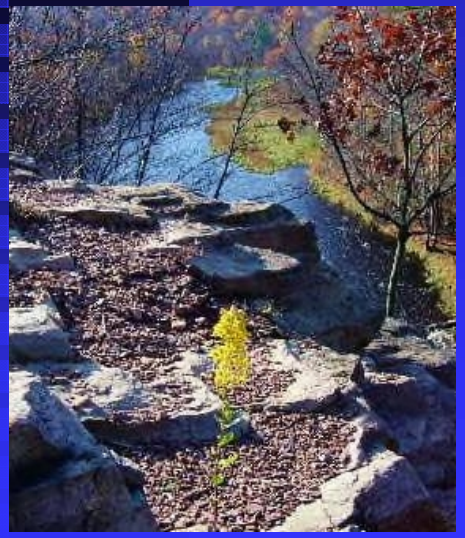
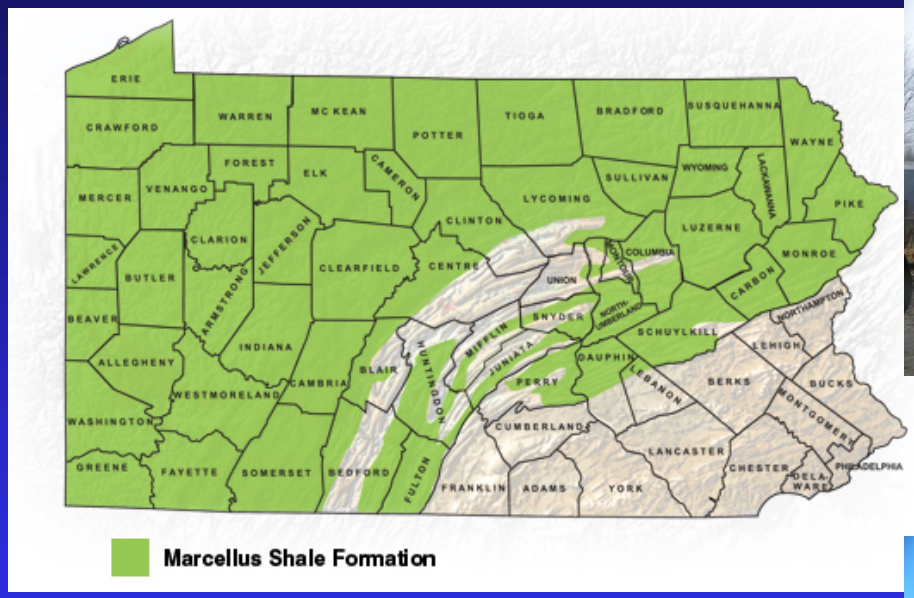
# Getting The Waters Tested
# The Marcellus Shale Factor

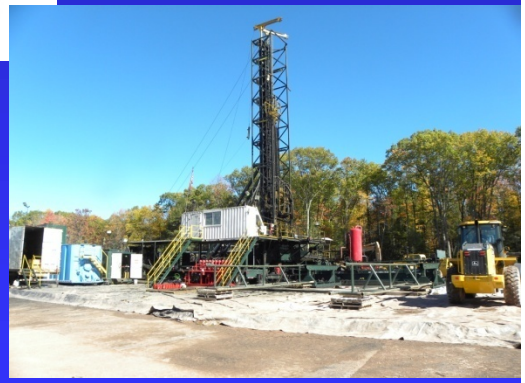
Water Resources



Environment




Old Issues



New Issues

# Presented by:

Mr. Brian Oram, Professional Geologist (PG),
Soil Scientist, Licensed Well Driller, IGSHPA

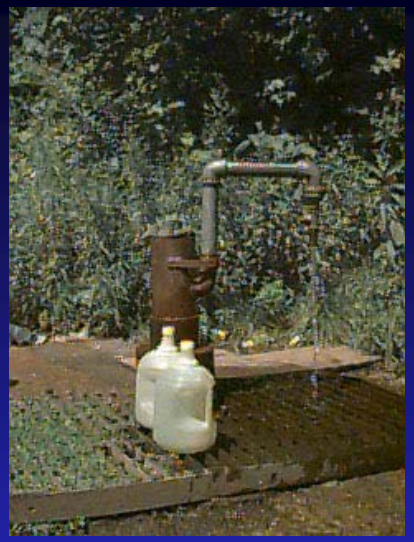
B.F. Environmental Consultants Inc.
http://www.bfenvironmental.com

Water Research Center
http://www.water-research.net

# B.F. Environmental Consultants Inc.

- Professional Consulting Services in the areas of water quality, soils, stormwater, geology, aquifer analysis, and land-development.
- Baseline – Chain-of-Custody
- Expert Testimony
- Water Treatment Process/ Product Development
- http://www.bfenvironmental.com

# Water-Research Center



Education and Outreach Program funded by

B.F. Environmental Consultants Inc.

Outreach Programs

- Environmental and Professional Education and Training for Citizens and Local Municipalities
- Water Quality Help Guides – Information Library
- Community and Business Outreach Programs
- Low Cost – Informational Water Testing Program with National Laboratory
- Citizen Monitoring Programs

Website: http://www.water-research.net

# Announcements

- Announcement – New Private Well Owner and Watershed Survey for Marcellus Shale Region - Going to Offer 200 Free Radon in Water Tests. http://www.surveymonkey.com/s/NMG6RQ3

- Want to host a community meeting to discuss baseline testing, gas migration, community monitoring, Citizen Groundwater/Surfacewater Database or other issues – call (570) 335-1947, bfenviro@ptd.net or Visit Us at http://www.bfenvironmental.com

New Fact Sheet Related to Methane Gas and Updating the Free Booklet for Private Well Owners.

# Target Audience

- Stakeholders
- Community Advocates and Scientists
- Municipal and Local Officials
- Water Supplies and State Regulators
- Grassroots Conservation and Environmental Groups

# What is the Marcellus Shale Factor?

- We have been educating private wellowners for 20+ years- but it was difficult to get citizens to test their well water. It looks clear – I am not sick – It is fine.
- The Marcellus Shale Factor – Baseline Testing for Natural Gas Development is conducting Testing and Citizens are be told they have a Problem NOW.
- Based on Private Well Construction and Placement - Some Private Wells may be the pathways for Contamination.
- **WE NEED TO PROTECT OUR SOURCE WATER- not just from Marcellus Shale Development and other hazards, but from "us" and our past.**
- **How do we track an unregulated activity – such as: Private Wells and Identify Zones or Areas that are Vulnerable to Contamination.**
- **This lead to the idea for creating the Citizen Groundwater / Surfacewater Database**

WE Support the Citizen Groundwater Database at Wilkes University !

# Goals

- Private Well Water Quality for the Region
- Existing Problems in Region
- Brief Introduction to Marcellus Shale and Importance of Proper Well Construction
- Review of Hydraulic Fracturing
- The Citizen Groundwater Database
- Well Monitoring and Purging
- Chain-of-Custody
- Baseline Testing – What Parameters?
- Educating the Community

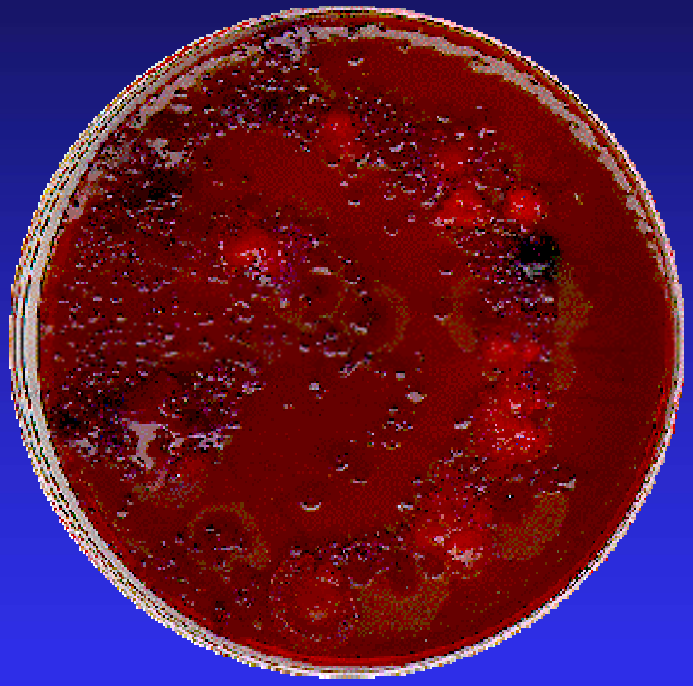
# Private Wells/ Water Systems in Pennsylvania

What ?

| County | # of homes served by private water systems | | | Avg. Change in homes served by private water systems per year | % of all homes served by public water | % of all homes served by private water system |
|---|---|---|---|---|---|---|
| | 1980 | 1990 | 2000 | | | |
| Bradford | 13,443 | 16,865 | 20,287 | +342 | 37 | 63 |
| Carbon | 6,594 | 12,235 | 17,876 | +564 | 55 | 45 |
| Lackawanna | 9,952 | 12,745 | 15,538 | +279 | 86 | 14 |
| Luzerne | 19,994 | 24,662 | 29,330 | +467 | 82 | 18 |
| Monroe | 21,129 | 37,246 | 53,363 | +1612 | 32 | 68 |
| Pike | 9,441 | 16,875 | 24,309 | +743 | 45 | 55 |
| Sullivan | 2,147 | 4,727 | 7,307 | +258 | 13 | 87 |
| Susquehanna | 9,423 | 15,212 | 21,001 | +579 | 25 | 75 |
| Tioga | 9,126 | 11,888 | 14,650 | +276 | 35 | 65 |
| Wayne | 9,913 | 19,097 | 28,281 | +918 | 33 | 67 |
| Wyoming | 7,236 | 8,657 | 10,078 | +142 | 27 | 73 |
| Region | 118,398 | 180,209 | 242,020 | +562 | 43 | 57 |

# Our Groundwater is Pure and Regulated?
# Information We Know Without Compiling the Baseline Water Quality Data

**Based on the geology of the NEPA and my 20 years experience, the common water quality problems are as follows:**



Corrosive Water

Low pH

Soft Water (low hardness) to Moderate Hardness

Iron and Manganese

Discolored Water – Reddish to Brown Tints

Total Coliform Bacteria

Sulfur Odors and Methane- Biogenic Gas (Tends to be < 10 mg/L)

Radon Gas

Contamination by VOCs, SOCs, Glycols, Saline Water ( < 3 %), and Radionuclides are NOT COMMON!

# This is Drinking Water in PA?

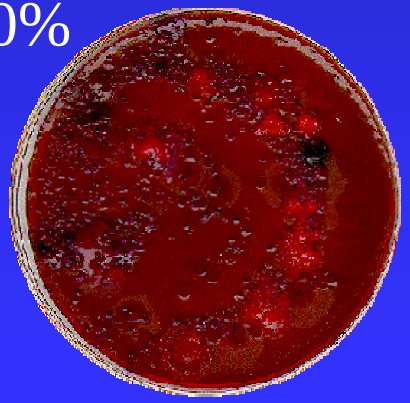
50%

Iron / Manganese

Sediment / Gases

Other 50%

Corrosion



Bacteria

# Drinking Water Regulations

The Safe Drinking Water Act (SDWA), passed in 1974 and amended in 1986 and 1996, gives the Environmental Protection Agency (EPA) the authority to set drinking water standards.

These standards are divided into two broad categories: Primary Standards (NPDWR) and Secondary Standards (NSDWR).

# Primary Standards (NPDWR)

## National Primary Drinking Water Regulations

Primary standards protect drinking water quality by limiting the levels of specific contaminants that can adversely affect public health and are known or anticipated to occur in water. They take the form of Maximum Contaminant Levels or Treatment Techniques.

There are over 100 chemical and biological primary drinking water standards, which include: trace metals, disinfection agents, disinfection by-products, radiological, microbiological agents, and organic chemicals.

Examples: Arsenic, Lead, MTBE, total coliform, *Giardia*, Trihalomethanes, Asbestos, Copper, Benzene, Trichloroethane, etc.

# Secondary Standards

National Secondary Drinking Water Regulations

These standards were established more for cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor or color) in drinking water.

The secondary standards include: aluminum, chloride, color, corrosivity, fluoride, foaming agents, iron, manganese, odor, pH, silver, sulfate, total dissolved solids, and zinc.

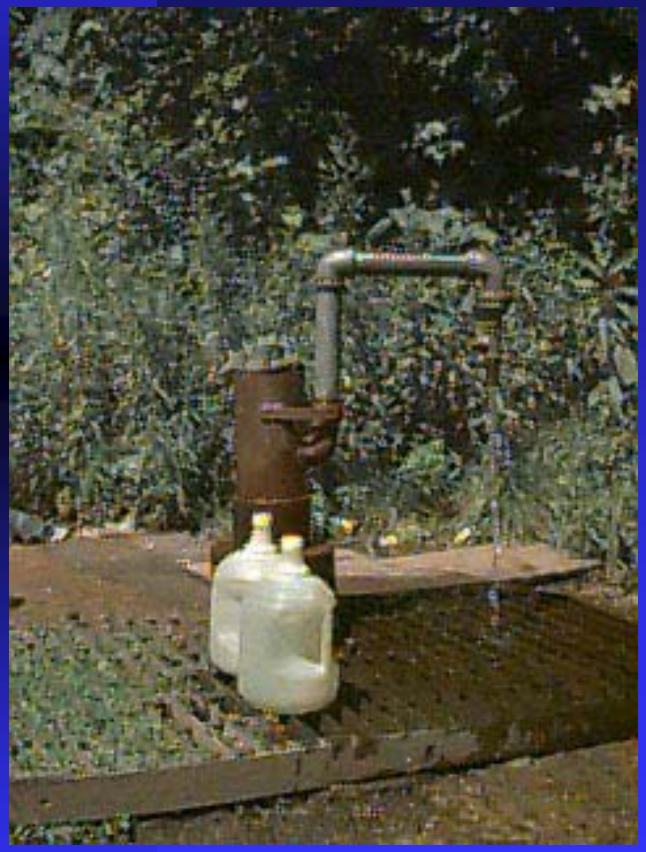
# Private Wells Not Regulated

- Private Wells Are Not Regulated under Safe Drinking Water Act
  - EPA – NO
  - PADEP – NO
  - County – Very Few Counties in PA
  - Townships – some have basic ordinance on placement- some have comprehensive requirements

# Private Wells - The Facts

- Are they Regulated?
  - Not really – no state-wide construction standard
  - Not Classified as a Regulated Source
- Are they Permitted?
  - May be the Licensed Well Driller Submitted a Log
  - Maybe a permit issued at the local level
- Are they Tested?
  - Not required- Data not stored
- Do we know where they are located?
  - Maybe +/- a few hundred feet.
  - PaGWIS - PA Groundwater Information System

# Factor - Private Wells / Landowners



1. Concerns about groundwater quality
2. Concerns related to surfacewater quality.
3. They have never tested the water
4. They had testing done, but no-one explained the results.
5. There is no program to help fix existing problems.

Some Believe Their Water is PURE H2O - It is not.

# Before Marcellus Shale Development
# What was the Quality of Private Well Water?

A USGS survey found that 70% of private wells were contaminated. This contamination could result in acute or chronic health concerns (1996).

Testing Conducted under my supervision at Wilkes University in through out the United States indicates that 30 to over 50 % may be contaminated – Mostly by Total Coliform  Bacteria (1989 – 2011).

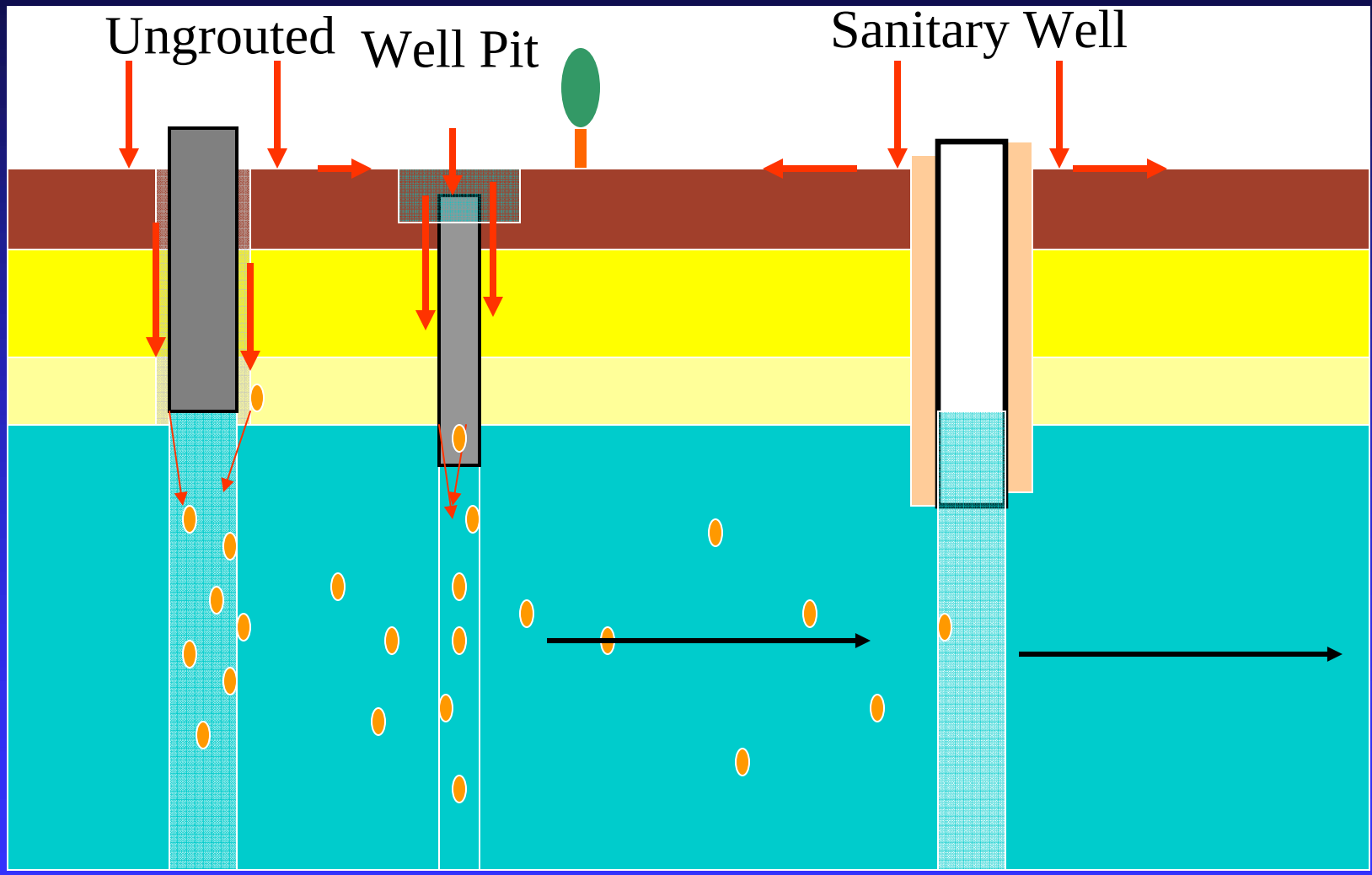
PSU – Master Well Owner Network suggests that 33 to 50 % of Private Well Owners in PA may have some form of contamination.

# Most Contamination appears to be associated with Total Coliform Bacteria

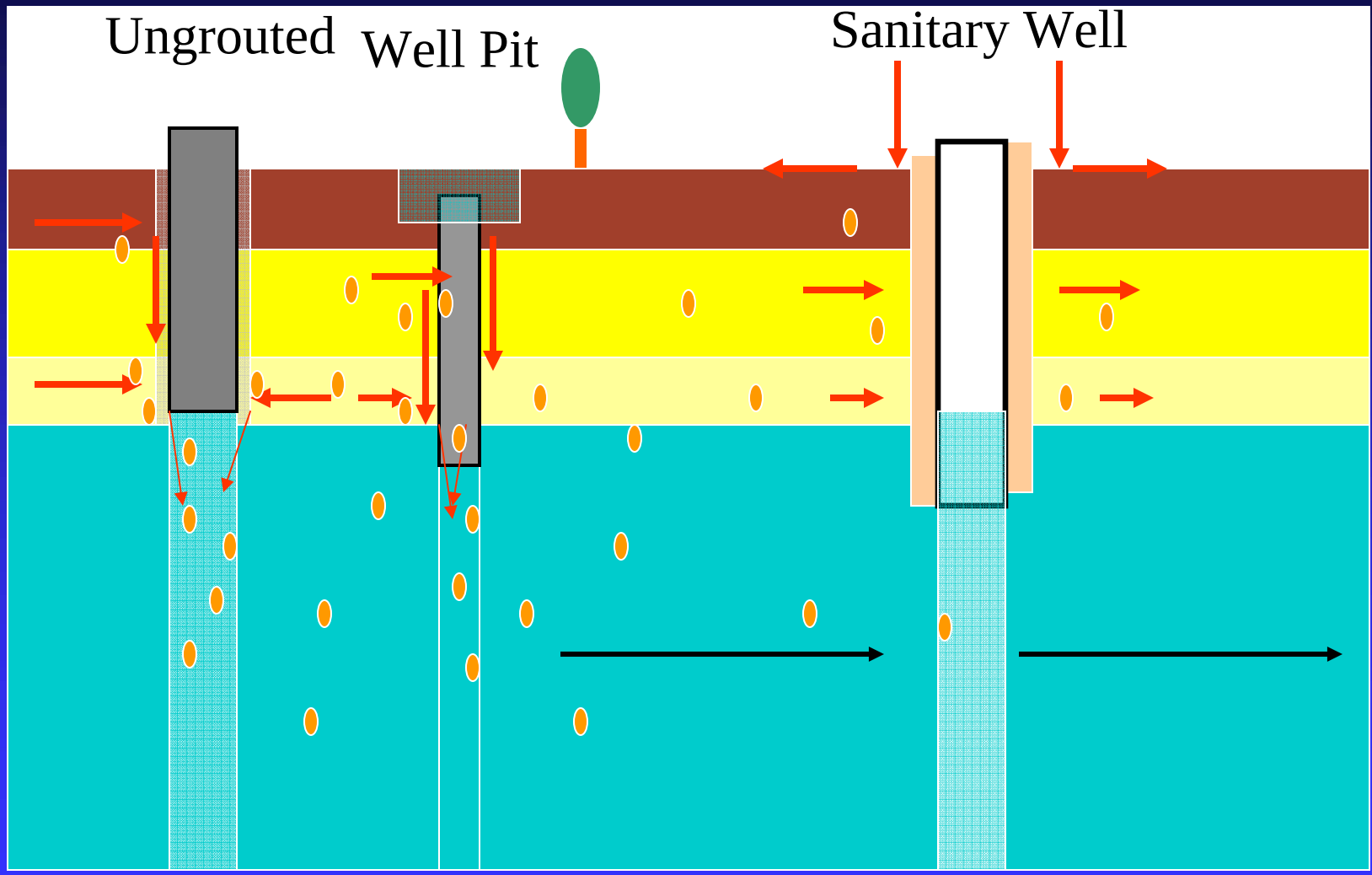
- Insects, Larvae and Nests / Egg Masses
- Mouse Colonies
- Snakes
- Beehives
- Mud - when casing to close to ground

Therefore – In some cases - the Private Wells are Facilitating Groundwater Contamination.

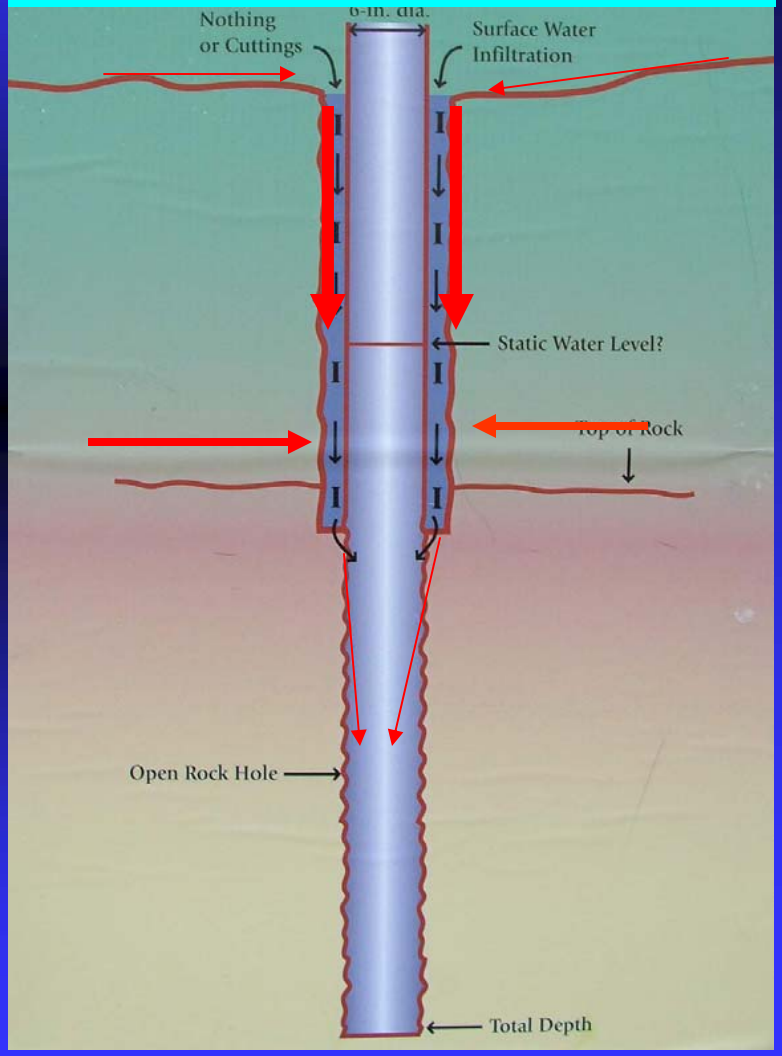
# How Contaminants Can Get In to the Aquifer (Surface)



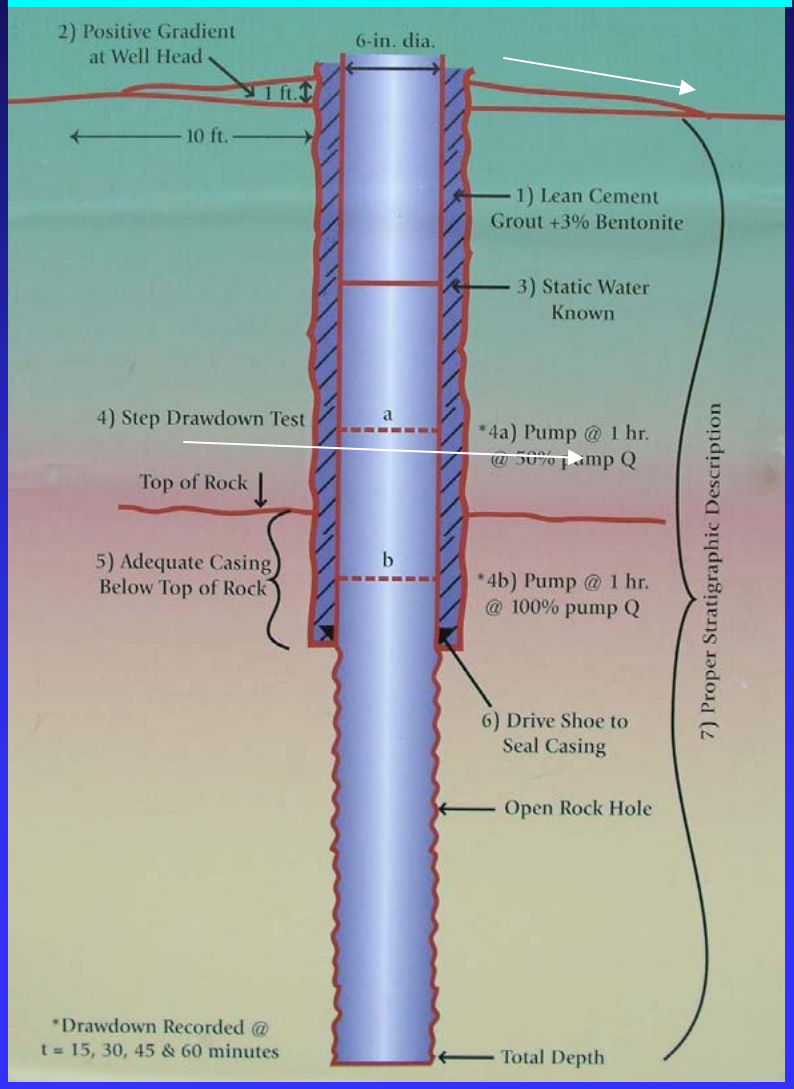
# How Contaminants Can Get In to the Aquifer (Subsurface)



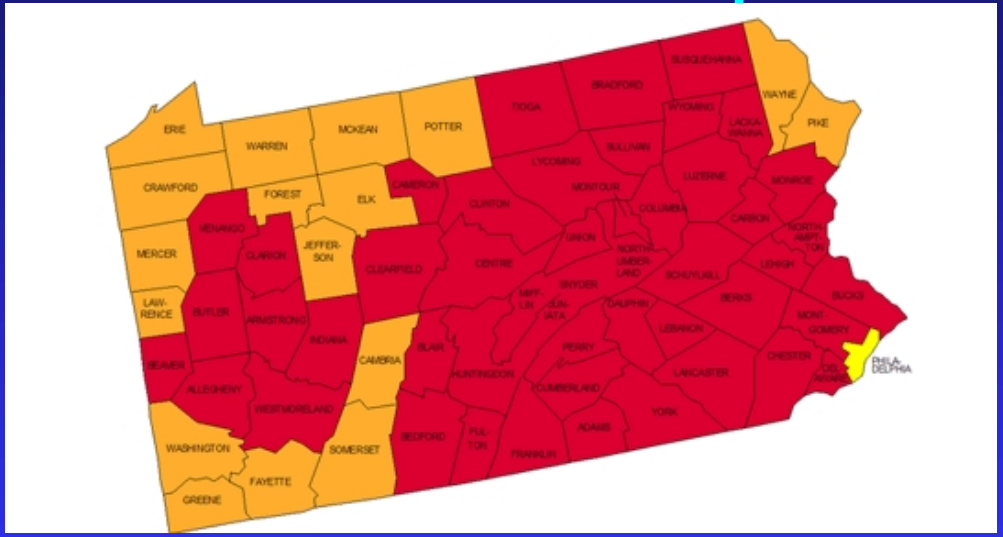
# An Ungrouted Residential Well




# A Properly Grouted Well



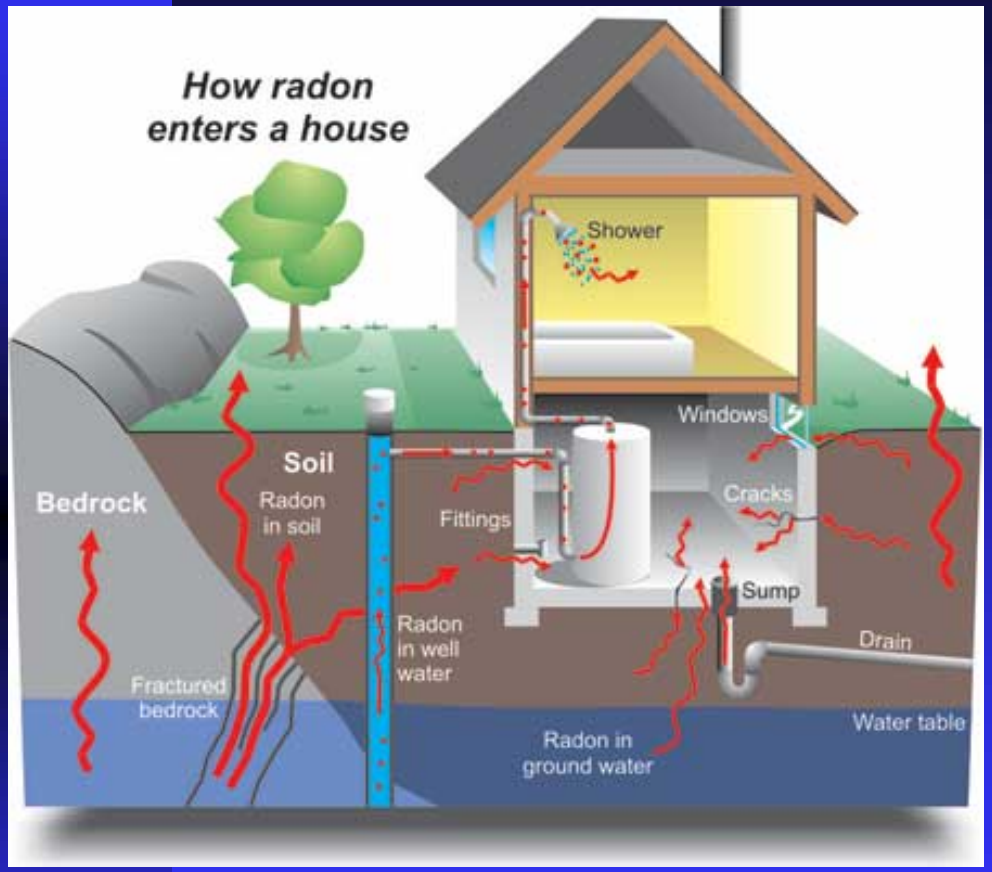
# Radon (In Air)- PA
# Recommend < 4 pCi/L




Susquehanna County – 48 % < 2 pCi/L, but 31 % > 4 pCi/L

Bradford County – 38 % < 2 pCi/L, but 43 % > 4 pCi/L

# Radon Exposure




Radon in Water – no Standard, but proposed range 300 to 4000 pCi/L

Recent testing in Susquehanna/ Luzerne County at 577 to 2200 pCi/L – 100% over 300 pCi/L

Recommendations

1. Test indoor radon in air levels.
2. If radon in air > 2 pCi/L- test the radon level in the water.
3. Add to Community Baseline Testing Program

# Methane in Water

- Methane has been a hidden issue in NEPA.
- The gas is colorless, tasteless, and odorless and there are no known health effects.
- Potential concerns relate to flammability/ explosiveness of gas.
- Background – appears to range from non-detect to over 20+ mg/L (highly variable) in Northeast Pennsylvania.
- I made my first well water sample burn in about 1989- thanks to methane gas.

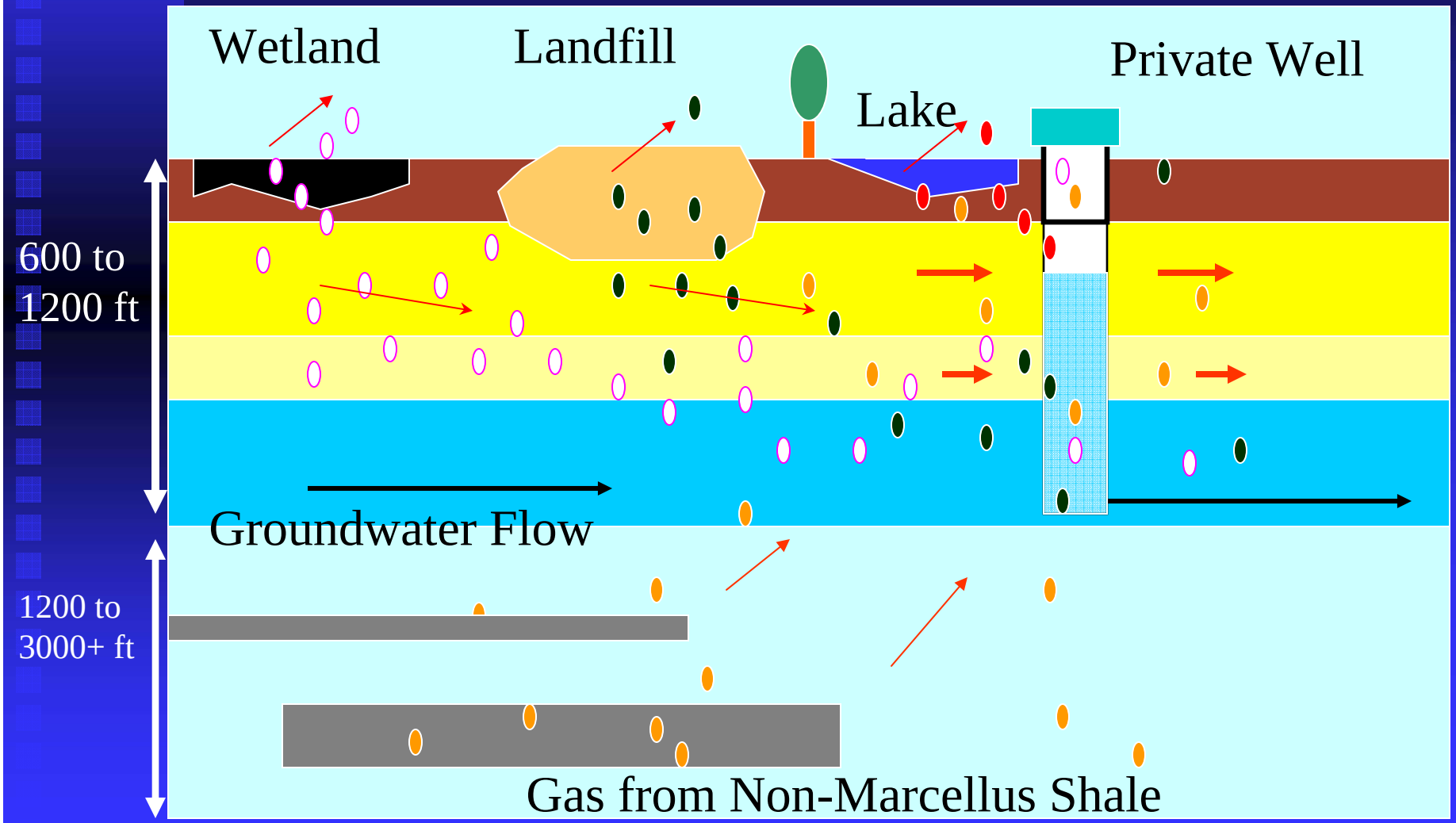
# Methane Gas

Video from Salt Springs State Park – Fall 2010, by Brian Oram

http://www.friendsofsaltspringspark.org

"At the base of the gorge is a bubbling salt spring, traces of an 1850s woolen mill, and mid-19th century farmhouses and barns."

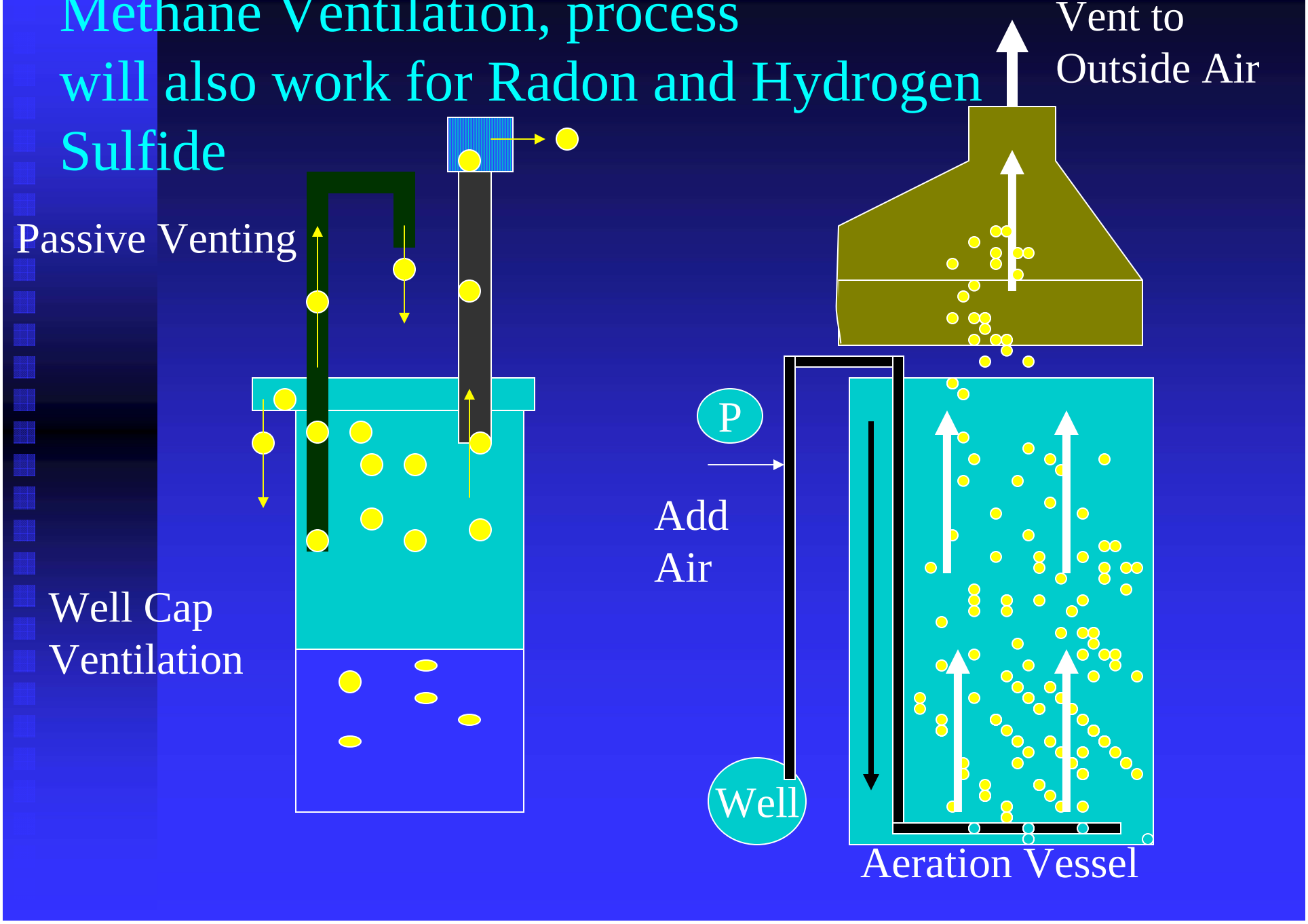
# Methane Gas Migration- Not Related to Marcellus Shale



# Methane (a little more)

- The Coal regions and northern portion of NEPA, and areas associated with the Mahantango / Marcellus Shale may have elevated levels of methane.
- No drinking water limit, but Office of Surface Mines recommends monitoring for concentrations from 10 to < 28 mg/L and immediate action for concentrations > 28 mg/L
- My Recommendations:
  - < 2 mg/L – Monitor annually with passive venting
  - > 2 to 7 mg/L – Real-Time Monitoring with passive venting.
  - > 7 mg/L to < 10 mg/L – active venting, Isotopic Analysis – “Like fingerprinting the source of the gas”
  - > 10 mg/L – Treatment , plus active venting and Isotopic Analysis

# Methane Ventilation, process will also work for Radon and Hydrogen Sulfide



# Problems with Iron, Manganese, and Sulfur – May be Bacterially Related

In Northeastern PA- “Nuisance Bacteria may be associated with an Odor, Iron, Manganese, or Sulfur problem. Up to 50% of the time.

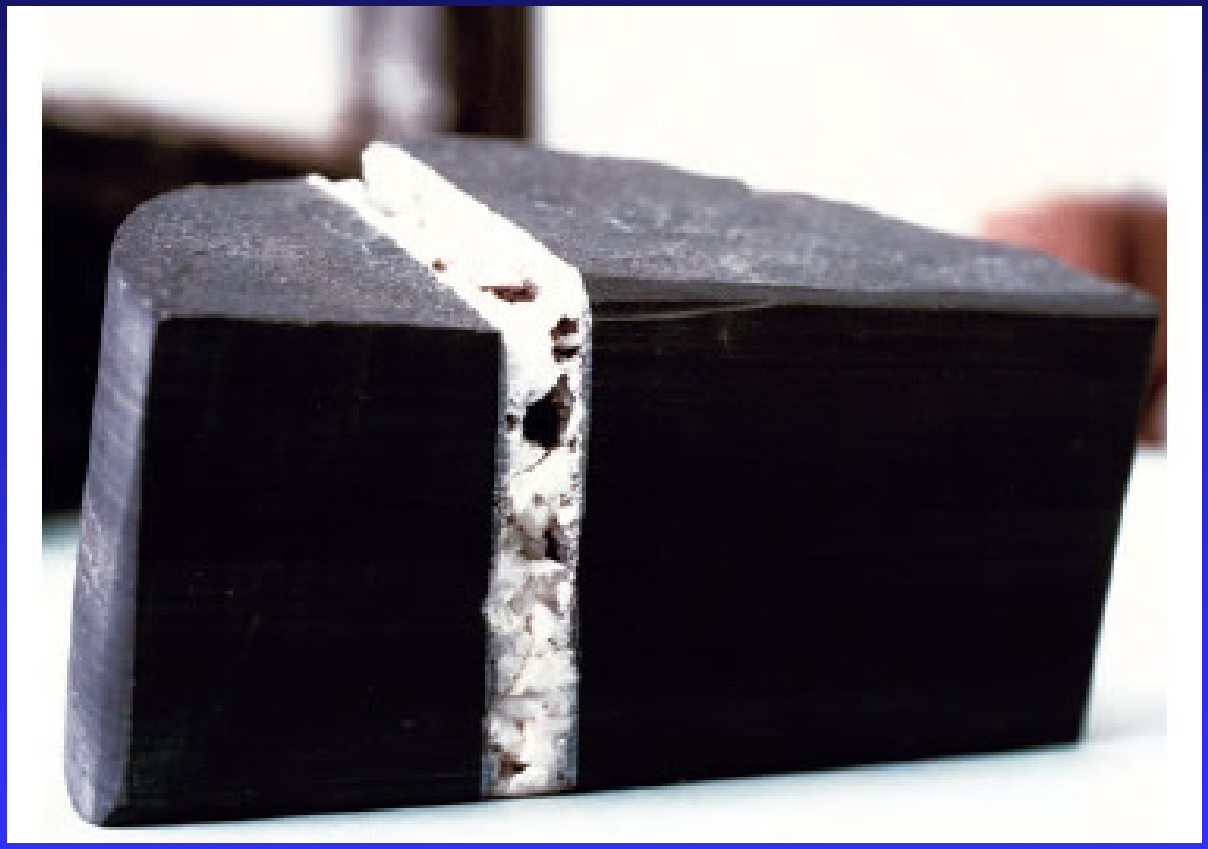
Make sure to test for total coliform, standard plate count, and Nuisance Bacteria.

These may impact the performance of any water treatment system.

# Marcellus Shale- What is it?

Dr. Sid Halsor
Holding a Core Sample from
About 7800 feet

# Marcellus Shale



This is Causing all the Concern?

## Geological Sequence

OLDER

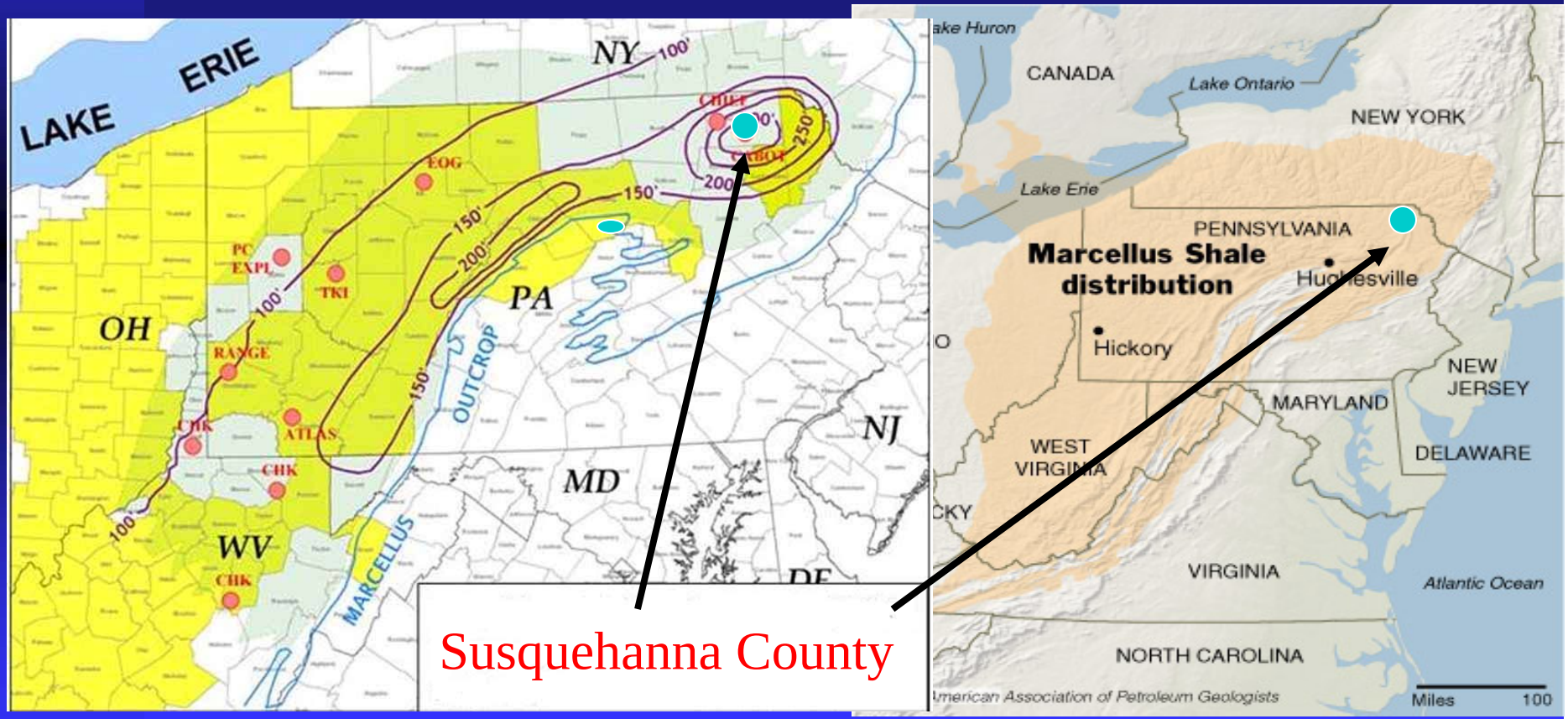
| Time | Period | Deposit or Rock Type |
|---|---|---|
| **0 to 1.8 million years** | Quaternary – Glaciation | sand, silt, clay, and gravel |
| 1.8 to 290 million | Tertiary to Permian | **Not present (eroded and weathered)** |
| 290 – 320 million | Pennsylvanian | **Llewellyn (coal) and Pottsville ( minor coal)** |
| 320 – 354 million | Mississippian | **Mauch Chunk Pocono and Spechty Kopf** |
| 354 - 417 million | Devonian | **Catskill Formation Trimmers Rock Formation Mahantango Formation Marcellus Formation (Black Shale)- Target Onondaga Formation (calcareous sandy shale)** |
| 417 – 443 million | Silurian | |

# 385 Million Years Ago


Source: http://www2.nau.edu/rcb7/nam.html


Barkley, 2009

# Marcellus Shale- Natural Gas Play
# 84 to 500 trillion cubic feet




Shale may be 300+ feet thick.

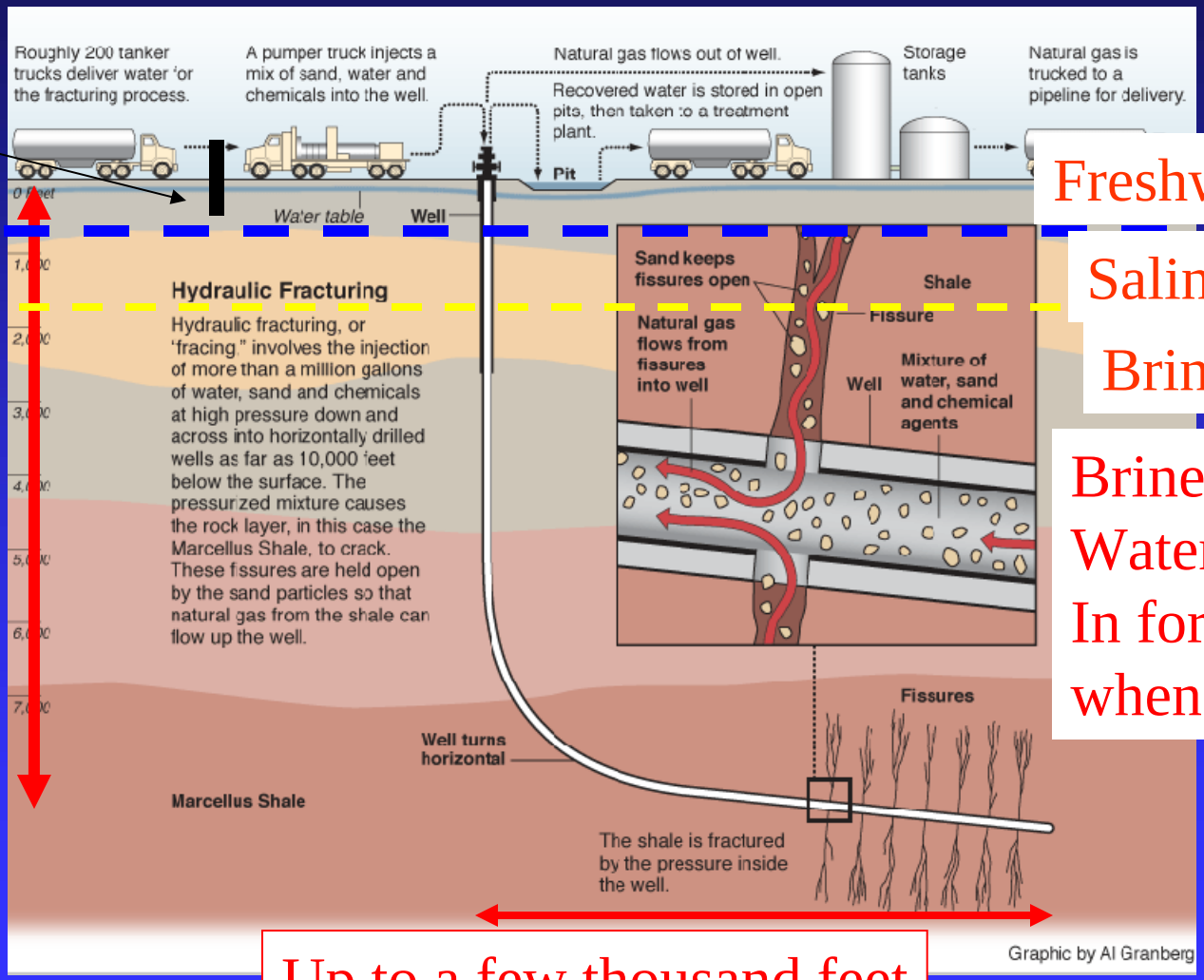
- Marcellus Shale Development
  - Drilling
  - Casing
  - Cement
  - What are the weaknesses?
  - What are the contaminants of concern?
  - Where to monitor?

# Marcellus Shale Drilling Site

Total disturbed pads areas can be 5 acres – but one pad may support drilling  multiple horizontal wells.

# Getting to The Natural Gas

Freshwater Well




Freshwater

Saline

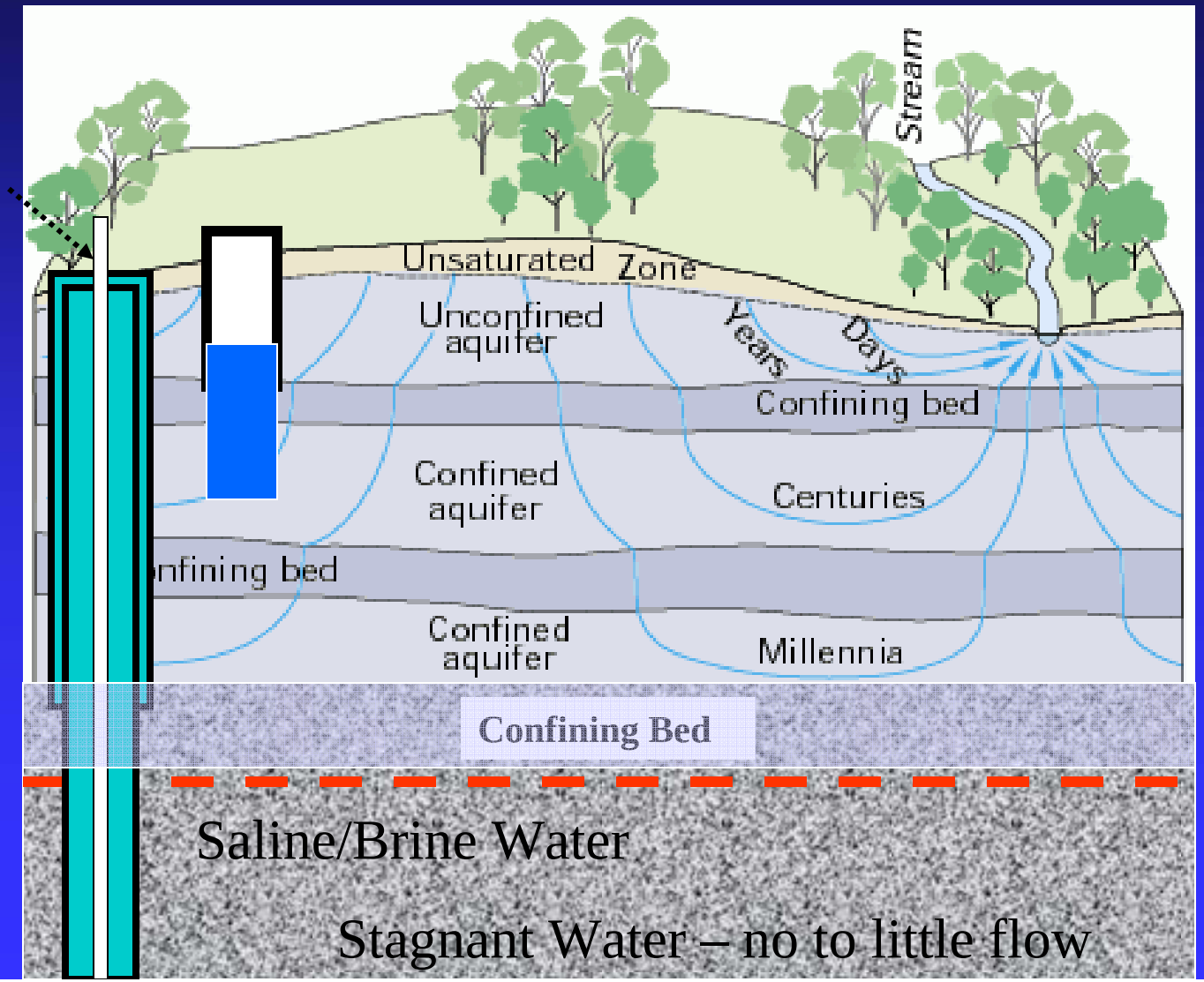
Brine

5000 to 7000 feet

Brine / connate Water- Trapped In formation when deposited

Up to a few thousand feet

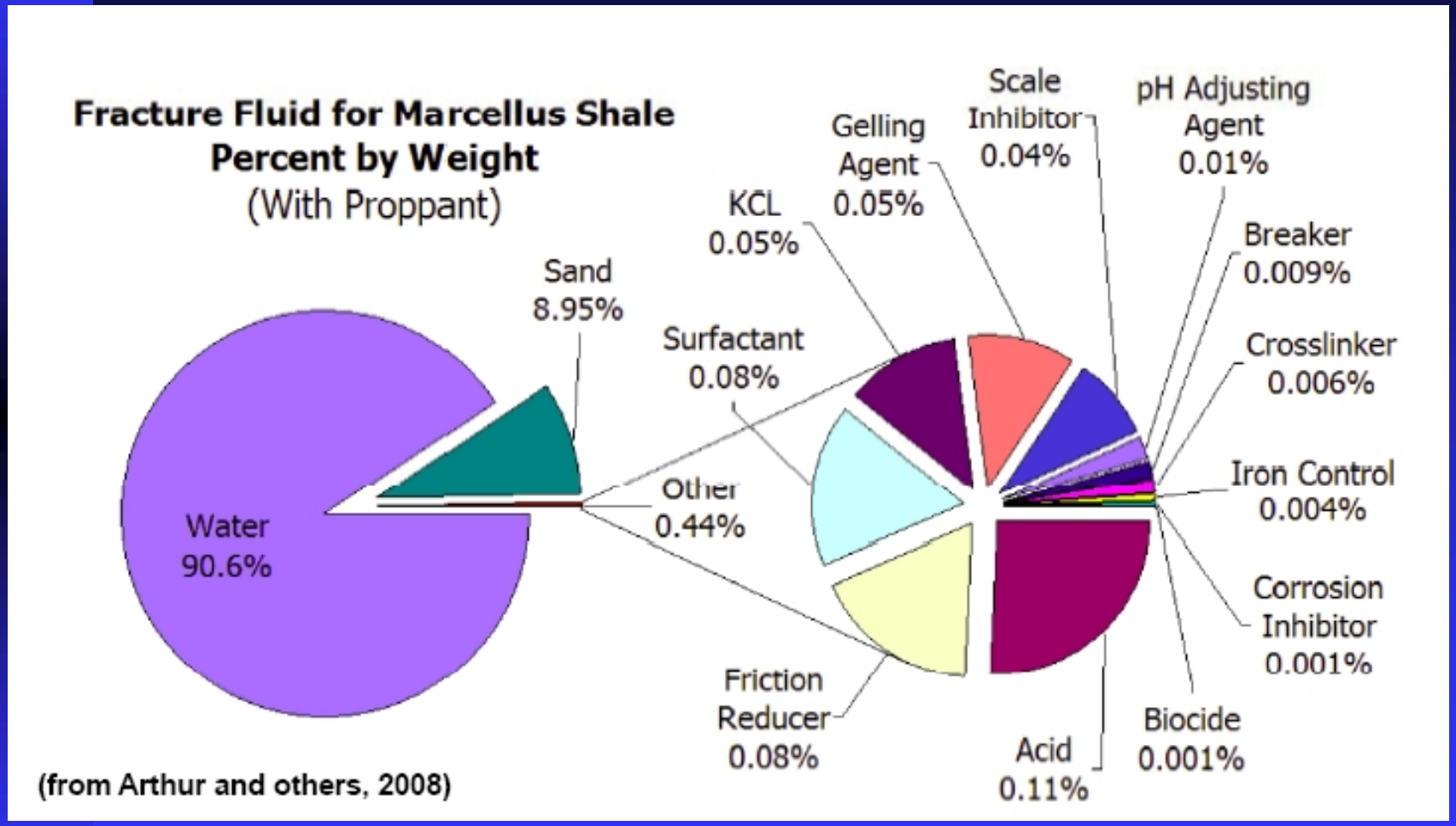
# Properly Constructed Wells and Ideal Natural Gas Wells




Sea Level

# Types of Fluids - Associated with Marcellus Shale

- Top hole fluids – typically the water from the freshwater aquifer. This water from the first 600 to 1200 feet.
- Bottom hole fluids – brine or connate water.
- Stimulation Fluids – fluid used to improve recovery (frac process)- includes biocides and other chemicals.
- Production Fluids – water produced along the natural gas release – similar to bottom hole fluid.




Arthur et. al., 2008 – All Consulting – " Natural Gas Wells of the Marcellus Shale", Presented at Groundwater Protection Council 2008 Annual Forum.

# Active Marcellus
# Production Site – Frac Fluid Chemistry

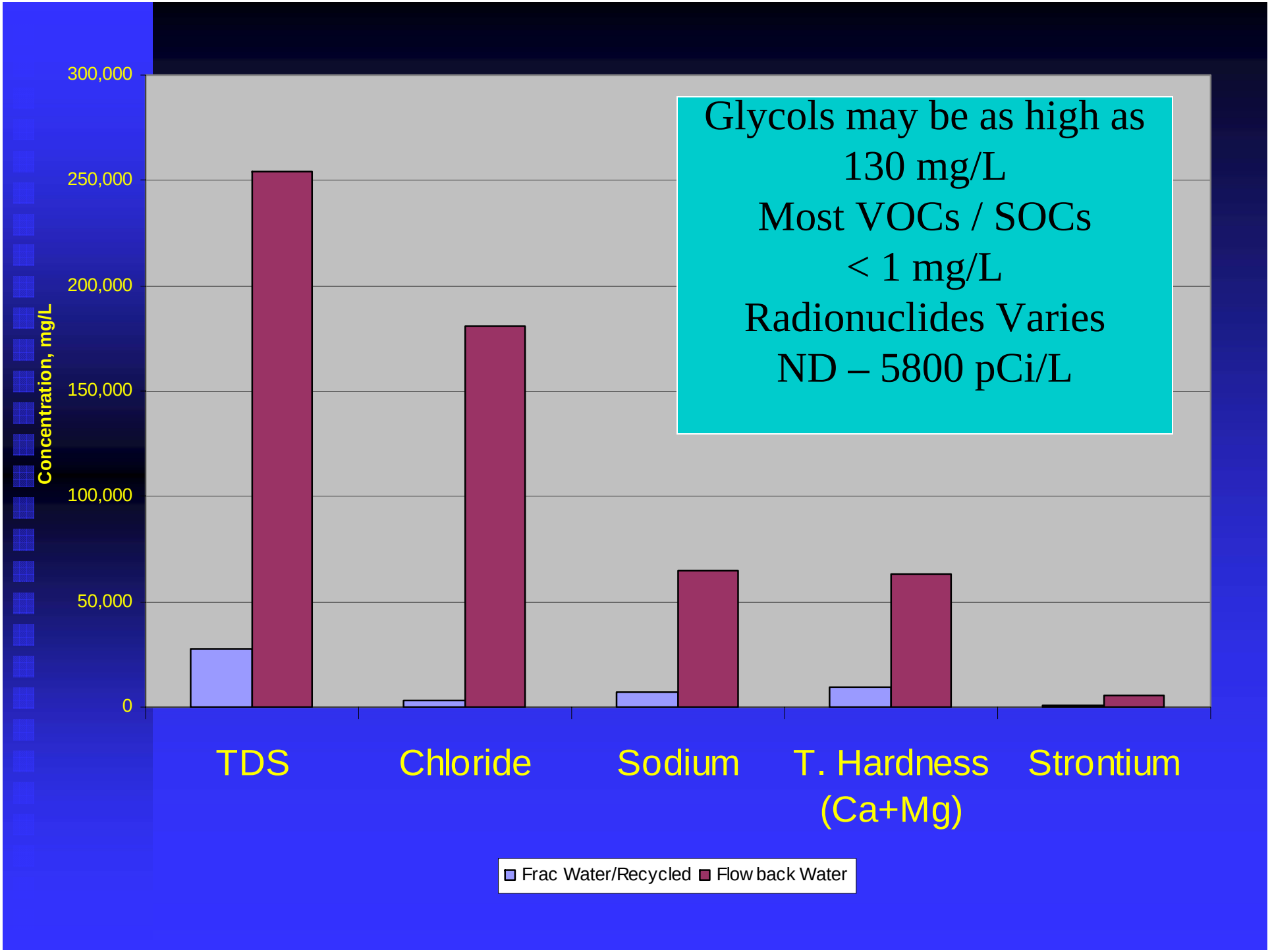
Typically Frac Water is comprised of clean water with a low probably for scale formation, but treated effluents and other sources being evaluated.
The components include:

Friction Reducer – anionic polymer high molecular weight
(hold frac sand and other particles)

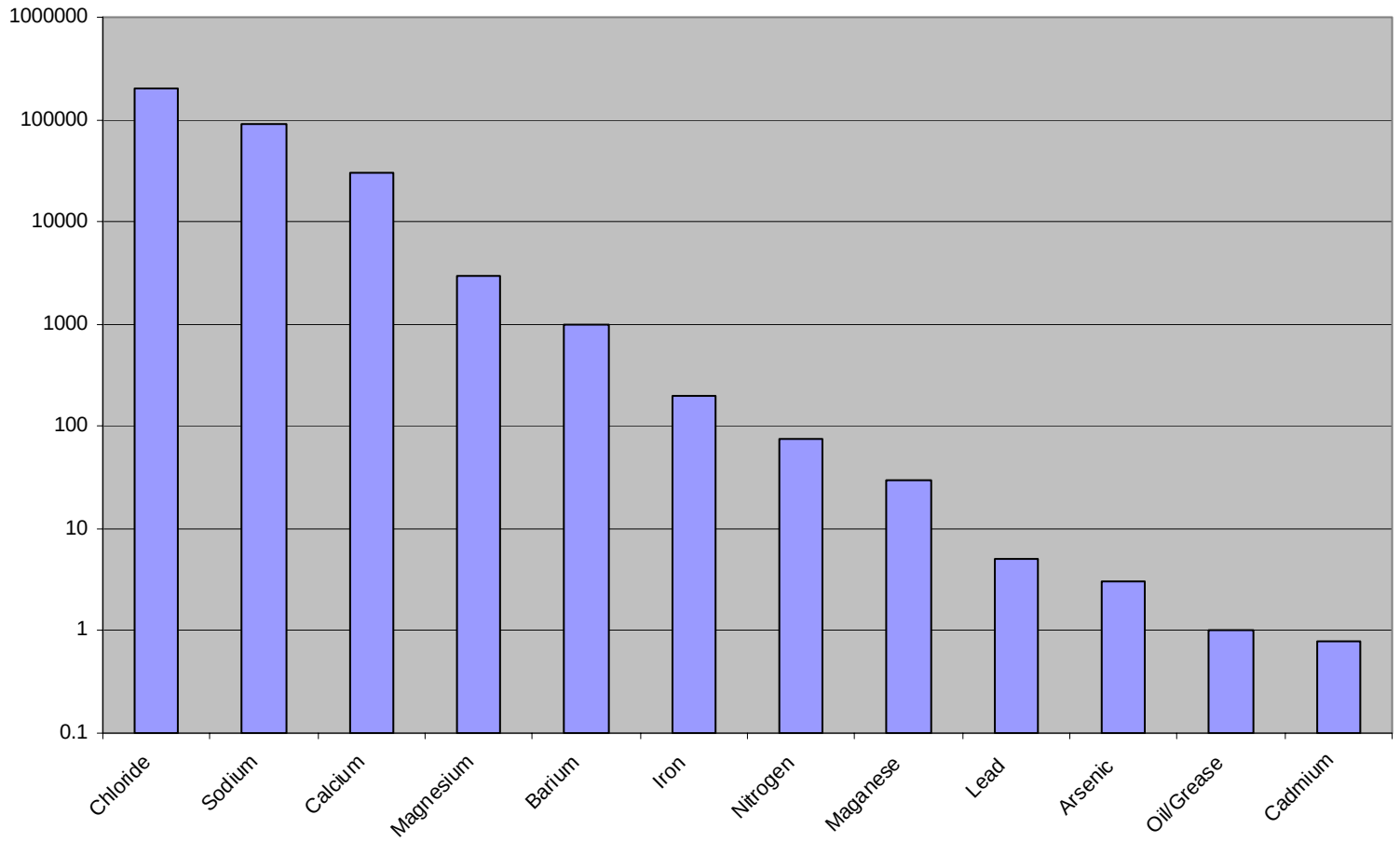
Wetting Agent- nonionic surfactant – reduce surface tension and improve frac water flowback.

Biocides- control growth or regrowth of microorganisms.

Scale Inhibitor – phosphate based chemicals to inhibit precipitate formation and scale formation.


Glycols may be as high as
130 mg/L
Most VOCs / SOCs
< 1 mg/L
Radionuclides Varies
ND – 5800 pCi/L
Concentration, mg/L
300,000
250,000
200,000
150,000
100,000
50,000
0
TDS
Chloride
Sodium
T. Hardness (Ca+Mg)
Strontium
Frac Water/Recycled
Flow back Water

# Approximate Flowback Water - Wastewater Chemistry Concentration - mg/L (Source: PSU and Marcellus Shale Coalition




More Data can be found at http://www.bfenvironmental.com

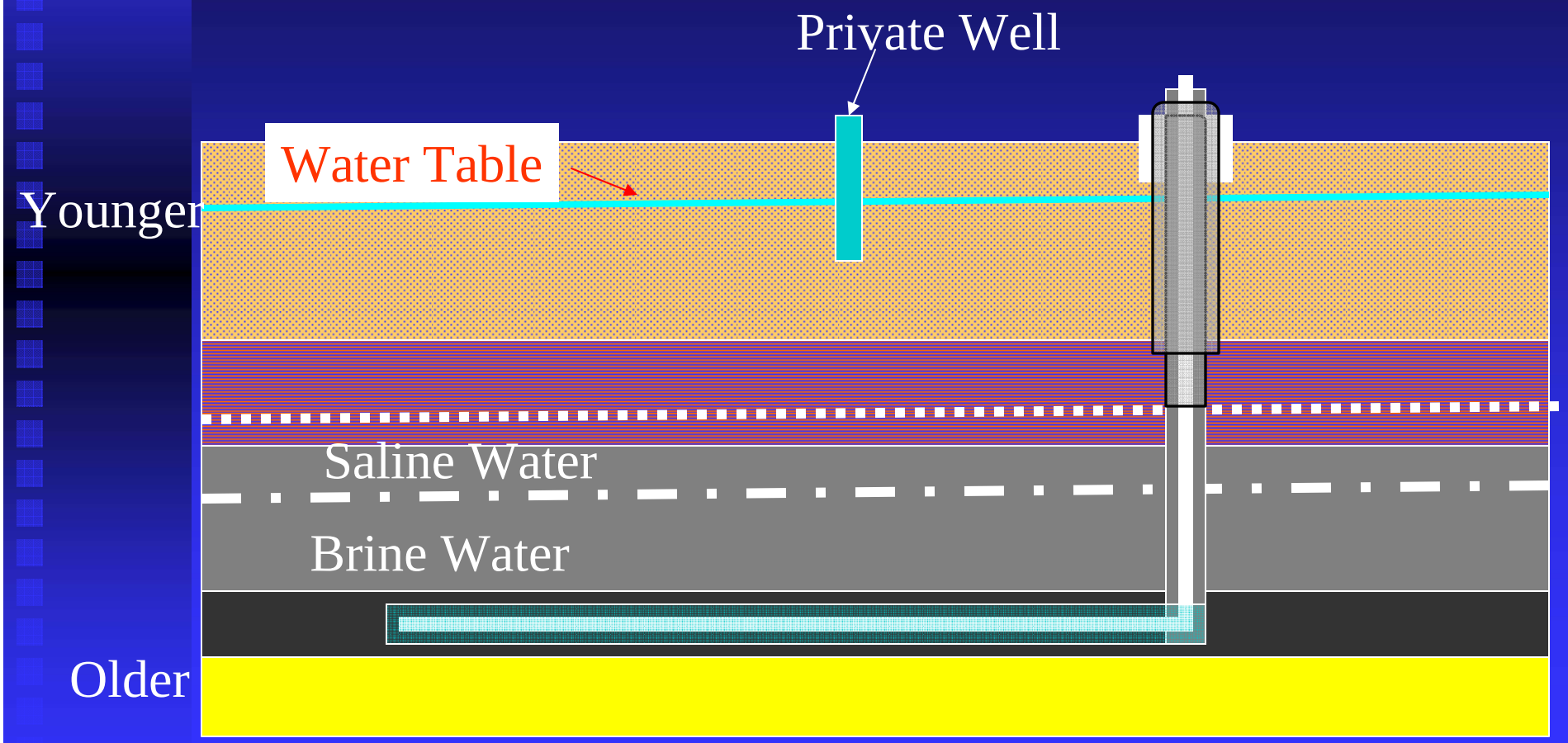
# Concerns Related to Marcellus Shale

- In general, the concerns are related to the following:
  - Surface Spills and Releases Near Surface
  - Methane Gas Migration
  - Pushes and Slugs associated with Improper Cementing and not Properly Sealing the Existing Confining Layers Improper Disposal of Brines
  - Freshwater Aquifer Contamination by brine water and drilling fluids/ muds.
  - Drilling fluids may contain environmental contaminations (metals and organics).

# Frac Water Chemical Disclosures

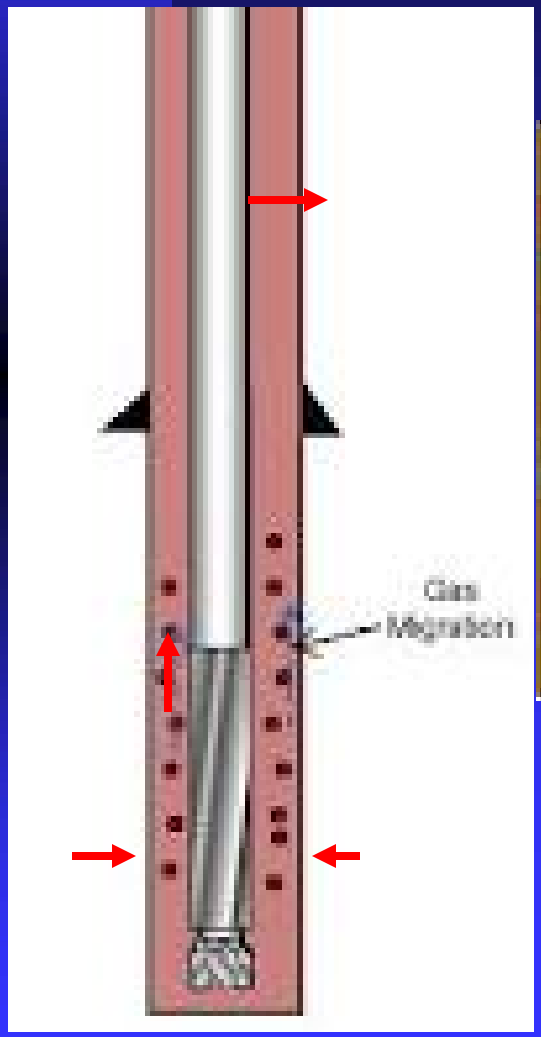
- FracFocus”- **http://fracfocus.org/**. - the hydraulic fracturing chemical registry website.
- This website is a joint project of the Ground Water Protection Council Interstate Oil and Gas Compact

# General Geology- Susquehanna County

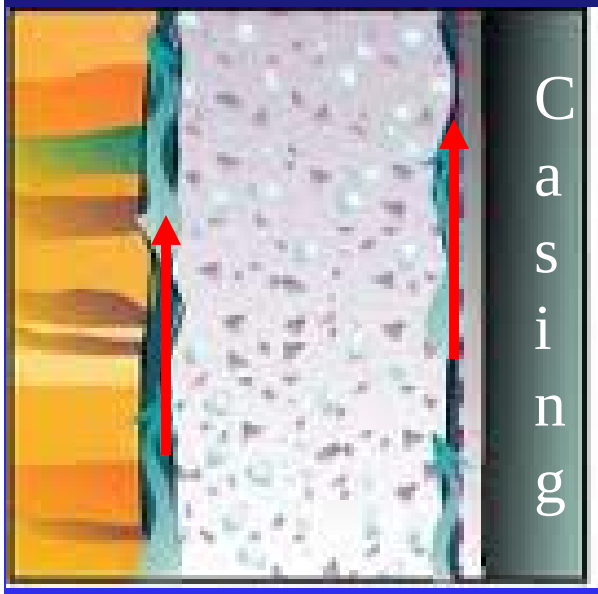


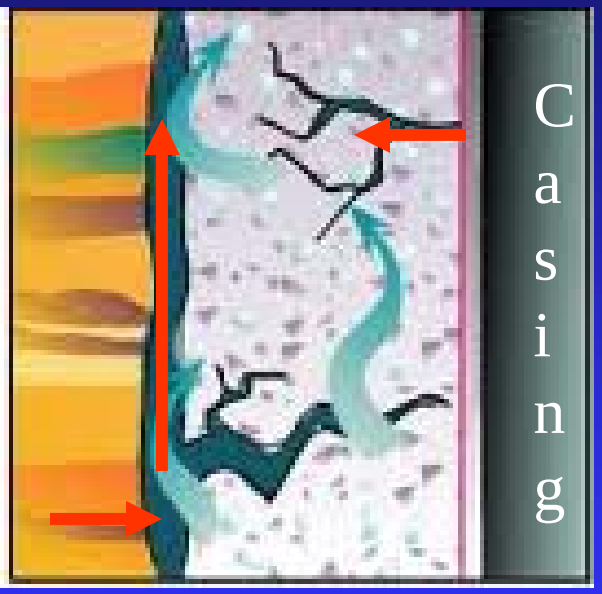
# Protective Casing – Do it Right !

# Problems with Gas Migration and Cement




Does not Bound



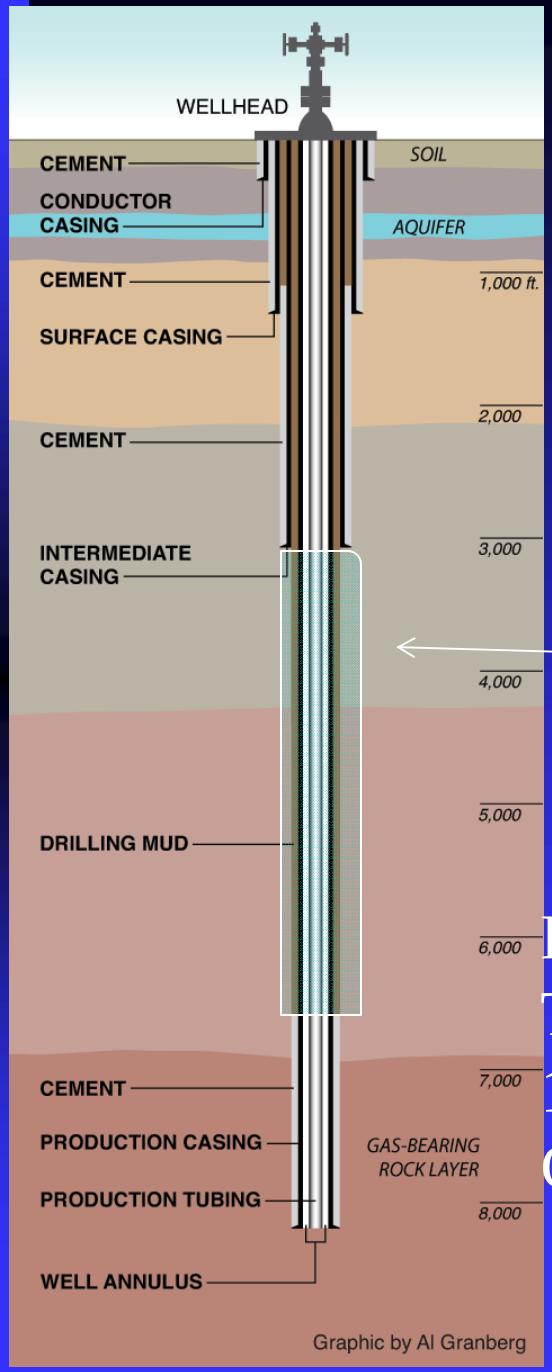



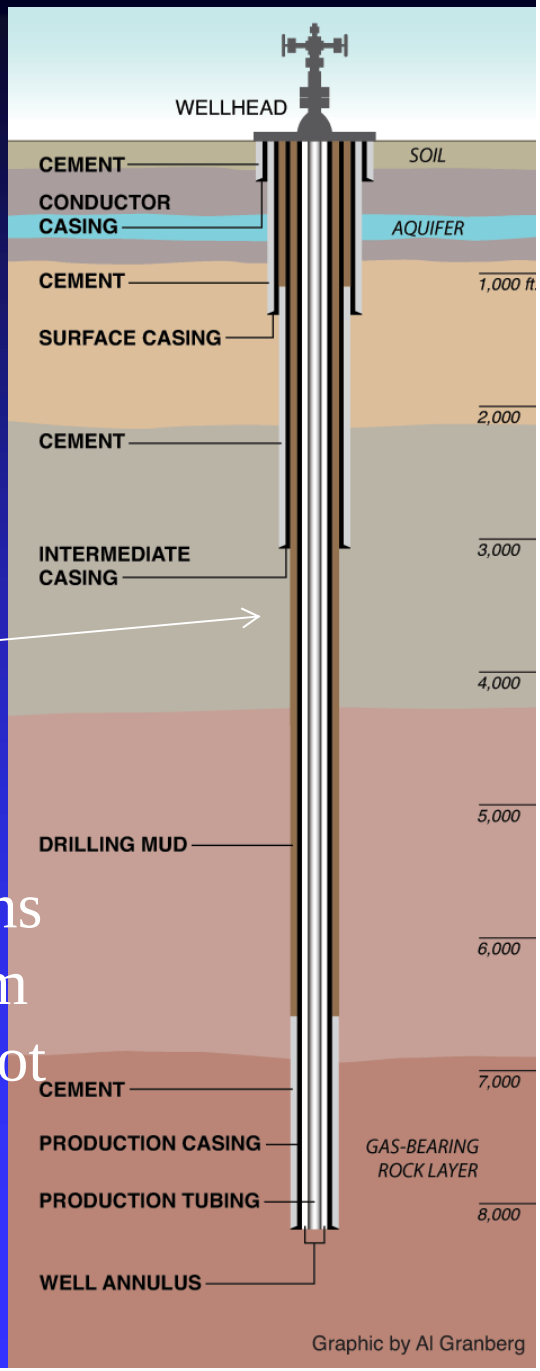
# Typical Well

## Additional Cemented Zones

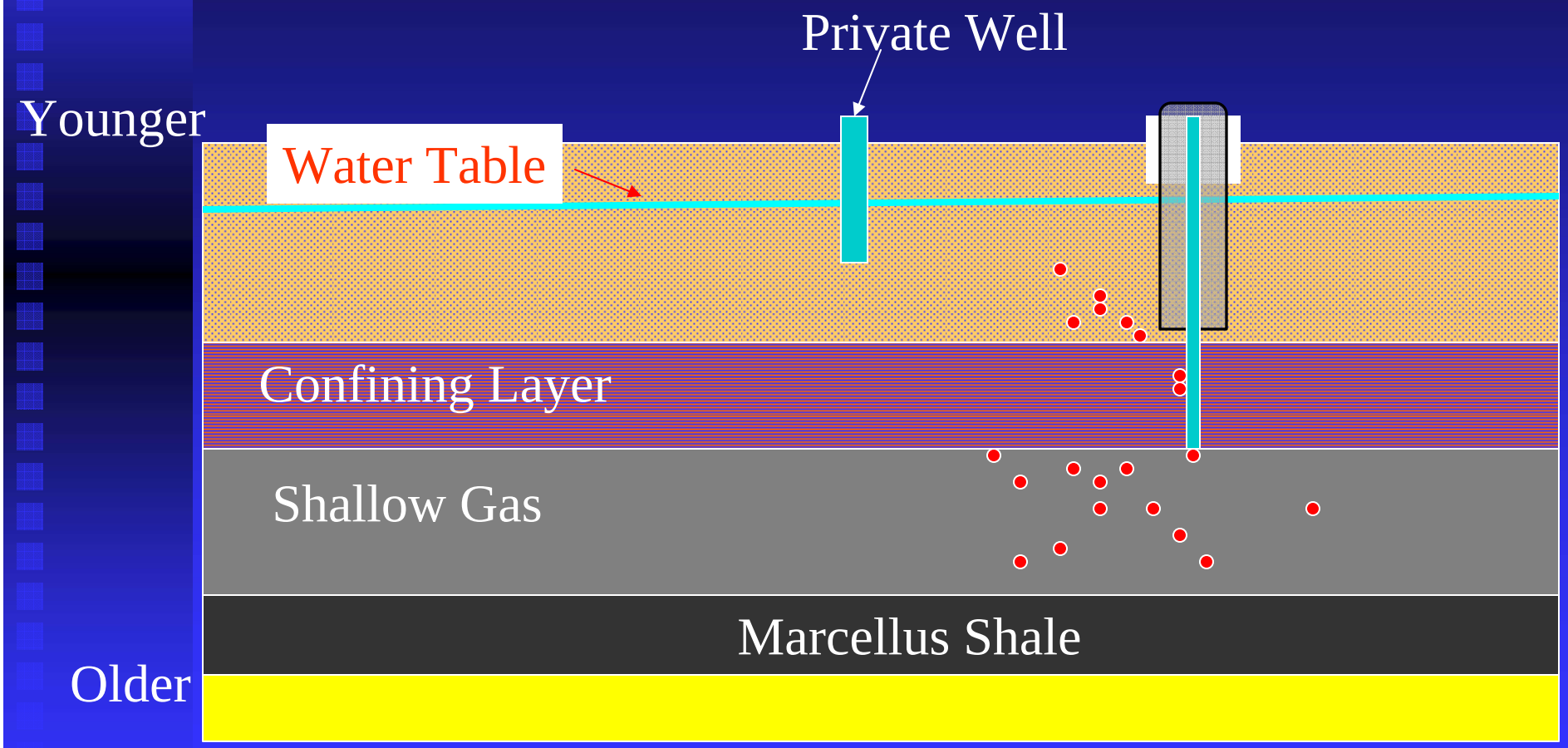
This Zone should be cemented

Even after new regulations There may be a zone from 1500 to 2000 feet thick not Cemented.

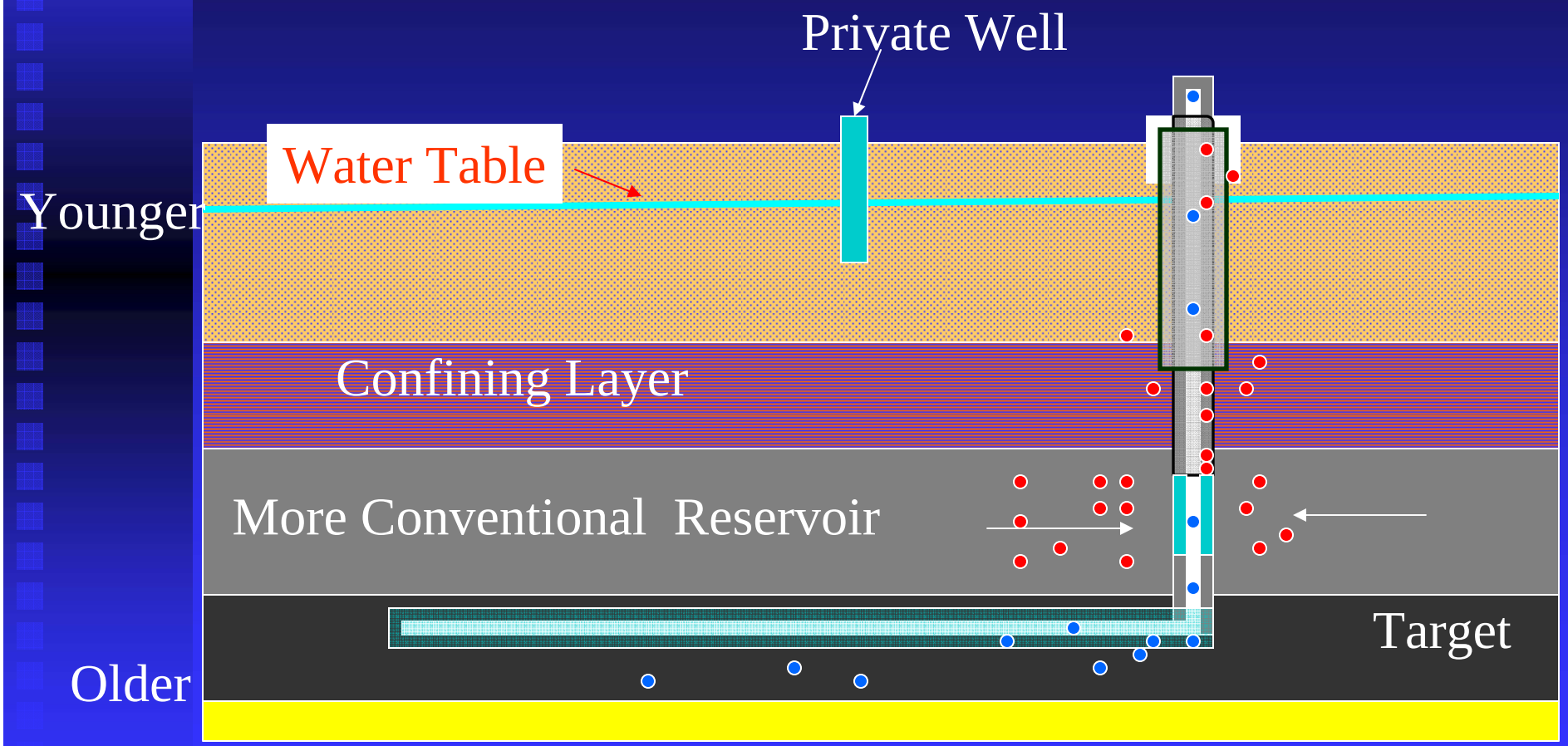


# Migration Concepts- Non-Marcellus Shale - While Drilling- Proper Casement Placement

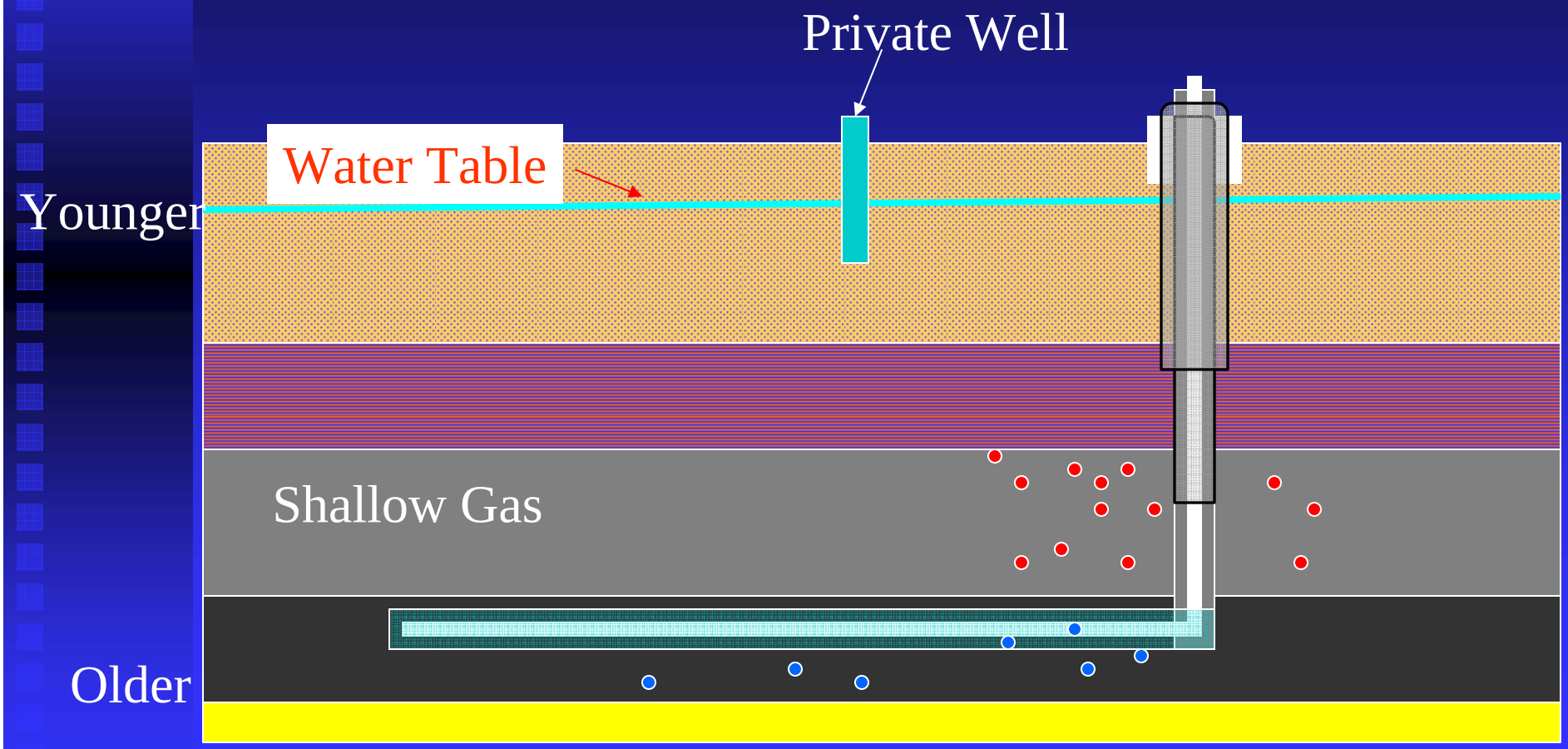


# Migration Concepts- Multiple Casements and Recreate Confining Layers- Need Good Cement Bonds- Cement up to Deepest Casement or Surface



# Migration

# Migration Concepts- Multiple Casements and Recreate Confining Layers – No Uncemented Zones.



- Citizen Database

# Goal of the Database

- Provide a Central Location to Store Baseline Pre-Drilling and/or Post-Drilling Water Quality Data for the Region
- Document Quality by Geological Formation
- Identify Existing Regional Issues or Concerns
- Provide an Un-Biased Community Resource
- Provide a Mechanism to Track Temporal, Spatial, and other Geospatial Variation in Water Quality.

# Citizen Database at Wilkes University- Guidelines for Submission

**II. Guidelines for Data Submission**

1. Third Party Samplers following chain-of-custody to certified laboratory.

2. Submit detailed reports from certified laboratory with a GPS position for the well.

3. The water sample must be collected ahead of any water treatment system.

4. other conditions – Learn More at the Wilkes University Website.

Learn More –
http://www.wilkes.edu/water

Recent Baseline Testing in Luzerne County, PA
320 Private Wells

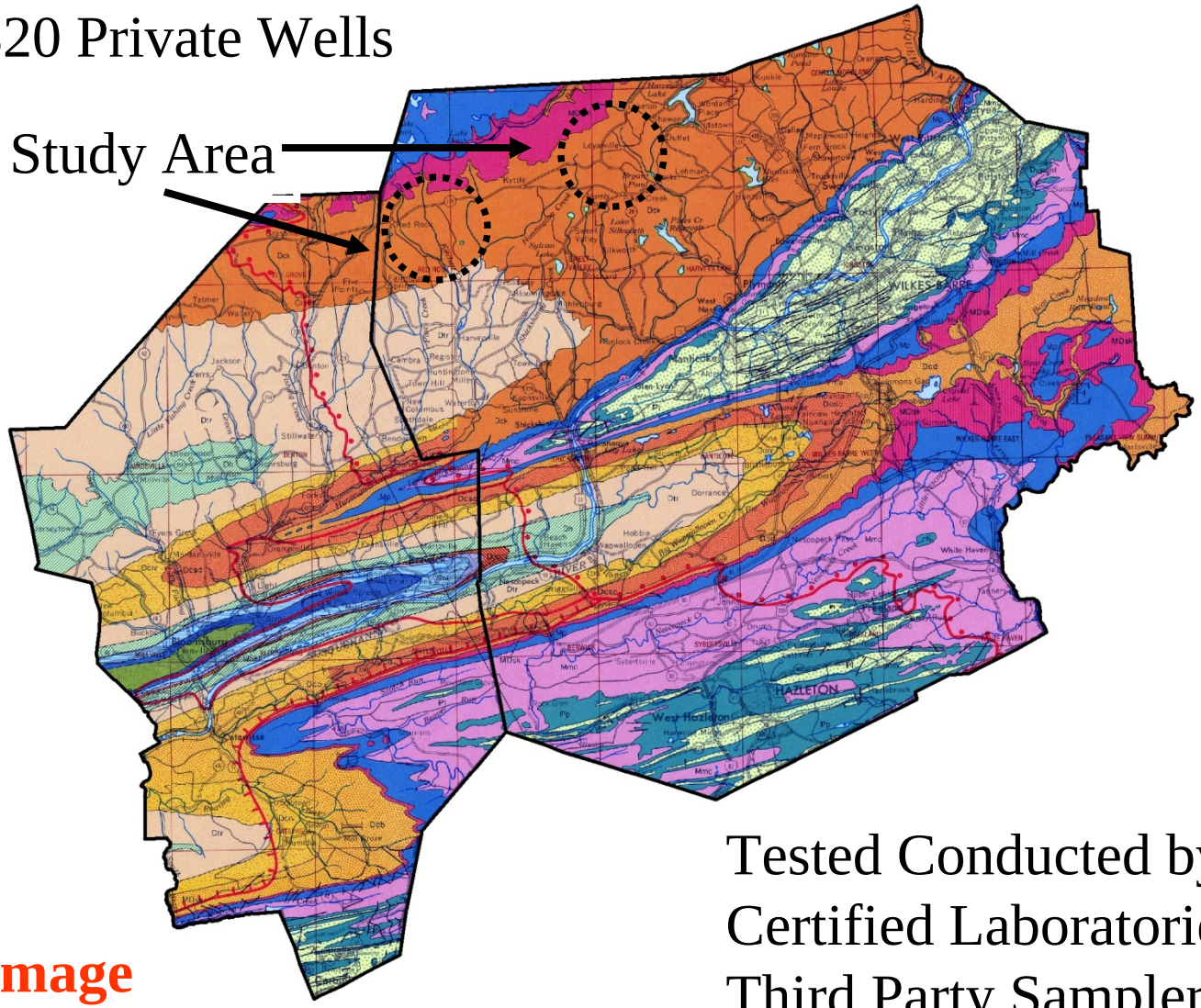
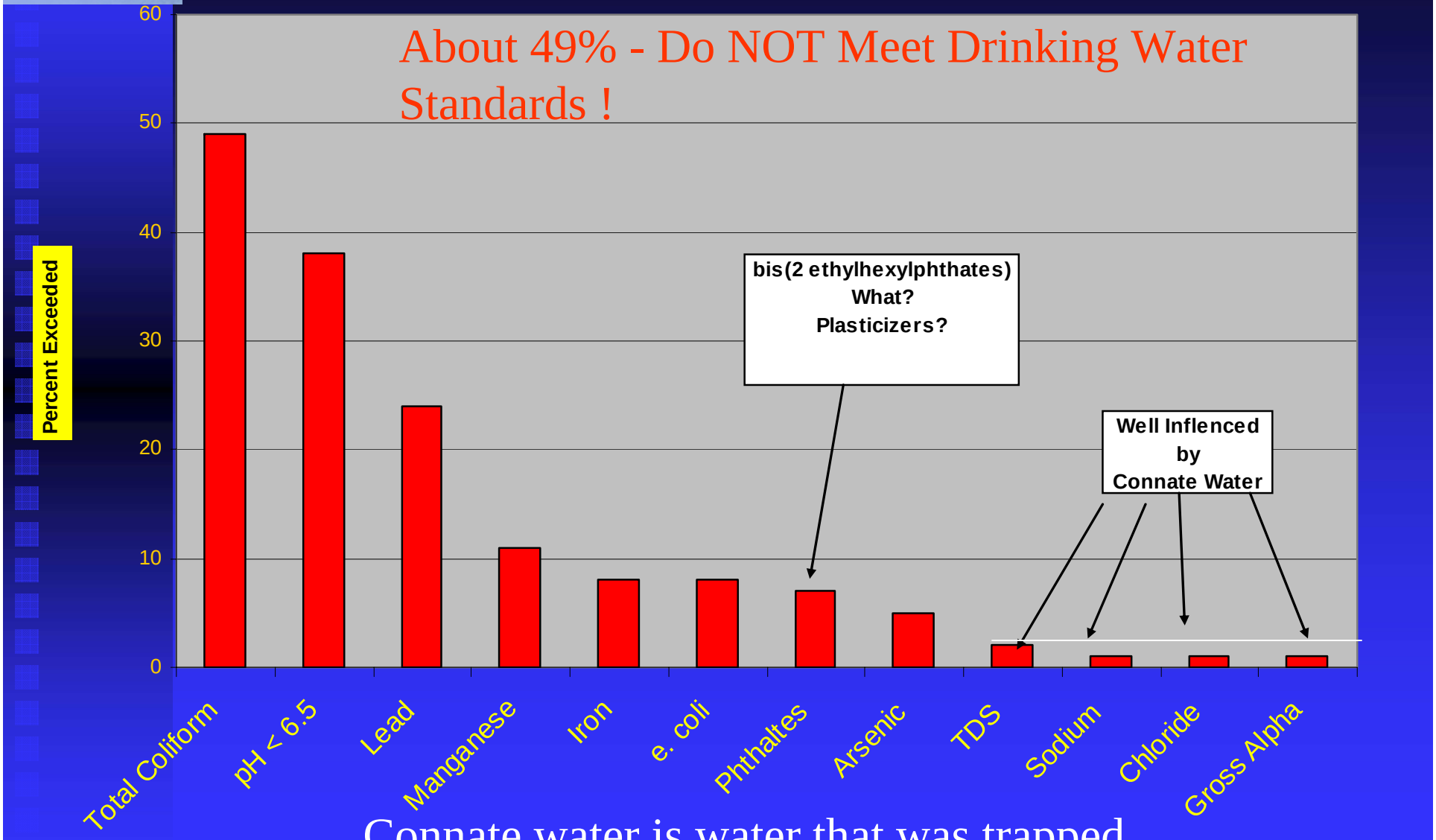



**Image**
**Source: Luzernecounty.org**

Tested Conducted by
Certified Laboratories
Third Party Samplers
Not Wilkes University

# Source – Wilkes University Database




Connate water is water that was trapped in formation when material was deposited.

# What are Phthalates?

- Used as Plasticizers- is a substance which when added to a material, usually a plastic, makes it flexible and easier to handle.
- Bis(2thylhexylphthalte) (DEHP) – DW Standard – 6 ppb – GI problems, possible endocrine disruptor and carcinogen.
- Recent Testing – Highest Value was 60 ppb.
- How did this get in the aquifer?

# How ?  Not Sure – Here are Some Ideas

- Trace Level or near Detection Limit may be related to contamination during field sampling or laboratory testing, but this does not appear to account for levels at or above the drinking water standard.

Other Sources

- Private Wells Not Regulated and there are no plumbing codes.
- Sources – PVC plastic piping used in the home.
- Sources – Drop Pipe and Delivery Piping used in the well.

This is only a hypothesis.

Sometimes we also see hits for **Vinyl Chloride** and **Toluene**

(What the electric Tape !!!!)

# The Marcellus Shale Factor- The Truth about Private Wells

- In 1996 – we knew 50% of Private Wells in PA where contaminated – But What Did We DO?
- The Marcellus Shale Factor or the Development of this resource is NOW bringing this problem to the surface.
- Baseline Testing is being conducted and more problems with groundwater quality are being identified.
- What do we do now? What is the Risk? What is the pathways to Contamination/ Impact? How should Risk be Managed?
- What to Test For as Part of Baseline Testing?
- Some Private Wells may be the pathway to Contamination.

# Baseline Testing

- Baseline Testing
  - Proper Well Purging, Field Monitoring, and Sampling
  - Documenting Existing Conditions and Well or Water Source Information
  - Chain-of-Custody Protocols
  - Using a Certified Lab / Using Certified Methods
  - Picking Water Quality Parameters

Entrance Photo

Locate Well

Look for Treatment (Bypass System)

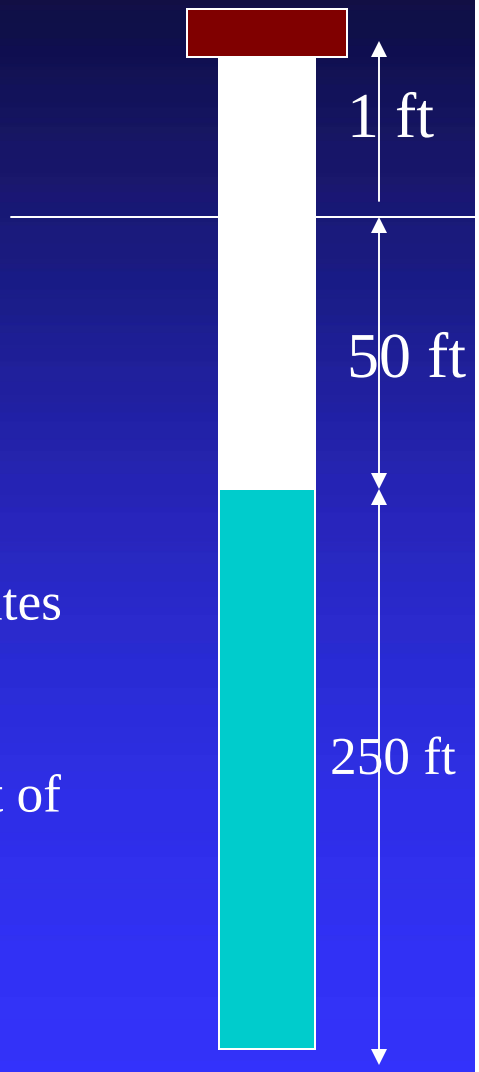
Work as a Team

# Wellbore Volume- Volume of Water in Storage (WBV)

Well Depth from Drillers Log – 300 feet
Well Diameter – 6 inches
Static Water Level (no pumping) – 51 feet
Water Column in the Well – 250 feet
Water in the Well ( 250 ft * 1.5 g/ft = 375gallons)
1 – Wellbore Volume – 375 gallons

If pump produces 5 gallons per minute, it will take 75 minutes to purge wellbore volume

Normally – we attempt to purge 3 wellbore volumes as part of a monitoring effort.



I Got to Lose Weight !

Make sure to complete the Following:

1. Take Notes and Record Observations

2. Label Each Container Name, Site ID, Date, Time, Parameters, Your Initials, Preservation

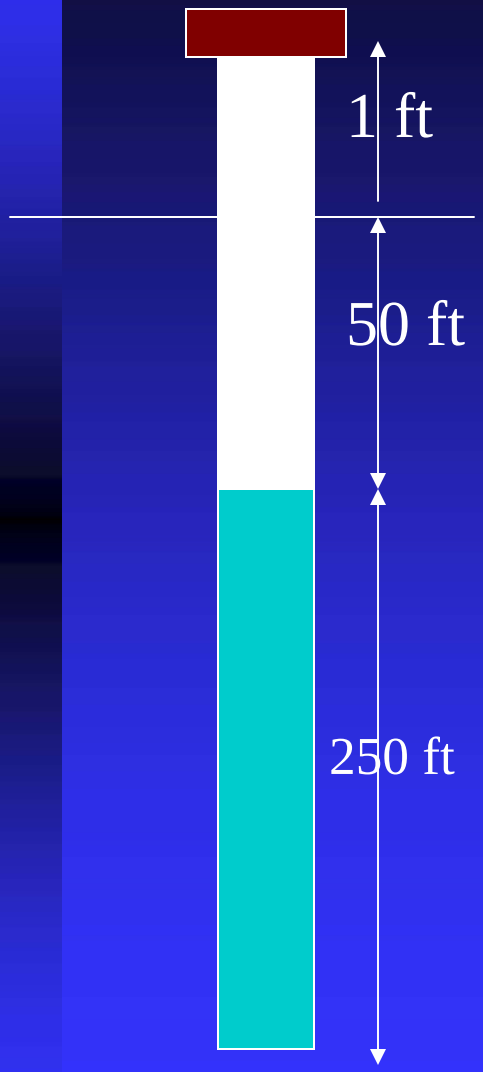
3. Prepare Chain-of-Custody

4. Record Field Water Quality Data

# Methane Gas Level – Change over Time – Highest Methane Level When

- barometric pressure is low and soils are saturated;
- when snow cover is just beginning to melt;
- the ground is frozen or ice covered; or
- under long-term pumping conditions for the well when the well is experiencing the lowest dynamic water level and greatest drawdown.

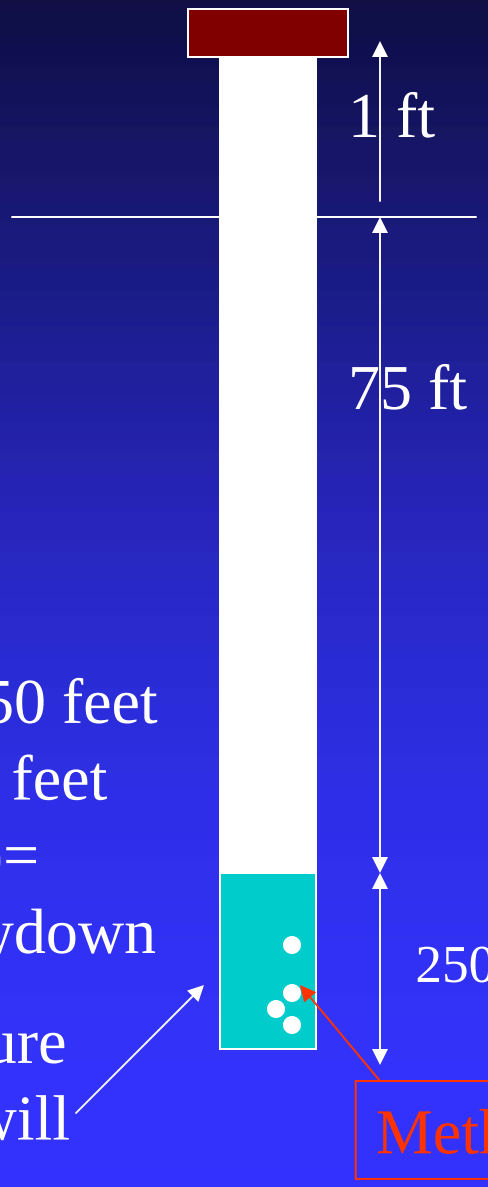
# Estimating Specific Capacity

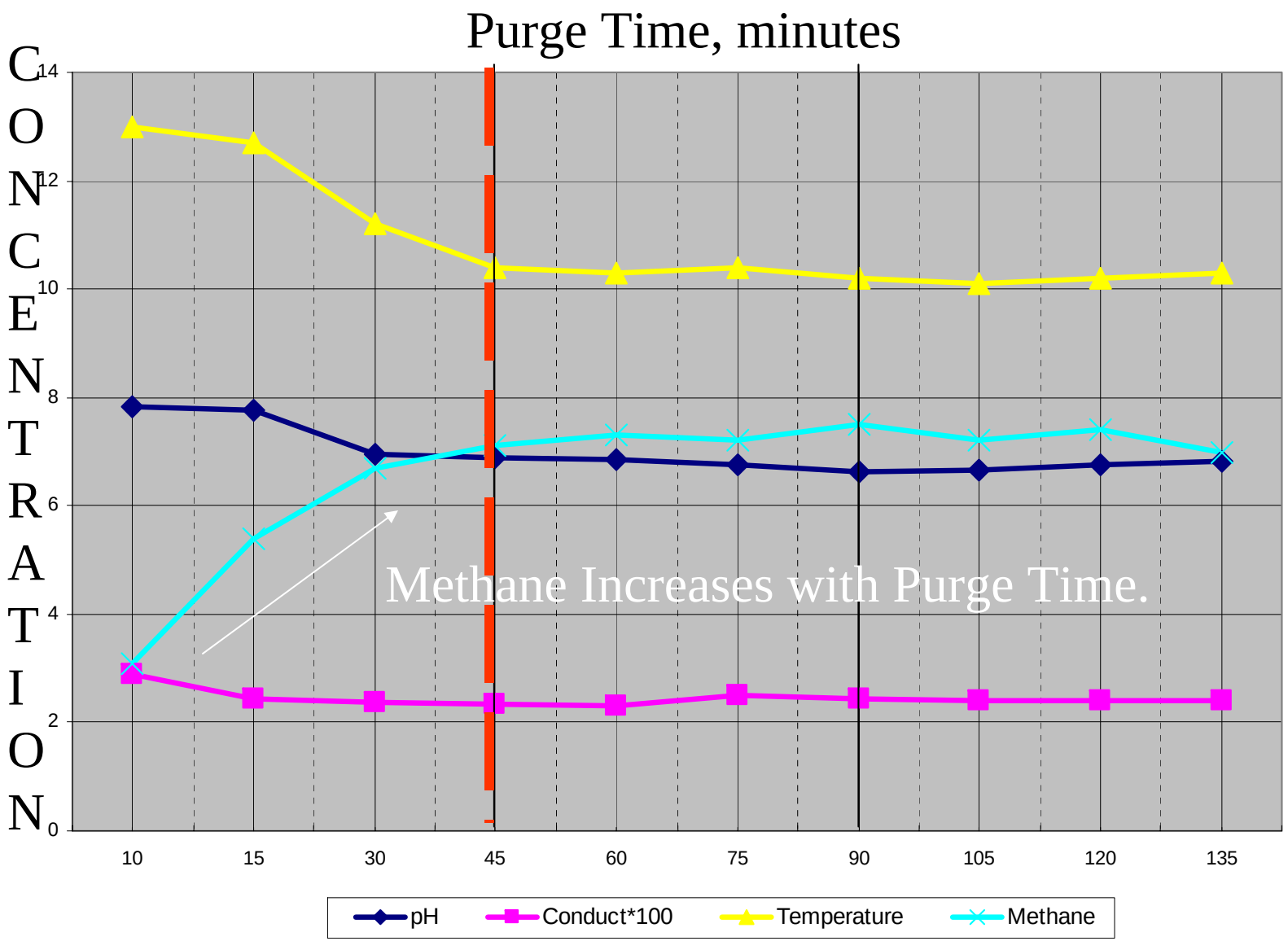



Specific Capacity =
Gpm/ft of drawdown

gpm = 5 gpm
Static Water Level – 50 feet
Dynamic Level – 200 feet
Sc = (5 gpm/ (150 ft))=
Sc = 0.03 gpm/ft drawdown

Less head pressure
More methane will
be released.






1 WBV = 45 minutes

# What Parameters

- Baseline Testing

# Suggested Baseline- For Citizens from PADEP (11/2010)

- Alkalinity, Chloride, Conductivity, Hardness, Oil and Grease, pH, Sulfate, Total Dissolved Solids, Total Suspended Soilds, Total Solids
- Barium, Calcium, Iron, Magnesium, Manganese, Potassium, Sodium, Strontium
- Ethane/Methane
- Total Coliform / E. coli

Other Recommendations at:
http://www.wilkes.edu/water (Fact Sheet - Recommended Baseline)

# Baseline Testing – Oram's Recommendations for Citizens

- Where are you located?
- What is your surrounding land-use?
- Do you have any water quality problems- such as discolored water, odors, or staining?
- Do you have a water treatment system?
- What is the source of your water?
  - Well, Spring, Cistern, etc

Same Baseline Parameters?

Quarry

Mixed Hazards

Saline Seep

# Suggested Baseline- For Citizens

- Testing Package # 1 Recommendations

  Total Coliform with e. coli confirmation, chloride, sodium, bromide, barium, pH, total dissolved solids, MBAS, iron, manganese, and methane/ethane.

- Testing Package # 2 Recommendations
  Package # 1- plus T. Hardness, Magnesium, Selenium, Strontium, Conductivity, Calcium, Zinc, Alkalinity, Arsenic, Nitrate, Total Suspended Solids, Sulfate, Oil & Grease, and 21-VOCs/MTBE.

- Testing Package # 3 Recommendations

  Package #1 and # 2 - plus Potassium, Sulfide, Ammonia, Acidity, Nickel, Gross, Alpha/Beta, Lead, and Uranium.

It may be advisable to add Glycols, Radon in water,and other organics and inorganics. Depending on surrounding land-use, use of geothermal wells, and past history.

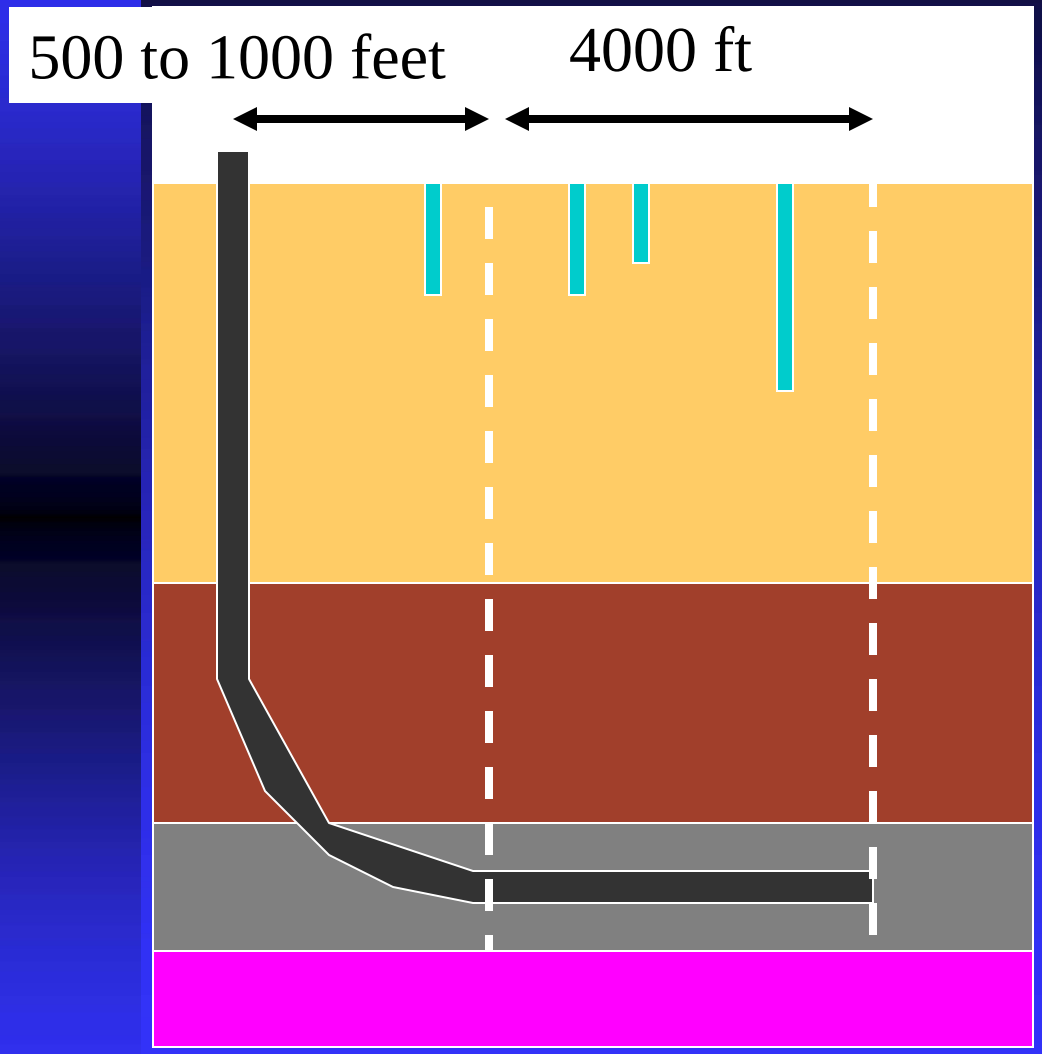
http://www.bfenvironmental.com or call 570-335-1947

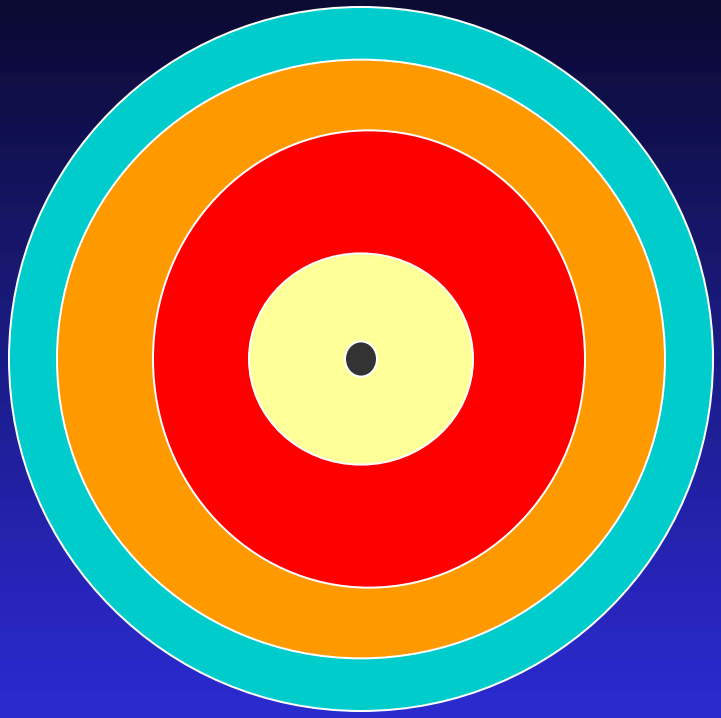
# Suggestions for Baseline Testing

- Bacterial Series
- General Water Quality (pH, alkalinity, hardness, turbidity)
- Secondary Drinking Water Standards
- Oil/Grease
- Volatile Organics and regulated SOCs (Maybe MTBE)
- Radionuclides (Alpha/Beta – Maybe Uranium),
- Gases – Methane/ Ethane/ Propane – Add Radon !
- Major Cations / Anions
  - Plus Bromide, Sulfide, Potassium, Sodium, Aluminum,
  - Selenium, Strontium, Arsenic, Lithium (?), Lead (?), Mercury (?), Silver (?)

Companies need to take a few extra steps – they are assumed responsible.

In general – I could see a radius from 3000 ft to 1 mile



Mud/ Methane Migration (up to 1000 ft)

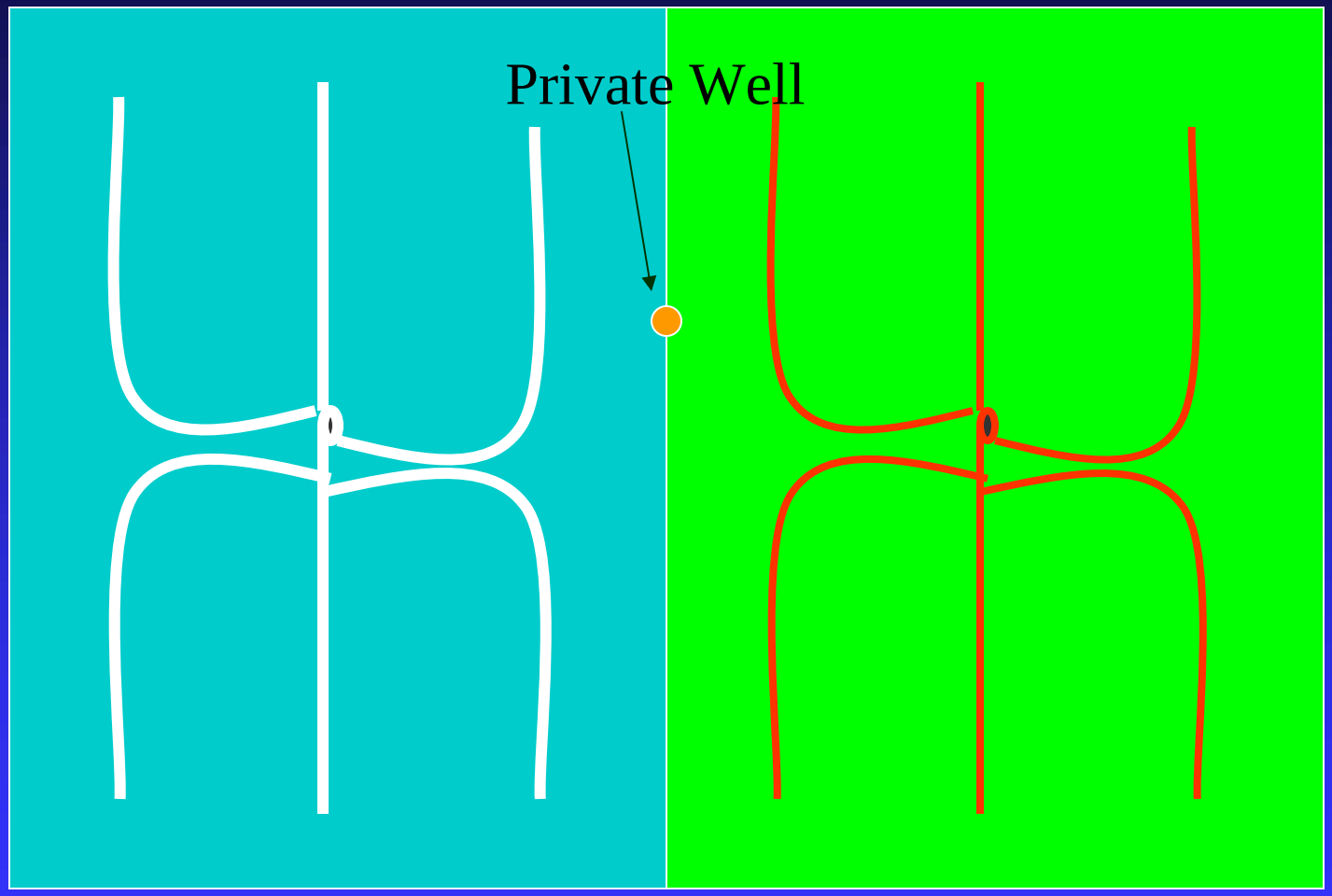
Methane Pushes (2500 feet)

Area Above Lateral

1000 ft Buffer

This is More Opinion/ Judgment- not fact.

My Primary Concern with Respect to Radius and Assumed Liable is “Who is Responsible”




Company A

Company B

Maybe Baseline Testing Zone should match well capture zone.

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# New Community Resource


Download a Free Copy (pdf) or
at http://www.bfenvironmental.com

Also:

1. BFE are Working on a Regional Citizen Water Quality Database.

2. BFE provide informational water testing and Facilitate certified baseline testing.

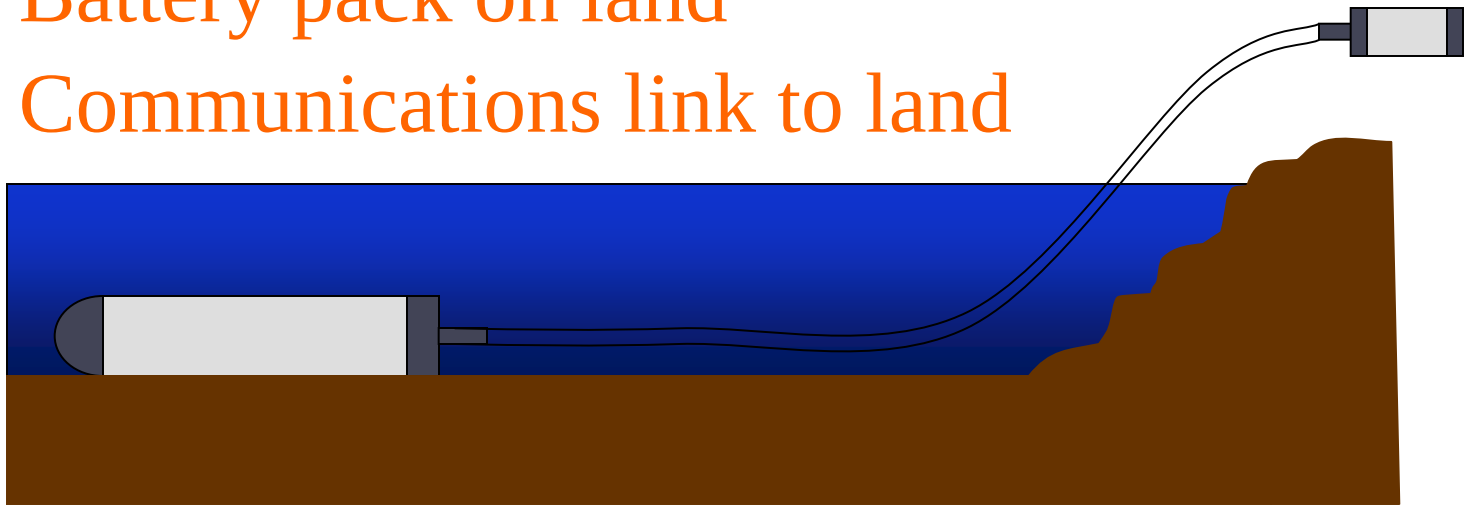

Add Your Data to the Citizen Database- Contact Mr. Brian Oram at brian.oram@wilkes.edu or bfenviro@ptd.net

# What Citizens Can Do?

- Be active in Proposed Legislation.
- Participate and Release Data to the Citizens Groundwater/ Surfacewater Database
- Push for Local Zoning/ Subdivision Ordinances in Community.
- Private Well Construction and Siting Standards
- Getting Marcellus Shale related infrastructure added to deeds for parcels.
- Get a copy of the well permit for natural gas wells at a local office.
- Self Monitoring
  - Baseline Testing- Certified, Chain-of-Custody- call (570) 335-1947 – ask for Brian
  - Post Testing Using Informational Water Test Services – http://www.water-testing-kits.com
  - Self Monitoring – Easy to Use Monitoring Equipment and Citizen Monitoring Programs http://www.bfenvironmental.com

# Sensor Deployment

- Fully Submerged Sensor
- Breather tube for ambient air pressure
- Battery pack on land
- Communications link to land



http://www.dragonflyscientific.com/

# More Citizen Science

## Battery Pack and Communications

- Allows battery change without moving sensor
- Initial version has cable to download to microserver
- Add-on bluetooth wireless interface module
- Provides link to Smart Phone

http://www.dragonflyscientific.com/

# Changes in the Regulations

- Require Lined Sites with Containment.
- Require Cement Bond Logging.
- Require Cementing to Surface for all strings and production casing.
- Require Monitoring Private Wells During Drilling Process – Field Screening Only
- Increase baseline testing zone to cover the anticipated capture zone for the well pad.
- More Cased Zones – Multiple Cement Casing
  - New Strings
    - Shallow Freshwater
    - Deeper Freshwater
    - Saline Zone Casing

# Two Free Things that You Can Do To Make a Difference!

- We Need Your Help – Act Now

http://www.surveymonkey.com/s/NMG6RQ3

- Add your baseline Data to the Citizens Database – Contact Mr. Brian Oram
  - bfenviro@ptd.net
  - http://www.bfenvironmental.com
  - 570-335-1947

## Recent Site Tour- Towanda, PA

I took both photos – First Time on the Drilling Platform

# Certificate of Completion

## Training Event

### Getting The Waters Tested The Marcellus Shale Factor

10/17/2011

2 – hour PDH or 0.1 CEUS

Presented by

Mr. Brian Oram, PG

B.F. Environmental Consultants Inc

15 Hillcrest Drive

Dallas, PA 18612

More Online Training @

http://www.bfenvironmental.com

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Located in Northeastern Pennsylvania
water reuse hydrogeology soil testing

# Presented by:

Mr. Brian Oram, Professional Geologist (PG),
Soil Scientist, Licensed Well Driller, IGSHPA

B.F. Environmental Consultants Inc.
http://www.bfenvironmental.com

And

Water Research Center
http://www.water-research.net

Announcement – New Private Well Owner and Watershed Survey for Marcellus Shale Region - Going to Offer 200 Free Radon in Water Tests.
http://*www.**survey**monkey.com/s/NMG6RQ3*