The Water / Energy Nexus

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Our mission is to conserve the lands and waters on which all life depends.

Global organization

Every state and 35 countries

Science-based approach

~ 1 million members in United States
Rising Population

Figure 1. Estimated world population, 1950-2000, and projections: 2000-2050

United Nations Department of Economic and Social Affairs/Population Division 5
World Population to 2300
What are the Risks?
Susquehanna River Basin

Largest river entirely in U.S. that flows into Atlantic Ocean (over 27,510 mi²; NY, PA, MD)

More than 75% of demand currently comes from public water supply and electricity generation

Susquehanna River Basin Commission (SRBC) role in water management
Consumptive Water Use – Susquehanna Basin

Maximum Approved Daily Consumptive Use

Maximum Approved Daily Consumptive Use (in mgd)

- Water Supply
- Power Generation
- Recreation
- Gas Drilling
- Manufacturing
- Other
- Mining
- Education

Current Estimate
Marcellus Shale and Susquehanna Basin
SRBC Passby Flow Policy

Flow that must be allowed to pass a specific point downstream of a withdrawal.

“Hands Off” flow
Flow Studies in PA River Basins

Objective: to develop **science-based** flow recommendations that are **useful** to water managers.
What About Our Forests?

Photo: George Gress
How Many Marcellus Well Pads?

- **Low**: 7,000
- **Med**: 11,000
- **High**: 16,000

Projected Current: ~1,000 drilled well pads
Where Is Marcellus Development Most Likely?

Modeled the relationship between:

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

Existing & Projected Marcellus Shale Natural Gas Wells in PA

- Drilled Marcellus Shale Wells
- Projected Marcellus Shale Pads

Data Sources: PA Dept. of Environmental Protection (Jan 4, 2012), Projected Locations based on high development scenario from the PA Energy Impacts Assessment led by TNC (2010)
How Could Forests Be Affected?
How Could Birds Be Affected?
Black-Throated Blue Warbler

High Scenario (15,000 new well pads by 2030)

Probable % Reduction in BT Blue Warbler Habitat
- 0%
- 0.1% - 5%
- 5.1% - 10%
- 10.1% - 44.3%
- BTBW Not Present
How Could Brook Trout Be Affected?
How Many New Gas Pipelines?

Photos: Nels Johnson
How Many New Gas Pipelines?
How Many New Gas Pipelines?

- As many as **25,000 miles of new, large-diameter pipelines** will be built in Pennsylvania over the next twenty years.

- At least double, possibly quadruple, what we have now.

- Pipeline footprint alone will be larger than the cumulative area affected by all other Marcellus gas infrastructure combined.
In the Susquehanna Basin, up to 110,000 forest acres will be cleared by gas development

= 2 ½ new Washington D.C.s
Statewide, up to 240,000 forest acres will be cleared by gas development = 2 ½ new Philadelphias
How Can We Avoid & Minimize Impacts?

- Site well pads and roads in existing open areas and co-locate pipelines with existing rights-of-way
- More wells on each pad and 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)
- Rigorous implementation, monitoring, and enforcement of E&S controls for roads, pipelines, and pads
Development by Design
Questions / Comments

More information can be found at:
www.nature.org/paenergy

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Global Energy Use by Source 2008
Source: IEA, World Energy Outlook 2010

- TPED
- Power Generation
- OECD
- Non-OECD

Billions of Barrels of Oil Equivalent

- Renewables
- Biomass
- Hydro
- Nuclear
- Gas
- Oil
- Coal
Shale Gas Across the U.S.
Where and How Much?

Model Drivers:
- Drilling Permits from PA-DEP
- Thermal Maturity
- Shale Depth
- Shale Thickness
- Percent Slope
- Distance to Roads
- Distance to Pipelines
Where and How Much?
Where and How Much?

Medium Development Scenario

(10,000 new well pads by 2030 with an average of 6 wells per pad)

Projected Pad Locations

Probability Surface

High

Low

Some input datasets unavailable in this area.