Managing Our State Forests

DCNR, Bureau of Forestry

Marcellus Shale Management and Field Tour

PA Forest Coalition

May 14, 2012

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AND NATURAL RESOURCES

Outline

- Pennsylvania's State Forests
- Natural gas history on State Forests
- Marcellus shale on State Forests
  - Current activities
  - Management approach
  - Geology and infrastructure

State Forest System

- Established in 1898
- 2.2 Million Acres
- 48 of 67 Counties
- Created for:
  - Continuous supply of timber & wood products
  - Protect watersheds & conserve the waters
  - Furnish opportunities for healthful recreation

Bureau of Forestry

Mission:

"Ensure the long-term health, viability and productivity of the Commonwealth's forest and to conserve native wild plants."

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State Forest values

Clean water – over 5,000 miles of streams on SFL

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State Forest values

Wood products – 14,000 acres harvested annually producing nearly 80 million board feet of lumber and pulpwood

State Forest values

Recreation & tourism – over 5,000 miles of trails open for public use

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State Forest values

Habitat for thousands of plants and animals

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State Forest values

Scenic and aesthetic beauty

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State Forest values

Energy – natural gas, biomass, firewood

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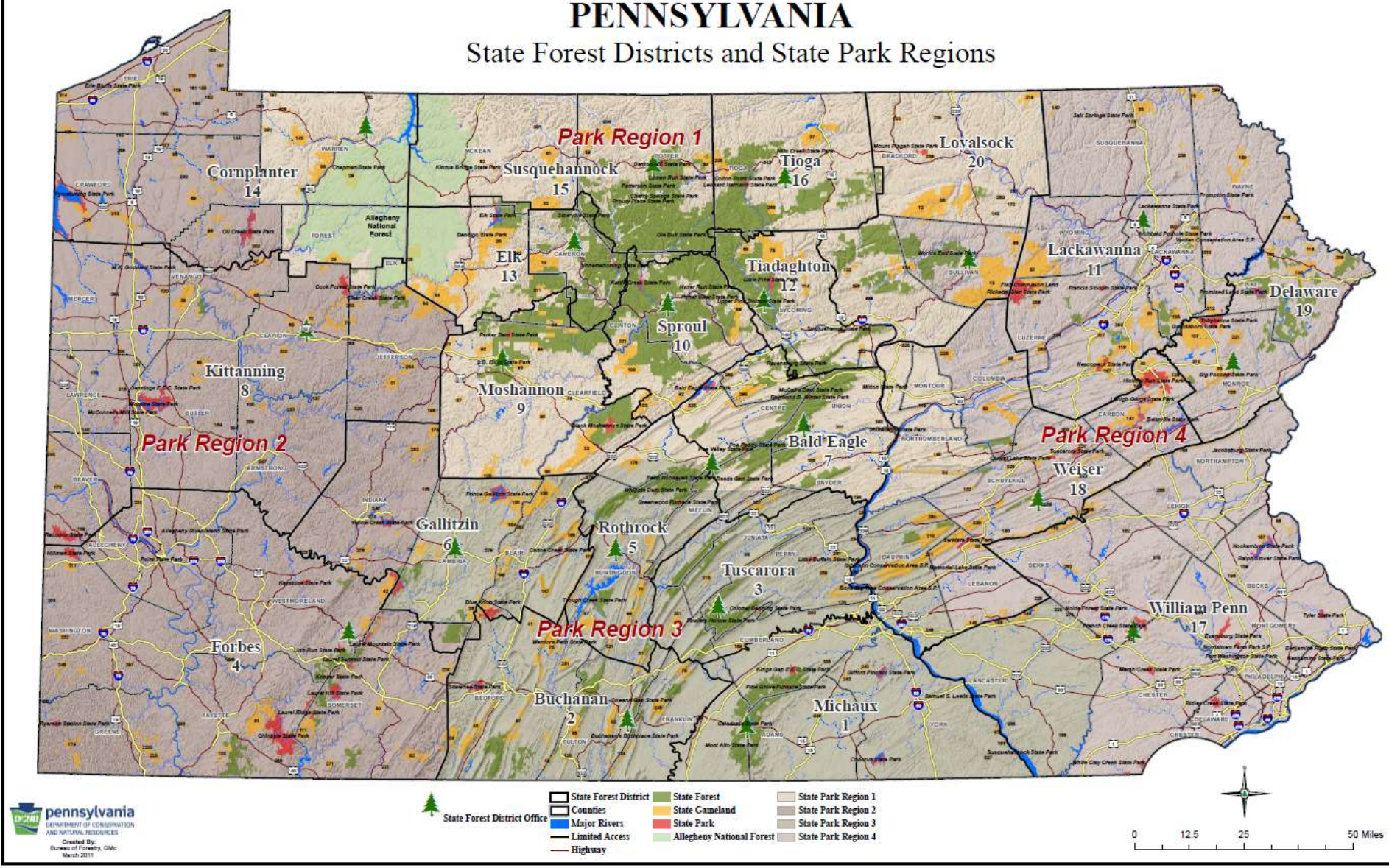
PENNSYLVANIA

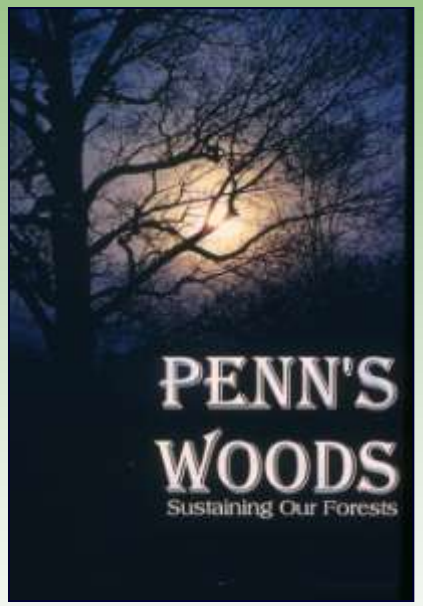
State Forest Districts and State Park Regions



Bureau of Forestry

Management Guidance

- **PA Constitution**
- **Act 18 (legal mandates)**
- **Executive Order**
- **Strategic Plan**
- **State Forest Resource Management Plan**
- **Forest Certification**
- **Advisory Committees**
- **Guidance Documents**



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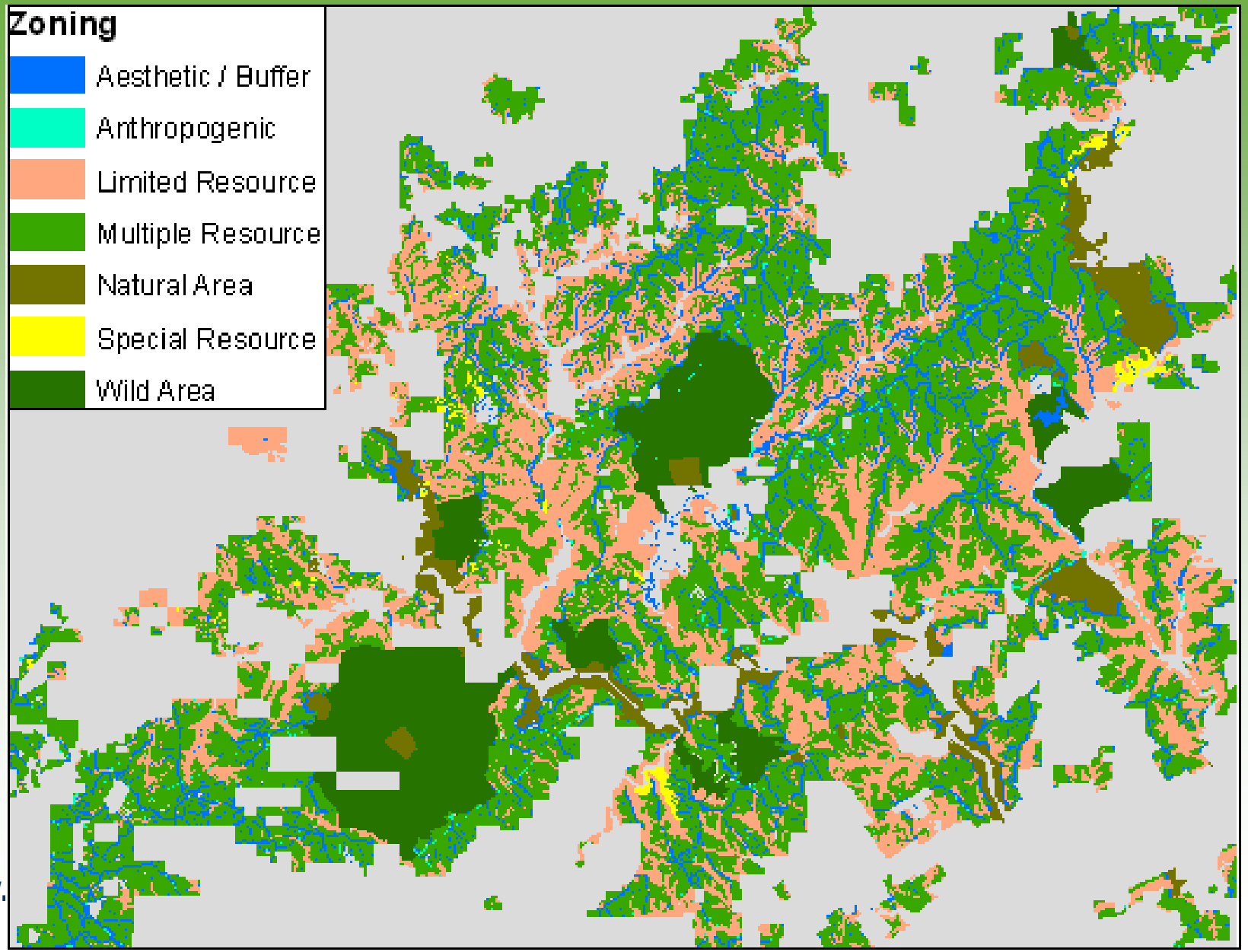
DCNR Legal Mandates

- **Conservation and Natural Resources Act 1995(1947)**
  - 302(a)(6) Authorizes DCNR to make and execute leases for mining or removal of valuable material from State Forests.
  - 302(b)(10) Empowers DCNR to lease State Forest for underground storage of natural gas

- **Act 1955-256** Established “Oil and Gas Fund.” Royalties and rents to be used by DCNR for conservation, recreation, and flood control

State Forest Management Zoning



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Natural Gas History on SFL

(pre-Marcellus shale)

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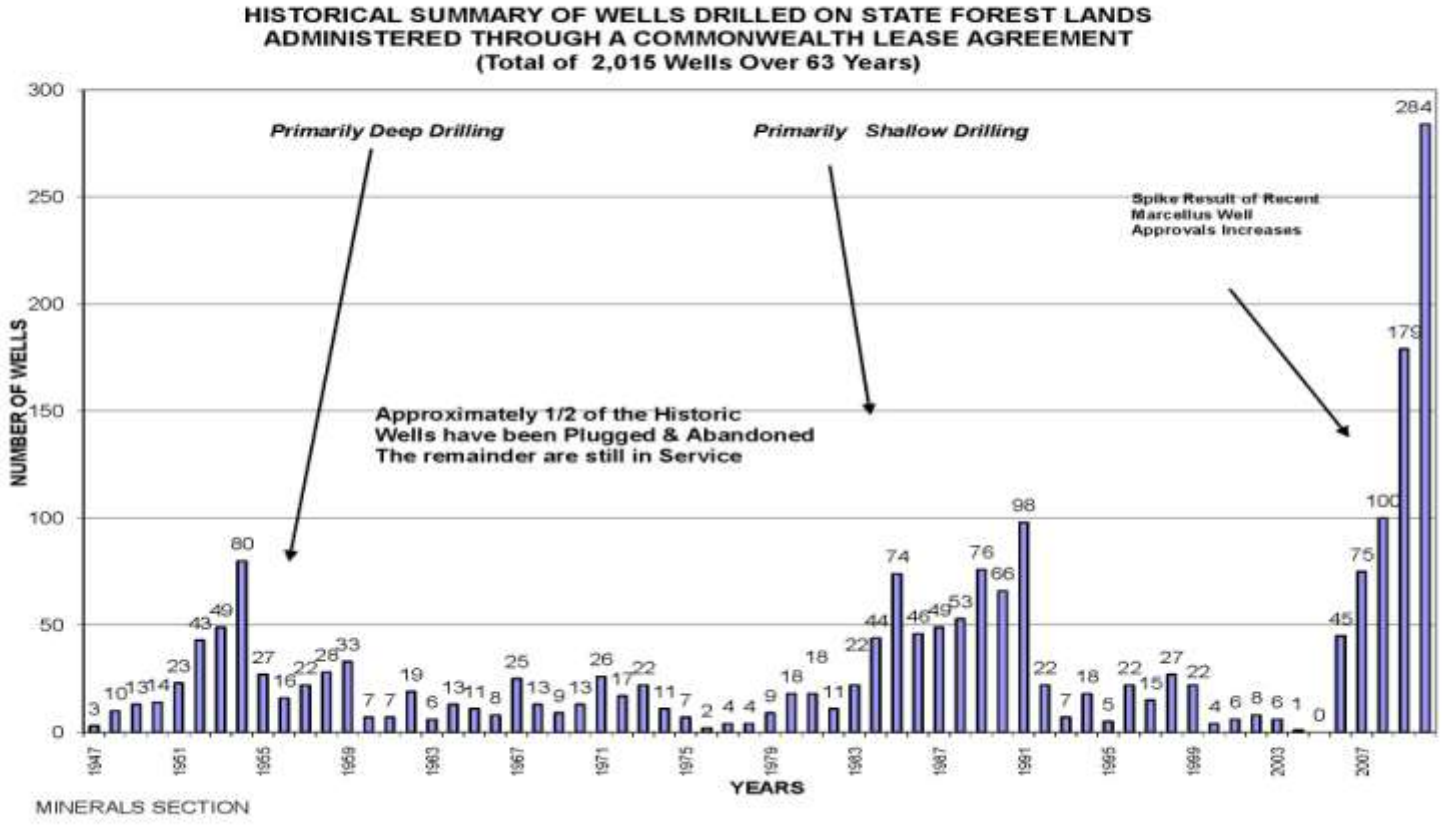
Oil and Gas, pre-Marcellus shale

- Significant historical use in some areas
- DCNR owns 85% of the State Forest fee simple
- Early milestones:
  - 1947: First lease sale
  - 1955: Oil and Gas Lease Fund Established
  - 1956: First gas storage lease

Well Development Since 1947



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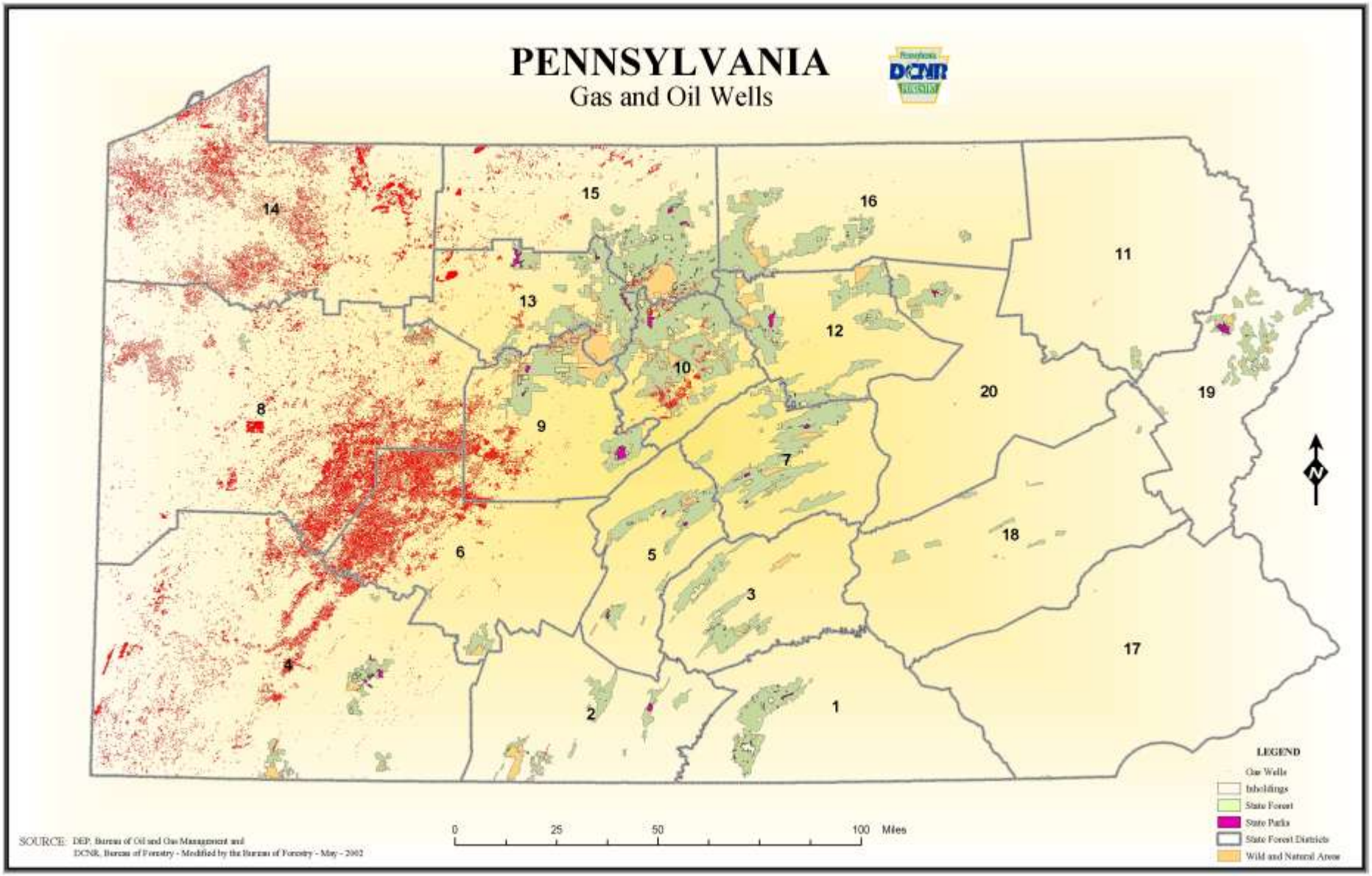
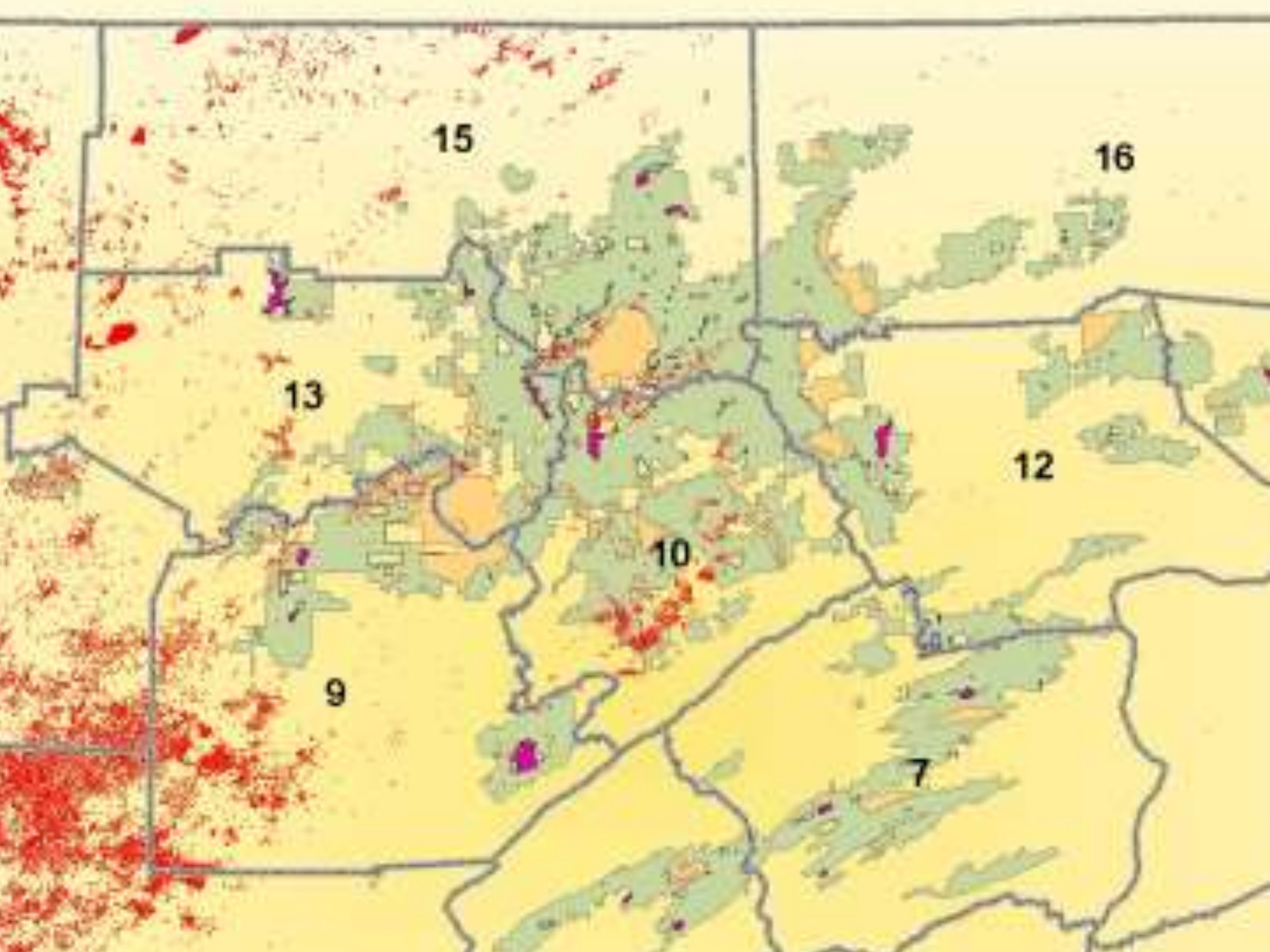
Pre-Marcellus shale development

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16
13
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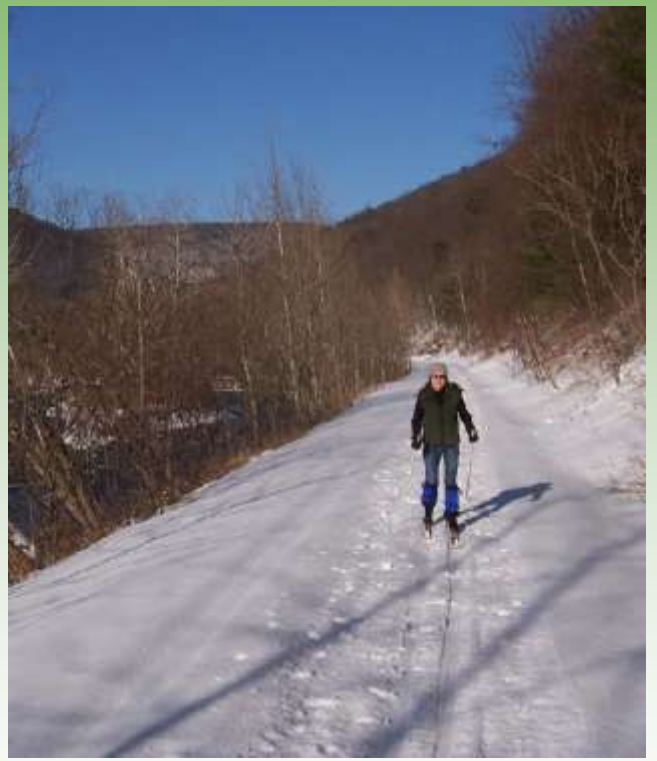
10
9
7

DCNR Oil & Gas Fund

- From 1955 to 2008 has provided $153 million for conservation, recreation and flood control projects
- Land acquired for state parks and forests
- Used to purchase 26 State Parks
- Oil and gas development rights under state parks and forests
- Pine Creek trail development
- Heritage projects and botanical surveys
- Vehicles, computers, equipment



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Marcellus Shale on State Forest Lands

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Marcellus shale considerations

How it differs from historical development…

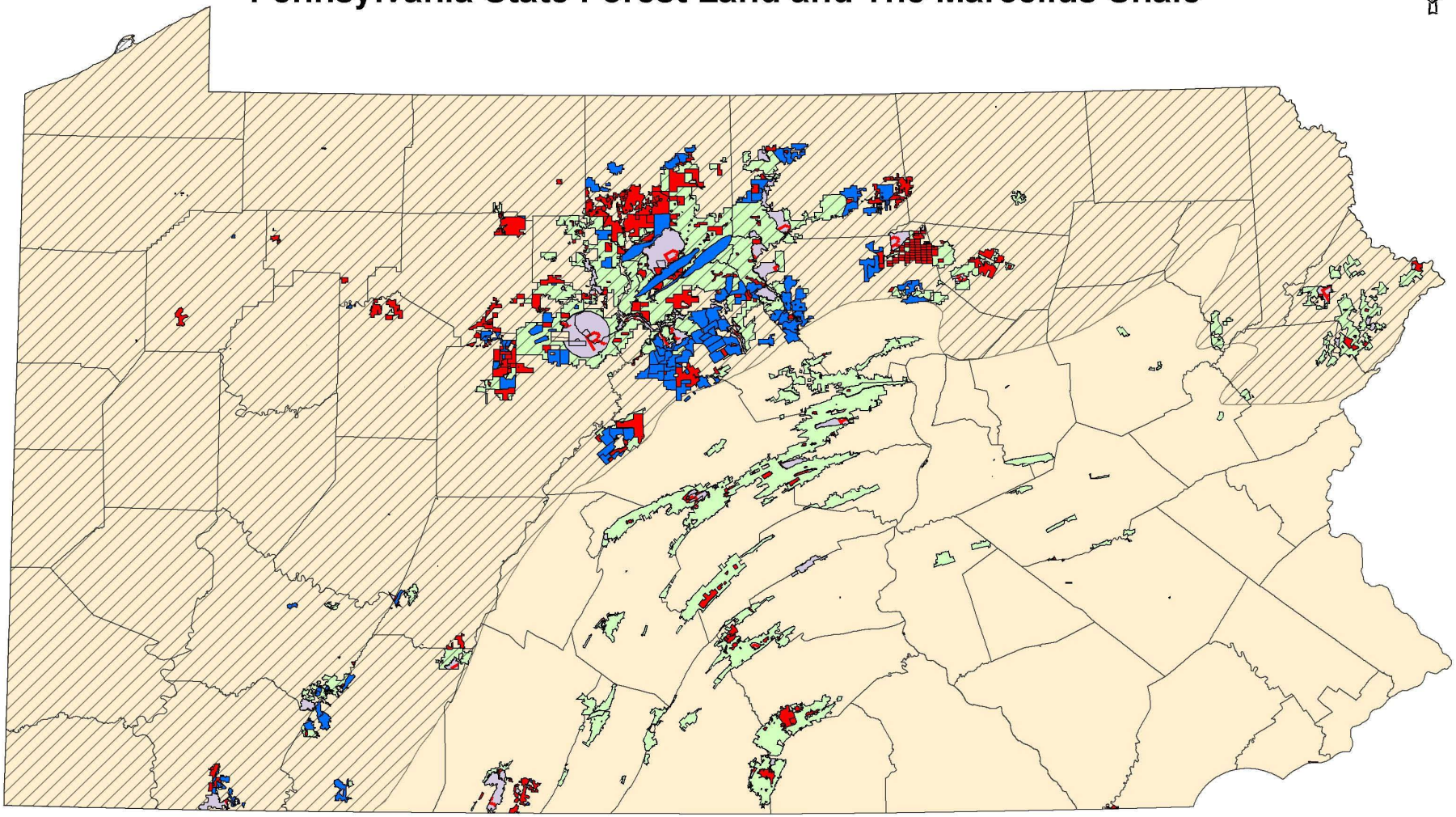
- Global operators – Exxon, Anadarko, Talisman…
  - Initially unfamiliar with PA's weather and topography
- Larger scale and fast-paced operations
- Industrialized infrastructure
  - multi-acre pads, water and gas pipelines, compression facilities, water impoundments, communication towers
- Economic implications

SFL – Marcellus shale statistics

Acres

- 1.5 million acres of SFL in the main fairway
- Approx. 675,000 acres available for development
  - 290,000 acres of severed rights
  - 385,400 acres under Commonwealth-issued leases
- 18 operators on SFL

Pennsylvania State Forest Land and The Marcellus Shale



DCNR Oil & Gas Lease Agreements

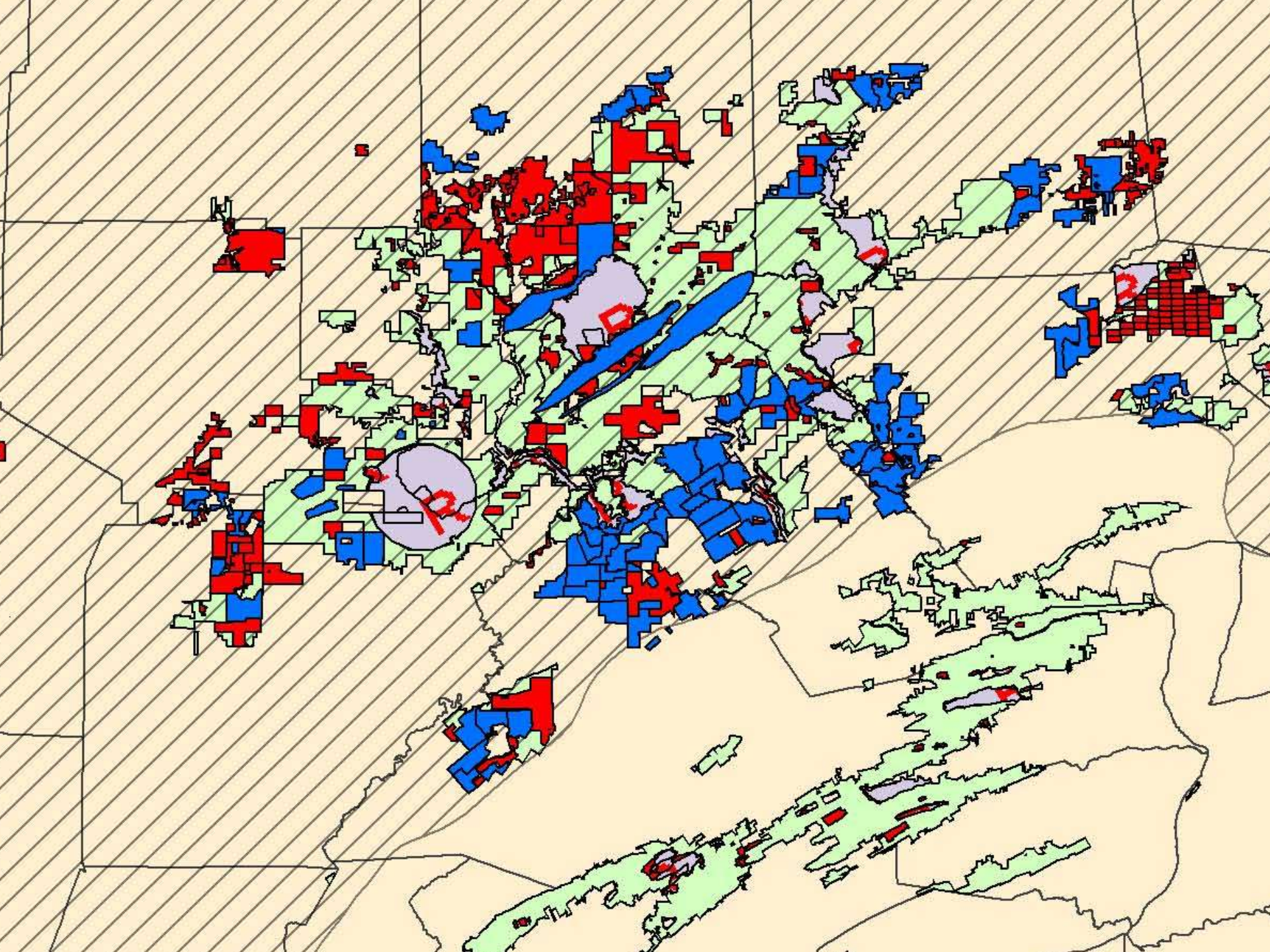
Privately Owned Oil & Gas Rights

Marcellus Shale Fairway

Wild or Natural Areas

State Forest Land

1:1,900,000



SFL – Marcellus shale statistics

Lease sales and revenue as of March, 2012

Year	Acres	Bonus Bid
2008	74,023	$163 million
2010	31,947	$130 million
2010	32,896	$120 million
Totals	138,866	$413 million

- **Approx. $64 million in Marcellus royalty revenue since 2008**
- **Pre-Marcellus Revenue = $154 MM (through Sept ’08)**
  - **Previous average annual income of $4-5 MM**

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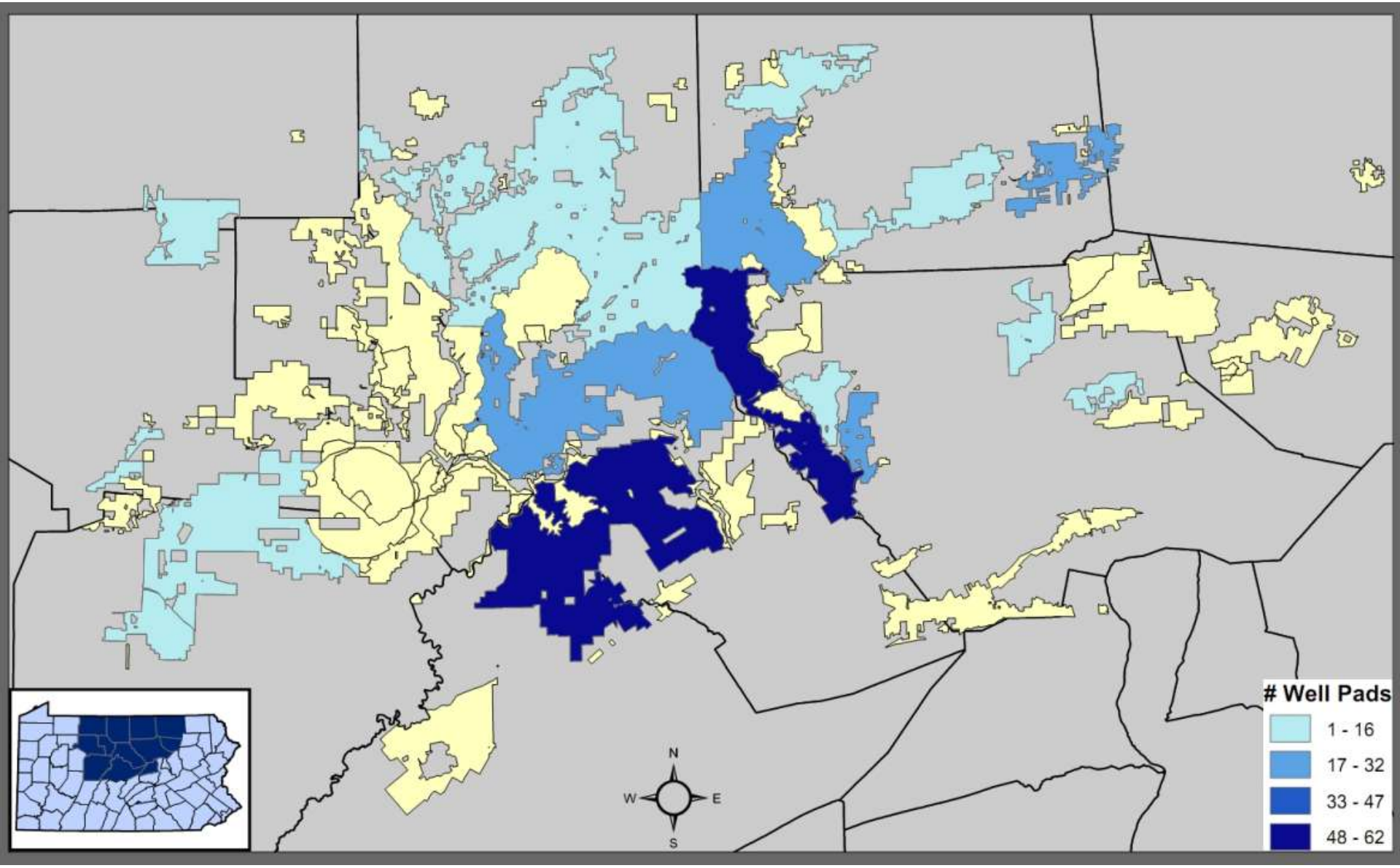
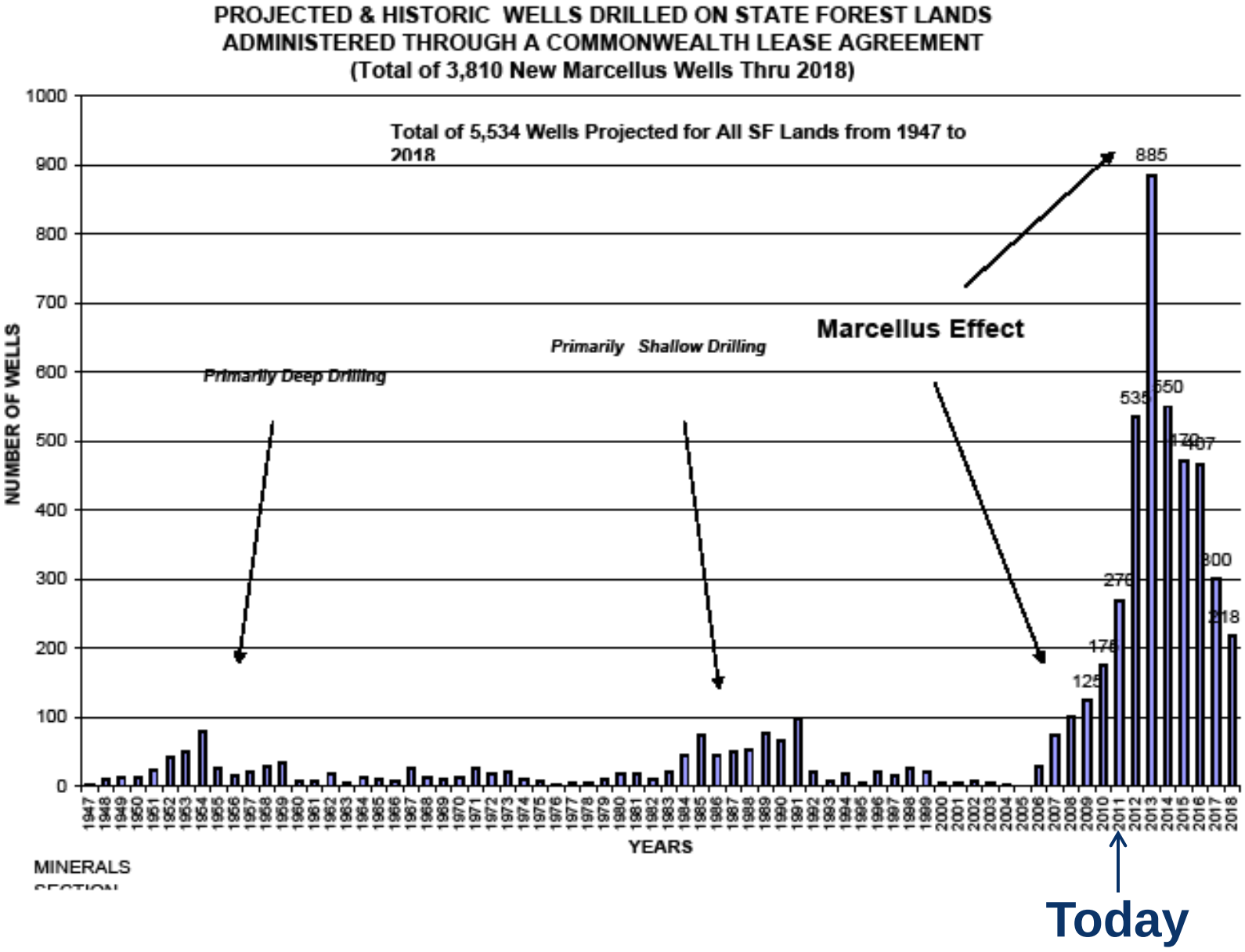
SFL – Marcellus shale statistics

Wells and Pads as of March, 2012

- 814 Marcellus well locations approved by BOF
- 447 Marcellus wells drilled on SFL
- 200 well pads approved; 80+ constructed on SFL
- 167 wells reporting royalties


Well Pads
1 - 16
17 - 32
33 - 47
48 - 62
N
W
E
S


PROJECTED & HISTORIC WELLS DRILLED ON STATE FOREST LANDS
ADMINISTERED THROUGH A COMMONWEALTH LEASE AGREEMENT
(Total of 3,810 New Marcellus Wells Thru 2018)
Total of 5,534 Wells Projected for All SF Lands from 1947 to 2018
Primarily Deep Drilling
Primarily Shallow Drilling
Marcellus Effect
NUMBER OF WELLS
YEARS
885
535
550
470
467
300
270
218
176
125
MINERALS
Today

Management Challenges

- Surface disturbance
- Forest fragmentation
- Habitat loss & species impacts
- Invasive plants
- Loss of wild character
- Recreation conflicts
- Water use and disposal

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Motto for addressing challenges & impacts

Avoid

Minimize

Mitigate

Monitor

Management Approach

- Staffing
- Leases and surface use agreements
- Guidelines and BMPs
- Monitoring
- Outreach

Staffing

- “Gas Management Team” involving nearly 50 staff
- Harrisburg and Field Offices
  - Geologists, ecologists, foresters, GIS specialists, managers
- Administer agreements, review and approve infrastructure, conduct field surveys, mark timber, interact daily with operators, public outreach, etc.

Leases

Strong agreement with provisions to protect Commonwealth interests and assets

- Lease term
- Acreage Rentals
- Royalty Rates
- Gas Measurements
- Audits
- Financial Security (bonds)
- Comprehensive and Pollution Liability Insurance
- Development and Well Spacing
- Drilling Restrictions , Operations & Approval Process
- Unitization
- Pipelines
- Seismic Surveys
- Well Plugging

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Lease Vintages

- 1947 to 2002: Historic leases, 12.5% Royalty
- 2002: Trenton Black River lease, 12.5% Royalty, no producing wells
- 2008: 1st Marcellus lease sale, 16% Royalty
- 2010: 2nd Marcellus lease sale and Sole Source, 18% Royalty

Enter into Surface Use Agreements where possible on lands with severed rights

Oil and Gas Guidelines Document

- Purpose
- Key Principles
- BOF Gas Mgt Team
- Recreation and Public Safety
- Review and Approval Process
- Waiver Requests
- Field Inspections
- Record-keeping
- Emergency and Pollution Events

Sustainable Resource Management

- Seismic Surveys
- Well Pad Sites
- Freshwater Acquisition
- Wastewater Treatment, Storage, Transportation, and Disposal
- Roads
- Pipelines
- Compressor Stations
- Re-vegetation and Native Planting
- Non-native Invasive Plants
- Site Reclamation and Restoration

AVOID

- Comprehensive Planning and Review
  - Development plans critical
- Use Existing Disturbance
- Mapping sensitive areas
  - Ecological and Recreation areas of concern
  - Avoid or no-surface disturbance

MINIMIZE

Appropriately site infrastructure:

- -field views prior to approval
- -buffer resources from activities
- -timing restrictions
  - hunting and fishing seasons
  - breeding season
  - seasons with high E&S impacts
  - Dark Sky events

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MINIMIZE

Buffers

- 200 ft stream or body of water
- 200 ft wetland, or 300 ft if T&E species in wetland
- 200 ft building
- 300 ft EV or HQ stream or body of water
- 300 ft picnic area or sheltered area
- 300 ft trail, road or ROW
- 300 ft historic, overlook, vista areas
- 600 feet State Park lands or Wild and Natural Areas
- T&E buffers as required by DCNR, FBC, PGC, USFWS—varies
- Steep slopes

MITIGATE

Wetland Enhancements

Species Habitat Enhancements

Invasive Species Removal

Extra Safety Precautions-near wetlands/streams

MITIGATE

Reclamation and Restoration

- After construction & drilling

- Interim reclamation
  - Activity may return to pad site or pipeline depending on performance or transport needs

- Final reclamation:
  - Clear objectives for site reclamation or restoration
  - Site assessment and objectives include:
    - Larger landscape-level plan and management goals
    - Existing habitat and current features
    - Target species or habitat

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MONITOR

- Lease compliance
  - Environmental concerns, forest health, water, invasive species
- Developing comprehensive monitoring program
  - Plants
  - Wildlife
  - Water and soil
  - Social/Recreation
- Adaptive Management
- Report credible information

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Outreach

- DCNR website
  - Leases, maps, general information, impacts, FAQs, etc
- Tours, tours, tours!
- Partnerships to enhance Guidelines/BMP development and implementation
- Natural Gas Advisory Committee

Working towards a balance of…

- Contiguous Forests
- Wetlands
- T&E plants and animals
- Wild Character
- Recreation
- Water Quality

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…while utilizing minerals

Marcellus Geology

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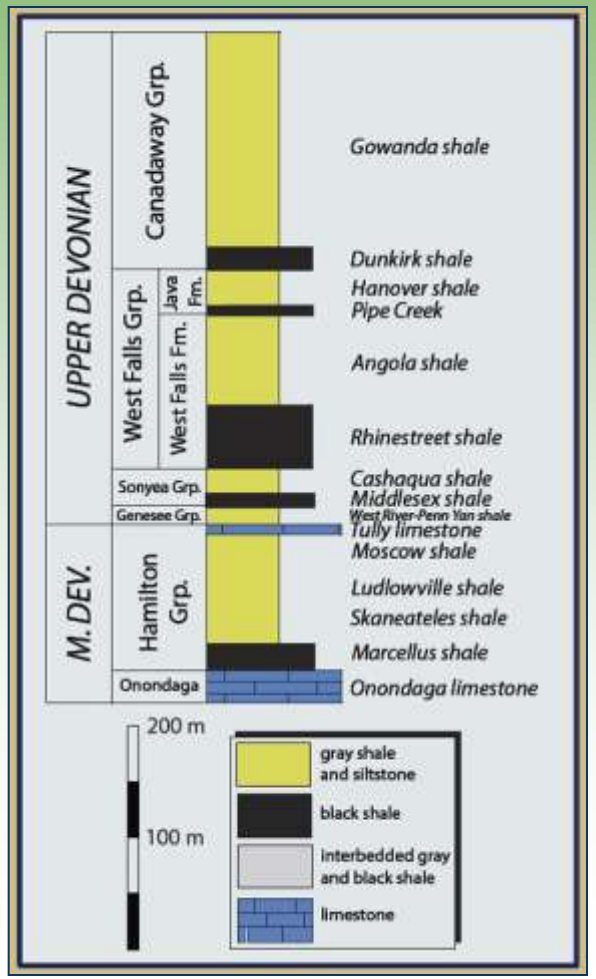
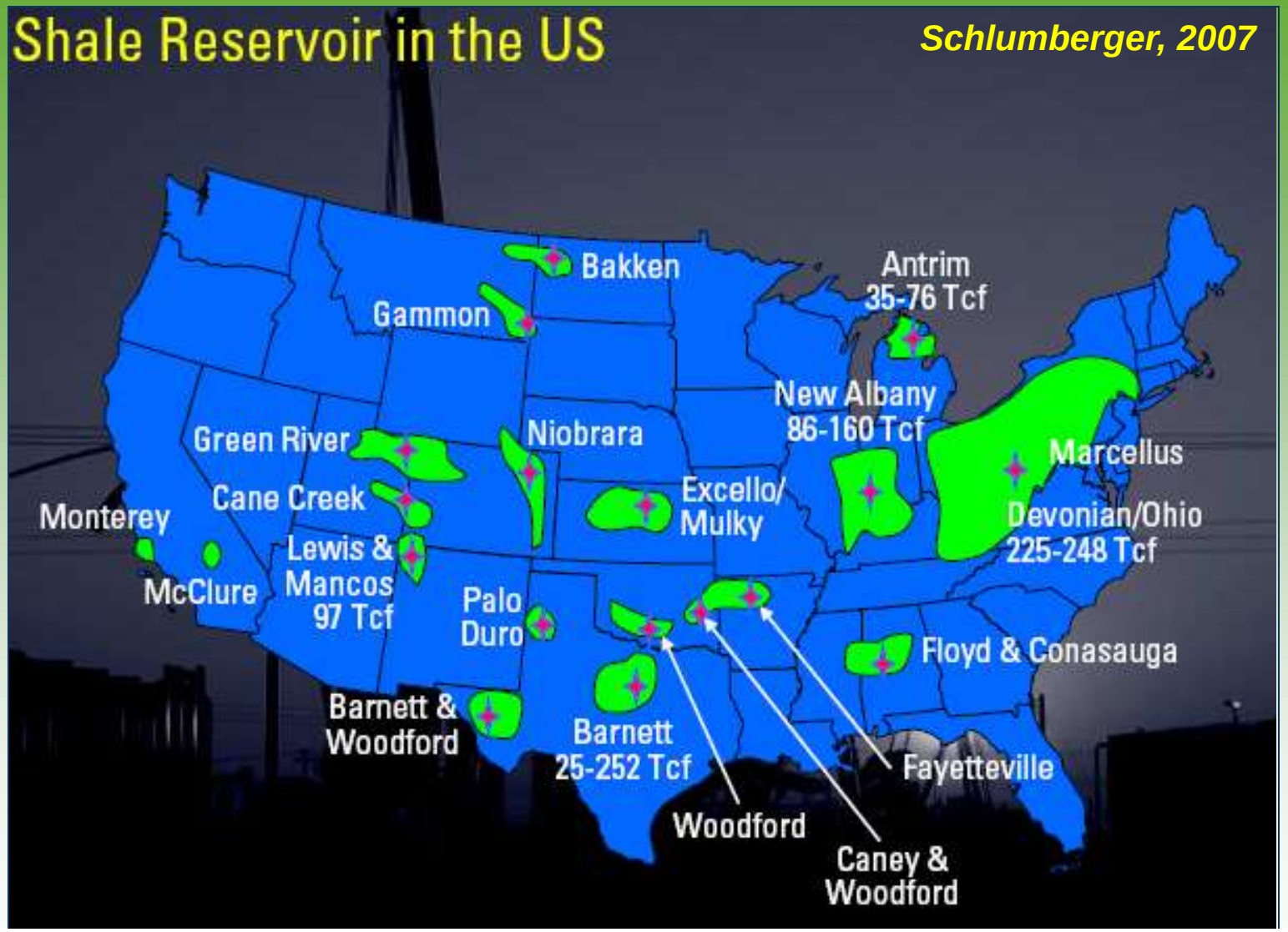
Marcellus Shale

- 385-390 Million Years Old – Middle Devonian black shale
- Oxygen deficient marine environment
- Rich in Carbon, Sulfide, & Organic Matter
- Thinly Bedded / Fractured / Very Tight
- Nano-Darcy Permeability
- Large Prospective Area
- Non-Homogenous Reservoir



(Lash, 2007)

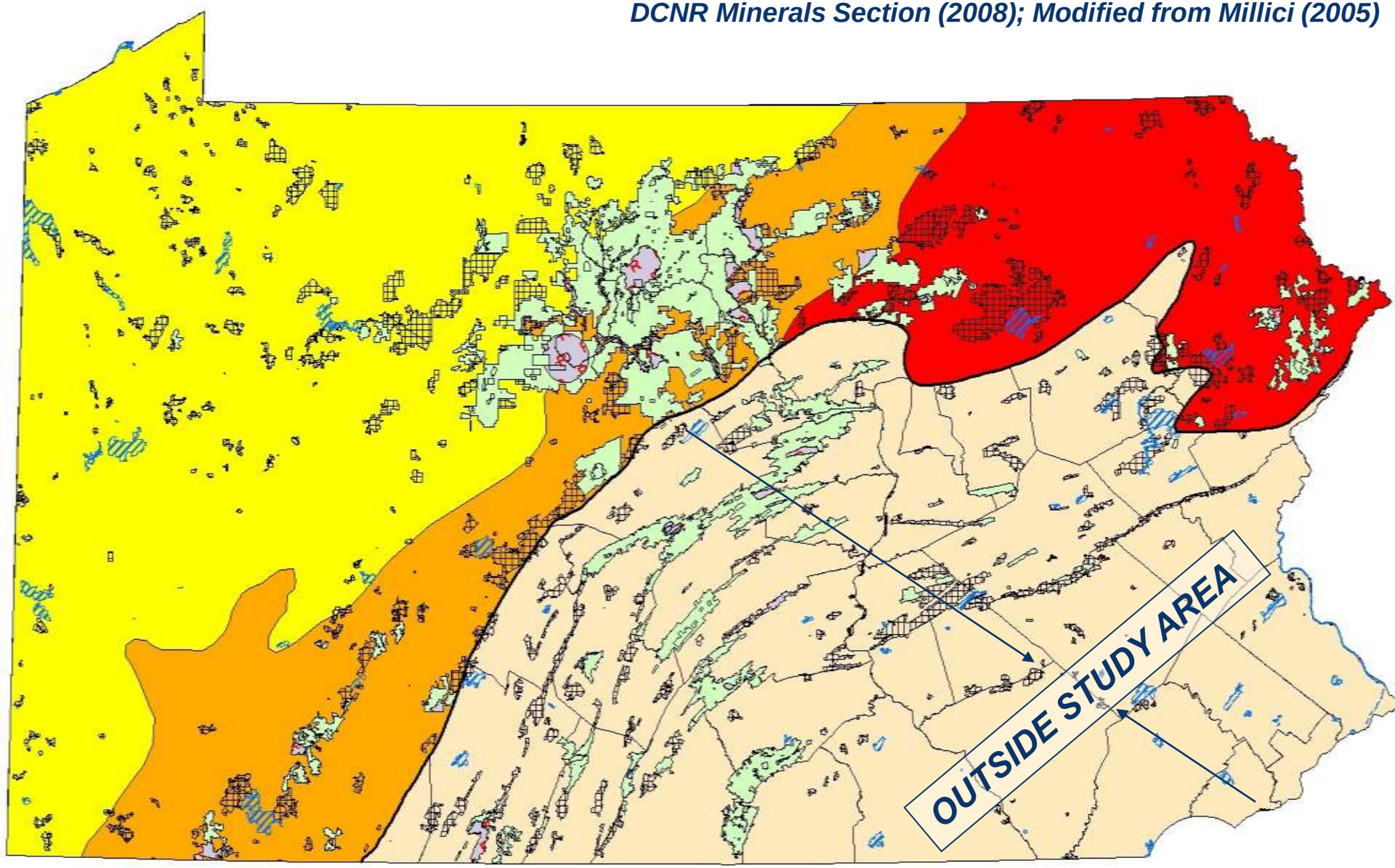
WHERE ARE THE BLACK SHALES?



Fredonia, NY (1821); Big Sandy, KY (1921); Cottageville, WV (1930); Midway-Extra, WV (1948); Lakeshore, OH/PA/NY (1970s)

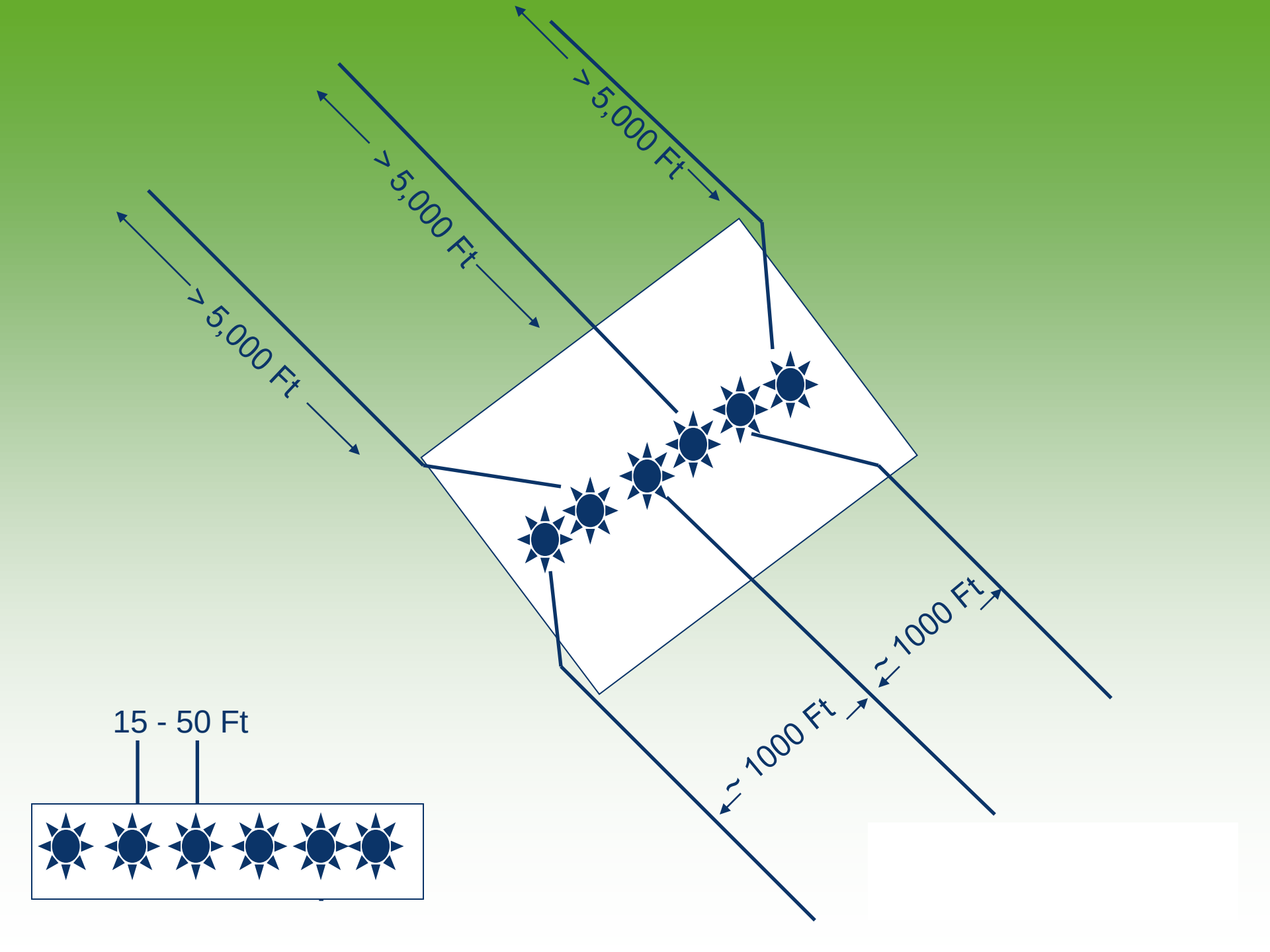
Depth to and Thickness of the MS

DCNR Minerals Section (2008); Modified from Millici (2005)



WHY GO HORIZONTAL ?

Simple Assumptions: More Surface Area = More *potential* Natural Fractures; More Natural Fractures = More *potential* Gas; More Gas = Better *potential* Return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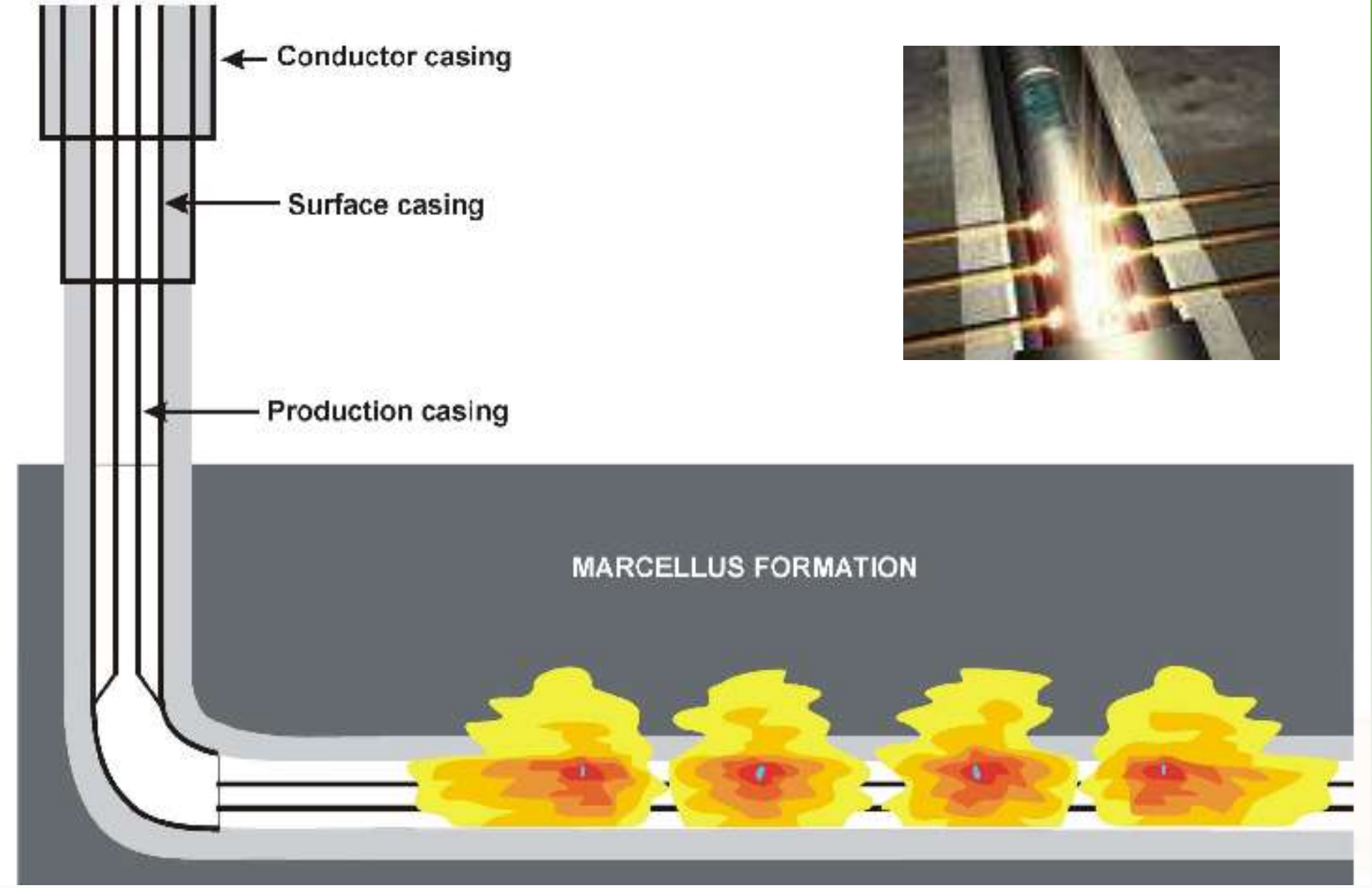
- Drilling Process Video
  - Marcellus Shale Coalition



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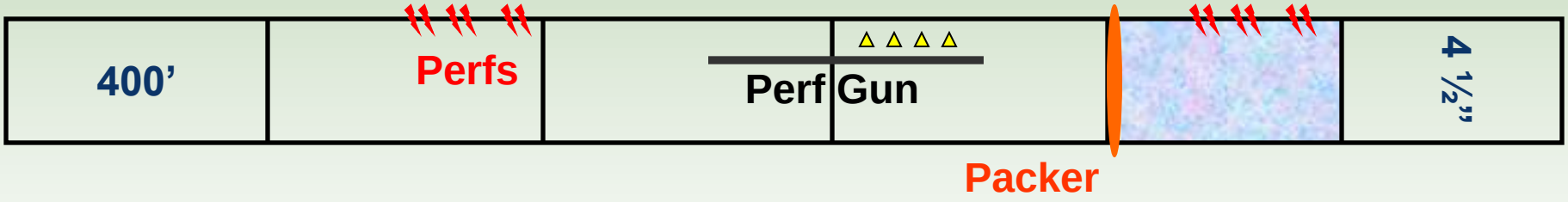
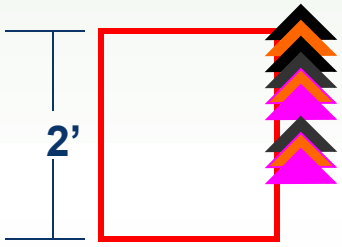
WATER NEEDS: Well Stimulation

- Marcellus Wells Need Treatment To Flow ECONOMIC Quantities of Natural Gas
- 600K – 1 MM gal (V); 3 MM – 5 MM gal (H)
  - 1000 one way truck trips
- Slickwater Frac – Sand + Additives = Gelatin
- Flowback Water – Recovery and Disposal
- DEP requires Water Management Plan

Well Completions

- Designed Based on Geology / Engineering
- Multiple Stages / Multiple Days / Multiple Wells
- Horizontal Well – 3 to 5 MM gallons Water
- High Injection Pressures ~ 9300 psi
- Sand ~ 3,100,000 lbs





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Gas Activities on SF Lands

Seismic surveys
Active drilling
Well pad sites
Water storage/networks
Water Recycling

ROWs
Roads
Compressor stations
Communication towers
Tap sites

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Natural Gas Development Timeline

- Operator acquires lease
- Perform seismic surveys
- Determine pad location
- Perform environmental surveys
- Upgrade and/or create new roads to handle trucking
- Clear and grub and construct pad site
- Plan and construct for water needs (trucking, intakes, pipeline networks, FWI or AST storage)
- Identify and construct pipeline ROWs, meter and tap sites
- Plan and construct for compression facilities
- Drill wells (top-hole rig, horizontal rig, frac rig)
- Pad infrastructure build out
- Full restoration – 30-50 yrs?

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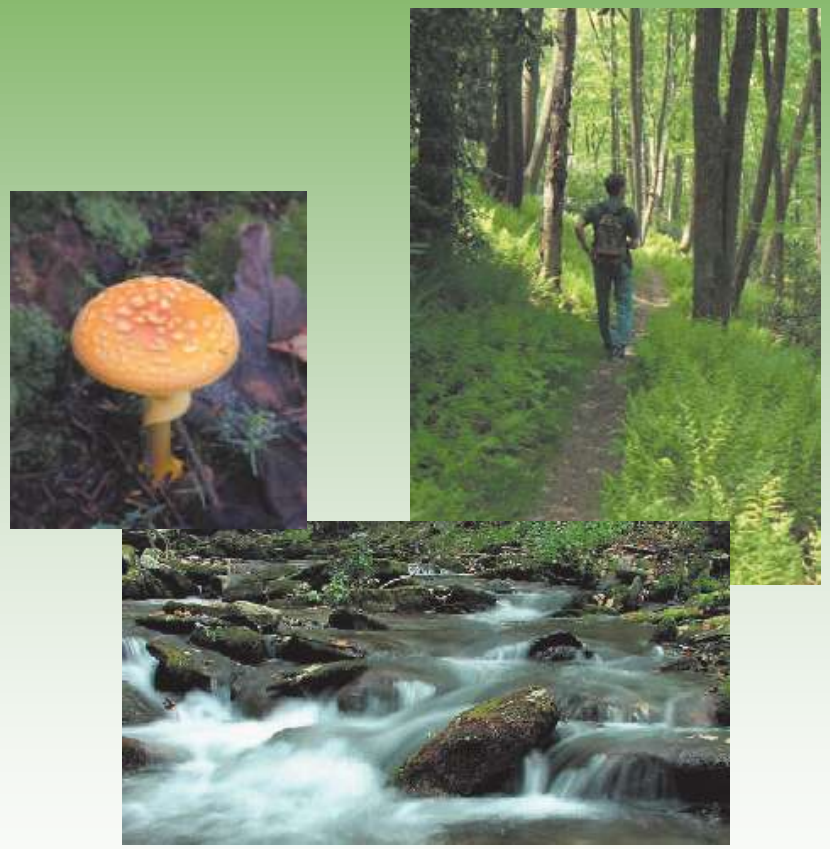
CATERPILLAR


HALLIBURTON

DCNR Oil & Gas Program

Managing Impacts & Balancing Tradeoffs

- Apply ecosystem management principles
- Honor agreements and contracts
- Acknowledge that Marcellus shale will be a long-term influence on the character of Pennsylvania landscapes



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