BASELINE WATER QUALITY SAMPLING IN SHALE GAS EXPLORATION AND PRODUCTION AREAS
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CURRENT BASELINE WATER QUALITY PROGRAM CONCEPTS

- Baseline (pre-drill) sampling is considered the backbone of CHK’s prevention measures to protect drinking water supplies
  - Risk management tool to decrease overall risk
  - Success of the program rests heavily on the accuracy, timeliness and quality of analytical data provided by environmental laboratories
  - Data from baseline sampling programs becomes the base of all subsequent environmental investigations in active drilling, completion and production areas
CURRENT BASELINE WATER QUALITY PROGRAM CONCEPTS

- Chesapeake has had over 31,000 baseline samples collected
  - More than 1,162,000 individual laboratory analyses
  - In some areas, as many as 92% of baseline samples have results for at least one water quality parameter that exceeds an established drinking water criteria
  - This much data requires considerable investment in management and evaluation
  - Environmental laboratories involved in baseline programs must be prepared to meet challenges associated with varying numbers of samples
CURRENT BASELINE WATER QUALITY PROGRAM CONCEPTS

- Water Quality Analysis (pre-drill) using independent environmental consultants (sampling) and analytical laboratories (testing) based on written program documents and procedures
  - Clarifies expectations for consultants and laboratories
- On-going communications between all consultants and laboratories involved in the program
  - Consistency of sampling procedures
  - Increased comparability of data between consultants and laboratories
  - Joint training activities
  - Field and laboratory auditing conducted by CHK
CURRENT BASELINE PROGRAM COMPONENTS

- Independent Consultants
  - Identify private water sources
  - Coordinate water sampling survey form delivery
    - Critical element in assisting to identify potential sources of variability, e.g. use prior to sampling
  - Schedule sampling times with residents/landowners, conduct sampling, and follow-up contact
    - Photo documentation during sampling – can prove to be a most critical element
    - Field notes, site sketch and field activities documentation – specific timeframes for conversion to electronic form
    - Verification of multiple contacts and adequate documentation of refusals for testing
    - Coordinate delivery of results to landowners & state agencies (where required)
  - Assist in Public Outreach Meetings in local community groups
CURRENT BASELINE PROGRAM COMPONENTS

- Independent Analytical Laboratories
  - Analyze for specific indicator parameters to establish general water quality
  - Use scientifically validated methods for testing groundwater and surface water

- Data Internally Stored in EQuIS Format
  - Able to utilize data for statistical reports
  - Readily access data for complaints or other uses
WATER TESTING PARAMETERS AND LANDOWNER REPORTS

- Chesapeake Standard Baseline Parameters
  - **Field Screening:** pH, Temperature, Specific Conductivity, DO, Turbidity, GE/GC/FID/PID and LEL readings, Eh, and Hydrogen Sulfide
  - **General Chemistry:** pH, Specific Conductance, Turbidity, Chloride, Sulfate, Bromide, Carbonate Alkalinity, Bicarbonate Alkalinity, MBAS, TDS, and TSS
  - **Total Metals:** Ag, As, Ba, Ca, Cd, Cr, Fe, Hg, Li, K, Mg, Mn, Na, Pb, S, Se, and Sr
    - Dissolved Metals: Fe and Mn, if field turbidity exceeds 10 NTU
  - **Organics:** BTEX, O&G (HEM), and Dissolved Light Gases (C₁-C₃)
    - Rush dissolved light gas results if field LEL reading is greater than 10% or sample is effervescent
  - **Isotopic Methane:** if dissolved methane exceeds 20 mg/L
    - Some states have a lower threshold of 1 to 2 mg/L
WATER TESTING PARAMETERS & LANDOWNER REPORTS

- Chesapeake Resident Package
  - Full Copy of Analytical Laboratory Report
    - How to Read Your Laboratory Report Fact Sheet
  - Frequently Asked Questions (FAQs)
  - Methane Fact Sheets (when dissolved methane is detected)
WATER SOURCES & SAMPLING RADIUS

- Water Sources utilized for household purposes:
  - Bathing and Washing
  - Drinking and Cooking
  - Other household uses

- Sampling Radius:
  - One Thousand feet (1000’) from well pad (surface hole) location or state regulatory requirement, whichever is greater
  - Some areas radius is extended (4,000’) based on location and available water sources
BASELINE WATER SAMPLING POINT

- Sample Collection Point:
  - Non-invasive sampling
    - Dissolved gases should be collected under water head
  - Water Line from Water Well or Spring:
    - Sample point/spigot at well head or prior to treatment/pressure tank
    - Base of pressure tank
    - Sink tap
  - Springs: end of the pipe, outlet, or from cistern/water collection system
  - Surface water: mid-depth from center of water source, if possible
BENEFITS OF PRE-DRILL SAMPLING & TESTING

- Better understanding of general water quality in immediate area
  - Water well records obtained during baseline sampling surveys may be incomplete in counties where records are poorly kept
  - Landowner knowledge of water quality is documented in Water Sampling Survey
  - Help identify areas with pre-existing dissolved methane sources
BENEFITS OF PRE-DRILL SAMPLING & TESTING

- Help establish a baseline of water quality if complaint is made
  - Use in addition to a timeline for events prior to the complaint
  - Additional data can be gleaned from mud logger data, area data compilations, and evaluation of other possible sources (e.g., legacy wells, etc.)
BENEFITS OF PRE-DRILL SAMPLING & TESTING

- Water testing in the area demonstrates the operator’s commitment to protection of water source(s)
- Landowners receive a full analytical report documenting their water quality
  - Provide educational fact sheets to assist landowners in understanding their resident package
  - Many landowners do not know the depth of their well
- Help educate the general public in localized town hall meetings
  - Helps to overcome public perceptions
  - Presents baseline data findings for the general area
  - One-on-one sessions are made available
LESSONS LEARNED

- Operator’s program document must be written
- Photo documentation is critical
  - Consultants must act as the eyes for the operator at each site being sampled
  - Photos of wellhead, sample point and any special or unusual conditions noted
- Document all attempts to provide testing
  - Consultant must document all written and oral contact with well owner to offer water sampling in order to establish due diligence
  - All refusals must be clearly documented
LESSONS LEARNED

- Laboratories should be prepared to be flexible
  - Numbers of samples are not guaranteed
  - Participation in baseline sampling programs may lead to additional work
    - Example: 26 baseline samples lead to an additional 750 samples in a subsequent investigation
LESSONS LEARNED

- Laboratories need rigorous electronic data delivery systems and robust QA/QC for data reporting
  - Correct reporting of data, units, etc.
  - Use of consistent analyte nomenclature
    - 1,2-xylene versus o-xylene
    - Dibromochloromethane versus chlorodibromomethane
  - Use of multiple methods for the sample analyte
    - Appears as two different compounds
  - Electronic data delivery (EDD) must be consistent with written analytical report
    - Multiple confirmation runs reported in the EDD
LESSONS LEARNED

- Laboratories need to invest in excellent analytical capabilities for general water quality parameters
  - Need to be robust and provide irrefutable analytical data
  - Example: Sulfate data for 30 wells collected on the same day
    - Results reported on one day were 4 times higher than actual concentration due to manual calculation error at the bench level
    - Data had not been internally reviewed by the laboratory for consistency with other general water quality parameters reported for the samples and for the project
    - Investments need to be made in upgrading capacity and capabilities in the general chemistry laboratory
LESSONS LEARNED

- Laboratories need to provide consistently accurate sample results
  - Baseline sampling programs for a single O&G operator may involve multiple laboratories
  - O&G operators are beginning to share data collected in the sample area
  - It is critical that data from each laboratory be comparable
LESSONS LEARNED

- Laboratories need to improve laboratory reports
  - Many are difficult to read and understand
  - Example: Well owner indicated he was concerned about the 100% acetylene in his well
    - Misinterpreting the surrogate data for light gases reported in the midst of the analytical data for his well
  - Surrogates and other quality assurance information is necessary but confusing for the non-professional
  - Laboratory reports should contain a summary of detected results at the beginning of the laboratory report
LESSONS LEARNED

- Laboratories need to improve case narratives
  - Laboratories are using data qualifiers instead of extensive case narratives
  - The case narrative is often critical to the correct interpretation of the data
  - Example: Total metals results for a domestic water well sample were highly elevated compared to three prior samples
    - Inquiry to the laboratory revealed the sample analyzed for metals contained substantial amounts of sediment
    - This was not noted in the case narrative
  - Example: Set of 10 air samples analyzed by EPA Method TO-15
    - Case narratives on 9 of 10 samples indicated issues with analysis of samples in Tedlar bags
    - The one sample with significant results did not have the statement in the case narrative
  - Laboratories need to prepare well written and completely descriptive case narratives
LESSONS LEARNED

- Laboratories need to have in place a mechanism to rapidly notify the client of analytical results which exceed an established threshold.
  - Baseline samples with dissolved method 20 mg/L or above require notification so that the well owner can be immediately notified and appropriate education and mitigation can begin.
CONCLUSIONS

- Laboratories need to be prepared to be an active partner with the oil and gas operator client.

- Laboratories need to have robust systems to support accurate delivery of data into electronic database systems.

- Laboratories need to invest in excellent analytical capabilities for general water quality parameters.
CONCLUSIONS

- Laboratories need to update laboratory report formats so they are more easily read and understood.

- Laboratories need to improve case narratives.

- Laboratories need to have a rapid notification system in place for results which exceed established thresholds.
QUESTIONS?

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