Baseline Sampling

Environmental Standards Committee
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NCDENR - DELMR

- Environmental Standards Committee bucket number 6 outlines four components related to G.S. 113-421(a):

1. Collection of baseline data to include groundwater, surface water, and air quality.
2. Establish standards to satisfy the pre-drilling testing requirements outlined under G.S. 113-421(a).
3. List of contaminants an operator must include in testing.
4. Necessary qualifications for persons conducting pre-drilling collection and testing.

North Carolina G.S. 113-421

- Presumptive Liability for Water Contamination
- 5,000 feet from wellhead
- No time limit for presumptive liability
- Operator may have to compensate for damage to water supply
- Operator shall replace water supply with one adequate in quality and quantity before drilling activities commenced

- States/Organizations Discussed in this presentation:
  - Ohio
  - Pennsylvania
  - Colorado
  - West Virginia
  - North Dakota
  - Arkansas
  - American Petroleum Institute
  - National Ground Water Association
  - Ground Water Protection Council

Ohio Baseline Sampling

- **1,500** feet from wellhead in both urban and rural areas.
- Operator must sample all water wells prior to commencement of drilling & disclose results in permit application.
- If conditions at the proposed well site warrant a revision of the sampling distance the authority remains with the chief.
- Sampling should be conducted by a professional who is familiar with all sampling and laboratory protocols.
- Sampling professional will document sample location, date, time, and collect the water in containers designed for specific parameters to be analyzed.
- Analysis completed by a certified laboratory for each parameter to be tested.
- ORC 1509.22(F) requires an operator to replace a water supply based on the results of a complete groundwater investigation initiated by a complaint.

Ohio EPA, Division of Drinking & Ground Waters
Recommendations for Water Well Sampling Before Oil & Gas Drilling

Tier 1 Water Sample Parameters	Tier 2 Water Sample Parameters	Tier 3 Water Sample Parameters
Barium (dissolved)*	**Tier 1 sample parameters+**	**Tier 1 and 2 sample parameters+**
Chloride*	Calcium (total)*	BTEX (benzene, toluene, xylene, ethylbenzene) and Methane (dissolved)
Magnesium (total)*	Hardness	
Potassium (total)*	Total Alkalinity*	
Sodium (total)*	pH*	
Strontium	Iron (dissolved)*	
Sulfate*	Manganese	
Total dissolved solids*	Total suspended solids	
Specific Conductivity (at 25 ° C)*	Bromide	**$740 per well**
* Minimum parameters required by the Division of Oil & Gas to characterize pre-drilling water quality.		

Pennsylvania Baseline Sampling

- **1,000** feet from vertical wellhead & **2,500** feet from horizontal wellhead.
- Operator must sample all water supplies prior to commencement of drilling.
- Presumptive liability if pollution occurred within 6 months after completing a conventional well and within 12 months after completing an unconventional well.
- To rebut presumption: pollution existed prior to drilling, landowner refused access, water supply is not within 2,500 feet of unconventional vertical well bore, pollution occurred more than 12 months after completion of well, and pollution is the result of activity other than drilling.
- Independent certified laboratory for each parameter to be tested.
- Report to State within 10 days of receiving data packet to include: sample location, owner, date, laboratory, name of sampler, where and how sample was collected, description of type, age, and treatment of water supply, name of operator, name and number of well to be drilled.
- Act 13, Title 58, Section 3218(c.1) – if the affected water supply is within rebuttable presumption area and presumption applies, operator shall provide temporary water supply adequate in quality and quantity for the purpose served.
- Air monitoring – Natural gas operations in unconventional formations shall submit a source report annually identifying and quantifying actual air contaminant emissions.

Pennsylvania Department of Environmental Protection
Recommended Basic Oil & Gas Pre-Drill Parameters

Analyte (Inorganic)
Alkalinity
Chloride
Conductivity
Hardness
Oil and Grease
pH*
Sulfate
Total Dissolved Solids*
Residue - Filterable
Total Suspended Solids
Residue – Non Filterable

Analyte (Trace Metal)
Barium
Calcium
Iron*
Magnesium
Manganese*
Potassium
Sodium*
Strontium

Analyte (Organic)
Ethane*
Methane*

Analyte (Microbiology)
Total Coliform/E.coli

$600 per well

* As a minimum, a homeowner wishing to have their private well tested should analyze for these parameters.

Colorado Baseline Sampling

- Surface Water Supply Area: Drilling, Completion, Production, & Storage (DCPS) operations
  - Internal Buffer Zone (0 feet to 300 feet) – DCPS may not occur without a variance.
  - Intermediate Buffer Zone (301 feet to 500 feet) & External Buffer Zone (501 feet to 2,640 feet) – DCPS may occur with one pre-drill sample immediately down gradient of well and one follow up sample 3 months after completion.
  - Current applicable EPA approved methods for drinking water performed by accredited laboratory.
  - Report to commission within 3 months to include analytical results and sample location in EDD format.

Colorado Surface Water Supply Area

Sample Parameters	Intermediate Buffer Zone	External Buffer Zone
pH	✓	✓
Alkalinity	✓	✓
Specific Conductance	✓	✓
Major Cations/Anions (Chloride, Fluoride, Sulfate, Sodium)	✓	✓
Total Dissolved Solids	✓	✓
BTEX	✓	✓
Total Petroleum Hydrocarbon (TPH) – GRO & DRO	✓	✓
Polycyclic Aromatic Hydrocarbon (PAH) (including benzo(a)pyrene)	✓	✓
Metals (Arsenic, Barium, Calcium, Chromium, Iron, Magnesium, Selenium)	✓	✓

$640 per sample for initial sampling

$640 per sample for subsequent sampling

$1280 per sample

Colorado Baseline Sampling

- Groundwater Sampling: Rule 609 effective May 1, 2013
  - One half (1/2) mile from well to include all available water sources up to a maximum of 4 sources.
  - If more than 4 sources are available selection is based on proximity, type of source, orientation of sample location, multiple aquifers available, and condition of water source.
  - Initial sample 12 months prior to setting conductor casing.
  - One subsequent sample between 6 and 12 months after completion of well.
  - Second subsequent sample between 60 and 72 months after completion of well.

WATER SOURCE shall mean water wells that are registered with Colorado Division of Water Resources, including household, domestic, livestock, irrigation, municipal/public, and commercial wells, permitted or adjudicated springs, or monitoring wells installed for the purpose of complying with groundwater baseline sampling and monitoring requirements under Rules 318A.e.(4), 608, or 609.

Colorado Groundwater Sampling Criteria

$1250 per source for initial sampling

$760 per source for each subsequent sampling event – 2 rounds of subsequent sampling

Total per source equals $2770

Total cost to meet State requirements $2,770 x 4 = 11, 080

Sample Parameters	Initial Baseline Sampling	Subsequent Sampling
pH	✓	
Specific Conductance	✓	
Total Dissolved Solids (TDS)	✓	✓
Dissolved Gases (Methane, Ethane, & Propane)	✓	✓
Alkalinity	✓	✓
Major Anions (Bromide, Chloride, Fluoride, Sulfate, Nitrate & Nitrite as N, & Phosphorus)	✓	✓
Major Cations (Calcium, Iron, Magnesium, Manganese, Potassium, Sodium)	✓	✓
Other Elements (Barium, Boron, Selenium, & Strontium)	✓	
Presence of Bacteria (Iron related, Sulfate reducing, & slime forming)	✓	
Total Petroleum Hydrocarbons (TPH)	✓	✓
BTEX compounds (Benzene, Toluene, Ethylbenzene, & Xylenes)	✓	✓
Field Observations – Odor, Color, Sediment, Bubbles, & Effervescence	✓	
Gas Compositional Analysis (Performed if the dissolved methane concentration exceeds 1 mg/L) & stable isotope analysis of the methane (Carbon (12C & 13C) & Hydrogen (1H & 2H))		

West Virginia Baseline Sampling

- **1,500** feet from the center of the horizontal well pad
- Presumptive liability if pollution occurred within 6 months after completing a well.
- To rebut presumption: pollution existed prior to drilling as determined by a pre-drilling test, landowner refused access, water supply is not within 1,500 feet of well, pollution occurred more than 6 months after completion of well, and pollution is the result of activity other than drilling.
- Independent certified laboratory must conduct the pre-drilling test.
- Air monitoring – study air pollution occurring from well sites to include: possible health impacts, air quality inspections during drilling, compressors, pits, impoundments, and any other potential air quality impacts generated from drilling activity. Report to Legislature by July 1, 2013.

North Dakota Baseline Sampling

- **One mile** from a well site.
- Certified water quality and quantity test performed by property owner within one year prior to commencement of drilling.
- Owner of property is entitled to recover cost of replacing water supply.
- 38-11.1-06 Protection of Surface and Groundwater: passed April 7, 1987.
- State does not require operators to test water wells prior to drilling.
- Recommends following National Ground Water Association & Ground Water Protection Council guidelines for sampling.

Arkansas Baseline Sampling

- No rules for baseline sampling or presumptive liability. Water sampling is performed only if a complaint is received by landowner.

American Petroleum Institute (API)

- "Once the location for a well has been selected and before it is drilled, water samples from any source of water located nearby should be obtained and tested in accordance with applicable regulatory requirements."
- "This would include rivers, creeks, lakes, ponds, and water wells. If testing was not done prior to drilling, it should be done prior to hydraulically fracturing a well. The area of sampling should be based on the anticipated fracture length plus a safety factor."

National Ground Water Association & Ground Water Protection Council

- Step 1: Have a qualified water well system professional test groundwater quality.
- Step 2: Analyze water sample for constituents outlined in NGWA list to establish baseline water quality.
- Step 3: Retest water quality against baseline results within 6 months of well completion.
- Subsequent screening: An increase in concentration or occurrence of pH, specific conductance or TDS, and dissolved methane could indicate more sophisticated water quality testing is required.

Major Ions: **Alkalinity, Calcium, Chloride, Magnesium, Potassium, Sodium, Sulfate**
Minor & Trace Elements: **Arsenic, Barium, Boron, Bromide, Chromium, Iron, Manganese, Selenium, Uranium**
Water Quality Parameters: **pH, Specific Conductance, Total Dissolved Solids (TDS), Turbidity**
Organic Chemicals: **Benzene, Toluene, Ethylbenzene, Xylene (BTEX), Diesel Range Organics (DRO), Dissolved Methane, Gasoline Range Organics (GRO), & Total Petroleum Hydrocarbons or oil and grease (HEM)**

$840 per sample

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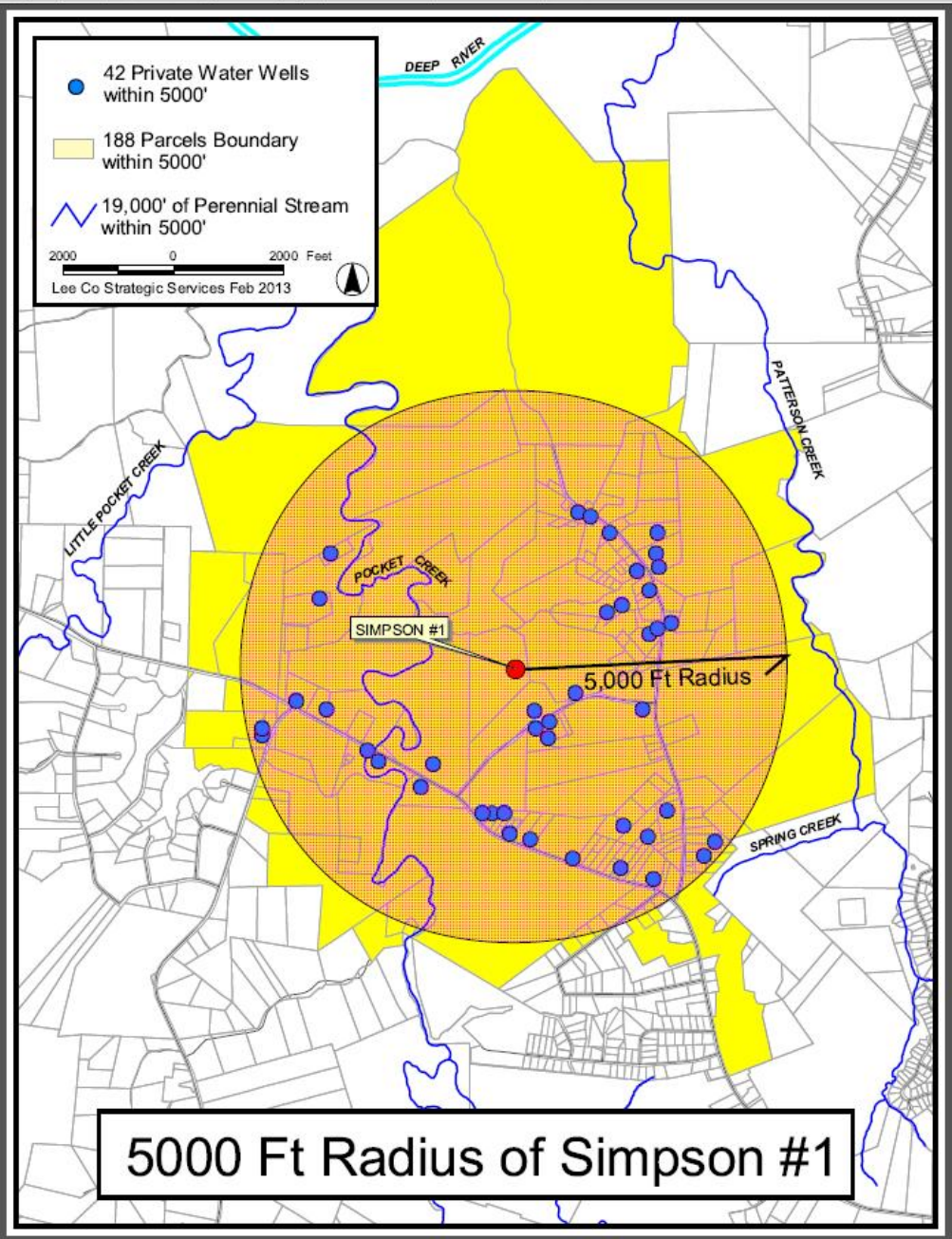

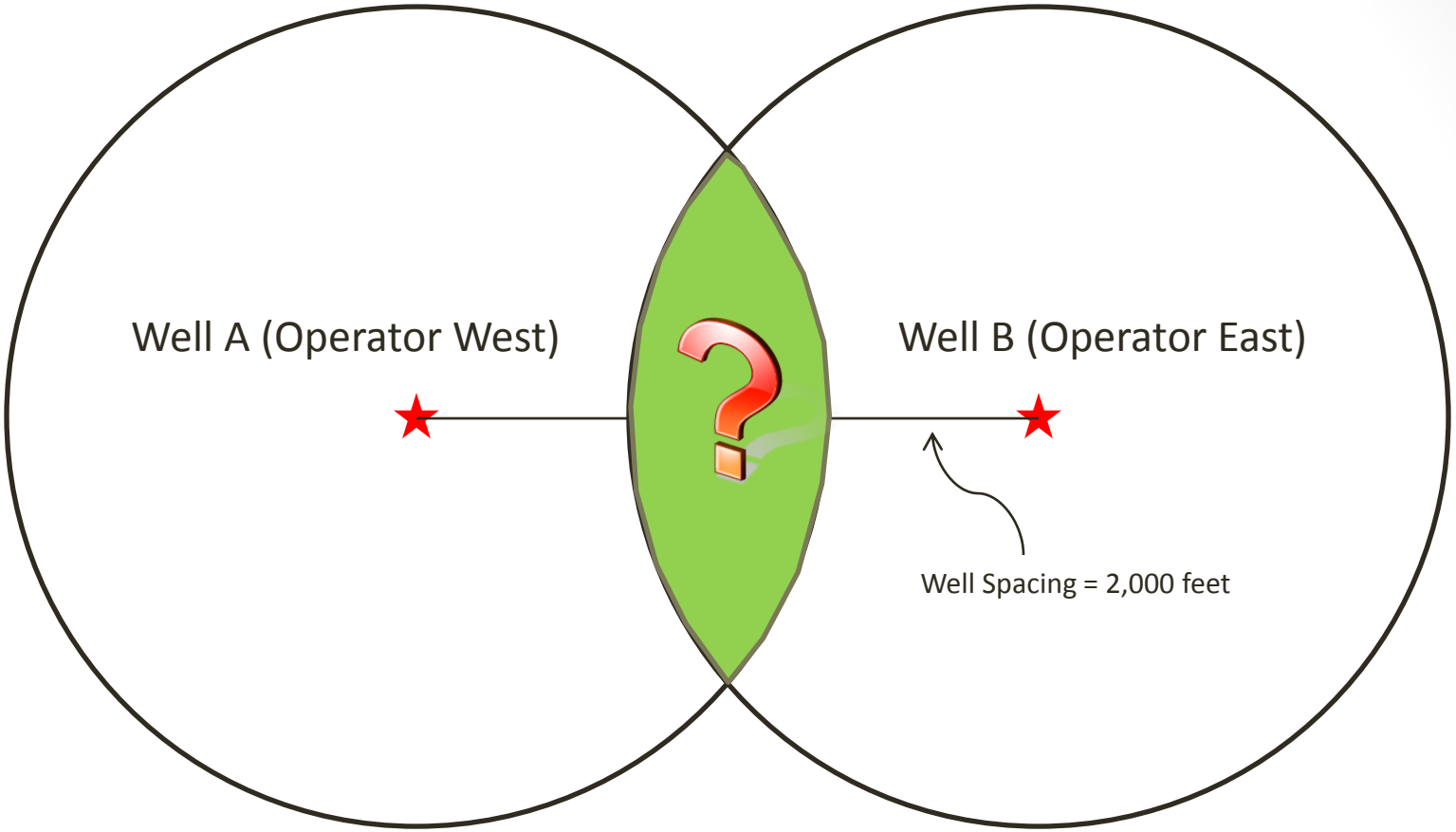

5,000 foot sampling radius from each wellhead:

- How should DENR handle the area of overlap?

Recommendations

- Adopt National Ground Water Association (NGWA) baseline water sampling parameters (NGWA list covers all parameters from Ohio and most parameters from Colorado).
- Should subsequent sampling be incorporated into the baseline sampling program?
- Determine timeframe for presumptive liability if applicable.
- Decide on radius for pre-drilling sampling – currently 5,000 feet (Simpson #1 – 42 private wells @ $1,600/well = $67,200).
- Decide on the number of wells needed to satisfy baseline sampling requirements.
- How to handle overlap in baseline sampling with well spacing – shared responsibility between operators.
- Division of Air Quality has regulatory framework in place to cover shale gas activity.