The local/community impacts of shale gas development:
What we know and don’t

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SPECIAL SCIENTIFIC COMMITTEE ON UNCONVENTIONAL OIL & GAS DEVELOPMENT: PUBLIC WORKSHOP
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Example of Impact Pathways

Activities → Burdens → Intermediate Impacts → Final Impacts

On-road vehicle activity

- Conventional air pollutants and CO2
- Noise pollution
- Road congestion

Intermediate Impacts

- Air quality
- Community disruption

Final Impacts

- Morbidity
- Climate change impacts
- Aesthetics
- Time loss

Activities Burdens Intermediate Impacts Final Impacts
Overlap of each groups’ high priority routine risk pathways
Policy Context

• Localities have concerns
  • Front line for explosion of “industrial activity” in their often rural communities
  • Many of the impacts are obvious, but others are hidden, scary and/or hard to attribute to oil and gas activity
  • These concerns can boil over into bans and moratoria

• Key Issues (other than health and ecological effects)
  • Economic benefits/costs
  • Local finance
  • Environmental (air, water, land)
  • Community-related
    • Traffic accidents
    • Schools
    • Time lost
    • Crime
    • Noise, light, odor
    • Recreational opportunities, etc.
  • Seismic
  • Property Values
  • Public Preferences (willingness to pay)
Positive Local Economic Impacts

- Lease payments and royalties (Split estates)
- Tax revenues, fees, etc.
- Economic growth/jobs
- Boom towns
- Reduced gas and electric utility expenses
## Dickinson, ND Financial Statistics

<table>
<thead>
<tr>
<th>Category</th>
<th>2009</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Tax</td>
<td>$4,388,670</td>
<td>$16,428,510</td>
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<tr>
<td>Hospitality Tax</td>
<td>$554,009</td>
<td>$1,060,639</td>
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<tr>
<td>Occupancy Tax</td>
<td>$256,331</td>
<td>$597,266</td>
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<tr>
<td>Property Tax (Net)</td>
<td>$2,886,383</td>
<td>$3,462,321</td>
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<td>Enterprise</td>
<td>$6,676,027</td>
<td>$11,373,655</td>
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<tr>
<td>Debt</td>
<td>$2,630,497</td>
<td>$65,000,000</td>
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<tr>
<td>City Operating Budget</td>
<td>$7,522,143</td>
<td>$13,550,120</td>
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<tr>
<td>Capital Budget</td>
<td>$1,677,974</td>
<td>$132,000,000</td>
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<tr>
<td>State Support</td>
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<td>$12,300,000</td>
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</tbody>
</table>

Source: Shawn Kessel, City Administrator, 2014
Surface Water Quality Risk Study (PNAS, 2013)

We exploit spatial and temporal variation in the proximity of shale gas wells, waste treatment facilities, and surface water quality monitors in Pennsylvania to estimate:

1. the impact of *shale gas wells* on downstream chloride and TSS concentrations; and

2. the impact of *shale gas waste treatment* and release to surface water on downstream chloride and TSS concentrations.
Conclusions

- No statistically significant impact of shale gas wells on downstream chloride concentrations.
  - A positive result here would have been consistent with contamination problems from spills, dumping, etc.

- Release of treated shale gas waste to surface water by permitted waste facilities appears to increase downstream chloride concentrations.

- Shale gas wells appear to increase downstream TSS concentrations.
Compare Concentrations to Standards/Criteria

### Primary environmental public health concerns:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>NOB</th>
<th>Median</th>
<th>Standard (mg/L)</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barium</td>
<td>180</td>
<td>431</td>
<td>2</td>
<td>EPA MCL</td>
</tr>
<tr>
<td>Barium</td>
<td>180</td>
<td>431</td>
<td>10</td>
<td>PA wastewater effluent standards monthly average</td>
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<tr>
<td>Bromide</td>
<td>164</td>
<td>491</td>
<td>0.1</td>
<td>General agreed level in fresh water sources</td>
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<tr>
<td>Strontium</td>
<td>175</td>
<td>1080</td>
<td>4</td>
<td>EPA recommended limit for finished municipal drinking water</td>
</tr>
<tr>
<td>Strontium</td>
<td>175</td>
<td>1080</td>
<td>10</td>
<td>PA wastewater effluent standards monthly average</td>
</tr>
<tr>
<td>Benzene</td>
<td>61</td>
<td>0.03</td>
<td>0.005</td>
<td>EPA MCL</td>
</tr>
</tbody>
</table>

### Ecological and secondary drinking water concerns:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>NOB</th>
<th>Median</th>
<th>Standard (mg/L)</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorides</td>
<td>175</td>
<td>46500</td>
<td>250</td>
<td>EPA SMCL, PA wastewater effluent standards</td>
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<tr>
<td>Magnesium</td>
<td>172</td>
<td>526.5</td>
<td>0.05</td>
<td>EPA SMCL</td>
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<tr>
<td>TDS</td>
<td>175</td>
<td>82600</td>
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<td>EPA SMCL, PA wastewater effluent standards</td>
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<tr>
<td>Sulfate</td>
<td>90</td>
<td>61.05</td>
<td>250</td>
<td>EPA SMCL</td>
</tr>
</tbody>
</table>
Induced Seismicity

- Seismicity from fracking NOT a problem
- Deep well injection: 40,000 wells taking oil and gas liquid wastes.
- Better than pits, which leak; better than CWTs which can’t treat produced water
- DWI is #3 in anthropogenic earthquakes.
- Growth in earthquakes > 3.0 since 2009, “coincident with” oil and gas waste injections.” In CO, TX, OH, ARK, OK. A few “caused by.”
- Can it be managed?
- Industry cutting water flows through recycling, using less liquids
Cumulative number of earthquakes with a magnitude of 3.0 or larger in the central and eastern United States, 1970–2013. The dashed line corresponds to the long-term rate of 20.2 earthquakes per year, with an increase in the rate of earthquakes starting around 2009.
Truck Traffic Accidents in Pennsylvania by Well Activity

- Accidents in counties with more than 20 wells
- Accidents in counties with less than 20 wells
- Well pads drilled

Year

- 1997
- 2000
- 2003
- 2006
- 2009
- 2012

Avg. No. of Accidents/Population

- 0.0006
- 0.0007
- 0.0008
- 0.0009
- 0.001

No. Well Pads

- 0
- 500
- 1000
- 1500
- 2000

Accidents in counties with more than 20 wells

Accidents in counties with less than 20 wells

Well pads drilled
Property Values and Housing

- Great aggregator of local perceived risks – with **real** effects
- Effects of proximity and intensity
- Proximity Matters
  - Within 1.5 km and on groundwater: $33,000 decrease versus homes further away and on public water
- Intensity Matters a little
Residential property sales in Washington County, PA
Figure 2. Estimated WTP ($ household⁻¹ year⁻¹), on average, for the reduction of risks associated with shale gas development
Research Priorities for the Future

• Boom town impacts, particularly on low income
• Mental health stress
• Groundwater data
• Produced water info more important than fracking fluids disclosure
• Waste treatment plant emissions
• Solid waste risks and RCRA
• Traffic-related

Lesser problems:
• Water quantity in PA
• Air quality (but non-attainment issues in West)
Thank you!

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