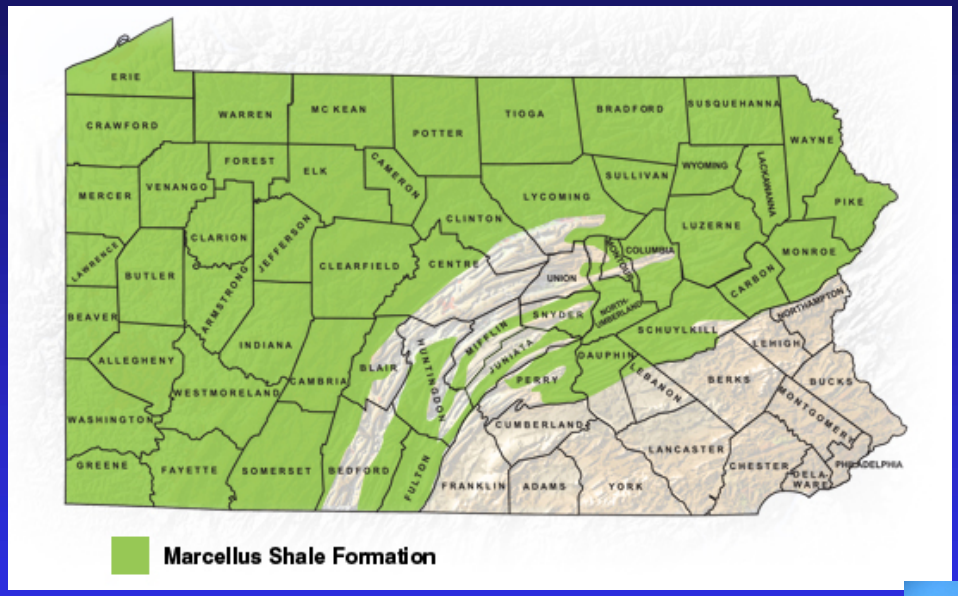
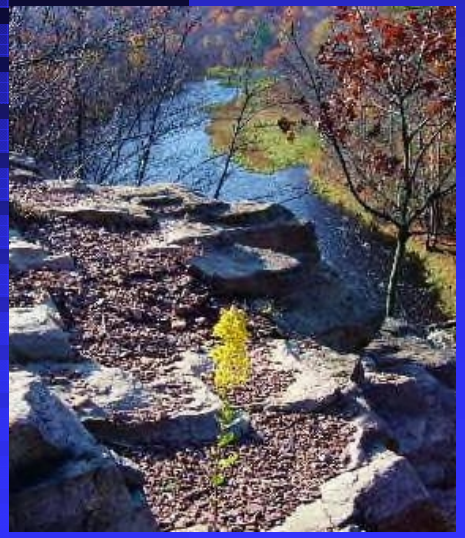
Getting The Waters Tested
The Marcellus Shale Factor

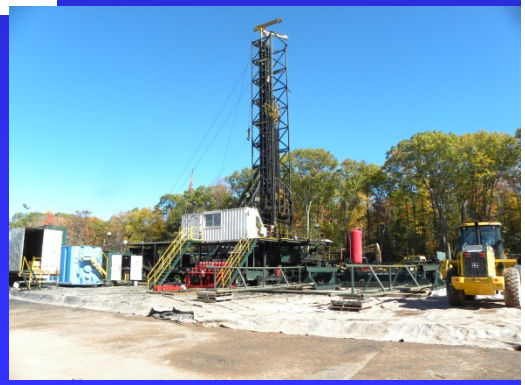
Water Resources



Old Issues



Environment



New Issues

My Approach – Working as a Community

Document

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- For permission – Contact Mr. Brian Oram, PG
- bfenviro@ptd.net
- 570- 335-1947

Protecting Groundwater - This is Not Just a Marcellus Shale Issue

Methane Gas Migration at Wellhead - 2009

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

Well Water PA

December 6, 2012

Abandon Gas Well in a Stream

Well Water PA

Thanks to Our Local Host

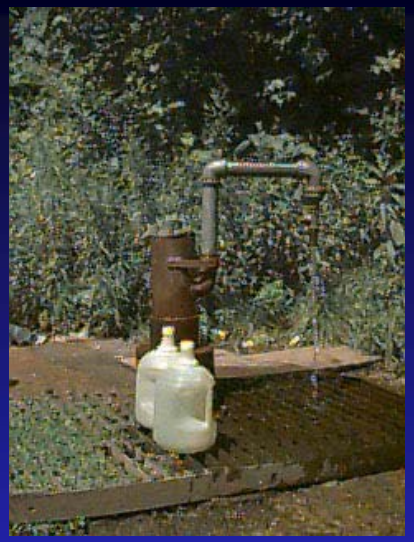
- Izaak Walton League of America – Washington Chapter
- The ***Izaak Walton League of America*** is a national non-profit organization dedicated to protecting the soil, air, woods, and water of the United States.
- http://www.iwla.org

What Other Organizations or Groups are Present?

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

Certificate of Completion

Training Event

Getting The Waters Tested The Marcellus Shale Factor

12/6/2012

3 – hour PDH or 0.3 CEUS

Presented by

Mr. Brian Oram, PG

B.F. Environmental Consultants Inc

15 Hillcrest Drive

Dallas, PA 18612

More Online Training @

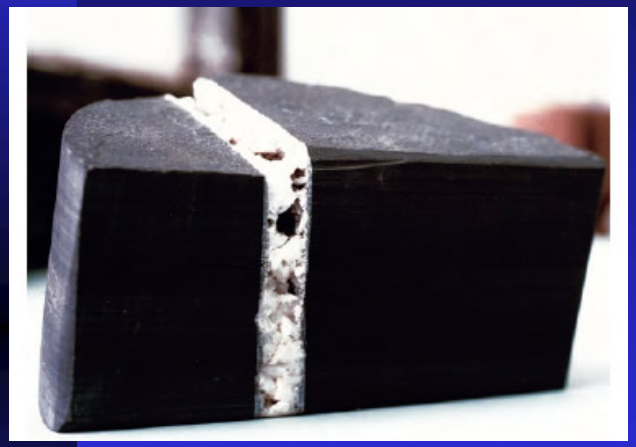
http://www.bfenvironmental.com

iCONSERVE PENNSYLVANIA

Target Audience

- Stakeholders
- Private Well Owners
- Community Advocates and Scientists
- Health Related Professionals
- Municipal and Local Officials
- Water Supplies and State Regulators
- Gas Companies
- Consultants

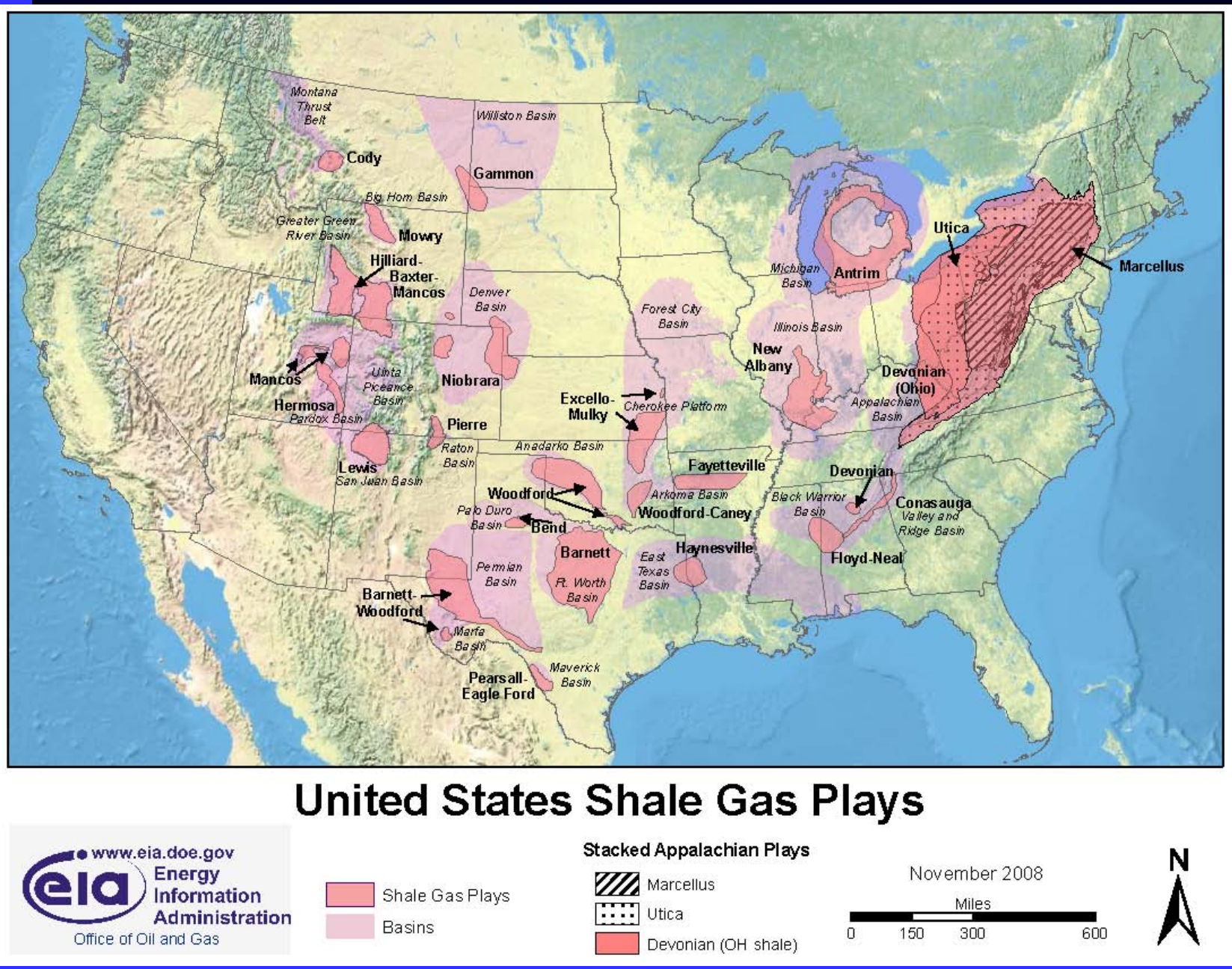
Marcellus Shale / Clean Water
The Match of the Century or Couple Hundred Years.



The Match Of the Century – Pick a Side and Lets See Who Wins.

No –This mindset will NOT get us Anywhere.

We ALL Live Downstream !
We Need to Work as a Community !



United States Shale Gas Plays

www.eia.doe.gov
Energy Information Administration
Office of Oil and Gas

Shale Gas Plays
Basins

Stacked Appalachian Plays
Marcellus
Utica
Devonian (OH shale)

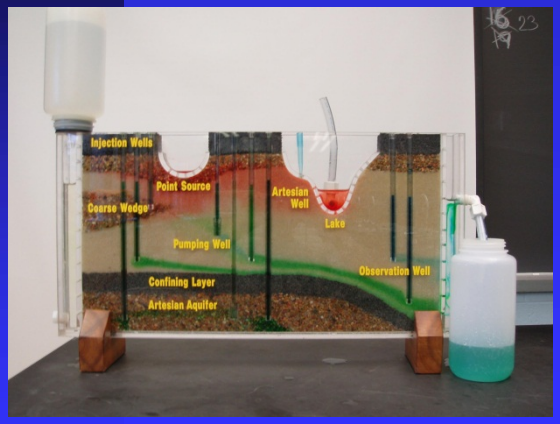
November 2008
Miles
0 150 300 600

N

We are not Alone ! Issues are Same and Different.

Presentation

- Does Water Quality Change – if so how?
- What is Baseline Testing?
- What are the Critical Issues?
- What are some of the Key Parameters?
- What is Working as a Community?



Education

Documentation

Monitoring

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 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.

This is Drinking Water in PA?

50%

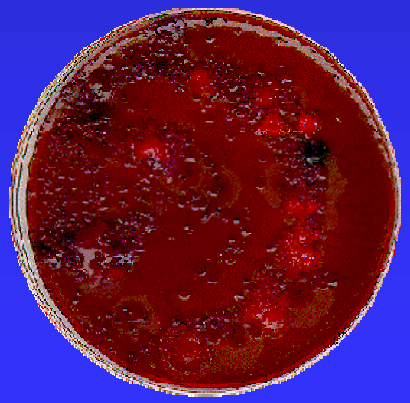
Iron / Manganese

Sediment / Gases

How do we know this?

Other 50%

Corrosion



Bacteria

Citizen Groundwater and Surface Water Database

What is in the Database?
How you can contribute ? (anonymously to the database)
It is Free ?

Citizen Database- Guidelines for Submission

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.

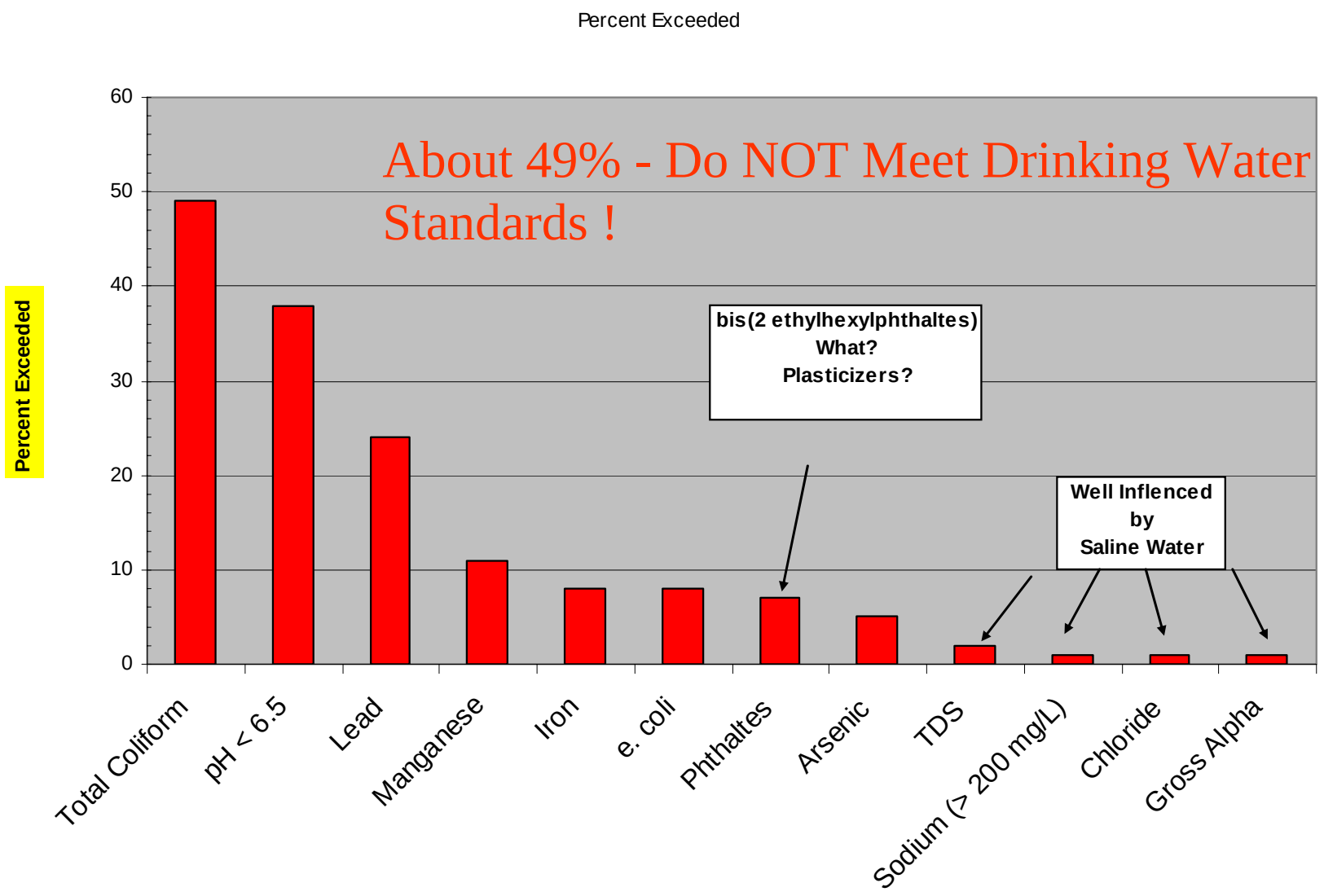
3. The water sample must be collected ahead of any water treatment system.

4. Learn More about the this Program at the Water-Research Center http://www.water-research.net or bfenviro@ptd.net

WATER QUALITY DATABASE CONSENT & INFORMATION

Information Available
No Charge to Participate

Read About the Program in Our New Booklet →


Percent Exceeded
Percent Exceeded
About 49% - Do NOT Meet Drinking Water Standards !
bis(2 ethylhexylphthaltes)
What?
Plasticizers?
Well Inflenced
by
Saline Water
60
50
40
30
20
10
0
Total Coliform
pH < 6.5
Lead
Manganese
Iron
e. coli
Phthaltes
Arsenic
TDS
Sodium (> 200 mg/L)
Chloride
Gross Alpha

Role of Poor Siting / Maintenance

- How does this impact groundwater quality?

Draining a Hotwater Heater
Intermittent – Discolored Water
Sulfur Like Odors

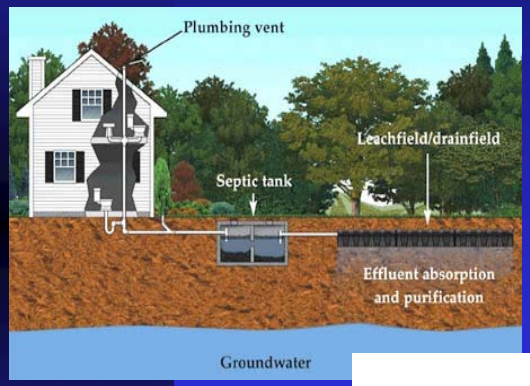
Some Private Well Photos

Things I have found within 100 feet of a private well – Just a Few

By the way – these two photos are only 200 feet apart
Groundwater is Safe and Pure – Really ?

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



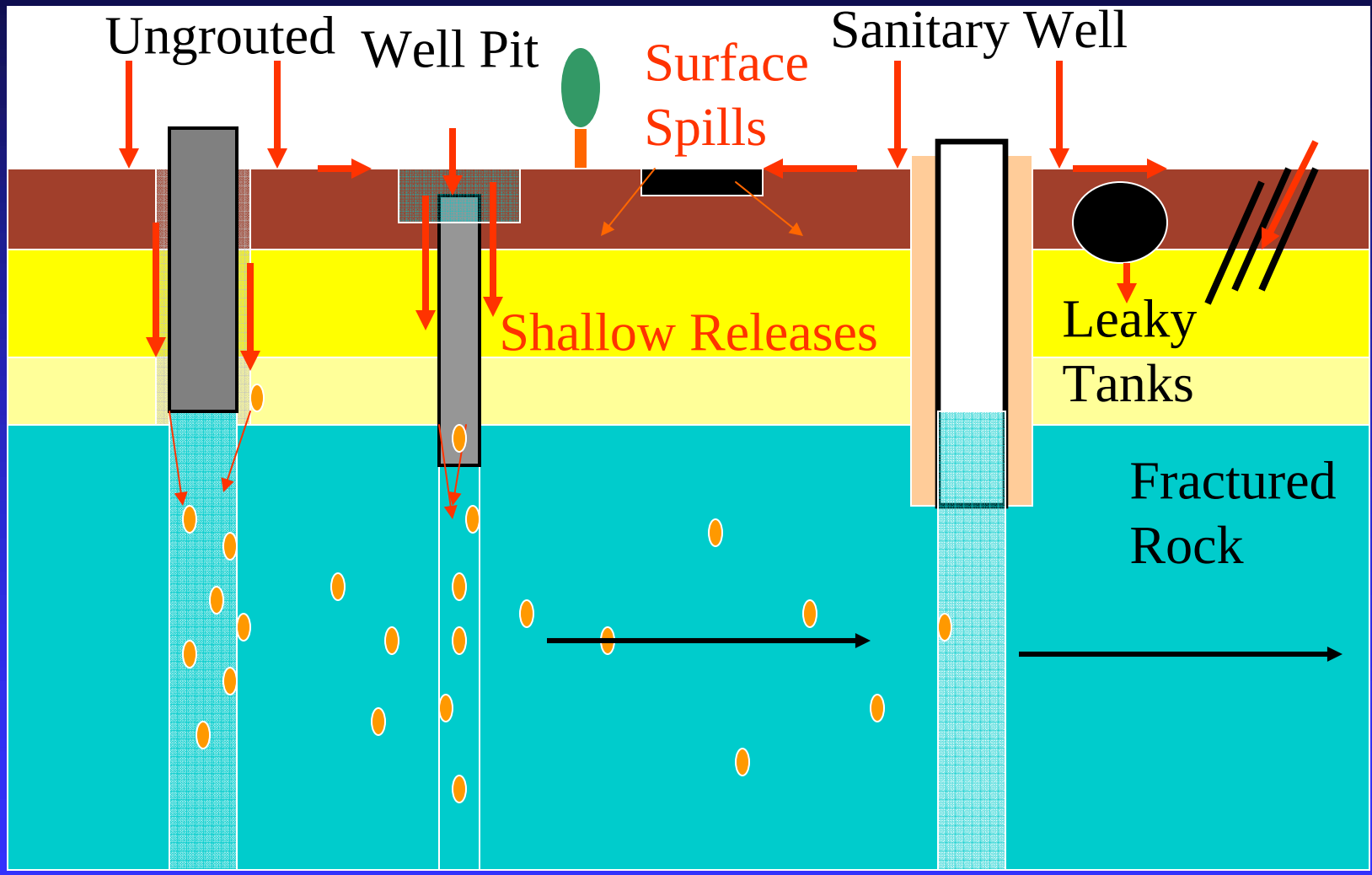
Not Just a Marcellus
Shale Issue and in some cases
other Private Wells are Part of the Problem

How do these contaminants move?

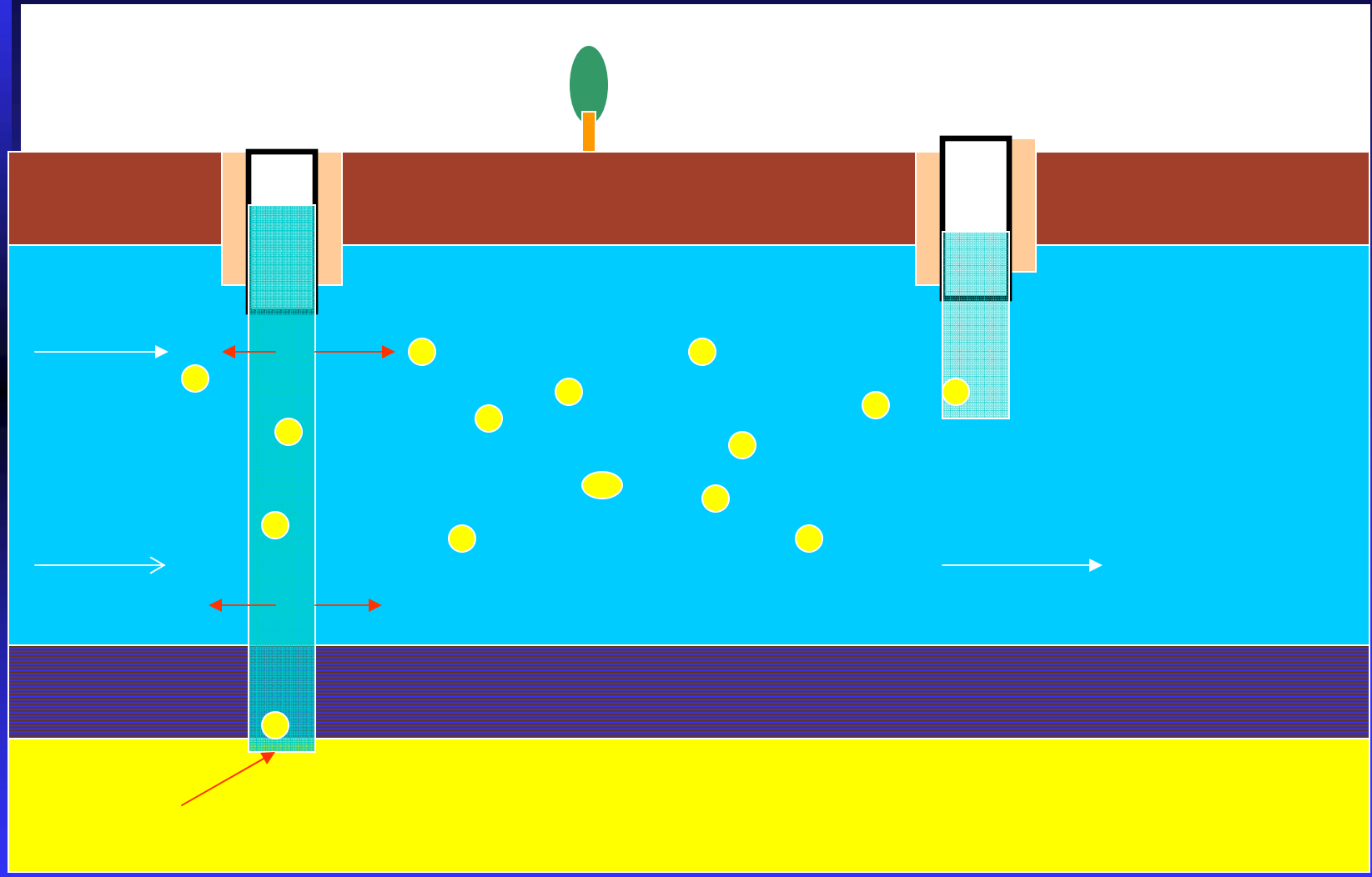
- What are the pathways?

What ? Where? How?

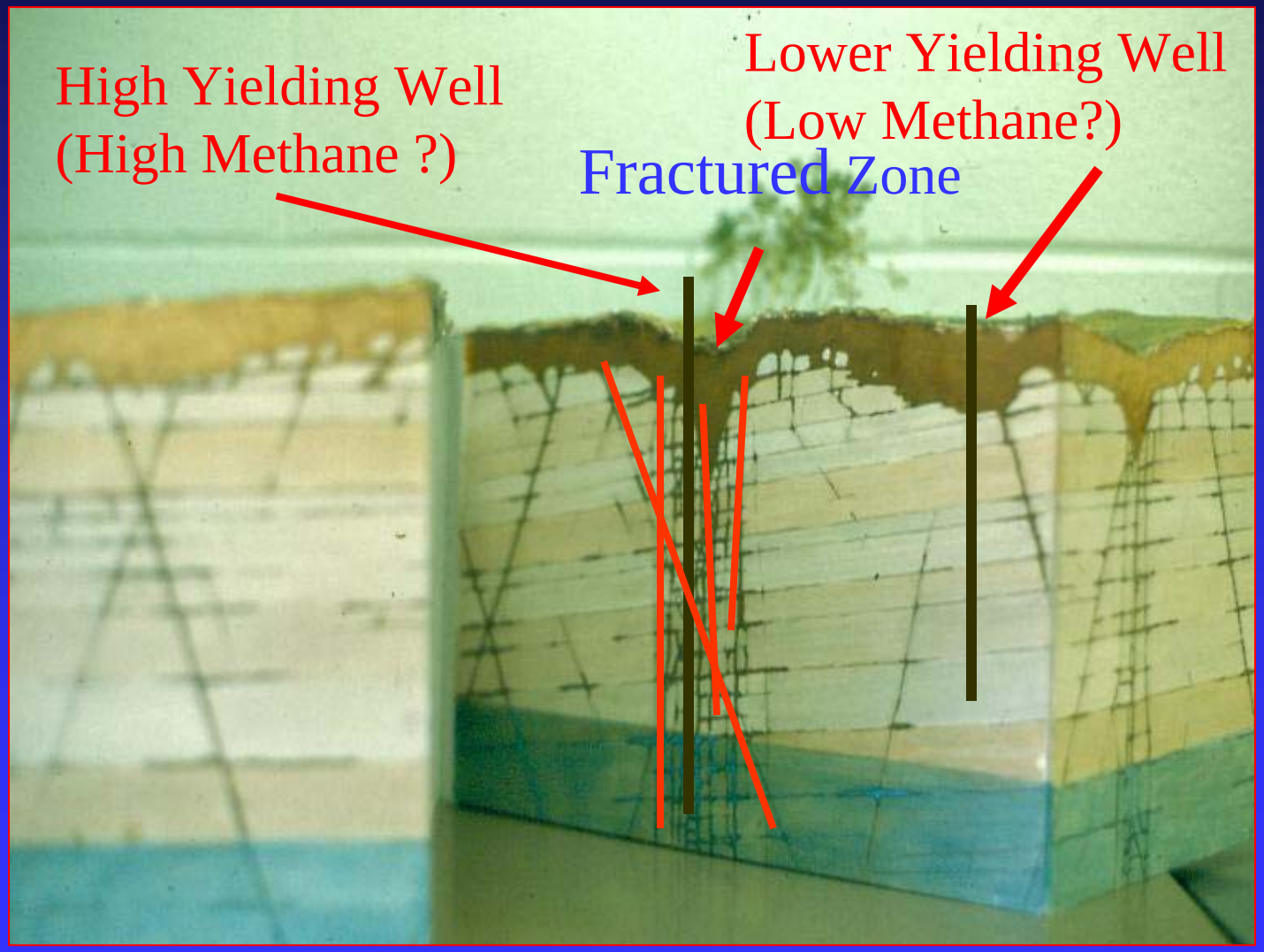
How Contaminants Can Get In to the Aquifer (Surface)



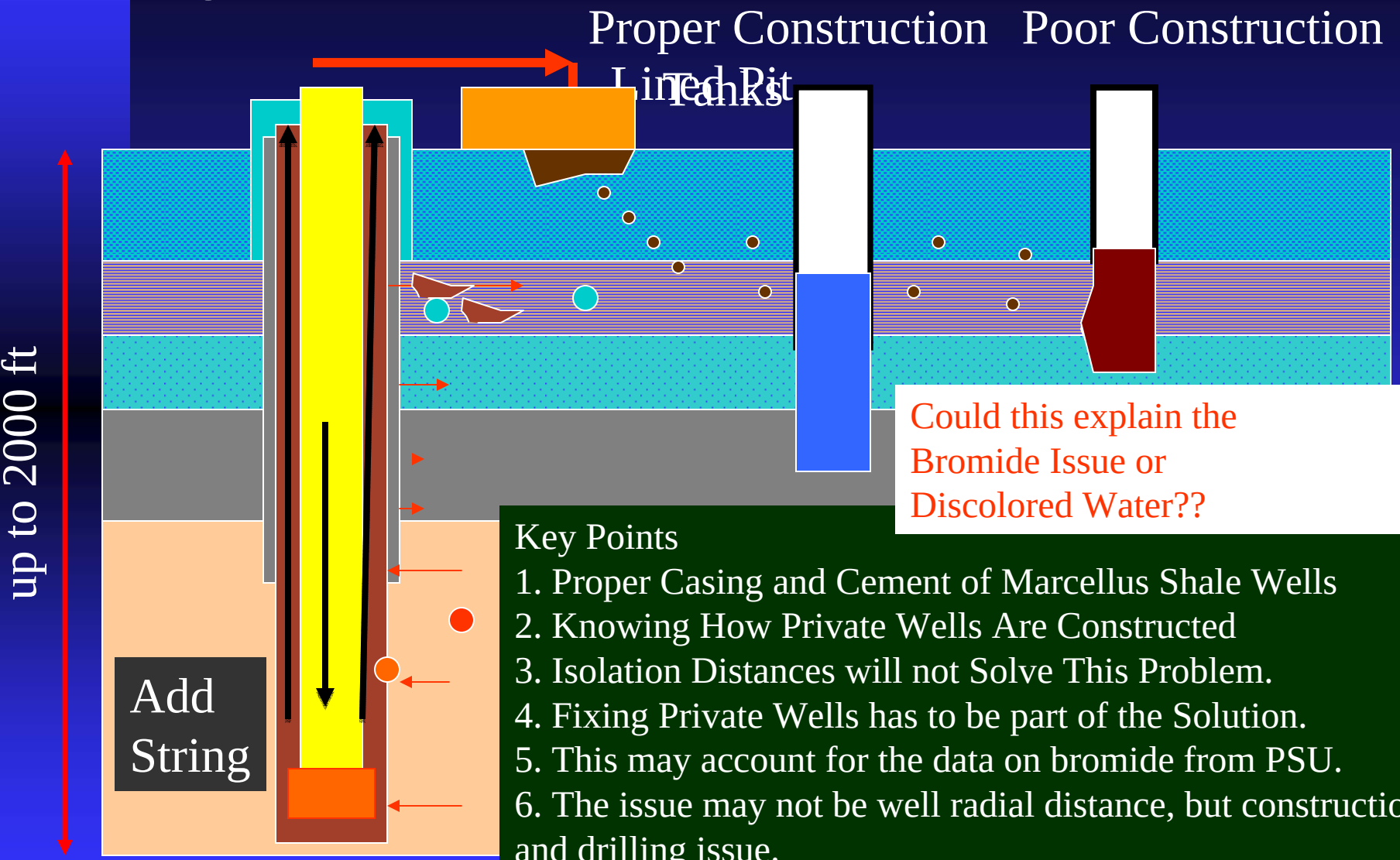
How Contaminants Can Up into a Shallow Aquifer



Bedrock Fractures and Fractured Zones



PSU Study -Migration and Disturbance During Drilling- losing circulation



Could this explain the Bromide Issue or Discolored Water??

Key Points

1. Proper Casing and Cement of Marcellus Shale Wells
2. Knowing How Private Wells Are Constructed
3. Isolation Distances will not Solve This Problem.
4. Fixing Private Wells has to be part of the Solution.
5. This may account for the data on bromide from PSU.
6. The issue may not be well radial distance, but construction and drilling issue.
7. Recommend closed loop drilling with water within freshwater aquifer (no muds) or water-based muds.

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Environmental Scientists, Hydrogeologists, & Environmental Education Specialists
Located in Northeastern Pennsylvania
water reuse hydrogeology soil testing

Movement of Soils and Sediment
Along Bedding, Joints, and Fractures
Open Fractures Tend to Decrease with Depth

Movement and Migration along Bedding Planes, Joints, and Fractures

How Can Private Wells Be Impacted by Marcellus Shale Development?

1. First this is a bad question and premise.

We should be concern about ALL activities that can adversely Impact a Private Well, plus we should be concerned that there are no private well construction standards for most of PA.

2. My water was fine – here is the before and after – this must be caused by Marcellus Shale Related Activity? Maybe Not

Then

Now

Oram, 2011
Susquehanna County, PA

Example of Nuisance Bacteria
Iron Related Bacteria Count - > 140,000 colonies per ml
Aluminum – 0.511 mg/L, Iron 1.87 mg/L, Manganese – 5.4 mg/L,
Lead 0.029 mg/L, Methane - < 0.001 mg/L

Nuisance Bacteria Can Really Do This?

Before

Homeowner Calls

Findings: Iron, Manganese, Aluminum High
Chloride, Barium, Methane Low
Nuisance Bacteria – Extremely High
ORP – Low- No Methane

Evaluate

Shock
Disinfect
and Clean
Wellbore

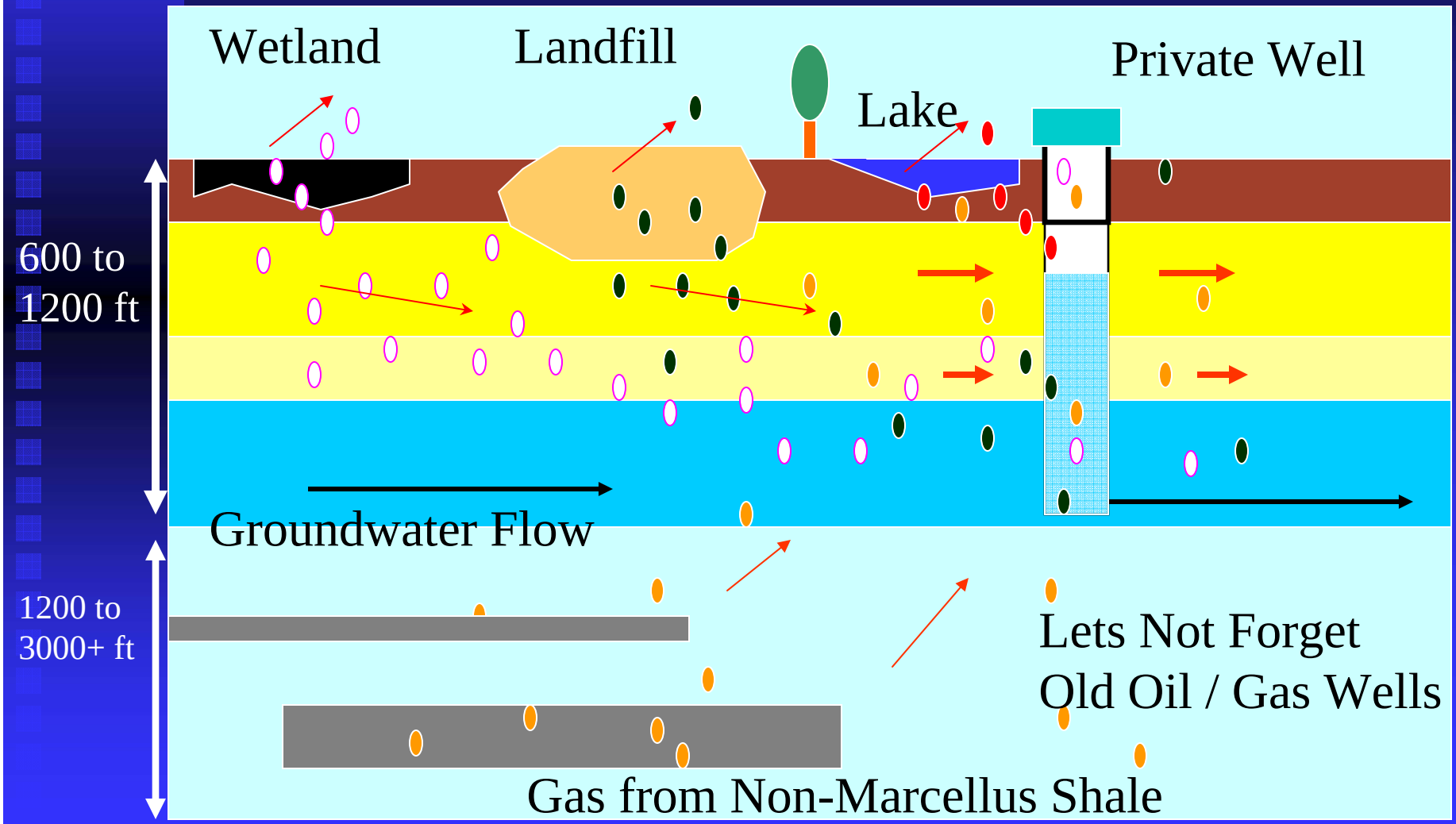
Primary Cause
Nuisance Bacteria

Methane Migration (Natural, Induced, Facilitated)

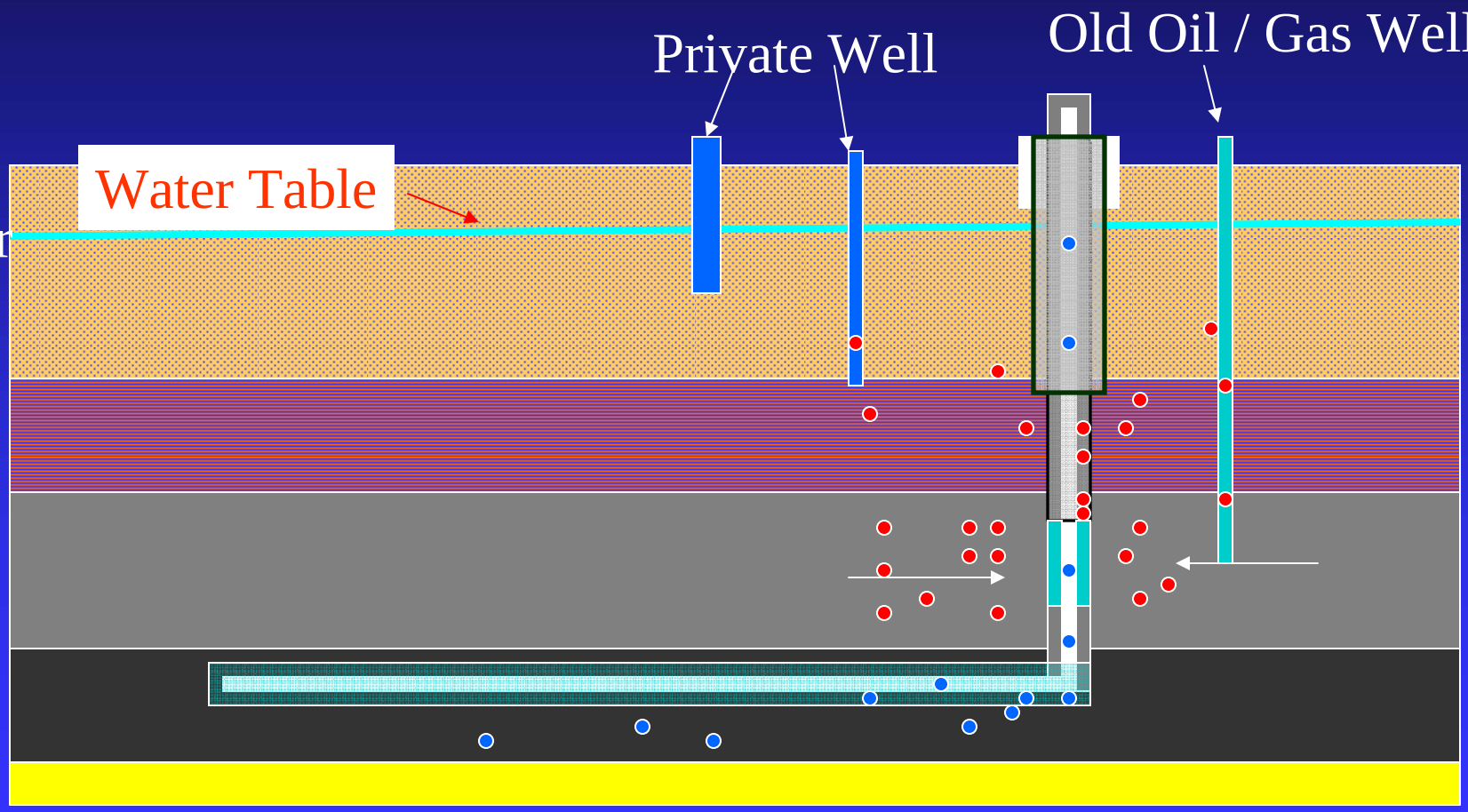
Smell is Odorless, Colorless, and Looks Like This:

Add Ignition Source And Oxygen

Methane Gas Migration- Not Related to Marcellus Shale



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



Other Pathways – Deep Private Wells with Saline Water Fingerprints
Old Abandon Oil/ Gas Wells

Salt Springs State Park, Susquehanna County, PA
http://youtu.be/N4Ibbs7BN_E

How Can Methane Level be Above 28 mg/L ?

	Methane Solubility
Zero Head	28 mg/L
50 feet Head	69 mg/L
100 feet Head	110 mg/L
150 feet Head	151 mg/L
200 feet Head	192 mg/L

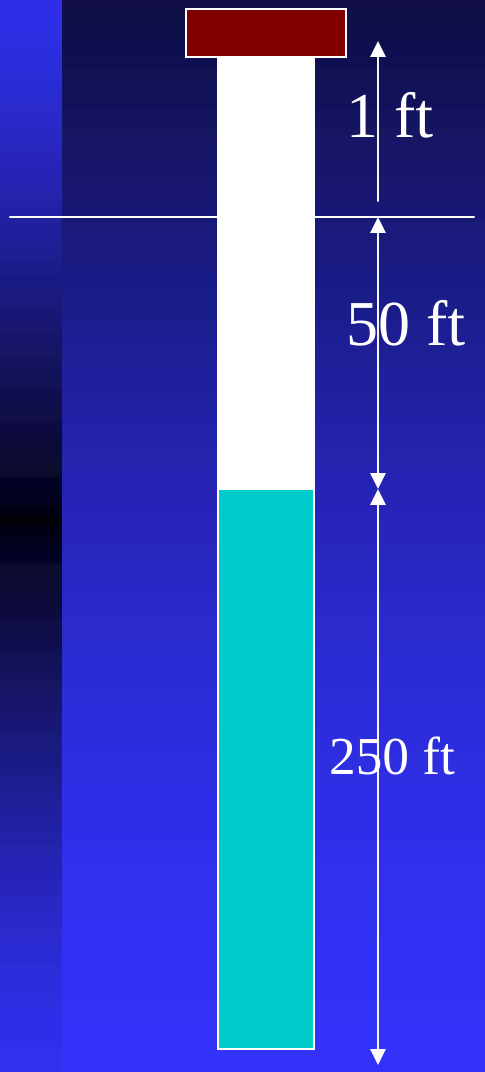
Therefore, Water Well methane levels can exceed 28 mg/L if water is not in equilibrium with the atmosphere.

Freshwater – Solubility as a function of pressure, temperature, and water quality.

Methane in Water

- Methane has been a hidden issue in PA.
- 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 Pennsylvania- Probably 5% Existing Wells have methane above 7 mg/L.
- I light my first well water sample in about 1989- thanks to methane gas.

Why Measure Water Level-Estimating Specific Capacity



Pump Well @ 5gpm

Specific Capacity =
Gpm/ft of drawdown

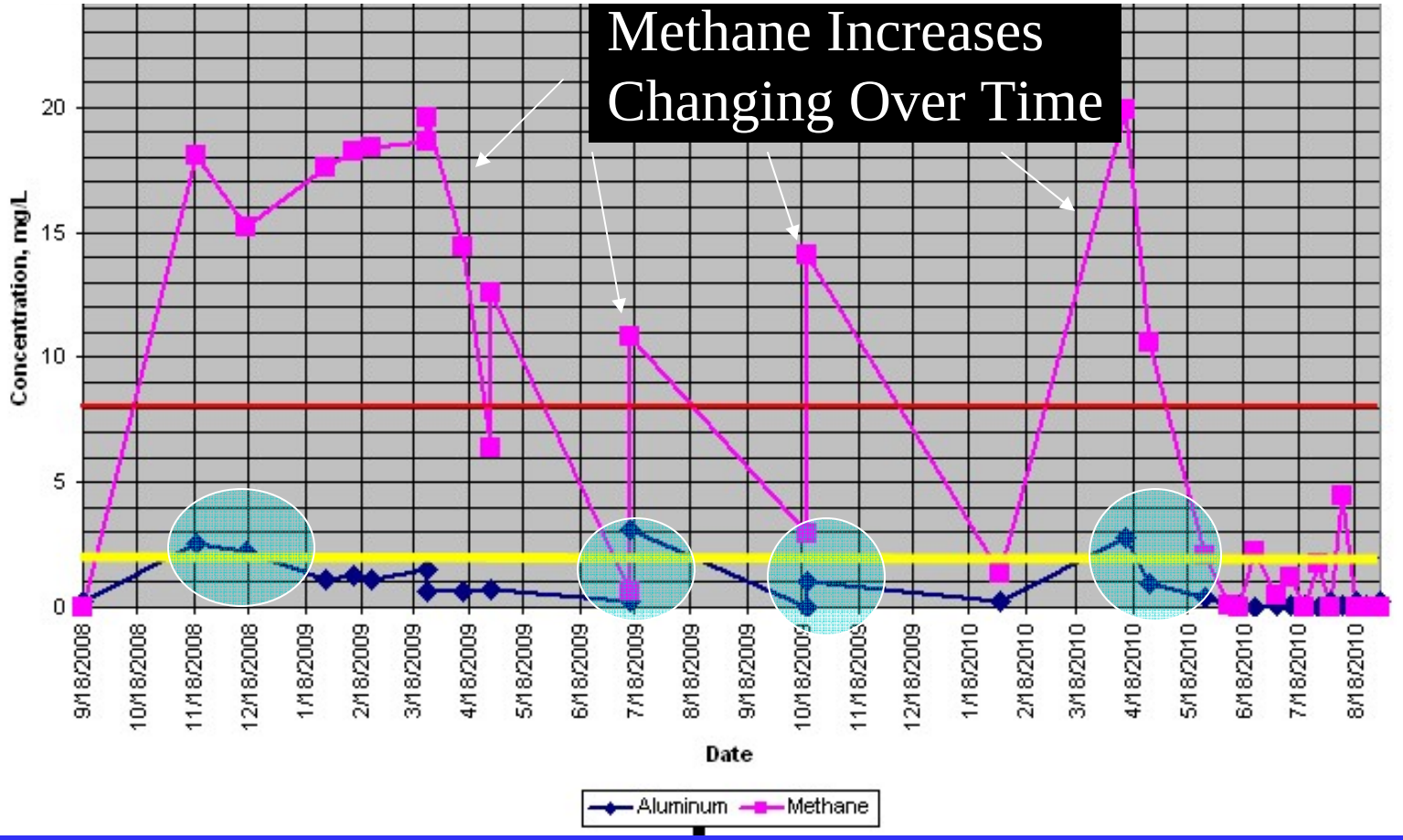
gpm = 5 gpm
Static Water Level – 50 feet
Dynamic Level – 200 feet
Sc = (5 gpm/ (150 ft))=
Sc = 0.03 gpm/ft drawdown

Less head pressure
more methane will
be released.

Methane Gas Level – Change over Time- Time with Highest Levels

- 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.

Changes in Methane Concentration may induce water quality changes, such as changes in iron, manganese, aluminum, etc



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Located in Northeastern Pennsylvania
water reuse
hydrogeology
soil testing

Abandon Oil / Gas Well – Western PA

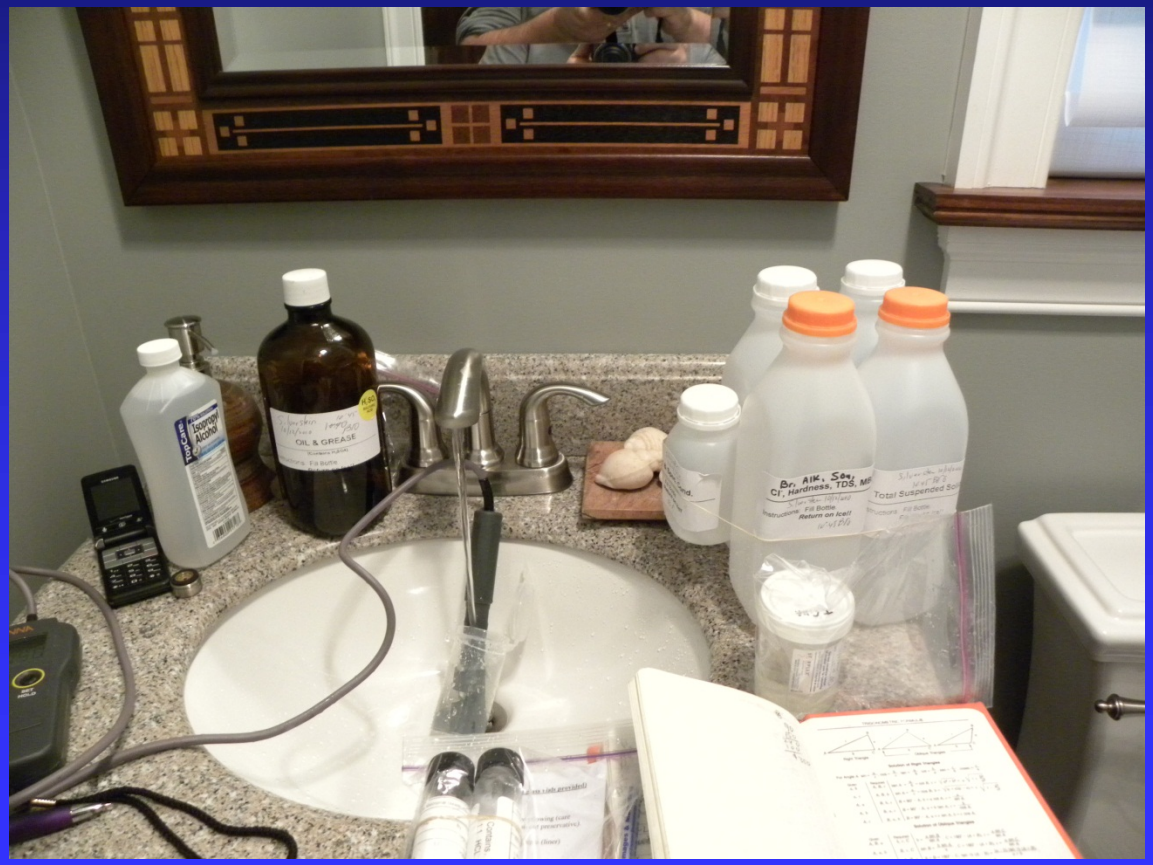
More Videos - http://youtu.be/N4Ibbs7BN_E

Therefore, natural gas migration

- **Follows Natural or Artificial Pathways and can easily be 1000 feet from a wellhead**
- **Associated with Both Biogenic and Thermogenic Gas Sources**
- **Thermogenic Gas – includes shallow gas just below freshwater aquifer and from Unconventional Gas Formations and Storage Areas.**
- **Natural Discharge areas may be associated with natural discharge zones or "short-circuits" that included private wells, wetlands, soils, lake sediments, glacial till, gas wells, and other subsurface disturbances.**
- **Key Wells in the Community that may be vulnerable to this pathway:**
  - **Shallow Poorly Constructed near lakes, streams, and river valleys**
  - **Deep Wells located in a discharge zone that have elevated levels of methane gas**
  - **Wells that have a saline water fingerprint**
  - **Reason we need to work together !**

What Parameters ?

- Baseline Testing



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water reuse hydrogeology soil testing

Baseline Testing- Private Well Owner Perspective

- Baseline Testing
  - Proper Well Purging, Field Monitoring, and Sampling
  - Documenting Existing Conditions and Well or Water Source Information
  - Chain-of-Custody Protocols – Third Party Samplers (Samplers with Zero Interest)
  - Using a Certified Lab / Using Certified Methods
  - Picking Water Quality Parameters To Meet the Homeowner Needs
  - Maybe Seasonal Monitoring for some parameters

Summary

- Baseline Testing is a Function of:
  - Local Geology and Land-Use
  - Well Construction, Location, Existing Water Quality Issues, and Well Use
  - Other Private Wells
  - Who is the Client?
  - Clients Budget- Clients Goals
  - It is not a one size fits all program.

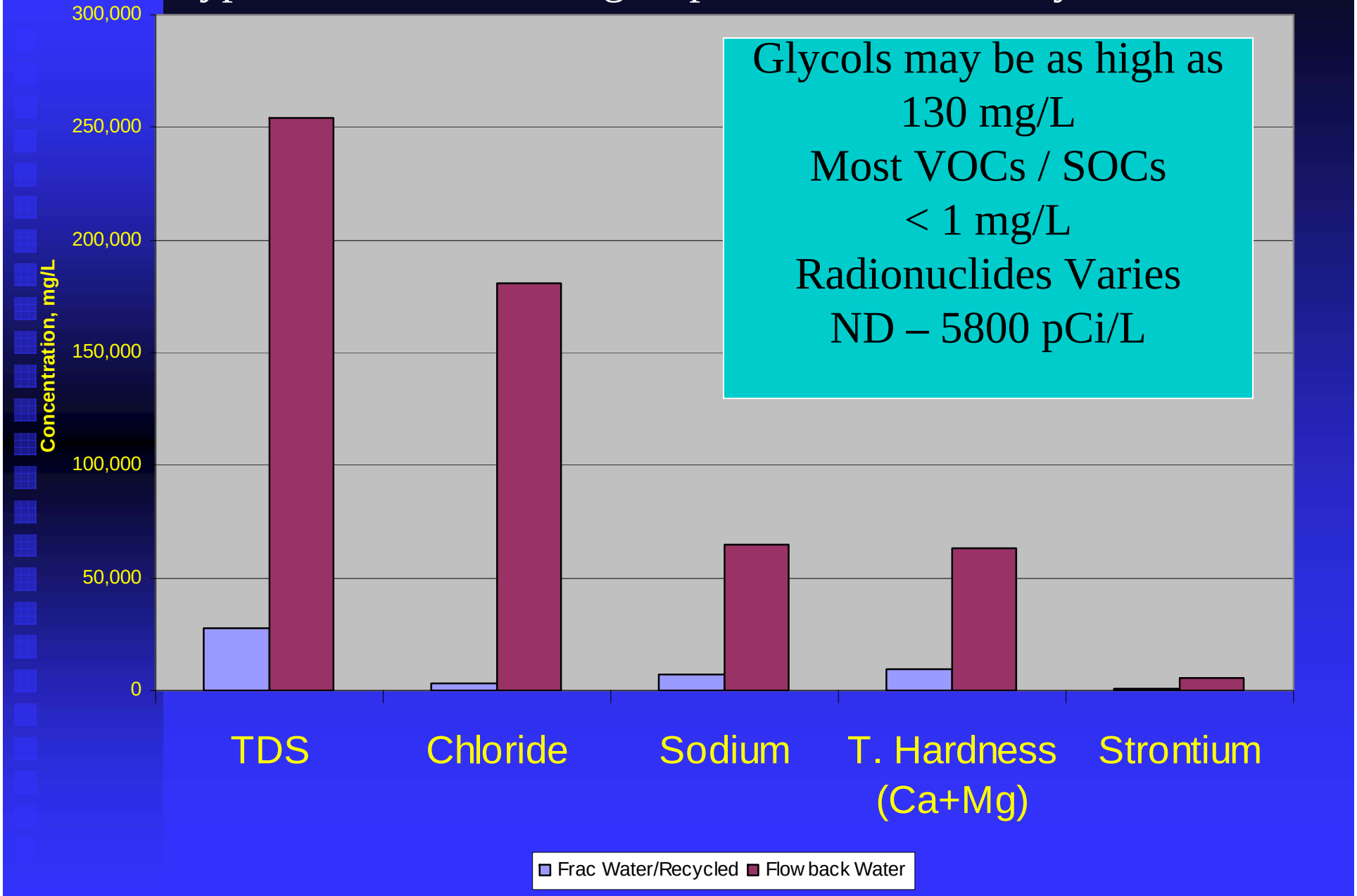
Same Baseline Parameters?

Quarry

Mixed Hazards

Saline Seep

Type of Baseline Testing Depends on the Activity

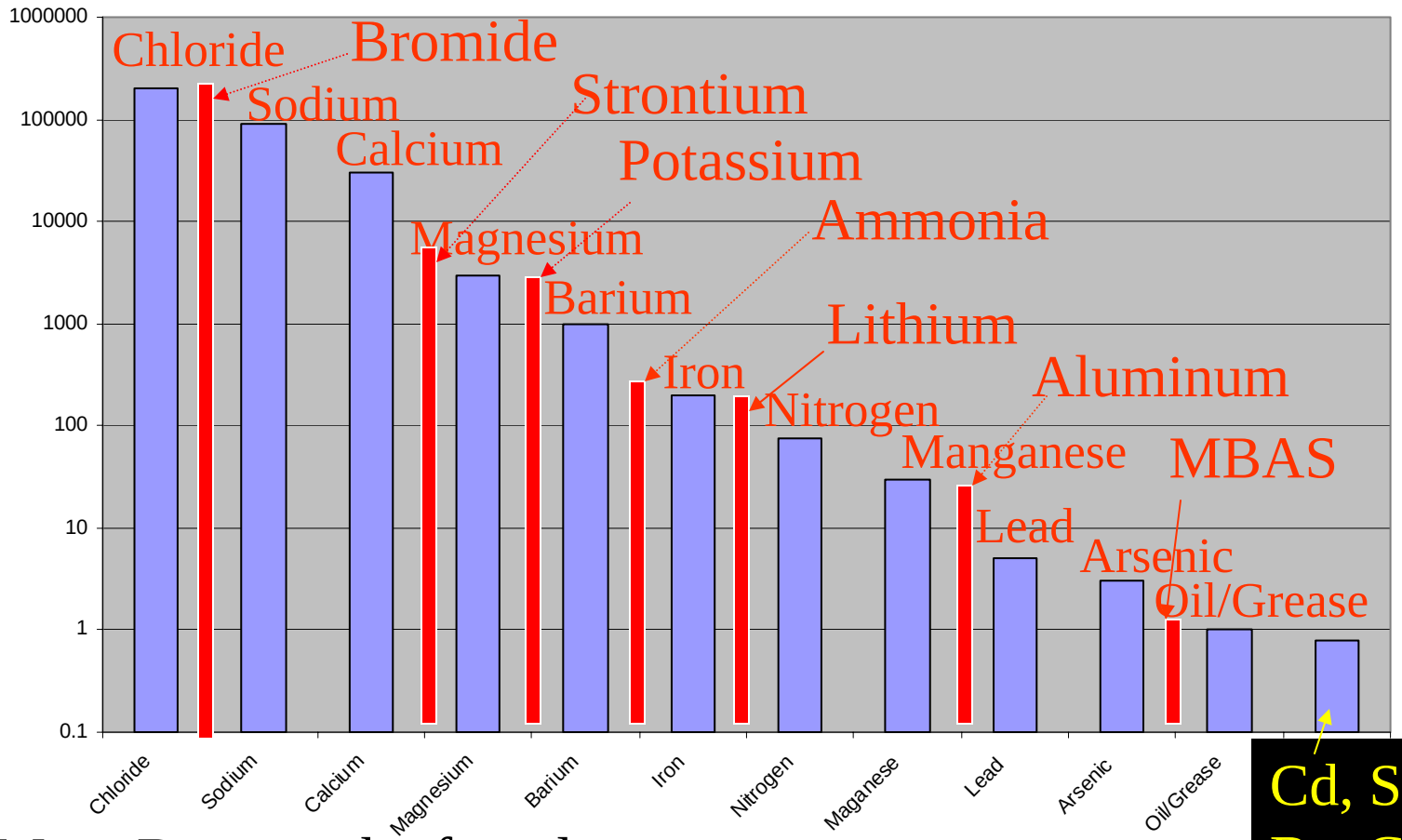


Glycols may be as high as 130 mg/L

Most VOCs / SOCs < 1 mg/L

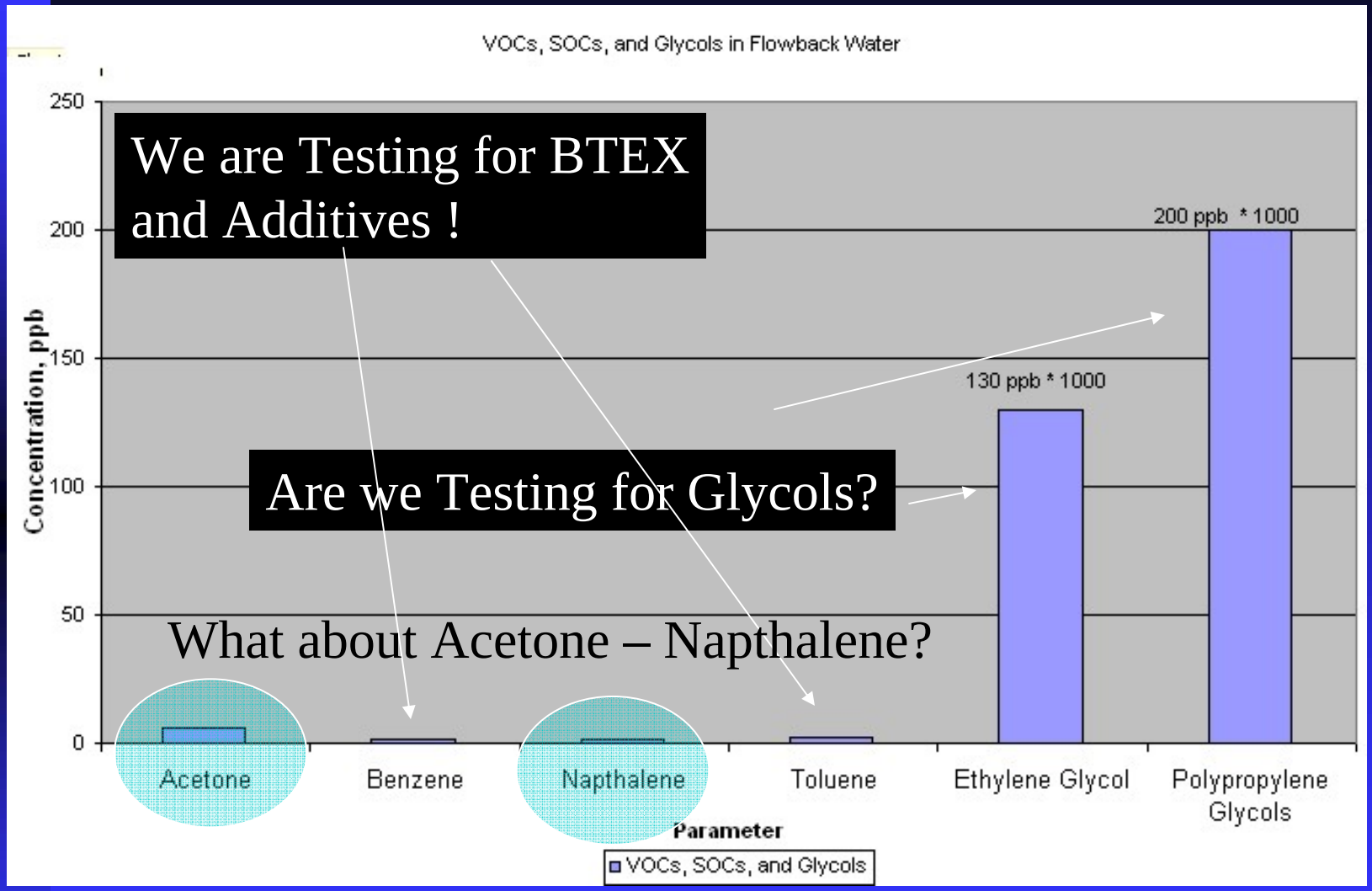
Radionuclides Varies ND – 5800 pCi/L

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



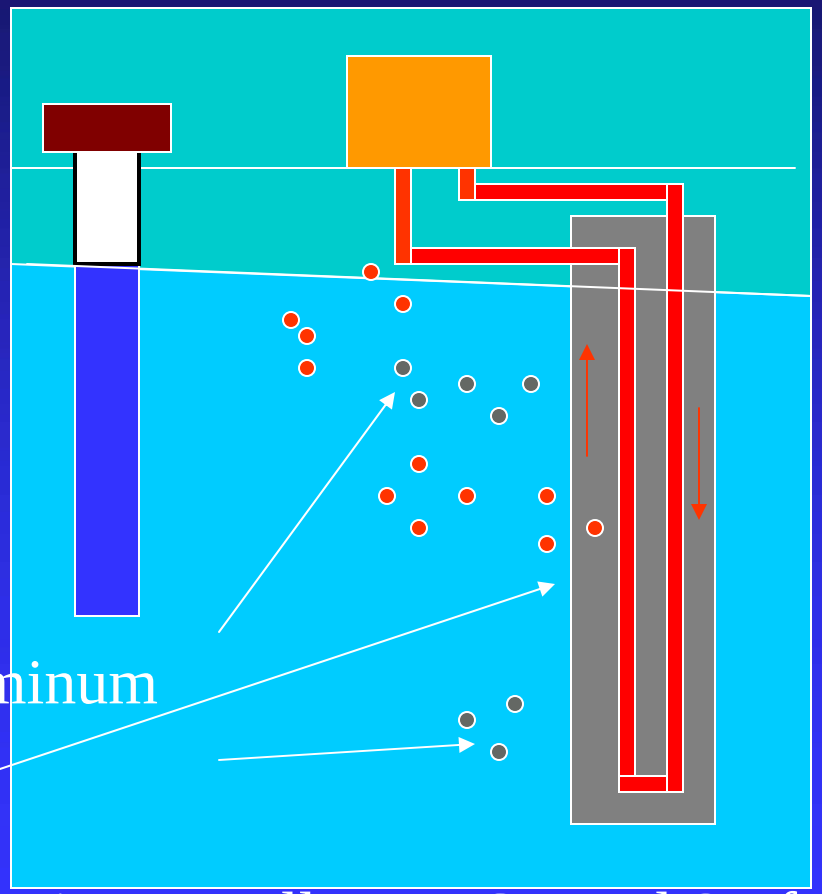
More Data can be found at
http://www.bfenvironmental.com

Cd, Sb,
Be, Cr
Ni, Ag, etc


VOCs, SOCs, and Glycols in Flowback Water
We are Testing for BTEX and Additives !
Are we Testing for Glycols?
What about Acetone – Napthalene?
200 ppb * 1000
130 ppb * 1000
Concentration, ppb
250
200
150
100
50
0
Acetone
Benzene
Napthalene
Toluene
Ethylene Glycol
Polypropylene Glycols
Parameter
VOCs, SOCs, and Glycols

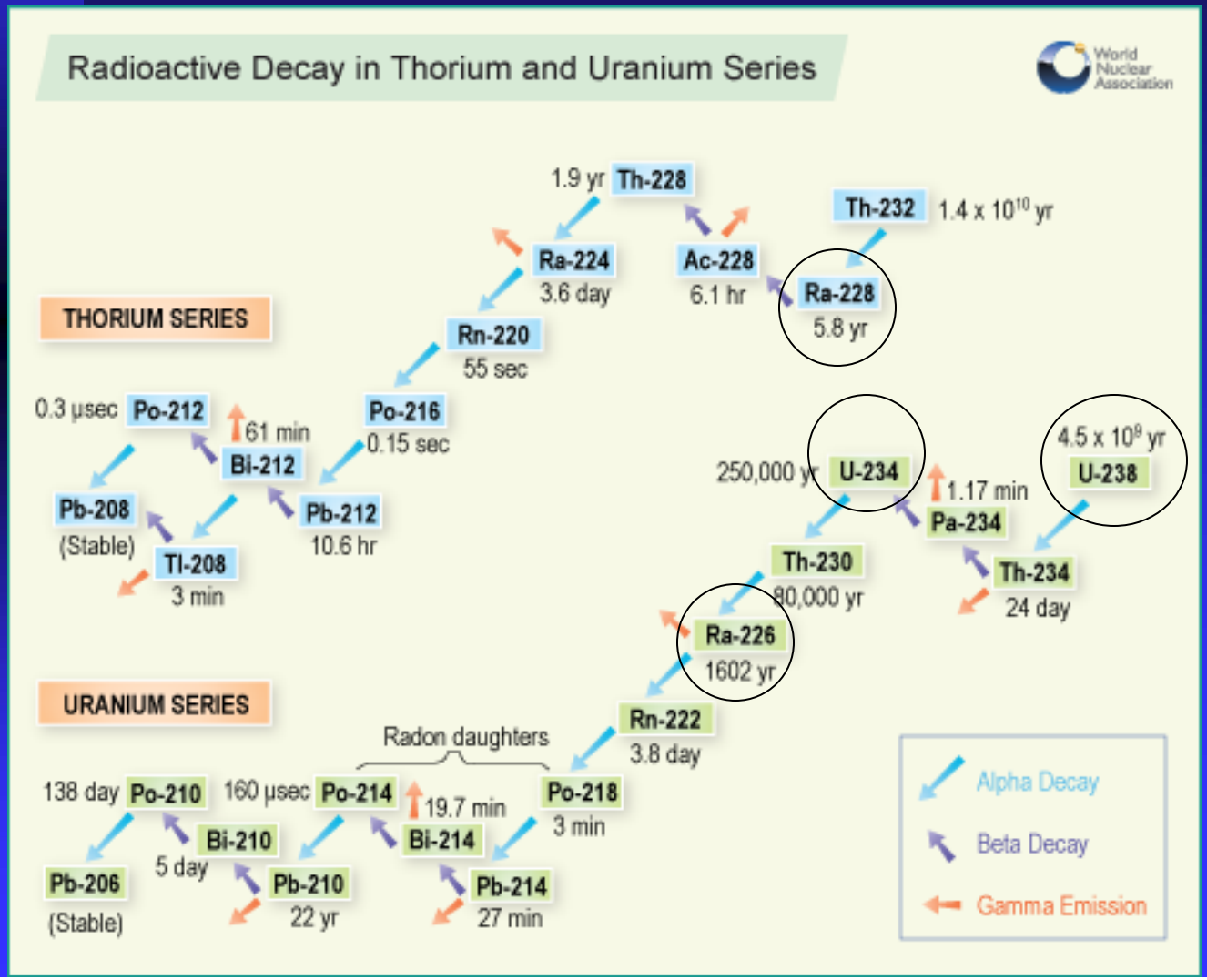
Glycols- not a common problem – no real drinking water standard

- ground-water heating and cooling systems, deicing agents, and natural gas development
- EPA guidance is ≤ 7000 ppb or 7 mg/L (ethylene glycol)

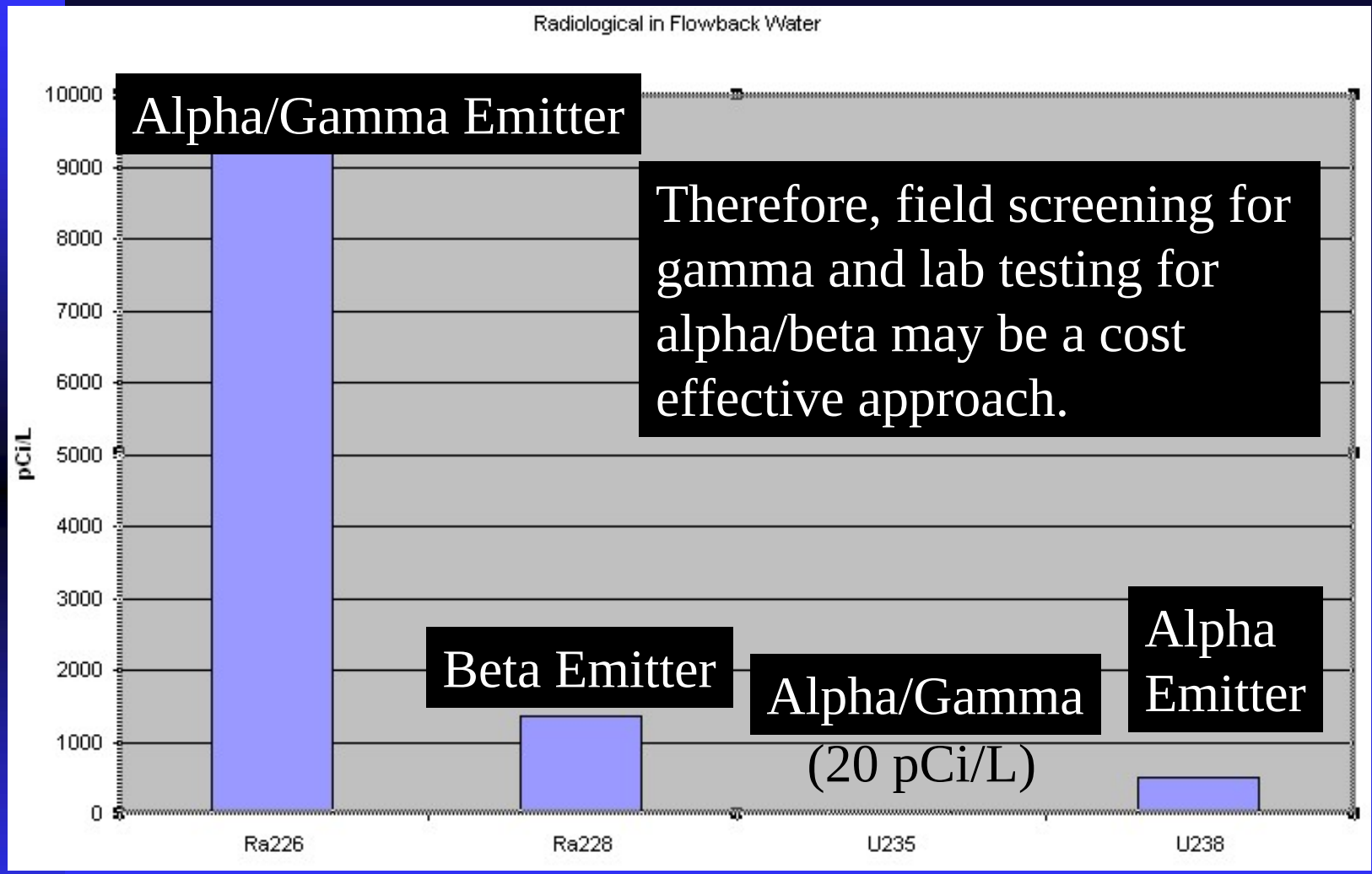


Recirculated Glycol in Plastic Piping surrounded by Sand with Clay
No Construction Standards No Protective Casing

Marcellus Shale - NORM



Note:
Alpha Decay
Some Gamma Emission and Beta Decay


Radiological in Flowback Water
Alpha/Gamma Emitter
Therefore, field screening for gamma and lab testing for alpha/beta may be a cost effective approach.
Beta Emitter
Alpha/Gamma
(20 pCi/L)
Alpha Emitter
pCi/L
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Ra226
Ra228
U235
U238

Suggested Baseline- For Citizens

- **Testing Package # 1 Recommendations – Document Lower Explosion Limit and Static and Dynamic Water Level**

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

- **Testing Package # 2 Recommendations**
  Package # 1- plus Aluminum, T. Hardness, Magnesium, Selenium, Strontium, 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 organic and inorganic parameters. Depending on surrounding land-use, use of geothermal wells, personal history, and past history.

Marcellus Shale Coalition

Their Recommendation to Gas Companies

- The parameters they recommended:

  Alkalinity, Total Chromium, Oil & Grease,

  Total Arsenic, Barium, Lead, Selenium, Strontium, Iron, Manganese,

  Potassium, Calcium, Magnesium

  pH, Specific Conductance, Total Dissolved Solids, Total Suspended Solids,

  Chloride, Sulfate, Hardness, Surfactants (MBAS/foaming agents), Benzene, Toluene, Ethylbenzene, Xylenes (BTEX),
  Dissolved Methane, Ethane, Propane,

  E. Coli. Total Coliform, Nitrate as N , Turbidity

My Comments

1. Missing bromide, aluminum, full range of VOCs, MTBE, ORP
2. Missing surrogate organics like glycols, alcohols, etc.
3. Missing Radionuclides at least alpha, beta, and Uranium.

I Got to Lose Weight !

Make sure to complete the Following:

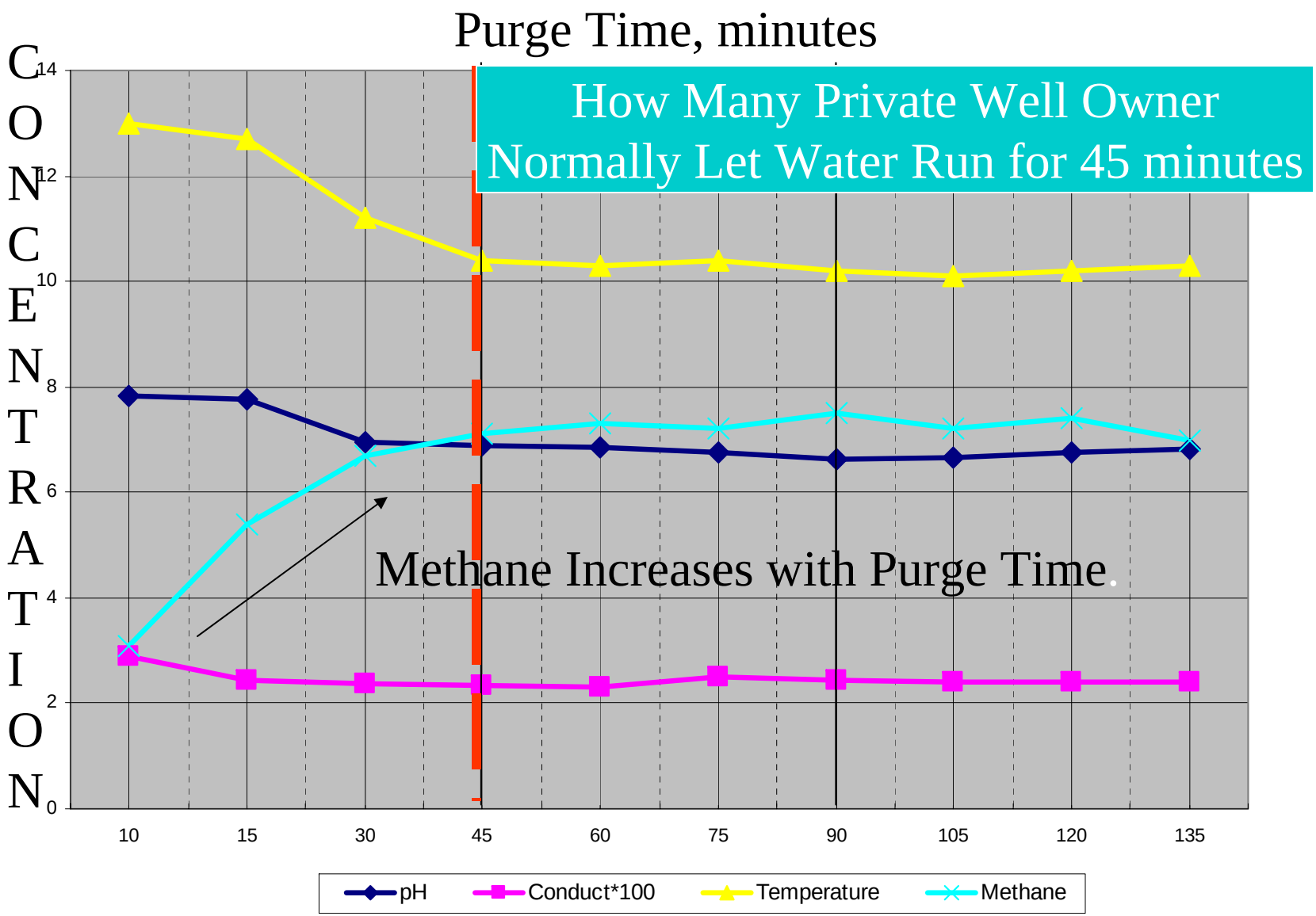
1. Take Notes and Record Observations

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

3. Prepare Chain-of-Custody

4. Record Field Water Quality Data

Photo Document Sampling Site, Purging, and Monitoring Process



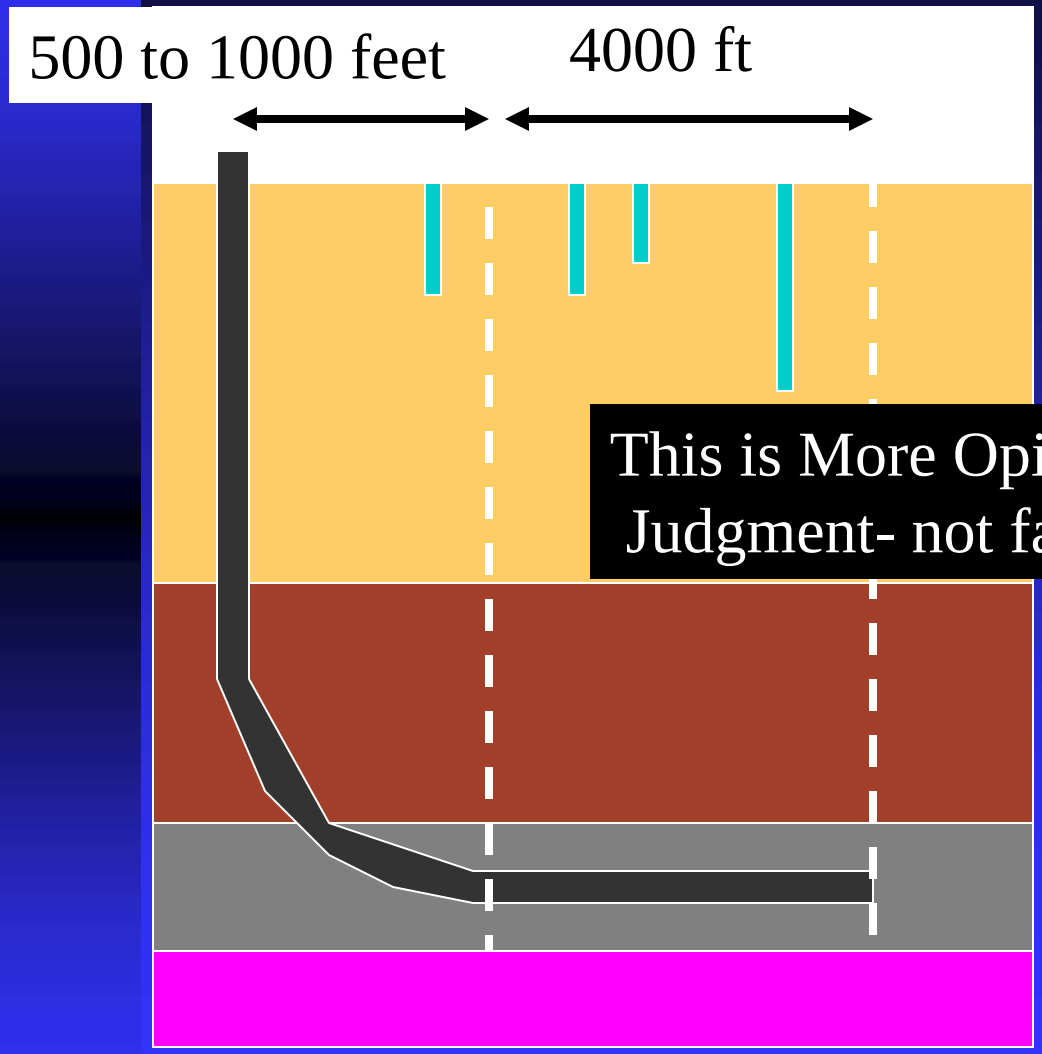
1 WBV = 45 minutes

Other Issues with Baseline Testing

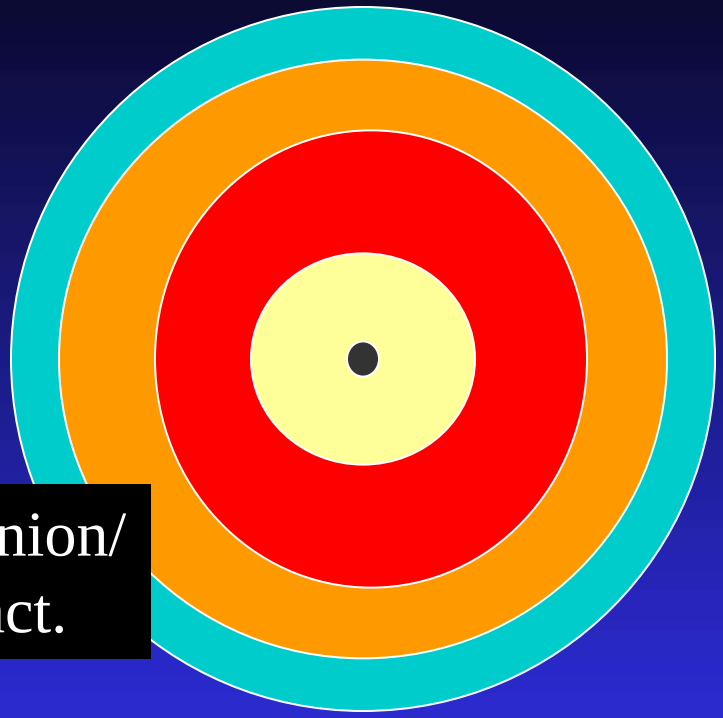
- Purging Process – Not long enough!
- Not Conducting Isotropic analysis, unclear methods for methane and gas sampling and detection.
- Insufficient Number of Samples- May need to conduct seasonal testing to document baseline conditions.
- Not Documenting Static and/or Dynamic Water Level.
- Citizens are not sure the results are from their well or water source.
- Using wrong methods or detection limits that are not low enough.
- Lack of Quality Control for the Data or homeowners not getting the QC/QA data.
- No explanation of the results.

OUR New Book May Help with the Education →

In general – I could see a radius from 2500 ft to 1 mile (depending on geology)



This is More Opinion/ Judgment- not fact.



Mud/ Methane Migration (up to 1000 ft)

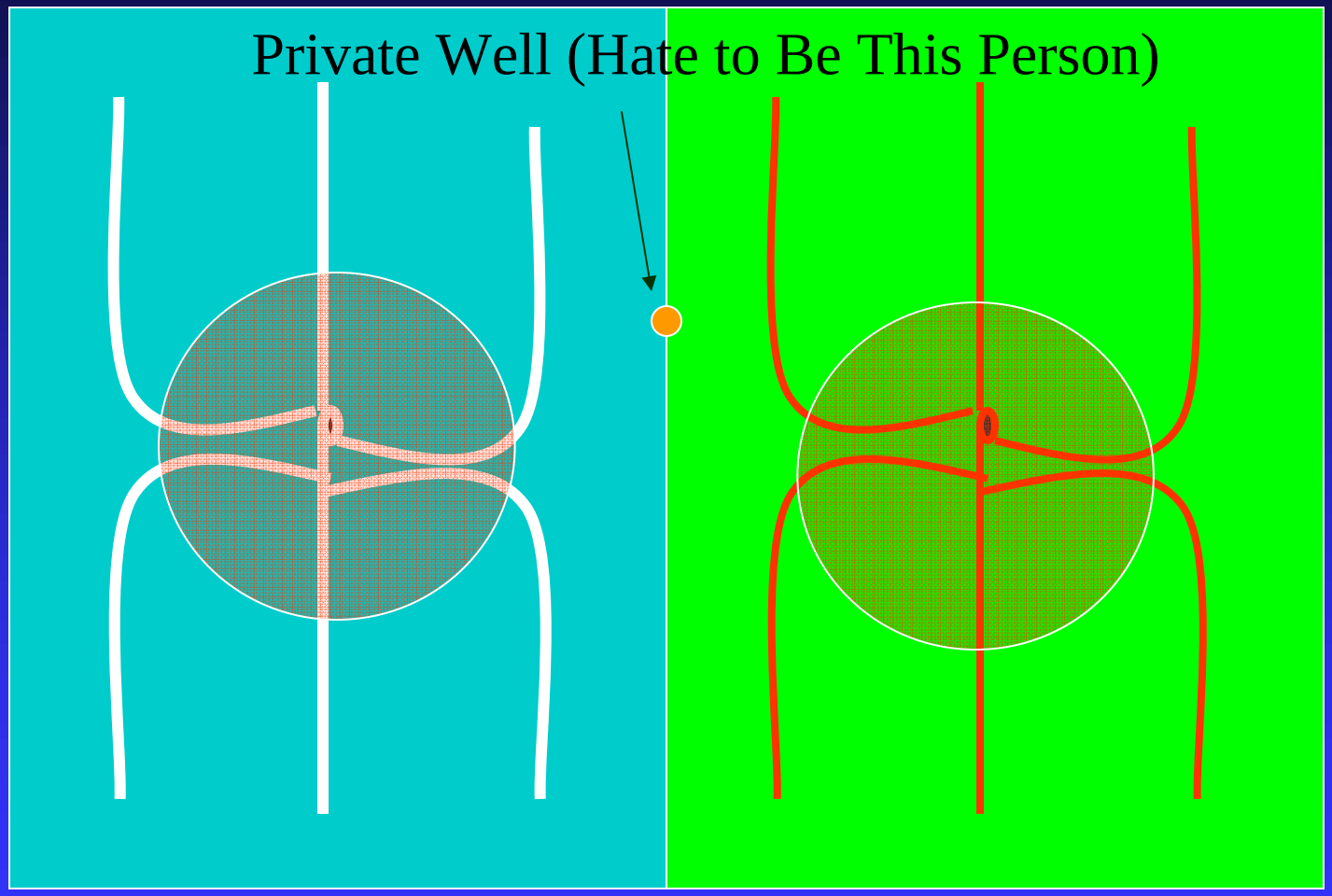
Methane Pushes (2500 feet)

Area Above Lateral

1000 ft Buffer

PA New Regulations – 2500 feet and 1 year (Company Assumed Liable)

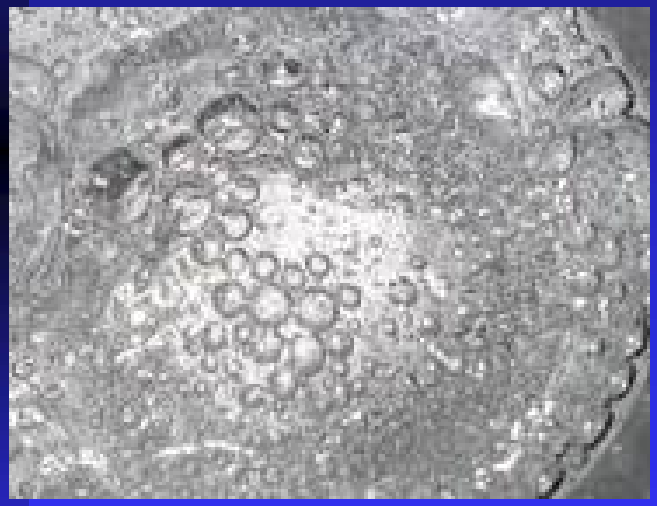
My Primary Concern with Respect to Radius and Assumed Liable is “Who is Responsible”



Induced Migration – Need Proper Casing and Cement
(video from 2009)
More Videos - http://youtu.be/N4Ibbs7BN_E

Do Not Get In This Situation !

- Natural Gas Development > 2500 feet.
- Site - Seasonal Cabin on a Lake for 15+ yrs
- No Baseline Testing or Screening Test.

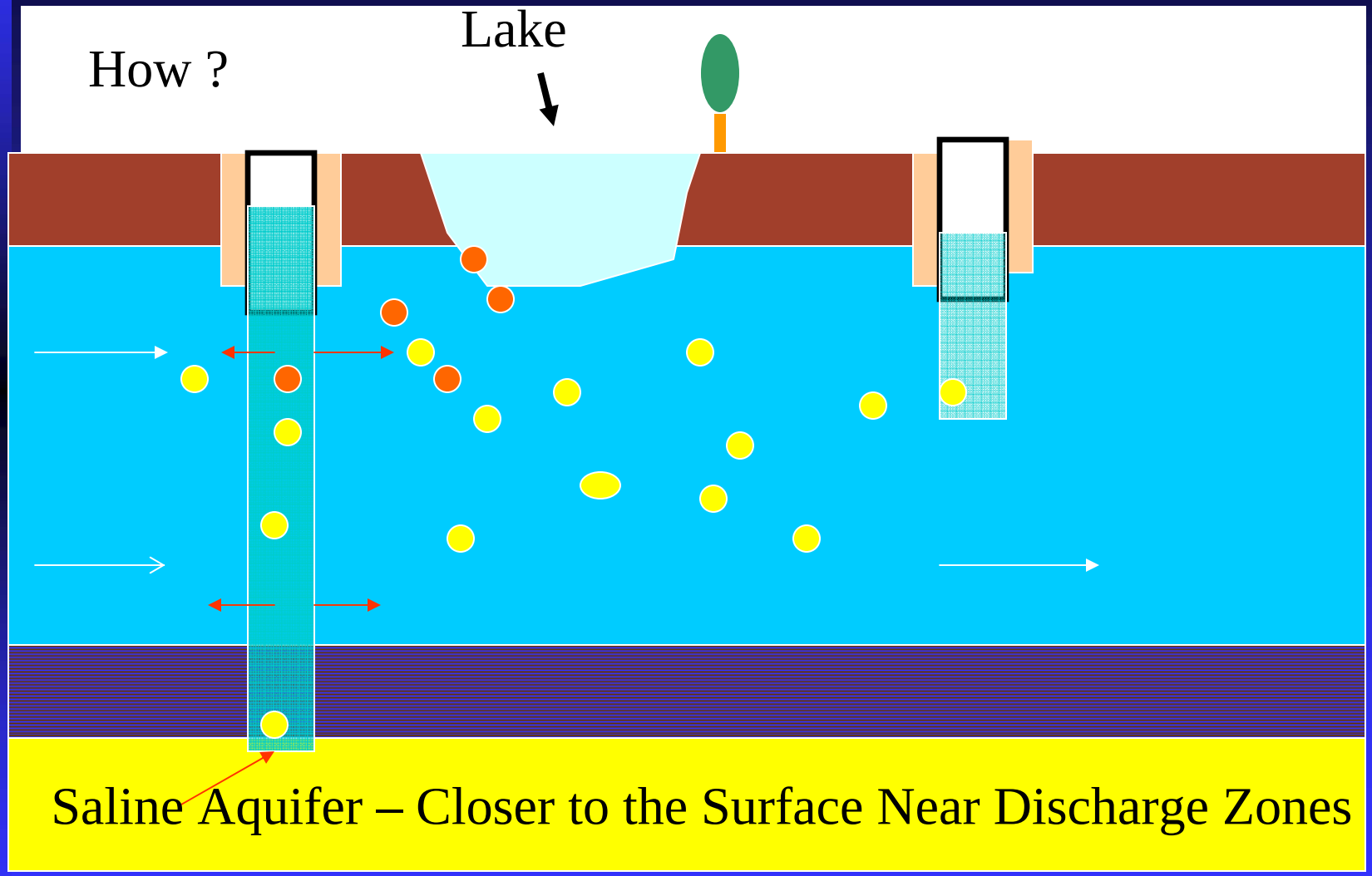


Methane 17 mg/L
Ethane – not detectable
Propane – not detectable
Ratio 173 (unclear could be a mixture)
Barium – 3.43 mg/L
Chloride – 390 mg/L
Sodium – 264 mg/L
TDS – 760 mg/L

Fizzy Water – Well 400 ft Deep

Likely Source – Well Influenced by Saline Water (part of this 5 %)
Caused by Drilling – Will be Difficult to Demonstrate without historic data – Only $ 200.00 could have protected the homeowner.

How Contaminants Can Up into a Shallow Aquifer



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

Working as a Community

- Getting the Community Educated
- Encouraging Well Owners to Get their water tested as best as they can afford and sharing this data (data only) with the Citizen Database.
- Working with Local Water Authorities- Watershed Groups Using Source Water Protection As a Guide
- Developing a Program to Fix Private Well – where baseline pre-drilling testing has identified a Problem – Remember we all live upstream.
- Permitting the gas company to conducting baseline testing and sharing this data (data only) with the Citizen Database.
  - This should include wells, springs, surface ponds, and major waterways in the area.

Health Study – Wise Use of Impact Fees (One Idea)

3 Million + Private Wells in PA - Up to 1.5 Million maybe associated with Short term and/or Chronic **disease- In some cases, the disease is communicable.**

Up to 5 % of existing private wells look like that have been impacted by Marcellus Shale Development.

20,000 new Private Wells Drilled Every Year – Not Standards

Use Baseline Testing Results to Help Select or Identify Vulnerable Areas.

Private Well Constructions Standards – Good, but will NOT Fix this Problem.

Be Part of the Solution We ALL Live Downstream.

I Do Not Look at this as a Marcellus Shale Issue – It is Health Issue and a Community Matters Issue!

Our Latest Resource

Description of the following:

a. Citizen Database
b. Baseline Testing
c. Drinking Water Standards
d. Specific Water Quality Standards
e. Treatment Options
f. How to Shock Disinfect a Well
g. How to Properly Construct a Well
h. General Guidelines on Baseline Testing Parameters And More. Cost $ 5.00

Other Resources at http://www.water-research.net

New Methane Gas Fact Sheets (Free) – http://www.water-research.net/methanegas.htm

Presented by:

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B.F. Environmental Consultants Inc.

http://www.bfenvironmental.com

And

Water Research Center

http://www.water-research.net

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