

*Maryland's Proposed Stream and Groundwater Baseline  
Monitoring Plan in the Marcellus Shale Region: 2012 and 2013*



Bruce Michael, Director, Resource Assessment Service  
January 27, 2012



## Overview

- Why Monitor Streams and Groundwater?
- What Should Be Targeted?
- What Parameters Should Be Measured and How?
- Proposed Baseline Monitoring Plan
- Future Monitoring – During and After Drilling

## Why Monitor Streams/Rivers?

- State's Responsibility: Streams and Rivers must be protected.
- Detect and identify problems experienced by other states that may occur in Maryland

### **WASHINGTON COUNTY CROSS CREEK LAKE FISH KILL MAY 26, 2009**

*Hopewell Township, Washington County, Pa*

#### **PITTSBURGH POST-GAZETTE**

*Waste from Marcellus shale drilling in Cross Creek Park kills fish*

June 5, 2009  
Pittsburgh Post-Gazette

A leaking waste water pipe from a Range Resources Marcellus shale gas well drilled in Washington County's Cross Creek Park has polluted an unnamed tributary of Cross Creek Lake, killing fish, salamanders, crayfish and aquatic insect life in approximately three-quarters of a mile of the stream.

The state Department of Environmental Protection said Range Resources reported the May 26 waste water discharge from a coupling on a 6-inch pipe running from a recently drilled well to a waste water impoundment.

### **BRADFORD COUNTY ATGAS 2H OG WELL**

**April 20, 2011**

*LeRoy Township, Bradford County, Pa  
Chesapeake Appalachia gas well blow-out*

#### **PA DEP fines driller \$1.1 million over contamination, fire**

May 17, 2011  
By Laura Olson, Pittsburgh Post-Gazette

HARRISBURG -- State environmental officials have issued a nearly \$1.1 million fine against Chesapeake Energy for water contamination in Bradford County and a February fire at its Avella site. Another \$188,000 was assessed for the Avella tank fire that injured three workers. Two of those workers, who suffered burns, have since sued Chesapeake and two other companies working at the site.

[Full story >>](#)

#### **Chesapeake suspends well completion operations**

By C.J. Marshall, Staff Writer

## Why Monitor Groundwater and Surface Water Flow?

- 72% of Garrett County population served by individual wells, generally <500 feet deep
- 28% of Garrett County population served by community systems
  - 12 systems are supplied by groundwater wells
  - 3 systems are supplied from surface waters
- Groundwater and surface water are closely interconnected through the hydrologic cycle, which is the continuous movement of water through the environment
- Regional groundwater quality can be compromised by constituents such as acid mine drainage, salts, iron, methane, radioactivity and others

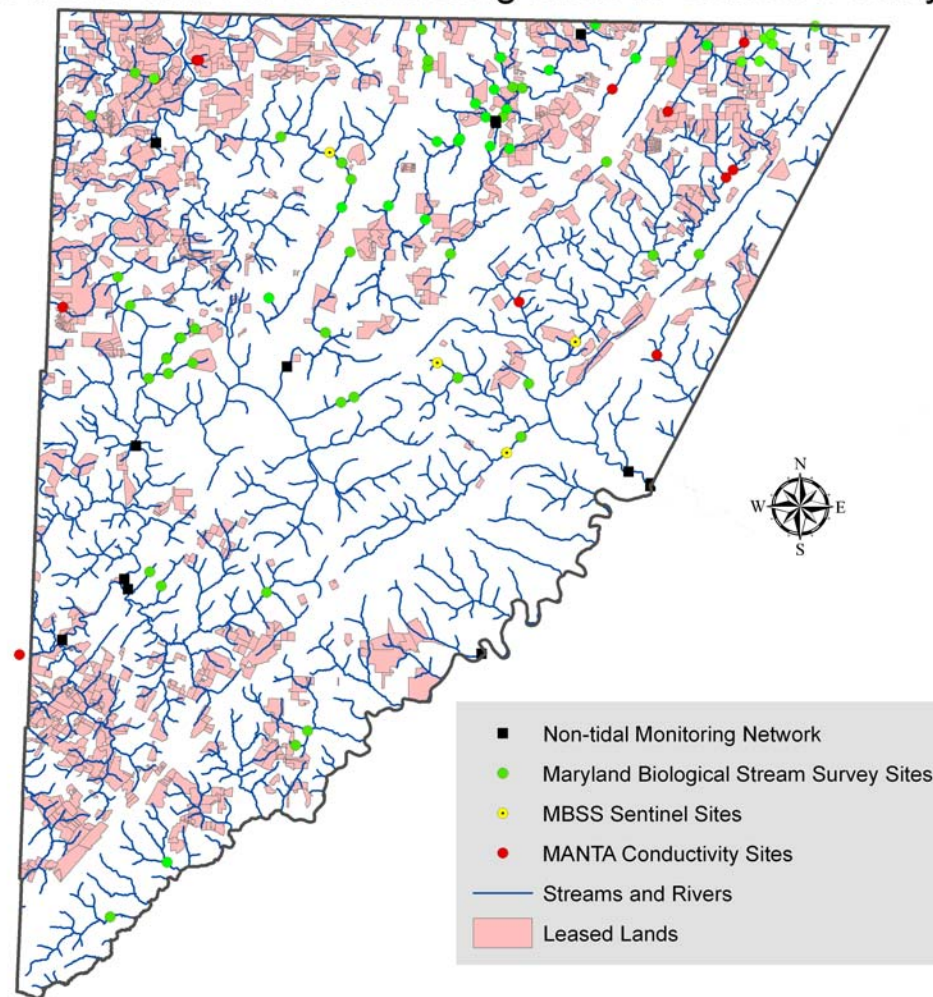
## Current Stream Monitoring Data (since 2007)

- Data exists for 64 stream reaches, or about 10% of all reaches in the county.

## Current Data Good, but Limited

- Partial information
- Different management questions
- Lack Marcellus Shale signature water quality parameters

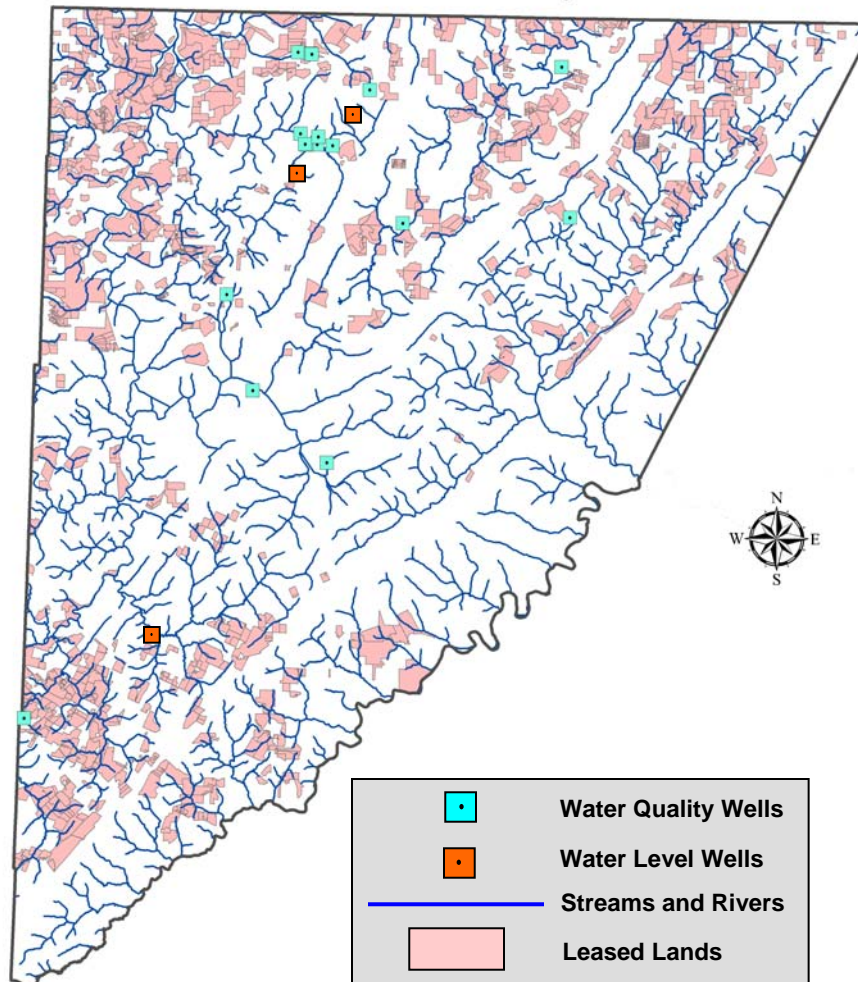
Locations of Current (sampled since 2007) Stream and River Monitoring Sites in Garrett County



Locations of Current Groundwater Monitoring Wells  
in Garrett County

Current Groundwater Monitoring Data

- Groundwater level monitoring occurs in 3 relatively shallow wells
- Groundwater quality data are available for 18 wells (since 2008), 10 additional wells scheduled for sampling this year



## Description of Monitoring Programs

### **Streams and Rivers**

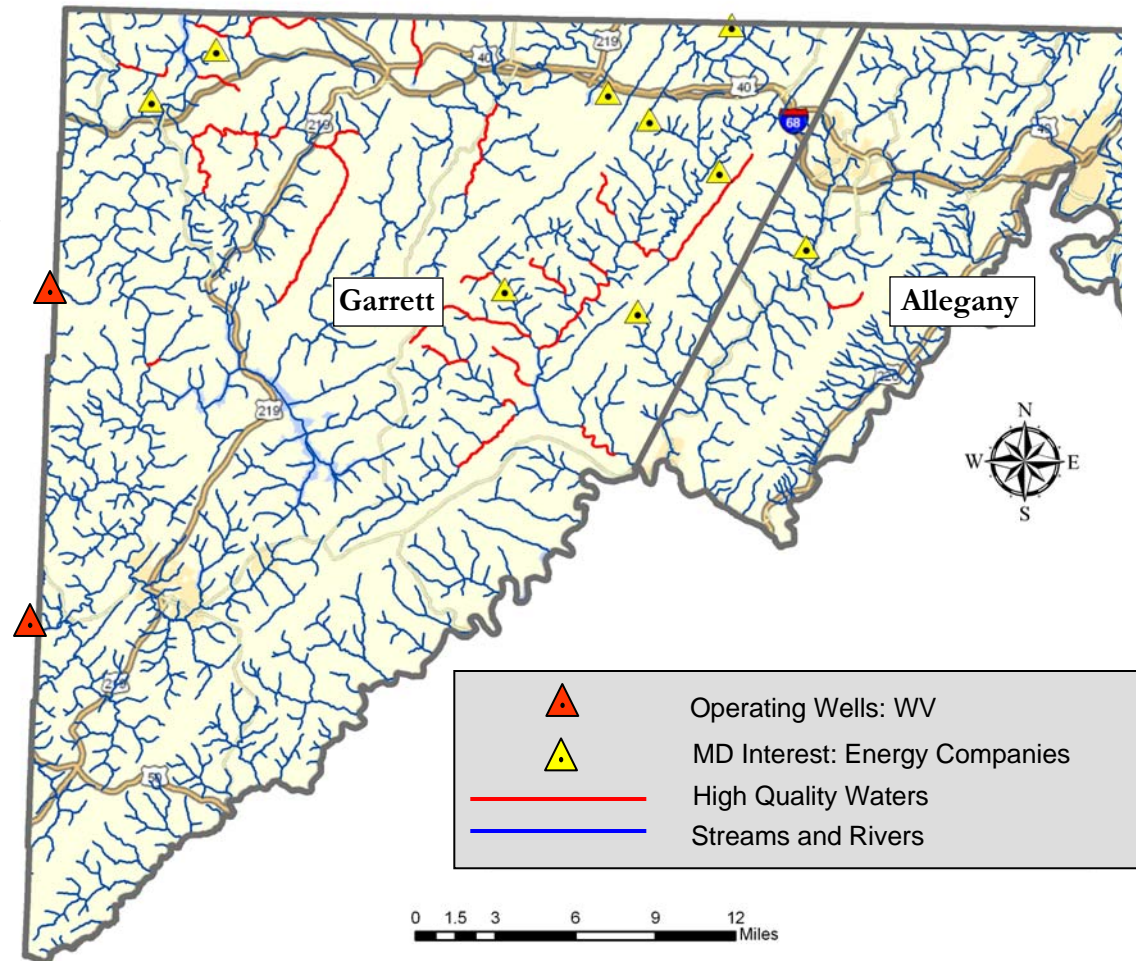
- Non-tidal Monitoring Network: water chemistry – fixed stations
- MBSS: streams monitoring – physical, chemical and biological community data
- Sentinel Sites: high quality streams monitored yearly to assess natural variability in stream conditions
- Conductivity Sites: continuously-recording conductivity data loggers

### **Groundwater and Water Budget**

- QW (Ground Water Quality): public/private wells
- Ground Water Level: fixed well locations
- Stream Gages: flow

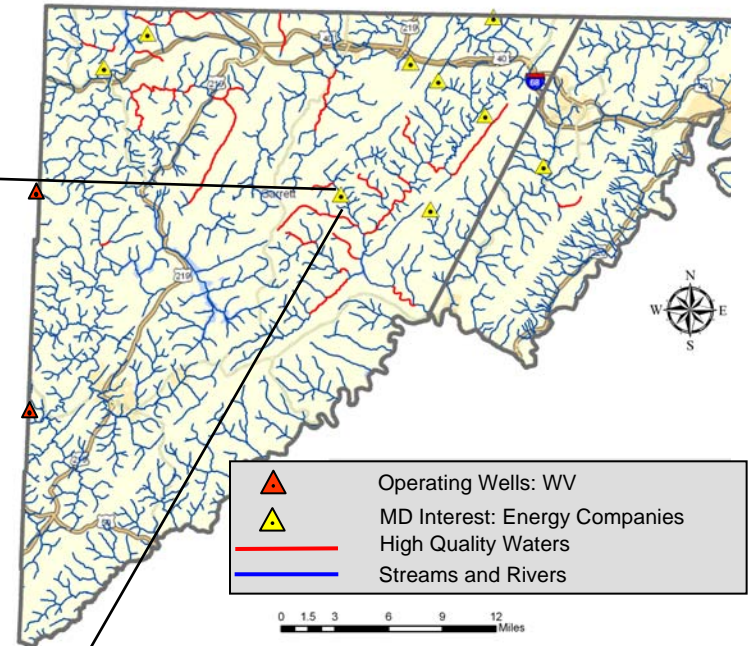
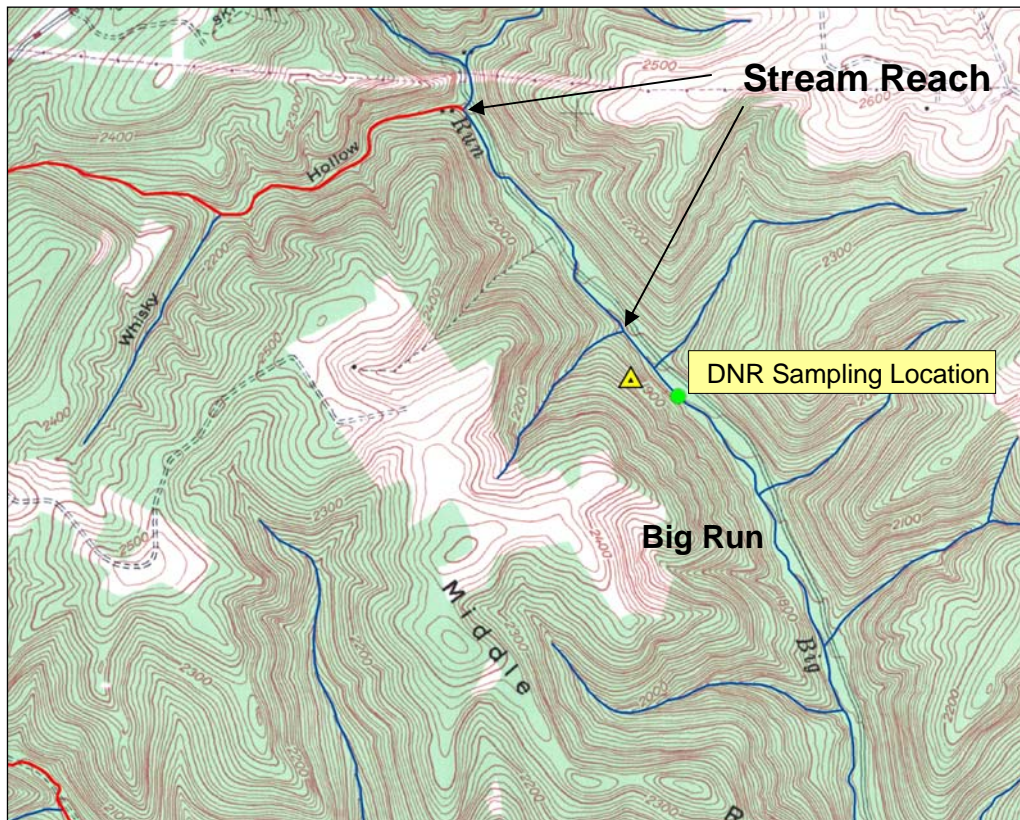
## 2011 Targeting Effort

- MD Interest: Energy Companies
- Two Operating Wells in WV



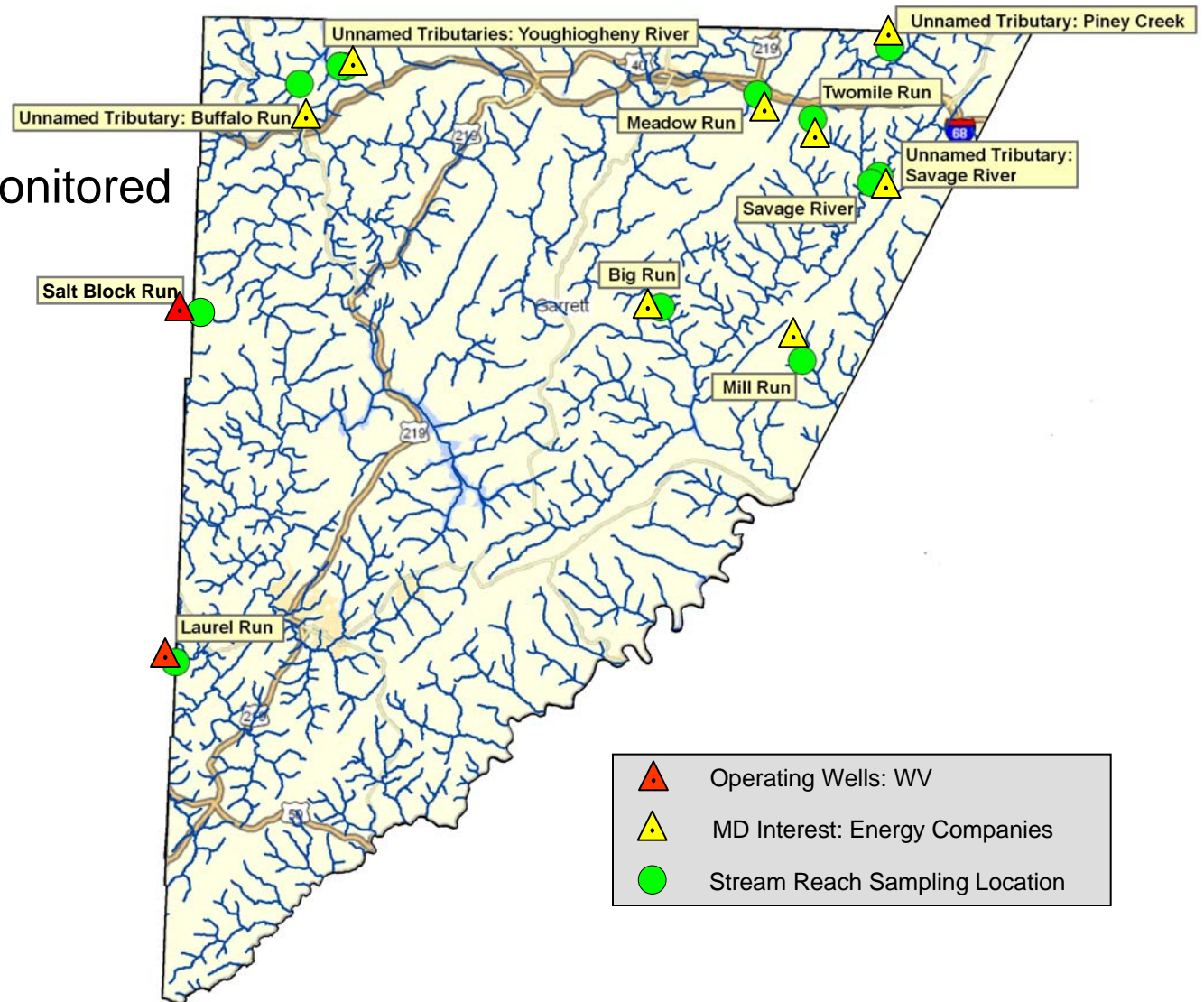


## Stream Reach Selection - 2011



Sample in the nearest stream  
downslope of the well location

- 12 Stream Reaches Monitored in 2011
- Continuing in 2012

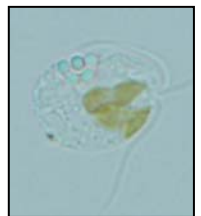


## 2011 Data Collected in 12 Stream Reaches

- Continuous Conductivity and Temperature Measurements
  - Conductivity is a good surrogate water quality parameter for detecting contamination from gas well activities
- Presence/absence of *Prymnesium parvum* (Golden Algae)
  - Organism that can produce toxins under high conductivity conditions

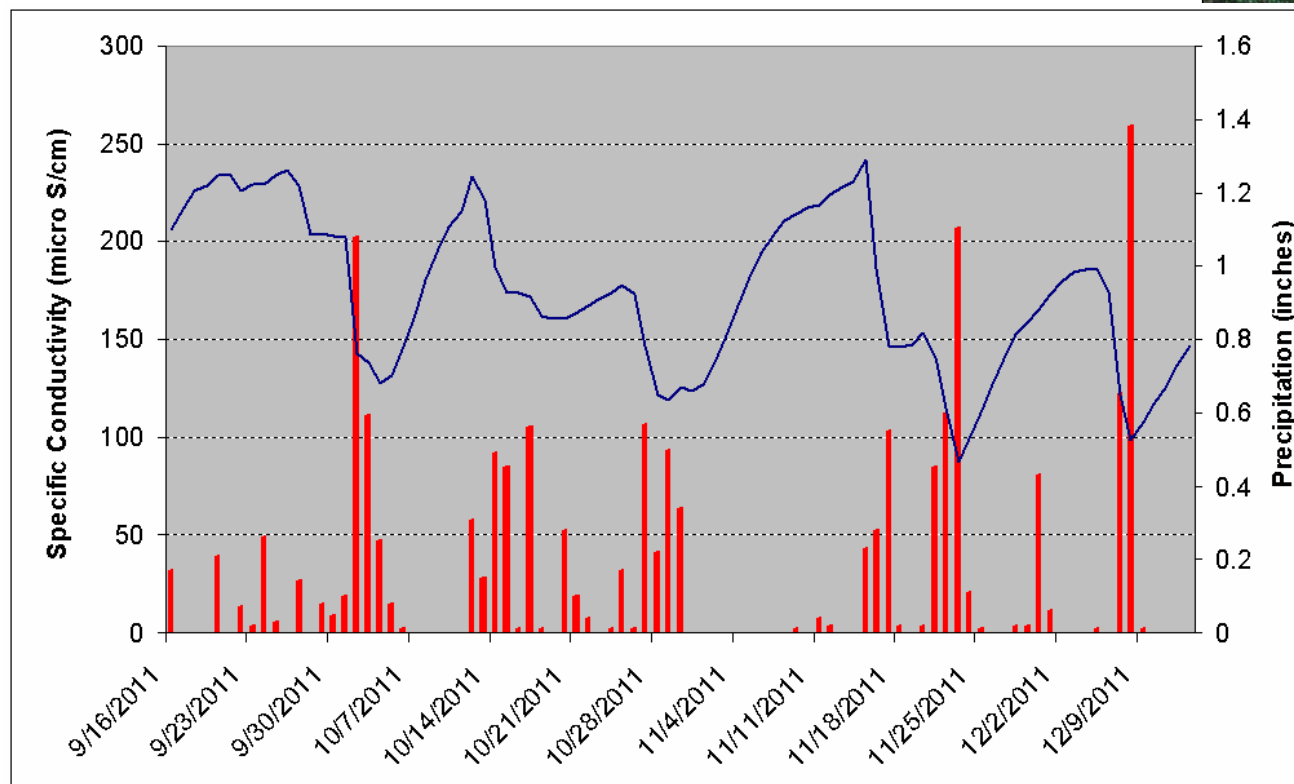
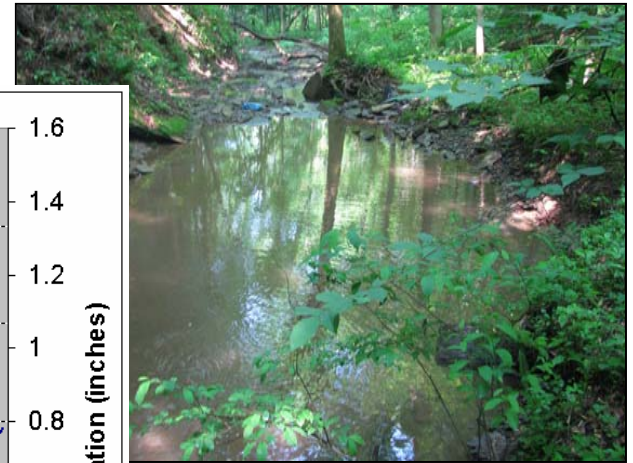
## Stream Data Collection in 2012

- Maryland Biological Stream Survey Protocols
- Continuous Conductivity and Temperature Measurements
- Presence/absence of *Prymnesium parvum* (Golden Algae)



## 2011 Results: Unnamed Tributary, Youghiogheny River

Influence of Precipitation on Fluctuations in Conductivity



Golden Algae: Not Present

## Information Collected to Date in Water Wells

- Water levels in 3 shallow wells monitored for fluctuations related to precipitation changes and demand increases
- Water quality
  - pH, conductivity, total dissolved solids
  - Anions (e.g., chloride, silica)
  - Cations (e.g., calcium, sodium)
  - Trace metals (e.g., cadmium, chrome, iron)
  - Radium, radon, uranium, general radioactivity
  - Limited organic constituents

Marcellus Shale Baseline Monitoring Plan: (Streams and Groundwater)  
Part I: Marcellus Shale Safe Drilling Initiative

- Proposed Monitoring Plan will Build on Existing Programs and Data
- Goal and Management Questions
- Targeting Effort: Where Should We Monitor?
- Monitoring Components (What and How?): Learn from Others
- Study Duration
- Adaptive Management Framework will be Utilized

## Proposed Baseline Stream Monitoring Plan

**Goal:** Establish baseline stream conditions before gas well development begins

### **Management Questions:**

- What is the range of seasonal and annual fluctuations in water quality and biological condition?
- What are the current thresholds for signature water chemistry parameters?
- How does existing landuse/landcover influence water chemistry and baseline stream conditions?
- What are the appropriate analyses to distinguish impacts of gas well development from baseline stream conditions?

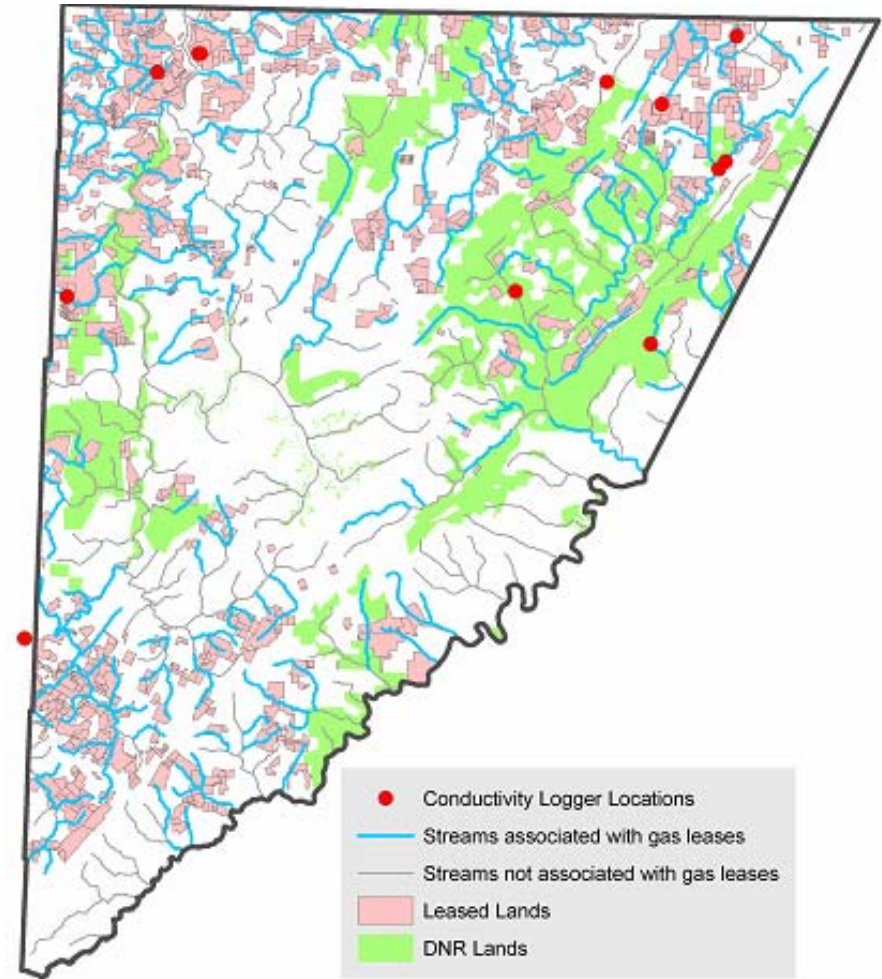
## Potentially Affected Streams

Currently, one-third (231/652) of the stream reaches in Garrett County\* are associated with parcels that have been leased for gas well activity.\*\*

\*Most recent lease information available from Garrett County

\*\*DNR lands not included

## Streams and Rivers in Garrett County Associated with Gas Leases





## Selection of Stream Monitoring Locations

- 50 additional stream reaches will be targeted + 12 reaches from current monitoring effort (total = 62)
- Criteria to be Used for Stream Reach Selection
  - Streams associated with highest density of known leased parcels
  - Streams that lack recent data (fill information gaps)
  - Streams near drinking water supplies
  - Streams with imperiled aquatic species
- Streams will be sampled for two years to describe seasonal and annual fluctuations

## Programs Evaluated to Develop MD Baseline Monitoring Plan

- Pennsylvania:
  - Pennsylvania Department of Environmental Protection
  - Pennsylvania Geological Survey
  - Susquehanna River Basin Commission
  - ALLARM (Alliance for Aquatic Resource Monitoring)
  - Izaak Walton League
- West Virginia:
  - WVU/West Virginia Water Research Institute: Mon River QUEST
  - West Virginia Department of Environmental Protection
- Federal Agencies:
  - USEPA Region III
  - USGS

## Baseline Stream Monitoring Plan: Selected Components

- Continuous Conductivity and Temperature
  - Conductivity is a good surrogate parameter for detecting salts/dissolved substances associated with gas well development
- Other Water Quality Parameters (grab samples: spring and late summer)
  - Anions (e.g., chloride, bromide)
  - Cations (e.g., calcium, sodium)
  - Metals (e.g., barium, boron, strontium)
  - PAHs
  - Total dissolved solids\turbidity
- Maryland Biological Stream Survey Protocols
  - Biological Communities (Fish, Benthic Macroinvertebrates, etc.)
  - Additional Water Chemistry (in-situ)
  - Physical Habitat
- Presence/Absence of Golden Algae

## Volunteer Monitoring Component

- Recruit, train and equip citizen scientists in western Maryland
- Organizations/entities involved
  - Savage River Watershed Association
  - Youghiogheny River Watershed Association
  - George's Creek Watershed Association
  - Trout Unlimited (Youghiogheny and Nemasquin Chapters)
  - Maryland Conservation Corp
  - Garrett County Public Utilities and Health Department
  - Garrett Community College
- Participate in MDNR's Stream Waders Program
  - Collect data on benthic macroinvertebrate communities (stream health)
  - Water quality (conductivity)
- Volunteer data will add spatial coverage and help fill in data gaps to characterize baseline conditions

## Proposed Baseline Groundwater Monitoring Plan

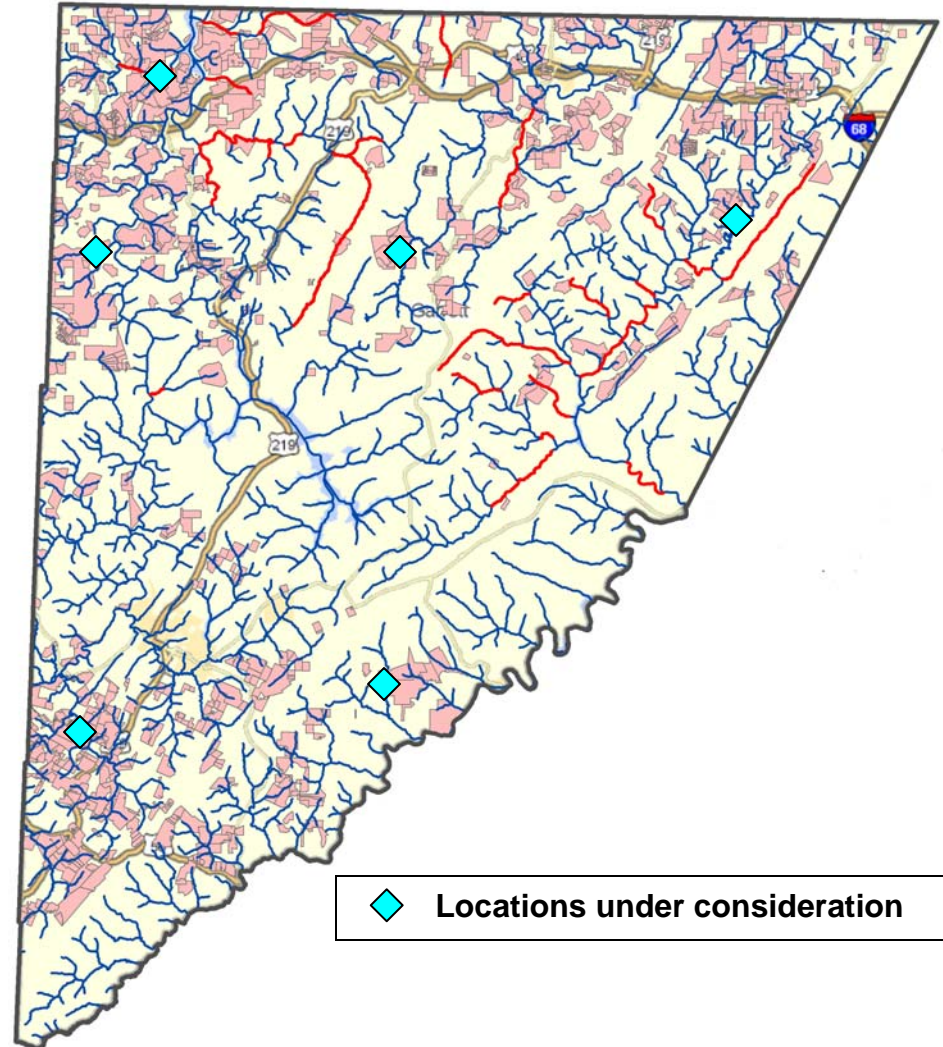
**Goal:** Establish regional baseline groundwater characteristics and relation to streamflow before gas well development begins

### **Management Questions:**

- How will hydraulic fracturing, which is a consumptive use, effect the availability of water?
- How will drilling and hydraulic fracturing influence groundwater quality?
- How will an increasing population be provided with sufficient water?

## Proposed Groundwater Wells

- 6 Sets of paired (shallow and deep) wells with associated stream gage
- Geology and watershed size considered in locating wells
- Water level measurements to quantify regional water availability
- Water quality measured to determine baseline conditions at these wells and other existing wells



## Future Stream Monitoring Activities: During and After Drilling Primary Modification to Baseline Monitoring Plan

- Continuous records of real time data
  - Provide ability to detect fluctuations in key water quality parameters beyond what is considered baseline
  - Function as a early warning system to detect pollution
  - Ability to implement rapid response for enforcement and mitigation

Data Sonde Protective Casing (SRBC)

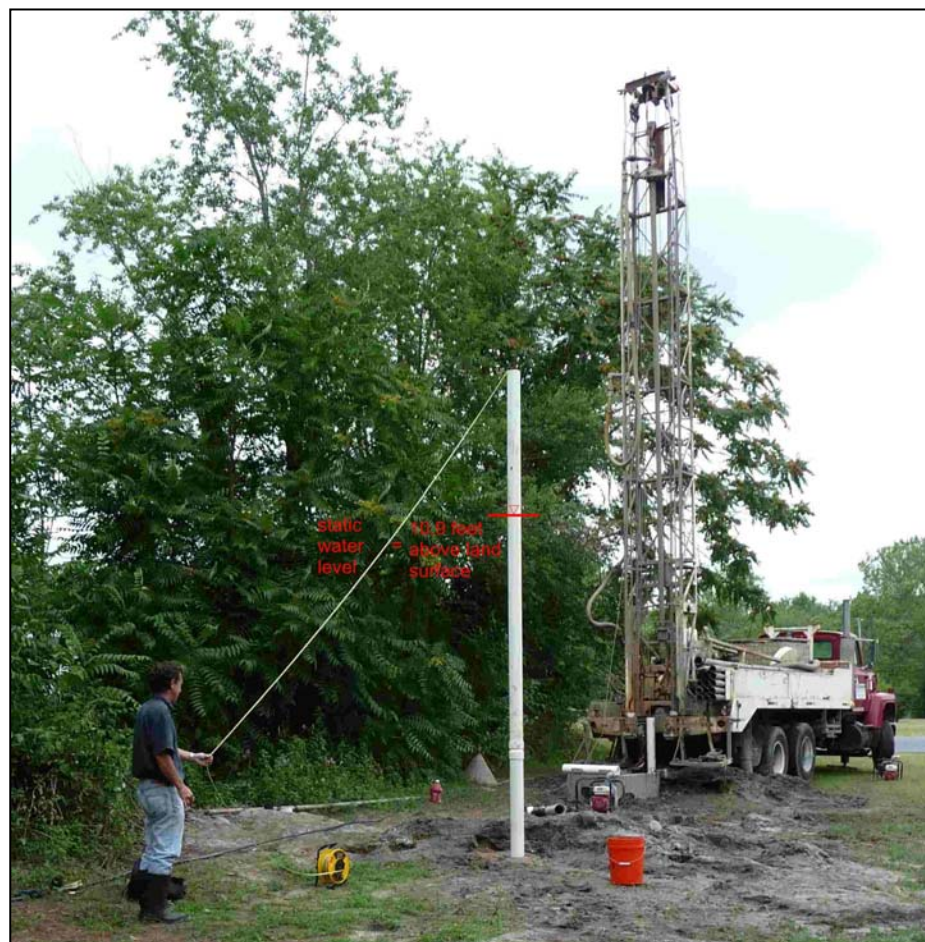


Data Platform (SRBC)



## Future Groundwater Monitoring Activities: During and After Drilling

- More frequent water level measurements
- More frequent water quality measurements
- Additional wells and gages installed as leasing and drilling increases







Questions?



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