



MARCELLUS
SHALE COALITION™

RECOMMENDED PRACTICES:

Pre-Drill Water Supply Surveys

MSC RP 2012-3
August 28, 2012



RECOMMENDED PRACTICES FOR PRE-DRILL WATER SUPPLY SURVEYS

Overview

The Marcellus Shale Coalition is recommending that operators conduct a pre-drill water survey on identified water supply sources within a given area of the well pad surface location, as is required by the relevant regulatory agency.

Water supply sources such as wells, springs and ponds should be evaluated prior to earth disturbance for site construction or prior to spud. Consideration should also be given to sampling water supply sources that are not currently in use.

Water samples should be obtained by a properly trained and experienced independent third party and in accordance with applicable state and federal regulations and requirements. Sampling shall be conducted as close to the water supply source as is practical.

Surveying and sampling should be conducted with the landowner's consent. If the landowner or water purveyor refuses to allow the operator access to conduct the water sampling, the operator should issue notice to the landowner or water purveyor by certified mail, with a copy to the regulatory agency, that access was refused.

Water samples should be analyzed by a certified laboratory using EPA SW-846 methods or drinking water methods. A list of test parameters appears in Section 4.2 of the Recommended Practices for Pre-drill Water Supply Surveys.

A report of the analytical results should be provided to the regulatory agency and to the water supply owner or resident if applicable. Operators should consider including in reports references that the homeowner may use to interpret the analytical data, such as publicly available guidance documents from regulatory agencies.



RECOMMENDED PRACTICES FOR PRE-DRILL WATER SUPPLY SURVEYS

Preface

This document provides general guidance on recommended practices for the subject(s) addressed. It is offered as a reference aid and is designed to assist industry professionals in improving their effectiveness. It is not intended to establish or impose binding requirements. Nothing herein constitutes, is intended to constitute, or shall be deemed to constitute the setting or determination of legal standards of care in the performance of the subject activities. The foregoing disclaimers apply to this document notwithstanding any expressions or terms in the text that may conflict or appear to conflict with the foregoing.

Section 1 Introduction

1.1 MSC Guiding Principles

We, the members of the Marcellus Shale Coalition, embrace and operate by the following guiding principles:

- We provide the safest possible workplace for our employees, our contractors, and in the communities in which we operate;
- We implement state-of-the-art environmental protection across our operations;
- We continuously improve our practices and seek transparency in our operations;
- We strive to attract and retain a talented and engaged local workforce;
- We are committed to being responsible members of the communities in which we work;
- We encourage spirited public dialogue and fact-based education about responsible shale gas development; and
- We conduct our business in a manner that will provide sustainable and broad-based economic and energy security benefits for all.

We recognize that to succeed in business, we must not only embrace these principles, we must live by them each and every day. This will be our legacy.

1.2 Purpose

These recommended practices address relevant considerations and guidelines for Pre-drill Water Supply Surveys. These recommended practices support our guiding principles.

Section 2 General

The objective of a pre-drill survey is to establish a baseline for conditions that existed prior to drilling. Groundwater may contain some natural impurities or contaminants even with no human activity or pollution. Therefore, it is important for both the operator and the water supply owner to understand the concentrations of constituents in water supplies located in the area of planned drilling activities. For example, there are areas throughout the United States where naturally occurring methane gas is present in shallow aquifers frequently used as water supplies for private land owners. This has been well documented for decades in portions of the Appalachian basin. Refer to the MSC's Recommended Practice for Responding to Stray Combustible Gas Incidents for further information on this subject.

A pre-drill survey should be conducted on all identified water supplies within a given area of the well pad surface location as required by the State Regulatory Agency (SRA). An oil and gas company may choose to sample beyond the area required by the SRA in accordance with the oil and gas company's internal sampling protocols. Sampling may be based on hydrology, geology, aquifer characteristics or any number of other factors. Water supplies such as wells, springs, and ponds should be evaluated. Consideration should also be given to sampling water supplies that are not currently in use, as they could be put in use in the future.

Sampling and laboratory analyses should be conducted prior to any earth disturbance for site construction or prior to spud. If the original analyses are conducted more than 6 months prior to spud of the first well on the pad or remobilization, it is recommended that sampling and analyses should be performed again prior to spud. Consult with the SRA for the definitions of spud and remobilization.

Section 3 Initial Survey

All water supplies within the selected/required area of the gas well pad surface location should be identified during initial water supply inventorying activities. The following tools may be utilized to identify water well, pond, and spring locations; regulatory databases; topographic and aerial maps; windshield surveys; and property tax rolls. Each water supply shall be given a unique identifier.

Contact the owner and/or resident of the water supply to schedule the initial survey using, at minimum, methods prescribed by the SRA (e.g., certified mail, direct contact, etc.). Operators should inform the water supply owners and/or residents that any and all information/data collected will be provided to the owner/occupant and to the SRA (if required by state regulations) and, as such, the information could be disclosed as public information upon inquiry to the SRA.

With the assistance of the water supply owner, locate the water supply(ies) and sampling location(s). Use GPS (preferably NAD83 datum) to determine and record the latitude and longitude of each water supply. For each water supply, conduct a survey or interview with the water supply owner and document available basic water supply information (i.e., if the supply is a water well obtain the depth, year drilled, casing type, treatment, historic water quality issues). Prepare a plan view sketch to document the location of the water supply (and sampling point), residence, septic system, adjacent surface water bodies and any other pertinent features. Photograph all notable features, such as the wellhead, spring location, sample point, etc. Note the approximate relative distances between features on the sketch. For informational purposes, Appendix A contains an example site visit form to help illustrate information that should be collected during each sampling event.

Section 4 Water Sampling

Water samples shall be obtained by a properly trained and experienced independent third party. The sampling shall be performed in accordance with applicable state and federal regulations and requirements. The samples shall be collected, in accordance with all appropriate sample collection, preservation, handling, and defensible chain-of-custody procedures. Appropriate sample collection procedures can be found on the United States Environmental Protection Agency (USEPA) website (www.epa.gov).

Sampling shall be conducted as close to the water supply as is practical. In other words, the sample should be collected prior to any treatment system or storage tank. Whenever the sample cannot be collected prior to the treatment system/storage tank, the sampler shall note this as part of the sample collection documentation.

If the landowner or water purveyor refuses to allow the operator access to conduct the water sampling, the operator shall issue notice to the landowner or water purveyor by certified mail, with a copy to the SRA, that access was refused. The notice should include the following:

- The operator's intention to drill or alter a gas well.
- The desire to conduct a predrilling or pre-alteration survey.
- The name of the person who requested and was refused access to conduct the survey and the date of the request and refusal.
- The name and address of the well operator and the address of the SRA, to which the water purveyor or landowner may respond.

4.1 Sample Analyses

Water samples shall be analyzed by an SRA certified laboratory using USEPA SW-846 methods or drinking water methods (where drinking water methods exist). For parameters that have a Maximum Contaminant Level (MCL), the laboratory should be instructed to provide a laboratory reporting limit no greater than the published MCL.

The USEPA primary and secondary MCLs have been established for treated drinking water at the delivery point. A MCL is the maximum permissible level of a contaminant in drinking water, which is delivered to any user of a public water system. A public water system is defined as at least 15 service connections or a system that regularly serves an average of 25 individuals. Although MCLs are commonly used as a benchmark for private water supplies, it should be noted that the USEPA and the SRAs do not have authority to regulate private drinking water wells. The following parameters should be considered:

4.2 Parameters

Alkalinity	Total Chromium
Oil & Grease	Total Arsenic
pH	Total Barium
Specific Conductance	Total Lead
Total Dissolved Solids	Total Selenium
Total Suspended Solids	Total Strontium
Chloride	Total Calcium
Sulfate	Total Iron
Total Hardness	Total Magnesium
Surfactants (MBAS/foaming agents)	Total Manganese
Benzene, Toluene, Ethylbenzene, Xylenes (BTEX)	Total Potassium
Dissolved Methane*	Total Sodium
Dissolved Ethane	E. Coli
Dissolved Propane	Total Coliform
Nitrate as N	Turbidity**

*Refer also to the MSC Recommended Practices for Responding to Stray Combustible Gas Incidents and consider obtaining isotopic analysis if the pre-drill samples show levels of methane in a water supply that exceed background levels in the area.

**If Turbidity exceeds 10 ntu, the operator should consider collecting samples for dissolved metals analysis.

Additional parameters may be appropriate based on location and specific conditions and may be added at the discretion of the operator.

Appendix B contains a spreadsheet that provides the list of parameters, along with the possible test methods, appropriate holding times, and the MCLs for the parameters that have a MCL.

4.3 Reporting

A report documenting the analytical results of the preconstruction or predrill survey shall be prepared, in accordance with SRA requirements. Where required, the report shall be provided to the SRA and to the water supply owner and/or resident. The report should contain the following information:

- The location of the water supply and the name of the surface landowner or water purveyor
- The date of the survey, the name of the certified laboratory and the person who conducted the survey
- A description of where and how the sample was collected
- A description of the type and age, if known, of the water supply, and treatment, if any
- The name of the well operator, name and number of well to be drilled and permit number if known
- The results of the laboratory analysis

Consider including references that the homeowner may use to interpret the analytical data such as publicly available guidance documents from regulatory agencies.

APPENDIX A

SITE VISIT FORM ONE FORM FOR EACH WATER SOURCE

Part A: GENERAL INFORMATION

Water Source ID:	O&G Well Name/No.:	Permit No.:	Well Operator:
Coordinates: (in NAD83, in decimal degrees) Lat _____ Long _____ Elevation _____ FT.			
Sampled By:	Date Sampled:	<input type="checkbox"/> N/A: No Sample (See Notes)	
Person Interviewed (circle one): Owner Resident Other: _____			
PROPERTY OWNER		RESIDENT OR OTHER	
Name:		Name:	
Address:		Address:	
Address:		Address:	
Phone No.:		Phone No.:	

Part B: WATER QUALITY

	Reported Quality			Observed Quality			Treatment			Pump Type
	Yes	No	N/A	Yes	No	N/A	<input type="checkbox"/> None	<input type="checkbox"/> UV Light	<input type="checkbox"/> None	
Staining	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Softening	<input type="checkbox"/> pH Adjustment	<input type="checkbox"/> Gas Piston	
Odor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Chlorination	<input type="checkbox"/> Other: _____	<input type="checkbox"/> Submersible	
Cloudiness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Iron Removal		<input type="checkbox"/> Windmill	
Sheen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> In-line Sediment Filter		<input type="checkbox"/> Jet	
Effervescence	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Charcoal Filter		<input type="checkbox"/> Other: _____	
Taste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	N/A	N/A	N/A	Yes <input type="checkbox"/> No <input type="checkbox"/> Functioning Properly		<input type="checkbox"/> Capacity _____ GPM	

Part C: WATER SOURCE INFORMATION

Does this source supply any other properties? _____ If yes, identify properties _____
Is the water source(s) located on the property: Yes <input type="checkbox"/> No <input type="checkbox"/> If No, please explain: _____
Number of people using this water source? _____ Gallons/day, if metered: _____
Has water source ever gone dry? Yes <input type="checkbox"/> No <input type="checkbox"/>
Pressure Tank Yes <input type="checkbox"/> No <input type="checkbox"/> Size of tank _____ gallons <input type="checkbox"/> Actual size <input type="checkbox"/> Estimated <input type="checkbox"/> Unknown
Water Use <input type="checkbox"/> Domestic <input type="checkbox"/> Husbandry <input type="checkbox"/> Irrigation <input type="checkbox"/> Other: _____
Compass course from water source to dwelling _____ Estimated distance from water source to dwelling _____ FT.
Are there any other water sources on the property? Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, how many? _____
Provide all water source ID(s) _____
Are you aware of any abandoned water source (s)? _____ If yes, where _____, when _____
Water Source Type: <input type="checkbox"/> Water Well
Drilled Well: Yes <input type="checkbox"/> No <input type="checkbox"/> Dug Well: Yes <input type="checkbox"/> No <input type="checkbox"/> Artesian: Yes <input type="checkbox"/> No <input type="checkbox"/> Other: _____
Reported total well depth: _____ FT. Well casing diameter: _____ IN. Missing/damaged pit-less adaptor Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown <input type="checkbox"/>
Reported depth of water level: _____ FT. Reported pump depth _____ FT.
Date Drilled _____ Drillers Name _____ Is the well in basement or crawlspace? _____

APPENDIX A

SITE VISIT FORM ONE FORM FOR EACH WATER SOURCE

Driller log available Yes <input type="checkbox"/> No <input type="checkbox"/> Driller's name _____	
Signature of owner authorizing release of well log(s) _____	
Water Source Type: <input type="checkbox"/> Spring	
Discharge Pipe Yes <input type="checkbox"/> No <input type="checkbox"/> Seep/Ground Surface Flow Yes <input type="checkbox"/> No <input type="checkbox"/> Spring House Yes <input type="checkbox"/> No <input type="checkbox"/> Underground Vault Yes <input type="checkbox"/> No <input type="checkbox"/>	
Water Source Type: <input type="checkbox"/> Cistern	
Size of Cistern _____ gallons <input type="checkbox"/> Actual size <input type="checkbox"/> Estimated <input type="checkbox"/> Unknown	
Source of water: _____ (e.g. delivered, spring, well, gutter, etc.)	
Water Source Type: <input type="checkbox"/> Surface Water	
<input type="checkbox"/> Pond <input type="checkbox"/> Lake <input type="checkbox"/> Creek <input type="checkbox"/> River	
Water Source Type: Public Water Yes <input type="checkbox"/> No <input type="checkbox"/>	

PART D: DESCRIPTION OF WATER SOURCE (check all that apply)

<input type="checkbox"/> Loose, missing, or damaged cover (circle one if applicable)	<input type="checkbox"/> Evidence of erosion
<input type="checkbox"/> Evidence of insects, spiders, animals (circle one if applicable)	<input type="checkbox"/> Water source secured
<input type="checkbox"/> Any cracked or damaged well casing/spring vault (circle one if applicable)	<input type="checkbox"/> Source buried
<input type="checkbox"/> Water source open to surface water	<input type="checkbox"/> Location unknown
<input type="checkbox"/> Additional storage or holding tank/coyote system (circle one if applicable)	<input type="checkbox"/> Other: _____
<input type="checkbox"/> Cover flush with ground	

PART E: DESCRIPTION OF AREA SURROUNDING WATER SOURCE (check all that apply) Show locations on site sketch and provide approximate distance & compass course. Document housekeeping conditions. (Attach photos.)

<input type="checkbox"/> Ground sloping toward water source
<input type="checkbox"/> Water source downgradient of septic system
<input type="checkbox"/> Signs of failing septic, soggy ground, foul odor (circle all that apply)
<input type="checkbox"/> Close proximity to garden, agricultural field, orchard, greenhouse. (circle all that apply)
<input type="checkbox"/> Close proximity to junkyard, dumping area, landfill. (circle all that apply)
<input type="checkbox"/> Close proximity to fuel storage tanks, equipment storage or maintenance areas, garage. (circle all that apply)
<input type="checkbox"/> Located in field with livestock, barn, barnyard, other out building. (circle all that apply)
<input type="checkbox"/> Close proximity to salt storage area, salted roadway.
<input type="checkbox"/> Close proximity to pipeline.
<input type="checkbox"/> Other: _____

ADDITIONAL REMARKS & COMMENTS: (record details from any previous sampling events, including who for, when, and who collected samples)

PART F: SAMPLING

SAMPLED	SAMPLING POINT LOCATION
<input type="checkbox"/> Before Treatment <input type="checkbox"/> After Treatment	<input type="checkbox"/> Inside Faucet: _____ <input type="checkbox"/> Pressure Tank <input type="checkbox"/> Overflow/Discharge Pipe
<input type="checkbox"/> No Treatment <input type="checkbox"/> Not Sure	<input type="checkbox"/> Outside Faucet: _____ <input type="checkbox"/> Wellhead <input type="checkbox"/> Other: _____
	<input type="checkbox"/> Seep <input type="checkbox"/> Surface Water (sampled at coordinates in Part A)

APPENDIX A

SITE VISIT FORM
ONE FORM FOR EACH WATER SOURCE

SAMPLING METHOD: <input type="checkbox"/> Existing well pump <input type="checkbox"/> Sampling pump <input type="checkbox"/> Low flow <input type="checkbox"/> Bailer <input type="checkbox"/> Other: _____	
Was the water source purged before sampling? Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, volume (gal.) and/or time (min) purged: _____	
Is it possible to run water for 30 minutes? Yes <input type="checkbox"/> No <input type="checkbox"/> If no, please explain: _____	
Average water usage within last 24 hours _____	
Chain of custody attached? <input type="checkbox"/> Yes <input type="checkbox"/> No Name of Certified Laboratory: _____	
FIELD ANALYSES:	
Turbidity: _____ pH: _____ Conductivity: _____ Temperature: _____	
Combustible Gas Reading (Describe location and method):	

PART G: PLAN SKETCH and PHOTOGRAPHS (use additional pages as necessary) Show compass course and provide approximate distance.

Sampler/Interviewer

I hereby acknowledge that I have supplied the correct information to the best of my knowledge		
Sign _____	Print _____	Date _____
Company: _____	Address: _____	Phone: _____

APPENDIX B

Summary of Aqueous Predrill Constituents, Maximum Concentration Limits, Analytical Methods, and Holding Times

Constituent	MCL ¹ (mg/L ²)	Required Laboratory Reporting Units	EPA/600/R-95-131	SW-846	Annual Book of ASTM Standard, Vol. 11.01	Standard Methods for the Examination of Water and Wastewater, 18th Edition	Other	Holding Times (with proper preservative)
Conventional Analyses								
Alkalinity	--	mg/L	--	--	D1067	2320B, 2320 B-97		14 days
Oil & Grease	--	mg/L	1664A	9071	--	5520B		28 days
pH	6.5-8.5 SU ³	SU	150.1, 150.2	9040, 9045, 9041	D1293	4500-H+-B		Immediately
Specific Conductance	--	uhmos/cm	120.1	9050	D3448	2510B		28 days
Total Dissolved Solids	500 ³	mg/L	--	--	--	2540C		7 days
Total Suspended Solids	--	mg/L	--	--	--	2540D		7 days
Chloride	250 ³	mg/L	300.0, 300.1	6500, 9056, 9057, 9212, 9250, 9251, 9253	D4327, D512	4110B, 4500Cl-B,C,D,E		28 days
Sulfate	250 ³	mg/L	300.0, 300.1	6500, 9035, 9036, 9038, 9056	D4327, D516	4110B, 4500-SO42 Cor D		28 days
Hardness	--	mg/L	130.1, 130.2, 200.7 (calc)	6010 (calc)	D1126-86(92)	2340 B or C		6 months
Nitrate as N	10	mg/L	300.0, 300.1, 352.1	6500, 9056, 9210	D4327-97	4110B, 4500-NO3 B		48 hours
MBAS/ Surfactants	0.05 ³	mg/L	--	--	D2230-88, 02	5540C		48 hours
Total Coliform	5.00%	<1	1604	9131, 9132	--	9221,D-99, 9222, C-97, 9223		6 - 24 hours
E. Coli	--	<1	1600, 1603	--	--	1103.1, 1106.1, 9223		4 - 24 hours
Turbidity	--	NTU	180.1	--	D1889-94	2130B		48 hours
Hydrocarbons								
Dissolved Methane	--	ug/L	RSK-175	8015M	--	--	PA-DEP 3686	14 days
Dissolved Ethane	--	ug/L	RSK-175	8015M	--	--	PA-DEP 3686	14 days
Dissolved Propane	--	ug/L	RSK-175	8015M	--	--	PA-DEP 3686	14 days
Volatile Organic Compounds								
Benzene	0.005	ug/L	624	8015,8021,8260, 8261	--	--		14 days
Toluene	1	ug/L	624	8015,8021,8260, 8261	--	--		14 days
Ethylbenzene	0.7	ug/L	624	8015,8021,8260, 8261	--	--		14 days
Xylene	10	ug/L	624	8015,8021,8260, 8261	--	--		14 days
Total Metals								
Arsenic	0.01	mg/L	200.7, 200.8	6010, 6020, 6200, 7010, 7061, 7062, 7063	D2972	3113, 3114		6 months
Barium	2	mg/L	200.7, 200.8	6010, 6020, 6200, 6800, 7000, 7010	--	3111, 3113, 3120		6 months
Calcium	--	mg/L	200.7, 200.8	6010, 6020, 6200, 6800, 7000	D511	3111, 3120, 3500		6 months
Chromium	0.1	mg/L	200.7, 200.8	6010, 6020, 6200, 6800, 7000, 7010	--	3113, 3120		6 months
Lead	0.015 ⁴	mg/L	200.7, 200.8	6010, 6020, 6200, 6800, 7000, 7010	D3559	3113		6 months
Iron	0.3 ³	mg/L	200.7, 200.8	6010, 6020, 6200, 6800, 7000, 7010		3111, 3113, 3120		6 months
Magnesium	--	mg/L	200.7, 200.8	6010, 6020, 6800, 7010	D511	3111, 3120, 3500		6 months
Manganese	0.05 ³	mg/L	200.7, 200.8	6010, 6020, 6800, 7000	--	3111, 3113, 3120		6 months
Potassium	--	mg/L	200.7, 200.8	6010, 6020, 6200, 6800, 7000	--			6 months
Selenium	0.05	mg/L	200.7, 200.8	6010, 6020., 6200, 6800, 7010, 7741,	D3859	3111, 3113		6 months
Sodium	--	mg/L	200.7, 200.8	6010, 6020, 7000	D6919	3111		6 months
Strontium	--	mg/L	200.7, 200.8	6010, 6020, 7000	D6919	3111		6 months

Notes:

- 1 - MCL - Maximum Contaminant Level - The maximum permissible level of a contaminant in drinking water which is delivered to any user of a public water system.
- 2 - Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million.
- 3 - Limit is a secondary drinking water standard. Secondary drinking water standards are non-enforceable guidelines regulating contaminants that may cause cosmetic or aesthetic effects in drinking water.
- 4 - Lead is regulated by a Treatment Technique that requires a system to control the corrosiveness of its water. This limit is an action level.
- 5 - The analytical laboratory should use the most current analytical methods.
- 6 - The US EPA regulates public water systems, it does not have the authority to regulate private drinking water wells.
- 7 - The laboratory reporting limits should be equal to or less than the MCLs.