TRENDS IN BASELINE WATER TESTING NEAR PA DRILLING SITES

Bryan R. Swistock, M.S., Water Resources Extension Specialist
Elizabeth W. Boyer, Ph.D., Associate Professor of Water Resources
James Clark, M.A., Extension Educator, McKean County Extension
Mark Madden, B.S., Extension Educator, Bradford County Extension
Dana E. Rizzo, M.S., Extension Educator, Westmoreland County Extension

The Pennsylvania State University

Funded by the Center for Rural Pennsylvania &
the Pennsylvania Water Resources Research Center

Penn State **Extension**

Groundwater Supplies
Private Water Wells and Springs

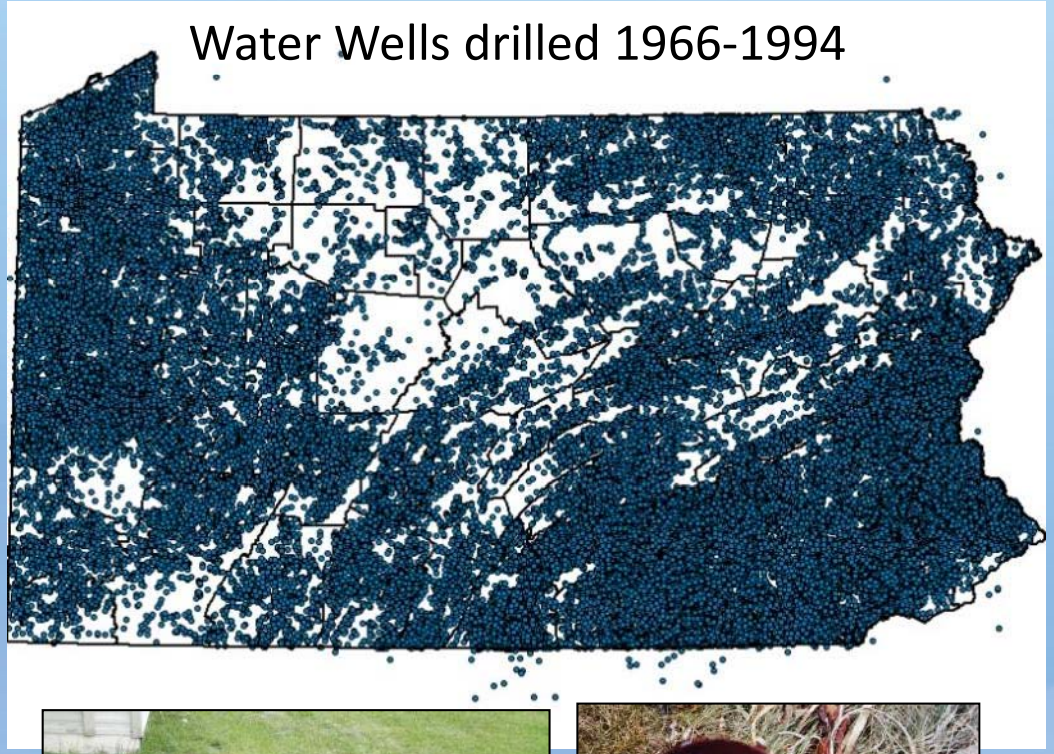
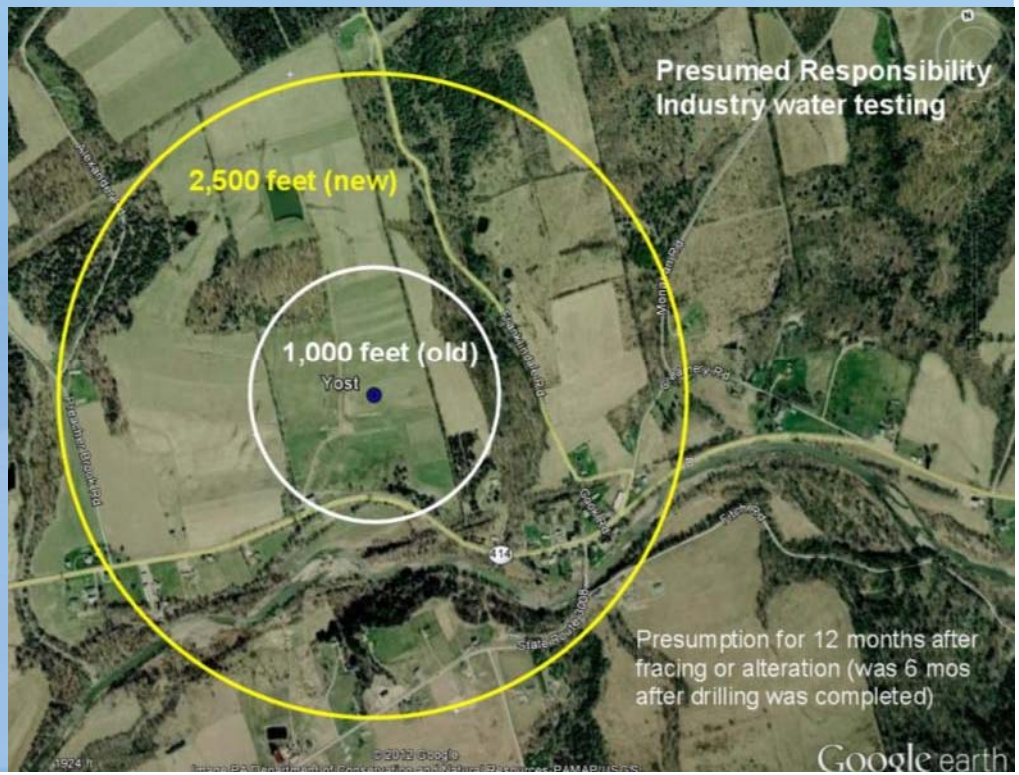


Photo: U.S. Geological Survey

- One million homes and farms
- More than 30% of the population in most Marcellus counties uses a private water supply
- No statewide regulations – everything is voluntary
- Previous studies show high rate of contamination
- Limited testing before Marcellus gas exploration

Regulations for Protection of Drinking Water Supplies

- Certified mail notification during permit phase if water supply is within 3,000’ of gas well (was 1,000’)
- Freshwater protection string installed to protect groundwater
- 500’ setback (was 200’)
- Pit and tanks for waste fluids
- “Presumed responsibility”



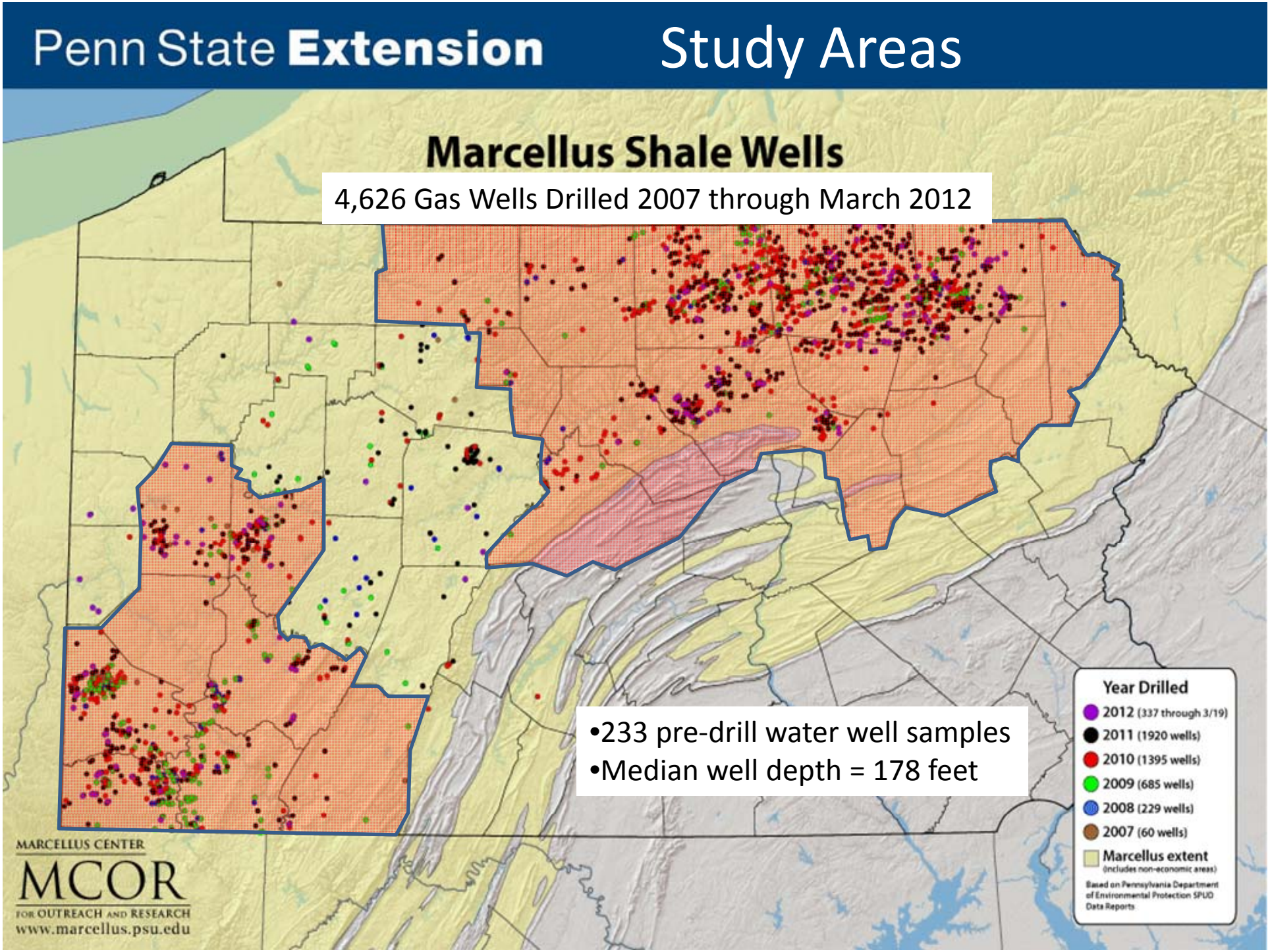
Study Summary

- Analysis of pre-drilling water quality data collected from private water wells within about one mile of Marcellus drilling sites

- Detailed survey of water supply owners to determine water testing practices and opinions

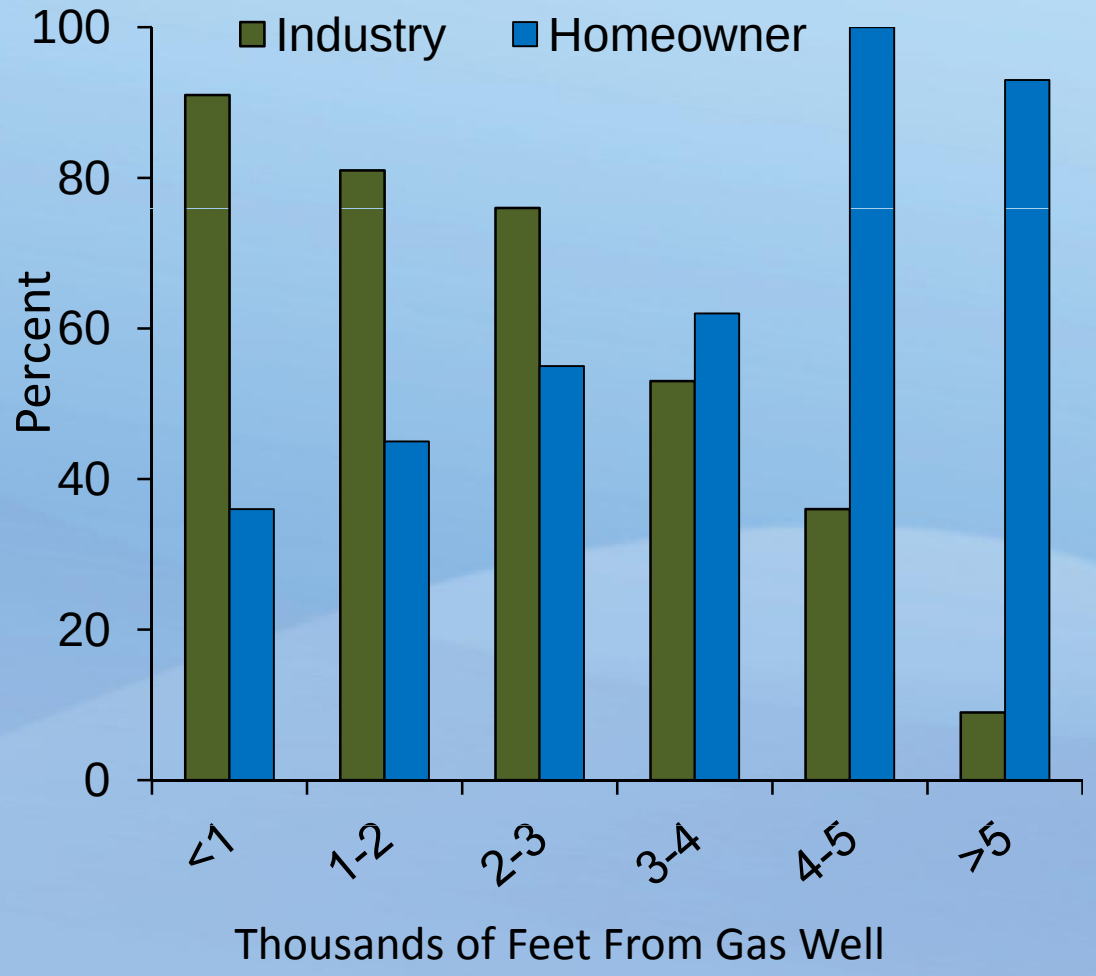
Penn State **Extension**

Study Areas



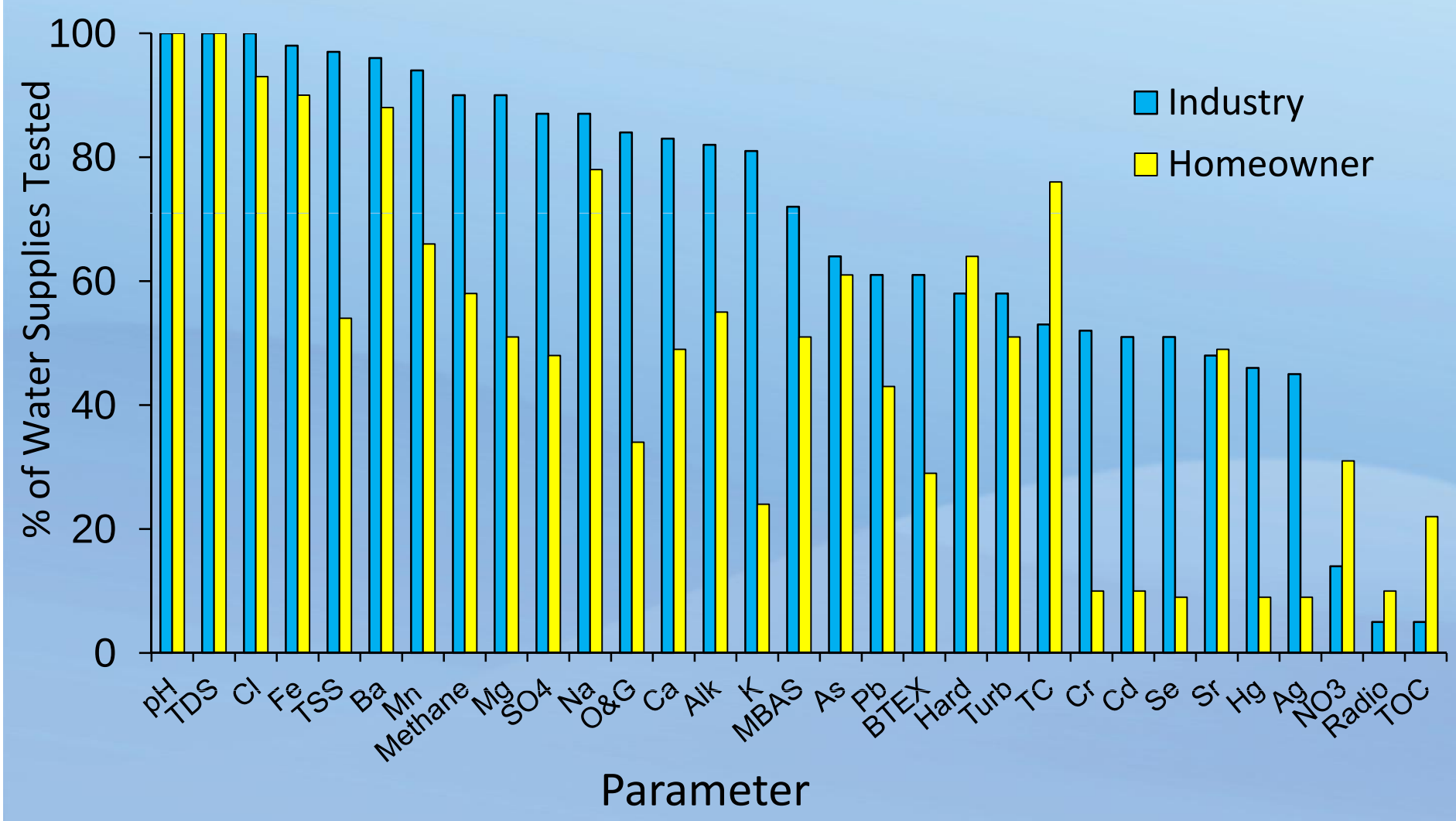
Pre-Drilling Water Testing

- 93% using third party, chain of custody collection – educational success!
- 64% of water wells were tested by industry
- 28% of well owners had both industry and voluntary testing



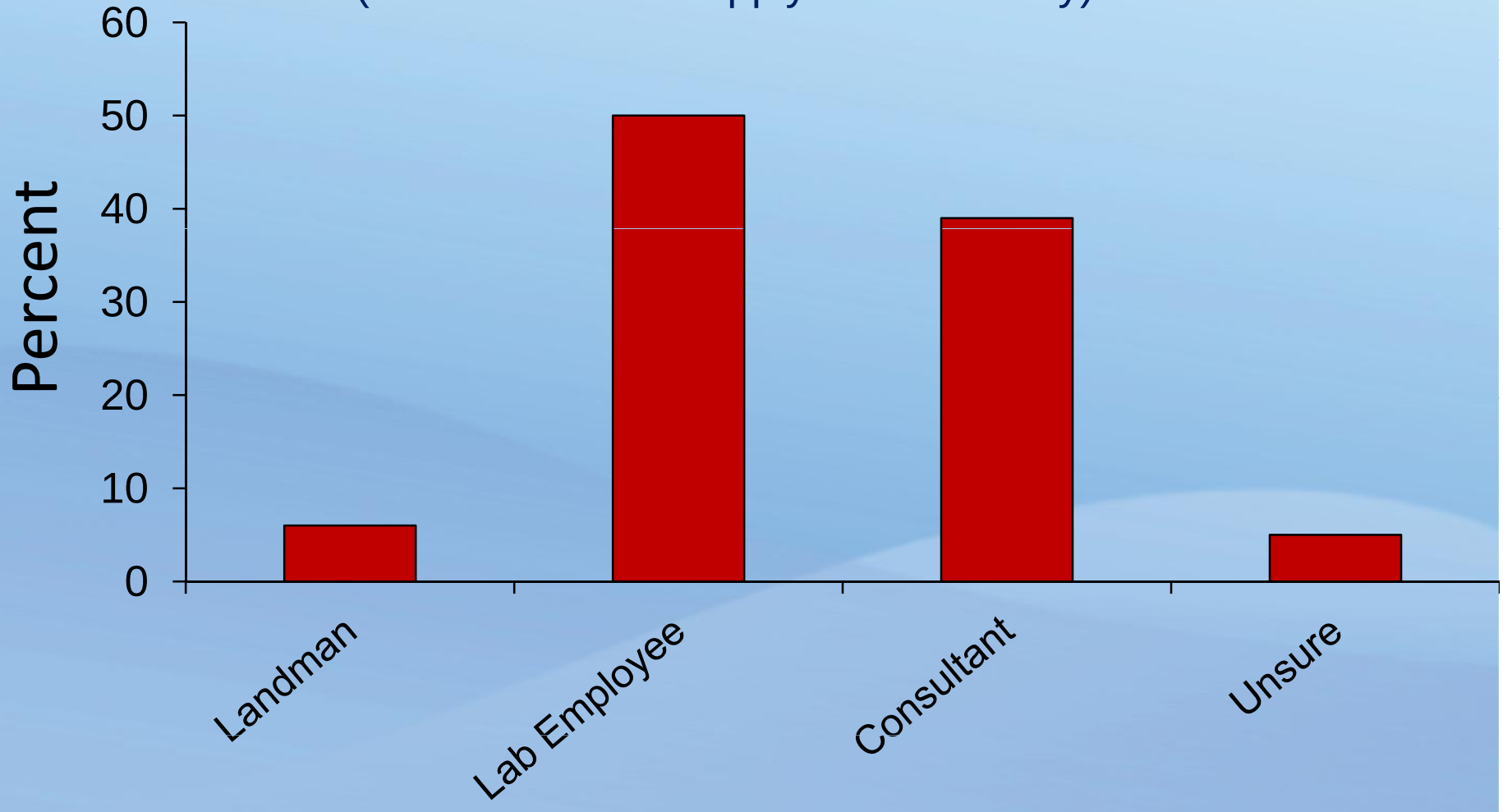
Penn State **Extension**

Pre-Drilling Water Test Parameters



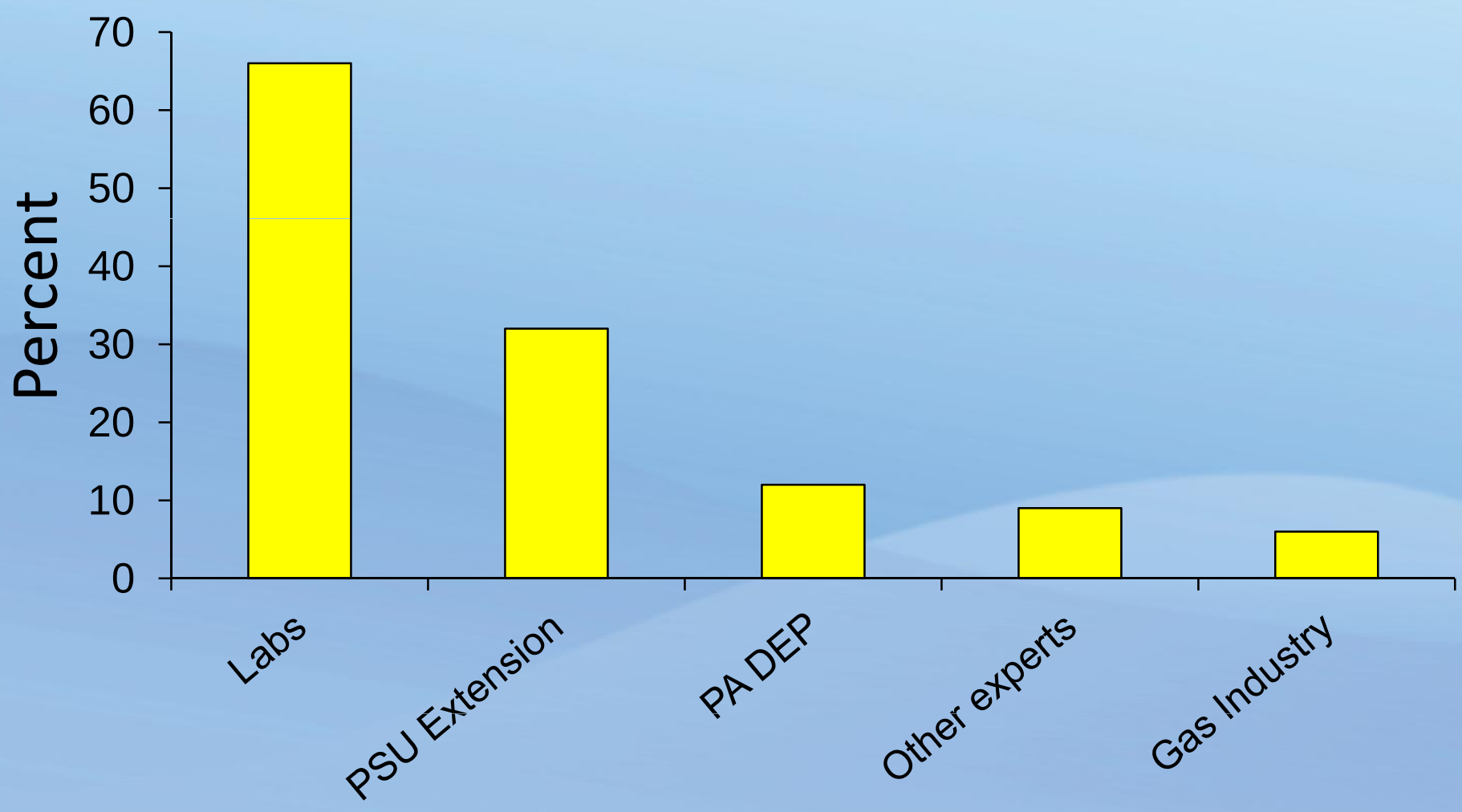
Who Collected Industry Pre-Drill Sample?

(based on water supply owner survey)



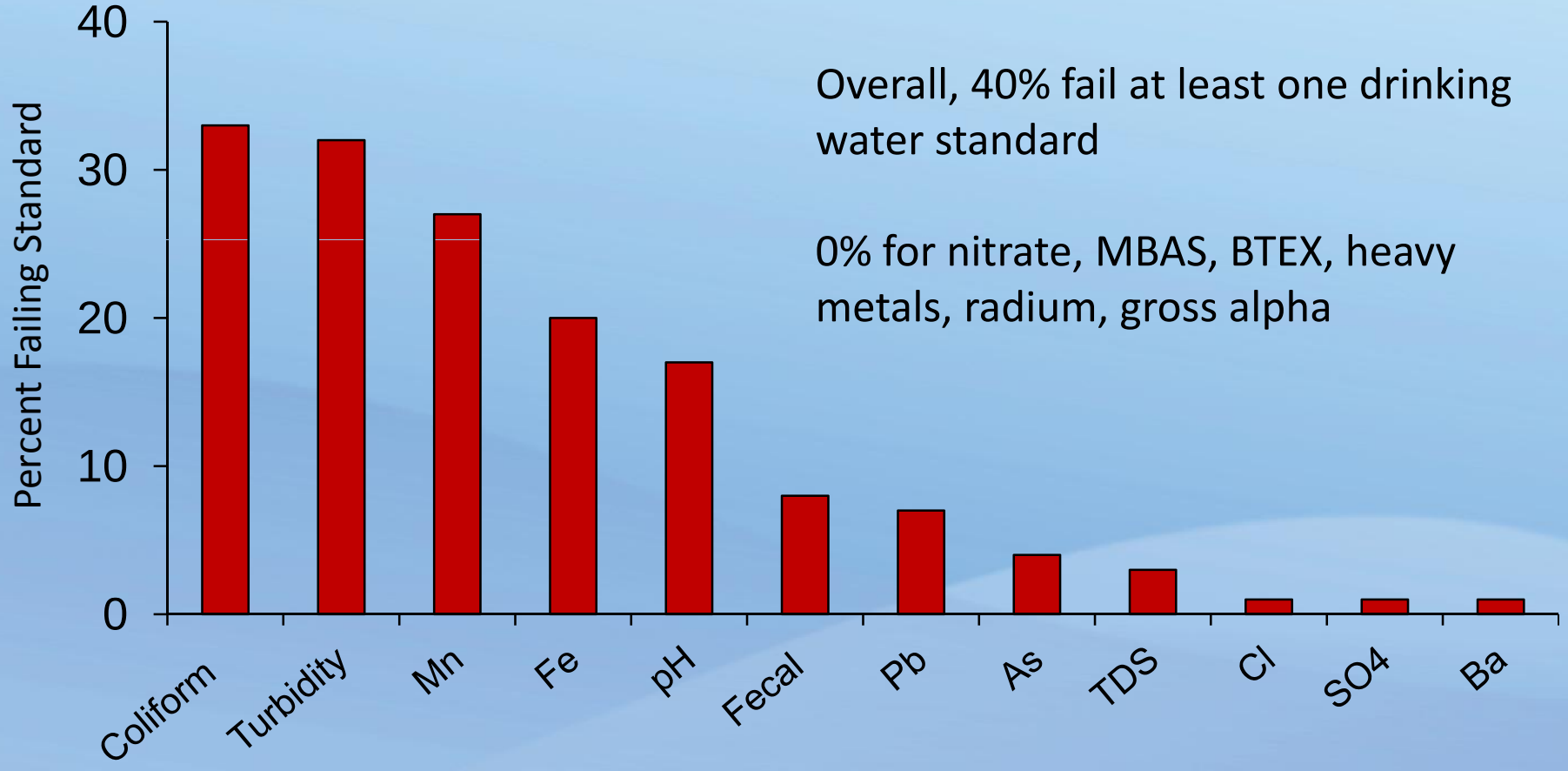
Ability to Pay for Pre-Drill Testing

Sources of Testing Strategies



Parameter	Penn State	PA DEP	NY WRI	NY DEC	Ohio EPA	Drilling Co.
TDS	1	1	1	1	1	1
pH	1	1	1	1	2	1
Iron/Mn	1	1	1	1	2	1
Chloride	1	2	1	1	1	1
Barium	1	2	1	1	1	1
Methane	1	1	1	1	3	1
Ethane	1	1	3	1		1
Bromide	1		1		2	
Sodium	2	1	2	1	1	1
Conductivity	2	2	2	1	1	1
Hardness	2	2	2		2	
Strontium	2	2	2		1	
Alkalinity	2	2	2		2	1
Suspended solids	2	2	2		2	1
VOC's (BTEX)	3		2	1	3	1
Surfactants	2		3			1
Radionuclides	3		2/3	1		
Arsenic	2		3			1
Coliform	2	2	3			
Oil&Grease	2	2	3			1
Sulfate	2	2	3		1	1
Nitrate	2					
Calcium	2	2	3		2	1
Magnesium	2	2			1	1
Potassium	2	1			1	1

Pre-Drilling Water Quality Issues



Overall, 40% fail at least one drinking water standard

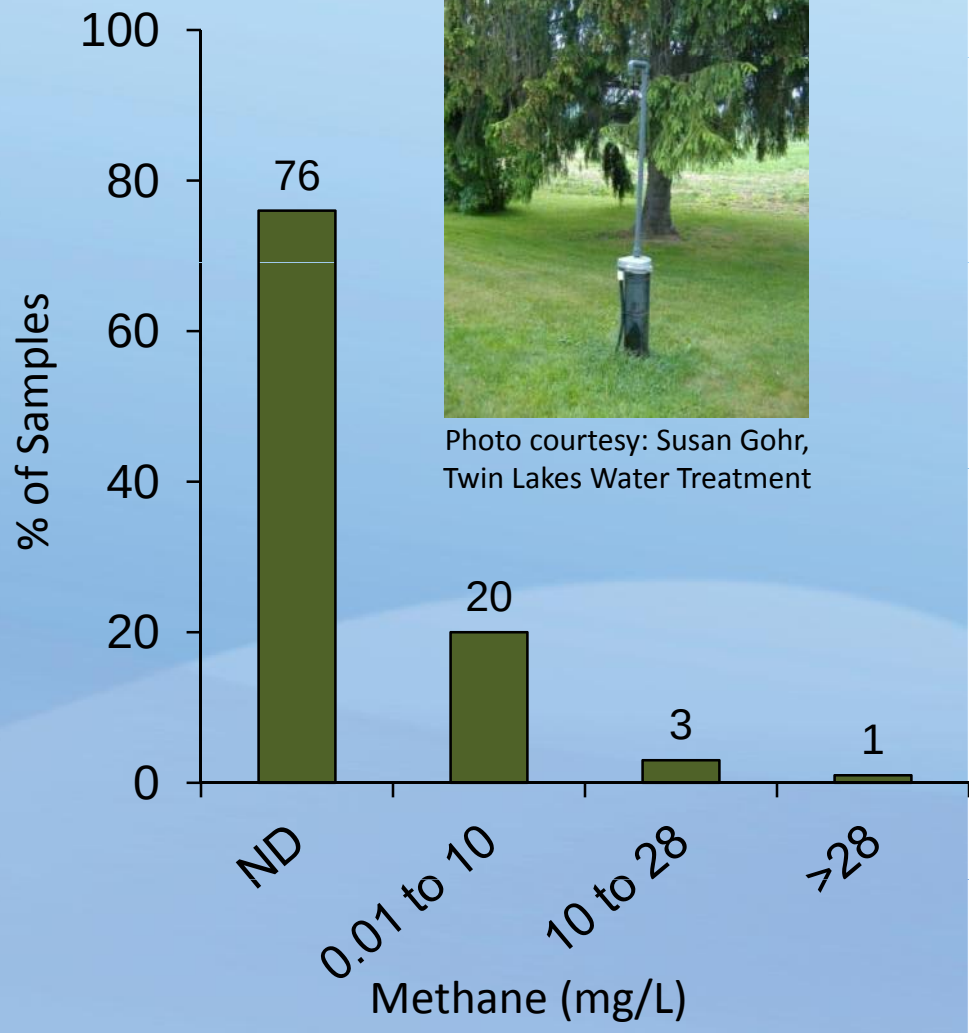
0% for nitrate, MBAS, BTEX, heavy metals, radium, gross alpha

PRE-EXISTING METHANE

- Pre-drilling samples from 189 water wells
- 24% had detectable methane but most concentrations were well below any action level
- Issues:
  - Sample protocols
  - Lack of a drinking water std
  - Mixed messages

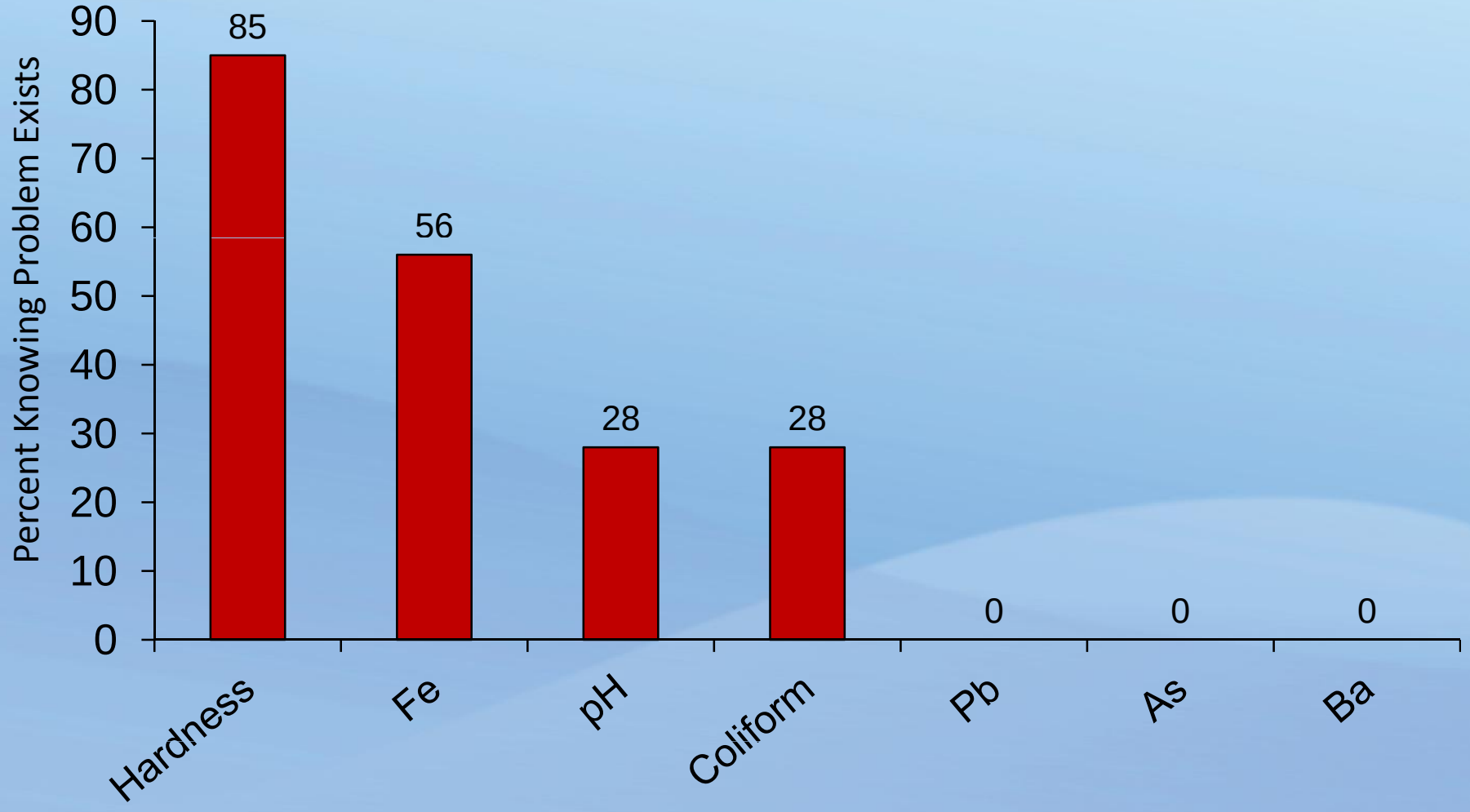
Vented Well Cap

Photo courtesy: Susan Gohr, Twin Lakes Water Treatment

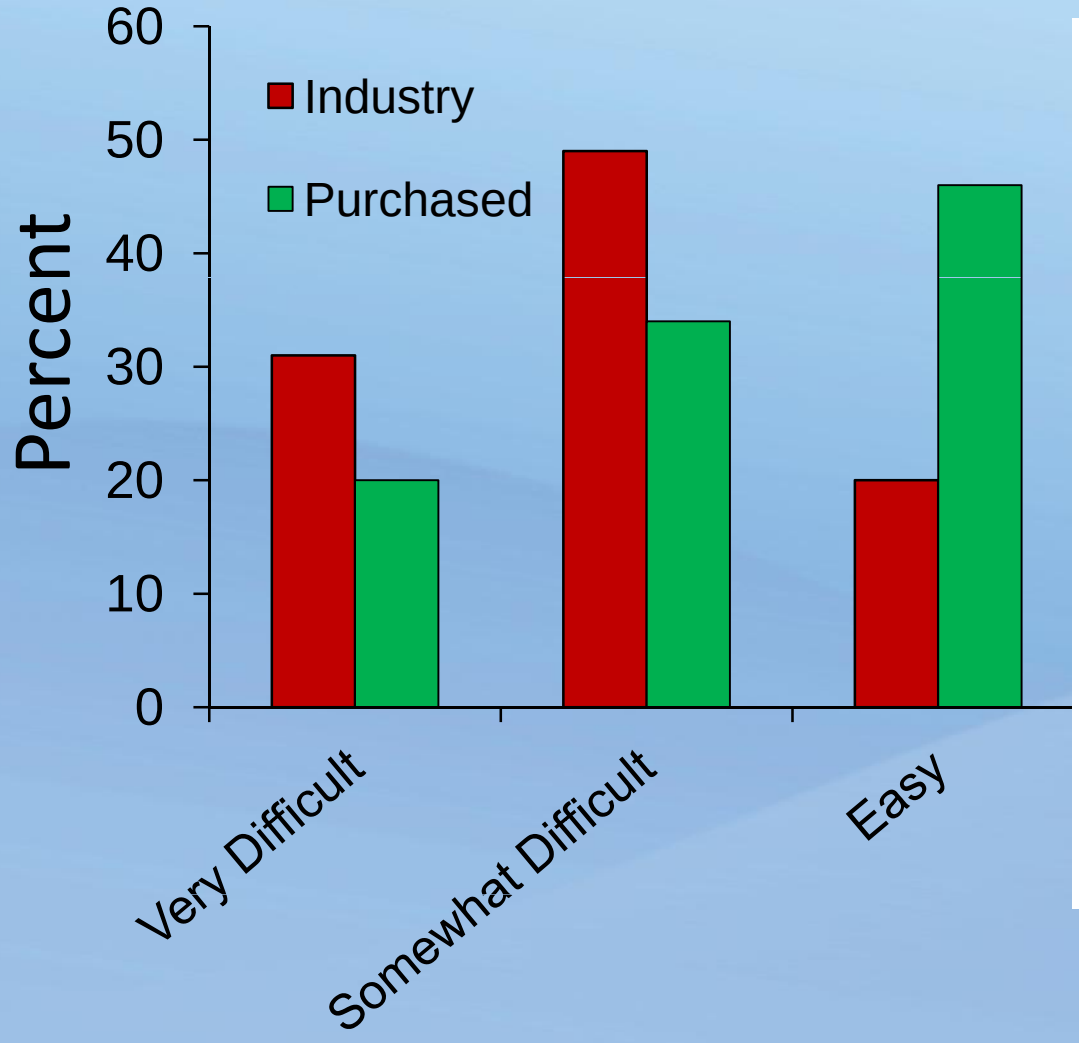


Awareness of Pre-Drilling Problems

(Based on 233 pre-drilling samples)



Many Found Water Tests Difficult to Understand

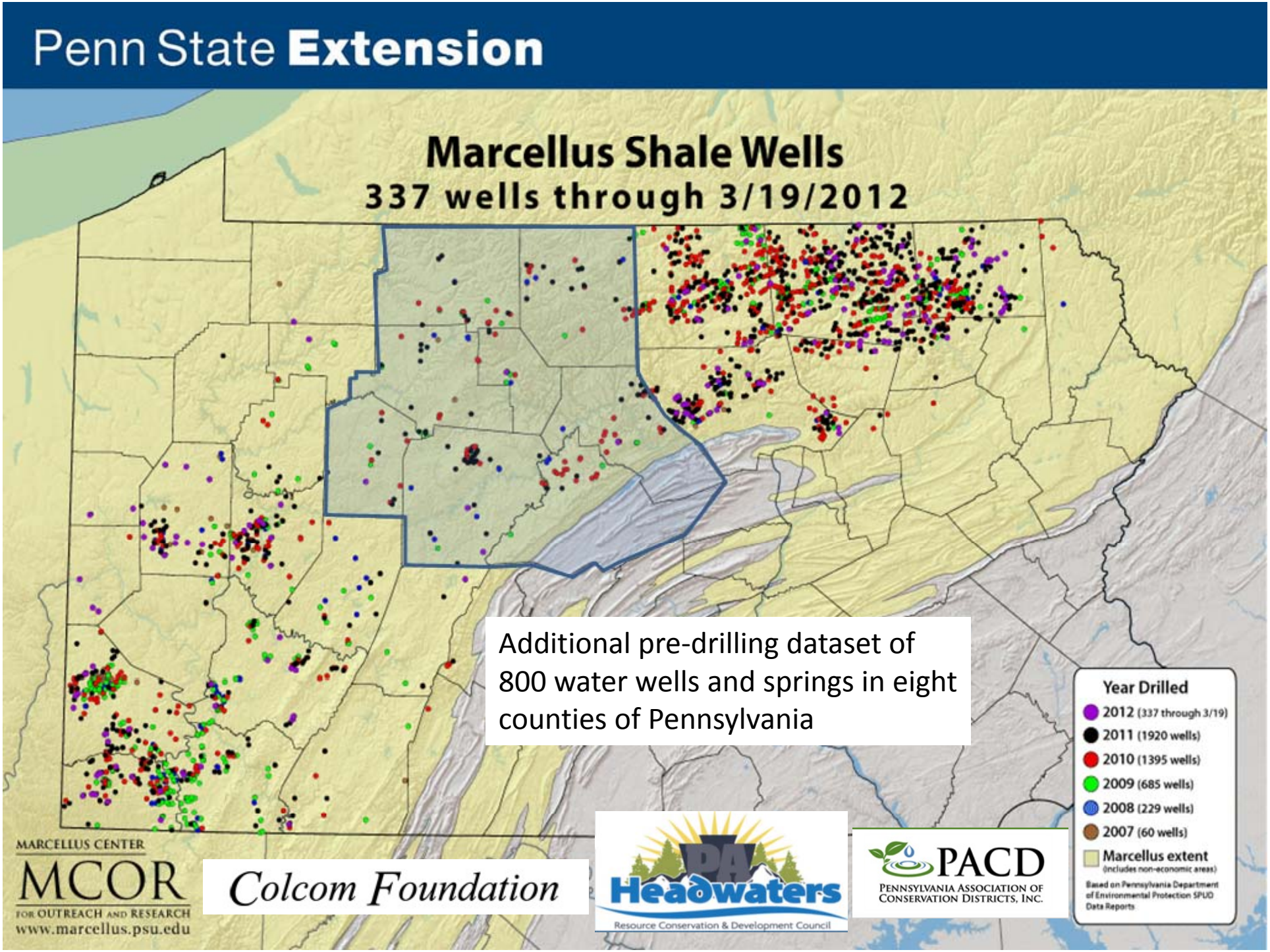


Client [redacted]
Atm

Work Order: [redacted]
Project Name:
Project Number:
Received:

ANALYTICAL REPORT

Analyte	Result	Flag	Units	MRL	Dilution Factor	Analysis Date/Time	Method	Batch
Sample ID: [redacted] - Ground Water) Sampled: 01/10/10 16:00								
General Chemistry Parameters								
Bicarbonate Alkalinity as CaCO3	**248**		mg/L	10.0	1	01/12/10 17:38	SM 2320B	10A1180
Carbonate as CaCO3	**21.2**		mg/L	10.0	1	01/12/10 17:38	SM 2320B	10A1182
Chloride	**13.2**	E	mg/L	1.00	1	01/27/10 01:17	EPA 300.0	10A2370
MBAS (mol.wt 320)	**0.0985**		mg/L	0.0500	1	01/12/10 14:07	SM5540 C	10A1193
Oil & Grease HEM	ND		mg/L	5.81	1	01/21/10 13:08	EPA 1664A	10A2497
pH	**8.20**	HTI	pH Units	0.100	1	01/13/10 14:00	SM 4500 H B	10A1254
Specific conductance	**532**		umho/cm	10.0	1	01/21/10 10:37	SM2510 B	10A2581
Sulfate	**7.79**		mg/L	1.00	1	01/27/10 01:17	EPA 300.0	10A2370
Total Dissolved Solids	**310**		mg/L	20.0	1	01/14/10 15:31	SM2540 C	10A1341
Total Suspended Solids	ND		mg/L	1.00	1	01/13/10 21:01	SM2540 D	10A1337
Turbidity	ND		NTU	1.00	1	01/12/10 13:15	EPA 180.1	10A1163
Temperature of pH determination	**21.2**	HTI	Deg C	NA	1	01/13/10 14:00	EPA 170.1	10A1254
Methane, Ethane, and Ethene by GC								
Methane	**3.55**		mg/L	0.0520	2	01/18/10 13:47	RSK 175	10A1454
Ethane	ND		mg/L	0.0260	1	01/18/10 12:59	RSK 175	10A1454
Propane	ND		mg/L	0.0340	1	01/18/10 12:59	RSK 175	10A1454
Surr: Acetylene (70-122%)	*103 %*					*01/18/10 12:59*	*RSK 175*	*10A1454*
Total Metals by EPA Method 6010B								
Arsenic	ND		mg/L	0.0100	1	01/13/10 18:21	SW846 6010B	10A1134
Barium	**0.327**		mg/L	0.0100	1	01/13/10 18:21	SW846 6010B	10A1134
Cadmium	ND		mg/L	0.00100	1	01/13/10 18:21	SW846 6010B	10A1134
Calcium	**8.30**		mg/L	1.00	1	01/13/10 18:21	SW846 6010B	10A1134
Chromium	ND		mg/L	0.00500	1	01/13/10 18:21	SW846 6010B	10A1134
Iron	**0.0534**		mg/L	0.0500	1	01/13/10 18:21	SW846 6010B	10A1134
Lead	ND		mg/L	0.00500	1	01/13/10 18:21	SW846 6010B	10A1134
Magnesium	**3.72**		mg/L	1.00	1	01/13/10 18:21	SW846 6010B	10A1134
Manganese	ND		mg/L	0.0150	1	01/13/10 18:21	SW846 6010B	10A1134
Potassium	**1.93**		mg/L	1.00	1	01/13/10 18:21	SW846 6010B	10A1134
Selenium	ND		mg/L	0.0100	1	01/13/10 18:21	SW846 6010B	10A1134
Silver	ND		mg/L	0.00500	1	01/13/10 18:21	SW846 6010B	10A1134
Sodium	**109**		mg/L	1.00	1	01/13/10 18:21	SW846 6010B	10A1134
Mercury by EPA Methods 7470A/7471A								
Mercury	ND		mg/L	0.000200	1	01/20/10 10:22	SW846 7470A	10A1697
Volatile Organic Compounds by EPA Method 8260B								
Benzene	ND		ug/L	0.500	1	01/13/10 02:30	SW846 8260B	10A0503
Ethylbenzene	ND		ug/L	0.500	1	01/13/10 02:30	SW846 8260B	10A0503
Toluene	ND		ug/L	0.500	1	01/13/10 02:30	SW846 8260B	10A0503
Xylenes, total	ND		ug/L	0.500	1	01/13/10 02:30	SW846 8260B	10A0503


Penn State Extension
Marcellus Shale Wells
337 wells through 3/19/2012
Additional pre-drilling dataset of 800 water wells and springs in eight counties of Pennsylvania
Year Drilled
2012 (337 through 3/19)
2011 (1920 wells)
2010 (1395 wells)
2009 (685 wells)
2008 (229 wells)
2007 (60 wells)
Marcellus extent
(includes non-economic areas)
Based on Pennsylvania Department of Environmental Protection SPUD Data Reports
MARCELLUS CENTER
MCOR
FOR OUTREACH AND RESEARCH
www.marcellus.psu.edu
Colcom Foundation
PA Headwaters
Resource Conservation & Development Council
PACD
Pennsylvania Association of Conservation Districts, Inc.

Study Implications - Educational Needs

- Water testing strategies
  - Where, what, how
  - Regulatory changes driving testing
  - Industry vs. voluntary testing
- WATER TEST INTERPRETATION
  - Workshops
  - Publications
  - Website tools
- Understanding pre-drilling issues

Water test interpretation workshop
Lock Haven, PA – May 2012

PENNSTATE

College Of Agricultural Sciences

Penn State **Extension**

http://extension.psu.edu/water

Water Resources

- Drinking Water
- Pond Management
- Water Conservation
- Drought and Climate Information
- Discovery Watersheds
- Septic Systems
- Marcellus Shale
- Master Well Owners Network
- Events
- News
- Contact Us

Nutrient and Water Policy

Latest News

DEA Drug Take-Back April 28, 2012

April 11, 2012

There are many excellent reasons to dispose of unwanted medications properly. To encourage proper disposal, the DEA will again be sponsoring Drug Take-Back programs at many sites across Pennsylvania.

New Marcellus Shale Electronic Field Guide

April 9, 2012

Penn State introduces a new online field guide to assist landowners, land managers, and gas companies understand terrestrial challenges facing shale gas development.

Building Your Relationship with Water

April 2, 2012

This spring, get a little closer to the water in your life by making a visit to a stream near you.

Spotlight

- Penn State Water Testing
- Pharmaceutical Disposal and Water Quality
- Water Conservation Home Study
- Weather Observer Training
- Webinar Series

Upcoming Events

Aquatic Pesticide Recertification Correspondence Course
February 1, 2012 to December 31, 2014

Fundamentals of Shale