

TIMOTHY M. MURTHA AND BRIAN ORLAND
HAMER CENTER FOR COMMUNITY DESIGN
DEPARTMENT OF LANDSCAPE ARCHITECTURE
PENN STATE UNIVERSITY

LOCAL LESSONS FOR A GLOBAL LANDSCAPE CHALLENGE:
DESIGN AND PLANNING RESPONSES TO
UNCONVENTIONAL SHALE GAS DEVELOPMENT

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TAKE HOME:

- Classic case of niche construction/inheritance dynamics, with added complexity because of the alienation of traditional feedback mechanisms.
- Most of the focus of the attention on the exploitation of this resource is centered on the holes in the ground and the technology used to extract the gas. We conclude that to understand this resource and its cultural and natural context, the focus needs to be on the broader footprint.
- There is an ethnographic imperative to document the material and cultural changes occurring in the context of shale gas exploration. It's basic human science for understanding the dynamics of a coupled natural human system.
- Existing planning guidelines and regulations aren't necessarily insufficient; they are simply not paired to the unique resource and equally unique methods and footprint of extraction.

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- Most of the focus of the attention on the exploitation of this resource is centered on the holes in the ground and the technology used to extract the gas. We conclude that to understand this resource and its cultural and natural context, the focus needs to be on the broader footprint
- There is an ethnographic imperative to document the material and cultural changes occurring in the context of shale gas exploration. It's basic human science for understanding the dynamics of a coupled natural human system

WHAT?: FOR THE PAST 3+ YEARS BRIAN AND I HAVE BEEN DEVELOPING SCALABLE TOOLS, USING A GEODESIGN FRAMEWORK NOT ONLY TO DOCUMENT AND DESCRIBE THE CHANGING LANDSCAPE OF SHALE GAS, BUT ALSO TO DISTRIBUTE THOSE TOOLS TO INDIVIDUALS AND COMMUNITIES.

PURPOSES:

- To show how and where land use planning plays a role in shaping the landscape
- To provide insights into how individual citizens and communities can influence the outcomes of landscape change
- To show ways that different values play out in the landscape, and how multiple values can be satisfied in a single plan

WHY?

- “Our human landscape is our unwitting autobiography reflecting our tastes, our values, our aspirations, and even our fears, in tangible visible form. We rarely think of landscape that way, and so the cultural record we have “written” in the landscape is liable to be more truthful than most autobiographies because we are less self-conscious about how we describe ourselves,”
- “To be sure, reading landscapes is not as easy as reading books, and for two reasons. First ordinary landscape seems messy and disorganized, like a book with pages missing, torn, and smudged; a book whose copy has been edited and re-edited by people with illegible handwriting.”
- -Pierce Lewis (1979:11)



AMERICA'S
NATURAL GAS
CHAMPION



CHK.COM



LAMAR

WARNING

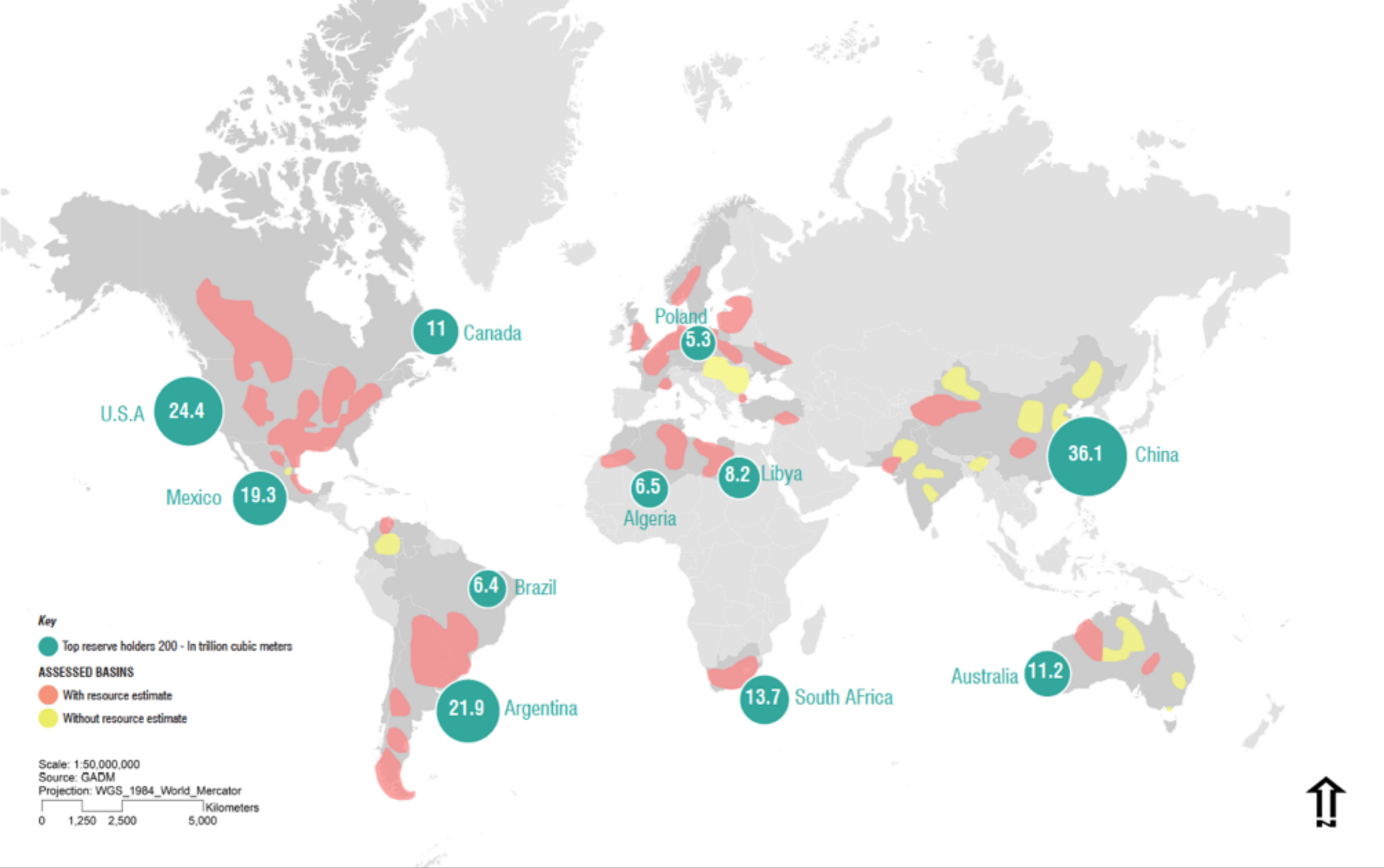
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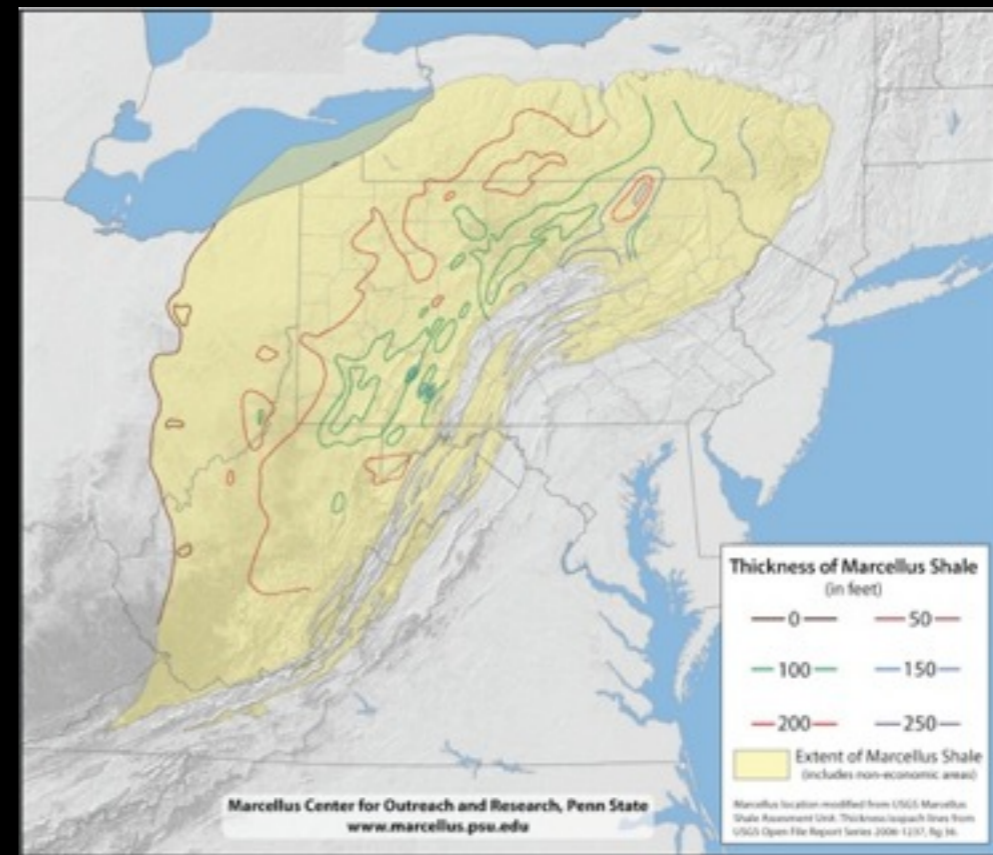
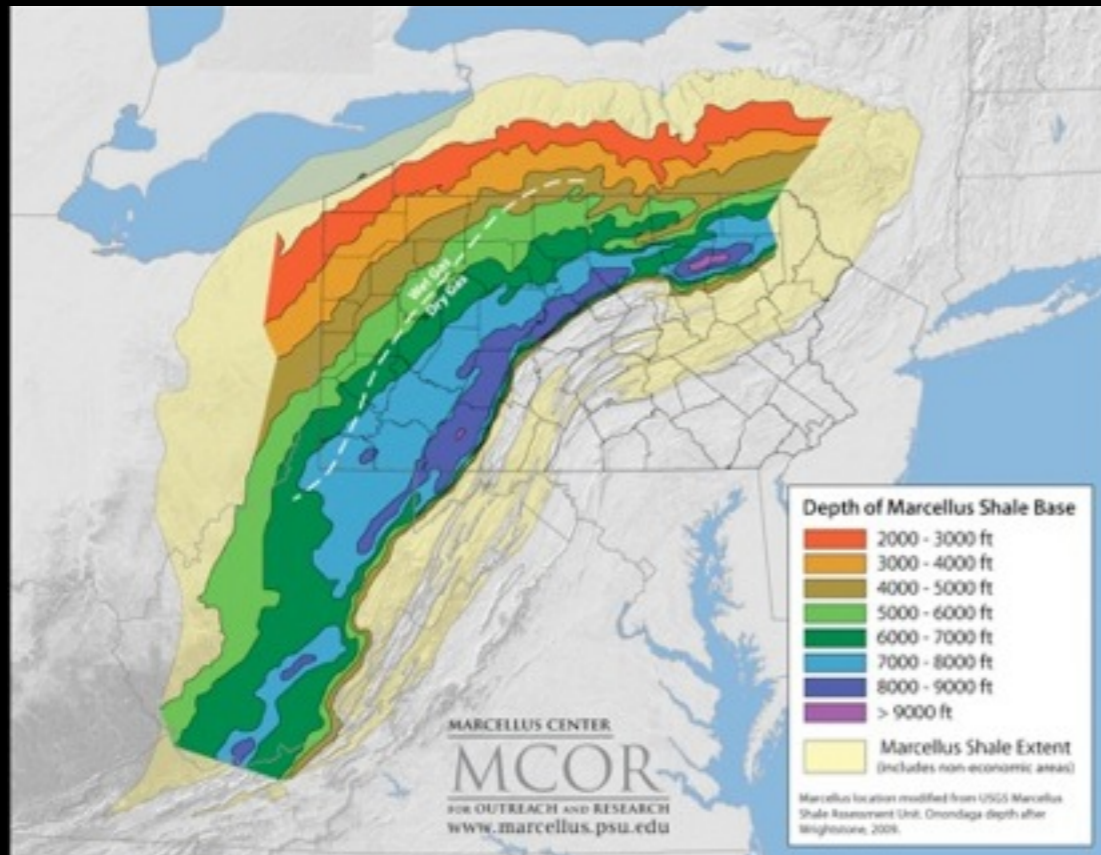
BRAD LITTLE OWNER

175 McKNIGHT ROAD BLAIRSVILLE
OWNER BRAD LITTLE ^{is} IS CHEEZY
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GLOBAL SHALE GAS BASINS



MARCELLUS SHALE



Cross-Section of Typical Horizontal Marcellus Well

24" conductor casing (brown) is installed up to 50 feet deep and cemented (grey) to the surface.

20" casing is installed through the 24" casing and continuing up to 500 feet deep. This casing is cemented to surface to isolate and protect near-surface groundwater.

13 3/8" casing is installed through the 20" casing and continuing up to 1000 feet deep. This casing is also cemented to the surface to protect the groundwater aquifer from the gas well.

5 1/2" casing continues down and is turned laterally into the Marcellus formation at a depth of 5000 to 9000+ feet below the surface.

Fresh groundwater zone up to 1000 feet deep

Vertical portion of well

Kick off point for the bend from vertical to horizontal drilling.

Horizontal, "lateral" portion of well extends from 3,000 to over 10,000 feet within Marcellus formation.

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M-Shale Figures:

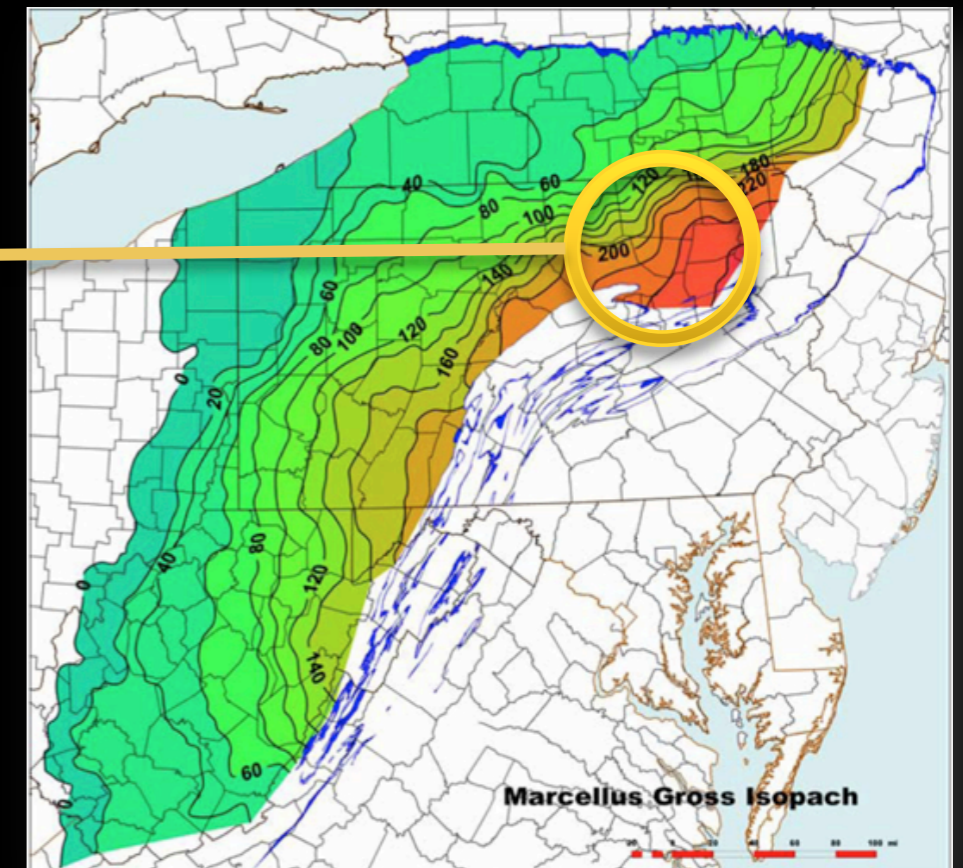
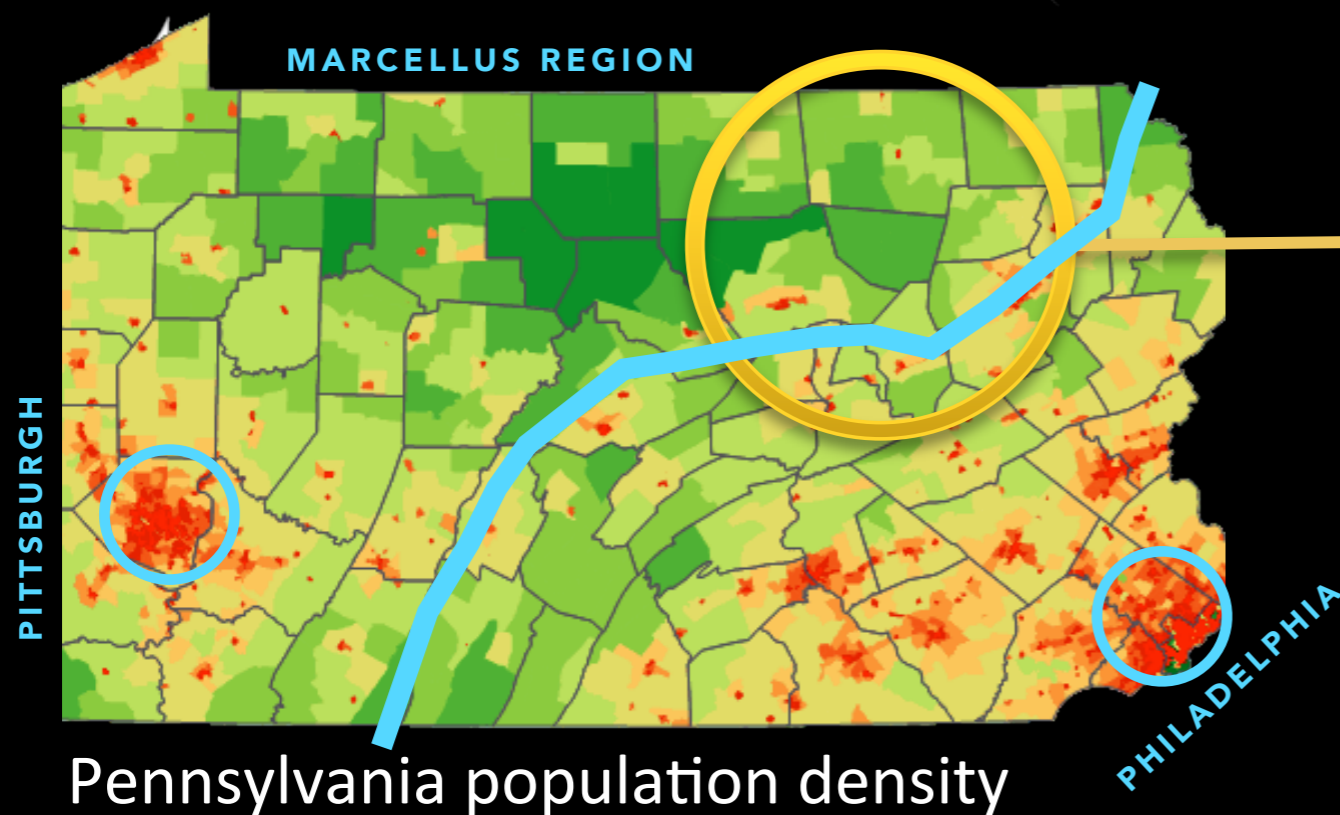
- 1.2 tcf recoverable gas in Pennsylvania
- 2nd largest gas find in the world? Potential recoverable gas is **489 trillion cu. ft.** US consumption is **20 trillion cu. ft. annually**
- 52+ Companies have invested 6+ Billion Dollars Collectively in leasing, development and exploitation. **Expected \$55+ Billion by 2014**
- \$128 Million in State Forest Lease. More recently, millions of dollars in impact fees

PENNSYLVANIA FACTORS INFLUENCING SHALE GAS DEVELOPMENT AND IMPACTS:

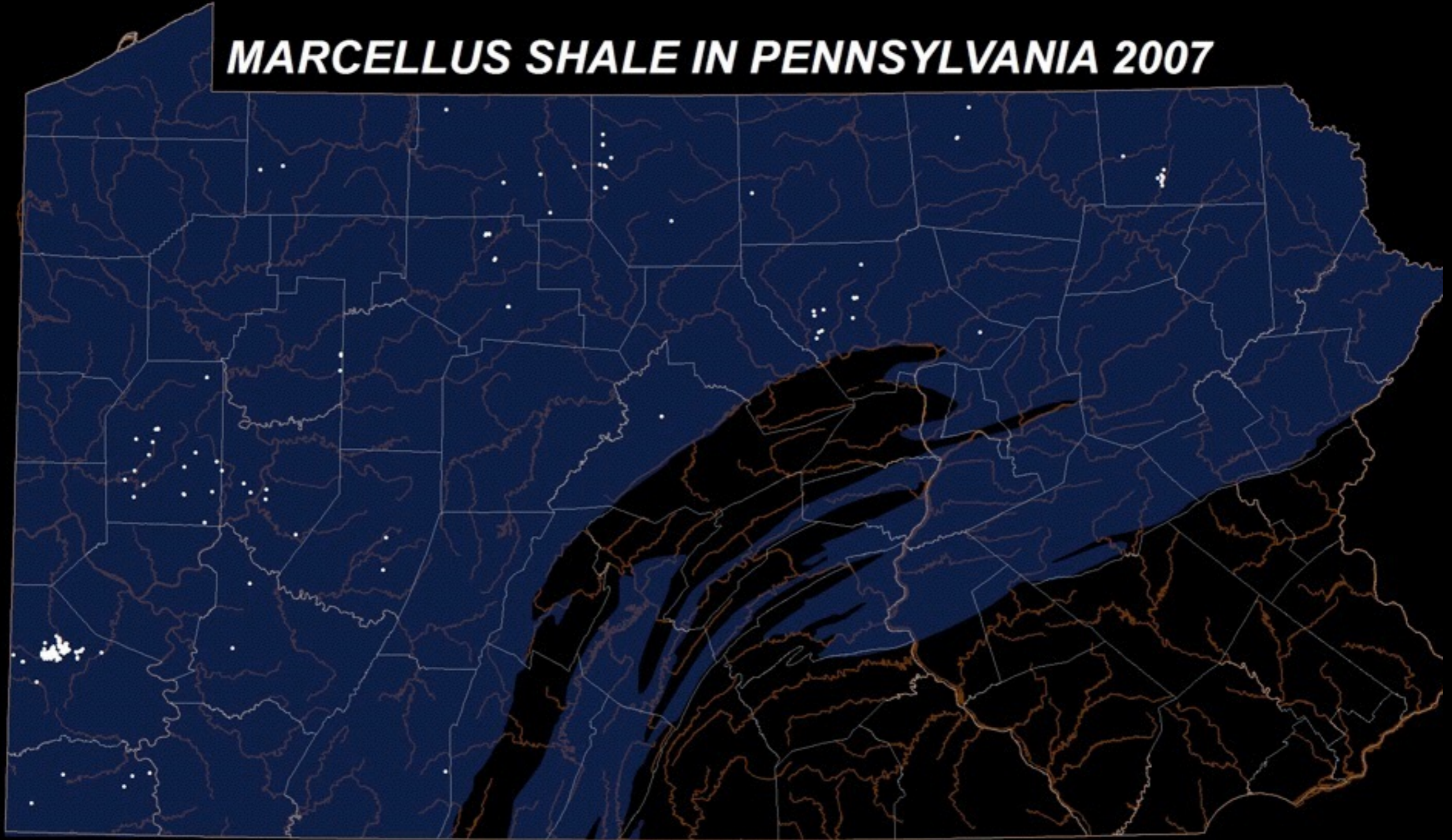
- 1) Largely rural and depopulated
- 2) Marcellus region watersheds average 91% Forest and Agriculture Landcover
- 3) Marcellus basins average 77% forested, while non Marcellus basins average just 48%
- 4) On average there are 3 times as many dirt roads in the Marcellus basins
- 5) 400% more developed residential outside of the Marcellus Region

SULLIVAN COUNTY, PA RURAL SHALE GAS EXPLORATION

6,428 people, 15/square mile
Projected gas wells in Sullivan County—6,000
Lifetime estimated royalty per well— \$1.6m
 $\$1.6m \times 6,000 / 6428 = \$1.5m/\text{person}$

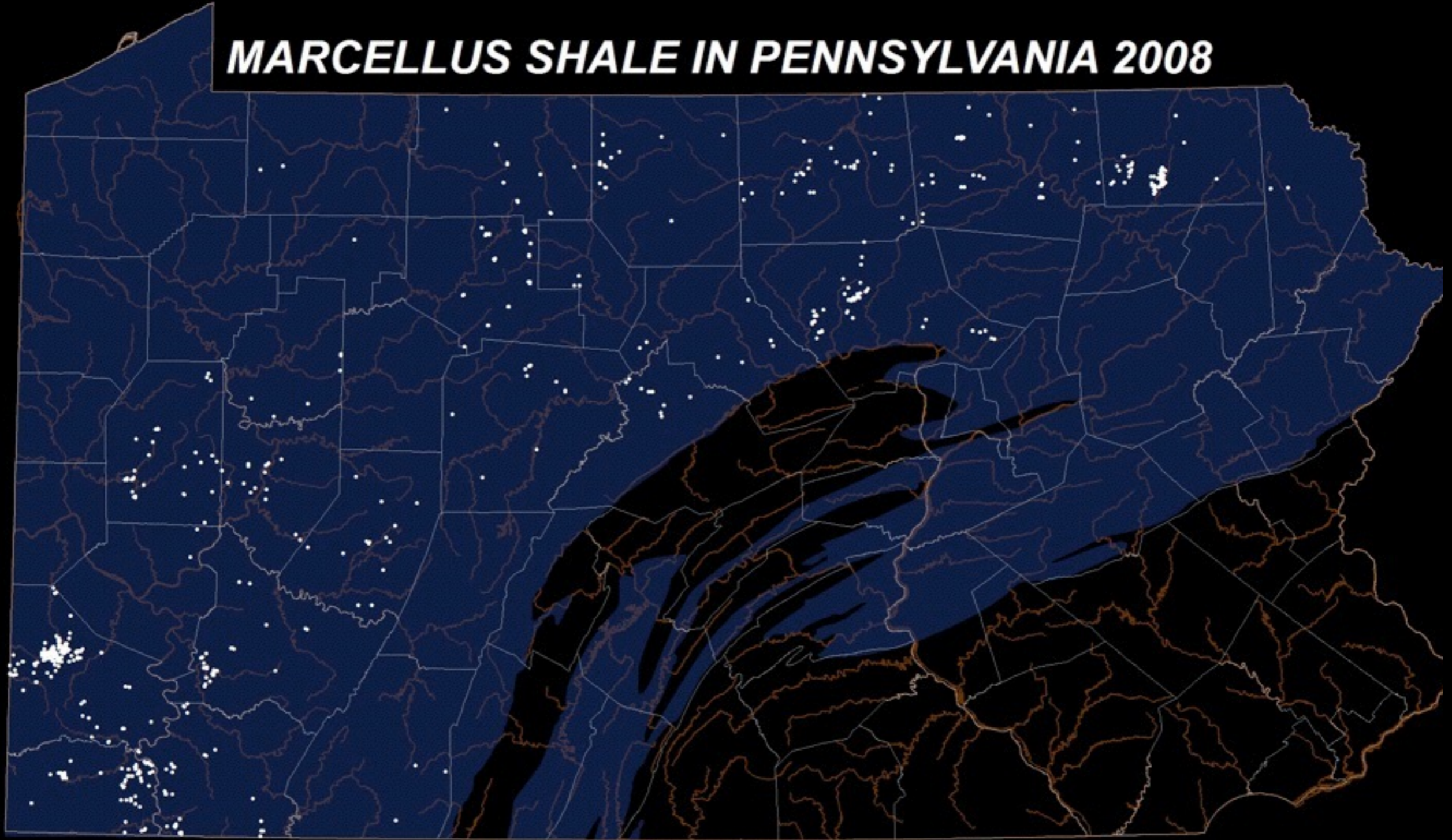


MARCELLUS SHALE IN PENNSYLVANIA 2007



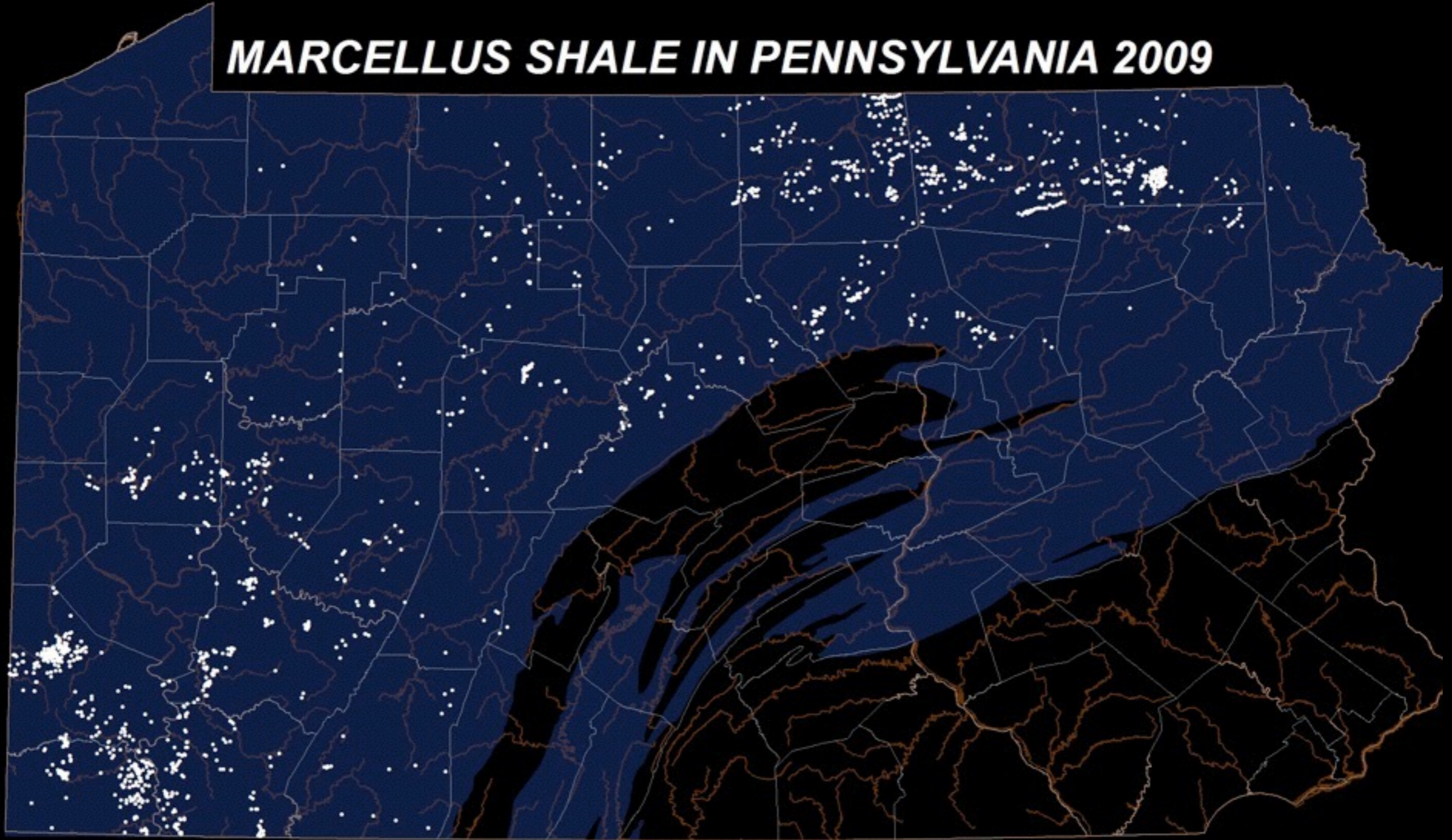
Permitted Unconventional Wells

MARCELLUS SHALE IN PENNSYLVANIA 2008



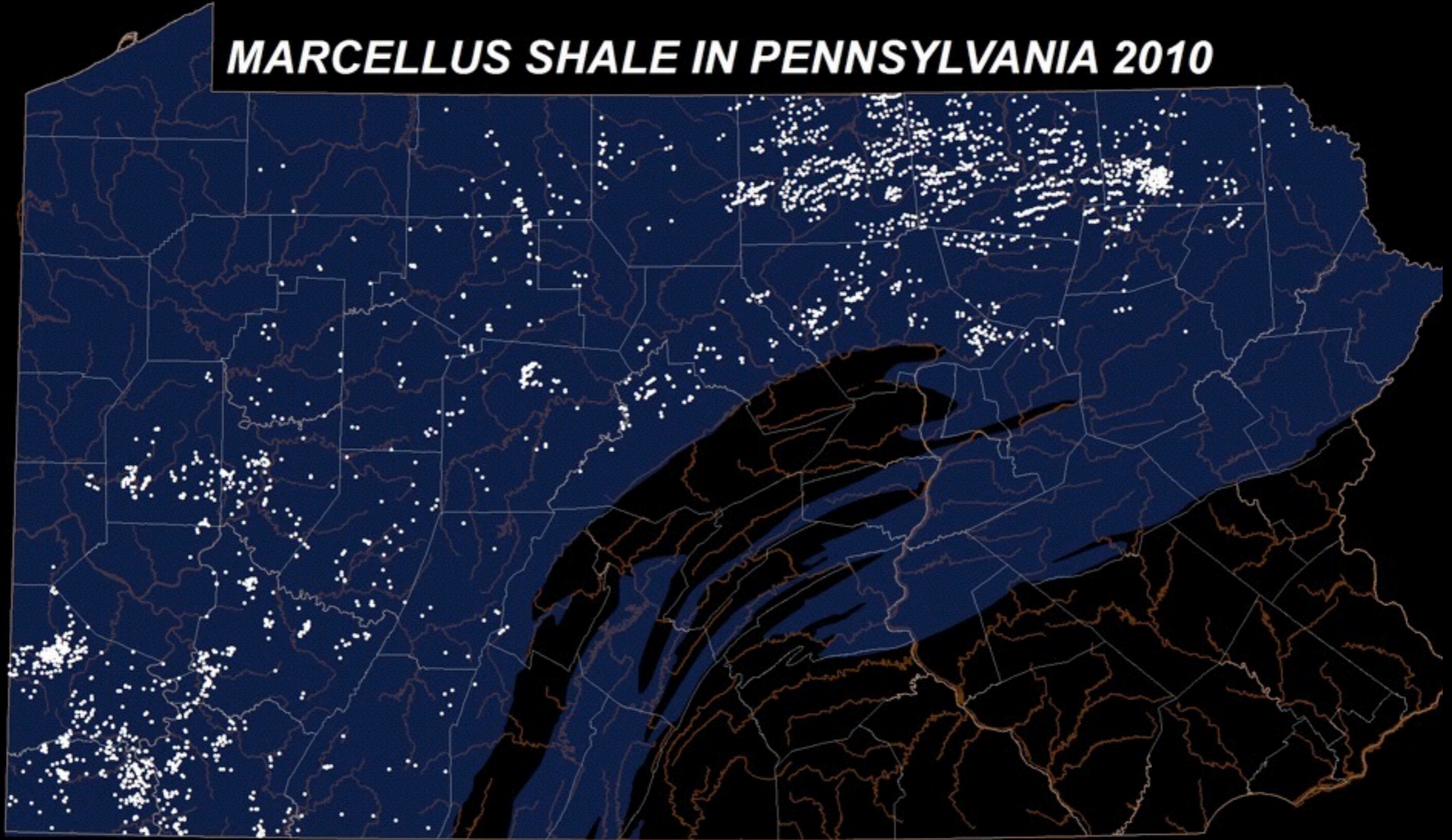
Permitted Unconventional Wells

MARCELLUS SHALE IN PENNSYLVANIA 2009



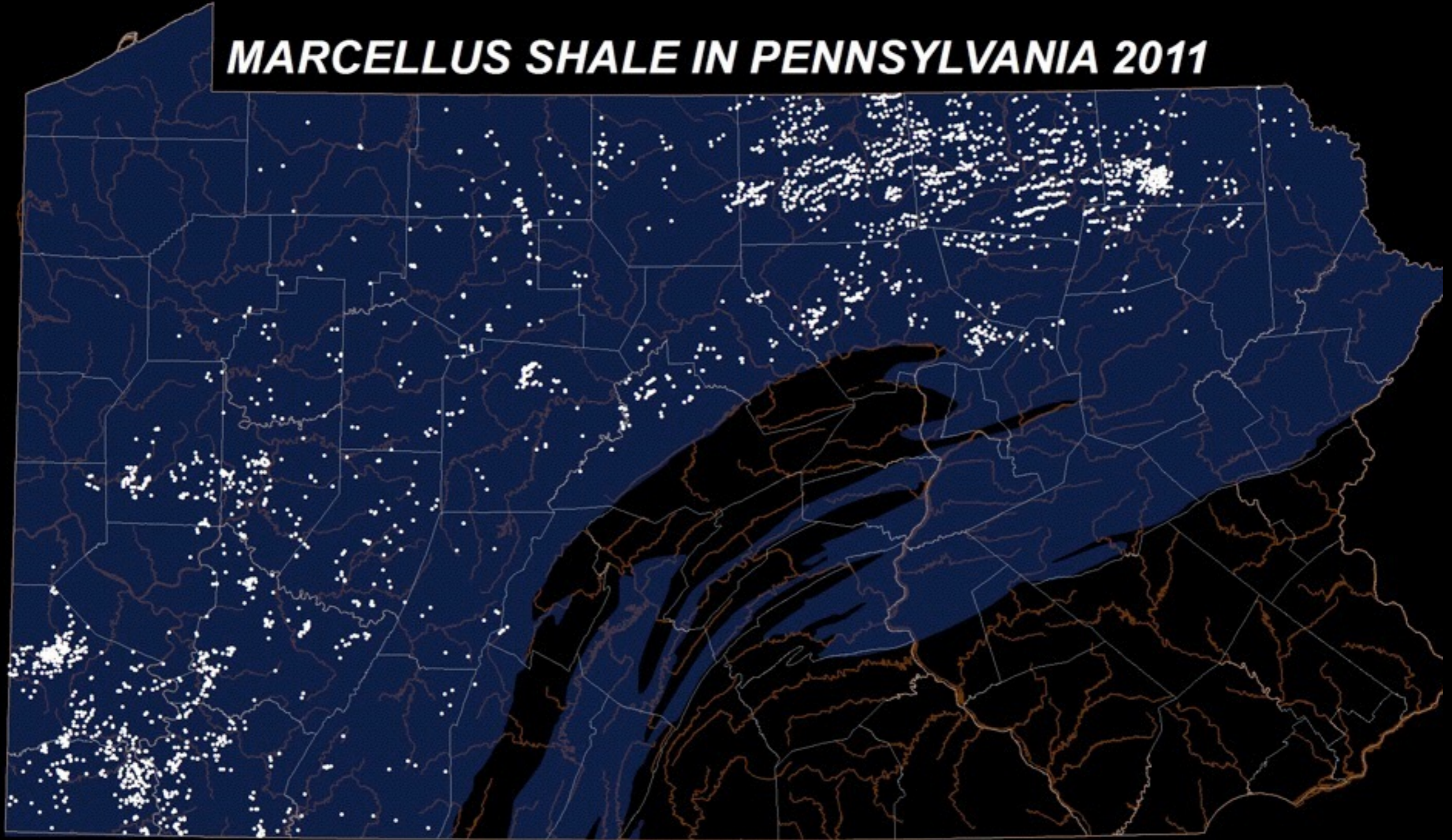
Permitted Unconventional Wells

MARCELLUS SHALE IN PENNSYLVANIA 2010



Permitted Unconventional Wells

MARCELLUS SHALE IN PENNSYLVANIA 2011



Permitted Unconventional Wells

MARCELLUS SHALE IN PENNSYLVANIA

Marcellus Shale Permits (Complete Until January 2011)

All Marcellus

Operator

- AB RESOURCES PA LLC
- ALPHA SHALE RES LP
- ALTA OPR CO LLC
- AMER OIL & GAS LLC
- ANADARKO E&P CO LP
- ANSCHUTZ EXPLORATION CORP
- ANTERO RESOURCES APPALACHIAN CORP
- ATLAS RESOURCES LLC

- BAKER GAS INC
- BLX INC
- BURNETT OIL CO INC
- CABOT OIL & GAS CORP
- CARRIZO (MARCELLUS) LLC
- CARRIZO OIL & GAS INC
- CHESAPEAKE APPALACHIA LLC
- CHEF OIL & GAS LLC
- CITRUS ENERGY CORP
- CNX GAS CO LLC

- CONSOL GAS CO
- DL RESOURCES INC
- DOMINION TRANS INC
- EAST RESOURCES INC
- EAST RESOURCES MGMT LLC
- ENCANA OIL & GAS USA INC
- ENERGY CORP OF AMER
- ENERPLUS RES (USA) CORP
- ENERVEST OPR LLC
- EOG RESOURCES INC

- EQT PROD CO
- EQT PRODUCTION LLC
- EXCO RESOURCES PA INC
- FLATIRON DEVELOPMENT LLC
- GREAT OAK ENERGY INC
- GUARDIAN EXPLORATION LLC
- HESS CORP
- INTERSTATE GAS MKT INC
- J W OPERATING CO
- JR RESOURCES LP

- LONGFELLOW ENERGY LP
- M & M ROYALTY LTD
- MARATHON OIL CO
- MDS ENERGY LTD
- MEKA LLC
- MTN V OIL & GAS INC
- NEWFIELD APPALACHIA PA LLC
- NORTHEAST NATURAL ENERGY LLC
- NOVUS OPERATING LLC
- PALON ENERGY CO LLC

- POC MOUNTAINEER LLC
- PENN VIRGINIA OIL & GAS CORP
- PETRO DEV CORP
- PHILLIPS EXPLORATION INC
- RANGE RESOURCES APPALACHIA LLC
- REX ENERGY OPERATING CORPORATION
- RICE DRILLING B LLC
- SAMSON RES CO
- SCHRADER KEVIN E
- SENECA RESOURCES CORP

- SM ENERGY CO
- SNYDER BROS INC
- SOUTHWESTERN ENERGY PROD CO
- SPECIAL JHR CORPORATION
- STONE ENERGY CORP
- TALISMAN ENERGY USA INC
- TANGLEWOOD EXPL LLC
- TEXAS KEYSTONE INC
- TRIANA ENERGY LLC
- TRUE OIL LLC

- TURN OIL INC
- ULTRA RESOURCES INC
- US ENERGY EXPLORATION CORP
- VISTA OPR INC
- WILLIAM MCINTIRE COAL OIL & GAS
- WILLIAM S BURKLAND
- WILLIAMS PRODUCTION APPALACHIA LLC
- XTO ENERGY INC



Permitted Unconventional Wells



A Transformed Landscape



Testing



Construction



Active Sites

ONE APPROACH?

GEOSPATIAL MODELS - MACRO SCALE

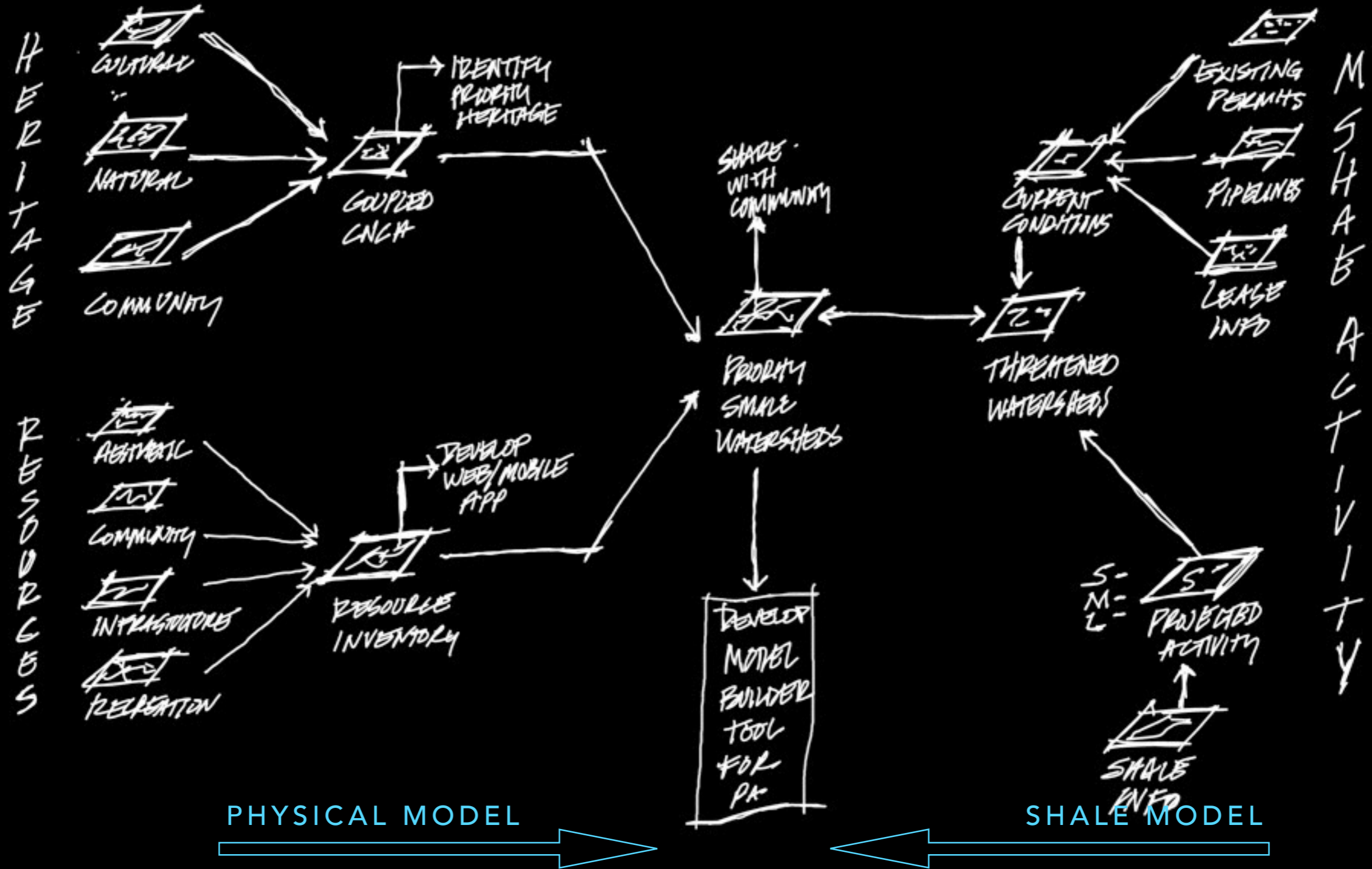
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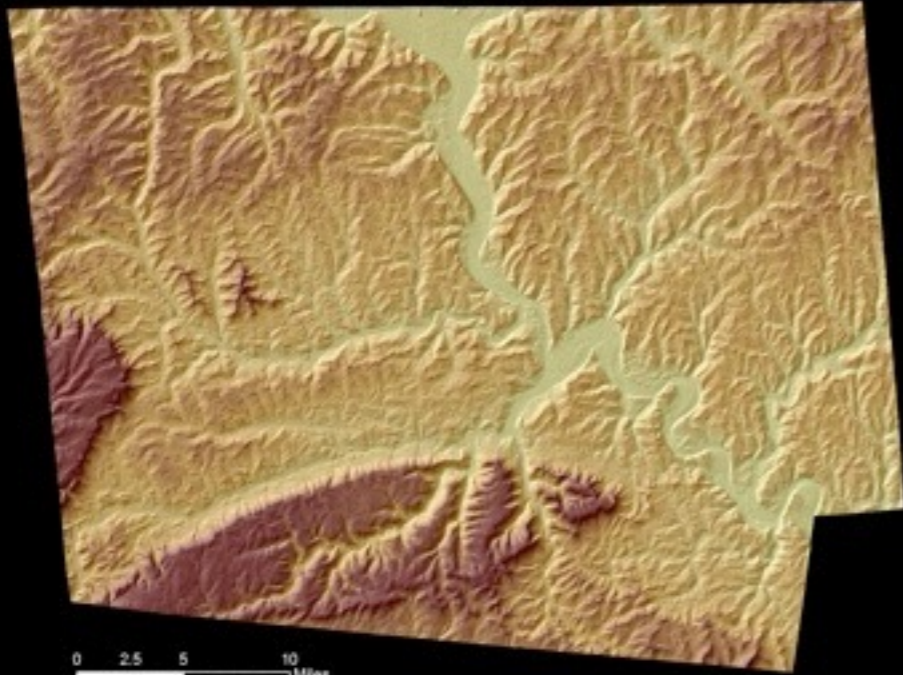
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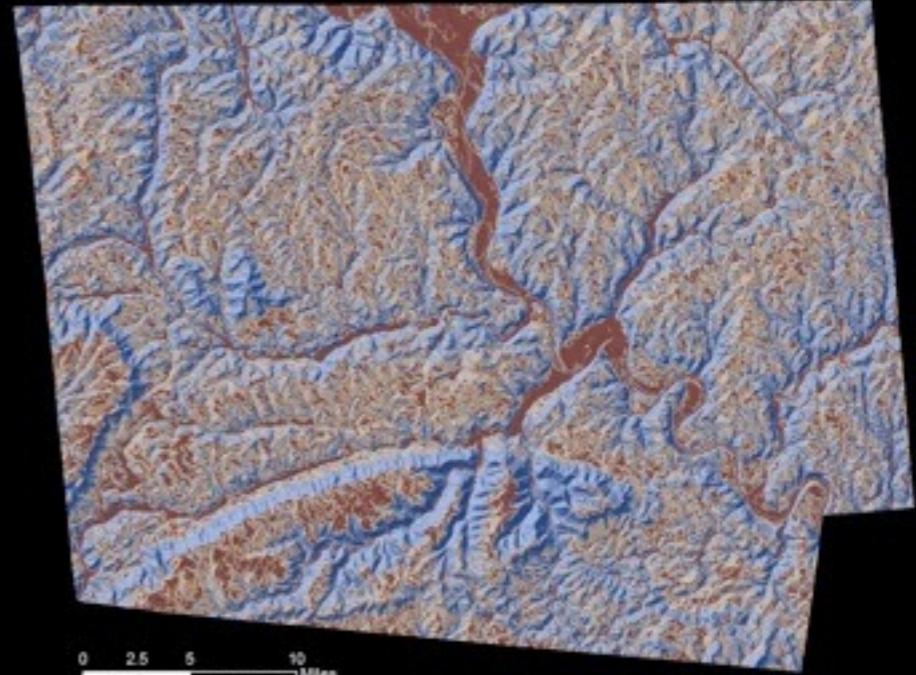
CLARIS CONCEPTUAL MODEL



CULTURAL LANDSCAPE ASSESSMENT AND RESOURCE INFORMATION SYSTEM



BRADFORD COUNTY - Topography/Physiography



BRADFORD COUNTY - Slope

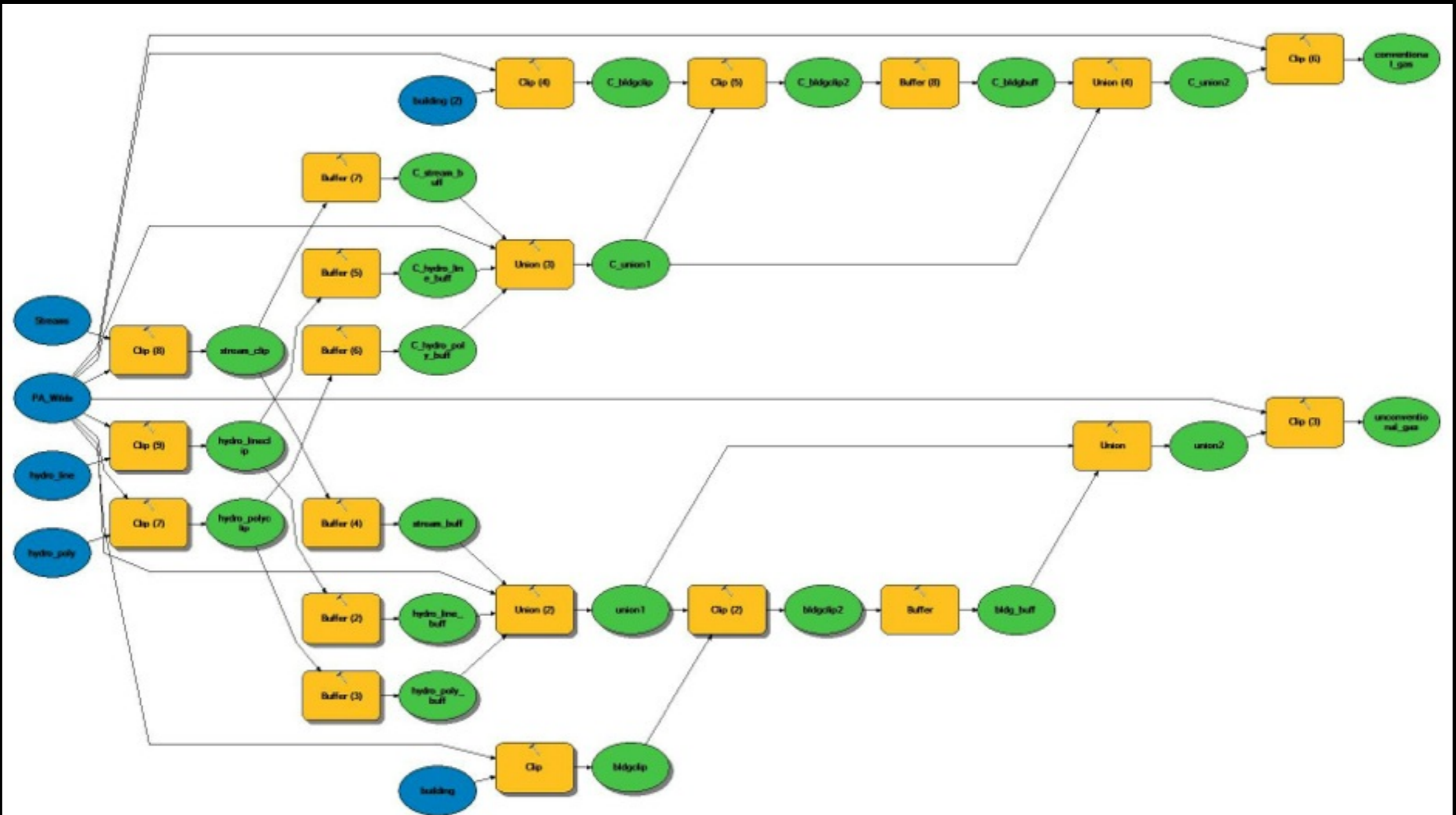


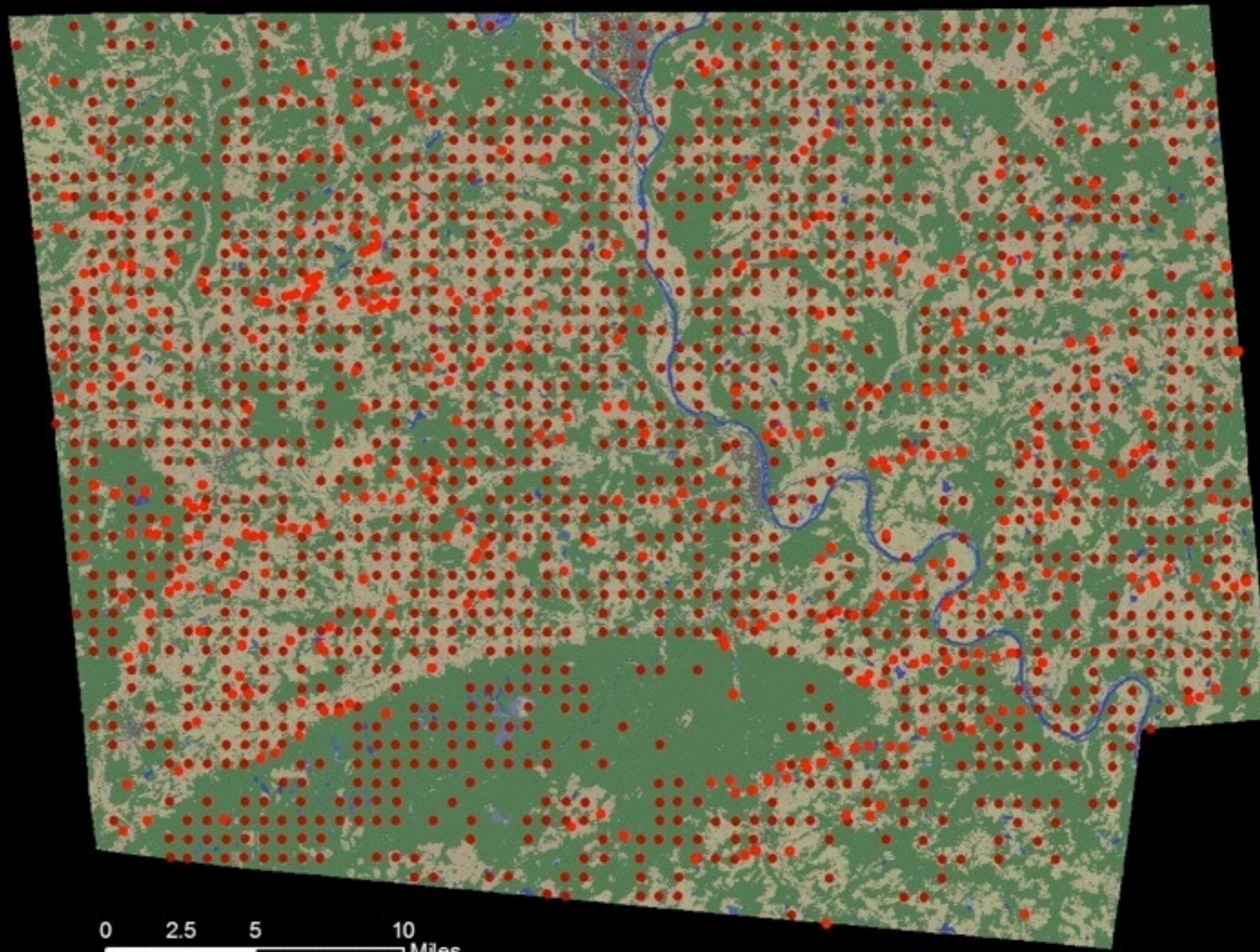
BRADFORD COUNTY - Wetlands



BRADFORD COUNTY - Land Use/Land Cover

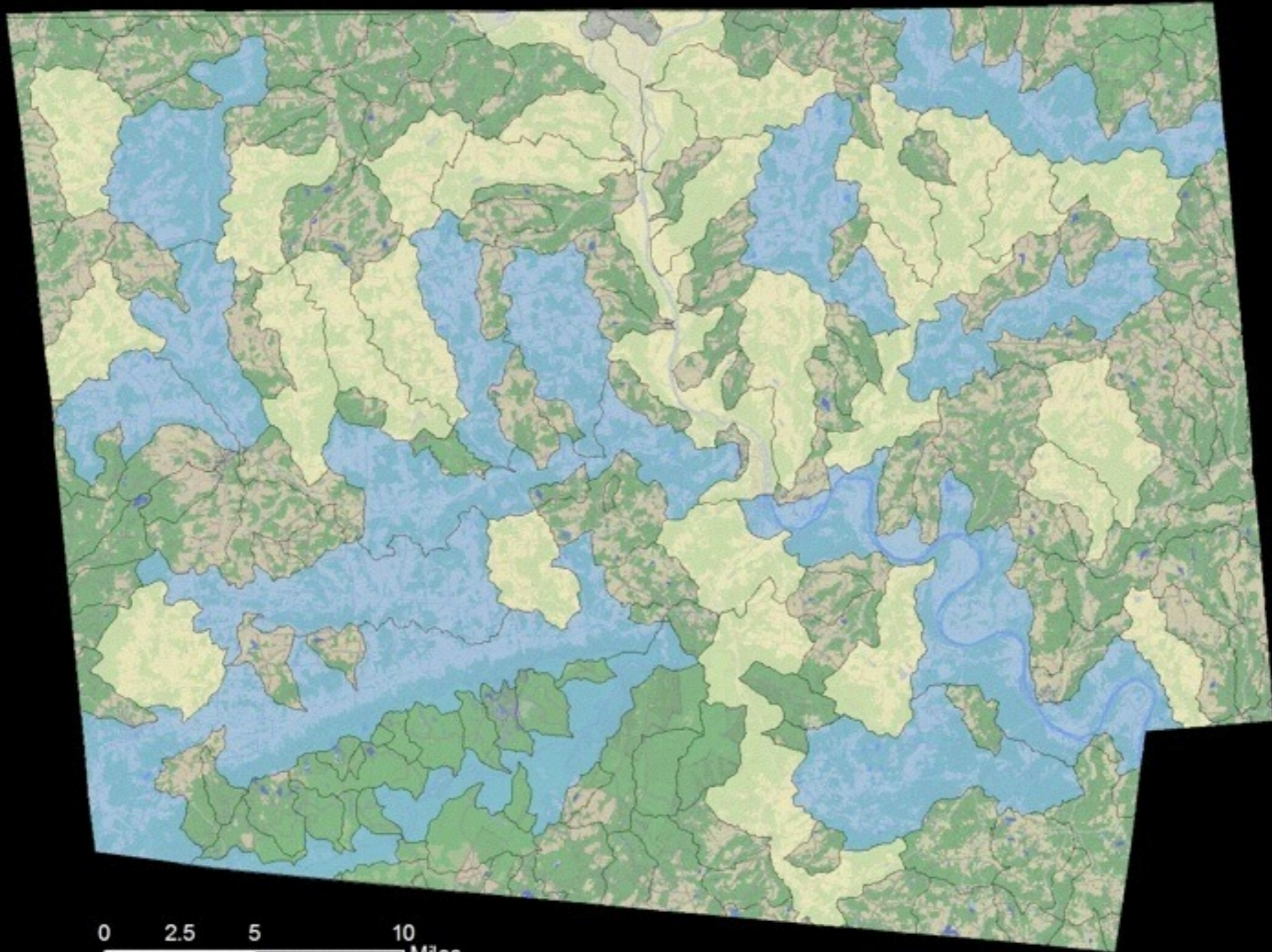
EXAMPLE MODEL PARAMETERS





BRADFORD COUNTY PERMITS NC HIGH IMPACT MODEL

Model developed by the Nature Conservancy...A Useful Start
20 Year Potential Development



0 2.5 5 10 Miles

BRADFORD COUNTY Threatened Watersheds + High Impact Permit Model
Blue = more than 20 Well Pads Yellow = more than 10

Merge two models.

EXAMPLE RESULTS:

- Indirect Impacts are potentially more complicating than direct impacts of drilling and fracking.
 - >80% of roads and bridges will be substantially repaired or rebuilt. Could be the greatest challenge to cultural resources in the next 50 years.
 - Water extraction + transportation pressures present important challenges.
 - Aesthetic, Visual + Scenic Context needs to be more aggressively addressed.
 - Impact to non-listed or locally recognized buildings and places is far greater, because they often are not as visible (e.g., local historic cemeteries).



A SECOND APPROACH?

DISTRIBUTING TOOLS

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175 McKNIGHT ROAD BLAIRSVILLE
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HOGUE, WILL LIE TO YOUR
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HOME



THE ISSUES



WHY DESIGN



BY DESIGN 2012

BY DESIGN 2013



PEOPLE



COMMUNITY



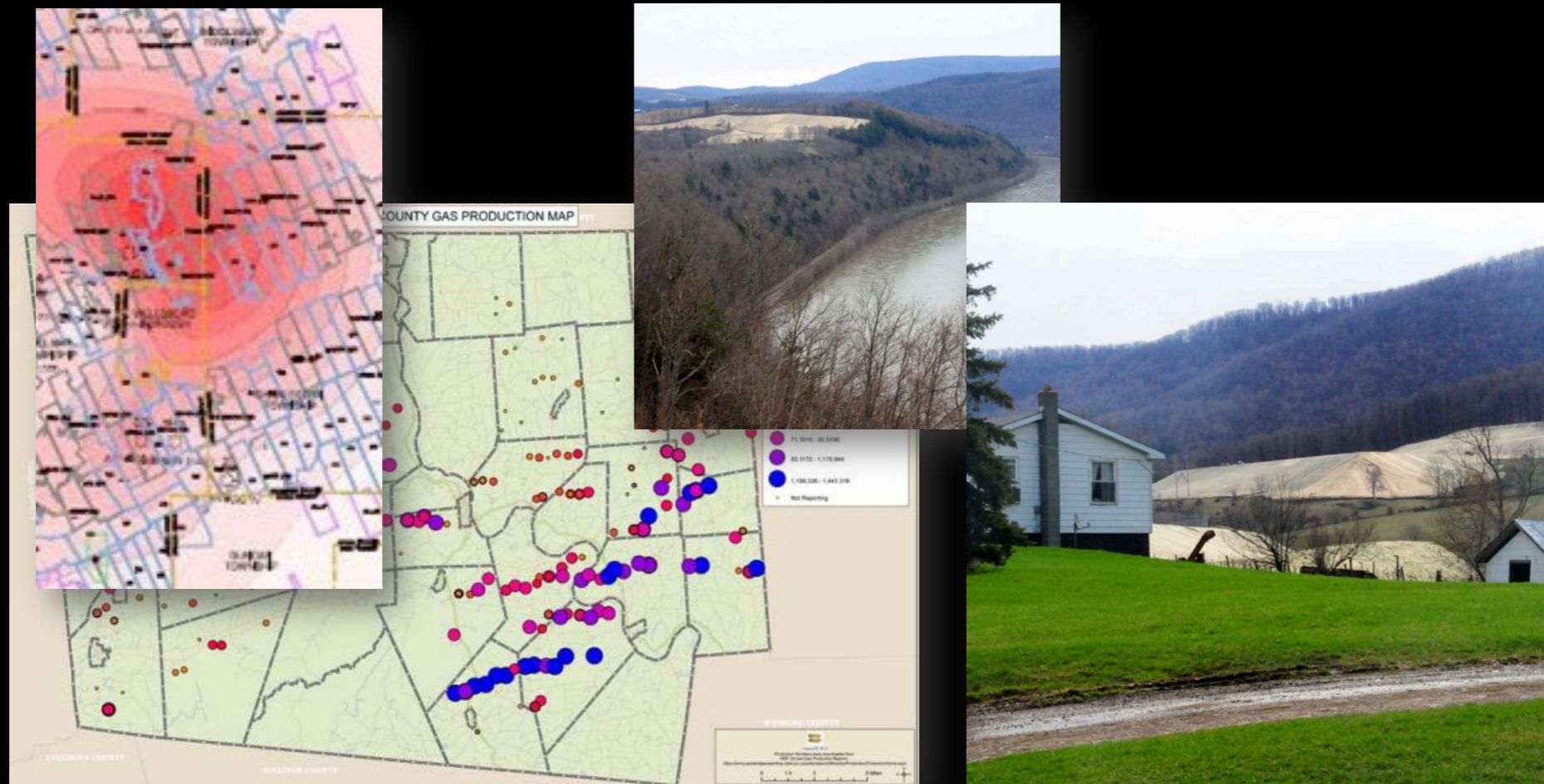
ENVISIONING THE FUTURE OF NORTHEASTERN PENNSYLVANIA



Marcellus by Design is a Penn State University Landscape Architecture studio initiative to enhance awareness of planning and design in the context of Marcellus Shale natural gas development in Pennsylvania. We strive to provide a balanced approach to integrating environmental, economic, sociological, and aesthetic dimensions of landscape through strategic research and design. Accepting that Marcellus Shale gas will continue to be a driving force behind economic development in many Pennsylvania communities, we are committed to expanding the breadth and accessibility of knowledge about alternative approaches to landscape planning under current and future gas development scenarios. Our goal is to provide stakeholders

HOW GEOLOGY SHAPES GAS DEVELOPMENT?

ISSUE: DRILLING UNITS ARE CREATED TO MAXIMIZE PRODUCTION
OUR JOB: PREDICT AND SHOW HOW AND WHERE IMPACTS OCCUR



HOW GAS INFRASTRUCTURE SHAPES DEVELOPMENT?

ISSUE: PIPELINES LOCATED TO MINIMIZE COST

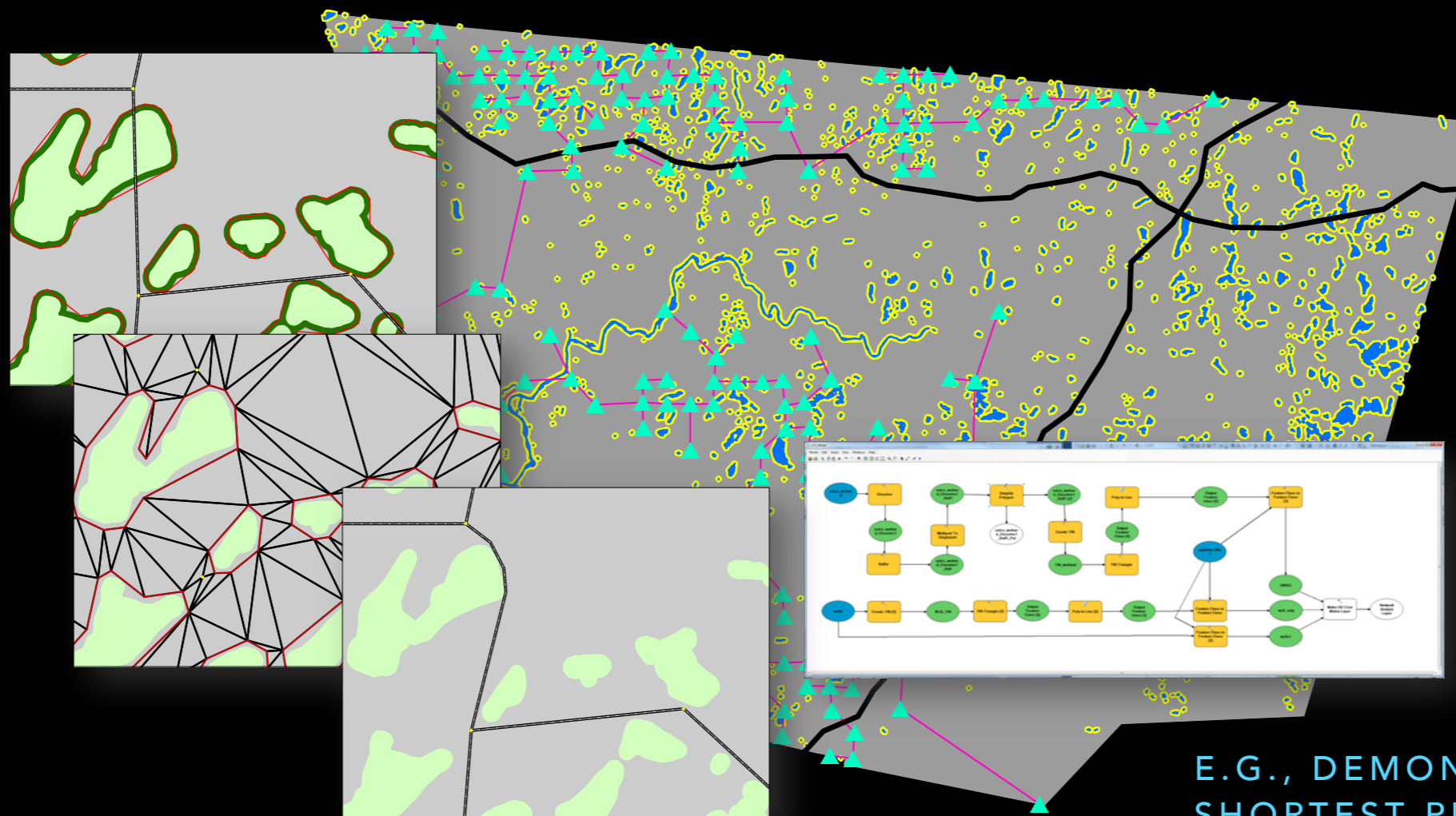
OUR JOB: SHOW HOW CHOICE OF PLACEMENT AFFECTS LANDSCAPE



WELL LOCATION DICTATES PIPELINE ROUTING?

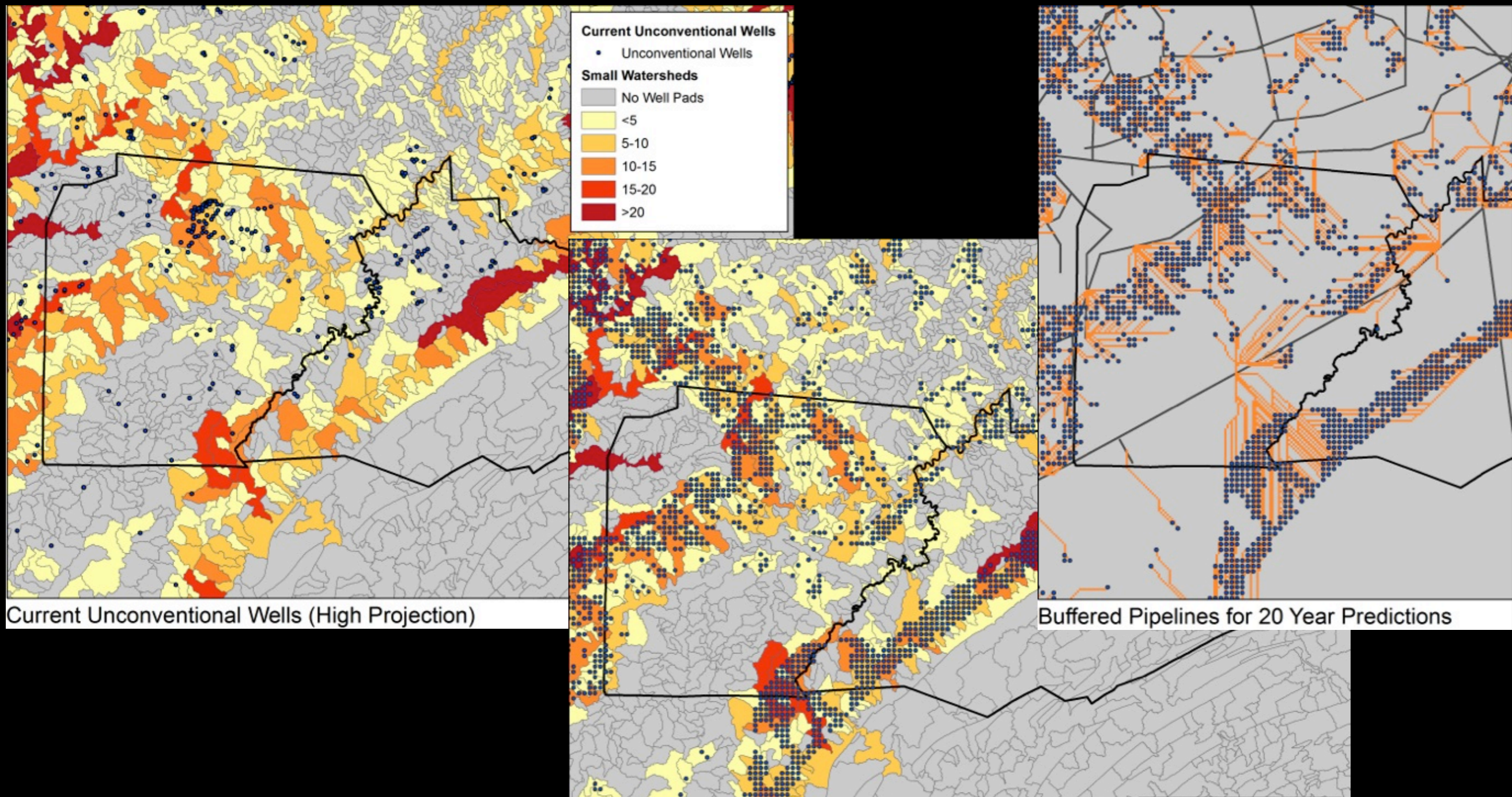
ISSUE: PIPELINES CONNECT WELL PADS TO MARKETS

OUR JOB: ILLUMINATE WHERE PIPELINES WILL LIKELY HAVE TO GO

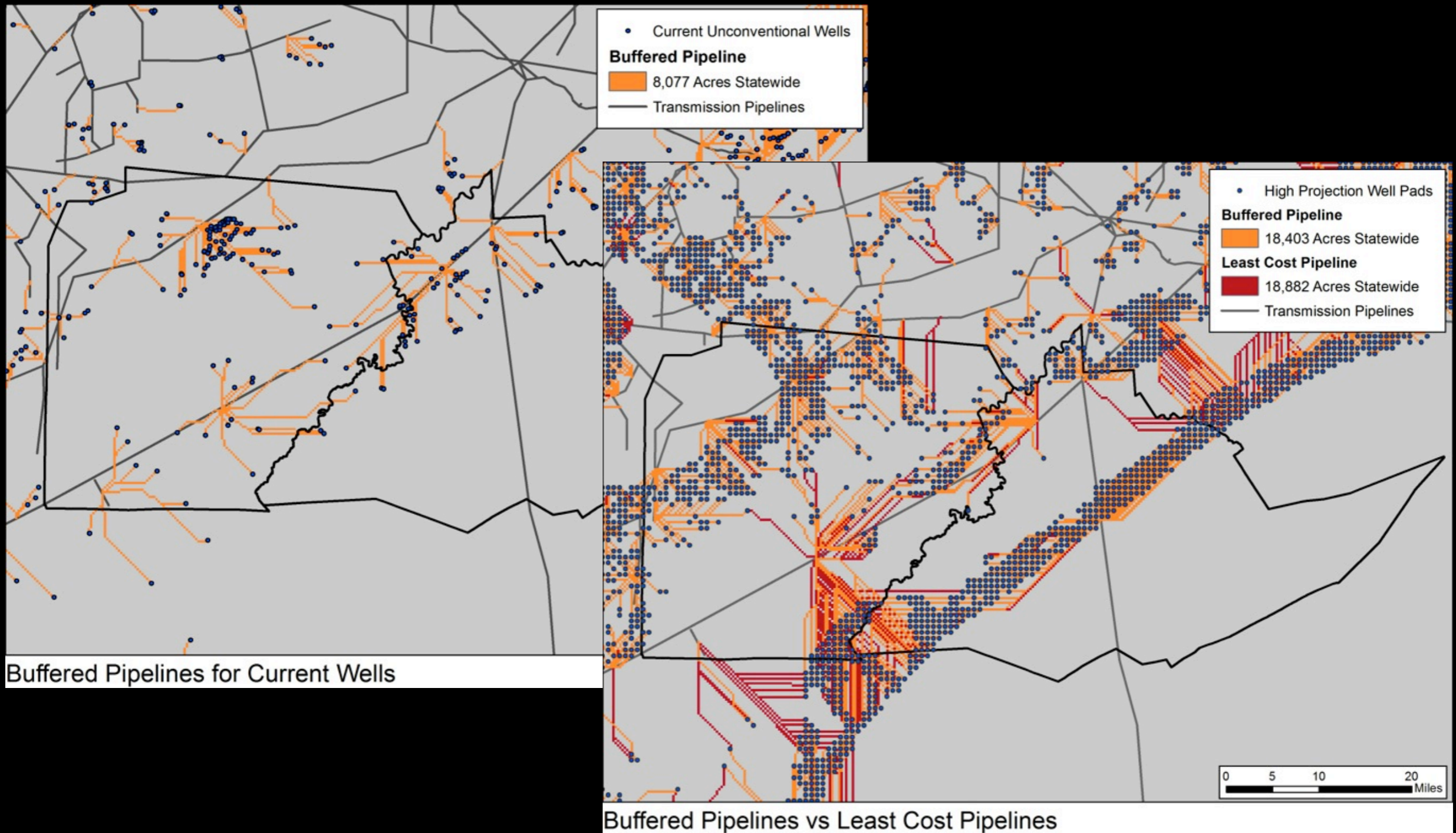


E.G., DEMONSTRATE
SHORTEST PIPELINE ROUTING
AVOIDING WETLANDS

PREDICTIVE TOOLS AND MULTIPLE SCENARIOS: COMPARING EXISTING IMPACTS WITH FUTURE SCENARIOS

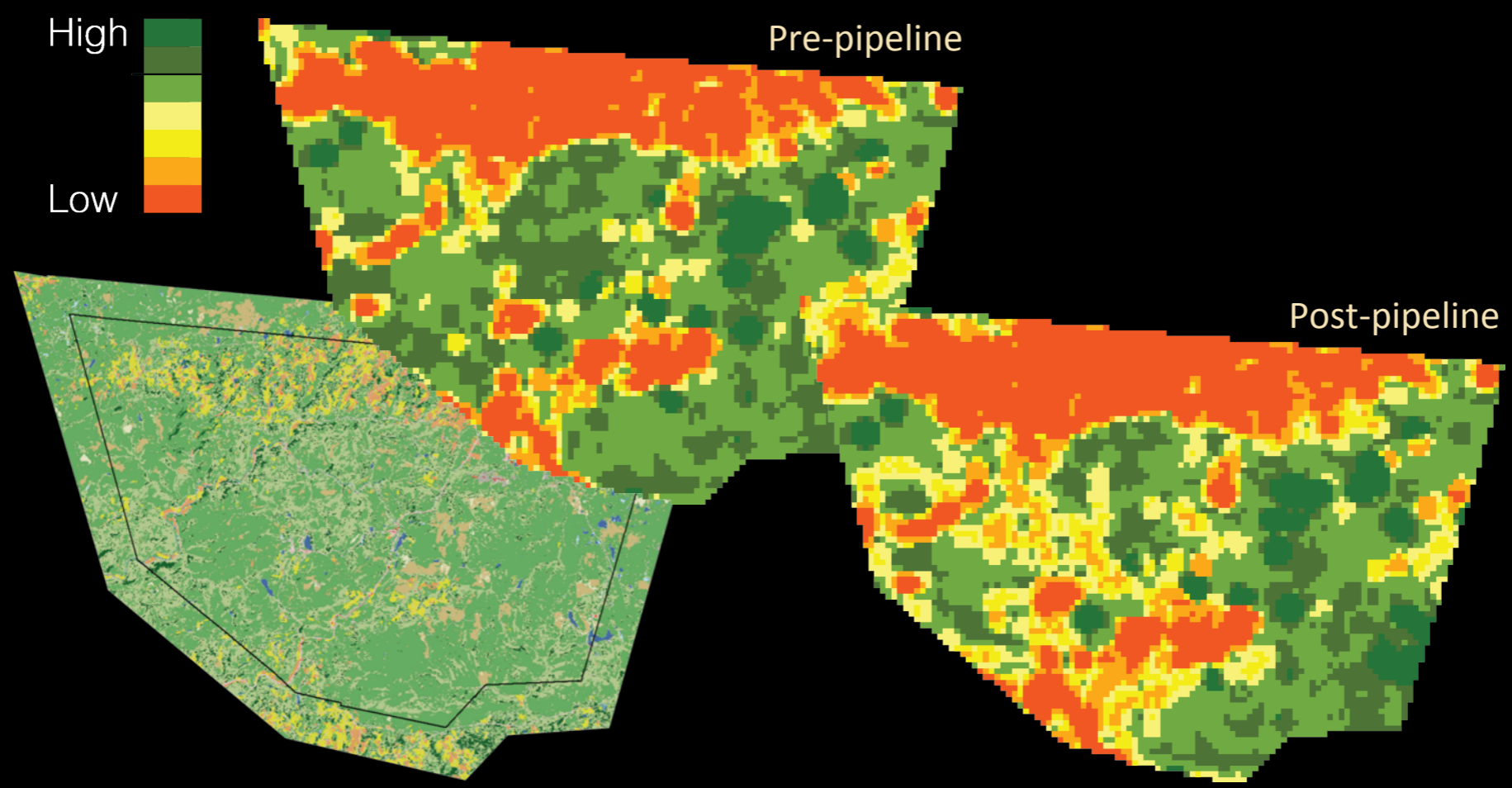


PREDICTIVE TOOLS AND MULTIPLE SCENARIOS: COMPARING EXISTING IMPACTS WITH FUTURE SCENARIOS



PIPELINES AFFECT MORE AREA THAN WELL PADS

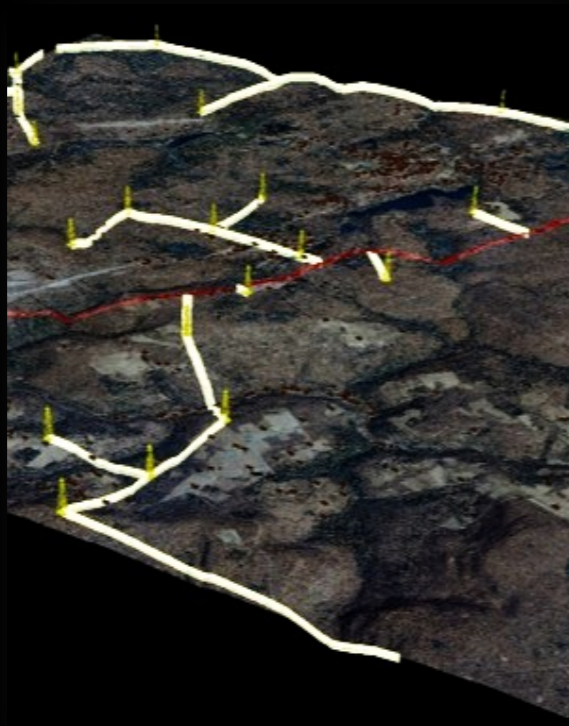
ISSUE: FOREST COVER IS IMPACTED BY LINEAR RIGHT-OF-WAYS
OUR JOB: ILLUMINATE PROJECTED CHANGES IN VISUAL QUALITY



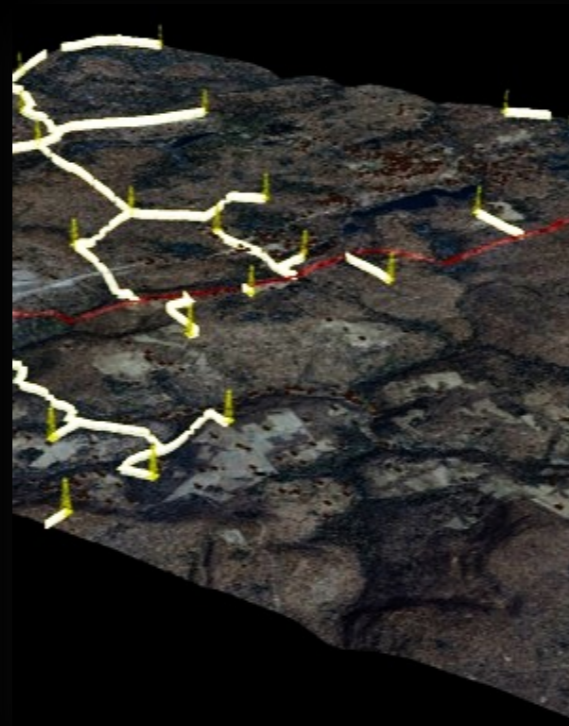
REGRESSION MODEL PROJECTS VISUAL
QUALITY IMPLICATIONS OF LAND USE CHANGE

EVALUATE PIPELINE LOCATIONS AND IMPACTS

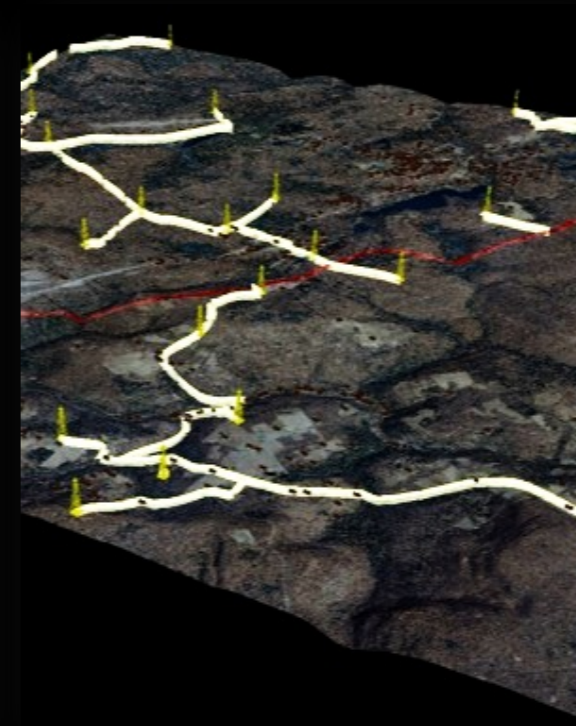
ISSUE: DIFFERENT LOCATION STRATEGIES, DIFFERENT OUTCOMES
OUR JOB: EXAMINE THE IMPLICATIONS OF ROUTINGS



SHORTEST-DISTANCE MODEL
158 STREAM CROSSINGS
18 HOMES DISPLACED
84 WETLANDS IMPACTED
1,648 PROPERTIES IMPACTED
0.56 MILES PER WELL



LEAST BOUNDARY CROSSINGS
148 STREAM CROSSINGS
3 HOMES DISPLACED
49 WETLANDS IMPACTED
1,248 PROPERTIES IMPACTED
0.63 MILES PER WELL



CONSERVATION-ORIENTED
124 STREAM CROSSINGS
10 HOMES DISPLACED
19 WETLANDS IMPACTED
2,198 PROPERTIES IMPACTED
0.66 MILES PER WELL

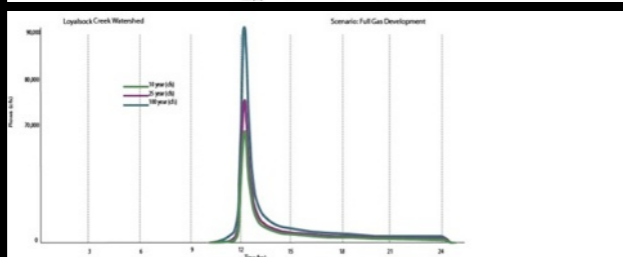
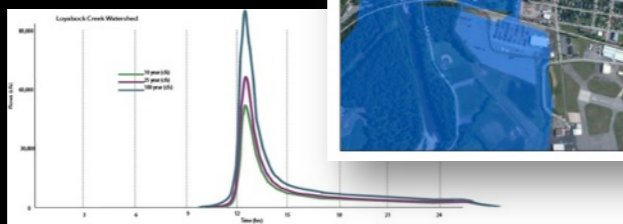
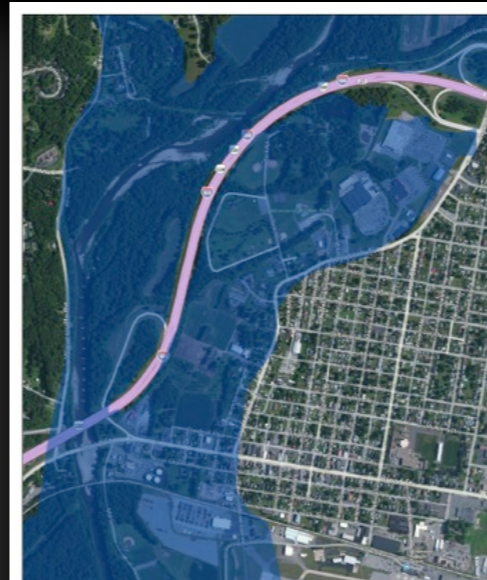
EVALUATE STORMWATER MANAGEMENT

ISSUE: DOWNSTREAM IMPACTS OF LAND COVER CHANGE
OUR JOB: EXAMINE IMPLICATIONS FOR FLOOD-PRONE COMMUNITIES

MONTOURSVILLE, PA
TROPICAL STORM LEE
FALL, 2011

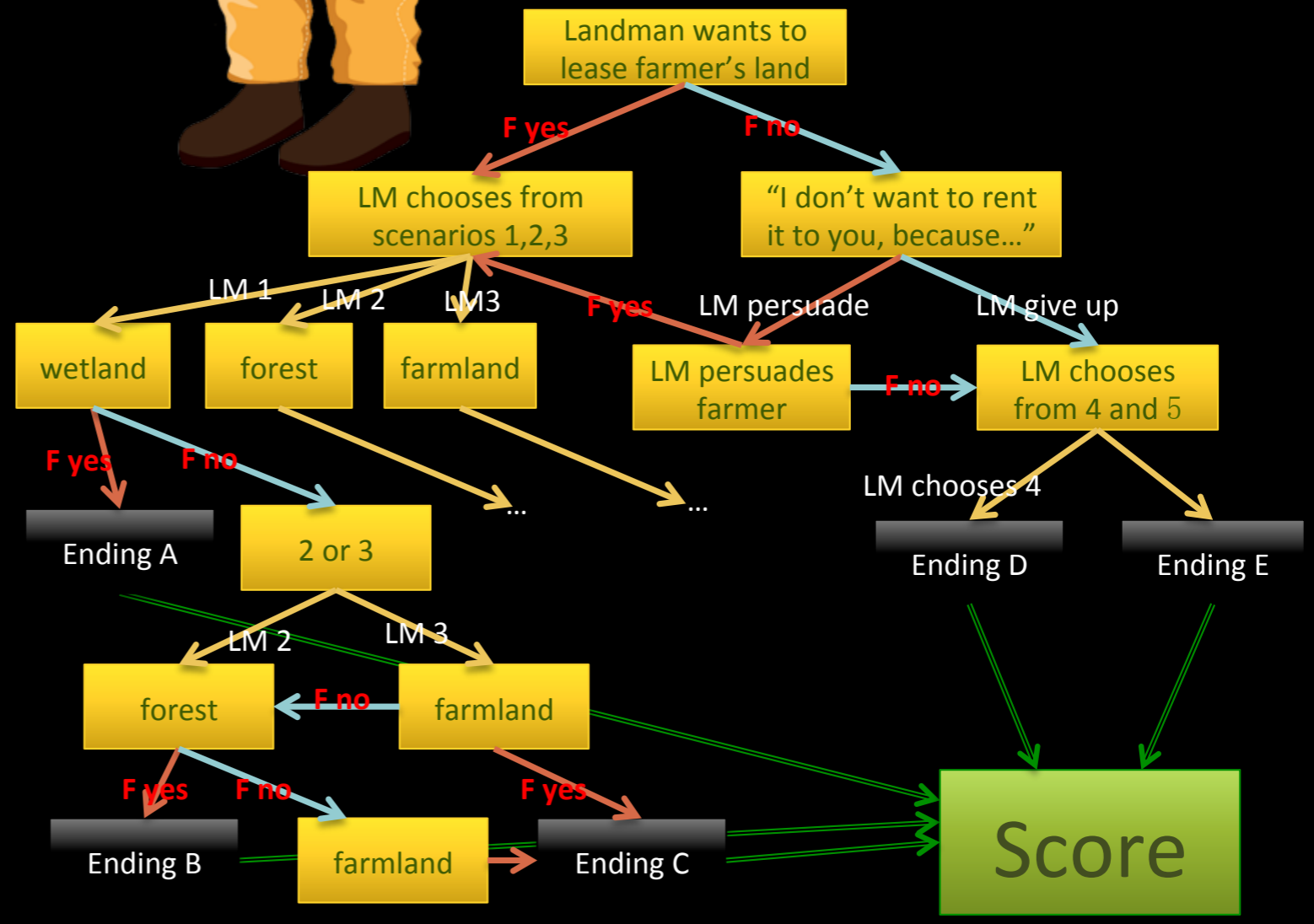
REDUCED LAND COVER
FULL GAS BUILD-OUT

PIPELINE CORRIDOR
BMP MITIGATION





Let's explore some of the factors that determine where a pipeline can go



EXAMPLES OF TOOLS

(IF WE HAVE TIME AND INTERNET):

- <http://marcellusbydesign.psu.edu/by-design>
- http://youtu.be/yWsqf_AgBJU
- <http://www.personal.psu.edu/tmm184/dubois/#>
- <http://psugeo.maps.arcgis.com/home/webmap/viewer.html?webmap=562fa8eda7a941b59e470640ef9986d3>
- <http://psugeo.maps.arcgis.com/apps/StorytellingSwipe/?appid=e4a36b186d214d8da8ca7e05b91d1d0b>

THE DESIGN, PLANNING AND ETHNOGRAPHIC IMPERATIVE



TAKE HOME MESSAGES:

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