Development by Design:

Blending Science, Policy and Practice to Improve Mitigation in the Real World

Joseph Kiesecker Ph.D.

Lead Scientist
Director
Development by Design

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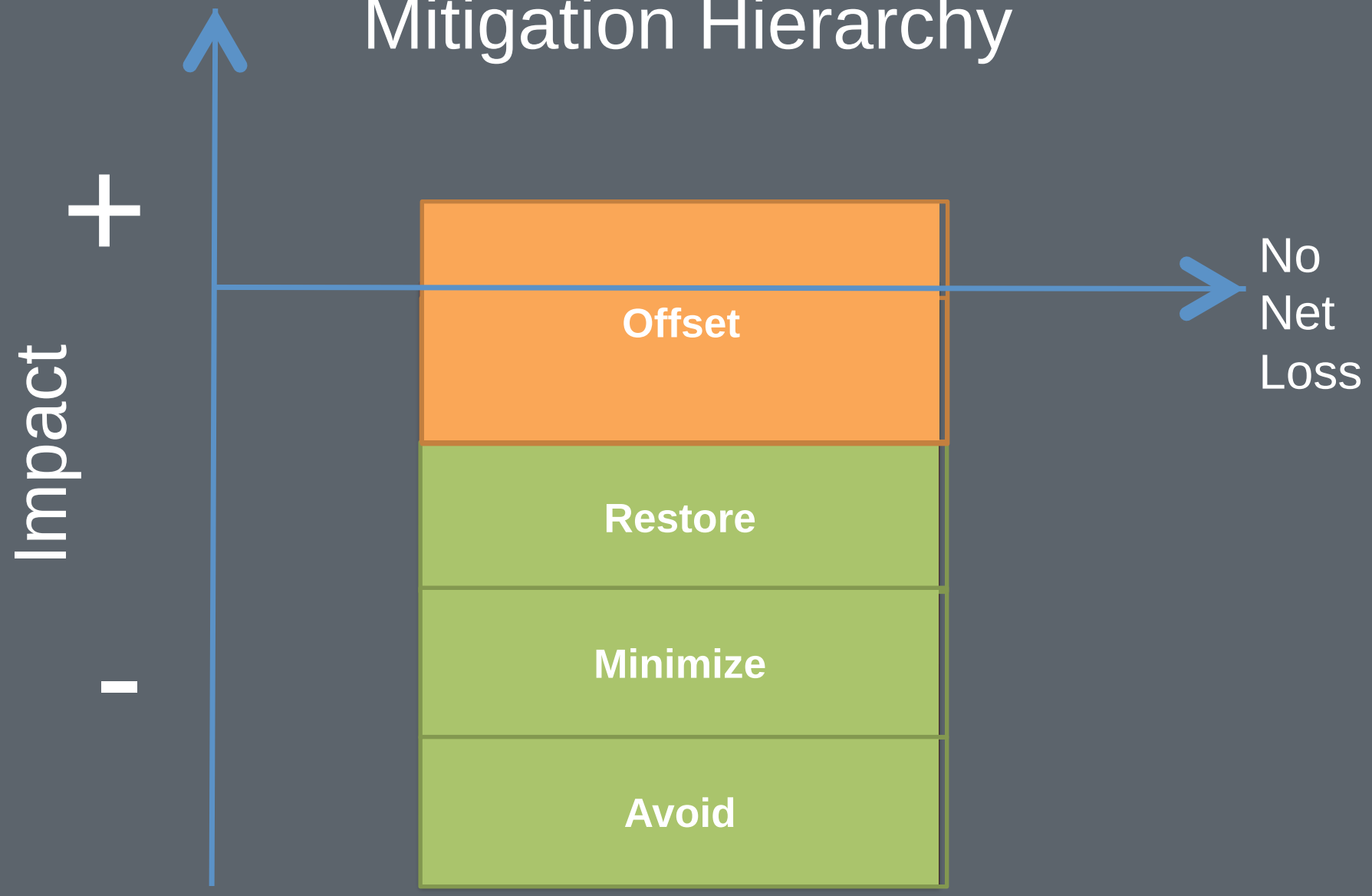
Mitigation Hierarchy



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.*

Common Problems with Mitigation Process

Avoid
↓
Minimize
↓
Restore
↓
Offset

- Arbitrary, opaque and ad hoc approach
- Reactive piecemeal planning
- Cumulative Impacts Often Not Assessed
- Improper ecological scale
- Lack of defined outcome
- Assessments often time/cost-prohibitive

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What needs to change?

Avoid

Minimize

Restore

Offset

GO BIG

-Site based to landscape scale

-Revise current EIA process?

GO EARLY

-Project future potential development

-Advanced mitigation planning

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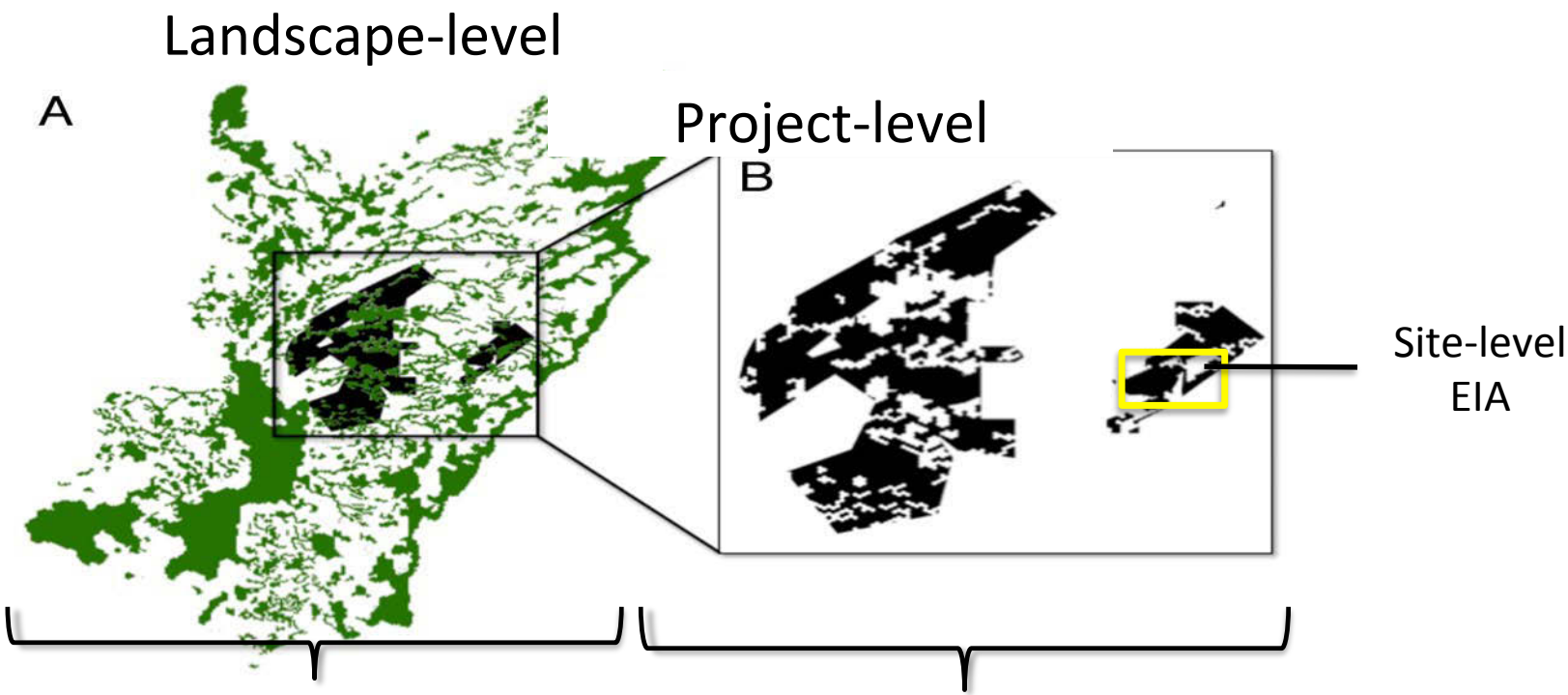

Siting Decisions

Offset Design

Impact & Offset Accounting

Key Steps

Avoid

Minimize

Restore

Offset

Create a Conservation Vision

- How much is enough?
- Stakeholder engagement

Projecting Development

- Where?
- How Much?

Estimating Impacts & Effectiveness of Mitigation Actions

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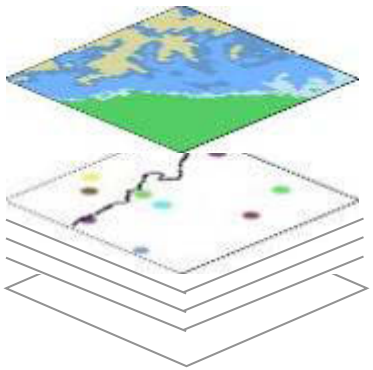
Development by Design Process

Select BIODIVERSITY ELEMENTS



COARSE FILTER
Vegetation Types

FINE FILTER
Species

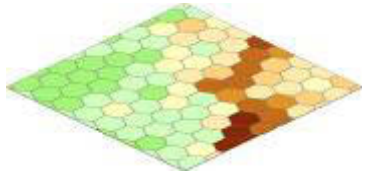
Other Goals i.e. Eco. Services
Social/Cultural

Set GOALS

(X) Acres of habitat needed to maintain viability

(Y) Acres of habitat or point locations (i.e. nests) needed to maintain viability

assess ECOLOGICAL CONDITION



Cost / Suitability Index

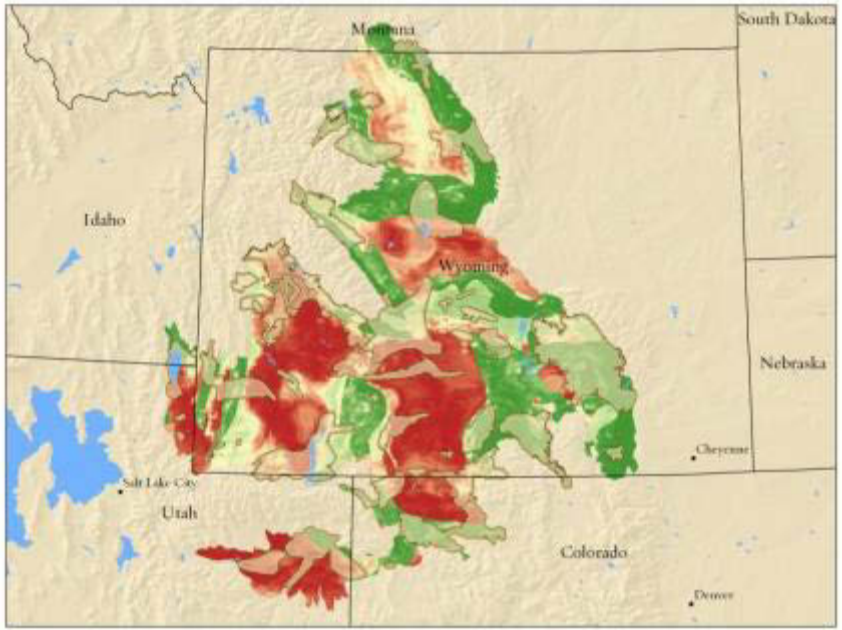
- Road & RR Density
- Population Density
- Converted Land Cover
- Irrigated Land Cover
- Housing density

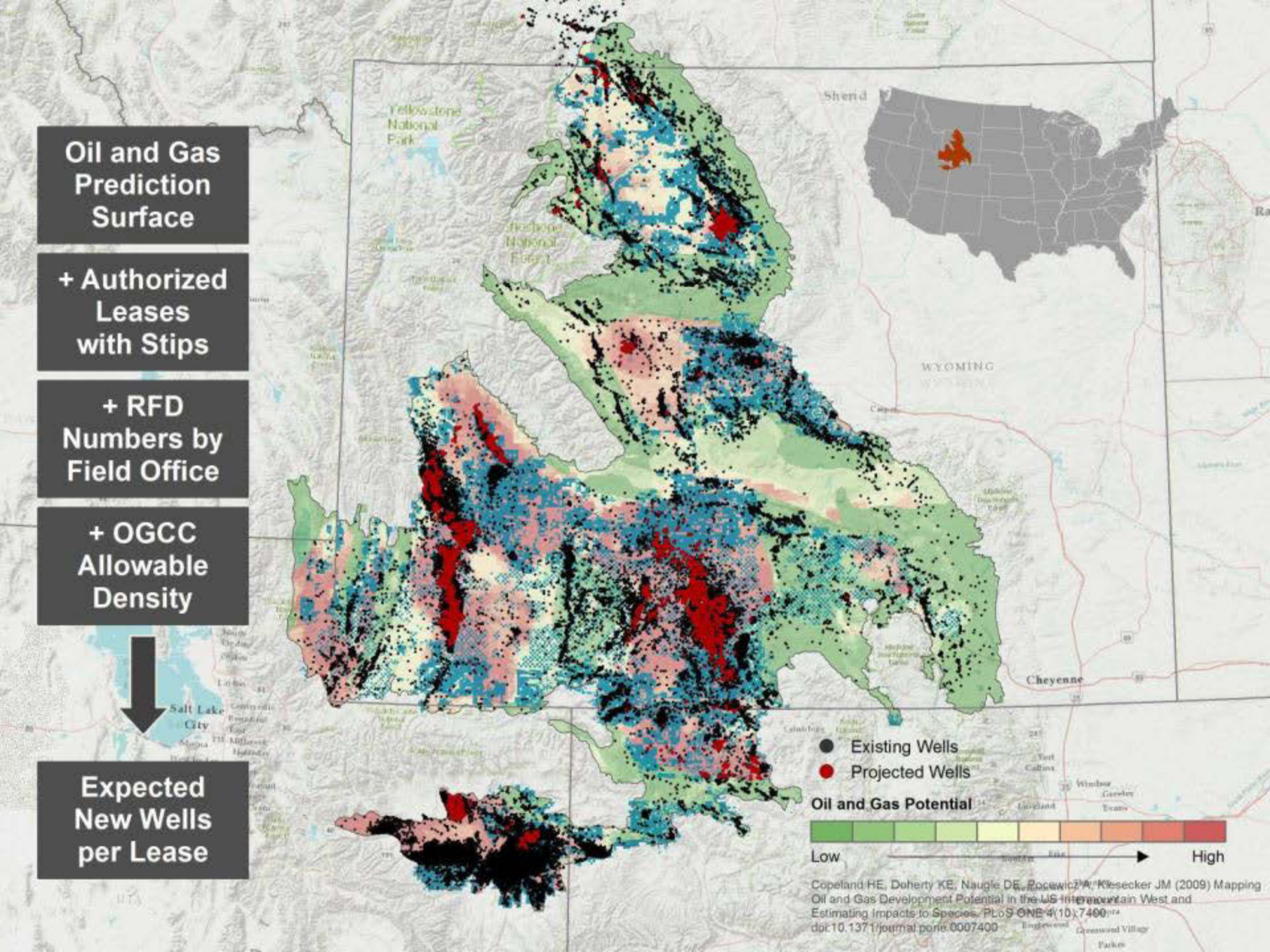
Future development pressure

(Z) Amount of production

Conservation Portfolio Design:
Development Portfolio Design:

automated site selection (MARXAN with ZONES)



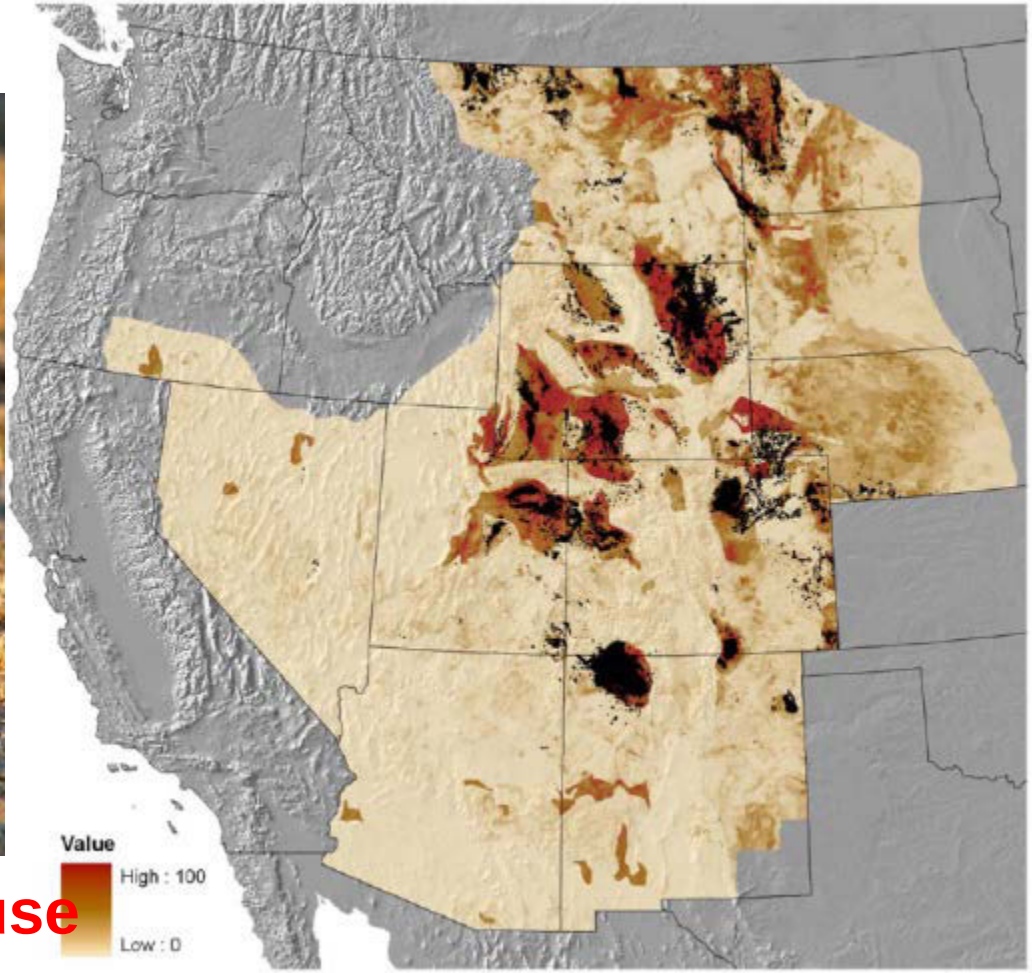

Oil and Gas Prediction Surface
+ Authorized Leases with Stips
+ RFD Numbers by Field Office
+ OGCC Allowable Density
Expected New Wells per Lease
Yellowstone National Park
Shoshone National Forest
WYOMING
Cheyenne
Salt Lake City
Existing Wells
Projected Wells
Oil and Gas Potential
Low
High
Copeland HE, 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):7400. doi:10.1371/journal.pone.0007400

OPEN ACCESS Freely available online PLoS one

Mapping Oil and Gas Development Potential in the US Intermountain West and Estimating Impacts to Species

Holly E. Copeland[1]*, Kevin E. Doherty[2], David E. Naugle[3], Amy Pocewicz[1], Joseph M. Kiesecker[1]

1 The Nature Conservancy, Lander, Wyoming, United States of America, 2 National Audubon Society, Laramie, Wyoming, United States of America, 3 Wildlife Biology Program, University of Montana, Missoula, Montana, United States of America

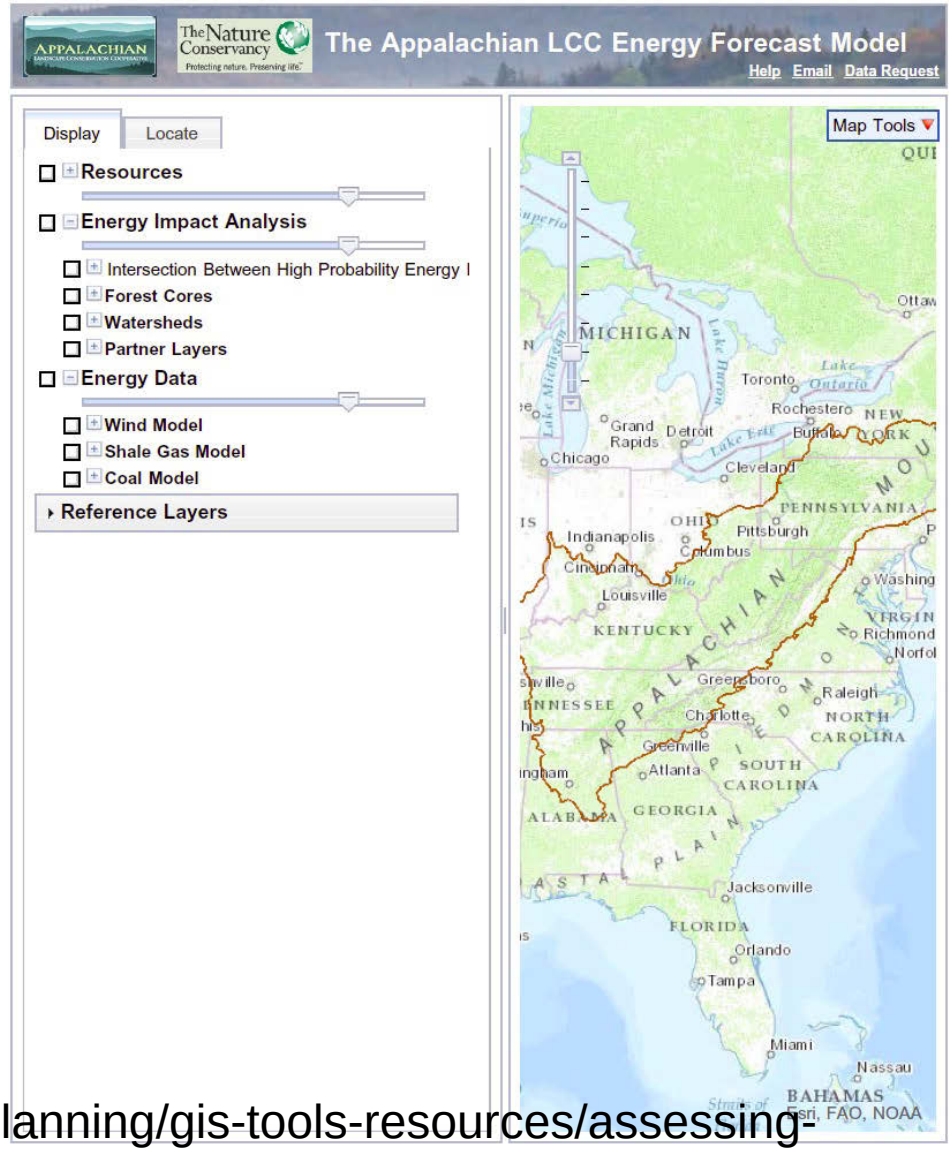


7-19% decline in Sage Grouse

GIS & PLANNING

Assessing Future Energy Development across the Appalachians

The Nature Conservancy - with support from the Appalachian LCC - has completed a study to assist policy makers, land management agencies, and industry in assessing potential future energy development and how that may overlap with biological and ecological values.



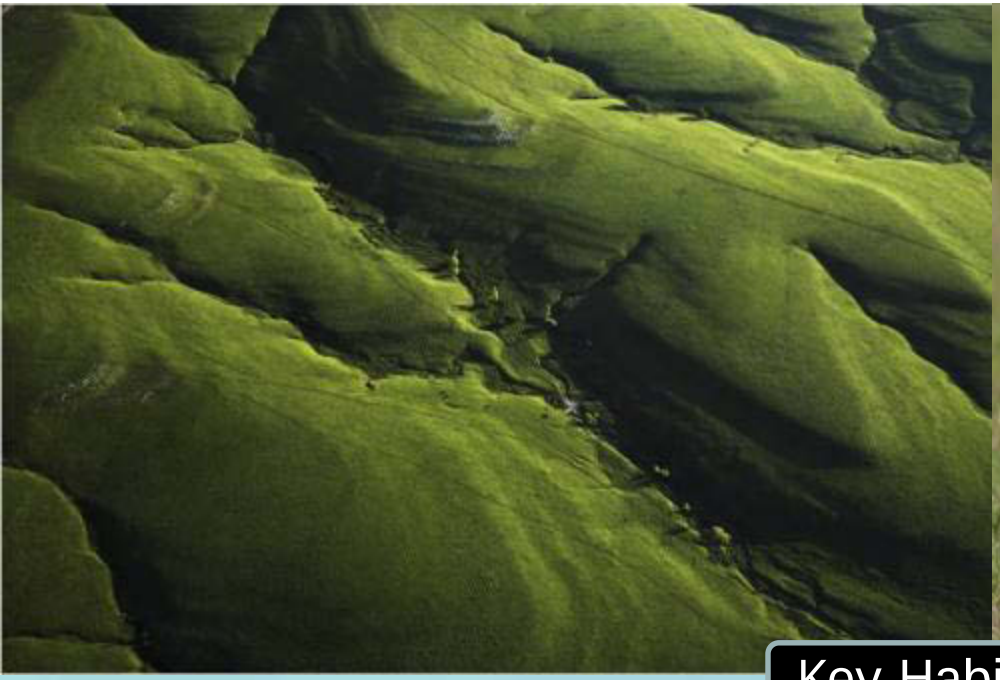
http://applcc.org/conservation-design/gis-planning/gis-tools-resources/assessing-future-energy-development-1

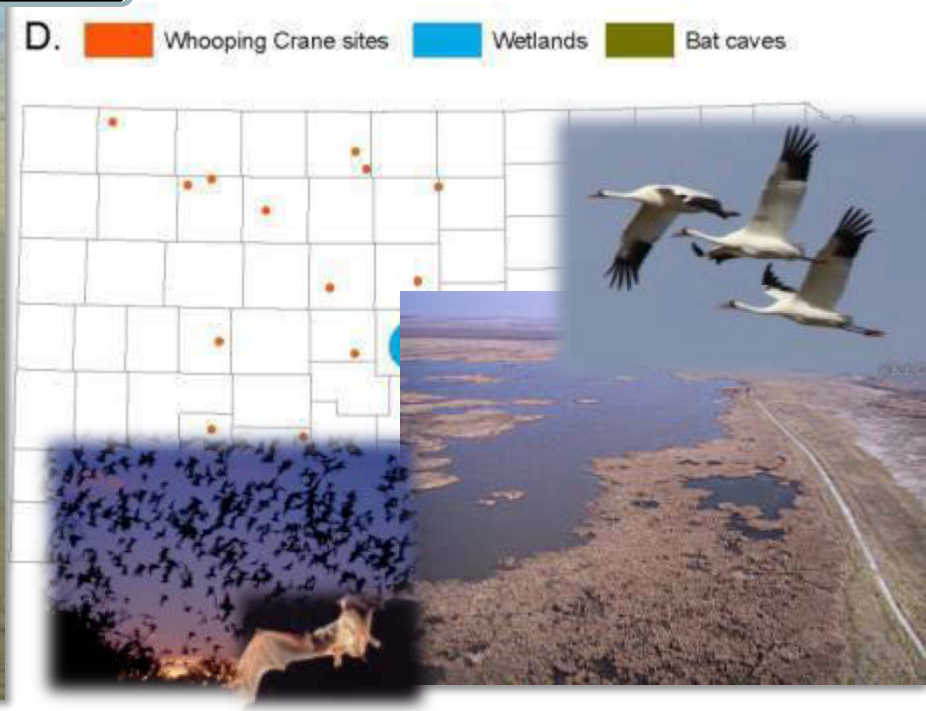
Development by Design: Mitigating Wind Development's Impacts on Wildlife in Kansas

Brian Obermeyer[1], Robert Manes[2], Joseph Kiesecker[3], Joseph Fargione[4]*, Kei Sochi[5]

1 The Nature Conservancy, Cottonwood Falls, Kansas, United States of America, 2 The Nature Conservancy, Topeka, Kansas, United States of America, 3 The Nature Conservancy, Fort Collins, Colorado, United States of America, 4 The Nature Conservancy, Minneapolis, Minnesota, United States of America, 5 The Nature Conservancy, Boulder, Colorado, United States of America

Key Habitats





Development by Design for Wind

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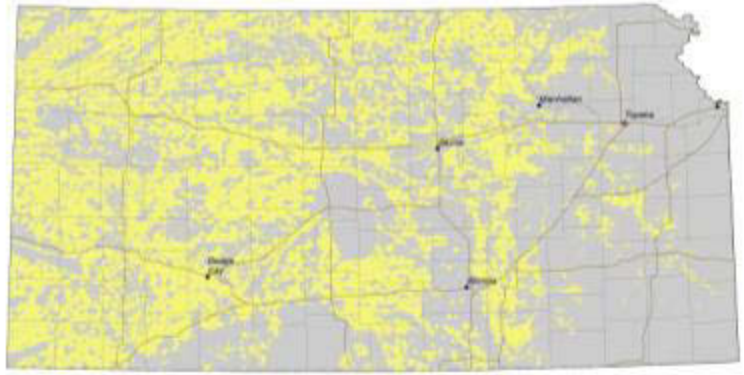
AVOID



OFFSET

No Mitigation

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Mitigation Costs

Based on actual costs of restoring and protecting

Prairie chicken

Grassland

Playa lakes

Development by Design for Wind

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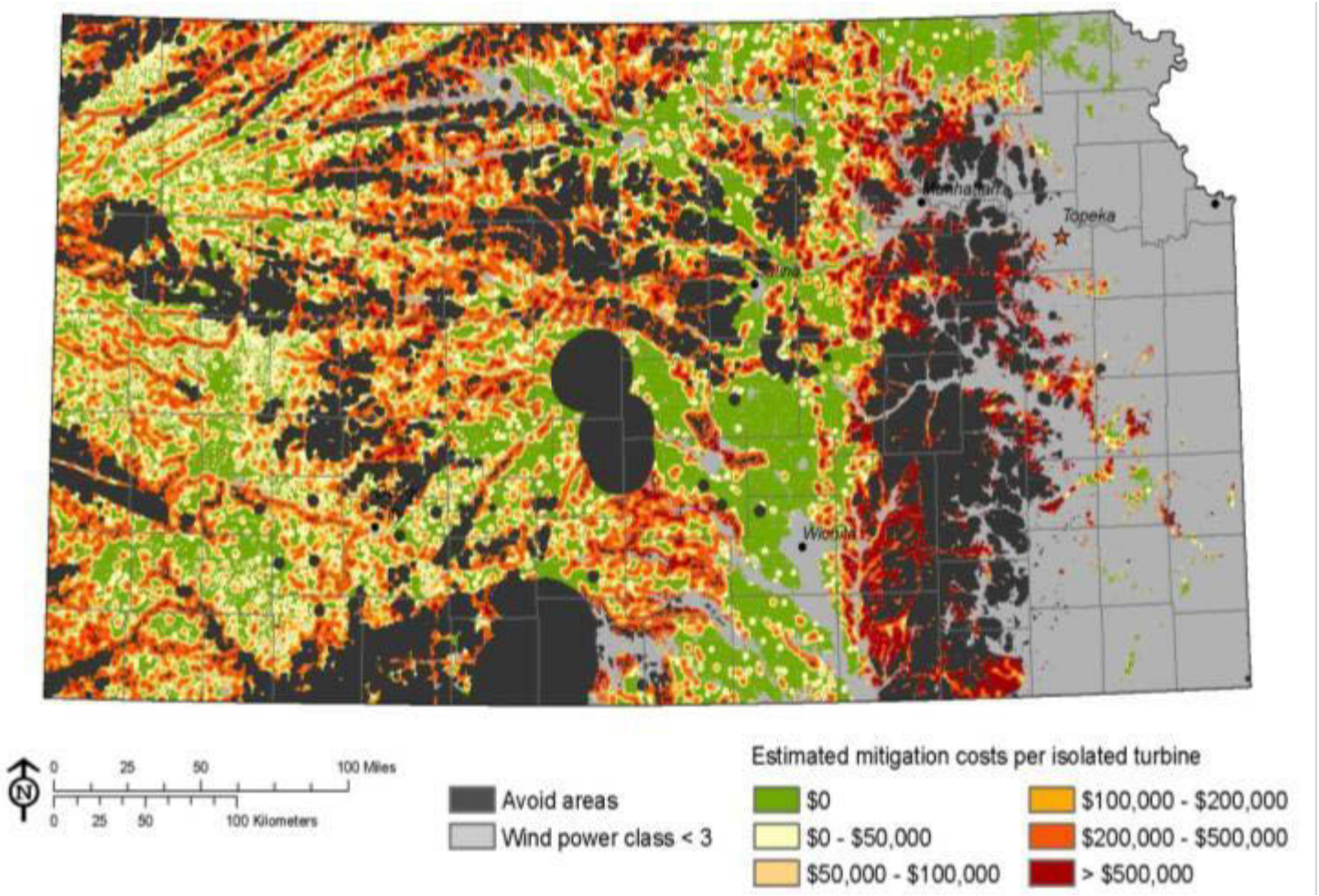
MITIGATION COSTS



Obermeyer B, Manes R, Kiesecker J, Fargione J, Sochi K (2011) Development by Design: Mitigating Wind Development's Impacts on Wildlife in Kansas. PLoS ONE 6(10): e26698. doi:10.1371/journal.pone.0026698

Development by Design:

www.nature.org/ourinitiatives/urgentissues/smart-development/index.htm

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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 2010. Development by Design: Blending Landscape Level Planning with the Mitigation Hierarchy. Frontiers in Ecology and the Environment 8: 261-266

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

McDonald R, Fargione J, Kiesecker J, Miller WM, Powell J (2009) Energy sprawl or energy efficiency: climate policy impacts on natural habitat for the United States of America. PLOS One 4: 8.

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 JM, Evans JS, Fargione J, Doherty K, Foresman KR, et al. (2011) Win-Win for Wind and Wildlife: A Vision to Facilitate Sustainable Development. PLoS ONE 6(4): e17566. doi:10.1371/journal.pone.0017566

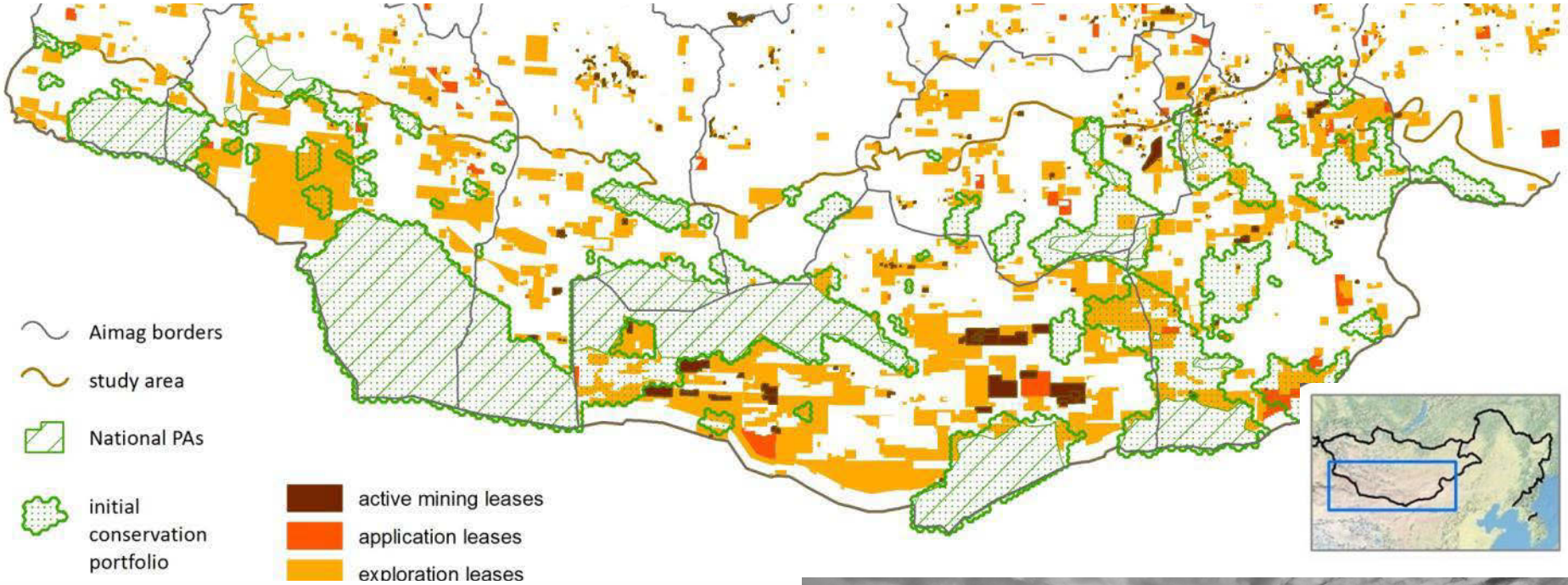
Evans, J. Kiesecker, J.M. Fargione, J. et al. Mapping human disturbance for bio diver conservation in the contiguous US. Target Journal: Conservation Letters

Obermeyer B, Manes R, Kiesecker J, Fargione J, and K Sochi. 2011. Development by Design: Mitigation of Wind Development's Impacts on Wildlife in Kansas. PLoS One 6(10): e26698. doi:10.1371/journal.pone.0026698

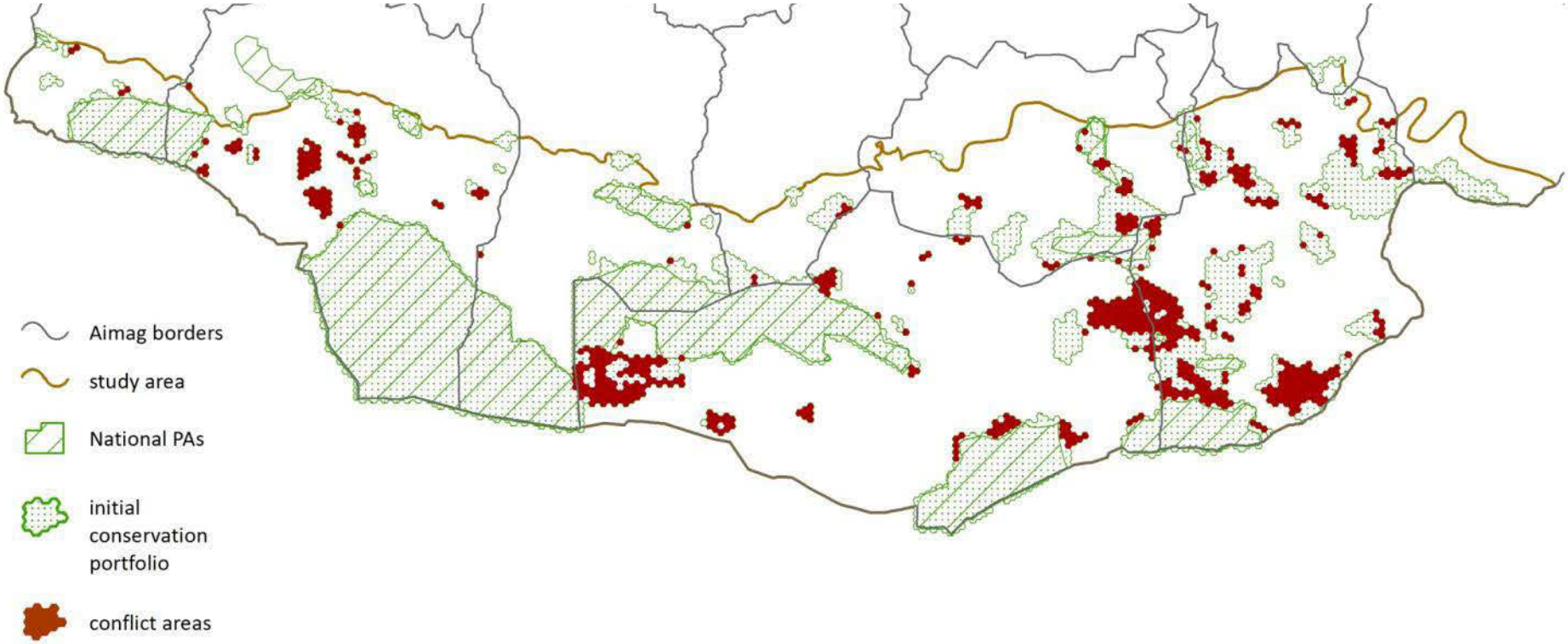
Cameron DR, Cohen BS, Morrison SA (2012) An Approach to Enhance the Conservation-Compatibility of Solar Energy Development. PLoS ONE 7(6): e38437. doi:10.1371/journal.pone.0038437

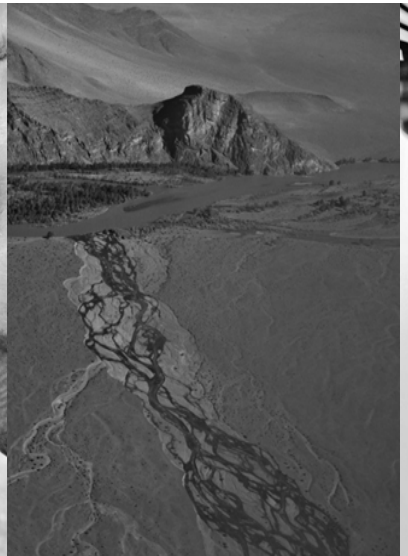
Infrastructure/Mining/Oil & Gas in Mongolia

Initial portfolio and existing mineral leases

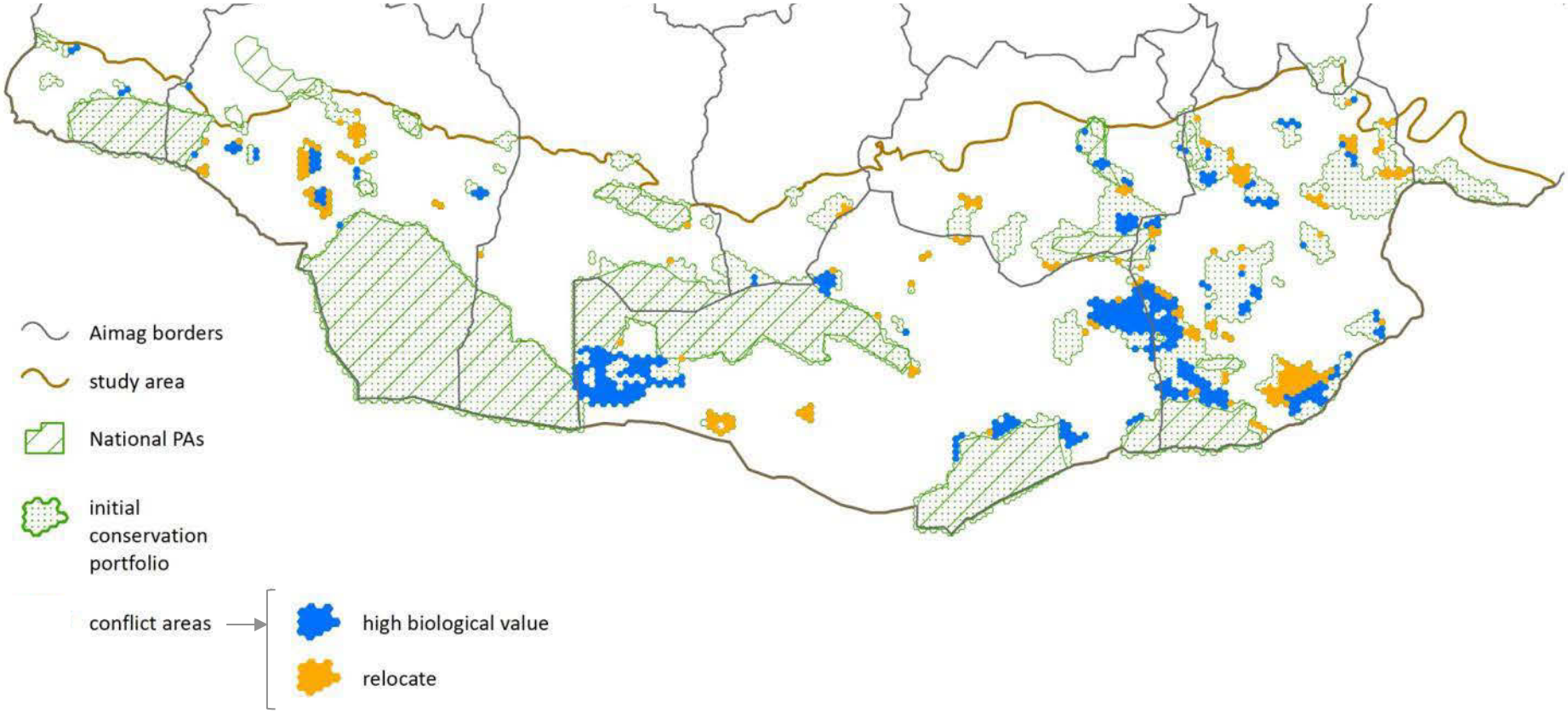


Areas of potential conflict with mineral development

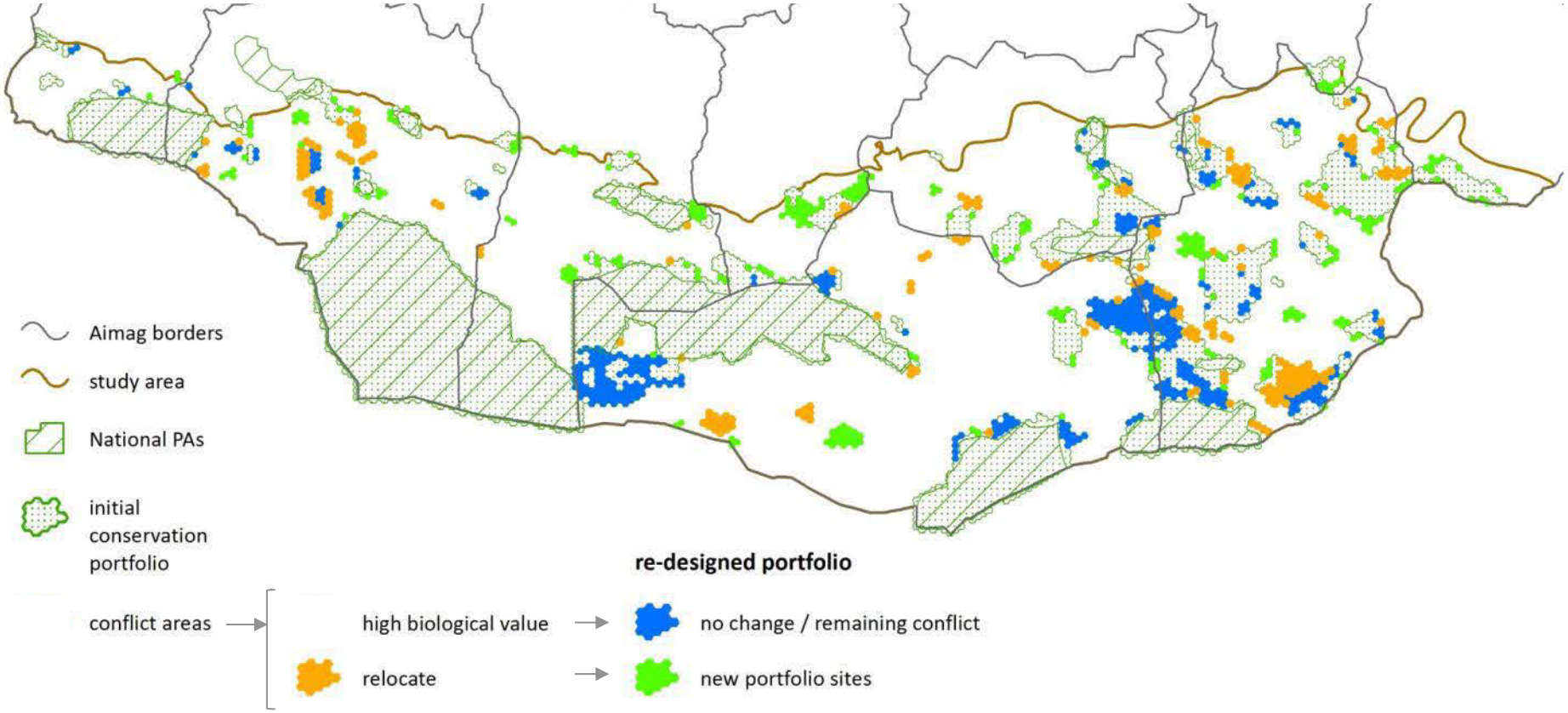


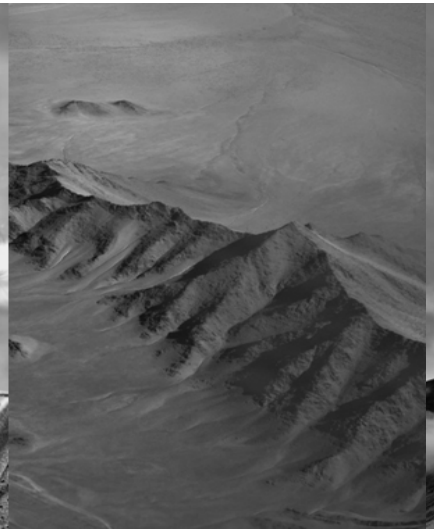


Initial portfolio re-designed to minimize conflict with mineral development



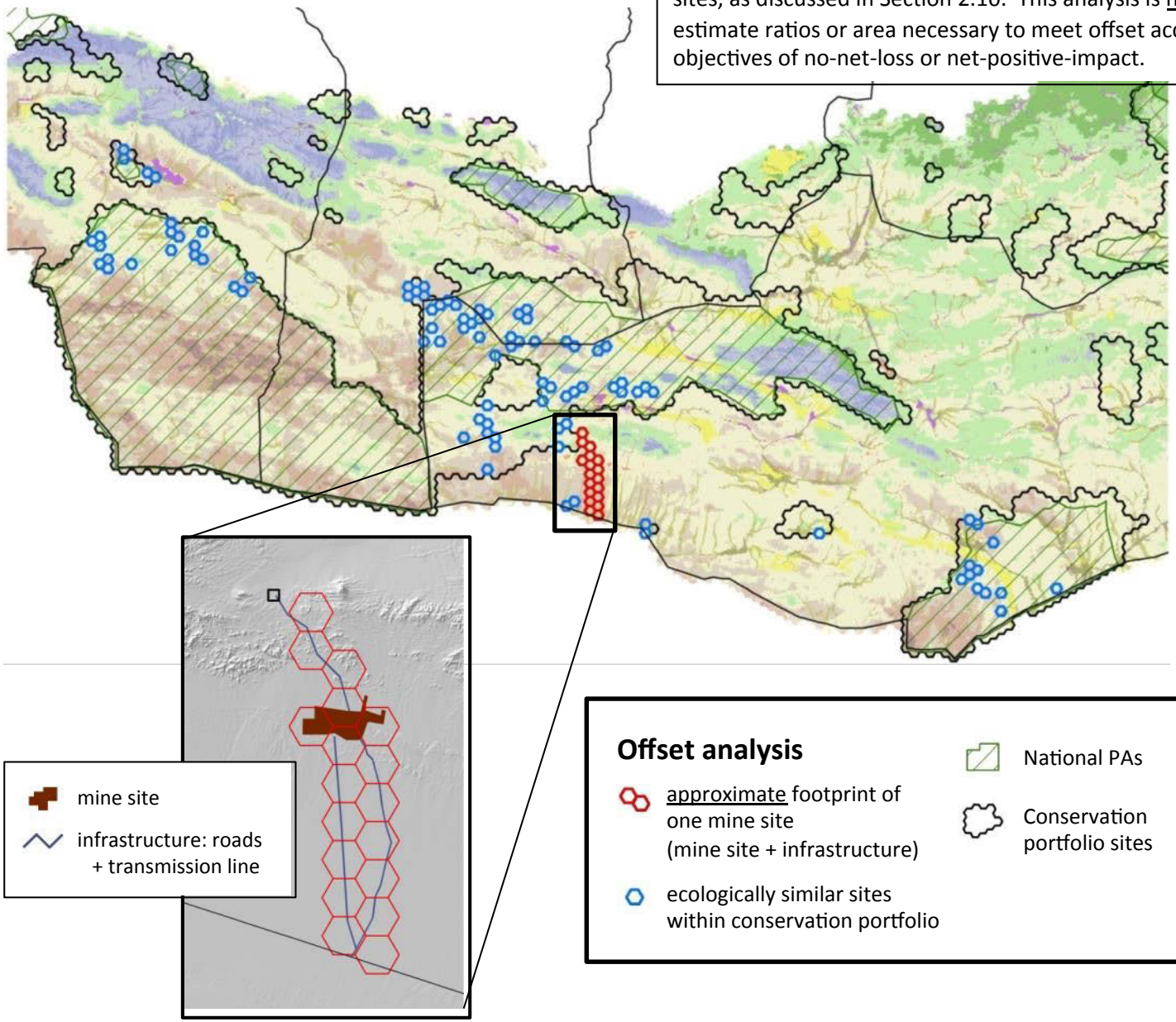
Portfolio re-designed to minimize conflict with mineral development



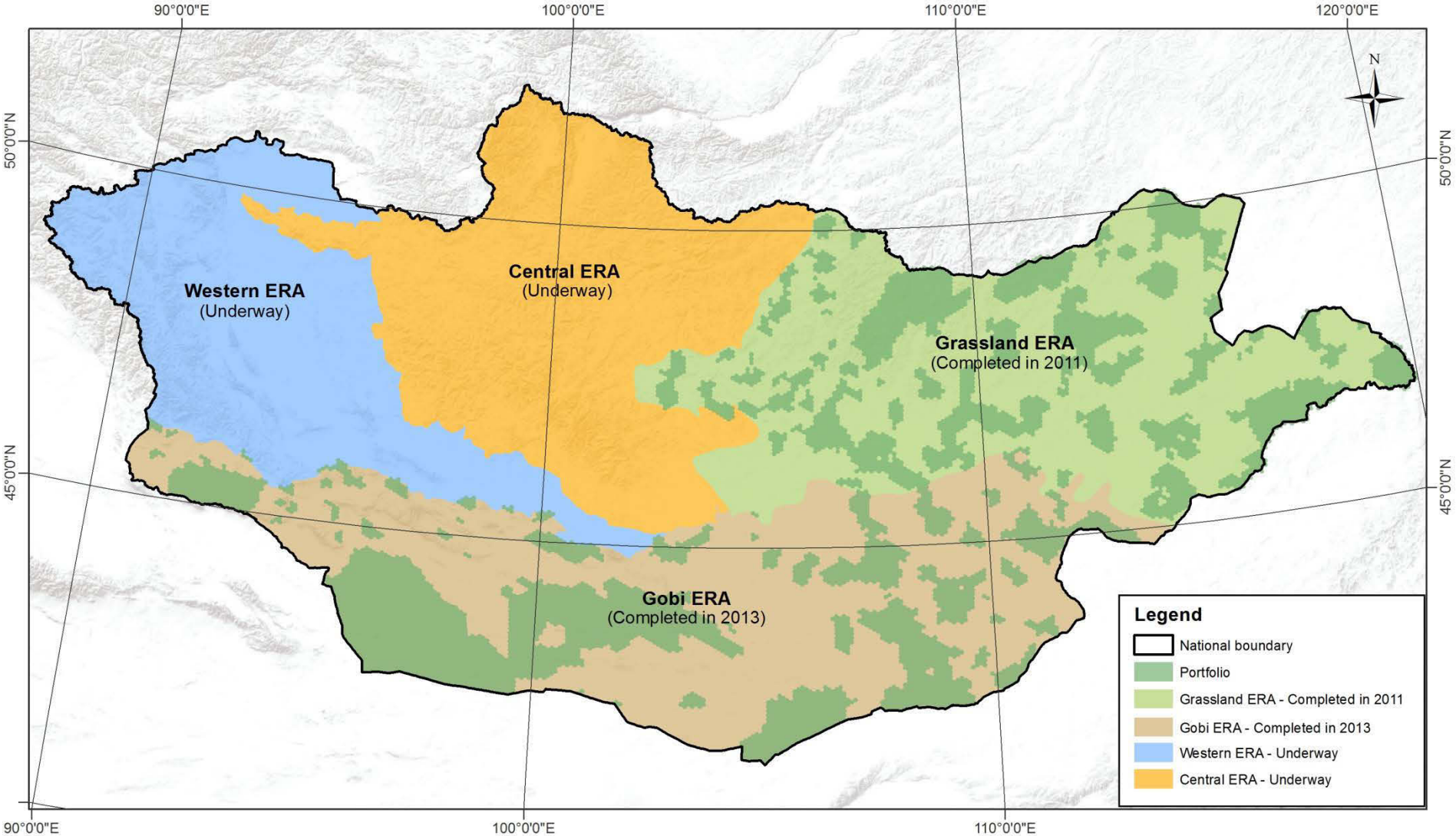


Regional offset scenario – one mine

This map shows the approximate footprint of the one mine site, and a set of ecologically similar sites within the conservation portfolio. This demonstrates how a landscape-level conservation plan and supporting information can be used to identify offset sites, as discussed in Section 2.10. This analysis is not intended to estimate ratios or area necessary to meet offset accounting objectives of no-net-loss or net-positive-impact.



DbD ERAs for Mongolia



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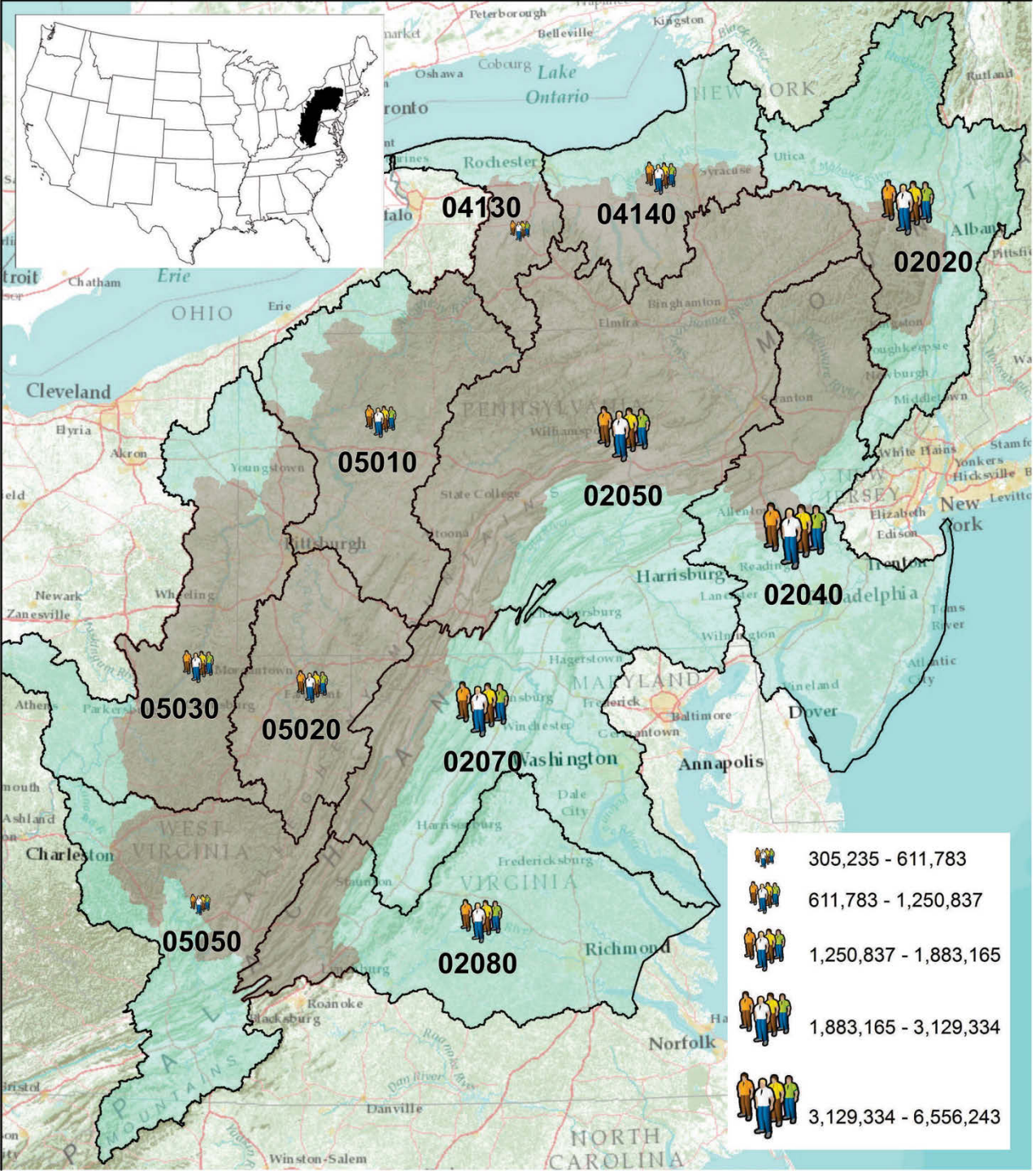
Shale Gas, Wind and Water: Assessing the Potential Cumulative Impacts of Energy Development on Ecosystem Services within the Marcellus Play

Jeffrey S. Evans[1,2]*, Joseph M. Kiesecker[3]

1 The Nature Conservancy, Fort Collins, Colorado, United States of America, **2** Department of Zoology and Physiology, University of Wyoming, Laramie, Wyoming, United States of America, **3** The Nature Conservancy, Fort Collins, Colorado, United States of America



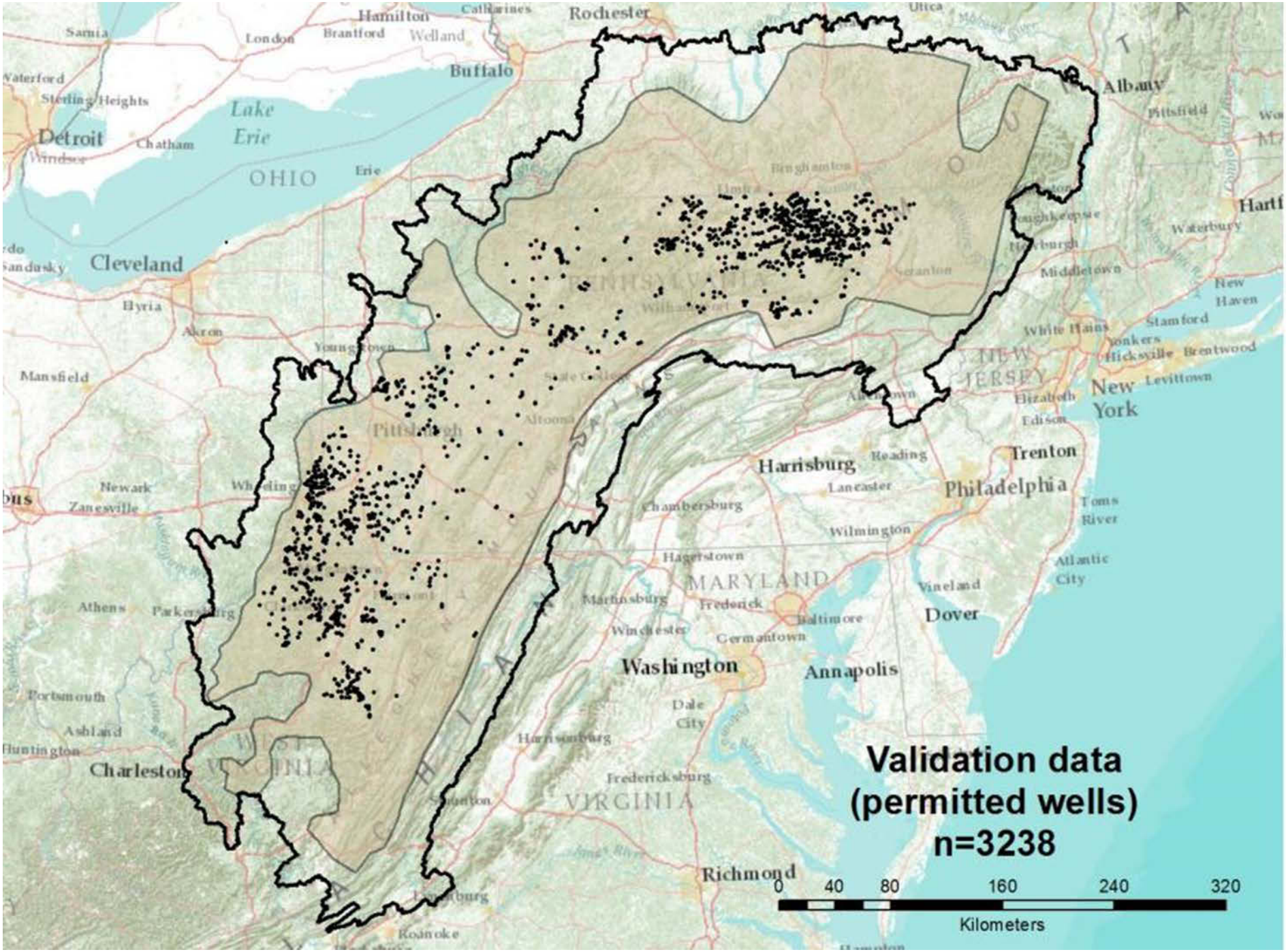
2003 code-six watersheds

~20 million people rely on headwater watersheds for drinking water supply

70% forested headwaters

High gas pressurization area with intersecting watersheds

42,963,005 acres

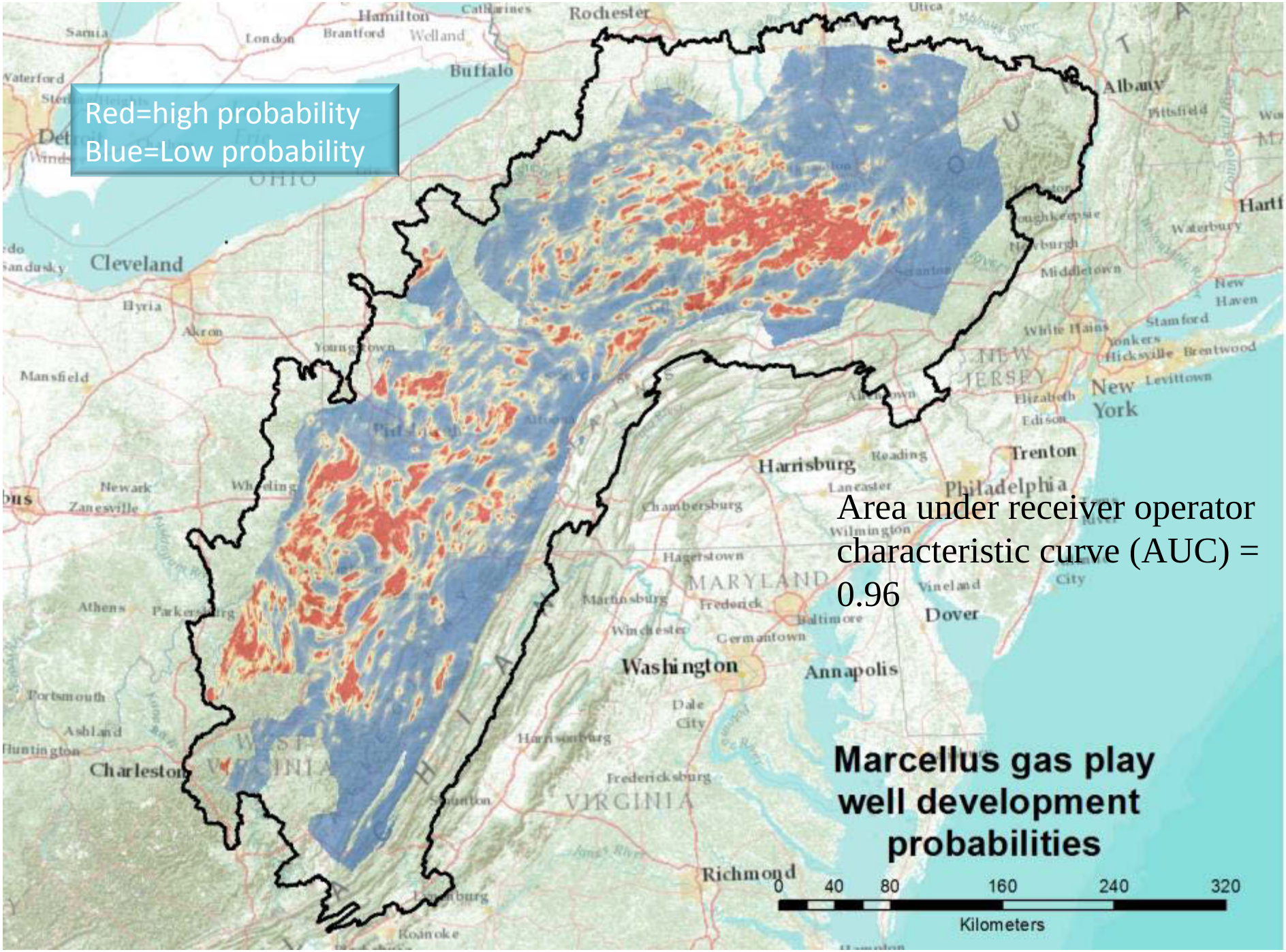

Validation data
(permitted wells)
n=3238
0 40 80 160 240 320
Kilometers
Lake Erie
OHIO
Cleveland
Detroit
Buffalo
Rochester
Albany
Harrisburg
Philadelphia
Trenton
New York
Washington
Annapolis
Baltimore
Dover
Pittsburgh
Charleston
Richmond
MARYLAND
VIRGINIA
NEW JERSEY

Scoping process – Gas candidate independent variables

Variable Name	Description
bouguer	Bouguer gravity anomalies
depth	Depth of Marcellus shale (kriging model)
dpipeline	Distance (meters) to gas pipeline.
droad	Distance (meters) to road.
isograv	Isostatic gravity anomalies
magnetic	Aeromagnetic gravity anomalies
slp	Slope intensity in degrees.
srr3	Surface relief ratio (ground surface complexity) at 3x3 window
srr15	Surface relief ratio (ground surface complexity) at 15x15 window
thickness	Marcellus shale thickness (kriging model)
tmaturity	Geologic Thermal Maturity (kriging model)

Selected gas independent variables (via model selection)

Variable Name	Description
bouguer	Bouguer gravity anomalies
depth	Depth of Marcellus shale (kriging model)
[redacted]	
isograv	Isostatic gravity anomalies
magnetic	Aeromagnetic gravity anomalies
[redacted]	
thickness	Marcellus shale thickness (kriging model)
tmaturity	Geologic Thermal Maturity (kriging model)

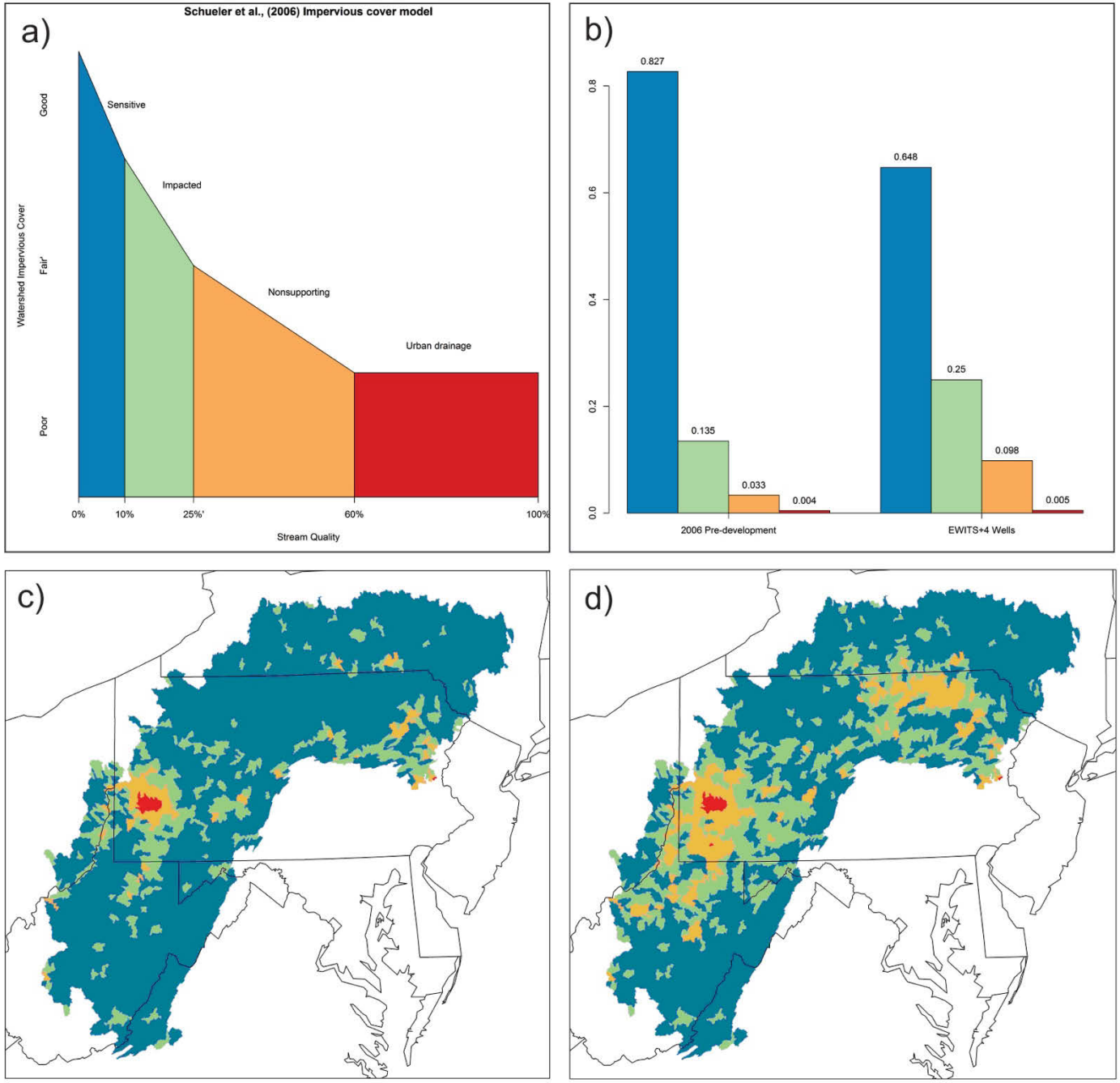


Area under receiver operator characteristic curve (AUC) = 0.96

Wellpad footprint	1.3	11.6
Associated infrastructure	(2.3+8) 10.3	
Indirect impact	8.6	
Total	20.2	

Turbine footprint	0.57	0.77
Associated infrastructure	0.2	
Indirect impact	5.42	
Total	6.19	

Photographs of a) example gas development footprint in hectares, and b) example wind farm footprint in hectares. Inset table represents associated impacts used in the analysis. Estimates of potential surface disturbance associated with gas wells and wind turbines were based on measurements taken from aerial photographs from Johnson (2010) and Johnson et al. (2011).



Impervious cover model at subwatershed-level

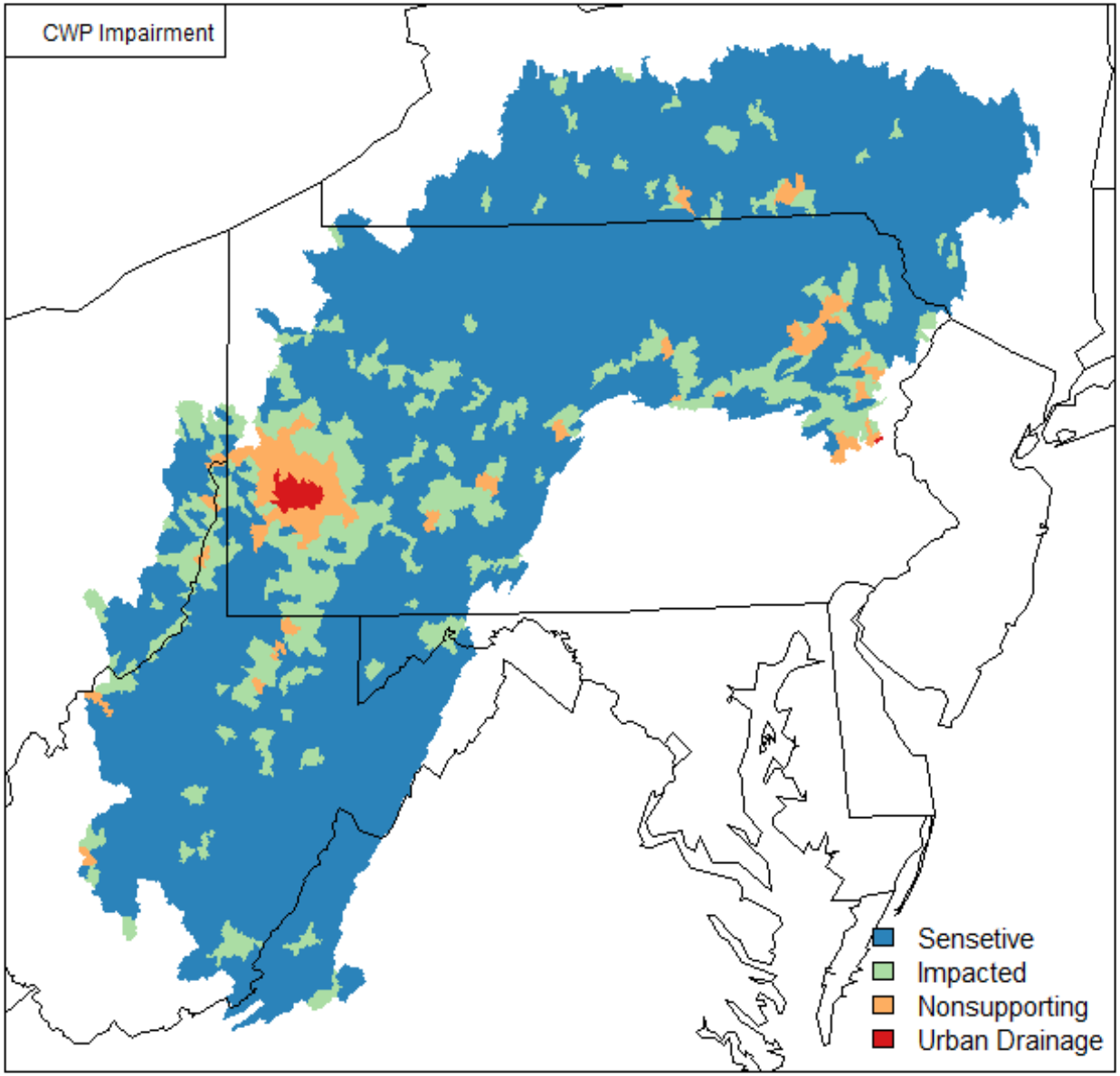
a) Graph of watershed impervious cover model (Schueler et al. 2009) representing classification of percent impervious surface. Colors in each impact class correspond to other panels in figure

b) bar graph showing percent subwatersheds in each class,

c) 2006 “pre-development” subwatershed impacts,

d) EWITS wind + 4 wells per pad subwatershed impacts.

2006 Pre-development Impairment



18% (n=360) of "sensitive" watersheds will transition into a higher impact status

7% (n=130) will move into a "nonsupporting" or "urban" drainage impact status.