



Rule Update

Currently, three Missouri Well Construction Rule amendments are moving through the rulemaking process. Draft rules are available on the division's webpage at dnr.mo.gov/geology/geo-srv/geo-rules-in-dev.htm.

The Well Installation Board voted, at its March meeting, to direct staff to conduct further stakeholder meetings regarding the heat pump rulemaking (10 CSR 23-5.010 – 10 CSR 23-5.080) to receive comments on the draft rule language.

The draft language of the Disciplinary Action and Appeal Procedures (10 CSR 23-1.075) rule was approved by the board in March. This proposed language clarifies the procedure to file an appeal with the Well Installation Board. The draft language will be submitted to other state agencies for their comments and staff will bring this information back to the Board at its August meeting.

The Board also voted to direct staff to begin working on a continuing education program for all permitted contractors. This rulemaking is in the very beginning stages; you will see more information regarding this topic in the future.

If you have any questions regarding these rulemakings or the rulemaking process, please contact Sheri Fry.

Direct Push Monitoring Wells

Revisions to the Missouri Well Construction Rules (10 CSR 23-4) were made last year and took effect August 1, 2011. One of the prominent changes in this version of the rules requires that monitoring wells constructed using direct-push technology have a minimum borehole diameter of 3.25". This change was instituted to ensure a larger annulus and better grout seal to protect the state's groundwater.

The Wellhead Protection Section received inquiries requesting that variances continue to be granted for a period of time to allow the construction of direct push monitoring wells utilizing a 2.25" diameter borehole. This is inconsistent with the Missouri Well Construction Rules. However, in light of these inquiries and the possible confusion resulting from the rule change, a grace period of six months from the date the rules became effective was granted for all monitoring well contractors and licensed drillers. This grace period expired February 1, 2012. Variances of this nature will no longer be granted. Please be aware that contractors and drillers must construct direct push monitoring wells with a 3.25" diameter borehole; otherwise, they will be in violation of the Missouri Well Construction Rules.

Well Installation Board News

The Missouri Well Installation Board's quarterly meeting scheduled for Monday, February 20, 2012, was postponed due to the absence of a quorum. The meeting was rescheduled for Friday, March 30, 2012, at the Clinton Community Building in Sikeston, Mo. Mr. Danny Flynn, Flynn Drilling Company, was elected Chairman of the Board and Mr. Fred Schoen, Geo-Enterprises, was re-elected Vice-Chairman.

The quarterly meeting in May was held at the Department's Division of Geology and Land Survey in Rolla. Rule updates, staff changes, and a permit appeal were discussed.

Future Meeting Dates

The next meeting of the Board is scheduled for 10 a.m., August 24, 2012, at the Missouri Department of Transportation, Northeast District, 1711 Highway 61 South, Hannibal.

The November meeting is scheduled for Monday, November 5, 2012, for 10 a.m., at the Department's Division of Geology and Land Survey, 111 Fairgrounds Road, Rolla.

Check Out the Form Submittal Website

The Well Online Form Submittal (WOLFS) system can be used by restricted or non-restricted monitoring well contractors to electronically submit monitoring well certification and registration forms and pay associated fees. This includes temporary monitoring wells such as soil borings.

Missouri Department of Natural Resources
Well Online Form Submittal

Well Online Form Submittal Registration
Fields marked with * are required.

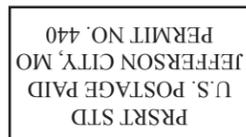
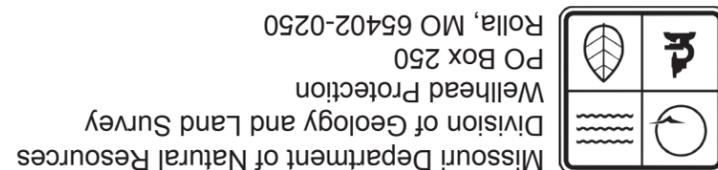
*Permit Number:

*Existing User:

*E-mail Address:

The WOLFS system will verify that the well construction or plugging meets Missouri Well Construction Rules requirements. Records submitted using WOLFS will be certified or registered immediately upon payment. Please remember to print your records before exiting the system, as previously submitted records are not yet accessible online.

WOLFS is available online at dnr.mo.gov/momonitoringwells/. A Frequently Asked Questions (FAQ) fact sheet is available to assist permittees who use the system. The FAQ is available at dnr.mo.gov/pubs/pub2440.pdf. If you have questions not addressed in the FAQ, please call 573-368-2165.



Jerry Prewett selected as Deputy Division Director and Assistant State Geologist

Following last year's retirement of Bill Duley, the Department issued a nationwide search for an experienced geologist and manager to succeed him. Effective February 14, 2012, Jerry Prewett was selected to serve as Deputy Director of the Division of Geology and Land Survey and Assistant State Geologist for Missouri.



Jerry brings a wealth of knowledge and experience to the position and has worked in a number of areas related to environmental and geology issues. Having joined the department in 1994, Jerry worked in the Northeast Regional Office on air pollution issues. He later joined the Jefferson City Regional Office to concentrate on water pollution issues. While assigned to the Water Resources Center, Jerry worked on groundwater issues. After nearly eight years dedicated to environmental geology projects at DGLS, Jerry served as Geologic Resources Section Chief for two years and more recently as program director for the Geological Survey Program. Throughout his career, Jerry has demonstrated a commitment to the department's mission and he has forged many valuable relationships across programmatic areas and with external stakeholders. His technical knowledge and leadership skills will be an asset to not only the division but to the department as well. A registered geologist, Prewett received his Bachelor of Science in Geology in 1992 from Southwest Missouri State University (now Missouri State University), Springfield. The division provides technical oversight for many geologic investigations and issues in the state, assists citizens in interpretation and understanding of our subsurface resources, and serves as the technical assistance agency for the department.

Visit the Division's webpage at dnr.mo.gov/geology/.

New and Revised Monitoring Well Forms

The following new and revised forms are available in hard copy and online:

Revised Monitoring Well Certification Record,
Form MO 780-1415

Monitoring Well Plugging Registration Record,
Form MO 780-2161

Nested Monitoring Well Certification Record,
Form MO 780-2169

These and other forms can be found online at:
dnr.mo.gov/forms/index.html#WellheadProtection

Please discard any old forms. Contact our office at 573-368-2165 if you have questions or if you prefer to have hard copies sent to you.

Carey Bridges selected as Program Director

With the promotion of Jerry Prewett to Deputy Director of the Division of Geology and Land Survey, Carey Bridges was hired to serve as the division's Geological Survey Program Director, effective May 16, 2012. Carey brings a plethora of exceptional qualities to the program including her varied background and experience, her ability to work well with people through diverse issues, and dedication to her job, staff, management and the public.



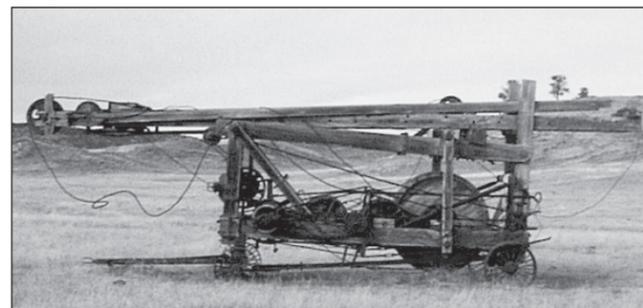
Carey began her career with the Missouri Department of Natural Resources in 1999 in the Hazardous Waste Program overseeing investigation and cleanup activities at Superfund sites and later Brownfields/Voluntary Cleanup Program sites. She served as Chief of the Brownfields/Voluntary Cleanup Unit for more than five years before joining DGLS as Chief of the Wellhead Protection Section in November 2011. Carey has a Bachelor of Science Degree in Geology from the University of Central Missouri and a Master of Science Degree in Geology from the University of Missouri – Columbia. She is also licensed in Missouri as a Registered Geologist and holds a restricted monitoring well permit.

The Geological Survey Program is organized into three sections that perform the following major functions: The Geologic Resources Section fulfills many of the traditional tasks of the Geological Survey. It acquires and maintains basic geologic data that are used by the other sections and provides technical assistance to both the private and public sectors.

The Environmental Geology Section conducts field investigations and provides services in determining the environmental hazards posed by waste disposal practices and spills.

The Wellhead Protection Section ensures that any new private water well (this includes domestic and multiple family class wells) is constructed to minimum standards as set by the state regulations. The section regulates the construction of private water wells, irrigation wells, monitoring wells and heat pump wells. In addition, we regulate how to properly plug all types of wells.

Visit the Program's webpage: dnr.mo.gov/geology/geosrv/wellhd



Welcome

The following individuals are now part of the Department of Natural Resources-permitted contractor community:

A & M Heating & Cooling – Michael Anderson
AST Environmental – William Brab
ATC Associates – Jeff Glassbrenner
Burge Irrigation – Adam Hemby
Directed Technologies Drilling – James Doesburg
Geotechnical Services – Glen Kurtz
Geotechnics – Matthew Sick
Geothermal Experts – Lois Keeven
K J Unnerstall Const – Kurt Unnerstall
Kolb Grading LLC – Thomas Greiwe
MODNR – Donald Kinkhorst, Gregory Jarman, Chris Thiltgen
Morris Pump Service – Jason Cross
North Central Missouri Electric Coop – Rick Sands Rueff, Ardel
Scott-Lee Heating – Shaun Tarrillion
Southern Environmental Management – Charles Thibault Satterfield, Ira
Wellington Environmental – Wesley Robb, Elizabeth Miller
Wideman Well Drilling – Robert Bussa

Welcome

The following individuals are now part of the Department of Natural Resources-permitted apprentice contractor community:

Brown Well Drilling – Ty Brown
Custom Pump & Well Drilling LLC – Shane Dorton
Anthony Baretich
Drill It Well – Joshua Rupp
Energy America Construction – Kirby Mckenzie, William Smith
Environmental Works – Trevor Penner
Finch Drilling – Darrin Keller
Lefty's Pump & Drilling – Brian Murray, David Scott
Morris Pump Service – Jason Cross
Reid Pump Service – Jamie Blomberg
Roberts Environmental – Eric Wetzell
Schroepfer Well Drilling – Dillon Schroepfer
Wallace, Rodney
Wideman Well Drilling – Dennis Ammerman

Missouri Geology Blog

Did you know we have been publishing a blog for more than a year? Check out the Missouri Geology Blog by visiting this link: blogs.mo.gov/geology/. Consider signing up via GovDelivery to receive automatic updates when blog content changes. See article on page 6 about GovDelivery.

Farewell

The following individuals are no longer permitted to operate as contractors according to the Water Well Drillers Act and Well Construction Regulations:

Anthony, Frankie
ATC Associates – Mark Burton
B & B Pump – Robert Kincheloe
Bureau Veritas – Timothy Orf
Burns & McDonnell – Stephen Siesener, Kenneth Simmons
CH2M Hill – Laura Crause
Drill It Well – Clifford King
Drilling Service – Mark McNamara
Dudley, Gregory
ECO Energia – David Hancock
Elledge, Bryan
Enviroguard Drilling – Daniel Bandimere
Geo Engineers Inc – Gary Pendergrass
Geosyntec Consultants – Edward Dolan
Golder Associates – Sara Struttman
Ground Source Systems – Rocky Johnson
Heartland Drilling & Remediation – Marc Simmering
Herst & Associates – Brandon Killon
Hilton, Jarrod
Hurst-Rosche Engineers – Malcolm Weiser, Jr
Jet Drilling – Steve Woodstock
Jim's Well Drilling – Jimmy Foulks
Jungmeyer Heating & Cooling – Adam Johnson
Kuster Drilling – Paul Kuster
Lappe Cement Finishing – Jason Grantham
Lathrop Construction – Daniel Flynn
Lavy's Water Well Service – Mark Lavy
Layne Western – David Meyer
Mac's Pump Sales & Service – Michael MacAffree
McKinzie Construction – Russell Seybert
Midwest Hydro Drilling – Damon Berti, Frank Young
Midwest Pump & Well – Zachary Kemp
MO DNR – Beth Marsala, James Vandike, Bill Duley, Cynthia Thompson
North Central MO Electric – Paul Custer
Patterson Drilling – Joseph Hinch
Pense Bros Drilling – Ronald Pense
Petro Con Inc – Vinancio Rea Jr
Priority Heating & Cooling – Kurt Schaben
PSI – Katherine Crets
Quad County Plumbing – Larry Ragsdale
Roberts Environmental Drilling – Joseph Cox
Scott & Sons Drilling – Gary Conway, Michael Harris
Sheeley, Ron
Smith & Co – James Hobbs, James Clifford
Stantec Consulting Corp – Justin Olson
Stovall Pump Service – Billy Stovall
Terracon – Scotty Silverman
Toxic Discovery – Stephen Johnston Jr
Tuggle Pump Service – Ralph Tuggle
Water Works Well Service – Bruce Trimble, Ross Trimble
Yingling Well Drilling – Joel Yingling

Online Enhancements

Wellhead Protection staff have been working to provide more services online. The following are projects have recently been completed or will be available soon.

The Connection Newsletter – Online subscription to the newsletter is now available! You may subscribe to receive notification via email or text when new editions of the newsletter is available online. You may also change your mailing information and unsubscribe if necessary. Visit dnr.mo.gov/geology/geosrv/wellhd/subscription.htm to subscribe!

Prenotification Form – Is now available for online submittal. The form is located on our webpage at dnr.mo.gov/forms/index.html#WellheadProtection. You may fill out the form and submit it online or print the form and fax it to our office at 573-368-2317.

WIMS Online Search – The Well Information Management System (WIMS) will be available soon. This system will allow the public to search for well records using various information including but not limited to: owner name, owner address, reference number, legal description and GPS location. Once the record of interest is located, it can be viewed and printed.

Permit Renewals – Staff are working toward online permit renewals, which will allow contractors to complete the entire permit renewal process online. Once the permit is renewed, a new permit card will be generated in the office and sent via postal mail.

Please check our website frequently or subscribe for updates using our new GovDelivery system. GovDelivery allows website visitors to subscribe to information of specific interest to them. Individuals are able to create a personalized subscription list of content. When this content changes, GovDelivery automatically sends email or text alerts informing subscribers that the information has changed. Red envelopes have been added to many of our webpages identifying this service as being available.



Plugging Public Water Supply Wells

The rules contained in 10 CSR 23-3.110, Plugging of Wells, do not outline the procedure necessary for plugging public water supply wells or bedrock irrigation wells. Each plugging is considered on a case-by-case basis, and specific requirements are issued through the Wellhead Protection Section (WHP), effective July 1, 2012. Previously, this was handled through the Water Resources Center. Contractors are required to contact WHP before plugging any public water supply or bedrock irrigation well, including those being plugged full length with neat cement.

In the future, WHP staff members intend to add general specifications for plugging these types of wells to the rules. Until that time, please contact us to obtain instructions and/or approval before plugging a public water supply well or bedrock irrigation well.

Requirements to Become an Apprentice

MISSOURI DEPARTMENT OF NATURAL RESOURCES GROUNDWATER PROTECTION SECTION APPRENTICE PERMIT APPLICATION		FOR OFFICE USE ONLY	
MAIL COMPLETED APPLICATION AND FEES TO: GROUNDWATER PROTECTION FUND P.O. BOX 250 ROLLA, MO 65402-0250		<input type="checkbox"/> Water Well Install <input type="checkbox"/> Pump Install <input type="checkbox"/> Monitoring Well <input type="checkbox"/> Heat Pump Install	RESTRICTED <input type="checkbox"/> YES <input type="checkbox"/> NO RESTRICTIONS <input type="checkbox"/> HP Drilling Only <input type="checkbox"/> Test Hole Contractor Only <input type="checkbox"/> Test Hole Contractor Also
APPLICATION MUST BE FULLY COMPLETED IN INK OR TYPED.		PERMIT NUMBER	CHECK NO.
APPLICANT NAME (LAST, FIRST, MIDDLE)		TEST SCORES GEN	TEST DATE
BUSINESS NAME		DATE RECEIVED	DATE APPROVED
RESPONSIBLE PARTY FOR COMPANY <input type="checkbox"/> YES			

- Submit application along with required \$40 fee for general test
 - Report for test on assigned date; must score at least 70 percent
 - Submit apprentice contractor application with the required \$100 fee per permit within thirty days
 - Apprenticeship is for a period of two years. You must complete the required amount of installations as outlined in 10 CSR 23-1.050:
 - 25 water well
 - 25 pump
 - 10 heat pump systems
 - 20 monitoring well sites
 - Work must be supervised by a non-restricted permittee, until the required amount of installations are met
 - Permit is renewable each year with annual permit fee
 - Apprenticeship is transferrable if you change companies
- At the end of the two-year apprenticeship, if the applicant has completed all requirements listed in 10 CSR 23-1.050 and has no violations against his/her permit, he/she may apply for a non-restricted contractor's permit. If requirements have not been met, the apprenticeship may be extended on a yearly basis.

If you are an out-of-state contractor applying for a permit with the State of Missouri, you must be an apprentice and complete the requirements listed above.

If you have any questions, please contact Jeannie Hoyle at 573-368-2450, Wellhead Protection Section, PO Box 250, Rolla, MO 65402.

Reminder – Permitting with Violations

If a contractor has outstanding violations at permit renewal time, the violations must be resolved before the permit will be renewed.

- If the contractor sends renewal fees but does not resolve violations, enforcement staff will prepare an order of suspension. If issues are not resolved during the suspension, the permit will be revoked.
- If no response is received by the contractor's renewal date, the permit will be cancelled.
- If a contractor's permit has previously been cancelled with outstanding violations; those violations must be resolved before he/she may apply for a permit.

Staff News

Ruth Ann Williams Retires

Ruth Ann Williams, Wellhead Protection Section Processing Unit, retired May 31, 2012. Ruth Ann was a Senior Office Support Assistant who worked in the section more than nine years. She is looking forward to retirement and plans to just "enjoy life," along with helping with the family business. Ruth Ann was an asset to the section and her expertise will be greatly missed.



Brad Mitchell joins the Section

Geologist, Brad Mitchell joined the Wellhead Protection Section Investigation and Remediation Unit in February 2012. Brad holds a Bachelor of Science degree in Geology and a Master of Science degree in Geospatial Science from Missouri State University. Brad's duties include reviewing and certifying monitoring wells and testhole abandonments, performing well searches, and issuing casing points and variances. Contact Brad about any of these aspects or regarding general geology inquiries at 573-368-2116 or by email at brad.mitchell@dnr.mo.gov.



Chris Thiltgen Resigns

Chris Thiltgen resigned his position as the Investigation and Remediation Unit Chief effective June 30, 2012. Chris will begin his new career as a science teacher at a local school district in the fall.

Permit Testing Deadline

Applications and fees for testing must be received by our office 15 days prior to the testing date for which the applicant wishes to be scheduled (see 10 CSR 23-1.050(7)). If applications and fees are received after the 15 day deadline, the applicant will be scheduled to test the following month. See this website for the testing schedule: dnr.mo.gov/geology/geosrv/wellhd

Wellhead Protection Section

We are here to ensure any new well drilled in Missouri is constructed to minimum standards as set by state regulations. This helps protect our groundwater resources from contamination due to poor well construction. We regulate the construction of private water wells (this includes domestic and multiple family class wells), irrigation wells, monitoring wells and heat pump wells. In addition, we regulate how to properly plug all types of wells. Our job is to balance the concerns of the land owner and the driller, while at the same time performing our overall directive of protecting Missouri's vast underground water supply from contamination due to improper construction and abandonment of wells.

Prenotification Requirements

Effective May 1, 2012, 10 CSR 23-1.050(3)(C)11 requires all applicants applying for a non-restricted permit who are currently or were previously permitted with the state to notify the Wellhead Protection Section prior to any work performed that is regulated by the Missouri Well Construction Rules. The prenotification requirement is effective for the first full year from the permit issue date. The applicant must notify the division of work to be performed at least twenty-four (24) hours prior to the start of any regulated work.

This includes:

- Water well Installation
- Pump Installation
- Heat Pump Installation
- Monitoring Well Installation
- Test Hole Installation
- Reconstruction
- Plugging

A prenotification form must be used when reporting and must include owner name, address, GPS location, type of work to be performed and date work will begin. Prenotification forms may be submitted online by going to this website: dnr.mo.gov/forms/780-2167.htm. Alternatively, this form may be submitted by fax, email, mail. All Wellhead Protection forms can be found on this website: dnr.mo.gov/forms/index.html#WellheadProtection

If an emergency arises, and the contractor is unable to submit a prenotification form prior to performing work, the form must be submitted the next business day.

Contact Jeannie Hoyle, Wellhead Protection Section, at 573-368-2450 if you have questions or to request paper copies of forms.

Managing Overpayments and Credits

The Wellhead Protection Section has developed a new process to manage overpayment of fees or "credits." Currently, credits are kept on file until they are used by the contractor; however, several credits have been on file for years.

Beginning March 1, 2012, if there is an overpayment of fees, staff began sending "credit letters" to individuals who submitted the payment stating the reason for the overpayment and the amount of credit issued.

The letter will also explain options for applying the credit to outstanding fees owed. The credit may be used for the following:

- payment of certification or registration fees;
- permit and/or machine fees (renewals);
- test applications; and/or
- payment of late fees.

Every year, at the end of June, a second notice will be sent to individuals who continue to have credits on file. If the credit has not been used by the end of December, a refund will be issued. If you have any questions, please contact us at 573-368-2165.

Special Area 2 Water Sampling

Water sampling methods in Special Area 2 (Newton and Jasper counties) have remained unchanged since January 2002, when the Missouri Well Construction Rules 10 CSR 23-3.100(6)(D) Special Area 2 were amended to address contamination in the upper aquifer. This special area was formed due to contamination by one or more of the following: lead, cadmium, TCE, TCE degradation products or other contaminants identified in U.S. Environmental Protection Agency National Primary Drinking Water Regulations.

Missouri Well Construction Rules state, "Water from all new wells and deepened wells throughout Special Area 2 shall be sampled and analyzed for lead and cadmium, plus TCE and its degradation products within TCE impact areas. Where indicated by objective factors, the division may require sampling and analysis for other contaminants listed in the NPDWR. Qualified and trained persons must complete sample collection. The laboratory that analyzes the sample must be approved by the EPA for such analysis." The rule also includes the following sentence, which has been a source of confusion for some time, "A copy of the chain of custody form shall be submitted to the division with the well certification report form to document sampling has occurred. An appropriate chain of custody form will be available from the division." Previously, staff requested the pump installation contractor submit the sample analysis with their pump record, when the rule actually states the chain of custody is required when the water well certification form is submitted. In the past, a pump installation contractor installed the pump, developed the well, took the required water sample and submitted the analysis to the division. However, the rule requires the drilling contractor to submit the chain of custody for the water sample, (see 10 CSR 23-3.100(6)(D) sos.mo.gov/adrules/csr/current/10csr/10c23-3.pdf). When all required information is not received, including the sample analysis and/or chain of custody, the well owner's certification is delayed.

Rules also state, "In order to ensure proper well development, the well pump must run continuously for five (5) hours or until the water clears, whichever occurs first, but in no case shall the well be pumped less than two (2) continuous hours. After proper well development, water samples shall be collected from the tap nearest the well. All new and deepened old wells in Special Area 2 shall be constructed with a sampling port or tap within ten feet (10') of the wellhead. Water must be purged from the sampling port prior to collection of a sample."

In an effort to resolve these issues, a new report has been developed that will be sent to each well installation contractor listing the wells they have drilled where the division has not received sample results. The initial report was mailed in November 2011 and will continue on a monthly basis. A monthly report will also be sent to pump installation contractors listing the pumps they have installed where no sample results have been received. The division has begun requiring the chain of custody and/or sample analysis to be submitted when the water well certification form is submitted.

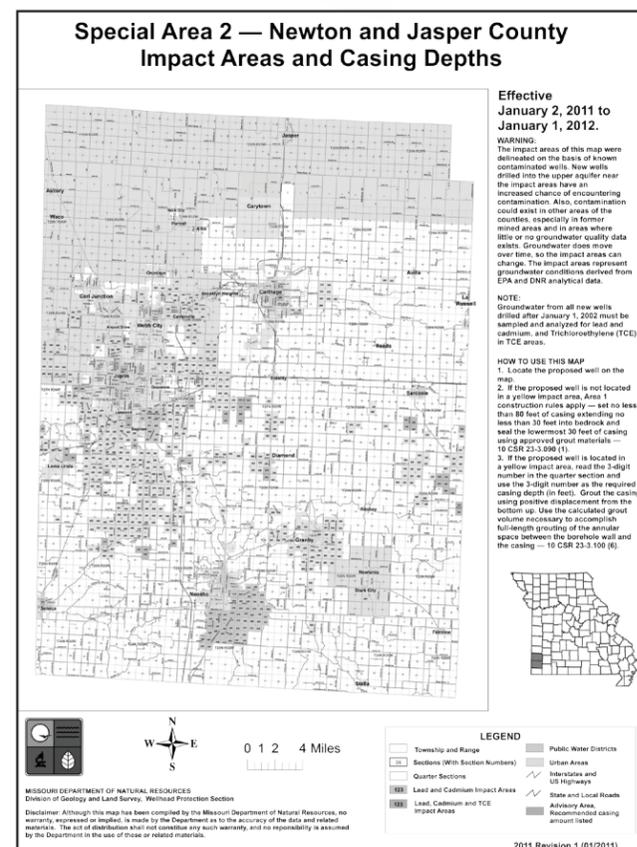
If you have any questions regarding this issue please contact staff at 573-368-2165.

Wellhead Protection Section Staff

Wellhead Protection Section: 573-368-2165

Website: dnr.mo.gov/geology/geosrv/wellhd/job.htm

- **Connie Edwards** – Processing Unit Chief
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- **Sheri Fry** – Enforcement and Compliance
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- **Debbie Stogsdill** – Section Secretary
573-368-2165 • debbie.stogsdill@dnr.mo.gov



Campylobacteriosis

Campylobacteriosis, an infection by the Campylobacter (pronounced, kam-pi-lō-'bak-tār) bacterium, is one of the most common bacterial causes of diarrhea illness. Campylobacter causes five to 11 percent of all diarrheas in the United States, more than salmonella or shigella combined. According to the World Health Organization, Campylobacter infections have been on the rise for some time in developed countries around the world. The reason is unknown. In Missouri, the number of reported cases rose from 49 in 1980 to 614 in 1992. By 2003, more than 3,000 cases across the nation had been reported to the Center for Disease Control (CDC). Campylobacter outbreaks can originate from water, milk or food contamination.

What happens when someone contracts a Campylobacter infection?

Infection usually ensues two to five days after exposure but may take up to 10 days, causing fever, cramps and bloody diarrhea, the result of invasion of the lining of the small intestine. The organism excretes toxins that damage the gut mucosa. Nausea, vomiting and headache may also manifest with symptoms normally lasting two to five days, although sometimes recovery can take up to 10 days. Most people who get a Campylobacter infection will recover completely. Long-term consequences rarely result in these cases; however, some people may have arthritis following a Campylobacter infection while others may develop a rare disease that affects the nerves of the body beginning several weeks after diarrheal illness. This disease, called Guillain-Barré Syndrome, occurs when a person's immune system is "triggered" to attack the body's own nerves, can lead to paralysis that lasts several weeks. According to the CDC, an estimated one in every 1,000 reported Campylobacter infections leads to Guillain-Barré syndrome. As many as 40 percent of Guillain-Barré cases in this country may be triggered by Campylobacteriosis.

Why should this be a concern for the well drilling community?

Campylobacter transmission routes are not well defined, but are expected to be transmitted through drinking water supplies. In addition to being carried by humans, it is carried by a variety of animals. Cattle, pigs, chickens, birds, cats, dogs, hamsters and even turtles can harbor this pathogen. Cattle and poultry are the most common reservoirs for Campylobacter species. A large percentage of Missouri's domestic water wells are in rural areas,

often near large concentrations of poultry, cattle or hogs. Several of the outbreaks of Campylobacter infection in Missouri occurred near large poultry processing plants. The infected people came in direct contact with live or recently killed birds. However, the process water from poultry plants, as well as runoff from any concentration of human, poultry, cattle or hog manure, can contain bacterial concentrations. Many bacterial infections occur where septic influences (human and animal) are transported via karst geology.

Recent history is full of examples of bacterial contamination in wells. A septic tank located up gradient from a well was the cause of more than 130 cases of illness due to the Norwalk virus at a South Dakota campground in 1986. Four deaths and more than 243 illnesses occurred in Cabool, Missouri, in 1989 as a result of water-borne bacteria contamination (E. coli 0157:H7). In 1996, an outbreak of Campylobacter from groundwater contaminated by a broken sewage pipe resulted in 2,400 illnesses in Denmark. In 1993, seven deaths and 650 illnesses occurred in Gideon, Missouri, as a result of water-borne salmonella. In 2011, an outbreak of Campylobacter in the Northeast United States infected 76 individuals across four states.

Although it is rarely associated with mortality, Campylobacter infection is an important public health concern due to its frequent association with severe diarrhea, high occurrence rate, and the possibility of complications such as Guillain-Barré syndrome. With the emergence of drug-resistant strains of Campylobacter species, prevention is an important first line of defense. Knowledge of the area, surface features, drilling

conditions, and the ability to ensure a good annular seal becomes critical when constructing wells that provide for the adequate protection of Missouri's groundwater and the health of those who consume it.

Information about Campylobacteriosis derived from these websites. Read more online:

- cdc.gov/nceid/about-nceid.html
- wwwnc.cdc.gov/eid/article/10/6/03-0635_article.htm

