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Marcellus Gas Development: Forest Habitat Impacts and Conservation Opportunities in the Central Appalachians

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Central Appalachian Forests

The Central Appalachians harbor some of the most biologically diverse temperate broad-leaf forests in the world. These forests provide large interior forest habitats, migratory pathways, and nested rare communities...

Photo: George Gross

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Central Appalachian Forests

...but new energy development is clearing and fragmenting those precious forests.

Photos: Web Johnson

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Central Appalachian Energy Threats

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Marcellus Shale Natural Gas

Data Sources: USGS, USRI


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Marcellus Shale Natural Gas

Image: Chesapeake Energy
Image: Energy Resources


Pennsylvania Energy Impacts Assessment

- Project Goal:** Develop projections of how new energy development could impact natural habitats in Pennsylvania and shape strategies that avoid or minimize those impacts
- Energy Types:** Focused on energy types that have the most potential for land use change during the next twenty years in Pennsylvania:
 - Marcellus Shale natural gas**
 - Wind
 - Wood biomass
 - Electric transmission lines
 - Gas pipelines



Pennsylvania Energy Impacts Assessment

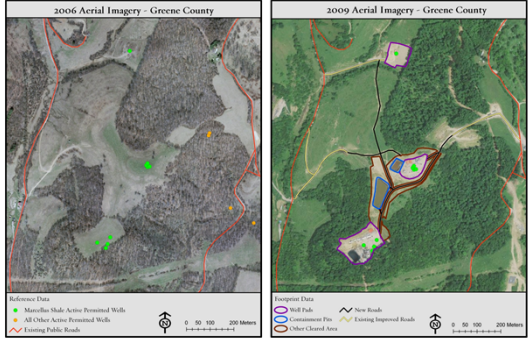
- Analytical Team:** Twelve staff from The Nature Conservancy, Western Pennsylvania Conservancy, Audubon Pennsylvania
- Assumptions:**
 - 20-year time period
 - Stable and sufficient prices and capital investment for steady development growth
- Keep in mind that:**
 - Energy projections are informed scenarios – *not predictions*
 - The assessment focuses on impacts to forest habitats and *does not* address other potential environmental impacts, including water quality, water quantity, air quality, and migratory pathways



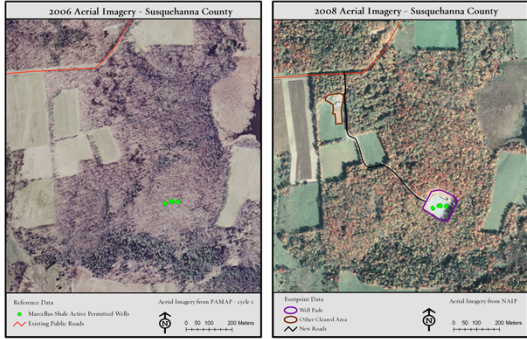
Assessment Steps

- What is the **SPATIAL FOOTPRINT** of existing energy development?
- PROJECTIONS:**
 - HOW MUCH** energy infrastructure might be developed by 2030?
 - WHERE** is energy development more and less likely to occur?
- CONSERVATION IMPACTS:**
 - How could future energy development affect forest habitats?


Spatial Footprint – Marcellus Gas



Spatial Footprint – Marcellus Gas



Forest Habitat Impacts – Marcellus Gas




BEFORE	AFTER	IMPACT
193 acres	174 acres	(-19 acres)

Forest Habitat Impacts – Marcellus Gas

Average Spatial Disturbance for Marcellus Shale Well Pads in Forested Context (acres)

Forest cleared for Marcellus Shale well pad	3.1	8.8
Forest cleared for associated infrastructure (roads, pipelines, containment pits, etc.)	5.7	
Indirect forest impact from new edges	21.2	
TOTAL DIRECT AND INDIRECT IMPACTS	30	

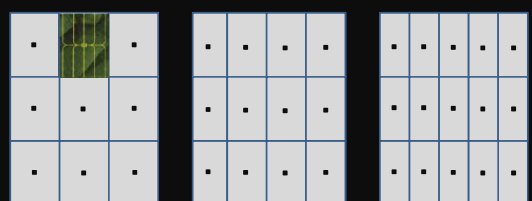
How Many Marcellus Wells?



250 horizontal drill rigs
 x 1 well drilled per month (or 12/yr)
 x 20 years
 = **60,000** new wells drilled by 2030

How Many Marcellus Well Pads?

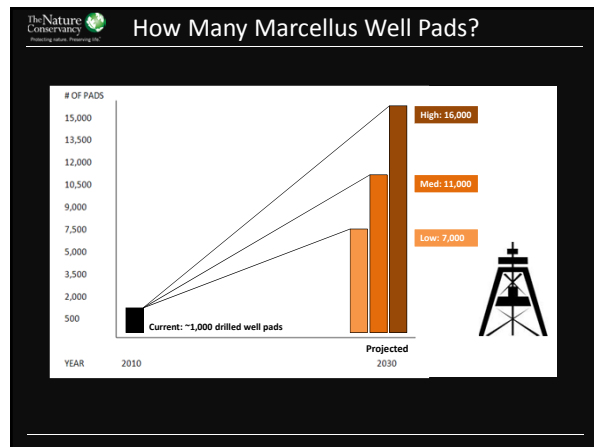
60,000 projected Marcellus wells distributed differently across the landscape



Low Scenario
10 wells per pad

Medium Scenario
6 wells per pad


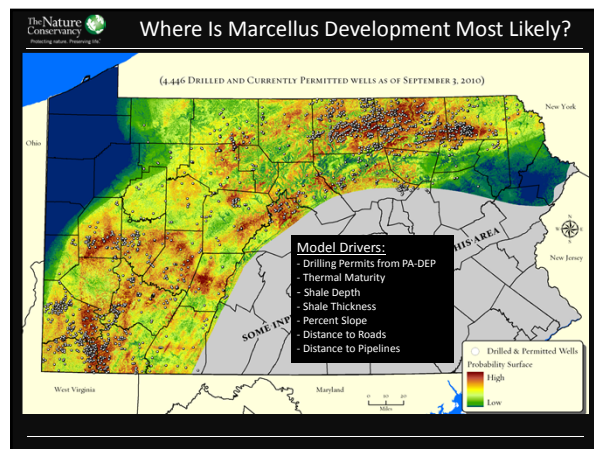
High Scenario
4 wells per pad

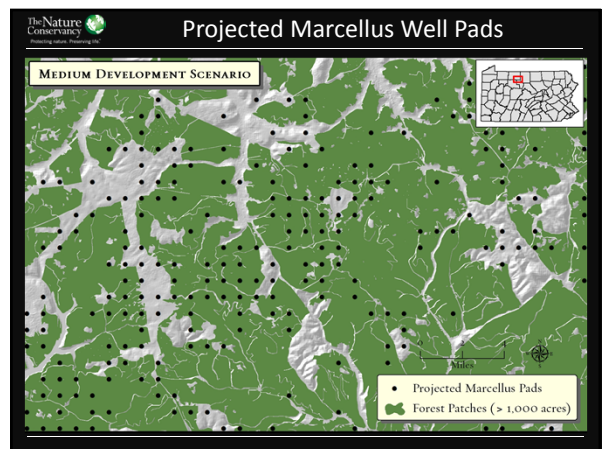
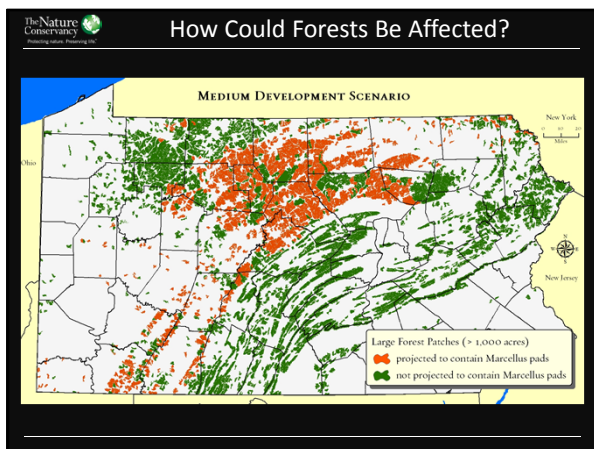
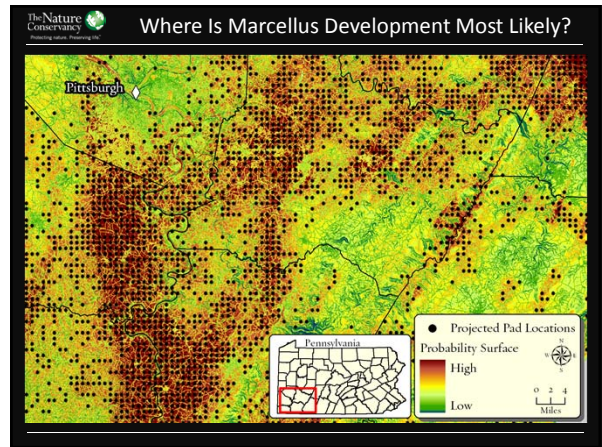
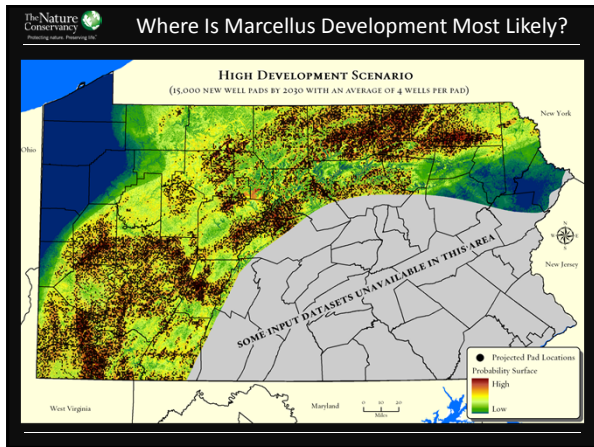
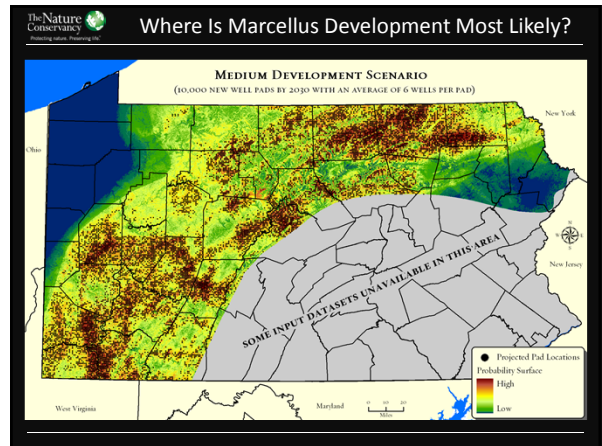
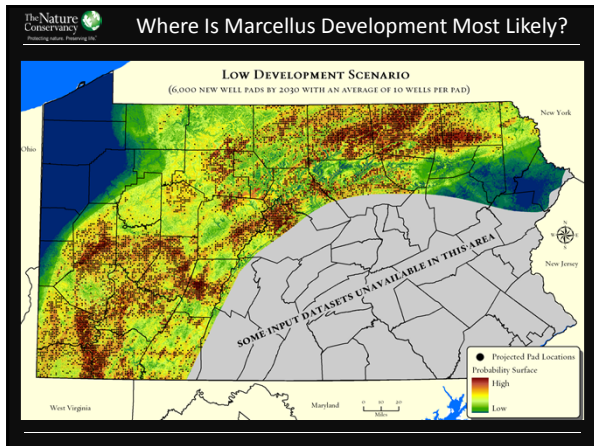


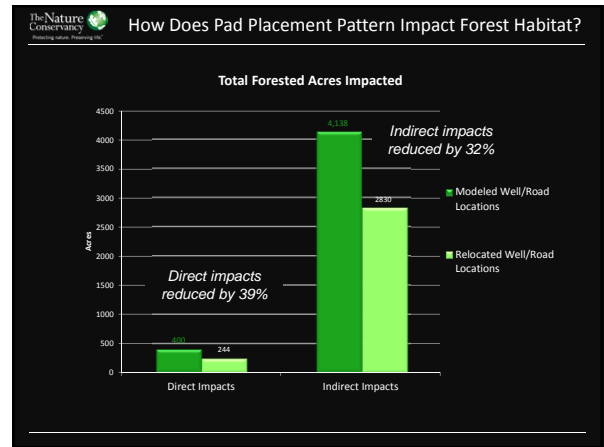
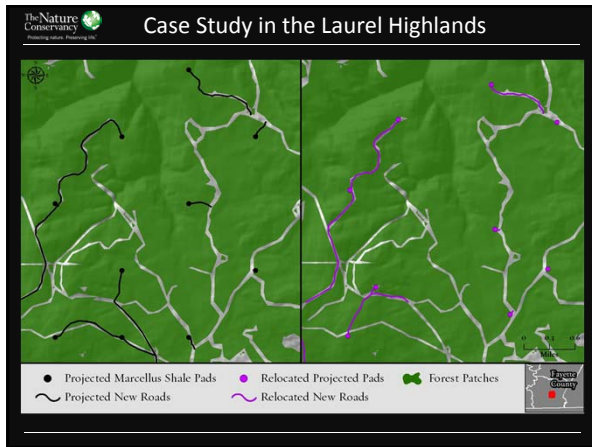
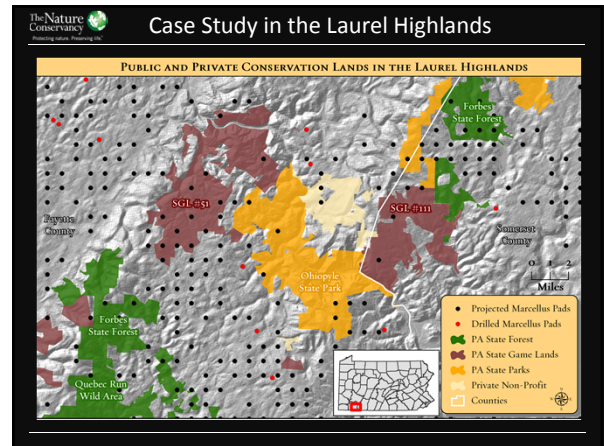
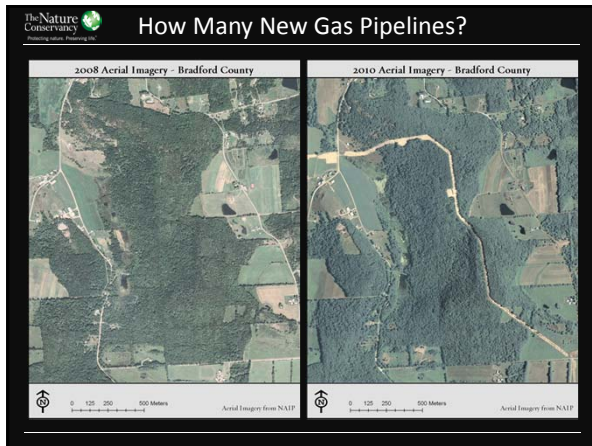
Where Is Marcellus Development Most Likely?

Using Maximum Entropy (MaxEnt) approach, modeled the relationship between:

- Drilled and permitted Marcellus wells (from PA-DEP data), and
- Spatial variables related to geology and infrastructure:
 - Thermal Maturity
 - Shale Depth
 - Shale Thickness
 - Percent Slope
 - Distance to Roads
 - Distance to Pipelines






- ### How Can We Avoid & Minimize Impacts?
- Site well pads and roads in existing open areas and co-locate transmission with existing rights-of-way
 - More wells on each pad and (recognizing economic constraints) extend lateral well distances
 - Create tools to integrate habitat/environmental data into energy infrastructure planning
 - Establish landscape approach to energy permitting
 - Inform energy and consulting company staff in use of habitat data and Best Management Practices (BMPs)

- ### Development by Design
- Development by Design balances the needs of planned development – such as oil and gas, mining, and infrastructure – with those of biodiversity conservation.
 - Approach:
 - **Avoid** conflicts between development impacts and areas of high biodiversity or conservation value
 - Where development occurs:
 - **Minimize** impacts as much as possible, using appropriate siting guidelines and Best Management Practices for operations
 - **Mitigate** impacts as appropriate (most common for wetlands)

DbD in the Central Appalachians

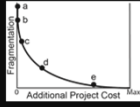



We are expanding the energy assessment to cover the entire Central Appalachians region

- Marcellus gas
- Wind
- Coal


DbD in the Central Appalachians


- Interactive GIS-based **decision support tool** for siting Marcellus gas well pads
- Scientific “report card” of existing **Best Management Practices (BMPs)**
- **Demonstration sites** in PA and WV

Questions / Comments

The report and other information can be found at:
www.nature.org/paenergy





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