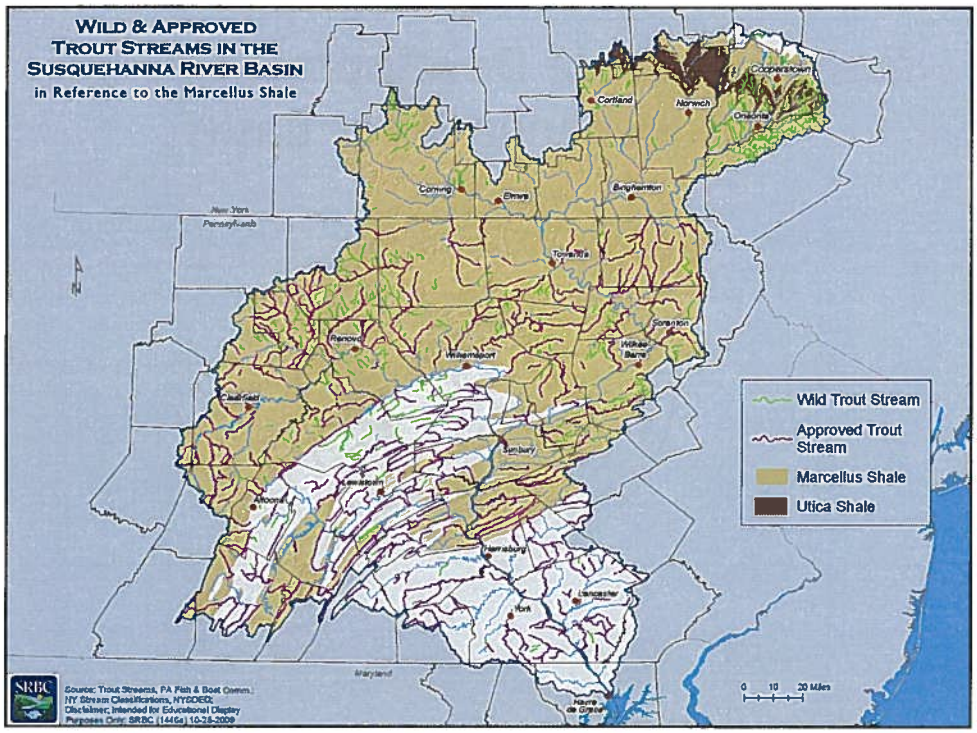
Marcellus Shale Development in the Susquehanna River Basin

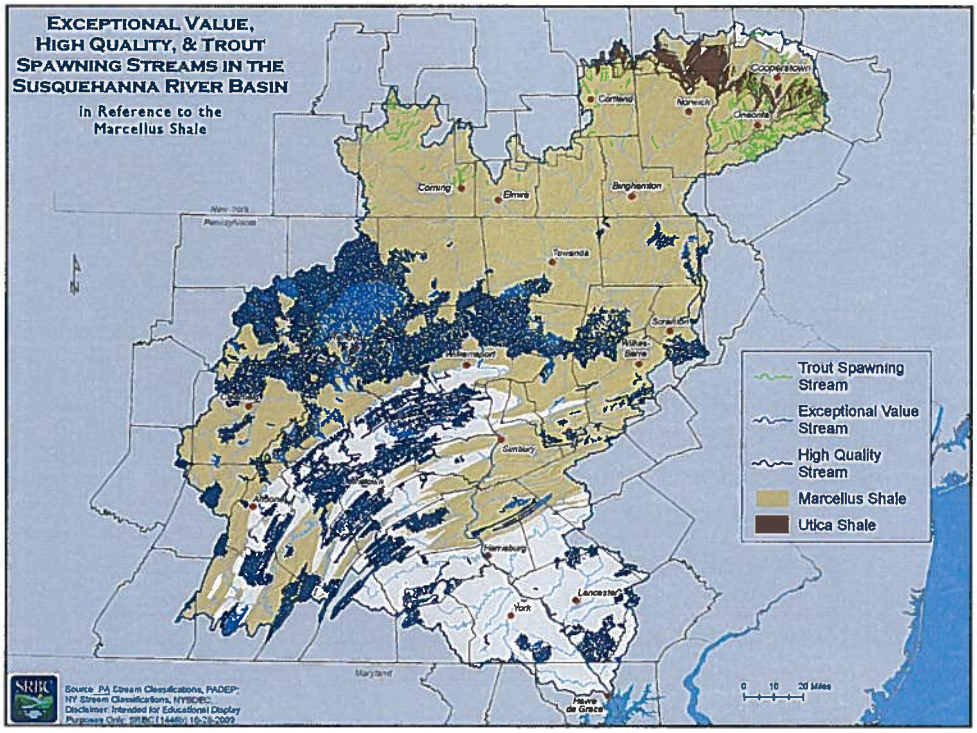
April 7, 2010 Indiana, PA

Geographic Location

Appalachian Basin Province

- NY to PA, OH, MD, WV and VA
- Trending northeast, spans a distance of about 600 linear miles and 54,000 square miles
- 72% of Susquehanna River Basin is underlain by Marcellus Shale


WILD & APPROVED TROUT STREAMS IN THE SUSQUEHANNA RIVER BASIN
in Reference to the Marcellus Shale
Wild Trout Stream
Approved Trout Stream
Marcellus Shale
Utica Shale
Cooperstown
Cortland
Norwich
Oneonta
Corning
Elmira
Binghamton
Towanda
Scranton
Wilkes-Barre
Williamsport
Sunbury
Harrisburg
York
Lancaster
Havre de Grace
Maryland
0 10 20 Miles


EXCEPTIONAL VALUE, HIGH QUALITY, & TROUT SPAWNING STREAMS IN THE SUSQUEHANNA RIVER BASIN
In Reference to the Marcellus Shale
Trout Spawning Stream
Exceptional Value Stream
High Quality Stream
Marcellus Shale
Utica Shale
Cooperstown
Cortland
Norwich
Oneonta
Corning
Elmira
Binghamton
Towanda
Scranton
Wilkes-Barre
Williamsport
Sunbury
Harrisburg
York
Lancaster
Havre de Grace
Maryland
0 10 20 Miles

Regulatory Approvals To Date

- Surface Water Withdrawals
  - 111 approvals
  - 55 pending
- Public Water Supply Systems
  - 22 approvals
  - 14 pending
- Approvals by Rule - (Well Pads)
  - 487 issued
  - 181 pending (Notice of Intent)
- Groundwater Withdrawals -pending

Actual Water Use Data

- **Total water withdrawn as of 03/16/2010: 433.0 M/gal**
  - 177.2 M/gal from public water supply (41%)
  - 255.8 M/gal from surface water sites (59%)
- **Average total volume of fluid used per well: 2.8 M/gal**
  - Average fresh water used per well: 2.4 M/gal
  - Average flowback reuse per well: 0.4 M/gal

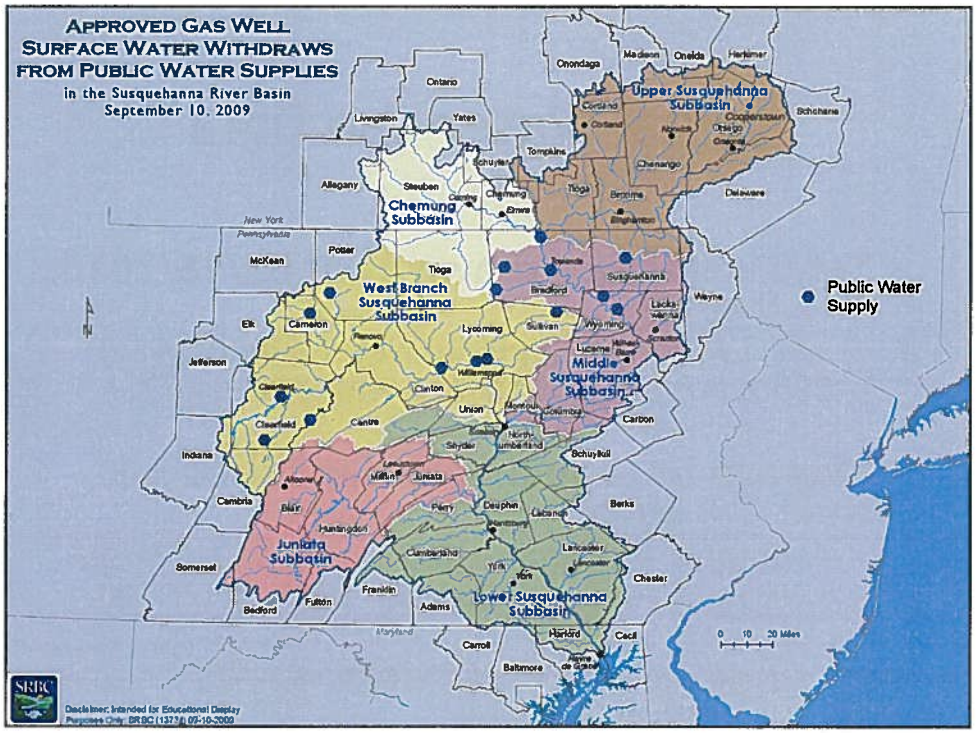
184 wells reported

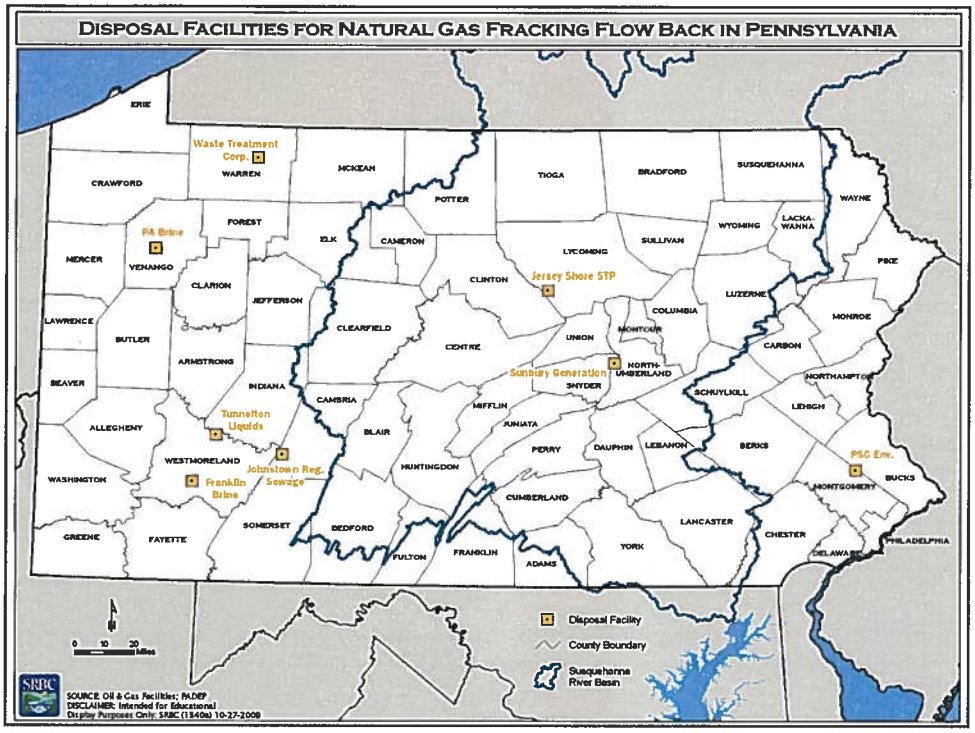
- **Average recovery of fluids: 11.9%** (first 30-

Post-Hydrofracture Data

- On average 83% of water brought on site is used. The maximum percentage is 100% and the minimum percentage is 30%.
- On average 12% of injected water is recovered. The maximum percentage is 57% and the minimum percentage is 2%.
- 41% of wells use flowback in fracing. 46% companies use flowback in fracing.
- On average 84% flowback brought on site is used.
- The maximum, average, and minimum of water injected are 6.1 mgal, 2.7 mgal, and 0.1 mgal.
- The maximum, average, and minimum of flowback transferred are 1.2 mgal, 0.2 mgal, 0 mgal.
- The maximum, average, and minimum of flowback disposed are 1.4 mgal, 0.2 mgal, and 0 mgal.

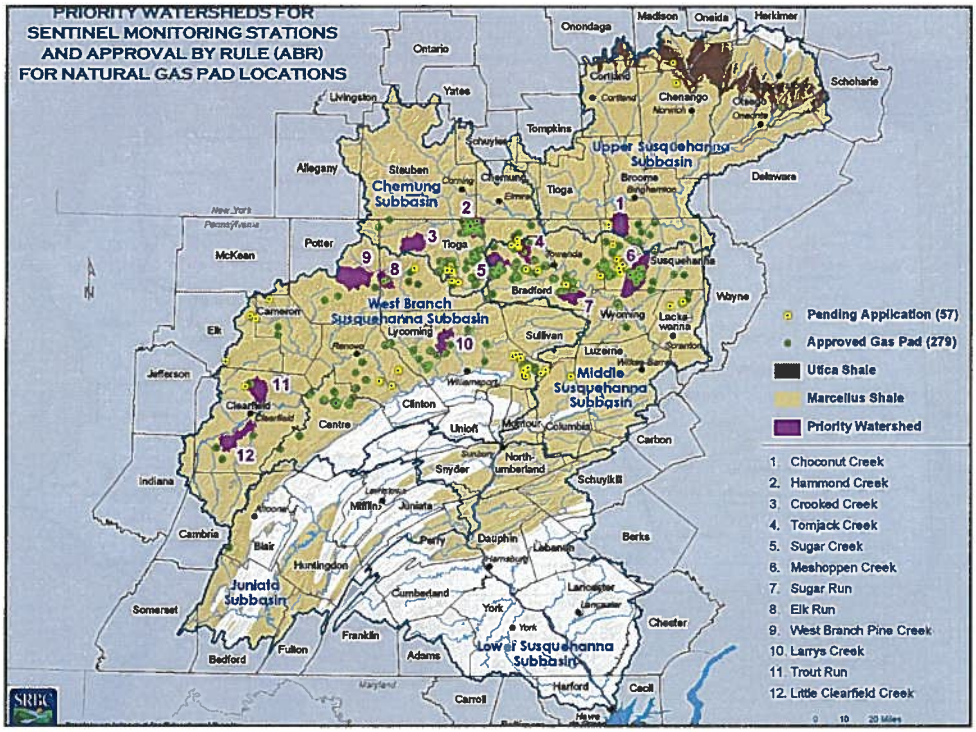
Susquehanna River Basin Commission www.srbc.net

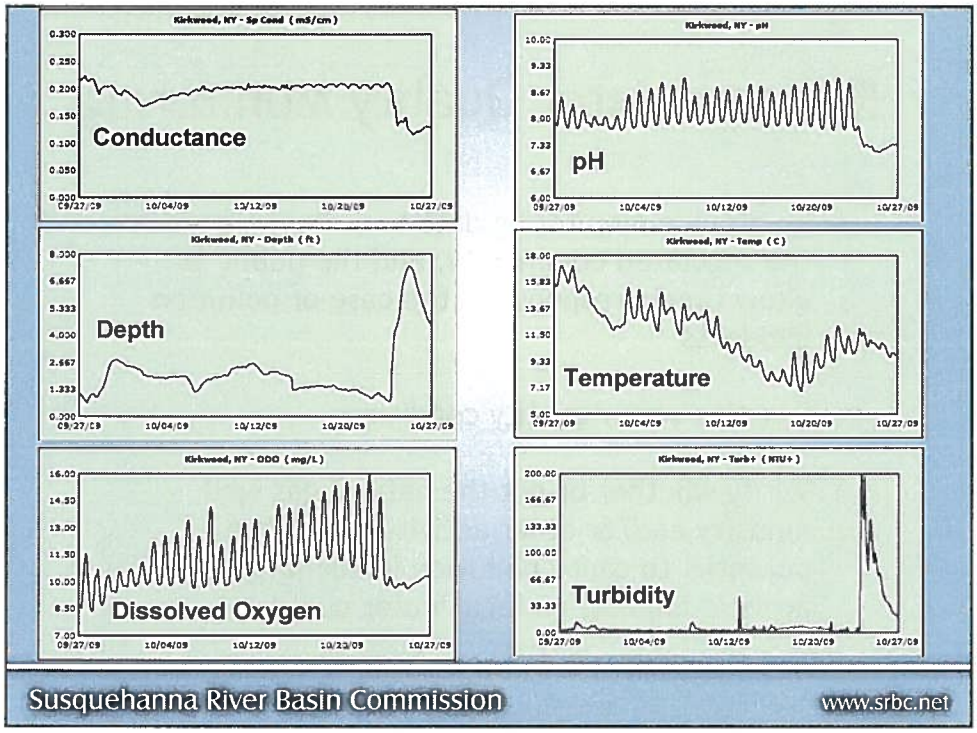




Remote Water Quality Monitoring

- To provide monitoring data to resource agencies, the regulated community, and the public to allow timely response in the case of pollution incidents
- Baseline water quality conditions
- Verify whether or not the natural gas well industry and/or other activities with the potential to cause pollution incidents are causing adverse impacts on local water quality


PRIORITY WATERSHEDS FOR
SENTINEL MONITORING STATIONS
AND APPROVAL BY RULE (ABR)
FOR NATURAL GAS PAD LOCATIONS
Chemung Subbasin
Upper Susquehanna Subbasin
West Branch Susquehanna Subbasin
Middle Susquehanna Subbasin
Juniata Subbasin
Lower Susquehanna Subbasin
Pending Application (57)
Approved Gas Pad (279)
Utica Shale
Marcellus Shale
Priority Watershed
1. Choconut Creek
2. Hammond Creek
3. Crooked Creek
4. Tomjack Creek
5. Sugar Creek
6. Meshoppen Creek
7. Sugar Run
8. Elk Run
9. West Branch Pine Creek
10. Larrys Creek
11. Trout Run
12. Little Clearfield Creek


Conductance
pH
Depth
Temperature
Dissolved Oxygen
Turbidity
Susquehanna River Basin Commission
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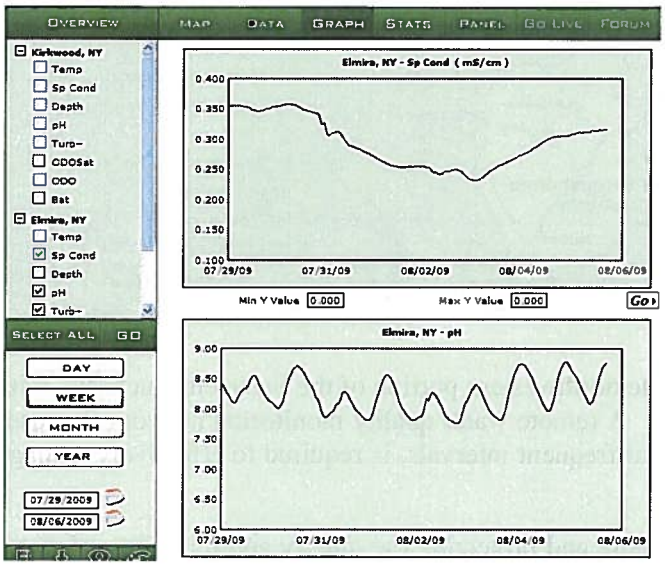
Susquehanna River Basin Commission
Information Sheet

Remote Water Quality Monitoring Network

Network Overview – The Susquehanna River Basin Commission (SRBC) initiated a network designed to remotely monitor water quality conditions to maintain and protect surface waters in select portions of the Susquehanna basin. The monitoring network uses state-of-the-art monitoring and communication technology to collect and transmit real-time water quality data. Increasing demands for water throughout the basin, coupled with increasing wastewater flows, require the application of this advanced technology to effectively monitor rapid changes in water quality conditions. SRBC previously operated and maintained such a system only on the mainstem of the Susquehanna River for the purpose of monitoring drinking water sources; however, expanding the existing system meets a greater need to track water quality conditions within smaller rivers and streams throughout the basin where existing/proposed water demands are increasing.



Internet-accessible data provided by the monitoring network

Network Implementation – The network will consist of thirty (30) monitoring stations in the Pennsylvania and New York portions of the Susquehanna basin, starting with 10 in January 2010 and the remaining 20 by June 2010. The stations will continuously monitor and record the following five parameters: temperature, pH, conductance, dissolved oxygen, and turbidity. In addition, water depths will be recorded to establish a relationship with stream flows. These data will enable water resource agencies, water users, and the public to make informed decisions regarding management and use of the resource.

Each monitoring station includes a datasonde and data platform, powered by a solar panel or other power source. Observations may be made as frequently as five-minute intervals, with transmission to a web site at predetermined intervals. The web site interface also provides user-friendly access to other critical information and tools, such as tables, graphs, maps, and statistics.

The implementation process includes SRBC staff:

- Determining optimal locations for monitoring stations and obtaining access approval;
- Installing and maintaining 30 monitoring stations;
- Establishing a data management system for the monitoring network; and
- Providing a framework for data sharing among partners.

(over)

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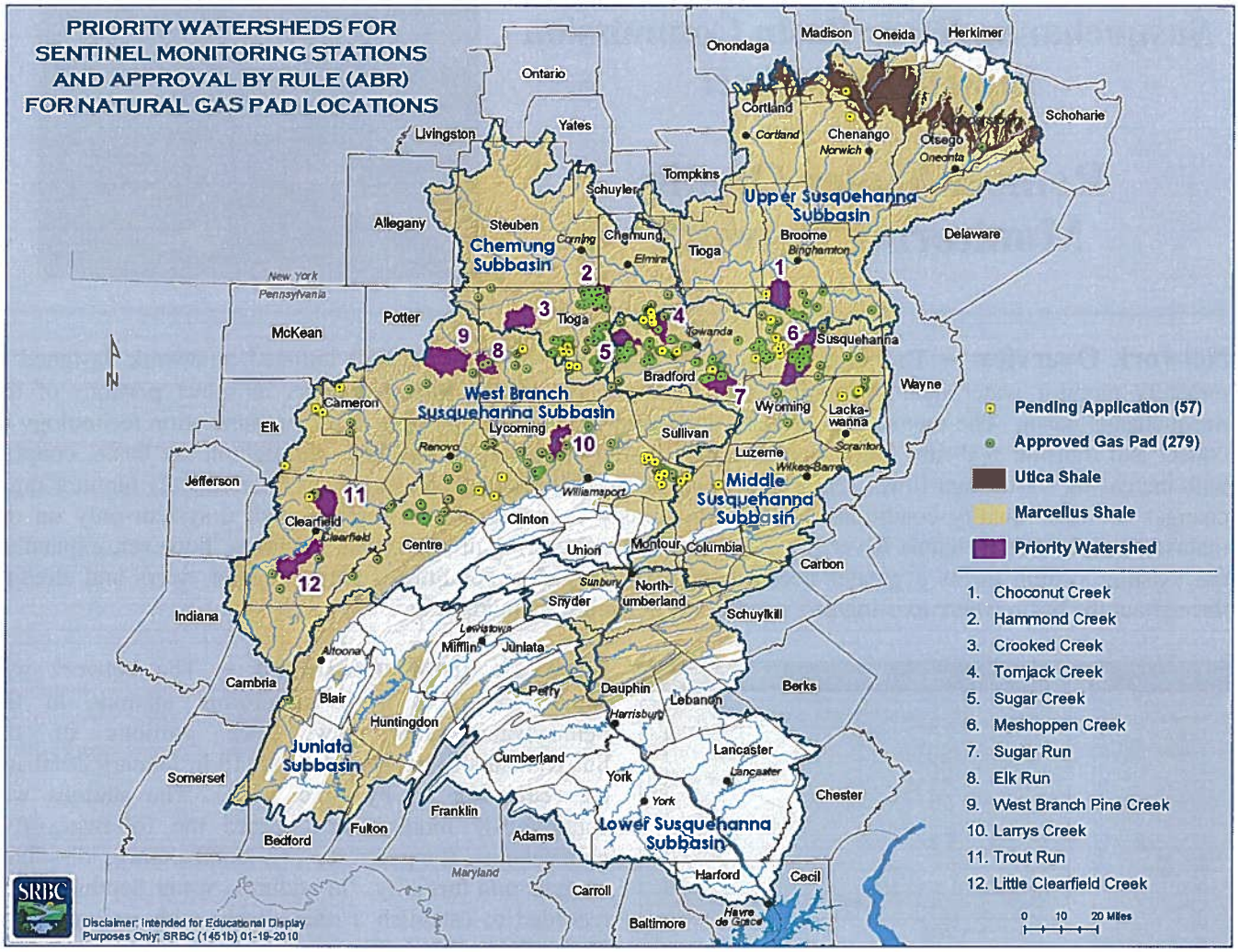
Phone: 717-238-0423 Web Site: www.srbc.net E-mail: srbc@srbc.net



Network Coverage – The network area mostly spans the northwestern portion of the Susquehanna basin, with additional focus along the Pennsylvania–New York border. A remote water quality monitoring network that uses instrumentation sensitive enough to detect subtle changes, at frequent intervals, is required to effectively manage the water resources of this area.

The network is to provide enhanced capability for maintaining and protecting the quality and reliability of water resources in the basin, and foster communication and data sharing among partners. These goals represent those supported by SRBC's Comprehensive Plan, with respect to the *Priority Management Areas* related to water quality, water supply, ecosystems, and coordination.

Operation and Maintenance – SRBC staff will visit each station at approximately six to eight-week intervals to perform routine maintenance. At certain times, some stations may require additional visits depending on site-specific conditions. During any such site visits, staff will collect additional data to assist with characterizing water quality conditions (i.e., streamflow measurements, water samples for lab analysis).

Contact – For more information related to an overview of the network, please contact **Jim Richenderfer**, Acting Chief, Water Resources Management, at (717) 238-0425 or jrichenderfer@srbc.net. For technical information regarding the operation and maintenance of the network, please contact **Andrew Gavin**, Section Chief, Restoration and Protection, at (717) 238-0426 or agavin@srbc.net.