MAPPING KNOWLEDGE INVESTMENTS DURING THE MARCELLUS SHALE GAS RUSH

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"[W]e currently do not have the resources to conduct baseline testing prior to the start of drilling activities. The Department is responsible for assessing all of our waterways, and should therefore be able to document an impact that would actually cause impairment of a stream’s designated use. However, it might be difficult to measure more subtle changes."

- PA Department of Environmental Protection

“To date, we have not seen either a comprehensive impact assessment of drilling in the Marcellus Shale region or even careful environmental analysis for site-specific permits—steps we believe are necessary to ensure that land, air, and water resources are protected.”

- Chesapeake Bay Foundation
HOW CAN SOCIAL SCIENTISTS CONTRIBUTE TO UNDERSTANDING SURFACE WATER QUALITY MONITORING IN THE MARCELLUS SHALE?

- Focus on the HOW, WHERE, and WHO of monitoring, not WHAT is and is not being monitored.
- Understanding the social and political processes of knowledge production.
- Understanding the social and political processes of production of ignorance and undone science.
- Both involve two related socio-political processes (so far):
  - Budget cuts and overall reduced capacity of publicly funded environmental agencies.
  - Growth of citizen capacity to do “undone science.” Sometimes involving the support of research universities and other non-governmental organizations.
- Understanding the different ways that citizens, academics, regulators, and others define what is “reliable” monitoring data.
- Understanding the spatial distribution of knowledge investments.
RPI’S NY/PA WATERSHED KNOWLEDGE MAPPING PROJECT: OBJECTIVES

- Produce a comprehensive database and map of efforts to monitor watershed impacts of shale gas development in NY and PA.
- Identify regions and watersheds that may require greater monitoring by governments, researchers, and the public.
- Explain why water monitoring efforts are unevenly distributed across the region.
- Analyze the relationships and tensions between government, academic, and civil society research efforts.
RESEARCH QUESTIONS

1. To what extent does citizen water quality monitoring fill knowledge gaps about the impacts of shale gas development on fresh water quality, and how are these volunteer efforts spatially distributed?

2. Where are public agencies investing in watershed monitoring, and how are these public efforts spatially distributed?

3. How and to what extent do academic scientists aid in filling knowledge gaps about the impacts of shale gas development on fresh water quality?
METHODS & ANALYSIS

- Survey to civil society & county conservation districts
  - Began in January 2012
  - 312 mailed, 123 responses (39% response rate) as of May 1, 2012

- Interviews with government, academic, and citizen contacts and organizations
  - Began in Spring 2012

- Geographic Information System
  - Survey results and interview transcript coding
  - Watershed Density, Socio-demographic Density, Monitoring Intensity
  - Identify geographic “hot spots” and “cold spots” through spatial autocorrelation plus associative classification by organization type.
  - Began in Fall 2011, Results expected August 2012

- Case studies in 4-6 counties (half “hot,” half “cold”)
  - Set to begin in Fall 2012
Knowledge Investments are the *density and intensity of resources* used for research in the pursuit of Knowledge Production.
1. To what extent does citizen water quality monitoring fill knowledge gaps about the impacts of shale gas development on fresh water quality, and how are these volunteer efforts spatially distributed?

- Methods of data collection: Surveys, interviews, case studies

- Data collected to date:
  - survey responses on organizational mission, structure, capacity, and knowledge investments
  - U.S. Census and American Community Survey data (demographic analysis)
These civil society organizations responded to the survey, reported surface water monitoring activities related to Marcellus Shale natural gas development, and gave permission to reveal the organization name. Current as of May 1, 2012.

<table>
<thead>
<tr>
<th>Civil Society Organization</th>
<th>Location</th>
<th>State</th>
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</thead>
<tbody>
<tr>
<td>Audubon Society of Western PA</td>
<td>Pittsburgh</td>
<td>PA</td>
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<tr>
<td>Baylor Lake Volunteer Water Testers</td>
<td>Clarks Summit</td>
<td>PA</td>
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<tr>
<td>Centre County Chapter of the Senior Environmental Corps</td>
<td>Bellefonte</td>
<td>PA</td>
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<tr>
<td>Chartiers Creek Watershed Association</td>
<td>McMurray</td>
<td>PA</td>
</tr>
<tr>
<td>Clearfield Creek Watershed Association</td>
<td>University Park</td>
<td>PA</td>
</tr>
<tr>
<td>Community Science Institute</td>
<td>Ithaca</td>
<td>NY</td>
</tr>
<tr>
<td>Delaware Riverkeeper Network</td>
<td>Bristol</td>
<td>PA</td>
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<tr>
<td>Loyalhanna Watershed Association</td>
<td>Ligonier</td>
<td>PA</td>
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<tr>
<td>Mid Valley Secondary Center – Project WATCH</td>
<td>Throop</td>
<td>PA</td>
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<tr>
<td>Project Watershed Central New York</td>
<td>Cazenovia</td>
<td>NY</td>
</tr>
<tr>
<td>South Branch Tunkhannock Creek Watershed Coalition (SBTCWC)</td>
<td>Dalton</td>
<td>PA</td>
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<tr>
<td>The Peak Center Senior Environment Corps</td>
<td>Lansdale</td>
<td>PA</td>
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<tr>
<td>Tidewaters Gateway Partnership Inc.</td>
<td>Piperstown</td>
<td>PA</td>
</tr>
<tr>
<td>Twin Walker Creeks Watershed Conservancy</td>
<td>Shohola</td>
<td>PA</td>
</tr>
<tr>
<td>Washington County Watershed Alliance</td>
<td>Washington</td>
<td>PA</td>
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Locations where civil society surveys were mailed by population density.

As of May 1, 2012 we have mailed 204 surveys to civil society orgs, and received 65 responses (32% response rate).
CIVIL SOCIETY ORGANIZATIONS:
MONITORING DENSITY BY COUNTY (05/01/12)

* Size of each circle represents approximate number of monitored surface water locations in a county. In counties where more than one organization is monitoring, organizations are represented by separate circles.

Civil Society Monitoring Locations
Number of Locations (381*), Civil Society Organizations (14)

- 1-8
- 9-15
- 16-23
- 24-30
- 31-37
- 38-50

Extant of Marcellus Shale
CIVIL SOCIETY ORGANIZATIONS: PRELIMINARY RESULTS

Trends in the density of monitoring by civil society organizations.....

- 74% of the counties where Marcellus shale development could potentially occur are not reported to be monitored by civil society organizations.
- The Marcellus shale formation encompasses 30 New York and 54 Pennsylvania counties.
- Civil society organizations reported monitoring for Marcellus shale impacts in 33% (10) of New York and 22% (12) of Pennsylvania counties where the Marcellus shale formation is found.
- One of the monitored counties in Pennsylvania, Montgomery, is located outside of the Marcellus shale formation.
- 17% of the counties being monitored have more than one citizen group conducting monitoring.

And, a bit about intensity...

- 52% of the counties being monitored by citizen groups have 15 or fewer sampling locations.
CIVIL SOCIETY ORGANIZATIONS: NEXT STEPS

- Contacting organizations for coordinates and/or exact watersheds (HUC 10 or 8) where conducting monitoring related to Marcellus shale developments.

- Mapping monitoring locations by type and number of indicators being monitored, and by HUC, census tract/socio-demographic variables, and shale gas development type (e.g., well pads, water withdrawals, waste disposal, etc.) and density.

- Conducting spatial clustering and autocorrelation analyses.
CIVIL SOCIETY ORGANIZATIONS:
MONITORING DENSITY BY COUNTY (05/01/12)
+ ALL (MARCELLUS AND NON-MARCELLUS) ACTIVE PA OIL AND GAS WELLS
(05/01/12)

* Size of each circle represents approximate number of monitored surface water locations in a county. In counties where more than one organization is monitoring, organizations are represented by separate circles.

Civil Society Monitoring Locations
Number of Locations (381*), Civil Society Organizations (14)
- 1-8
- 9-15
- 16-23
- 24-30
- 31-37
- 38-50

Extent of Marcellus Shale
2. Where are public agencies investing in watershed monitoring, and how are these public efforts spatially distributed?

- Methods of data collection: Surveys (county soil & water conservation districts), interviews, publicly available data, case studies

- Data collected to date:
  - survey responses from County Soil & Water Conservation Districts on organizational mission, structure, capacity, and knowledge investments
  - public data sets from state agencies including Pennsylvania’s Spatial Data Access (PASDA, [http://www.pasda.psu.edu](http://www.pasda.psu.edu)), and New York State’s GIS Data Clearinghouse (NYSGIS, [http://gis.ny.gov/](http://gis.ny.gov/)).

- Data still to be collected:
  - interviews with federal and state agencies
The following county conservation districts (PA) and soil and water conservation districts (NY) responded to the survey and reported surface water monitoring activities related to Marcellus Shale natural gas development. Current as of May 1, 2012.

<table>
<thead>
<tr>
<th>County Conservation District</th>
<th>Town/Location</th>
<th>State</th>
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<tbody>
<tr>
<td>Bradford County Conservation District</td>
<td>Towanda</td>
<td>PA</td>
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<tr>
<td>Elk County Conservation District</td>
<td>Ridgway</td>
<td>PA</td>
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<tr>
<td>McKean County Conservation District</td>
<td>Smethport</td>
<td>PA</td>
</tr>
<tr>
<td>Otsego County Soil and Water Conservation District</td>
<td>Cooperstown</td>
<td>NY</td>
</tr>
<tr>
<td>Pike County Conservation District</td>
<td>Hawley</td>
<td>PA</td>
</tr>
<tr>
<td>Potter County Conservation District</td>
<td>Coudersport</td>
<td>PA</td>
</tr>
<tr>
<td>Schoharie County Soil and Water Conservation District</td>
<td>Schoharie</td>
<td>NY</td>
</tr>
<tr>
<td>Somerset Conservation District</td>
<td>Somerset</td>
<td>PA</td>
</tr>
<tr>
<td>Wayne Conservation District</td>
<td>Honesdale</td>
<td>PA</td>
</tr>
</tbody>
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Locations where county surveys were mailed by population density.

As of May 1, 2012 we have mailed 108 surveys to county orgs, and received 58 responses (54% response rate).
* Size of each circle represents approximate number of monitored surface water locations in a county. In counties where more than one organization is monitoring, organizations are represented by separate circles.

County Conservation District Monitoring Locations
Number of Locations (134*), County Conservation Districts (8)
- 1-8
- 9-15
- 16-23
- 24-30
- 31-37
- 38-50

Extent of Marcellus Shale
Trends in the density of monitoring by county conservation districts.....

- 89% of the counties where Marcellus shale development could potentially occur are not reported to be monitored by local public agencies.
  - The Marcellus shale formation encompasses 30 New York and 54 Pennsylvania counties.
  - County conservation districts have reported monitoring for Marcellus shale impacts in 7% (2) of New York and 13% (7) of Pennsylvania counties where the Marcellus shale formation is found.
  - All counties where monitoring is taking place are within the Marcellus shale formation.

And, a bit about intensity of monitoring by conservation districts...

- 66% of the counties being monitored by county conservation districts have 15 or fewer sampling locations.
Contacting organizations for coordinates and/or exact watersheds (HUC 10 or 8) where conducting monitoring related to Marcellus shale developments.

Mapping monitoring locations by type and number of indicators being monitored, and by HUC, census tract/socio-demographic variables, and shale gas development type (e.g., well pads, water withdrawals, waste disposal, etc.) and density.

Conducting spatial clustering and autocorrelation analyses.
Public Agencies (County Conservation Districts): Monitoring Density by County (05/01/12)

+ All (Marcellus and Non-Marcellus) Active PA Oil and Gas Wells (05/01/12)

* Size of each circle represents approximate number of monitored surface water locations in a county. In counties where more than one organization is monitoring, organizations are represented by separate circles.
PUBLIC AGENCIES (FEDERAL & STATE): MONITORING DENSITY BY STATE, COUNTY & WATERSHED

FEDERAL AGENCY (USGS) EXAMPLE
117 NY, 248 PA USGS Stream Gages within the Marcellus shale formation by watershed (1:250,000).

STATE AGENCY (PA DEP) EXAMPLE
132 PA DEP Water Quality Network Stations within the Marcellus shale formation by watershed (1:250,000).
Density of Knowledge Investments:
- Number of civil and county organizations reporting Marcellus shale-related water monitoring activities in NY and PA = 26
- Total number of civil and county water quality monitoring locations (as reported in survey responses) = 527

Intensity of Knowledge Investments:
- 23 types of visual indicators. Erosion most monitored.
- 29 types of chemical indicators. Conductivity most monitored.
- 5 types of biological indicators. Macroinvertebrates most monitored.
- Top four indicators monitored: conductivity/TDS (90% of organizations), temperature (66.7% of organizations), pH (52% of organizations), benthic macroinvertebrates (48% of organizations).
- Frequency of sampling/monitoring activities: varies widely, from 1-5/year to daily.

Organizational Histories and Financial Resources:
- Proportion of projects in which monitoring for gas development impacts began in 2011 or later ~ 50%
- Range of reported annual expenses (not including personnel costs): $0- over $50,000, but about half reported $0-$999
- Top three sources of funding: private foundations, educational organizations, and individual volunteers or participants
How and to what extent do academic scientists aid in filling knowledge gaps about the impacts of shale gas development on fresh water quality?

- Methods of data collection: Interviews, case studies

- Data to be collected: Interview responses on capacity, knowledge investments, perspectives on volunteer versus professional surface water monitoring

What role do academic scientists play in monitoring?
NEXT STEPS
SURFACE WATER QUALITY & MARCELLUS SHALE: THE BIG PICTURE
Public and Private Monitoring Locations, Watersheds, Census Tracts
SURFACE WATER QUALITY & MARCELLUS SHALE: THE BIG PICTURE

Public and Private Monitoring Locations, Watersheds, Census Tracts + All (Marcellus and non-Marcellus) PA Active Oil and Gas Wells
SURFACE WATER QUALITY & MARCELLUS SHALE: THE BIG PICTURE

Public and Private Monitoring Locations, Watersheds, Census Tracts, All (Marcellus and non-Marcellus) PA Active Oil and Gas Wells + PA Marcellus shale water management plans
THANK YOU!

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For more information visit:
http://www.watershed-mapping.rpi.edu/

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