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Introduction To Marcellus Shale Natural Gas Development

Public Presentations
Summer 2009

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Natural Gas Resources on the Web

Cornell Cooperative Extension
Natural Gas Development Resource Center
gasleasing.cce.cornell.edu

The New York State Water Resources Institute
wri.eas.cornell.edu



Agenda

1. Introduction to the Marcellus Shale
2. Marcellus Development Process
3. Possible Environmental Impacts
4. Leasing Considerations
5. DEC's Supplemental Generic Envir. Impact Statement (SGEIS)
6. Local Government Preparations



Shale

Ancient oceans produced sedimentary rock layers under time, temperature, pressure, compaction

- Saltwater → salt, brine deposits
- Dead organisms → fossil fuels including natural gas, which is mostly methane (CH₄)
- Fine mud particles → shale

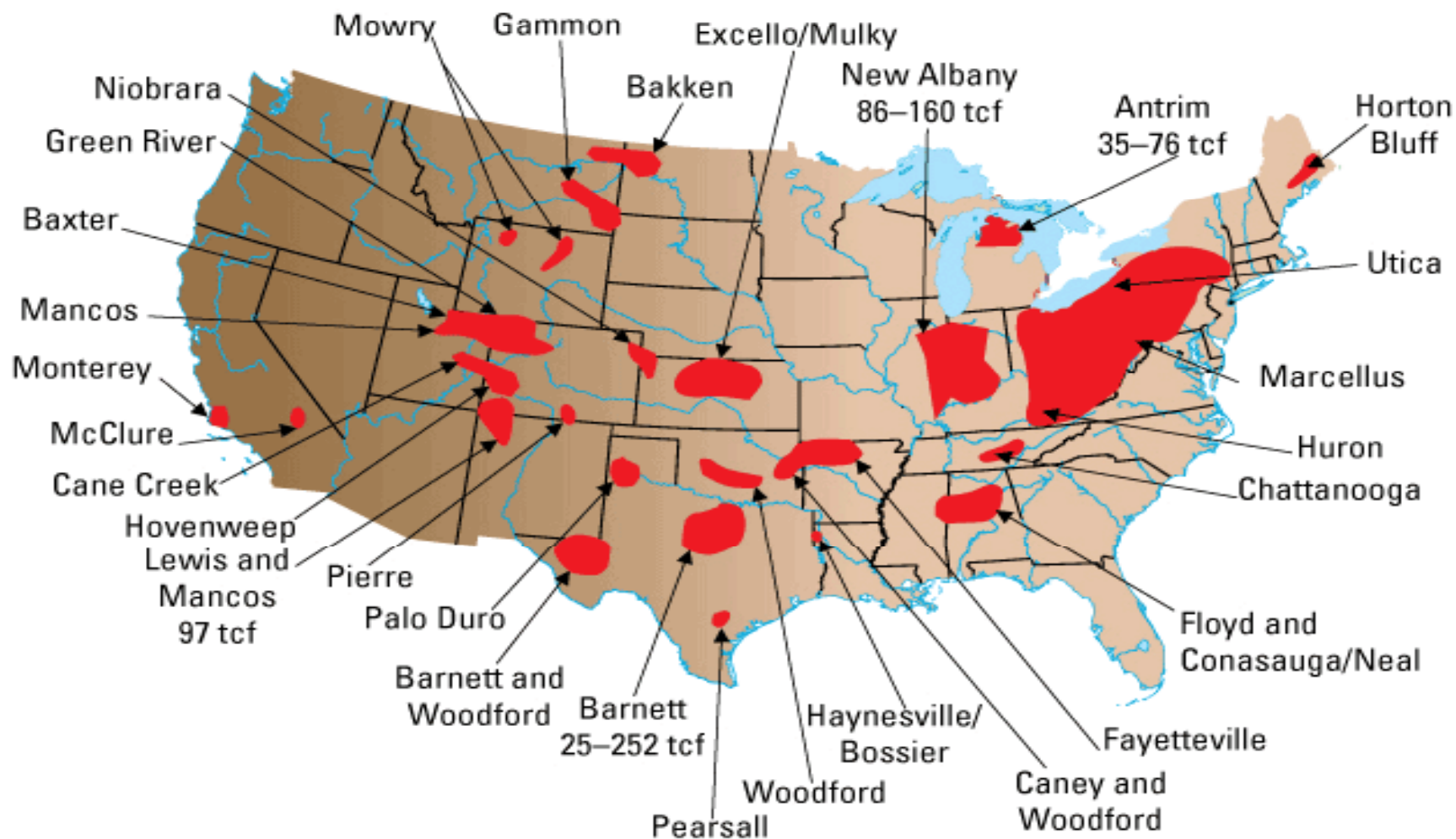
Shale is tightly packed – hard to get natural gas out

Shale does have vertical joints (cracks) and can be fractured further



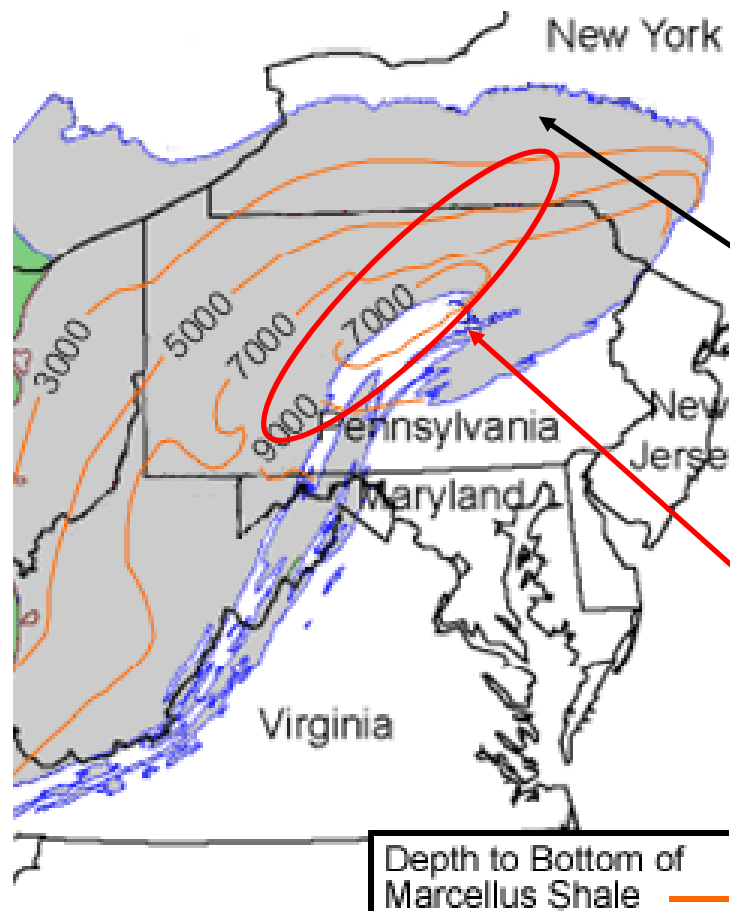
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Major Natural Gas Shale Basins





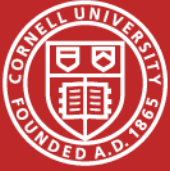
Marcellus Shale is large – why not tapped before?



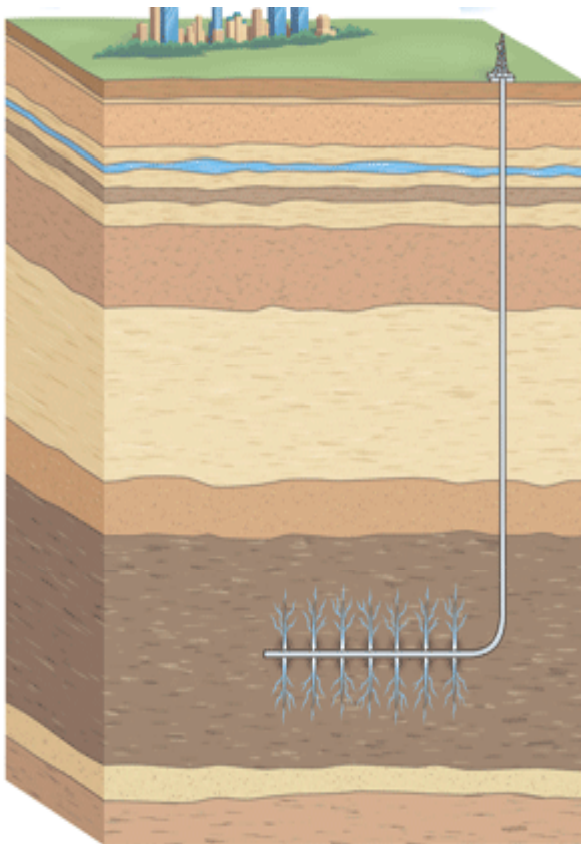
- Increase in gas estimates
- Economics
- Technology to access it

Marcellus Shale is
0 – 5000 feet deep
in NY, deeper in PA

Marcellus Shale is thickest
(100-200 feet thick) in Northern
Tier PA and Southern Tier NY



How is Marcellus Shale Different Than Previous Gas Development in NY?



- Accessing a large formation, not a pocket of natural gas
- Deeper than most previous wells
- More horizontal drilling
- For gas to flow, requires fracturing with large volumes of high-pressure water = **hydrofracturing**
- Takes longer, requires more people, more resources
- Permitting process being updated



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Current Drilling Activity

- Active drilling in Marcellus Shale in PA
- **Well information is posted on DEC's website**
<http://www.dec.ny.gov/energy/46288.html>
- Active drilling in other rock formations in NY
- Active vertical wells in Marcellus formation in NY
- Permits for horizontal Marcellus drilling in NY
– on hold during DEC's SGEIS review



Phases of Well Drilling

Development (months per well, years per region)

- Construct access roads
- Construct well pad
- Construct local collection pipeline
- Drill well
- Fracture well

Production (years)

- Truck water from well site
- Monitor production of natural gas
- Occasional well work-overs (partially re-drill/re-frac)
- Reclaim some disturbance

Reclamation

- Remove surface equipment
- Plug well
- Restore landscape



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Development Phase Typical Well Pad Footprint





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Development Phase Associated Staging Area





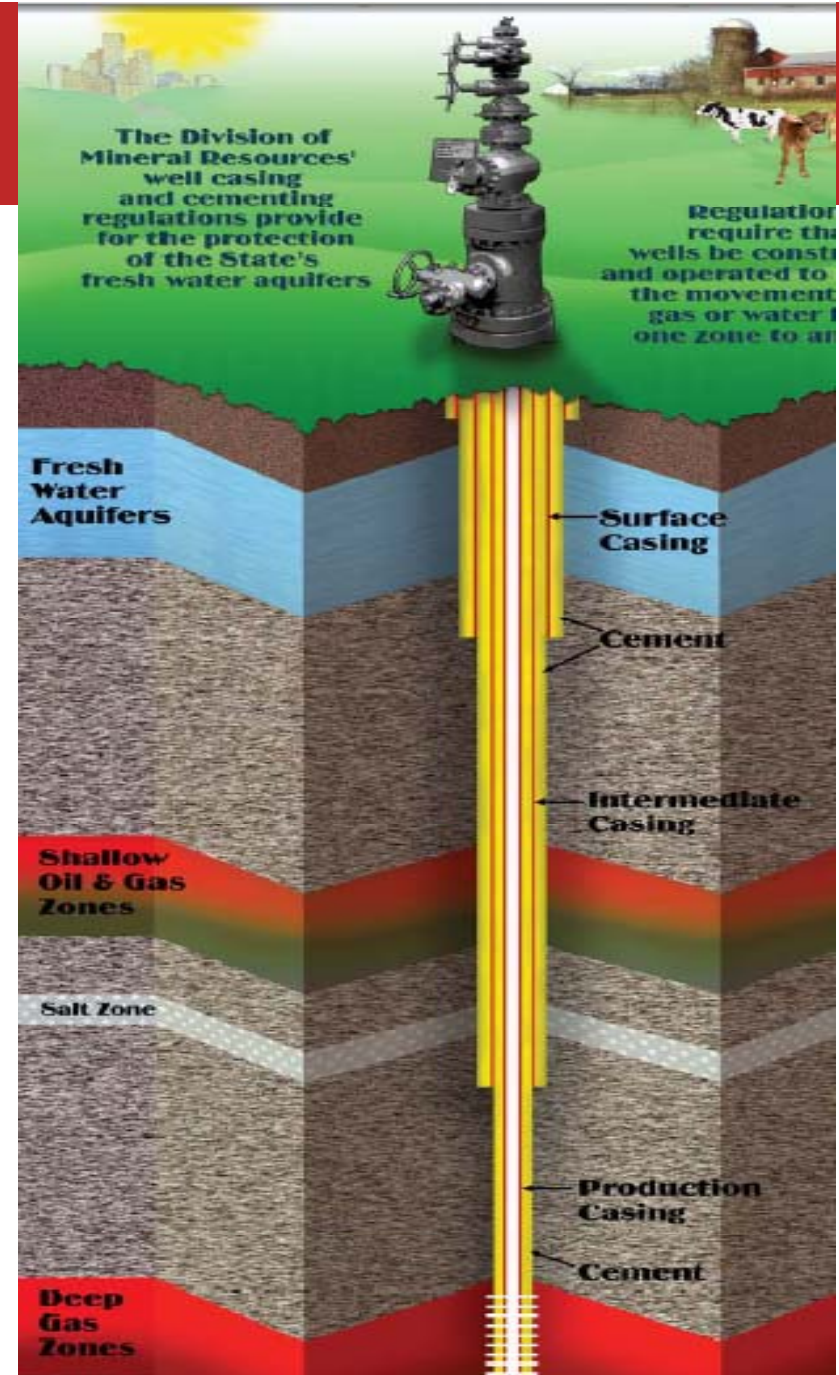
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**Layers of steel
casing and cement**

**Largest diameter
first, next drilled
inside that, etc.**

**More layers in first
few hundred feet**

figure from NYS DEC website
(vertical well)



Roughly 200 tanker trucks deliver water for the fracturing process.

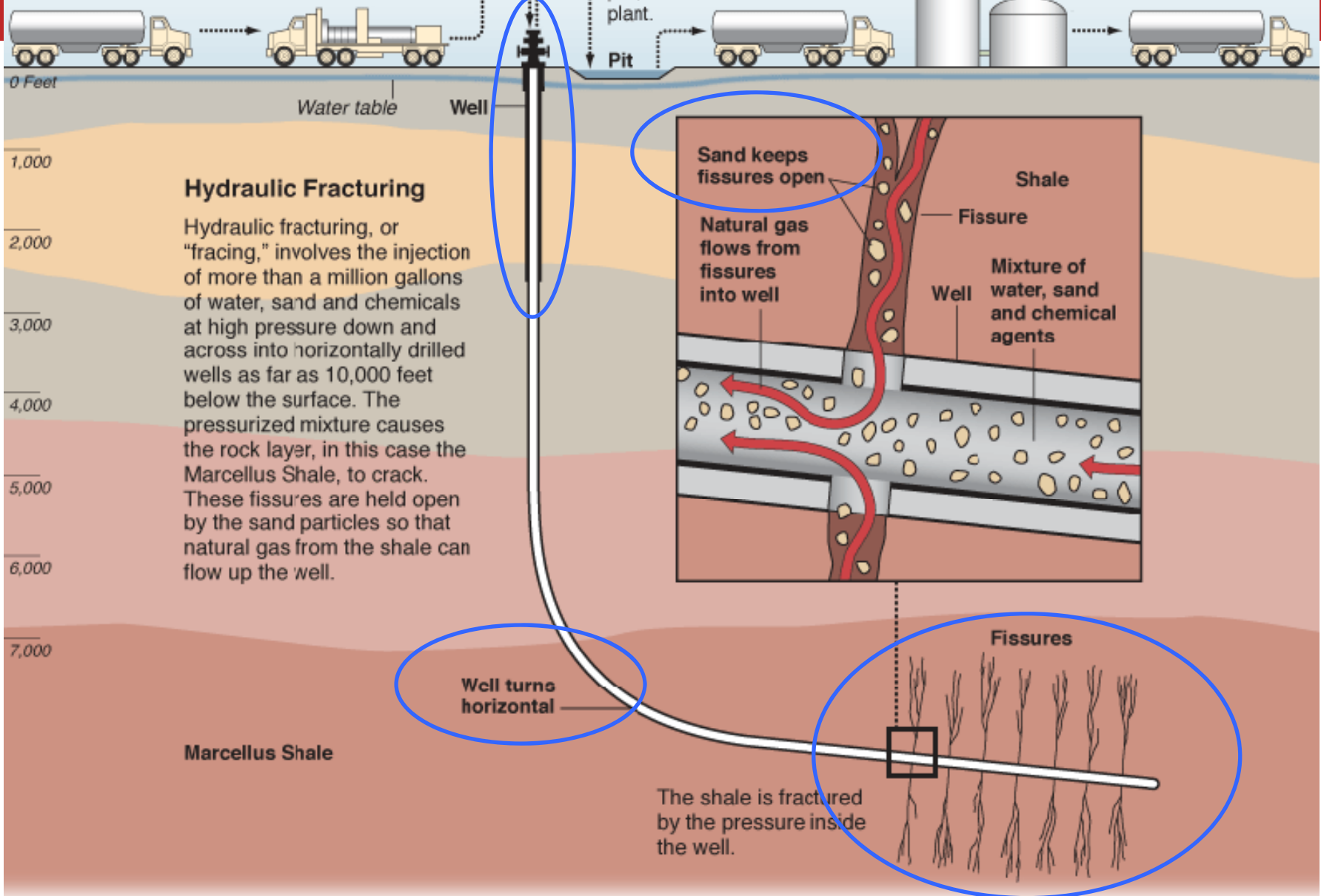
A pumper truck injects a mix of sand, water and chemicals into the well.

Natural gas flows out of well.

Recovered water is stored in open pits, then taken to a treatment plant.

Storage tanks

Natural gas is trucked to a pipeline for delivery.





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Production and Reclamation Phases



Reclaimed well-pad with
producing well in Chemung
County (James Grace, CCE
Steuben County)



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Marcellus Shale gas drill rig, Troy, PA (Jerry Gordon,
Environmental Health Specialist, Cornell University)

Environmental Impacts

- Water Usage
- Fluids Disposal
- Water Well Contamination
- Surface Water Contamination
- Surface Disturbance
- Air Quality



Water Usage



Susquehanna River Watershed

- Approx. 3.5 million gallons of water per hydrofracturing
- In their watersheds, Susquehanna River Basin Commission and Delaware RBC regulate water withdrawals (diversion, evaporation from watershed)
- Water withdrawal is permitted based on lowest flow rates observed in past 10 years
- Susq. R. flow at southern end is 18 million gallons/minute



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Open vs. Closed Loop Drilling



Wastewater in open-air,
plastic-lined pit

Freshwater storage in
open-air, plastic-lined pit

In “Closed Loop”

- Wastewater is stored in containers (e.g. steel tanks), not open pits
- Less chance for surface contamination
- Easier to reuse water on multiple wells
- Less overall water use
- Fresh water is still stored in open pits



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Fluids Disposal

- Drilling fluids/muds
- Fracking fluids
- Formation water



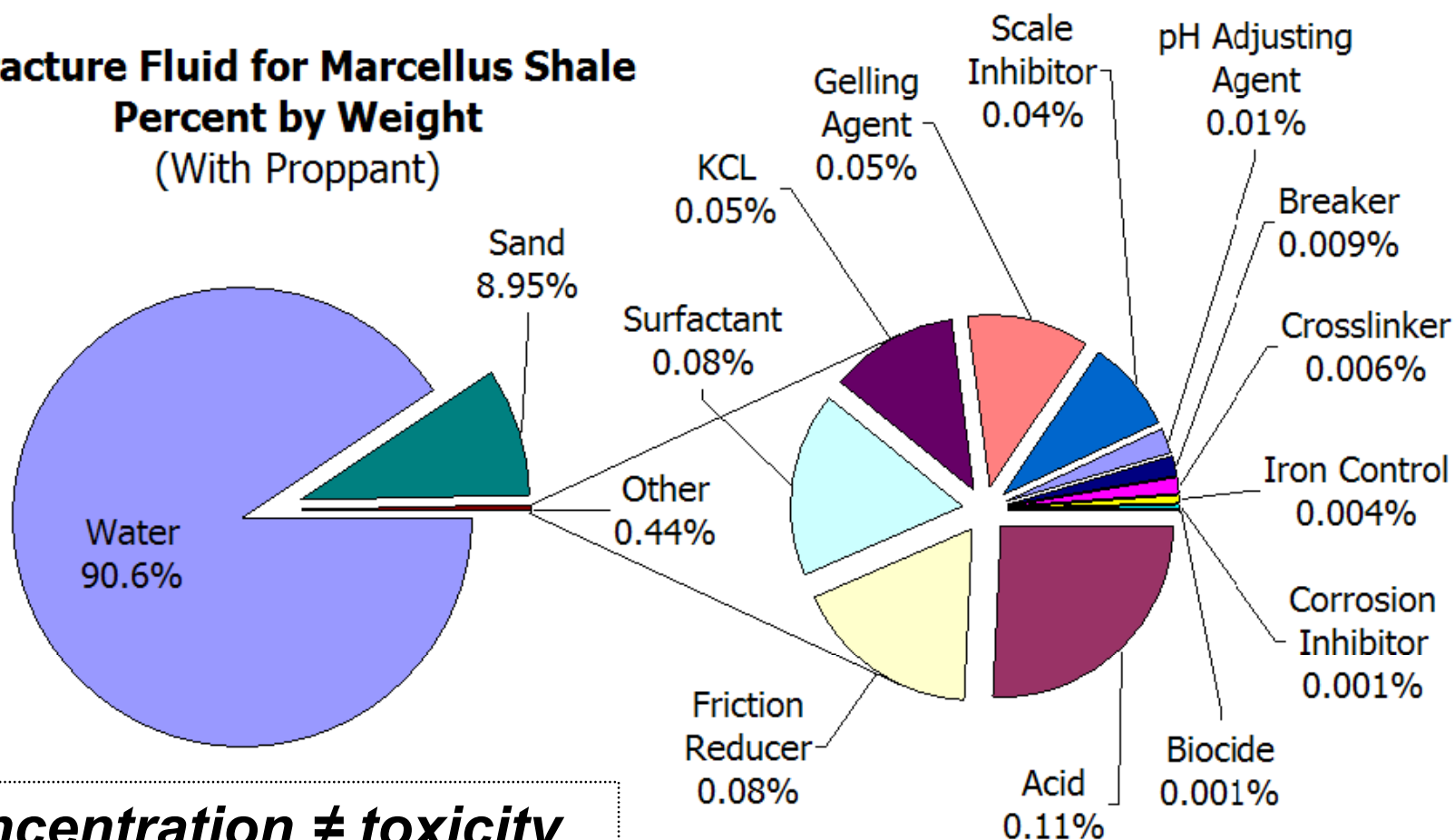
Above: Fresh water tanks and metered connection for tanker trucks.

Left: A lined fresh water pit ~ 120' x 225' and holding about 1.2 million gallons of fresh water to be used during fracking.
(Both photos: Jerry Gordon, Environmental Health Specialist, Cornell University)



What is in hydraulic fracturing fluid?

Fracture Fluid for Marcellus Shale
Percent by Weight
(With Proppant)



concentration ≠ toxicity

Arthur et al. 2008, http://www.dec.ny.gov/docs/materials_minerals_pdf/GWPCMarcellus.pdf,
http://ipec.utulsa.edu/Conf2008/Manuscripts%20&%20presentations%20received/Arthur_73_presentation.pdf



More on frac fluids

- * Information on chemical MSDS – CU Env. Health & Safety <http://ehs.cornell.edu/>
- * Will be posting more info on our blogs from multiple sources
- * Disclosure of this information is an important issue for companies, state agencies, local health departments, and emergency responders

Table 2: Fracturing Fluid Additives, Main Compounds and Common Uses.		
Additive Type	Main Compound	Common Use of Main Compound
Acid	Hydrochloric acid or muriatic acid	Swimming pool chemical and cleaner
Biocide	Glutaraldehyde	Cold sterilant in health care industry
Breaker	Sodium Chloride	Food preservative
Corrosion inhibitor	N,n-dimethyl formamide	Used as a crystallization medium in Pharmaceutical Industry
Friction Reducer	Petroleum distillate	Cosmetics including hair, make-up, nail and skin products
Gel	Guar gum or hydroxyethyl cellulose	Thickener used in cosmetics, sauces and salad dressings.
Iron Control	2-hydroxy-1,2,3-propanetricarboxylic acid	Citric Acid it is used to remove lime deposits Lemon Juice ~7% Citric Acid
Oxygen scavenger	Ammonium bisulfite	Used in cosmetics
Proppant	Silica, quartz sand	Play Sand
Scale inhibitor	Ethylene glycol	Automotive antifreeze and de-icing agent

Arthur et
al. 2008



Fluid Disposal Impacts

- Shale changes the water used in drilling & fracking process
 - Brine (salt), Total Dissolved Solids (TDS)
 - Metals
- Drilling & fracking chemicals are present in fluid waste
- Human effects of low concentrations of chemicals over time is currently debated
- TDS is major obstacle to treatment plants and river basins:
 - Many treatment plants are already in non-compliance
 - TDS can cause ecological damage to river systems and oceans if not treated properly.



Water Disposal Options

- Municipal Wastewater Treatment Plants
 - Current approach
 - Questions about capacity, cost, down-stream effects
- Specifically-designed Treatment Plants
 - Construction of several plants being planned/discussed
Towanda, PA; Waverly, NY
 - Questions about down-stream effects
- Injection Wells
 - Are rock formations here suitable?
 - Long-term science/safety impacts are less known
 - Test well planned for Chemung Co. (Fortuna)



Water Well Contamination



Photo: Contaminated
water well in Dimock,
PA (Tim Shaffer /
Reuters)

- Several documented cases in PA, CO, WY, NY, TX
- Most likely source will be surface spills
- Also initial drilling through the aquifer
- Hydrofracturing can shake wells, releasing sediment for 2-3 days
- Problems have been primarily methane gas and solids
- Properly installed, intact well casing will prevent most occurrences
- Leaks are rare but will happen
- Natural gas leak can yield much more extensive damage (such as in Dimock, PA)



Water Well Testing

- Need to test both before and after drilling
- PA law - company tests within 1000 ft. of gas well
- Good idea to test if within 3000 ft. (pending PA law)
- Penn State Extension recommends testing for:
 - Tier 1: total dissolved solids, pH, barium, chloride
 - Tier 2: coliform bacteria, arsenic, hardness, total suspended solids (turbidity), iron, manganese
 - Tier 3: methane, oil/grease, lead, strontium, sodium, calcium, volatile organic compounds, surfactants



Water Water Testing (cont.)

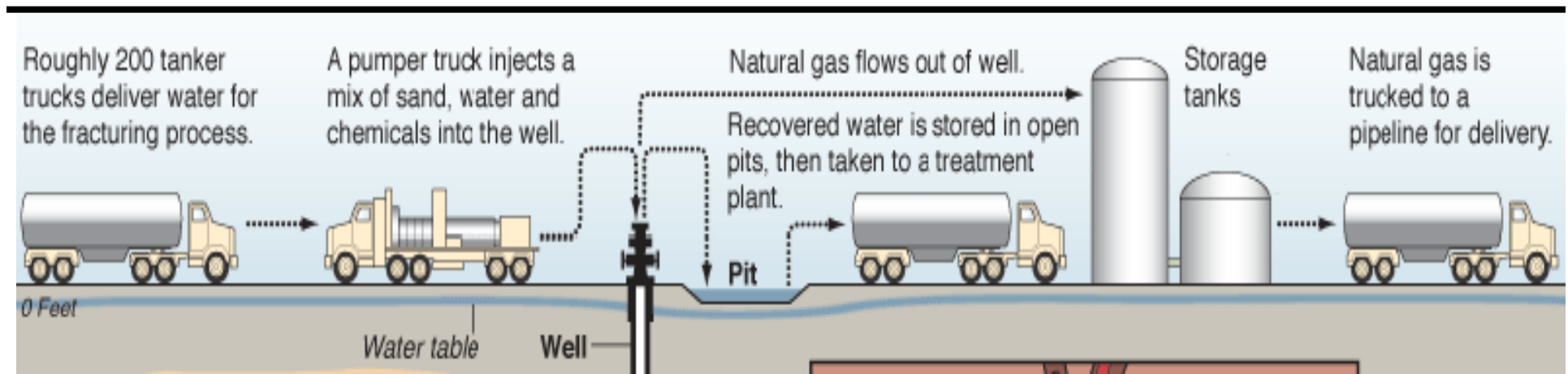
- Cost of testing substances listed in previous slide will run in the range of several hundred dollars
- Test needs to stand up in court of law!
 - Needs to be performed by state certified lab
 - Water sample taken by certified third party
- State certified labs are licensed by the NYS Dept. of Health
- Find labs at
<http://www.wadsworth.org/labcert/elap/comm.html>



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Surface Water Impacts

Aquifers, Streams, Lakes, Wetlands



- Truck Leaks
- Chemical Storage/Spills
- Equipment Malfunction
- Human Error
- Pit Leaks
- Drilling Mud Spills
- Stormwater Run-off



Fragmentation and Surface Disturbance



Reclaimed well-pad with producing well in Chemung County (James Grace, CCE Steuben County)

- Well spacing limit is likely to be 1 well-pad per 640 Acres (1 sq. mile)
 - Single well-pad is 3 to 5 acres in size during development
 - Well-pads, access roads, staging areas, and pipelines all create land disturbance
-
- Fragmentation of land reduces and damages habitat and forest land
 - Noise has further habitat impacts as well as human quality of life impacts



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Air quality



- Ozone and dust from trucks and rigs
- Fumes from compressors, pumps, drill rig

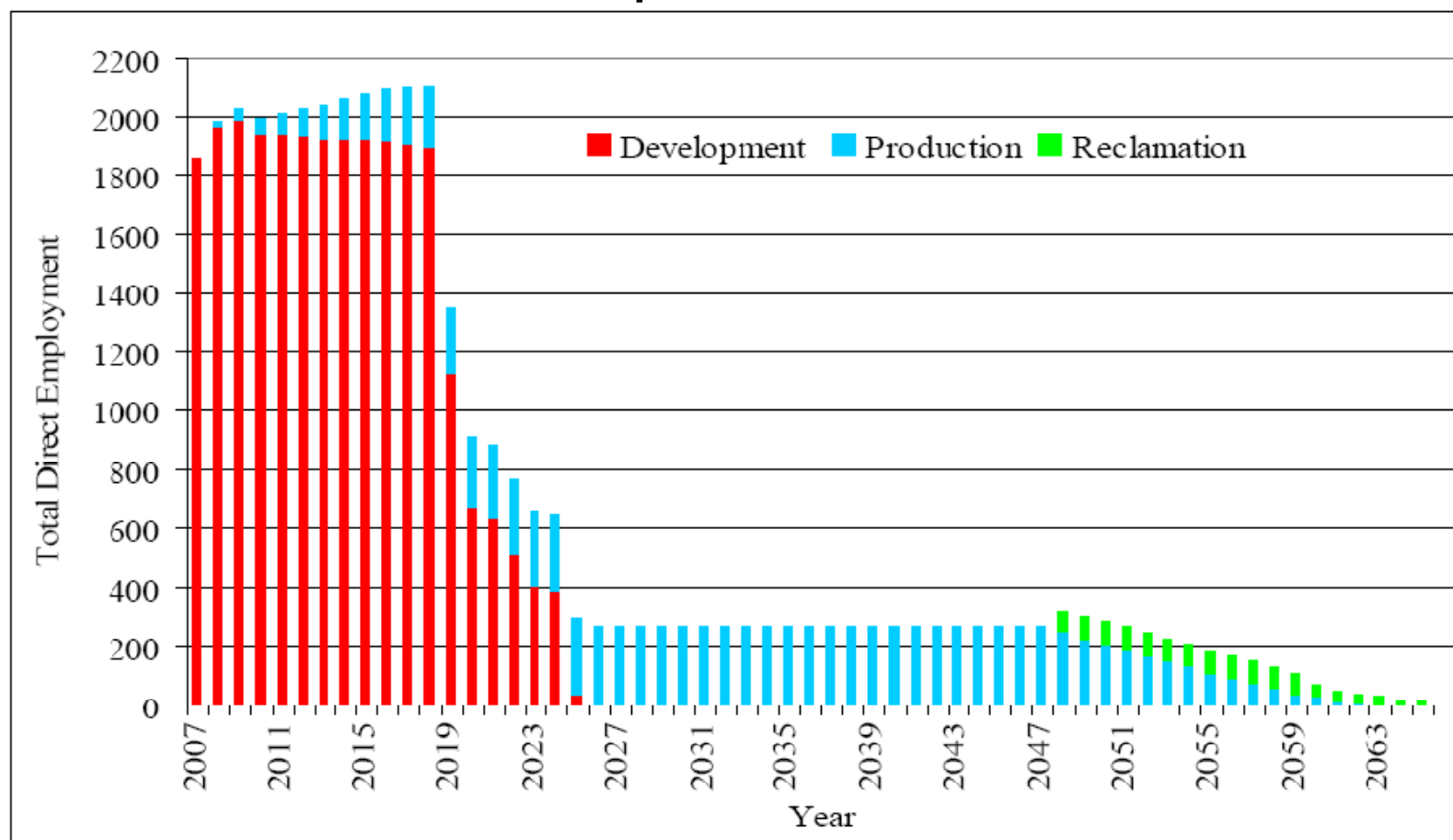


Social and Economic Impacts

- Quality of Life Concerns:
 - Truck Traffic
 - Dust
 - Noise
 - View sheds and light pollution
- Growth Management
 - Temporary Housing (RV parks, “Man camps”, motels, rentals)
 - New Industrial lots and development
 - Increase in Residential and Commercial Rental Prices
- Strain on Local Governments
 - Emergency Response Services
 - Police, Court System
 - Permitting, building permits, regulations
 - Growth in Schools, medical services



Drilling Phase is Short Lived, Very Intensive, and Unpredictable





Social and Economic Impacts

- New Job Creation
 - 11.53 “Development Phase” Jobs Per Well/Year
 - Mix of Non-local and local workers
 - 0.17 Long-term Production Phase jobs per well
 - Local Workers
- Increased Property Tax Revenue
- Increased local spending/new businesses catering to workers
- Increased Home Values due to demand



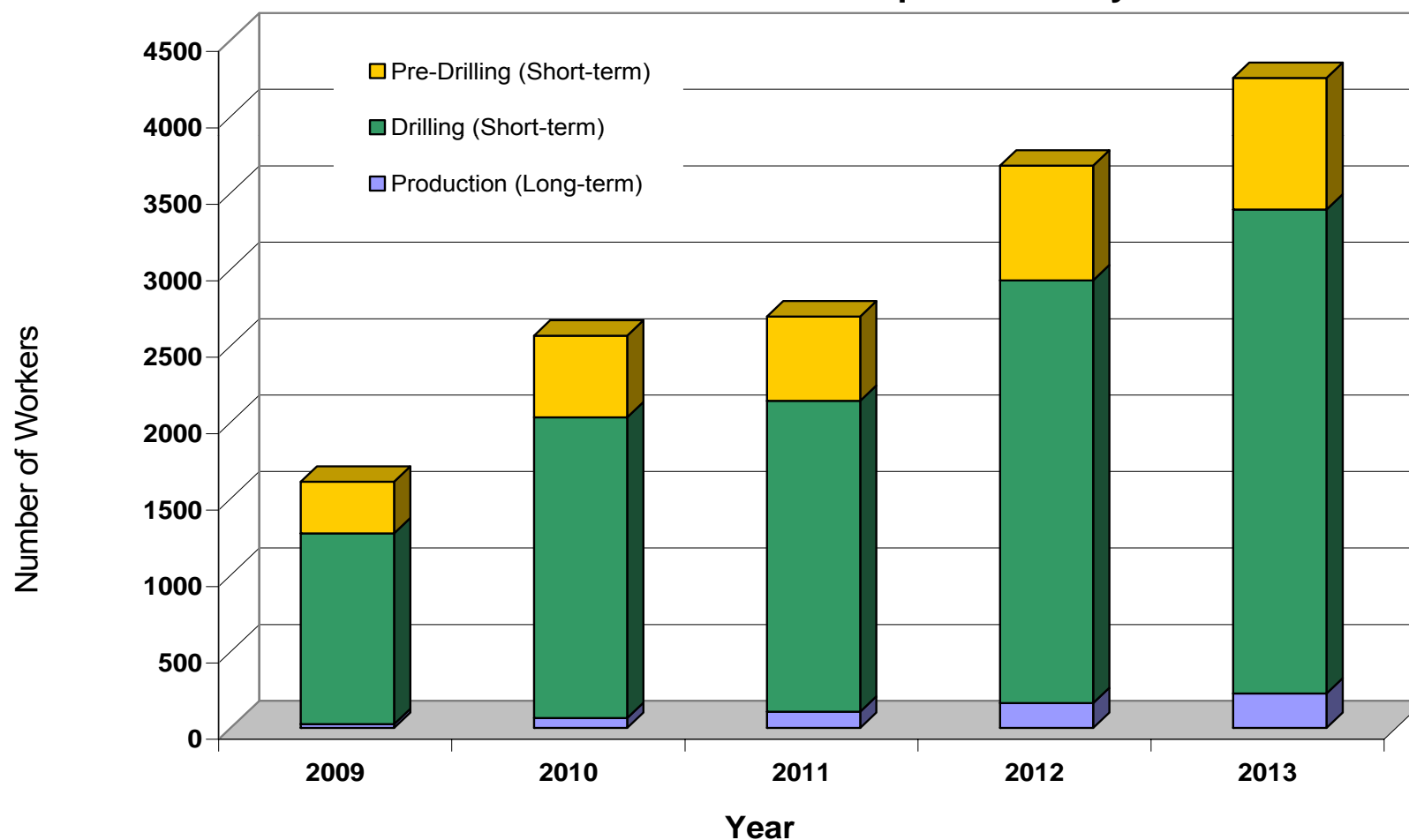
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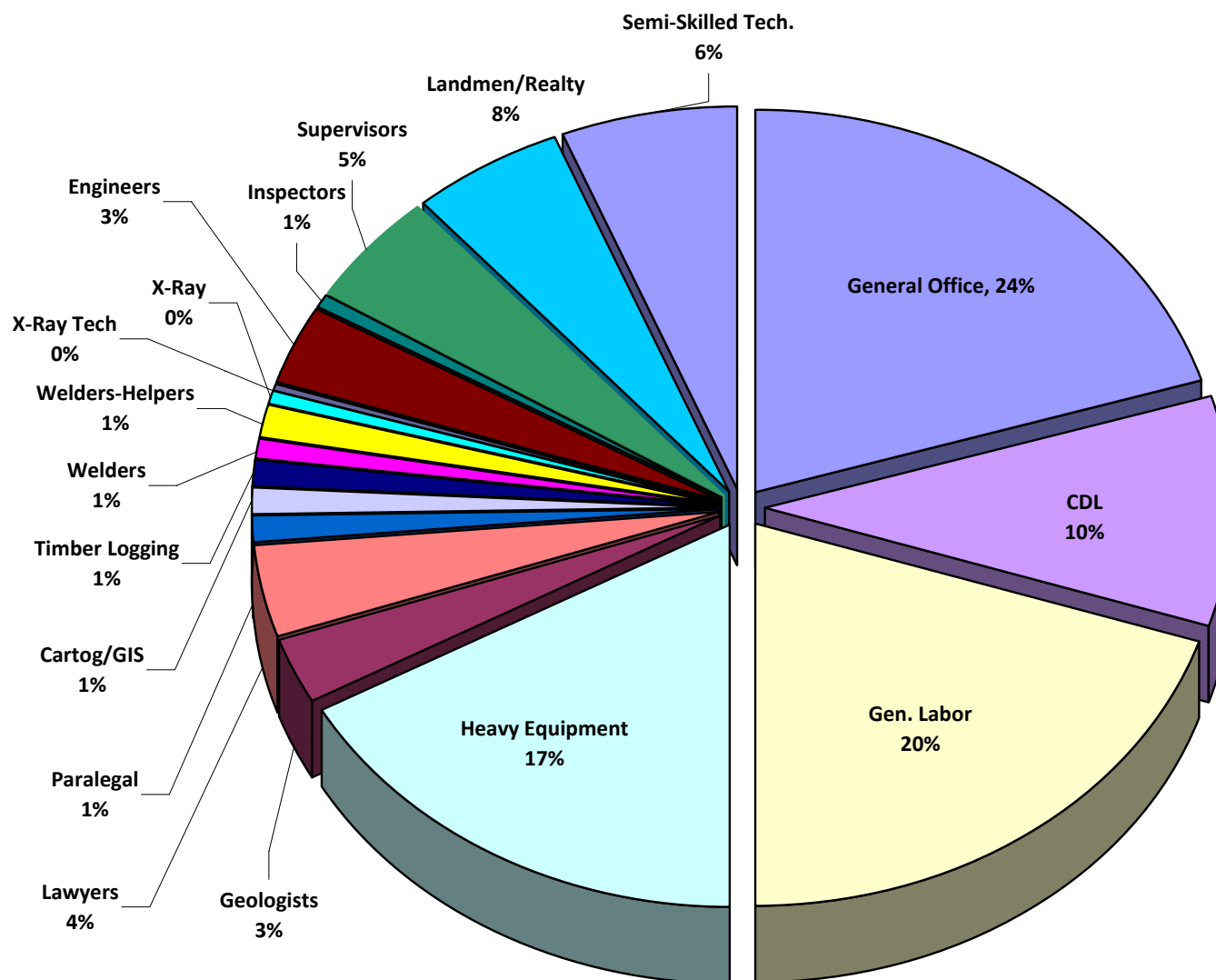
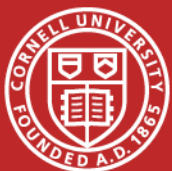




Northern PA Workforce Projections

"Likely" Scenario Northern Tier WIB Region Marcellus Shale Workforce Requirements By Phase





What specific jobs are required?



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To Lease or Not To Lease?

- A number of considerations needed to make informed decisions
- Explore the options available





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Leasing Considerations

- *Contact an Attorney familiar with gas leases!*
- You can change the “Standard Lease”
- You can:
 - Determine locations of wells, collector pipelines, roads
 - Require closed-loop drilling practices
 - Require setbacks from buildings
 - Demand before/after water testing
 - Reclamation/Forestry Practices to your specifications
 - Require No Surface Occupancy
 - Require liability for all pollution or clean-up
 - Require No Gas Storage on your Land



Leasing Considerations

- Per-Acre lease payment may not be most important consideration
- Royalty will dwarf lease payment if drilling is successful
- If drilling occurs, lease becomes “forever”
- Landowner coalitions can provide advice and leverage when dealing with companies



Landowner Coalitions

- Collectively bargain with energy companies for large lease
- Many different coalitions are forming
- Grassroots organization
- Legal, geologic, drilling advice
- Many have websites with links to other resources
- Pay a per-acre fee upon lease signing



Compulsory Integration

- Shale gas “drilling units” can be 36 to 640 acres depending on drilling technique
- If >60% of the spacing unit is leased, your property can be forced into compulsory integration
- Hearing process, you will be involved
- There will be no surface occupancy, but they can drill under your property
- No signing bonus, but you will get a royalty



3 Kinds of Compulsory Integration

- Integration as a Royalty Owner
 - Default option
 - No-surface occupancy
 - At least 12.5% royalty
 - No Risk to you for dry well
- Integration as a Participating Owner
 - You receive 100% of royalty
 - You must pay 100% of drilling expenses
 - Very risky if well is dry
- Integration as a Non-Participating Owner
 - You receive 100% of profits after company receives 300% of drilling expenses
 - You are under no risk of a dry well



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Supplemental Generic Environmental Impact Statement (SGEIS)

- This document is the state's Minimum Requirements for drilling permits under State Environmental Quality Review (SEQR).
- If SGEIS requirements are met, then most permits will be *issued without further review*.
- Requirements can include best practices, well spacing, environmental conditions, notification, monitoring, mitigation etc. "How they do business"
- Cannot include "a ban on drilling" or set regulations for specific areas.



(SGEIS) Process

- Permits for Marcellus Shale Horizontal Drilling or Fracturing are not issued during SGEIS review.
- Department of Environmental Conservation will:
 - Issue A Draft Document (early Fall?)
 - 30 Day Public Comment Period (can be extended)
 - Issue A Final Document (winter?)
 - Issue A Decision Document (soon after)
- Drilling Permits will then be issued under the rules of the new SGEIS



(SGEIS) Process

You Can:

- Contact DEC and ask for an extended comment period
- Contact DEC and ask to keep comment period short
- Send DEC comments during comment period:
 - Be professional, polite and address specific concerns, using examples and references when possible.
 - Emotional language or extreme rhetoric is likely to be dismissed. Form-letters are taken less seriously.
 - Encourage municipalities and local government agencies to co-sign or submit similar comments.
 - Encourage businesses, and local organizations to co-sign or submit similar comments.



Other Government Actions

- Federal Level
 - Hydro-fracturing is currently exempt from EPA oversight, bill in House (Rep. Hinchey) to federally regulate fracturing. Actual effect of such a law is unknown.
- State Legislature
 - Many laws being considered regarding notification, taxes, setbacks, testing, regulation. Tax revenues could go to state general fund, DEC, municipalities, any/all of the above, etc.



Local Government Preparation

- Prepare Emergency Services
 - Are they trained to handle equipment, materials, injuries involved?
 - Are 911 addresses assigned to drilling rigs or well pads?
 - Is Public Health trained to advise water well testing, and effects of well contamination?
- Perform Road Inventory
 - What are the current conditions of roads
 - Widths, materials, surfaces, ages, etc.



Local Government Preparation

- Prepare Planning and Zoning Department
 - Map and track locations of rigs, wells, yards, pipelines
 - Train staff regarding development process
- Update Permit Fees and Paperwork
 - Will create a lot of town/county staff demands
 - Industrial driveway permit fees
 - Industrial Addressing fees
 - Roadway Bonding Fees, etc.



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Community Preparation

- Get informed by attending educational workshops
- Review resources available on the CCE gas leasing webpage
- Participate in the SGEIS review process
- Talk to your neighbors and get involved



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