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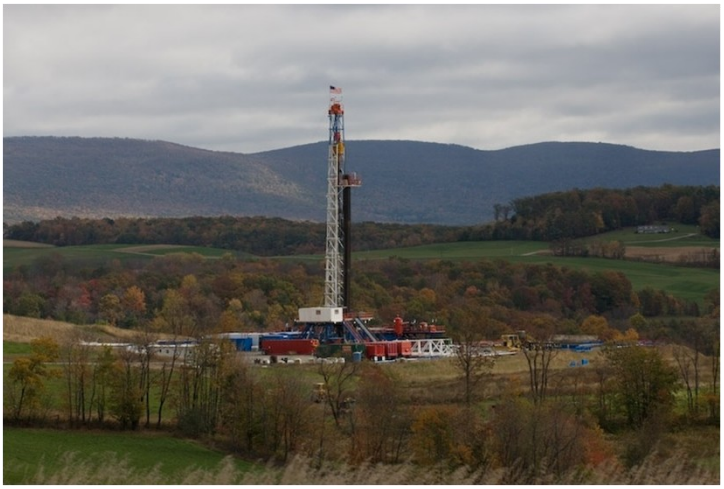
Water Facts #28

Gas Well Drilling and Your Private Water Supply

Gas well drilling has occurred for decades in much of western and northern Pennsylvania with tens of thousands of active gas wells in the state and over 5,000 new wells drilled each year. Most of these wells tap gas reserves a few thousand feet below the earth's surface. With discoveries of new gas reserves in the Marcellus shale and new drilling technologies to reach previously untapped gas reserves, both the number and depth of gas wells are expected to rise dramatically over the next several decades.



A typical Marcellus gas well site (Tom Murphy, Lycoming County Cooperative Extension).

Potential Water Quality Impacts from Drilling

Gas well drilling can occasionally impact groundwater resources that are the source of water for household water wells and springs. A single gas well can produce hundreds of thousands of gallons of waste fluids during drilling and during years of gas production. The wastes fluids generated from a gas well can be classified into several categories including:

- Top hole fluids are the fresh water aquifers that are encountered usually within the first few hundred feet of the drilling process.
- Bottom hole fluids are very old salt water deposits encountered deep underground during drilling below the fresh water aquifers. These fluids are commonly referred to as "brines".
- Stimulation or flow back fluids are fluids that are used to improve gas recovery from the rock and are returned to the ground surface. An example is "hydrofracturing" which uses high pressure fluids to break the gas-producing rock to improve the flow of gas. Along with large amounts of water, various other materials may be used or mixed with the water for the fracturing process including sand, oils, gels, acids, alcohols and various man-made organic chemicals. The exact additives have traditionally been difficult to determine because they were considered proprietary. Recent changes to the state gas well drilling permit along with action by River Basin Commissions now requires disclosure of additives used in hydrofracturing as part of the gas drilling permit application and approval.
- Production fluids are produced along with the natural gas after the well is in production. Production fluids usually have a similar chemistry to the bottom hole fluids.

The volume of fluids produced during gas well drilling and operation can vary considerably depending on the depth and location of the gas well. One study in Pennsylvania found average volumes of water produced during shallow gas well drilling in western Pennsylvania was 25,000 gallons during drilling, 50,000 gallons during stimulation and 150 gallons per day during production. Drilling of deeper gas wells in the Marcellus formation relies more on hydrofracturing which requires several million gallons of freshwater. On average, about 10 to 30 percent of the water used for hydrofracturing Marcellus wells returns to the ground surface as a "flow back" waste fluid.

While top hole fluid is usually representative of groundwater used for local water wells and springs,

the remaining water encountered during gas well drilling (bottom hole, stimulation and production fluids) may be contaminated with various pollutants.

Groundwater Pollutants from Gas Wells
Pollution of private water supplies from gas well activity has occurred in Pennsylvania. This contamination may occur from absent or corroded gas well casings (on older or abandoned gas wells) or it may originate from flooded or leaking waste fluid holding pits or spills at the drilling site.

Gas well waste fluids usually contain levels of some pollutants that are far above levels considered safe for drinking water supplies. As a result, even small amounts of pollution from waste fluids can result in significant impacts to nearby drinking water supplies. The broad categories of pollutants in gas drilling waste fluids includes:

- Salts—most notably sodium and chloride. Gas well waste fluids can have over 100,000 mg/L of these compounds. Other pollutants that can occur as various salts include magnesium, calcium and potassium. These salts cause the "total dissolved solids" in the wastes to be very high.

- Metals—including iron, manganese, barium, arsenic and trace amounts of other heavy metals.

- Organics—these include both natural and man-made materials that are used during the drilling process such surfactants, detergents, oil, grease, benzene and toluene. Dozens of other man-made organics may be used in small concentrations during hydrofracturing.

Another problem that can occur from gas well drilling is methane gas migration from gas wells into nearby water wells. The methane gas will rapidly escape from the groundwater and may pose an explosion hazard in confined spaces. Methane gas testing in water is difficult but it usually creates obvious symptoms in the home including effervescence and spurting faucets due to gas build-up. To learn more about methane gas problems in private wells, consult the Penn State Extension publication entitled Water Facts #24—Methane Gas and Its Removal from Wells in Pennsylvania available from your local Cooperative Extension office or online at:

http://*pubs.cas.psu.edu/FreePubs/pdfs/XH0010.pdf*

How Common are Problems?
Contamination of private wells and springs can occur from gas well drilling but it has not been common over the past few decades. Data from various regulatory agencies responsible for enforcement of gas well drilling regulations indicate that more than 95% of complaints received by homeowners suspecting problems from nearby gas well drilling are, instead, due to pre-existing problems or other nearby land use activities.

A study by McKean County Cooperative Extension and Penn State University in 2007 looked at water quality in 200 private water wells in an area that has undergone extensive oil and gas well drilling for several decades. About three percent of these private water wells exceeded drinking water standards for total dissolved solids, barium or chloride (three of the most likely water pollutants from gas well drilling). Another five percent of these private wells had elevated levels of at least one of these pollutants that could be tied to gas well drilling. A similar study of 200 water wells in the northeast region of the state in early 2008 did not detect any water wells with these same pollutants prior to intensive Marcellus shale drilling activity.

It is important to note that the McKean County study did not attempt to differentiate between effects from past versus current gas well drilling. Given the changes and strengthening of regulations on gas well drilling that occurred in the mid 1980's, it is likely that most of the groundwater contamination found in McKean County occurred from past drilling practices. Still, these results point to the importance of remaining vigilant in properly testing and monitoring private water supplies near gas wells using the strategies outlined later in this publication.

Regulations to Protect Water Supplies
Gas well drilling is regulated by the Oil and Gas Act of 1984. This Act regulates the permitting, construction and abandonment of gas wells drilled throughout the state. A summary of the various relevant components of the Oil and Gas Act are provided here.

1) Permits
Before drilling a gas well in Pennsylvania, the operator must submit an extensive permit application for approval from the Pennsylvania Department of Environmental Protection (DEP). Among other things, the permit application must include a map showing the location of the gas well, proximity of the gas well to coal seams, and distances to nearby surface water and water supplies. The map must also

include the projected horizontal boreholes, property lines and acreage which will be disturbed during drilling. A bond ranging from $2,500 to $25,000 must be posted with the permit to ensure compliance with environmental regulations related to the well drilling. The permit also requires notification of surface land owners and coal mineral right owners at the well site along with all drinking water supply owners within 1,000 feet of the well. Notification of these various stakeholders is done by certified mail. As a result, homeowners with private water wells or springs which are located within 1,000 feet of the proposed gas well site should receive notification by certified mail during the permit process.

2) Setback Distances
Gas wells must be at least 200 feet from any drinking water supplies. This setback may be waived by the water supply owner in a lease agreement. Gas wells must also be 100 feet from any stream, spring or body of water identified on the most current 7.5 minute USGS topographic map. A 100 foot setback is also required from any wetland greater than one acre in size. These setbacks may also be relaxed if additional protection is put in place to protect these natural resources.

3) Protection of Drinking Water Quality
Section 208 of the Oil and Gas Act specifically includes language to protect nearby drinking water supplies. This includes a requirement that gas well drilling operators restore or replace any water supply determined by the DEP to be polluted as a result of nearby gas well drilling. The gas well operator is presumed to be responsible for pollution of any drinking water supply within 1,000 feet of the gas well **IF** it occurs within six months after completion of the gas well. The operator can use any one of five defenses to prove the are not responsible for water contamination including:

- The pollution existed prior to the drilling
- The landowner or water purveyor refused to allow the operator access to conduct a pre-drilling water test
- The water supply is not within 1,000 ft of the well
- The pollution occurred more than six months after completion of drilling
- The pollution occurred as the result of some cause other than the gas drilling

To preserve their defense, most gas well operators will collect the necessary pre-drilling water quality information from all drinking water supplies within 1,000 feet of their drilling operation. Although there is no list of required water quality parameters, most pre-drilling survey water samples and samples collected by DEP during investigations are analyzed for the salts and metals listed on page two. Individual gas well companies and DEP may choose additional water tests such as coliform bacteria, methane, and various organic compounds depending on the circumstances.

As part of any pre-drilling survey water sample, the gas well company is required to hire an independent state-certified water testing laboratory to conduct the water testing. You can find local, state-certified water testing labs by contacting your local Penn State Cooperative Extension. An up-to-date listing of state certified water testing labs from the DEP Bureau of Labs is also linked on the Penn State Water Resources Extension site at:

http://water.cas.psu.edu/WS_Testing.htm

Gas well drilling companies will contract with independent state-certified water testing labs to conduct pre-drilling water testing at nearby homes using drinking water wells and springs.

An employee or subcontractor from the certified laboratory will visit homes within 1,000 feet of the proposed gas well site to collect the water samples. This ensures that the samples are collected correctly using proper methods and materials. To ensure data quality, documentation must be completed for each sample showing proper sample collection, preservation, handling procedures and chain of custody (people who handled the sample).

Here are some important things to remember if you are visited by someone wanting to test your water as part of a pre-gas drilling survey:

- Do not deny access to the water testing laboratory personnel. It is important to note that gas well operators are NOT presumed

responsible for pollution of water supplies that they were denied access to prior to the drilling.

- Get the name and company affiliation of any person asking to sample your water supply and ask for proof of identification.
- Tell the person testing your water as much as you know about your water supply including approximate depth, yield, age, and treatment devices. This information will help them to determine proper sampling locations. It may also help the gas drilling company choose proper drilling techniques to avoid causing problems to your water supply.
- Ask what water quality tests will be performed by the laboratory on your water sample. This list may help you decide if you want to have your own, more extensive test done at your own cost (see discussion in the *Homeowner Strategies to Protect Water Supplies* section).
- The owner of the water supply has a right to receive a copy of any pre-drilling water test results collected by a lab representing the energy company. You can request a copy of these water test reports from the water laboratory or the energy company. If they are unwilling to provide a copy, contact one of the Pennsylvania DEP, Bureau of Oil and Gas Management offices below and they will obtain a copy for you.

Central Office	717-772-2199
Southwest Office	412-442-4024
Northcentral Office	570-321-6550
Northwest Office	814-332-6860

4) Protection of Water Flows from Wells and Springs

Gas well drilling can occasionally change the flow of water from a water well or spring, although these changes are often temporary. Unlike water quality impacts, gas well operators are NOT presumed responsible for water quantity impacts to nearby water supplies. For this reason, water flow data is often not measured during pre-drilling surveys conducted during the permitting process. Instead, impacts to water quantity would need to be investigated by DEP inspectors and/or proven by the water supply owner. Concerned water supply owners may wish to hire a well driller or water consultant to document the flow of water from their well or spring prior to the gas drilling activity (see *Homeowner Strategies* section for more detail).

5) Land Disturbance

Gas well construction involves extensive disturbance including roads, drilling pads and pipelines. Drilling pads alone may be four to six acres in size for deeper gas wells. Various regulations are in place to protect surface water and groundwater from erosion and sedimentation due to these disturbances. Erosion and Sediment Plans may be required that include the use of filter fence, sediment traps, vegetation, hay bales, culverts and rocked road entrances. These plans also include a requirement to restore vegetation to the drill site within nine months of well completion. Enforcement of erosion and sediment problems related to gas well operations is overseen by personnel from the DEP, Bureau of Oil and Gas Management.

6) Groundwater Protection During Drilling

New protections were included in the 1984 Oil and Gas Act to ensure that groundwater aquifers are not contaminated by drilling fluids, brines and wastes. A thick, steel casing is cemented into place from the ground surface to below the deepest freshwater aquifer (typically several hundred feet below the ground surface). This *freshwater protection string* segregates the fresh groundwater from the drilling process and prevents waste fluids from entering freshwater aquifers. Changes to these regulations are proposed in 2010 to provide even greater protection for groundwater aquifers.

7) Disposal of Drilling Fluids

Disposal of the various fluids used and generated during and after the drilling process are also regulated to protect surface and groundwater resources. All waste fluids produced during drilling are collected in metals tanks or pits. All pits must have an acceptable liner with at least two feet of freeboard to protect both groundwater and nearby surface water. Final use or disposal of waste fluids depends on the source of the water. The relatively clean freshwater or top hole water encountered in the first several hundred feet of drilling is sometimes re-used later in the drilling process or land applied and allowed to infiltrate back into local groundwater if it meets certain water quality criteria. Top-hole water may also be trucked to an off-site treatment facility. Some of the remaining drilling fluids (brines, fracturing wastes, etc.) may be recycled and reused during the drilling and hydrofracturing process but most is eventually trucked to dedicated treatment sites where it is treated and discharged to a surface stream. Another less common method to dispose of waste fluids is through pumping into very deep disposal wells regulated by the Pennsylvania Department of Environmental Protection and the U.S. Environmental Protection Agency. These wells access a confined, deep permeable formation where the wastes can be segregated from shallow, groundwater aquifers. Some brine may also be trucked to municipal or industrial treatment plants or applied to rural gravel and dirt roads for dust control.

Municipal or industrial treatment facilities can only accept gas well waste fluids if they have a permit demonstrating adequate capacity and technology to properly treat the waste fluids. Waste fluids from below the fresh water casing must meet limits for iron, oil/grease, total suspended solids and pH before they can be discharged. Alkalinity, acidity, total dissolved solids and chlorides are also monitored in these treated waters. Proposed changes to regulations may require treatment plants to further treat these waste fluids to meet a standard of less than 500 mg/L of total dissolved solids by January of 2011. Other recent changes to regulations now require the gas well drilling operators to specifically identify the location of treatment facilities where drilling and hydrofracturing fluids will be taken for treatment and ultimate disposal.

8) Water Withdrawals

A major concern with newer and deeper gas well drilling technologies has been the withdrawal of large volumes (millions of gallons) of water used mostly in the hydrofracturing process. These large water withdrawals may come from many sources (streams, ponds, lakes, etc.) and can have significant effects if not done carefully. Water withdrawals generally exceeding 10,000 gallons per day require permits or registration with DEP under authority of the Water Resources Planning Act. Withdrawals occurring in the Susquehanna or Delaware River watersheds may also require permits from the Susquehanna River Basin Commission or the Delaware River Basin Commission. The Clean Streams Law also limits the amount of water that can be withdrawn from streams to maintain sufficient stream flows to protect aquatic life. These various regulations have all been used to shut down gas well drilling operations that failed to acquire the proper permits or exceeded allowable withdrawals from streams.

Concerns over water use during gas well drilling prompted changes to the state permit in 2008. The permit now must include information on the sources and locations of water to be used in the drilling process, the impacts of drilling on water resources and proof that the water withdrawals have been approved by the appropriate river basin commission.

9) Well Plugging

Once a well is no longer in production (a period of a few years to several decades for most wells), it must be decommissioned and plugged. In some cases, the production well casing (below the freshwater protection string) may be removed and re-used at other sites. The freshwater protection casing is left in place and the hole is filled to the ground surface with non-porous material.

Prior to current regulations, gas wells were often left in place even after they were taken out of production. Thousands of these wells are located throughout much of western and north-central Pennsylvania. These abandoned gas wells, often referred to as "orphan wells" should be properly decommissioned to prevent future groundwater contamination. The state has a fund to properly decommission orphan gas wells. Contact one of the regional Pennsylvania Department of Environmental Protection (DEP), Bureau of Oil and Gas Management offices listed on the previous page to report an orphan gas or oil well in your area.

Homeowner Strategies to Protect Water Supplies

1) Maintain Your Water Supply

Most homeowner complaints related to gas well drilling and drinking water supplies are determined to be problems that existed before gas drilling or were caused by other activities. Periodic maintenance and testing of private water supplies can help to identify and avoid these problems. Penn State Cooperative Extension has many resources and publications dedicated to proper management of private water systems. They are available at your local county Extension office or online at:
http://water.cas.psu.edu

2) Learn When and Where Drilling Will Occur

Some homeowners will learn of nearby gas well drilling plans through lease agreements or through required notification by certified mail if their water supply is within 1,000 feet of the proposed well. But, anyone can be kept abreast of gas well drilling plans through several online features available through the Pennsylvania DEP including:

PA DEP Marcellus web site: Includes spreadsheets, graphs and maps of Marcellus drilling activity. (*http:// www.depweb.state.pa.us/* then enter Marcellus as a keyword).

eNotice: once registered on this web site you can choose to receive notice of gas well permits in your area. *(www.dep.state.pa.us/enotice/)*

eMap: a web-based geographic information system that allows mapping of proposed gas well locations by permit number.
(www.emappa.dep.state.pa.us/emappa/viewer.htm)

eFacts: after drilling begins, monitor inspection reports, violations, etc. on this web site. *(http://www.dep.state.pa.us/dep/efacts/*

3) Control Seismic Testing
Prior to drilling wells in an area, gas companies will often seek permission from land owners to do seismic testing to determine the thickness of gas bearing rocks and other geologic information. A certain type of seismic testing commonly called "3D" uses two to three-inch diameter holes that are usually about 20 feet deep. Explosive charges are detonated in each hole and the resulting shock waves are recorded by instruments.

There are no regulations to protect water supplies from seismic testing. If 3D seismic testing with small explosives is going to occur on your property, make sure to stipulate that each shot hole is immediately filled to prevent groundwater contamination by surface water. If seismic testing is to be done close to your water supply, you may want to stipulate that water quantity conditions be documented in your well or spring by a professional water well contractor or hydrogeologist before allowing the seismic exploration.

4) Collect Water Quality Data Prior to Drilling
Prior to gas well drilling occurring, drinking water supplies within 1,000 feet of the proposed gas well will likely be tested at no charge to the homeowner by a certified testing laboratory hired by the gas company. Make sure to arrange to receive results from this water testing.

If your water supply is more than 1,000 feet from a proposed gas well site OR if you simply want to confirm the results collected during the pre-drill survey, you would need to arrange to have your water tested at your expense. This test should also be arranged through a state-certified water testing laboratory.

It is important to remember that water samples collected to document impacts from gas well drilling generally should be collected by an unbiased professional. Most often this is an employee of the water testing laboratory. This adds significantly to the cost of water testing but will be vital to the admissibility of the results in any legal action related to pollution of a private water supply. You can expect to pay $200 to $800 or more to have a pre-drilling water sample collected and analyzed by a certified water testing laboratory depending on the complexity of the test package.

Local state-certified water testing labs can assist with selection of water quality parameters and many offer standard packages of tests that correspond to gas well drilling activities. Keep in mind that testing for all of the possible contaminants will be costly (several hundred dollars for the tests alone). Listed below are three general categories of pollutants that are increasingly comprehensive of all possible pollutants but also increasingly costly:

- *Tier 1*—are basic parameters that are likely to change if gas drilling affects groundwater. These include total dissolved solids (TDS), pH, barium, chloride, and methane. These tests are available from most certified labs and can be tested for a reasonable cost.
- *Tier 2*—are good additions to the Tier 1 pollutants that include total suspended solids (turbidity), iron manganese, hardness (calcium and magnesium), sodium, total organic carbon, strontium, oil&grease, detergents, lead, arsenic, alkalinity, coliform bacteria, sulfate and nitrate.
- *Tier 3*– are pollutants that are more costly and include volatile organic compounds (VOC's) or a subgroup of VOC's called BTEX (benzene etc.) along with radionuclides like gross alpha, radium and radon.

5) Document Well and Spring Flow Before Drilling
Diminished or lost water supplies resulting from gas well drilling have occurred but are rare. When this does occur, it is usually an obvious, complete loss of water rather than a subtle decrease in water yield. Well and spring owners that wish to document water supply conditions before and after gas well activities would need to hire a professional water well contractor or hydrogeologist to independently measure and document these conditions. You can find a list of local water well contractors certified by the National Ground Water Association (NGWA) at www.wellowner.org.

6) Continuously Monitor Water Quality
In addition to water samples analyzed by labs, some water supply owners are interested in methods to continuously monitor their water quality. Inexpensive total dissolved solids (TDS) or conductivity meters can be purchased from many online suppliers for $50 to $100. These meters allow the water supply owner to quickly and easily measure the total amount of dissolved contaminants in their water. Large increases in the TDS or conductivity of water in conjunction with nearby gas drilling activity would warrant follow-up testing by a state accredited water lab.

7) Test Water After Drilling

There are no requirements for gas well companies to test private water supplies, even those within 1,000 feet of an active gas well, after the gas well drilling has concluded. Therefore, any post-drilling water sampling is a voluntary decision that must be arranged by the homeowner unless the testing is previously stipulated in a lease agreement or part of a complaint to DEP. Obvious changes to your water supply that would warrant a complaint to DEP can include:

- Rapid increases in the TDS or conductivity of the water supply based on readings from a meter.
- Occurrence of increased severity of sediment in local surface water (streams, ponds, etc.).
- Changes in the appearance of drinking water from a well or spring such as sediment, foaming, bubbling or spurting faucets
- Changes in drinking water taste including salty or metallic tastes
- Changes in water odor such as a rotten egg odor, fuel or oily smell
- Reduction or loss of water quantity

Should you notice any obvious changes in your water supply in conjunction with nearby gas well drilling, you can file a complaint with the regional DEP, Bureau of Oil and Gas offices listed earlier in this publication. They will investigate the claim within ten days and make a determination of the cause within 45 days. Water pollution complaints filed during gas well drilling operations or within six months after drilling was completed place the burden of proof on the gas well operator. Water pollution complaints filed more than six months after drilling has ended and all water quantity complaints place the burden of proof on the homeowner. During the investigation, DEP will obtain results from all pre-drilling water testing. They may also decide to collect additional water samples as part of the investigation. While many of the pollutants associated with gas well drilling will have obvious stains, odors or tastes in your water, others have no obvious symptoms. For this reason, some homeowners may wish to hire an independent water laboratory to collect a post-drilling water sample.

Many homeowners question whether they can collect their own water samples and deliver them to an independent laboratory to save on testing costs. While this method will save money, it is important to realize that test results from water samples collected by the homeowner are generally not recognized in legal proceedings because they are not independent. As a result, samples collected and submitted by homeowners should be utilized only for educational purposes including:

- General water system education: about half of the private water systems in Pennsylvania have never been tested. Penn State recommends that all private wells and springs should be routinely tested for coliform bacteria, pH, total dissolved solids, and any other pollutants associated with land use activities occurring within sight of the water supply.

- Comparison to pre-drilling test results: water test results collected by the homeowner could be used to confirm pre-drilling results collected by certified labs contracted by the gas company. In this case, homeowners should collect and submit a duplicate sample within a few days of samples collected by the gas company. If the homeowner collected sample shows lower levels of contaminants than the sample collected by the laboratory, it would then be advisable to hire a certified water testing lab to visit your home and collect an additional sample that would be admissible in any future legal action.

- Post-drilling decisions: homeowner-collected samples after drilling could be used to look for any changes in water quality. If concentrations of contaminants are present at higher levels than the pre-drilling concentrations, further testing is again warranted by an independent representative of a certified lab. Keep in mind that samples collected after drilling should be scheduled soon after drilling is completed to allow time to receive the results and take action before six months has passed. This will maintain the burden of proof on the gas company rather than the homeowner.

If you choose to sample your water supply yourself, make sure to obtain proper sample containers from the laboratory and follow their sample collection instruction very carefully. For more details on how to collect water samples, consult the Penn State Cooperative Extension publication entitled *Water Facts #10—Testing Your Drinking Water* available from your Extension office or online at:
http://pubs.cas.psu.edu/FreePubs/pdfs/XH0023.pdf

8) Include Water Resource Protection in Your Lease

Many of the aforementioned ideas for protecting a water supply can be stipulated in a gas leasing agreement (if a lease is offered by the gas company). The lease agreement provides an

opportunity for the homeowner to set rules for the gas company to follow in order to access private property. Some items to consider for the lease agreement include:

- Setback distances—don't allow gas well drilling or seismic testing within 200 feet of any water resources (wells, springs, ponds, streams, etc.).
- Water testing—request pre- and post-drilling testing of all drinking water supplies. Stipulate a complete list of test parameters (i.e. all three tiers of tests on the previous page). If you are concerned about other sources of water on your property (springs, streams, ponds, etc.) request that these water sources also be tested.
- Water flow—request measurement of water flow from wells and springs prior to gas well drilling by a water well contractor certified by the National Ground Water Association.
- Water sources—stipulate which sources of water on your property can and cannot be used during the drilling and hydrofracturing processes.
- Waste handling—stipulate proper off-site disposal of all drilling waste materials.

Summary

As gas well drilling operations increase in size and scope across Pennsylvania, environmental concerns about their effects will also grow. Basic regulations are in place to protect private water supplies from gas well drilling influences. The homeowner strategies outlined in this publication provide additional steps that can be taken to ensure safe and adequate drinking water near gas well drilling activities.

More Information

For additional information on all aspects of managing a private water system or help in reading your water test results, contact your local Penn State Cooperative Extension office or consult he Water Resources Extension web site at *http:// water.cas.psu.edu*

For more information on all aspects of gas and oil well drilling in Pennsylvania, consult the Pennsylvania Department of Environmental Protection web site at *http:// www.depweb.state.pa.us* and choose keyword: "Oil and Gas"

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Penn State College of Agricultural Sciences research, extension, and resident education programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

This publication is available in alternative media on request.

Rev: March 2, 2010