Penn State Shale Network 2017 Workshop

Black Shale Waste Disposal Concerns

By **Bill Hughes**

Wetzel County, WV

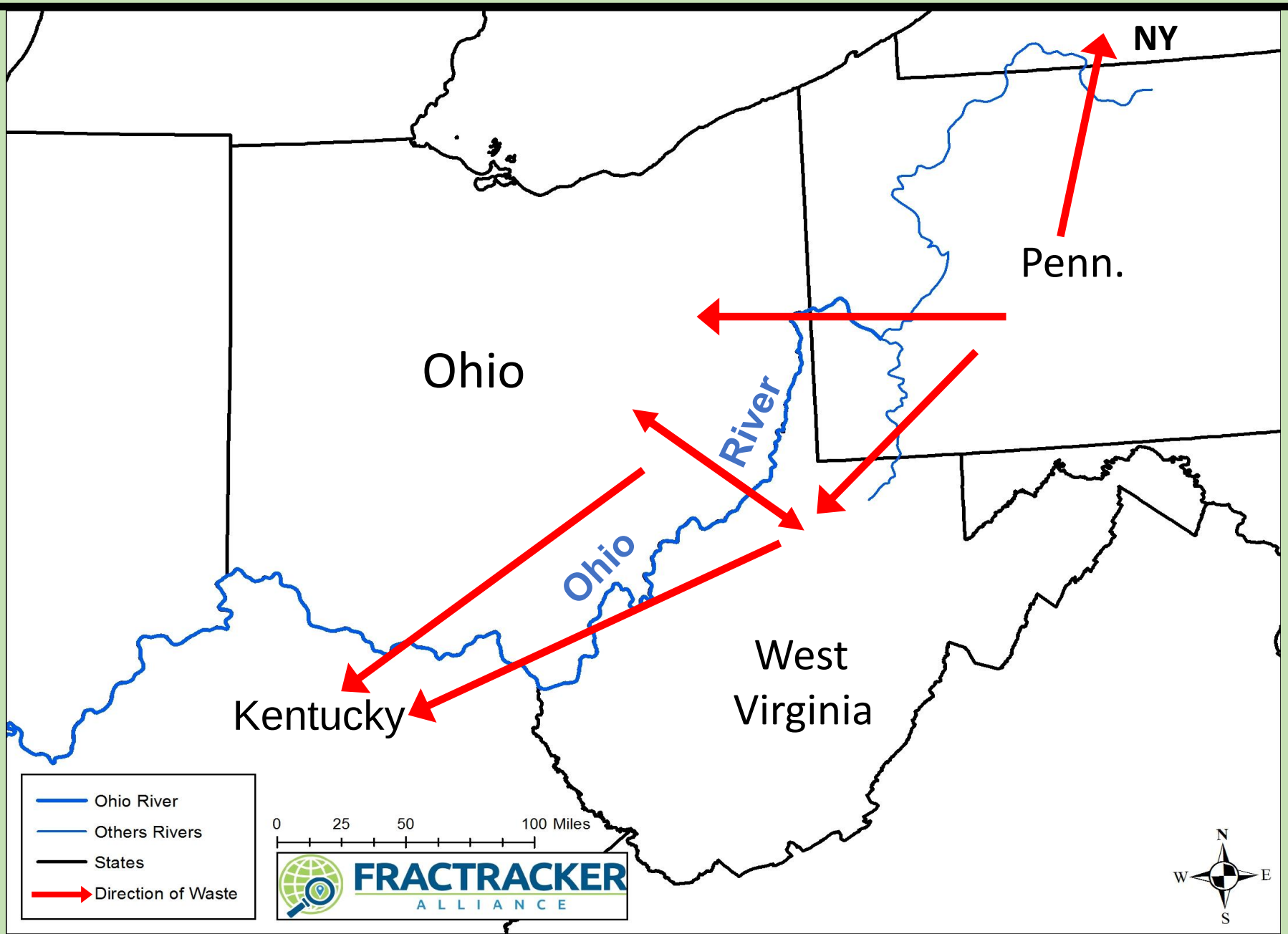
Developed with support from: FracTracker Alliance and Ohio Valley Environmental Coalition

Black Shale Waste Disposal Concerns

1. Minimal restrictions on interstate waste transfers
2. Consists of a variety of solid; liquid; semi-solids
3. Inconsistent or non-coordinated state regulations
4. Over all weak state regulations; minimal Federal oversight
5. **Hazardous; toxic; threat to watershed—Ohio River**
6. **Inadequate waste characterization**

We will explore the last two topics here

Some Known Interstate Waste Transfers



Shale Waste

OH

PA

KY

WV

Shell Game

Shale Waste

Shell Game


Shale Waste
OH
PA
?
KY
WV
Shell Game


Shale Waste
OH
PA
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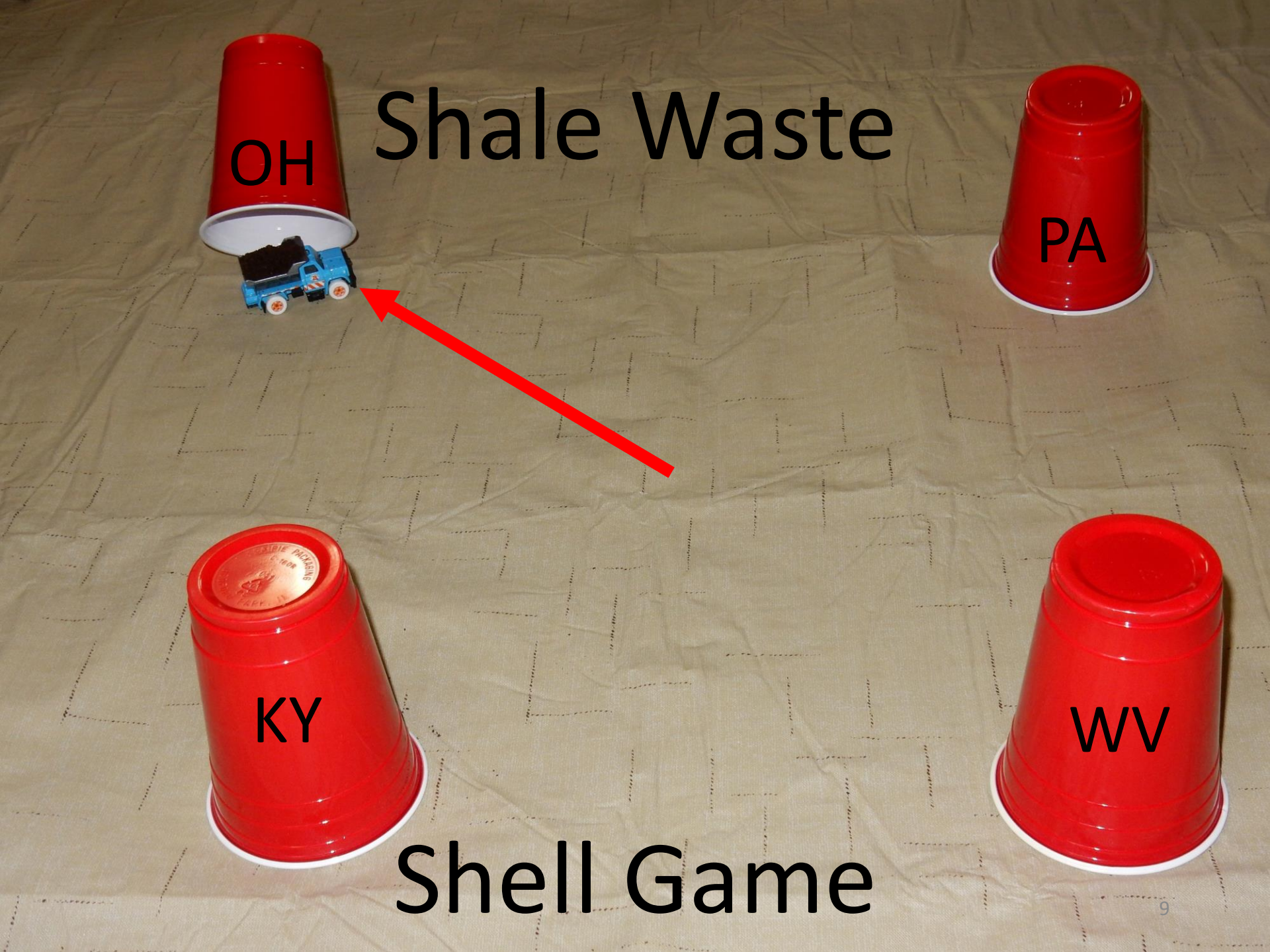
Shale Waste

Shell Game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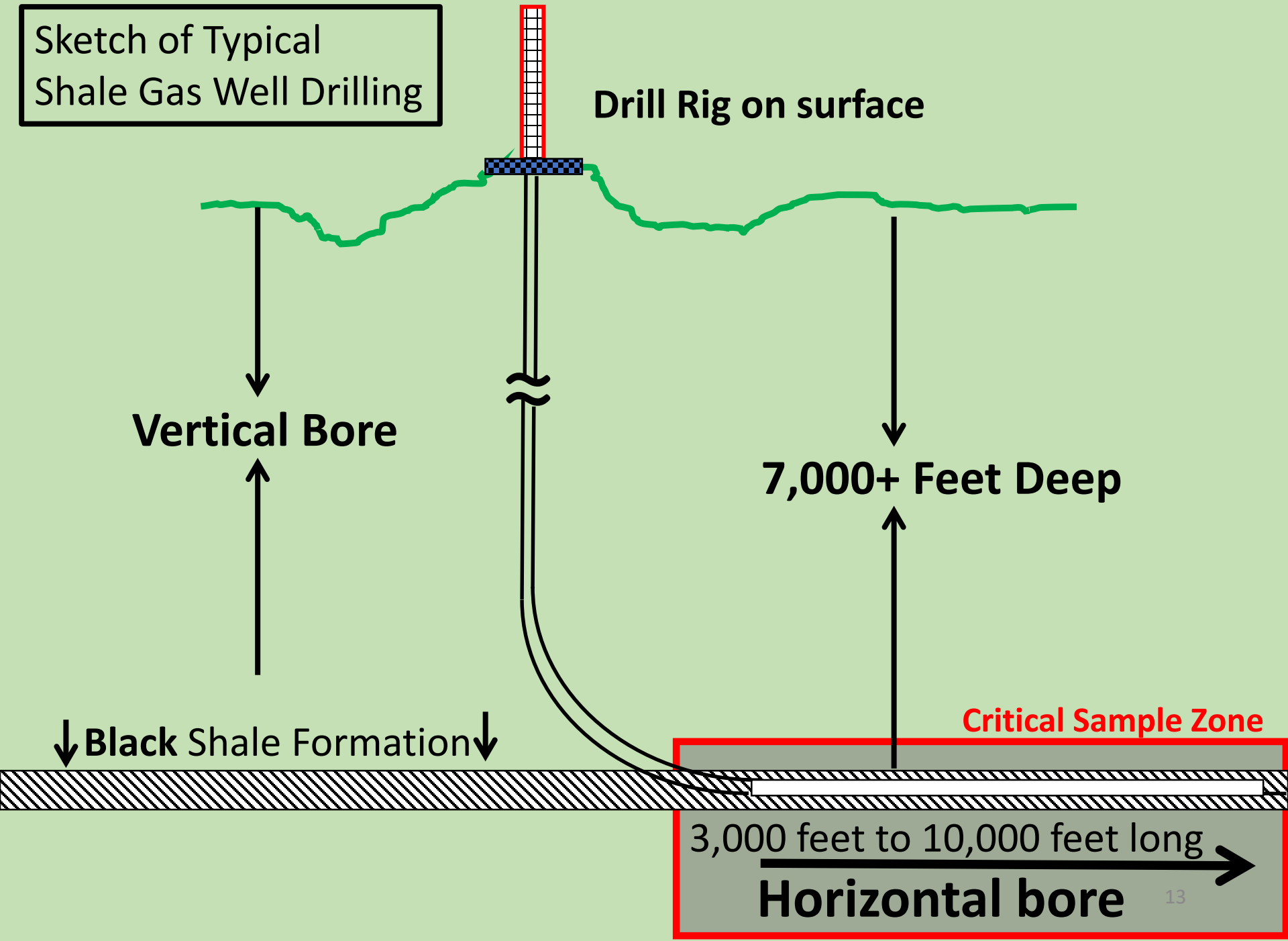
Quick review of Shale Gas Drilling And Drill Cuttings


Sketch of Typical
Shale Gas Well Drilling
Drill Rig on surface
Vertical Bore
7,000+ Feet Deep
Black Shale Formation
Critical Sample Zone
3,000 feet to 10,000 feet long
Horizontal bore

More Benign Drill Cuttings from the **Vertical** bore on a **Horizontal** Well Pad

Radioactive and Toxic Drill Cuttings
From the Horizontal bore on a Horizontal Well Pad

Drill Cuttings on way to Landfill

Drill Cuttings being dumped at the Wetzel County Landfill

Rainfall or
Drilling Fluids or
Fracturing Fluids or
Formation fluid

Fresh
Water

Marcellus Shale
Drill Cuttings
Buried in Landfills

Coffee
Grounds

Leachate

Fresh Coffee

OUR LANDFILLS

Municipal
Solid Waste

Your KITCHEN

Marshall University was tasked by the WVDEP To Investigate **Five Topics**

We will only review part of the **FIRST TWO**

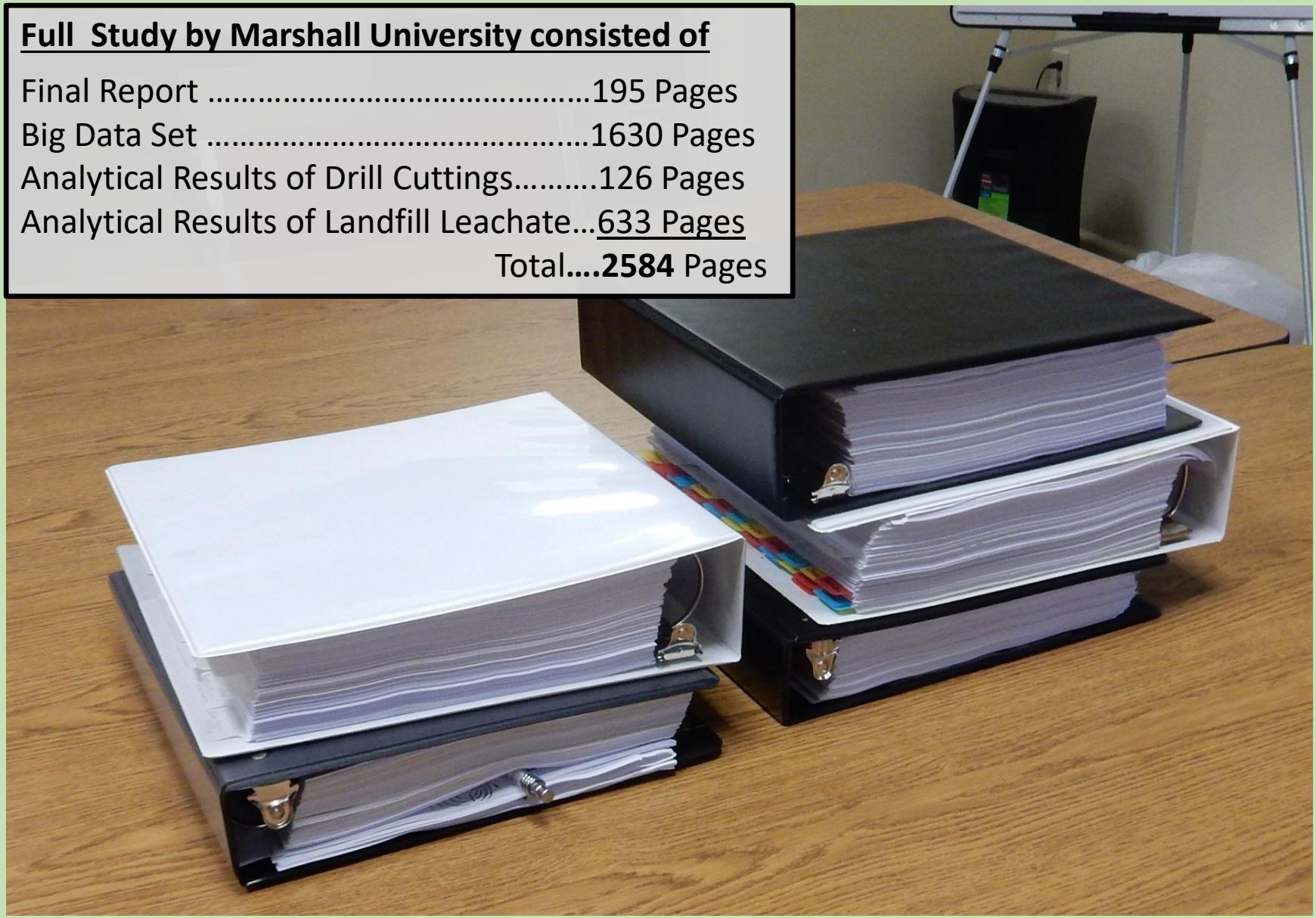
1. **The hazardous characteristics of leachate in landfills accepting drill cuttings**

2. **The negative impacts of that liquid on surface and ground water**

Marshall University Report Total over **2,500 pages**.

Full Study by Marshall University consisted of

Final Report ……195 Pages
Big Data Set ……1630 Pages
Analytical Results of Drill Cuttings…….126 Pages
Analytical Results of Landfill Leachate…633 Pages
Total**….2584** Pages



This Is What Marshall University was tasked to Examine

Marcellus Shale Operations Potential Water Contamination

1. Well pad drill rig → Drill cuttings → Landfills
2. → Moisture drains out becomes → Leachate
3. Leachate shows radioactive levels of concern
4. **Radioactivity** cannot be filtered out →
5. **Leachate** goes to Water treatment plant →
6. Effluent from water treatment plant goes into **Surface Streams and Rivers**
7. Surface waters→water intake→**Drinking water**

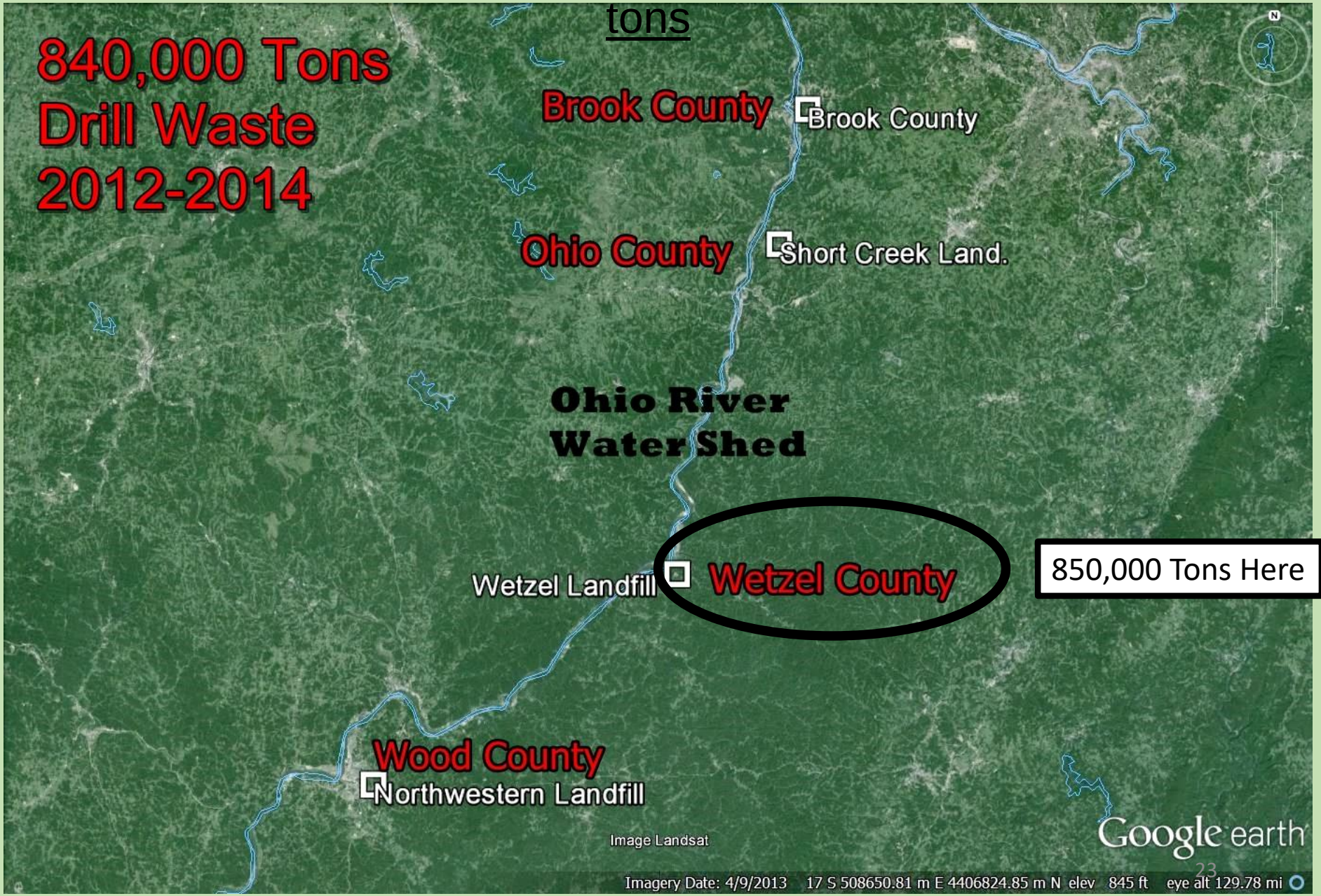
?

?

Why is this Waste Critical ?

Drill Cuttings
Are Radioactive--
Toxic---Hazardous
And
Lots of It

Total Tonnage of Drill Waste in West Virginia now over 1.5 million tons



What We

Do

Know

Marcellus Shale

Is

Radioactive

DON'T TELL ANYONE ELSE

How do we know that Marcellus is Radioactive

- Geologists reports from over **35 years ago**
- WVDEP required landfills to test leachate
- Marshall University report confirms it 7-01-2015
- Drillers use **gamma** logs to identify it
- A few drill waste loads trip alarms at landfills

General Observations

Taken from the Marshall University Report

- Few existing studies on landfills with drill cuttings
- Little or no empirical data on risks with drill cuttings
- Studies of long-term exposure to unconventional natural gas development have not been conducted
- **Landfill liners will leak**

The Marshall University report states:

1. The **Marcellus Shale** has higher concentrations of **radioactivity** than other shales
2. Drill cuttings contain **radioactive** compounds.
3. The **Radium** isotopes within the Marcellus shale are **soluble in water**
4. **Radioactive** compounds are present in landfill leachate
5. **Radium 226** has a half-life of **1600** years.
6. **Landfill liners will leak**

Conclusions
From the Marshall University Report

- Drill Cuttings **toxic** to plants
- Leachate **toxic** to plants and invertebrates
- Radioactive compounds are in **LEACHATE**
- **Long term** studies have **not been done**

Marshall Report Flaws

A. **<u>NO METHODS</u> Discussion Section** in the final report on the **choice** of Test Protocols used for radiologicals

B. **INACCURATE TEST Protocols** were used for radiologicals

Test Methods for SOLID DRILL CUTTINGS by Marshall

Well name Date of sample	Test method used for Gross Alpha	Test method used for Gross Beta	Test method used for Radium 226	Test method used for Radium 228
Sheep Run 4-17-15	EPA 9310	EPA 9310	901.1	901.1
Bierstadt 4-20-2015	EPA 9310	EPA 9310	901.1	901.1
McGee 1-28-2015	900.0	900.0	901.1	901.1
Morton 1-28-2015	900.0	900.0	901.1	901.1
Wentz 1-28-2015	900.0	900.0	901.1	901.1

EPA Method 9310
For the measurement of gross alpha and gross beta particle activities in surface and ground **waters**.

EPA Method 900.0
For Gross Alpha and Gross Beta in **Drinking Water**

EPA Method 901.1
For Gamma Emitting Radionuclides In **Drinking water**

Summary of test methods used

Leachate Samples	Solid Samples
Existing Data Set from WVDEP	Samples obtained by Marshall U.
900.0	
903.1	
904.0	
900.0M	
SM7110C & EPA 9310	
Newer samples by Marshall U.	**Newer** Samples by Marshall U.
900.0	901.1
903.1	9310
904.0	900.0
SM7110C	

These SEVEN test protocols were used with NO discussion of WHY any specific one was used.

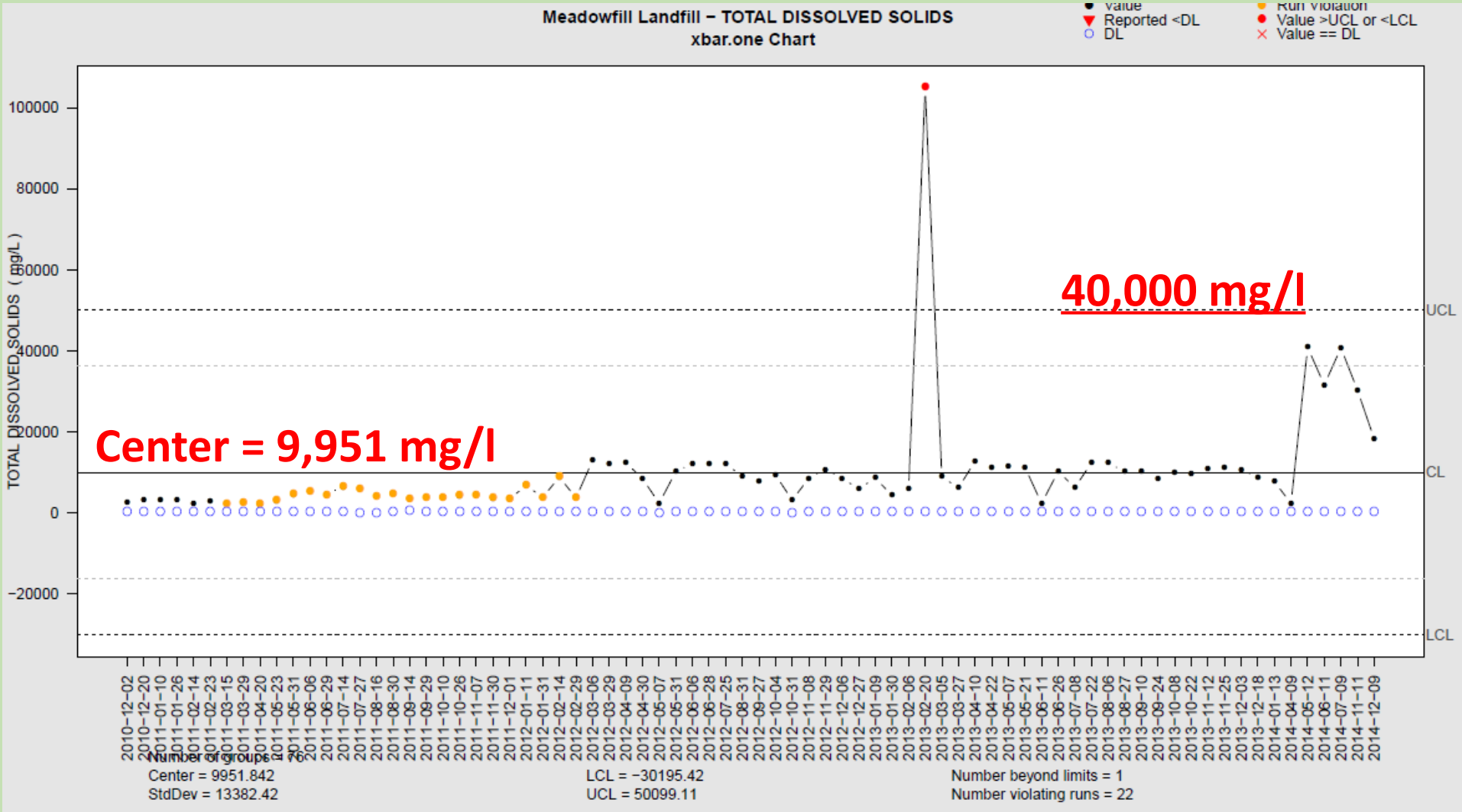
EPA TEST METHOD 900.0

Technical Notes for EPA Method 900.0 —
Gross Alpha and Gross Beta Radioactivity in Drinking Water

1.9 Drinking water samples with high levels of solids will prove challenging for this technique as the solids will contribute significantly to self-absorption of the alpha and beta particles

The alternate method for Gross Alpha Screening, 900.1 is meant for radium isotopes in water with **HIGH DISSOLVED SOLIDS** …recommended if the sample has solid loading of **> 500 ppm.**

Total Dissolved Solids in Leachate
at Meadowfill Landfill



From Marshall Page 762 of 1630

TENORM Analytical Measurements

May 12, 2014

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Working Together to Protect Our Environment and Improve Our Health

Techniques

- GAB Screen (900.0, 9310)
  - Cost vs. TDS Limitation
- GAB Co-precip (SM7110C)
  - Robust vs. Cost
- Radiochemical (903.1, 904.0, 9315, 9320)
  - MDC & speed vs. matrix effects
- Gamma Spec (901.1)
  - Selectivity vs. sensitivity & speed?

Shale Related Challenges

- Dissolved solids

  100 mg limit for 900.0

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Conclusion

- Presence of dissolved Radium species may be indicated by increased Cation, Anion, or Dissolved Solids concentrations
- In the presence of these high concentration interferents, traditional methods for Radium analysis may result in erroneous results
  - Dilution may remove interferences but result in increased detection limits and decreased counting efficiency
- Use of Gamma-Spectroscopy for analysis may be more appropriate for these matrices

What we

Do not

Know


Small
RESIDUAL WASTE
COYLE
Medium
RESIDUAL WASTE
COYLE
Large
RESIDUAL WASTE
COYLE
? ? Residual Waste ? ?

Fresh—Brine—Fresh—Brine—Fresh--Brine

Radiation Detectors at the Scales at Wetzel County Landfill

They Look Good, they are brand new —**but they will not detect Radium 226**

From the manufacturer

"**Portions** of Radium 226/228 may be detected but our gate monitor systems do not "quantify" isotopes"

"**Radium** contains Alpha and Beta particles; these cannot travel far or penetrate like Gamma waves. **Therefore they are nearly impossible to detect with a gate monitor** scintillator detector through a metal sided vehicle".

Known Problems

- **Inaccurate test methods are being** used to measure the radioactivity in leachate with high **Total Dissolved Solids**
- **Horizontal** drill cuttings are **NEVER REQUIRED** to be tested for any radioactive isotopes
- **Leachate is radioactive** and drill cuttings are toxic to plants and aquatic life
- **Goal-post** radiation monitors will **not likely detect Radium** or Radon
- Waste—routine and **HOT** — transferred among states in the **Ohio River** Basin is not tracked
- This is a **new problem** with **little historical guidance**

Our HIGH Priority **TO-DO** List

1. We must get this right
2. We must use proper test protocols
3. We must test the horizontal bore material for radiologicals
4. This will be a very long-lasting problem
5. We must accurately identify all risks to waters in the Ohio River Basin from shale waste

We Just Do NOT Know Now

The End

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