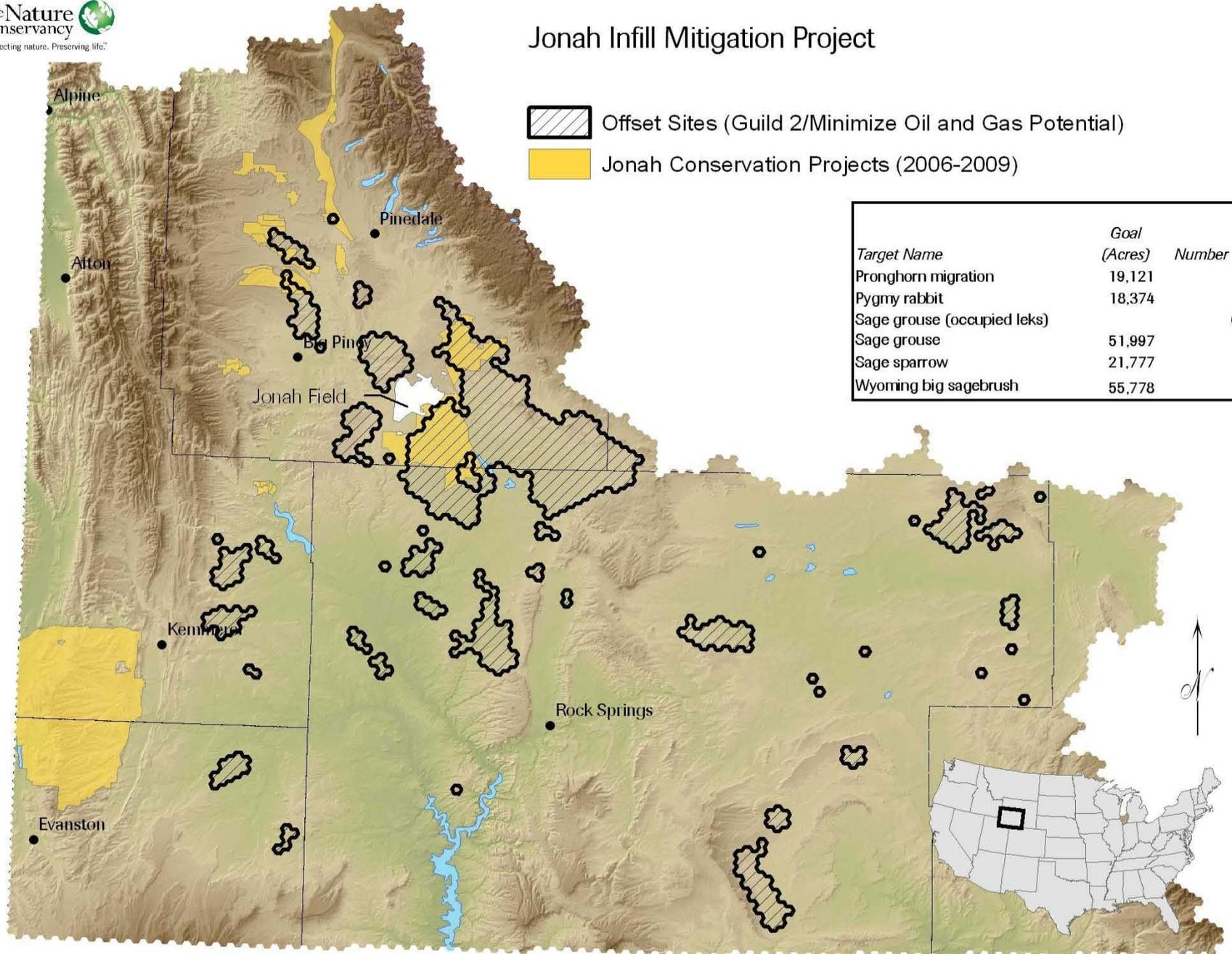
Kiesecker, JM, H Copeland, B McKenney, A Pocewicz, and K Doherty (In Press) Energy by Design: Making mitigation work for conservation and development. Chapter in: *Energy development and wildlife conservation in Western North America* (Edited by DE Naugle)

Kiesecker, J.M. McKenney, B. Copeland, H. and D. Stroud. (In Prep) Accounting 101: Assessing no-net-loss for biodiversity offsets. Target Journal: *Conservation Biology*

Kiesecker, J.M., Evans, J. Fargione, J. et al. Win-Win for Wind: A Vision to Facilitate Sustainable Development. Target Journal: *Science*

Evans, J. Kiesecker, J.M. Fargione, J. et al. Mapping human disturbance for bio diver conservation in the contiguous US. Target Journal: *Proceedings of the National Academy of Sciences, USA*

Jonah Infill Mitigation Project



OFF-SITE MITIGATION DESIGN PROJECT PROCESS

Assemble Team of Experts



Compile Key Species List for Jonah



**Gather Spatial Data &
Develop Species Models**



Set Species & Vegetation Goals



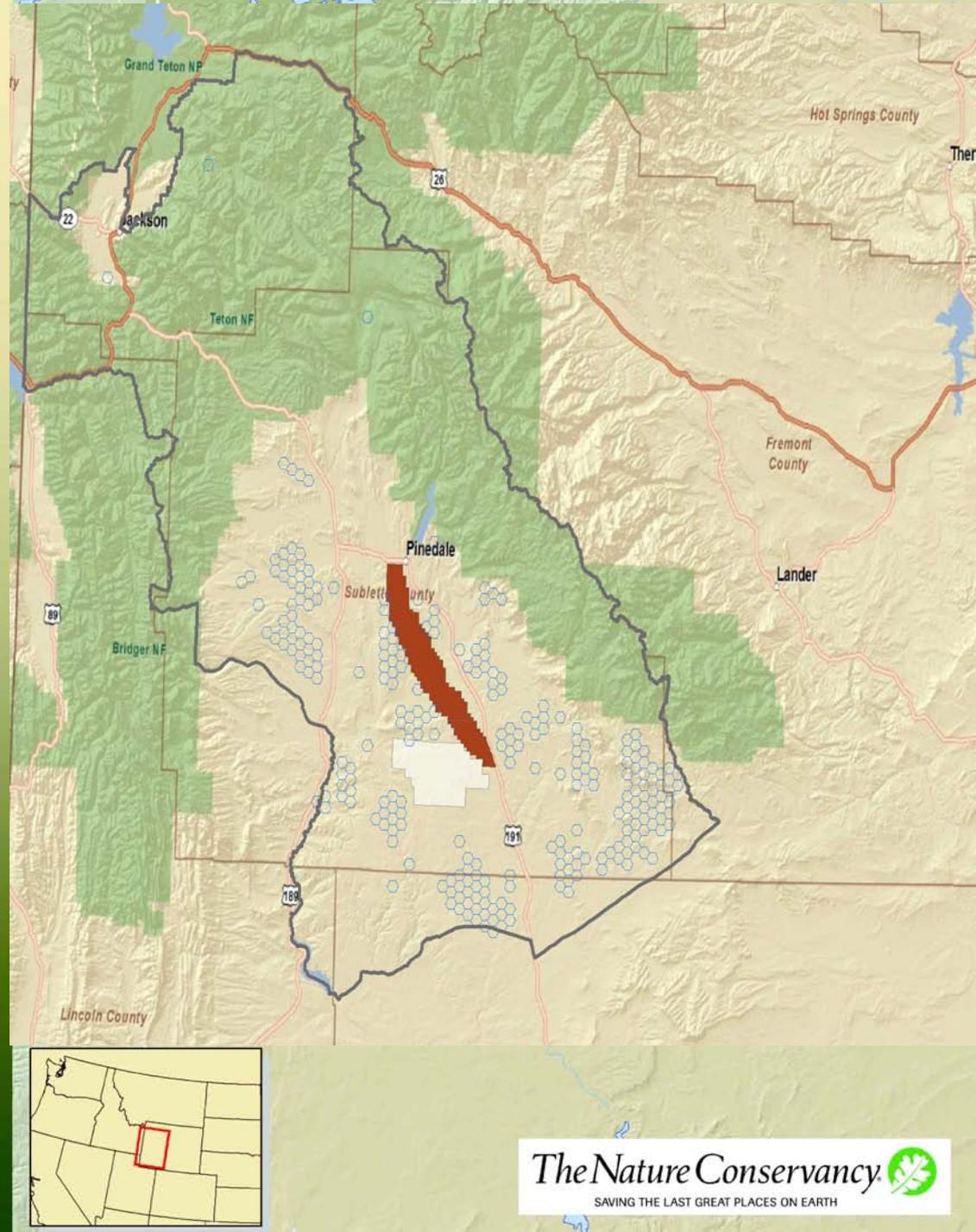
Run Marxan Model



Validate Model Results



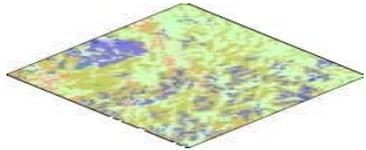
Report Results & Track Progress



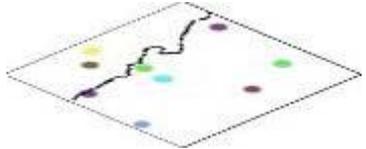
**Each step includes expert review*

Mitigation Planning: *portfolio design process*

Select BIODIVERSITY ELEMENTS



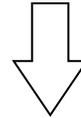
COARSE FILTER
Vegetation Types



FINE FILTER
Species

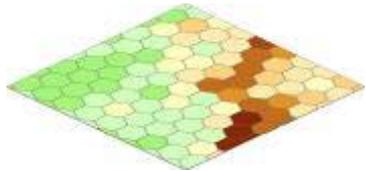
Set GOALS

**Acres of habitat or point locations (i.e. nests)
potentially Impacted by development**



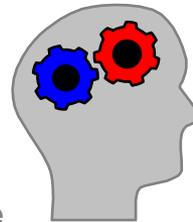
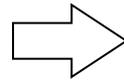
**automated
site selection
(MARXAN)**

assess ECOLOGICAL CONDITION



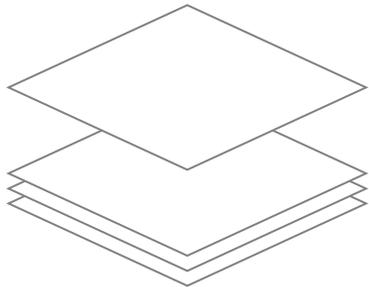
Cost / Suitability Index

- Road & RR Density
- Population Density
- Converted Land Cover
- Irrigated Land Cover
- Housing density

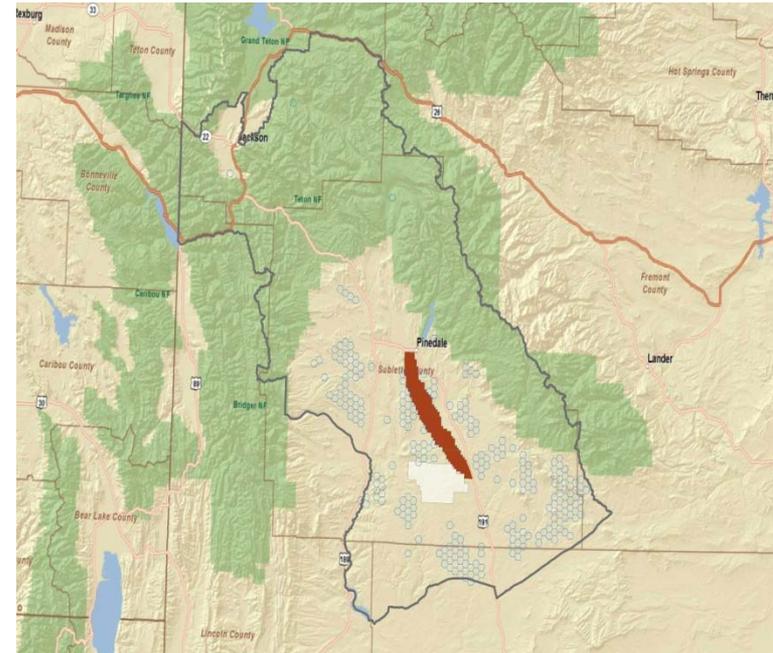


**Expert
Review/Data
Based Model
Validation
and Refinement**

Mitigation Portfolio Design:



**Future development pressure
(areas under concession)
other rules**



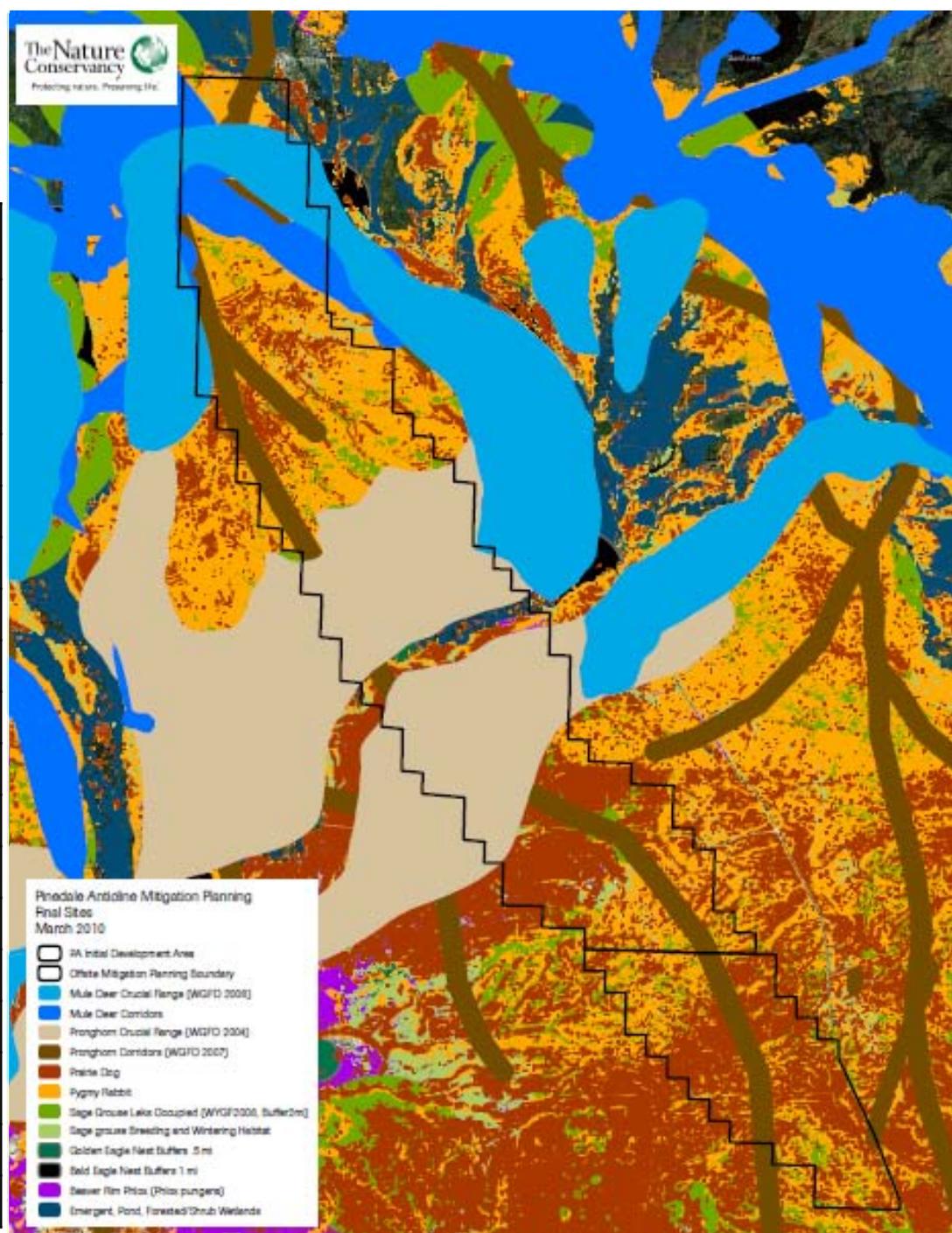
Pinedale Anticline Mitigation Targets

<i>Conservation target</i>
Mule deer crucial winter range
Mule deer migration corridors
Pronghorn crucial winter range
Pronghorn migration corridors
White-tailed prairie dog and associated targets
Pygmy rabbit habitat
Sage-grouse occupied leks
Sage-grouse breeding and wintering habitat
Golden eagle nests
Bald eagle nests
Phlox pungens
Wetlands
Inter-Mountain Basins Big Sagebrush Steppe (117)
Inter-Mountain Basins Big Sagebrush Shrubland (97)
Intermountain Basins Greasewood Flat (159)
Western Great Plains Riparian Woodland and Shrubland (198)
Northwestern Great Plains Mixedgrass Prairie (130)
Inter-Mountain Basins Montane Sagebrush Steppe (118)

Pinedale Anticline

Targets and Goals

Conservation target
Mule deer crucial winter range
Mule deer migration corridors
Pronghorn crucial winter range
Pronghorn migration corridors
White-tailed prairie dog and associated targets
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Pinedale Anticline

Mitigation Targets and Goals

<i>Conservation target</i>	<i>Goal (hectares or number)</i>
Mule deer crucial winter range	1,365
Mule deer migration corridors	1,700
Pronghorn crucial winter range	7,705
Pronghorn migration corridors	5,162
White-tailed prairie dog and associated targets	11,538
Pygmy rabbit habitat	19,272
Sage-grouse occupied leks	10
Sage-grouse breeding and wintering habitat	21,890
Golden eagle nests	5
Bald eagle nests	2
Beaver Rim Phlox (Phlox pungens)	3,643
Wetlands	596
Inter-Mountain Basins Big Sagebrush Steppe (117)	8,356
Inter-Mountain Basins Big Sagebrush Shrubland (97)	15,134
Intermountain Basins Greasewood Flat (159)	134
Western Great Plains Riparian Woodland and Shrubland (198)	487
Northwestern Great Plains Mixedgrass Prairie (130)	197
Inter-Mountain Basins Montane Sagebrush Steppe (118)	286

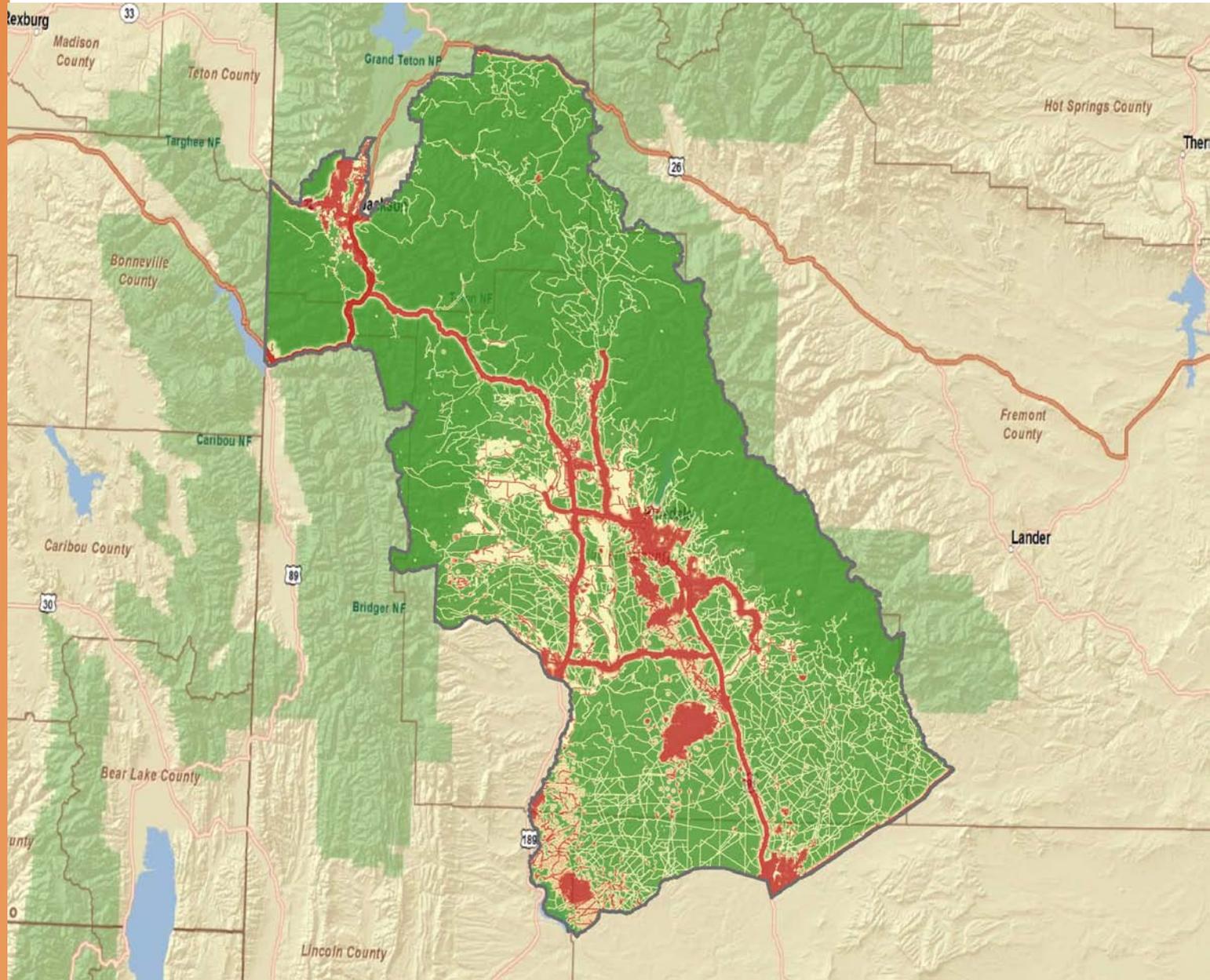
Cost Surface

Avoid

Minimize

Restore

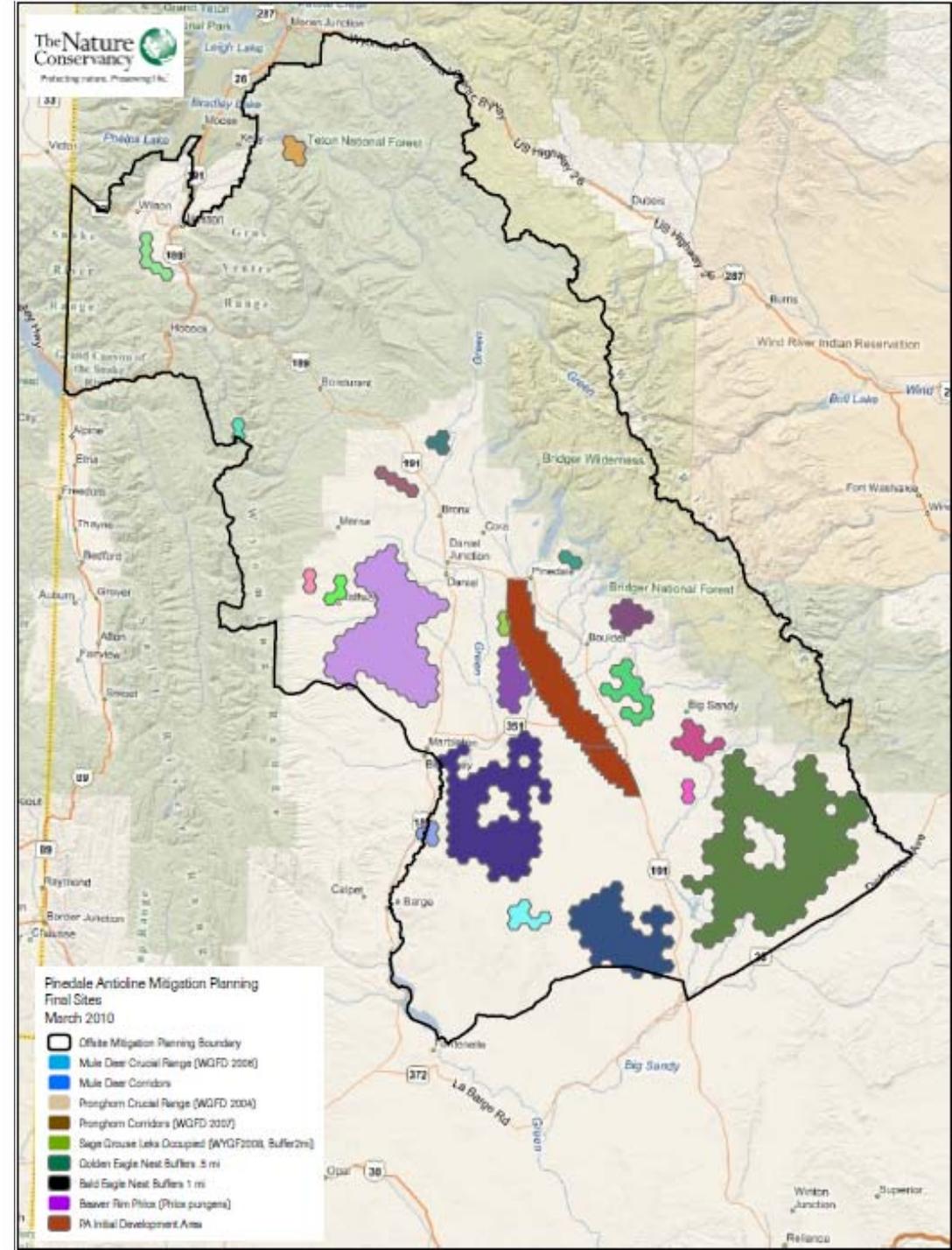
Offset



Project Area

Targets Spatial Data

Conservation target
Mule deer crucial winter range
Mule deer migration corridors
Pronghorn crucial winter range
Pronghorn migration corridors
White-tailed prairie dog and associated targets
Pygmy rabbit habitat
Sage-grouse occupied leks
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Northwestern Great Plains Mixedgrass Prairie (130)
Inter-Mountain Basins Montane Sagebrush Steppe (118)



Target ID	Conservation target	Target Goal (Acres)	Target Acres in Prop. Solution	Goal Met	Run Target Met?
1	Mule deer crucial winter range	3,373	82,918	24.6	Yes
2	Mule deer migration corridors	4,201	74,421	17.7	Yes
3	Pronghorn crucial winter range	19,039	99,567	5.2	Yes
4	Pronghorn migration corridors	12,755	75,922	6.0	Yes
5	White-tailed prairie dog and associated targets	1,567	183,187	116.9	Yes
6	Pygmy rabbit habitat	47,621	220,116	4.6	Yes
7	Sage-grouse occupied leks, buffered by 2 mi	44,461	229,652	5.2	Yes
8	Sage-grouse breeding and wintering habitat	54,090	310,588	5.7	Yes
10	Golden eagle nests, buffered by 0.5 miles	501.613	502	1.0	Yes
11	Bald eagle nests, buffered by 1 mile	2011.394	6,846	3.4	Yes
12	Beaver Rim Phlox (Phlox pungens)	9,002	57,548	6.4	Yes
16	Emergent, Forested/Shrub, Pond Wetlands	1,473	9,110	6.2	Yes
17	Inter-Mountain Basins Big Sagebrush Steppe (117)	20,648	90,694	4.4	Yes
18	Inter-Mountain Basins Big Sagebrush Shrubland (97)	37,396	197,761	5.3	Yes
20	Intermountain Basins Greasewood Flat (159)	331	1,290	3.9	Yes
21	Western Great Plains Riparian Woodland and Shrubland (198)	1,203	2,685	2.2	Yes
22	Northwestern Great Plains Mixedgrass Prairie (130)	487	1,209	2.5	Yes
23	Inter-Mountain Basins Montane Sagebrush Steppe (118)	707	24,515	34.7	Yes

Project Area Mitigation Portfolio

Land Management

Conservation target

Mule deer crucial winter range

Mule deer migration corridors

Pronghorn crucial winter range

Pronghorn migration corridors

White-tailed prairie dog and associated targets

Pygmy rabbit habitat

Sage-grouse occupied leks

Sage-grouse breeding and wintering habitat

Golden eagle nests

Bald eagle nests

Phlox pungens

Wetlands

Inter-Mountain Basins Big Sagebrush Steppe (117)

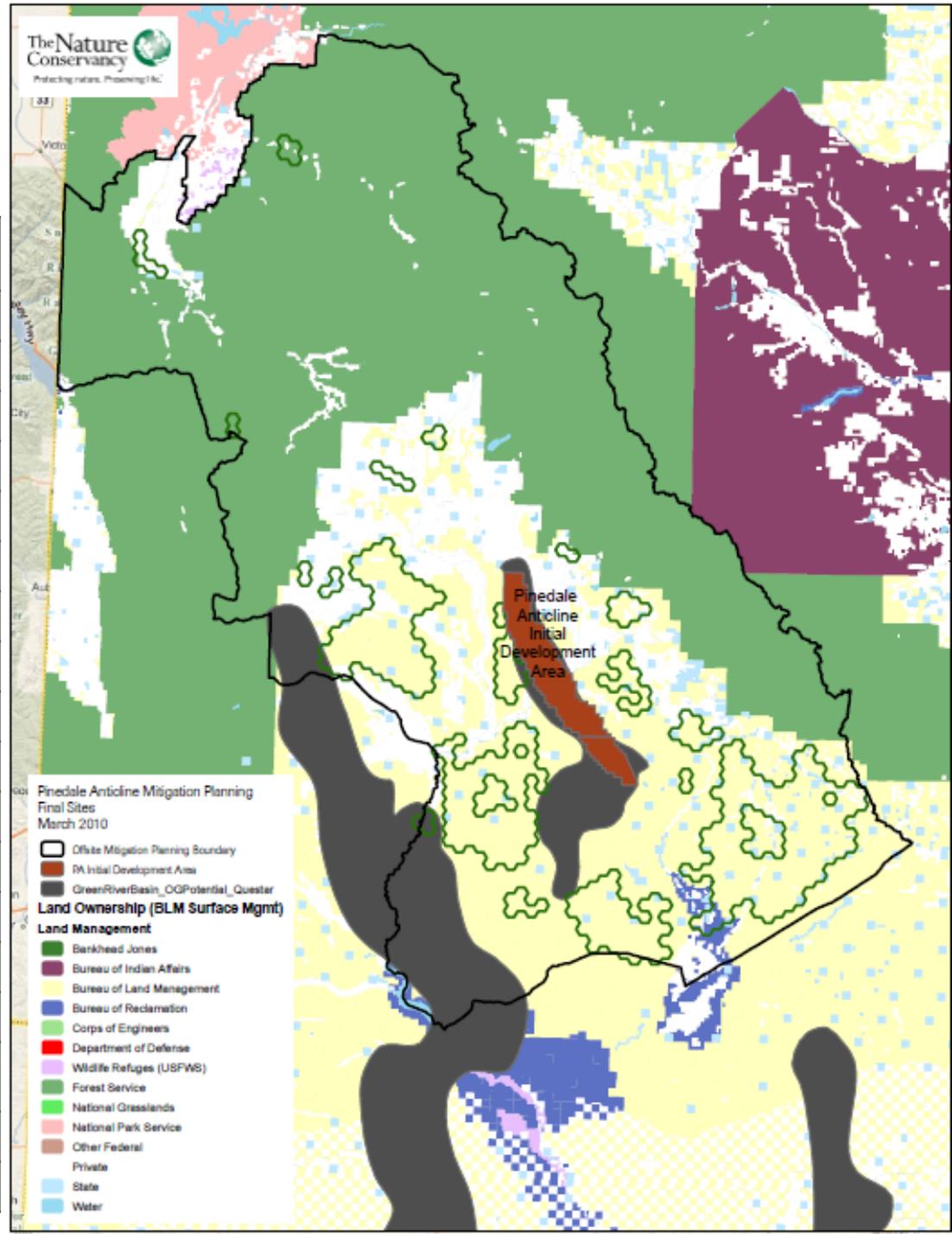
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Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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US Dept of State Geographer

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Impact Site



Offset Sites and Actions:



Protection



Restoration

Offset Accounting Framework

Hectares of impact = Goal	2000 ha	
Offset portfolio	Site A	Site B
Hectares of suitable habitat	3000 ha	3000 ha
Conservation action	Protection	Restoration
Expected background rate of loss (res dev)	10%/yr	0%/yr
Probability of success	90%	25%
Timing (yrs to conservation maturity)	0 yrs	15 yrs
Actual offset hectares	1659 ha	380 ha
% of goal	83%	19%
Offset to impact ratio	1.8 to 1	7.9 to 1
Cost per hectare	\$1,500/ha	\$400/ha
Total cost for offset	\$4.5 million	\$1.2 million
Cost per offset hectare delivered	\$2,700/ha	\$3,200/ha